CEBMW18020

SHOP MANUAL

KOMATSU

WA250-1LC

WHEEL LOADER

MACHINE MODEL	SERIAL NUMBERS
WA250-1LC	A65001 and up

It is our policy to improve our products whenever it is possible and practical to do so. We reserve the right to make changes or add improvements at any time without incurring any obligation to install such changes on products sold previously.

Due to this continuous program of research and development, periodic revisions may be made to this publication. It is recommended that customers contact their distributor for information on the latest revision.

FEB 92

PRODUCT PUBLICATIONS INFORMATION

VARIOUS PRODUCT PARTS & SERVICE PUBLICATIONS ARE AVAILABLE TO ALL **KOMATSU** CONSTRUCTION EQUIPMENT OWNERS, INCLUDING OPERATION & MAINTENANCE MANUALS, PARTS BOOKS AND SHOP MANUALS.

SPECIAL PUBLICATIONS SUCH AS SERVICE TOOL, AIR CONDITIONING, AND TURBOCHARGER SHOP MANUALS ARE ALSO AVAILABLE AS WELL AS SELECTED OPERATION & MAINTENANCE AND SHOP MANUALS IN FOREIGN LANGUAGES.

THE PUBLICATIONS LISTED BELOW ARE AVAILABLE FOR THIS PARTICULAR MACHINE(S).

DESCRIPTION	FORM NUMBER
PARTS BOOK - PAPER:	
Engine and Chassis	BEPBW18021
PARTS BOOK - MICROFICHE:	
Engine and Chassis	BEPMW18021
OPERATION & MAINTENANCE MANUAL:	
Chassis	CEAMW18020
SHOP MANUAL:	
Chassis	CEBMW18020
Engine:	
Shop Manual	CEBM610SM0
Specification Manual	CEBM610AR0
SAFETY MANUAL	1085 883 R3

PARTS AND SERVICE PUBLICATIONS CAN *ONLY* BE ACQUIRED BY AN AUTHORIZED KOMATSU DISTRIBUTOR, USING THE "REQUEST FOR LITERATURE" FORM KDC-EPS-05 SHOWN ON THE REVERSE SIDE OF THIS PAGE.

PLEASE TEAR OUT THIS PAGE AND FILL IN *ALL* THE INFORMATION REQUESTED ON THE ORDER FORM!

REQUISITION FOR TECHNICAL SERVICE PUBLICATIONS AND SERVICE FORMS

COMPLETE FORM AND RETURN TO ⟶

Komatsu America International Company
440 North Fairway Drive
Vernon Hills, IL 60061-8112 U.S.A.
Attn: Technical Publications
Fax No. (847) 970-4186
Tel No. (847) 970-5887

SHIP TO ⟶

TYPE or PRINT ONLY ⟶

COMPANY NAME
ATTN.
STREET ADDRESS
CITY, STATE, ZIP CODE
COUNTRY

PURCHASE ORDER NO.

ORDER DATE

PHONE NO.	FAX NO.	SHIPPING METHOD	DISTR/BRANCH CODE

IMPORTANT - TO ASSURE SHIPMENT OF THE CORRECT PUBLICATION(S), THE MODEL NUMBER AND MACHINE SERIAL NUMBER MUST BE SHOWN.

QTY.	PUBLICATION FORM NUMBER	PARTS BOOK P-Paper ⬇ M-Microfiche		PUBLICATION DESCRIPTION	MODEL NUMBER	SERIAL NUMBER

CURRENT PRICES WILL BE CHARGED

CONTENTS

No. of page

10 ENGINE

12 TESTING AND ADJUSTING 12-1
13 DISASSEMBLY AND ASSEMBLY 13-1

20 POWER TRAIN

21 STRUCTURE AND FUNCTION 21-1
22 TESTING AND ADJUSTING 22-1
23 DISASSEMBLY AND ASSEMBLY 23-1
24 MAINTENANCE STANDARD 24-1

40 STEERING SYSTEM

41 STRUCTURE AND FUNCTION 41-1
42 TESTING AND ADJUSTING 42-1
43 DISASSEMBLY AND ASSEMBLY 43-1
44 MAINTENANCE STANDARD 44-1

50 BRAKE AND AIR SYSTEM

51 STRUCTURE AND FUNCTION 51-1
52 TESTING AND ADJUSTING 52-1
53 DISASSEMBLY AND ASSEMBLY 53-1
54 MAINTENANCE STANDARD 54-1

60 WORK EQUIPMENT SYSTEM

61 STRUCTURE AND FUNCTION 61-1
62 TESTING AND ADJUSTING 62-1
63 DISASSEMBLY AND ASSEMBLY 63-1
64 MAINTENANCE STANDARD 64-1

80 ELECTRIC AND ELECTRONIC SYSTEM

81 STRUCTURE AND FUNCTION 81-1
82 TESTING AND ADJUSTING 82-1
83 DISASSEMBLY AND ASSEMBLY 83-1

90 OTHERS

91 STRUCTURE AND FUNCTION 91-1
93 DISASSEMBLY AND ASSEMBLY 93-1
97 GEAR PUMP 97-1
99 METRIC CONVERSION TABLE 99-1

WARNING! IMPORTANT SAFETY NOTICE

Proper service and repair is extremely important for the safe operation of your machine. The service and repair techniques recommended and described in this manual are both effective and safe methods of operation. Some of these operations require the use of tools specially designed for the purpose.

To prevent injury to workers, the symbol shown is used to mark safety precautions in this manual. The cautions accompanying these symbols should always be followed carefully. If any dangerous situation arises or may possibly arise, first consider safety, and take the necessary actions to deal with the situation.

SAFETY

GENERAL PRECAUTIONS

Mistakes in operation are extremely dangerous. Read the Operation and Maintenance Manual carefully BEFORE operating the machine.

1. Before carrying out any greasing or repairs, read all the precautions given on the decals which are fixed to the machine.
2. When carrying out any operation, always wear safety shoes and helmet. Do not wear loose work clothes, or clothes with buttons missing.
   -Always wear safety glasses when hitting parts with a hammer.
   -Always wear safety glasses when grinding parts with a grinder, etc.
3. If welding repairs are needed, always have a trained, experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, glasses, cap and other clothes suited for welding work.
4. When carrying out any operation with two or more workers, always agree on the operating procedure before starting. Always inform your fellow workers before starting any step of the operation. Before starting work, hang UNDER REPAIR signs on the controls in the operator's compartment.
5. Keep all tools in good condition and learn the correct way to use them.
6. Decide a place in the repair workshop to keep tools and removed parts. Always keep the tools and parts in their correct places. Always keep the work area clean and make sure that there is no dirt or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.

PREPARATIONS FOR WORK

7. Before adding oil or making repairs, park the machine on hard, level ground, and block the wheels or tracks to prevent the machine from moving.
8. Before starting work, lower blade, ripper, bucket or any other work equipment to the ground. If this is not possible, insert the safety pin or use blocks to prevent the work equipment from falling. In addition, be sure to lock all the control levers and hang warning signs on them.
9. When disassembling or assembling, support the machine with blocks, jacks or stands before starting work.
10. Remove all mud and oil from the steps or other places used to get on and off the machine. Always use the handrails, ladders or steps when getting on or off the machine. Never jump on or off the machine. If it is impossible to use the handrails, ladders or steps, use a stand to provide safe footing.

PRECAUTIONS DURING WORK

11. When removing the oil filler cap, drain plug or hydraulic pressure measuring plugs, loosen them slowly to prevent the oil from spurting out.
    Before disconnecting or removing components of the oil, water or air circuits, first remove the pressure completely from the circuit.
12. The water and oil in the circuits are hot when the engine is stopped, so be careful not to get burned.
    Wait for the oil and water to cool before carrying out any work on the oil or water circuits.

13. Before starting work, remove the leads from the battery. Always remove the lead from the negative (-) terminal first.

14. When raising heavy components, use a hoist or crane.
    Check that the wire rope, chains and hooks are free from damage.
    Always use lifting equipment which has ample capacity.
    Install the lifting equipment at the correct places. Use a hoist or crane and operate slowly to prevent the component from hitting any other part. Do not work with any part still raised by the hoist or crane.

15. When removing covers which are under internal pressure or under pressure from a spring, always leave two bolts in position on opposite sides. Slowly release the pressure, then slowly loosen the bolts to remove.

16. When removing components, be careful not to break or damage the wiring, Damaged wiring may cause electrical fires.

17. When removing piping, stop the fuel or oil from spilling out. If any fuel or oil drips on to the floor, wipe it up immediately. Fuel or oil on the floor can cause you to slip, or can even start fires.

18. As a general rule, do not use gasoline to wash parts. In particular, use only the minimum of gasoline when washing electrical parts.

19. Be sure to assemble all parts again in their original places.
    Replace any damaged part with new parts.
    - When installing hoses and wires, be sure that they will not be damaged by contact with other parts when the machine is being operated.

20. When installing high pressure hoses, make sure that they are not twisted. Damaged tubes are dangerous, so be extremely careful when installing tubes for high pressure circuits. Also check that connecting parts are correctly installed.

21. When assembling or installing parts, always use the specified tightening torques. When installing protective parts such as guards, or parts which vibrate violently or rotate at high speed, be particularly careful to check that they are installed correctly.

22. When aligning two holes, never insert your fingers or hand. Be careful not to get your fingers caught in a hole.

23. When measuring hydraulic pressure, check that the measuring tool is correctly assembled before taking any measurements.

24. Take care when removing or installing the tracks of track-type machines.
    When removing the track, the track separates suddenly, so never let anyone stand at either end of the track.

FOREWORD

This shop manual has been prepared as an aid to improve the quality of repairs by giving the serviceman an accurate understanding of the product and by showing him the correct way to perform repairs and make judgements. Make sure you understand the contents of this manual and use it to full effect at every opportunity.

This shop manual mainly contains the necessary technical information for operations performed in a service workshop.
For ease of understanding, the manual is divided into chapters for each main group of components; these chapters are further divided into the following sections.

STRUCTURE AND FUNCTION

This section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting.

TESTING AND ADJUSTING

This section explains checks to be made before and after performing repairs, as well as adjustments to be made at completion of the checks and repairs.
Troubleshooting charts correlating "Problems" to "Causes" are also included in this section.

DISASSEMBLY AND ASSEMBLY

This section explains the order to be followed when removing, installing, disassembling or assembling each component, as well as precautions to be taken for these operations.

MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

NOTICE

The specifications contained in this shop manual are subject to change at any time and without any advance notice. Contact your distributor for the latest information.

HOW TO READ THE SERVICE MANUAL

VOLUMES

Service manuals are issued as a guide to carrying out repairs. They are two manuals for each machine, **Chassis volume** and **Engine volume.**

These volumes are designed to avoid duplication of information. Therefore to deal with all repairs for any model, both chassis and engine volumes are needed.

DISTRIBUTION AND UPDATING

Any additions, amendments or other changes will be sent to your distributors. Get the most up-to-date information before you start any work.

FILING METHOD

1. See the page number on the bottom of the page. File the pages in correct order.
2. Following examples show how to read the page number:

   Example 1 (Chassis volume):

   10 - 3
   - 10: Item number (10. Structure and Function)
   - 3: Consecutive page number for each item

   Example 2 (Engine volume):
   Refer to the pertinent engine manual.

3. Additional pages: Additional pages are indicated by a hyphen (-) and numbered after the page number. File as in the example.

   Example:

   21-4
   21-4-1
   21-4-2
   21-5

   Added pages

REVISED EDITION MARK ([1] [2] [3] ....)

When a manual is revised, an edition mark is recorded on the bottom outside corner of the pages.

REVISIONS

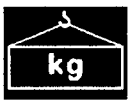
Revised pages are shown at the LIST OF REVISED PAGES on the between the title page and SAFETY page.

SYMBOLS

So that the shop manual can be of ample practical use, important places for safety and quality are marked with the following symbols.

Symbol	Item	Remarks
	Safety	Special safety precautions are necessary when performing the work
		Extra special safety precautions are necessary when performing the work because it is under internal pressure.
	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing the work.
	Weight	Weight of parts or systems. Caution necessary when selecting hoisting wire or when working posture is important, etc.
	Tightening torque	Places that require special attention for tightening torque during assembly.
	Coat	Places to be coated with adhesives and lubricants etc.
	Oil, water	Places where oil, water or fuel water must be added, and the capacity.
	Drain	Places where oil or water must be drained, and quantity to be drained.

HOISTING INSTRUCTIONS



Heavy parts (25 kg or more) must be lifted with a hoist etc. In the **Disassembly and Assembly** section, every part weighing 25 kg or more is indicated clearly with the symbol 

1. If a part cannot be smoothly removed from the machine by hoisting, the following checks should be made:
   - Check for removal of all bolts fastening the part to the relative parts.
   - Check for existence of another part causing interface with the part to be removed.

2. **Wire ropes**

   1) Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

Wire ropes
(Standard "Z" or "S" twist ropes without galvanizing)

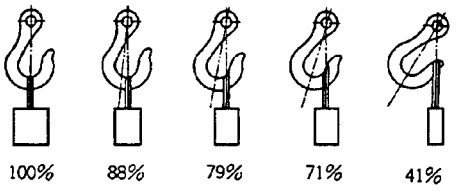
Rope diameter (mm)	Allowable load (tons)
10.0	1.0
11.2	1.4
12.5	1.6
14.0	2.2
16.0	2.8
18.0	3.6
20.0	4.4
22.4	5.6
30.0	10.0
40.0	18.0
50.0	28.0
60.0	40.0

The allowable load value is estimated to be one-sixth or one-seventh of the breaking strength of the rope used.

2) Sling wire ropes from the middle portion of the hook.

Slinging near the edge of the hook may cause the rope to slip off the hook during hoisting, and a serious accident can result.

Hooks have maximum strength at the middle portion.

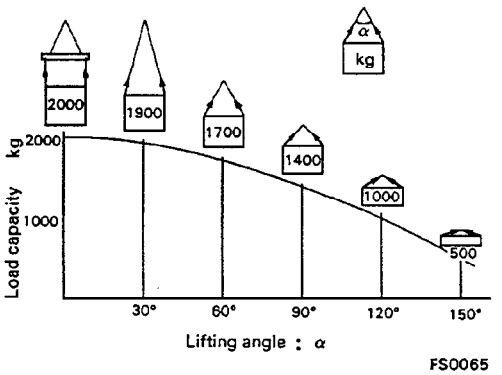


FS0064

3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound on to the load.

Slinging with one rope may cause turning of the load during hoisting, untwisting of the rope, or slipping of the rope from its original winding position on the load, which can result in a dangerous accident.

4) Do not sling a heavy load with ropes forming a wide hanging angle from the hook.
When hoisting a load with two or more ropes, the force subjected to each rope will increase with the hanging angles. The table below shows the variation of allowable load (kg) when hoisting is made with two ropes, each of which is allowed to sling up to 1000 kg vertically, at various hanging angles.
When two ropes sling a load vertically, up to 2000 kg of total weight can be suspended. This weight becomes 1000 kg when two ropes make a 120° hanging angle. On the other hand, two ropes are subject to an excessive force as large as 4000 kg if they sling a 2000 kg load at a lifting angle of 150°.

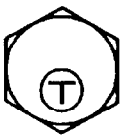
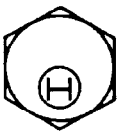


FS0065

STANDARD TIGHTENING TORQUE

1. STANDARD TIGHTENING TORQUE OF BOLTS AND NUTS

The following charts give the standard tightening torques of bolts and nuts. Exceptions are given in sections of "Disassembly and Assembly".

Thread diameter of bolt (mm)	Width across flat (mm)		
		kgm	Nm
6	10	1.35±0.15	13.2±1.4
8	13	3.2±0.3	31.4±2.9
10	17	6.7±0.7	65.7±6.8
12	19	11.5±1.0	112±9.8
14	22	18.0±2.0	177±19
16	24	28.5±3	279±29
18	27	39±4	383±39
20	30	56±6	549±58
22	32	76±8	745±78
24	36	94.5±10	927±98
27	41	135±15	1320±140
30	46	175±20	1720±190
33	50	225±25	2210±240
36	55	280±30	2750±290
39	60	335±35	3280±340

This torque table does not apply to the bolts with which nylon packings or other non-ferrous metal washers are to be used, or which require tightening to otherwise specified torque.

★ Nm (newton meter): 1Nm ≒ 0.1 kgm

2. TIGHTENING TORQUE OF SPLIT FLANGE BOLTS

Use these torques for split flange bolts.

Thread diameter of bolt (mm)	Width across flats (mm)	Tightening torque	
		kgm	Nm
10	14	6.7±0.7	65.7±6.8
12	17	11.5±1	112±9.8
16	22	28.5±3	279±29

3. TIGHTENING TORQUE FOR NUTS OF FLARED FITTINGS



Use these torques for nut part of flared.

Thread diameter of nut part (mm)	Width across flats of nut part (mm)	Tightening torque	
		kgm	Nm
14	19	2.5±0.5	24.5±4.9
18	24	5±2	49±19.6
22	27	8±2	78.5±19.6
24	32	14±3	137.3±29.4
30	36	18±3	176.5±29.4
33	41	20±5	196.1±49
36	46	25±5	245.2±49
42	55	30±5	294.2±49

COATING MATERIALS



The recommended coating materials prescribed in the shop manuals are listed below.

Nomenclature	Code	Applications
Adhesives	LT-1A	Used to apply rubber pads, rubber gaskets, and cork plugs.
	LT-1B	Used to apply resin, rubber, metallic and non-metallic parts when a fast, strong seal is needed.
	LT-2*	Preventing bolts, nuts, and plugs from loosening and leaking oil.
	LT-3	Provides an airtight, electrically insulating seal. Used for aluminum surfaces.
Liquid gasket	LG-1	Used with gaskets and packings to increase sealing effect.
	LG-3	Heat-resistant gasket for precombustion chambers and exhaust piping.
	LG-4	Used by itself on mounting surfaces on the final drive and transmission cases. (Thickness after tightening: 0.07 - 0.08 mm).
	LG-5	Used by itself to seal grease fittings, tapered screw fittings and tapered screw fittings in hydraulic circuits of less than 50 mm in diameter.
Antifriction compound (Lubricant including molybdenum disulfide)	LM-P	Applied to bearings and taper shafts to facilitate press-fitting and to prevent sticking, burning or rusting.
Grease (Lithium grease)	G2-LI	Applied to bearings, sliding parts and oils seals for lubrication, rust prevention and facilitation of assembling work.
Vaseline	---	Used for protecting battery electrode terminals from corrosion.

*LT-2 is also called **LOCTITE** in the shop manuals.

ELECTRIC

ELECTRIC WIRE CODE

In the wiring diagrams, various colors and symbols are employed to indicate the thickness of wires. This wire code table will help you understand WIRING DIAGRAMS.

Example: 05WB indicates a cable having a nominal number 05 and white coating with black stripe.

CLASSIFICATION BY THICKNESS

Nominal number	Copper wire			Cable O.D. (mm)	Current rating (A)	Applicable circuit
	Number strands	Dia. of strands (mm)	Cross section (mm^2)			
0.85 (01)*	11	0.32	0.88	2.4	12	Starting, lighting, signal etc.
2 (02)*	26	0.32	2.09	3.1	20	Lighting, signal etc.
5 (05)*	65	0.32	5.23	4.6	37	Charging and signal
15	84	0.45	13.36	7.0	59	Starting (Glow plug)
40	85	0.80	42.73	11.4	135	Starting
60	127	0.80	63.84	13.6	178	Starting
100	217	0.80	109.1	17.6	230	Starting

* Old numbers

CLASSIFICATION BY COLOR AND CODE

Priority	Classification	Circuits	Starting	Charging	Lighting	Signal	Instrument	Other
1	Primary	Code	B	W	R	G	Y	L
		Color	Black	White	Red	Green	Yellow	Blue
2	Auxiliary	Code	BW	WR	RW	GW	YR	LW
		Color	Black & White	White & Red	Red & White	Green & White	Yellow & Red	Blue & White
3		Code	BY	WB	RB	GR	YB	LR
		Color	Black & Yellow	White & Black	Red & Black	Green & Red	Yellow & Black	Blue & Red
4		Code	BR	WL	RY	GY	YG	LY
		Color	Black & Red	White & Blue	Red & Yellow	Green & Yellow	Yellow & Green	Blue & Yellow
5		Code	--	WY	RG	GB	YL	LB
		Color	--	White & Yellow	Red & Green	Green & Black	Yellow & Blue	Blue & Black
6		Code	--	WG	RL	GL	YW	
		Color	--	White & Green	Red & Blue	Green & Blue	Yellow & White	

WEIGHT TABLE



This weight table is a guide for use when transporting or handling components.

Unit: kg

Engine assembly	465
Radiator assembly	130
Torque converter assembly	40
Transmission with torque converter	510
Front axle assembly (dry)	480
Rear axle assembly (dry)	95
Rear axle pivot	95
Wheel (1 piece) (14.00 X 25)	85
Wheel (1 piece) (17.00 X 25)	117
Tire (1 piece) (17.5 X 25 - 12 PR)	105
Tire (1 piece) (20.5 X 25 - 12 PR)	147
Hydraulic tank (dry)	160
Lift cylinder (1 piece)	105
Dump cylinder	110
Engine hood	28
Front frame (without accessorys)	920
Rear frame (without accessorys)	740
Tilt lever	195
Lift arm (with bushing)	735
Bucket (with edges)	835
Counterweight	1,020
Fuel tank (empty)	105
Battery (1 piece) (wet)	40
Floor borad	105
ROPS cab	500

LUBRICANTS, FUEL AND COOLANT

PROPER SELECTION TABLE

RESERVOIR	FLUID TYPE	AMBIENT TEMPERATURE (Top line °F, Bottom line °C) -22 -4 14 32 50 68 86 104 122 -30 -20 -10 0 10 20 30 40 50	CAPACITY	
			Specified	Refill
Engine with filter	Engine oil See NOTE 1	SAE 20W-40 or 20W-50 SAE 15W-40, 15W-50 SAE 10W-30 Synthetic SAE 5W-20 or 5W-30	22.4 ℓ	18.9 ℓ
Torque converter Transmission & Service brakes	Engine oil See NOTE 2	SAE 30W SAE 10W	55 ℓ	53 ℓ
Hydraulic system		SAE 10W	140 ℓ	114 ℓ
Drive axles - Front & rear	Axle oil	See NOTE 3	48 ℓ each	48 ℓ each
All lubrication fittings	Grease	See NOTE 4	Fill as instructed	--
Fuel tank	Diesel fuel	See NOTE 5	260 ℓ	--
Cooling system	Coolant	See NOTE 6	48 ℓ	--

Specified capacity: Total amount of oil including oil for components and oil in piping.
Refill capacity: Amount of oil needed to refill system during normal inspection and maintenance.

API: American Petroleum Institute
ASTM: American Society of Testing and Material
SAE: Society of Automotive Engineers

NOTES:

1. ENGINE OIL

Normal Operation

Oil performance recommendations are as follows:

The use of a quality engine lubricating oil combined with appropriate oil and filter change intervals are critical factors in maintaining engine performance and durability.

SAE 15W-40 multi-viscosity oil meeting the American Petroleum Institute (API) Classification of CE/SF is recommended. CD/SF oil may be used in areas where CE/SF oil is not available.

A sulfated ash limit of 1.0 mass percent is suggested for optimum valve and piston deposit and oil consumption control. The sulfated ash **must not** exceed 1.85 mass percent. The sulfated ash limit of 1.85 mass percent has been placed on all engine lubricating oils recommended for use in the engine. Higher ash oils can cause valve and/or piston damage and lead to excessive oil consumption.

The API service symbol displays the following information. The upper half of the symbol displays the appropriate oil categories; the lower half may contain words to describe oil energy conserving features. The center section identifies the SAE oil viscosity grade.

Oil viscosity recommendations are as follows:

The use of a multi-graded lubricating oil has been found to improve oil consumption control and improve engine cranking in cold temperatures while maintaining lubrication at high operating temperatures.

While SAE 15W-40 multi-viscosity oil is recommended for most operating climates, refer to the previous chart for oil viscosity recommendations for extreme climates.

Limited use of low viscosity oils, such as SAE 10W-30 may be used for easier starting and providing sufficient oil flow at ambient temperatures below +23°F (-5°C). However, continuous use of low viscosity oils can decrease engine life due to wear.

Do not use special "break-in" lubricating oils for a new or rebuilt engine. Use the same type of oil during the "break-in" as specified for normal operation.

Arctic Operation

If an engine is operated in ambient temperatures consistently below -10°F (-23°C) and there are no provisions to keep the engine warm when it is **not** in operation, use a synthetic CE/SF or CD/SF engine oil with adequate low temperature properties such as SAE 5W-20 or 5W-30.

The oil supplier **must** be responsible for meeting the performance service specifications.

IMPORTANT: The use of a synthetic base oil does not justify extended oil change intervals. Extended oil change intervals can decrease engine life due to factors such as; corrosion, deposits and wear.

Additional information regarding lubricating oil availability throughout the world is available in the "E.M.A. Lubricating Oils Data Book for Heavy Duty Automotive and Industrial Engines." The data book may be ordered from the Engine Manufacturers Association, One Illinois Center, 111 East Wacker Drive, Chicago, IL U.S.A. 60601. The telephone number is (312) 644-6610.

2. ENGINE OIL

Use API classification CE engine oil. If API classification CD is used, reduce the oil change interval to half.

3. AXLE OIL

For axle oil, use only the recommended oil as follows:

SHELL: DONAX TT or TD
CALTEX: RPM TRACTOR HYDRAULIC FLUID
CHEVRON: TRACTOR HYDRAULIC FLUID
TEXACO: TDH OIL
MOBIL: MOBIL AND SUPER UNIVERSAL

* It is possible to substitute engine oil SAE 30W API classification CD for axle oil. If noise comes from the brake, it is no problem of durability.

4. GREASE

The recommended lubricating grease is No. 2 multipurpose lithium grease with 3% molybdenum disulfide.

5. DIESEL FUEL



WARNING! Do not mix gasoline or alcohol with diesel fuel. This mixture can cause an explosion.

IMPORTANT: Due to the precise tolerances of diesel injection systems, it is extremely important that the fuel be kept clean and free of dirt or water. Dirt or water in the system can cause severe damage to both the injection pump and nozzles.

The use of ASTM No. 2-D diesel fuel with a minimum Cetane number of 40 is recommended. The use of No. 2-D diesel fuel will result in optimum engine performance under most operating conditions. Fuels with Cetane numbers higher than 40 may be needed in high altitudes or extremely low ambient temperatures to prevent misfires and excessive smoke.

At operating temperatures below +32°F (0°C), acceptable performance can be obtained by using a blend of No. 2-D and No. 1-D fuels. The use of lighter fuels can reduce fuel economy.

Use a low sulfur content fuel having a cloud point that is at least 10 degrees below the lowest expected fuel temperature. Cloud point is the temperature at which crystals begin to form in the fuel.

The viscosity of the fuel **must** be kept above 1.3 cSt to provide adequate fuel system lubrication.

6. COOLANT

Heavy duty diesel engines require a balanced coolant mixture of water, antifreeze, and supplemental coolant additives. Supplemental coolant additive recommendations are included in the section entitled "CHANGE THE COOLANT AND FLUSH THE COOLING SYSTEM". The coolant should be changed at the specified service interval shown in the "MAINTENANCE TABLE".

DCA4 is recommended to inhibit corrosion in the cooling system.

In climates where the temperature is above -34°F (-37°C), use a coolant mixture that contains 50 percent antifreeze. **Antifreeze is essential in any climate.** It broadens the operating temperature range by lowering the coolant freezing point and by raising its boiling point. Do **not** use more than 50 percent antifreeze in the mixture unless additional freeze protection is required. **Never** use more than 68 percent antifreeze under any condition.

Low silicate ethylene glycol antifreeze is recommended. The antifreeze should contain no more than 0.1% anhydrous alkali metasilicate. Low silicate antifreeze is recommended to avoid the formation of silica-gel (hydro-gel). This gel formation can occur when the cooling system contains an over concentration of high silicate antifreeze and/or supplemental coolant additive. DO NOT use methanol or alcohol as an antifreeze because of its low boiling point.

Antifreeze may retain its freeze protection for more than one season but coolant conditioners must be added to maintain corrosion protection.

Antifreeze formulated with methoxy propanol, or propylene glycol, is not recommended for this system.

NOTE: *Do not mix types of antifreeze solutions. Mixed solutions make it impossible to determine the protection against freezing. Antifreeze containing sealer or anti-leak additives should NOT be used in this system. Sealer or anti-leak additives will cause plugging problems in the cooling system.*

Check the solution periodically and at normal operating temperature, to be sure the cooling system has sufficient protection against freezing.

Use water which has a low mineral content. Water used in conjunction with antifreeze, coolant filters and inhibited water must meet the following standards:

Total Hardness - Not to exceed 170 parts per million (10 grains/gallon maximum) to prevent scale deposits. Water containing dissolved magnesium and calcium (the usual reason for water hardness) above the specified amount will cause scale deposits to develop in the engine.

Chlorides - Not to exceed 40 parts per million (2.5 grains/gallon maximum) to prevent corrosion.

Sulfites - Not to exceed 100 parts per million (5.8 grains/gallon maximum) to prevent corrosion.

Dissolved Solids - Not to exceed 340 parts per million (20 grains/gallon maximum) to minimize sludge deposits, scale deposits, corrosion or a combination of these.

If any of the above requirements cannot be met, use distilled, de-ionized, or de-mineralized water. To determine if local water supplies meet these standards, water samples can be tested by water treatment laboratories. "Softened" water that is prepared using common salt (sodium chloride) contains excessive amounts of chlorides and should not be used.

NOTE: *Never use water alone in the cooling system because corrosion will occur.*

Maintain supplemental coolant additive levels at 1 unit DCA4 per 1 U.S. gal (3.8 liters) of coolant.

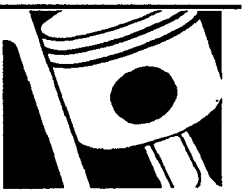
Use antifreeze during all seasons to protect the cooling system from corrosion as well as freezing damage.

A mixture of 50% water and 50% ethylene glycol base antifreeze is required for operation of the engine in temperature environments above -34.6°F (-37°C). A mixture of 40% water and 60% antifreeze is recommended for temperatures below -34.6°F (-37°C).

In tropical climates where antifreeze availability may be limited, use a corrosion inhibitor (Cummins liquid DCA), or an equivalent to protect the engine cooling system.

Do not operate the engine without a thermostat.

ENGINE
12 TESTING AND ADJUSTING



STANDARD VALUE TABLE 3
ENGINE ON TEST BENCH 3
ENGINE ON CHASSIS 4

TOOL LIST 4

VALVE CLEARANCE 5

FUEL INJECTION TIMING 5

ENGINE OIL PRESSURE 6

ENGINE OIL TEMPERATURE 7

BLOW-BY PRESSURE 8

EXHAUST GAS COLOR 9

ACCELERATOR PEDAL 10
OPERATING FORCE 10
OPERATING ANGLE 11

★ The following precautions are necessary when using the Standard Value Tables to make judgements during troubleshooting or during testing and adjusting.

1. The values in these tables are based on the values for new machines leaving the plant, so they should be used as target values when repairing or when estimating wear after a period of use.

2. The standard values in these tables for judgement when troubleshooting are estimated values based on the standard values for the machine when shipped from the plant, and on the results of various tests. Therefore, they should be used as reference in combination with repair and operating records when making judgements.

3. These standard value tables must not be used for standard values when judging claims. In addition, do not use these values alone to make simple judgements.

When carrying cut testing, adjusting or troubleshooting, stop the machine on level ground, install the safety bar on the frame , lower the bucket to the ground, and stop the engine.
Then apply the parking brake and block the tires.

Do not allow unauthorized persons near the machine.

When measuring the engine speed, one worker should measure the engine speed while the another person sits in the operator's seat to operate the controls. Always check that the operation is safe, and use agreed upon signals.

Be careful not to get caught in rotating parts.

When installing or removing gauges, loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the control levers several times to release the remaining pressure in the hydraulic piping.

When taking measurements, do not allow unauthorized persons near the machine.

The oil in the circuit is hot, so be careful not to get burnt.

STANDARD VALUE TABLE
• ENGINE ON TEST BENCH

Engine				610T	
Category	Item	Condition, etc	Unit	Standard value	Permissible value
Performance	Engine speed	High idling speed Low idling speed	rpm rpm	2700 - 2800 725 - 775	
	Necessary starting speed	0°C -20°C (ether aided)	rpm rpm	Min 150 Min 80	
Intake and exhaust system	Intake resistance Exhaust pressure Exhaust temperature	All speed At rated output All speed rated (intake air temp.:20°C)	mmH_2O mmHg °C	Max 635 Max 76.2 Max 438	635 76.2
	Exhaust gas color	Quick acceleration At high idling	Bosch scale	Max 6.5 Max 2.0	
	Valve clearance (When engine is cold)	Intake valve Exhaust valve	mm mm	0.254 0.508	
Engine body	Blow-by pressure	At rated output, oil temperature min. 60°C SAE10W-30 oil	mmh_2O	Max 178 (New limit)	Max 730 (worn limit)
Lubrication system	Oil pressure (Oil temperature min. 80°C) SAE10W-30 oil	At rated idling At low idling	kg/cm^2 kg/cm^2	Min 2.1 Min 0.7	2.1 0.7
	Oil temperature	Whole speed range (inside oil pan)	°C	120	
	Oil consumption ratio	At continuous rated horsepower (proportion of fuel consumption)	%	0.3	
Fuel system	Fuel injection timing	Before top dead center	mm	1.5	
Cooling system	Radiator pressure valve function	Operating pressure (Differential pressure)	kg/cm^2	0.7±0.15	
	Fan speed	At rated speed	rpm	2750	
	Fan belt tension	Deflect when pushed with a force of 6 kg	mm	Auto tension	

• ENGINE ON CHASSIS

Engine			610T	
Check item	Condition	Unit	Standard value	Permissible value
Engine speed	High idling Low idling	rpm rpm	2620 - 2750 675 - 775	2620 - 2750 675 - 775
Exhaust color	Sudden acceleration At high idling	Bosh system	Max 6.5 Max 2.0	
Valve clearance	Intake valve (20°C) Exhaust valve (20°C)	mm mm	0.254 0.508	
Blow-by pressure	At rated output SAE10W-30 oil (water temperature inside operating range)	$mmh_2 0$	Max 178	Max 178
Oil pressure	At high range At low range (water temperature inside operating range)	kg/cm^2	Min 2.1 Min 0.7	2.1 0.7
Oil temperature	Whole speed range (inside oil pan)	°C	120	120
Fuel injection timing	Compression B.T.D.C.	mm	1.5	

TOOL LIST

No.	Check item	Tool	Part number	Remarks
1	Engine speed	Multi-Tachometer	799-203-8000	Digital display L: 60 - 2,000rpm H: 60 - 19,000rpm
2	Water, oil, and intake temperature	Thermistor kit	799-101-6000	0 - 200°C
3	Oil pressure	Pressure measuring kit	799-203-2002	0 - 25kg/cm^2
4	Blow-by pressure	Blow-by checker (pipe tee)	3822476	Cummins part
5	Valve clearance	Feeler gauge	795-125-1330	mm
6	Exhaust color	Smoke checker	799-201-9001	Discoloration 0 - 70%, with standard color (Discoloration % x 1/10% ≒ Bosch index)

⚠ When carrying out testing, adjusting, or troubleshooting, stop the engine on level ground, install the safety bar on the frame, lower the bucket to the ground, and stop the engine. Then apply the parking brake.

⚠ **Do not** allow unauthorized persons near the machine.

⚠ When measuring the machine speed, one worker should measure the engine speed while the other sits in the operator's seat to operate the controls. Always check that the operation is safe, and use agreed signals.

⚠ Be careful not to get in rotating parts.

VALVE CLEARANCE

★ Condition: Engine is cold
★ Adjust clearance between valve and rocker lever as follows.

	Intake valve	Exhaust valve
Cold	0.254mm	0.508mm

1. Remove engine side covers and engine center hood.
2. Remove air cleaner and air cleaner bracket
3. Remove muffler
4. Adjust valve clearance.

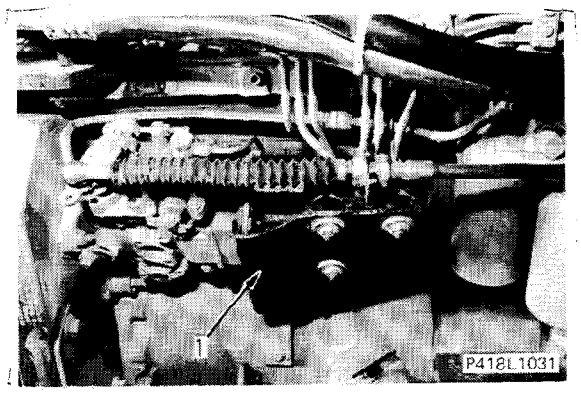
★ For details of adjusting valve clearance, see engine shop manual.

FUEL INJECTION TIMING

★ Measurement condition
- Coolant temperature: Inside operating range.

1. Remove bracket (1).
2. Testing and adjusting fuel injection timing.

★ For details of adjusting fuel injection timing, see engine shop manual.



ENGINE OIL PRESSURE

★ Measurement condition.
- Coolant temperature: Inside operating range.

Item	Standard value	Permissible value
Rated idling	2.1 kg/cm^2	2.1 kg/cm^2
Low idling	7.0 kg/cm^2	7.0 kg/cm^2

Special Tool

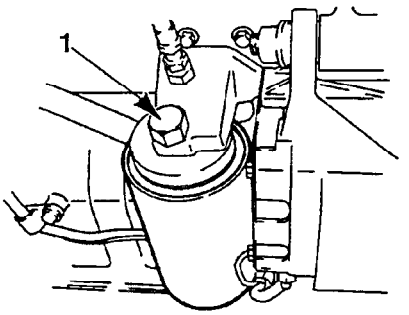
	Part number	Part name	Qty.
A	799-203-2002	Engine pressure measuring kit	1

WARNING! When measuring, be careful not to get caught in rotating parts.

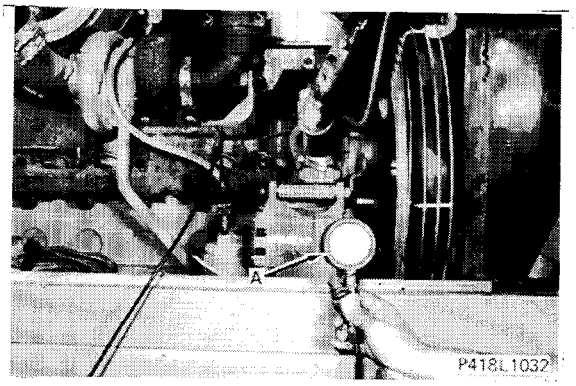
WARNING! Install and remove the plug and oil pressure gauge with the engine stopped.

★ Measure the engine oil pressure when the oil temperature is at the specified temperature.

1. Remove plug (1).
2. Install oil pressure gauge (A) 25 kg/cm^2.
3. Start engine and measure oil pressure.



L12AH013



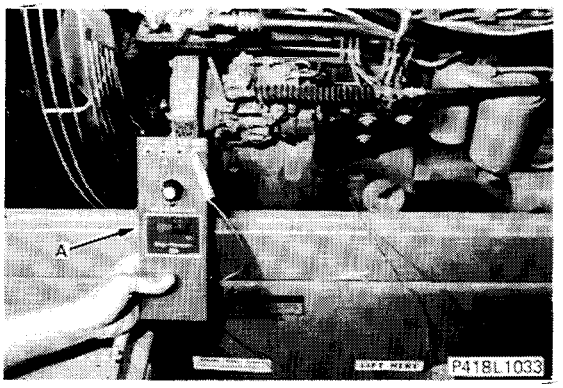
ENGINE OIL TEMPERATURE

★ Measurement condition.
- Coolant temperature: Inside operating range.

Special Tool

	Part number	Part name	Qty.
A	790-500-1300 or 799-101-6000	Thermistor temp. gauge	1

1. Remove dipstick.
2. Insert sensor or thermistor temperature gauge in the dipstick guide. Connect sensor to thermistor temperature gauge (A) and measure temperature of oil in the oil pan.



BLOW-BY PRESSURE

★ Measurement condition.
- Coolant temperature: Inside operating range.
- Valve clearance: Standard value.
- Engine speed: Rated idling.

Item		Permissible valve
Blow-by Pressure	New Engine	187 mmH_2O
	O.V. Engine	730 mmH_2O

Special Tool

	Part number	Part name	Qty
B	3822476	Blow-by tool	1

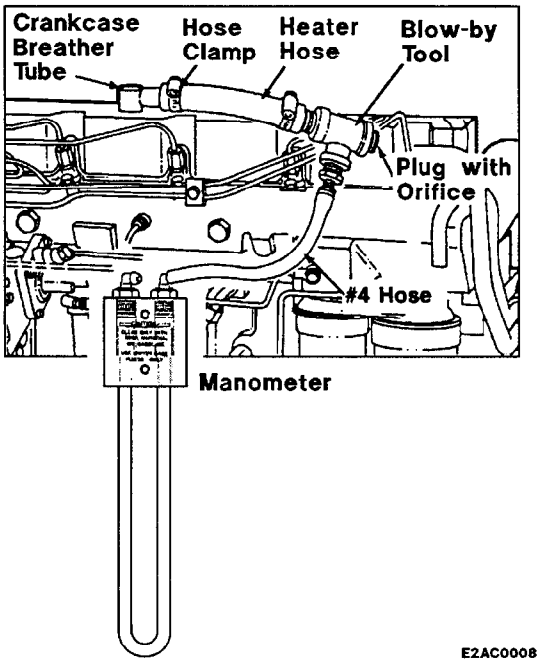
⚠ **WARNING!** When taking measurements, be careful not to touch the exhaust muffler, or to get caught in rotating parts.

Measuring blow-by

1. When measuring the blow-by, warm the engine up thoroughly (oil temperature: min. 60°C)
2. Stop engine and install pipe tee (B) of blow-by checker on engine breather hose (1).
3. Connect adapter and pressure gauge (A) 0 - 1000 mmH_20 with hose.
4. Run engine at rated idling and measure blow-by pressure.

Precautions when measuring blow-by

★ Blow-by may vary according to condition of the engine, so if there is any abnormality in the measured value, check for any problem related to defective blow-by, such as excessive oil consumption, defective exhaust gas color, early deterioration or contamination of the oil.



EXHAUST GAS COLOR

★ Measurement condition.
- Coolant temperature: Inside operating range.
- Valve clearance: Standard value.

Item		Standard value
Exhaust gas color	Acceleration	Max. 6.5 Bosch index
	High idling	Max. 2.0 Bosch index

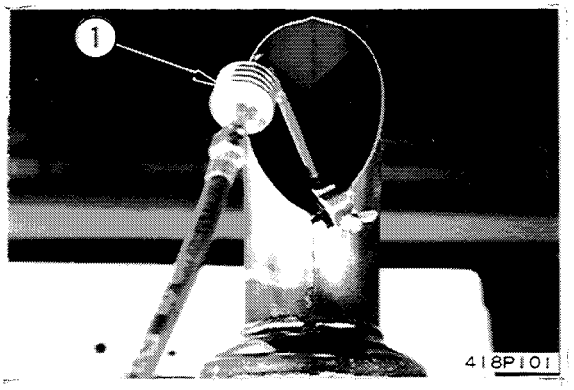
Special tool

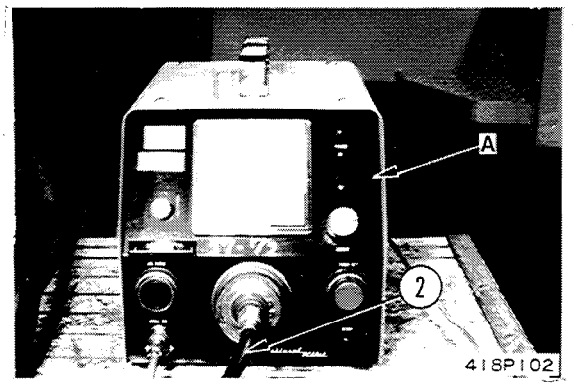
	Part number	Part name	Qty
A	799-201-9001	Smoker meter	1

⚠ **WARNING!** When measuring the exhaust color, be careful not to touch the exhaust pipe.

★ When measuring exhaust color, warm the engine thoroughly (Oil temperature min. 60°C).

1. Insert probe hose (1) in outlet of exhaust pipe and secure to exhaust pipe with clip.
2. Connect probe hose, connector of accelerator switch and air hose (2) to smoke meter (A).
   ★ The air supply pressure should be under 15 kg/cm_2.
3. Connect power cord to socket, making sure the power switch is in off position.
4. Loosen cap nut of suction pump and insert filter paper (insert filter paper securely to prevent exhaust gas leakage).
5. Turn the power switch on.
6. Accelerate the engine suddenly. At the same time depress the accelerator pedal, operate the relief valve, and catch the exhaust gas color on filter paper.
7. Lay the used filter paper on top of unused filter paper (10 sheets or more) inside the filter paper holder, and read indicated value.

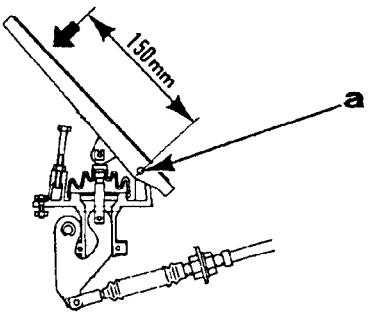




ACCELERATOR PEDAL
OPERATING FORCE

★ Measurement condition.
- Coolant temperature: Inside operating range

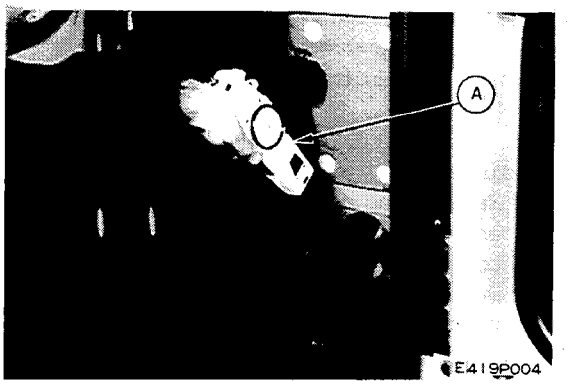
Item	Standard value	Permissible value
Operating force of accelerator pedal	9.0 kg	13.5 kg



L12ZZ020

Special tools

	Part number	Part name	Qty.
A	7A0-262-0020	Push-pull scale	1
B	Commercially available	Angle gauge	1



1. Measuring procedure.

   a) Put push-pull scale (A) in contact with the accelerator pedal at point 150mm from pedal fulcrum "a". (The center of push-pull scale A must be in contact with a point 150mm from the pedal fulcrum).

   b) Start the engine, push the pedal in the direction of operation and measure the maximum value when pushing from idling to the end of the pedal travel (high idling).

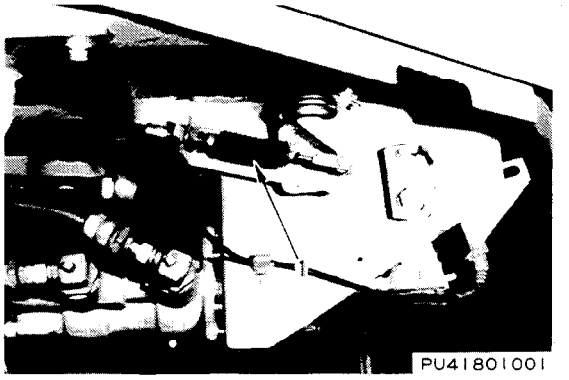
2. Testing adjusting.

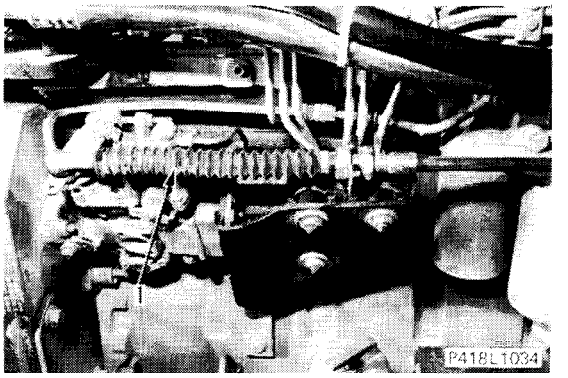
   a) Stop the engine.

   b) Disconnect the accelerator cable (1) at the bottom of the pedal, and check that the linkage and ball joint at the bottom of the pedal move smoothly.

   c) Connect the cable at the bottom of the pedal, then disconnect at the connection for the injection pump, and check that the cable (1) moves smoothly.

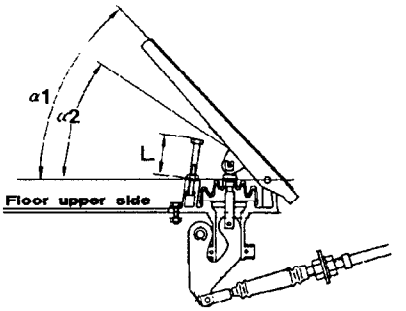
   ★ When carrying out the this inspection, adjust or replace parts as necessary. Measure the operating force again and check that it is within the standard value.





OPERATING ANGLE

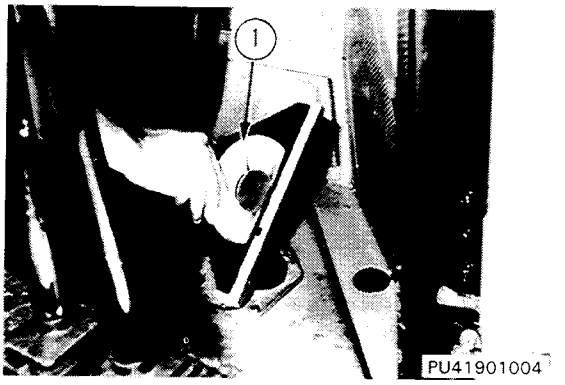
Item		Standard value
Operating angle of accelerator pedal	a_1	45°
	a_1	26 ± 2°
Installed height of accelerator pedal stopper	L	47mm

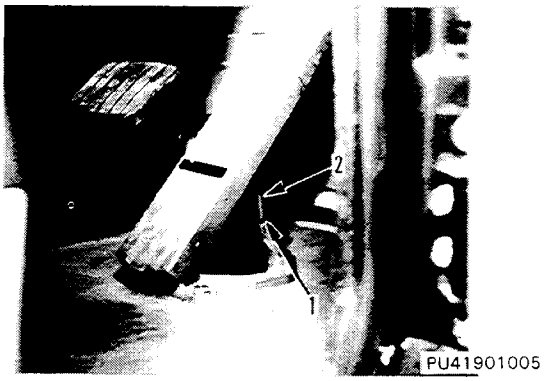


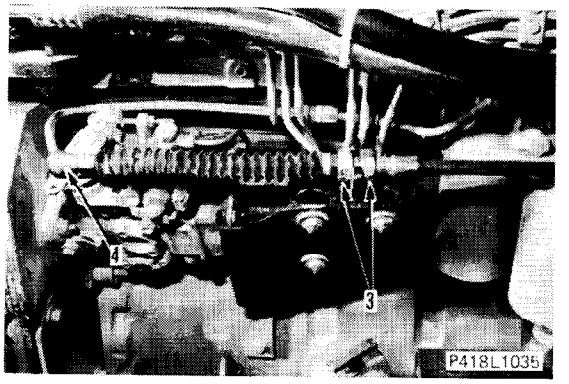
L12ZZ021

1. Measuring.
   a) Stop the engine.
   b) Put angle gauge (1) in contact with the accelerator pedal and measure the angle of movement a = a_1 -a_1 from low idling (a_1) to high idling (a_2).
2. Adjusting.
   a) Remove the cover at the bottom of the cab, open the engine hood and apply the safety lock.
   b) Loosen nut (1) and adjust with bolt (2) so that installed height L of the accelerator pedal stopper is 47mm.
   c) Loosen locknut (3) and adjust the length of the cable so that the injection pump governor lever contacts the high idling stopper when the accelerator pedal is fully depressed (high idling).
   d) Check that the injection pump governor lever contacts the low idling stopper when the accelerator pedal is released (low idling).
   e) Adjust the travel of the governor lever at joint (4).

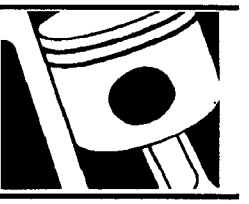
★ After performing the above adjustments, measure all parts again to check that the dimensions are within the standard value.







ENGINE
13 DISASSEMBLY AND ASSEMBLY



NOZZLE HOLDER ASSEMBLY 2
REMOVAL 2
INSTALLATION 2

CYLINDER HEAD ASSEMBLY 3
REMOVAL 3
INSTALLATION 4

RADIATOR 5
REMOVAL 5
INSTALLATION 7

ENGINE 9
REMOVAL 9
INSTALLATION 14

FUEL TANK 18
REMOVAL 18
INSTALLATION 19

★ Take the following method for air bleeding when you start to operate hydraulic cylinders after reassembling cylinders, pumps and piping.

1. Start engine, keep idling.
2. Operate hydraulic cylinder 4 - 5 cycles, but do not exceed beyond 100 mm of stroke end.
3. Continue to operate cylinder 3 - 4 cycles until stroke end.
4. After finishing above steps, keep normal engine speed.

NOTE: After long storage, same procedure is required.

NOZZLE HOLDER ASSEMBLY

REMOVAL

WARNING! Disconnect the cable from the negative (-) terminal of the battery.

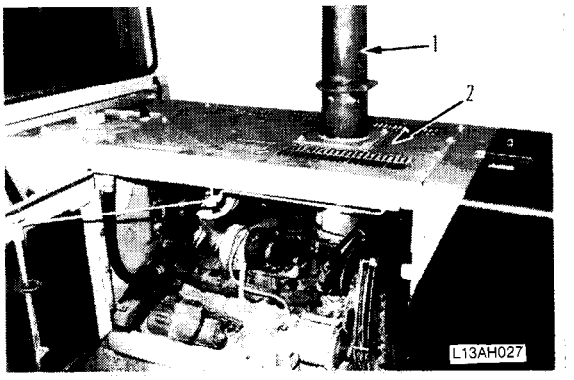
1. Side cover hood.
   a) Remove left and right engine side covers.
   b) Remove exhaust pipe (1), then remove hood (2).

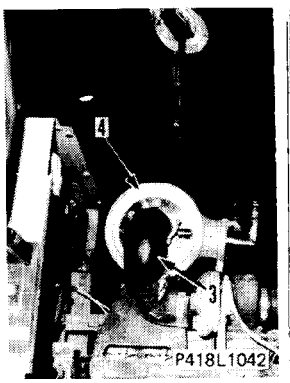
2. Connector hose.
   a) Disconnect connector hose.

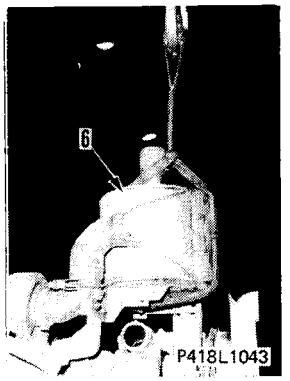
3. Air cleaner assembly.
   a) Remove air cleaner assembly (4) and air cleaner bracket (5).

4. Muffler and exhaust manifold assembly.
   a) Disconnect the drain pipe, then remove the muffler and exhaust manifold together (6).

5. Remove the nozzle holder assembly.
   ★ For details of the engine, see the Engine Shop Manual.







INSTALLATION

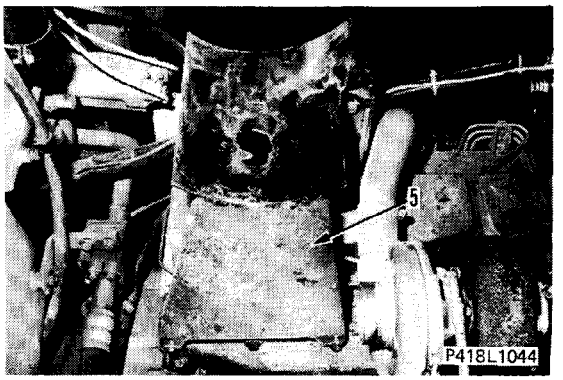
1. Install the nozzle holder assembly.
   ★ For details of the engine, see the Engine Shop Manual.

2. Muffler and exhaust manifold.
   a) Fit gaskets and install muffler and exhaust manifold assembly (6) as one unit, then connect the drain pipe.

3. Air cleaner assembly.
   a) Install the air cleaner bracket (5).
   b) Install the air cleaner assembly (4) and secure with band.

4. Connector hose.
   a) Install connector hose (3).

5. Hood and engine side covers.
   a) Install the hood (2), then install the exhaust pipe (1).
   b) Install the left and right engine side covers.



CYLINDER HEAD ASSEMBLY
REMOVAL

WARNING! Disconnect the cable from the negative (-) terminal of the battery.

1. Drain water.
   a) Remove radiator drain plugs (1) and (2), and drain coolant.

   Drain 38ℓ of coolant.

   ★ If the coolant contains antifreeze, dispose of it correctly.

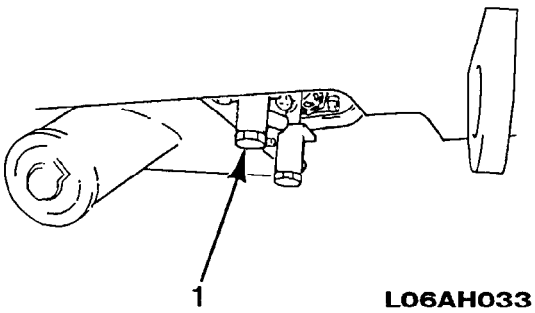
2. Engine hood and side covers.
   a) Remove left and right engine side covers.
   b) Remove exhaust pipe (3), then remove hood (4).

3. Connector hose.
   a) Disconnect connector hose (5).

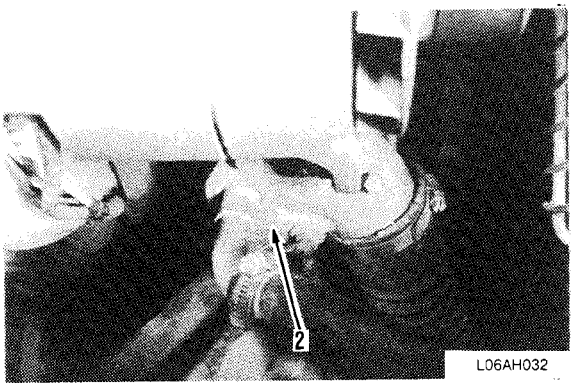
4. Air cleaner assembly.
   a) Remove air cleaner assembly (6).
   b) Remove air cleaner mounting bracket (7).

5. Muffler and exhaust manifold assembly.
   a) Disconnect the drain pipe, then remove the muffler and exhaust manifold together (8).

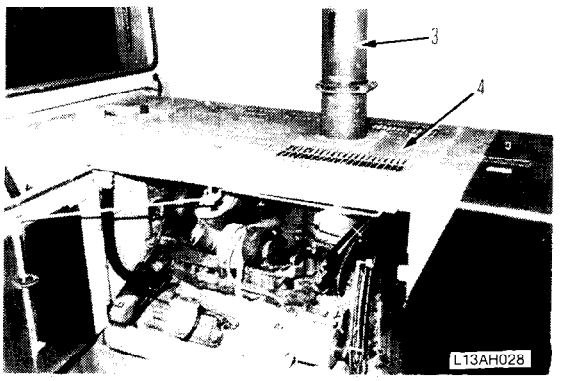
6. Remove the cylinder head assembly.
   ★ For details of the engine, see the Engine Shop Manual.



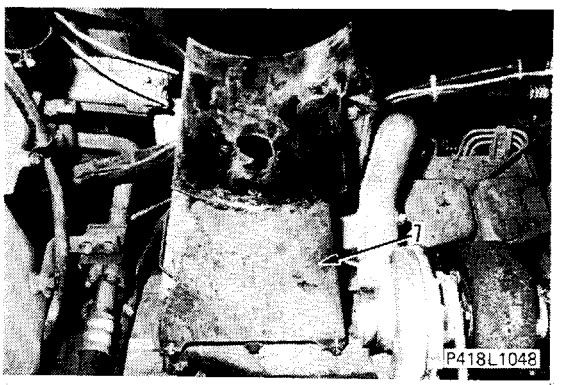
L06AH033



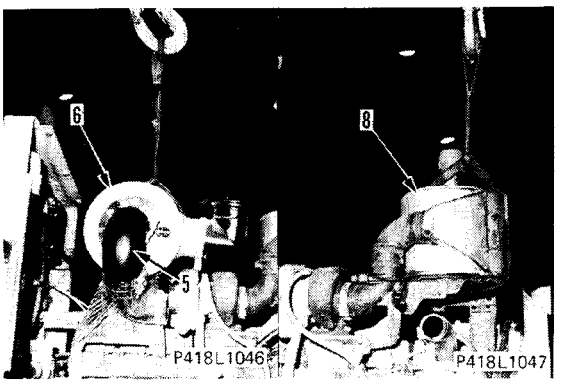
L06AH032



L13AH028



P418L1048



P418L1046 P418L1047

INSTALLATION

★ Check to make sure there is no dirt or foreign material on the cylinder head mounting face, or inside the cylinder.

1. Install the cylinder head assembly.
   ★ For detail of engine, see the Engine Shop Manual.

2. Muffler and exhaust manifold assembly.
   a) Fit gaskets and install the muffler and exhaust manifold assembly (8) as one unit, then connect the drain pipe.

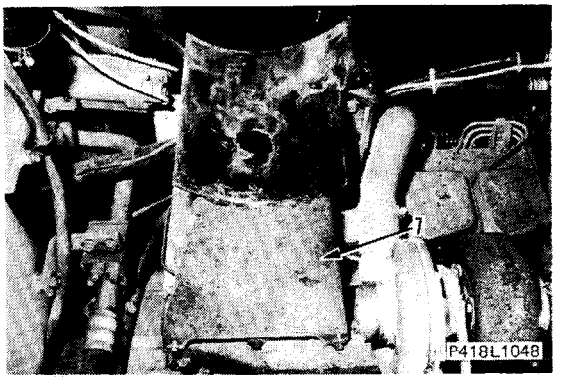
3. Air cleaner assembly.
   a) Install the air cleaner bracket (7).
   b) Install the air cleaner assembly (6) and secure with band.

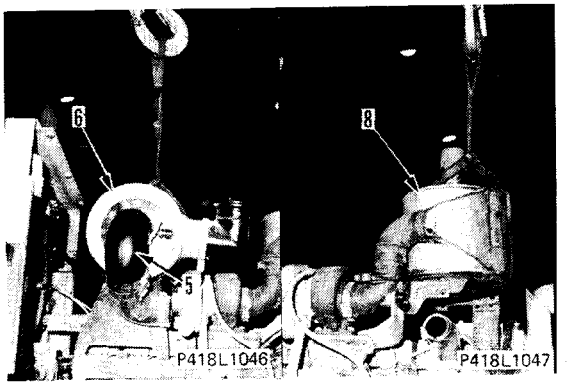
4. Connector hose.
   a) Install connector hose (5).

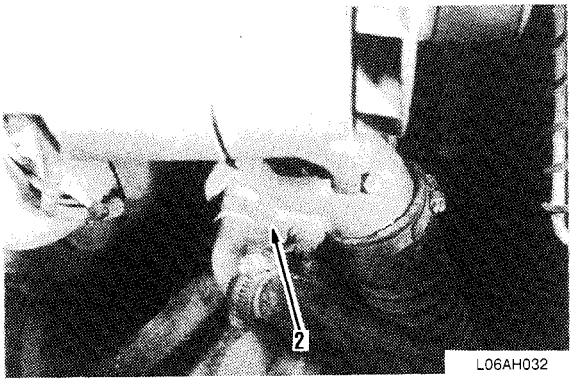
5. Hood and engine side covers.
   a) Install hood (4), then install the exhaust pipe (3).
   b) Install the left and right engine side covers.

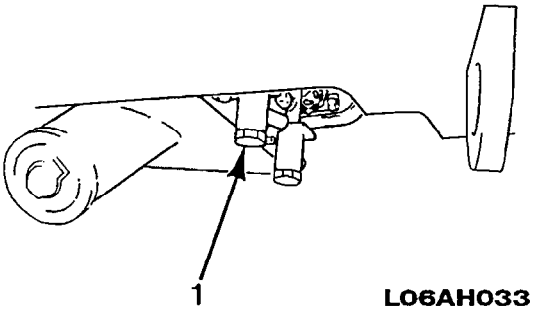
6. Refilling with coolant.
   a) Replace drain plugs (1) and (2) and add coolant through radiator filler neck to the specified level.

Add 38ℓ of coolant
★ Run the engine to circulate the coolant through the system, Then check the coolant level again.

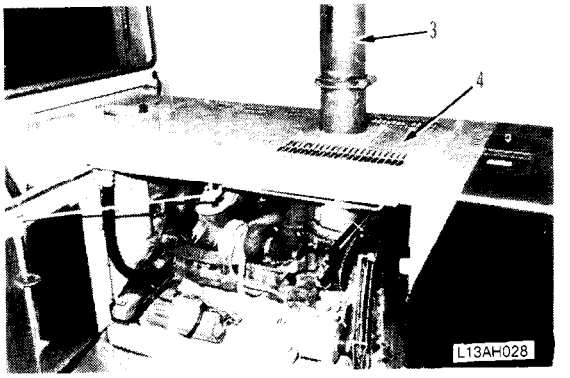








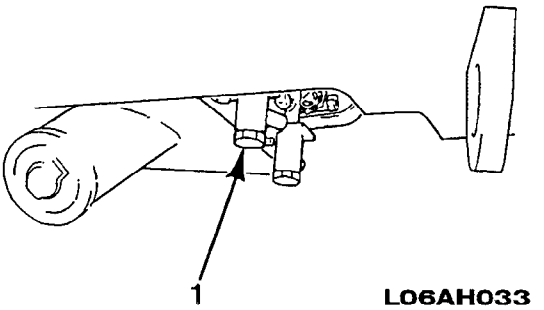
L06AH033



RADIATOR
REMOVAL

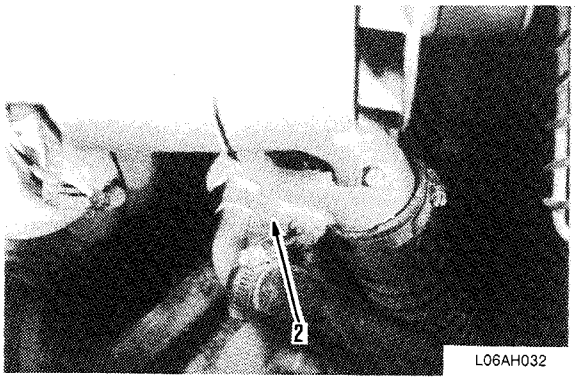
WARNING! Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake, and place blocks under the tires.

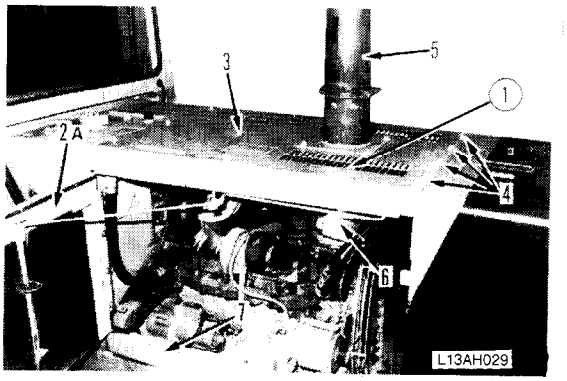
1. Draining the coolant.
   a) Remove drain plugs (1) and (2) and drain the coolant.



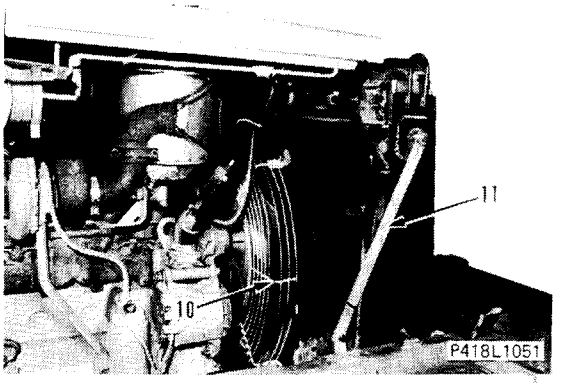
Drain 38ℓ of coolant.
★ If the coolant contains antifreeze, dispose of it correctly.

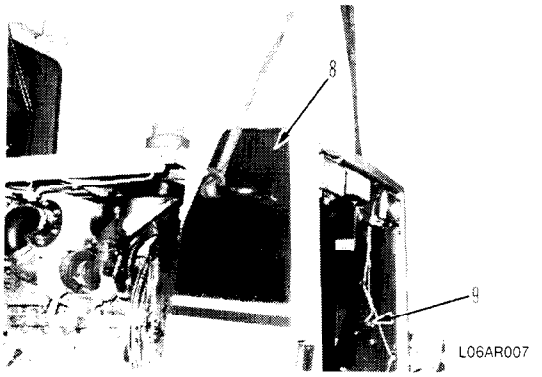
2. Hood.
   a) Open left and right engine side covers (2A).
   b) Remove mounting bolts (4) on radiator side of engine center hood (3).
      ★ Loosen mounting bolts on hydraulic oil tank side.
   c) Remove exhaust pipe (5). Place block ① between engine and center hood (3) and muffler (6).
      ★ Leave about a 30mm space between the engine center hood and the radiator guard.
   d) Remove the left and right engine side panels (7).
   e) Remove radiator guard (8).
      ★ Disconnect the rear lamp connector (9).



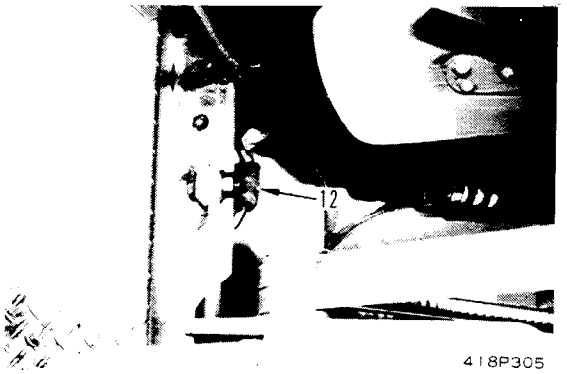


3. Fan guard.
   a) Remove fan guard (10) and radiator support (11).

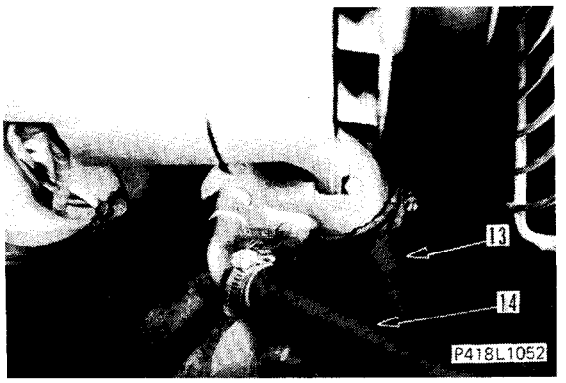




4. Electric wiring.
   a) Disconnect wiring (12) of radiator coolant level sensor from connector.

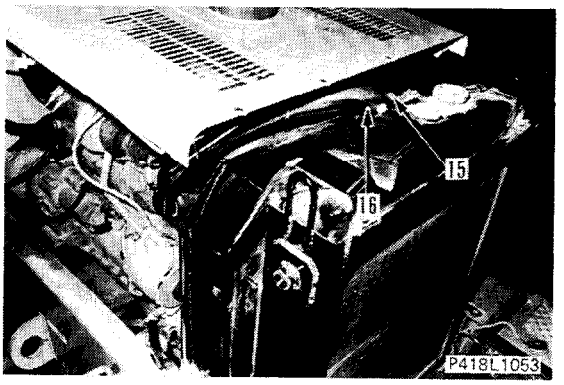


5. Radiator hoses.
   a) Disconnect radiator hose (13) from the engine.
   b) Disconnect radiator hose (14) from both the radiator and the engine.
   c) Disconnect radiator hoses (15) and (16) from radiator.
      ★ Loosen lower hose clamp (17).
   d) Disconnect radiator drain hose from radiator.



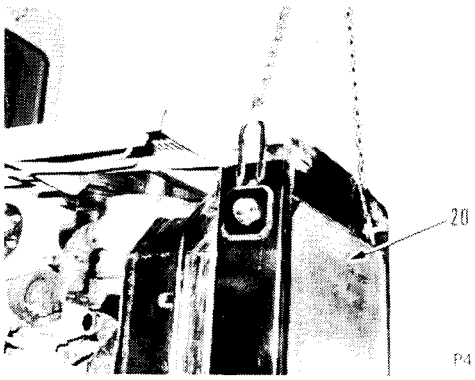
6. Cooler piping.
   a) Disconnect oil cooler hoses (18) and (19).

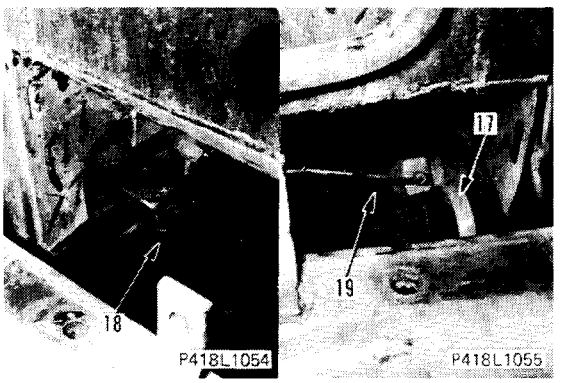
7. Radiator.
   a) Sling radiator (20), remove mounting bolts, and lift radiator.
      ★ When removing the radiator, move it towards the counterweight to prevent the radiator core from coming near the fan.



kg

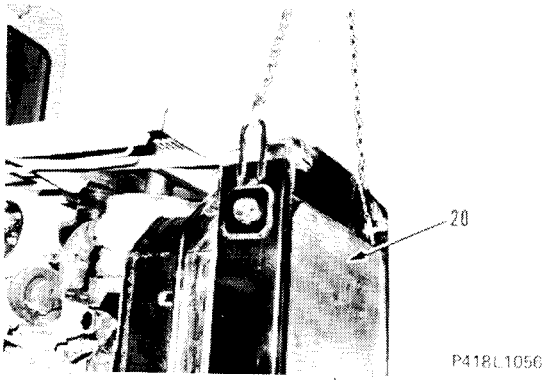
Radiator: 130 kg.





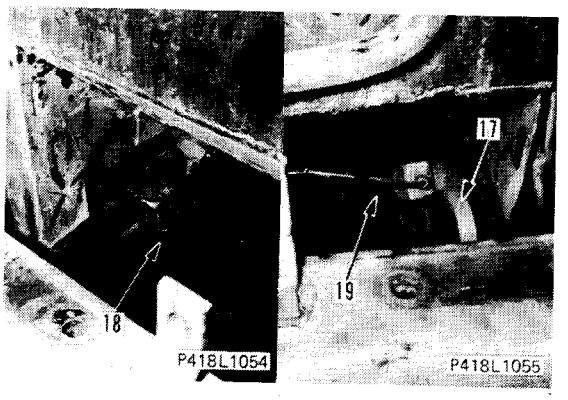
INSTALLATION

1. Radiator.
   a) Sling radiator (20) and place at mounting position. tighten the mounting bolts.
   b) Insert radiator upper hose (15) into the radiator.
   ★ Be careful not to damage the radiator core.
   ★ Insert the radiator carefully from the counter-weight side.
   ★ Install so that the clearance from the fan is uniform.
   ★ After connecting the hoses, tighten the clamps.



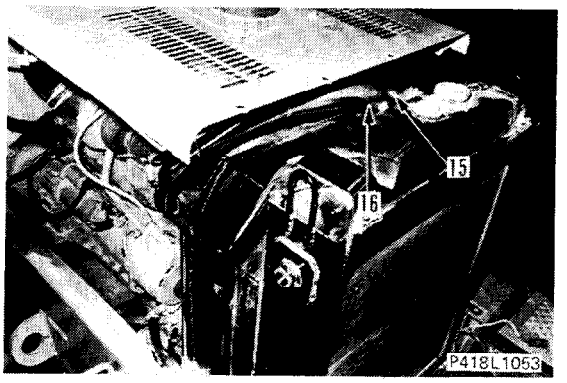
Mounting bolts: 28.5 ± 3.0 kgm.

2. Cooler piping.
   a) Connect oil cooler hoses (18) and (19).
   ★ Be careful not to twist the hoses.
   ● Hose width across the flats: 41 mm.

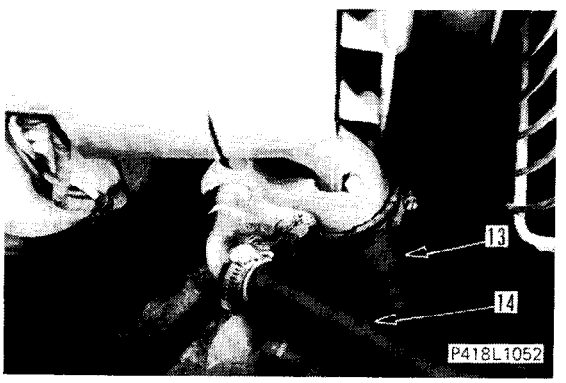


3. Radiator hoses.
   a) Connect drain hose to the radiator.
   b) Connect radiator hoses (15) and (16) to the radiator.
   ★ Tighten lower hose clamp.
   c) Connect radiator hose (14) to engine and radiator.
   d) Connect radiator hose (13) to the engine.

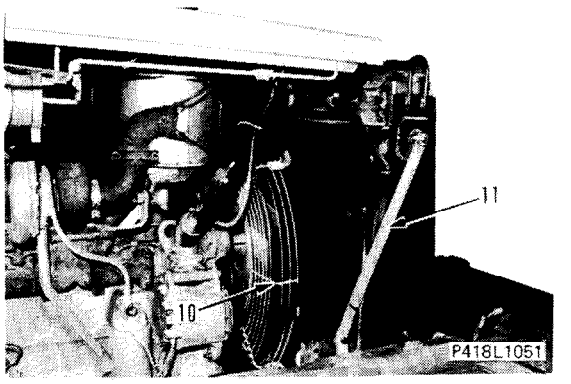
4. Electric wiring.
   a) Connect wiring (12) of radiator coolant level sensor to the connector.



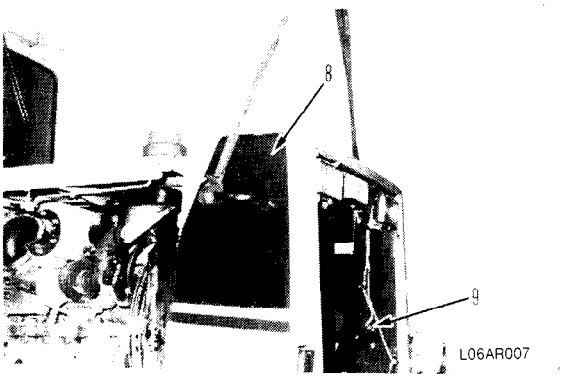




5. Fan guard.
   a) Install fan guard (10) and radiator supports (11).

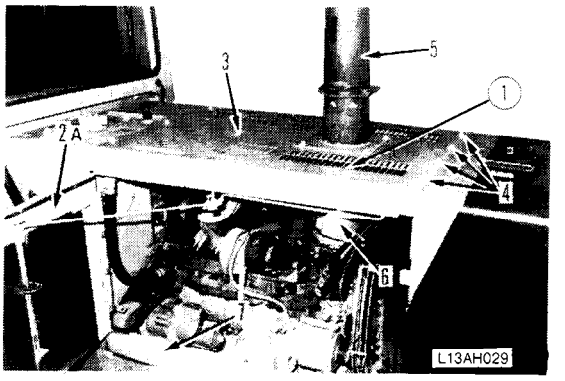


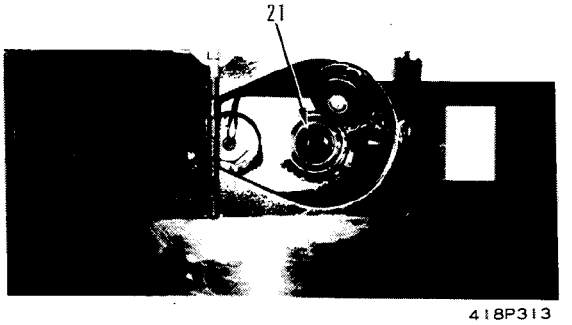
6. Hood.
   a) Set radiator guard (8) in position, then temporarily tighten the mounting bolts.
   b) Install left and right engine side panels (7).
   c) Close engine side hood (2A), then adjust the latches.
   d) Remove block ① and tighten mounting bolts of engine center hood (3), then install exhaust pipe (5).
      ★ The final tightening of all mounting bolts is done.
      ★ Connect rear lamp connector (9).



7. Refilling with coolant.
   a) Install radiator drain plugs and add coolant through the radiator filler neck (21) to the specified level.
      ★ Run the engine to circulate the coolant through the system. Then check the coolant level again.

Coolant: 38ℓ.





ENGINE
REMOVAL

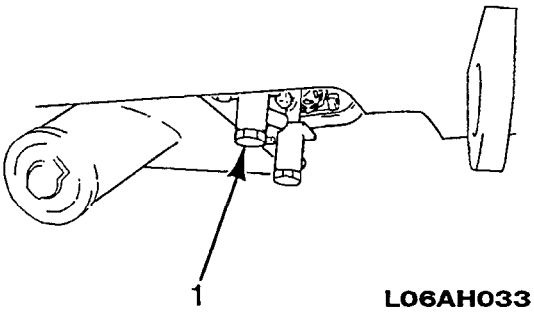
WARNING! Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake, and place blocks under the tires.

WARNING! Disconnect the lead from the negative (-) battery terminal.

1. Draining the engine coolant.
   a) Remove drain plug (1) and drain coolant.

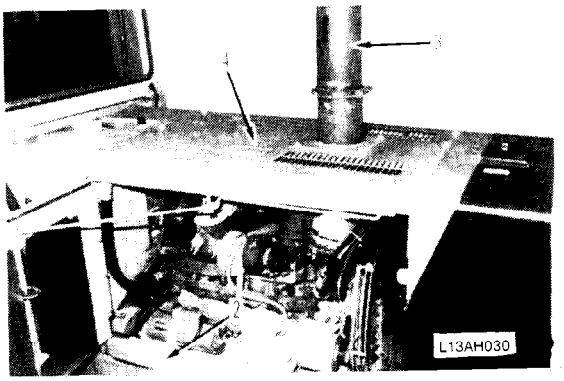
Coolant: 38ℓ.

★ If coolant contains antifreeze, dispose of it correctly.



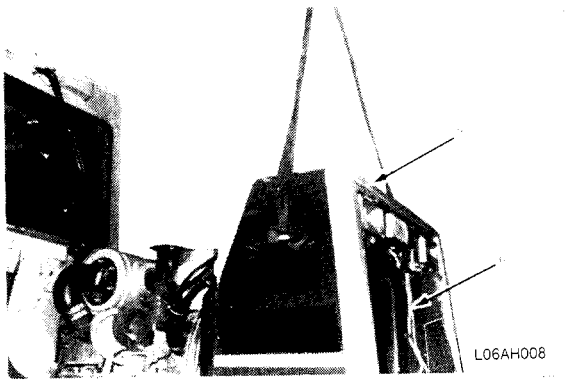
2. Hood and guard.
   a) Open engine side hood, remove engine side panels (2) and exhaust pipe (3), and lift off engine center hood (4).

kg Engine center hood: 28 kg.

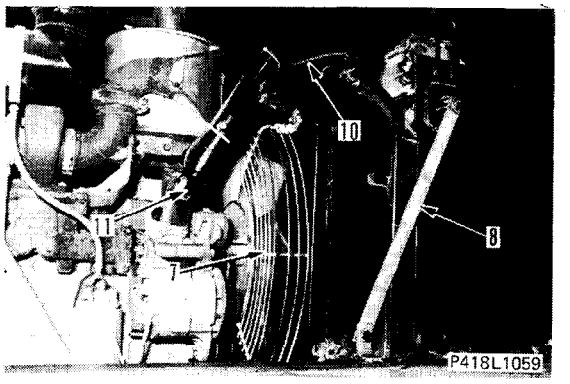


   b) Sling radiator guard, remove mounting bolts, and lift off radiator guard (5).
      ★ Disconnect rear lamp connector wiring (6).

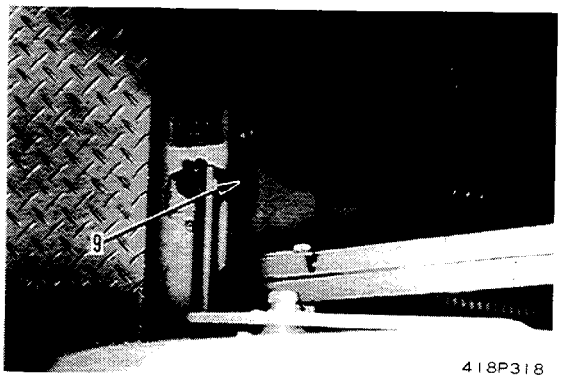
kg Radiator guard: 30 kg.



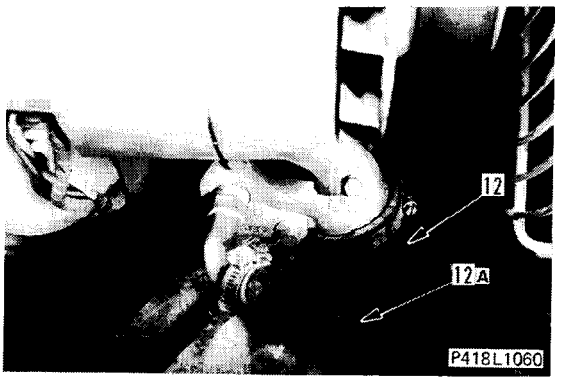
3. Fan guard.
   a) Remove fan guard (7) and radiator supports (8).



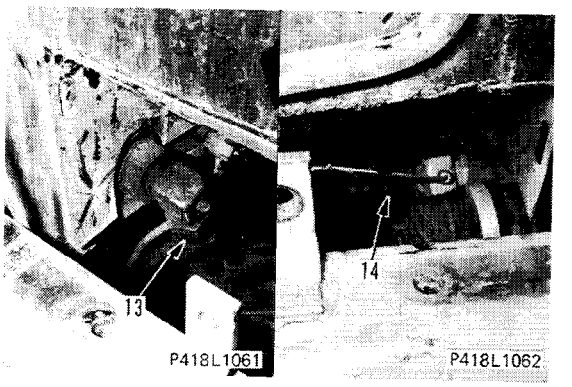
4. Electric wiring.
   a) Disconnect wiring (9), the radiator coolant level sensor from the connector.



5. Radiator hoses.
   a) Disconnect radiator hoses (10), (11), (12), and (12A) from the engine.
      ★ Loosen lower hose clamps.
   b) Disconnect radiator drain hose from radiator.

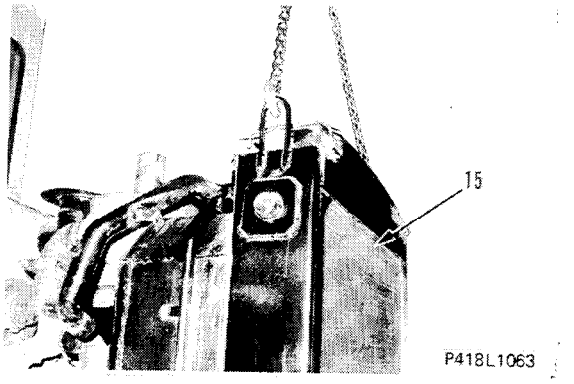


6. Cooler piping.
   a) Disconnect cooler hoses (13) and (14).

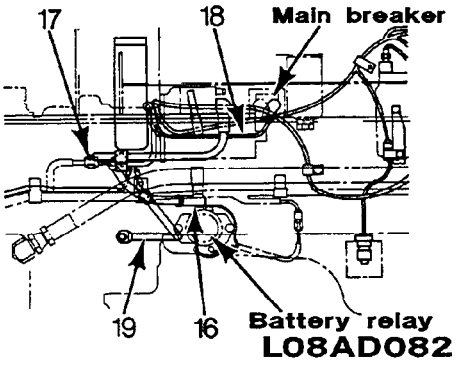


7. Radiator.
   a) Remove radiator (15).
   ★ When removing the radiator, move towards the counterweight to prevent the core from coming near the fan.

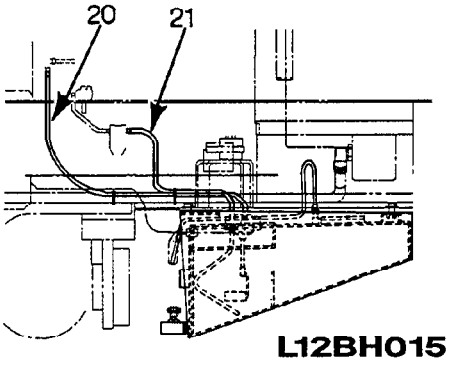
kg Radiator: 130 kg.



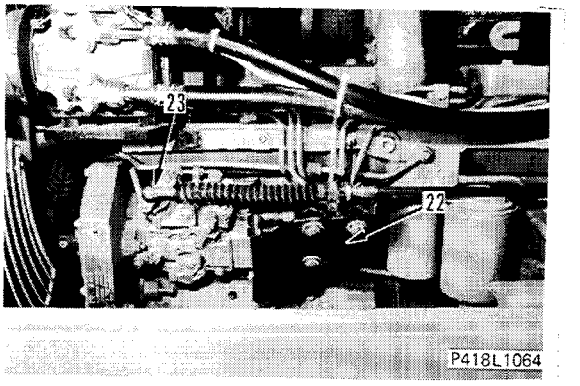
8. Electric wiring.
   a) Disconnect the following electric wiring:
      - Cable (16) between starting motor and battery relay.
      - Engine wiring (17) from connector.
      - Main breaker wiring (18) from main breaker.
      - Ground connection.
   ★ Before removing the wiring, mark each wire with a tag to distinguish when installing.



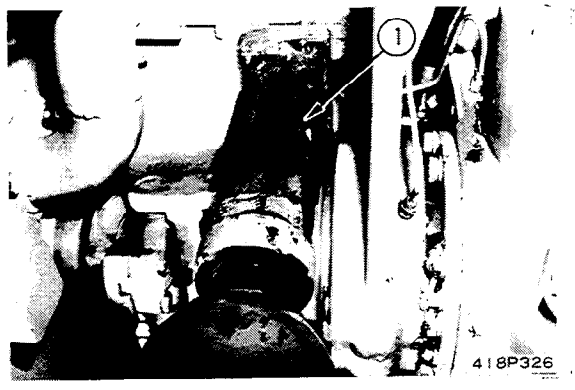
9. Fuel hoses.
   a) Disconnect hose (20) between fuel tank and fuel injection nozzle from fuel tank.
   b) Disconnect hose (21) between fuel tank and fuel injection pump from the fuel tank.



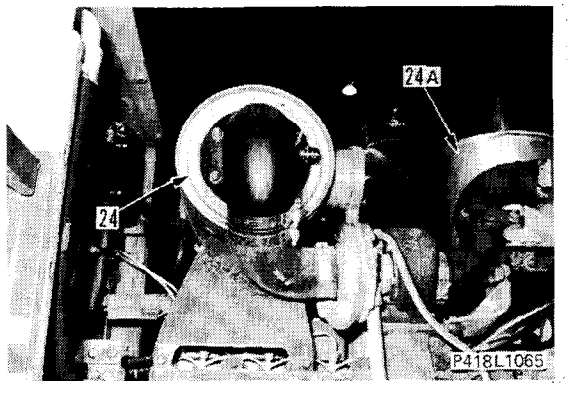
10. Fuel control cable.
    a) Remove the fuel control cable bracket (22) mounting bolt, then remove the fuel control cable bracket.
    b) Disconnect the fuel control cable (23) from the engine.



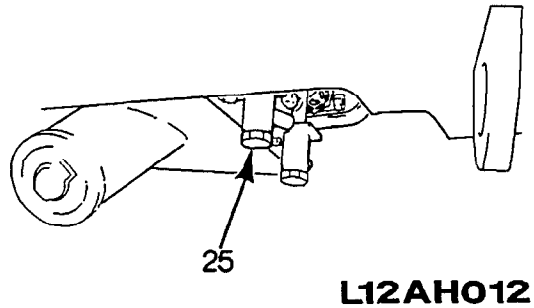
11. Transmission support.
    a) Set support ① under the transmission.
       ★ Set the support securely so that it does not slip out of position.
       ★ Adjust the support to the correct height.



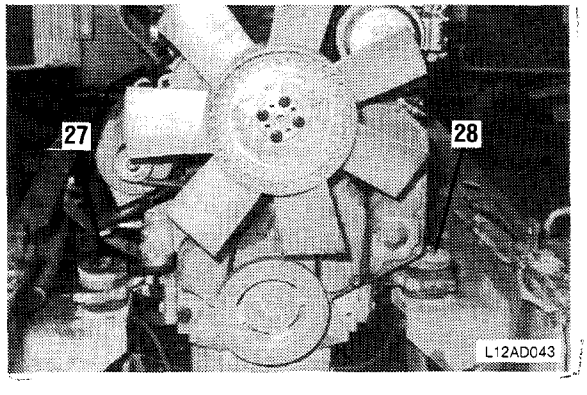
12. Air cleaner and muffler.
    a) Remove the air cleaner (24).
    b) Remove the muffler (24A).

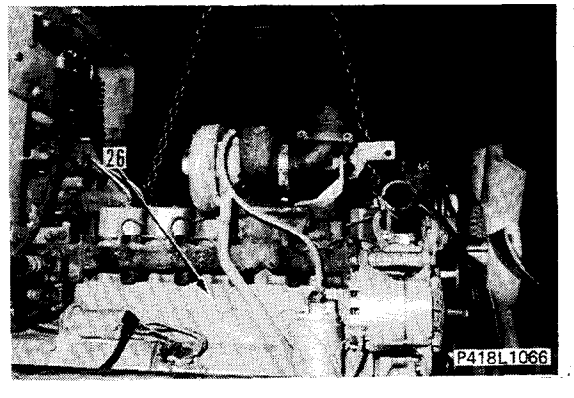


13. Engine.
    a) Remove the engine oil drain plug (25).
    b) Sling the engine (26), then remove the mounting bolts (27) and (28).



L12AH012

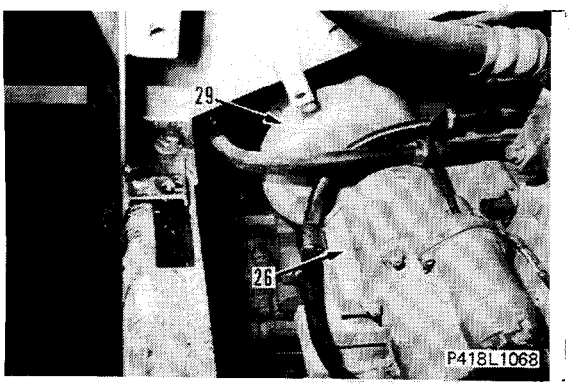




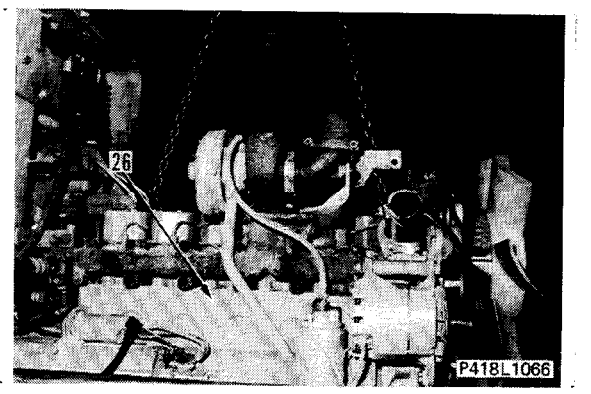
c) Remove connecting bolts of torque converter (29), then remove the engine (26).

★ When removing the engine, be careful of the contact face of the torque converter. Move out horizontally and when the pilot comes completely free, raise the engine and remove.

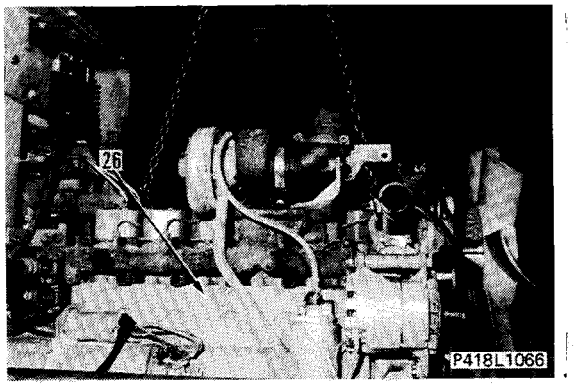
★ When removing the engine be careful that the engine oil drain hose does not interfere with the fuel tank, therefore, remove the engine slowly.



kg Engine: 465 kg.



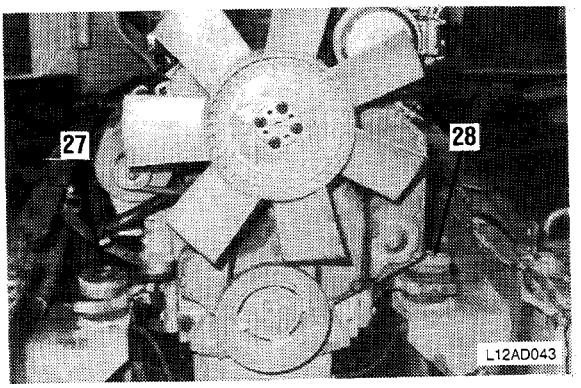
INSTALLATION



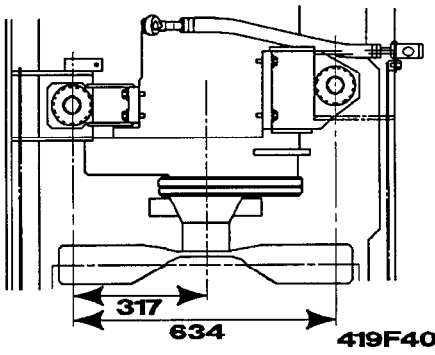
1. Engine.
   a) Set engine (26) in mounting position, then tighten the torque converter connecting bolts.
      ★ Check and make sure that there is a O-ring fitted to the torque converter contact surface.

   O-ring circumference: Soapy water.

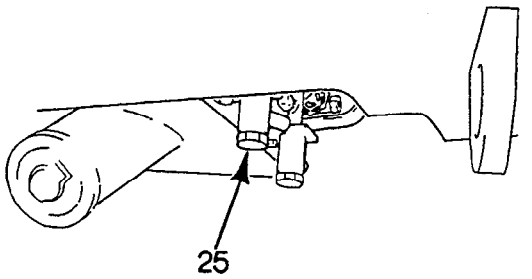
      ★ When connecting the engine to the torque converter, adjust the height so that the torque converter pilot goes in smoothly. **Do Not** try to force it in.
   b) Tighten the rear mounting bolts (27) and (28).
      ★ Fit the rubber cushion securely in the bracket groove.
      ★ Position the engine correctly.
      ● Mounting bolt width across the flats: 32mm.



Mounting bolts: 76.0 ± 8.5 kgm.

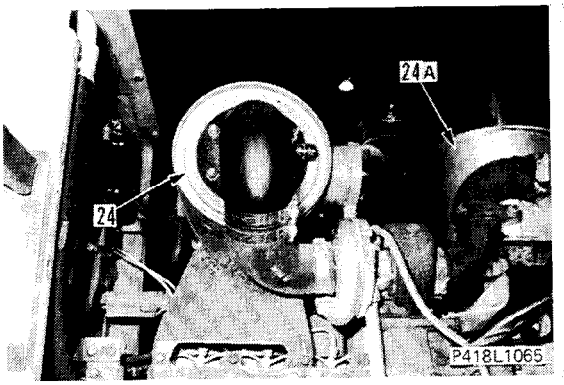


   c) Install the engine drain plug.

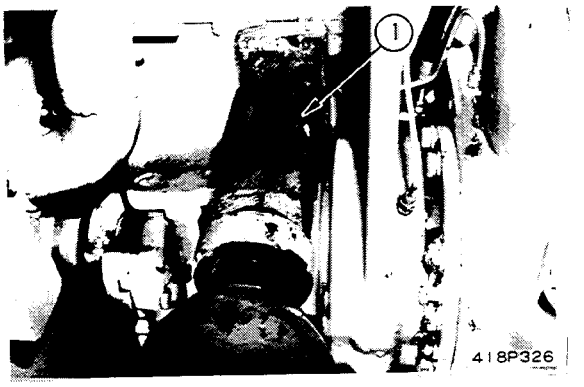


L12AH012

2. Air cleaner and muffler.
   a) Set the air cleaner (24) and the muffler (24A) in mounting position, then tighten mounting bolt and clamps.



3. Transmission support.
   a) Remove support ① from under transmission.
      ★ Remove the support carefully.

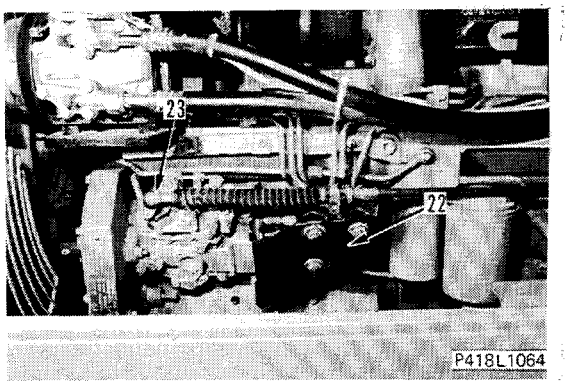


4. Fuel control cable.
   a) Set fuel control cable bracket (22) in position to mount on the engine, then tighten mounting nuts.

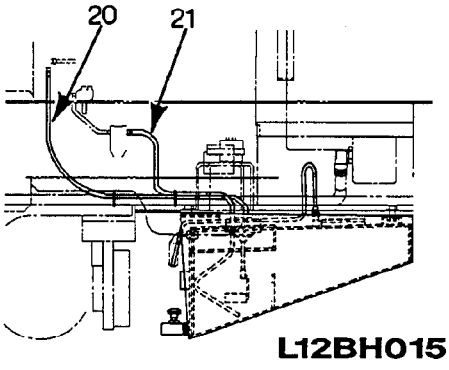
   Mounting nuts: 5.25 ± 0.75 kgm.

   b) Connect fuel control cable (23) to the engine.
      ★ For details of adjusting the length of the fuel control cable, see TESTING AND ADJUSTING.

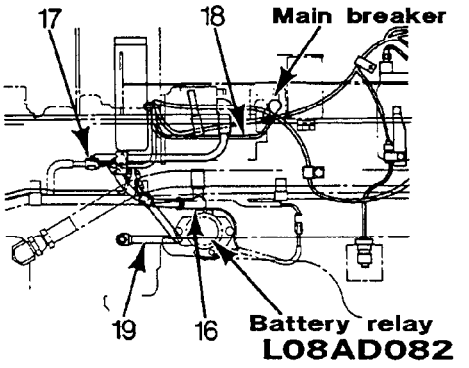
   Mounting nuts: 1.3 ± 0.1 kgm.



5. Fuel hoses.
   a) Connect hose (21) between fuel tank and fuel injection pump at the fuel tank end.
   b) Connect hose (20) between fuel tank and fuel injection nozzle at the fuel tank end.

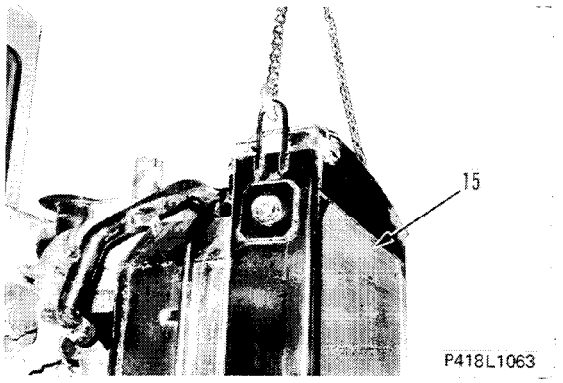


6. Electric wiring.
   a) Connect the following electric wiring.
      - Ground connection (19).
      - Main breaker wiring (18) to main breaker.
      - Engine wiring (17) at connector.
      - Cable (16) between starting motor and the battery relay.

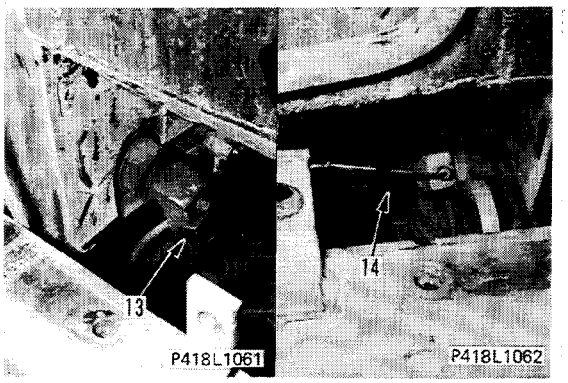


7. Radiator.
   a) Set the radiator (15) in mounting position, then tighten the mounting bolts.
      ★ Be careful not to damage the radiator core. insert the radiator carefully from the counterweight side.
      ★ Raise the radiator and stop 20 cm above the mounting position, then first insert radiator hose.
      ★ Install so that the clearance from the fan is uniform.

   Mounting bolts: 28.5 ± 3.0 kgm.



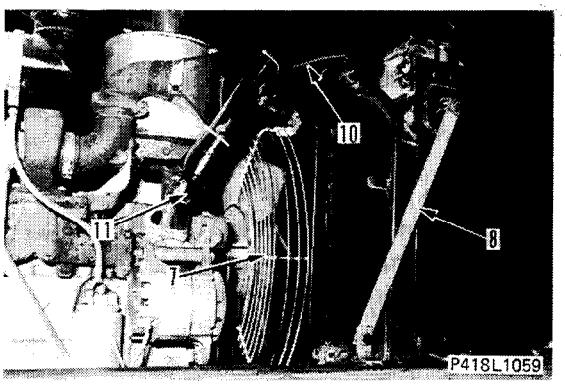
8. Cooler piping.
   a) Connect oil cooler hoses (13 and (14) to the radiator (15).
      ★ Install the hoses without twisting or interference.
      • Hose nut width across the flats: 41 mm.

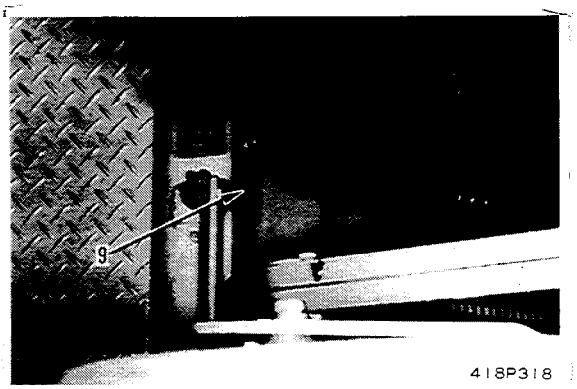


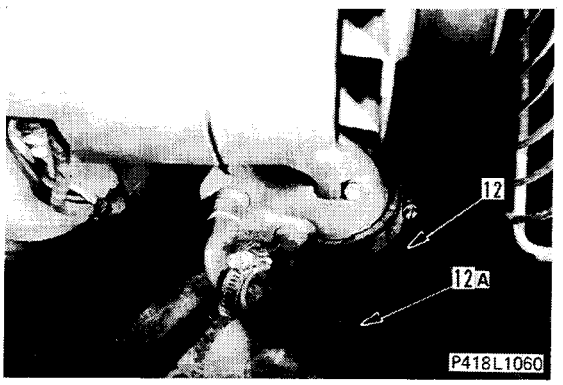
9. Radiator hoses.
   a) Connect the radiator drain hose to the radiator
   b) Connect radiator hoses (10), (11), (12), and (12A) to the engine.
      ★ Tighten lower hose clamps.

10. Electric wiring.
    a) Connect wiring (9) of radiator coolant level sensor to connector.

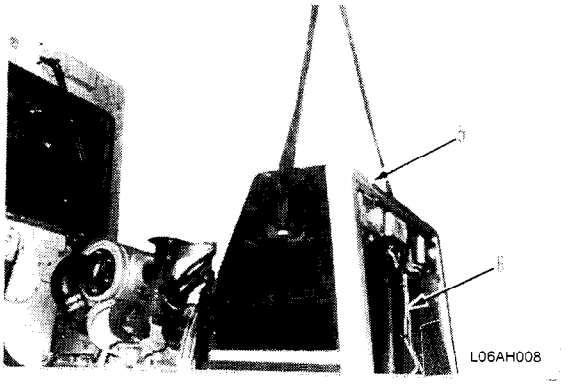
11. Fan guard.
    a) Install fan guard (7) and radiator supports (8).
       ★ Install so that the clearance between the fan guard and the fan is uniform.



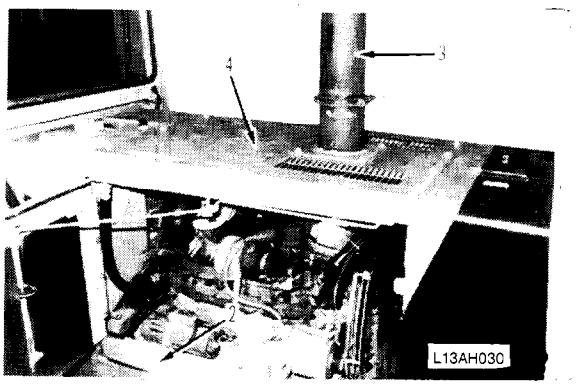




12. Hood and radiator guard
    a) Raise radiator guard (5), set in mounting position, then temporarily tighten mounting bolts.
       ★ After adjusting the engine side hood latches tighten all mounting bolts.



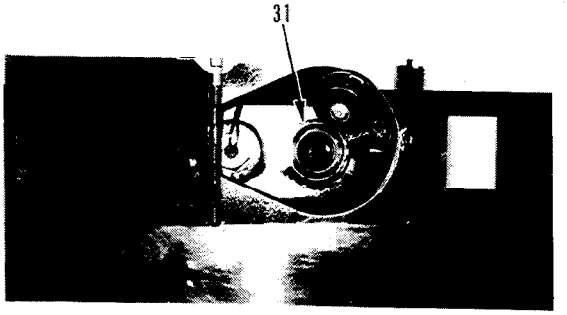
    b) Install engine center hood (4), engine side panels (2), and exhaust pipe (3), then close engine side hoods.
    c) Tighten the mounting bolts on radiator guard (5) and center hood (4).



13. Refilling with coolant.
    a) Install radiator drain plug and add coolant through the radiator filler (31) to the specified level.
       ★ Run the engine to circulate the water through the system. Then check the coolant level.

Coolant: 38 ℓ

       ★ Check to make sure the transmission oil level is at the specified level.



FUEL TANK
REMOVAL

WARNING! Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake, and place blocks under the tires.

1. Radiator grille.
   a) Remove radiator grille (1).

WARNING! Open the engine side hood (2) and apply the lock.

2. Draining fuel.
   a) Open drain valve (3) and drain fuel.

   Fuel: 170 ℓ.

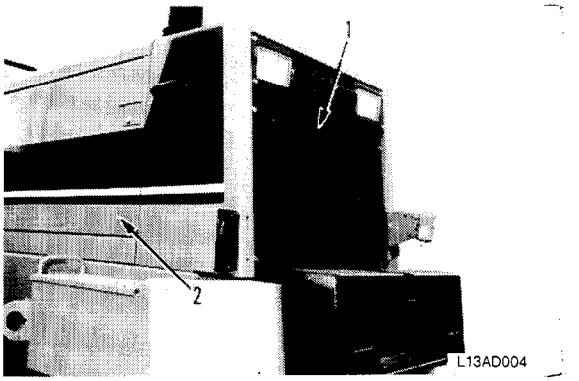
3. Drain plugs.
   a) Remove engine oil drain plug (4) from fuel tank.
   b) Remove radiator coolant drain plug (4A) from fuel tank.

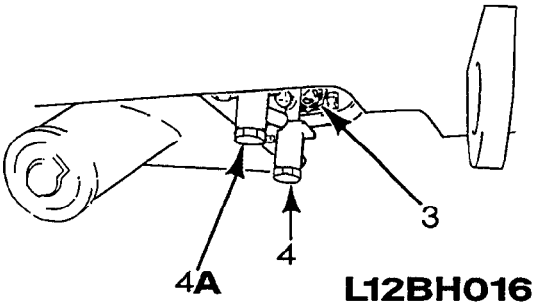
4. Fuel lines and electrical wiring.
   a) Disconnect fuel hoses (5) and (6) from fuel tank.
   b) Disconnect electrical wiring (7) from fuel sending unit from connector

5. Fuel tank.
   a) Sling fuel tank (8), remove mounting bolts, then lift off fuel tank.
      ★ Lay a pallet below the fuel tank, keep the tank balanced and lower slowly.

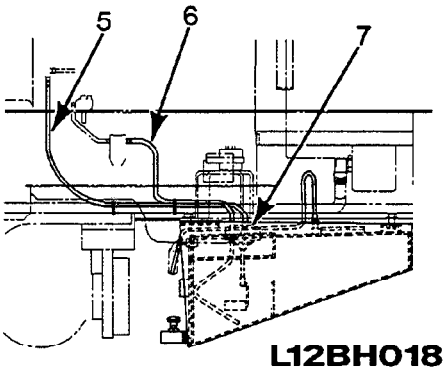
   Fuel tank: 105 kg.

   b) Pull fuel tank out from under the machine.
      ★ Be careful not to let the breather tube hit the machine body.

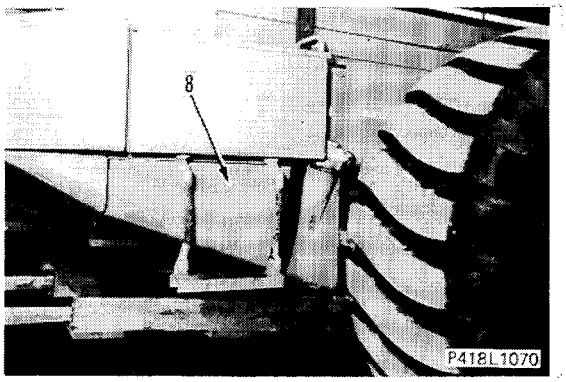




L12BH016



L12BH018



INSTALLATION

1. Fuel tank.
   a) Set the fuel tank (8) on a pallet, then pull in to below mounting position.
      ★ Be careful not to let the breather tube hit the machine body.
   b) Raise fuel tank (8), set in mounting position, then tighten the mounting bolts.
      ★ When raising the fuel tank, keep it horizontal and set in the mounting position.
      ★ Tighten the mounting bolts in the following order: Left, rear, right.
      ● Mounting bolts width across flats: 30mm.

   Mounting bolts: 56 ± 6 kgm.

2. Fuel lines and electrical wiring.
   a) Connect wiring (7) to the fuel sending unit connector.
   b) Connect fuel hoses (5) and (6) to the fuel tank.

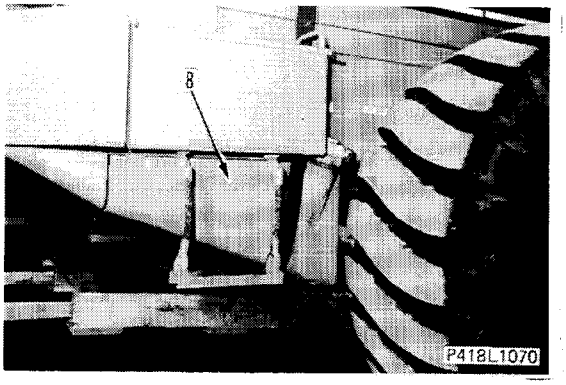
3. Drain plugs.
   a) Install engine oil drain plug (4) to the fuel tank.
   b) Install radiator coolant drain plug (4A) to the fuel tank.

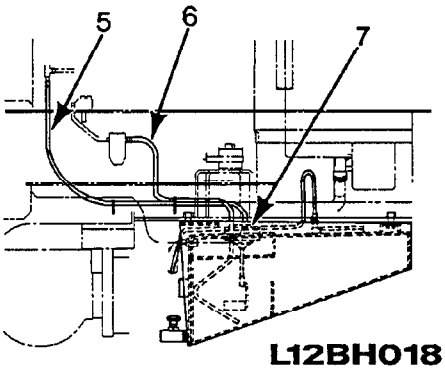
4. Engine side hood.
   a) Release lock and close engine side hood (2).

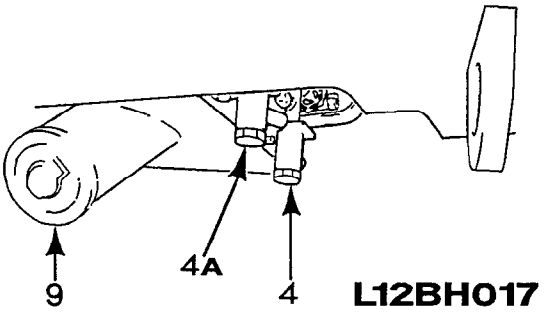
5. Radiator grille.
   a) Install radiator grille (1).

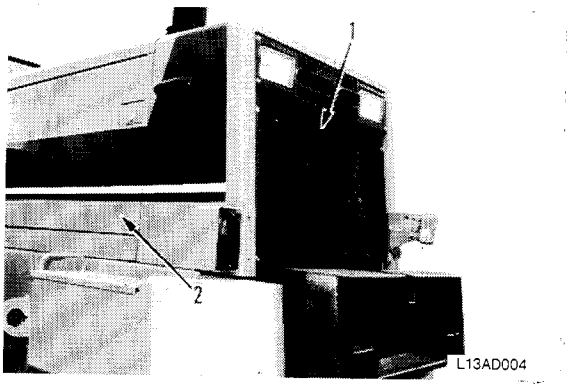
6. Refilling fuel tank.
   a) Close the drain valve and add fuel through the filler neck (9).

   Fuel: 170 ℓ.

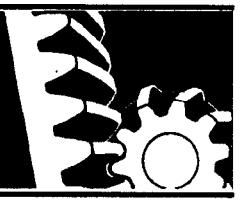








POWER TRAIN
21 STRUCTURE AND FUNCTION



GENERAL 3
HYDRAULIC CIRCUIT FOR POWER TRAIN 5
HYDRAULIC CIRCUIT DIAGRAM FOR POWER TRAIN 6

TORQUE CONVERTER AND TRANSMISSION PIPING 7

TORQUE CONVERTER CHARGING PUMP 8
SPECIFICATIONS 8
OUTLINE 8

TORQUE CONVERTER 9
SPECIFICATIONS 9
OUTLINE 10

TORQUE CONVERTER OIL FILTER 11

TORQUE CONVERTER OIL COOLER AND RADIATOR 12

TORQUEFLOW TRANSMISSION 13

CLUTCH PACK 15
FORWARD AND REVERSE CLUTCH 15
1ST AND 3RD CLUTCH 15
2ND AND 4TH CLUTCH 16
OPERATION OF CLUTCH 17
FORWARD 1ST 18
FORWARD 2ND 19
FORWARD 3RD 20
FORWARD 4TH 21
REVERSE 1ST 22

TRANSMISSION CONTROL VALVE 23
TRANSMISSION SOLENOID VALVE 24
UPPER VALVE 25
LOWER VALVE 26
TORQUE CONVERTER OUTLET VALVE 27
PILOT REDUCING VALVE 28
TRANSMISSION SOLENOID VALVE 29
PRIORITY AND MAIN REGULATOR VALVE 30
MAIN REGULATOR VALVE 31
MODULATING RELIEF VALVE 32
ACCUMULATOR VALVE 32
QUICK RETURN VALVE 32
EMERGENCY MANUAL SPOOL 36

FORWARD 1st 37
DIRECTIONAL SPOOL 38
FILL VALVE 39
PILOT OIL FILTER 41

DRIVE SHAFT 42

AXLE 43
FRONT 43
REAR 44

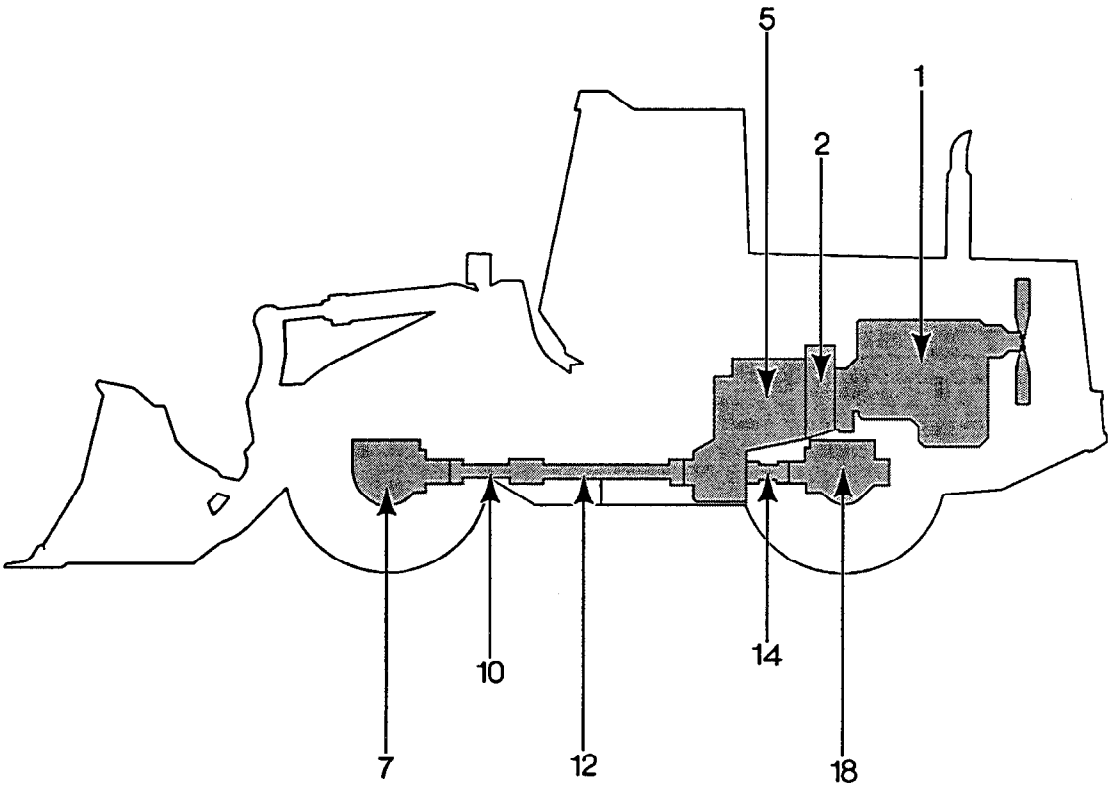
DIFFERENTIAL 45
FRONT 45
REAR 46
TORQUE PROPORTIONING 47

FINAL DRIVE 49

AXLE MOUNT 50

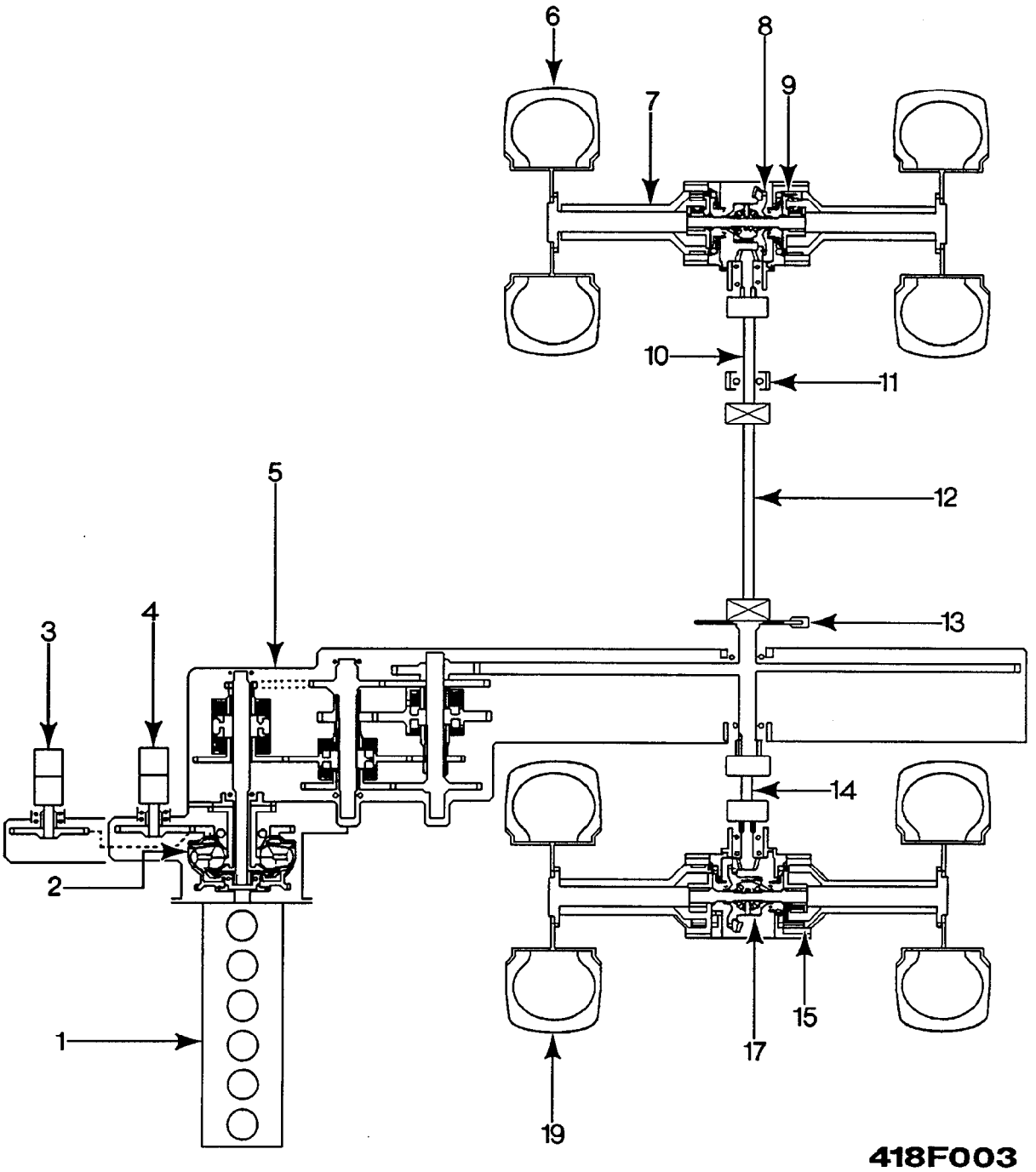
TIRE AND WHEEL 52

GENERAL



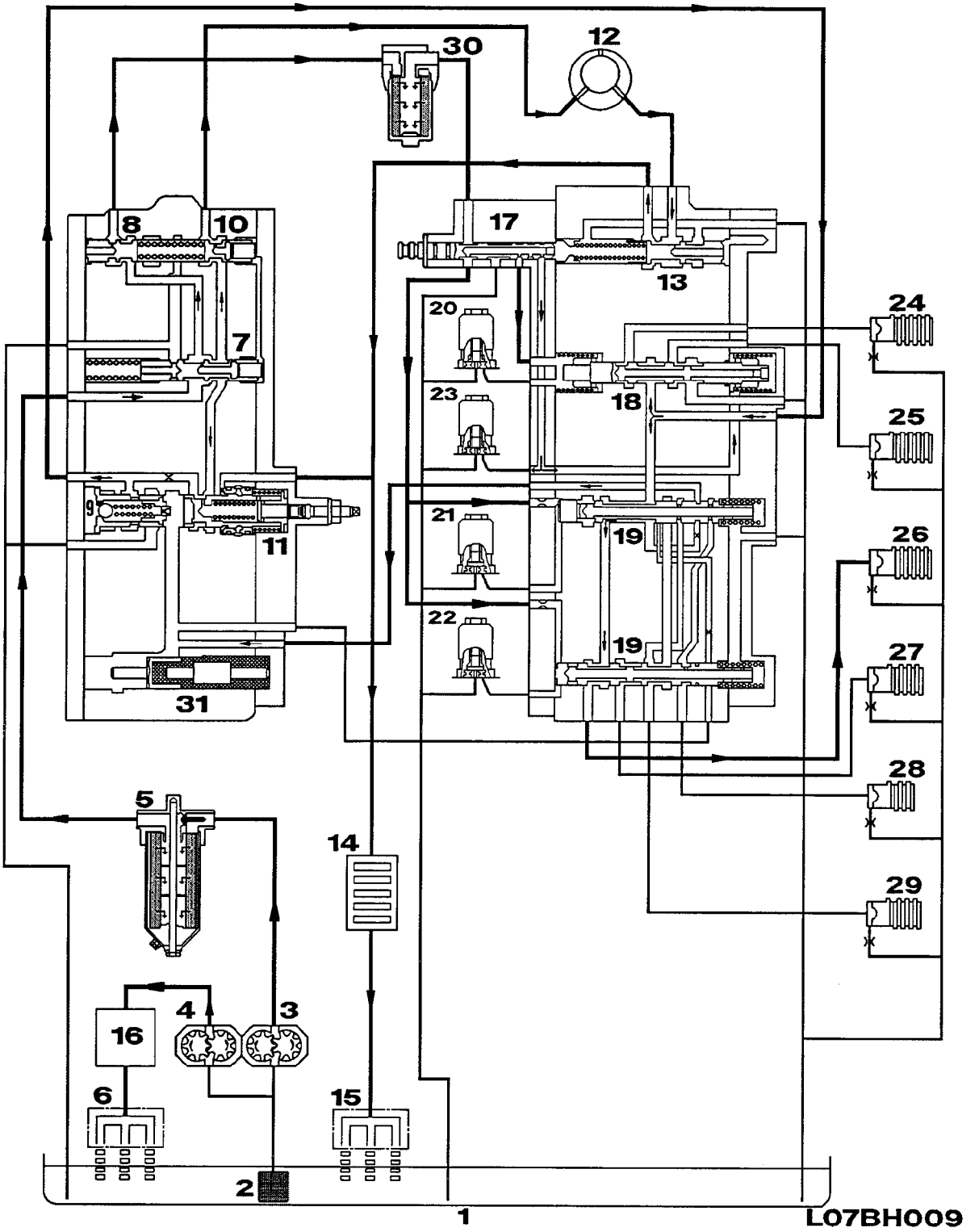
OUTLINE

- The motive force from the engine (1) passes from the flywheel through the ring gear and is transmitted to the torque converter (2). The torque converter uses oil to convert the transmitted torque to correspond to changes in the load. It transmits the motive force to the transmission input shaft. In addition, the motive force from the engine passes through the pump drive gear of the torque converter and is sent to the hydraulic and steering pump (3), and torque converter charging pump (4) to drive these pumps.
- Transmission (5) has six clutches which are actuated hydraulically by operating the solenoid valve to move the directional spool and range spool of the control valve. The transmission has a speed selection of four FORWARD and four REVERSE speeds. The speeds are selected manually.
- The motive force from the transmission output shaft is then sent to the front and rear axles. The power for the front axle (7) passes through the center drive shaft (12) and front drive shaft (10) and is transmitted to the front axle (7), the power for the rear axle passes through the rear drive shaft (14) and is sent to the rear axle (18).
- The motive force transmitted to the front axle (7) and the rear axle (18) is reduced by the pinion and ring gears of the differentials (8) and (17). It then passes from the differential to the sun gear shaft (axle shaft) of the final drive (15).
- The motive force of the sun gear is reduced by a planetary mechanism and is transmitted through the planetary hub to the wheel.

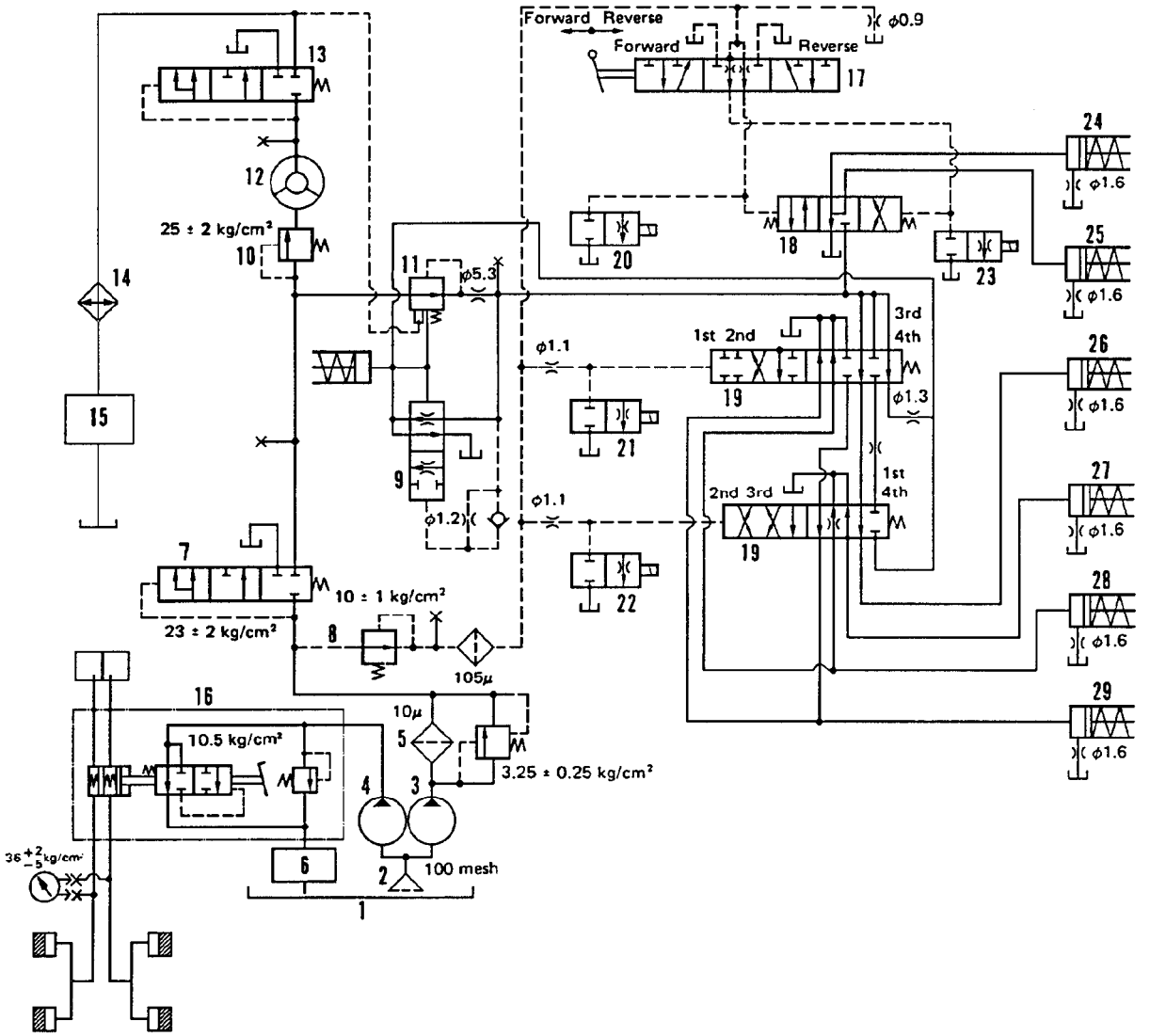


1. Engine
2. Torque converter
3. Hydraulic pump and steering pump
4. Torque converter charging pump
5. Transmission
6. Front wheel
7. Front axle
8. Differential (front)
9. Brake (Front)
10. Front drive shaft
11. Flanged bearing
12. Center drive shaft
13. Parking brake
14. Rear drive shaft
15. Final drive
16. Brake (Rear)
17. Differential (Rear)
18. Rear axle
19. Rear wheel

HYDRAULIC CIRCUIT FOR POWER TRAIN



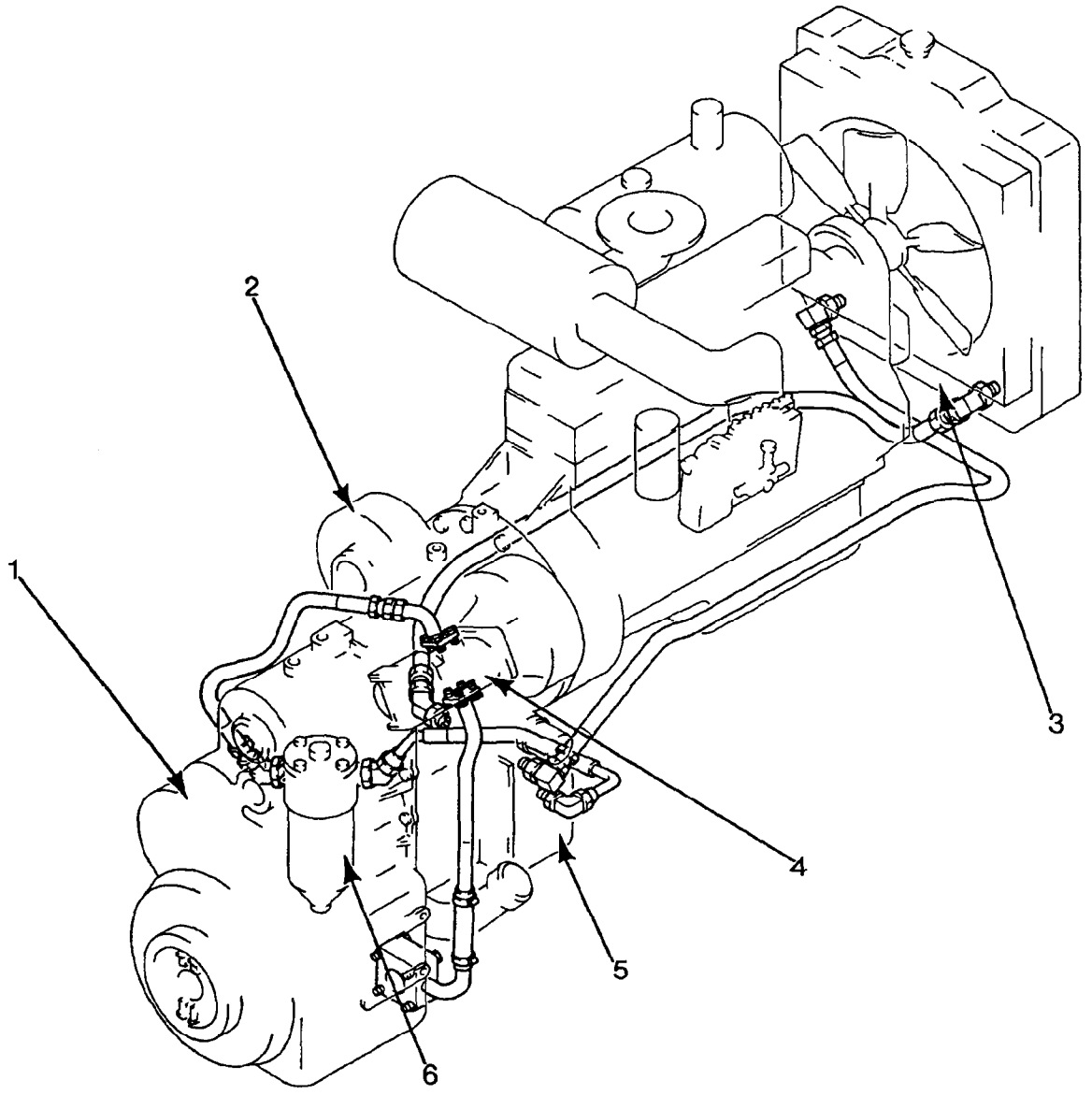
HYDRAULIC CIRCUIT DIAGRAM FOR POWER TRAIN



L07BH010

1. Transmission case
2. Strainer
3. Transmission charging pump
4. Lubricating pump
5. Oil filter
6. Direction clutch lubricating
7. Priority valve
8. Pilot reducing valve
9. Quick return valve
10. Main regulator valve
11. Fill valve
12. Torque converter
13. Torque converter outlet valve
14. Oil cooler
15. Transmission clutch lubricating
16. Brake circuit
17. Emergency manual spool
18. FORWARD-REVERSE spool
19. Speed control spool
20. FORWARD (F2nd) solenoid valve
21. 3rd/4th solenoid valve
22. 1st/4th solenoid valve
23. REVERSE (R2nd) solenoid valve
24. FORWARD clutch
25. REVERSE clutch
26. 4th clutch
27. 3rd clutch
28. 2nd clutch
29. 1st clutch
30. Pilot oil filter

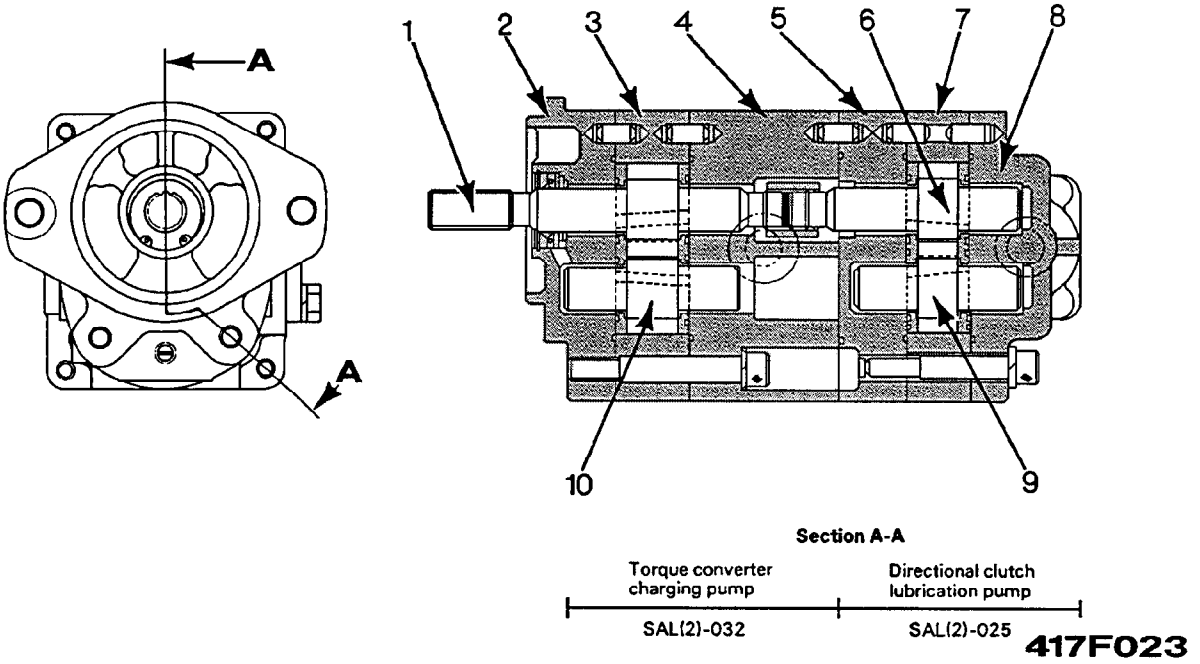
TORQUE CONVERTER AND TRANSMISSION PIPING



418F502

1. Transmission
2. Torque converter
3. Torque converter oil cooler
4. Torque converter charging pump
5. Transmission valve
6. Torque converter oil filter

TORQUE CONVERTER CHARGING PUMP



1. Drive gear (12 teeth)
2. Front cover
3. Gear case
4. Rear cover
5. Front cover
6. Drive gear (12 teeth)
7. Gear case
8. Rear cover
9. Driven gear (12 teeth)
10. Driven gear (12 teeth)

SPECIFICATIONS

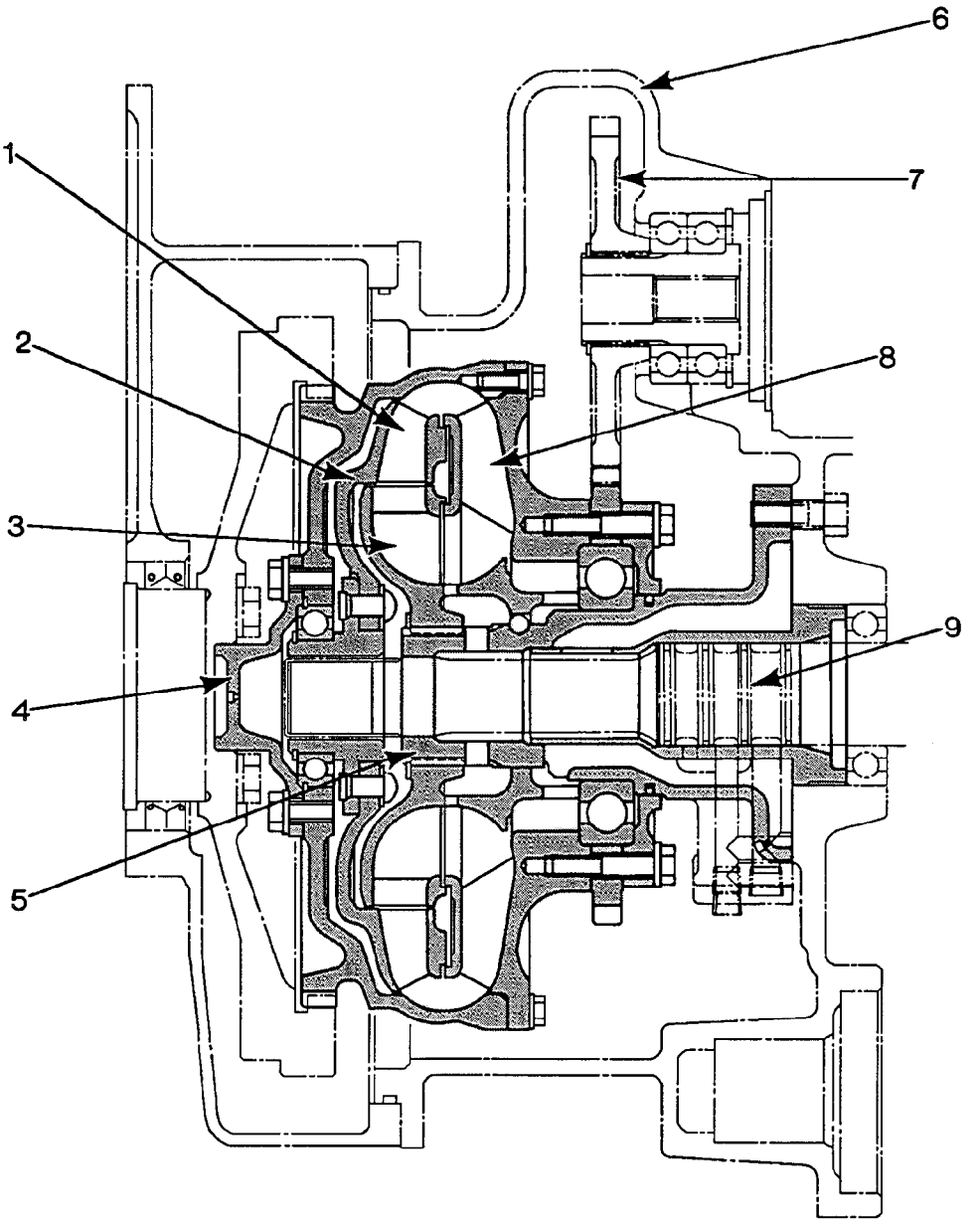
Type: SAL(2)032 (Front pump)
Theoretical delivery: 32.0 cc/rev
Maximum delivery pressure: 210 kg/cm^2
Maximum speed: 3000 rpm

Type: SAL(2)025 (Rear pump)
Theoretical delivery: 25.0 cc/rev
Maximum delivery pressure: 210 kg/cm^2
Maximum speed: 3000 rpm

OUTLINE

- The torque converter charging pump is installed to the torque converter case. It is driven by motive force from the engine and supplies oil to the torque converter and transmission.
- The torque converter charging pump sucks in oil through a strainer from the bottom of the transmission. The oil from the front pump is sent to the torque converter oil filter. The oil from the rear pump enters the lubrication ports of the torque converter regulator valve, and lubricates the FORWARD and REVERSE clutches of the transmission.

TORQUE CONVERTER



418F007

1. Turbine
2. Drive case
3. Stator
4. Pilot
5. Stator shaft
6. Housing
7. P.T.O. gear (drive)
8. Pump
9. Transmission input shaft

SPECIFICATIONS

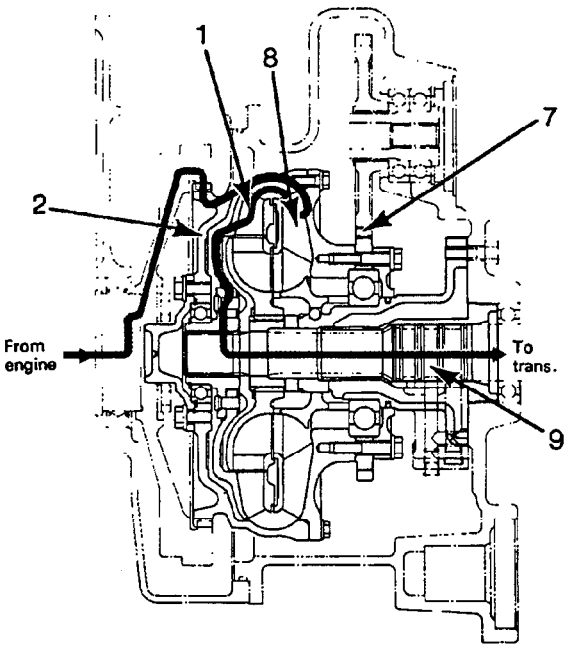
Model: TCA32-4A
Type: 3-element, single stage, single phase
Stall torque ratio: 2.92

OUTLINE

Flow of motive force.

- The torque converter is installed between the engine and transmission. the motive force from the engine passes from the flywheel and enters the drive case (2). Drive case (2), pump (8), and the P.T.O drive gear (7) are fixed with bolts. They are rotated directly by the rotation of the engine. The motive force of pump (8) uses oil to rotate the turbine (1). This transmits motive force to the transmission input shaft (9).

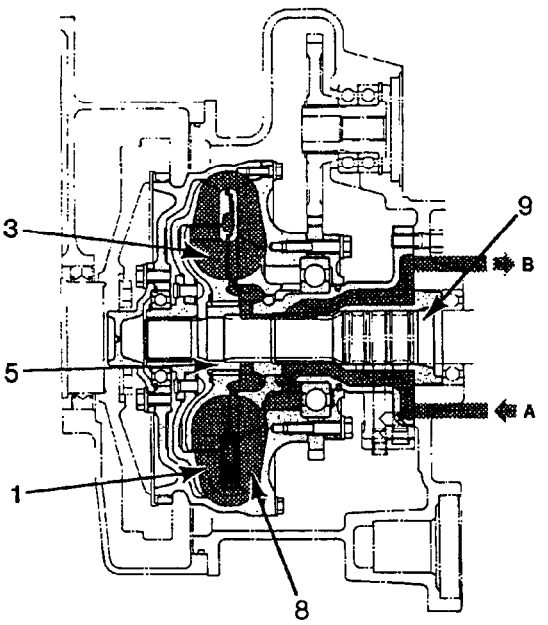
- The motive force of drive case (2) passes through the P.T.O. drive gear (7) and is also used as the motive force to drive the gear pump.



418F008

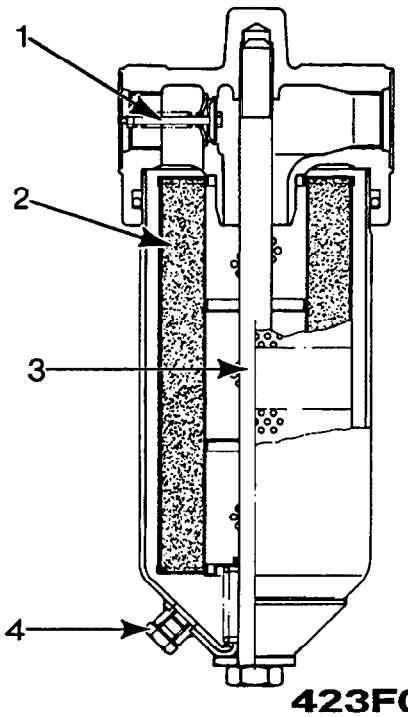
Flow of oil

- The oil pressure is adjusted by the torque converter relief valve and then enters inlet port "A", passes through the oil passage in the housing and flows to pump (8). In pump (8) centrifugal force is applied. The oil enters the turbine (1) and the energy of the oil is transmitted to the turbine. Turbine (1) is fixed to the transmission input shaft (9), so the motive force is transmitted to the transmission input shaft. The oil from turbine (1) is sent to the stator (3) and again enters the pump. However, part of the oil passes from the stator through outlet port "B" and is sent to the cooler.



418F009

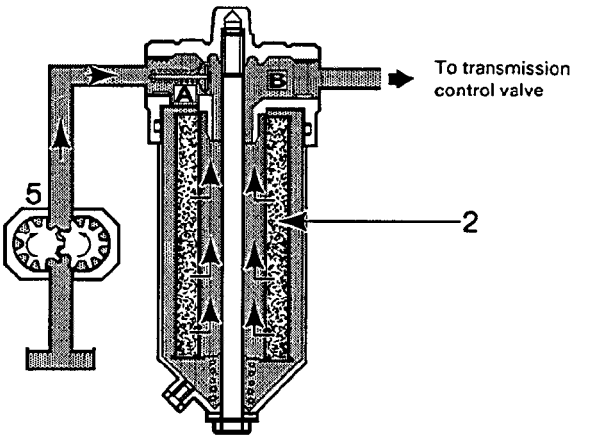
TORQUE CONVERTER OIL FILTER



423F009

1. Relief valve
2. Element (filter)
3. Center bolt
4. Drain plug

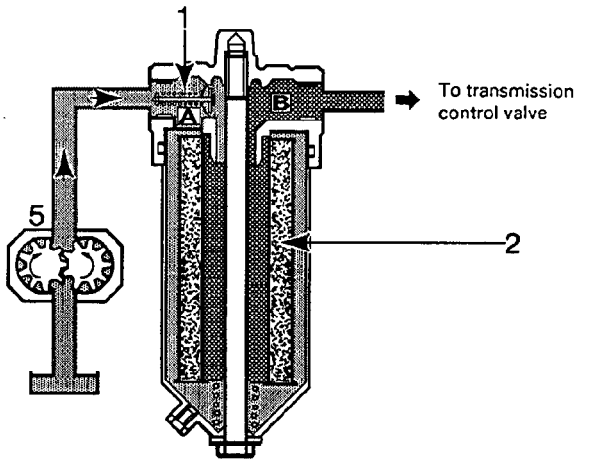
Filtration area: 8,900 cm^2
Relief pressure: 3.25 kg/cm^2



423F010

Operation

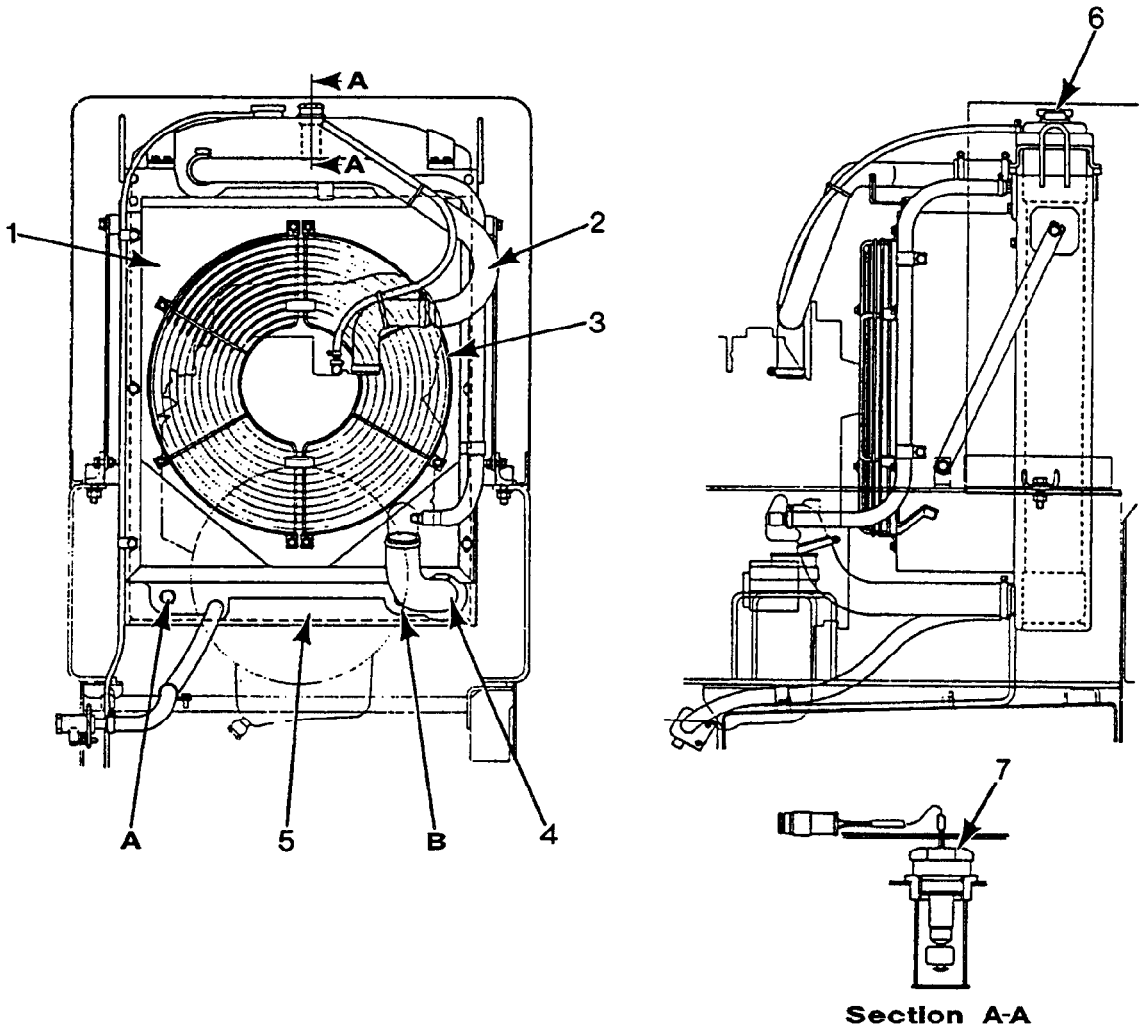
- The oil from the torque converter charging pump (5) enters the filter inlet port "A" and passes from the outside of element (2) to the inside. It then flows to the outlet port "B".



423F011

- If the element is clogged with dirt, or the oil temperature is low, the pressure at the inlet port rises. When this happens, the oil from the inlet port "A" opens relief valve (1) and flows directly to the outlet port. This prevents damage to the pump or filter element (2).

TORQUE CONVERTER OIL COOLER AND RADIATOR



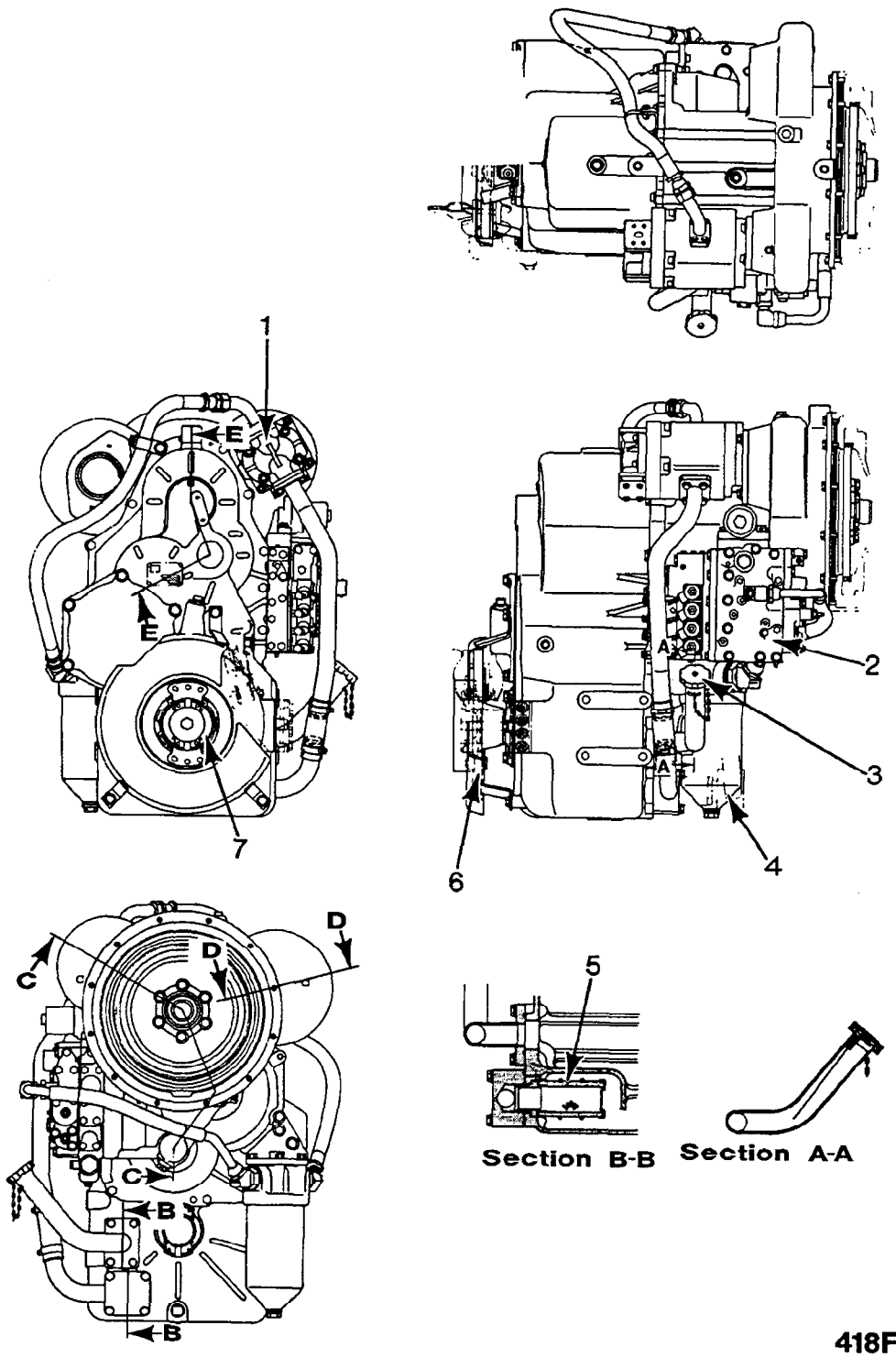
L06AD004

1. Radiator
2. Radiator inlet hose
3. Fan guard
4. Radiator outlet hose
5. Torque converter oil cooler
6. Filler cap
7. Coolant level sensor

A. Oil outlet port
B. Oil inlet port

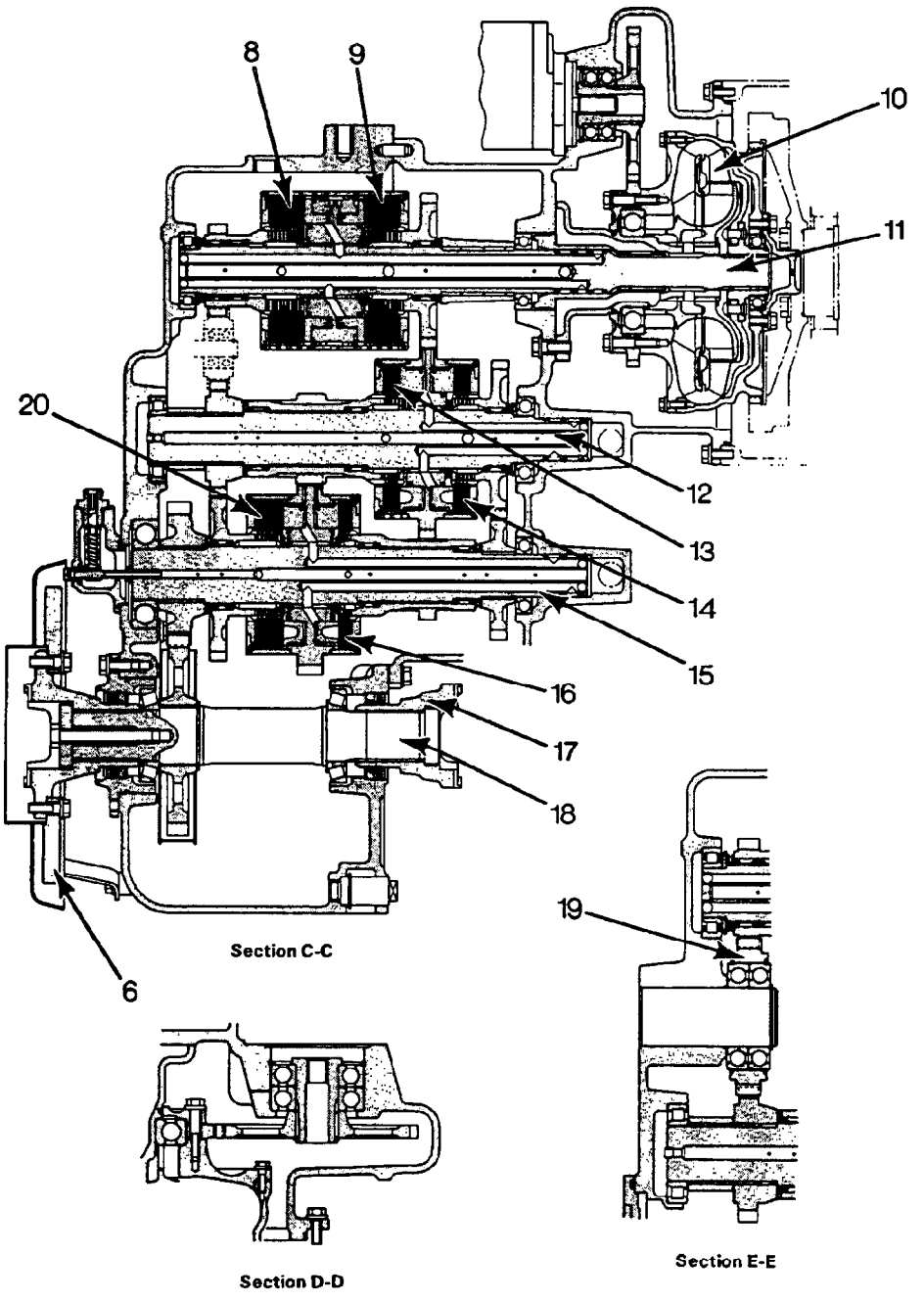
Specifications:
Core type: G6
Total radiation area: 45.44m^3

TORQUEFLOW TRANSMISSION



418F503

1. Torque converter charging pump
2. Transmission valve
3. Oil filter
4. Torque converter oil filter
5. Strainer
6. Parking brake
7. Output coupling



418F504

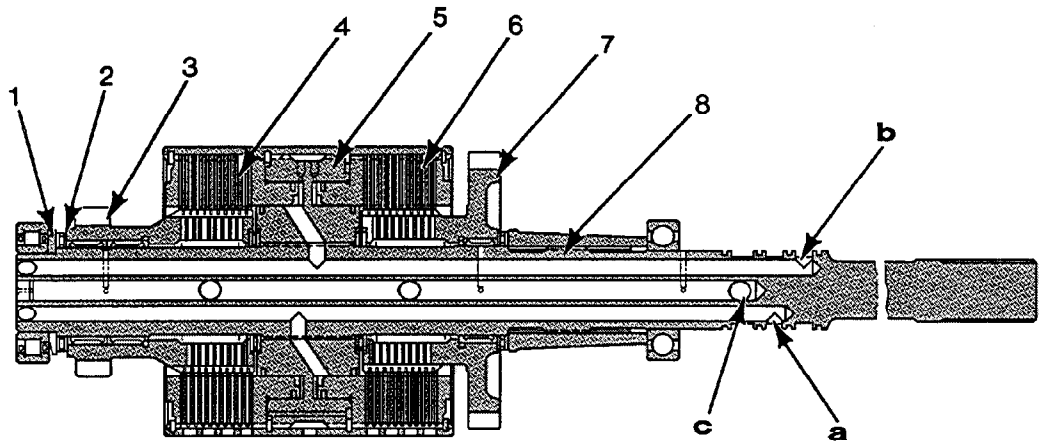
8. Reverse clutch
9. Forward clutch
10. Torque converter
11. Input shaft
12. 1st - 3rd shaft
13. 1st clutch
14. 3rd clutch
15. 2nd - 4th shaft
16. 4th clutch
17. Rear coupling
18. Output shaft
19. Reverse idler gear
20. 2nd clutch

OUTLINE

- The transmission consists of a 4-FORWARD, 4-REVERSE speed transmission and transmission valve.
- In the transmission, the motive force of the input shaft is changed by the combination of No. 1 or No. 2 clutch with No. 3, 4, 5, or 6 clutch to give FORWARD 1 - 4 or REVERSE 1 - 4 speed, and is transmitted to the output shaft.

CLUTCH PACK

FORWARD AND REVERSE CLUTCH

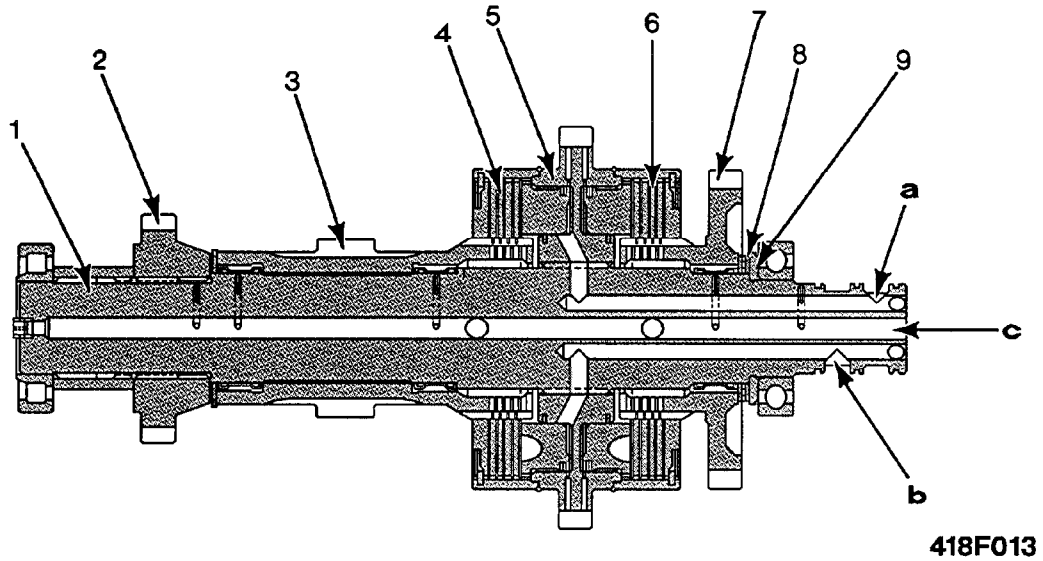


L07CZ039

1. Thrust washer
2. Thrust bearing
3. Reverse gear
4. Reverse clutch
5. Forward and reverse cylinder
6. Forward clutch
7. Forward gear
8. Input shaft

a. Forward clutch oil port
b. Reverse clutch oil port
c. Lubricating oil port

1ST AND 3RD CLUTCH

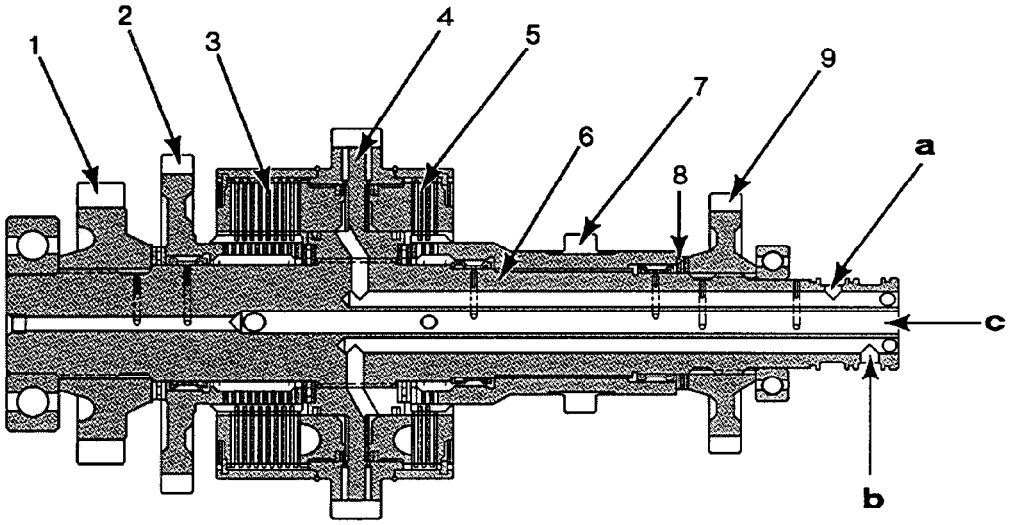


418F013

1. 1st and 3rd shaft
2. Idler gear
3. 1st gear
4. 1st clutch
5. 1st and 3rd cylinder
6. 3rd clutch
7. 3rd gear
8. Thrust bearing
9. Thrust washer

a. 1st clutch oil port
b. 3rd clutch oil port
c. Lubricating oil port

2ND AND 4TH CLUTCH



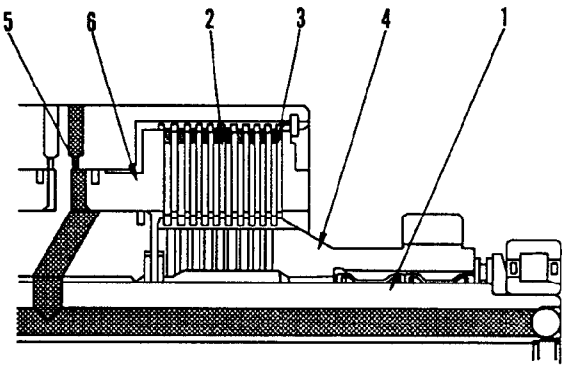
418F014

1. Idler gear
2. 2nd gear
3. 2nd clutch
4. 2nd and 4th cylinder
5. 4th clutch
6. 2nd and 4th shaft
7. 4th gear
8. Thrust bearing
9. Idler gear
   a. 2nd clutch oil port
   b. 4th clutch oil port
   c. Lubricating oil port

OPERATION OF CLUTCH

When engaged

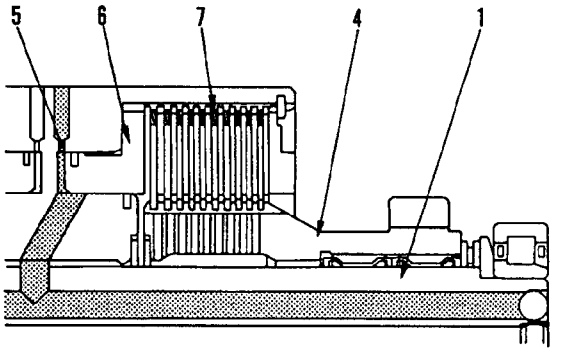
- The oil sent from the transmission valve passes through the oil passage inside shaft (1). It reaches the rear face of piston (6) and acts on the piston.
- When piston (6) is actuated, separator plate (2) and clutch disc (3) are brought into close contact. Shaft (1) and clutch gear (4) form one unit and transmit the motive force.
- When this happens, oil is drained from oil drain hole (5). However, the volume of oil drained is less than the volume of entering, so there is no effect on the operation of the clutch.



419F024

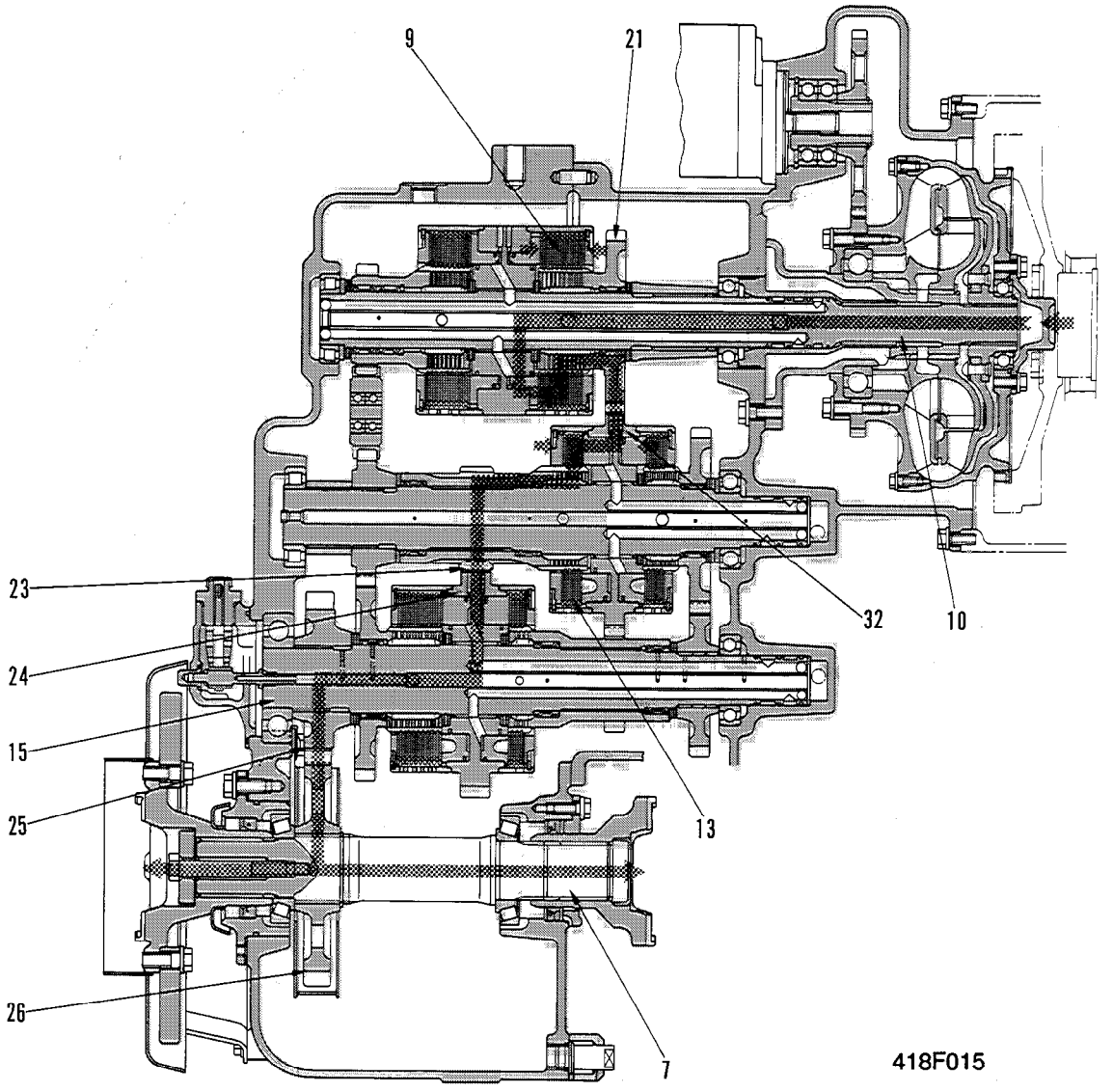
When disengaged

- The oil sent from the transmission valve is shut off, so the pressure of the oil acting on the rear face of piston (6) is reduced.
- The piston is returned to its original position by wave spring (7), shaft (1) and clutch gear (4) are separated.
- When the clutch is disengaged, the oil at the rear face of the piston is drained by centrifugal force through oil drain hole (5). This prevents the clutch from remaining partially engaged.



419F025

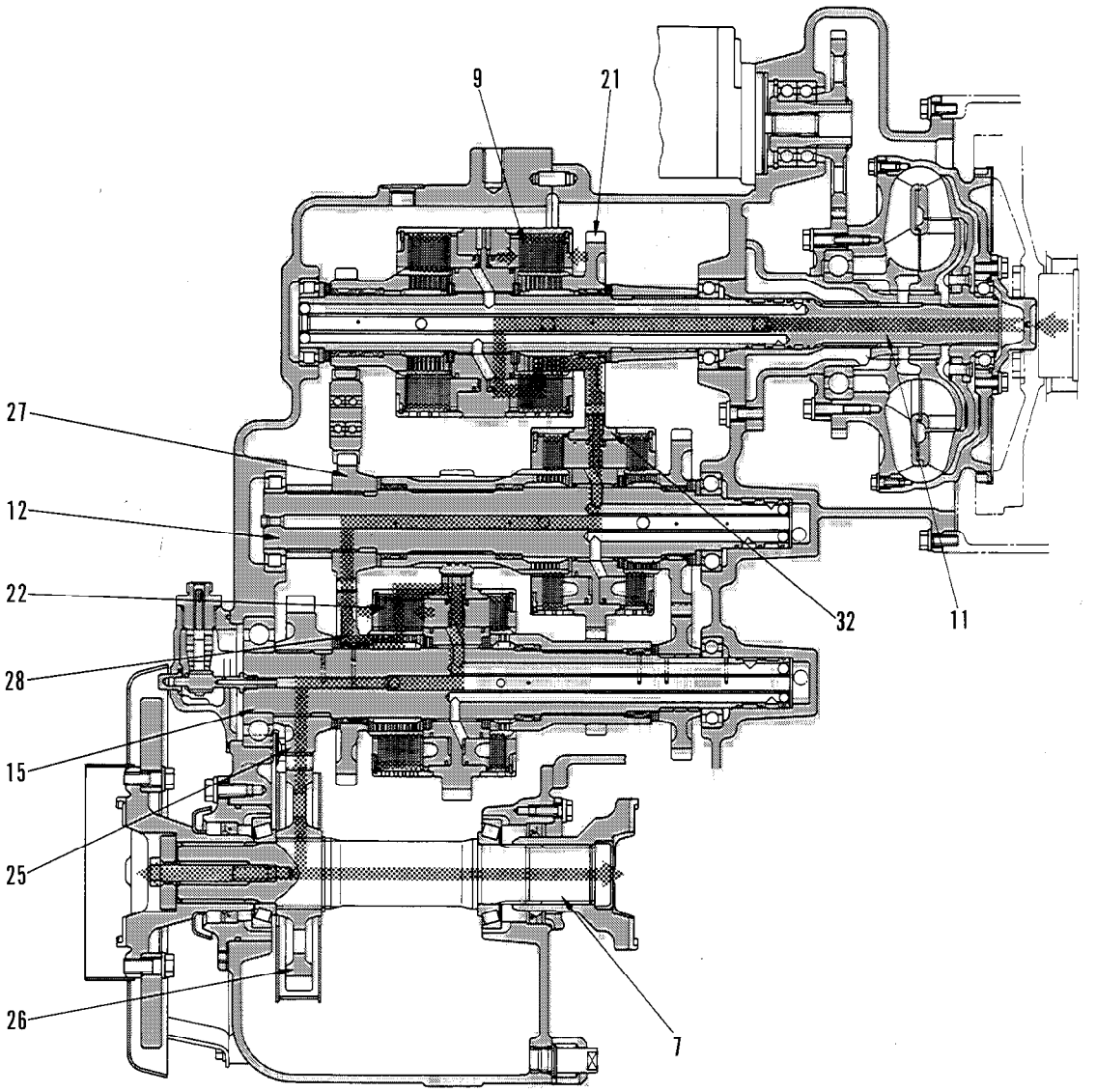
FORWARD 1ST



OPERATION

- In FORWARD 1st, FORWARD clutch (9) and 1st clutch (13) are engaged. the motive force transmitted to input shaft (10) from the torque converter is transmitted to output shaft (7).
- The clutch discs of FORWARD clutch (9) and 1st clutch (13) are held by hydraulic pressure applied to the clutch piston.
- The motive force from torque converter is transmitted from input shaft (10) through FORWARD clutch (9) to FORWARD gear (21). From here it is transmitted to 1st and 3rd cylinder gear (32).
- The 1st clutch is engaged, so the motive force transmitted to 1st and 3rd cylinder gear (32) is then transmitted through the 1st clutch and goes from 1st gear (23) to 2nd and 4th cylinder gear (24). The motive force then goes through 2nd and 4th shaft (15), idler gear (25), and output gear (26), and is transmitted to output shaft (7).

FORWARD 2ND

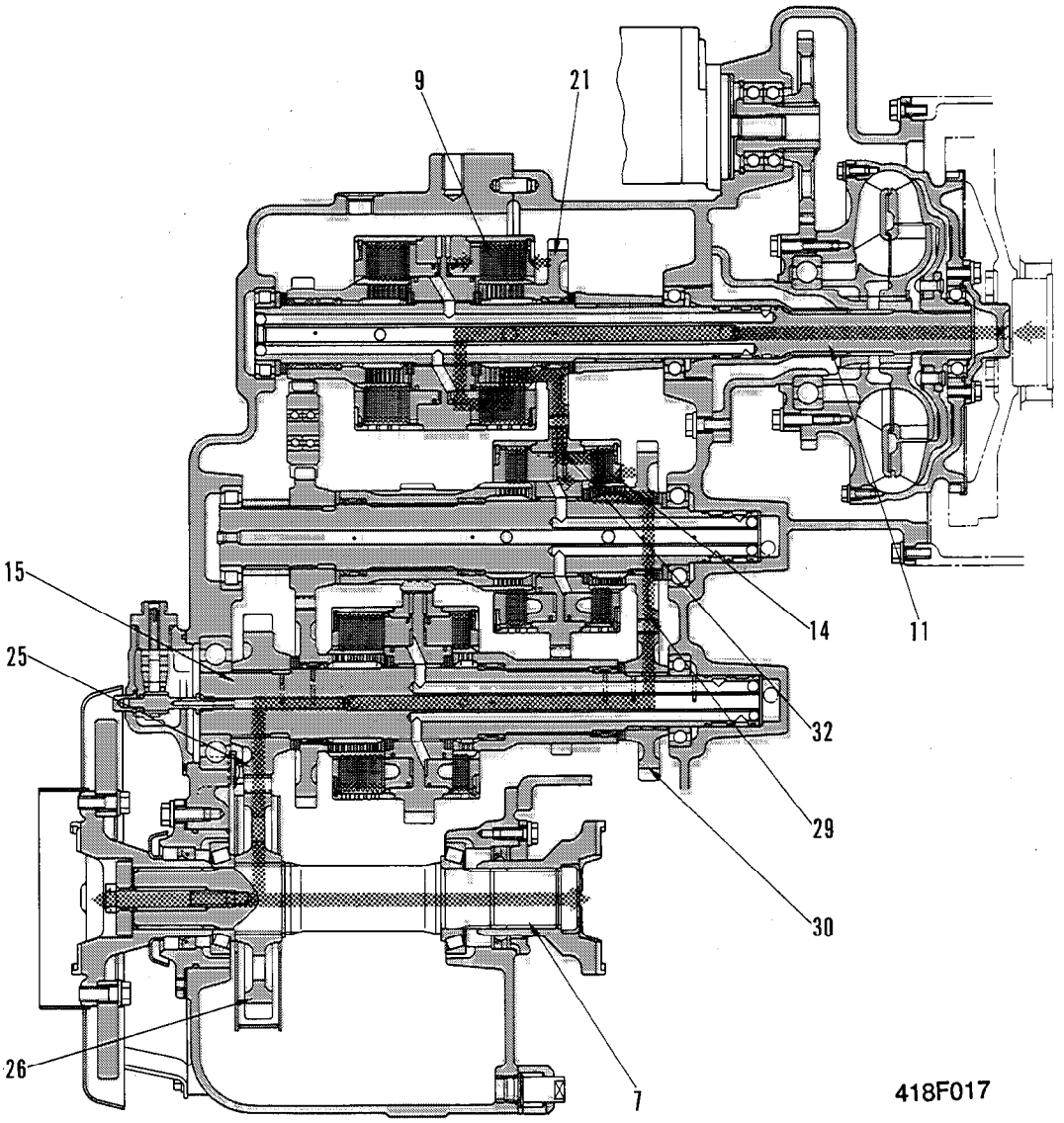


418F016

OPERATION

- In FORWARD 2nd, FORWARD clutch (9) and 2nd clutch (22) are engaged. The motive force transmitted to input shaft (11) from the torque converter is transmitted to output shaft (7).
- The clutch discs of FORWARD clutch (9) and 2nd clutch (22) are held by the hydraulic pressure applied to the clutch piston.
- The motive force from torque converter is transmit-
- ted from input shaft (11) through FORWARD clutch (9) to FORWARD gear (21). From here it is transmitted through 1st and 3rd cylinder gear (32), 1st and 3rd shaft (12), and idler gear (27) to 2nd gear (28).
- The 2nd clutch (22) is engaged, so the motive force transmitted to the 2nd gear is then transmitted through the 2nd clutch. The motive force then goes from the 2nd, and 4th cylinder gear through 2nd and 4th shaft (15), idler gear (25), and output gear (26), and is transmitted to output shaft (7).

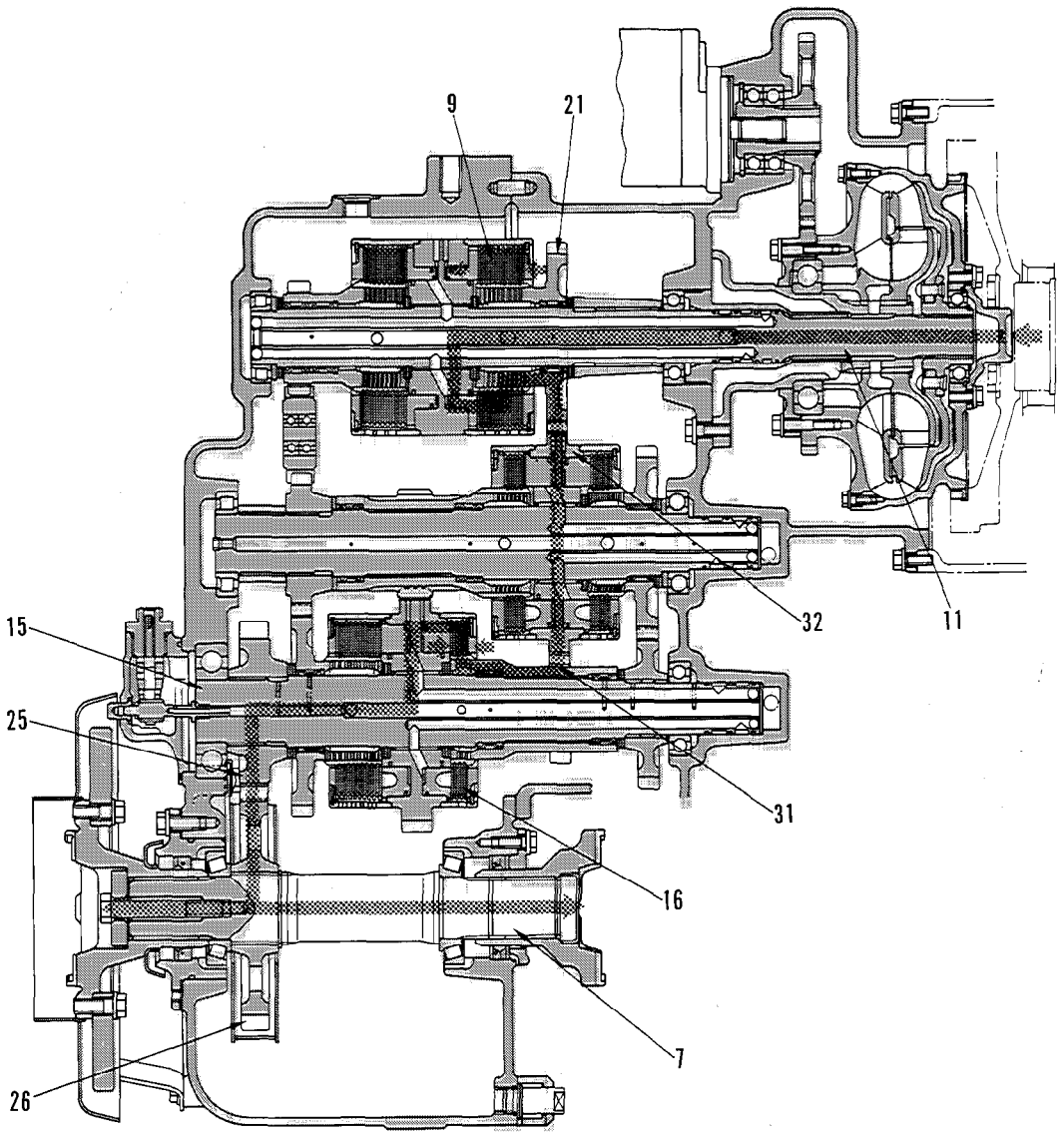
FORWARD 3RD



OPERATION

- In FORWARD 3rd, FORWARD clutch (9) and 3rd clutch (14) are engaged. the motive force transmitted to input shaft (11) from the torque converter is transmitted to output shaft (7).
- The clutch discs of the FORWARD clutch and the 3rd clutch are held by the hydraulic pressure applied to the clutch piston.
- The motive force from torque converter is transmitted from input shaft (11) through FORWARD clutch (9) to FORWARD gear (21). From here it is transmit ted to 1st and 3rd cylinder gear (32).
- The 3rd clutch (14) is engaged, so the motive force transmitted to 1st and 3rd cylinder gear (32) is then transmitted through the 3rd clutch and goes from 3rd gear (29) to idler gear (30). The motive force then goes through 2nd and 4th shaft (15), idler gear (25), and output gear (26), and is transmitted to output shaft (7).

FORWARD 4TH

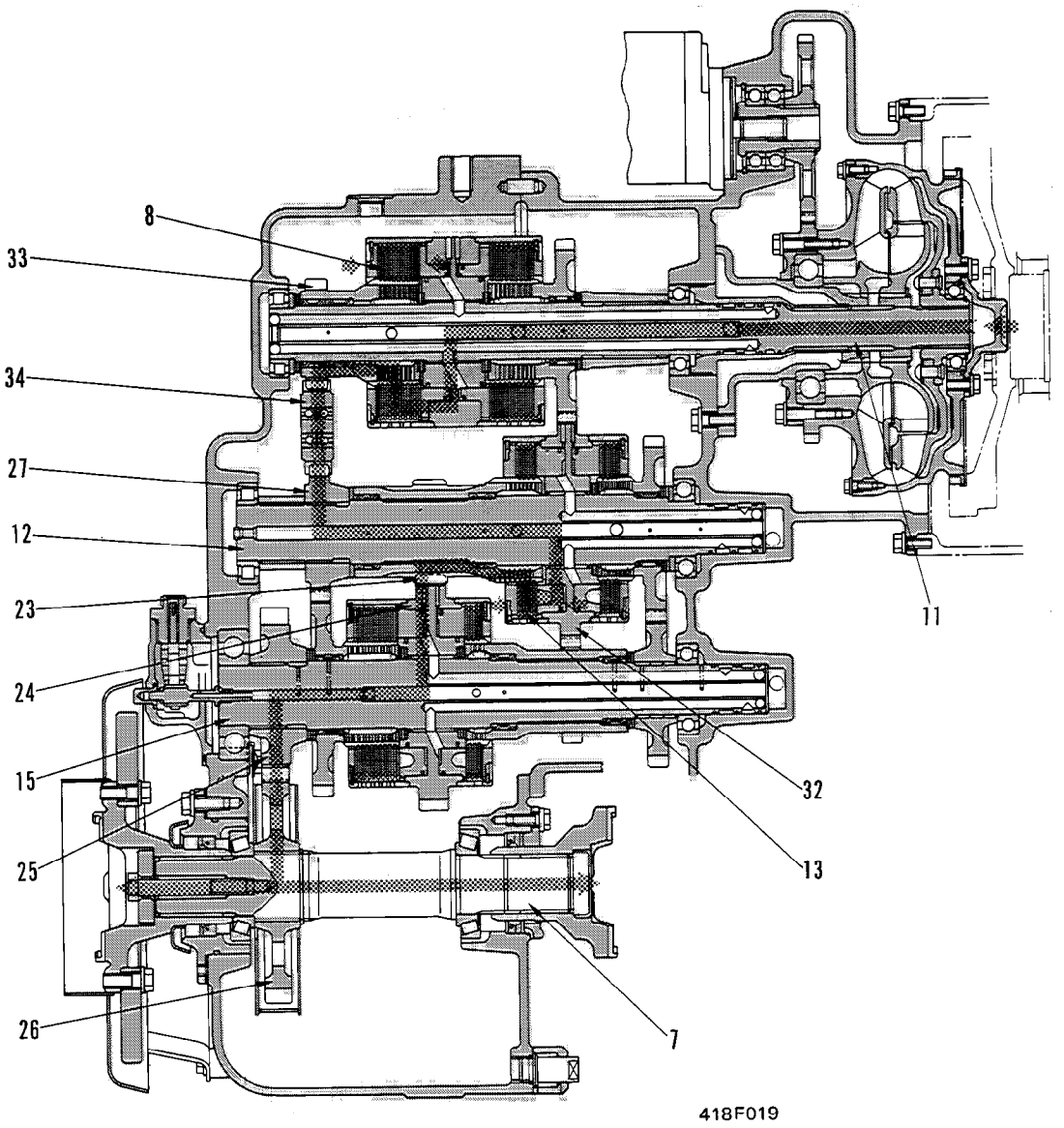


418F018

OPERATION

- In FORWARD 4th, FORWARD clutch (9) and 4th clutch (16) are engaged. The motive force transmitted to input shaft (11) from the torque converter is transmitted to output shaft (7).
- The clutch discs of FORWARD clutch (9) and 4th clutch (16) are held by the hydraulic pressure applied to the clutch piston.
- The motive force from torque converter is transmitted from input shaft (11) through FORWARD clutch (9) to FORWARD gear (21). From here it is transmitted through 1st and 3rd cylinder gear (32) to 4th gear (31).
- The 4th clutch (16) is engaged, so the motive force transmitted to the 4th gear then transmitted through the 4th clutch. The motive force then goes from the 2nd and 4th cylinder gear through 2nd and 4th shaft (15), idler gear (25), and output gear (26), and is transmitted to output shaft (7).

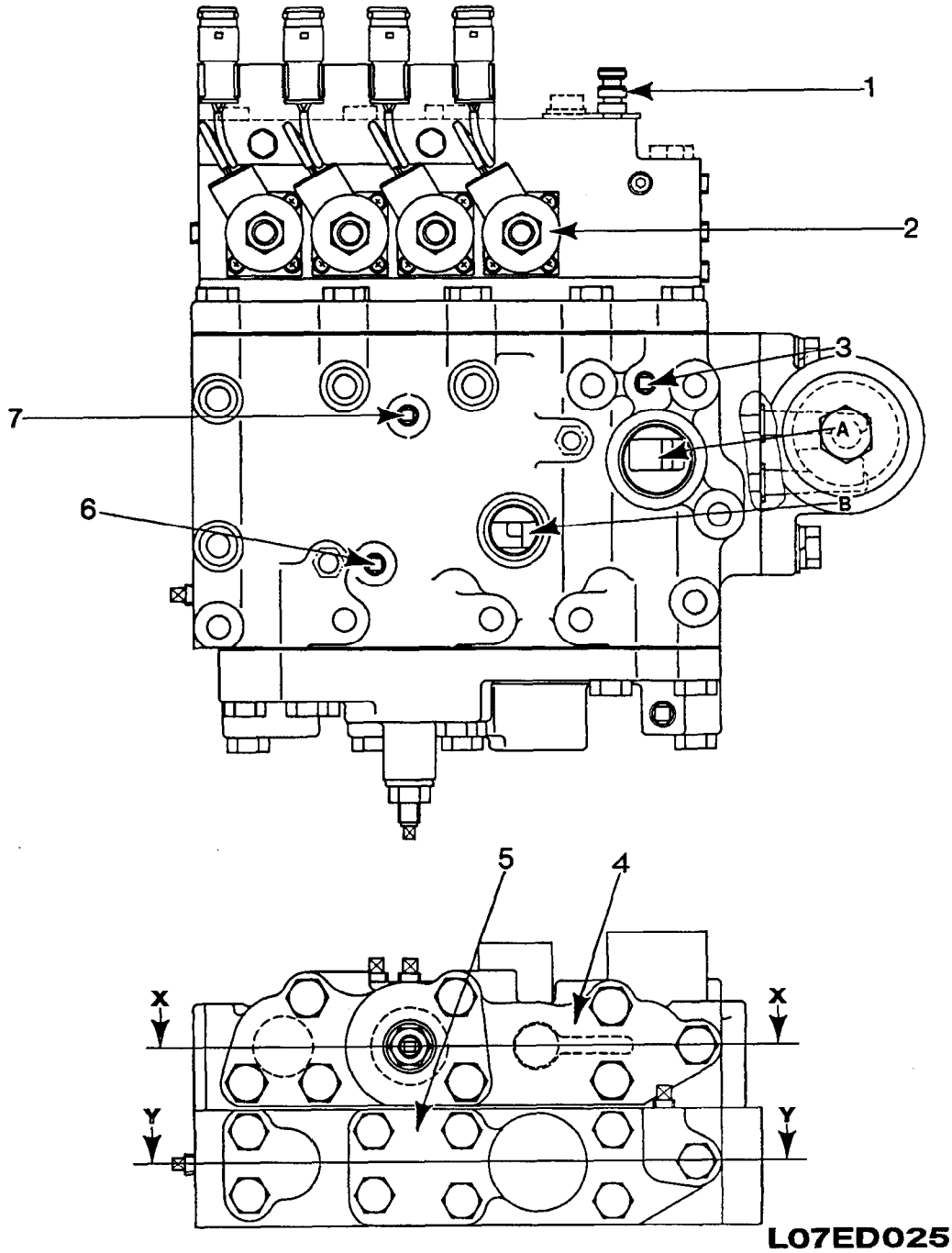
REVERSE 1ST



OPERATION

- In REVERSE 1st, REVERSE clutch (8) and 1st clutch (13) are engaged. the motive force transmitted to input shaft (11) from the torque converter is transmitted to output shaft (7).
- The clutch discs of REVERSE clutch (8) and 1st clutch (13) are held by the hydraulic pressure applied to the clutch piston.
- The motive force from torque converter is transmitted from input shaft (11) through REVERSE clutch (8) to REVERSE gear (33). The direction of rotation is reversed by idler gear (34) and the motive force is then transmitted through idler gear (27) and the 1st and 3rd shaft to 1st and 3rd cylinder gear (32).
- The 1st clutch is engaged, so the motive force transmitted to 1st and 3rd cylinder gear (32) is then transmitted through the 1st clutch and goes from 1st gear (23) to 2nd and 4th cylinder gear (24). The motive force then goes through 2nd and 4th cylinder gear (24), 2nd and 4th shaft (15), idler gear (25), and output gear (26), and is transmitted to output shaft (7).

TRANSMISSION CONTROL VALVE

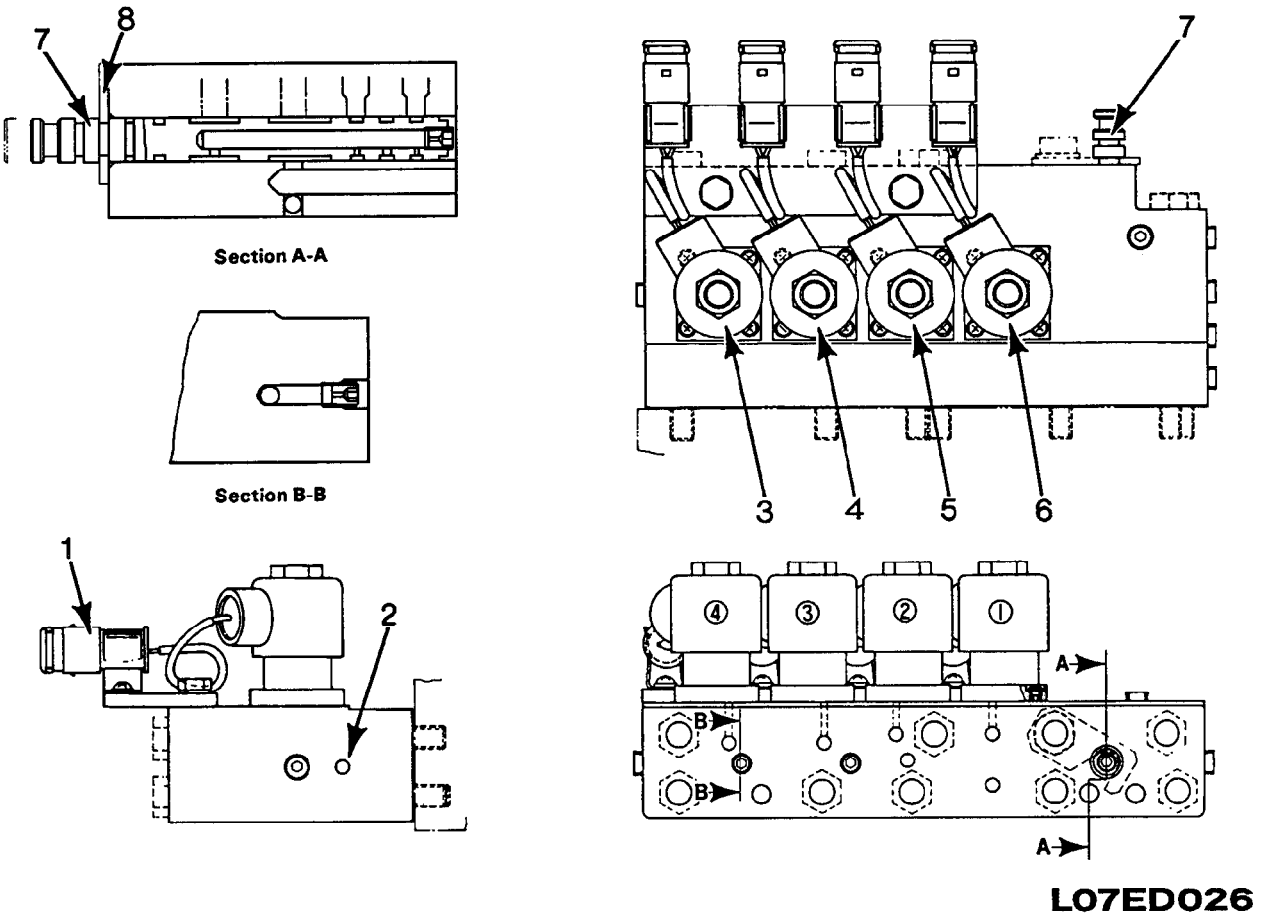


1. Emergency manual
2. Solenoid valve
3. Pilot pressure check plug
4. Upper valve
5. Lower valve
6. Pump pressure check plug
7. Clutch pressure check plug

A. To cooler
B. From plug

section X-X (see page 21-24)
section Y-Y (see page 21-25)

TRANSMISSION SOLENOID VALVE



1. Connector
2. Valve body
3. 1st/4th solenoid valve
4. 3rd/4th solenoid valve
5. Reverse solenoid valve
6. Forward solenoid valve
7. Emergency manual spool
8. Lock plate

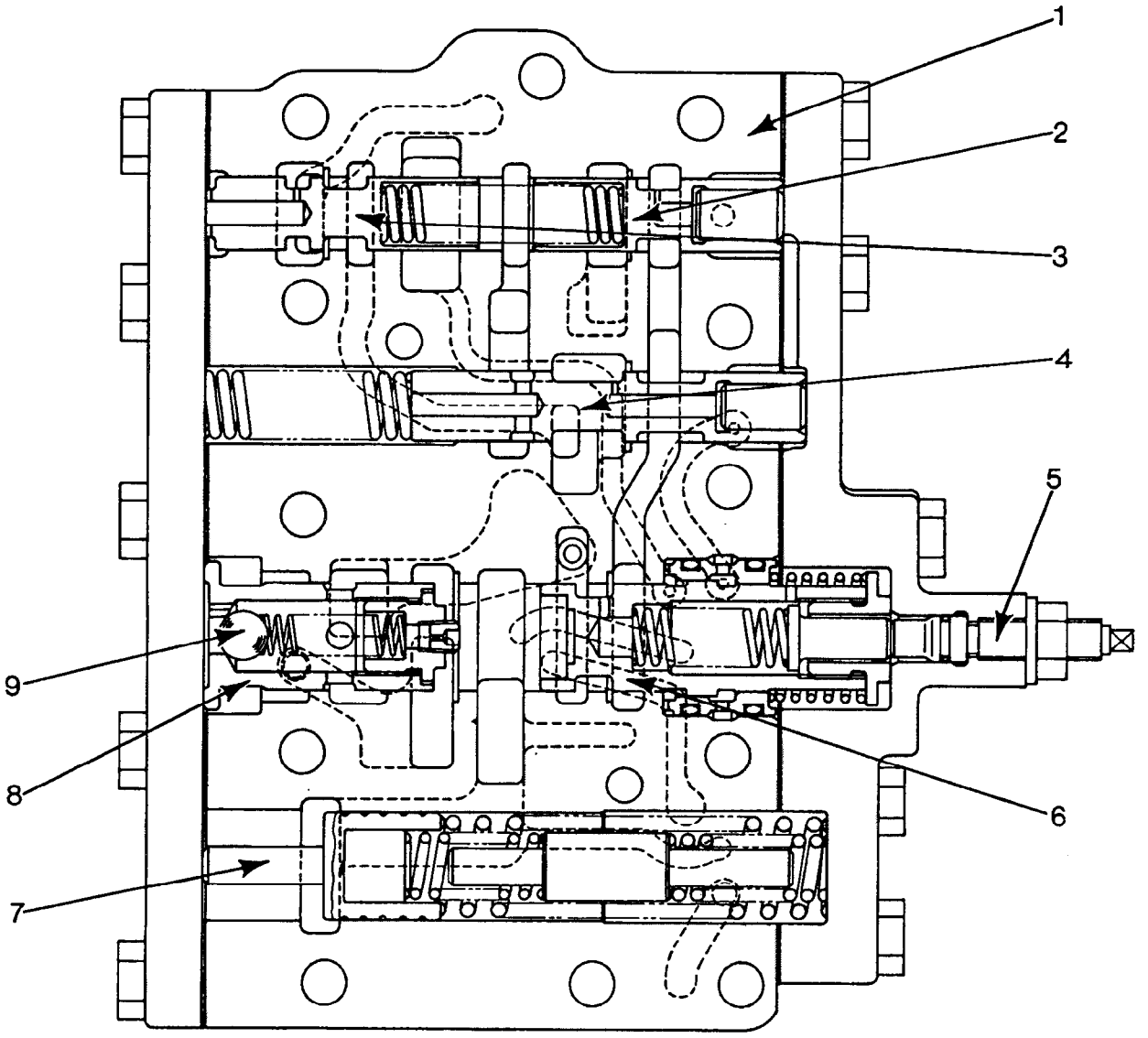
Solenoid operating table

	1	2	3	4
F1	O			O
F2	O			
F3	O		O	
F4	O		O	O
N				
R1		O		O
R2		O		
R3		O	O	
R4		O	O	O
O = Solenoid on				

Structure

- The transmission solenoid valve is installed to the transmission together with the transmission valve. When the directional lever or speed control lever are operated, the solenoid valve is actuated and moves the spool inside the transmission valve.

UPPER VALVE

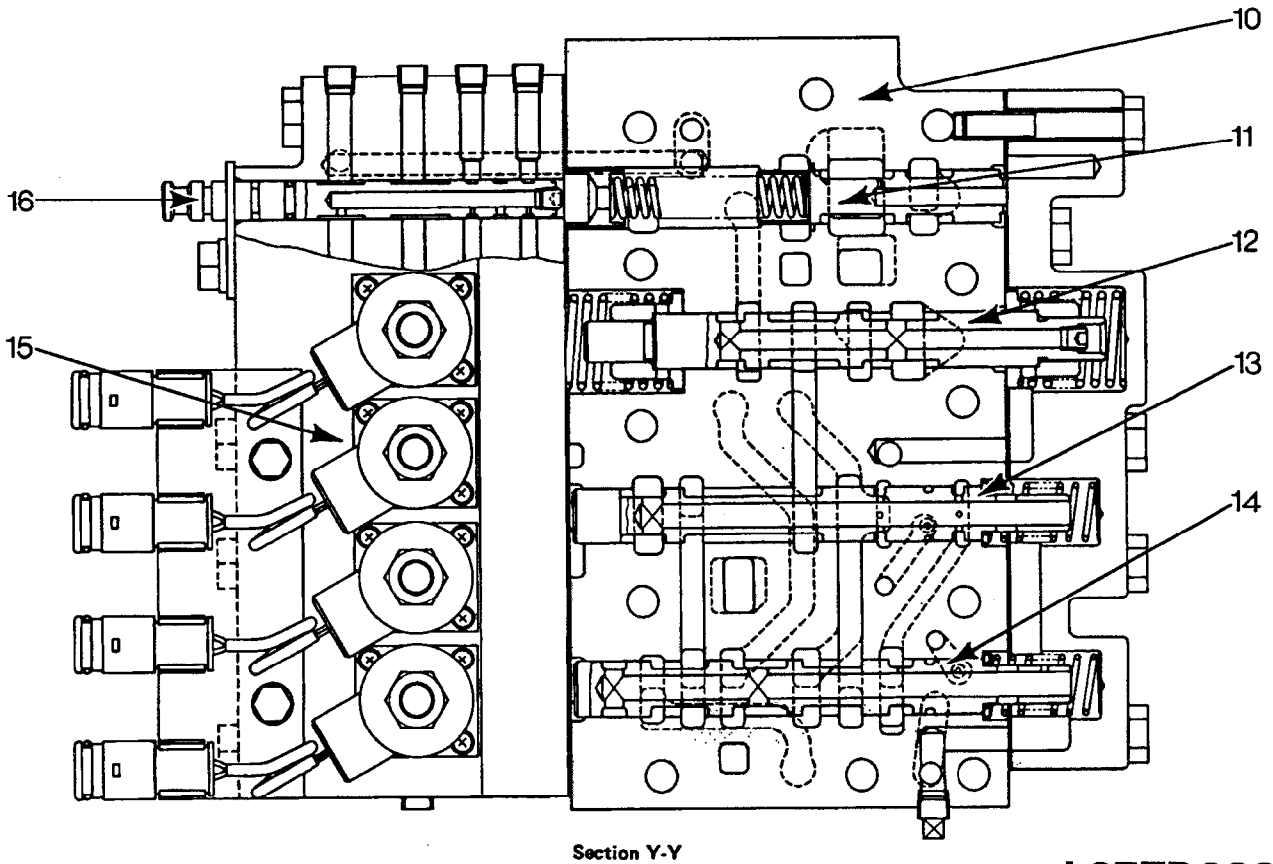


Section X-X

L07ED027

1. Upper valve body
2. Main regulator valve
3. Pilot reducing valve
4. Priority relief valve
5. Fill valve pressure adjusting screw
6. Modulation fill valve
7. Accumulator valve
8. Quick return valve
9. Check valve
10. Lower valve body
11. Torque converter oil outlet valve
12. FORWARD and REVERSE spool
13. HIGH and LOW spool
14. Speed range spool
15. Solenoid valve
16. Emergency manual spool

LOWER VALVE



OUTLINE

- The oil from the pump passes through the torque converter oil filter, enters the transmission valve, and is divided into the pilot circuit and the clutch actuation circuit. The priority valve gives priority to the oil sent to the pilot circuit, so the pilot pressure is always kept the same.
- The pressure of the oil flowing to the clutch actuation circuit is adjusted by the modulation valve and actuates the clutch. The oil which is relieved is sent to the torque converter.
- The quick return and modulating valve are interconnected during gear shifting. They act to raise the clutch oil pressure smoothly, thereby reducing the shock when shifting gears. During traveling, the clutch pressure is kept the same.
- The pressure of the oil which flows to the circuit is adjusted by the pilot reducing valve. During gear shifting, the oil flows in accordance with ON-OFF position of the solenoid valves and actuates the FORWARD, REVERSE, and speed spools.
- By switching the FORWARD, REVERSE, and speed spools, the oil regulated by the modulating valve is sent to the selected clutch to obtain the necessary gear combination.

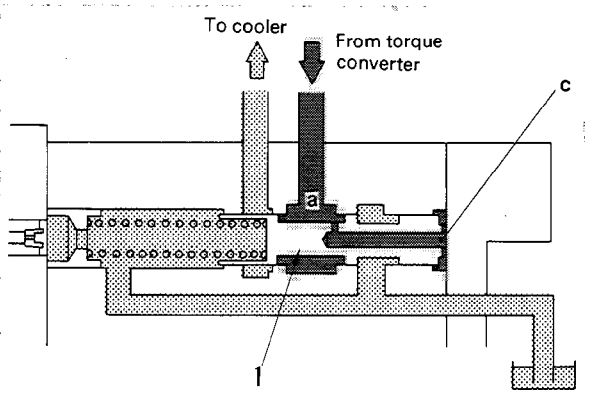
TORQUE CONVERTER OUTLET VALVE

FUNCTION

- The torque converter outlet valve is installed at the outlet side of the oil flow from the torque converter and functions to limit the maximum pressure of the oil inside the torque converter.

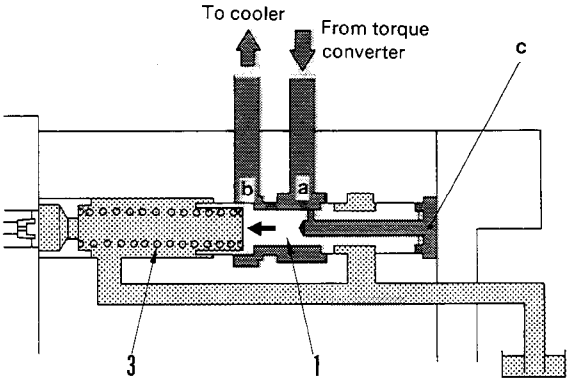
OPERATION

- The oil flowing out the torque converter and entering chamber "c" through the orifice in spool (1), acts against spool (1).



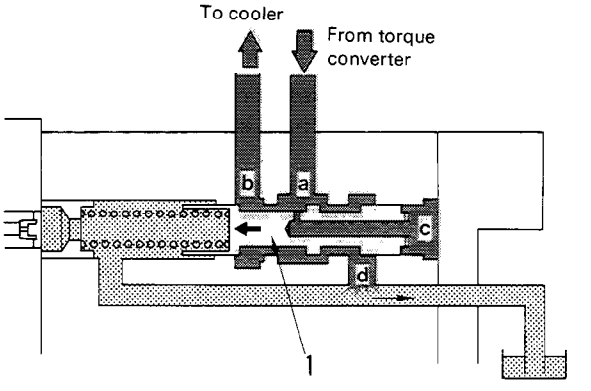
U41901012

- When the pressure at port "a" becomes high, the oil pressure in chamber "c" also becomes high. Spool (1) moves in the direction left as the oil pressure becomes high enough to overcome the force of the spring (3), and the oil then flows from port "a" to port "b".



U41901013

- When the increasing pressure at port "a", spool (1) moves further in the direction of left, and oil port "a" opens to drain port "d" through port "b" (this is called a "cold relief").



U41901014

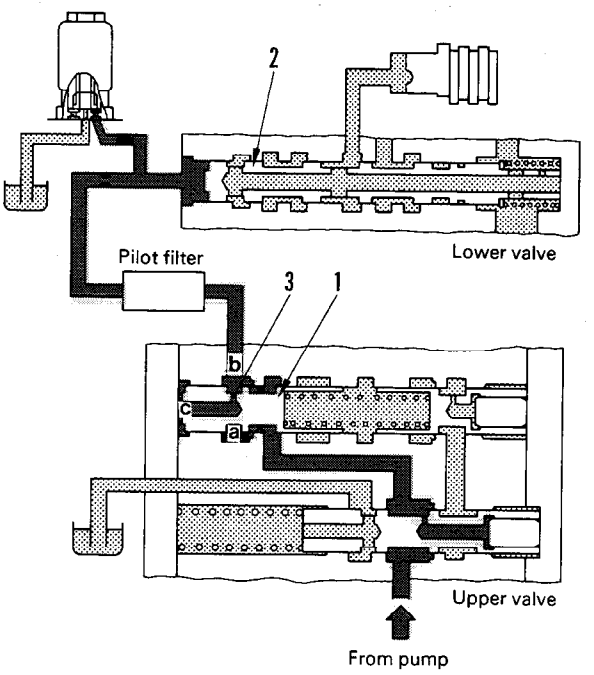
PILOT REDUCING VALVE

FUNCTION

- The pilot reducing valve regulates the pressure use to actuate the transmission spools.

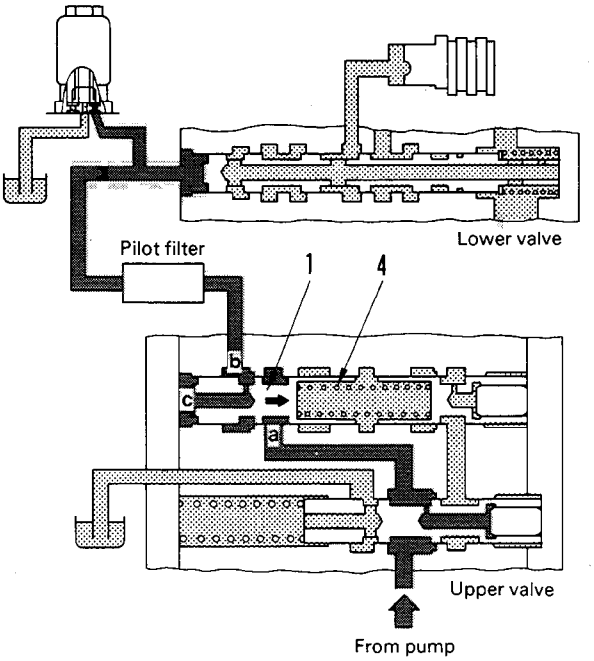
OPERATION

- The oil from the pump enters port "a". It passes through port "b" of pilot reducing valve (1), and enters transmission spool (2) of the lower valve to fill the pilot circuit. The oil at port "b" passes through orifice (3) and goes to port "c".



U41901015

- As the pressure in the pilot circuit rises, the hydraulic pressure at port "c" also rises. It pushes against spring (4) and moves pilot reducing spool (2) in the direction of the right. Port "a" and port "b" are shut off, so the pressure at port "c" is maintained at the same level.



U41901016

TRANSMISSION SOLENOID VALVE

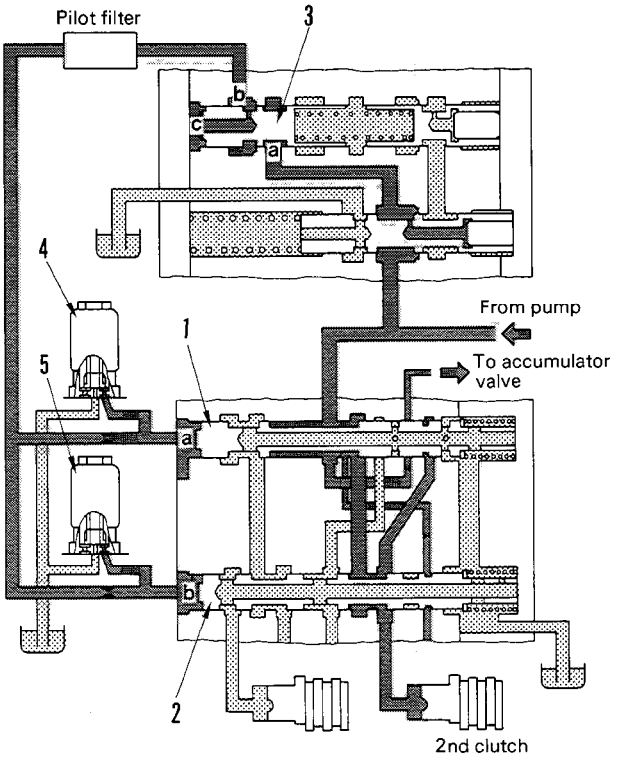
FUNCTION

- There are four solenoid valves installed to the transmission control valve. When the gear shift lever in the operator's compartment is operated, the solenoid valves are switched ON/OFF. This drains the oil, and actuates the speed spool.

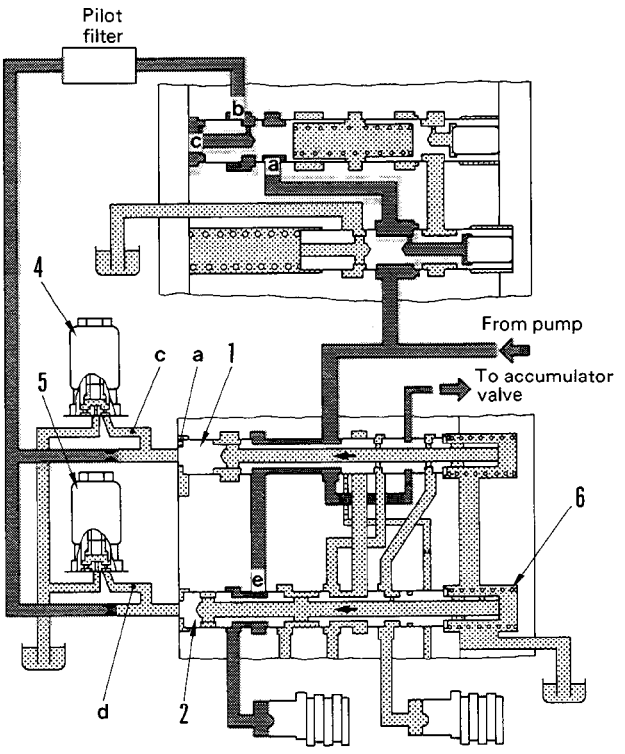
OPERATION

1) Solenoid valve OFF
The oil at ports "a" and "b" of speed spools (1) and (2) is sealed by solenoid valves (4) and (5). Pilot reducing valve (3) is closed, so the condition is maintained. as a result, the oil flows only to the second clutch.

2) Solenoid valve ON
When the gear shift lever is operated, the drain ports of solenoid valves (4) and (5) open. The oil at ports "a" and "b" of speed spools (1) and (2) flows from ports "c" and "d" to drain circuit. therefore, ports "a" and "b" become the low pressure circuit, and spring (6) moves the speed spool to the left. As a result, the oil at port "e" flows to the 4th clutch and the clutch is engaged.



U41901017



U41901018

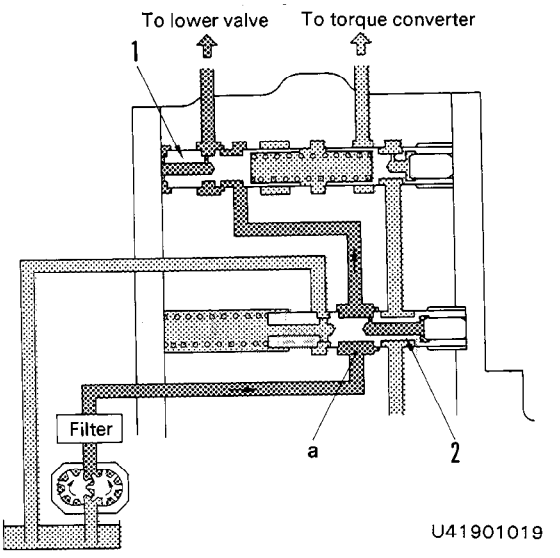
PRIORITY AND MAIN REGULATOR VALVE

FUNCTION

- The priority valve gives priority to the oil sent to the pilot circuit of the lower valve. It also acts as a main relief valve to maintain the maximum pressure at the specified level.

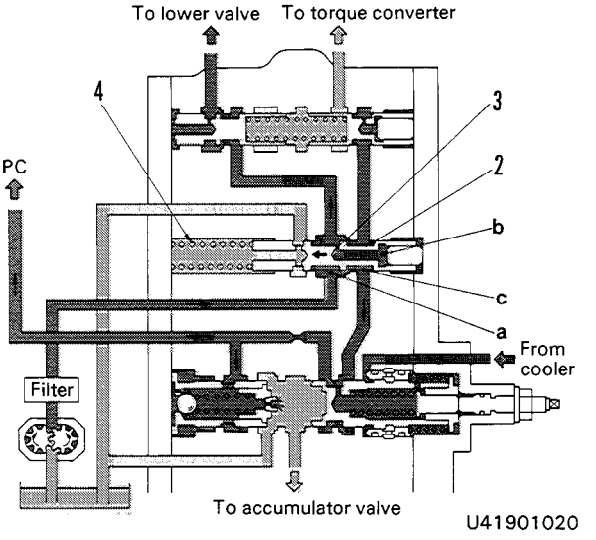
OPERATION

- The oil from the pump enters port "a". It passes through pilot reducing valve (1) and is divided into oil which flows to the pilot circuit of the lower valve and oil which flows to priority valve (2).



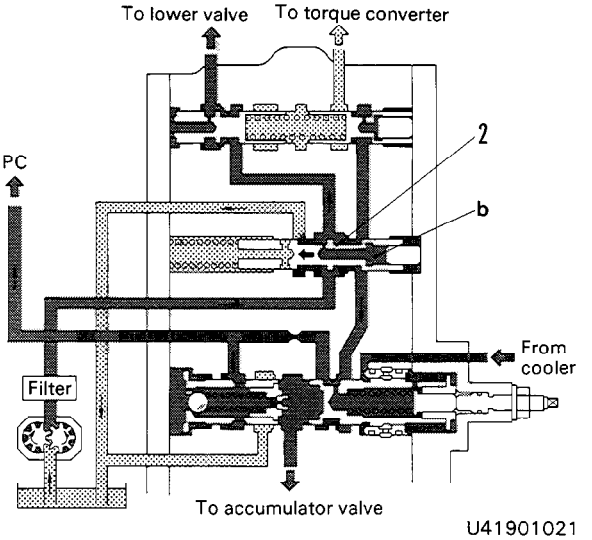
U41901019

- The oil which flows to priority valve (2) passes Through orifice (3) and flows to port "b". As a result, it pushes spring (4) and moves priority valve (2) in the direction of the left, so the oil flows to port "c".



U41901020

- When the hydraulic pressure at port "b" goes above the specified pressure, priority valve (2) moves further to the left. The oil is drained from port "d" to protect the circuit (main regulator function).

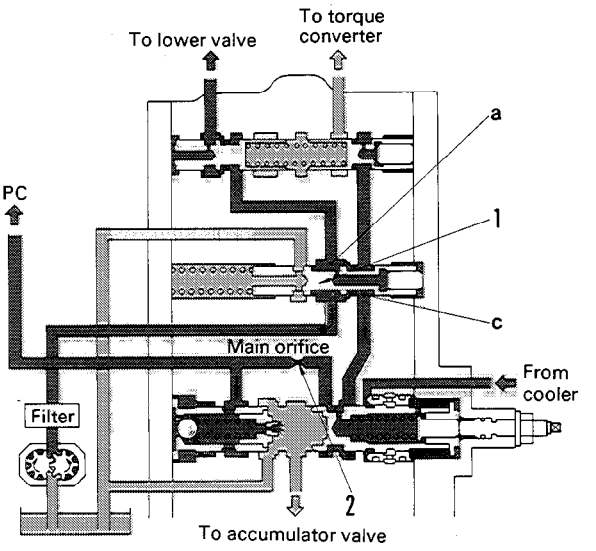


U41901021

MAIN REGULATOR VALVE

FUNCTION

- The main regulator valve controls the amount of oil that flows to the clutch circuit. It sends any excess oil to the torque converter circuit.

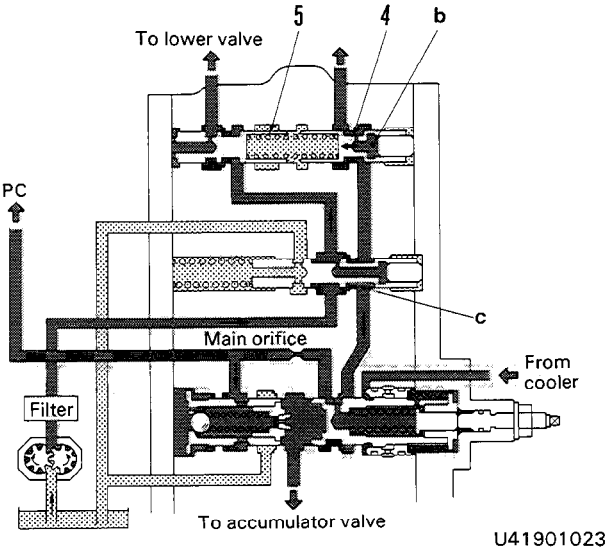


U41901022

OPERATION

- The oil from the pump enters priority valve (1). It then flows from port "a" through main orifice (2) and fills the clutch circuit.

- The oil which passes through orifice (4) and enters port "b" acts against spring (5) and moves the spool to the left. It then passes through port "c" and flows to the torque converter circuit.

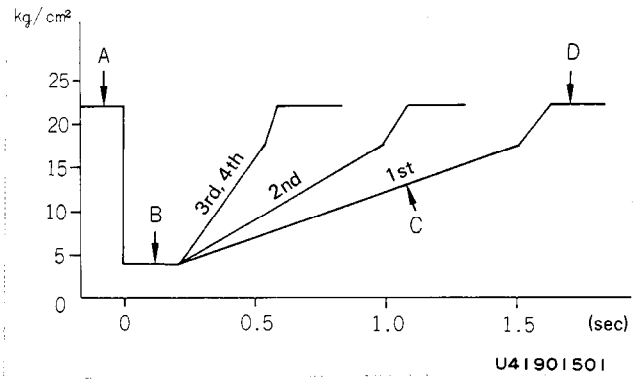


U41901023

MODULATING RELIEF VALVE, ACCUMULATOR VALVE, QUICK RETURN VALVE

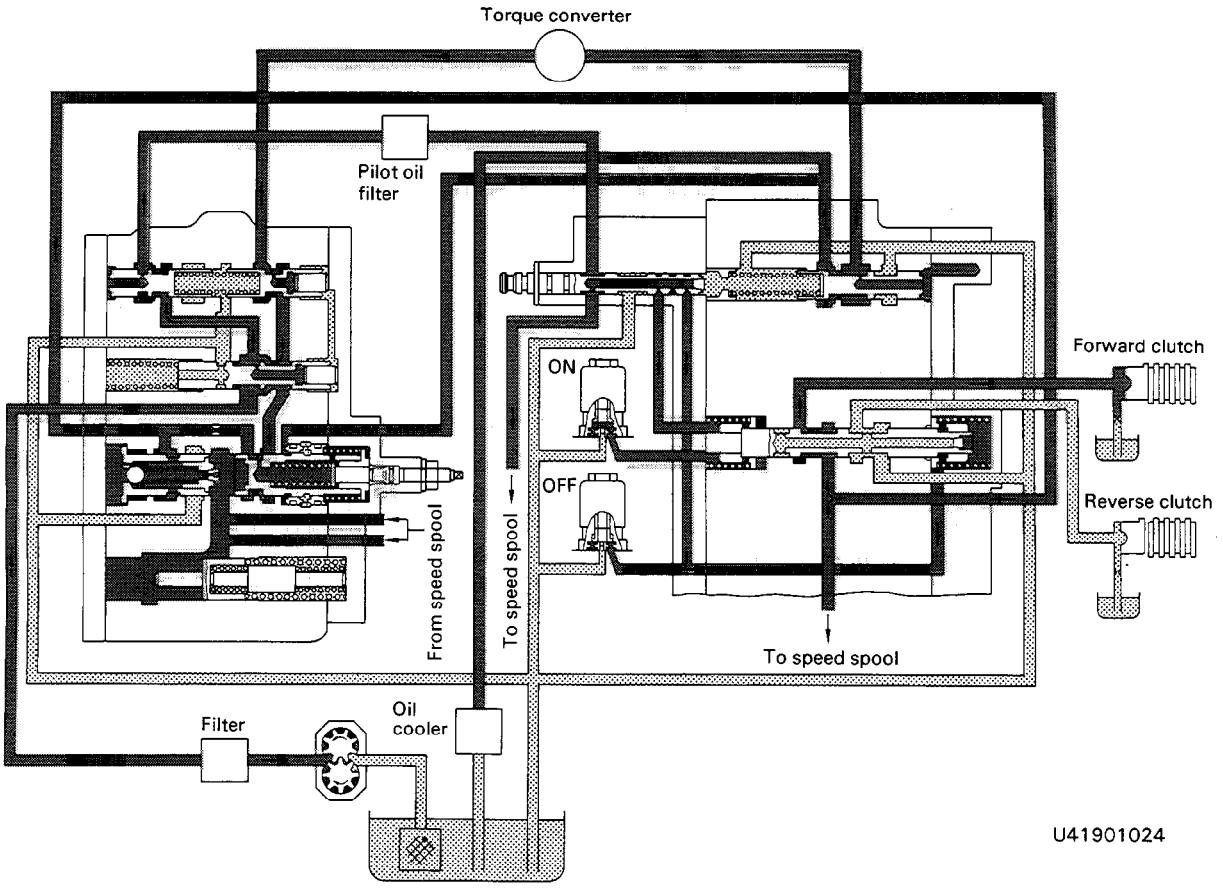
FUNCTION

- The modulating relief valve and quick return valve act together to raise the transmission clutch pressure smoothly. This reduces shock when shifting gears, and prevents the generation of peak torque in the power train. therefore, operator fatigue is reduced to give better operating comfort, and at the same time, the durability of the power train is increased.

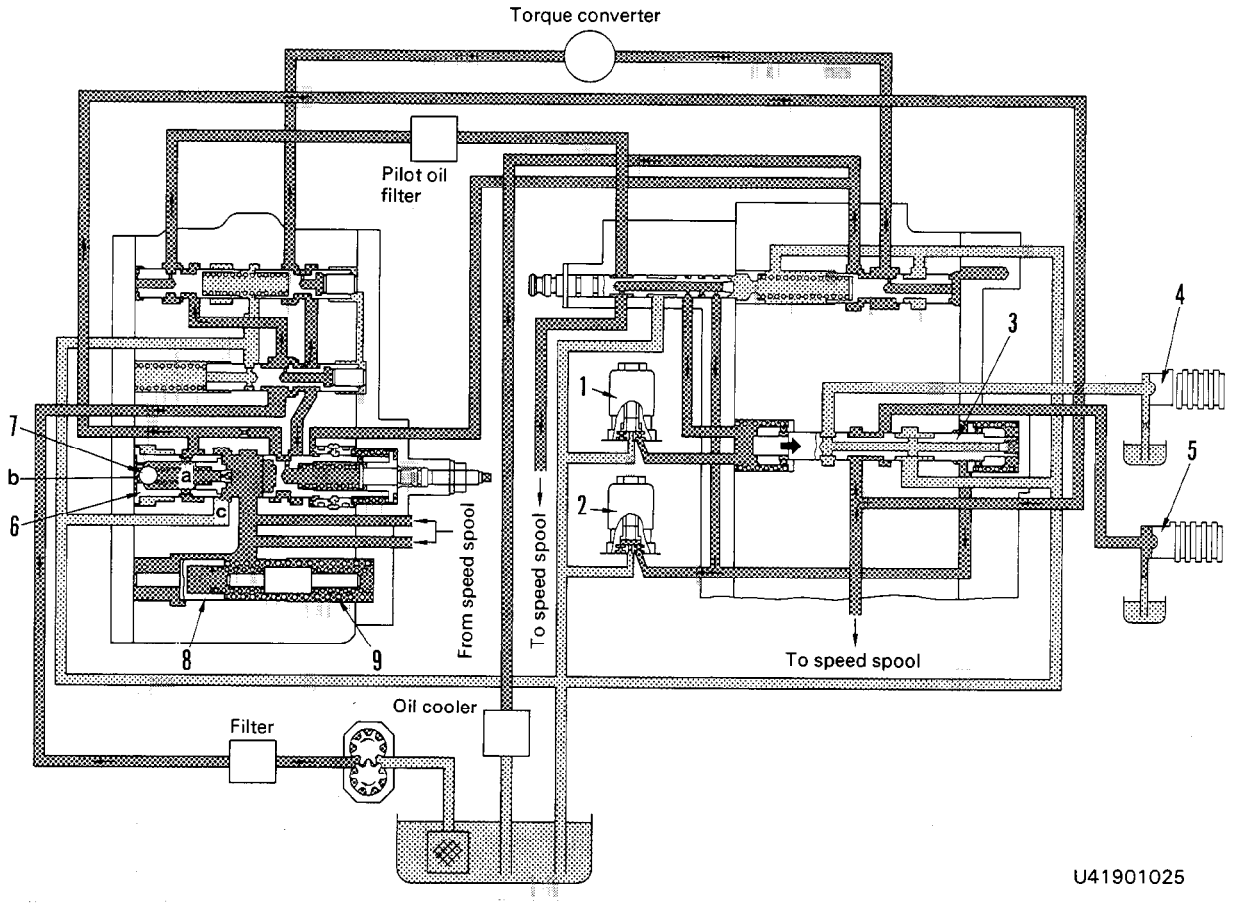


OPERATION

1) FORWARD clutch completely engaged (see chart for clutch pressure point A).

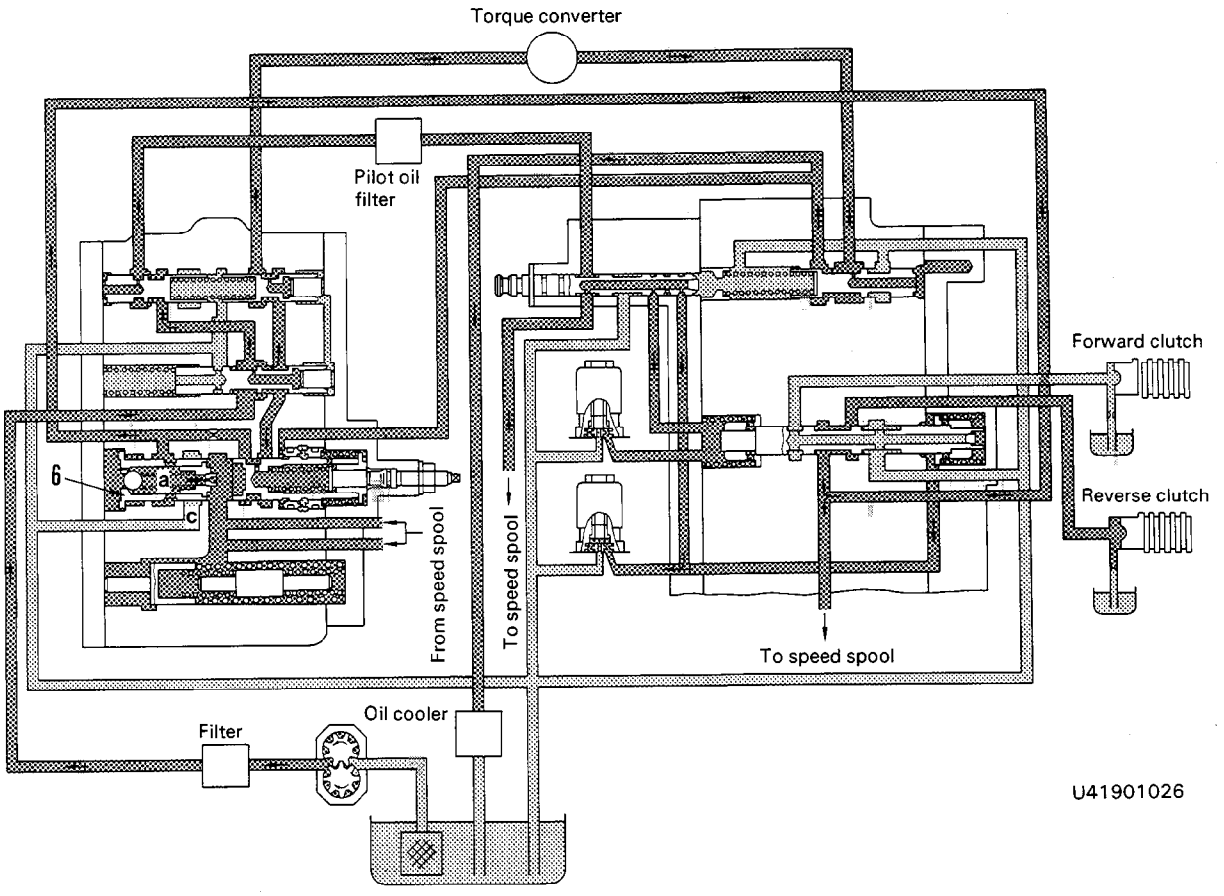


2) Immediately after FORWARD to REVERSE (see page 31 for clutch pressure point B)



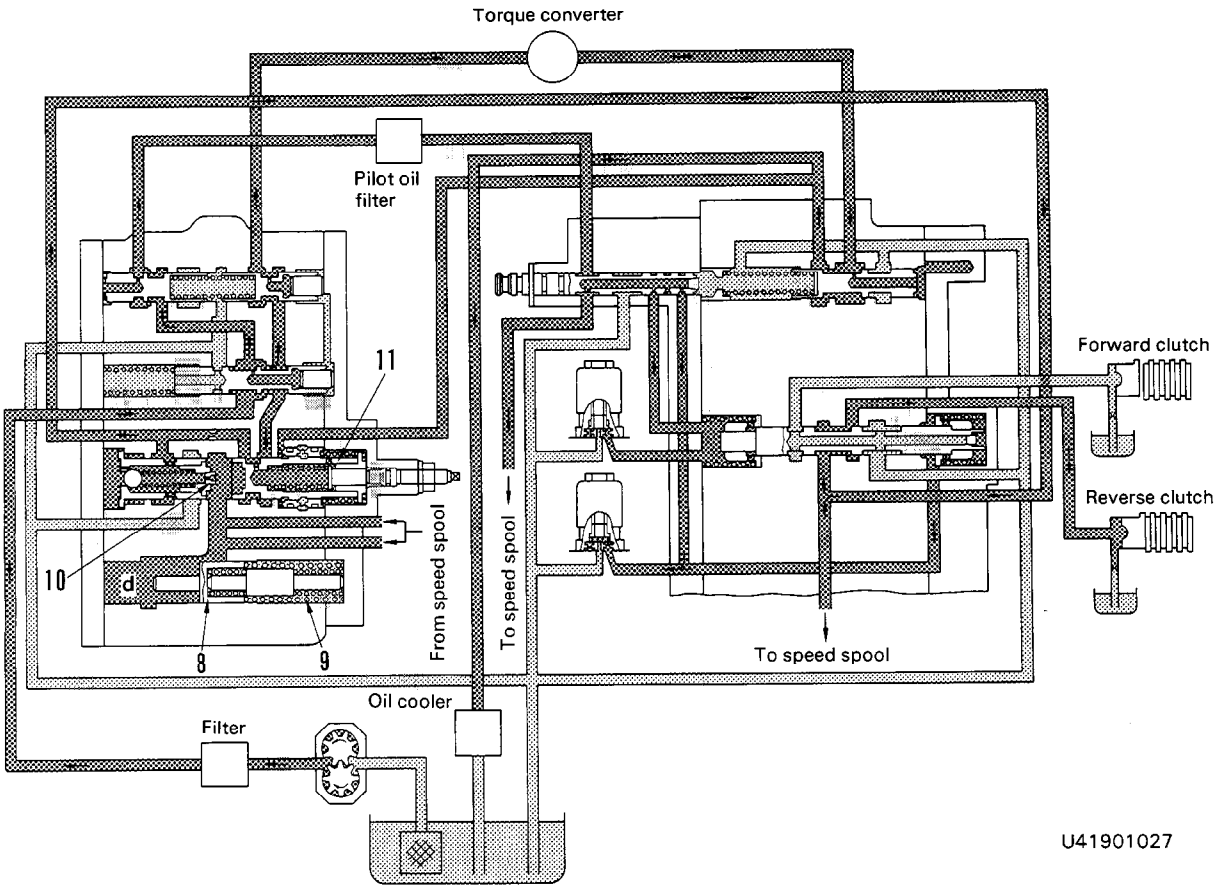
- When the directional lever is moved from FORWARD to REVERSE, FORWARD solenoid valve (1) closes and REVERSE solenoid valve (2) opens. Directional spool (3) moves to the right, and the oil at FORWARD clutch (4) is drained to the drain circuit.
- At the same time, the oil from the pump flows to REVERSE clutch (5), but while the clutch is filling with oil, the pressure at the clutch is low. For this reason, the pressure at port "a" of quick return valve (6) is low, check valve (7) opens, and the oil at port "b" flows to port "a". At the same time, the accumulator pressure moves quick return valve (6) to the left, so the oil in accumulator (8) is suddenly drained from port "c".
- Accumulator (8) returns to the left end under the force of spring (9). To make the shock small when shifting gears, the oil pressure in the clutch circuit drops, and accumulator (8) must be at the left end.

3) Clutch pressure rising (see page 31 for clutch pressure point C)



- The oil from the pump fills the REVERSE clutch and the pressure in the clutch circuit start to rise. As a result, the pressure at port "a" rises, quick return valve (6) moves to the right and drain port "c" is closed.

4) Clutch engaged (see page 31 for clutch pressure D)



- Because of the differential pressure created by fill valve (11), the oil passing through 1st orifice (10) flows to accumulator piston (8) at a constant flow. As this oil flows in, the accumulator moves gradually to the right and compresses spring (9). As a result, the accumulator pressure rises. At the same time, the clutch pressure also rises.

- For speeds other than 1st speed, oil flows into the accumulator from 1st orifice plus 2nd and 3rd orifices, so the modulation time is shorter than for 1st speed.

- When accumulator piston (8) moves to the end of its stroke, the rise in pressure at port "d" stops. The specified pressure is maintained and the REVERSE clutch is fully engaged. This action is the same action as when the speed spool is operated.

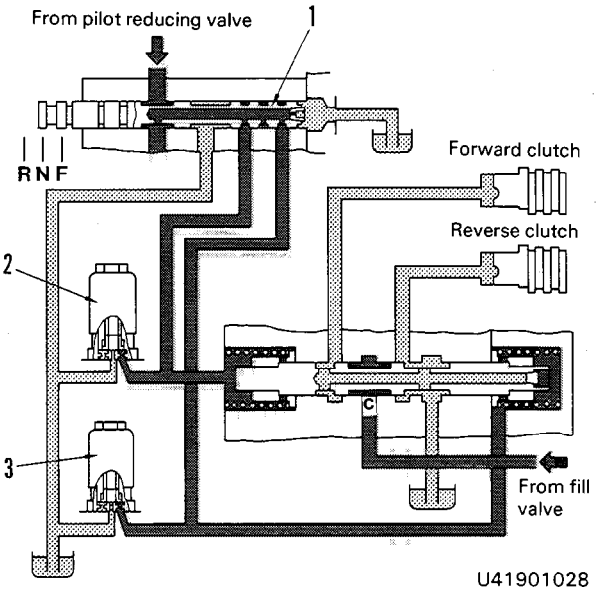
EMERGENCY MANUAL SPOOL

FUNCTION

- If there is a failure in the electrical system, and the FORWARD and REVERSE solenoid valves cannot be actuated, the emergency manual spool actuates the FORWARD and REVERSE clutches manually.

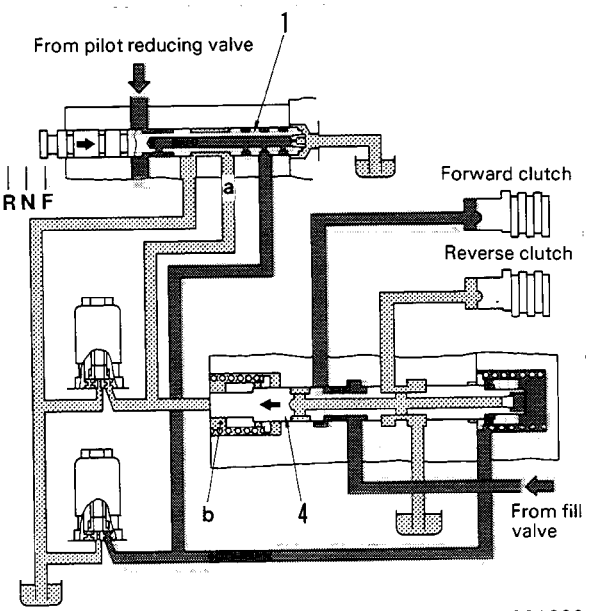
OPERATION

1) Neutral
   - The oil from the upper valve (pilot reducing valve) passes around emergency manual spool (1) and is sealed by solenoid valves (2) and (3).
   - For normal operations, the emergency manual spool is in the neutral position.



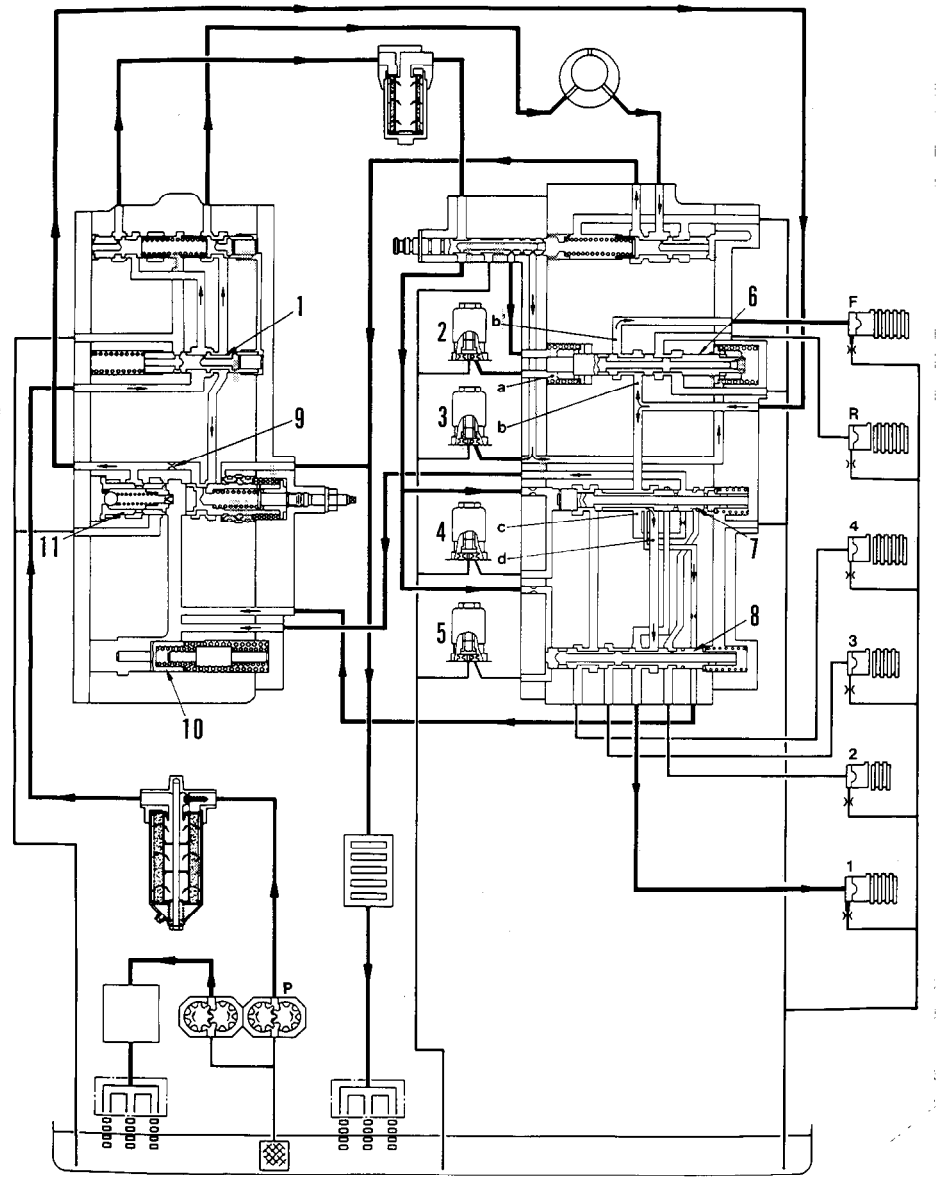
U41901028

2) Emergency manual spool actuated (FORWARD)
   When emergency manual spool (1) is pushed, port "a" and the drain port are connected, so the oil from chamber "b" is drained. As a result, directional spool (4) moves to the left, so the oil flows to the FORWARD clutch and the clutch is engaged.



U41901029

FORWARD 1st



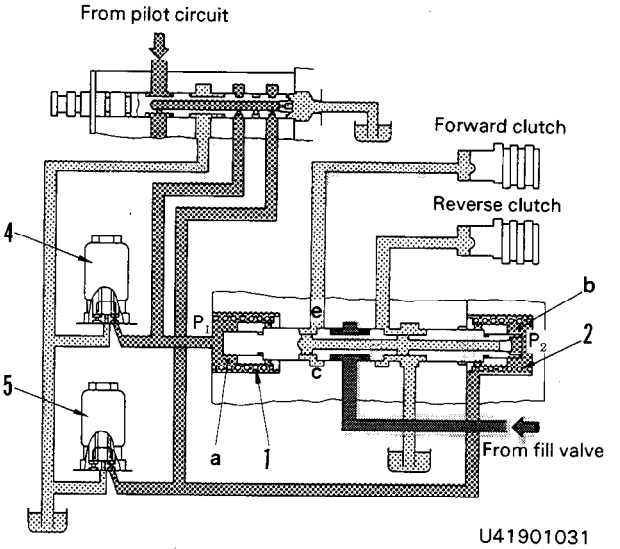
U41801130

- The oil from pump (P) passes through priority valve (1) and is divided to the pilot circuit and clutch actuation circuit.
- When the gear shift lever is operated to 1st FORWARD, Forward solenoid valve (2) is actuated, and the oil filling port "a" is drained. Directional spool (6) moves to the left, and clutch pressure port "b" and FORWARD clutch pressure port "b" are connected. At the same time, H.L. solenoid valve (4) is closed, so H.L. spool (7) is pushed to the right. In this condition, clutch pressure port "c" and 1st clutch port "d" are connected.
- At the same time, the oil in the clutch actuation circuit passes through main orifice (9), spools (6), (7), and (8) and flows to the FORWARD clutch and 1st clutch.
- When the oil completes filling the clutch cylinder, accumulator valve (10) and quick return valve (9) act to raise the pressure gradually. When the pressure reaches the set pressure, the FORWARD and 1st clutches are completely engaged.

DIRECTIONAL SPOOL

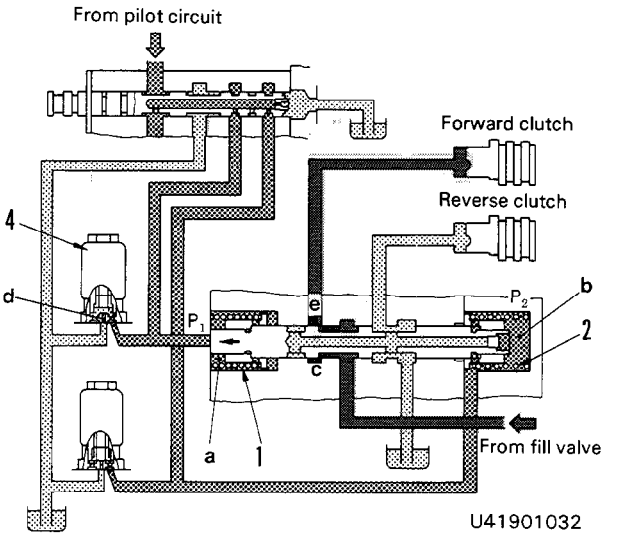
OPERATION

1) AT neutral
   - Solenoid valves (4) and (5) are OFF, and the drain port is closed. The oil from the pilot circuit passes through the oil hole in the emergency manual spool, and fills ports "a" and "b" of the directional spool.
   - In this condition, P_1 + spring force (1) = P_2 + spring force (2), so the balance is maintained. Therefore, the oil at port "c" does not go to the FORWARD or REVERSE clutches.



U41901031

2) At FORWARD
   - When the directional lever is placed at FORWARD, solenoid valve (4) is switched ON, drain port "d" opens and the oil which was filling port "a" is drained. As a result, P_1 + spring force (1) < P_2 + spring force (2), so the directional spool moves to the left. The oil from port "c" flows to port "d" and is supplied to the FORWARD clutch.

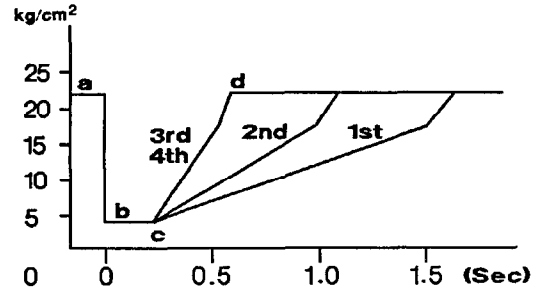


U41901032

FILL VALVE

FUNCTION

- The fill valves adjust the pressure of the oil entering the accumulator and the flow of the oil, and allows the clutch pressure to rise.

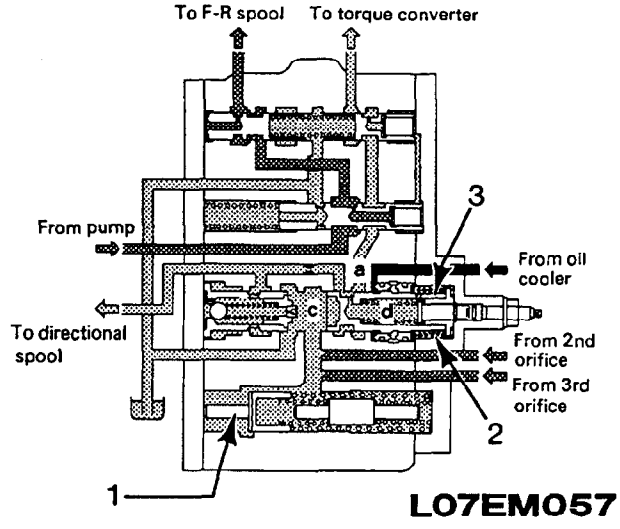


L07EM055

OPERATION

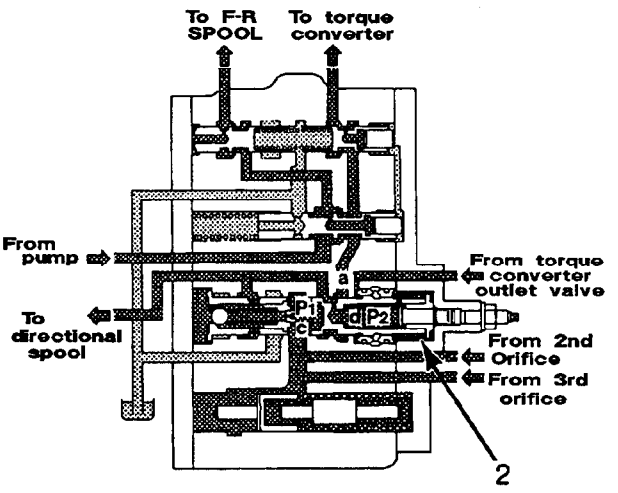
1. Clutch fully engaged (point "a")

2. When shifting from FORWARD to REVERSE (point "b")
   - The oil inside the accumulator is drained by the quick return valve and moves accumulator piston (1) to the left. When this happens, the pressure in chamber "c" and chamber "d" drops, so the force of spring (2) moves fill valve (3) to the right and opens port "a".



L07EM057

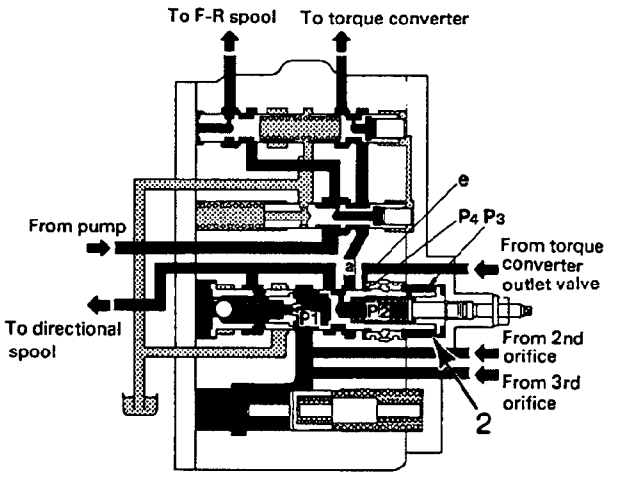
3. Start of rise in clutch pressure (point "c" - point "d")
   - When the oil from the pump fills the clutch piston, the pressure in the clutch circuit start to rise. As a result, the drain circuit of the quick return valve is closed. When the drain circuit of the quick return closes, the oil passing through port "a" enters chamber "d", and the pressure P_2 in chamber "d" start to rise. When this happens, the relationship between P_1 and P_2 is $P_2 > P_1 + P_3$ (tension of spring (2)). The fill valve moves to the left, and port "a" is shut off, so this prevents any sudden rise in the clutch pressure.



L07EM058

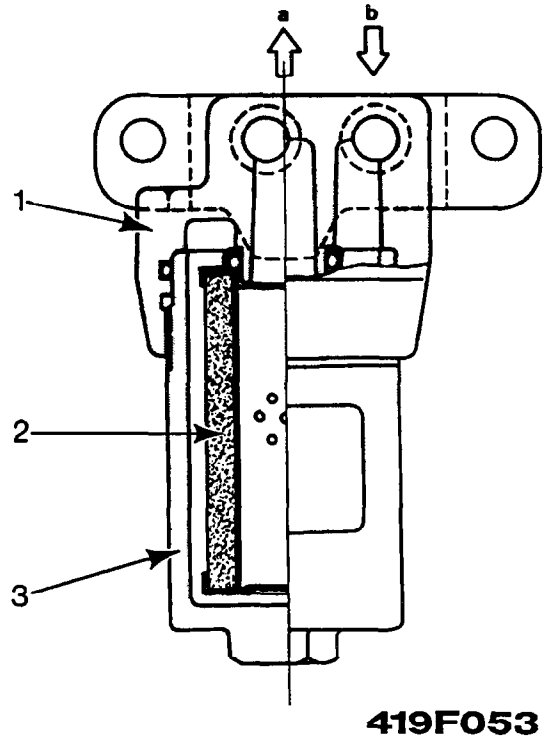
   - The oil from port "b" flows to the directional spool, and at the same time, because of the condition $P_2 > P_1$, the oil also passes through the orifice in the quick return valve and flows to chamber "c". P_1 and P_2 both rise, and the relationship is $P_2 = P_1 + P_3$ (tension of spring (2)). This action is repeated to raise the clutch pressure.

   - The oil from the oil cooler circuit is sent to the fill valve and flows to port "e". The pressure at port "e" changes according to the engine speed. Therefore, because of the relationship $P_2 = P_1 + P_3 + P_4$ (changed according to engine speed), the pressure of P_2 changes also by the same amount as the change in pressure of P_4. Therefore, the pressure of P_2 rises by the same amount as the change in the pressure of P_4 at the same time, so it is possible to create pressure characteristics corresponding to the engine speed.



L07EM056

PILOT OIL FILTER



419F053

1. Head
2. Element
3. Case
a. Oil suction port
b. Oil delivery port

SPECIFICATIONS

- Particle size: 105 microns (150 mesh)
- Filtering area: 370cm^2

FUNCTION

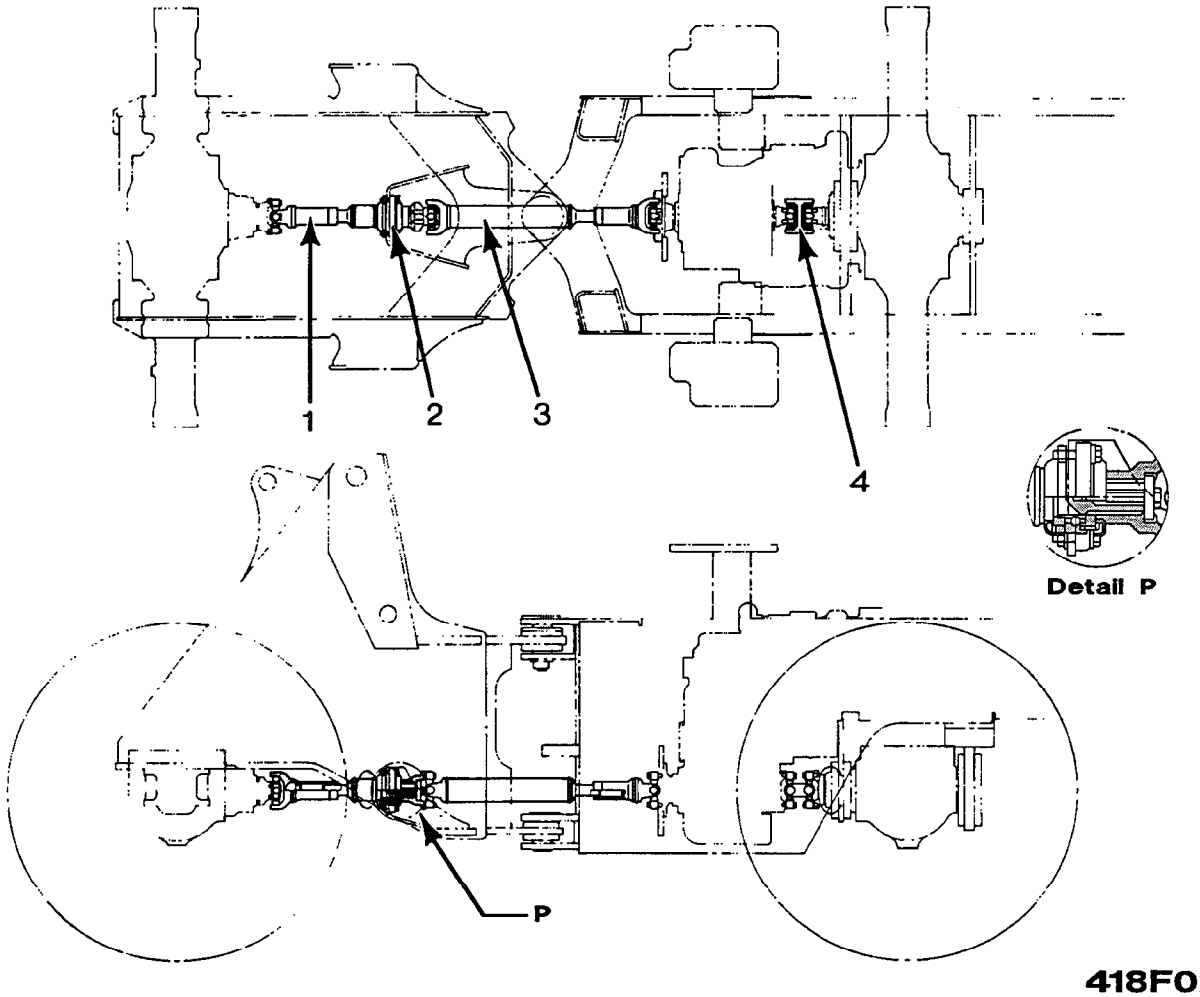
- The pilot oil filter is installed between the upper valve and lower valve of the transmission control valve. It removes dirt from the oil flowing to the pilot circuit.

DRIVE SHAFT

OUTLINE

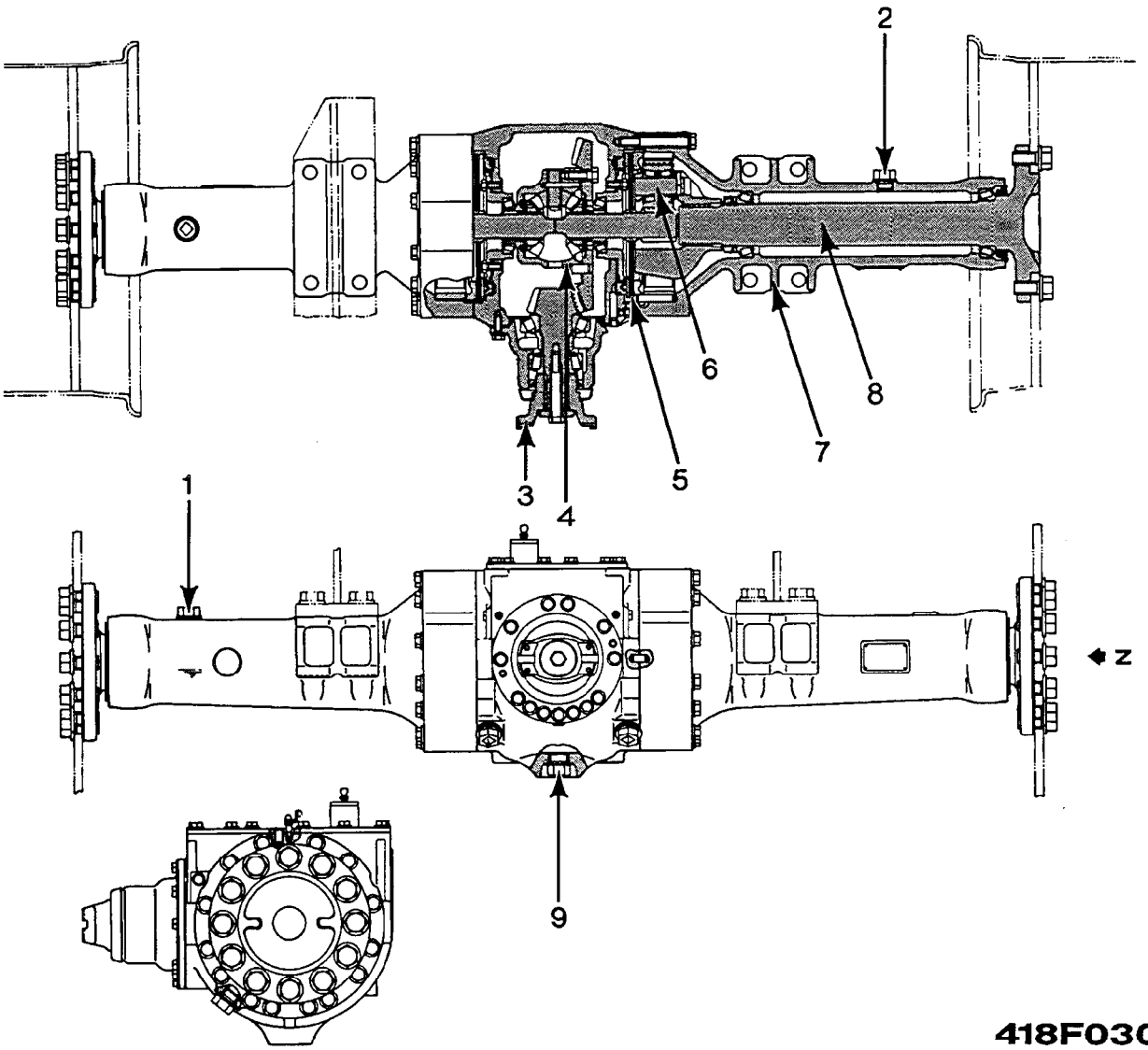
- The motive force from the engine passes through the torque converter, transmission, and transfer. Part of this motive force passes through rear drive shaft (4) and goes to the rear axle. The rest of the motive force passes through center drive shaft (3), flanged bearing (2), and front drive shaft (1) and is sent to the front axle. In addition to transmitting the motive force, the drive shafts have the following purpose.
- When the body is articulated, or when there is shock from the road surface during traveling, or when there is shock during operations, the axle in front and behind the engine and transmission change position.

  To allow the motive force to be transmitted without damage to parts of the machine when there is shock or when the components move position, the drive shafts have a universal joint and a sliding joint. This allows them to handle changes in angle and length.



1. Front drive axle
2. Flanged bearing
3. Center drive shaft
4. Rear drive shaft

AXLE
FRONT



418F030

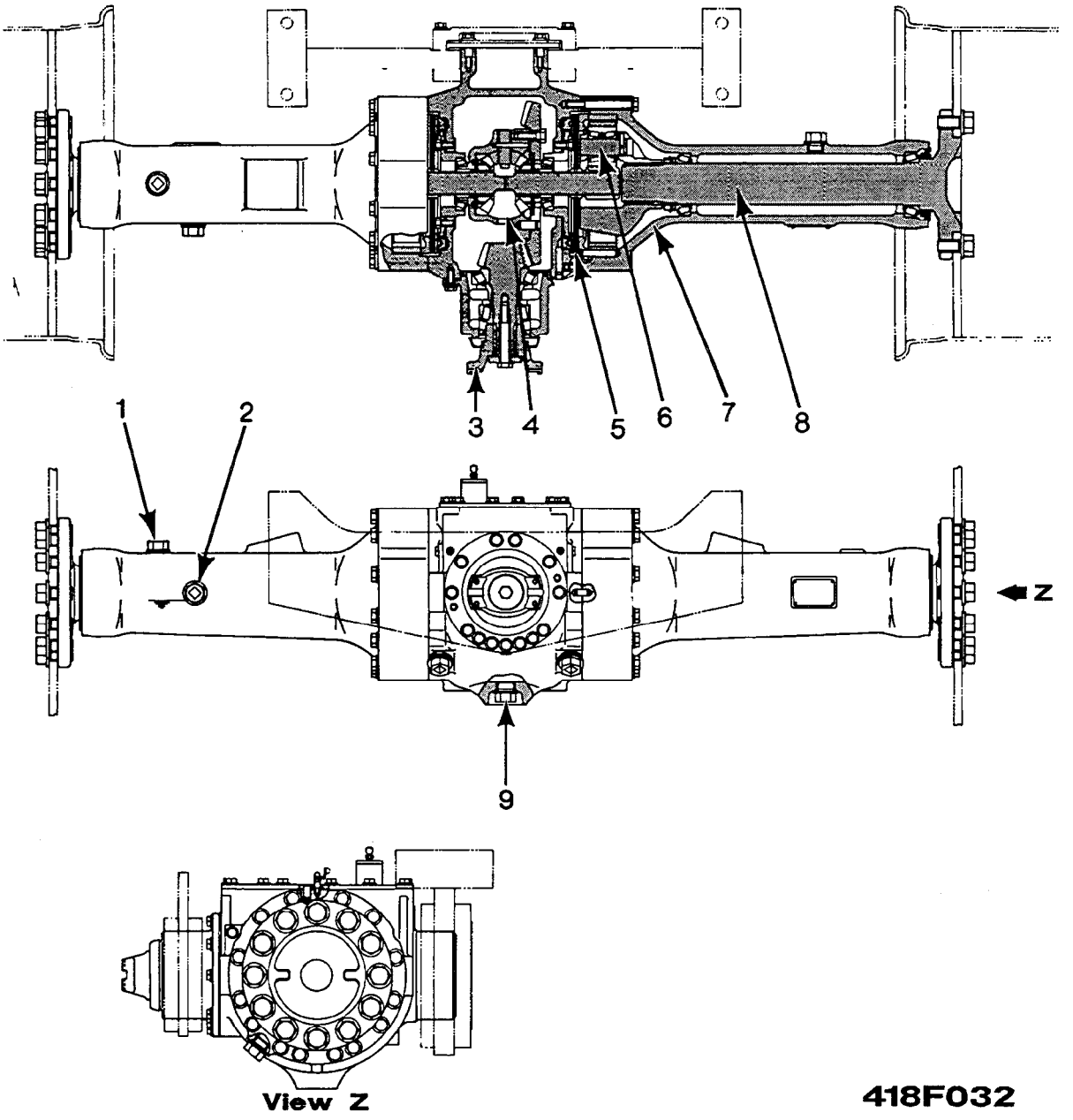
View Z

1. Filler plug
2. Level plug
3. Coupling
4. Differential (See page 21-45)
5. Brake (see page 51-7)
6. Final drive (See page 21-49)
7. Axle housing
8. Axle shaft
9. Drain plug

OUTLINE

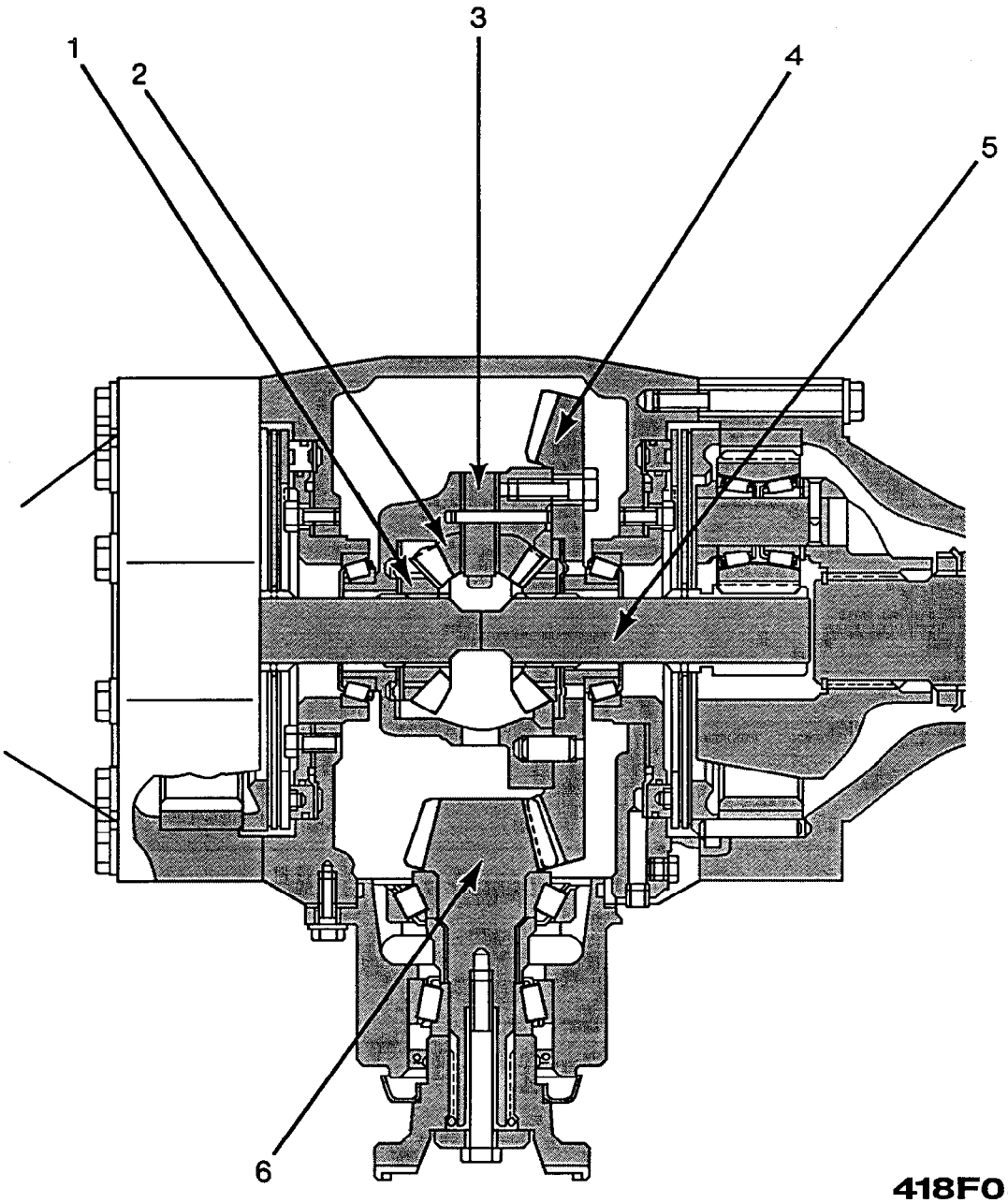
- The motive force from the engine passes through the torque converter, transmission, and drive shafts and is transmitted to the front and rear axles.
- Inside the axle, the motive force is transmitted from the pinion gear to the ring gear, and is sent at right angles. the speed is reduced and it passes through the differential and is transmitted to the sun gear shaft.
- The motive force of the sun gear is further reduced by the planetary-type final drive, and is transmitted to the axle shaft and wheel.

REAR



1. Filler plug
2. Level plug
3. Coupling
4. Differential (See page 21-46)
5. Brake (See page 51-7)
6. Final drive
7. Axle housing
8. Axle shaft
9. Drain plug

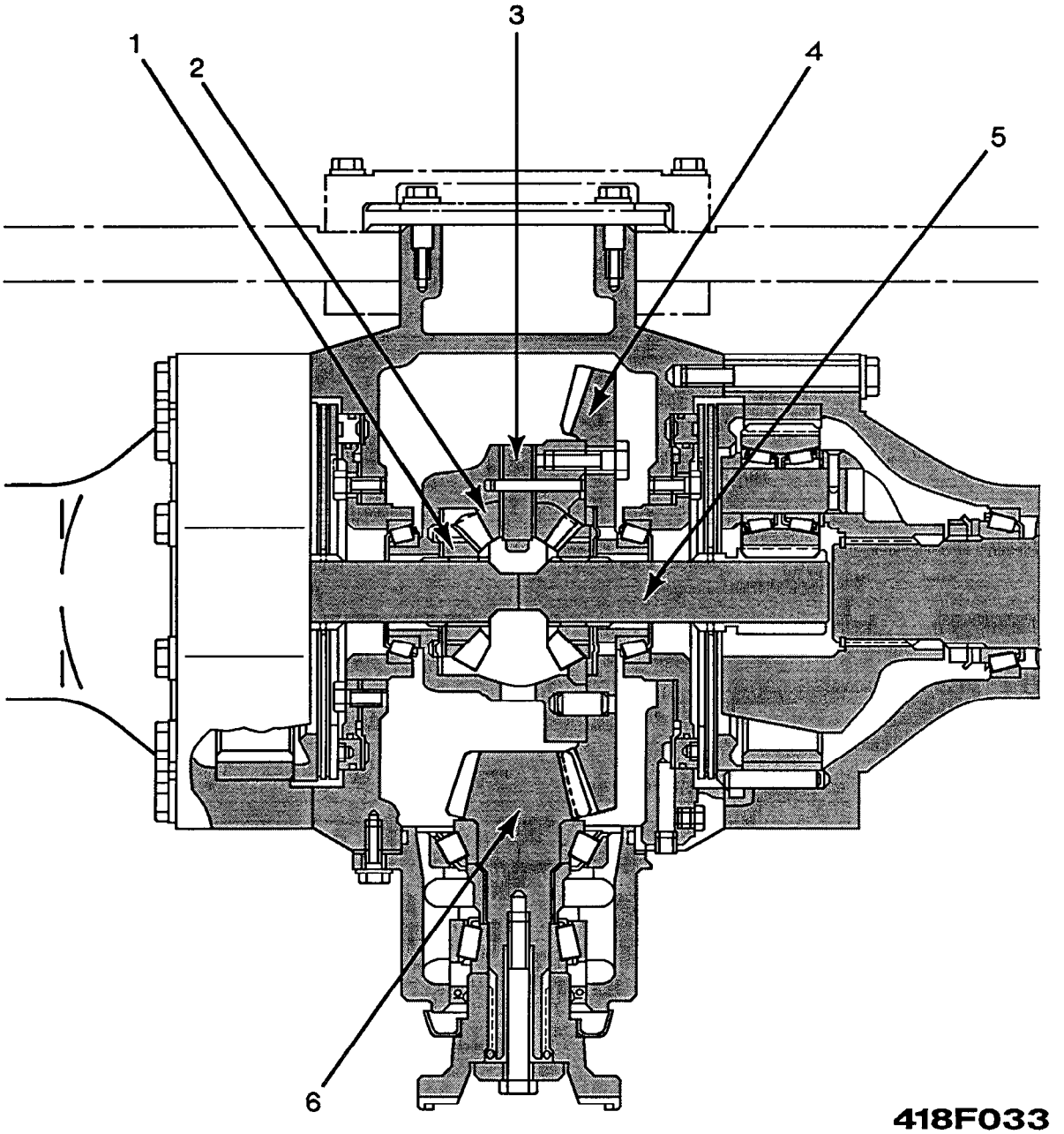
DIFFERENTIAL
FRONT



418F031

1. Side gear (differential - 12 teeth)
2. Pinion gear (differential - 9 teeth)
3. Spider
4. Bevel gear (47 teeth)
5. Sun gear shaft
6. Pinion gear (13 teeth)

REAR



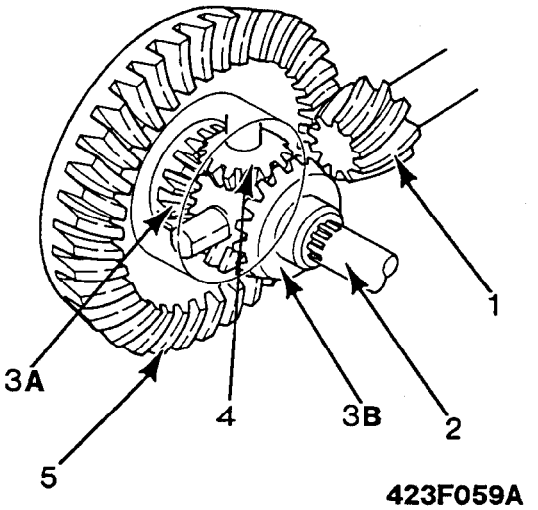
418F033

1. Side gear (differential - 12 teeth)
2. Pinion gear (differential - 9 teeth)
3. Spider
4. Bevel gear (47 teeth)
5. Sun gear shaft
6. Pinion gear (13 teeth)

TORQUE PROPORTIONING DIFFERENTIAL

General

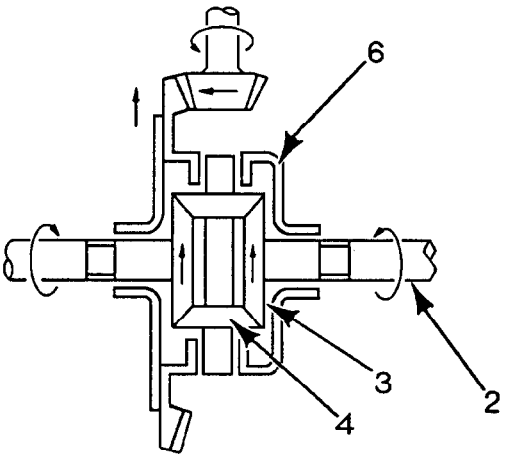
- Power from the engine is transmitted to the front and rear axles through the torque converter, transmission, and propeller shafts.
- In the rear axle, power is transmitted from pinion gear (1) to bevel gear (5). That is, the direction of power is changed 90° while reducing the gear speed and is transmitted to sun gear shaft (2) through differential (4)
- Power from the sun gear is transmitted to the axle shaft and wheels reducing the gear speed in the planetary gear type final drive.



423F059A

When driving straight forward

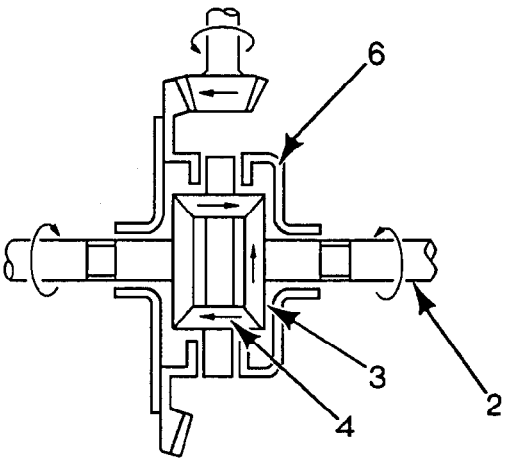
- When the machine is driven straight forward, the rotating speed of the left and right wheels is the same, so the pinion gear (4) inside the differential assembly does not rotate. The motive force of the carrier (6) is sent through the pinion gear (4) and the side gear (3) and is transmitted equally to the left and right sun gear shafts (2).



423F060A

When turning

- When turning, the rotating speed of the left and right wheels is different, so the pinion gear (4) and side gear (3) inside the differential assembly rotate in accordance with the difference between the rotating speed of the left and right wheels. The motive force of the carrier (6) is then transmitted to the sun gear shafts (2).



423F061A

Function

- Because of the nature of their work, 4-wheel -drive loaders have to work in places where road surfaces are bad. In such places, if the tires slip, the ability to work as a loader is reduced, and also the life of the tire is reduced. The torque proportioning differential is installed to overcome this problem.
- In structure it resembles the differential of an automobile, but the differential pinion gear (4) has a odd number of teeth. because of the difference in the resistance from the road surface, the meshing of the pinion gear (4) and the side gear (3A), (3B) changes, and this changes the reaction of the left and right tires.

OPERATION

When traveling straight (equal resistance from road surface to left and right tires)

- If the resistance from the road surface to the left and right wheels is the same, the distance between the pinion gear and the meshing point "a" of the left side gear is the same as the distance between the pinion gear and meshing point "b" of the right side gear (3B).
- Therefore the left side traction TL and the right side traction TR are balanced.

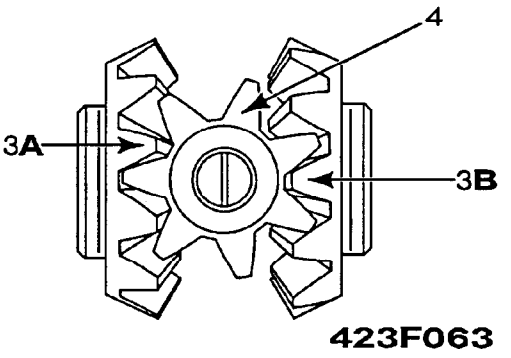
When traveling on soft ground (resistance from road surface to left and right tires is different)

- On soft ground, if the tire on one slips, the side gear of the tire on the side which has the least resistance from the road surface tries to rotate forward. Because of this rotation, the meshing of the pinion gear and side gear changes.
- If left side gear (3A) rotates slightly forward, the distance between the pinion gear and the meshing point "a" of the left side gear becomes longer than the distance between the pinion gear and the meshing point "b" of the right side gear. The position is balanced as follows.

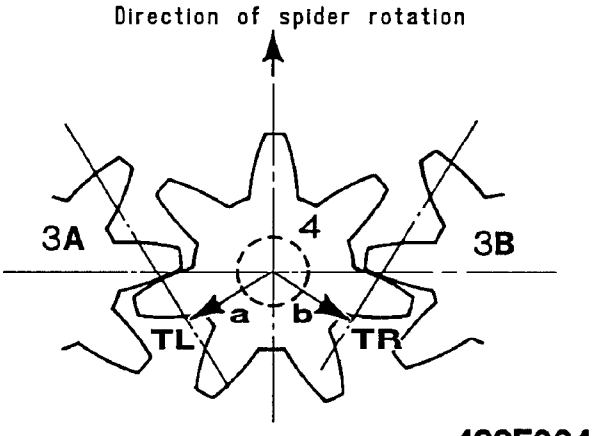
  a x TL = b x TR

  The ratio between the distances to "a" and "b" can change 1:1.38.

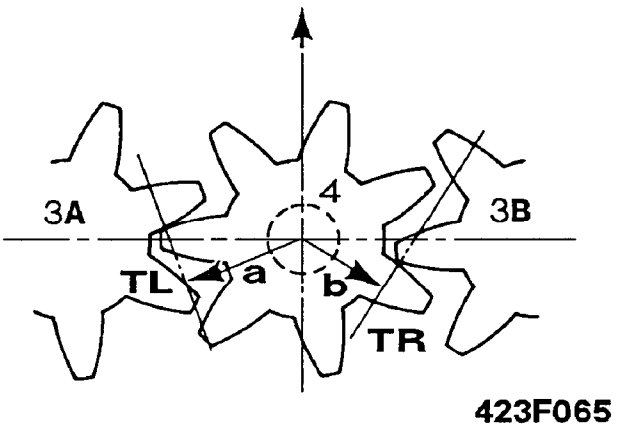
- Therefore when the ratio of the distances to "a" and "b" is less than 1:1.38 (that is, the difference between the resistance from the road surface to the left and right tires is less than 38%), the pinion gear will not rotate freely, so drive force will be given to both side gears, and the tires will not slip. Because of this effect, the tire life can be increased by 20 - 30%, and at the same the operating efficiency is also increased.



423F063



423F064

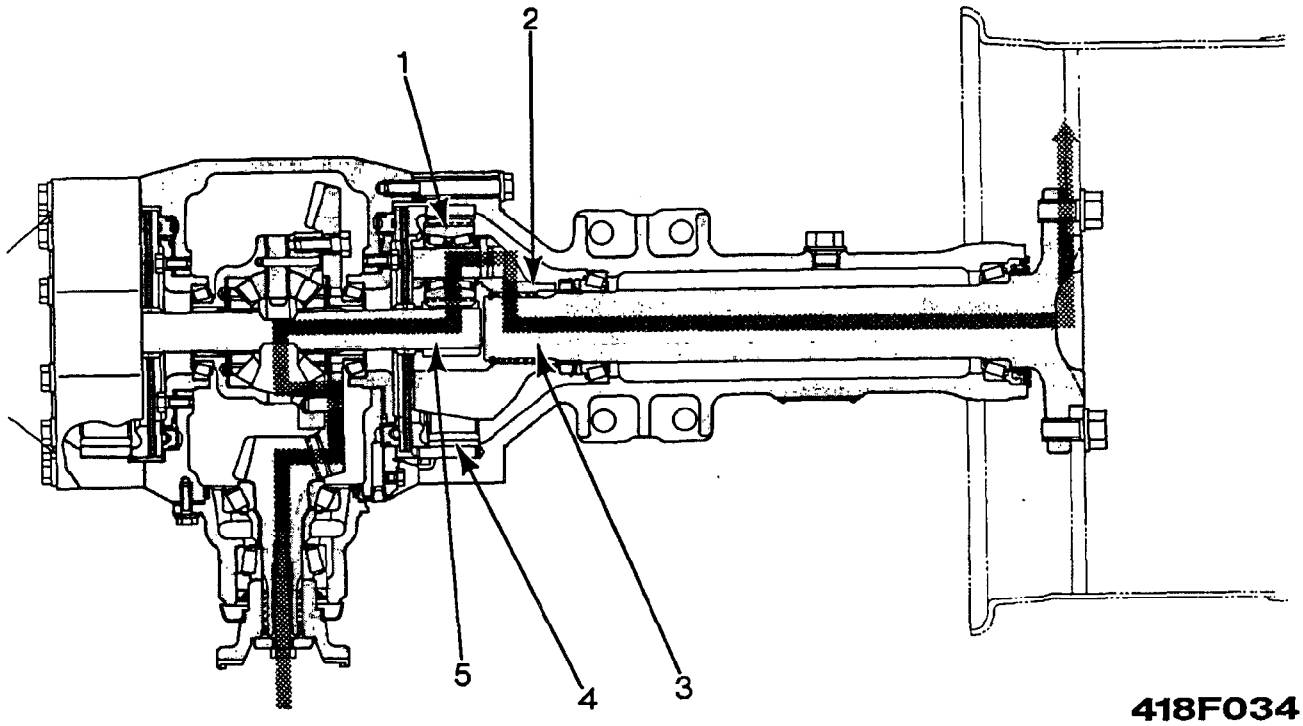


423F065

FINAL DRIVE

OUTLINE

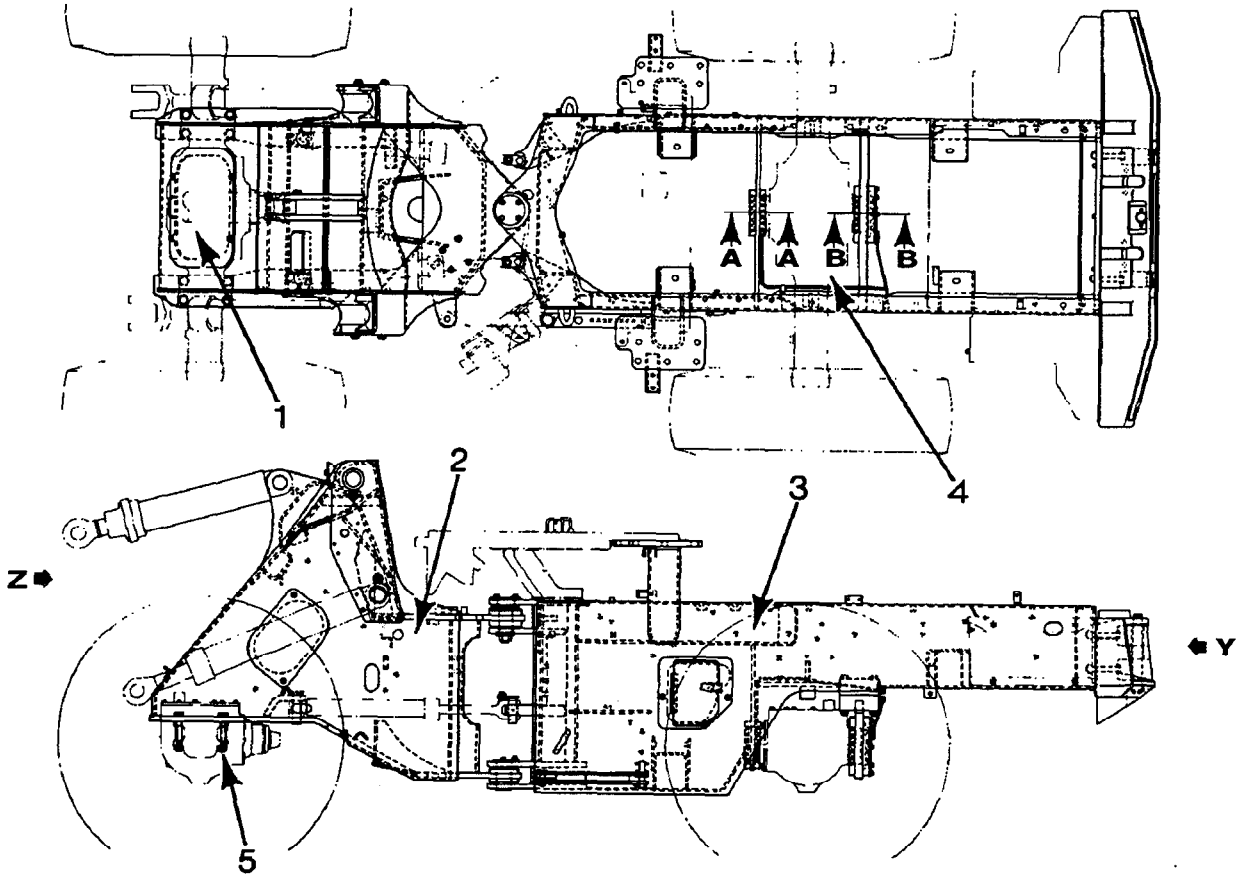
- The final drive makes the final reduction in speed of the motive force from the engine to increase the drive power.
- Ring gear (4) is press fitted to the axle housing and is held by a pin.
- The motive force from the differential passes through sun gear shaft (5) and enters the planetary gear system. Here the rotating speed is reduced and the drive power is increased. The increased drive power is then transmitted by planetary carrier (2) and axle shaft (3) to the wheels.

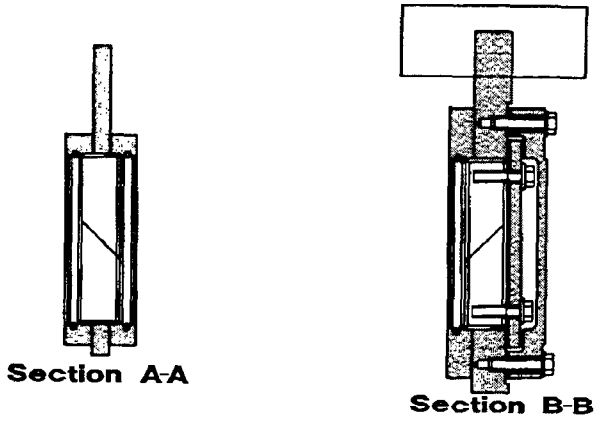


418F034

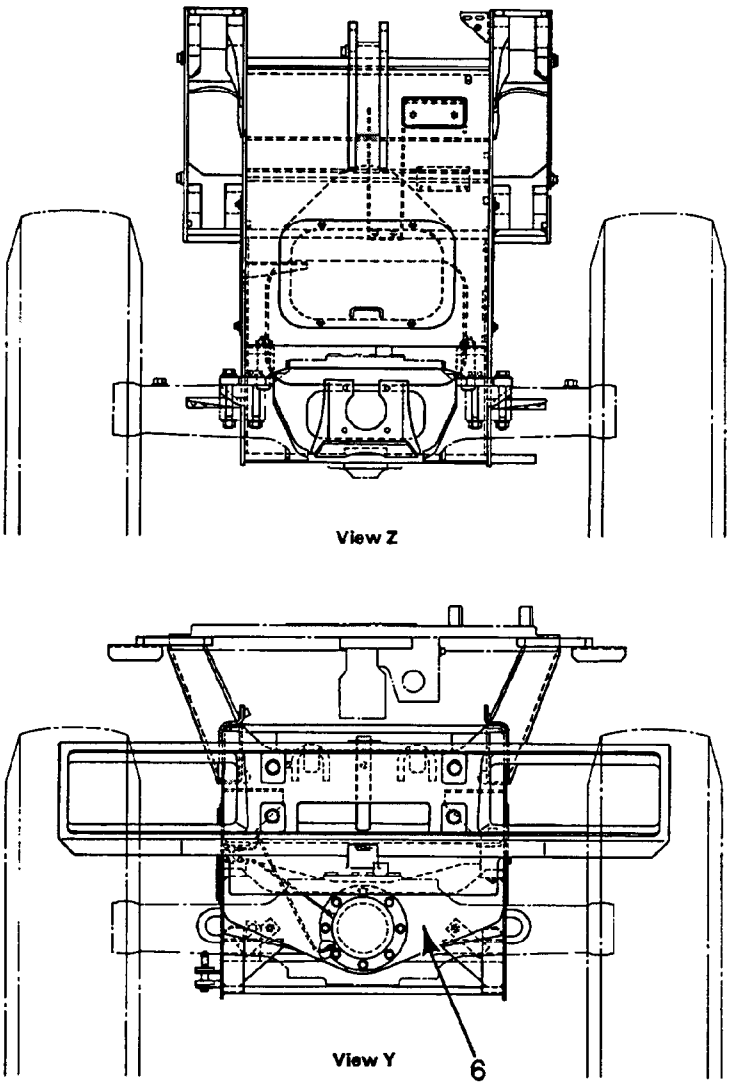
1. Planetary gear (26 teeth)
2. Planetary carrier
3. Axle shaft
4. Ring gear (69 teeth)
5. Sun gear shaft (15 teeth)

AXLE MOUNT





418F035



418F036

1. Front axle
2. Front frame
3. Rear frame
4. Rear axle
5. Tension bolt
6. Pivot

Front axle

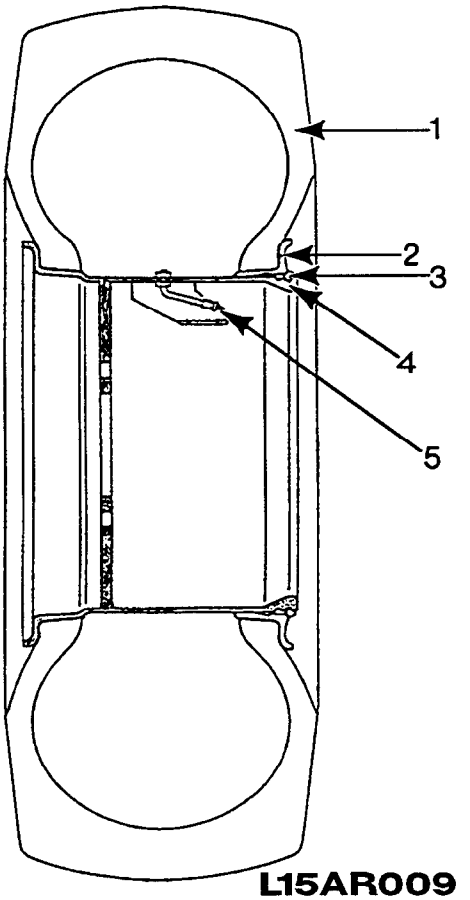
- The front axle (1) receives the force directly during operations, so it is fixed directly to the front frame (2) by tension bolts (5).

Rear axle

- The rear axle (4) has a structure which allows the center of the rear axle to float, so that all tires can be in contact with the ground when traveling over soft ground.

TIRE AND WHEEL

- The tires act to absorb the shock from the ground surface to the machine, and at the same time they must rotate in contact with the ground to gain the power which drives the machine.
- Various types are available to suit the purpose. Therefore it is very important to select the correct tires for the type of work and bucket capacity.



L15AR009

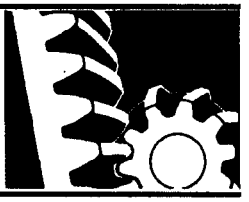
1. Tire
2. Side ring
3. Lock ring
4. Rim
5. Air valve

Specifications

Tire:	17.5 x 25 - 12PR
TRA code:	L2
Wheel size:	14:00 x 25
Air pressure:	2.8 kg/cm^2

Tire:	20.5 x 25 - 12PR
TRA code:	L2
Wheel size:	17:00 x 25
Air pressure:	2.8 kg/cm^2

POWER TRAIN
22 TESTING AND ADJUSTING



STANDARD VALUE TABLE 2

ENGINE STALL SPEED 3

OIL PRESSURE OF TORQUE CONVERTER AND TRANSMISSION 5

SHIFT LEVER 8

METHOD FOR OPERATION OF EMERGENCY MANUAL SPOOL 9

TIRE AND WHEEL 11

TROUBLESHOOTING 12
- PREVENTING RECURRENCE OF TROUBLE 13
- METHOD OF READING TROUBLESHOOTING TABLE 14
- CHECKS BEFORE TROUBLESHOOTING 16
- METHOD OF LOCATING MAIN PROBLEM POINTS WHEN TROUBLESHOOTING TRANSMISSION SYSTEM 17
- TROUBLESHOOTING TABLE 18
- TORQUE CONVERTER AND TRANSMISSION 18
  1. Machine does not move off. 18
  2. Machine speed is low, thrust is weak, gradeability falls off. 20
  3. Large shock when moving off or changing gear. 22
  4. Large time lag when moving off or changing gear. 23
  5. Oil temperature in torque converter is high. 24

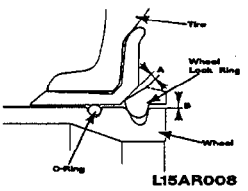
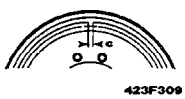
★ The following precautions are necessary when using the Standard Value Table to make judgements during troubleshooting or during testing and adjusting.

1. The values in these tables are based on the values for new machines leaving the plant, so they should be used as target values when repairing or when estimating wear after a period of use.

2. The standard values in these tables for judgement when troubleshooting are estimated values based on the standard values for the machine when shipped from the plant, and on the results of various tests. Therefore, they should be used as reference in combination with repair and operating records when making judgements.

3. These standard value tables must not be used for standard values when judging claims. In addition, do not use these values alone to make simple judgements.

STANDARD VALUE TABLE

Testing and measuring item	Measurement condition	Unit	Standard value	Permissible value
Engine stall speed	Coolant temperature: Inside operating range	rpm		
• Low idling			725±50	725±50
• High idling	Hydraulic temperature 45 - 55°C		2720+50 -100	2720+50 -100
• Torque converter stall	Torque converter oil temperature: 60 - 80°C		2610+50 -100	2610±200
• Hydraulic stall	Engine speed: High idling		2555±100	2555±200
• Full stall			2000±100	2000±200
Shift lever operating force and stroke	Torque converter oil temperature: 60-80°C			
• Directional lever operating force N - F	Engine speed: Low idling	kg	0.3-0.9	Max 1.4
N - R			0.3-0.9	Max 1.4
• Speed lever operating force 1st - 2nd		kg	0.3-0.9	Max 1.4
2nd - 3rd			0.3-0.9	Max 1.4
3rd - 4th			0.3-0.9	Max 1.4
• Directional lever travel N - F		mm	32-42	27-47
N - R			32-42	27-47
• Speed lever travel 1st - 2nd - 3rd - 4th		mm	32-42	27-47
Oil pressure of torque converter and transmission	Engine speed: High idling			
• Priority oil pressure	Coolant temperature: Inside operating range	kg/cm^2	23±2	23±2
• Main regulator pressure			25±2	25±2
• Pilot reducing pressure	Torque converter oil temperature: 60 - 80°C		10±1	10+1 -2
• All clutch oil pressure			23±2	23+2 -4
• Lubrication valve oil pressure			1.2±0.3	1.2±0.3
• Torque converter outlet oil pressure			4.2±0.2	4.2+0.4 -0.5
Tire and wheel	Tire inflation pressure: Specified pressure			
• Fitting of wheel lock ring (A)	 L15AR008	mm	Max 2.5	Max 2.5
(B)			Max 4.5	Max 4.5
• Clearance of wheel lock ring (C)	 423F309		2 - 12	2 - 12

ENGINE STALL SPEED

★ Measurement condition
- Coolant temperature: Inside operating range
- Hydraulic oil temperature: 45 - 55°C
- Torque converter oil temperature: 60 - 80°C

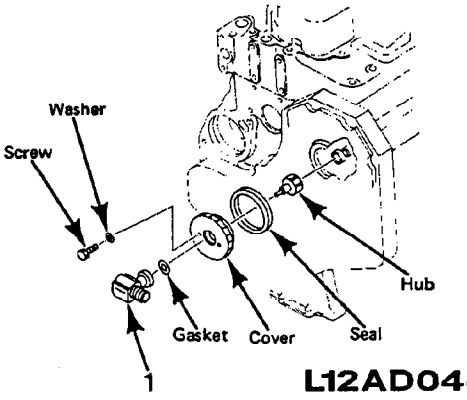
Unit: rpm

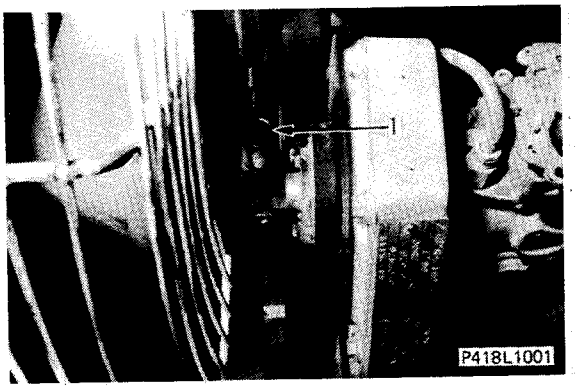
Item	Standard value	Permissible value
Engine speed		
Low idling	725±50	725±50
High idling	2720^{+50}_{-100}	2720^{+50}_{-100}
Torque converter stall	2610^{+50}_{-100}	2610±200
Hydraulic stall	2555±100	2555±200
Full stall	2000±100	2000±200

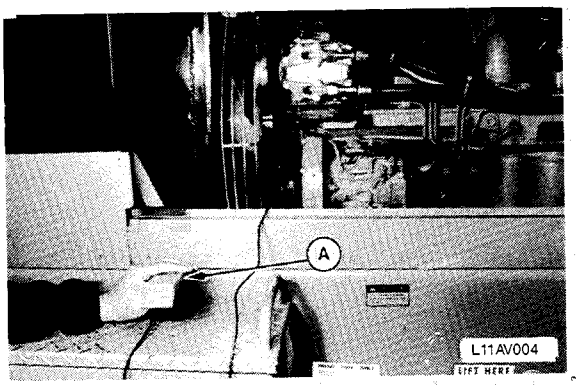
Special tools

	Part number	Part name	Qty
A	799-203-8000	Tachometer	1
B	799-101-6000	Thermistor kit	1
	DF 9035	Drive, mech tach	1
	• 3905306	Hub	1
	• 3903475	Seal	1
	• 391506A	Cover	1
1	• 3914132	Adapter	1
	• 62392	Washer	2
	• 3027685	Screw	2
	• 3905218	Gasket	1

★ Check that the low idling and high idling speeds are within the standard value.
★ Before measuring the stall speeds, install adapter (1) and other parts on the engine speed output portion of engine rear side, then connect tachometer A.







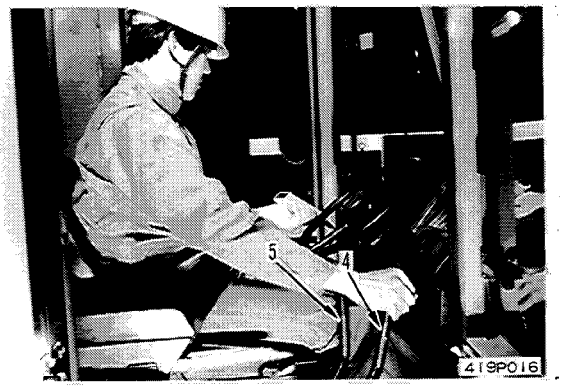
★ Check that the engine speeds are within the standard value. If any item is outside the permitted range, check for any looseness and play in the linkage.

⚠ Apply the parking brake and block the tires.

1. Measuring torque converter stall
1) Start engine and run at low idling.
2) Put the directional lever (2) in FORWARD or REVERSE, and speed control lever in the highest speed range.
3) Using the brake, stop the machine and measure the engine speed when the engine reaches high idling.
   ★ Turn the transmission cut-off valve switch to OFF, and use the left brake. (Check that the pilot lamp is OFF.)
   ★ Do not run at stall speed for more than 20 seconds, and do not let the torque converter oil temperature rise above 120° C.



2. Measuring hydraulic stall
1) Start engine and run at high idling.
2) Operate the dump (4) or lift lever (5) to move the cylinder to the stroke end and actuate the relief valve of the main control valve.
3) Measure the engine speed at this point.
   ★ Do not run the engine at stall speed for more than 20 seconds, and operate the control lever quickly.



3. Measuring full stall
Measure the engine speed when torque converter stall and hydraulic stall are reached at the same time.
★ Measure full stall when both the torque converter and hydraulic stall speeds are normal. If either stall speed is abnormal, remove the abnormality and measure the stall speed again.



OIL PRESSURE OF TORQUE CONVERTER AND TRANSMISSION

★ Measurement condition
- Coolant temperature: Inside operating range
- Torque converter oil temperature: 60 - 80°C

Unit: kg/cm^2

Item	Standard value	Permissible value
Priority oil pressure	23±2	23±2
Main regulator pressure	25±2	25±2
Pilot reducing pressure	10±1	10^{+1}_{-2}
All clutch oil pressure	23±2	23^{+2}_{-4}
Lubrication valve oil pressure	1.2±0.3	1.2±0.3
Torque converter outlet oil pressure	4.2±0.2	$4.2^{+0.4}_{-0.5}$

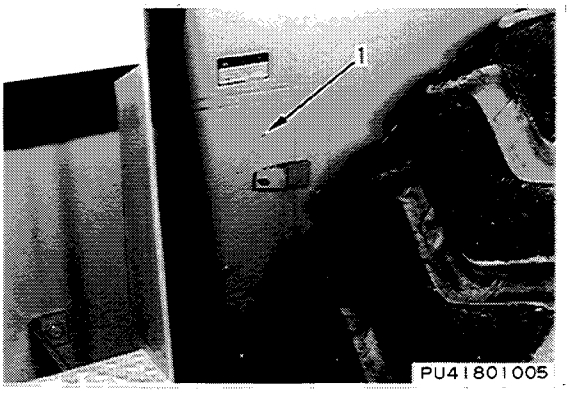
Special tool

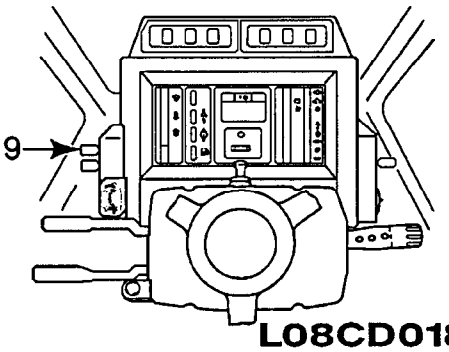
	Part number	Part name	Qty
A	799-101-5000	Hydraulic tester	1

Apply the parking brake and block the tires.

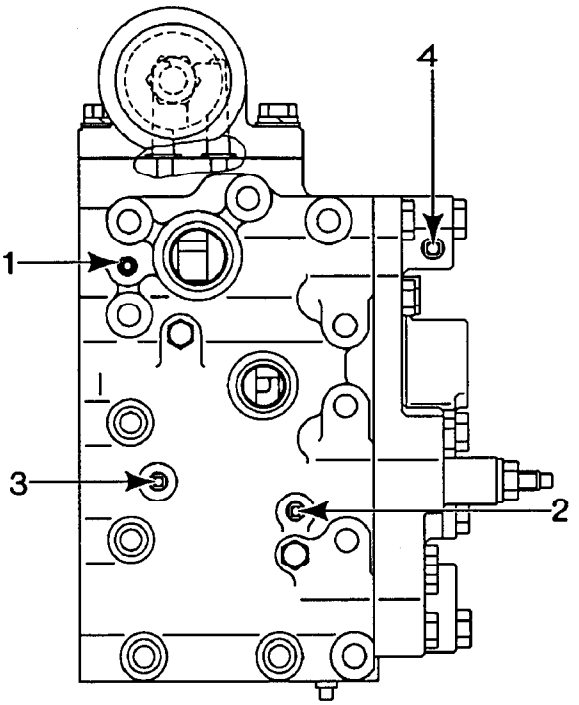
Preparatory work

★ The following operations are necessary preparatory work for all measurements of the hydraulic system.
- Open left inspection cover (1) of the rear frame.
- Turn transmission cut-off selector switch (9) to the OFF position, and use the left brake. (Check that the pilot lamp is OFF.)
- Remove the plug from the measuring port of the transmission valve.
- Install hydraulic test kit A to the measurement port, pull the gauge to the operator's compartment, then start the engine and measure the pressure.





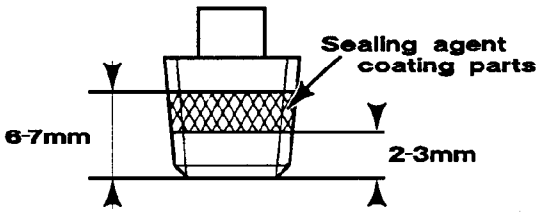
L08CD018



L07ED021

★ Check that there is no leakage of oil from any joints.
★ After removing the measurement plug, always coat the plug with adhesive.

Plug: Sealing agent (LG-1)

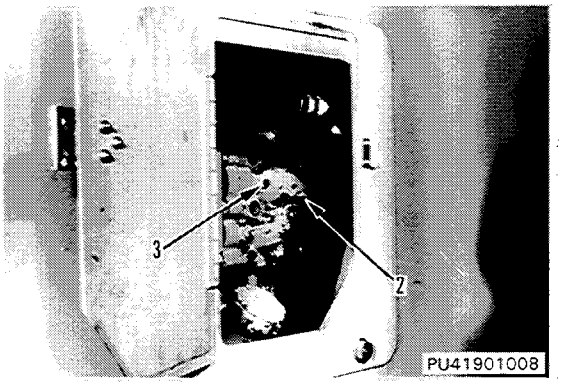


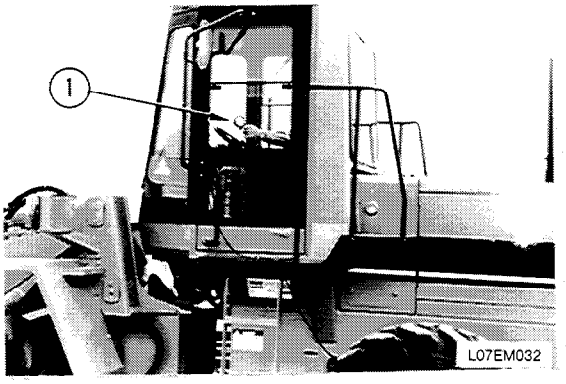
1. **Measuring main regulator pressure**
   1) Measuring port 2.
   2) Start the engine and measure the pressure at low idling and high idling.

2. **Measuring pilot pressure**
   1) Measuring port 1.
   2) Start the engine and measure the pressure at low idling and high idling.

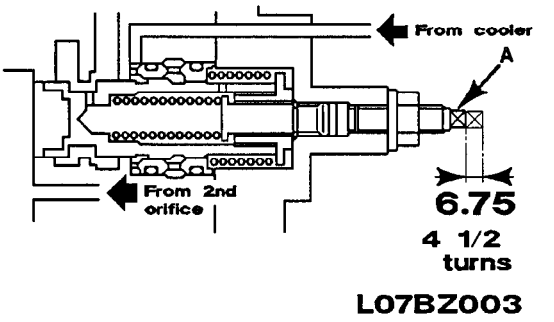
3. **Measuring pressure of all clutches**
   1) Measuring port 3.
   2) Start the engine and measure the pressure at low idling and high idling.

4. **Measuring torque converter outlet port pressure**
   1) Measuring port 4.
   2) Start the engine and measure the pressure at torque converter stall.

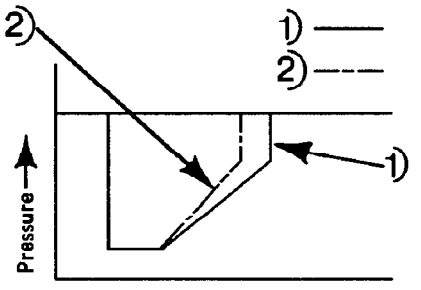




5. **Adjusting modulating time**
   The modulating time can be made longer or shorter by adjusting screw (A).
   1) Tighten the screw. ————
   2) Loosen the screw. — – —
      ★ Adjustment range: Within ±1 turn
      ★ Standard length: 6.75 mm
      (Turn back to end, then tighten 4-1/2 turns.)
      ★ Do not adjust needlessly, and check the pressure after adjusting to confirm that there is no abnormality.



L07BZ003



L07BZ002

SHIFT LEVER

Measuring conditions
- Engine speed: Stop

Unit: kg/cm^2

Item			Standard value	Permissible value
Operating force	Directional lever	Neutral-Forward	0.3-0.9	Max. 1.4
		Neutral-Reverse	0.3-0.9	Max. 1.4
	Speed lever	1st-2nd	0.3-0.9	Max. 1.4
		2nd-3rd	0.3-0.9	Max. 1.4
		3rd-4th	0.3-0.9	Max. 1.4
Travel	Directional lever	Neutral-Forward	32-42 mm	27-47 mm
		Neutral-Reverse	32-42 mm	27-47 mm
	Speed lever	In each range from 1st to 4th speeds	32-42 mm	27-47 mm

Special tools

	Part number	Part name	Qty
A	79A-264-0020	Push-pull scale	1
	799-101-6000	Thermistor kit	1

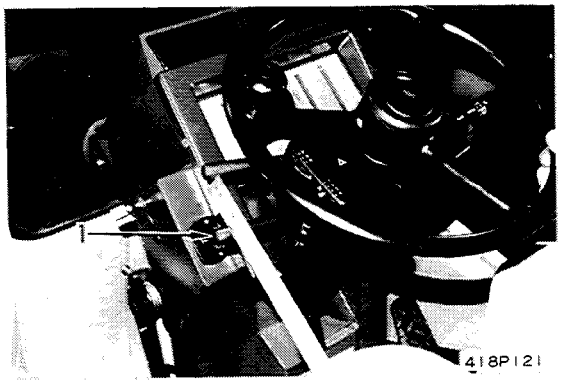
⚠ Be sure to set chocks firmly against the tires.

1. Measuring the lever operating force
1) Stop the engine.
2) Attach push-pull scale A or a spring balancer to the lever knob at the center and measure the operating effort required to pull it in the operating direction.
★ The measurement should be made in each speed range.

2. Measuring the lever travel
1) Stop the engine.
2) Put mark "1" on the center on the control lever knob and measure the travel when the lever is moved in the operating direction.



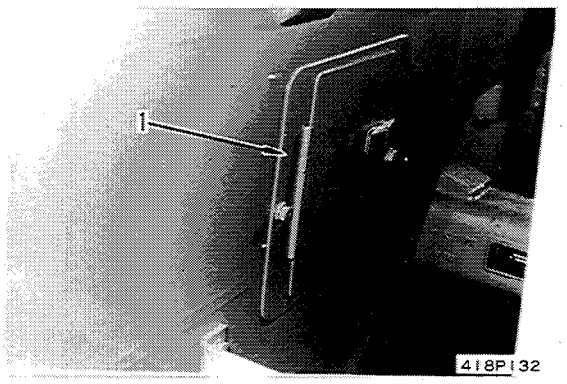




METHOD FOR OPERATION OF EMERGENCY MANUAL SPOOL

Outline

- The transmission valve is controlled electrically. Therefore, the emergency manual spool is installed to enable the machine to be moved if there is any failure in the electrical system, or in the solenoid valve and spool.

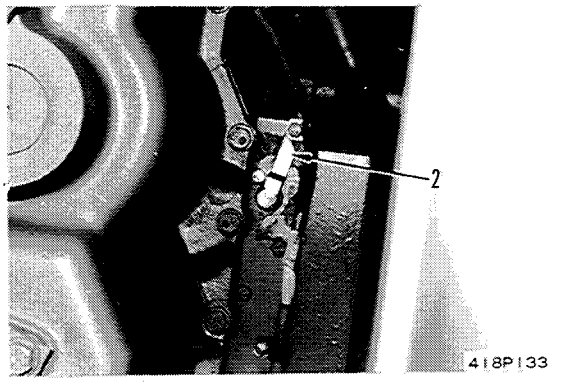


⚠ The emergency manual spool is for use when failure in the transmission control prevents the machine from being moved. It allows the machine to be moved from a dangerous place to a place where repairs can be carried out safely.

⚠ The emergency manual spool must never be used except when the transmission control has broken down.

⚠ To prevent the machine from moving, lower the bucket to the ground, apply the parking brake, and block the wheels.

1. Remove cover (1) for inspecting transmission oil level.

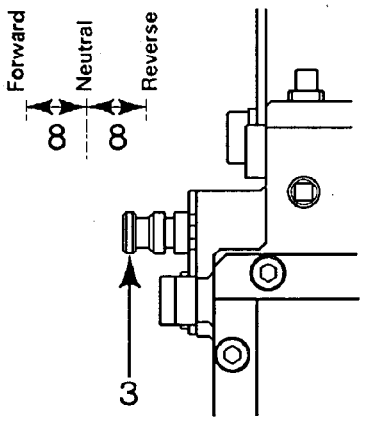


⚠ Always stop the engine before operating the spool.

2. Remove lock plate (2) of the emergency manual spool of the transmission valve.

3. Decide the direction to move the machine (FORWARD or in REVERSE), then move the emergency manual spool (3) to the operating position.

FORWARD:	Push spool until it enters detent. (a = approx. 8 mm)
REVERSE:	Pull spool in until it enters detent. (b = approx. 8 mm)

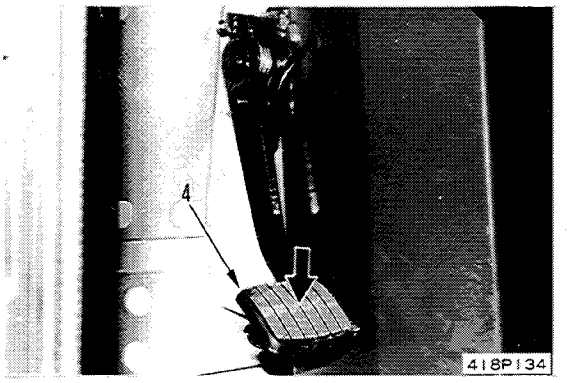


L07ED020

4. Check that the area around the machine is safe, then remove the blocks from under the wheels.

5. Sit in the operator's seat, and depress the left brake pedal (4) fully.

6. Start the engine, release the parking brake, then release the brake pedal gradually to start machine movement.



⚠ When the engine is started and the transmission is engaged, the **MACHINE WILL MOVE !!!!!** Therefore, before starting the engine, always check that the direction of travel is safe, and always keep the brake pedal depressed.

★ If the machine does not start, turn the 2nd spool, 3rd spool, and 4th spool clockwise, and screw in approx. 10 mm to the OFF position.

7. After moving the machine, stop the engine, apply the parking brake, and block the wheels.

8. Return the emergency manual spool to the neutral position, and install the lock plate.

TIRE AND WHEEL

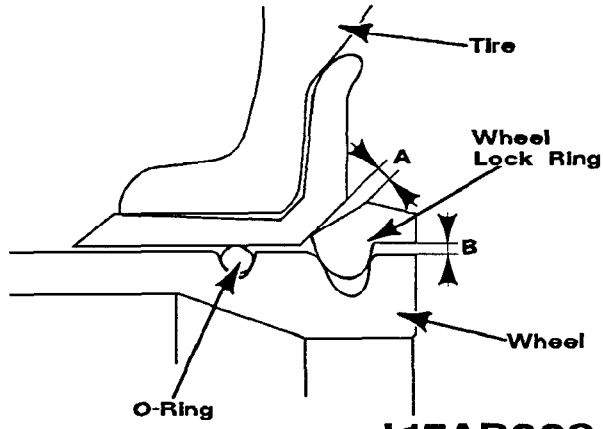
★ Measurement condition
● Tire inflation pressure: Specified pressure

Unit: mm

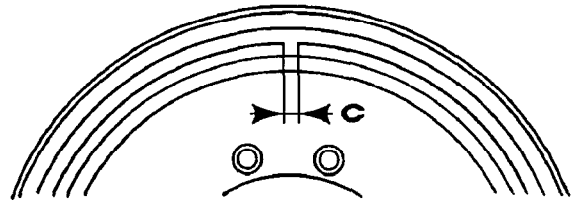
Item	No.	Standard value	Permissible value
Fitting of wheel lock ring	A	Max. 2.5	Max. 2.5
	B	Max. 4.5	Max. 4.5
Clearance of wheel lock ring	C	2-12	2-12

Measuring procedure

1. **Fitting of wheel lock ring**
   Measure dimensions A and B with a feeler gauge.
2. **Clearance of wheel lock ring**
   Measure dimension C.



L15AR008



423F309

TROUBLESHOOTING

PREVENTING RECURRENCE OF TROUBLE

- The troubleshooting table is used to establish the direct cause of damage or breakdown of a part or piece of equipment. It is not able to establish the root cause of the damage or failure, however.
- Also, this table only describes the action to be taken with the particular part or piece of equipment. It does not mention what action should be taken to prevent a recurrence of the root cause.
- In order to remove the root cause of a fault so as to prevent a recurrence, carefully investigate the real cause while referring to the following items.
- Regarding the method of checking and adjusting each part or piece of equipment, refer to "Testing and Adjusting" in the Shop Manual.

HYDRAULIC EQUIPMENT

1. Oil checks

- The fundamental cause of almost all faults occurring in hydraulic equipment is the inclusion of water, air or other foreign matter in the oil. Accordingly, it is necessary to check the oil to see whether or not it contains any of the above substances, and then take appropriate action.

1) Oil checks
- Check for water contamination.
  Check the oil for possible water contamination by means of a diesel engine oil checker or a hot plate.
- Check for contamination of other foreign matter. Remove the drain plug and filter, then check the bottom of the tank and also the filter to see if any foreign matter has collected there. Check the degree of contamination by means of a contamination checker.
- Viscosity check
  Check the viscosity of the oil using a viscometer in order to confirm whether or not the oil is satisfactory.

2) Check of contamination point
If, as a result of the above checks, it is discovered that the oil is contaminated by water or other foreign matter, it is necessary to find out where the contamination is occurring and also to take steps to prevent it.

Water:	Oil storage tank, breather, etc.
Sand:	Oil replenishing or replacing method, etc.
Rubber:	Cylinder packing, etc.
Metal:	Wear or damage to hydraulic equipment such as pump and motor, as well as transmission and torque converter, etc.

3) Oil cleaning and replacement
- If a large amount of metal particles or other foreign matter is discovered in the oil, either wash the oil using an oil refresher or replace it.
  - ★ If the oil is contaminated by water, it is not possible to remove the water by means of an oil refresher.
  - ★ When washing the oil, also wash or replace the strainer and replace the filter.

2. Cleaning fragments of damaged parts

- If a part becomes damaged, fragments may pass into the oil line. It is thus necessary to wash the oil.
- In addition, disassemble and wash such parts as valves and cylinders which are liable to collect metal fragments and other foreign matter, thus helping to prevent a recurrence of faults due to such fragments becoming lodged in various parts of the engine or hydraulic equipment.

METHOD OF READING TROUBLESHOOTING TABLE

Description of symbols used in TROUBLESHOOTING TABLE

The following symbols are used in the "Remedy" column to indicate the method of eliminating the cause of a fault.

x: Replace; △: Repair
A: Adjusting; C: Clean

Method of reading TROUBLESHOOTING TABLE

- The symbol ○ in the table is inserted only for causes which can be diagnosed. If a cause cannot be diagnosed, the corresponding box is left blank.
- If the result of problem 1 using the troubleshooting table shown at right is abnormal, the cause of the trouble can be assumed to lie between "a" and "d". Because it is not possible to make a problem regarding "e", it is necessary to perform the next problem (owing to the possibility of a multiple fault). If the result of problem 1 is normal, the cause of the fault does not lie between "a" and "d". In such a case, before diagnosing the cause as "e", however, carry out a check by means of problem 2 or 5.
- If now the result of problem 1 is abnormal and the result of problem 2 normal, the cause is one of "a", "b" or "d". In addition, if the result of problem 3 is abnormal, the cause will be narrowed down to one of "b" or "d". To determine which of "b" or "d" is the actual cause, perform problem 4.
- If the result of problem is abnormal, blacken out the corresponding ○ in the table and then perform the next problem on these causes in order to narrow the likely causes.

Example 1:

Problem 1→Abnormal
Problem 2→Normal
Problem 3→Abnormal
Problem 4→Normal

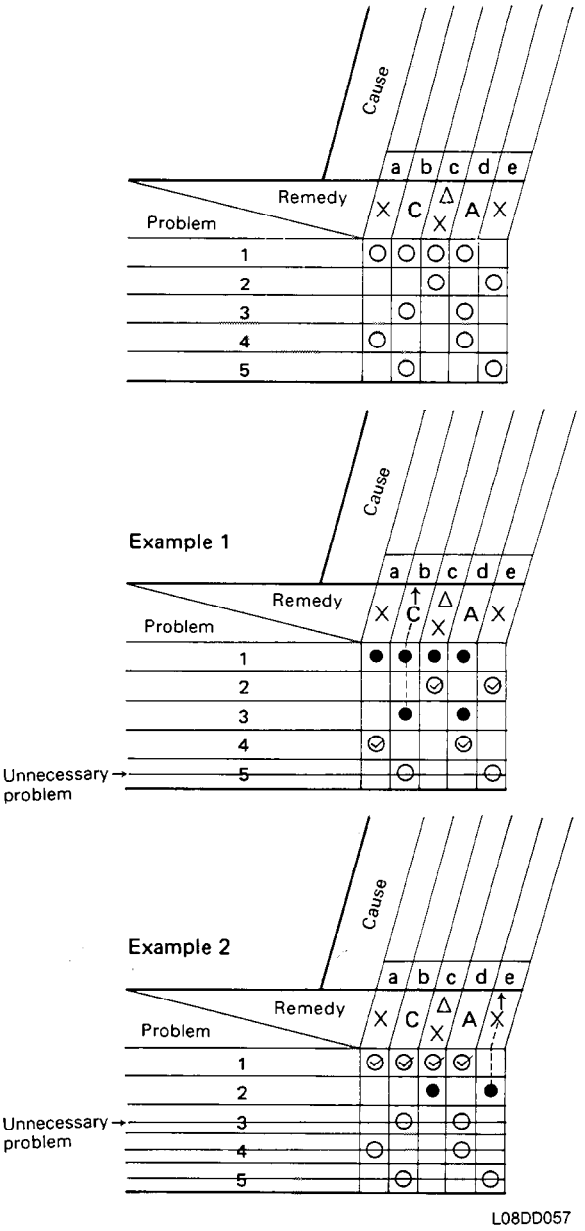
From the table of example 1, the cause of the fault is "b".

Example 2:

Problem 1→Normal
Problem 2→Abnormal

From the table of example 2, the cause of the fault is "e".

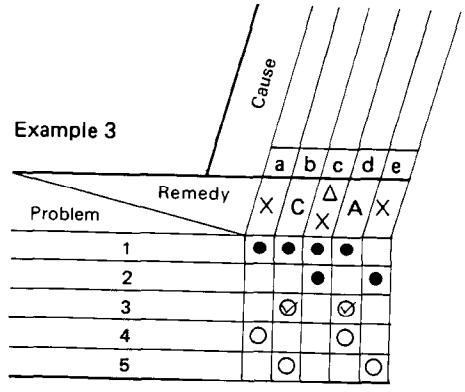
★ In example 2, it is evident that the cause is "e" without carrying out problem 2, however problem 2 is performed by way of an additional check.



Example 3:

Problem 1→Abnormal
Problem 2→Abnormal
Problem 3→Normal

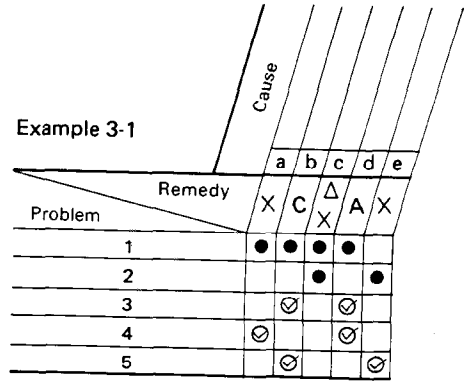
From the table of example 3, the cause is one of "a", "c" and "e".



Continue problems

Problem 4→Normal
Problem 5→Normal

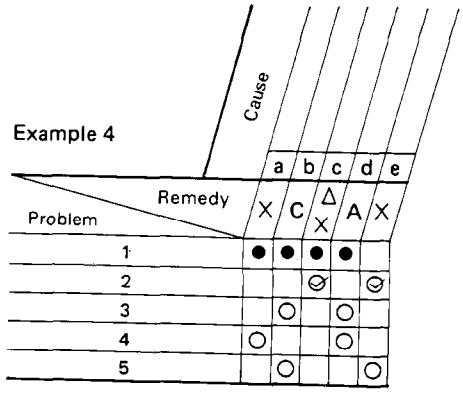
From the table of example 3-1, the cause is "c".



Example 4:

Problem 1→Abnormal
Problem 2→Normal

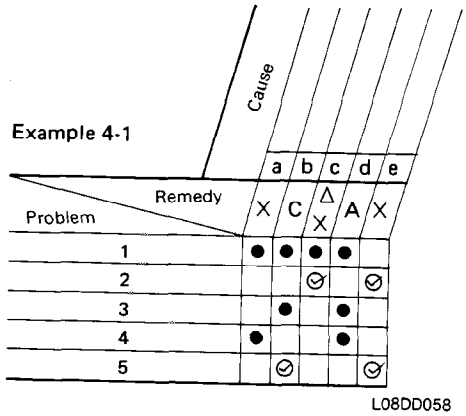
From the table of example 4, the cause is one of "a", "b" or "d".



Continue problems

Problem 3→Abnormal
Problem 4→Abnormal
Problem 5→Normal

From the table of example 4-1, the cause is "a" or "d".



As can be seen from the above examples, it is not necessary to perform all of the problems.
Also, looking at a particular cause, no matter how many • marks there are in the column corresponding to that cause, it will cause to be an actual cause if there is even one ○ mark in the same column.

L08DD058

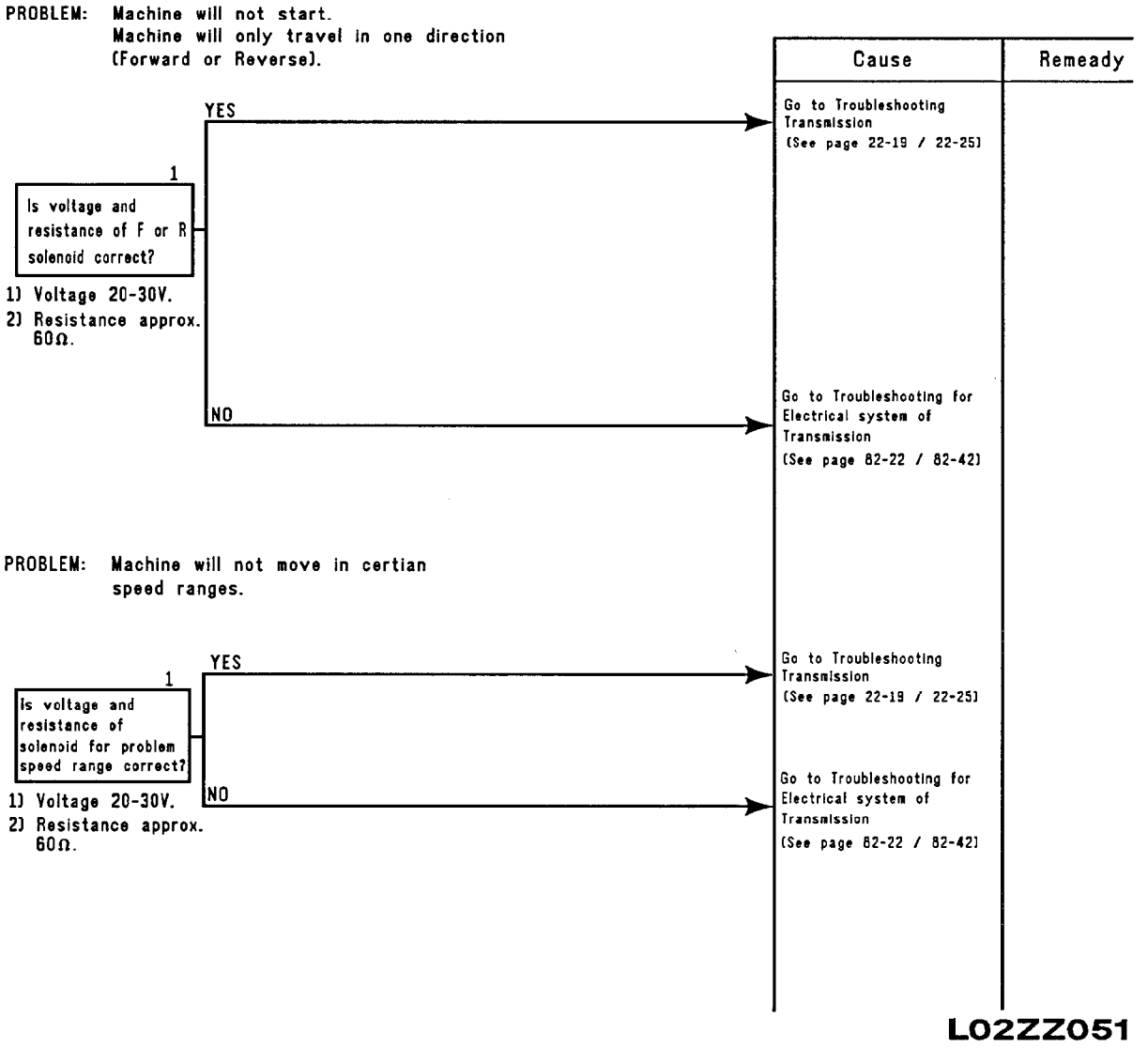
CHECKS BEFORE TROUBLESHOOTING

xxxxxxxx	xxxxxxxxx	Item	Standard value	Remedy
Checks before starting	Lubricating oil, cooling water	1. Check fuel level		Add fuel
		2. Check for dirt or water in fuel		Clean, drain
		3. Check hydraulic oil level		Add oil
		4. Check hydraulic oil strainer		Clean, drain
		5. Check brake oil level		Add oil
		6. Check engine oil level (Level of oil in oil pan)		Add oil
		7. Check cooling water level		Add water
		8. Check condition of dust indicator		Clean or replace
		9. Check air pressure in air reservoir		See Troubleshooting
Item	Electrical Equipment	10. Check for loose or corroded battery terminals		Tighten or replace
		11. Check for loose or corroded alternator terminals		Tighten or replace
		12. Check for loose or corroded starting motor terminals		Tighten or replace
Other check items	Hydraulic, mechanical components	13. Check for abnormal noise or smell		Repair
		14. Check for oil leakage		Repair
		15. Bleed air from system		Bleed air
	Electrical components	16. Check battery voltage (engine stopped)	20 - 30V	Replace
		17. Check level of battery electrolyte		Add or replace
		18. Check for discolored, burnt, or bare wires		Replace
		19. Check for missing wiring clamps, hanging wires		Repair
		20. Checks for water leaking onto wiring (check carefully water leakage at connectors and terminals)		Disconnect connector and dry connection
		21. Check for broken or corroded fuses		Replace
		22. Check alternator voltage (engine running at over half throttle)	27.5 - 29.5V	Replace
		23. Noise when battery relay is operated (switch starting switch from on to off)		Replace

METHOD OF LOCATING MAIN PROBLEM POINTS WHEN TROUBLESHOOTING TRANSMISSION SYSTEM

The problem points in the transmission system can be broadly divided into the following two areas.
1. Transmission itself and transmission control valve.
2. Transmission electric control.

Use the following method to decide which of the two areas has the problems.



L02ZZ051

TROUBLESHOOTING TABLE

TORQUE CONVERTER AND TRANSMISSION

1. Machine does not move off.

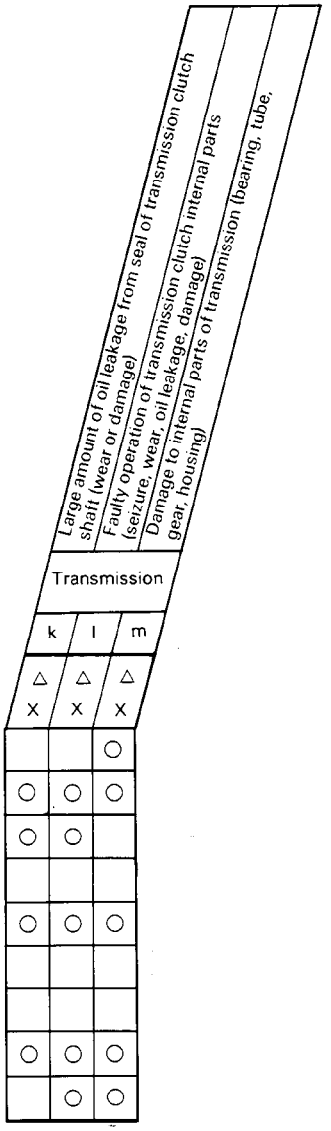
Ask the operator the following questions.
- Did the machine suddenly stop moving?
  Yes = Component seized or damaged.
- Was there any abnormal noise when the machine stopped moving?
  Yes = Component broken.

Checks before troubleshooting.
- ★ Is the machine monitor functioning normally?
- Is quantity and type of oil in transmission correct?
- Is the transmission filter or strainer clogged?
- Has oil in transmission deteriorated or does it emit a burnt smell?
- Is there any damage or oil leakage which can be discerned by viewing the exterior of the machine?
- Is the transmission drive shaft broken?
- Is wheel brake (including emergency brake) or parking brake locked?
- ★ Is the electrical circuit in transmission normally?

No.	Problem \ Remedy / Cause	Air being sucked into suction side of charging pump	Faulty charging pump	Charging pump not driven (faulty PTO)	Torque converter internally damaged (bearing, turbine, pump, stator, seal, etc.)	Torque converter relief valve malfunction	Transmission control valve internally damaged	Faulty pressure regulator valve for transmission clutch	Faulty operation of control valve (seizure due to foreign matter)	Faulty operation of solenoid valve	Blocked orifice on control valve
		Charging pump			Torque converter		Transmission control valve				
		a	b	c	d	e	f	g	h	i	j
		△ X	X	△ X	△ X	△ X	X	△ X	△ X	△ X	C
1	Machine does not move off in any speed position.	○	○	○	○	○	○	○	○	○	○
2	Machine only moves off in a certain speed position.						○		○	○	
3	Machine does not move off when oil temperature is high.		○								
4	The torque converter stall speed does not drop to the correct value for any speed position.				○	○	○	○			○
5	The torque converter stall speed does not drop to the correct value for a certain speed position.										
6	The torque converter charging pressure does not rise.	○	○	○	○	○					
7	The transmission clutch pressure does not rise for any speed position.	○	○	○			○	○			○
8	The transmission clutch pressure does not rise for a certain speed position.										
9	Metal particles (aluminium, copper, steel, etc.) adhere to the filter and strainer.		○		○						

L07ZZ015

Note: Disassemble the solenoid valve only in a clean and dry workshop because dust and moisture can cause the solenoid valve to fail. Replace the solenoid valve as an assembled unit when making the repair in the field.



L07ZZ016

The following symbols are used to indicate the action to be taken when a cause of failure is located:

X: Replace △: Repair
A: Adjust C: Clean

2. Machine speed is low, thrust is weak, grade-ability falls off.

Fault check.

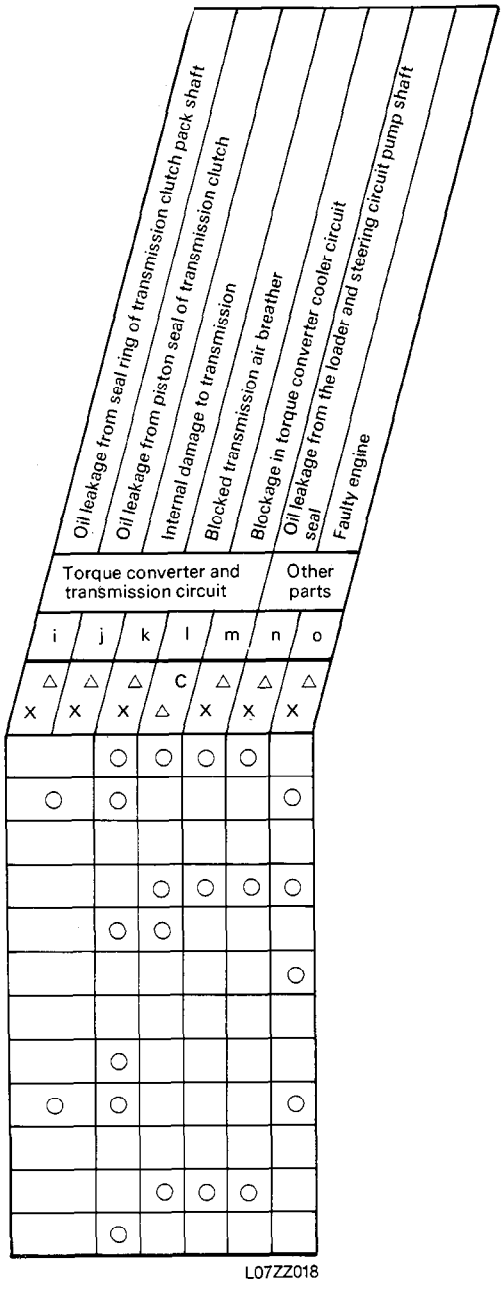
- Measure the machine speed during excavation work and also when it is on flat and sloping ground, respectively, in order to determine whether the machine is actually faulty or whether the operator simply feels that the machine lacks power.

Checks before troubleshooting.

- Is quantity and type of oil in transmission correct?
- Is the transmission filter or strainer clogged?
- Is there any leakage of oil from pipe or valve connections?
- Is wheel brake or parking brake dragging?
- Are tire pressure and tire tread satisfactory?
- Is the method of performing work correct?

No.	Problem \ Remedy		Cause: Air being sucked into suction side of charging pump (Charging pump a)	Faulty charging pump (Charging pump b)	Faulty torque converter regulator valve (Torque converter c)	Oil leakage inside torque converter (seal ring, bushing, snap ring, bearing, etc.) (Torque converter d)	Damage inside torque converter (bearing, pump, turbine, stator, etc.) (Torque converter e)	Fault inside transmission control valve (bearing, pump, turbine, spool) (Transmission control valve f)	Faulty operation of clutch pressure regulator of control valve (Transmission control valve g)	Blocked orifice of control valve (Transmission control valve h)
			a	b	c	d	e	f	g	h
			△ X	△ X	△ X	△ X	X	△ X	△ X	C X
1	Machine is faulty in all speed positions.		○	○	○	○	○		○	○
2	Machine is faulty in a certain speed position.							○		
3	Charging pump emits an unusual noise when the oil temperature is low.		○							
4	Oil in torque converter overheats.		○	○		○	○			
5	High idling and low idling speeds of engine are abnormal.						○			
6	Each stall engine speed is abnormal.			○	○	○	○			
7	Torque converter relief pressure is low.		○	○	○	○	○		○	
8	Transmission clutch pressure	Low at any speed range	○	○					○	○
9		Becomes low for at a certain speed position.						○		
10		Pointer of pressure gauge deflects by a large amount and in an unstable manner.	○							
11	Quantity of oil in transmission fluctuates.									
12	Metal particles adhere to the transmission strainer or torque converter filter.			○			○			

L07ZZ017



The following symbols are used to indicate the action to be taken when a cause of failure is located:

X: Replace △: Repair
A: Adjust C: Clean

3. Large shock when moving off or changing gear.

Fault check.
Because it is difficult to determine whether shock is abnormally large or normal, consider it large in the following cases.
- When a shock occurs which is clearly larger than any that has occurred so far.
- When the shock is large compared to that occurring on other machines of the same type.

Checks before troubleshooting.
- Is the low-idling speed of the engine too high?
- Is there excessive play in each drive shaft?

No.	Problem \ Remedy / Cause	Faulty transmission clutch pressure regulating valve	Seizure of accumulator piston	Faulty modulation valve (WA200-1 # 20001 and up, WA250-1)	Faulty quick retun valve	Faulty fill valve	Faulty piston return due to broken or flattened return spring of clutch pack	Blocked oil drain hole in circumferential direction of clutch pack cylinder
		Control valve				Trans-mission		
		a	b	c	d	e	f	
		△ X	△ X	△ X	△ X	△ X	C △	
1	Large shock in all speed positions.	○		○				
2	Large shock in a certain speed position.					○		
3	Clutch pressure excessively high.	○						

L07ZZ019

The following symbols are used to indicate the action to be taken when a cause of failure is located:

X: Replace △: Repair
A: Adjust C: Clean

4. Large time lag when moving off or changing gear.

Check the following items with the operator.
- If the time lag is large and also the machine speed, thrust force and gradeability are abnormal, refer to item 2. "Machine speed is low, thrust is weak, gradeability falls off".

Checks before troubleshooting.
- Is quantity and type of oil in transmission correct?
- Is there any leakage of oil from valve or pipe connections?

No.	Problem \ Remedy / Cause	Faulty accumulator	Blocked orifice of transmission control valve	Faulty quick return valve	Oil leakage due to wear of piston spool or bore	Oil leakage from transmission clutch pack and piston seal	Oil leakage from transmission clutch pack and shaft seal ring	Oil leakage from O-ring between transmission housing and valve
		Transmission control valve			Transmission			
		a	b	c	d	e	f	g
		△ X	C △	△ X	△ X	△ X	△ X	△ X
1	Large time lag at all speed positions.	○	○	○	○			
2	Large timg lag at a certain speed position.					○		
3	Low clutch pressure at all speed positions.		○		○			
4	Clutch oil pressure is low at speed stages having a large time lag.				○	○		

L07ZZ020

The following symbols are used to indicate the action to be taken when a cause of failure is located:

X: Replace △: Repair
A: Adjust C: Clean

5. Oil temperature in torque converter is high.

Ask the operator regarding the following points.
- If the oil temperature rises when the torque converter stalls and falls when it is unloaded. Select the correct speed position.
- If the oil temperature rises only when pushing soil uphill.
  Yes = Improve the working method.

Checks before troubleshooting.
- Radiator water level and fan belt tension.
- Is quantity and type of oil in transmission correct?
- Is the transmission filter or strainer clogged?

Fault check.
- Measure the temperature of the oil in the torque converter. Check temperature is really high.
  Yes = Faulty oil temperature gauge.

No.	Problem \ Remedy		a △ X	b △ X	c △ X	d △ X	e X	f △ X	g X	h C X	i △ X	j △ X	k △ X
			Cause	Air being sucked into suction side of charging pump	Faulty charging pump	Faulty torque converter regulator valve	Oil leakage in torque converter (seal ring, bushing, snap ring, bearing, etc.)	Damage inside torque converter (seal ring, bushing, snap ring, stator, etc.)	Faulty transmission clutch pressure regulator valve	Damage inside torque converter (bearing, pump, turbine,	Blockage in transmission	Faulty air bleed from transmission air breather circuit	Oil leakage from torque converter cooler or blocked seal	Faulty engine
			charging pump	Torque converter				Transmission		Torque converter and transmission circuits		Other parts	
1	Charging pump emits unusual noise when oil temperature is low.		○										
2	High idling and low idling engine speeds are abnormal.						○		○	○			○
3	Each stall engine speed is abnormal.			○	○	○	○						○
4	Machine speed, thrust force and gradeability are abnormal at all speed positions.		○	○	○	○	○	○	○	○	○		○
5	Machine speed, thrust force and gradeability are abnormal at a certain speed position.								○				
6	Torque converter outlet pressure is low.		○	○	○	○	○						
7	Transmission clutch pressure	Low at any speed range	○	○				○	○				
8		Becomes low for at a certain speed position.							○				
9		Pointer of pressure gauge deflects by a large amount and in an unstable manner.	○										
10	Quantity of oil in transmission fluctuates.									○	○	○	
11	Metal particles adhere to the transmission strainer or torque converter filter.			○			○		○				

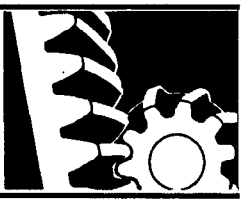
L07ZZ021

The following symbols are used to indicate the action to be taken when a cause of failure is located:

X: Replace △: Repair
A: Adjust C: Clean

POWER TRAIN

23 DISASSEMBLY AND ASSEMBLY



TORQUE CONVERTER CHARGING PUMP 3
REMOVAL 3
INSTALLATION 3

TRANSMISSION, TORQUE CONVERTER 4
REMOVAL 4
INSTALLATION 11

TORQUE CONVERTER 18
DISASSEMBLY 18
ASSEMBLY 21

TRANSMISSION 24
DISASSEMBLY 24
ASSEMBLY 31

CLUTCH PACK 43
DISASSEMBLY 43
FORWARD-REVERSE CLUTCH PACK 43
1ST-3RD SPEED CLUTCH PACK 46
2ND-4TH SPEED CLUTCH PACK 48
ASSEMBLY 50
FORWARD-REVERSE CLUTCH PACK 50
1ST-3RD SPEED CLUTCH PACK 55
2ND-4TH SPEED CLUTCH PACK 59

TRANSMISSION CONTROL VALVE 63
REMOVAL 63
INSTALLATION 64

TRANSMISSION SOLENOID VALVE 70
DISASSEMBLY 70
ASSEMBLY 70

DRIVE SHAFT 71
DISASSEMBLY 71
ASSEMBLY 73

FRONT AXLE 75
REMOVAL 75
INSTALLATION 77

REAR AXLE 79
REMOVAL 79

INSTALLATION 83

DIFFERENTIAL 88
DISASSEMBLY 88
ASSEMBLY 92

AXLE HOUSING 102
DISASSEMBLY 102
ASSEMBLY 106

★ For details of disassembly of the gear pump, see SECTION 97.

★ Take the following method for air bleeding when you start to operate hydraulic cylinders after reassembling cylinders, pumps and pipings.

1. Start engine, keep idling.
2. Operate hydraulic cylinder 4 - 5 cycles, but do not exceed beyond 100 mm of stroke end.
3. Continue to operate cylinder 3 - 4 cycles until stroke end.
4. After finishing above steps, keep normal engine speed.

NOTE: After long storage, same procedure is required.

TORQUE CONVERTER CHARGING PUMP

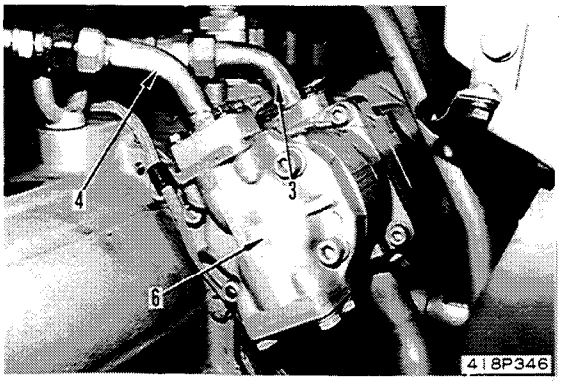
REMOVAL

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.



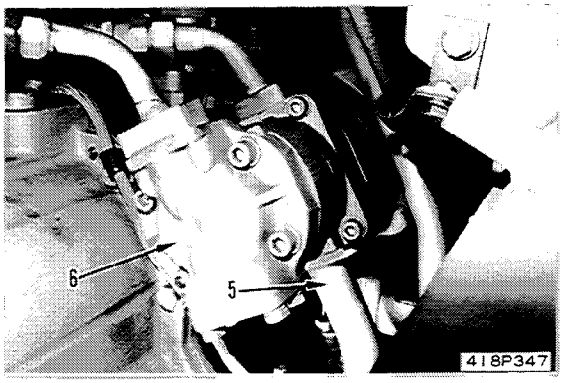
1. **Covers**
   Remove cover (1) under cab, transmission inspection cover, and side cover (2) of hydraulic oil tank.

2. **Hydraulic piping**
   Disconnect the following hydraulic piping.
   - Disconnect tube (3) between filter and pump from pump.
   - Disconnect tube (4) between pump and power master cylinder from pump.
   - Disconnect tube (5) between transmission strainer and pump from pump.



3. **Torque converter charging pump**
   Sling pump (6), and remove mounting bolts, then remove torque converter charging pump (6).
   ★ This operation should be carried out by two workers.

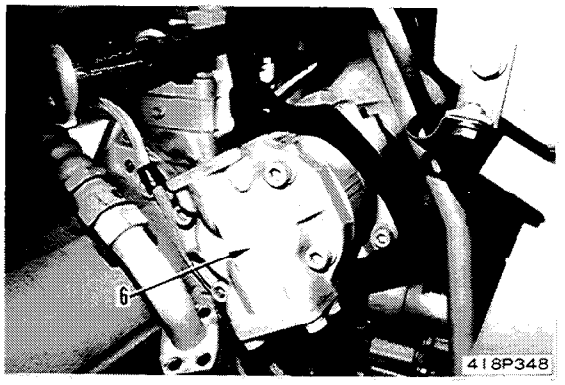
kg Torque converter charging pump: 13 kg



INSTALLATION

1. **Torque converter charging pump**
   Set torque converter charging pump (6) in mounting position, then tighten mounting bolts.
   ★ Check that there is an O-ring on the face in contact surface of housing.

2. **Hydraulic piping**
   Connect the following hydraulic piping.
   - Connect tube (5) between transmission strainer and pump at pump end.
   - Connect tube (4) between pump and power master cylinder to pump.
   - Connect tube (3) between filter and pump to pump.



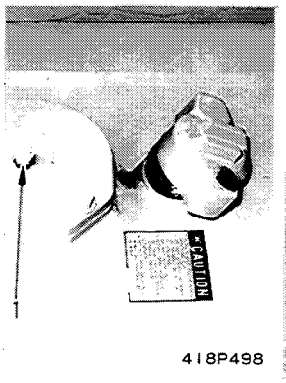
3. **Cover**
   Install covers (1 and 2).

TRANSMISSION, TORQUE CONVERTER

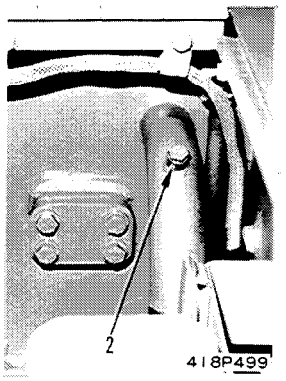
REMOVAL

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Open the hood and fit the lock.



418P498

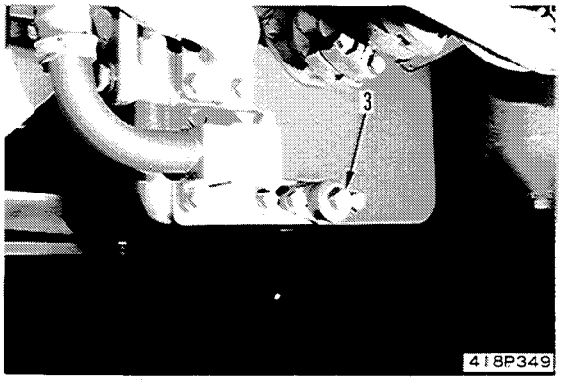


418P499

- Loosen plug (1) at the top of the hydraulic tank filter, and plug (2) of the pump piping to prevent the oil inside the tank from flowing out.
- Disconnect the cable from the negative (-) terminal of the battery.

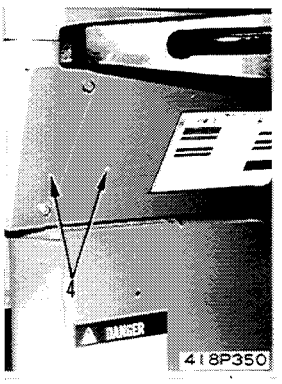
1. **Draining oil**
   Remove drain plug (3) and drain transmission oil.
   ★ After loosening the drain valve, pull out gradually to drain the oil.

   Transmission oil: 30ℓ

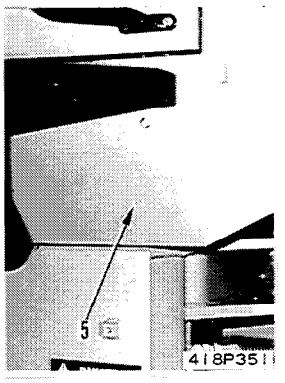


418P349

2. **Cover**
   Remove left and right covers (4 and 5) of under cab.



418P350



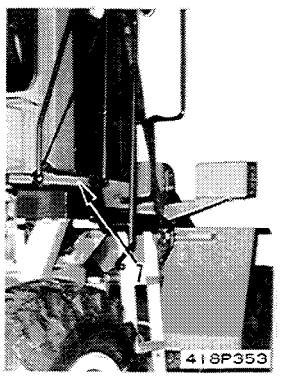
418P351

3. **Ladder**
   Using a sling, lift off left and right ladders (6 and 7).
   ★ The ladder is difficult to balance, so be careful of the center of gravity when removing.

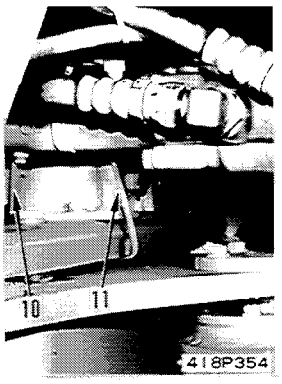
   kg Ladder: 60 kg

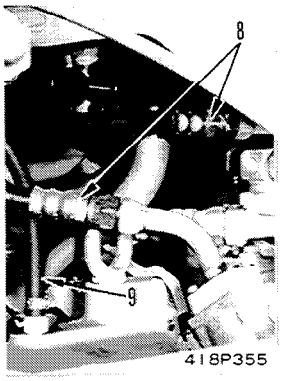


418P352


418P353

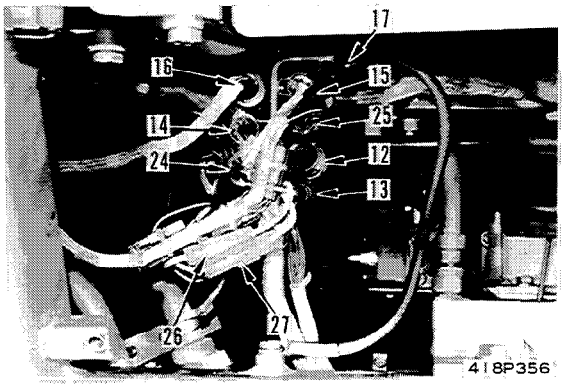
4. **Brake hoses**
   1) Disconnect hoses (8 and 9) between transmission and power master cylinder at transmission end.
      ★ Remove the hose clamps from the floor support.
   2) Disconnect tubes (10 and 11) between power master cylinder and front and rear axles at power master cylinder end.



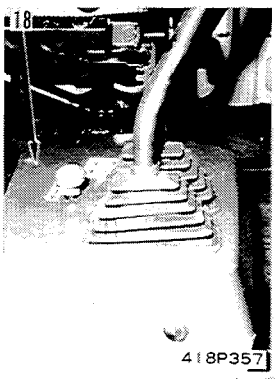


5. **Electric wiring**
   Disconnect the following wiring from the connector.
   - Wires (12 and 13) for front frame.
   - Wires (14 and 24) for rear frame.
   - Wires (15 and 25) for transmission.
   - Wire (16) for cab.
   - Ground connection (17) and others (26 and 27).

   ★ Before removing the harness, mark with a tag to distinguish when installing.



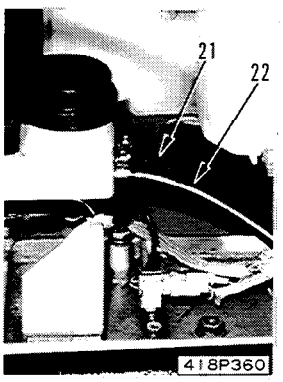
6. **Main control valve linkage, brake hose**
   1) Remove cover (8) of main control lever and disconnect main control valve linkage (19) at main control valve end, then push main control lever (20) to the rear.
      ★ Disconnect the washer liquid hose from the tank.



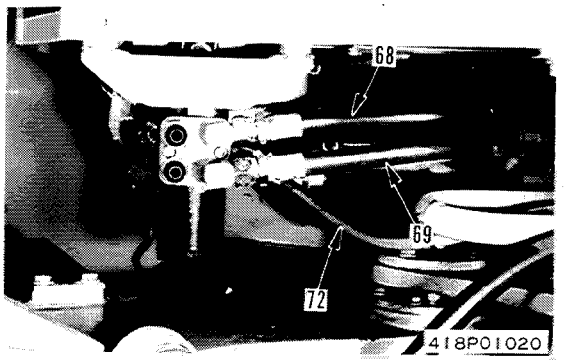


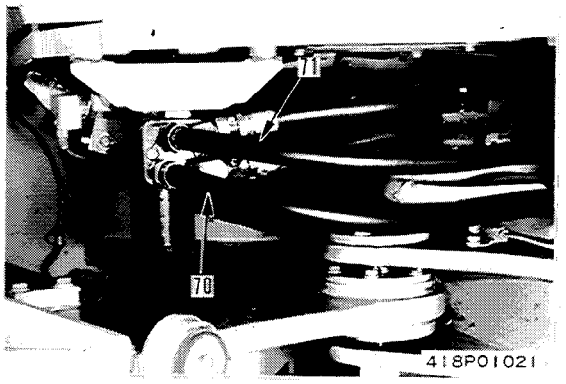
   2) Disconnect hoses (21 and 22) between brake oil tank and power master cylinder from brake oil tank.



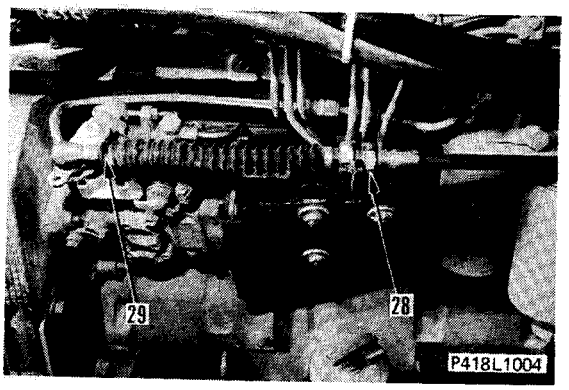


7. **Steering hydraulic piping**
   Disconnect the following hydraulic piping.
   - ★ Hoses (68 and 69) between the steering valve and steering cylinder.
   - ★ Hoses (70 and 71) between the steering valve to priority valve.
   - ★ Hose (72) between steering valve and hydraulic tank.

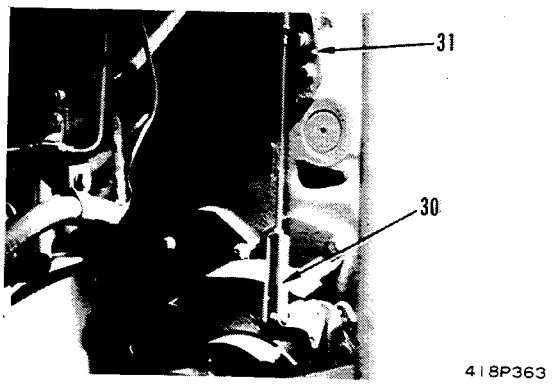




8. **Fuel control cable**
   1) Loosen lock nut (28) of fuel control cable (29).
   2) Remove nut of fuel control cable (29), then disconnect from fuel injection pump.
      - ★ Remove the clamp at the bottom of the hydraulic tank.



9. **Parking brake cable**
   1) Remove clevis (30) pin, then disconnect from caliper lever.
   2) Remove cable bracket (31).

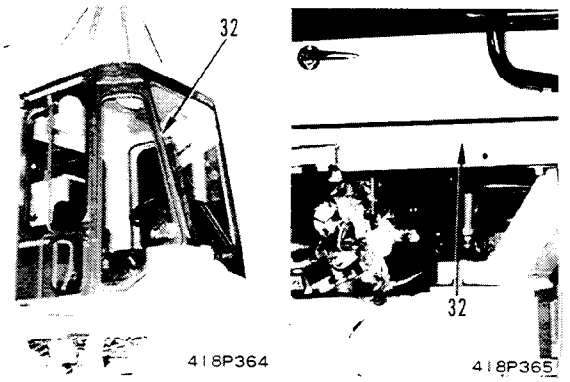


10. Cab, floor plate

Sling cab and floor support (32), remove mounting bolts, then lift off.

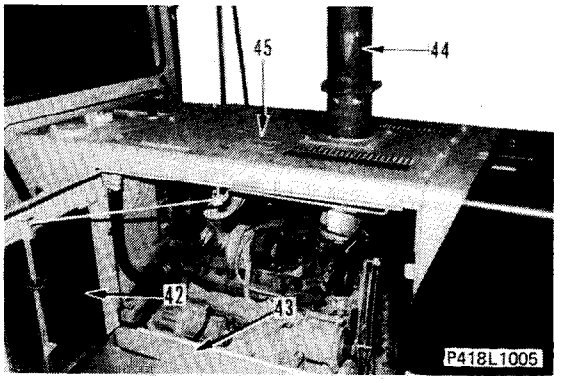
- ★ The work equipment linkage contacts the hydraulic tank, so push the work equipment control lever to the rear. Be careful not to bend the rod.
- ★ Be careful not to damage the cab window glass during the operation.
- ★ After removing, put blocks under the floor support and lower to the ground.
- ★ Check that hoses or electric wires are not caught, and lift off slowly.

kg Cab, floor support: 460 kg



11. Hood, exhaust pipe

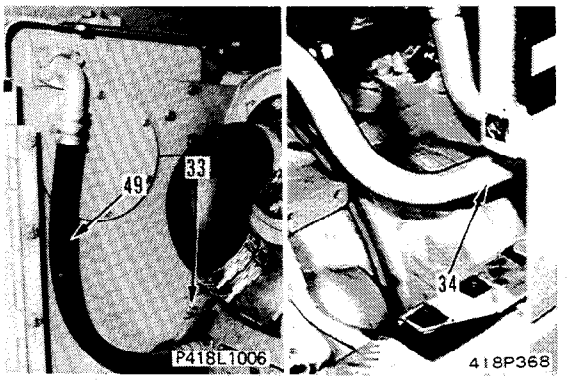
Remove engine side hood (42), left and right side panels (43), exhaust pipe (44), and engine center hood (45).

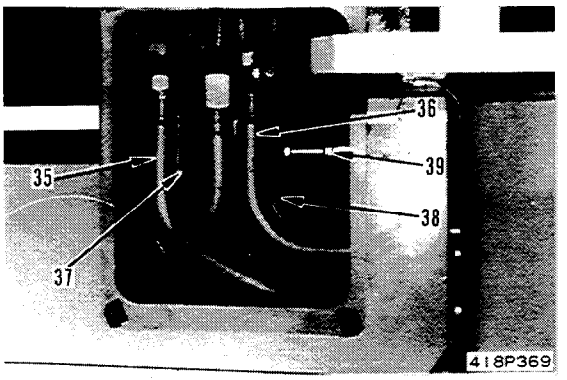


12. Hydraulic piping

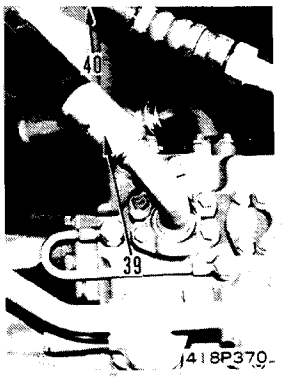
Disconnect the following hydraulic piping.

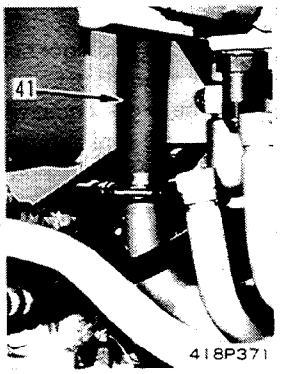
- Remove tube support (33) mounting bolts and hose (49) between main control valve and hydraulic tank.
- Disconnect tube (34) between hydraulic tank and main control valve at main control valve end.
- Disconnect hoses (35 and 36) between main control valve and lift cylinder at main control valve end.
- Disconnect tubes (37 and 38) between main control valve and dump cylinder at main control valve end.
- Loosen U-clamp nut for support for work equipment piping.
- Disconnect hose (39) between priority valve manifold and main control valve.

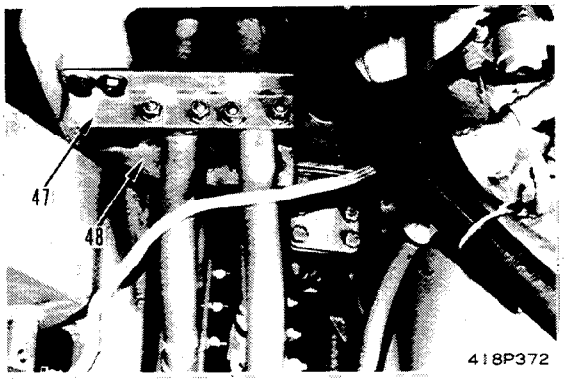




- Disconnect hose (40) between steering valve and hydraulic tank from priority valve tube connection.
- Loosen clamp of hose (41) between hydraulic tank and pump at pump end.

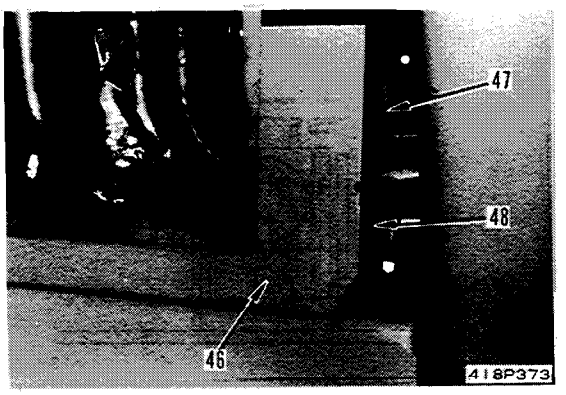






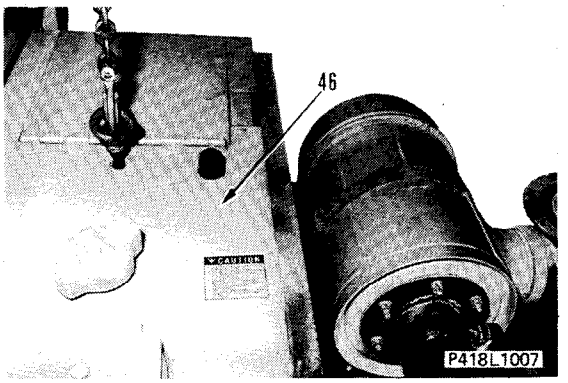
13. Hydraulic tank

Remove mounting bolts. Then, using eye bolts, sling hydraulic tank (46) and move it to the right. Next, disconnect supports (47 and 48) for work equipment piping from hydraulic tank.



After disconnecting supports for work equipment piping, sling and remove hydraulic tank (46).

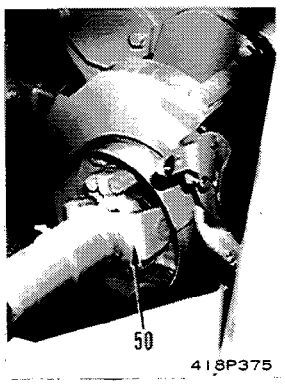
kg Hydraulic tank: 140 kg



14. Drive shaft

Disconnect center drive shaft (50) and rear drive shaft (51) from transmission.

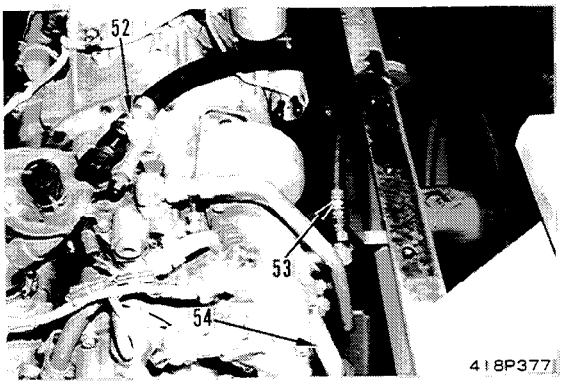
★ When disconnecting the center drive shaft, insert blocks between the frame.





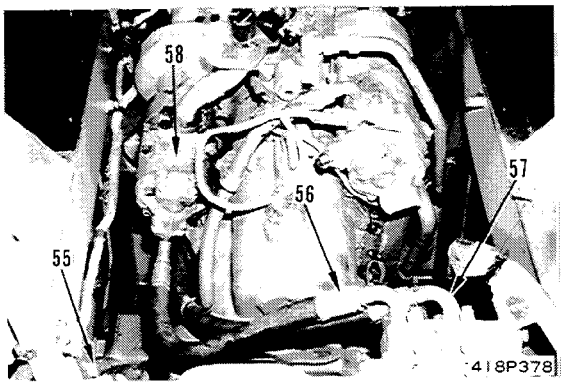
15. Transmission piping

1) Disconnect cooler hoses (52 and 53) from transmission valve.
2) Disconnect tube (54) between transmission strainer and torque converter charging pump.
3) Move work equipment piping (55) to front of chassis and secure with wire.



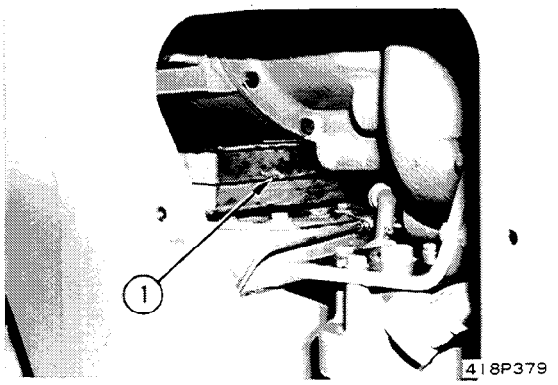
16. Hydraulic, steering pump

1) Remove hose (56) between priority valve and hydraulic, steering pumps, then remove hose (57) between priority valve and hydraulic, steering pumps.
2) Remove hydraulic and steering pump (58).
   ★ Remove the O-ring from the housing contact surface.

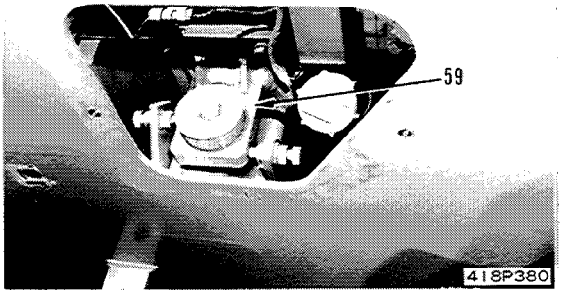


17. Torque converter, transmission

1) Set block ① between engine and axle housing, and adjust height.

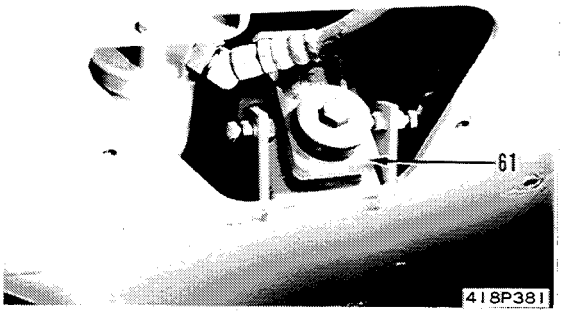


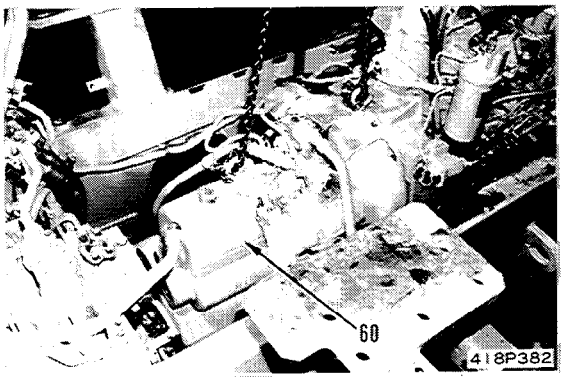
2) Using eye bolts, sling torque converter and transmission, remove bracket mounting bolts, then remove brackets (59 and 61).
   ★ Remove left side bracket first.

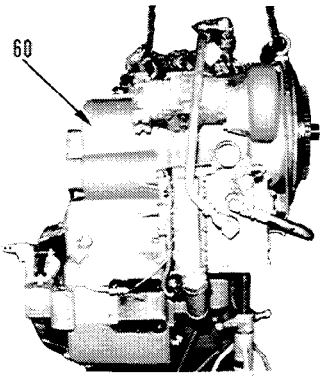


3) Remove mounting bolts on engine, then lift off torque converter and transmission (60).
   ★ Be careful of the fitting of the pilot cover, and lift off slowly.
   ★ Check that the piping does not interfere with other parts when lifting off the assembly.

kg Torque converter, transmission: 510 kg







INSTALLATION

1. **Torque converter, transmission**
   1) Set torque converter and transmission (60) in mounting position.
      ★ Check that there is an O-ring fitted to the torque converter housing.

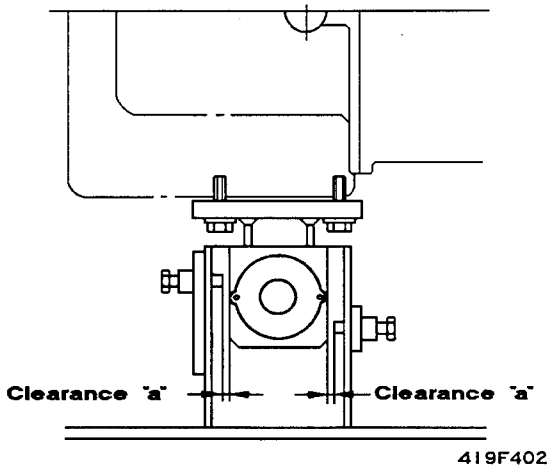
      O-ring circumference: Soapy water

      ★ When installing the torque converter to the engine, adjust the height of the pilot cover so that it enters the hole in the flywheel smoothly. Do not force it when installing.
   2) Tighten connecting bolts to the engine (62).
   3) Set left and right brackets (59 and 61) in mounting position, then temporarily tighten mounting bolts. After installing left and right brackets, tighten.
      ★ Install right side bracket (61) first.

      Mounting bolt of bracket: 28.5±3.0 kgm

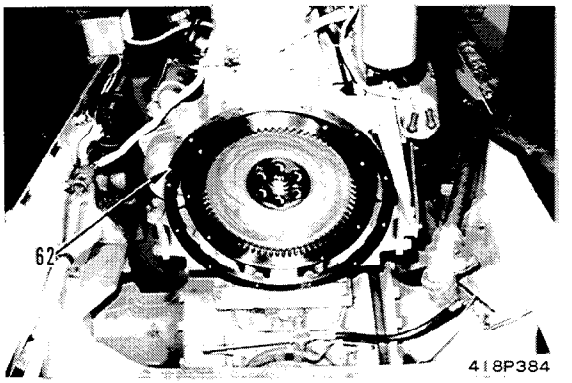
   4) Use adjustment screw to set transmission in position, adjust clearance 'a' to the specified value, then tighten mounting bolts (63 and 64).
      ★ Do not use oil, grease or soapy water when installing rubber.
      - Clearance 'a': 1-3 mm
      - Mounting bolt width across the flats: 32 mm

      Mounting bolt: 76.0±8.5 kgm

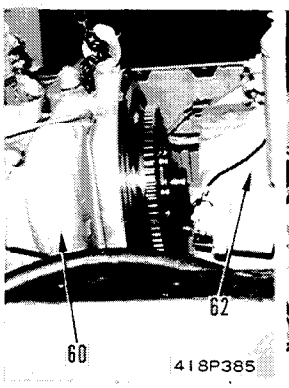


419F402

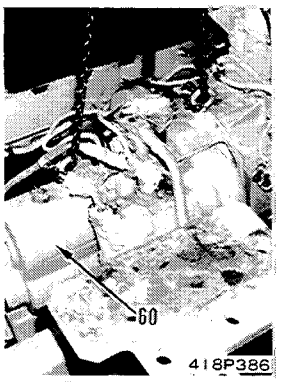
   5) Remove block ① at the bottom of the engine.



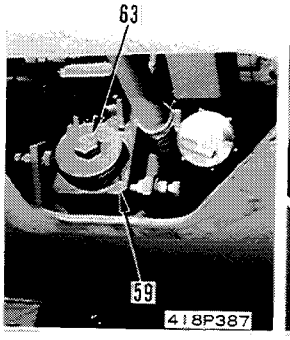
418P384



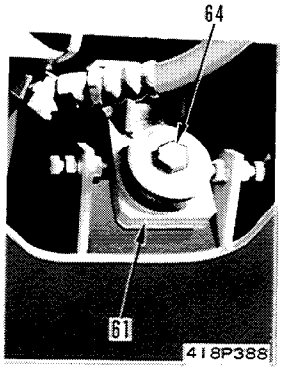
418P385



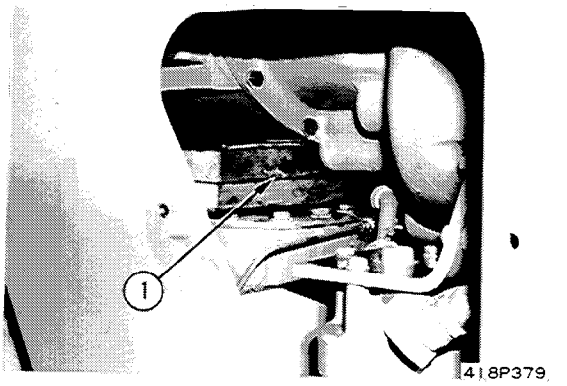
418P386



418P387



418P388



418P379

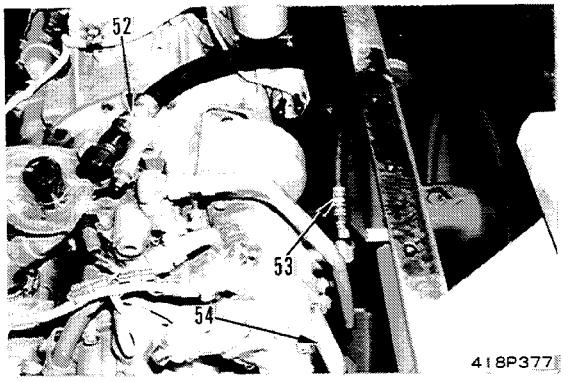
2. Hydraulic, steering pump

1) Set hydraulic and steering pump (58) in mounting position, then tighten mounting bolts.
   ★ Check that there is an O-ring fitted to the housing contact surface, and be careful not to get it caught.
2) Install hose (57) between priority valve and hydraulic, steering pumps, then install hose (56) between priority valve and hydraulic, steering pumps.



3. Transmission piping

1) Connect cooler hoses (52 and 53) to transmission valve.
   • Hose nut width across the flat: 41 mm
2) Connect tube (54) between transmission strainer and torque converter charging pump.
   • Tube cap, width across the flat: 32 mm
3) Return work equipment piping (55) to rear of chassis.

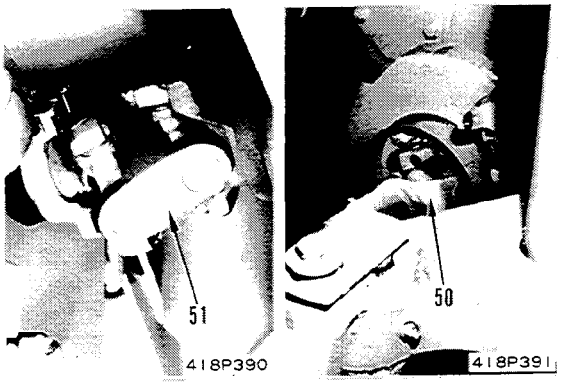


4. Drive shafts

Connect center drive shaft (50) and rear drive shaft (51) to transmission.

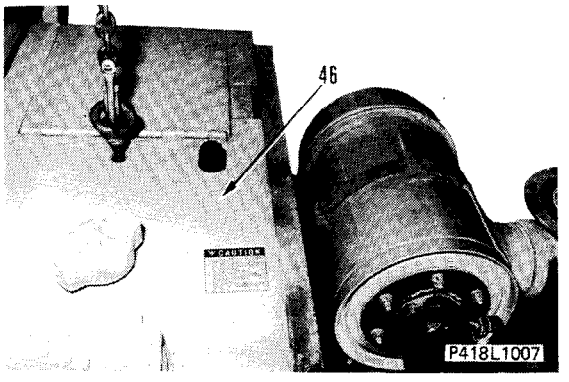
★ Be careful to install the coupling facing in the correct direction.

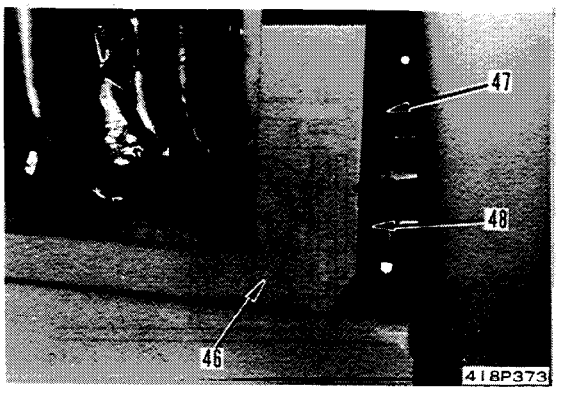
Mounting bolt: 6.75±0.75 kgm



5. Hydraulic tank

1) Using eye bolts, raise hydraulic tank (46), set in mounting position, install supports for work equipment piping (47 and 48) to hydraulic tank, then tighten mounting bolts.
2) Install hydraulic tank (46) and temporarily tighten mounting bolts.
   ★ First install hose between hydraulic tank and pump.

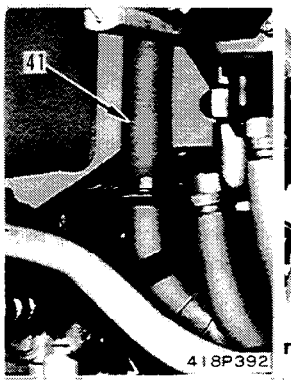


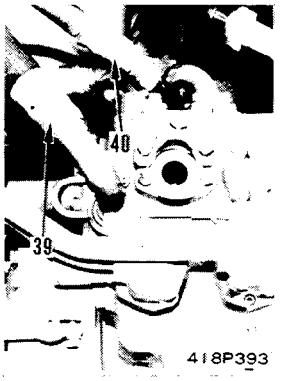


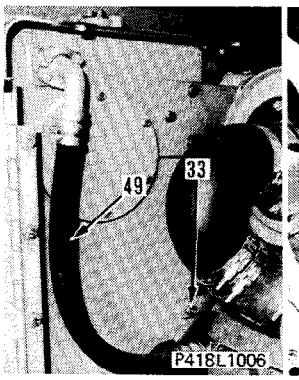
6. Hydraulic tank

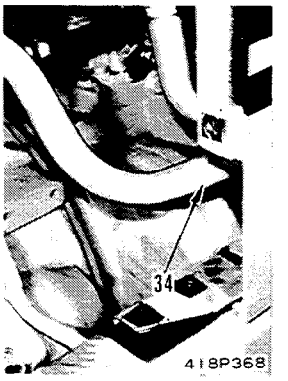
Connect the following hydraulic piping.

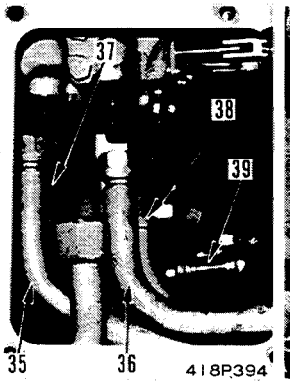
- Tighten the clamp of hose (41) between hydraulic tank and pump.
- Connect hose (40) between steering valve and hydraulic tank to priority valve tube.
- Connect hose (39) between priority valve manifold and main control valve.
- ★ Install hose without twisting or interference.
- Connect tubes (37 and 38) between main control valve and dump cylinder at main control valve end.
- Connect tubes (35 and 36) between main control valve and lift cylinder at main control valve end.
- Tube cap, width across the flat: 36 mm
- Connect tube (34) between hydraulic tank and main control valve at main control valve end, and mount hose (49) to hydraulic tank.
  - ★ Fit the O-ring securely in the groove.
  - ★ Tighten mounting bolts of work equipment piping supports (47 and 48), and tighten U-clamp mounting nuts.
  - ★ Be careful not to over-tighten U-clamp mounting nuts.

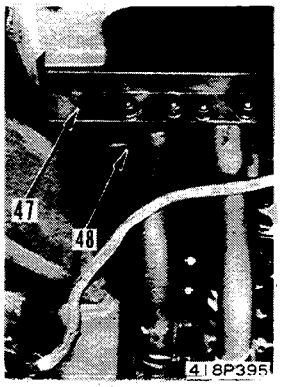






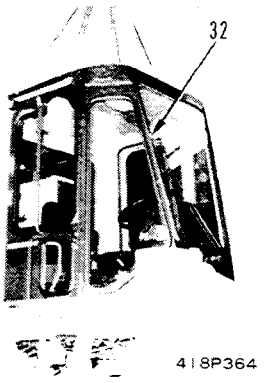


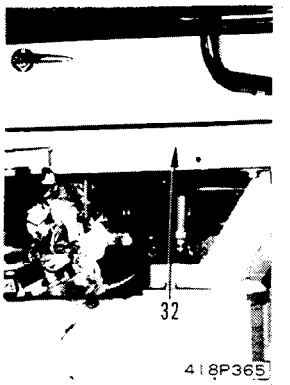




7. Cab, floor support

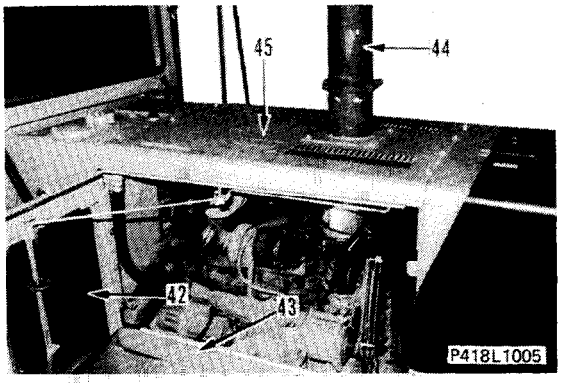
1) Raise cab and floor support (32), set in mounting position, then tighten mounting bolts.
2) The work equipment linkage contacts the hydraulic tank, so push the work equipment control lever to the rear, and mount the cab and floor support.
   - ★ Move the parking brake and fuel control cable towards the mounting position.
   - ★ Be careful not to interfere the electric wiring.
3) Assemble shims, then tighten mounting bolts.





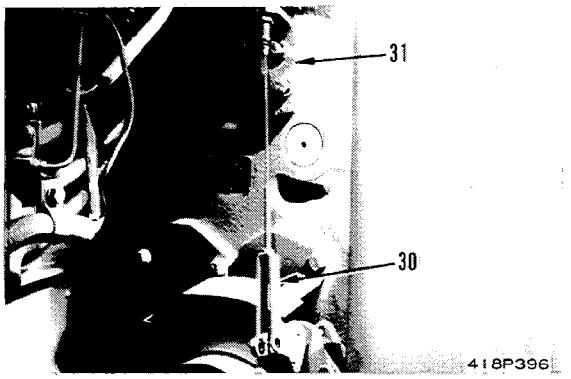
8. Hood and exhaust pipe

Install engine side hood (42), left and right side panels (43), exhaust pipe (44) and center hood (45).



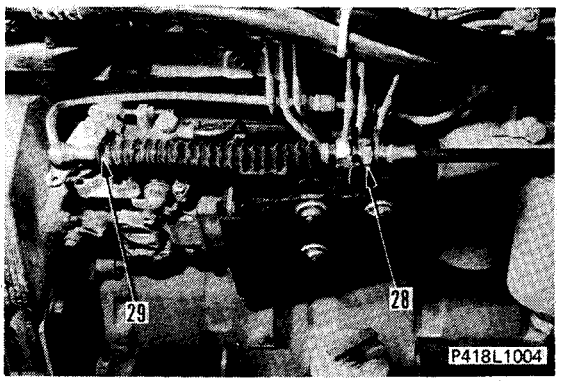
9. Parking brake cable

1) Install cable bracket (31).
2) Connect clevis (30) pin to caliper lever.
   ★ If the operation of the brake is poor, see SECTION 52, TESTING AND ADJUSTING.



10. Fuel control cable

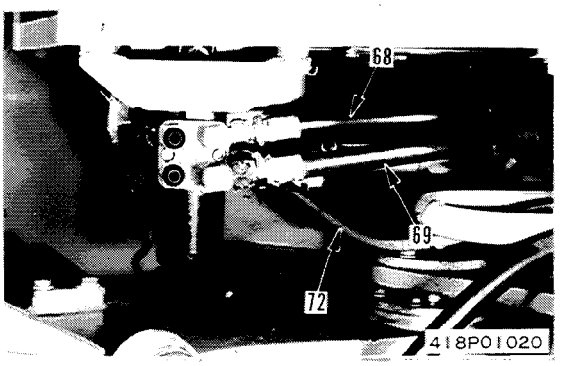
1) Set fuel control cable bracket (65) in mounting position, then secure with lock nut (28).
2) Connect fuel control cable (29) to fuel injection pump.
   ★ Install the clamp at the bottom of the hydraulic tank.

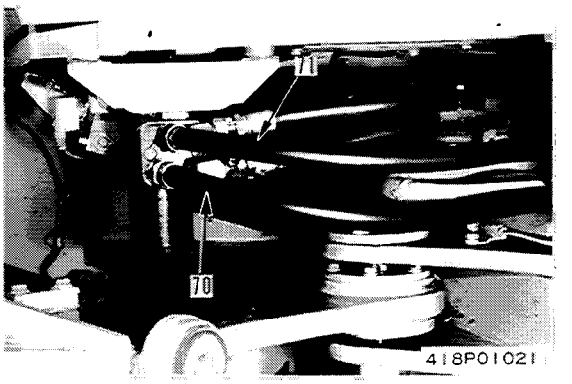


11. Steering hydraulic piping

Connect the following hydraulic piping.

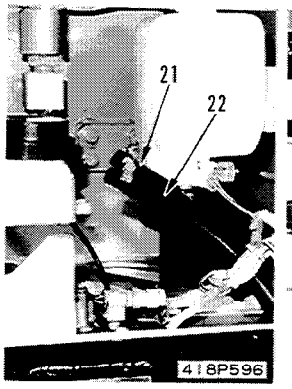
- Hoses (68 and 69) between steering valve and steering cylinder.
- Hoses (70 and 71) between steering valve and priority valve.
- Hose (72) between steering valve and hydraulic tank.

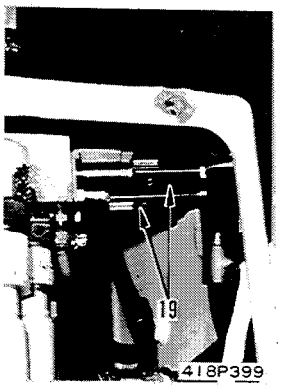




12. Main control valve linkage, brake hose

1) Connect hoses (21 and 22) between brake oil tank and power master cylinder at brake oil tank end.
2) Connect main control valve linkage (19) to main control valve, and mount cover (18) of work equipment control levers.
   - ★ Connect the washer liquid hose to the tank.
   - ★ Adjust work equipment levers. For details, see SECTION 62, TESTING AND ADJUSTING.

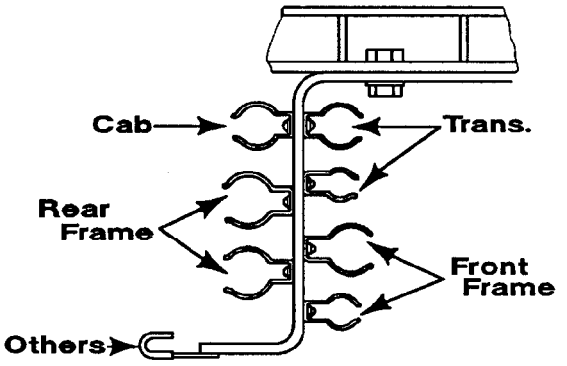




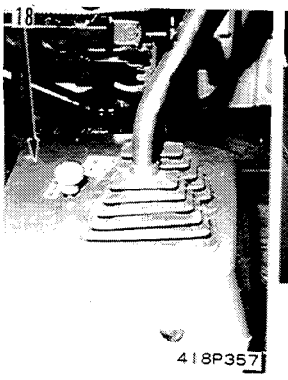
13. Electric wiring

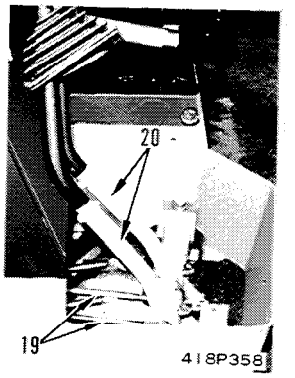
Connect the following wiring to the connector.

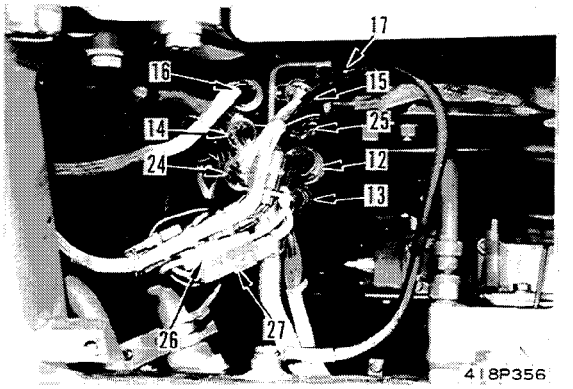
- Ground connection (17) and others (26 and 27).
- Wire (16) for cab.
- Wires (15 and 25) for transmission.
- Wires (14 and 24) for rear frame.
- Wires (12 and 13) for front frame.
  - ★ Apply the connector lock securely.



E419F403





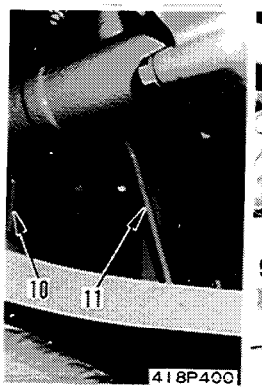


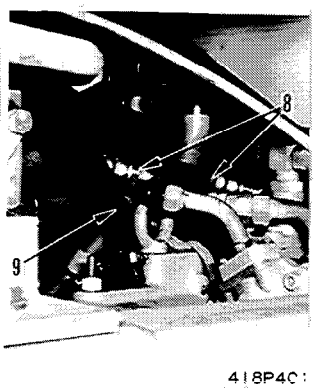
14. Brake hose

1) Connect tubes (10 and 11) between power master cylinder and front and rear axles at power master cylinder end.

Tube nut: 1.2±0.3 kgm

2) Connect hoses (8 and 9) between transmission and power master cylinder at transmission end.
   - ★ Install the hose clamp to the floor support.

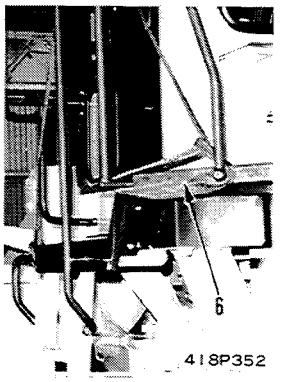


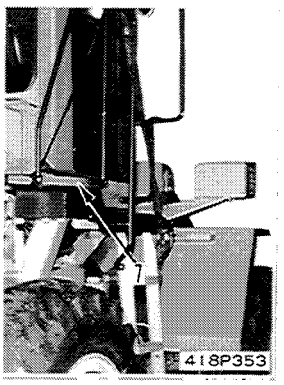


15. Ladder

Using eye bolts, raise left and right ladders (6 and 7), set in mounting position, then tighten mounting bolts.

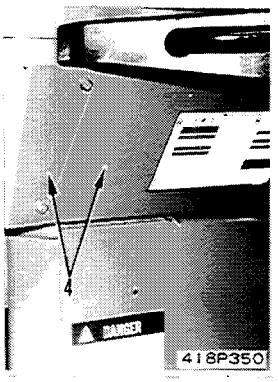
★ Tighten the mounting bolts after fixing the ladder in position.

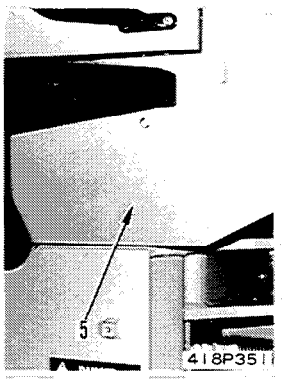




16. Cover

Install left and right covers (4 and 5) of under cab.





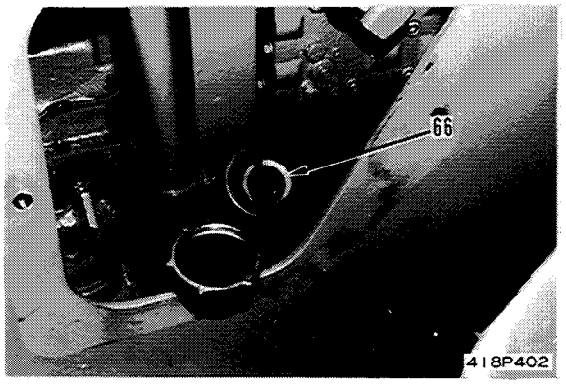
17. Refilling with oil

1) Tighten drain valve and add oil through oil filler (66) to the specified level.

Transmission oil: 30ℓ

2) Tighten plug at top of hydraulic tank filter, and plugs of pump piping, then add hydraulic oil through oil filler (67) to the specified level.

★ Run the engine to circulate the oil through the system. Then check the oil level again.



18. Bleeding air, from brake line

For details of bleeding air, see SECTION 52, TESTING AND ADJUSTING.

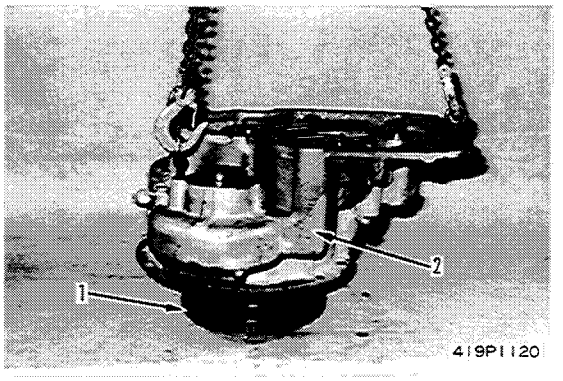


TORQUE CONVERTER
DISASSEMBLY

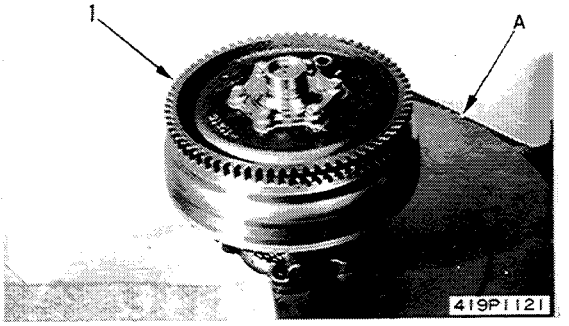
Special tools

	Part number	Part name	Q'ty
A	790-501-5000	Unit repair stand	1
A_1	790-901-2110	Bracket	1
A_2	793-310-2140	Plate	1
A_3	793-310-2131	Plate	1

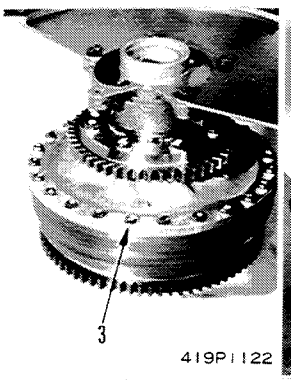
1. **Torque converter assembly**
   Remove torque converter assembly (1) from housing (2).



2. **Turbine, case assembly**
   1) Set torque converter assembly (1) in tool A.

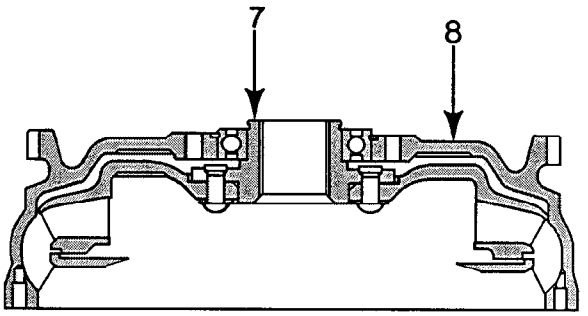


   2) Remove mounting bolts (3) of case, then remove turbine and case assembly (4).
      ★ When removing the mounting bolts, leave two mounting bolts on opposite sides, then turn over the assembly (pilot side at the top) and remove the remaining two mounting bolts.

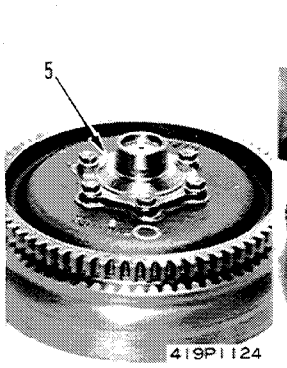


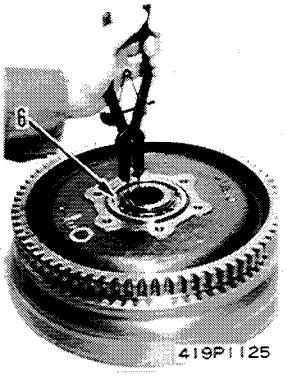


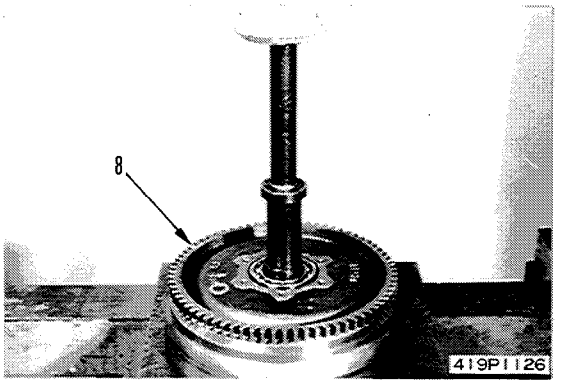
3) Disassemble turbine and case assembly as follows:
   i) Remove pilot (5).
   ii) Remove snap ring (6).
   iii) Push boss of turbine (7) and remove from case (8).



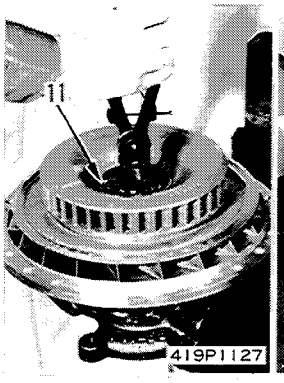
419F404

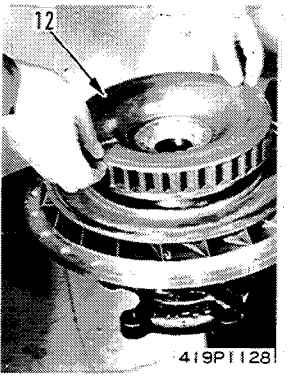




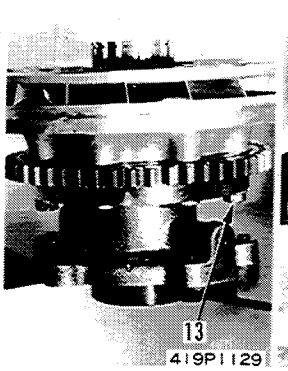


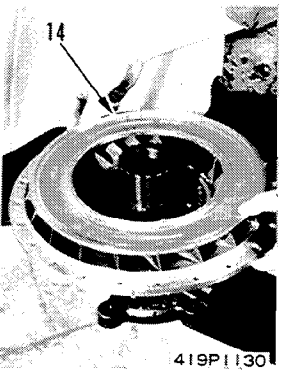
3. Stator
Remove snap ring (11), then remove stator (12).





4. Pump
1) Remove mounting bolts (13).
2) Remove pump (14) together with guide.

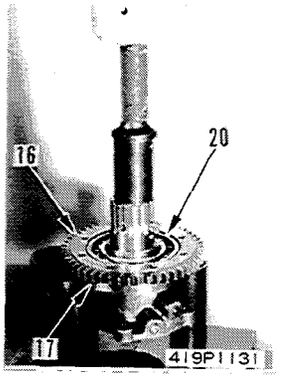


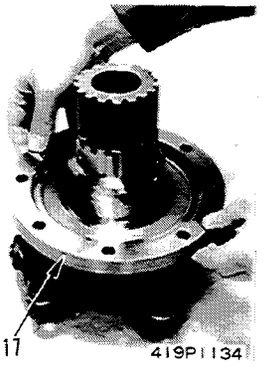


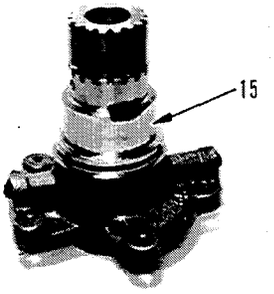
5. Gear, retainer

Push stator shaft (15), and remove gear (16) and retainer (17).

★ Support retainer (17) and take out shaft from inner race of bearing (20).







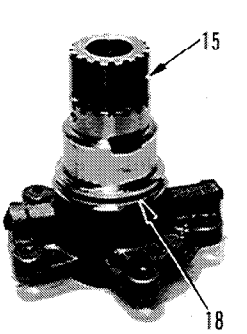
ASSEMBLY

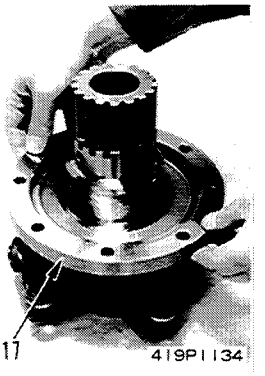
Special tools

	Part number	Part name	Q'ty
A	790-501-5000	Unit repair stand	1
A_1	790-901-2110	Bracket	1
A_2	793-310-2140	Plate	1
A_3	793-310-2131	Plate	1

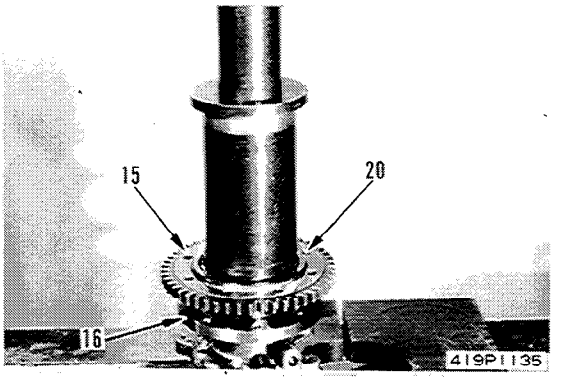
1. Retainer, gear

1) Install seal ring (18) to stator shaft (15).
   ★ Coat the seal ring with grease, and make the protrusion from the stator shaft uniform.
2) Install retainer (17).



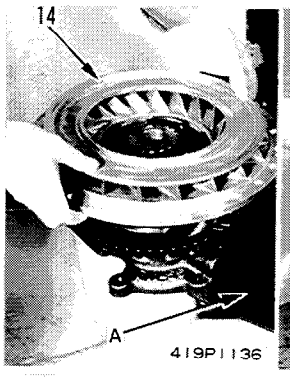


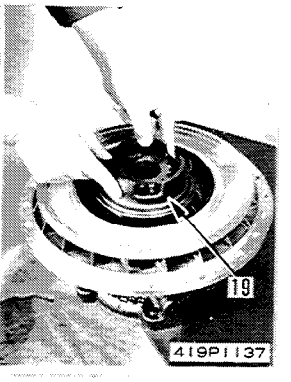
3) Install bearing (20) on gear (16).
4) Push inner race side of bearing (20) (I.D.: 85 mm), and install on stator shaft (15).



2. Pump

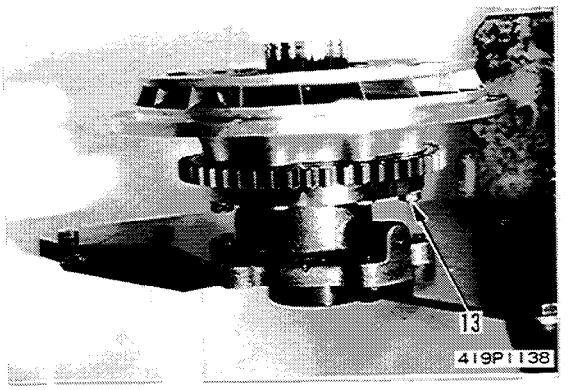
1) Set stator shaft (15) in tool A.
2) Install pump (14).
3) Coat ball with grease, then assemble to shaft.
4) Install guide (19).





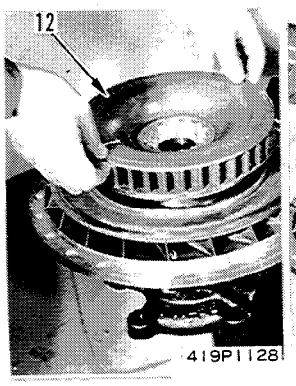
5) Tighten mounting bolts (13).

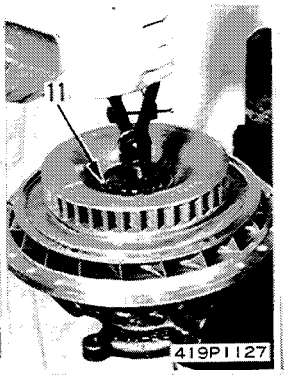
Mounting bolt: 7±0.5 kgm



3. Stator

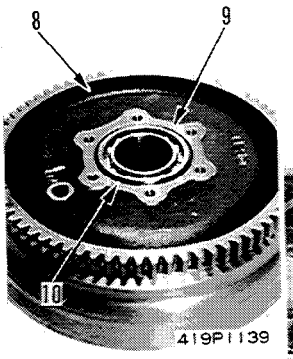
1) Install stator (12).
2) Install snap ring (11).

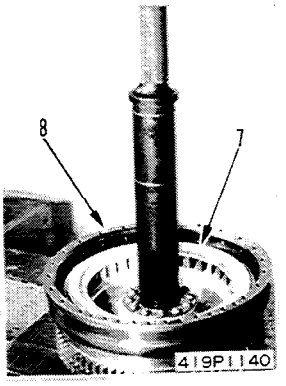




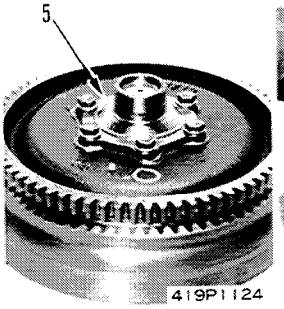
4. Turbine, case assembly

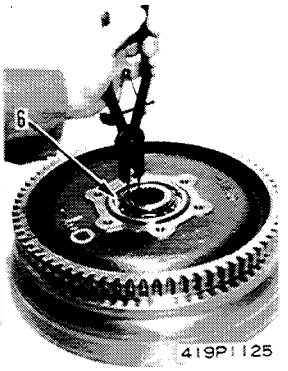
1) Assemble turbine and case assembly as follows.
   i) Install bearing (9) (O.D.: 90 mm) installed snap ring (10) to case (8).
   ii) Support inner race (I.D.: 55 mm) of bearing, and install turbine (7) in case (8).





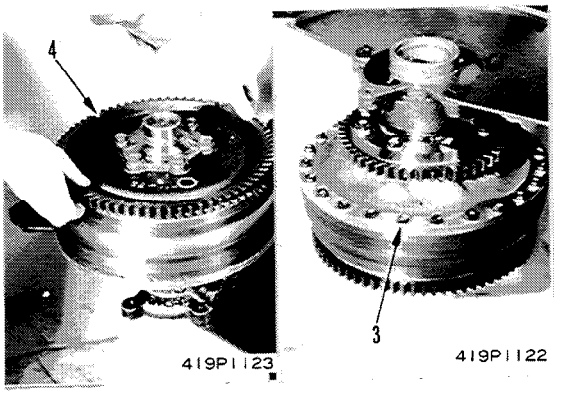
iii) Install snap ring (6).
iv) Install pilot (5).



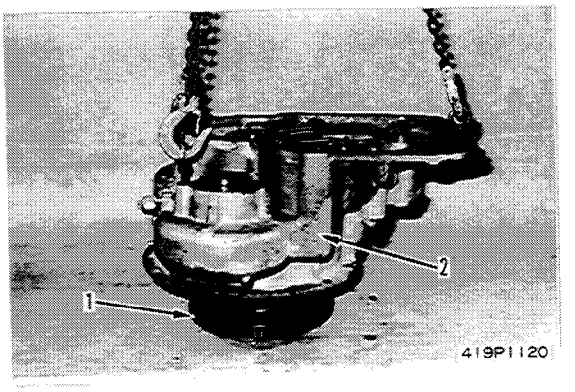


2) Align bolt holes, install turbine and case assembly (4), then install 24 mounting bolts (3).

Mounting bolt: 3.2±0.3 kgm



5. Torque converter assembly
Install torque converter assembly (1) in housing (2).

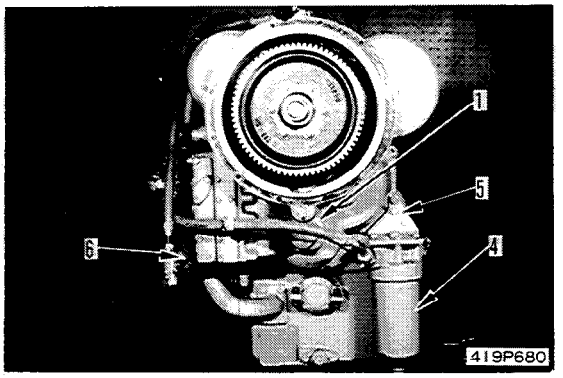


TRANSMISSION
DISASSEMBLY

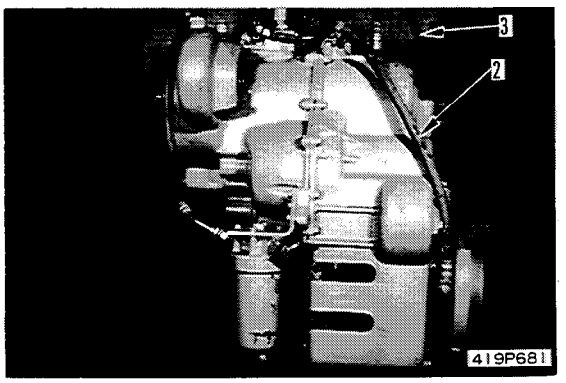
Special tools

	Part number	Part name	Q'ty
A	793-305-1600	Lifting tool	2
B	793-310-2100	Lifting tool	1
C	793-520-2900	Lifting tool	1

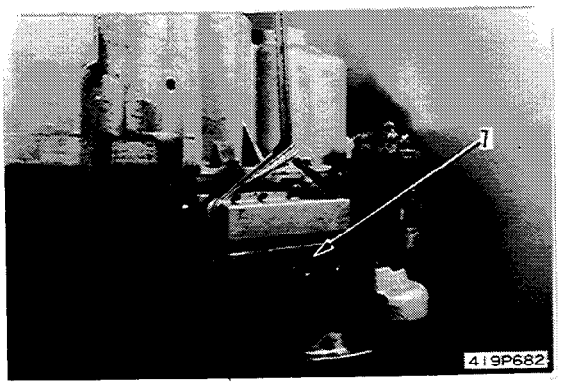
1. **Hydraulic piping**
   Disconnect the following hydraulic piping.
   - Tube between transmission control valve and torque converter regulator valve.
   - Hose (1) between filter and transmission valve.
   - Tube (2) between pump and filter.
   - Hose (3) between transmission and power master cylinder.
     ★ After removing the tubes, fit covers to protect the threads.



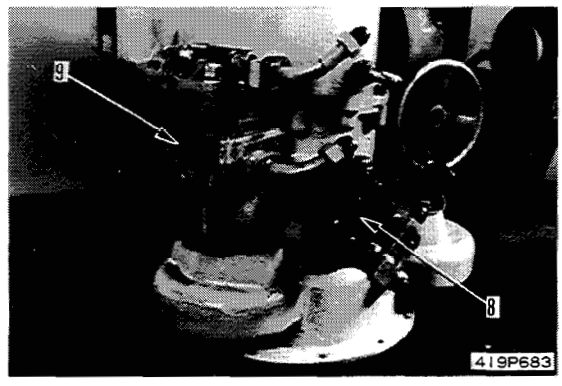
2. **Filter**
   1) Remove filter (4), then remove bracket (5).
   2) Remove oil filler (6).
      ★ Remove the rear coupling.



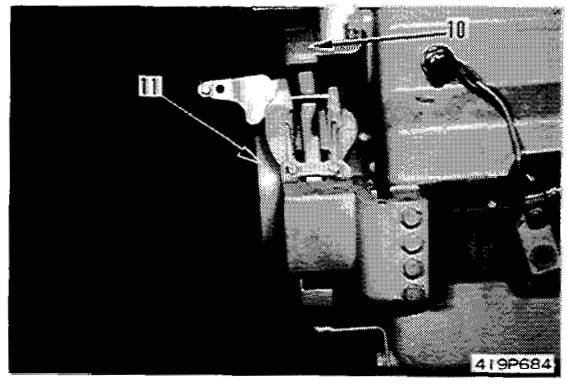
3. **Transmission control valve**
   Remove transmission control valve (7).



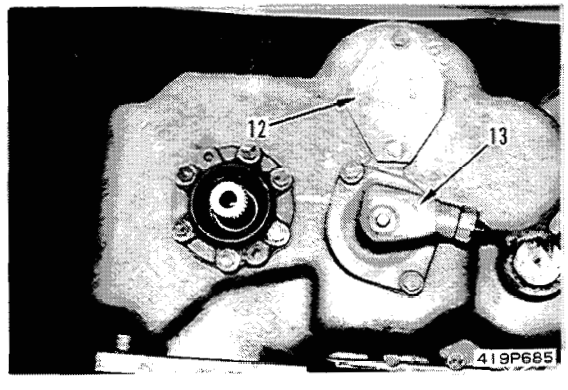
4. **Pump, regulator valve**
   1) Remove regulator valve (8).
   2) Remove pump (9), then remove O-ring.



5. **Parking brake**
   Remove cover (10), then remove parking brake (11).

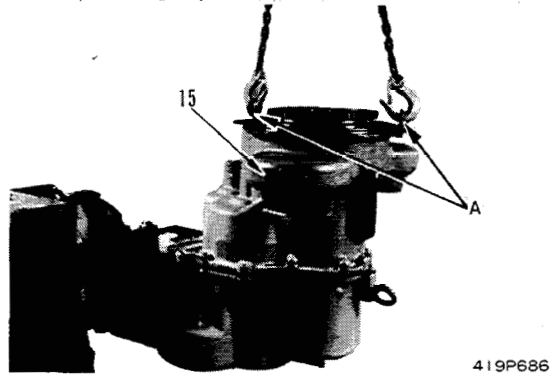


6. **2nd-4th speed shaft, emergency pump covers**
   1) Remove emergency pump cover (12), then remove O-ring.
   2) Remove cover (13) of 2nd and 4th speed shaft, then remove O-ring.



7. **Rear housing**
   Using forcing screw, raise rear housing (15), then lift off with tool A.
   ★ Lift off slowly and be careful not to damage the seal ring.

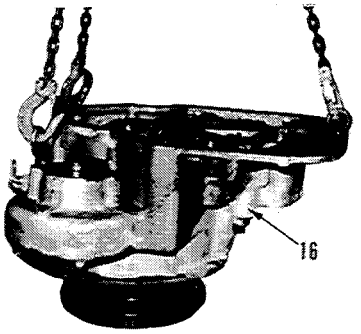
kg Rear housing: 130 kg



8. Torque converter

Lift off torque converter (16) from rear housing.

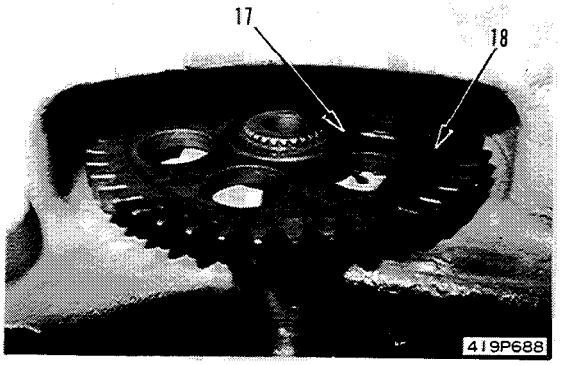
★ Make match marks on the contact faces of the housing and torque converter before removing.

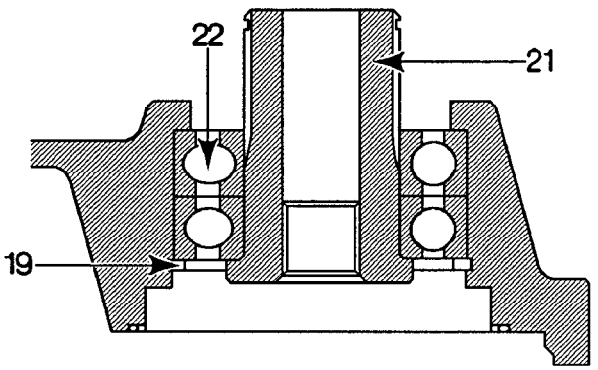


419P687

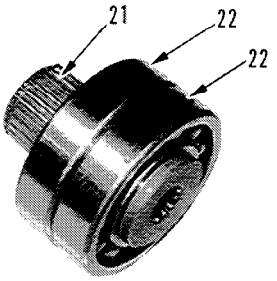
9. Pump gear

1) Remove ring (17), then remove gear (18).
2) Remove ring (19) from rear cover, then remove shaft and bearing (20). Remove bearing (22) from shaft (21).





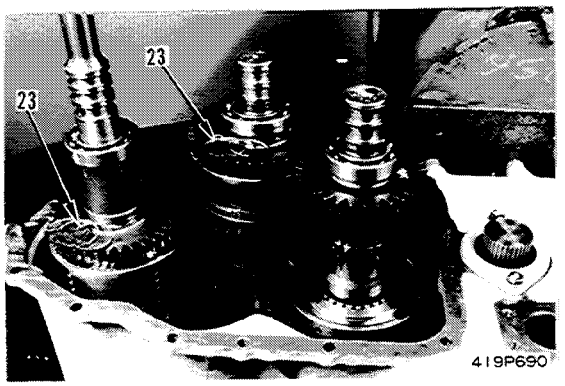
419F405



419P689

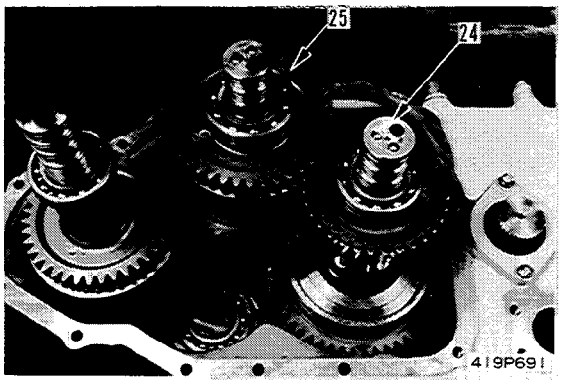
10. Seal ring

Remove seal ring (23) from each clutch shaft.



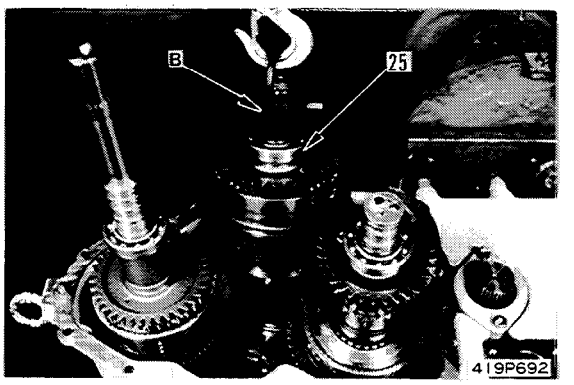
11. 2nd-4th speed, 1st-3rd speed clutches

1) Pull out 2nd and 4th speed clutch (24) together with 1st and 3rd clutch (25) from bearing of housing, then remove towards output shaft of 2nd and 4th speed clutch.
   ★ Pull out the 1st and 3rd speed clutch from the bearing, then move towards the FORWARD-REVERSE side.



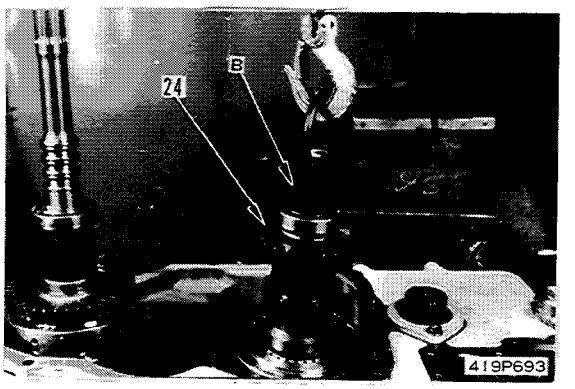
2) Using tool B, lift off 1st and 3rd speed clutch (25).
   ★ Remove slowly and be careful not to hit the other gears.

kg 1st-3rd speed clutch: 37.8 kg



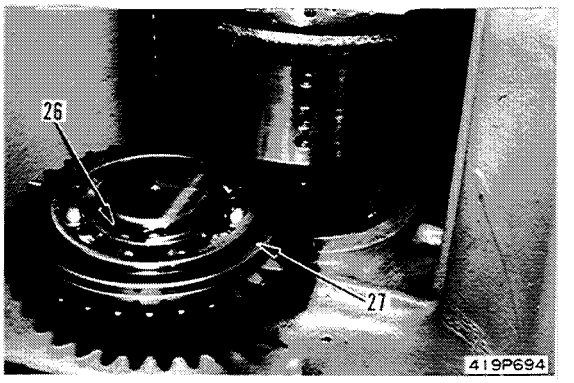
3) Using tool B, lift off 2nd and 4th speed clutch (24).

kg 2nd-4th speed clutch: 46.3 kg



12. FORWARD-REVERSE clutch

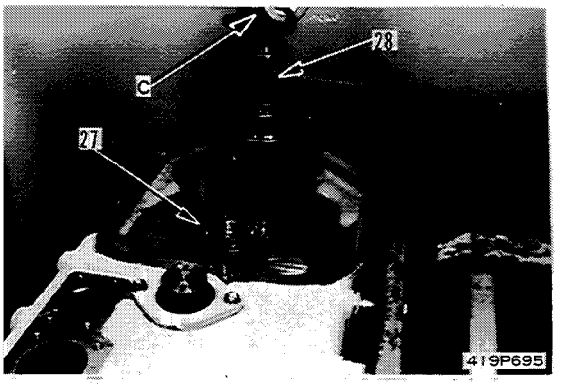
1) Remove ring (26) and leave gear (27) free.



2) Using tool C, pull out FORWARD-REVERSE clutch (28).
   ★ When pulling out the FORWARD-REVERSE clutch, gear (27) will contact the bearing, so raise the gear about half way.

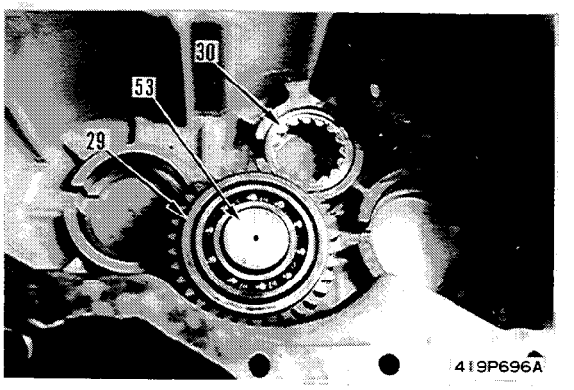
⚠ Be careful not to get your fingers caught between gear (27) and the housing.

kg FORWARD-REVERSE clutch: 40.4 kg

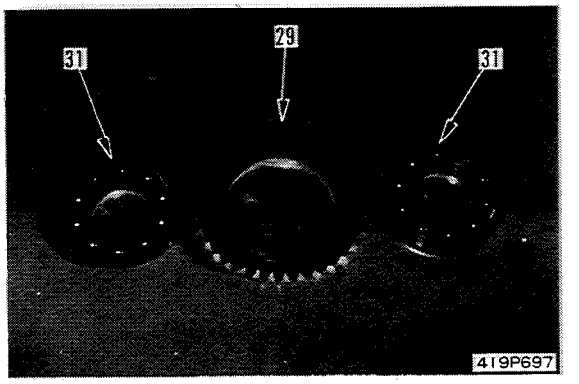


13. Idler gear

1) Remove gear (29) from housing.
   ★ Remove bearing (30) for the 1st and 3rd clutch.

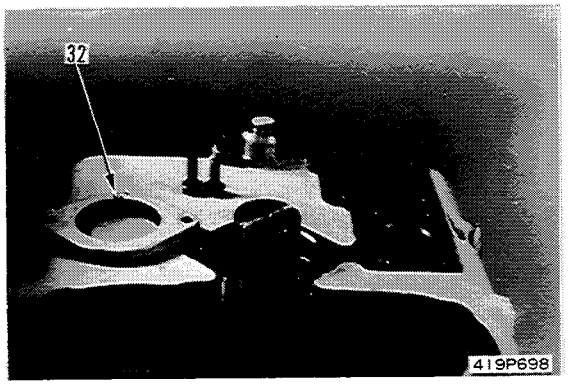


2) Remove ring from gear (29), then remove bearing (31).



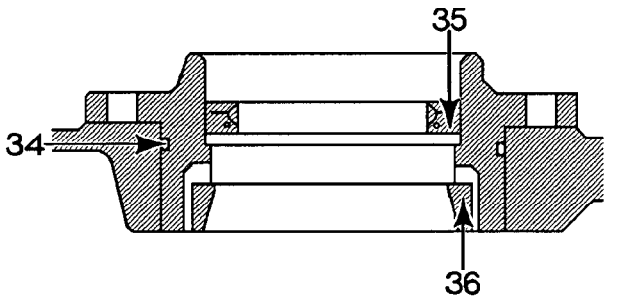
14. Rear retainer

Remove mounting bolts, then remove retainer (32) and oil seal.

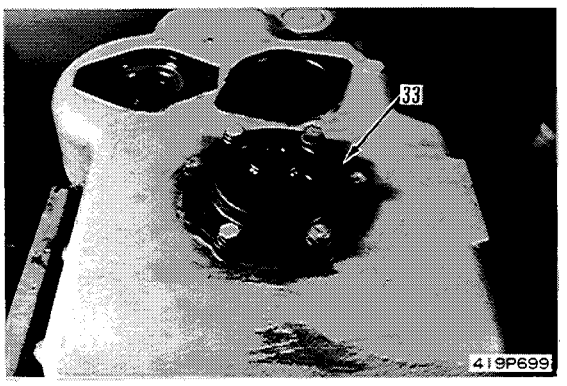


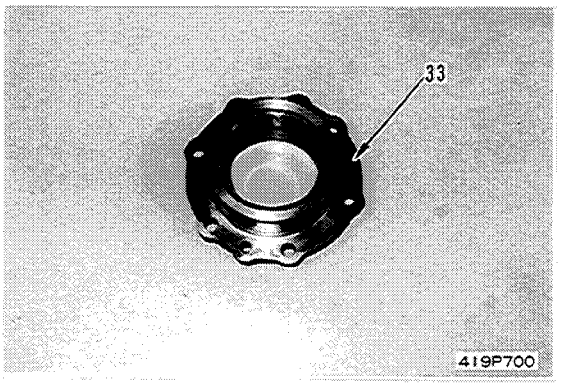
15. Front retainer

1) Remove mounting bolts, then using forcing screw, remove retainer (33) and shim.
   ★ Check the number and thickness of the shims, and keep in a safe place.
2) Remove O-ring (34), oil seal (35) and bearing cup (36) from retainer.



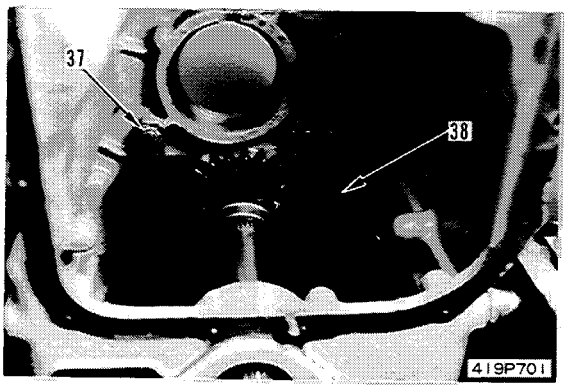
419F406



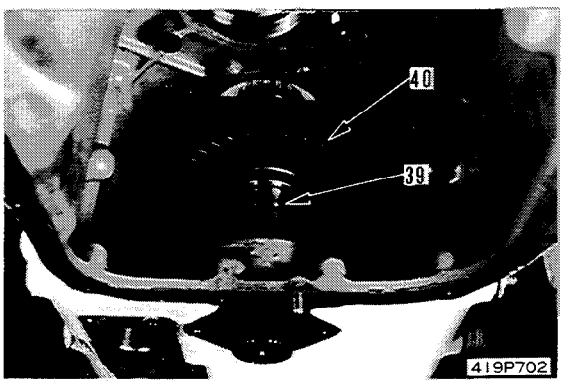


16. Output shaft gear

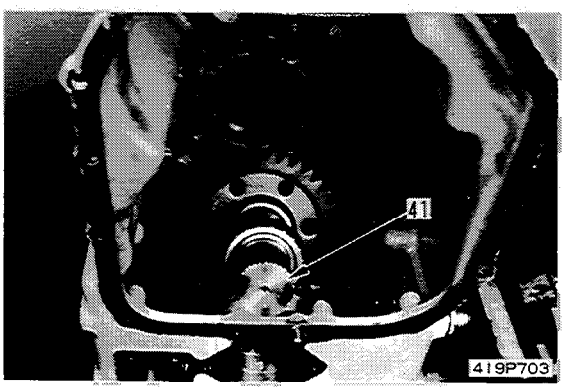
1) Remove lock plate (37), then remove shroud (38).
   ★ Be careful not to cut your hand with the edge of the shroud.



2) Remove ring (39) from groove, move it to center, then move gear (40) to same position as ring.



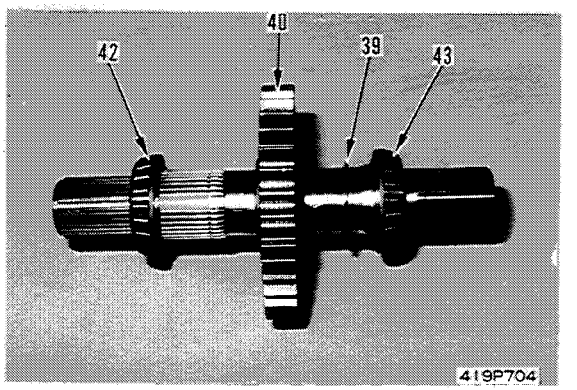
3) Push shaft (41) to rear, then pull shaft out past front housing.



⚠ Be careful not to get your fingers caught between the gear and the housing.

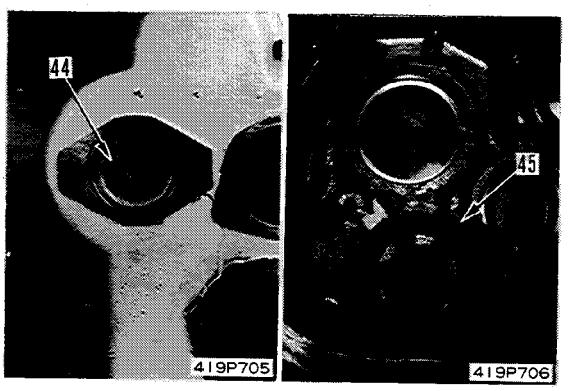
★ Be careful not to damage the spline groove of the shaft.

4) Remove gear (40), ring (39), and bearings (42 and 43) from shaft.

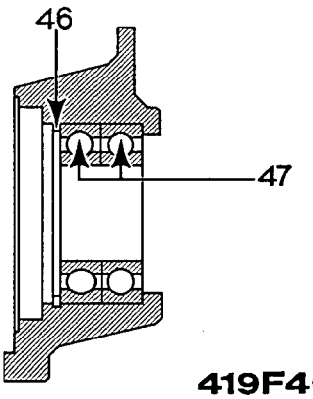


17. Gear of emergency steering pump

1) Remove ring (44), then remove gear (45).



2) Remove ring (46), then remove bearing (47).

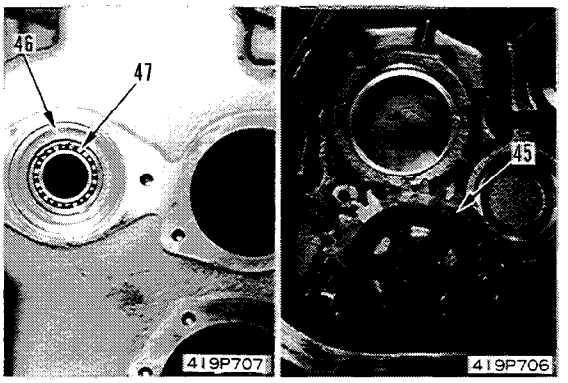


419F407

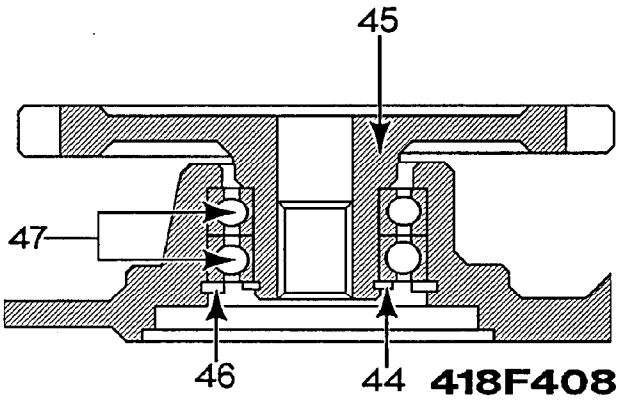
ASSEMBLY

Special tools

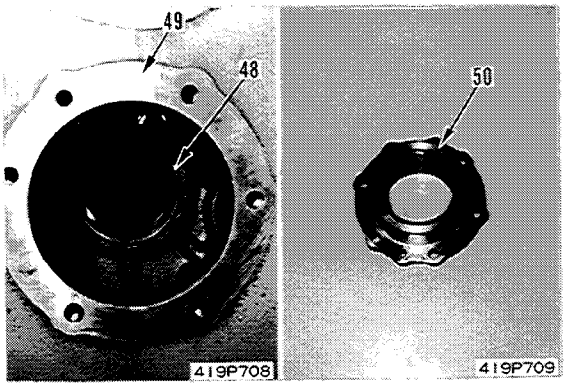
	Part number	Part name	Q'ty
A	793-305-1600	Lifting tool	2
B	793-310-2100	Lifting tool	1
C	793-520-2900	Lifting tool	1
D	790-415-1020	Expander	1
E	790-415-1030	Installer	1



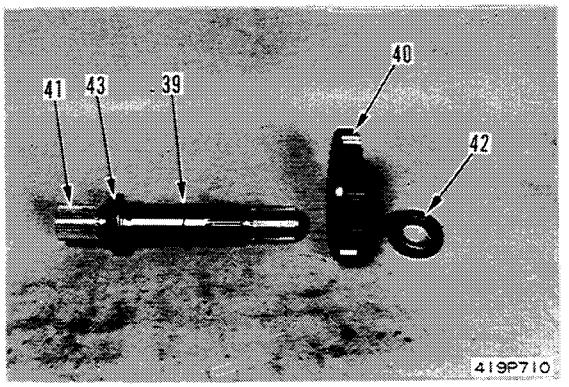
1. Gear of emergency steering pump (if equipped)
1) Press fit bearing (47) in housing, then secure with ring (46).
2) Insert gear (45) on bearing, then secure with ring (44).



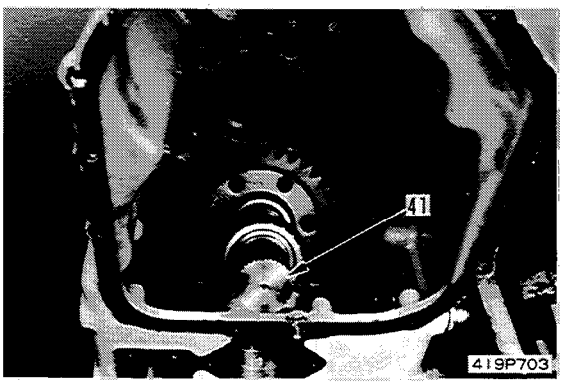
2. Output shaft gear
1) Press fit bearing cup (48) in housing (49) and retainer (50).



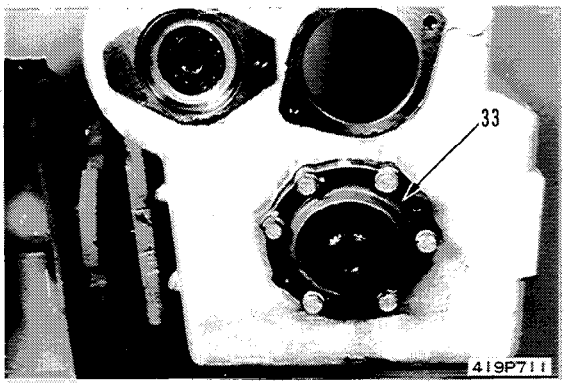
2) Press fit bearing cone (43) on shaft (41), assemble ring (39) and gear (40), then press fit cone (42).
★ Press fit the cone correctly up to the shoulder of the shaft to prevent incorrect adjustment of the end play.
★ Do not fit the ring into the groove. Move it to the center, then remove gear (40) from the spline groove and set in the same position as the snap ring.



3) Assemble shaft (41) in housing.
   ★ Insert the shaft at an angle as shown in the photograph.

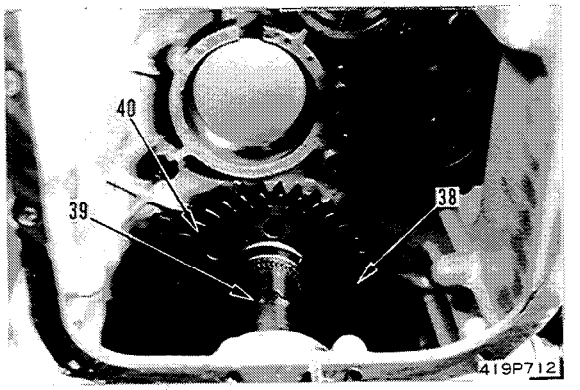


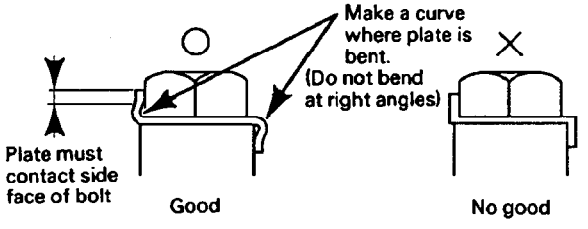
4) Temporarily tighten mounting bolts of shaft retainer (33).



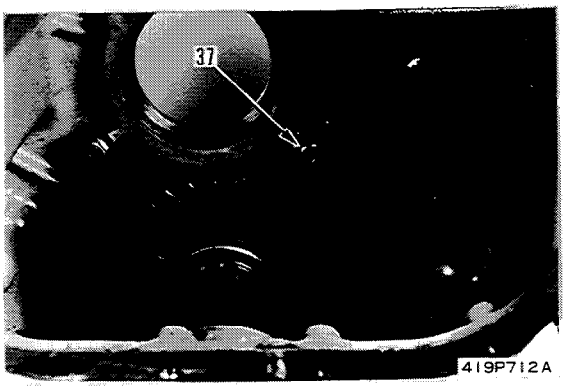
5) Insert gear (40) in shaft spline, then set shroud (38) in mounting position.
6) Secure with ring (39).
7) Fit lock plate (37) and install shroud.
   ★ Bend the lock plate securely.
   ★ Check that the gear does not contact the shroud.

Mounting bolt: 11.5±1.0 kgm





419F409



3. Adjusting rotating torque of bearing

1) Assemble desired thickness of shim to retainer (33), then install without O-ring. Tighten mounting bolts uniformly.
   - ★ Rotate the shaft when tightening to settle the bearing. After tightening, tap the end face of the shaft several times to settle the bearing again.
   - ★ Coat the bearing well with oil.
   - ★ Standard shim thickness: 0.9 mm

Bearing: Transmission oil

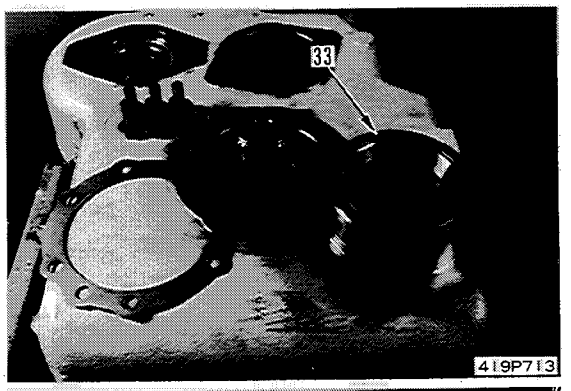
Mounting bolt: 11.5±1.0 kgm

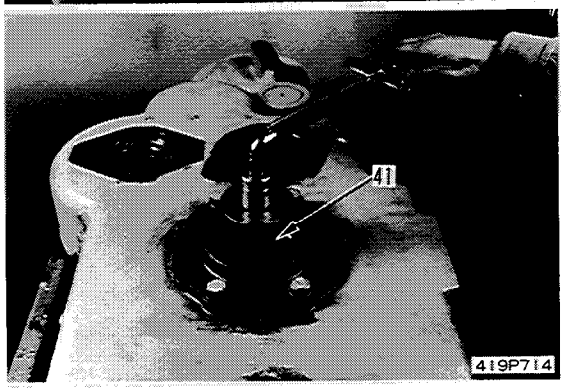
2) Tighten mounting bolts of coupling on shaft (41), then measure rotating torque.
   - ★ Rotating torque: 0.01-0.1 kgm
   - ★ If a small torque wrench is not available, measure as follows.
   - ★ Install measuring plate (50) and retainer plate on shaft (41), then tighten the mounting bolts of the coupling. Install a push-pull scale to the tip of plate (50) and measure the torque.
     Length of plate (ℓ): 100 mm
     Reading of push-pull scale: 0.1-1.0 kg
   - ★ Do not measure the torque when the rotating starts; measure the torque during the rotation.
   - ★ If the rotating torque is not within the standard value, adjust by changing the thickness of the shim.
   - ★ When the rotating torque is within the standard value, check that the end play is '0'.

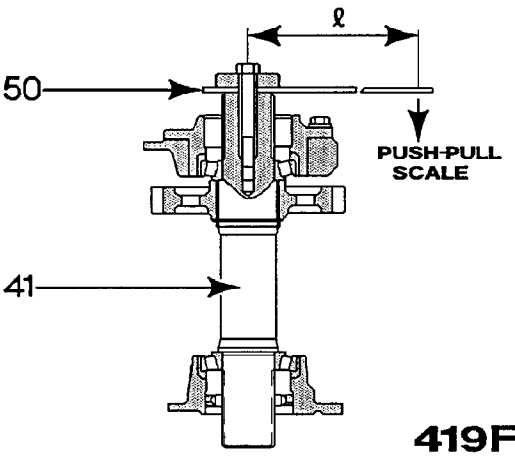
3) Install selected shim (51) and O-ring (34) to retainer (33), then assemble retainer.
   - ★ Put the thin shim in the middle and the thick shim on the outside.
   - ★ Coat the retainer mount and inside circumference of the housing with soapy water.

Retainer mount, inside circumference of housing: Soapy water

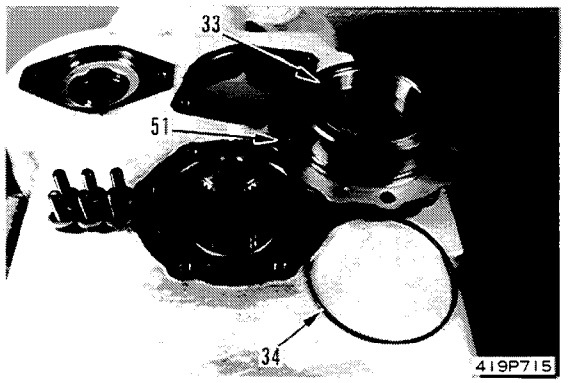
Mounting bolt: 11.5±1.0 kgm







419F410

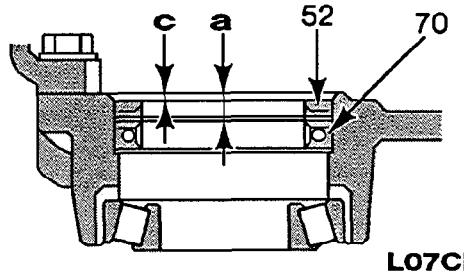


4. Oil seal

1) Press fit rear oil seal (52).
   ★ Press fitting distance 'a': 12.5 ± 2mm

2) Press fit rear dust seal (70).
   ★ Press fitting distance 'c': 3.5 ± 1.0mm.

Lip of oil seal: Grease (G2-L1)



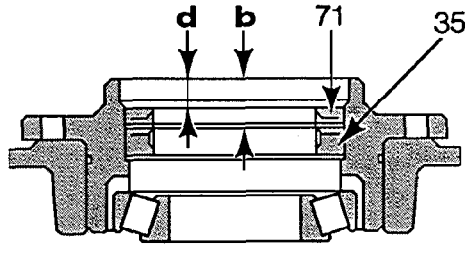
L07CR042

3) Press fit rear retainer (32).
   ★ Install the retainer with the concave side facing down.

4) Press fit front oil seal (35).
   ★ Press fitting distance 'b': 22.4 ± 1mm.

5) Press fit front dust seal (71).
   ★ Press fitting distance 'd': 13.5 ± 1.0mm.

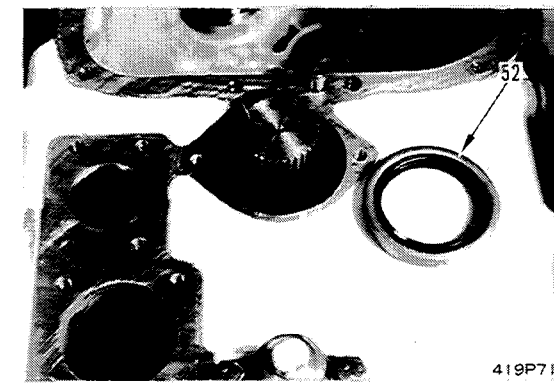
Lip of oil seal: Grease (G2-L1)

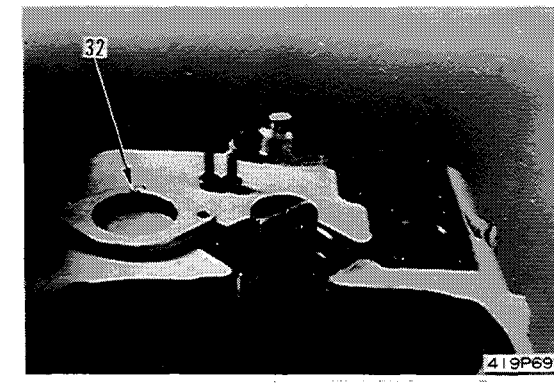


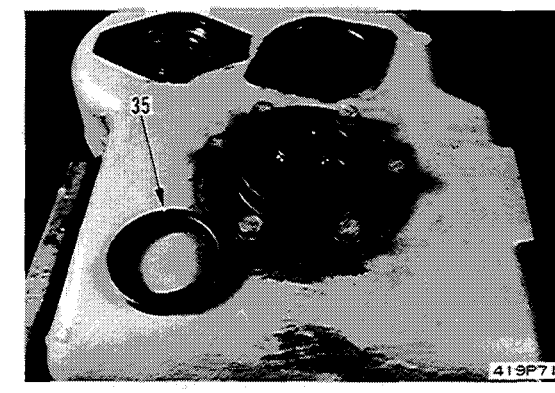
L07CR043

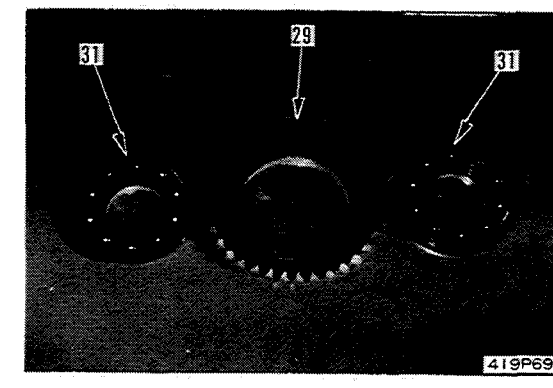
5. Idler gear

1) Press fit bearing (31) on gear (29).

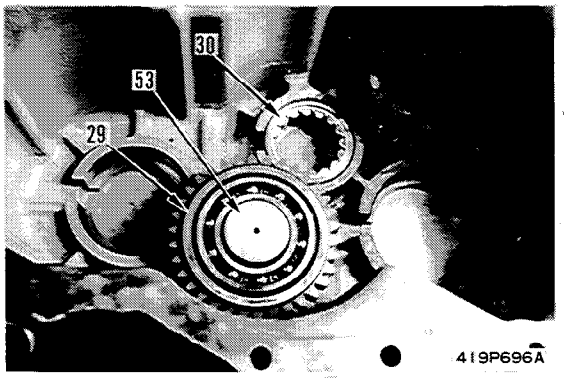








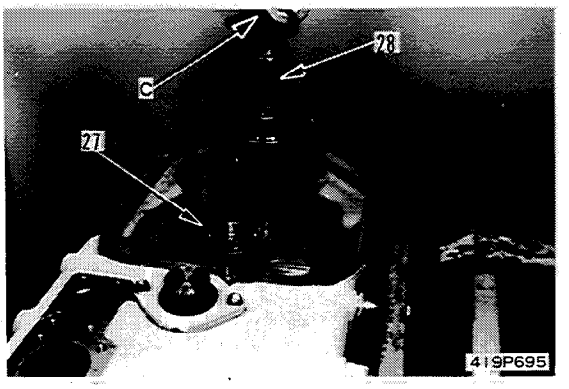
2) Press fit gear and bearing (29) on shaft (53).
   ★ Insert the gear and bearing up to the middle.
   ★ Assemble bearing (30) for the 1st and 3rd clutch.



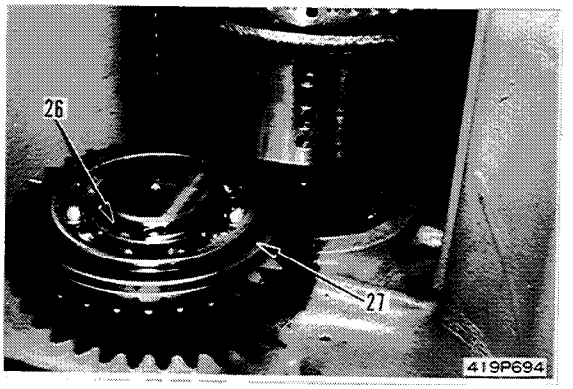
6. FORWARD-REVERSE clutch

1) Using tool C, insert FORWARD-REVERSE clutch (28) in housing, mesh FORWARD-REVERSE gear with back idler gear (27) and assemble.

⚠ Be careful not to get your fingers caught by the gear.

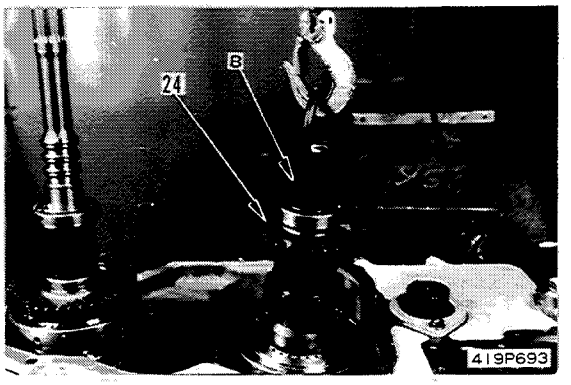


2) Press fit idler gear (27) completely, then secure with ring (26).
   ★ Always assemble the ring and fit it securely in the groove.

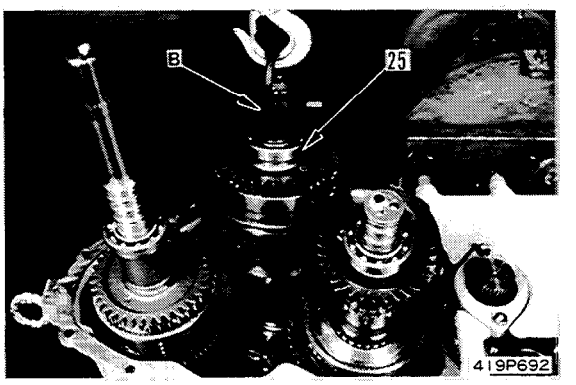


7. 1st-3rd speed, 2nd-4th speed clutches

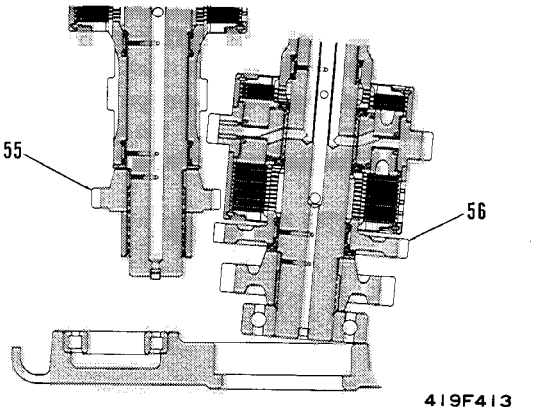
1) Using tool B, insert 2nd and 4th speed clutch (24) in housing, then move to output shaft side.
   ★ Do not fit the bearing at the bottom of the clutch.



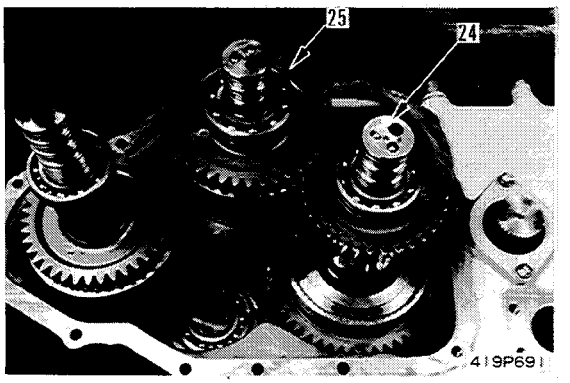
2) Using tool B, insert 1st and 3rd speed clutch (25) in housing.
   ★ Do not fit the bearing at the bottom of the clutch completely.



3) When 1st speed gear (55) passes gear (56) of 2nd and 4th speed clutch, insert bearing of 2nd and 4th speed clutch in housing.



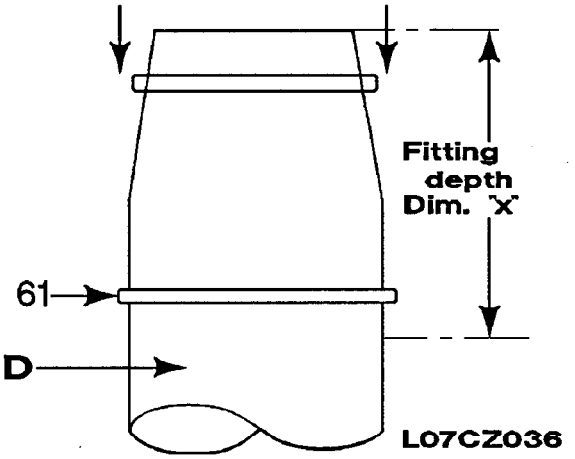
4) Insert 1st and 3rd speed clutch (25) in bearing.
   ★ Be careful that all gears are meshed when inserting in the bearing.
   ★ Be careful that gear (24) of the 2nd and 4th clutch is meshed with the emergency drive gear when assembling.
   ★ If the gears do not mesh properly, do not try to force them in. Rotate the gears slightly to mesh.



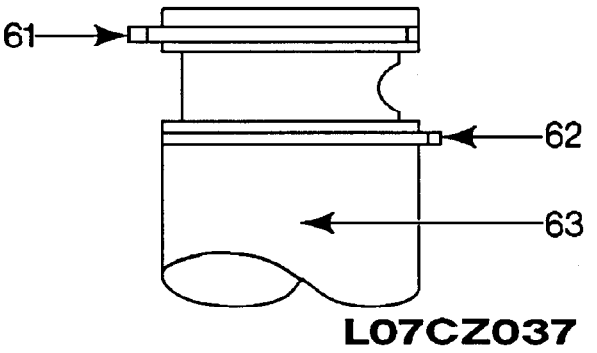
8. Seal ring

1) Coat seal ring (61) and external circumference of tool D with oil, and fit the seal ring with force on tool D to the depth of dimension "X".
   - ★ "X" = 110 mm
   - ★ Exercise care not to fit the seal ring deeper than dimension "X". The seal ring will be expanded excessively otherwise.
   - ★ The expanded seal ring should be removed from the lower side.

Seal ring: Transmission oil

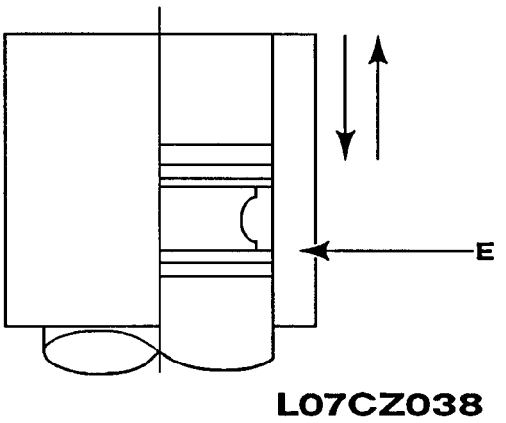


2) Quickly fit seal rings (61 and 62) removed from tool D on shaft (63).
   - ★ Fit a seal ring in the lower groove in the shaft first.
   - ★ Be sure to use new seal rings.



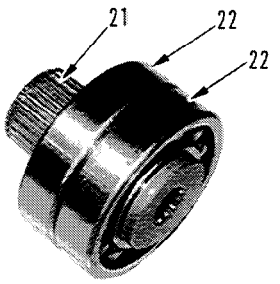
3) Coat the internal periphery of tool E with oil, and cause seal rings to fit it by moving it up and down.
   - ★ After the seal rings are fitted, assure that they are free of flaws.

Seal rings: Transmission oil



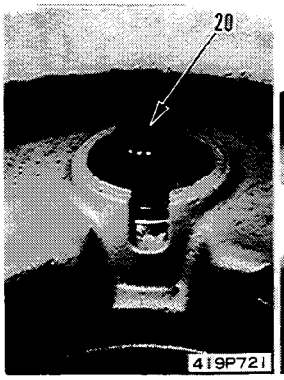
9. Pump gear

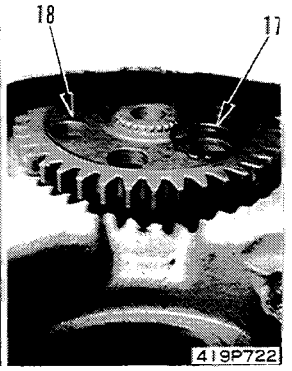
1) Press fit bearing (22) on shaft (21).
   ★ Press fit the bearing completely.



419P689

2) Press fit shaft and bearing (20) in housing.
   ★ Insert the shaft until it is level with the surface of the housing.
   ★ If the bearing is fixed, the gear cannot be inserted, so fix the bearing after inserting the gear.
3) Insert gear (18) on shaft, then secure with ring (17).



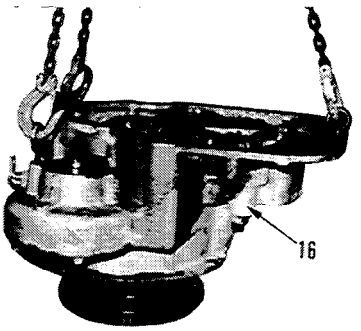


10. Torque converter

Using eye bolts, raise rear housing (16), set in mounting position on torque converter, then tighten mounting bolts.

★ Align the holes of the mounting bolts and mesh with the pump accessory gear properly when installing.
★ Blow in air to check that the oil holes are aligned properly.

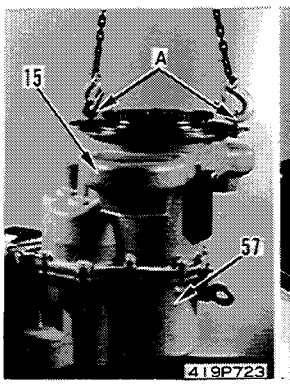
Mounting bolt: 11.5±1.0 kgm

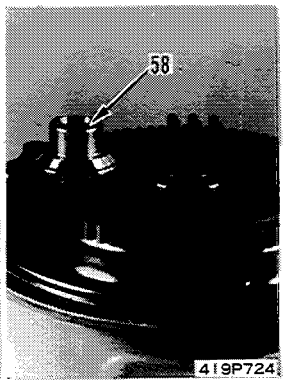


419P687

11. Rear housing

1) Using tool A, raise housing (15), and assemble to front housing (57).
   - ★ Be careful not to let the gasket sealant get inside the case. Install to the case within 5 minutes of coating with gasket sealant.
   - ★ Wait for at least one hour after assembling before filling with oil.
   - ★ Remove pilot cap (58) of the torque converter, and mesh the spline of the input shaft correctly.
   - ★ Be careful not to damage the seal rings of the shafts.





Housing contact face: Gasket sealant

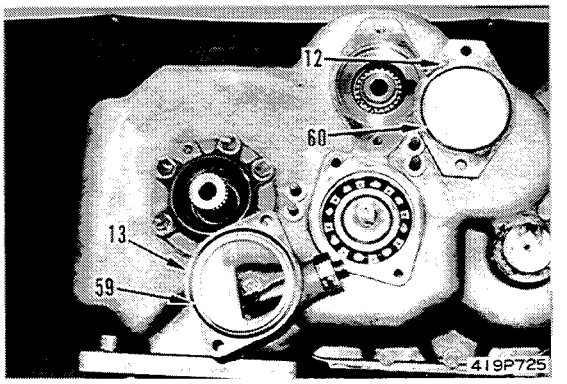
Mounting bolt of bearing cap: 7.0±0.5 kgm

2) Install pilot.

Housing mounting bolt: 11.5±0.5 kgm

12. 2nd-4th speed shaft, emergency pump covers

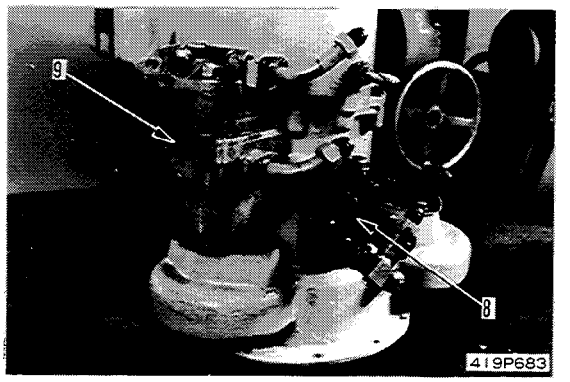
1) Fit O-ring (59) and install cover (13) of 2nd and 4th speed shaft.
2) Fit O-ring (60) and install emergency pump cover (12).
   - ★ Be careful not to let the O-ring come out of place.



O-ring: Transmission oil

13. Pump, regulator valve

1) Set pump (9) in mounting position, then tighten mounting bolts.
2) Set regulator valve (8) in mounting position, then tighten mounting bolts.



Mounting bolt: 6.8±0.7 kgm

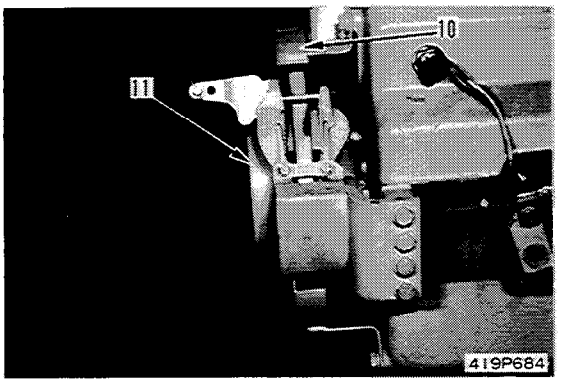
14. Parking brake

Set parking brake (11) in mounting position, then tighten mounting bolts of coupling and install cover (10).

★ Be careful not to damage the oil seal.

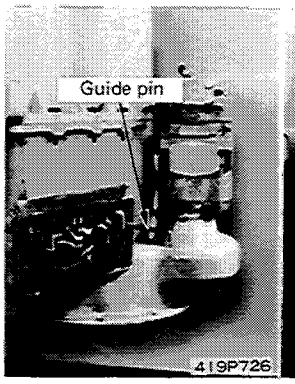
Outside circumference of coupling: Transmission oil

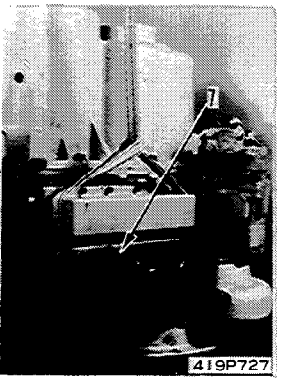
Mounting bolt of coupling: 27.5±4.0 kgm



15. Transmission control valve

1) Install guide pin in mount.
2) Raise transmission control valve (7), set in mounting position, then tighten mounting bolts.
   ★ Be careful to install the gasket in the right direction.
   ★ For the tightening torque and order of the mounting bolts, see page 23-64 the section under the bolts installing the transmission valve.

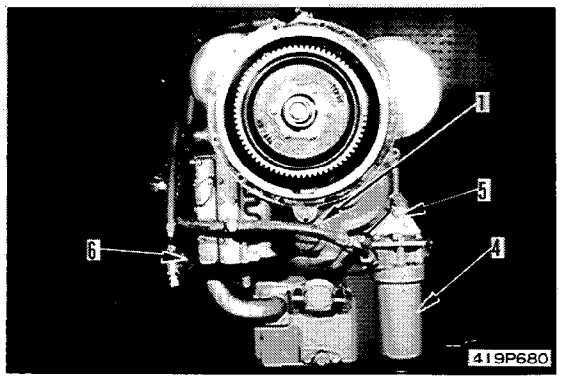




16. Filter

1) Install oil filler (6).
   ★ Install the rear coupling.
2) Install bracket (5), then install filter (4) to bracket.

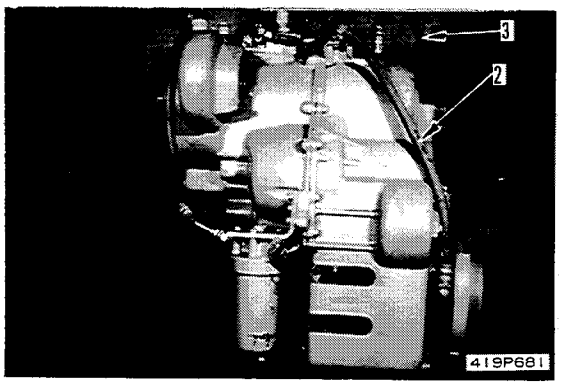
Mounting bolt of bracket: 11.5±1.0 kgm



17. Hydraulic piping

Connect the following hydraulic piping.

- Hose (3) between transmission and power master cylinder.
- Tube (2) between pump and filter.
- Hose (1) between filter and transmission valve.
- Tube between transmission control valve and torque converter regulator valve.
  ★ Install the hose without twisting or interference.

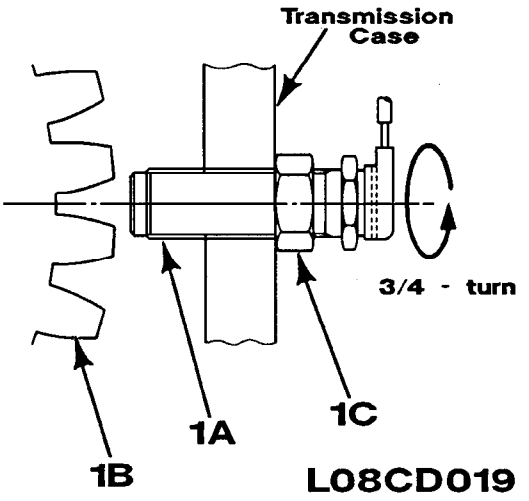


18. Adjustment of speedometer sensor

1) Screw sensor (1A) until it contacts outside surface of gear (1B).
   - ★ Before installing the sensor, check that the gear is at the outside surface compared with the mounting surface.
2) After sensor (1A) contacts gear (1B), turn in back 3/4 to 1 turn and secure with lock nut (1C).
   - ★ Be careful that the outlet direction of the sensor harness is not the opposite direction to the sensor connector damp.

Sensor thread: Adhesive (LT-2)

Sensor lock nut: 4±1 kgm



MEMO

CLUTCH PACK
DISASSEMBLY

Special tools

	Part number	Part name	Q'ty
A	793-310-1300	Stand	1
A_1	793-310-1370	Guide pin	5
A_2	793-310-1330	Plate	1
A_3	01541-1260	Nut	2
A_4	793-310-1360	Bar	2

FORWARD-REVERSE CLUTCH PACK

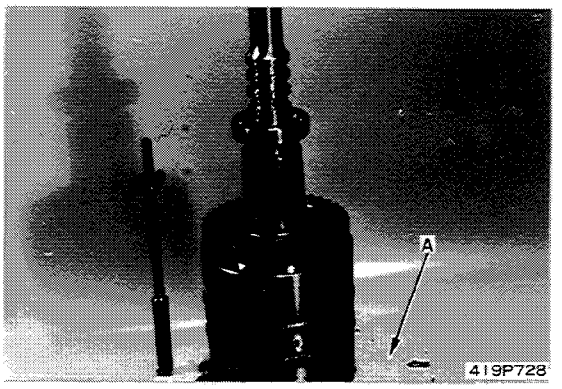
⚠ When setting the clutch pack on the stand, wipe off all oil to prevent the pack from slipping, and be careful not to get your fingers caught between the stand and the clutch pack.

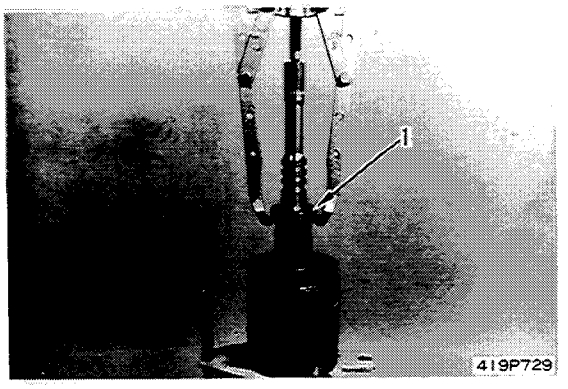
★ Set the pack on stand A with the FORWARD side at the top.

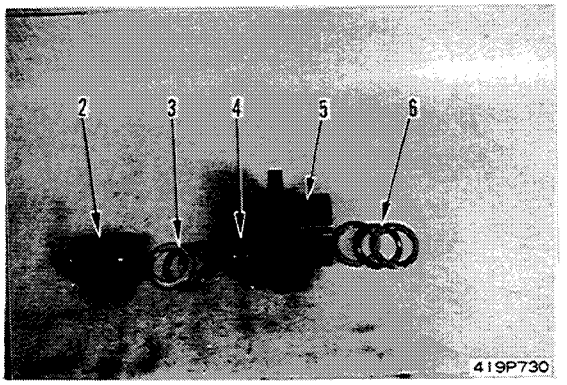
1. **Bearing**
   Using puller, remove bearing (1).

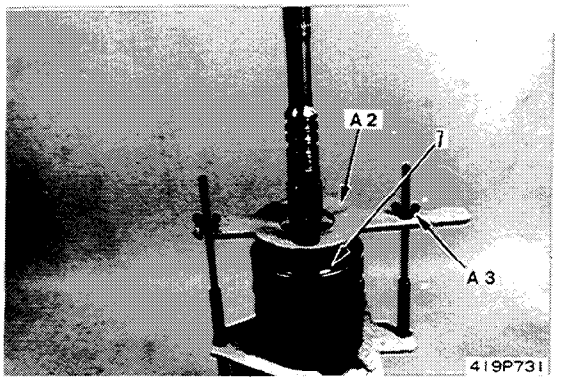
2. **Spacer, FORWARD gear**
   Remove spacer (2), thrust bearing (3), needle bearing (4), FORWARD gear (5) and thrust bearing (6).

3. **End plate**
   1) Install tool A_2, tighten tool A_3, and remove ring (7).
      ★ After removing the ring, remove tool A_2.

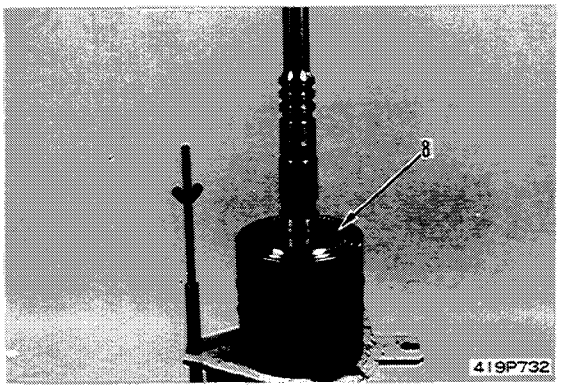




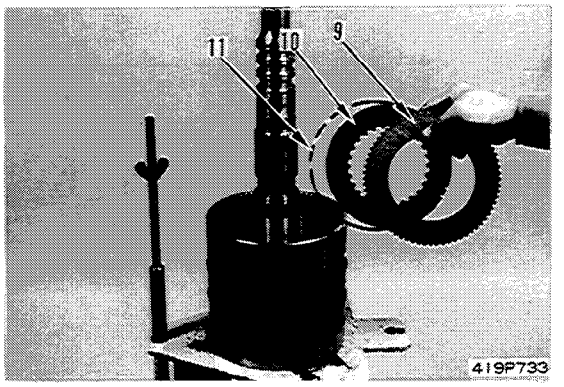




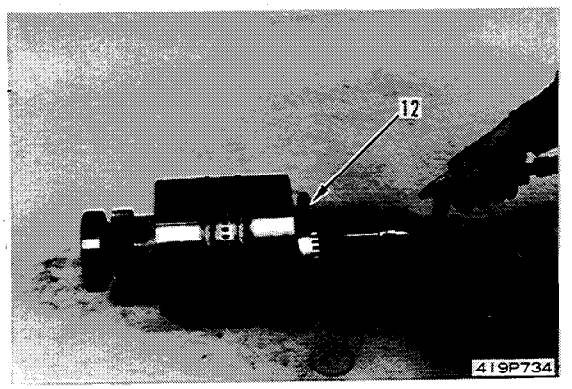
2) Remove end plate (8).



4. **Clutch plate**
Remove plate (9), disc (10) and spring (11) from housing.

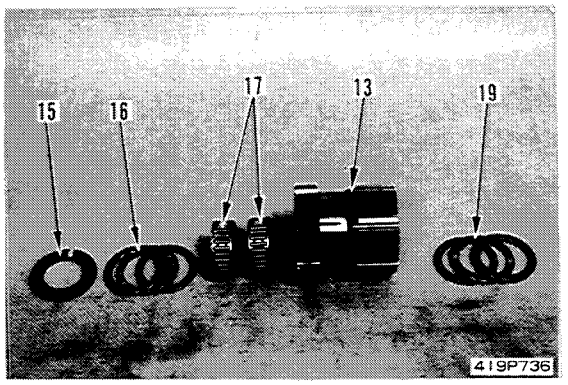


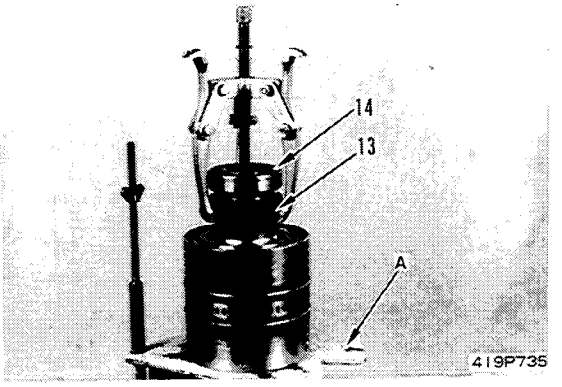
5. **Piston**
Blow in air through oil hole on FORWARD side of shaft, and remove piston (12).
★ If the piston is at an angle and cannot be removed, push the piston in and try again.
★ Do not force the piston out. This will damage the inside of the cylinder.



6. **Bearing**
★ Set the pack with the REVERSE side at the top. Using puller, remove gear (13) and bearing (14).

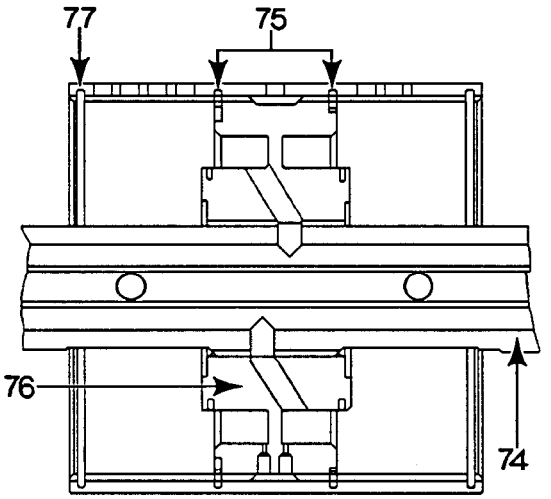
7. **REVERSE gear**
Remove washer (15), thrust bearing (16), needle bearing (17), REVERSE gear (13) and thrust bearing (19).
★ Repeat steps 3 to 5 used for the FORWARD clutch to disassemble the REVERSE clutch.





8. Shaft, cylinder

1) Remove shaft (74).
2) Remove snap ring (75) and remove cylinder (76) from housing (77).
   - ★ Suitably mark the cylinder for identification of forward side or reverse side.
   - ★ Carry out disassembly there after in the manner equal to what is described in steps 3 - 5 of the procedure on the forward side.

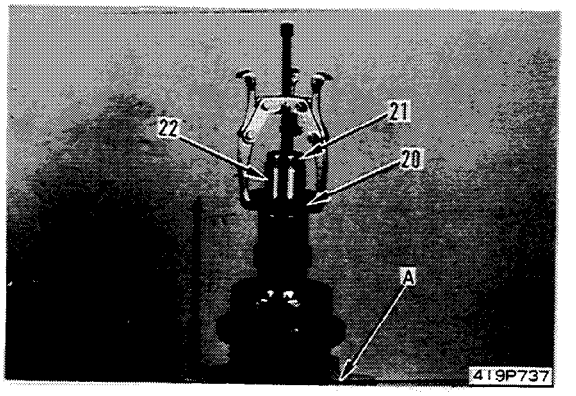


L10BM001

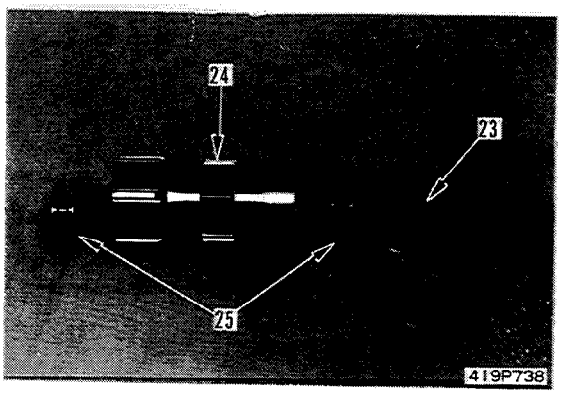
1ST-3RD SPEED CLUTCH PACK

★ Set the pack on stand A with the 1st speed side at the top.

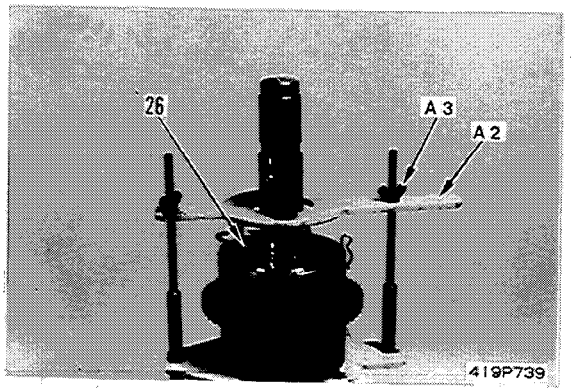
1. **Idler gear**
   Fit puller on idler gear (20), then remove bearing (21) and spacer (22) together with idler gear.



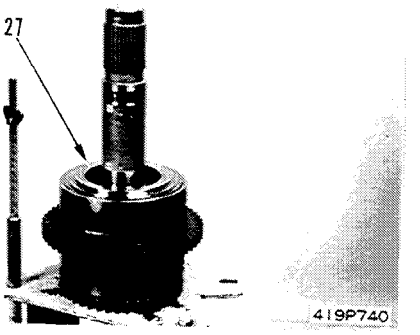
2. **1st gear**
   Remove thrust washer (23), 1st gear (24) and needle bearing (25).



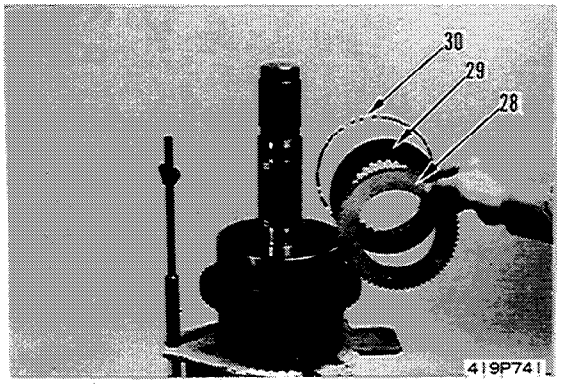
3. **End plate**
   1) Install tool A_2, tighten tool A_3, and remove ring (26).
      ★ After removing the ring, remove tool A_2.



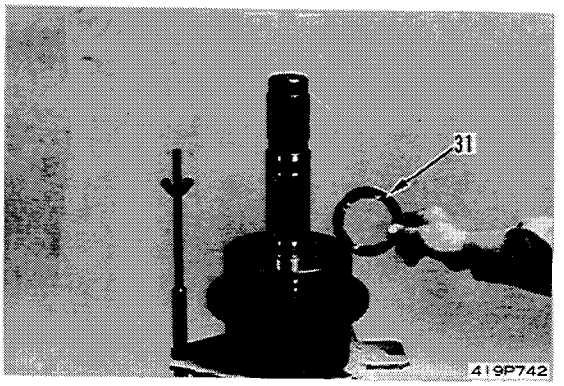
   2) Remove end plate (27).



4. **Clutch plate**
   1) Remove plate (28), disc (29) and spring (30) from housing.
   2) Remove thrust washer (31).

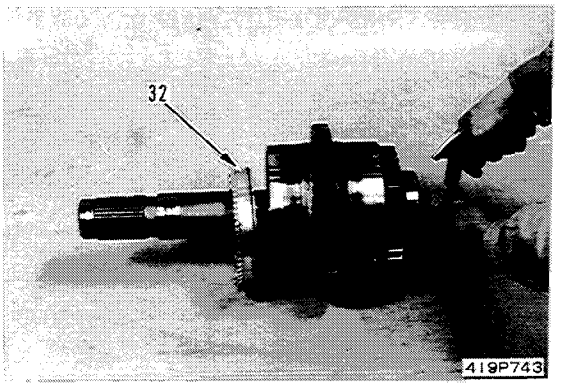


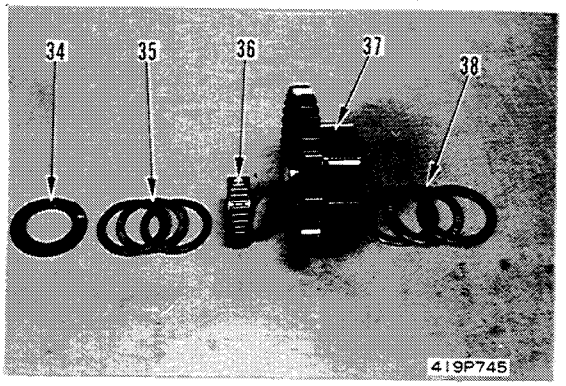
5. **Piston**
   Blow in air through oil hole on REVERSE side of shaft, and remove piston (32).
   ★ If the piston is at an angle and cannot be removed, push the piston in and try again.
   ★ Do not force the piston out. This will damage the inside of the cylinder.

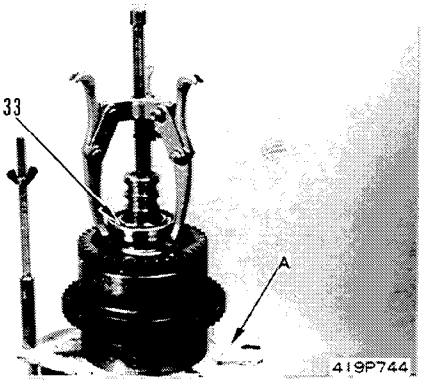


6. **Bearing**
   Set the pack with the 3rd speed side at the top. Using puller, remove bearing (33).

7. **3rd gear**
   Remove washer (34), thrust bearing (35), needle bearing (36), 3rd gear (37) and thrust bearing (38).
   ★ Repeat steps 3 to 5 used for the 1st clutch to disassemble the 3rd clutch.



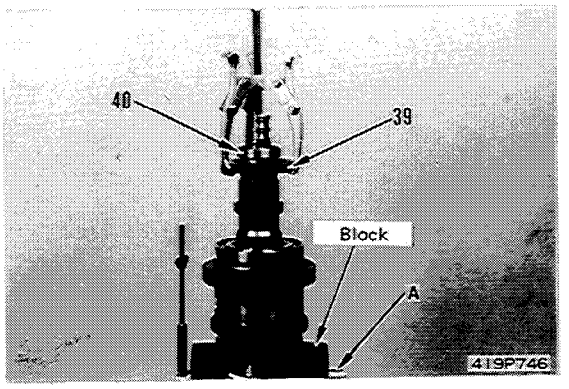




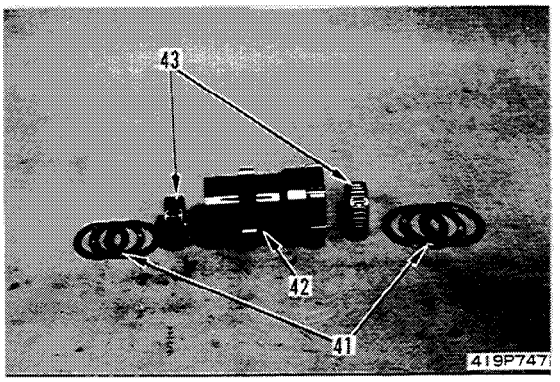
2ND-4TH SPEED CLUTCH PACK

★ Set the pack on stand A with the 4th speed side at the top.

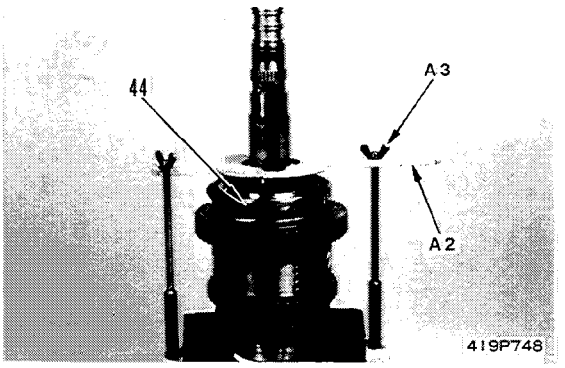
1. **Idler gear**
   Fit puller on idler gear (39), then remove bearing (40) together with idler gear.
   ★ Set a block between the housing and stand, and adjust the height of the stand.



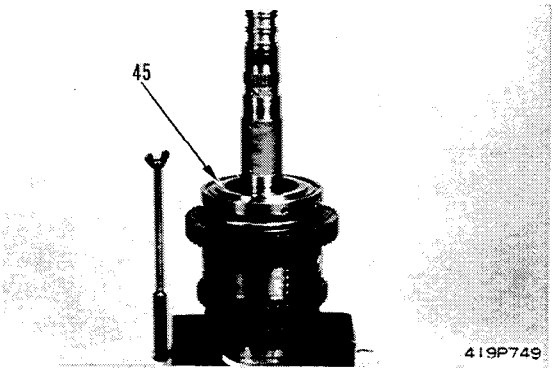
2. **4th gear**
   Remove thrust bearing (41), 4th gear (42) and needle bearing (43).



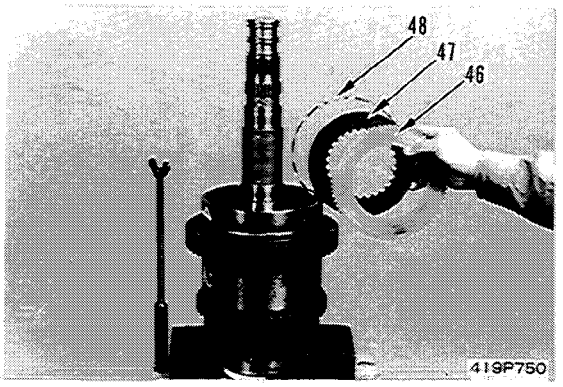
3. **End plate**
   1) Install tool A_2, tighten tool A_3, and remove ring (44).
      ★ After removing the ring, remove tool A_2.



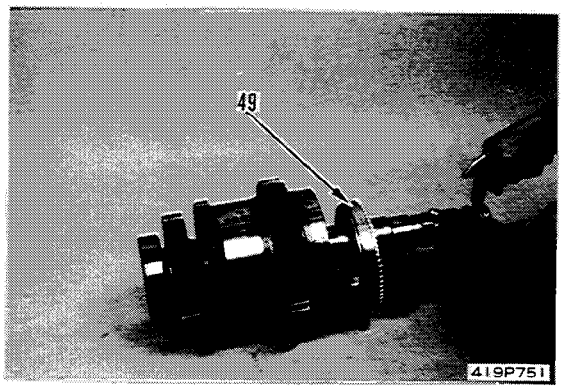
   2) Remove end plate (45).



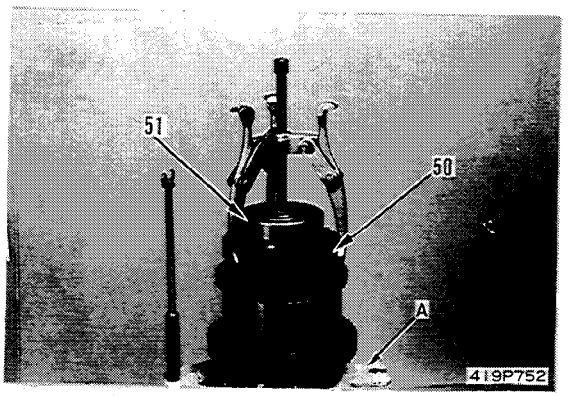
4. **Clutch plate**
Remove plate (46), disc (47) and spring (48) from housing.



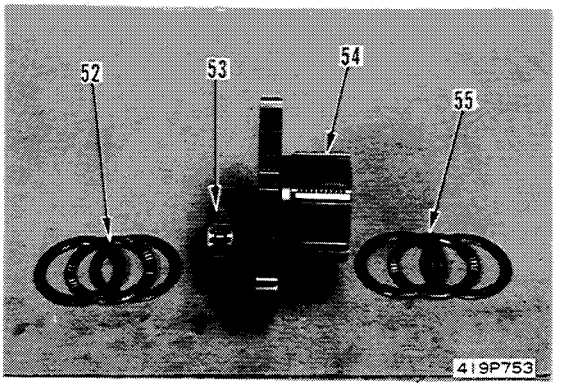
5. **Piston**
Blow in air through oil hole on 4th speed side of shaft, and remove piston (49).
★ If the piston is at an angle and cannot be removed, push the piston in and try again.
★ Do not force the piston out. This will damage the inside of the cylinder.



6. **Idler gear**
★ Set the pack on stand A with the 2nd speed side at the top. Fit puller on idler gear (50), then remove bearing (51) together with idler gear.
★ When fitting the puller, put the plate in contact with the center.



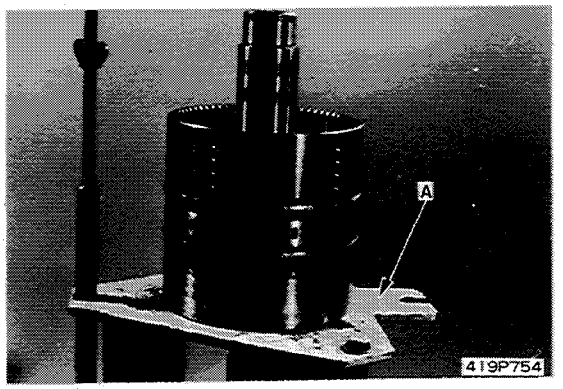
7. **2nd gear**
Remove thrust bearing (52), needle bearing (53), 2nd gear (54) and thrust bearing (55).
★ Repeat steps 3 to 5 used for the 4th clutch to disassemble the 2nd clutch.



ASSEMBLY

Special tools

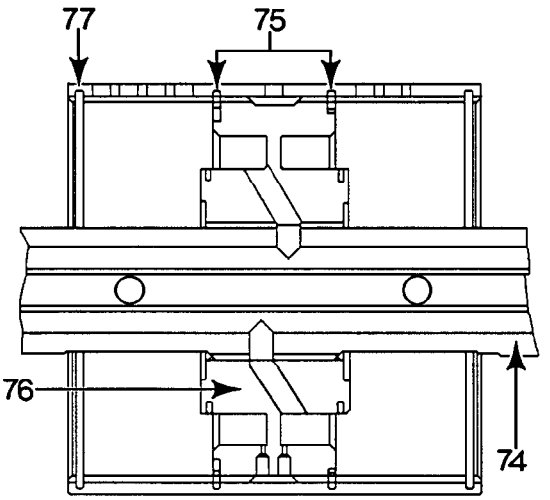
	Part number	Part name	Q'ty
A	793-310-1300	Stand	1
A_1	793-310-1370	Guide pin	5
A_2	793-310-1330	Plate	1
A_3	01541-1260	Nut	2
A_4	793-310-1360	Bar	2



FORWARD-REVERSE CLUTCH PACK

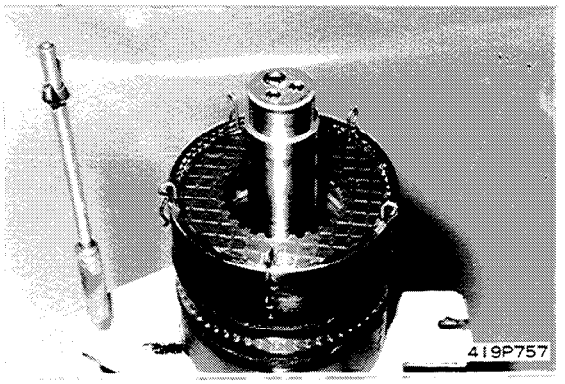
⚠ When setting the clutch pack on the stand, wipe off all oil to prevent the pack from slipping, and be careful not to get your fingers caught between the stand and the clutch pack.

★ Set the shaft and housing on stand A with the REVERSE side at the top.

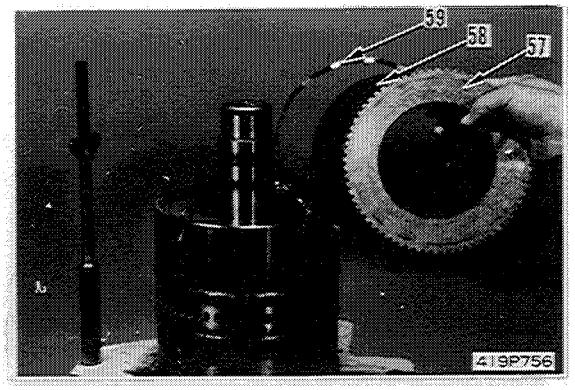


L10BM001

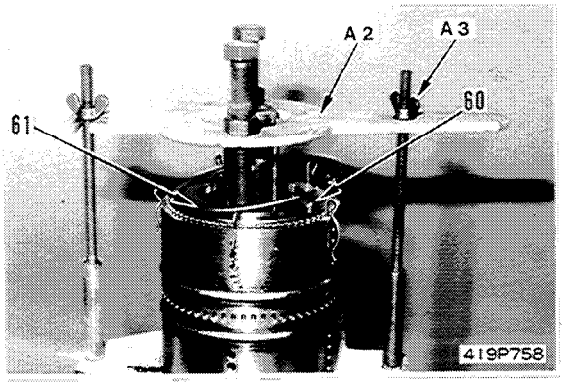
1. **Shaft, cylinder**
   1) Fit cylinder (76) in housing (77) and fix with snap ring (75).
   2) Fit shaft (74).
      ★ Assure that the snap ring is positively fitted in the groove.
      ★ Match marking for forward side or reverse side.



2. **Clutch plate**
   Insert tool A_1 in housing, then assemble plate (57), disc (58) and spring (59) in turn.
   - ★ Soak plate (57) in clean transmission oil for at least two minutes before assembling.
   - ★ Be careful not to let spring (59) and plate (57) catch on each other.
   - ★ Do not let the plate or spring catch in the ring groove of the clutch housing when assembling.

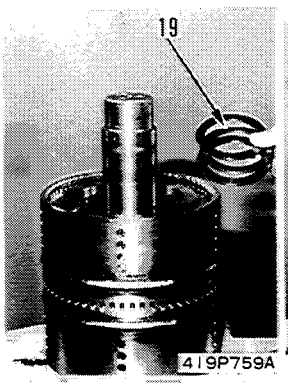


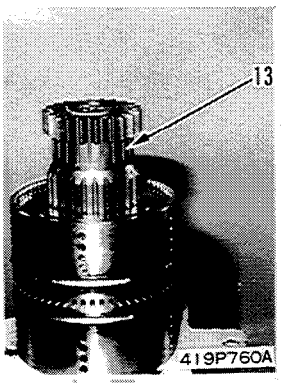
3. **End plate**
   1) Install tool A_2 and tighten tool A_3 to push in end plate (60).
   2) Assemble ring (61), then remove tool A_2.
      - ★ Check that ring (61) is fitted securely in the groove.
      - ★ Check that disc (58) rotates smoothly by hand.



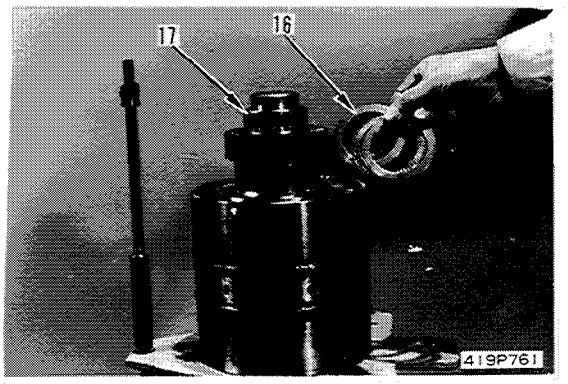
4. **Thrust bearing**
   Install thrust bearing (19).

5. **REVERSE gear**
   Using a screwdriver, align spline groove inside plate and install gear (13).
   - ★ If the spline of the gear cannot be aligned, rotate the gear lightly. Never try to force the gear into position.





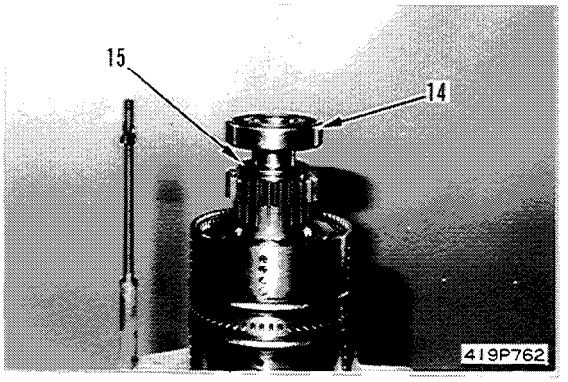
6. **Bearings**
   Install needle bearing (17) and thrust bearing (16).
   - ★ Check that the end face of the thrust bearing is level with or below the stepped part of the shaft.



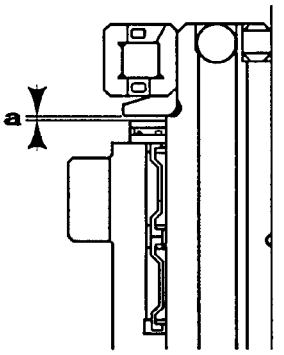
7. Bearing

Assemble washer (15), then press fit bearing (14).

★ Press fit completely so that washer (15) is in close contact with the stepped part of the shaft, and bearing (14).



★ After press fitting the bearing, check that clearance 'a' between thrust bearing and washer is within the standard range.
'a' = 0.07 - 0.74 mm



419F414

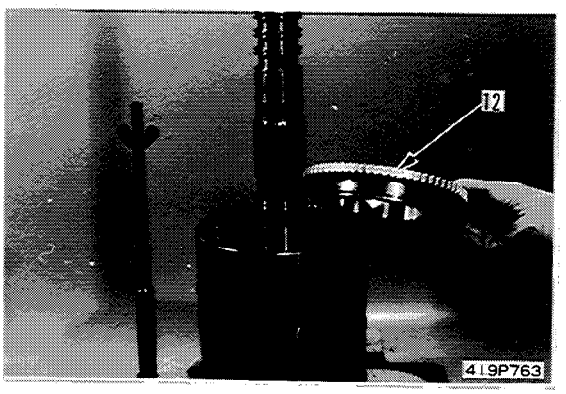
8. FORWARD piston

1) Turn over clutch pack.

⚠ When turning over the clutch pack, be careful not to get your fingers caught between the stand and clutch pack.

2) Assemble piston (12) in same way as for REVERSE piston.

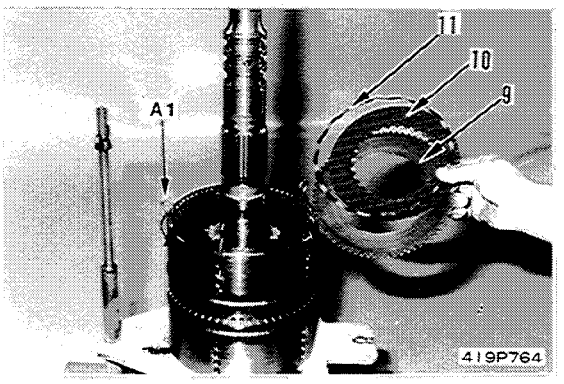
Sliding surface of piston seal: Transmission oil



9. Clutch plate

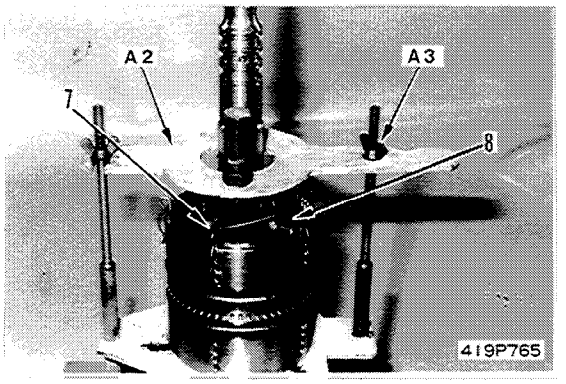
Insert tool A_1 in housing, then assemble plate (9), and disc (10) and spring (11).

★ Assemble in the same way as for the REVERSE side.



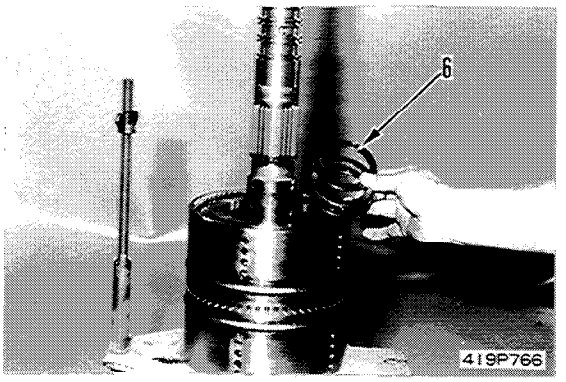
10. End plate

1) Install tool A_2 and tighten tool A_3 to push in end plate (8).
2) Assemble ring (7), then remove tool A_2.
   ★ Assemble in the same way as for the REVERSE side.



11. Thrust bearing

Install thrust bearing (6).

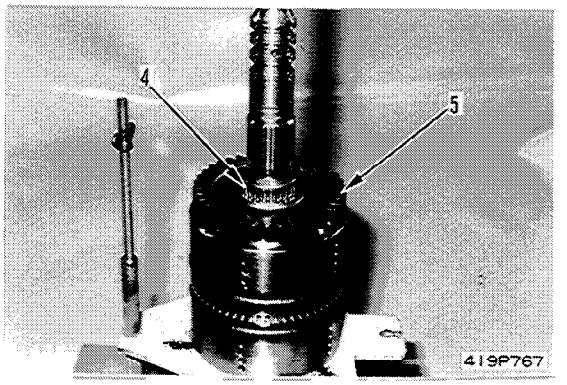


12. FORWARD gear

Install FORWARD gear (5).
★ Assemble in the same way as for the REVERSE side.

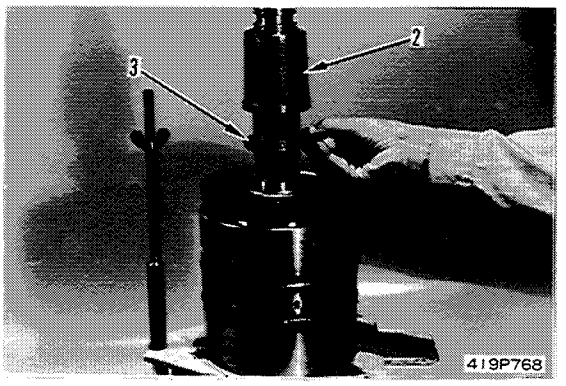
13. Bearing

Install needle bearing (4).



14. Spacer

Assemble thrust bearing (3), then assemble spacer (2).
★ Check that the end face of the thrust race of the thrust bearing is level with or below the stepped part of the shaft.



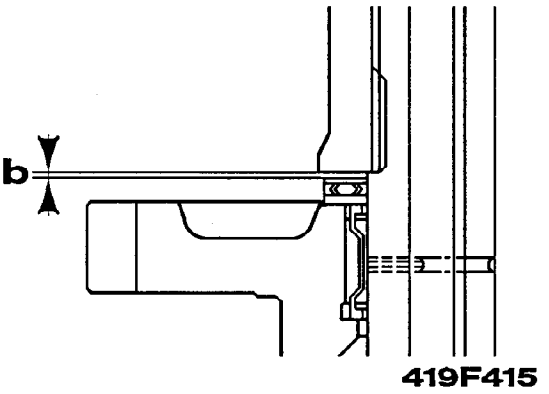
15. Bearing

Press fit bearing (1).

★ Press fit completely so that spacer is in close contact with the stepped part of the shaft, and bearing (1).



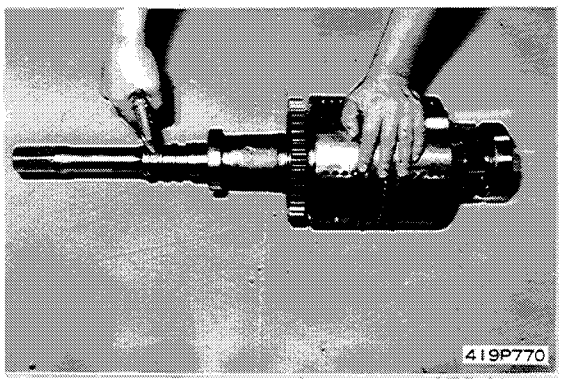
★ After press fitting the bearing, check that clearance 'b' between the thrust bearing and the spacer is within the standard range.
'b' = 0.04 - 1.17 mm



16. Clutch pack operation test

Blow in compressed air through the oil hole in the shaft and check the operation of each clutch.

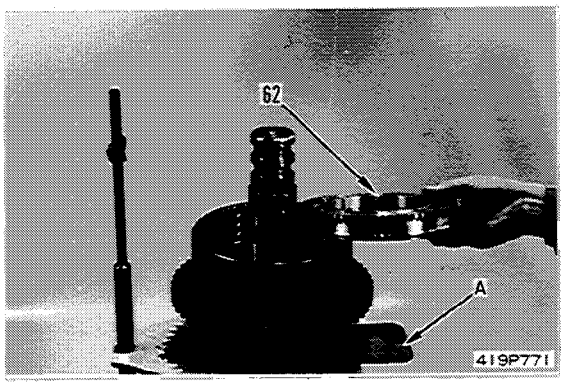
★ If the gear on the side where the air is blown in is held in place, the clutch is working normally.



1ST-3RD SPEED CLUTCH PACK

⚠ When setting the clutch pack on the stand, wipe off all oil to prevent the pack from slipping, and be careful not to get your fingers caught between the stand and the clutch pack.

★ Set the shaft and housing on tool A with the 3rd speed side at the top.

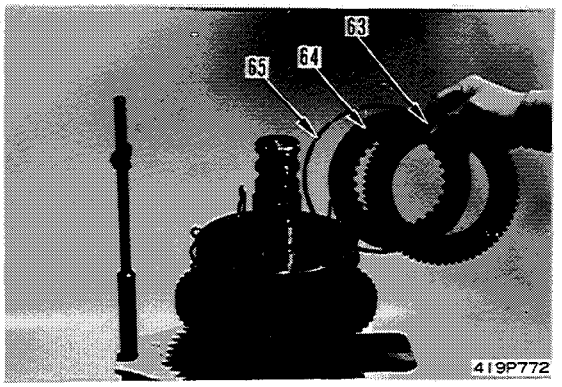


1. 3rd speed piston

Install 3rd speed piston (62).

★ Be careful not to damage the piston seal.
★ Check that the spring pin is not protruding from the circumference of the shaft.

Sliding surface of piston seal: Transmission oil



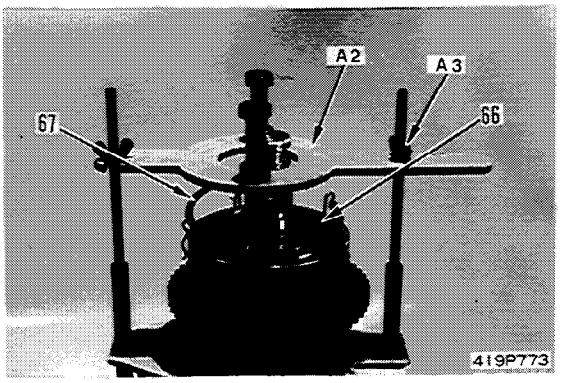
2. Clutch plate

Assemble plate (63), disc (64) and spring (65) in turn.

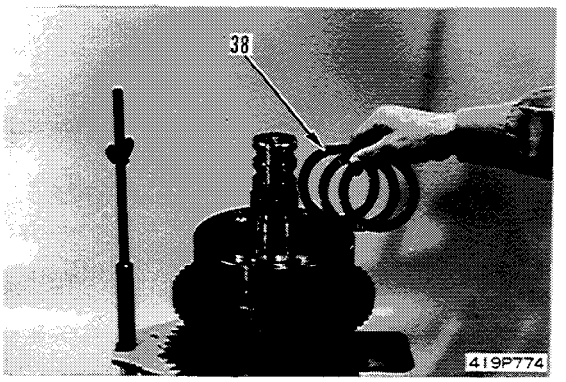
★ Soak plate (63) in clean transmission oil for at least two minutes before assembling.
★ Be careful not to let spring (65) and plate (63) catch on each other.
★ Do not let plate (63) or spring catch in the ring groove of the clutch housing when assembling.

3. End plate

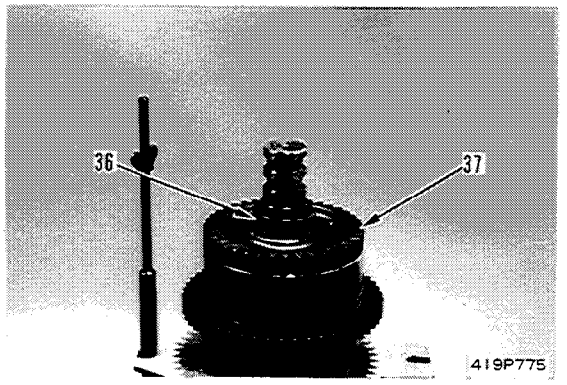
1) Install tool A_2 and tighten tool A_3 to push in end plate (66).
2) Assemble ring (67), then remove tool A_2.
   ★ Check that ring (67) is fitted securely in the groove.
   ★ Check that the disc rotates smoothly by hand.



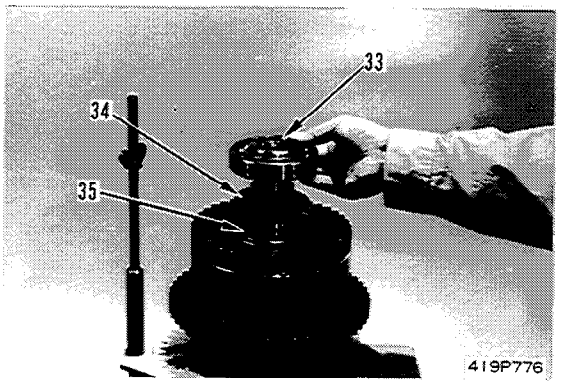
3) Install thrust bearing (38).

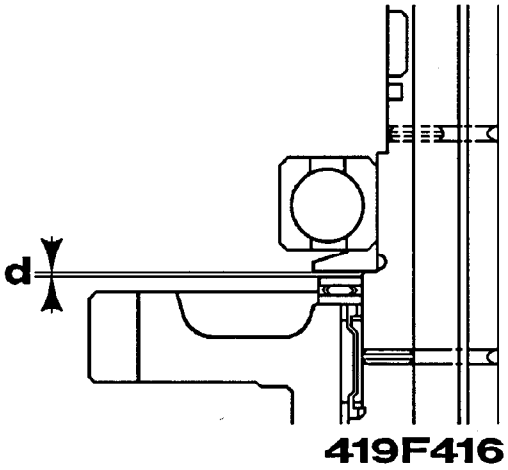


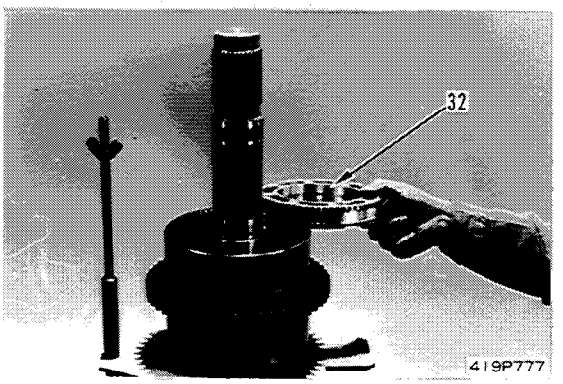
4. **3rd gear**
   Install 3rd gear (37), then install needle bearing (36).
   - ★ If the spline of the gear cannot be aligned, rotate the gear lightly. Never try to force the gear into position.
   - ★ Assemble the lower needle bearing first.



5. **Bearings**
   Install thrust bearing (35) and washer (34), then press fit bearing (33).
   - ★ Check that the end face of the thrust bearing is level with or below the stepped part of the shaft.
   - ★ Press fit completely so that the washer is in close contact with the stepped part of the shaft, and bearing (33).
   - ★ After press fitting the bearing, check that clearance 'd' between the thrust bearing and the washer is within the standard range.
     'd' = 0.03 - 0.70 mm







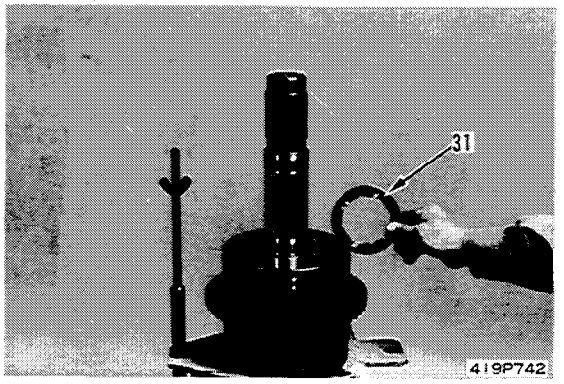
6. **1st speed piston**
   1) Turn over clutch pack.

   ⚠ When turning over the clutch pack, be careful not to get your fingers caught between the stand and clutch pack.

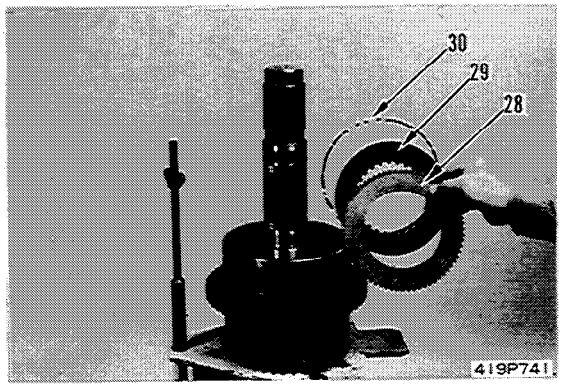
   2) Assemble piston (32) in same way as for 1st speed piston.

   Sliding surface of piston seal: Transmission oil

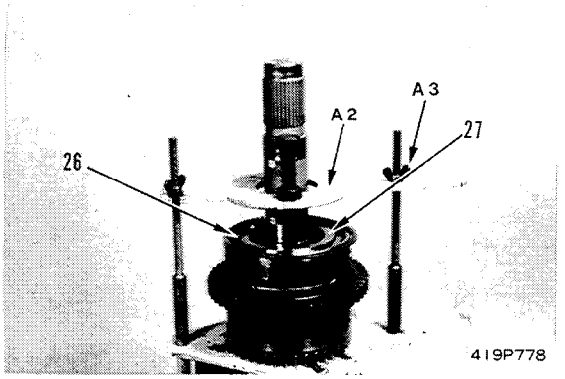
   3) Install thrust washer (31).



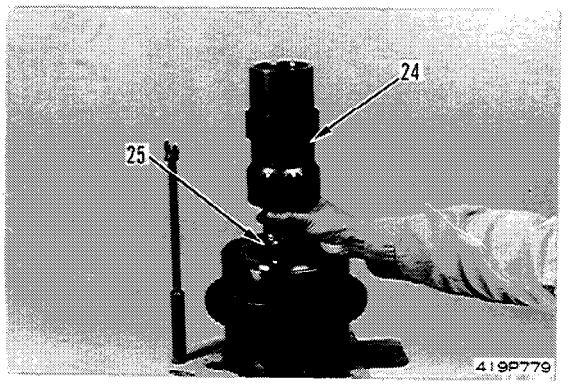
7. **Clutch plate**
   Assemble plate (28), disc (29) and spring (30) in turn.
   ★ Assemble in the same way as for the 3rd speed side.



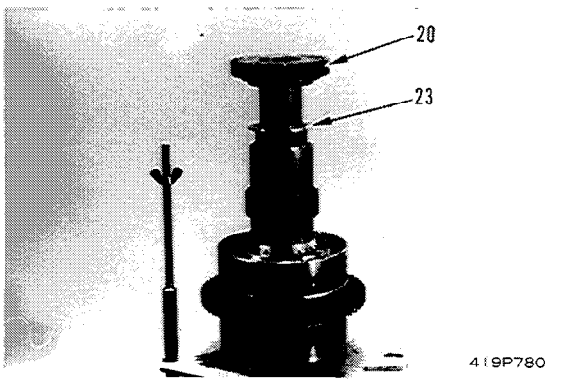
8. **End plate**
   1) Install tool A_2 and tighten tool A_3 to push in end plate (27).
   2) Assemble ring (26), then remove tool A_2 and A_3.
      ★ Assemble in the same way as for the 3rd speed side.



9. **1st gear**
   Install 1st gear (24), then assemble needle bearing (25).
   ★ Assemble in the same way as for the 3rd speed side.



10. **Idler gear**
    Assemble thrust washer (23), then assemble idler gear (20).

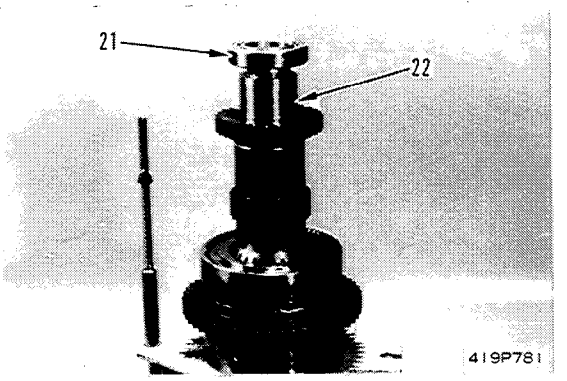


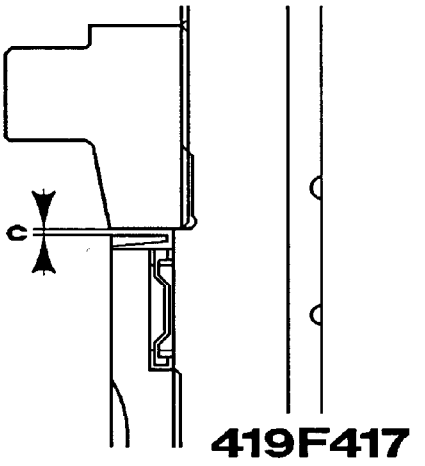
11. Bearing

Assemble spacer (22), then assemble bearing (21).

★ Assemble the spacer with the spline side at the bottom.

★ After press fitting the bearing, check that clearance 'c' between the washer and the gear is within the standard range.
'c' = 0.04 - 1.04 mm

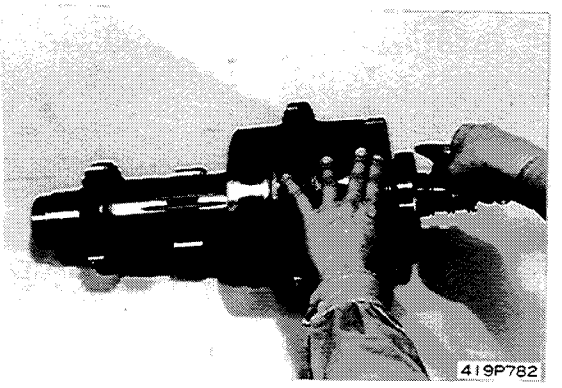




12. Clutch pack operation test

Blow in compressed air through the oil hole in the shaft and check the operation of each clutch.

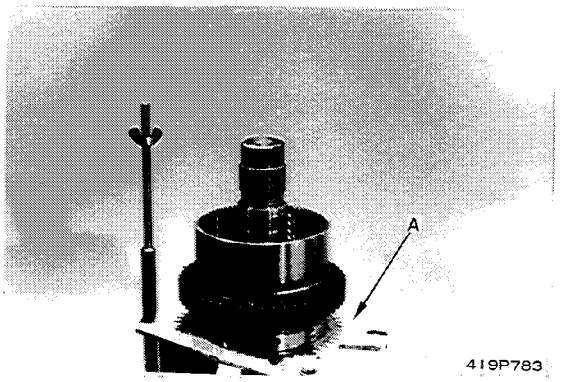
★ If the gear on the side where the air is blown in is held in place, the clutch is working normally.



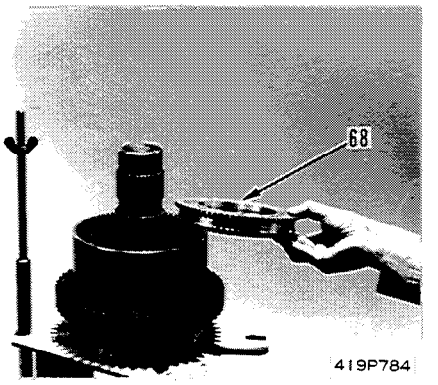
2ND-4TH SPEED CLUTCH PACK

⚠ When setting the clutch pack on the stand, wipe off all oil to prevent the pack from slipping, and be careful not to get your fingers caught between the stand and the clutch pack.

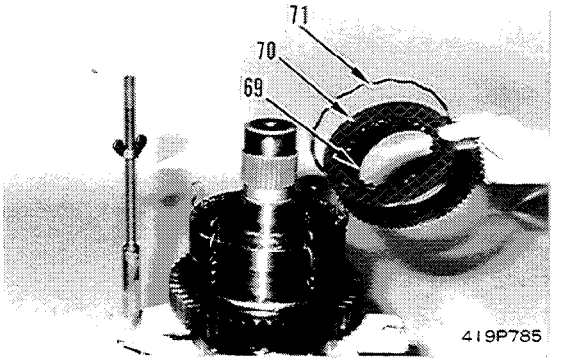
★ Set the shaft and housing on tool A with the 2nd speed side at the top.



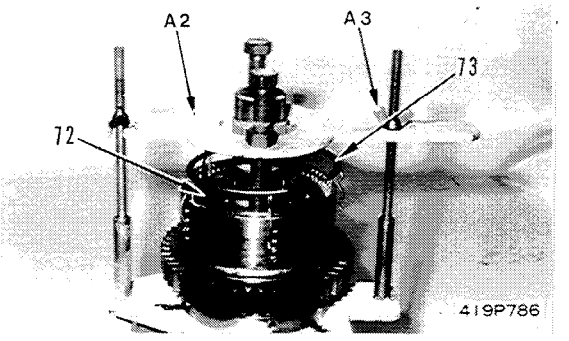
1. **2nd speed piston**
   Install 2nd speed piston (68).
   ★ Be careful not to damage the piston seal.
   ★ Check that the spring pin is not protruding from the circumference of the shaft.



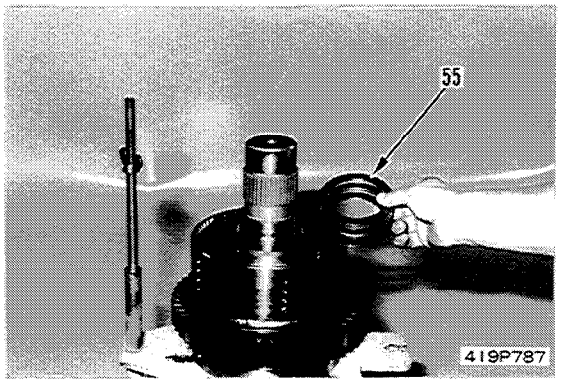
2. **Clutch plate**
   Assemble plate (69), disc (70) and spring (71) in turn.
   ★ Soak plate (69) in clean transmission oil for at least two minutes before assembling.
   ★ Be careful not to let spring (71) and plate (69) catch on each other.
   ★ Do not let plate or spring catch in the ring groove of the clutch housing when assembling.



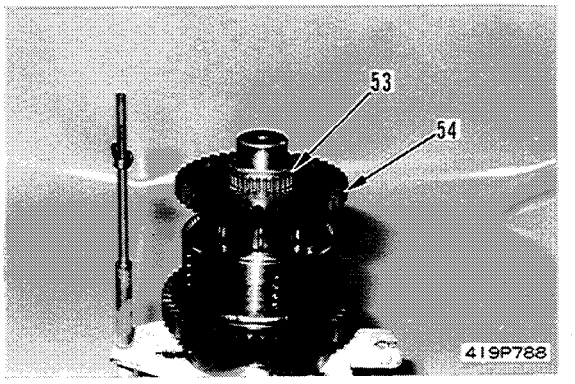
3. **End plate**
   1) Install tool A_2 and tighten tool A_3 to push in end plate (72).
   2) Assemble ring (73), then remove tool A_2.
      ★ Check that ring (73) is fitted securely in the groove.
      ★ Check that the disc rotates smoothly by hand.



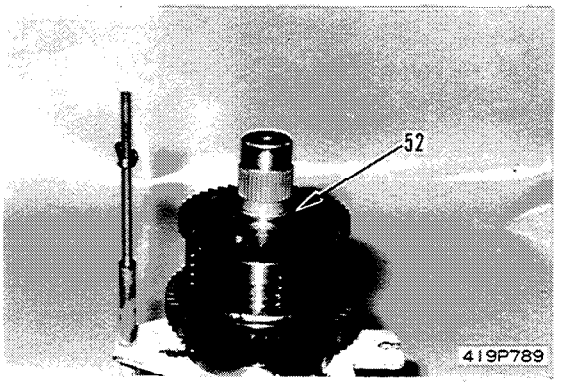
4. **Thrust bearing**
   Install thrust bearing (55).



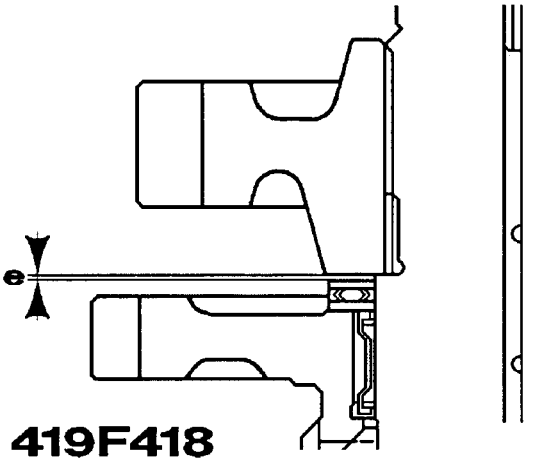
5. **2nd speed gear**
   Install 2nd gear (54), then assemble needle bearing (53).
   ★ If the spline of the gear cannot be aligned, rotate the gear lightly. Never try to force the gear into position.

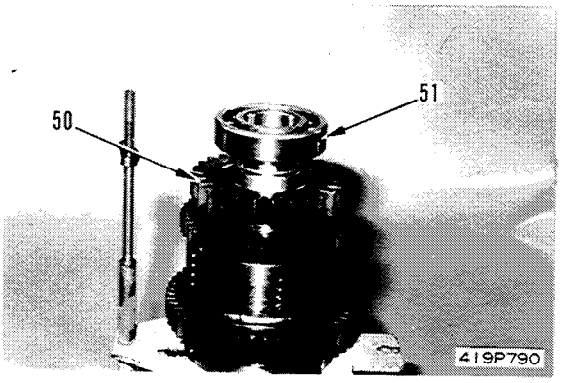


6. **Thrust bearing**
   Install thrust bearing (52).
   ★ Check that the end face of the thrust bearing is level with or below the stepped part of the shaft.



7. **Bearing**
   Assemble idler gear (50), then press fit bearing (51).
   ★ After press fitting the bearing, check that clearance 'e' between the thrust bearing and the idler gear is within the standard range.
   'e' = 0.04 - 0.71 mm





8. 4th speed piston

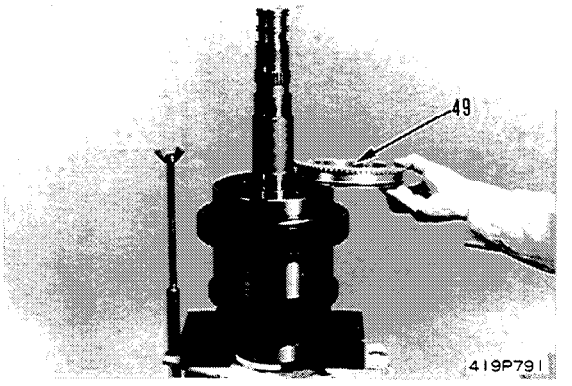
1) Turn over clutch pack.

⚠ When turning over the clutch pack, be careful not to get your fingers caught between the stand and clutch pack.

★ Put a block on top of the stand.

2) Assemble piston (49) in same way as for 2nd speed piston.

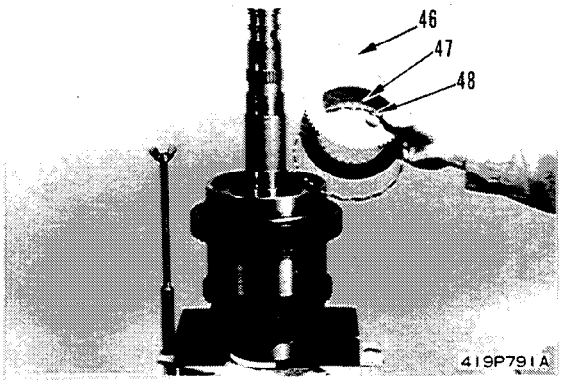
Sliding surface of piston seal: Transmission oil



9. Clutch plate

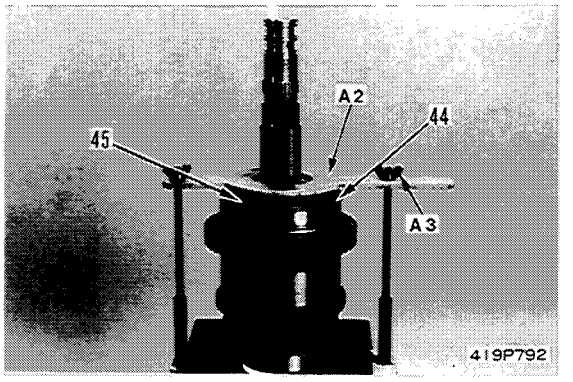
Assemble plate (46), disc (47) and spring (48).

★ Assemble in the same way as for the 2nd speed side.



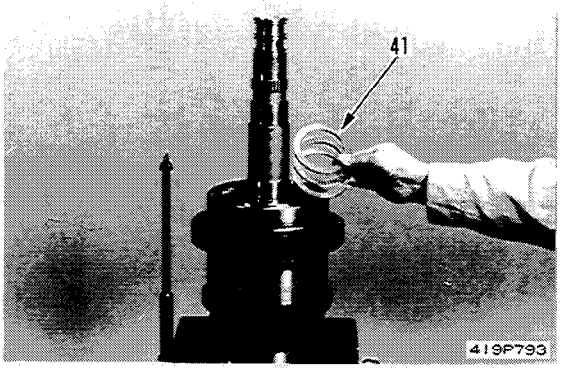
10. End plate

1) Install tool A_2 and tighten tool A_3 to push in end plate (45).
2) Assemble ring (44), then remove tool A_2.
   ★ Assemble in the same way as for the 2nd speed side.



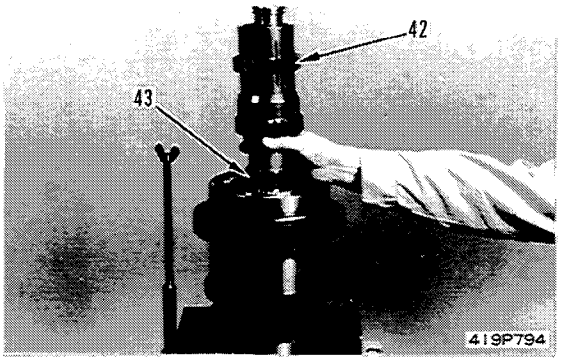
11. Thrust bearing

Install thrust bearing (41).



12. 4th gear

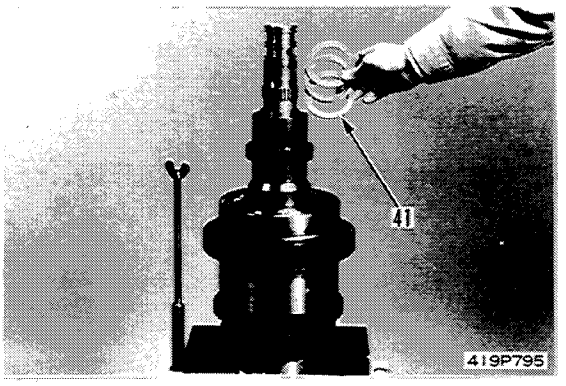
1) Assemble in same way as for 2nd speed side.
2) Install 4th gear (42), then assemble needle bearing (43).
   ★ Assemble the needle bearing at the bottom first.



13. Thrust bearing

Assemble thrust bearing (41).

★ Check that the end face of the thrust bearing is level with or below the stepped part of the shaft.

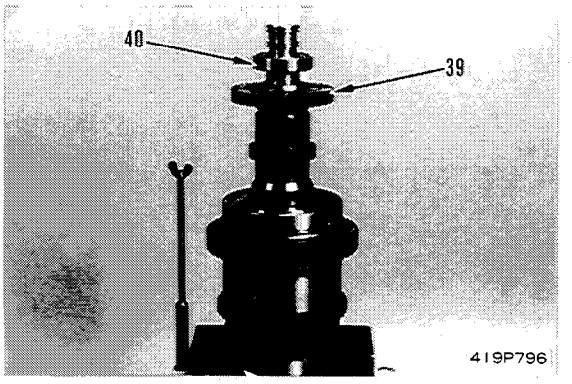


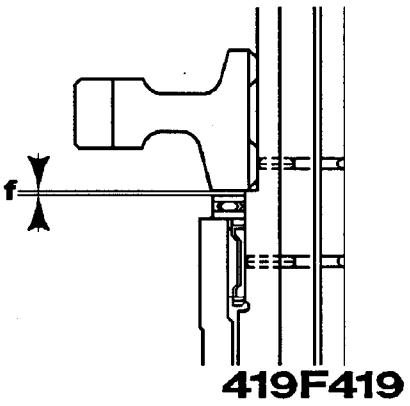
14. Bearing

Install idler gear (39), then press fit bearing (40).

★ Press fit completely so that the idler gear is in close contact with the stepped part of the shaft, and bearing (40).

★ After press fitting the bearing, check that clearance 'f' between the thrust bearing and the spacer is within the standard range.
'f' = 0.10 - 1.23 mm

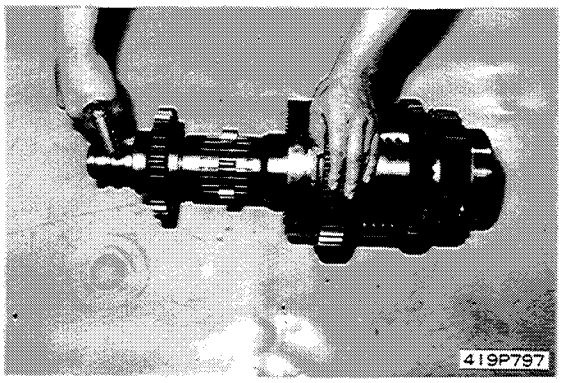




15. Clutch pack operation test

Blow in compressed air through the oil hole in the shaft and check the operation of each clutch.

★ If the gear on the side where the air is blown in is held in place, the clutch is working normally.



TRANSMISSION CONTROL VALVE
REMOVAL

⚠ Park the machine on level ground, set the safety bar on the frame, ground the bucket, shut down the engine, apply the parking brake and place blocks under the tires.
⚠ Open the engine hood and lock it.

- Remove hydraulic tank side cover and transmission oil filler cover.

1. **Draining oil**
   Remove drain plug (1) and drain oil from transmission case.

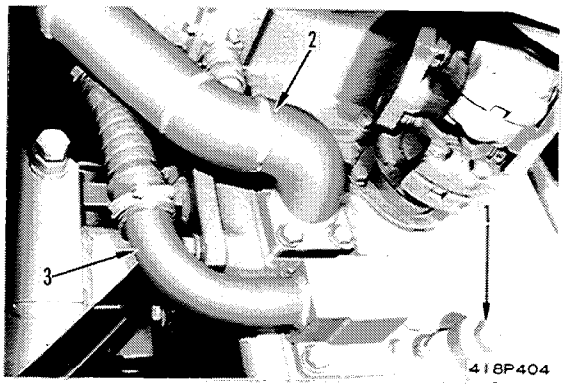
   Transmission oil: 30ℓ

2. **Hydraulic piping**
   1) Remove transmission oil filler tube (2).
   2) Remove tube (3) between transmission and torque converter charging pump.
   3) Disconnect the following hydraulic piping from transmission control valve.
      - Tube (4) between transmission control valve and torque converter regulator valve.
      - Tube (5) between transmission control valve and torque converter regulator valve.
      - Hose (6) between torque converter oil filter and transmission control valve.
        ★ Remove clamp support of hose (7).
      - Hose (8) between transmission control valve and oil cooler.
        ★ Remove the elbow of hose (5).
3. **Electric wiring**
   Disconnect wiring (9) of transmission solenoid valve from connector.
   ★ When removing the wiring connector, be careful not to damage or deform the thread case.
4. **Transmission control valve**
   Sling transmission control valve, remove mounting bolts, then lower and remove from under the machine.

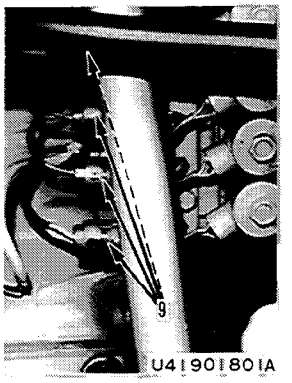
⚠ There is little space, so be careful when working.

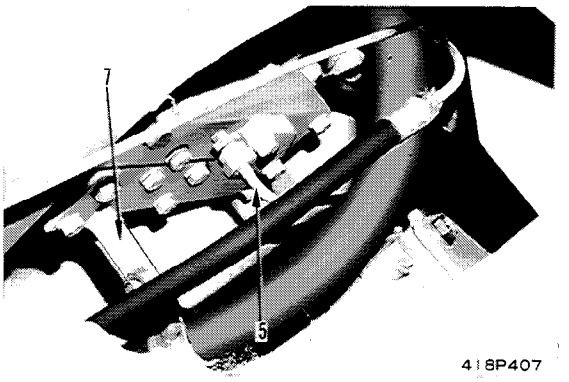
★ When installing the lifting tool, avoid the connectors and fit securely to the valve itself.

kg Transmission control valve: 48 kg









INSTALLATION

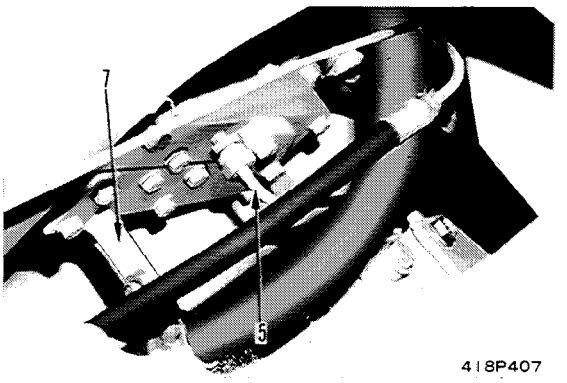
1. **Transmission control valve**
   Set transmission control valve in mounting position, then tighten mounting bolts.
   ★ For the tightening torque and order of the mounting bolts, see page 23-58, the section under the bolts installing the transmission valve.

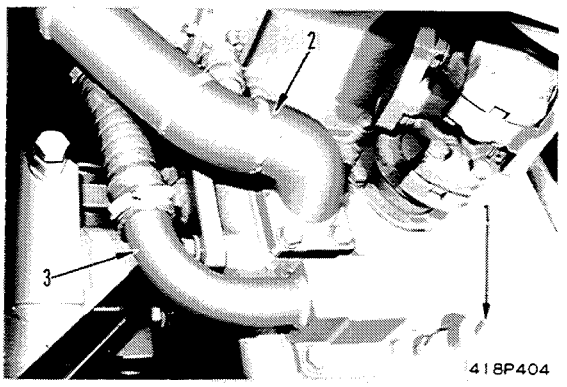
2. **Electric wiring**
   Connect wiring (9) of transmission solenoid valve to connector.
   ★ When installing the wiring connector, be careful not to deform the thread case.





3. **Hydraulic piping**
   1) Connect the following hydraulic piping to transmission control valve.
      - Hose (8) between transmission control valve and oil cooler.
      - Hose cap width across the flat: 41 mm
      - Hose (6) between torque converter oil filter and transmission control valve.
      - Hose cap width across the flat: 36 mm
        ★ Mount clamp support of hose (7) to transmission.
      - Tube (5) between transmission control valve and torque converter regulator valve.
      - Tube (4) between transmission control valve and torque converter regulator valve.
      - Tube nut width across the flat: 36 mm
   2) Install tube (3) between transmission and torque converter charging pump.
   3) Install transmission oil filler tube (2).



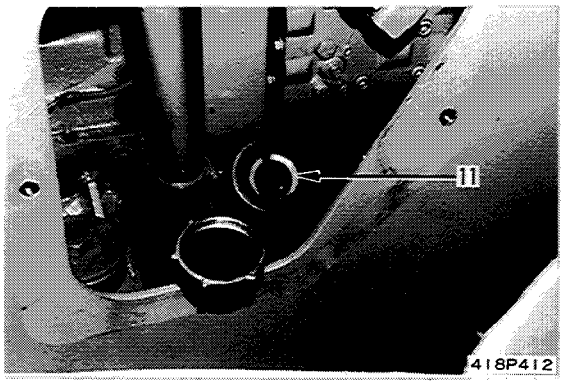


4. Refilling with oil

Tighten drain plug and add transmission oil through oil filler (11) to the specified level.

Transmission oil: 30ℓ

- Install the hydraulic tank side cover and transmission oil filler cover.

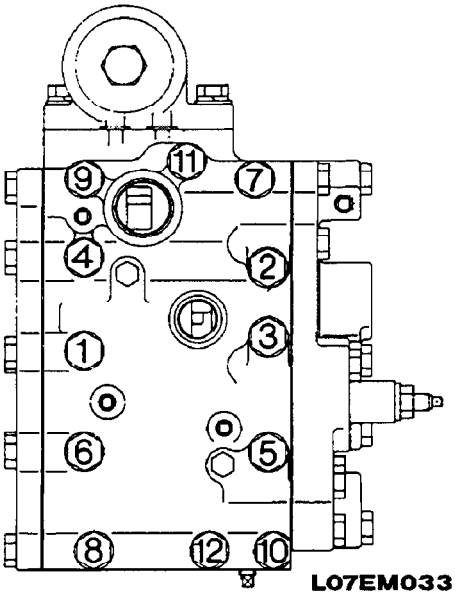


Transmission valve mounting bolts

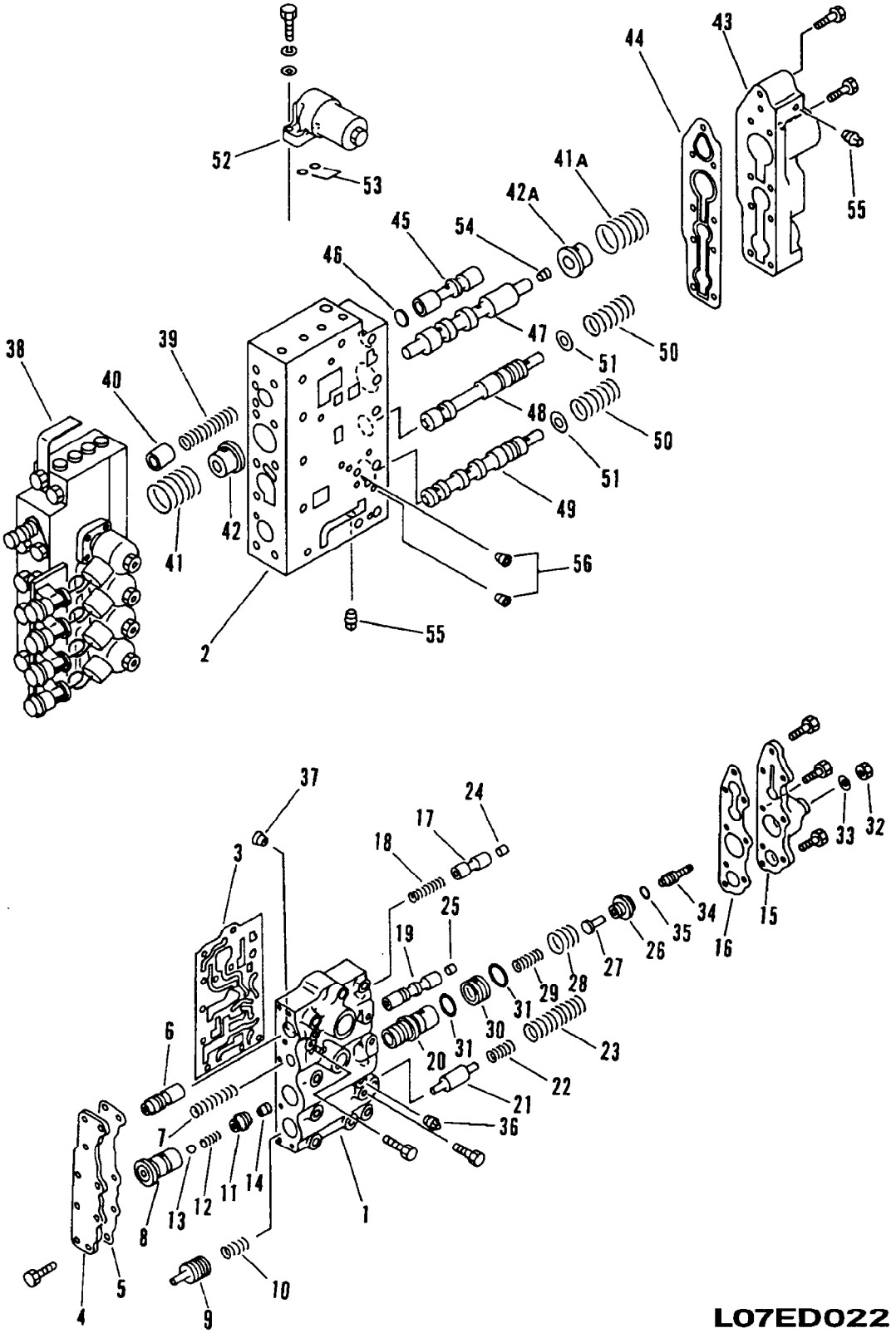
★ Tighten the bolts installing the transmission valve in the order indicated in the picture below to avoid the valve body from being distorted.

★ Torque down by two steps.

First step	1.5±0.5 kgm
Second step	3.5±0.5 kgm



Disassembly of Transmission Control Valve

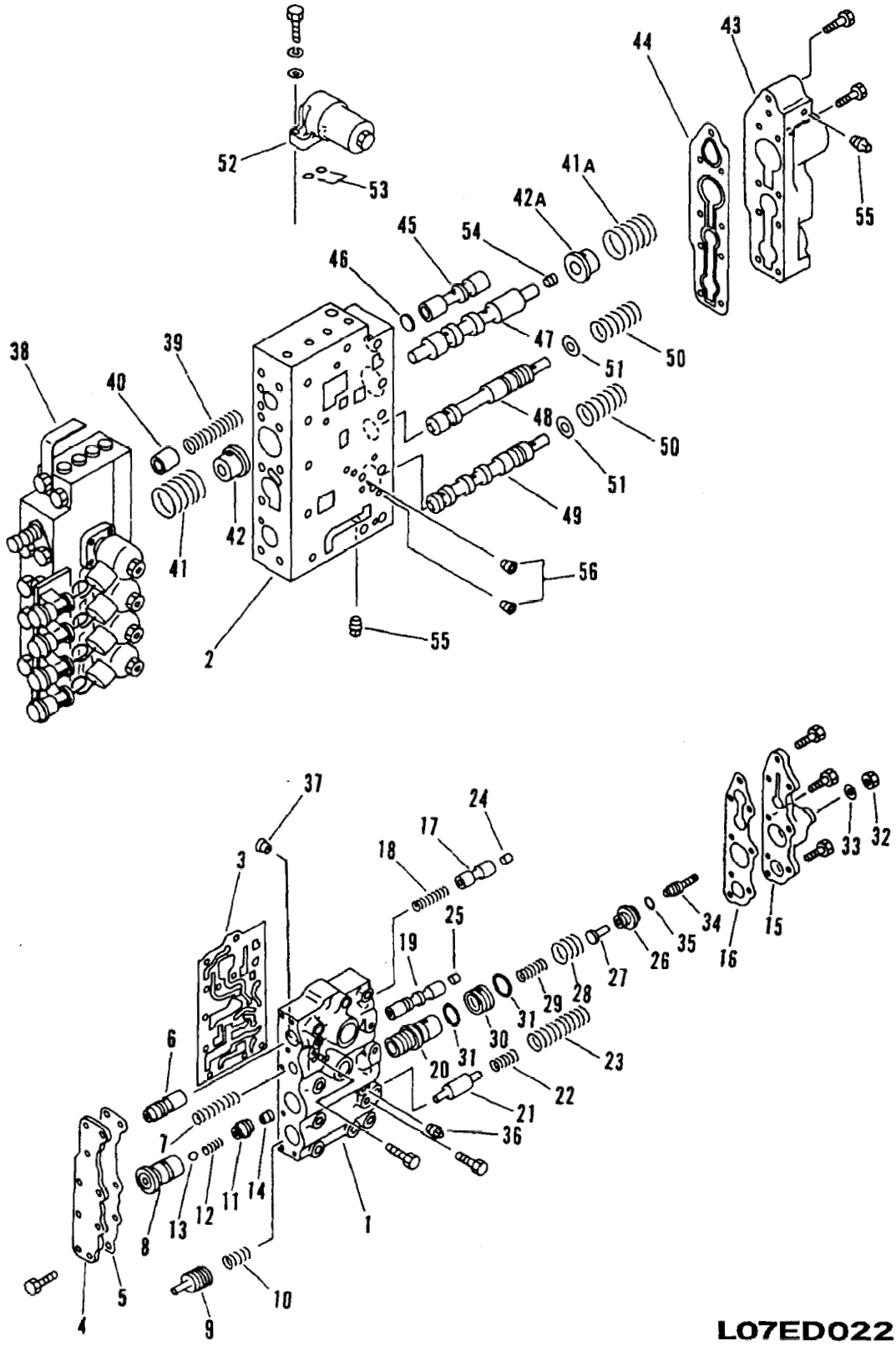


1. **Separating**
   Remove the mounting bolts, separate the unit into upper valve (1) and lower valve (2) and remove gasket (3).

2. **Disassembly of upper valve**
   1) Remove cover (4) with its mounting bolts removed, and then remove gasket (5), pilot valve (6), priority spring (7), quick return valve ass'y (8), accumulator piston (9) and spring (10).
   2) Remove sleeve (11) from the quick return valve ass'y and then remove spring (12) and ball (13).
   3) Remove plug (14) from sleeve (11).
   4) Remove cover (15) with its mounting bolts removed, and then remove gasket (16), (main regulator valve (17), spring (18), priority valve (19), modulating valve ass'y (20), accumulator shaft (21) and springs (22 and 23).
   5) Remove load pistons (24 and 25) from main regulator valve (17) and priority valve (19).
   6) Remove plug (26) from modulating valve ass'y (20) and then remove retainer (27), springs (28 and 29), sleeve (30) and O-ring (31).
   7) Remove nut (32) and washer (33) from cover (15) and then remove adjust screw (34) and O-ring (35).
   8) Remove plug (36) and main orifice (37) from upper valve (1).

3. **Disassembly of lower valve**
   1) Remove solenoid valve ass'y (38) with its mounting bolts removed, and then remove gasket, spring (39), retainer (40), spring (41) and sleeve (42).
   2) Remove cover (43) with its mounting bolts removed, and then remove gasket (44), torque converter regulator valve (45), shim (46), spring (41A), sleeve (42A), forward-reverse selector valve (47), H-L selector valve (48), range selector valve (49), spring (50) and spacer (51).
   3) Remove pilot filter (52) and O-ring (53) with the mounting bolt removed.
   4) Remove plug (54) from forward-reverse selector valve (47).
   5) Remove plug (55) from lower valve (2) and cover (43).
   6) Remove orifice (56) from lower valve (2).

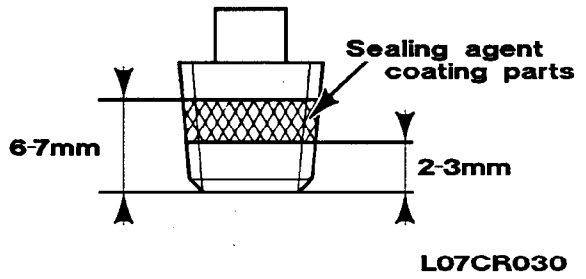
Assembly of Transmission Control Valve



1. Assembly of lower valve

1) Fit orifice (56) to lower valve (2).
   ★ Turn in the orifice until it clears the body by 2 mm or longer.
2) Fit plug (55) to lower valve (2) and cover (43).

Plug: Sealer (LG-1 or LG-5)



3) Fit plug (54) to forward-reverse selector valve (47).
4) Fit O-ring (53) to pilot filter (52) and mount the pilot filter in position by tightening its mounting bolt.

Mounting bolt: 7.0±0.5 kgm

5) Fit H-L selector valve (48), range selector valve (49), spacer (51), spring (50), forward-reverse selector valve (47), sleeve (43A), spring (41A), shim (46) and torque converter regulator valve (45), and then mount cover (43) with gasket (44) suitably fitted in position.

Mounting bolts: 7.0±0.5 kgm

6) Fit sleeve (42), spring (41), retainer (40) and spring (39), and mount solenoid valve ass'y (38) to lower valve (2) with gasket suitably fitted in position.

2. Assembly of upper valve

1) Fit plug (36) and main orifice (37) to upper valve (1).
   ★ Turn in the orifice until it clears the body by 2 mm or longer.

Plug: Sealer (LG-1 or LG-5)

2) Fit adjusting screw (34) together with O-ring (35) to cover (15) and also fit washer (33) and nut (32) to cover (15).
   ★ See "Testing and Adjusting Volume" for the adjusting procedure.
3) Fit plug (26) to modulating valve ass'y (20); fit O-ring (31) to sleeve (30) and then fit springs (28 and 29) and retainer (27).
4) Fit load pistons (24 and 25) to main regulator valve (17) and priority valve (19).
5) Fit springs (22 and 23), accumulator shaft (21), modulating valve ass'y (20), priority valve (19), spring (18) and main regulator valve (17) to cover (15); and then mount cover (15) with gasket (16) suitably fitted in position.

Mounting bolts: 7.0±0.5 kgm

6) Fit plug (14) to sleeve (11), set ball (13) and spring (12) to quick return valve (8) and then mount sleeve (11).
7) Fit spring (10), accumulator piston (9), quick return valve ass'y (8), priority spring (7) and pilot valve (6) to cover (4). Then mount cover (4) with gasket (5) suitably fitted in position.

Mounting bolts: 7.0±0.5 kgm

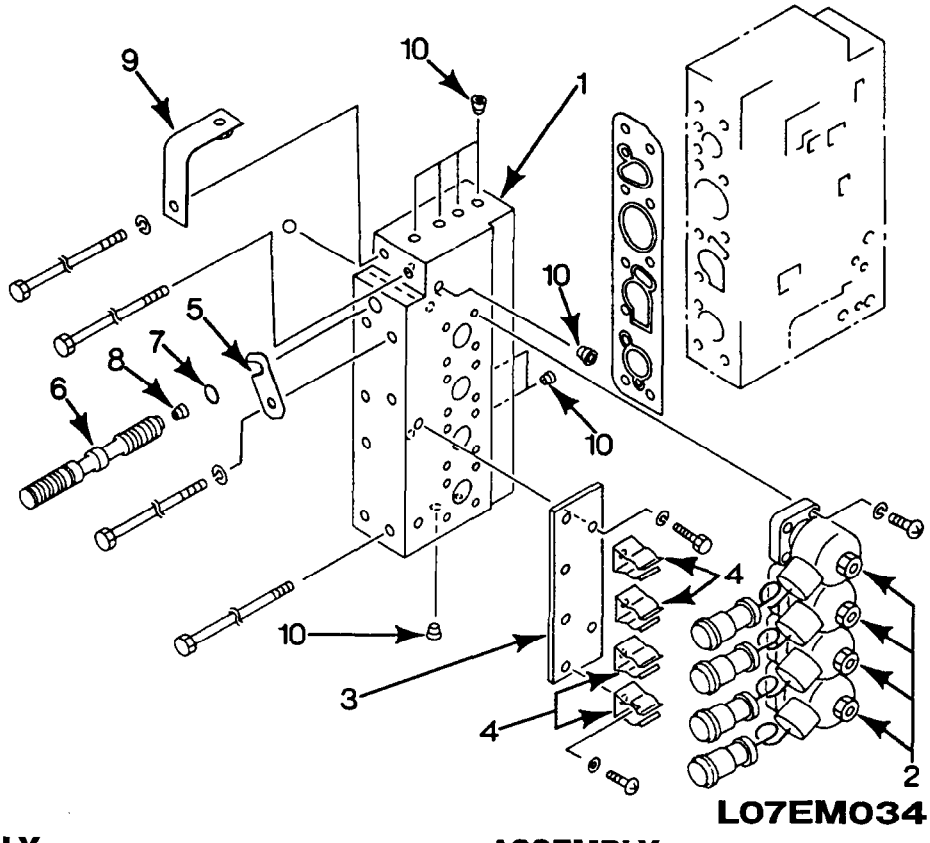
3. Connecting

Connect lower valve (2) and upper valve (1) together with gasket (3) suitably fitted in position.

Mounting bolts: 3.2±0.5 kgm

TRANSMISSION SOLENOID VALVE

(Electrical control transmission type)



DISASSEMBLY

1. Remove mounting bolts from solenoid valve body (1) and then remove solenoid (2), plate (3) and clip (4).
2. Remove lock plate (5) and then remove emergency manual spool (6) and O-ring (7).
   1) Remove orifice (8) from emergency manual spool (6).
   2) Remove plate (9).
3. Remove plug (10) from solenoid valve body (1).

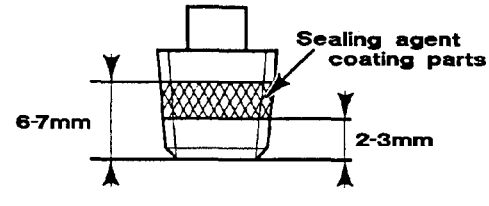
ASSEMBLY

1. Fit plug (10) to solenoid valve body (1).

   Plug: Sealer (LG-1 or LG-5)

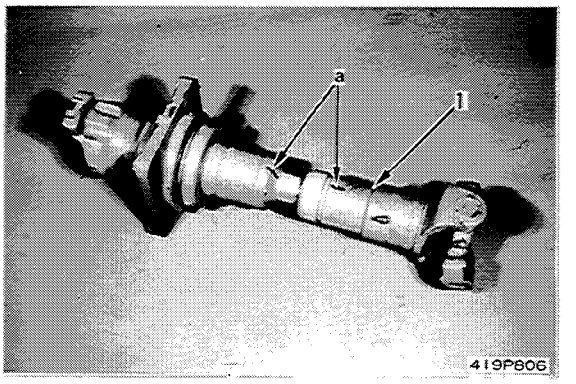
2. Fit orifice (8) and O-ring (7) to emergency manual spool (6), and fix them up by lock plate (5).
   1) Mount plate (9).
3. Fit plate (3) and clip (4) to solenoid (2), and mount solenoid (2) to valve body (1) by bolts.

   Mounting bolts: 7.0±0.5 kgm

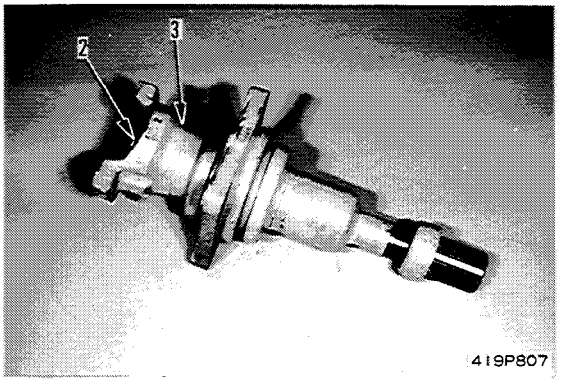


DRIVE SHAFT
DISASSEMBLY

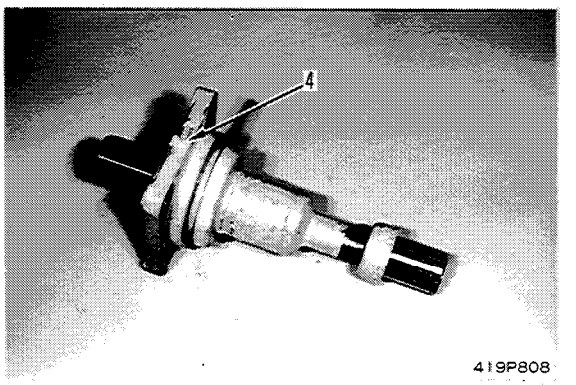
1. **Front drive shaft**
   1) Remove coupling and tube (1).
      ★ Make match marks "a" before removing so that the direction of the coupling does not change.



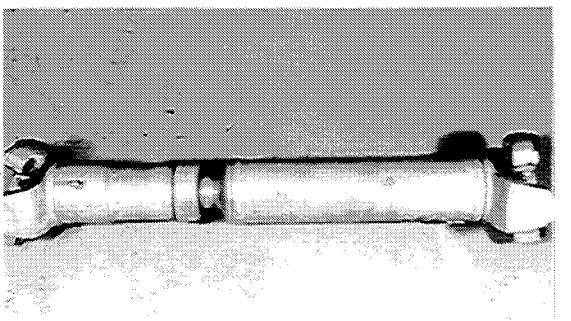
   2) Loosen bolt (2), then remove coupling (3) and retainer.
      ★ Make match marks before removing so that direction of the coupling does not change.



   3) Using a press, remove flange bearing (4).



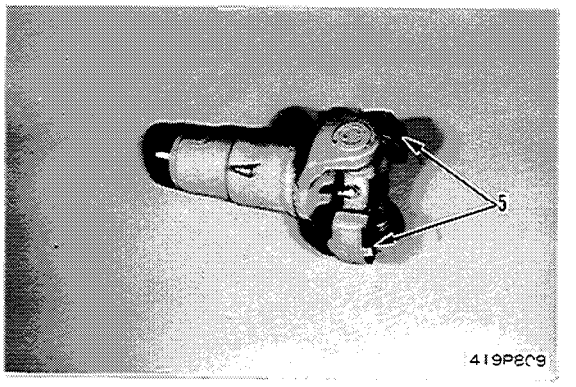
2. **Center drive shaft, rear drive shaft**
   ★ Follow the procedure in 1. **Front drive shaft** Step 1).



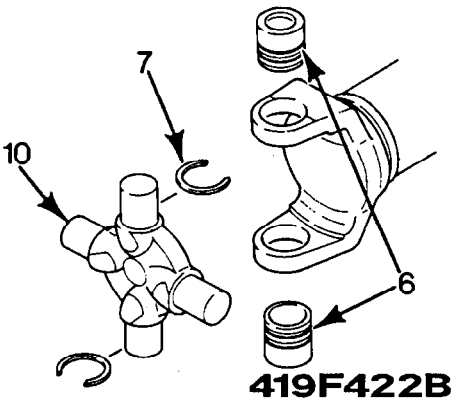
418P413

3. Spider, bearing

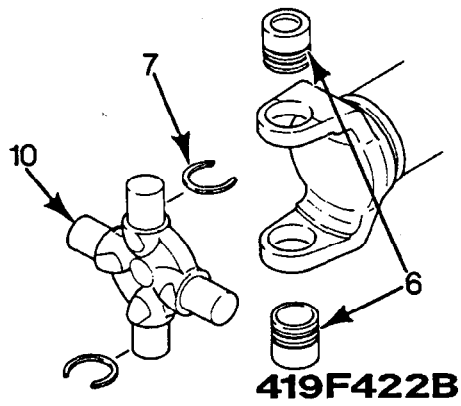
1) Remove seal and bearing caps (5).



2) Remove ring (7) of spider (10) and bearing (6), then tap with plastic hammer to remove spider and bearing.
   ★ Repeat the same procedure for the front, center and rear drive shafts.



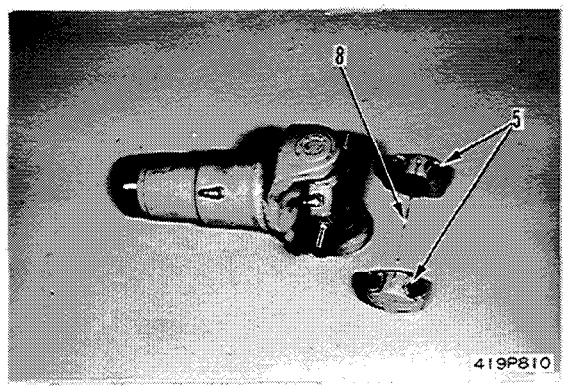
ASSEMBLY



1. **Spider, bearing**
   1) Set spider (10) and bearing (6) in mounting position, assemble ring (7), then install.
      ★ Assemble so that the grease nipples face in the same direction.
      ★ Repeat the same procedure for the front, center and rear drive shafts.

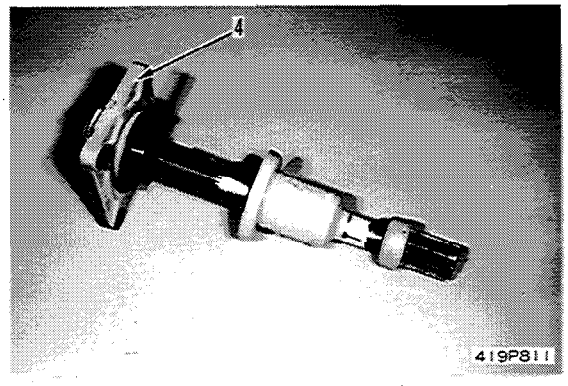
   2) Install bearing cap (5).
      ★ Check that there is a bearing and Derling washer inside the bearing cap.

   Bearing cap: Grease (G2-L1)



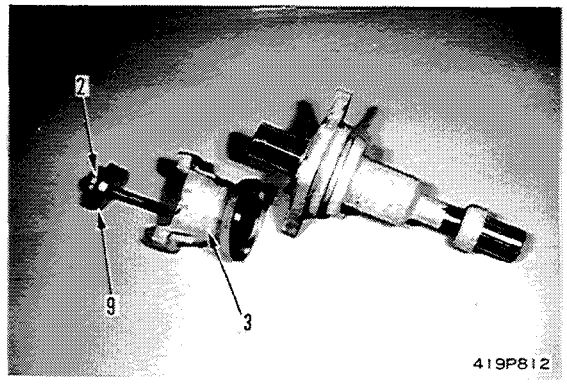
   ★ If the spider and bearing cap are worn, replace the spider and bearing.
   ★ Heat will damage the bearing, so do not weld strap (8) of the cap.

2. **Front drive shaft**
   1) Press fit flange bearing (4).
      ★ Do not hit the flange bearing directly with a hammer.



   2) Align match marks, install coupling (3) and retainer (9), then tighten mounting bolt (2).
      ★ Tighten the bolts to the specified tightening torque after installing on the machine.

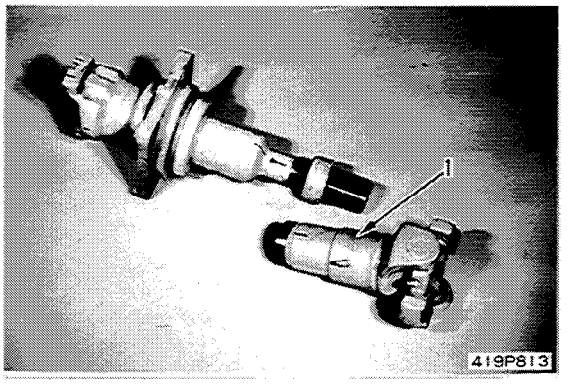
   Spline: Grease (G2-L1)



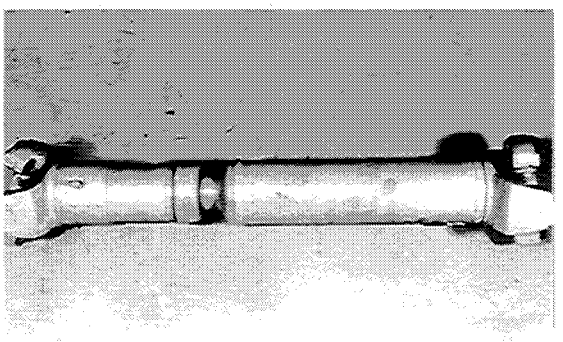
   Mounting bolt : 28.5±3.0 kgm

3) Align match marks and install coupling and tube (1).
   - ★ Check that the couplings are facing in the same direction.
   - ★ If the spline is worn, replace the whole drive shaft assembly.

Spline: Grease (G2-L1)



3. Center drive shaft, rear drive shaft
- ★ Follow the procedure in **1. Front drive shaft** Step 3).

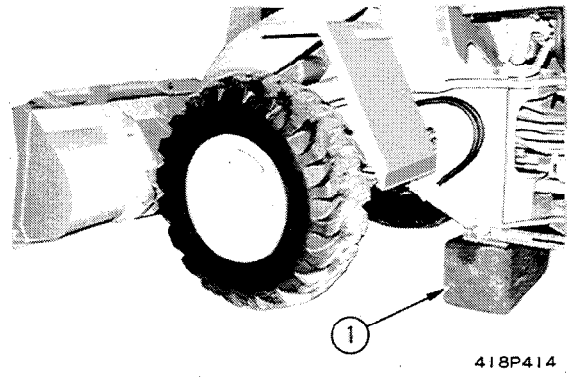




FRONT AXLE
REMOVAL

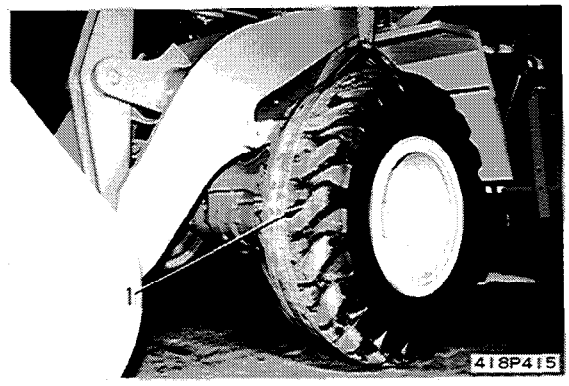
⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the work equipment to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

1. Jack up machine, and put blocks ① under front frame.
   ★ Use the bucket to raise the front frame, and insert the block when the tires are slightly off the ground.



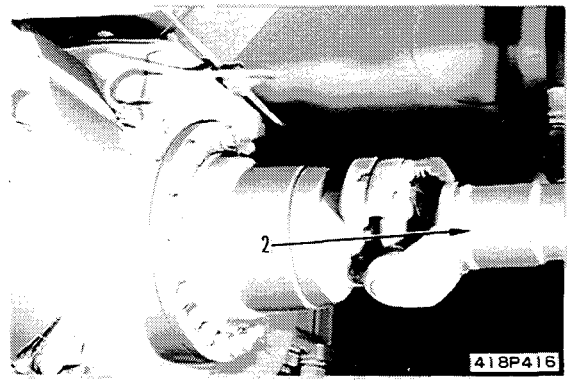
2. **Tire, wheel**
   Sling tire and wheel (1), remove mounting bolts, then lift off.

kg Tire, wheel: 225 kg

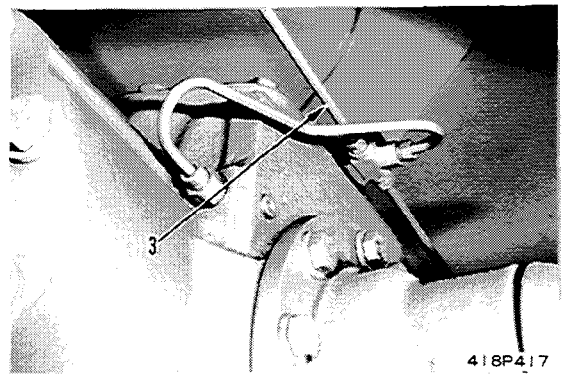


3. **Front drive shaft**
   Disconnect front drive shaft (2).

kg Front drive shaft: 20 kg

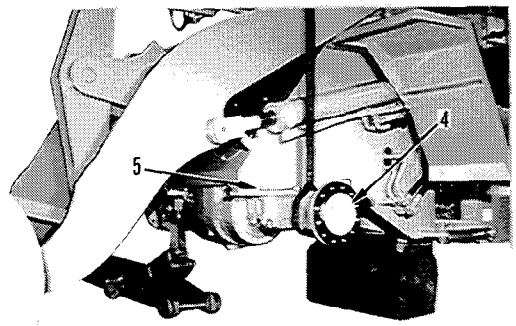


4. **Axle**
   1) Disconnect brake tube (3).



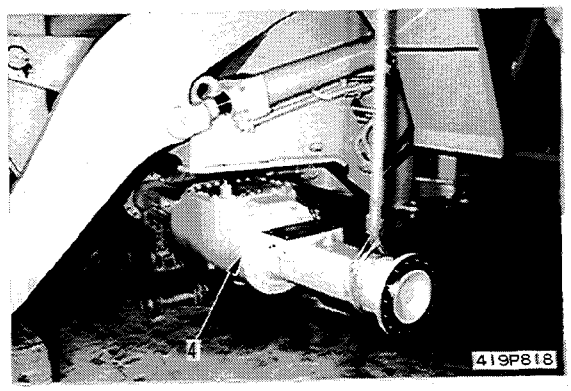
2) Using jack and hoist, sling axle (4), then remove mounting bolts and lower axle.
★ Use the jack to adjust the height when removing the mounting bolt.

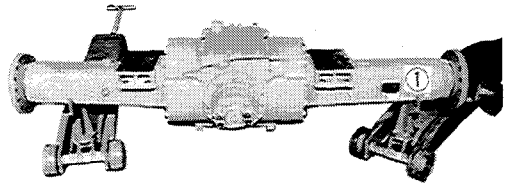
kg Axle: 460 kg



418P418

3) Pull out axle assembly from machine.
★ Use the jack and hoist.

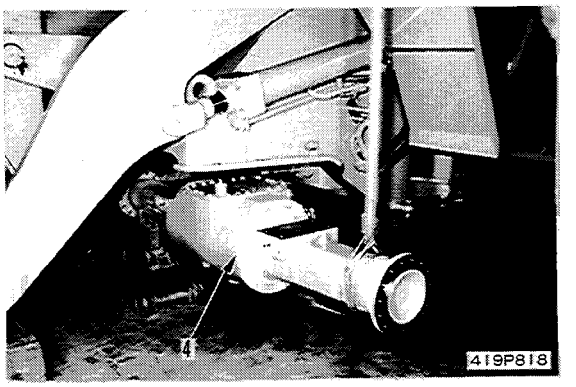




419P819

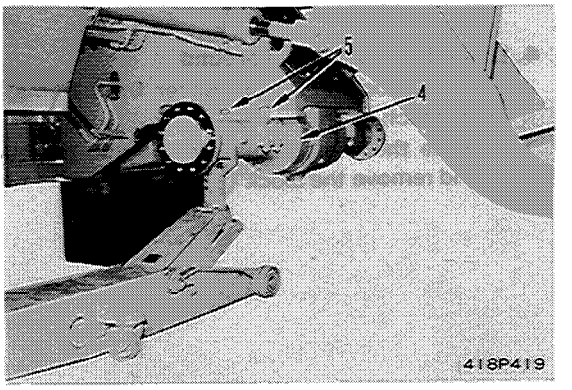
INSTALLATION

1. **Axle**
   1) Insert axle under machine body.
      ★ Use a hoist and jack to insert the axle.



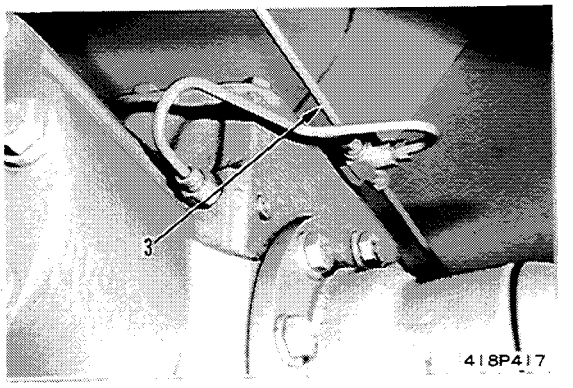
   2) Raise axle (4) with jack and hoist, set in mounting position, then tighten mounting bolts (5).
      ★ Use the bolts as guides to align with the mounting position.
      ● Mounting bolt width across the flat: 36 mm

      Mounting bolt: 69±7.0 kgm



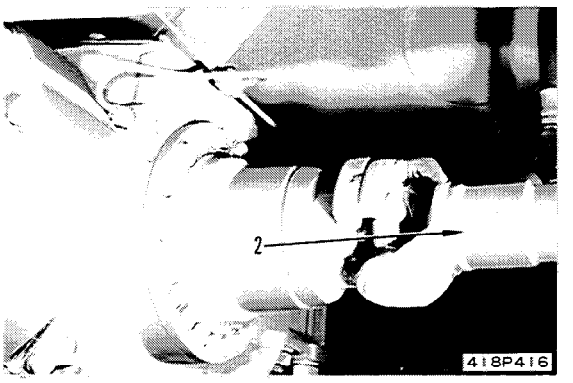
   3) Connect brake tube (3).
      ★ Be careful not to tighten the tube too much.

      Tightening torque of tube nut: 1.2±0.3 kgm



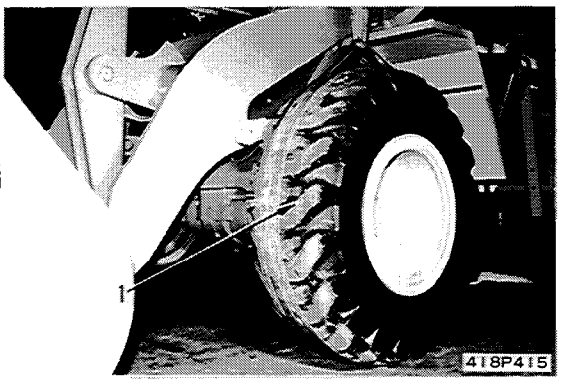
2. **Front drive shaft**
   Connect front drive shaft (2).

   Drive shaft: 6.75±0.75 kgm

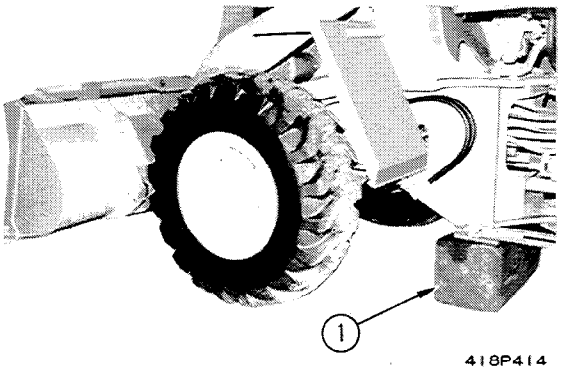


3. **Tire, wheel**
   Raise tire and wheel (1), set in mounting position, then tighten the mounting bolts.
   - Mounting bolt width across the flat: 36 mm

   Mounting bolt: 94.5±10.5 kgm



4. **Lowering machine to ground**
   Remove block ① from under front frame, and lower machine to ground.
   ★ Raise the front frame slightly with the bucket and remove the block ①.



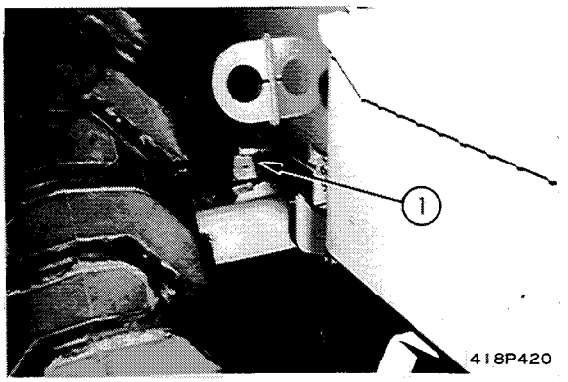
5. **Bleeding air from brakes**
   ★ For details of bleeding air, see SECTION 52, TESTING AND ADJUSTING.

REAR AXLE
REMOVAL

⚠ Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, shut down the engine, apply the parking brake and place blocks under the tires.

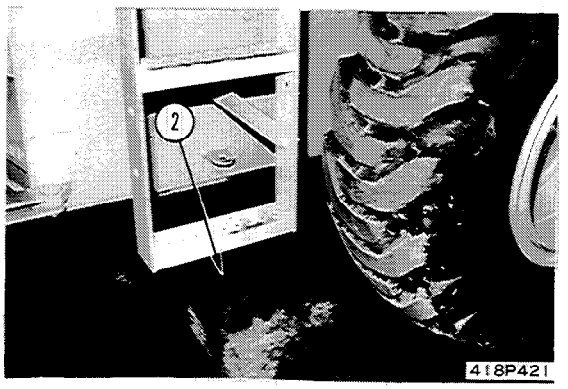
1. Raise machine

1) Put blocks ① between left and right rear axles and rear frame.



2) Put blocks ② under rear frame and jack up machine.

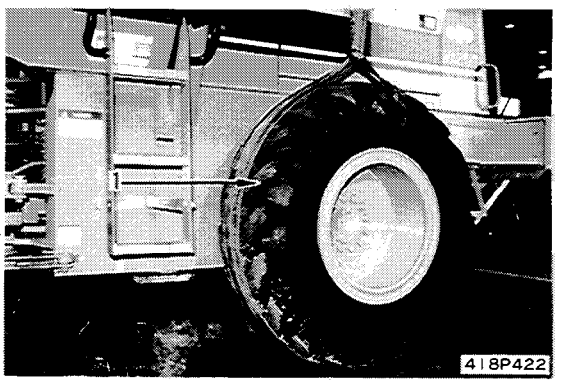
★ Use garage jack to raise the rear frame, and insert the blocks ② when the tires are slightly off the ground.



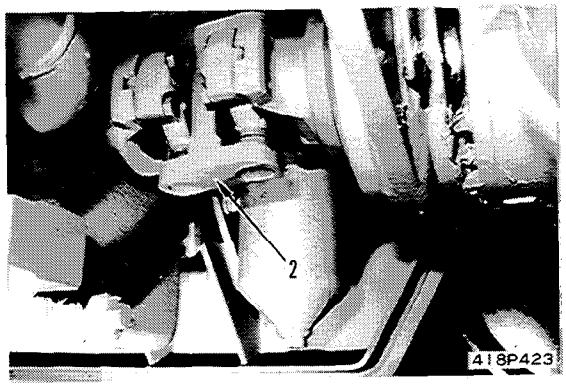
2. Tire, wheel

Sling tire and wheel (1), remove mounting bolts, then lift off.

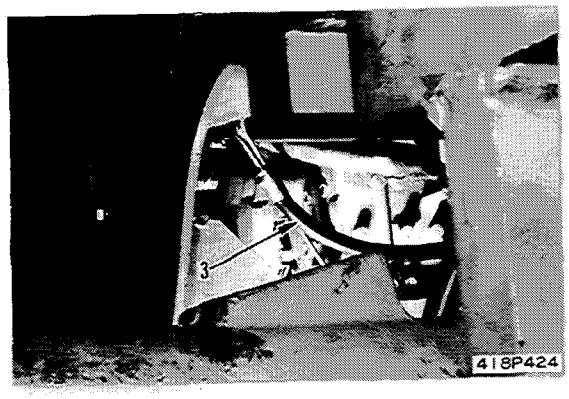
kg Tire, wheel: 225 kg



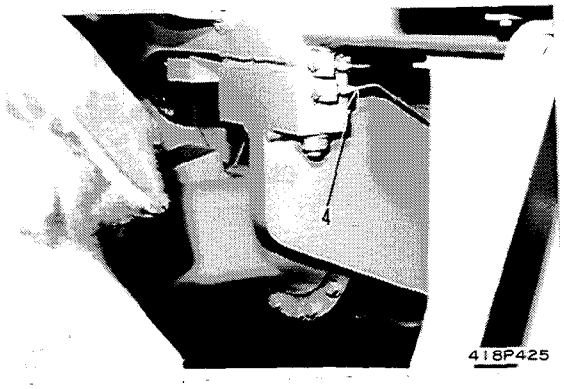
3. **Rear drive shaft**
Remove rear drive shaft (2).
★ Make match marks to show the mounting position.



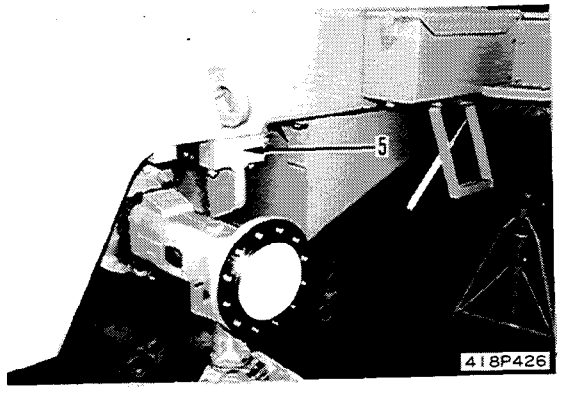
4. **Brake hose, grease tubes**
1) Disconnect brake hose (3).



2) Remove grease tube (4).

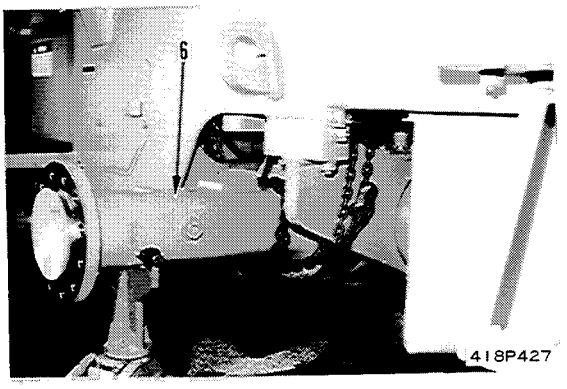


5. **Axle**
1) Secure pivot (5) to axle with wire.
★ Fit the wire securely so that the pivot cannot move.

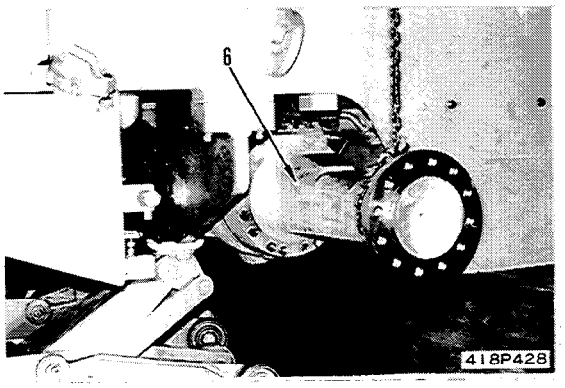


2) Sling one side of axle (6). Then, fit garage jack under other side of axle housing and remove mounting bolts.
   ★ Adjust the height of the garage jack when removing the mounting bolts.
   ★ When removing the axle, the pivot side will drop, therefore, remove the axle carefully.

kg Rear axle and pivot: 540 kg

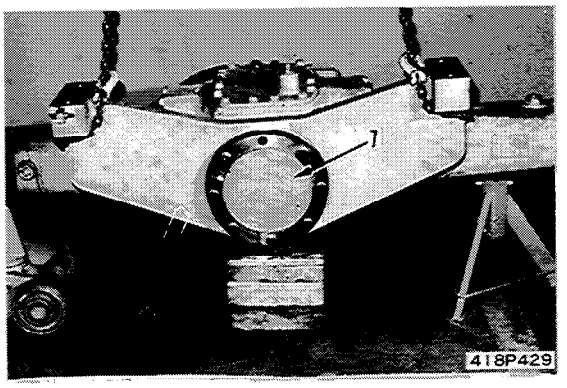


3) Pull out axle assembly from machine.
   ★ Use a hoist and jack.
   ★ After pulling the axle out from the machine body, remove wire.

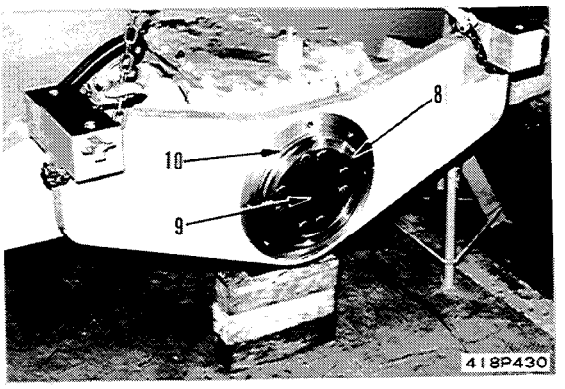


6. Rear pivot

1) Remove trunnion cap (7).
   ★ If there is shim, check the number and thickness of the shim, and keep in a safe place.

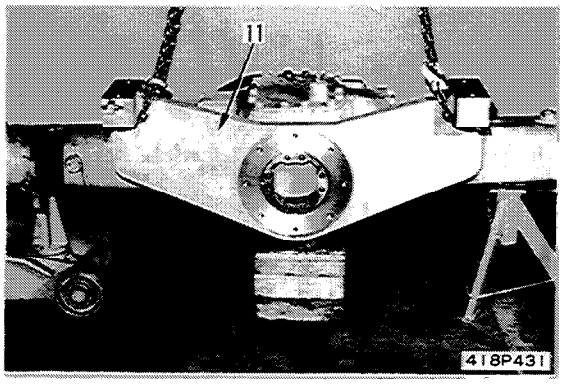


2) Remove thrust washer (8), thrust plate (9), and thrust washer (10).

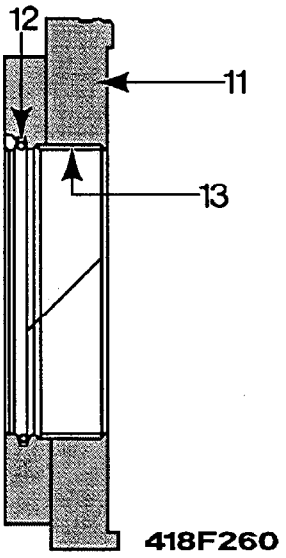


3) Lift off rear pivot (11).
★ Be careful not to let the lifting tool slip when lifting off the pivot.

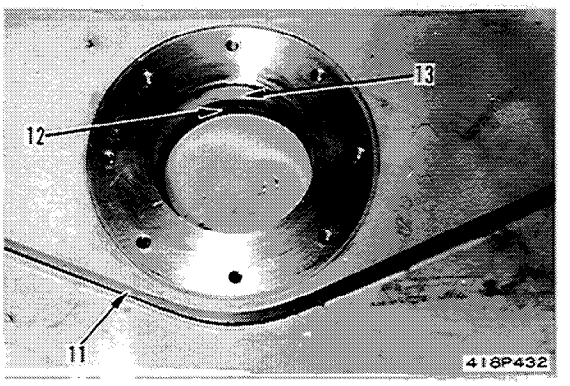
kg Rear pivot: 85 kg



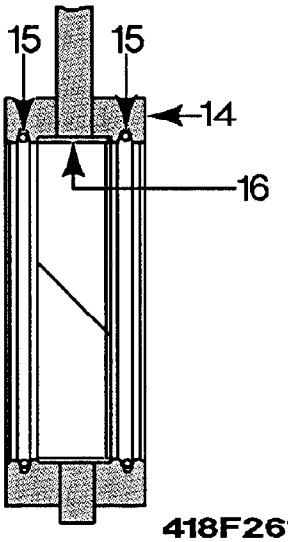
4) Remove O-ring (12) and bushing (13) from pivot (11).



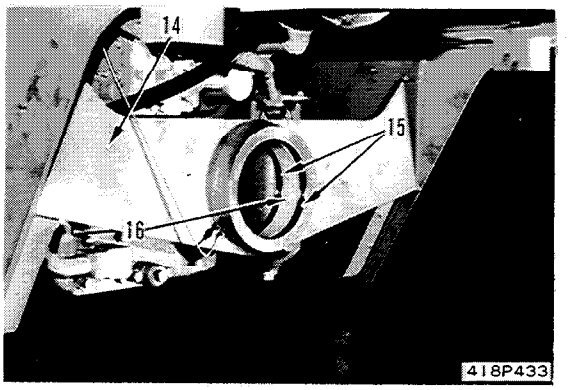
418F260



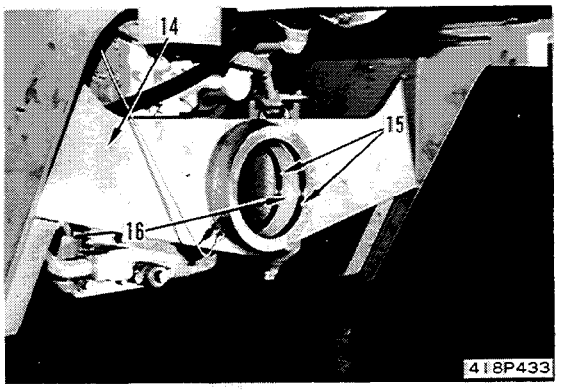
7. **Front pivot**
Remove O-ring (15) and bushing (16) from pivot (14).



418F261

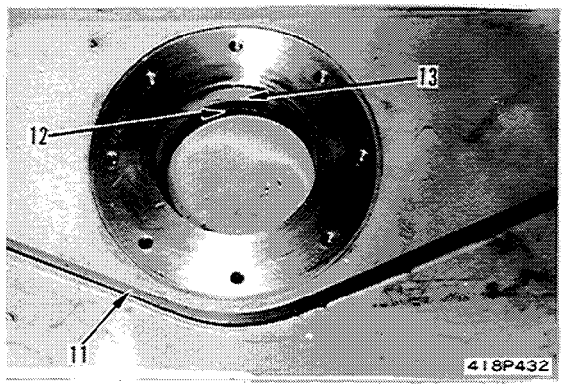


INSTALLATION



1. **Front pivot**
   1) Install O-ring (15) and bushing (16) to pivot (14).
      - ★ Assemble the bushing with the chamfered edge on the axle housing side.
      - ★ Install with the joint of the bushing at the side.

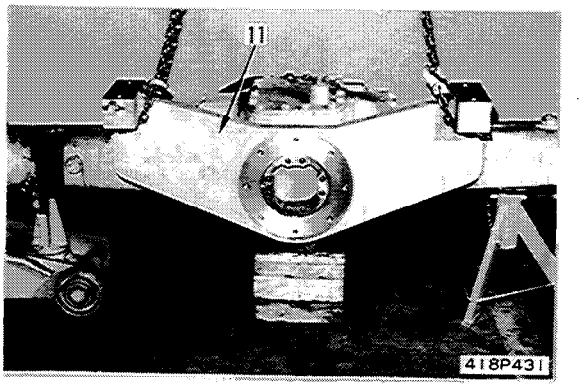
   O-ring, bushing: Grease (G2-L1)



2. **Rear pivot**
   1) Install O-ring (12) and bushing (13) to pivot (11).
      - ★ Assemble the bushing with the chamfered edge on the axle housing side.
      - ★ Install with the joint of the bushing at the side.

   O-ring, bushing: Grease (G2-L1)

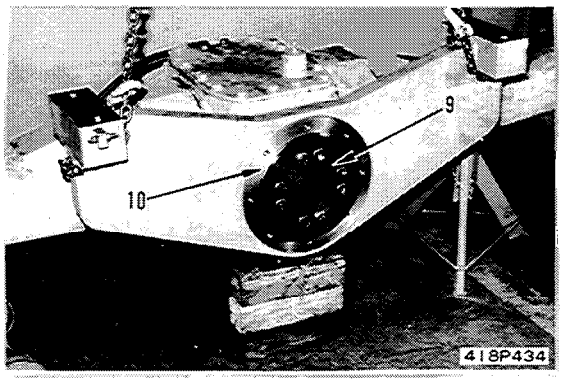
   2) Raise pivot (11), insert in axle mount.
      - ★ Check that the O-ring is not caught.



   3) Mount thrust washer (10) and thrust plate (9) on axle mounting.
      - ★ Clean the contact surface of thrust washer and thrust plate.
      - ★ Assemble the thrust washer with the chamfered edge on the thrust plate side.

   Pivot mounting outer circumference: Grease (G2-L1)

   Mounting bolt: Adhesive (Loctite 262)

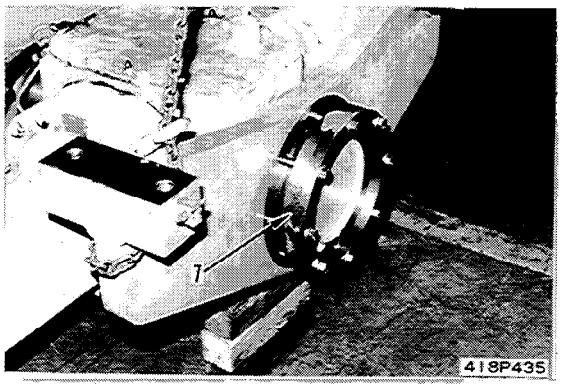


   Mounting bolt: 11.5±1.0 kgm

4) To make axle and pivot parallel, turn trunnion cap back to front, and tighten 8 bolts uniformly.

Mounting bolt: 7±1.0 kgm

★ First remove elbow for grease tube.
★ Check that the clearance between the pivot and trunnion cap is uniform.
★ Set in the mounting position on the machine with the trunnion cap turned back to front.

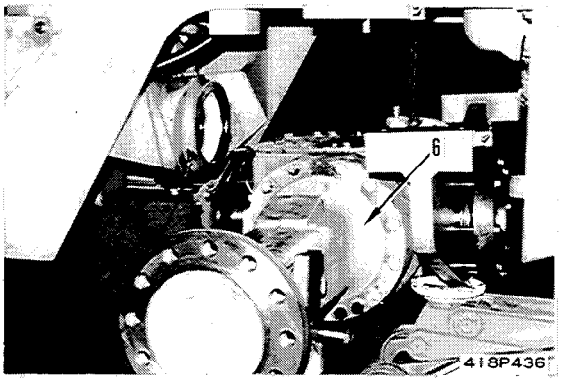


3. Axle

Raise axle (6) with jack and hoist, set in mounting position, then tighten mounting bolts.

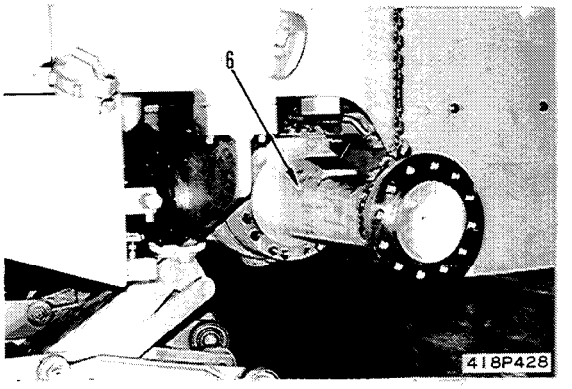
★ Use the bolts as guides to align with the mounting position.
★ Tighten the mounting bolts from the rear pivot end, and tighten in three stages.
★ After installing the axle assembly, remove the wire.
★ Mounting bolt width across the flat: 36 mm

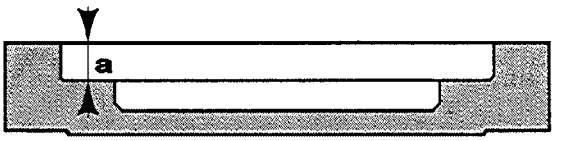
Mounting bolt: 56±6 kgm



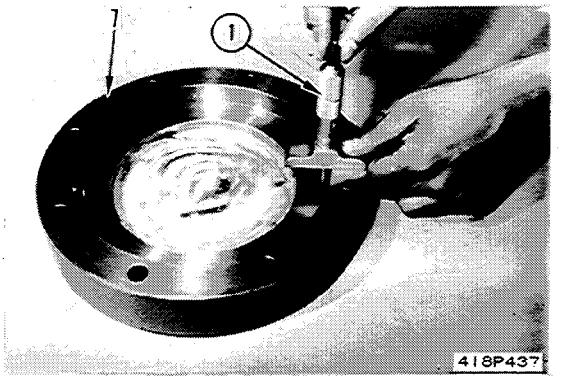
4. Adjusting shims at rear pivot

1) Measure clearance 'a' of trunnion cap (7) at four locations diagonally, with depth micrometer, and calculate the average value.
★ Clean the area that is to be measured.
★ Standard value 'a': 19.85-20.0 mm



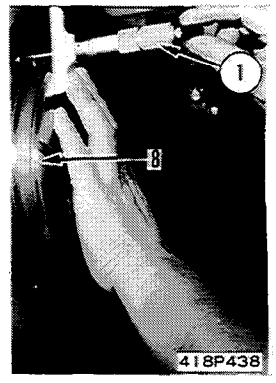


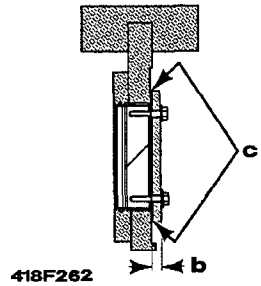
416F256

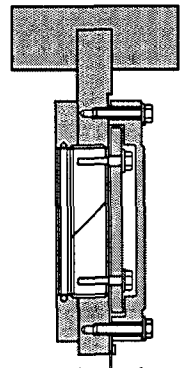


2) Install thrust washer (8) on rear pivot. Measure dimension 'b' at four locations diagonally with depth micrometer and calculate the average value.
   - ★ Clean the contact surface of thrust washer and thrust plate.
   - ★ Clean the area that is to be measured.
   - ● Reference value 'b': 19.65-20.0 mm
   - ★ Insert thickness gauge between contact surface of thrust washer and thrust plate and circumference 'c' to check that there is no clearance.
   - ★ Calculate the clearance 't' between contact surface (t = a - b) of rear pivot and trunnion cap. Then, select the number of shims.
   - ★ Select the number of shims from the following range.
   - ★ 1 shim thickness = 0.2 mm

   t (measured value) Number of shims
   mm
   0 -0.07 1 shim
   0.08-0.27 2 shims
   0.28-0.47 3 shims



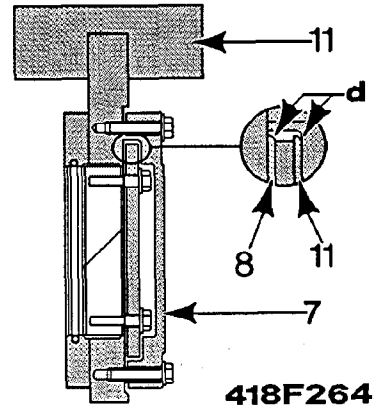




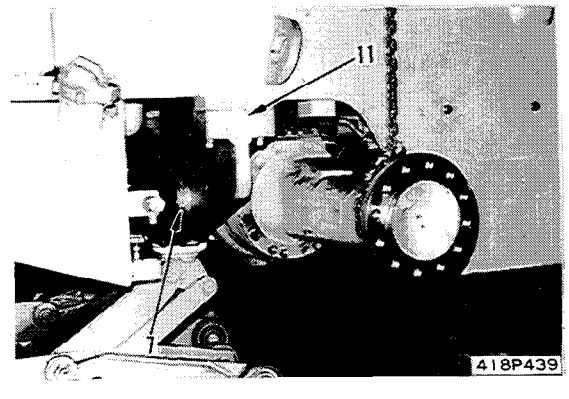
3) Install selected shims between rear pivot (11) and trunnion cap (7), and install mounting bolts.
   - ★ Fill trunnion cap with grease and mount.

Trunnion cap: Grease (G2-L1)

Mounting bolt: 11.5±1.0 kgm

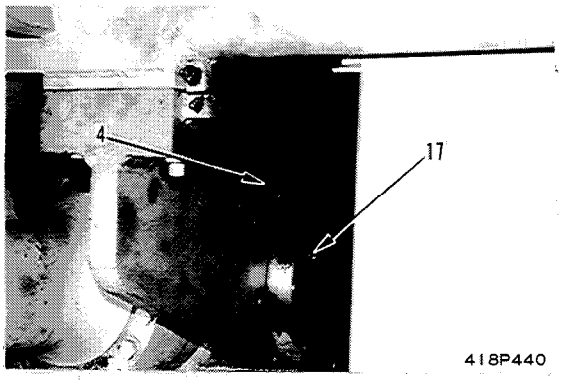


- ★ Assemble the thrust washers (8 and 10) with chamfered edges 'd' on trunnion cap (7) side.

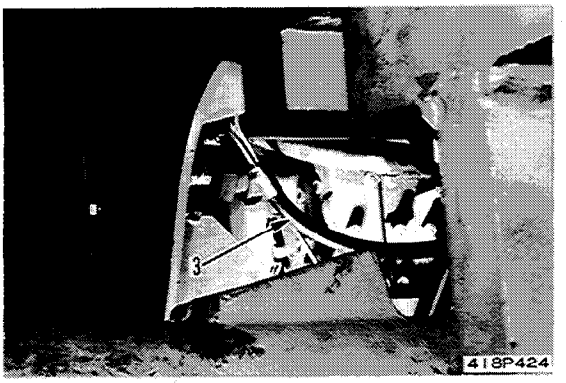


5. Brake hose, grease tubes

1) Install grease tubes elbow (17).
2) Install grease tube (4).



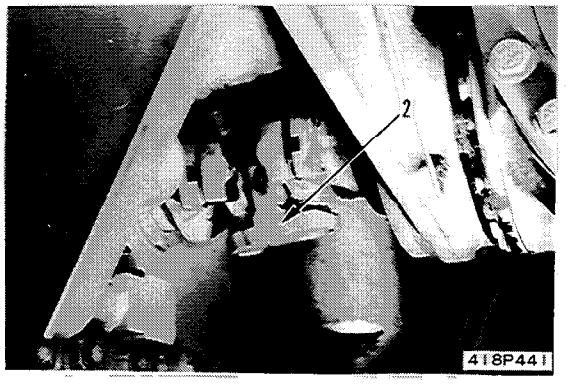
3) Connect brake hose (3).
   ★ Do not tighten the brake tube too much.



6. Rear drive shaft

Install rear drive shaft (2).
★ Align match marks and be careful to install with the coupling facing in the correct direction.

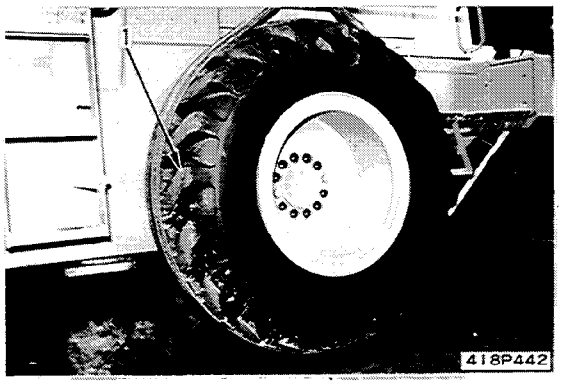
Mounting bolt: 6.75±0.75 kgm



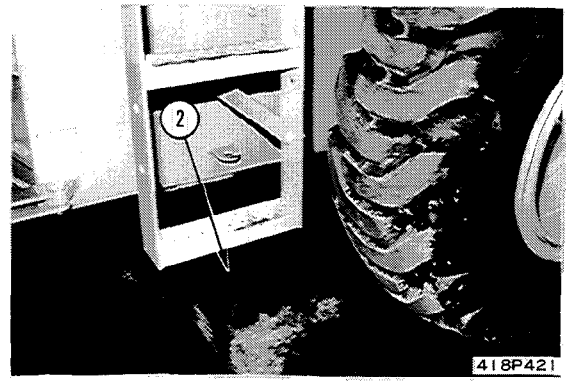
7. Tire, wheel

Sling tire and wheel (1), set in mounting position, then tighten mounting bolts.
- Mounting bolt, width across the flat: 36 mm

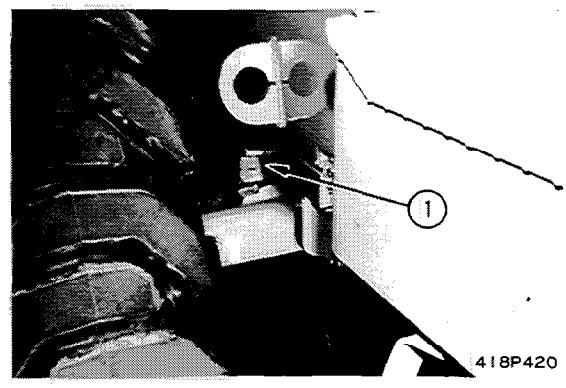
Mounting bolt: 94.5±10.5 kgm



8. **Lowering machine to ground**
   1) Remove block ② from under rear frame, and lower machine to ground.
   ★ Raise the rear frame slightly with a jack and remove the block ②.



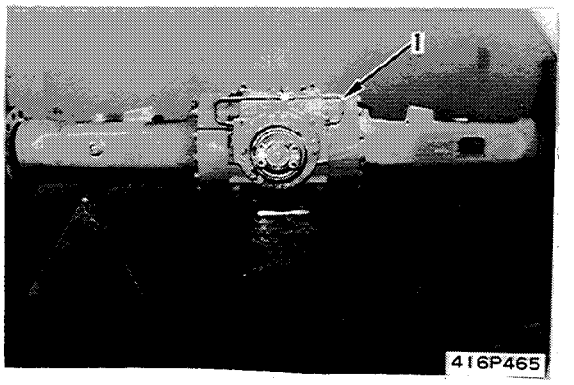
   2) Remove block ① from between left and right axles and rear frame.



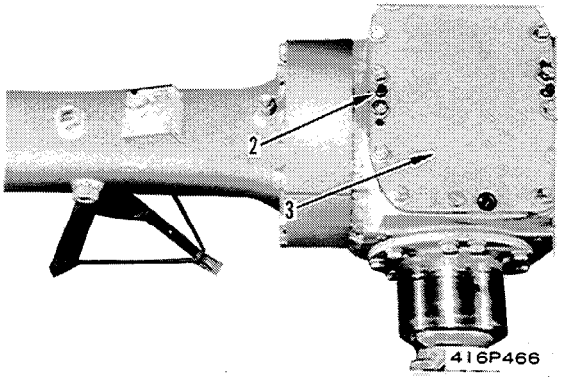
9. **Bleeding air from brakes**
   ★ For details of bleeding air, see SECTION 52, TESTING AND ADJUSTING.

DIFFERENTIAL
DISASSEMBLY

1. **Brake tube**
   Remove brake tube (1).



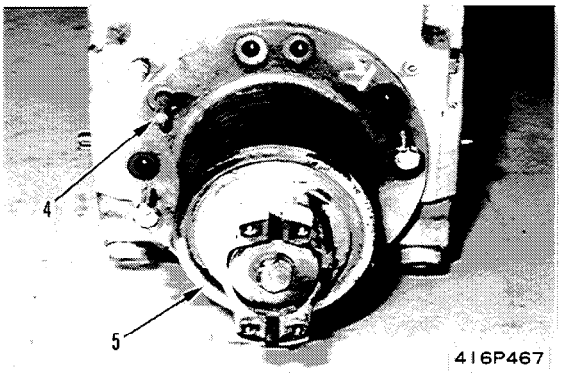
2. **Differential cover**
   Remove bleeder screw (2), then remove differential cover (3).
   ★ Install the axle assembly to a stand.
   ★ Remove the axle housing.



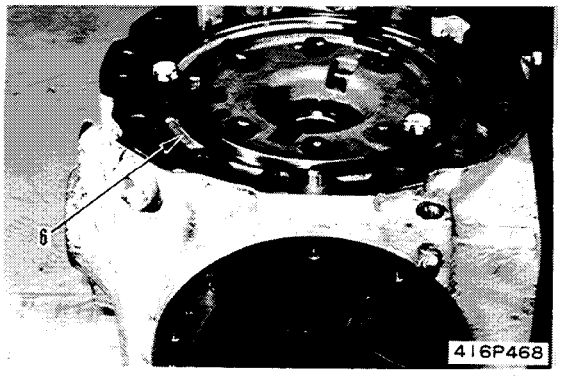
3. **Cage**
   1) Screw in forcing screw, use guide bolt (4), then remove cage (5).
      ★ Check the number and thickness of the shims, and keep in a safe place.
      ★ Loosen the mounting bolts of the coupling.

   kg Cage assembly: 20 kg

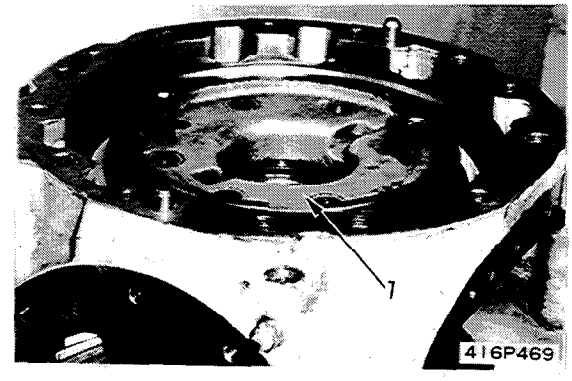
   2) Remove O-ring from cage.



4. **Brake piston**
   Screw in forcing screws at three places, raise uniformly and remove piston (6).
   ★ If the piston O-ring is not damaged, it is also possible to install the bleeder screw and blow in air to remove the piston.

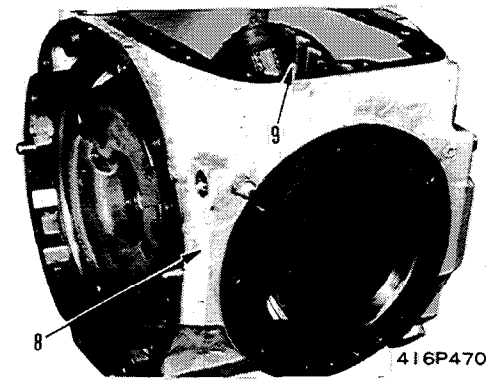


5. **Bearing carrier**
Screw in forcing screws, raise uniformly and remove bearing carrier (7). Remove square ring.
★ Check the number and thickness of the shims, and keep in a safe place.
★ Keep the left and right bearing carriers separately in sets.

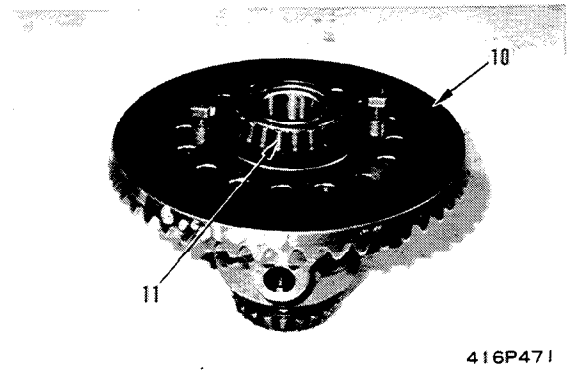


6. **Differential carrier**
1) Lift off differential carrier assembly (9) from housing (8).
★ Be careful not to let the lifting tool slip out of place when removing.

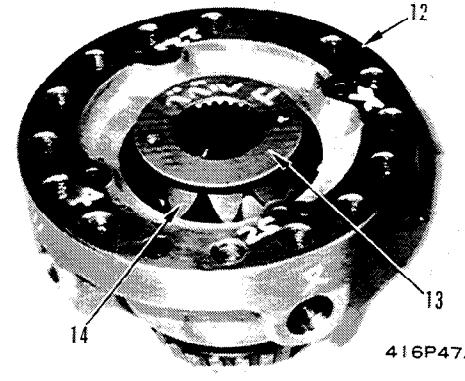
kg Differential carrier assembly: 40 kg



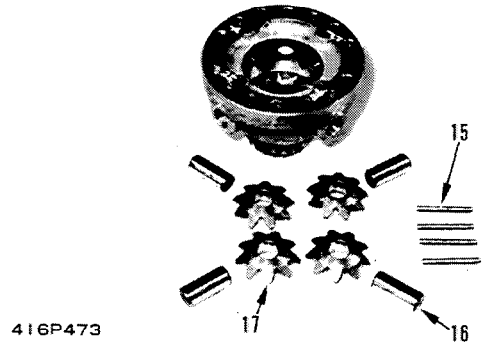
2) Remove mounting bolts, then remove bevel gear (10).
★ There is no dowel pin at the mating surface.



3) Remove thrust washer (13) from differential carrier, then remove side gear (14).

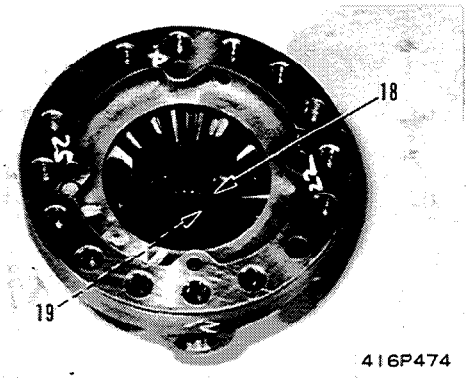


4) Remove lock pin (15) and take out shaft (16), then remove pinion gear (17).
   ★ There is a spherical washer installed at the pinion gear.
   (Serial No.: .-)



416P473

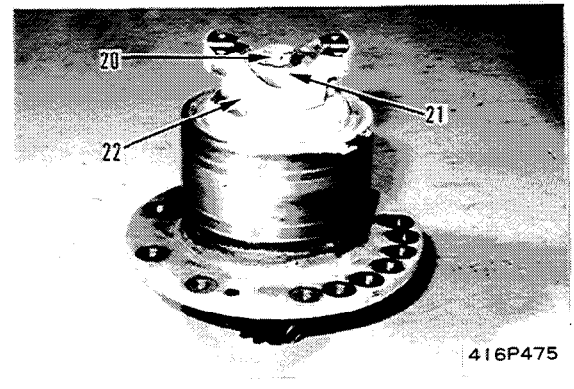
5) Remove side gear (18) and thrust washer (19).



416P474

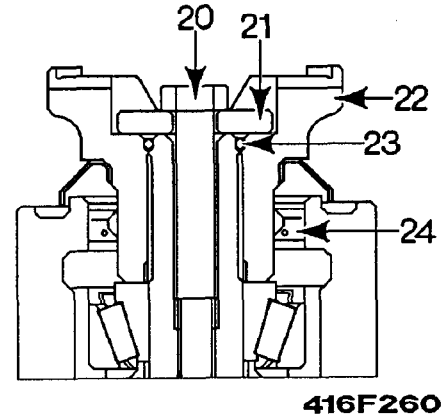
7. Coupling

1) Remove mounting bolts (20), then remove holder (21), coupling (22), and O-ring (23).
   ★ Do not remove the protector which is press fitted in the coupling, unless it is necessary.



416P475

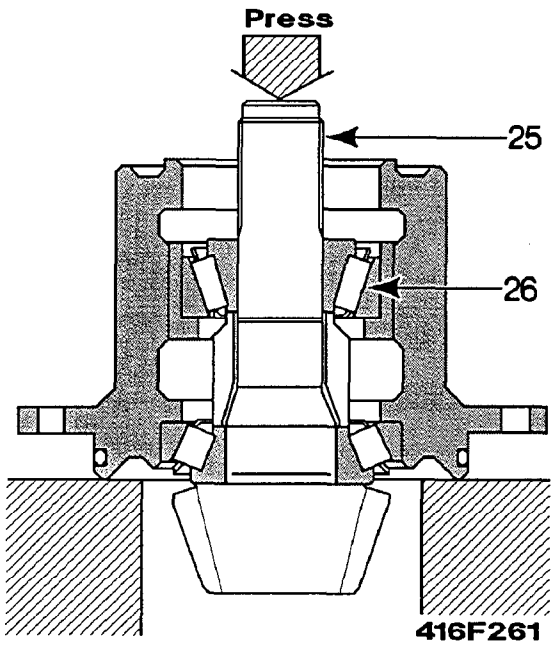
2) Remove oil seal (24).



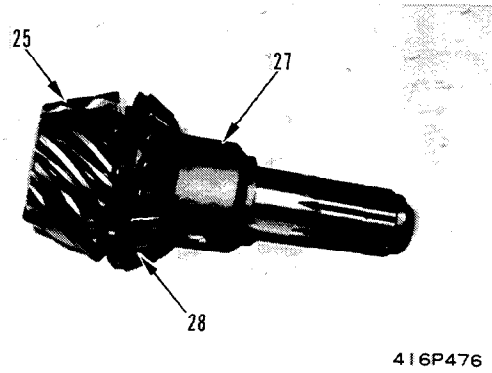
416F260

8. Pinion gear

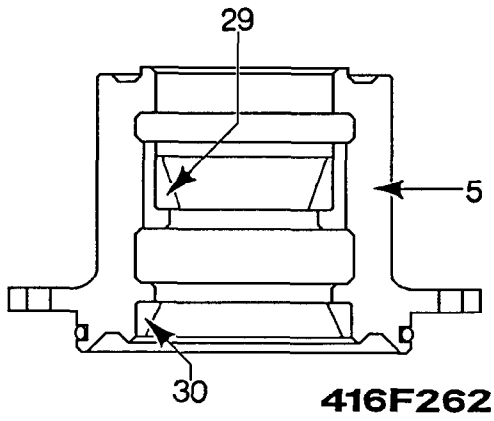
1) Using a press, push out bevel pinion gear (25) from cage, then remove bearing cone (26).



2) Remove spacer (27) and bearing (28) from pinion gear (25).



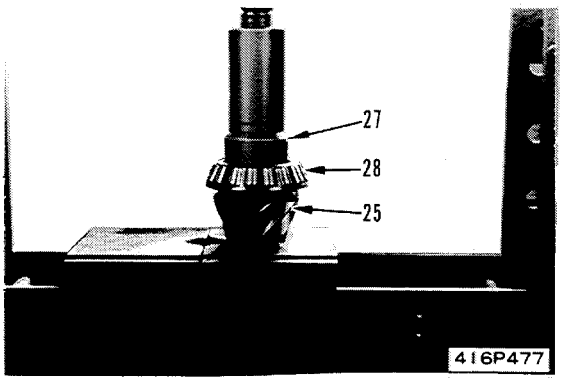
3) Remove bearing cups (29 and 30) from cage (5).



ASSEMBLY

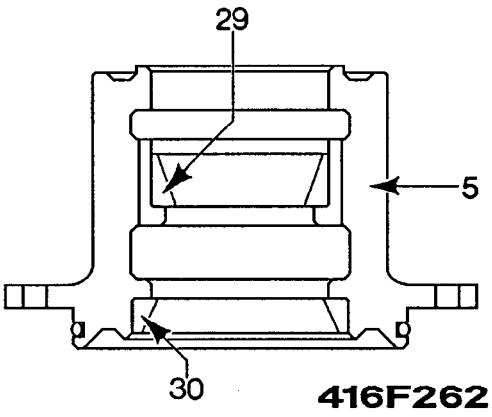
Special tools

	Part number	Part name	Q'ty
A	793-510-1600	Mandrel	1
B	793-520-2200	Installer	3
C	793-605-1001	Brake tester	1



1. Pinion gear

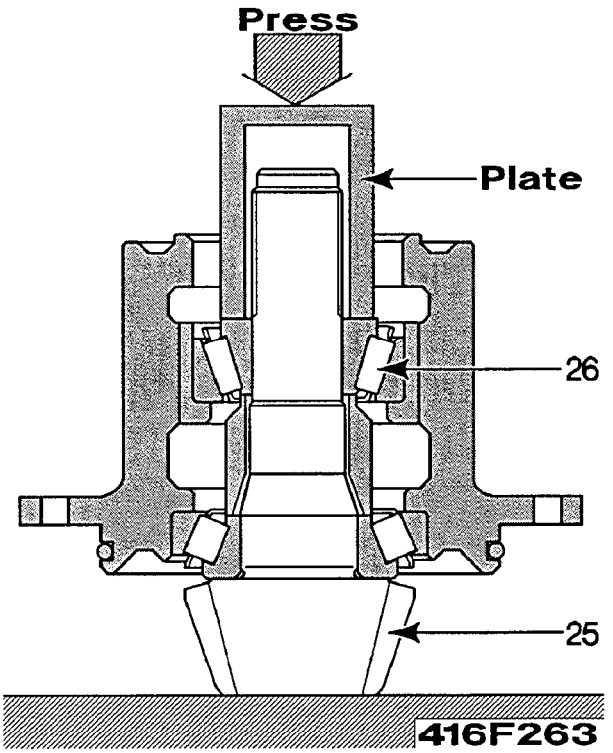
1) Press fit bearing cone (28) in pinion gear (25), then assemble spacer (27).
   ★ There must be no clearance at the contact surface of any parts.
2) Press fit bearing cups (29 and 30) in cage (5).



3) Assemble pinion gear (25) in cage (5), then press fit bearing cone (26).
   ★ Apply pressure to the bearing at the specified load, and rotate the cage to settle the bearing.
   Press load: 5 ton

Bearing: Oil (axle oil)

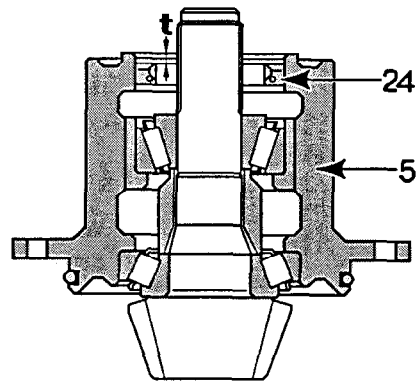
★ When rotating the cage at the specified load, rotate lightly by hand. If the rotation is not smooth, replace the bearing and spacer, and check that rotate lightly by hand again.



4) Press fit oil seal (24) in cage (5).
   ★ Assemble oil seal (24) evenly so that it has the specified depth "t".
   t = 6±0.5 mm

Oil seal lip: Grease (G2-L1)

Pinion gear shaft: Grease (G2-L1)



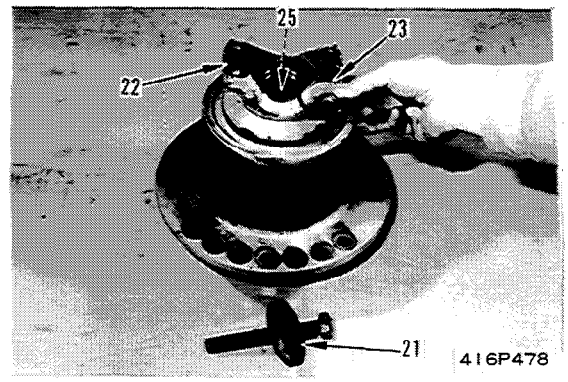
416F264

2. Coupling

Install coupling (22), O-ring (23) and holder (21) to pinion gear (25), then tighten mounting bolts.
   ★ Tighten the mounting bolts temporarily. Tighten them fully after completion of the assembly.
   ★ When inserting the coupling, be careful not to damage the seal.

Mounting bolt: Adhesive (LT-2)

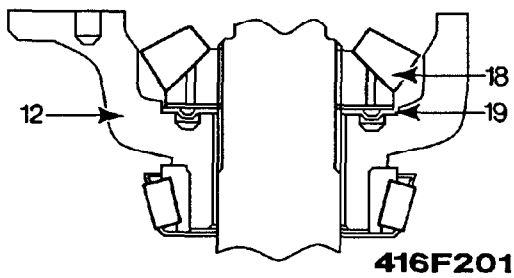
Mounting bolt: 28.5±3.0 kgm



416P478

3. Differential carrier assembly

1) Install side gear (18) and thrust washer (19) to differential carrier (12).

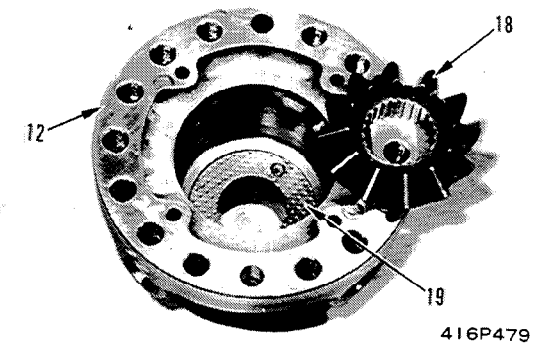


416F201

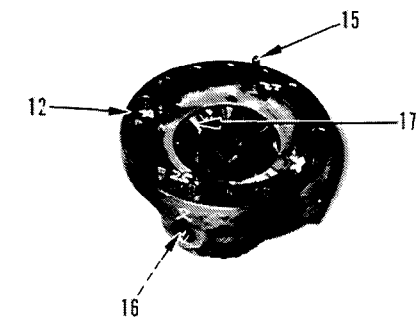
   ★ Install thrust washer (19) correctly with the groove in the carrier (12).

2) Install pinion gear (17) and shaft (16) to differential carrier (12), then insert lock pin (15).
   ★ Install a spherical washer at the pinion gear.

Gears, shafts: Oil (axle oil)



416P479

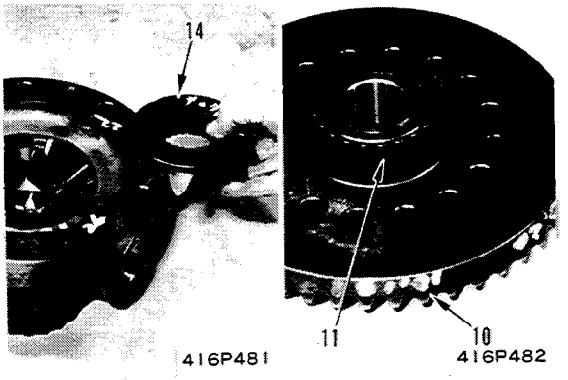


416P480

3) Assemble side gear (14) and thrust washer (13).

Sliding surface of thrust washer: Oil (axle oil)

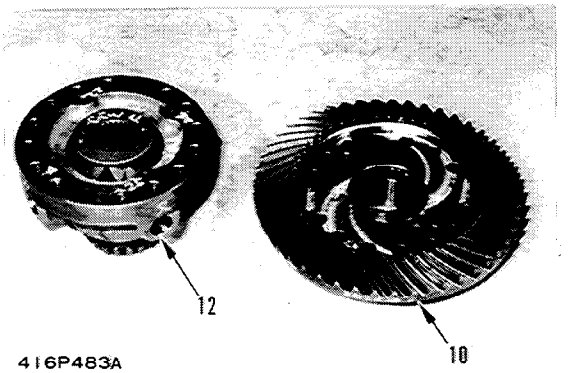
4) Press fit bearing (11) on bevel gear (10).



5) Assemble bevel gear (10) in differential carrier (12), then tighten mounting bolts.

Mounting bolts: Adhesive (LT-2)

Mounting bolts: 28.5±3.0 kgm

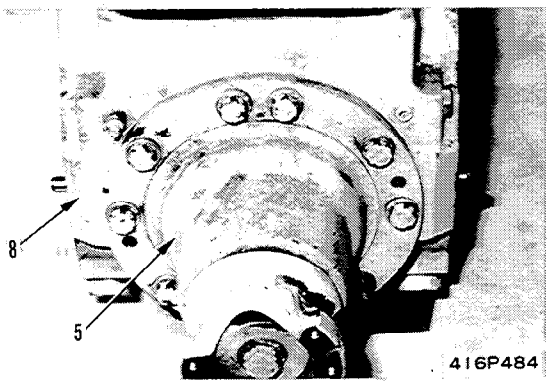


★ Coat the thrust washer with grease and stick it to the bevel gear to prevent it from falling off during installation.
★ Align the lock of the washer correctly with the groove in the bevel gear.
★ There is no dowel pin at the mating surface.

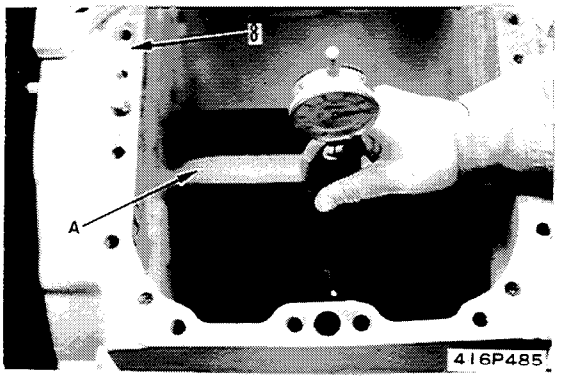
4. Adjusting shim of cage

1) Assemble cage (5) without shims in differential housing (8).

Mounting bolts: 11.5±1.0 kgm



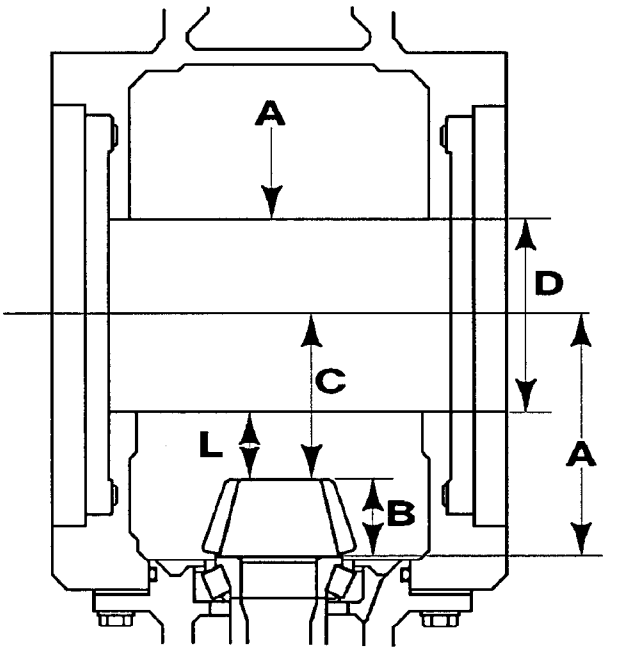
2) Insert measuring tool A in differential housing (8), and measuring distance between end face of bevel pinion gear and tool A with an inside micrometer or a cylinder gauge.
★ When inserting tool A in the differential housing, coat thinly with oil, and insert straight without twisting.



3) Selecting shim
   t = C - (L + D/2)
   t: Thickness of shim
   C: (A + a) - (B + b)
   L: Measured value
   D: Diameter of tool A
   A: 167.8
   B: 50.5
   a: Deviation from dimension A
   b: Deviation from dimension B
   ★ Use measured value for distance A.
   ★ Shim thickness 't' should be within 0.5 - 1.9 mm.
   The end face of the pinion gear is marked with an electric pen as follows.

   Example:
   MD Combination No. for bevel pinion gear and bevel gear
   +0.10 Distance "a" (mm)
   (-0.01) Distance "b" (mm)

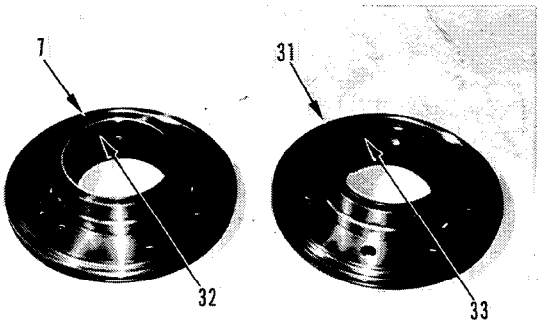
4) Remove cage.



416F265

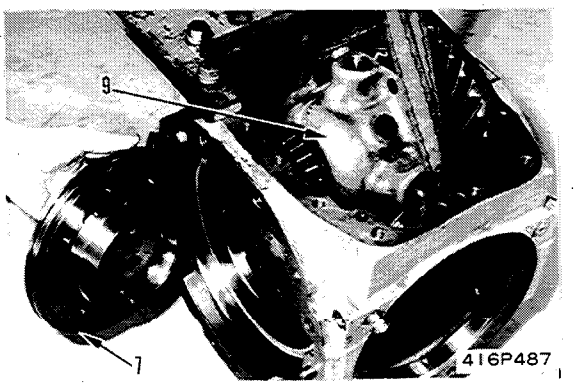
5. Bearing carrier
Press fit bearing cups (32 and 33) in bearing carriers (7 and 31).

Press fitting portion of bearing cup: Oil (axle oil)



416P486

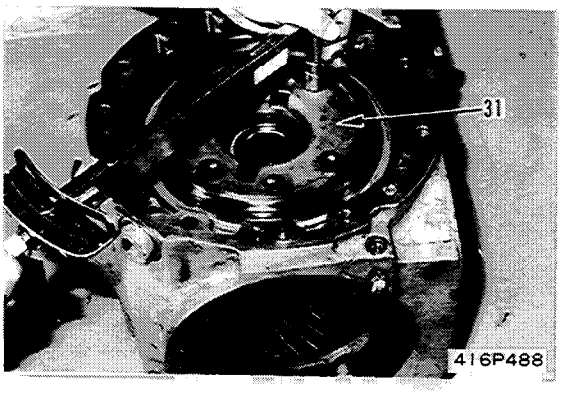
6. Adjusting bearing carrier shims
1) Raise differential carrier assembly (9), set in mounting position, then install left and right bearing carriers (7) temporarily.
   ★ Assemble the differential carrier assembly with the bevel gear on the right as seen from the cage mount.
   ★ Assemble the bearing carrier and adjust without the angle ring and shim.



416P487

2) Tighten carrier (31) at differential carrier end to specified tightening torque.

Mounting bolts: 11.5±1.0 kgm

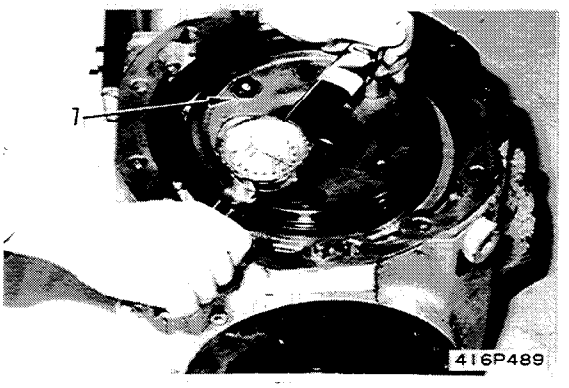


3) Tighten (4) mounting bolts of carrier (7) at bevel gear end.
   ★ Rotate the bevel gear and coat the bearing with oil.

Bearing: Oil (axle oil)

   ★ To settle all the parts, rotate the bevel gear when tightening.

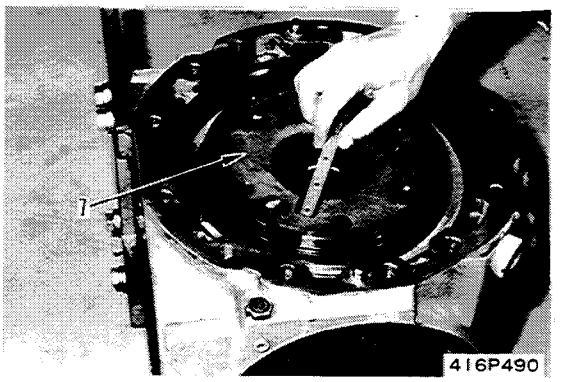
Mounting bolts: 1.2 kgm



4) Loosen 4 mounting bolts at bevel gear end until there is end play at bearing.
5) Tighten 4 mounting bolts uniformly again.

Mounting bolts: 0.4 kgm

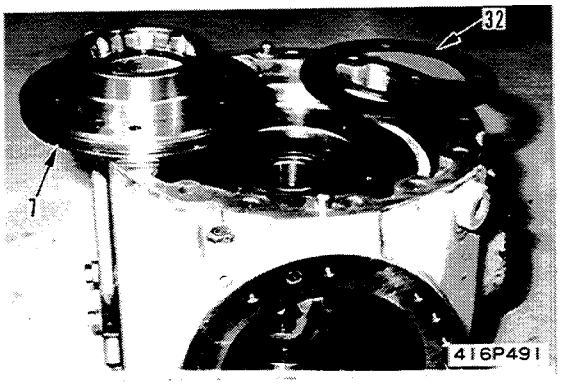
   ★ When doing this, check that there is end play at the bearing, and rotate the bevel gear when tightening.



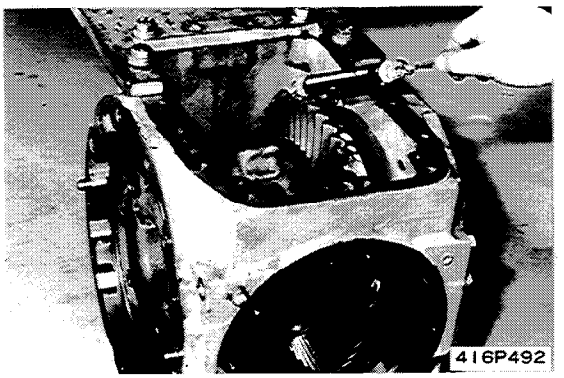
6) Using a feeler gauge at 2 places in groove of bearing carrier (7) at bevel gear end, measure clearances T_1 and T_2.
7) Selecting shims
   Shim thickness = $(T_1 + T_2)/2 \pm 0.035$ mm
   ★ Combine the following shims to give the necessary shim thickness.
   0.07 mm, 0.20 mm, 0.30 mm, 0.80 mm

8) Remove left and right bearing carriers (7), and assemble selected shims (32).
   ★ Rotate the bevel gear and tighten the mounting bolts of the bearing carrier uniformly.

Mounting bolts: 11.5±1.0 kgm



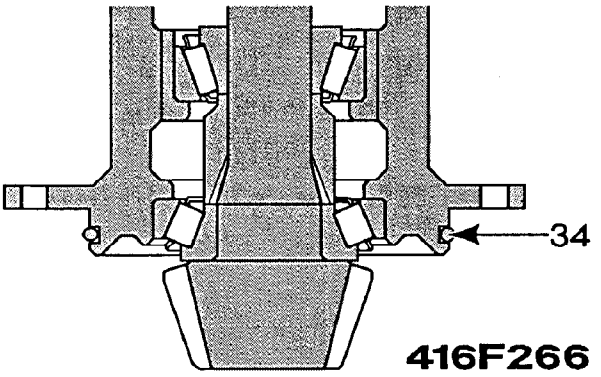
9) Using spring balance, measure preload of bevel gear and check that it is within specified range.
   ★ Preload: 0.75 - 2.4 kgm
   ★ If the preload is not within the specified range, change the shim thickness to adjust.



7. Cage

1) Assemble O-ring (34) in bearing cage.

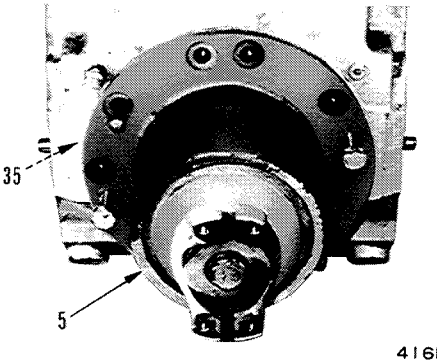
O-ring: Oil (axle oil)



2) Install guide bolt, assemble shims (35) selected in Step 4, and install cage (5).

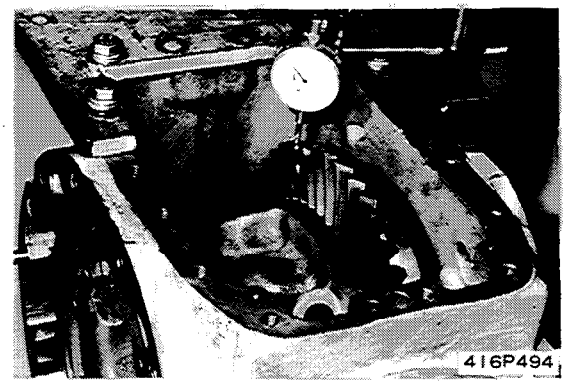
Mounting bolts: 11.5±1.0 kgm

★ Cage mounting bolts: 8 pcs.

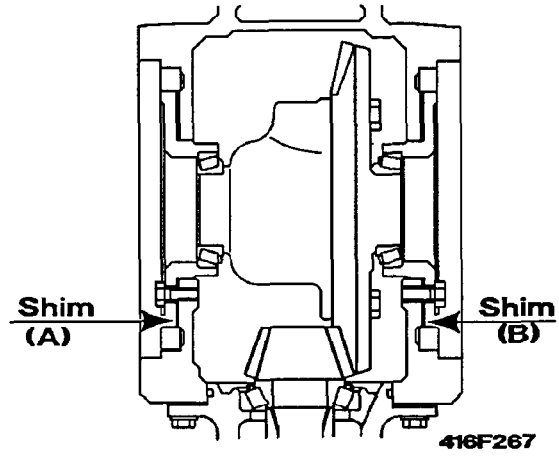


8. Adjusting backlash

1) Measure backlash of bevel gear with a dial gauge.
   - ★ First, measure with all the shims inserted at the bevel gear end.
   - ★ Measure the backlash at three places around the circumference of the bevel gear. The variation between the measurements must be within 0.1 mm.

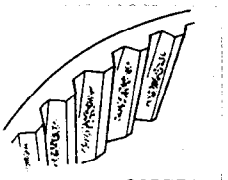
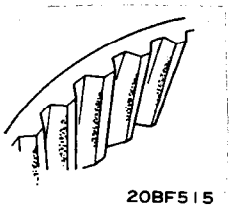
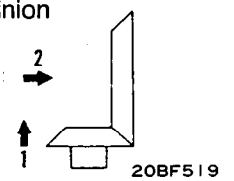
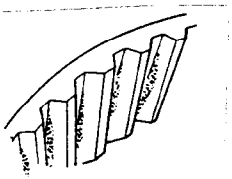
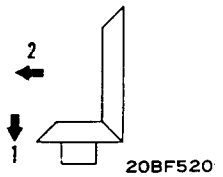
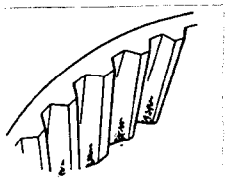
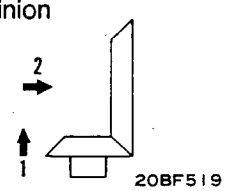
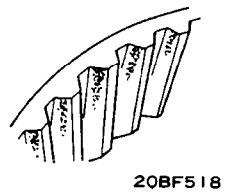
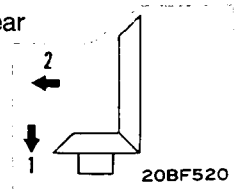


2) To make backlash within specified range, move some of shims from bevel gear side to opposite side.
   - ★ When moving the shims, do not change the total shim thickness. The total shim thickness on the left and right must remain the same.
   - ★ Adjust the backlash as follows.
     If the backlash is too LARGE, move shims from B to A.
     If the backlash is too SMALL, move shims from A to B.



9. Adjusting tooth contact

Coat face of 7 or 8 teeth of bevel pinion lightly with red lead (minimum). Hold the bevel gear by hand to act as a brake, rotate the pinion gear forward and backward and inspect the pattern left on the teeth.

Tooth contact	Cause	Procedure for adjustment
 20BF514	The tooth contact pattern should start from about 5 mm from the toe of the bevel gear and cover about 50% of the length of the tooth. It should be in the center of the tooth height.	Adjust the pinion gear by adjusting the shims at the cage. Adjust the bevel gear in the same way as when adjusting backlash.
 20BF515	Bevel pinion gear is too far from bevel gear.	1. Reduce shims at pinion gear to bring closer to bevel gear. 2. Move bevel gear further away from pinion gear and adjust backlash correctly.  20BF519
 20BF516	Bevel pinion gear is too close to bevel gear.	1. Increase shims at pinion gear to move away from bevel gear. 2. Move bevel gear closer to pinion gear and adjust backlash correctly.  20BF520
 20BF517	Bevel gear is too close to pinion gear.	1. Reduce shims at pinion gear to bring closer to bevel gear. 2. Move bevel gear further away from pinion gear and adjust backlash correctly.  20BF519
 20BF518	Bevel gear is too far from pinion gear.	1. Increase shims at pinion gear to move away from bevel gear. 2. Move bevel gear closer to pinion gear and adjust backlash correctly.  20BF520

★ When adjusting the bevel gear, do not change the preload of the bearing. Adjust by moving shims between the left and right. Always keep the same total thickness of shims.

10. Bearing carrier

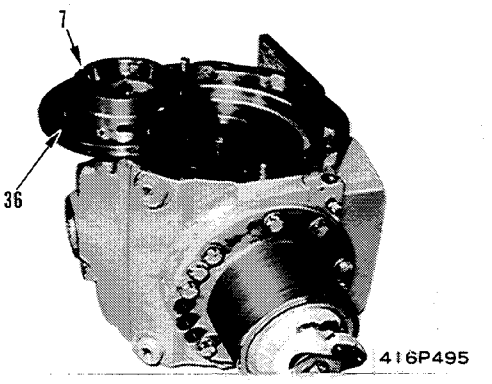
Remove bearing carrier (7), assemble Square-ring (36), then install together with adjusted shims (36).

★ Coat the Square-ring with grease, and be careful not to let it fall when assembling.

★ When installing bearing carrier (7), the Square-ring may fall out, so do not use a hammer to install.

Square-ring: Grease (G2-L1)

Mounting bolt: 11.5±1.0 kgm

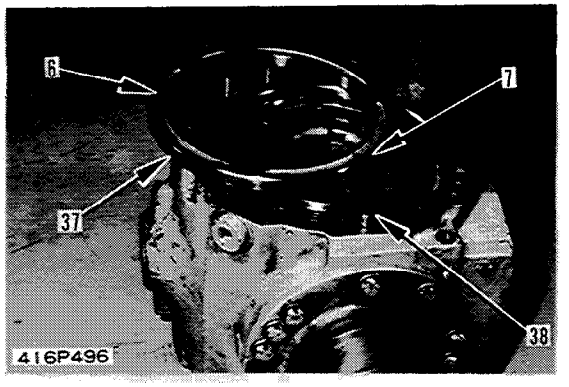


11. Brake piston

1) Fit O-rings (37 and 38) securely in grooves of brake piston (6) and bearing carrier (7).

★ Coat the brake piston and piston mount lightly with grease to prevent the O-ring from twisting or breaking.

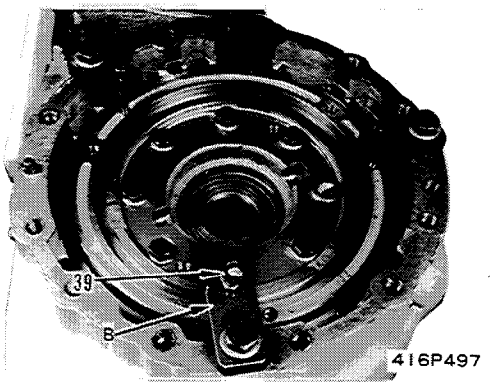
Piston and piston mount surface: Oil (Axle oil)



2) Install piston press fitting tool B to differential housing, then tighten screws (39) uniformly to press fit.

★ Press fit the piston until it contacts the housing.

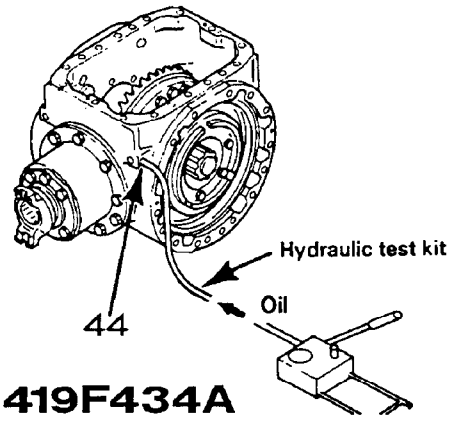
★ If using a plastic hammer to tap in, be careful not to damage the O-ring and piston.



12. Checking for leakage of brake oil

1) Install bleeder screw.
2) Tighten all screws (39) of piston press fitting tool B completely, then turn back one turn.
3) Install tool C to brake tube mount (44), then bleed air from inside cylinder.
4) Operate pump and raise pressure to 14 kg/cm^2.

★ After raising the pressure to 14 kg/cm^2, leave for 5 minutes and check that the drop in pressure is less than 3.5 kg/cm^2.



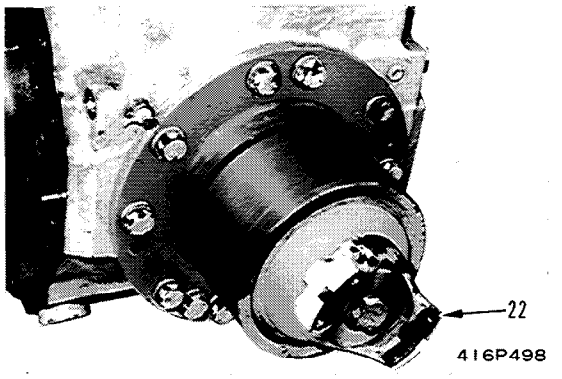
5) If the test shows that there is no leakage of oil, raise pressure to 42 kg/cm^2.
   - ★ After raising the pressure to 42 kg/cm^2, leave for 5 minutes and check that the drop in pressure is less than 3.5 kg/cm^2.
   - ★ If there is any leakage of oil, remove the brake piston and check the O-ring for damage, then reassemble.
   - ★ After checking for leakage of brake oil, insert piston fully.

13. Coupling

Tighten mounting bolts of coupling (22).

Mounting bolt: Adhesive (LT-2)

Mounting bolt: 28.5±3.0 kgm

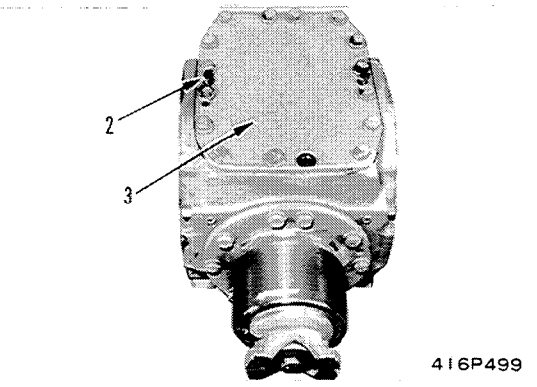


14. Differential cover

1) Install differential cover (3) on differential housing.
   - ★ Install a guide bolt in the mount hole of the bleeder screw to prevent gasket sealant from entering the hole.

Cover contact surface: Gasket sealant (Loctite 515)

Mounting bolt: 11.5±1.0 kgm

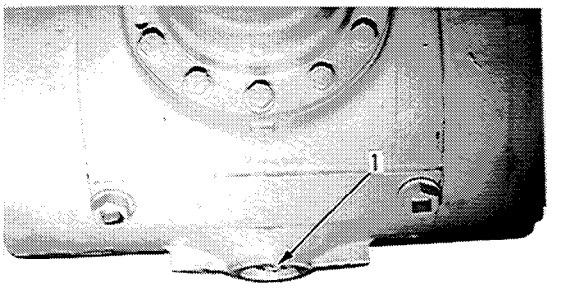


2) Remove guide bolt and install bleeder screw (2).
   - ★ Check that there is no gasket sealant in the screw hole when installing.

AXLE HOUSING
DISASSEMBLY

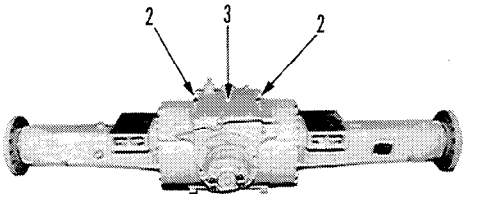
1. **Draining oil**
   Loosen drain plug (1) and drain oil from axle.

   Axle: 16ℓ



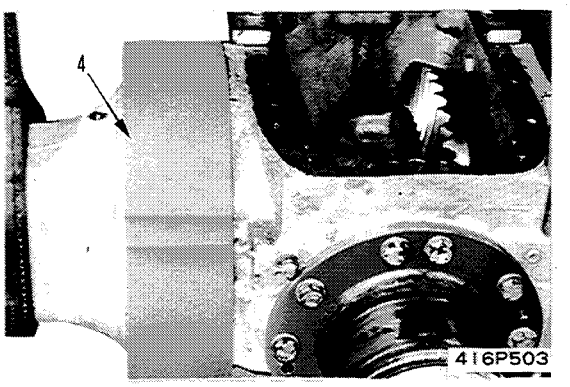
419P882

2. **Differential cover**
   1) Remove bleeder screw (2), then remove differential cover (3).
   2) Install axle on stand.



419P883

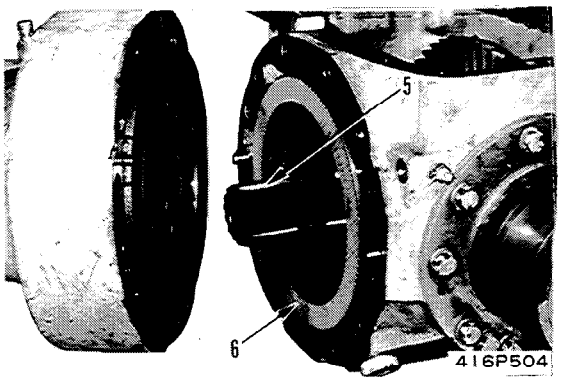
3. **Axle housing**
   1) Sling axle housing (4), remove mounting bolts, then lift off.
      ★ Mark the housings to distinguish the left and right axle housings.



416P503

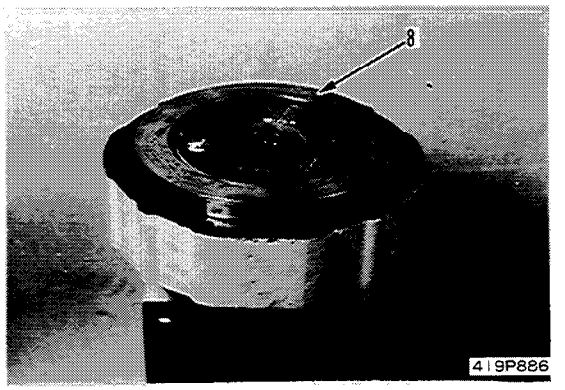
   2) Disconnect axle housing, then remove sun gear shaft (5), brake disc (6) and brake inner ring (7).
      ★ Be careful not to damage the face of the brake disc.

   kg Axle housing: 130 kg

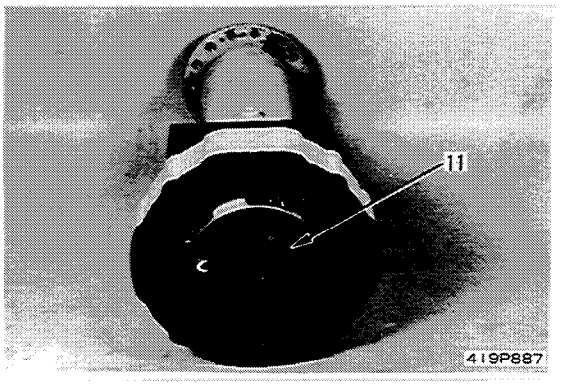


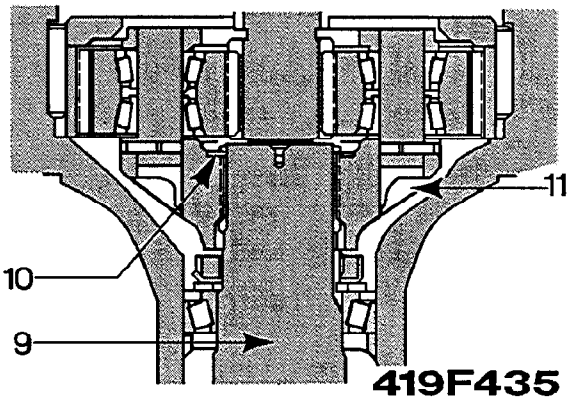
416P504

4. **Brake outer ring**
   Remove brake outer ring (8).
   ★ Be careful not do damage the surface in contact of the brake disc.
   ★ Pull out pin.

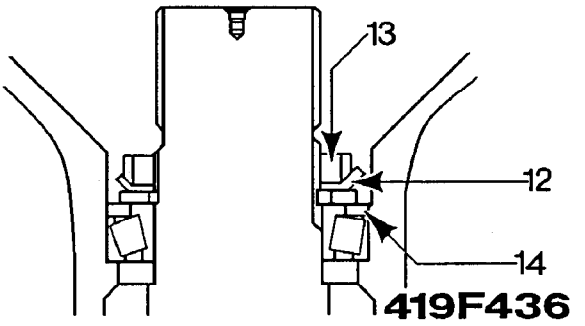


5. **Planetary carrier**
   1) Remove snap ring (10) from axle shaft (9), then pull out planetary carrier (11).
      ★ When removing the planetary carrier, be careful not to get your fingers caught between the pinion gears.

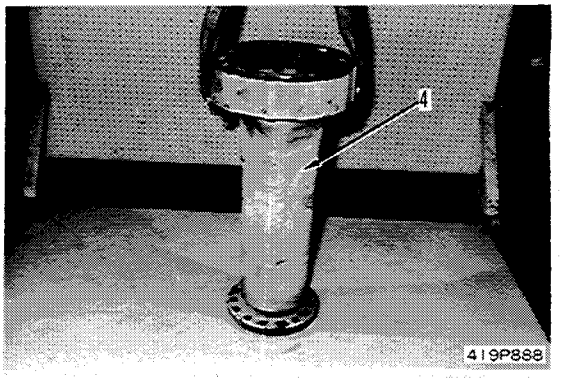




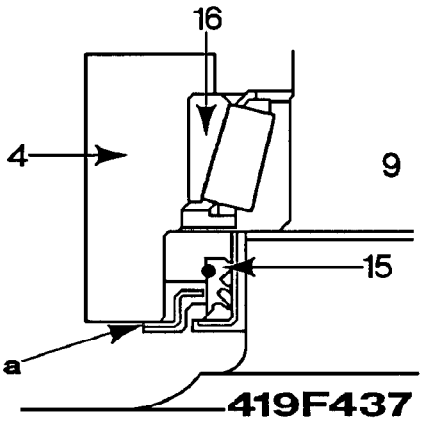
   2) Extend tab of lock washer (12), remove lock nut (13), then remove washer (14).



6. **Axle shaft**
   1) Stand housing (4) on end, and raise about 20 mm.
   2) Tap end face of axle shaft (9) with copper hammer to remove shaft, then remove bearing.
      ★ Pull the axle shaft out a short distance, then remove part 'a' of oil seal (15) with a screwdriver. This is to prevent bearing (16) from damaging the oil seal.

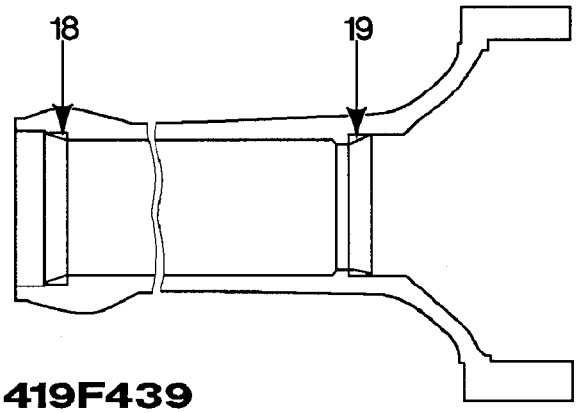


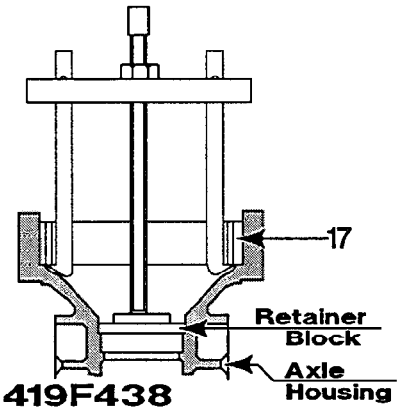
3) Remove bearing (16) and seal (15) from axle shaft (9).



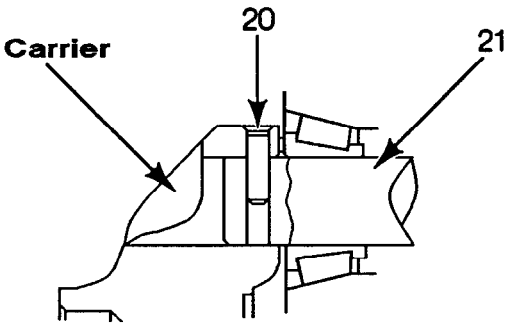
7. **Ring gear**
Using a puller, raise ring gear (17) uniformly, then remove.

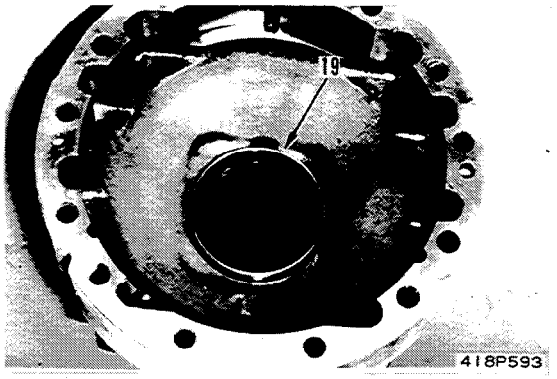
8. **Axle housing**
Remove bearing cups (18 and 19) from axle housing (4).

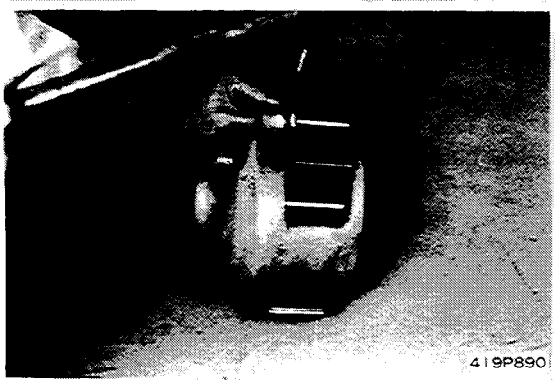




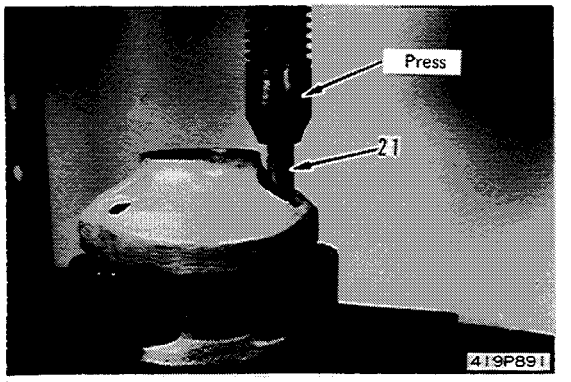
9. **Planetary carrier**
1) Knock in spring pin (20).
★ Be careful not to knock the spring pins in too far.



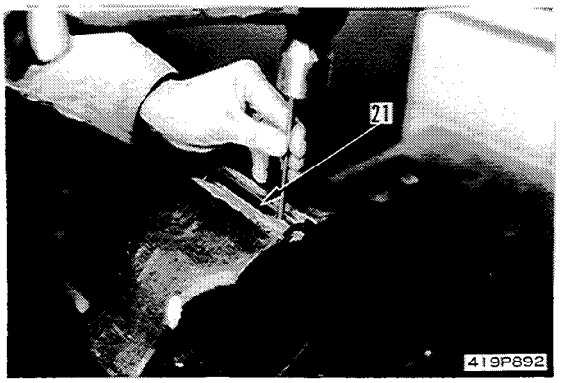




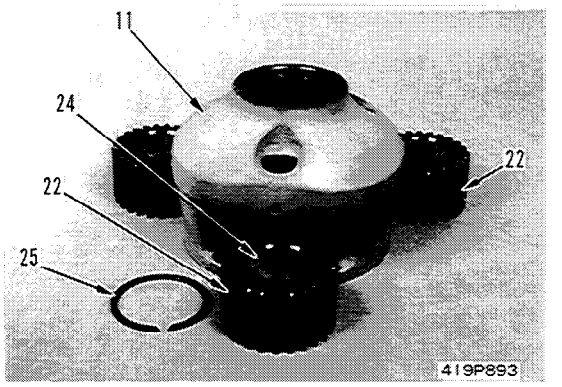
2) Using a press, remove shaft (21).

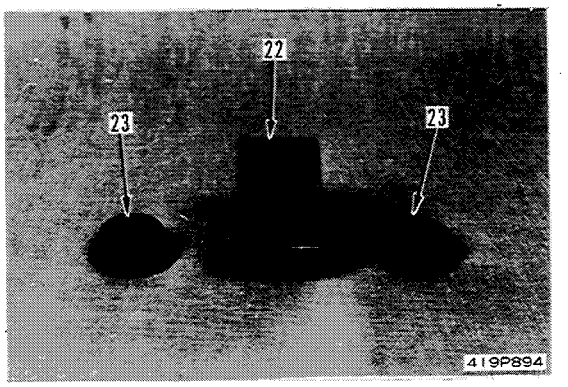


3) Remove spring pin (20) from shaft (21).



4) Remove pinion gear (22) from planetary carrier (11), then remove bearing cone (23), shim (24) and ring (25).
   ★ Repeat the above steps to remove pinion gears.

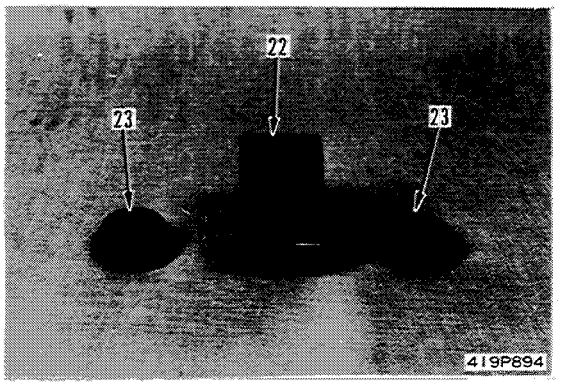




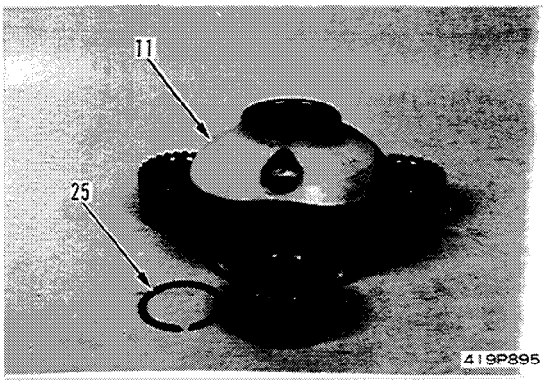
ASSEMBLY

Special tools

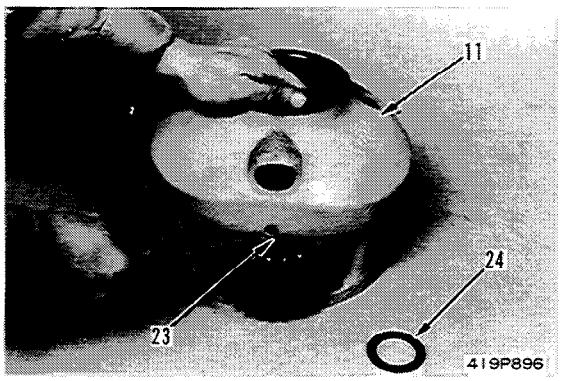
	Part number	Part name	Q'ty
A	793-520-1551	Seal support	1
B	793-520-1400	Nut wrench	1



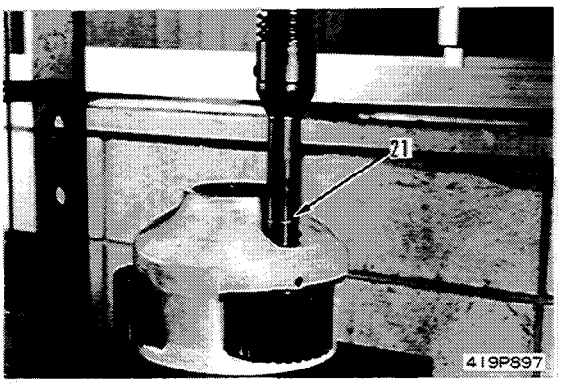
1. **Planetary carrier**
   1) Install bearing cone (23) on pinion gear (22), then set in carrier (11).
      ★ Insert ring (25) inside the planetary carrier before installing.



   2) Using a feeler gauge, measure clearance between carrier (11) and bearing cone (23), and select shims (24) to bring clearance within standard value.
      Clearance: 0.029 - 0.45 mm
      ★ Decide the shim (24) thickness for each gear separately.



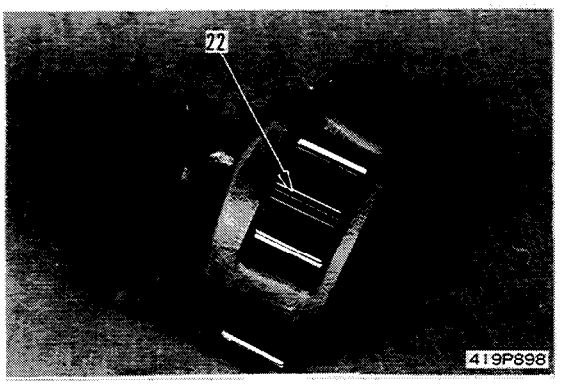
   3) Assemble selected shims and press fit shaft (21).
      ★ Align the holes of the shaft and spring pin, then knock in the spring pin until it is level with the carrier.
      Press fitting force: 5 tons





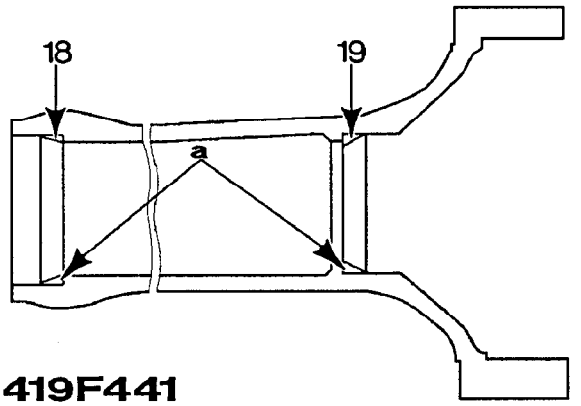
Shaft: Axle oil

4) Tap end face of shaft and differential end of gear (22) to push back bearing so that gear can rotate smoothly.
   ★ The gear must rotate smoothly.



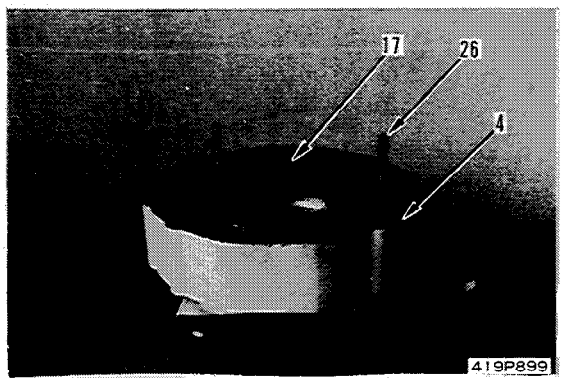
2. Axle housing
Press fit bearing caps (18 and 19) in axle housing (4).
★ After press fitting cup, check that there is no clearance at area 'a'.

Press fitting portion of cup: Axle oil



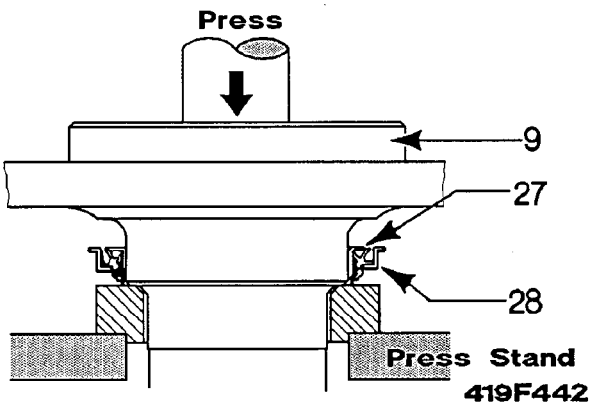
419F441

3. Ring gear
Press fit ring gear (17) in axle housing (4), then knock in pin (26).
★ Align the pin hole when installing the ring gear.
★ Cool ring gear (17) with dry ice at about -30°C before press fitting.



4. Axle shaft
1) Assemble outer oil seal (28) to inner oil seal (27).
2) Using a press, press fit oil seal on axle shaft (9).
   ★ Do not hit the seal with a hammer as the seal may be deformed.

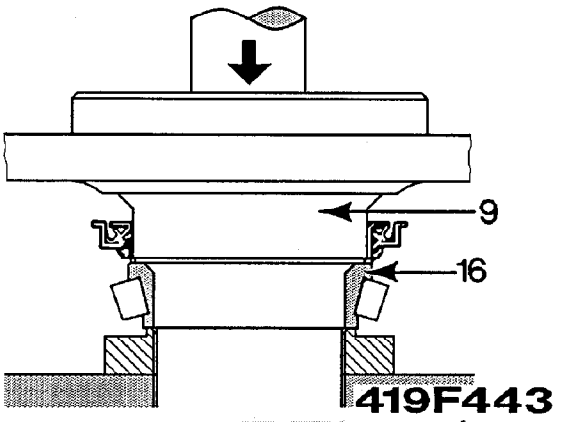
Lip of outer oil seal: Axle oil



419F442

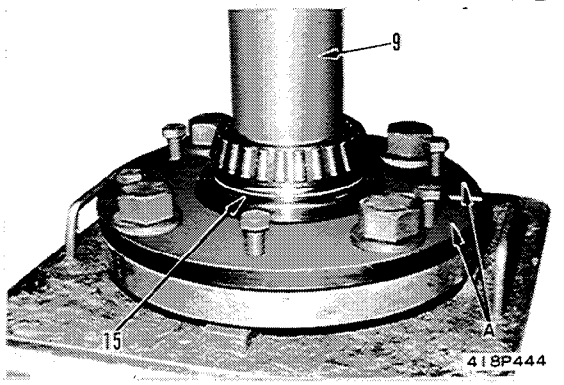
3) Set bearing (16) on press stand, and press fit axle shaft (9).
   ★ Be careful not to let the bearing slip out of position.

Press fitting portion of bearing: Axle oil



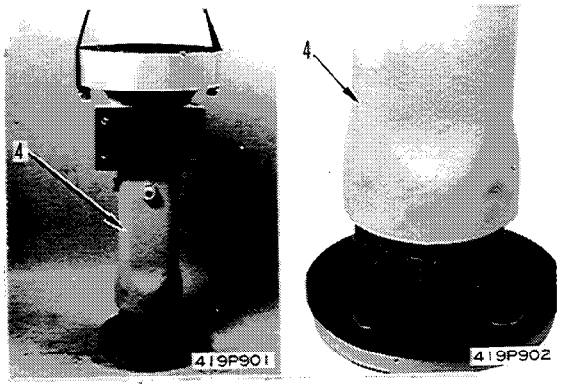
5. Housing

1) Stand shaft (9) on end, and install tool A.
   ★ Adjust the height with the adjustment bolt so that the top of tool A touches seal (15) lightly with a uniform clearance.
   ★ Secure tool A firmly so that it does not slip out of position.

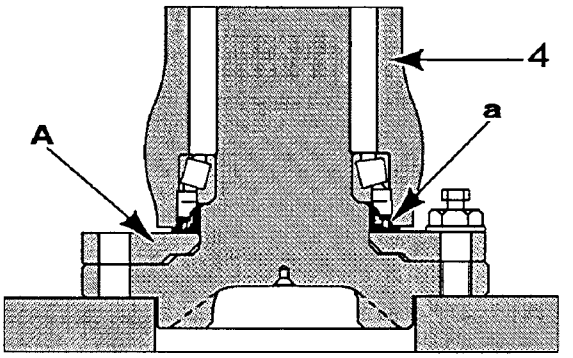


2) Raise housing (4) vertically and insert carefully on shaft.
   ★ Stop housing (4) before press fitting the oil seal.

Press fitting portion of oil seal: Axle oil



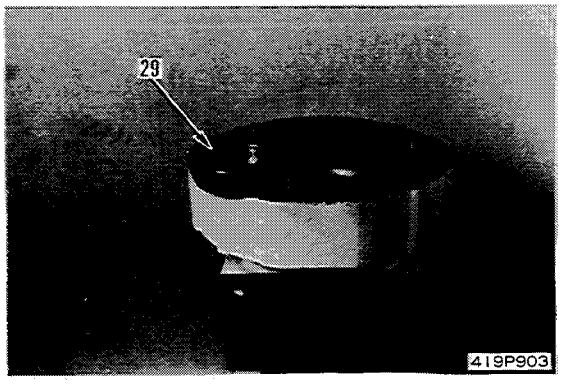
3) Align housing (4) with press fitting portion of oil seal and lower housing slowly.
   ★ Use the weight of the housing to insert it.
   ★ After installing the housing, seal surfaces (a and b) must be level. In addition, if there is any clearance at 'a', the clearance must be uniform.
4) Remove tool A.



419F444

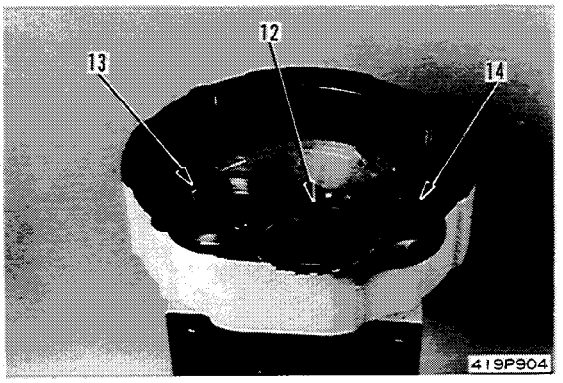
5) Assemble bearing (29) on shaft, and rotate housing by hand to settle bearing.
★ Press fit until the end play is 0.5 mm.

Press fitting portion of bearing cone: Axle oil

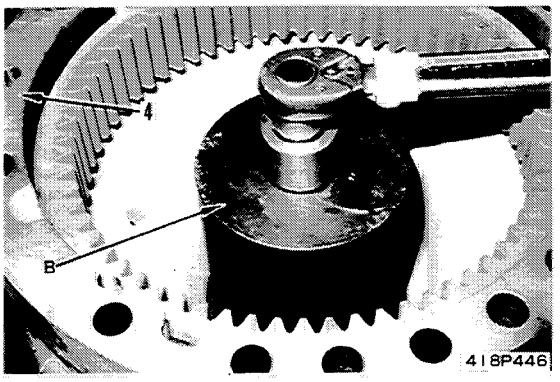


6. Adjusting end play

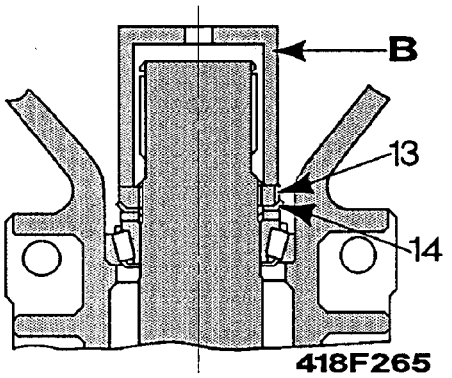
1) Install washer (14), lock washer (12), and nut (13) on shaft.
★ Align washer (14) with the groove of the shaft when installing.



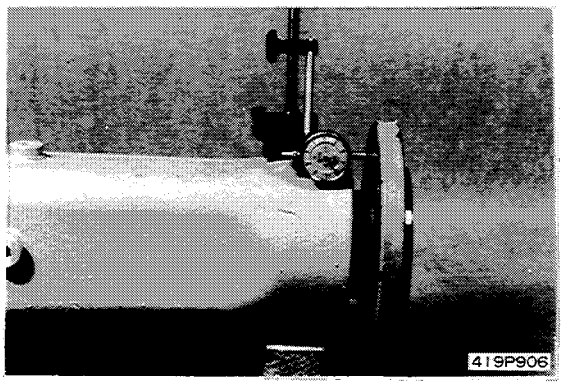
2) Rotate housing (4) by hand, and use tool B to tighten lock nut (13) until shaft can no longer be rotated by hand.



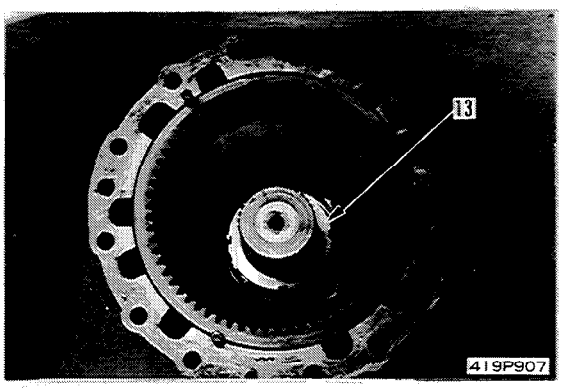
3) Loosen lock nut (13) until housing can be rotated easily by hand.



4) Rotate shaft and tighten lock nut until standard value is reached for end play.
End play: 0.025 - 0.200 mm
★ Put the axle housing on its side. Install a dial gauge to the housing and put the probe in contact with the wheel mounting surface.

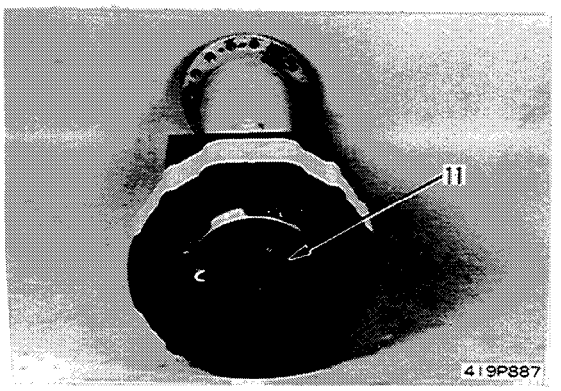


5) After deciding the end play, bend tap of lock washer (14) and fit in groove of lock nut (13).
★ Bend the tab of the lock washer and fit it securely in the groove of the lock nut.

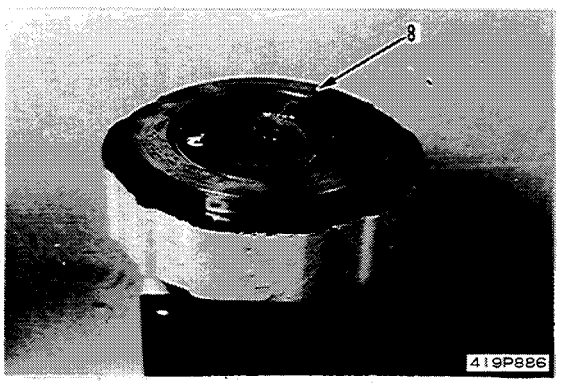


7. Planetary carrier
Align spline of axle shaft, install planetary carrier (11), then secure with ring.
★ Clean the shaft and planetary carrier spline before assembling.
★ Install the ring securely in the groove of the shaft.

⚠ When assembling the planetary carrier, be careful not to get your fingers caught in the gear.



8. Brake outer ring
Install brake outer ring (8) in axle housing.
★ Align the pin and the outer ring pin hole when installing.
★ Be careful not to damage the surface of the brake outer ring.



9. Axle housing

1) Install brake ring, brake disc (6) and sun gear shaft (5) in differential housing.
   - ★ Check that there is no damage to the surface of the brake ring.
   - ★ Soak the brake disc for at least two minutes in clean axle oil before installing.

2) Raise axle housing (4) horizontally, align spline groove and pin hole, and install carefully.
   - ★ When installing, be careful not to let the brake ring and disc slip out of position.
   - ★ Clean all grease and oil from the surface of the axle housing and differential housing, and coat with a continuous film of gasket sealant.

Housing contact surface: Gasket sealant (Loctite 515)

Mounting bolt of housing: 28.5±3.0 kgm

10. Differential cover

1) Knock pin into differential housing, then install differential cover (3).
   - ★ Coat with a continuous film of gasket sealant.
   - ★ Be careful not to get any gasket sealant in the mounting hole of the bleeder screw when installing.

Cover contact surface: Gasket sealant (Loctite 515)

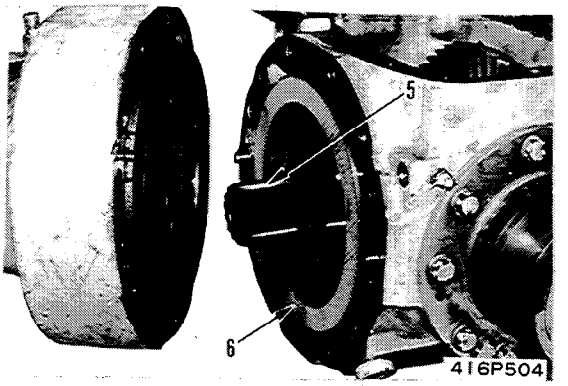
Mounting bolt of cover: 11.5±1.0 kgm

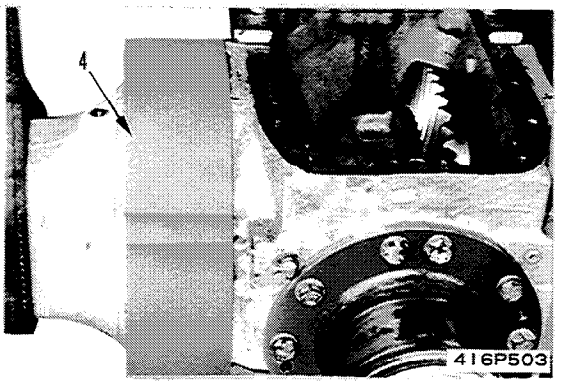
2) Install bleeder screw (2).

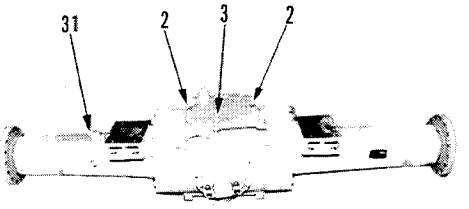
11. Refilling with oil

Tighten drain plug and add axle oil through oil filler (31) to the specified level.

Axle oil: 16ℓ

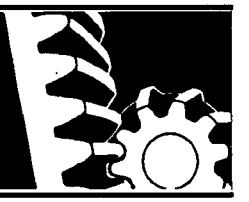






4I9P909

POWER TRAIN
24 MAINTENANCE STANDARD



ENGINE AND TRANSMISSION MOUNT 2

TORQUE CONVERTER CHARGING PUMP 3

TORQUE CONVERTER 4

TRANSMISSION 5

TRANSMISSION CLUTCH 8
UPPER VALVE 11
LOWER VALVE 13

SOLENOID VALVE 14

AXLE 15

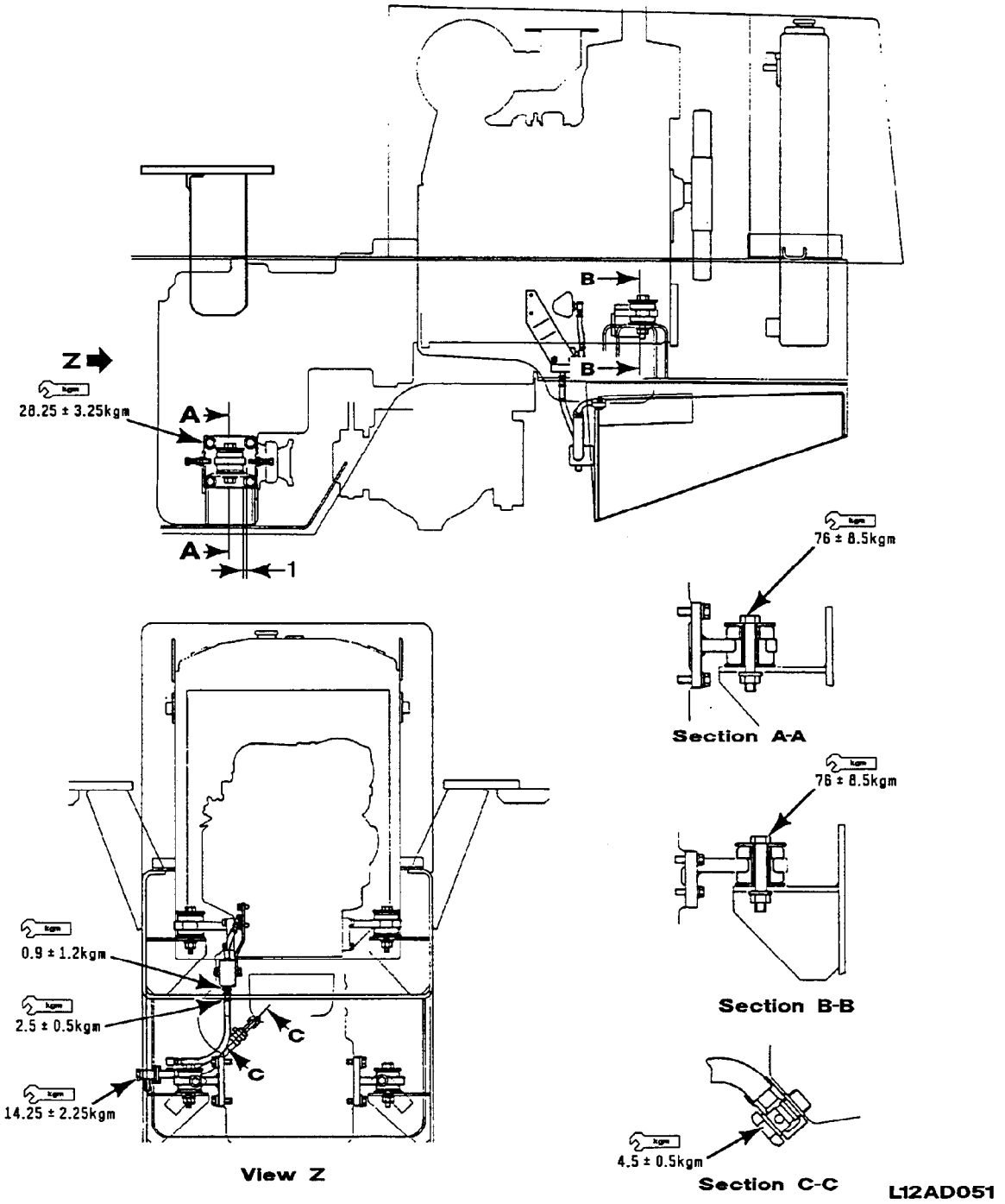
DIFFERENTIAL 18

FINAL DRIVE 20

DRIVE SHAFT 21

AXLE MOUNT 22

ENGINE AND TRANSMISSION MOUNT

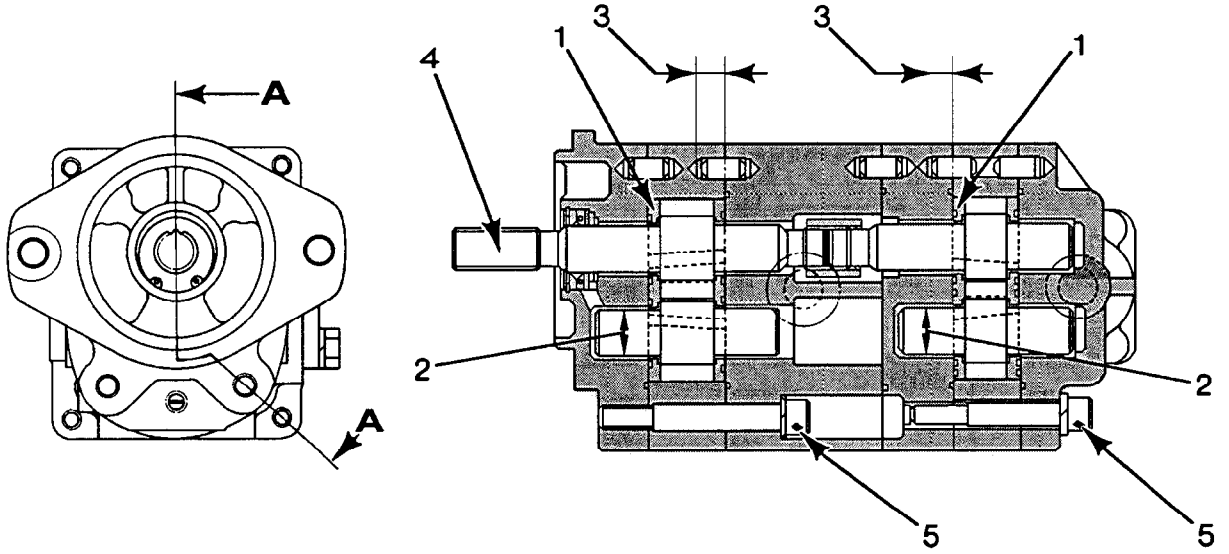


Unit: mm

No.	Check item	Criteria	Remedy
1	Clearance between transmission bracket and adjustment bolt	1-3	Adjust

TORQUE CONVERTER CHARGING PUMP

- Model SAL(2)-032
- Model SAL(2)-025

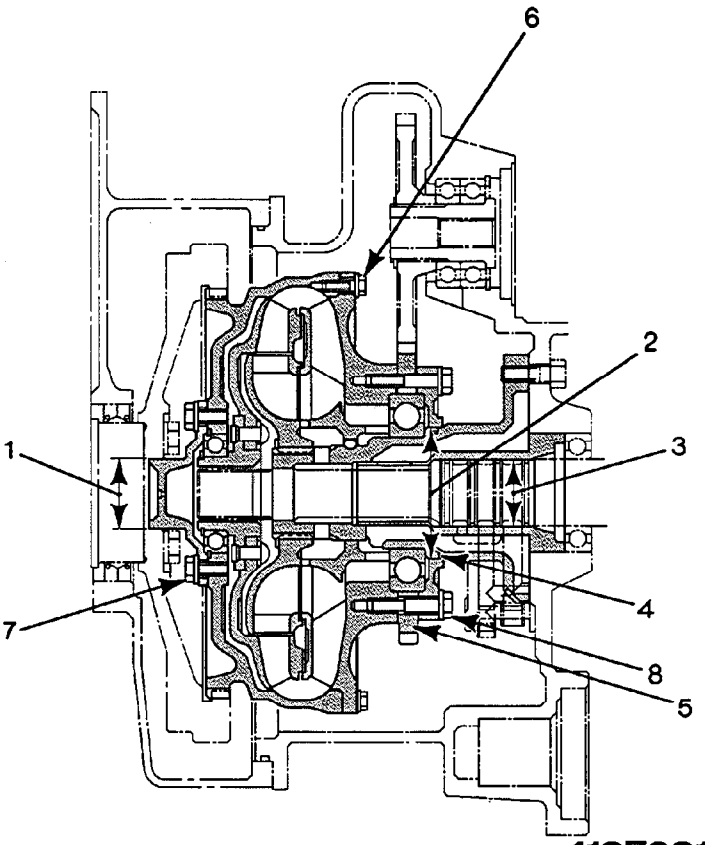


419F126

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between gear case and side plate, gear	Standard clearance		Clearance limit			Replace
		0.10-0.15		0.19			
2	Clearance between inside diameter of plain bearing and outside diameter of gear shaft	0.06-0.125		0.20			
3	Insertion depth of pin	Standard size		Tolerance			
		12		0 -0.5			
4	Rotating torque of spline shaft	0.5-1.5 kgm					
5	Tightening torque of bolt	11.5±1.0 kgm					Retighten
	Discharge (SAE10W-CD, 45-55°C)	Model	Revolution (rpm)	Discharge pressure (kg/cm²)	Standard discharge (ℓ/min)	Repair limit discharge (ℓ/min)	
		(Front) SAL(2)-032	3000	210	88	82	
		(Rear) SAL(2)-025	3000	210	72	66	

TORQUE CONVERTER

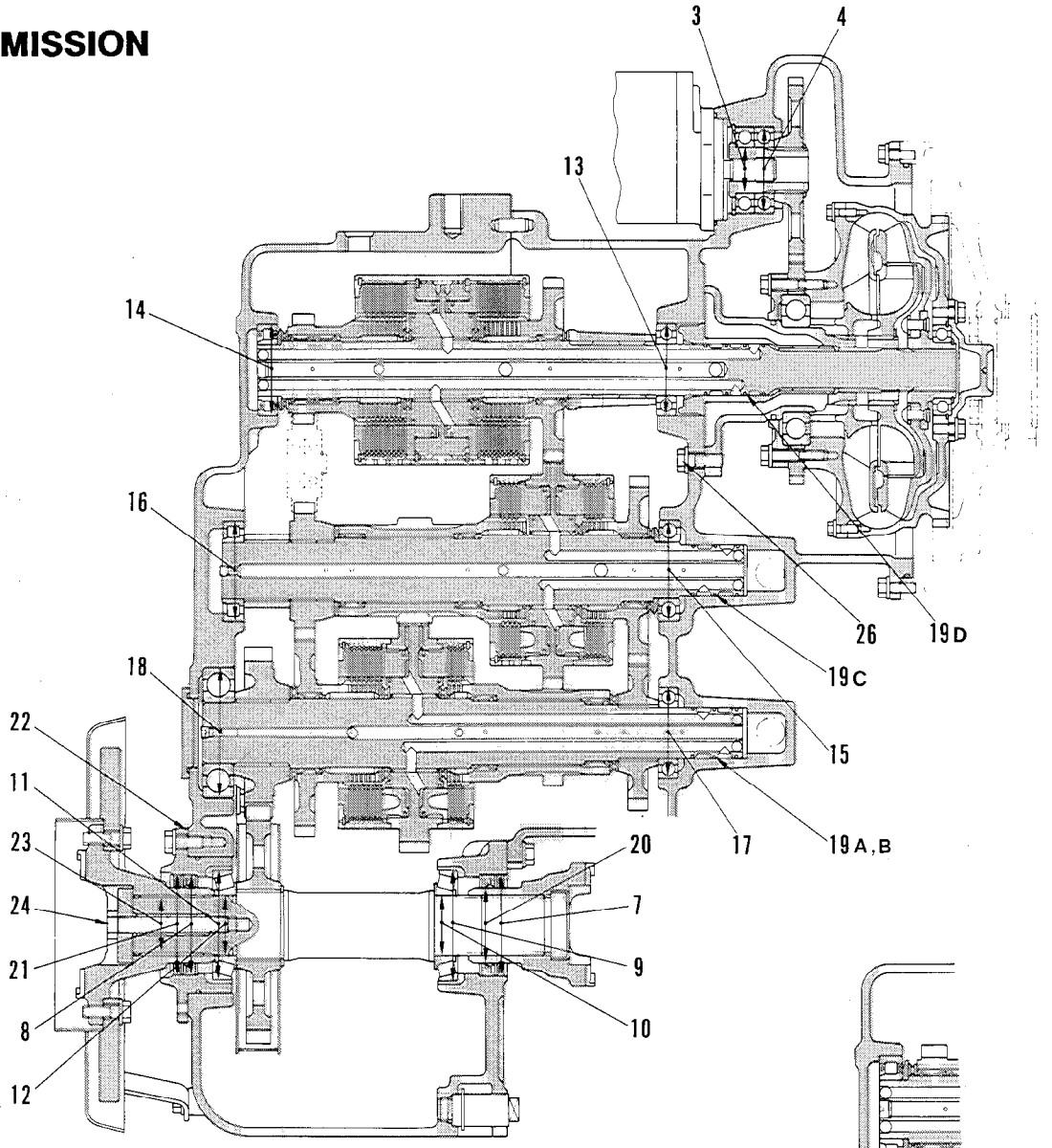


418F081

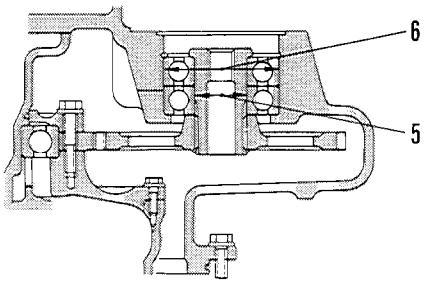
Unit: mm

No.	Check item	Criteria			Remedy
1	Outside diameter of pilot	Standard size	Tolerance	Repair limit	Repair chrome plating or replace
		52	-0.010 -0.040	51.75	
2	Inside diameter of retainer (Seal ring contact surface)	100	+0.040 0	100.5	
3	Inside diameter of sleeve (Seal ring contact surface)	50	+0.050 0	50.1	
4	Wear of seal ring	Width 3 Thickness 4		2.7 3.6	Replace
5	Backlash between PTO drive gear and driven gear	0.169-0.393			Replace
6	Tightening torque of pump mounting bolt	3.2±0.3 kgm			Retighten
7	Tightening torque of pilot mounting bolt	7.0±0.5 kgm			
8	Tightening torque of gear retainer mounting bolt	7.0±0.5 kgm			

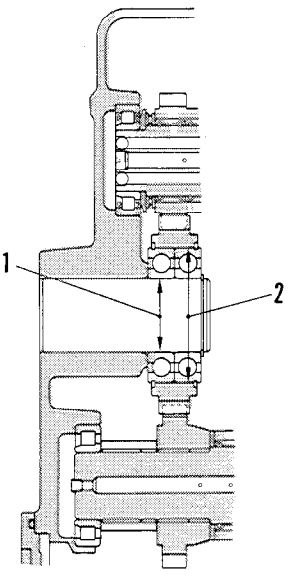
TRANSMISSION



Section C–C



Section D–D



Section E–E

U41801122

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between idle shaft and bearing	60	0 -0.012	0 -0.015	-0.015- -0.012		Replace
2	Clearance between idle gear bearing	110	0 -0.015	-0.012 -0.042	-0.042- 0.005		
3	Clearance between pump drive shaft and bearing	45	+0.013 +0.012	0 -0.012	-0.025- -0.002		
4	Clearance between pump drive gear bearing and housing	85	0 -0.015	+0.022 -0.013	-0.013- 0.037		
5	Clearance between pump drive shaft and bearing	45	+0.013 +0.002	0 -0.012	-0.025- -0.002		
6	Clearance between pump drive gear bearing and housing	100	0 -0.015	+0.022 -0.013	-0.013- 0.037		
7	Clearance between output shaft oil seal and housing	100	+0.170 +0.080	+0.054 0	-0.170- -0.026		
8	Clearance between output shaft oil seal and housing	100	+0.170 +0.080	+0.054 0	-0.170- -0.026		
9	Clearance between output shaft bearing and housing	110	0 -0.015	-0.015 -0.040	-0.04- 0		
10	Clearance between output shaft and bearing	60	+0.035 +0.015	0 -0.015	-0.05- -0.015		
11	Clearance between output shaft bearing and housing	110	0 -0.015	-0.015 -0.040	-0.04- 0		
12	Clearance between output shaft and bearing	60	+0.035 +0.015	0 -0.015	-0.05- -0.015		
13	Clearance between Forward-Reverse clutch bearing and housing	90	0 -0.015	+0.022 -0.013	-0.013- 0.037		
14	Clearance between Forward-Reverse clutch bearing and housing	90	0 -0.015	+0.022 -0.013	-0.013- 0.037		
15	Clearance between 1st-3rd clutch bearing and housing	100	0 -0.015	+0.022 -0.013	-0.013- 0.037		
16	Clearance between 1st-3rd clutch bearing and housing	100	0 -0.015	+0.022 -0.013	-0.013- 0.037		
17	Clearance between 2nd-4th clutch bearing and housing	110	0 -0.015	+0.022 -0.013	-0.013- 0.037		
18	Clearance between 2nd-4th clutch bearing and housing	130	0 -0.018	+0.026 -0.014	-0.014- 0.044		

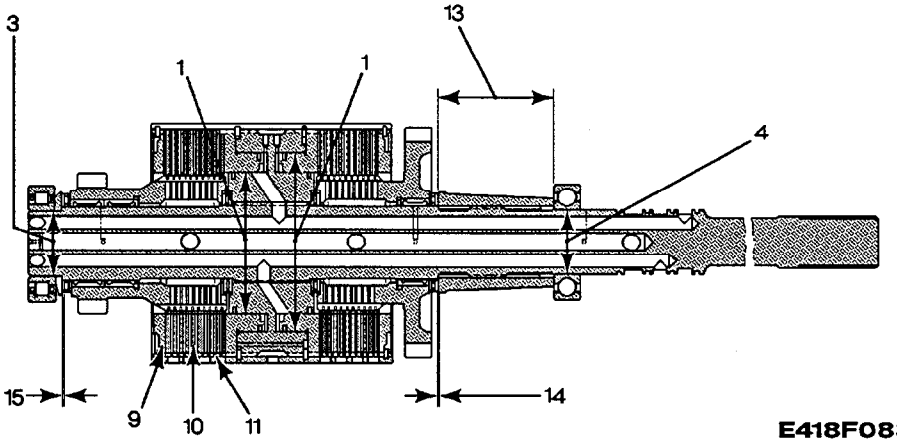
Unit: mm

No.	Check item	Criteria			Remedy
19A	Wear of diameter (Seal ring contact surface)	Standard size	Tolerance	Repair limit	Replace
		50	+0.005 0	0.05	
19B	Wear of seal ring groove width	3.2	+0.076 0	3.5	
19C	Wear of seal ring width	3.14	0 -0.02	2.7	
19D	Wear of seal ring thickness	2.3	±0.1	2.1	
20	Outside diameter of coupling (Oil seal contact surface) (R)	75	0 -0.074	0.05	
21	Outside diameter of coupling (Oil seal contact surface) (F)	75	0 -0.074	0.05	
22	Clearance between output shaft cover and housing	Standard size	Standard clearance	Clearance limit	Adjusting of shim
		0.9	0.1-0.17		
23	Rotating torque of output shaft	0.02-0.1 kgm			
24	Tightening torque of coupling mounting bolts	27.5±4.0 kgm			
25	Tightening torque of strainer mounting bolts	30.6±9.2 kgm			
26	Torque converter assembly mounting bolt	11.5±1.0 kgm			

TRANSMISSION CLUTCH

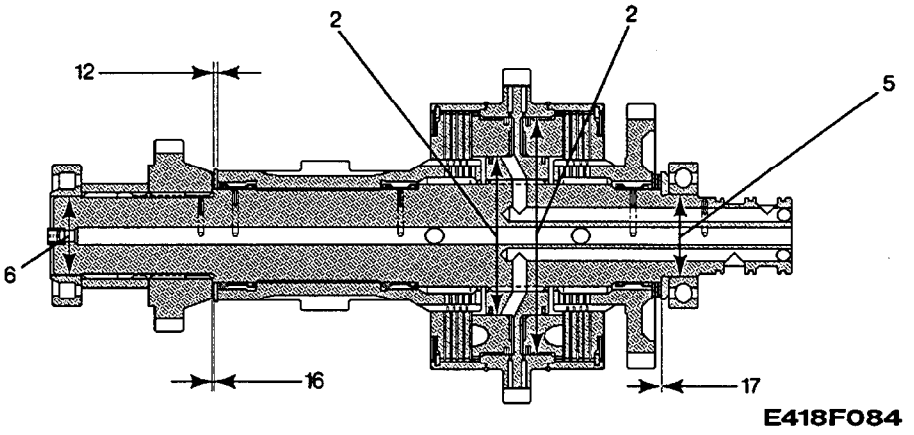
Forward, Reverse Clutch Assembly

(F) (R)



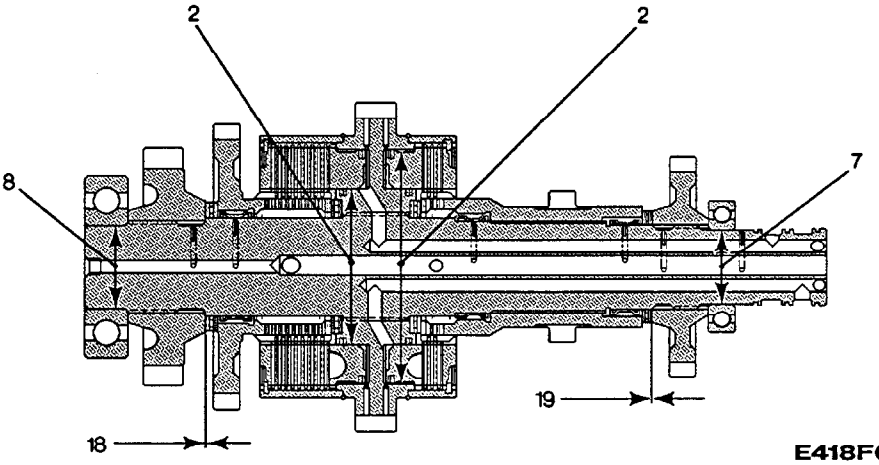
E418F083

1st, 3rd Clutch Assembly



E418F084

2nd, 4th Clutch Assembly



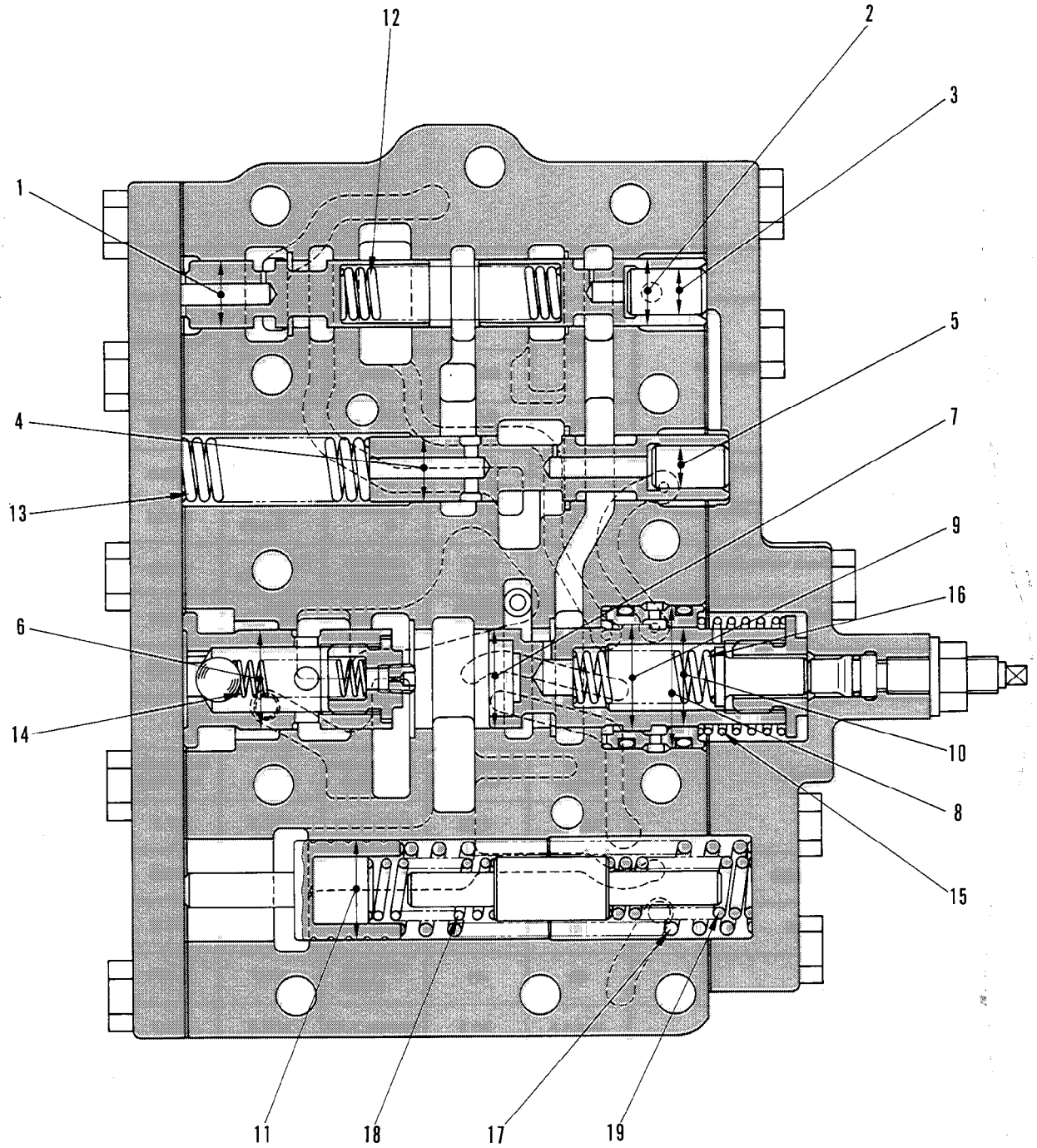
E418F085

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between piston and cylinder Inside	110	-0.27 -0.32	+0.06 -0.07	0.20- 0.38	0.43	Replace
	Outside	139	-0.27 -0.32	+0.06 -0.07	0.20- 0.38	0.43	
2	Clearance between piston and cylinder (1st, 2nd, 3rd, 4th) Inside	110	-0.27 -0.32	+0.06 -0.07	0.20- 0.38	0.43	
	(1st, 2nd, 3rd, 4th) Outside	165	-0.27 -0.32	+0.06 -0.07	0.20- 0.38	0.43	
3	Clearance between F-R clutch shaft and bearing inner race (R)	50	+0.013 -0.002	bearing 0 -0.012	-0.025- -0.002		
4	Clearance between F-R clutch shaft and bearing inner race (F)	50	+0.030 +0.015	bearing 0 -0.012	-0.042- -0.015		
5	Clearance between 1st-3rd clutch shaft and bearing inner race (R)	55	+0.015 +0.002	bearing 0 -0.015	-0.030- -0.002		
6	Clearance between 1st-3rd clutch shaft and bearing inner race (F)	55	+0.030 +0.015	bearing 0 -0.015	-0.045- -0.015		
7	Clearance between 2nd-4th clutch shaft and bearing inner race (R)	50	+0.013 +0.002	bearing 0 -0.012	0.002- 0.025		
8	Clearance between 2nd-4th clutch shaft and bearing inner race (F)	60	+0.015 +0.002	bearing 0 -0.015	-0.002- -0.030		
9	Thickness of separator plate	Standard size		Tolerance		Repair limit	
		1.7		±0.05		1.5	
	Deformation of wear surface of separator plate			0.08		0.15	
10	Thickness of friction plate	2.2		±0.08		1.9	
	Deformation of wear surface of friction plate			0.13		0.25	
11	Load of wave spring (at height 1.8 mm)	64.2 (kg)		±6.4 (kg)		52 (kg)	
12	Thickness of 1st clutch thrust washer	3.18		±0.05		2.7	

No.	Check item	Criteria			Remedy
13	F-R clutch spacer length	Standard size	Tolerance	Repair limit	Replace
		86.94	±0.1		
14	End play of forward gear	Standard size		Repair limit	
		0.04-1.17			
15	End play of reverse gear	0.07-0.74			
16	End play of 1st gear	0.04-1.04		1.47	
17	End play of 3rd gear	0.03-0.70			
18	End play of 2nd gear	0.04-0.71			
19	End play of 4th gear	0.10-1.23			

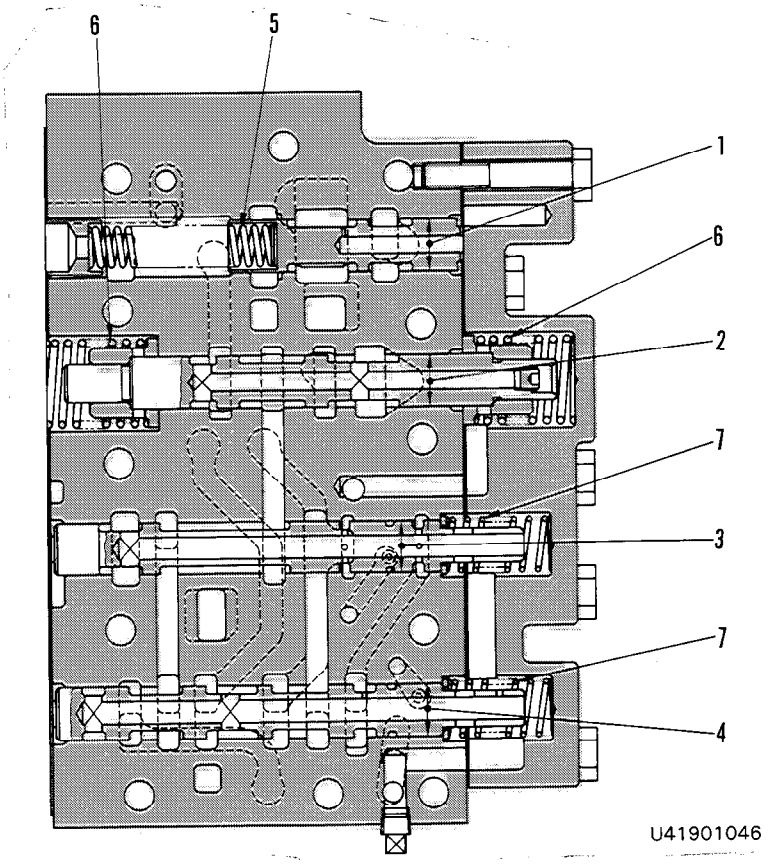
UPPER VALVE



Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between pilot reducing valve spool and body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		19	-0.02 -0.03	+0.013 0	0.020- 0.043	0.050	
2	Clearance between main regulator valve and body	19	-0.02 -0.03	+0.013 0	0.020- 0.043	0.050	
3	Clearance between main regulator valve and load piston	13.5	-0.02 -0.03	+0.018 0	0.020- 0.048	0.055	
4	Clearance between priority valve and body	19	-0.02 -0.03	+0.013 0	0.020- 0.043	0.050	
5	Clearance between priority valve and load piston	12.5	-0.02 -0.03	+0.018 0	0.020- 0.048	0.055	
6	Clearance between quick return valve and body	28	-0.020 -0.028	+0.013 0	0.020- 0.041	0.044	
7	Clearance between fill valve and body	28	-0.02 -0.03	+0.013 0	0.020- 0.043	0.050	
8	Clearance between fill valve and sleeve	28	-0.02 -0.03	+0.033 +0.020	0.040- 0.066	0.070	
9	Clearance between fill valve and sleeve	30	-0.04 -0.05	+0.041 +0.025	0.065- 0.091	0.100	
10	Clearance between sleeve and body	41	-0.050 -0.075	+0.025 0	0.050- 0.100	0.110	
11	Clearance between accumulator valve and body	28	-0.02 -0.03	+0.013 0	0.020- 0.043	0.050	
12	Main regulator valve and pilot valve spring	Standard size			Repair limit		
		Free length	Installation length	Installation load (kg)	Free length	Installation load (kg)	
		82.55	62.6	23.46±1.17	79.3	21.1	
13	Priority valve spring	69.5	52.6	25.92±1.30	66.7	23.3	
14	Quick return spring	48.0	41.0	0.08±0.004	46.1	0.072	
15	Fill valve spring (Inner)	41.8	40.0	2.46±0.12	40.1	2.21	
16	Fill valve spring (Outer)	43.6	24.3	14.07±0.70	41.9	12.7	
17	Accumulator spring (Outer)	99.6	99.6	0	95.6		
18	Accumulator spring (Inner-1)	35.6	35.6	0	34.2		
19	Accumulator spring (Inner-2)	40.8	40.8	0	39.2		

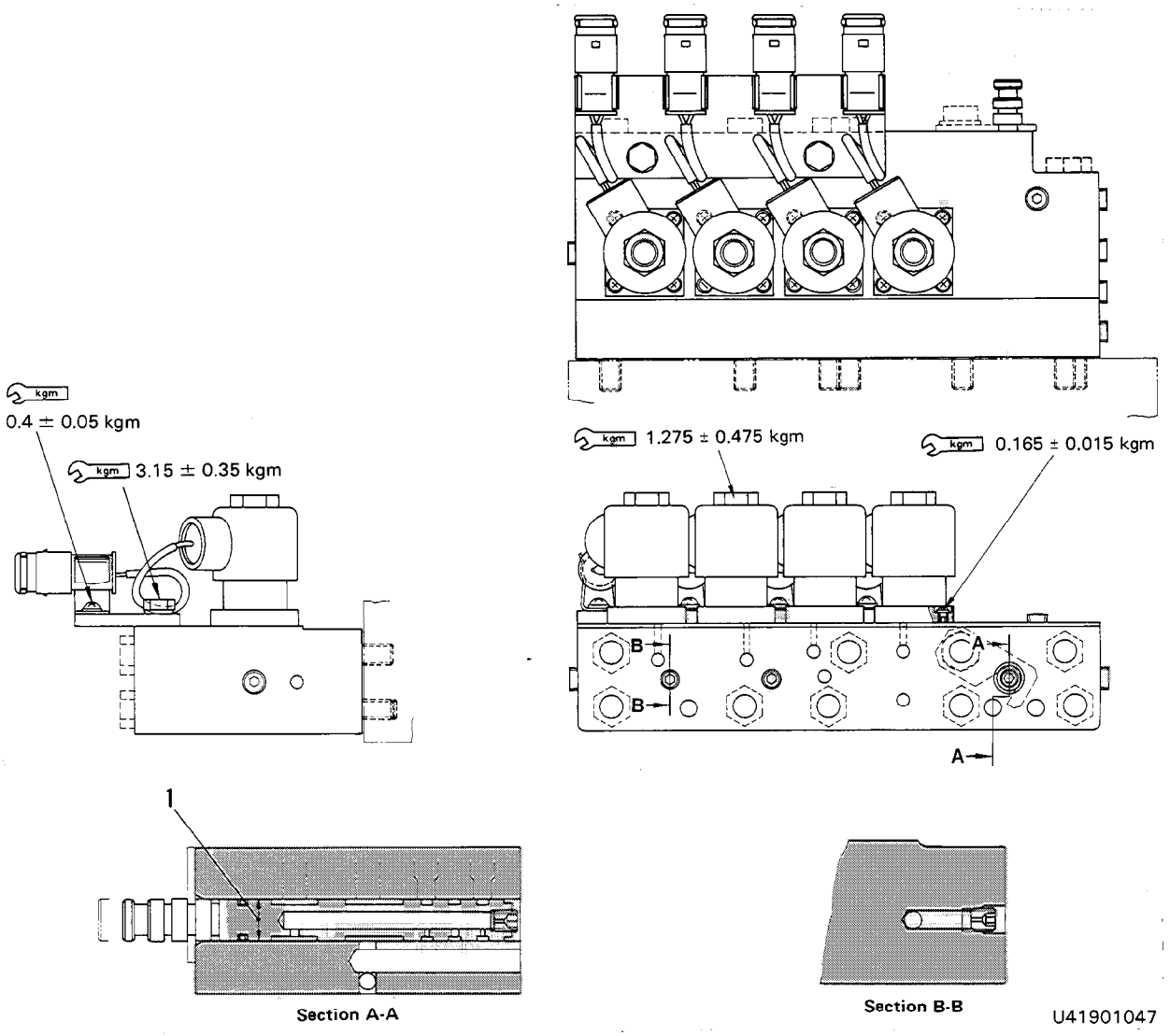
LOWER VALVE



Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between torque converter regulator valve and body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		19	-0.02 -0.03	+0.013 0	0.020- 0.043	0.050	
2	Clearance between Forward-Reverse selector spool and body	19	-0.02 -0.03	+0.013 0	0.020- 0.043	0.050	
3	Clearance between High-Low selector spool and body	19	-0.02 -0.03	+0.013 0	0.020- 0.043	0.050	
4	Clearance between range selector spool and body	19	-0.02 -0.03	+0.013 0	0.020- 0.043	0.050	
5	Torque converter regulator spring	Standard size			Repair limit		
		Free length	Installation length	Installation load (kg)	Free length	Installation load (kg)	
		70.3	66.1	5.68±0.28	67.5	5.1	
6	Forward-Reverse selector spool spring	48.8	36	8.5±0.43	46.8	7.7	
7	High-Low and speed range selector spool spring	48.0	36.7	7.12±0.36	46.1	6.4	

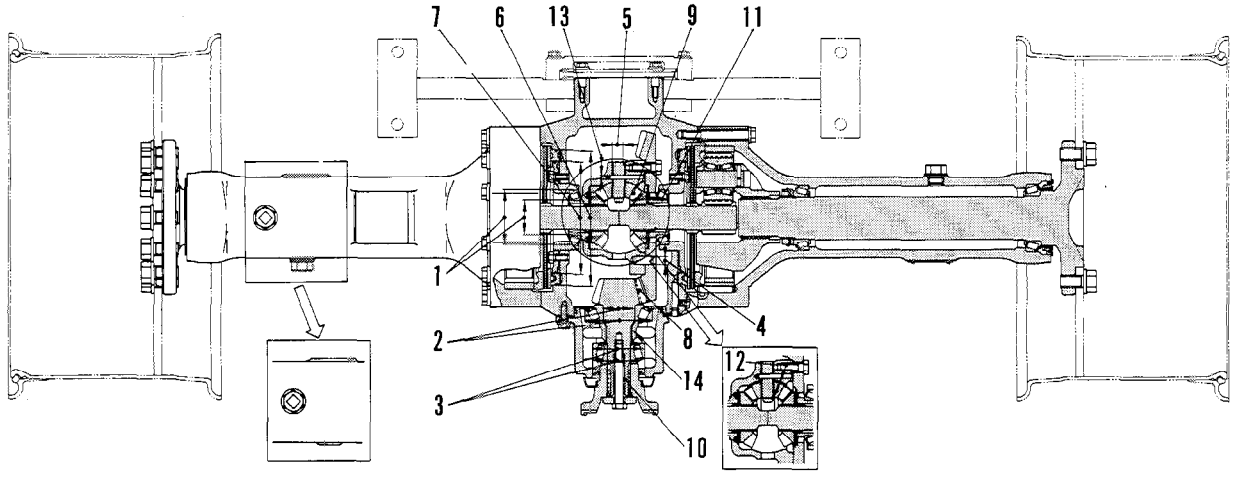
SOLENOID VALVE



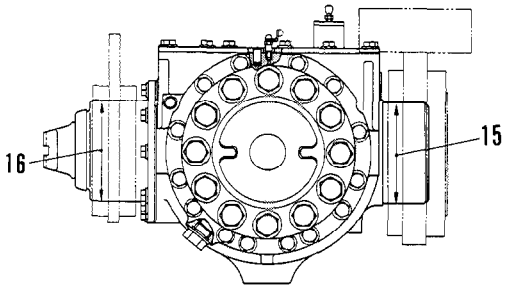
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between emergency manual valve spool and body	14	-0.02 -0.03	+0.013 0	0.020- 0.043	0.050	Replace

AXLE



FL41801031



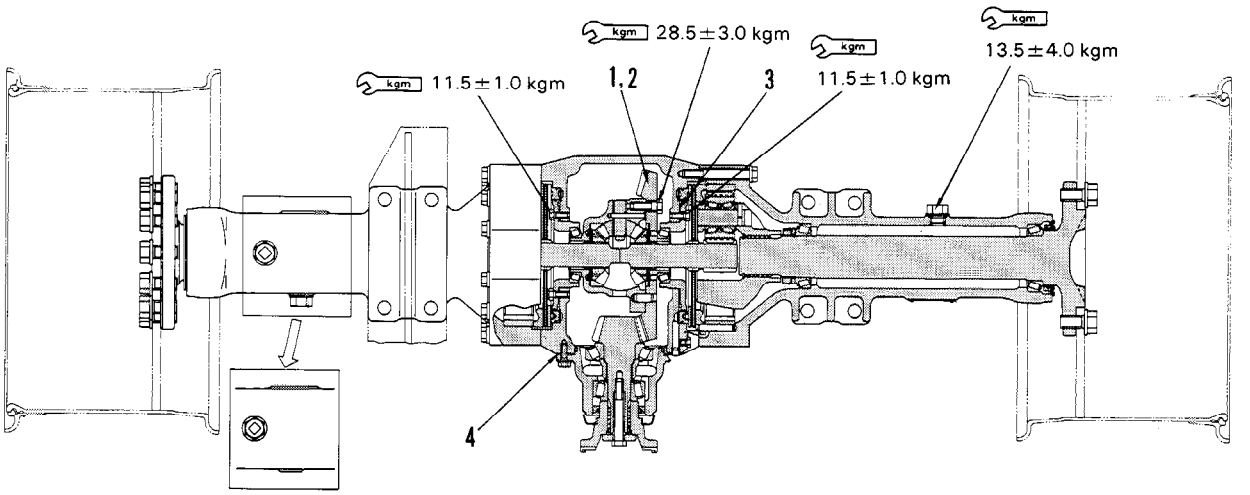
418F087B

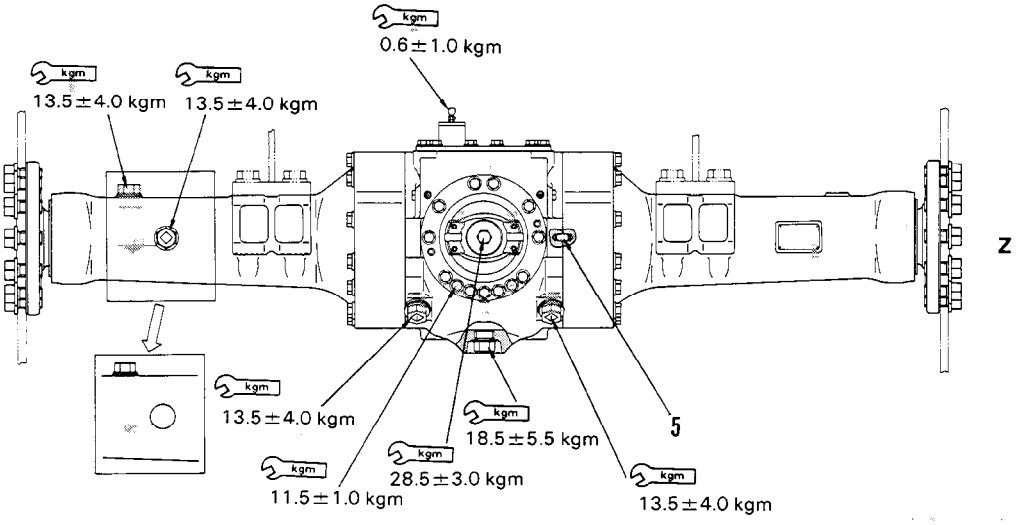
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance of bearing at differential side	Outer race 105	0 -0.020	-0.024 -0.059	-0.059- -0.004		Replace
		Inner race 65	+0.051 +0.032	0 -0.015	-0.066- -0.032		
2	Clearance of bearing of pinion shaft at coupling side	Outer race 130	0 -0.018	-0.048 -0.088	-0.088- -0.030		
		Inner race 60	+0.039 +0.020	0 -0.015	-0.054- -0.020		
3	Clearance of bearing of pinion shaft at coupling side	Outer race 100	0 -0.015	-0.038 -0.073	-0.073- -0.023		
		Inner race 45	+0.033 +0.017	0 -0.012	-0.045- -0.017		
4	Clearance of bevel gear pinion	16	+0.025 +0.007	+0.027 0	-0.025- +0.020		
5	Clearance between pinion gear and spider	25.4	-0.105 -0.118	+0.10 +0.05	-0.155- 0.218	0.3	
6	Clearance between differential housing and piston	260.4	-0.25 -0.45	+0.05 -0.05	0.20- 0.50		
7	Clearance between bearing carrier and piston	215.95	-0.25 -0.45	+0.05 -0.05	0.20- 0.50		
8	Backlash of bevel gear	0.15-0.30					Adjust
9	Backlash of differential gear	0.10-0.25					
10	End play of pinion gear	Max. 0.145					
11	Thickness of side gear washer	Standard size	Tolerance		Repair limit		Replace
		1.5	±0.05		1.3		
12	Thickness of pinion gear washer	2.0	±0.06		1.80		
13	Wear of lock-pin outside diameter	8.0	0 -0.09				
14	Height of spacer between pinion shaft bearing and bearing	45.315	±0.025				Replace at assembly

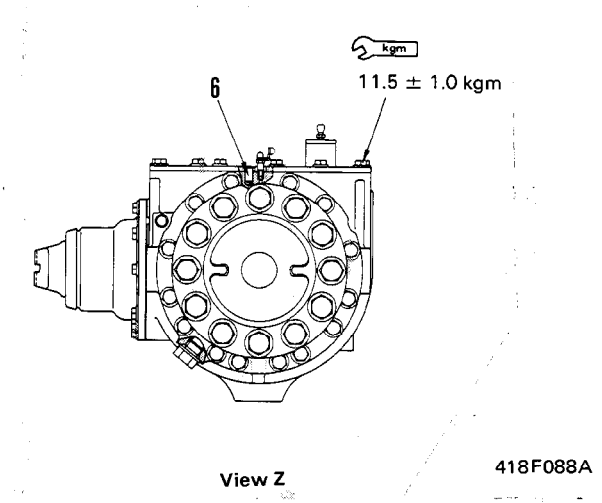
No.	Check item	Criteria			Remedy
		Standard size	Tolerance	Repair limit	
15	Outside diameter of axle mount mounting place (Rear differential)	170	-0.043 -0.106		Replace
16	Outside diameter of axle mount mounting place (Rear differential)	170	-0.043 -0.106		

DIFFERENTIAL





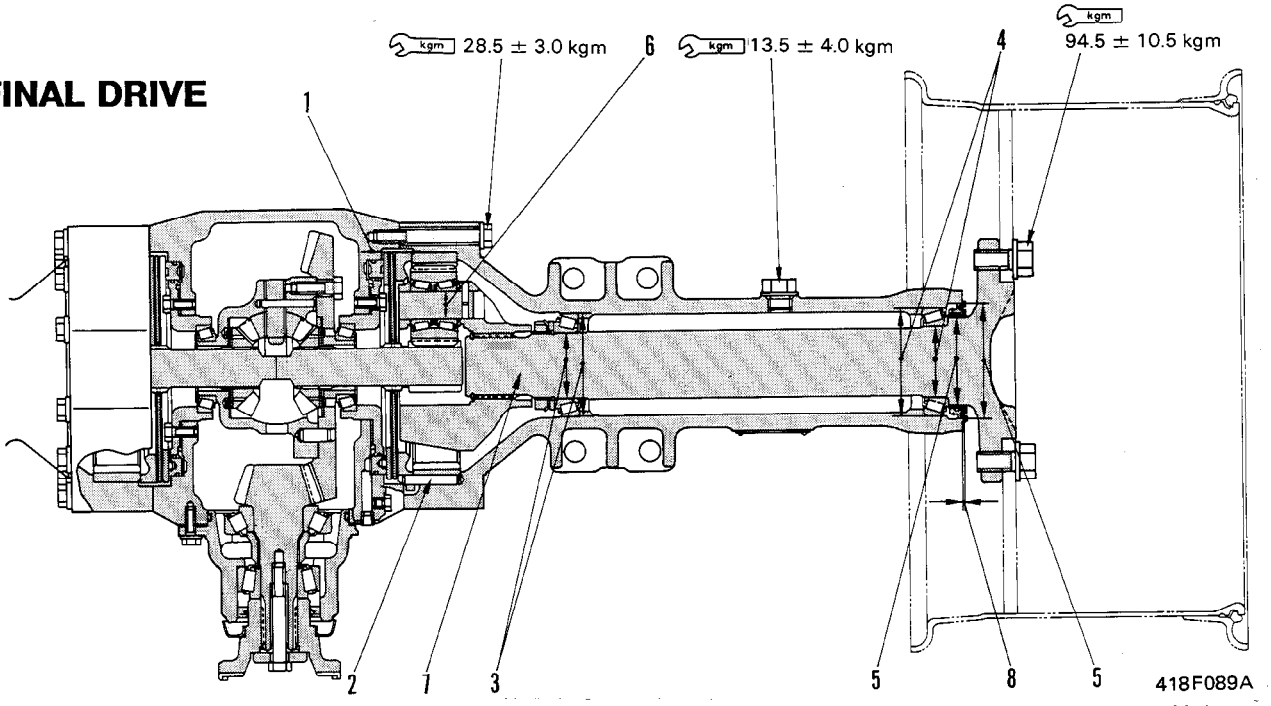
FL41801027



Unit: mm

No.	Check item	Criteria	Remedy
1	Free turning torque of bevel gear	0.12-0.40 kgm	Replace
2	Differential side bearing preload	230-770 kg	
3	Thickness shim of differential bearing carrier place	Standard shim 0.540-1.330	
4	Thickness shim of differential housing and cage assembly	Standard shim 0.175-1.550	
5	Height of jut out pin	13	
6	Height of jut out pin	8	

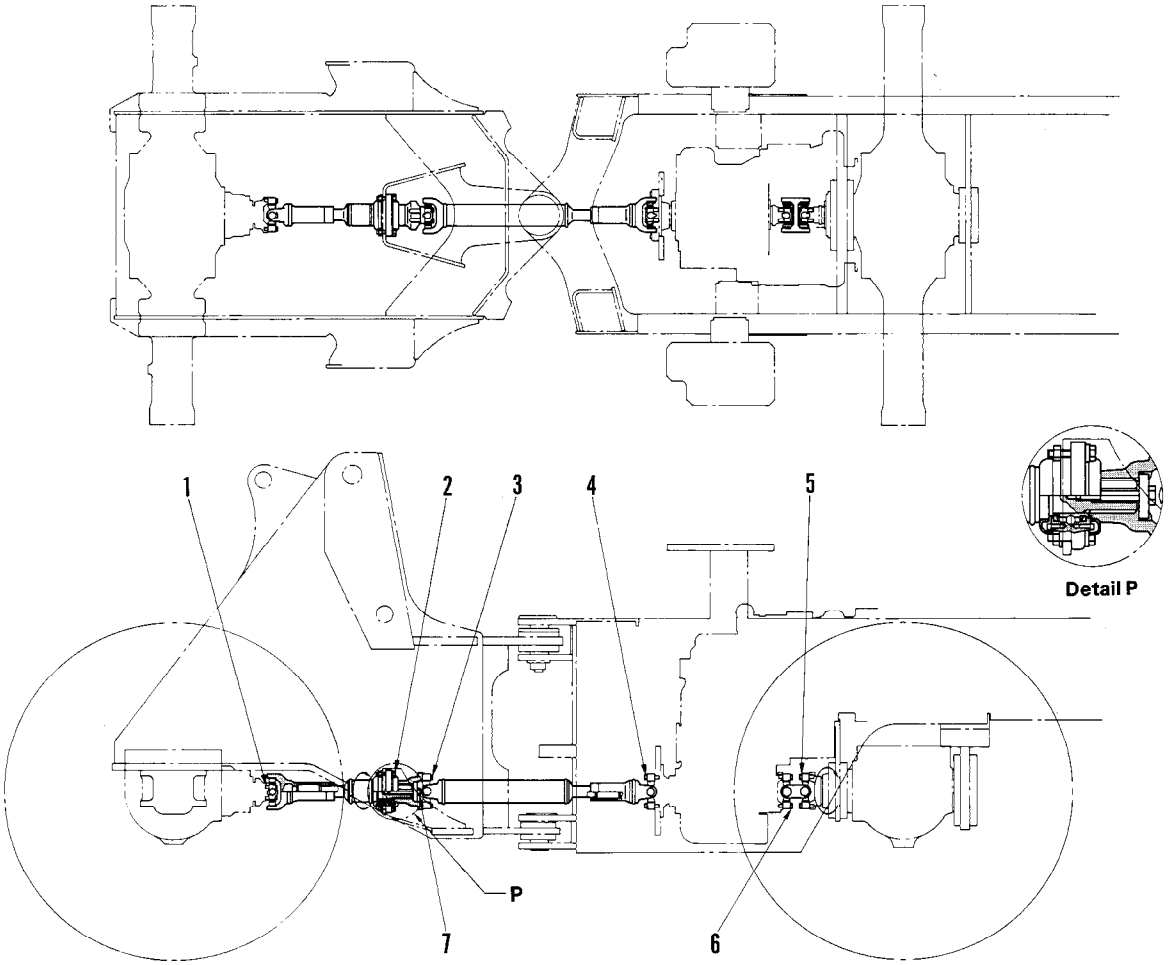
FINAL DRIVE



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between axle housing and ring gear	280	+0.10 +0.03	+0.10 0	-0.10- 0.07		Replace
2	Clearance of guide pin	12	+0.025 +0.007	+0.187 +0.125	0.10- 0.18		
3	Clearance of axle housing bearing of differential side (Outer race)	125	0 -0.018	-0.028 -0.068	-0.068- -0.010		
	(Inner race)	80	0 -0.019	0 -0.015	-0.015- 0.019		
4	Clearance of axle housing bearing of differential side (Outer race)	130	0 -0.025	-0.028 -0.068	-0.068- -0.003		
	(Inner race)	85	+0.045 +0.023	0 -0.020	-0.065- -0.023		
5	Diameter between pinion gear bearing and shaft (Housing)	140	+0.4 +0.2	+0.063 0	-0.4- -0.137		
	(Shaft)	105	0 -0.054	-0.2 -0.4	-0.4- -0.146		
6	Clearance between pinion gear bearing and shaft	33.338	+0.025 +0.013	+0.013 0	-0.025- 0		
7	End play of axle shaft	0.025-0.200					
8	Clearance between oil seal and housing	0.05-1.95					

DRIVE SHAFT

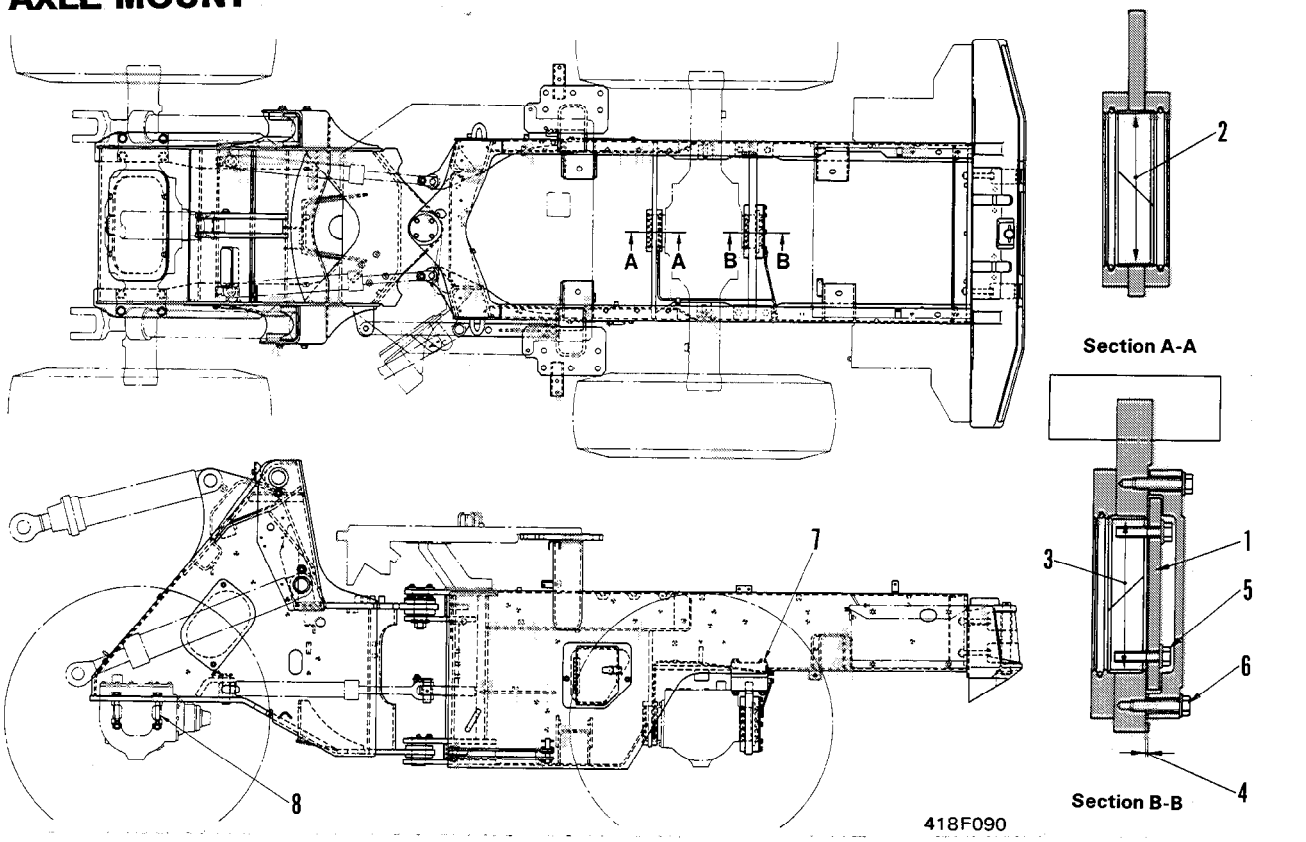


418F086

Unit: mm

No.	Check item	Criteria	Remedy
1	Tightening torque of bolt	6.75±0.75 kgm	Retighten
2	Tightening torque of bolt	28.5±3.0 kgm	
3	Tightening torque of bolt	6.75±0.75 kgm	
4	Tightening torque of bolt	6.75±0.75 kgm	
5	Tightening torque of bolt	6.75±0.75 kgm	
6	Tightening torque of bolt	6.75±0.75 kgm	
7	Tightening torque of bolt	28.5±3 kgm	

AXLE MOUNT

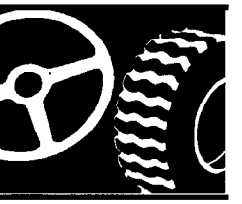


Unit: mm

No.	Check item	Criteria					Remedy
1	Thickness of thrust plate	Standard size			Repair limit		Replace
		10			0 -0.15		
2	Clearance between shaft and hole at front support side	Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
		170	-0.043 -0.106	+0.550 +0.050	-0.093- -0.656		
3	Clearance between shaft and hole at front support side	180	-0.142 -0.077	+0.700 +0.200	0.058- 0.623		
4	Thickness of axle mount shim	0.2 (Standard shim thickness)					
5	Tightening torque of mounting bolt	11.5±1.0 kgm					Retighten
6	Tightening torque of mounting bolt	28.0±3.0 kgm					
7	Tightening torque of mounting bolt	69.0±7.0 kgm					
8	Tightening torque of axle mounting bolt	69.0±7.0 kgm					

STEERING SYSTEM

41 STRUCTURE AND FUNCTION



STEERING PIPING 2

HYDRAULIC CIRCUIT FOR STEERING 3

HYDRAULIC CIRCUIT DIAGRAM FOR STEERING 4

TWO-WAY RESTRICTOR VALVE 5

STEERING VALVE 6
CONNECTION OF HAND PUMP AND SLEEVE 12

PRIORITY VALVE 14

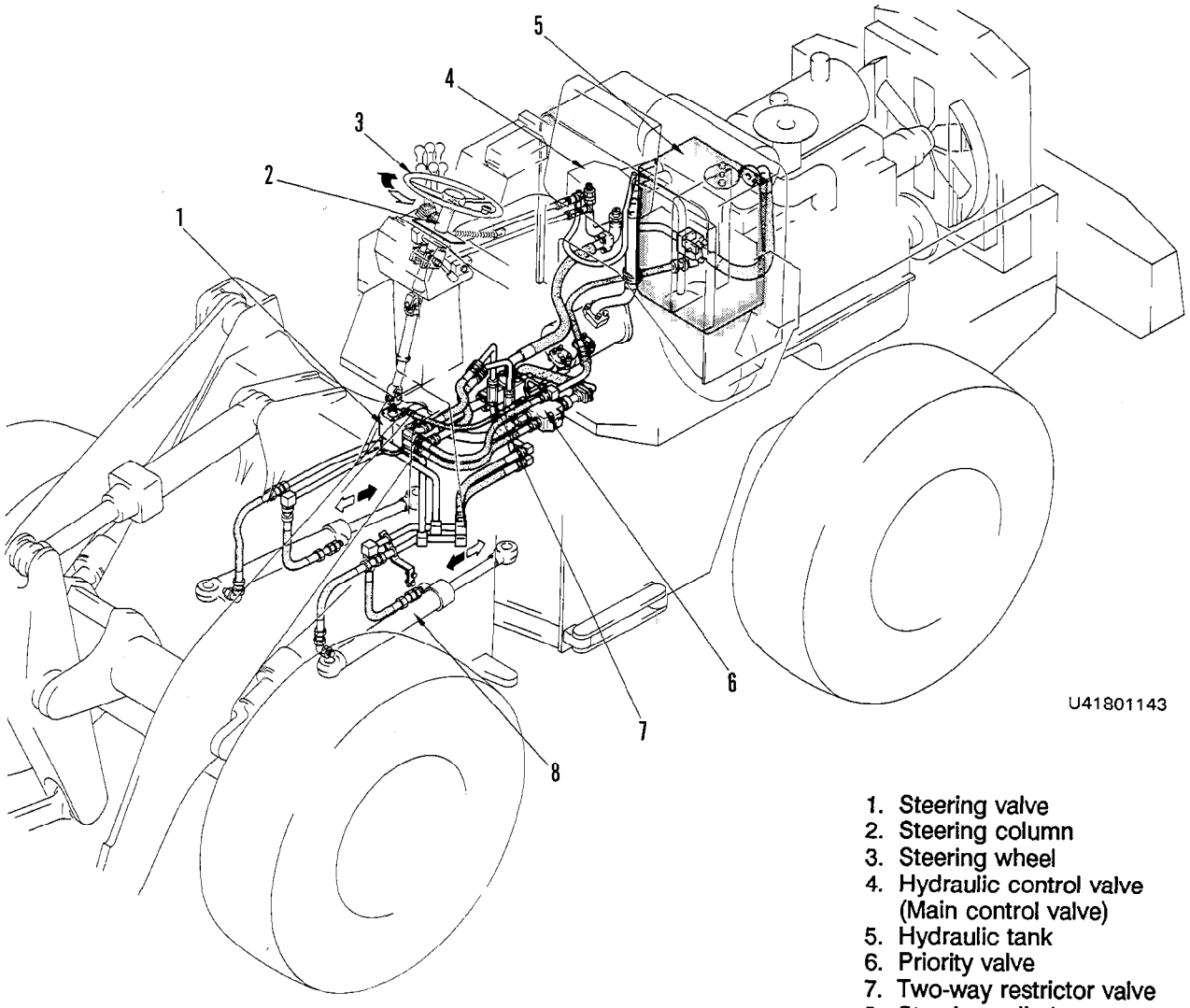
STEERING COLUMN 17

STEERING CYLINDER 18

CENTER HINGE PIN 19

STEERING PIPING

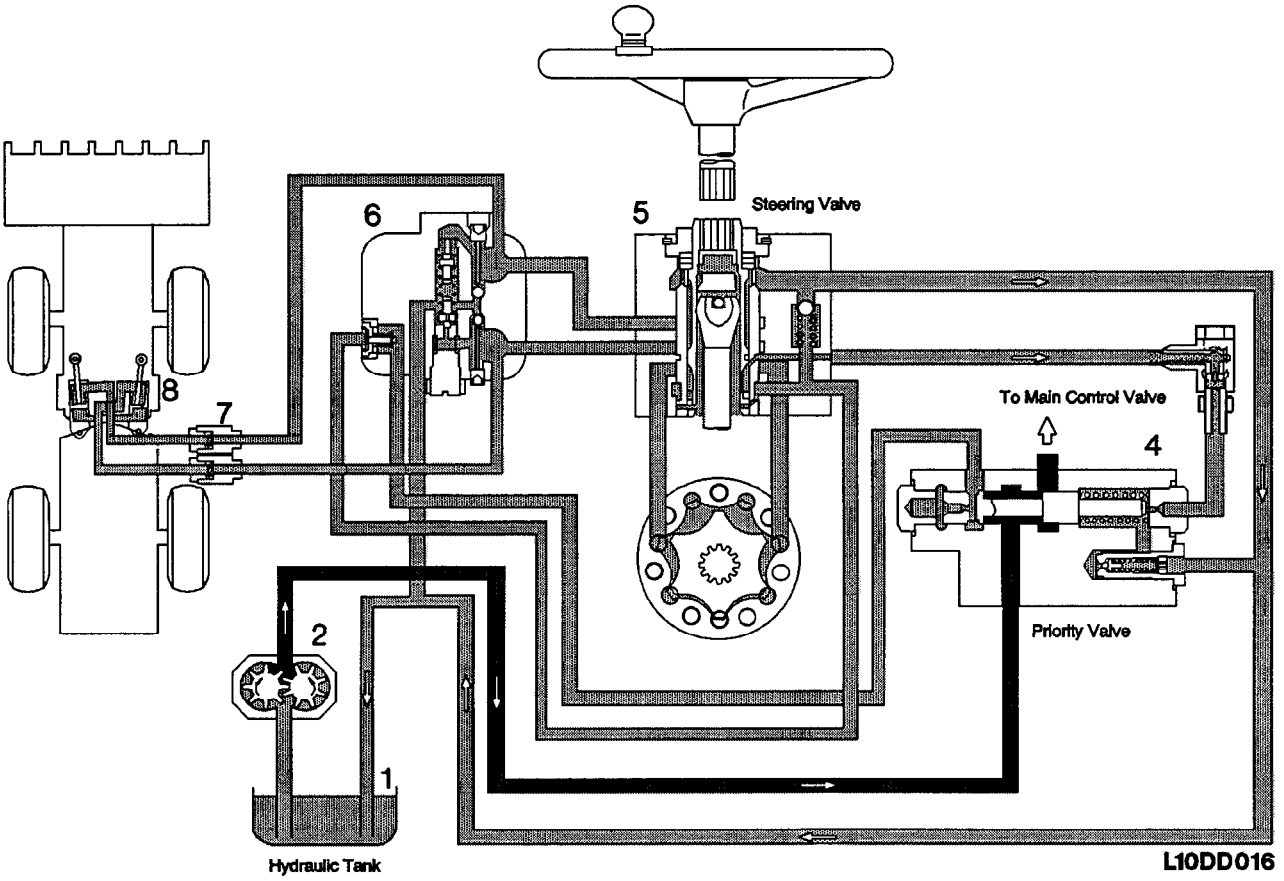
- The oil from hydraulic tank (5) is sent to priority valve (6) by hydraulic and steering pump.
- The steering system is of the fully hydraulic type. Hydraulic oil is sent to the steering cylinders by the steering valve, oil flow being varied with turning angle of the steering wheel. The valve has a built-in hand pump, which makes it possible to suck up oil and operation can be maintained in case of oil pump or engine trouble.
- When the steering wheel is not being operated, all the oil which enters priority valve (6) flows to the hydraulic equipment control valve.



1. Steering valve
2. Steering column
3. Steering wheel
4. Hydraulic control valve (Main control valve)
5. Hydraulic tank
6. Priority valve
7. Two-way restrictor valve
8. Steering cylinder

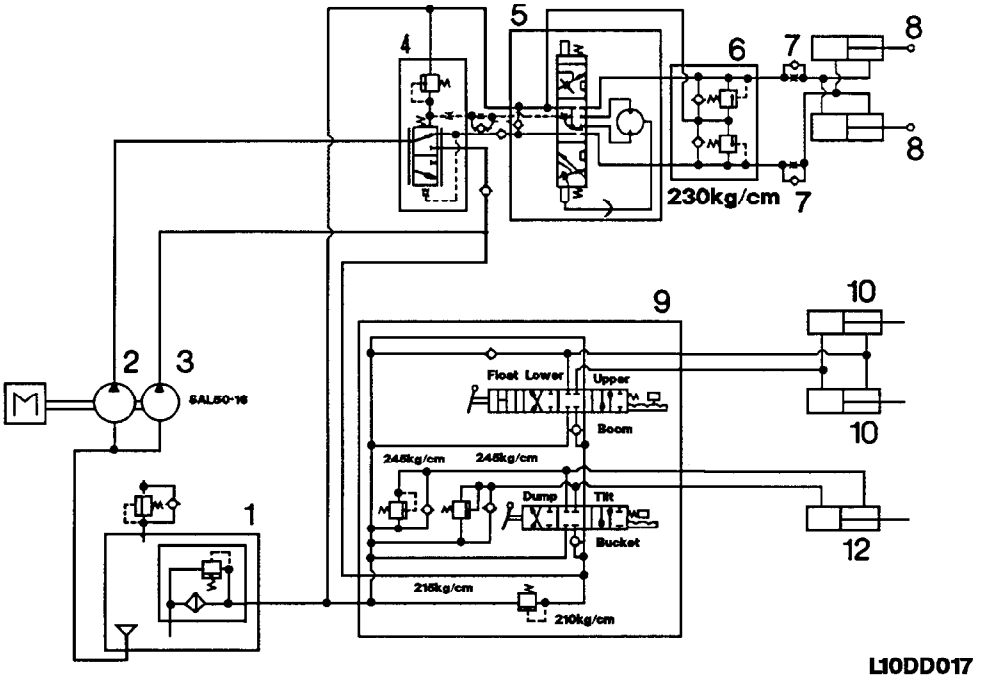
HYDRAULIC CIRCUIT FOR STEERING

Neutral



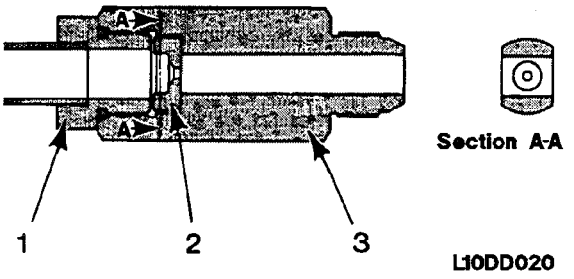
1. Hydraulic tank
2. Hydraulic pump (Steering)
3. -- Not Used --
4. Priority valve
5. Steering valve
6. Overload valve
7. Two-way restrictor valve
8. Steering cylinder

HYDRAULIC CIRCUIT DIAGRAM FOR STEERING



1. Hydraulic tank
2. Hydraulic pump (Steering)
3. Hydraulic pump (Work equipment)
4. Priority valve
5. Steering valve
6. Overload valve
7. Two-way restrictor valve
8. Steering cylinder
9. Main control valve
10. Lift cylinder
11. -- Not Used --
12. Dump cylinder

TWO-WAY RESTRICTOR VALVE



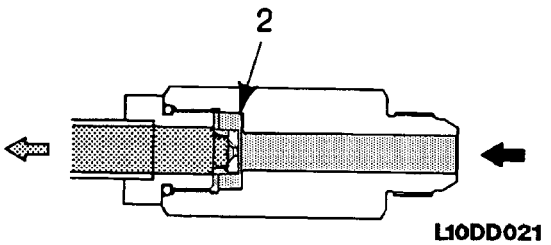
1. Tube
2. Poppet
3. Body

Function

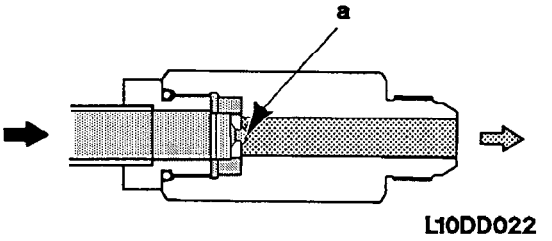
- To reduce the shock caused by the inertia of the machine when the steering is operated, an orifice is installed in the oil line of the return circuit from the cylinder. This applies pressure to the returning oil, and regulates the movement of the cylinder piston.

Operation

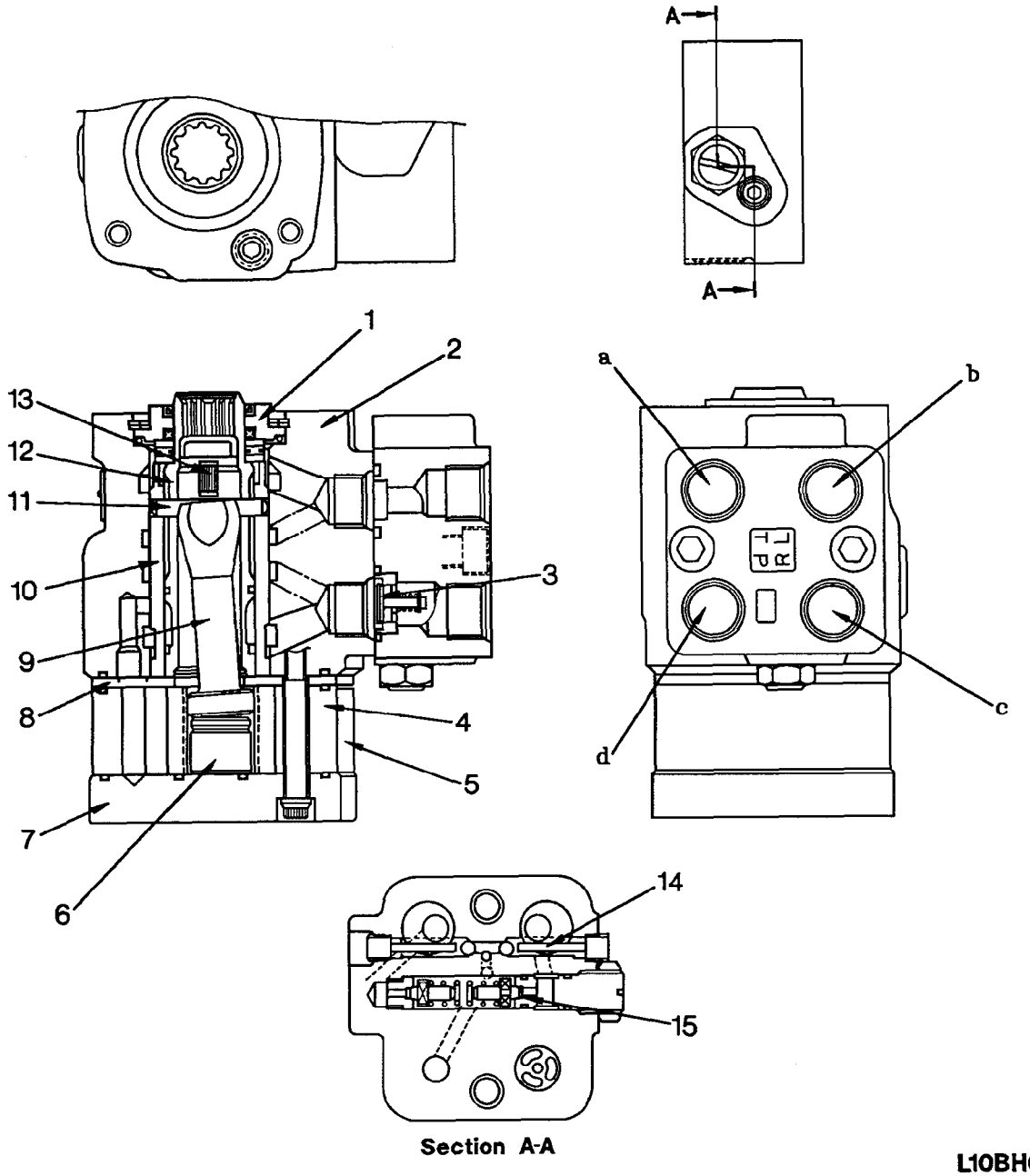
- When the oil is flowing to arrow ←, it pushes poppet (2) and flows through the orifice, and between poppet (2), and poppet notch.



- When the oil is flowing to arrow →, theoil flows only from orifice "a" inside the poppet, so the flow is controlled.



STEERING VALVE



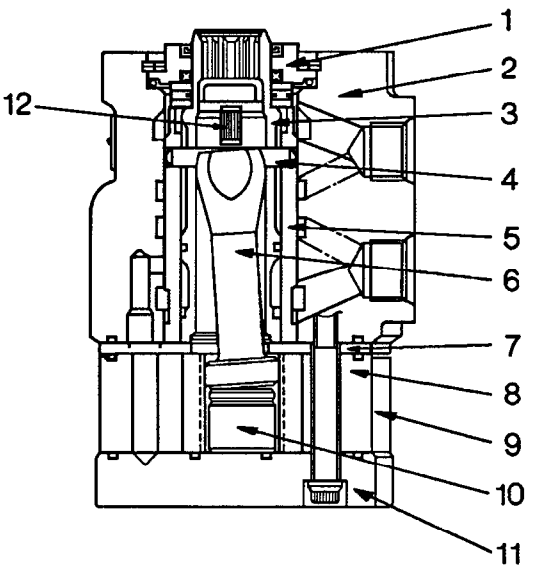
L10BH083

a. To hydraulic tank
b. To L.H. steering cylinder
c. To R.H. steering cylinder
d. From steering pump

1. Gland
2. Valve body
3. Check valve
4. Rotor
5. Stator
6. Spacer
7. Cover
8. Spacer
9. Drive shaft
10. Sleeve
11. Center pin
12. Spool
13. Centering spring
14. Suction valve
15. Overload valve

Outline

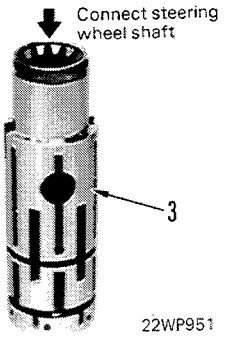
- The steering valve is connected directly to the steering wheel. It acts to switch the oil from the steering pump to the right and left steering cylinders to decide the direction of travel of the machine.
- The steering valve consists basically of spool (3), sleeve (5), rotor (8) and stator (9). Spool (3) and sleeve (5) have a rotary type direction selecting function. Rotor (8) and stator (9) operate as a hydraulic motor during normal steering operation, and as a hand pump when the supply of oil stops due to a breakdown in the steering pump or engine.



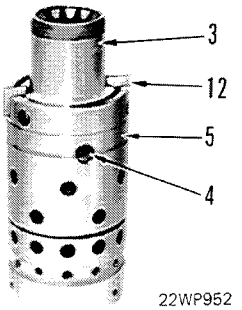
406F411

Structure

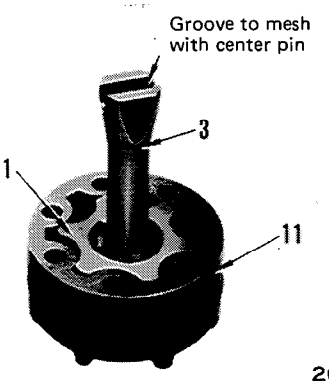
- Spool (3) is connected directly to the drive shaft of the steering wheel. It is connected to sleeve (5) by center pin (4) (not in contact with the spool when the steering wheel is at NEUTRAL) and centering spring (12).
- Drive shaft (6) is meshed at the top with center pin (4) and forms one unit with sleeve (5). At the same time, it is meshed with rotor (8) of the Girotor set by a spline.
- There are four ports in valve body (2). They are connected to the pump circuit, tank circuit, and the head, and front and rear steering cylinders. In addition, the pump port and tank port are connected inside the body by the check valve. Therefore, if there is any failure in the pump or engine, oil can be sucked in directly from the tank through the check valve.



22WP951



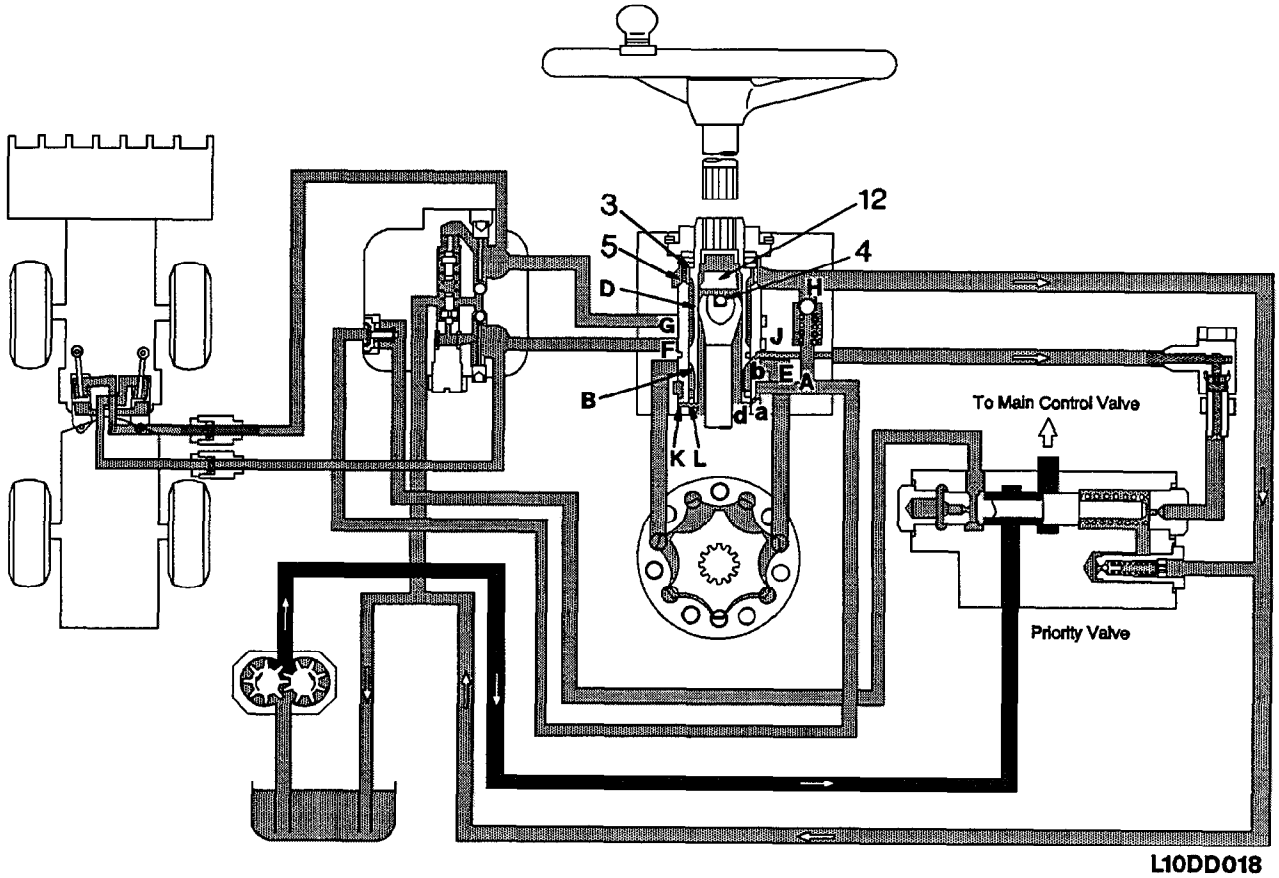
22WP952



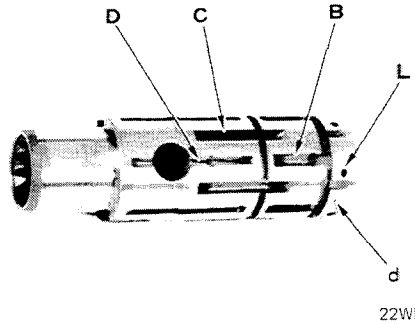
20BP008

Operation

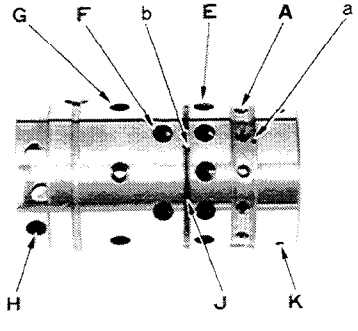
1. Steering wheel at NEUTRAL



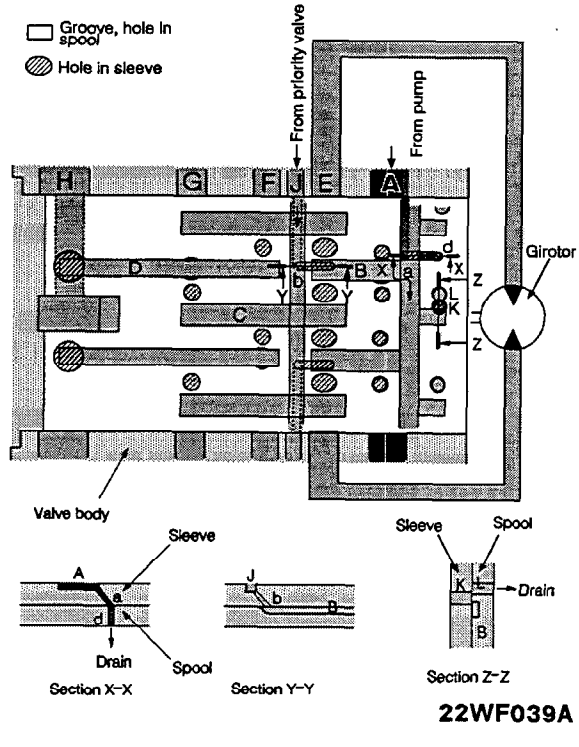
L10DD018



22WP953



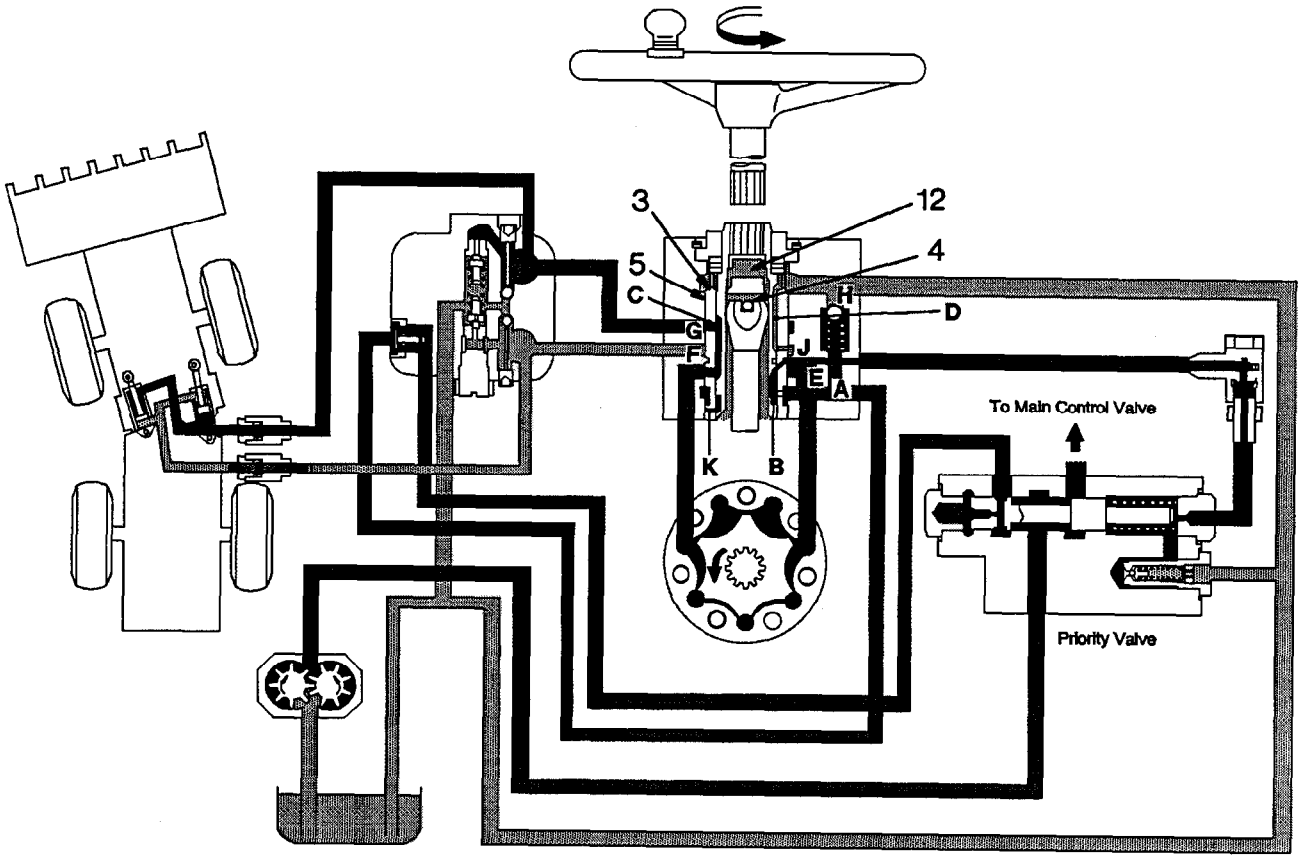
22WP954



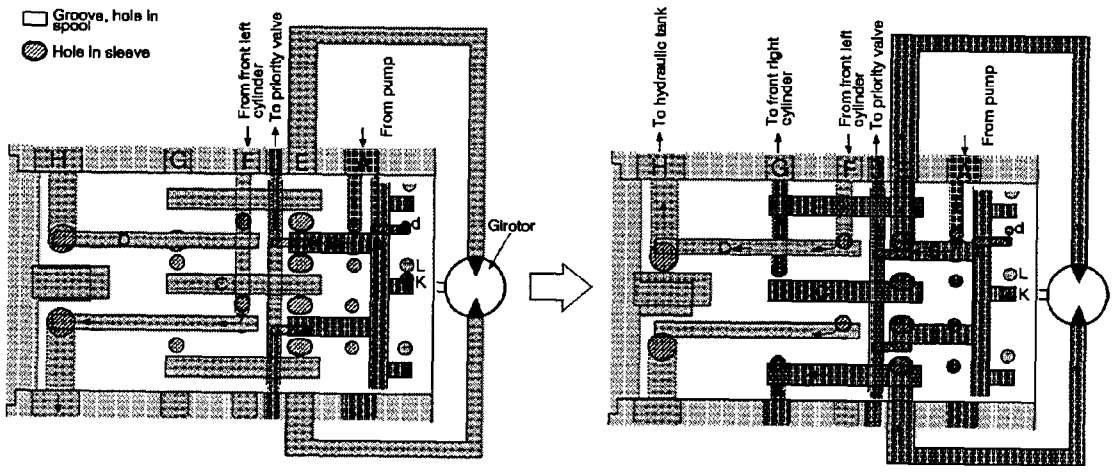
22WF039A

- When the steering wheel is not being used, center pin (4) is held by centering spring (12) in the center of the oblong hole of spool (3). Spool (3) and sleeve (5) do not move.
  When this happens, pump port A in the sleeve, ports E, F and G leading to the cylinder and Girotor, and vertical grooves B, C and D in the spool are shut off.
  However, orifice a of pump port A and orifice d (connected to drain port H) of the spool are connected.
  In addition, orifice b of port J from the priority valve is connected with the vertical groove B of the spool. Port K of the sleeve connects drain port L of the spool to vertical groove B.
- By connecting and disconnecting these ports and grooves, the oil from the pump passes through orifices a and d of port A and is drained to the hydraulic tank.
  The oil which forms the pilot pressure of the priority valve passes from port J through orifice b. It then goes through vertical groove B and port K, and returns to the hydraulic tank from port L.

2. **Steering wheel turned to the left**



L10DD019

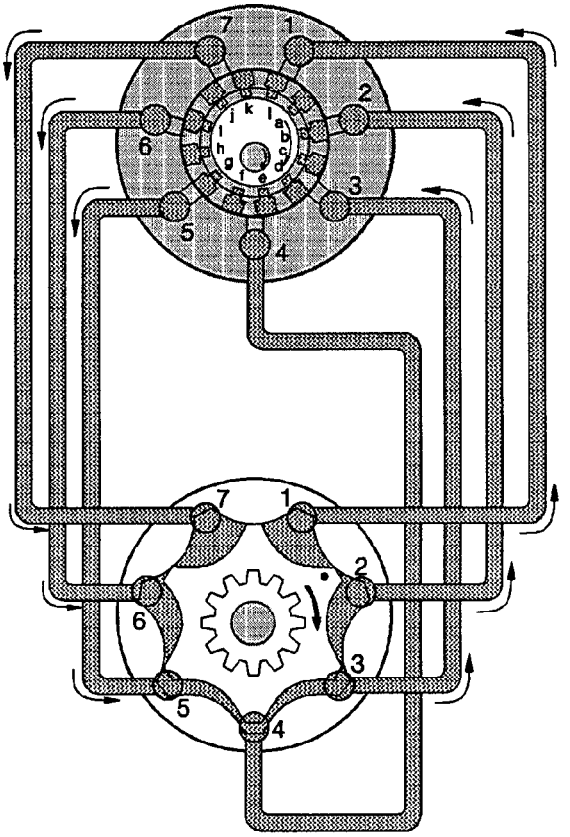


22WF833

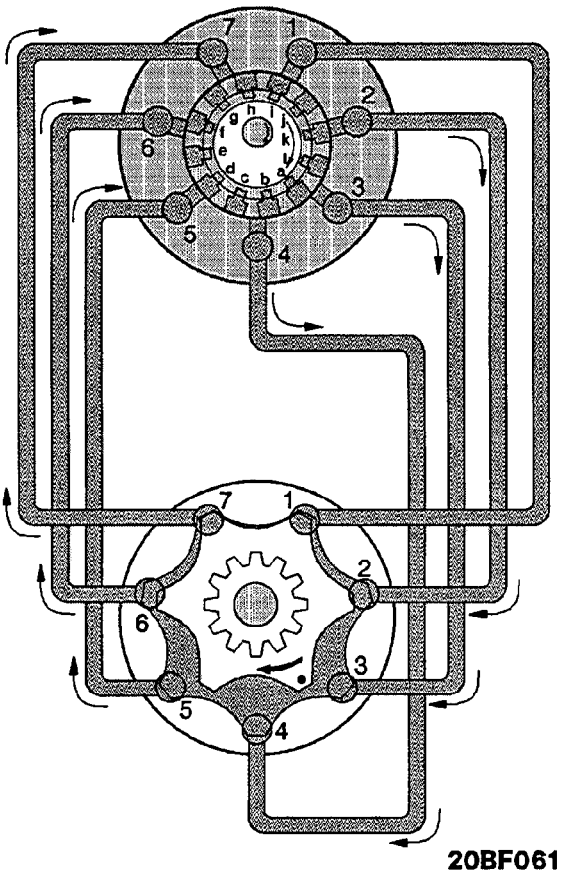
- When the steering wheel is turned to the left, spool (3), which is connected by the spline of the steering shaft, turns to the left. However, sleeve (5) and the spool are interconnected by centering spring (12), so the spool compresses the centering spring.
  As a result, there is a difference (angle variation) in the angle of rotation of the spool and the sleeve. This difference corresponds to the amount by which the centering spring is compressed.
  When this happens, first, port A and vertical groove B are connected, then vertical groove B and port E leading to the Girotor. Next, port E leading from the Girotor and vertical groove C are connected, and finally, vertical groove C and port G leading to the front right cylinder head are connected.
  At the same time, vertical groove B and orifice b of port J leading to the priority valve are kept connected, but the connection between port K of the sleeve and vertical groove B and port L gradually closes.
  Port F from the front left cylinder head is connected to vertical groove D (leading to drain port H) at the same time as port A and vertical groove B are connected.
- By connecting and disconnecting these ports and grooves, the oil from the pump goes from port A to vertical groove B, then flows to port E of the Girotor to rotate the Girotor. The oil delivered from the Girotor goes from port E and enters vertical groove C, then from port G to the head end of the front right cylinder.
  The oil entering vertical groove B passes through orifice b and flows to port J. From port J it becomes the pilot pressure of the priority valve.
  The oil from the head end of the front left cylinder goes from port F and enters vertical groove D, and is drained to the hydraulic tank.
- For details of the operation of the Girotor, see the next page.

3. **Steering wheel not operated**
   When the operation of the steering wheel is stopped, the difference in rotation of the spool and spring is returned to the NEUTRAL position by the reaction of centering spring (12).

CONNECTION OF HAND PUMP AND SLEEVE

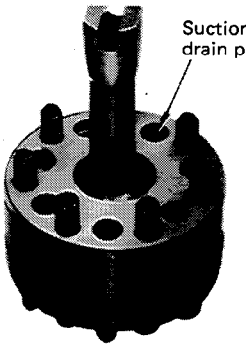


20BF060



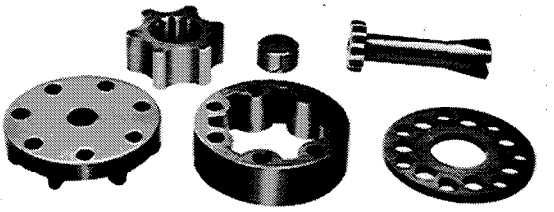
20BF061

- The connections between the sleeve ports and the suction and drain ports of the Girotor, which are joined by the sleeve, are as shown in the above diagram.
- If the steering wheel is turned to the right, ports a, c, e, g, i and k are connected to the pump by the vertical grooves of the spool. Ports b, d, f, h, j and l are connected in the same way to the head of the front left steering cylinders.
  In the situation shown in Fig. 1, ports 1, 2 and 3 are the delivery ports of the Girotor set. They are connected with ports 1, b and d, so oil is sent to the cylinder. At the same time, ports 5, 6 and 7 are connected, so oil flows in from the pump.
  If the steering wheel is turned 90° from this position, the condition changes to that in Fig. 2. In this case, ports 1, 2 and 3 are the suction ports and are connected with ports i, k and a. Ports 5, 6 and 7 are the delivery ports and are connected with ports d, f and h.



20BP011

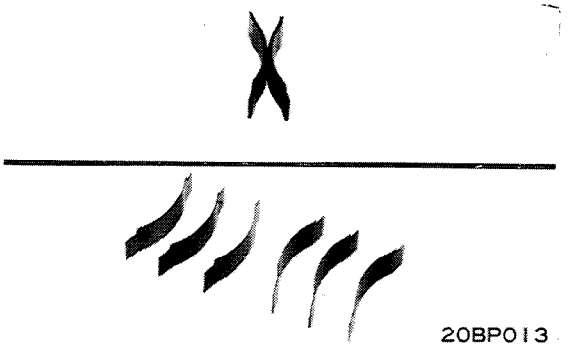
- In this way, the ports of the Girotor acting as delivery ports are connected to ports which are connected to the steering cylinder. The ports acting as suction ports are connected to the pump circuit.
- Adjusting delivery in accordance with angle of steering wheel:
  For every 1/7 turn of the steering wheel, the inner teeth of the Girotor gear advance one position, so the oil flow from the pump is adjusted by this movement. In this way, the oil delivered from the pump is directly proportional to the amount the steering wheel is turned.



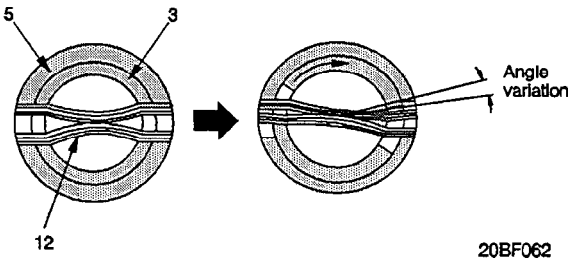
20BP012

Function of center pin

- Centering pin (12) consists of four layers of leaf springs crossed to form an X shape. The springs are assembled in spool (3) and sleeve (5) as shown in the diagram on the right.
  When the steering wheel is turned, the spring is compressed and a difference in rotation (angle variation) arises between the spool and the sleeve. Because of this, the ports in the spool and sleeve are connected and oil is sent to the cylinder. When the turning of the steering wheel is stopped, the Girotor also stops turning, so no more oil is sent to the cylinder and the oil pressure rises.
  To prevent this, when the turning of the steering wheel is stopped, the action of the centering spring only allows it to turn by an amount equal to the difference in angle of rotation (angle variation) of the sleeve and spool, so the steering wheel returns to the NEUTRAL position.

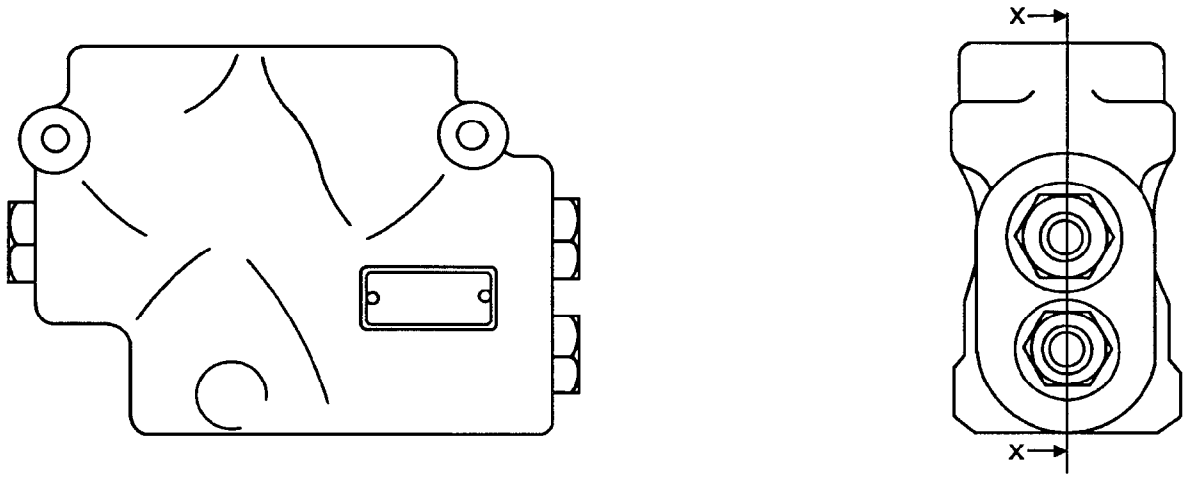


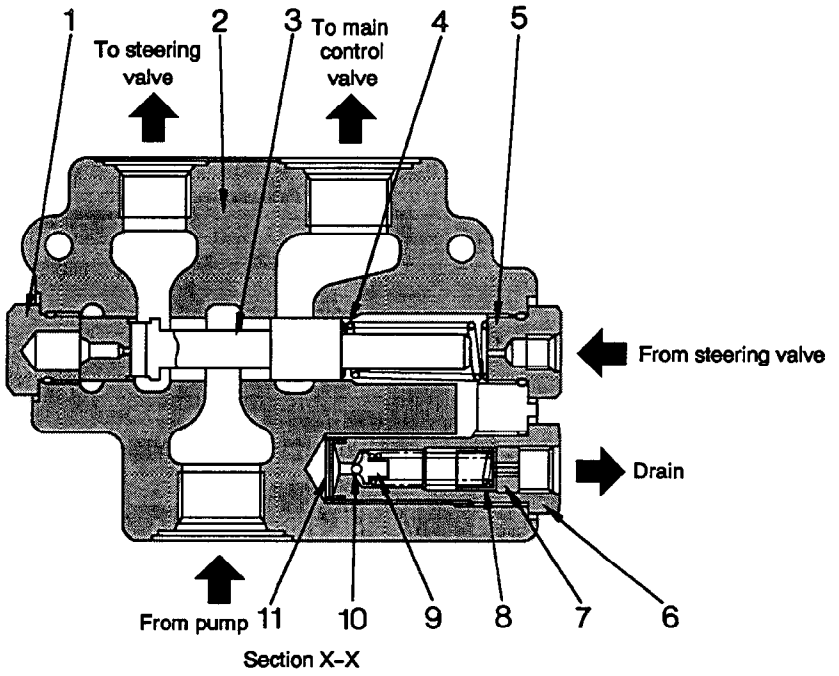
20BP013



20BF062

PRIORITY VALVE





L10BH084

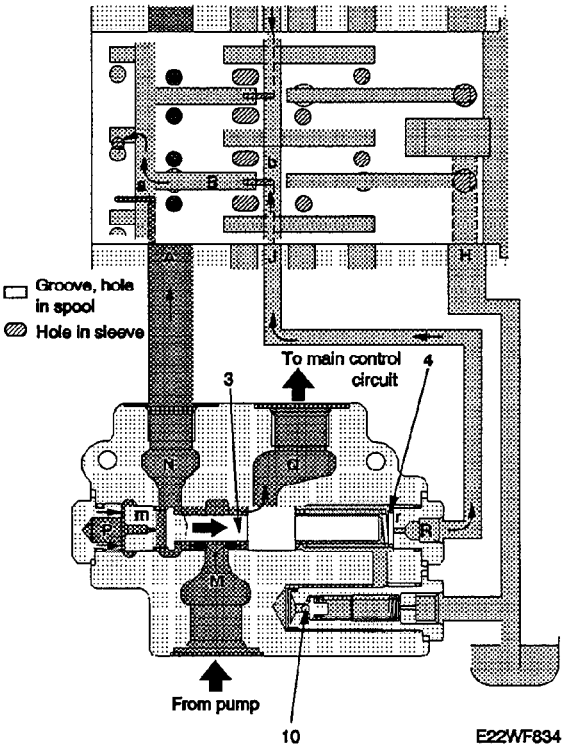
1. Plug
2. Valve body
3. Spool
4. Return spring
5. Plug
6. Relief valve body
7. Spring seat
8. Valve spring
9. Holder
10. Relief valve ball
11. Screen

Outline

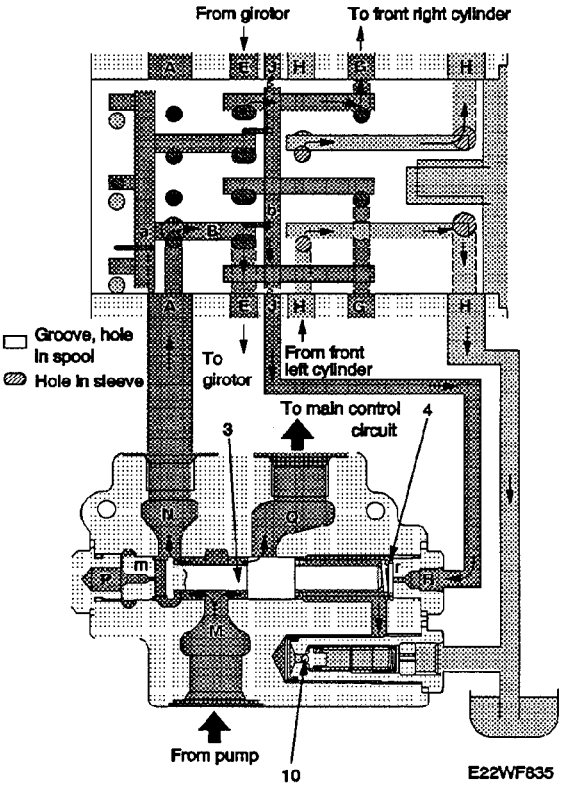
- The priority valve is in the circuit from the steering pump to the steering valve and main control valve. It acts to divide the oil from the steering pump to the steering valve or main control valve circuit. It protects the circuit by setting the hydraulic pressure in the circuit from the priority valve to the steering valve at 190 kg/cm^2.

Operation

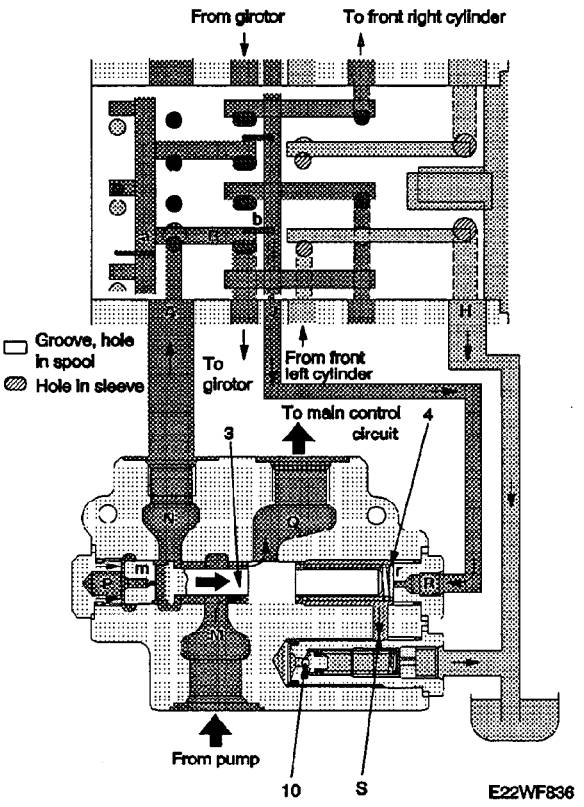
1. **Steering wheel at NEUTRAL**
   When the engine is stopped, the force of spring (4) pushes spool (3) to the left in the direction of the arrow. The circuit between port M and port N is FULLY OPEN, and the circuit between port M and port Q is FULLY CLOSED.
   In this condition, when the engine is started and the steering pump is rotated, the oil from the pump goes from port M to port N, and then flows to port A of the steering valve. The oil entering port A, is restricted by orifice a, so the pressure in the circuit rises.
   When this happens, the oil which passes through orifice m of spool (3) and enters port P compresses spring (4) and moves spool (3) to the right in the direction of the arrow. The circuit between port M and port Q becomes almost FULLY OPEN, and the circuit between port M and port N becomes almost FULLY CLOSED. The circuits are stabilized in this condition, and most of the oil from the pump goes to the main control circuit.



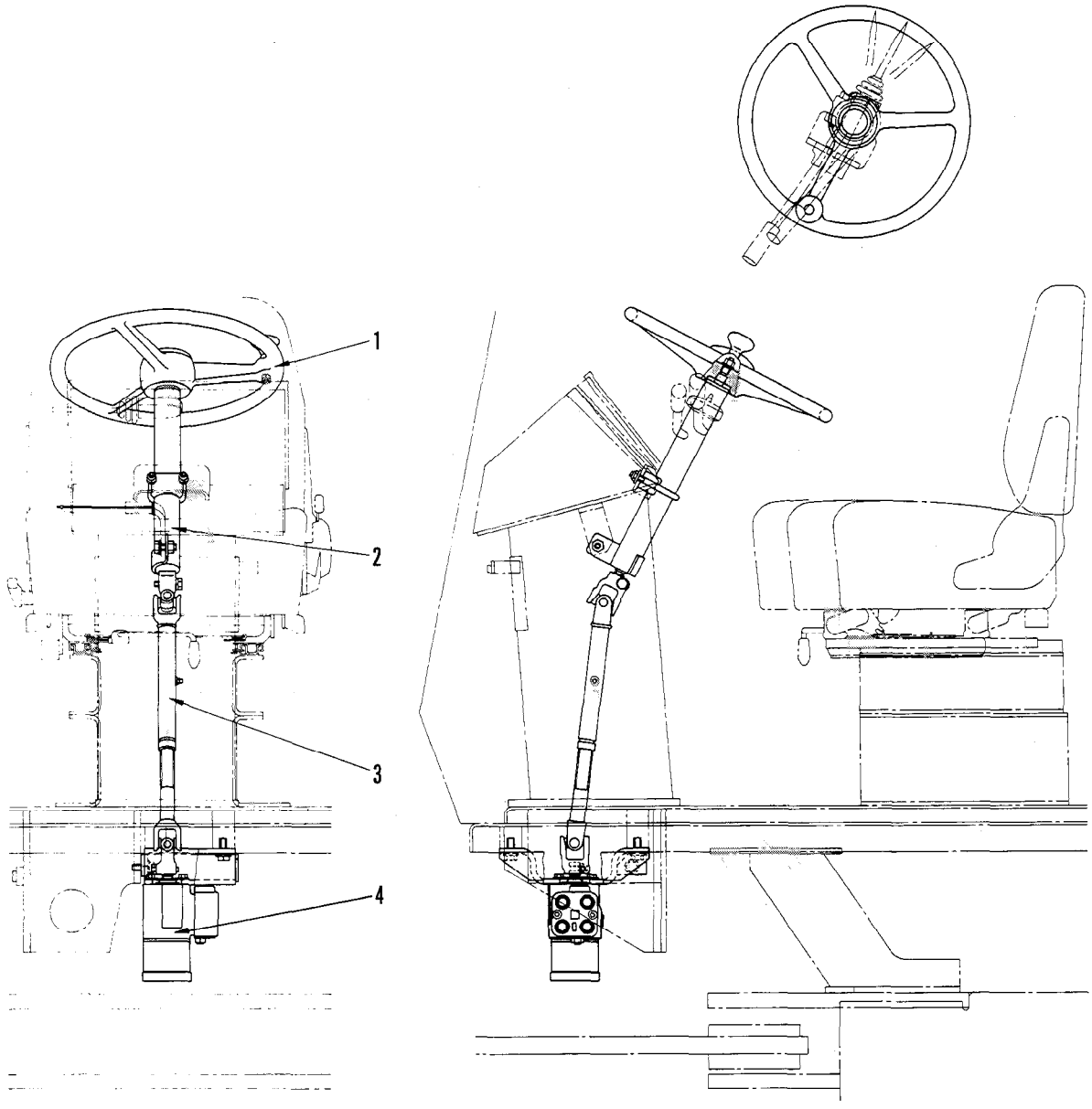
2. **Steering wheel turned to the left**
   When the steering wheel is turned to the left, an angle variation between the spool and the sleeve of the steering valve is created, and the flow of oil is switched. (See explanation of "Steering valve".) The oil from the pump flows from port M to port N and enters port A. Because of the opening of the sleeve (port A) and spool (port B), a difference in pressure is generated between the circuit up to port A and the circuit beyond port B. Some of the oil from port B flows to the Girotor and enters the front right cylinder; the rest of the oil passes through orifice b, flows to port J and enters port R. When this happens, spool (3) is stabilized in a position where the load of spring (4) is in balance with the difference in pressure between the circuit up to port A and the circuit beyond port B (pressure at port P - pressure at port R). The opening of the circuit from port M to port N and port Q is adjusted to divide the flow of oil to both circuits.
   The ratio of this flow is determined by the opening of port A and port B, that is, the angle variation between the sleeve and spool of the steering valve. The opening is adjusted steplessly by the number of turns of the steering wheel.



3. **Steering cylinder at end of stroke**
   If the steering wheel is turned after the steering cylinder has reached the end of its stroke, the circuit from port M through port N to S is kept open, so the hydraulic pressure rises.
   When this pressure reaches 190 kg/cm^2, relief valve (10) opens and the oil is relieved to the hydraulic tank. This flow of oil generates a difference in pressure on either side of orifice r. The balance between the load of spring (4) and the circuit up to port A and the circuit beyond port B is lost, and the pressure on the circuit up to port A becomes higher.
   For this reason, the pressure at port P moves spool (3) further to the right in the direction of the arrow than in Section 2. The circuit between port M and port N is stabilized at almost FULLY CLOSED, and the circuit between port M and port Q is stabilized at almost FULLY OPEN.



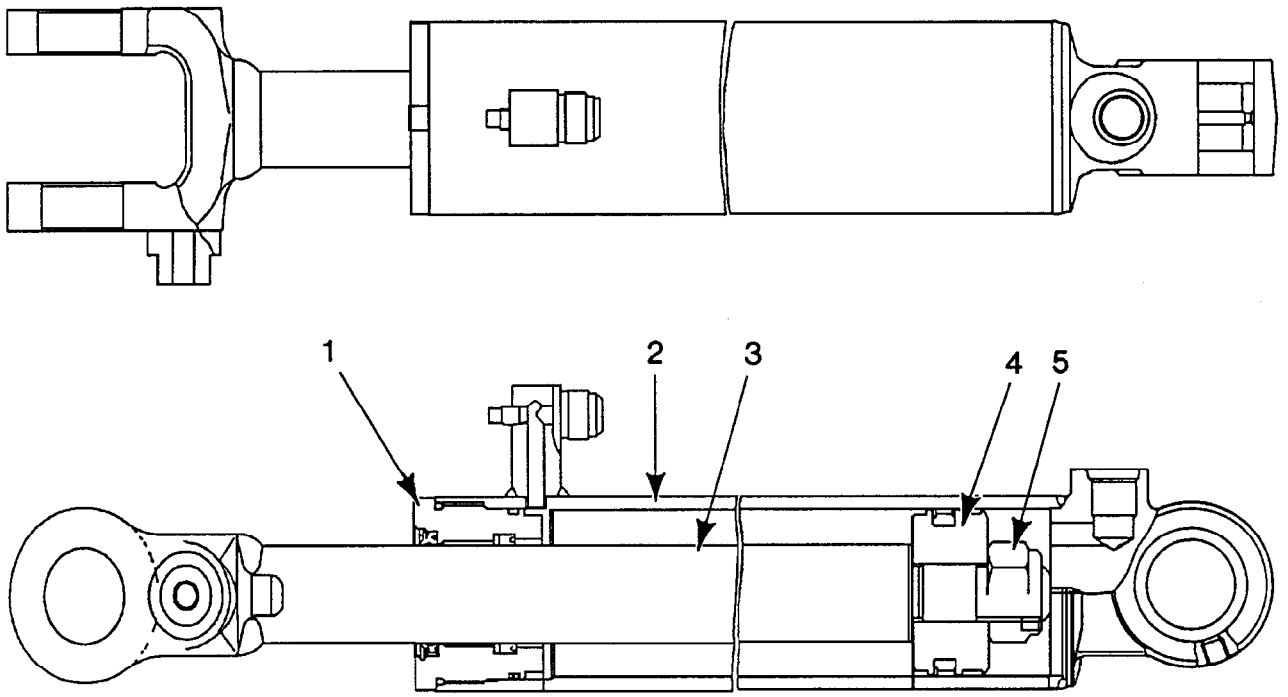
STEERING COLUMN



U41801126

1. Steering wheel
2. Steering column
3. Center shaft
4. Steering valve (Orbitrol)
5. Tilt lever

STEERING CYLINDER



L10BR060

1. Cylinder head
2. Cylinder
3. Piston rod
4. Piston
5. Piston nut

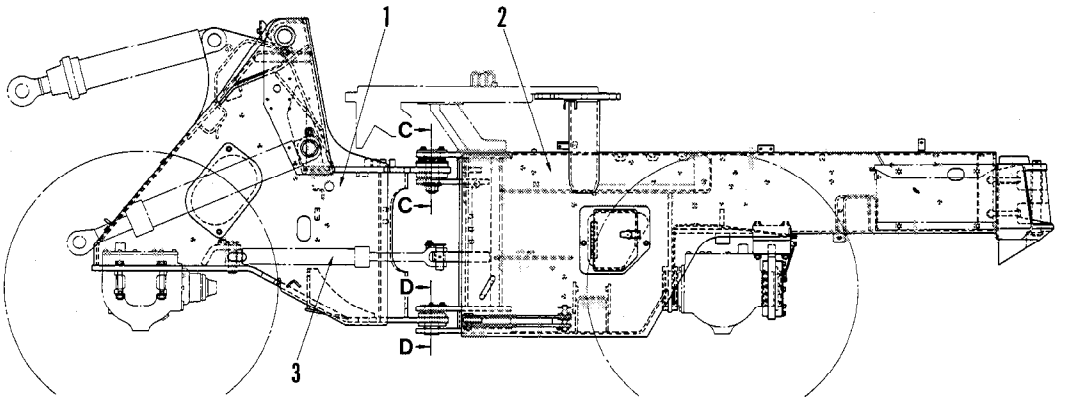
Specifications

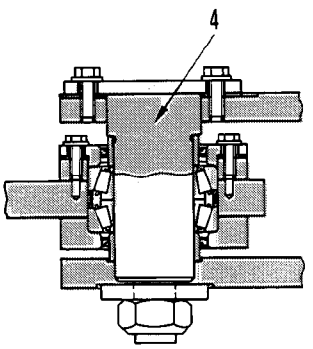
Cylinder bore: 70 mm
Rod diameter: 40 mm
Stroke: 460 mm
Width across flats of piston nut: 46 mm
Cylinder min. length: 818 mm
Cylinder max. length: 1,278 mm

CENTER HINGE PIN

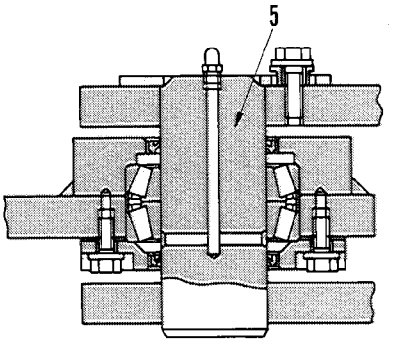
Outline

- The front frame and rear frame are connected through a bearing by the center hinge pin. The steering cylinders are connected to the left and right front and rear frames, so when the cylinders are operated, the frame bends at the middle to give the desired angle, that is the desired turning radius.





Section C-C

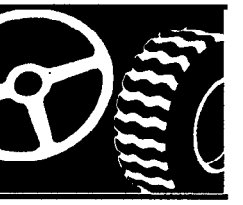


Section D-D U41801127

1. Front frame
2. Rear frame
3. Steering cylinder
4. Upper hinge pin
5. Lower hinge pin

STEERING SYSTEM

42 TESTING AND ADJUSTING



STANDARD VALUE TABLE 2

TOOL LIST 2

STEERING WHEEL PLAY 3

OPERATING FORCE OF STEERING WHEEL 4

OPERATING TIME OF STEERING WHEEL 5

STEERING OIL PRESSURE 6

TROUBLESHOOTING 9
- TROUBLESHOOTING TABLE 10
1. Steering wheel does not turn. 10
2. Steering wheel is sluggish. 11
3. Steering wheel moves unsteadily or is subjected to large shock. 12
4. Machine tends to turn naturally in one particular direction when traveling. 12
5. Left and right turning radii are different. 12

STANDARD VALUE TABLE

Testing & measuring item	Measurement condition	Unit	Standard value	Permissible value
• Steering wheel play		mm	0 - 40	Max. 60
• Steering wheel operating force	• Road surface: Flat, horizontal, dry paved surface • Hydraulic temperature: 45 - 55°C • Machine posture: Facing straight	kg	1.0 - 1.6	Max. 2.4
• Operating time of steering wheel (Low idling)		sec.	4.9	Max.5.4
(High idling)			2.8	Max. 3.1
Steering oil pressure • Steering relief oil pressure	Hydraulic temperature: 45 - 55°C	kg/cm²	190^{+7}_{0}	190±20

TOOL LIST

No.	Testing and measuring item	Tool	Part number	Remark
1	Steering wheel operating force	Push-pull scale	79A-264-0020	0 - 30 kg
2	Steering wheel operating play	Convex scale	Commercially available	
3	Steering wheel operating time	Stop watch	Commercially available	1/10 second
4	Clearance between front frame and rear frame	Convex scale	Commercially available	

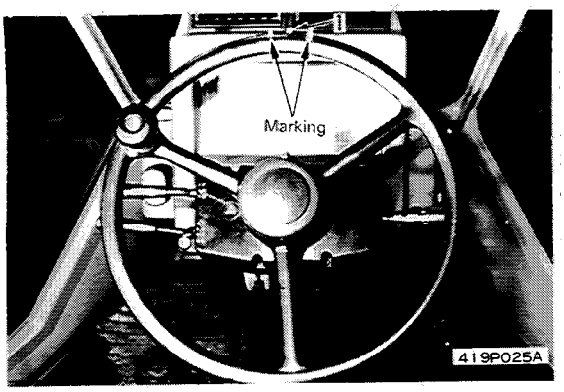
⚠ When carrying out testing, adjusting or troubleshooting, stop the machine on level ground, install the safety bar on the frame, lower the bucket to the ground, and stop the engine.

⚠ When installing or removing gauges, loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the control levers several times to release the remaining pressure in the hydraulic piping.

⚠ When taking measurements, do not allow unauthorized persons near the machine.

⚠ The oil in the circuit is hot, so be careful not to get burnt.

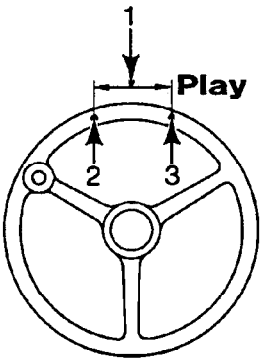
STEERING WHEEL PLAY



★ Measurement condition
- Engine speed: Low idling
- Machine posture: Facing straight

Unit: mm

Item	Standard value	Permissible value
Steering wheel play	0-40	Max. 60



419F302

1. Measuring procedure

1) Turn the steering wheel lightly clockwise and counterclockwise two or three times and confirm the neutral position of the steering mechanism. Put mark "1" on the outer frame of the vehicle monitor or instrument panel.
2) Turn the steering wheel clockwise. Align the position where the tires begin to move with mark "1", then put mark "2" on the steering wheel.
3) Turn the steering wheel counterclockwise. Align the position where the tires begin to move with mark "1", then put mark "3" on the steering wheel. Measure the distance of a straight line between mark "3" and mark "2".

OPERATING FORCE OF STEERING WHEEL

★ Measurement condition
- Road surface: Flat, horizontal, dry, paved surface
- Coolant temperature: Inside operating range
- Hydraulic oil temperature: 45 - 55°C
- Tire inflation pressure: Specified pressure
- Engine speed: Low idling (bucket unload)

Unit: kg

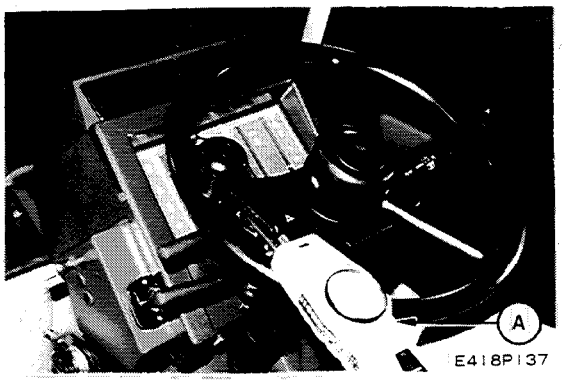
Item	Standard value	Permissible value
Force of steering wheel	1.0-1.6	Max. 2.4

Special tool

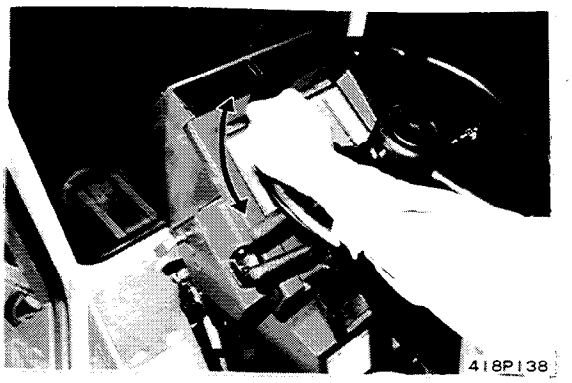
	Part number	Part name	Q'ty
A	79A-264-0020	Push-pull scale	1

Measuring procedure

1. Hook push-pull scale A to the knob of the steering wheel.
   ★ Hook push-pull scale to center of knob.
2. Start the engine.
   ★ After starting the engine, raise the bucket about 400 mm and remove the safety bar.
3. Pull push-pull scale A at a tangent, and read the value when the steering wheel is moving smoothly.
   ★ Do not read the value at the time the steering wheel starts to move.



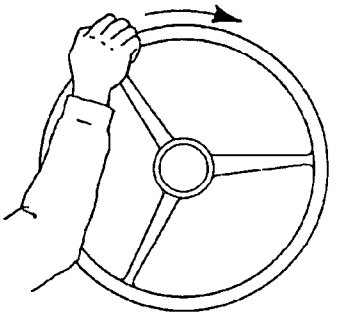
OPERATING TIME OF STEERING WHEEL



★ Measurement condition
- Road surface: Flat, horizontal, dry, paved surface
- Coolant temperature: Inside operating range
- Hydraulic oil temperature: 45 - 55°C
- Tire inflation pressure: Specified pressure
- Engine speed: Low idling and high idling

Measuring procedure

1. Start the engine.
   ★ After starting the engine, raise the bucket about 400 mm and remove the safety bar.
2. Turn steering wheel so that the machine is turned fully to the left or fully to the right.
3. Measure the time taken for the steering wheel to be turned to the right (left) to the full lock position.
   ★ Turn the steering wheel as fast as possible without forcing it.
   ★ Measure at low idling and high idling, and when turning to the right and to the left.



419F303

STEERING OIL PRESSURE

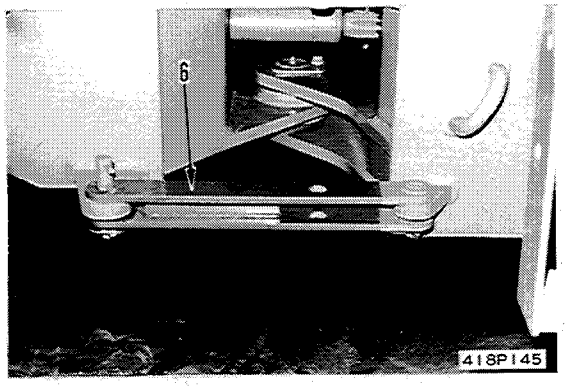
★ Measurement condition
- Hydraulic temperature: 45 - 55°C
- Engine speed: High idling

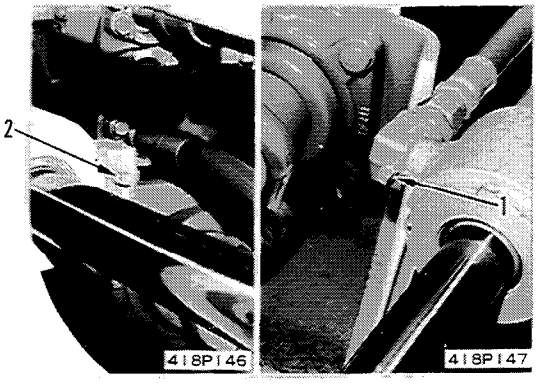
Unit:kg/cm²

Item	Standard value	Permissible value
Main relief oil pressure	190^{+7}_{0}	190±20

Special tool

	Part number	Part name	Q'ty
A	799-101-5000	Hydraulic tester	1

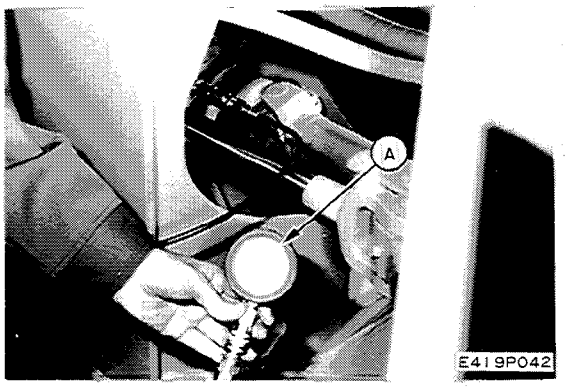




1. Measuring main relief pressure

Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the steering wheel several times to release the remaining pressure in the hydraulic piping.

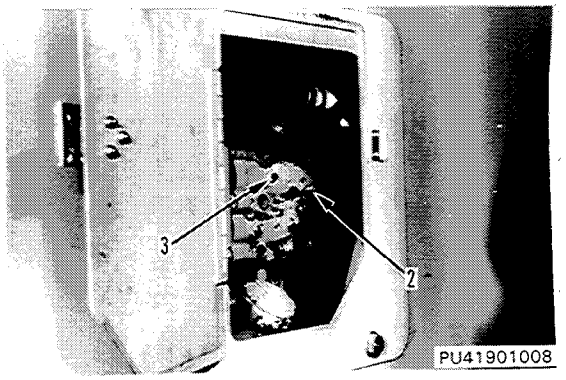
1) Fit safety bar (6) on the frame.
2) Remove plug (1) for measuring the right turn steering circuit.
3) Install hydraulic tester A to the measuring port.
4) Start the engine and run at high idling. Turn the steering wheel to the right and measure the pressure when the relief valve is actuated.
   ★ When removing the plug (2) for the left turn steering circuit, turn the steering wheel to the left and measure.



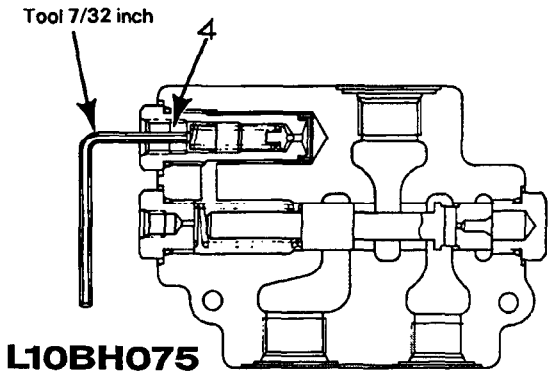
2. Adjusting main relief pressure

Always stop the engine before adjusting the hydraulic pressure.

1) Stop the engine.
2) Disconnect hoses (1 and 2) from manifold.
3) Remove manifold (3) from priority valve.



3. **Turn adjustment screw (4) to adjust.**
   - ★ One turn of the adjustment screw adjusts the pressure as follows.
     One turn = Approx. 70 kg/cm²
   - ★ Turn the adjustment screw to adjust as follows.
     To INCREASE pressure, TIGHTEN
     To DECREASE pressure, LOOSEN
   - ★ Size of adjustment screw tool = 7/32 inch, hexagonal
   - ★ If the relief pressure cannot be adjusted exactly, do not attempt to adjust it.



L10BH075

This page is blank.

TROUBLESHOOTING

TROUBLESHOOTING TABLE

1. Steering wheel does not turn.

Ask the operator the following questions.
- Did the steering wheel suddenly cease to turn? → Damage to equipment in steering circuit.
- Did steering wheel show signs of being sluggish for some time? → Worn parts in steering circuit or faulty seal.

Checks before troubleshooting.
- Is oil level and type of oil in the hydraulic tank correct?
- Is there any damage to the steering gear box or the steering linkage?
- Has the safety bar been removed from the frame?
- Is the steering linkage properly adjusted?

No.	Problems \ Remedy	Faulty hydraulic pump (Hydraulic pump, a) △ X	Faulty PTO (Hydraulic pump, b) △ X	Priority valve (Valve, c) △ X	Steering valve (Valve, d) △ X	Internal damage of steering cylinder (oil leakage from piston seal) (Other parts, e) △ X
		Hydraulic pump		Valve		Other parts
		a	b	c	d	e
1	Steering wheel cannot turn left or right.	○	○	○	○	
2	Fault of item 1 and also work equipment does not operate normally.	○	○			
3	Steering wheel can only turn to either left or right.					○
4	Steering wheel is sluggish and does not turn properly.	○	○	○		
5	Oil pressure in steering circuit does not rise at all.	○				

L10DD005

★ Because the steering circuit and the work equipment circuit are intimately related to each other, check the operation of the work equipment if the steering behaves abnormally.

The following symbols are used to indicate the action to be taken when a cause of failure is located:

X: Replace △: Repair
A: Adjust C: Clean

2. Steering wheel is sluggish.

Ask the operator the following questions.

- Did the steering wheel suddenly become sluggish?
  → Damage to equipment in steering circuit.
- Did the steering wheel show signs of being sluggish for some time? → Worn parts in steering circuit or faulty seal.

Checks before troubleshooting.

- Is oil level and type of oil in the hydraulic tank correct?
- Is there any abnormality in the steering gear box mounting part, steering column or linkage?
- Is the adjusting of the steering control lever stopper correct?
- Is there any oil leakage from the oil pressure hose, valves, cylinders, etc?
- Is there any seizure between the pin and bushing of the center hinge bearing and the steering cylinder pin and bushing?
- Check tire pressure.

Fault check.

- Measure the operating force of the steering wheel and also the operating time of steering wheel, then check the results against the standard value table to see whether or not there is any abnormality.

No.	Problems \ Remedy / Cause	Faulty steering pump	Faulty hydraulic pump	Priority valve	Steering valve	Internal fault in steering cylinder (oil leakage from piston seal)	Blockage in hydraulic oil return side filter or faulty bypass valve	Blockage in oil cooler
		Hydraulic pump		Valve		Other parts		
		a	b	c	d	e	f	g
		△ X	△ X	△ X	△ X	△ X	△C X	△C X
1	Steering wheel is sluggish in both left and right directions.	○		○	○	○		
2	Steering wheel is sluggish in one of left and right directions.				○	○		
3	Steering wheel is particularly sluggish at low engine speed.	○		○		○		
4	Boom lifting speed is insufficient when engine is at full throttle.		○					
5	Steering wheel is sluggish and jerky.	○	○					○
6	Hydraulic oil overheats.							
7	Steering circuit pressure is low.	○	○	○	○	○		
8	Oil pressure in return side piping of steering cylinder rises.						○	○

L10DD006

The following symbols are used to indicate the action to be taken when a cause of failure is located:

X: Replace △: Repair
A: Adjust C: Clean

3. **Steering wheel moves unsteadily or is subjected to large shock.**

Checks before troublshooting.
- Is the oil level and type of oil in the hydraulic tank correct?
- Is there any damage to the steering gear box mounting part, steering column or linkage?
- Is there any play in the center pin hinge bearing or steering cylinder pin bushing?
- Does tire pressure fluctuate?

Fault check.
Operate the wheel loader in a safe place and check the conditions under which the steering wheel becomes unsteady.

★ If, in addition to the steering wheel being unsteady, there are other faults such as sluggishness, etc., refer to item 2. "Steering wheel is sluggish."

No.	Problems \ Remedy	Faulty steering valve (a) △A X	Steering valve (b) X	Faulty 2-way restricter valve (c) △ X	Internal fault in steering cylinder (inside surface of cylinder, piston seal, nut, bolt)
1	Machine body is unsteady when traveling on bumpy road surface.	○		○	
2	Steering wheel becomes unsteady if suddenly turned when working or traveling.	○	○	○	
3	Machine body becomes unsteady when traveling at high speed.	○		○	
4	Machine body becomes unsteady during engine starting.	○			

Cause / Valve

L10DD007

4. **Machine tends to turn naturally in one particular direction when traveling.**

Cause: Faulty steering valve
- Incorrect positioning of spool.
- Faulty safety valve.
- Oil leakage in steering cylinder.
- Does tire pressure fluctuate?

5. **Left and right turning radii are different.**

Cause: Incorrectly adjusted steering linkage.
Left and right steering balance, lock position of stopper.
(Valve relief noise can be heard upon completion of turning).

The following symbols are used to indicate the action to be taken when a cause of failure is located:

X: Replace △: Repair
A: Adjust C: Clean

STEERING SYSTEM

43 DISASSEMBLY AND ASSEMBLY



STEERING VALVE 2
REMOVAL 2
INSTALLATION 4
DISASSEMBLY 6
ASSEMBLY 8

PRIORITY VALVE 10
REMOVAL 10
INSTALLATION 12

STEERING CYLINDER 14
REMOVAL 14
INSTALLATION 15
DISASSEMBLY 16
ASSEMBLY 18

CENTER HINGE PIN 21
REMOVAL 21
INSTALLATION 26

★ For details of disassembly and assembly of the gear pump, see SECTION 97.

★ Take the following method for air bleeding when you start to operate hydraulic cylinders after reassembling cylinders, pumps and pipings.

1. Start engine, keep idling.
2. Operate hydraulic cylinder 4 - 5 cycles, but do not exceed beyond 100 mm of stroke end.
3. Continue to operate cylinder 3 - 4 cycles until stroke end.
4. After finishing above steps, keep normal engine speed.

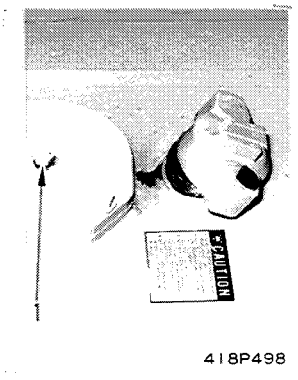
NOTE: After long storage, same procedure is required.

STEERING VALVE

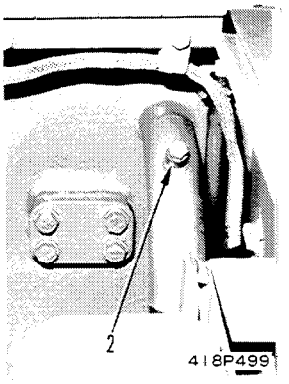
REMOVAL

Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.

Loosen the oil filler cap to relieve the pressure in the hydraulic oil tank, then operate the control lever 2 or 3 times to eliminate the residual pressure in the piping.



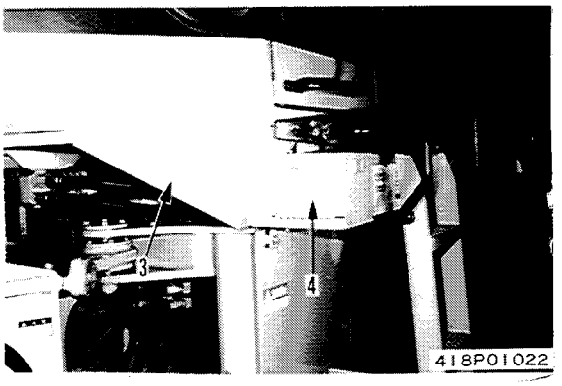
418P498



418P499

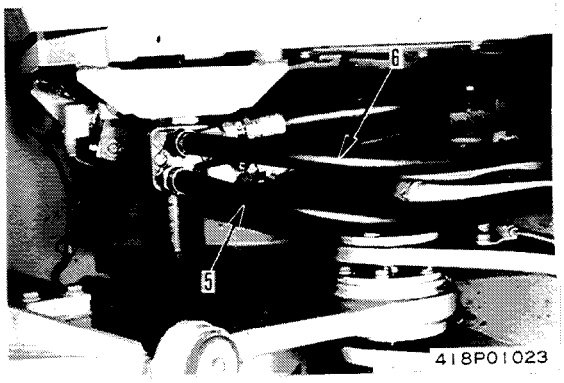
- Loosen plug (1) at the top of the hydraulic tank filter, and plug (2) of the pump piping to prevent the oil inside the tank from flowing out.

1. **Cover**
   Remove cover (3) at bottom of cab, and tool box (4).

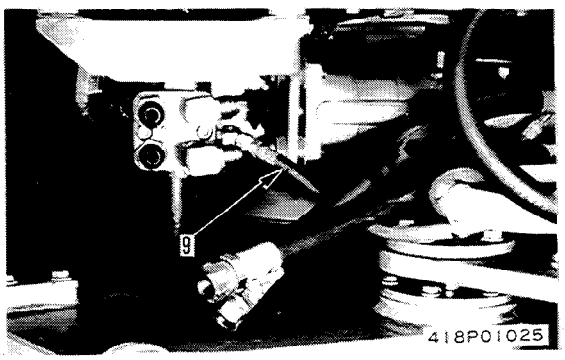


418P01022

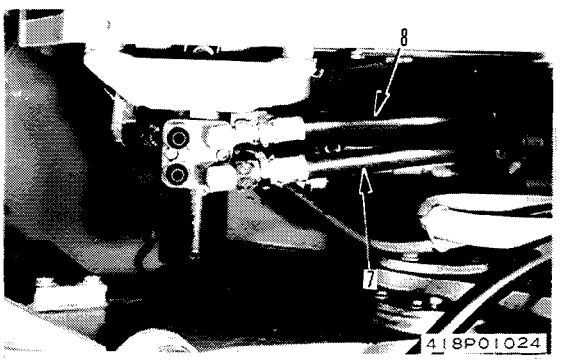
2. **Hydraulic piping**
   Disconnect the following hydraulic hoses from steering valve.
   - Hose (5) between steering valve and priority valve.
   - Hose (6) between steering valve and hydraulic tank.
   - Hoses (7 and 8) between steering valve and steering cylinder.
   - Hose (9) between steering valve and manifold.



418P01023

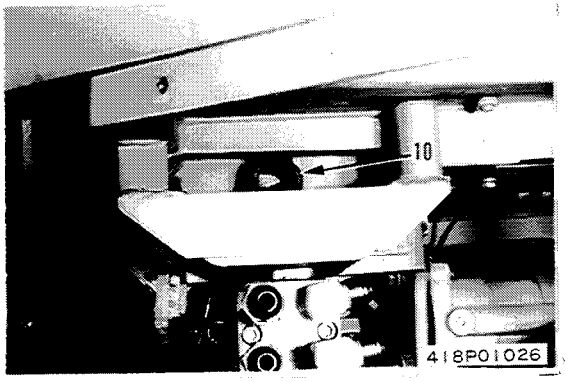


418P01025

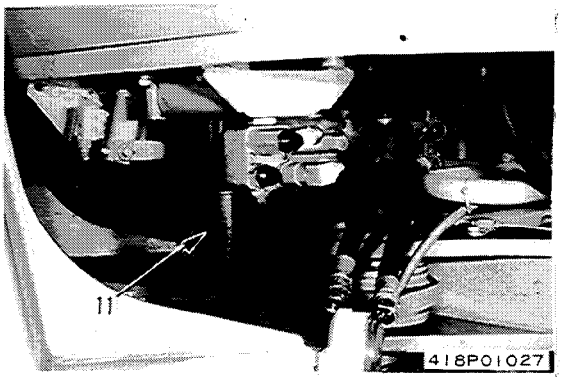


418P01024

3. **Linkage**
   Disconnect steering column (10) from steering valve.

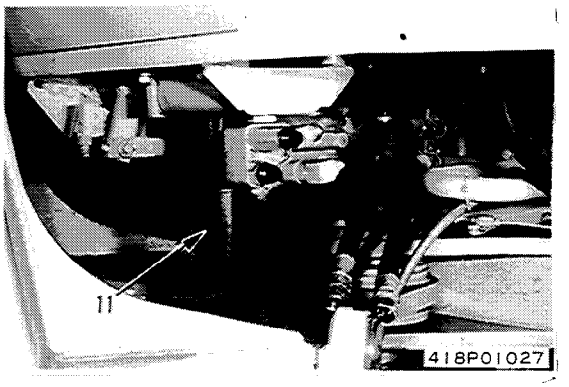


4. **Steering valve**
   Remove mounting bolts, then remove steering valve (11).



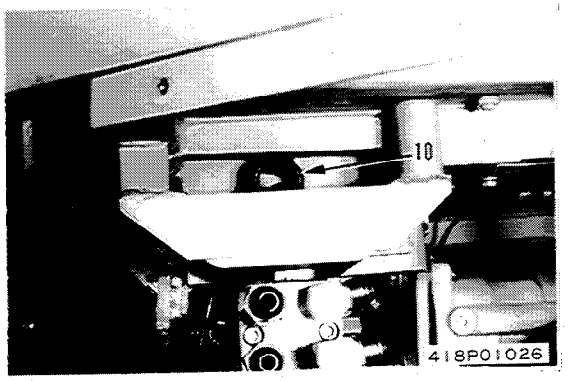
INSTALLATION

1. **Steering valve**
   Set steering valve (11) in mounting position, and tighten mounting bolts.

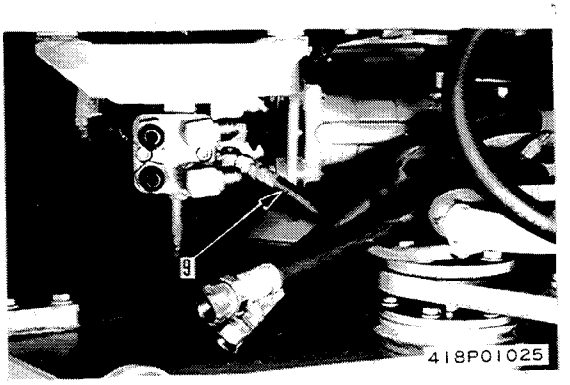


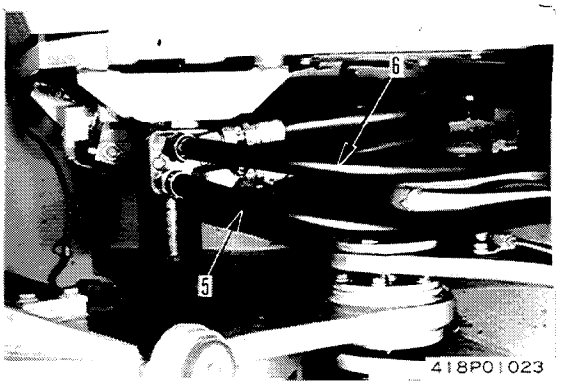
2. **Steering column**
   Connect steering column (10) to steering valve.

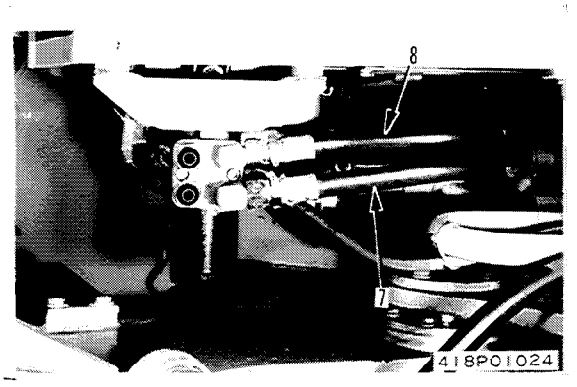
   Mounting bolt: 5.7±0.7 kgm



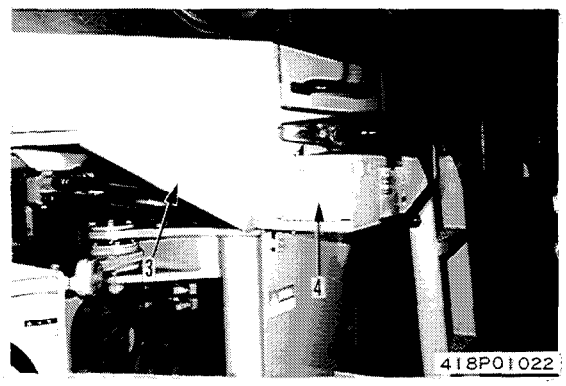
3. **Hydraulic piping**
   - Hose (9) between steering valve and manifold.
   - Hoses (8 and 7) between steering valve and steering cylinder.
   - Hose (6) between steering valve and hydraulic tank.
   - Hose (5) between steering valve and priority valve.



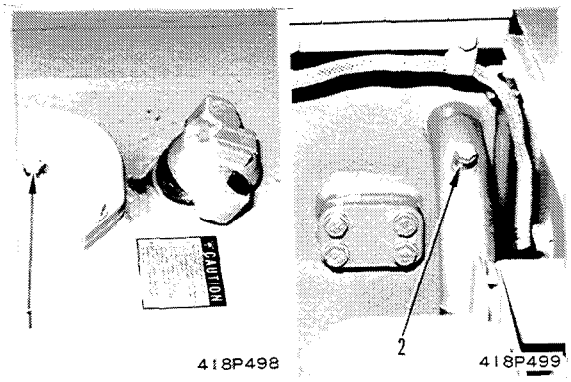


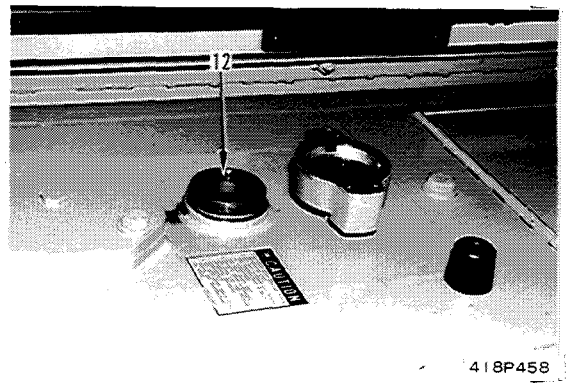


4. **Cover**
   Install cover (3) at bottom of cab, and tool box (4).

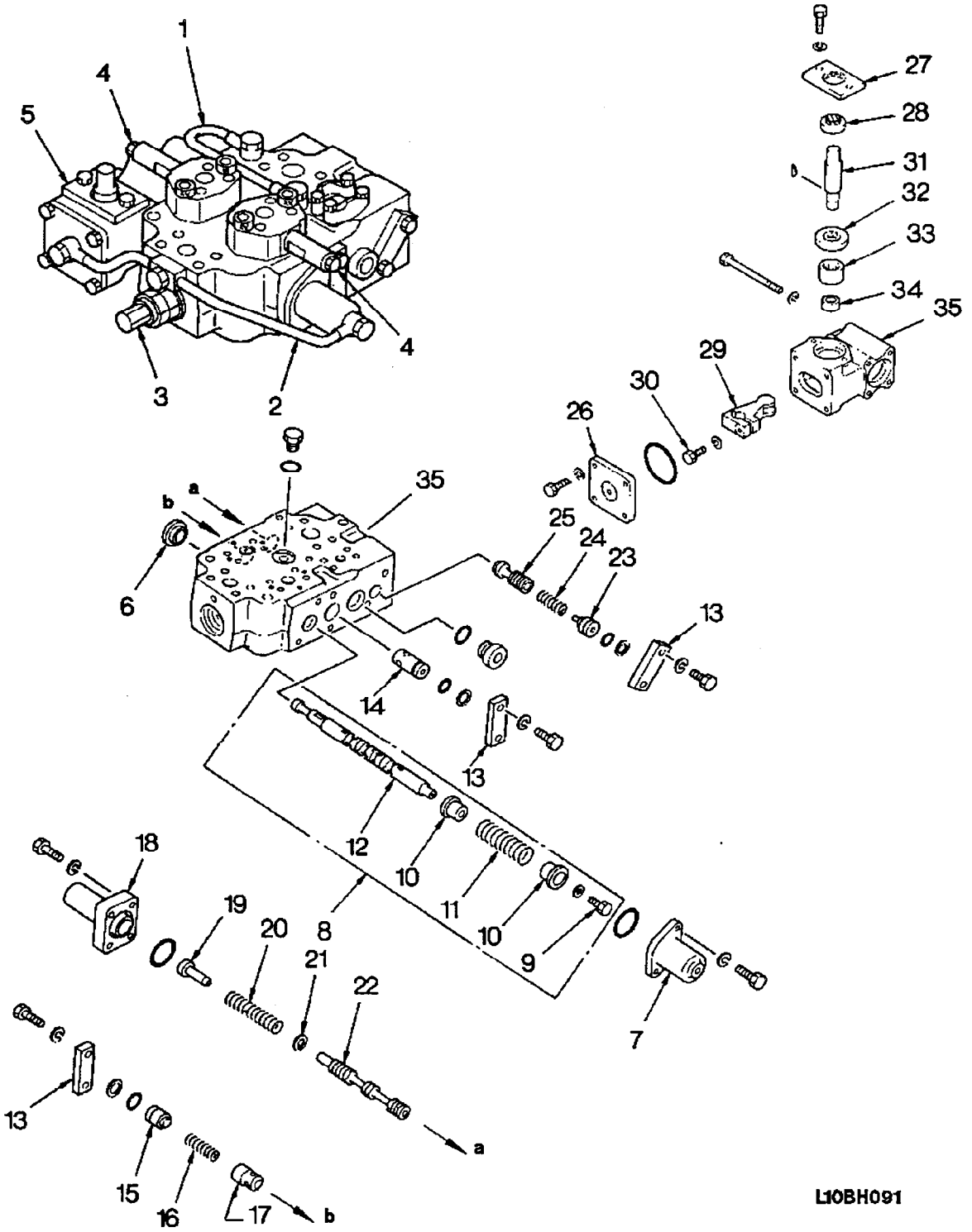


5. **Refilling with oil**
   Tighten drain plug (1) at top of hydraulic tank filter and plug (2) of pump piping, and add engine oil through oil filler (12) to the specified level.





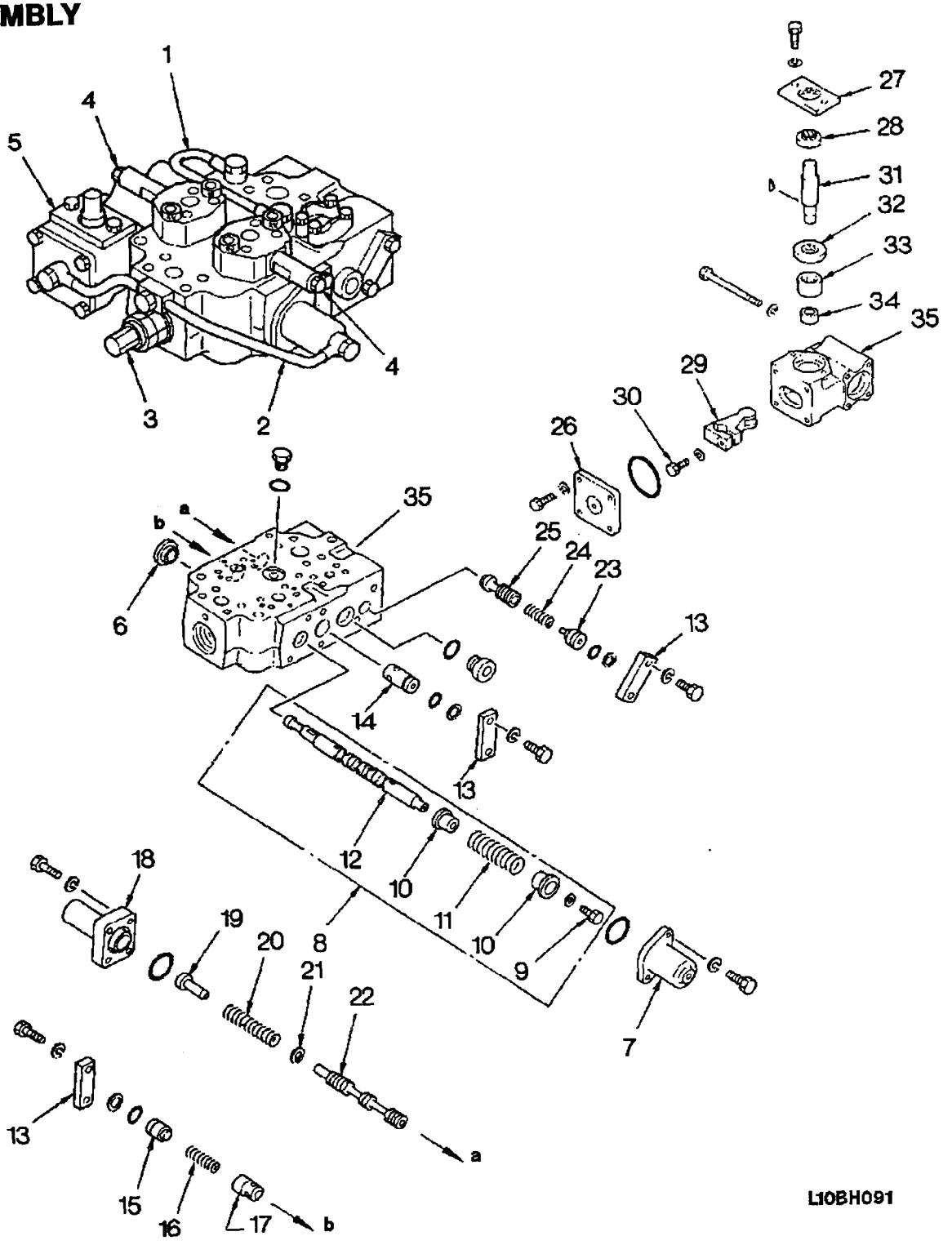
DISASSEMBLY



NOTE: For the following disassembly procedure, reference is made to the proceeding page.

1. Remove tubes (1 and 2).
2. Remove the main relief valve assembly (3) and the safety valve assembly (4).
3. Case assembly
   1) Remove the case assembly (5), then remove the collar (6).
   2) Remove covers (26 and 27).
   3) Remove the dust seal (28).
   4) Loosen bolt (30) of lever (29), then remove the shaft (31).
   5) Remove the oil seal (32) and bearings (33 and 34).
4. Spool assembly
   1) Remove case (7), then remove the spool assembly (8).
   2) Remove bolt (9), then remove retainer (10), spring (11) and retainer (10) from the spool (12).
      ★ When loosening the bolt, loosen with the spool assembled in the body.
5. Remove plate (13), then remove valve (14).
6. Remove plate (13), then remove seat (15), spring (16) and valve (17).
7. Remove cover (18), then remove boss (19), spring (20), washer (21) and spool (22).
8. Remove plate (13), then remove seat (23), spring (24) and poppet (25).

ASSEMBLY


1
4
5
4
3
2
27
28
31
32
33
34
35
29
30
26
35
b
a
6
25
24
23
13
14
13
12
10
11
10
9
8
7
18
19
20
21
22
13
15
16
17
b
a
L10BH091

NOTE: For the following assembly procedure, reference is made to the proceeding page.

1. Assemble valve (25) and spring (24), fit O-ring and back-up ring, install seat (23), then install plate(13).
2. Assemble spool (22), washer (21), spring (20) and boss (19), then fit O-ring and install cover (18).
3. Assembly valve (17) and spring (16), fit O-ring and back-up ring, install seat (15), then install plate (13).
4. Fit O-ring and back-up ring, install valve (14), then install plate (13).
5. Spool assembly
   1) Assemble retainer (10), spring (11) and retainer (10) to spool (12), then tighten the bolt (9).
      ★ When tightening the bolt, tighten with the spool assembled in the body.
   2) Assemble spool assembly (8) in body (35), then fit O-ring and install the case (7).
6. Case assembly
   1) Install bearings (33 and 34), and oil seal (32).



Oil seal: Grease (G2-LI)

   2) Assemble key, then install shaft (31) to lever (29) and tighten bolt (30).
   3) Install the dust seal (28).
   4) Fit O-rings and install covers (27 and 26).
   5) Assemble collar (6), then fit O-ring and install case assembly (5).
7. Fit O-rings and install safety valve assembly (4) and main relief valve assembly (3).



Safety valve assembly: 4.5±0.5 kgm



Main relief valve assembly: 8.5±1.5 kgm

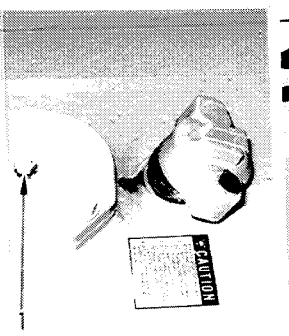
8. Fit O-rings and install tubes (2 and 1).

PRIORITY VALVE
REMOVAL

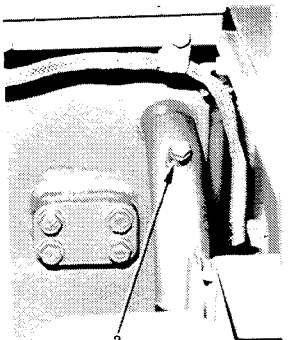
Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.

Loosen the oil filler cap to relieve the pressure in the hydraulic oil tank, then operate the control lever 2 or 3 times to eliminate the residual pressure in the piping.

- Loosen plug (1) at the top of the hydraulic tank filter, and plug (2) of the pump piping to prevent the oil inside the tank from flowing out.

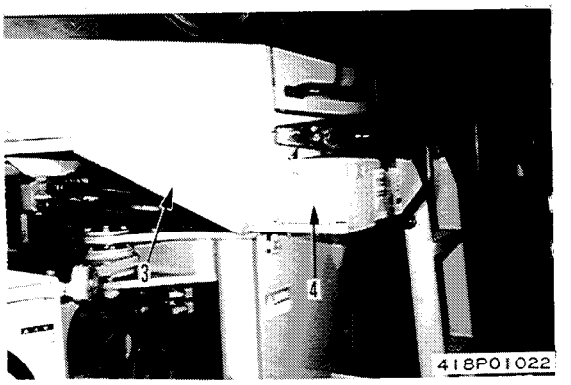


418P498



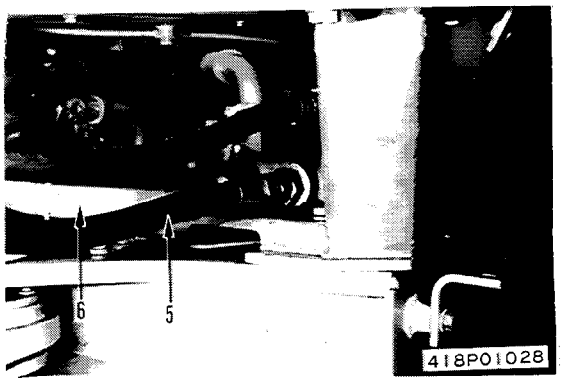
418P499

1. **Cover**
   Remove cover (3) at bottom of cab, and tool box (4).



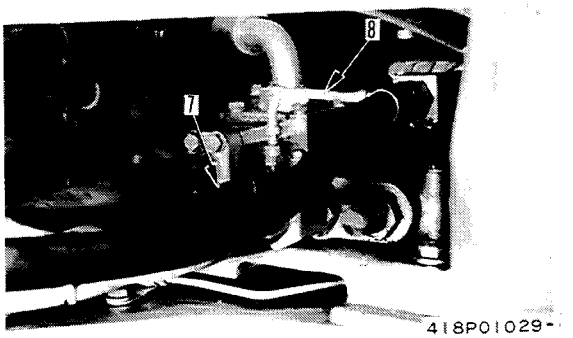
418P01022

2. **Hydraulic piping**
   Disconnect the following hydraulic piping.
   - Disconnect hose (5) between steering valve and priority valve from priority valve.
   - Disconnect tube (6) between priority valve and manifold from manifold.



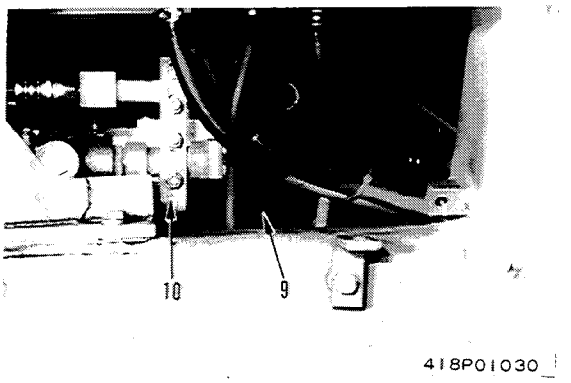
418P01028

   - Disconnect hose (7) between priority valve and steering valve from priority valve.
   - Remove tube (8) between priority valve and manifold.



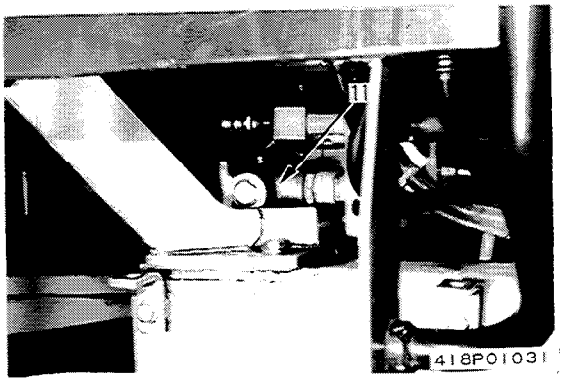
418P01029

- Disconnect hose (9) between hydraulic, steering pumps and priority valve from priority valve tube.
  - ★ After disconnecting hose (9), remove the clamp from bracket (10).



418P01030

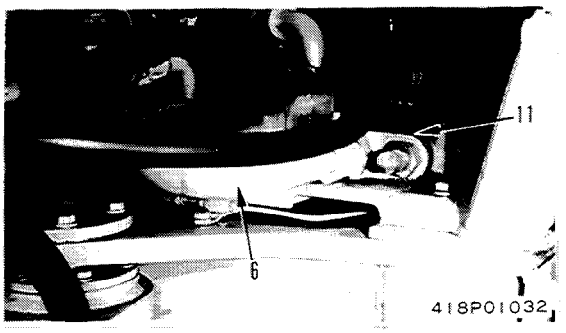
3. **Priority valve**
   Remove mounting bolts, then remove priority valve (11).



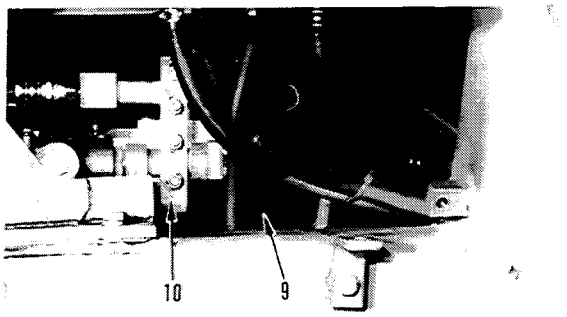
418P01031

INSTALLATION

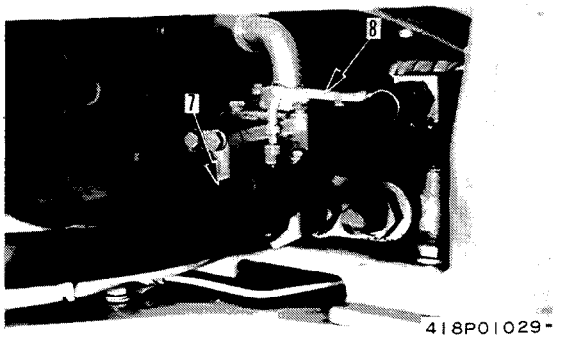
1. **Priority valve**
   Set priority valve (11) in mounting position, and tighten mounting bolts.



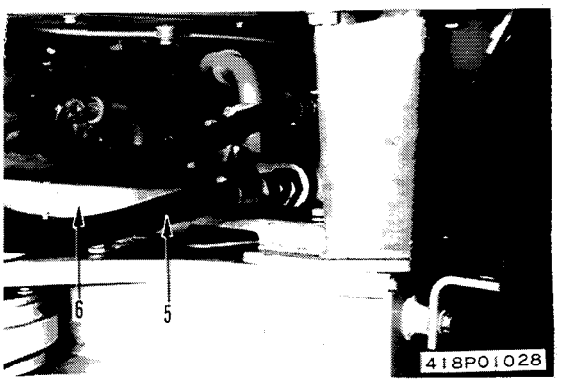
2. **Hydraulic piping**
   Connect the following hydraulic piping.
   - Connect hose (9) between hydraulic, steering pumps and priority valve to priority valve tube.
     ★ After connecting hose (9), secure the clamp to bracket (10).



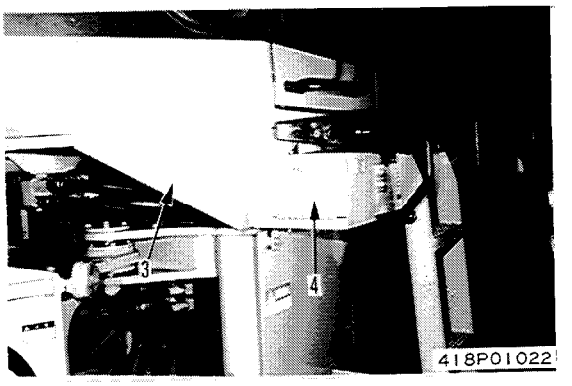
   - Connect hose (7) between priority valve and steering valve to priority valve.
   - Install tube (8) between priority valve and manifold.



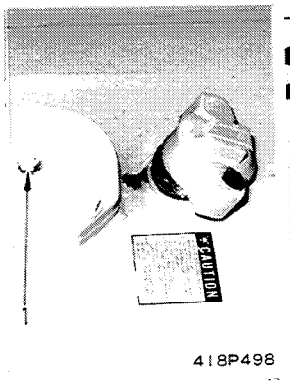
   - Connect hose (5) between steering valve and priority valve to priority valve.
   - Connect tube (6) between priority valve and manifold to manifold.

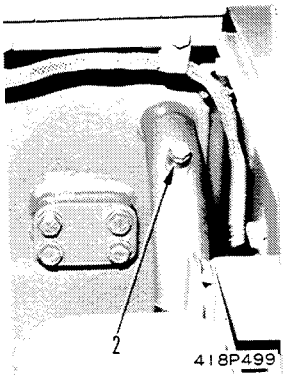


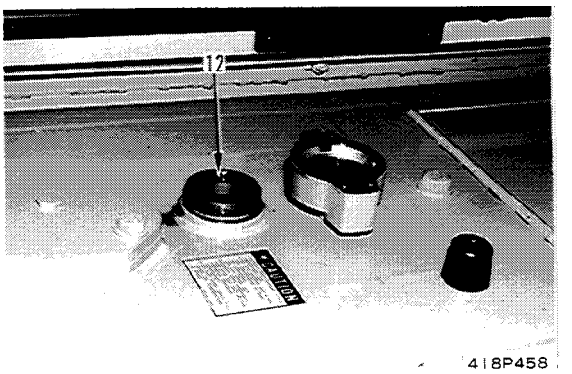
3. **Cover**
   Install cover (3) at bottom of cab, and tool box (4).



4. **Refilling with oil**
   Tighten drain plug (1) at top of hydraulic tank filter and plug (2) of pump piping, and add engine oil through oil filler (12) to the specified level.





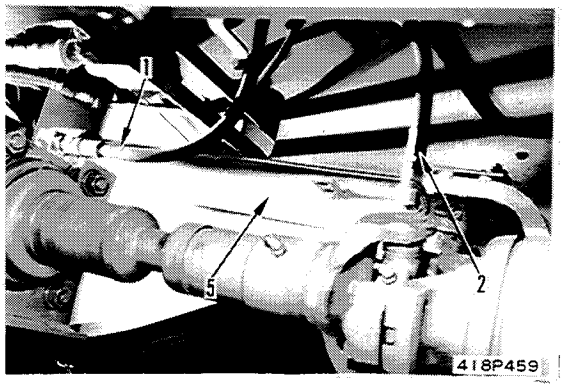


STEERING CYLINDER
REMOVAL

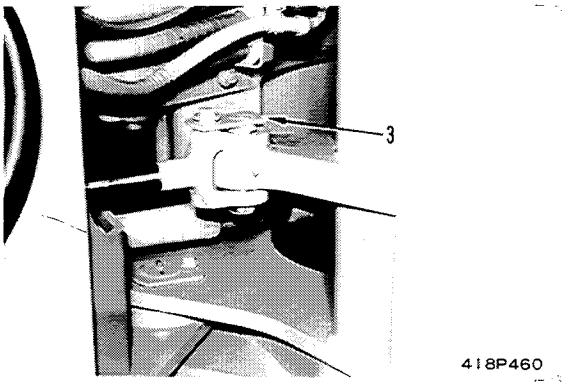
Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.

Loosen the oil filler cap to relieve the pressure in the hydraulic oil tank, then operate the control lever 2 or 3 times to eliminate the residual pressure in the piping.

1. **Hydraulic piping**
   Disconnect hoses (1 and 2) from cylinder.

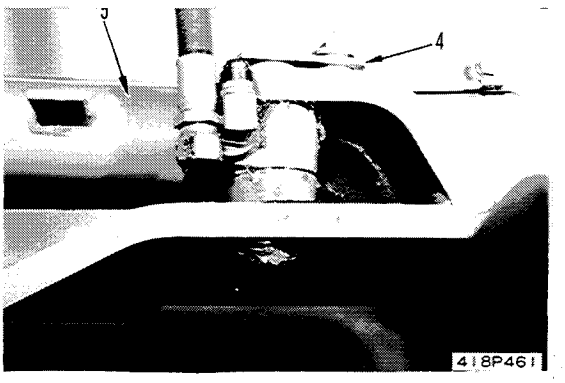


2. **Steering cylinder**
   1) Remove bolt at rod end, then remove pin (3).
      ★ If there are shim, check number and thickness of shim and keep in a safe place.



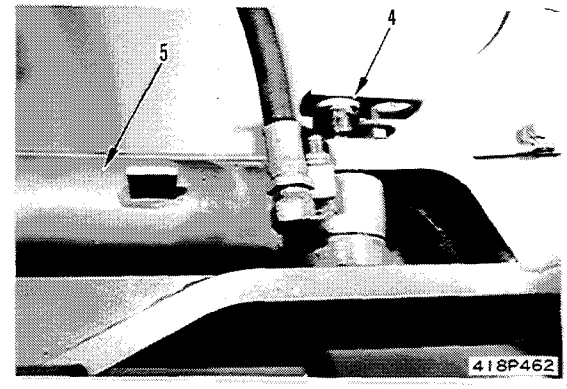
   2) Remove bolt at bottom end, then remove pin (4).
   3) Remove steering cylinder (5).
      ★ This operation should be carried out by two workers.
      ★ Be careful not to damage the cylinder rod.

kg Steering cylinder: 20 kg



INSTALLATION

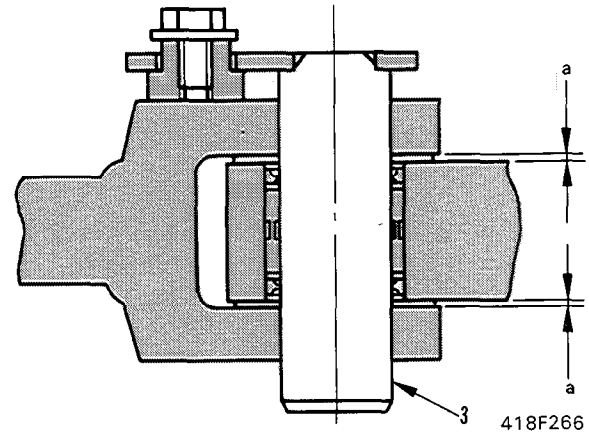
1. **Steering cylinder**
   1) Set steering cylinder (5) in mounting position.
   2) Install pin (4) at bottom end, then install bolt.



   3) Install pin (3) at rod end, then install bolt.

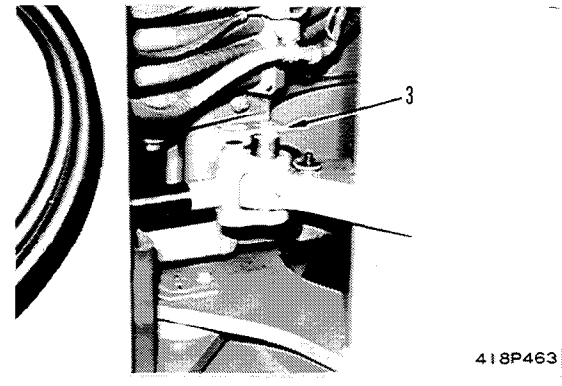
⚠ Use a bar to align the pin holes. Never use your fingers.

★ Adjust with shims to give specified value for clearance 'a'.
Clearance 'a' = 0 - 0.5 mm

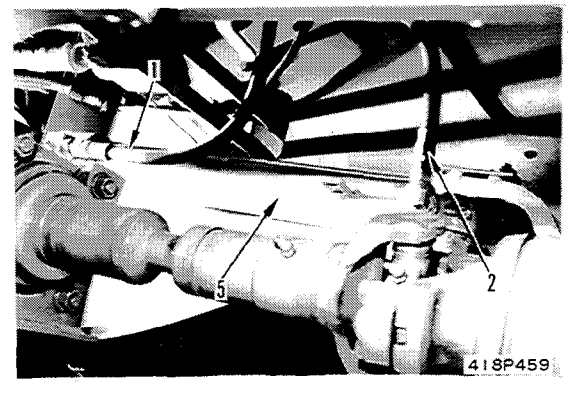


2. **Hydraulic piping**
Connect hoses (1 and 2) to cylinder.

Hose nut: 8.0±2 kgm



3. **Greasing**
Grease cylinder pins well.
★ Wipe off any grease which comes out.

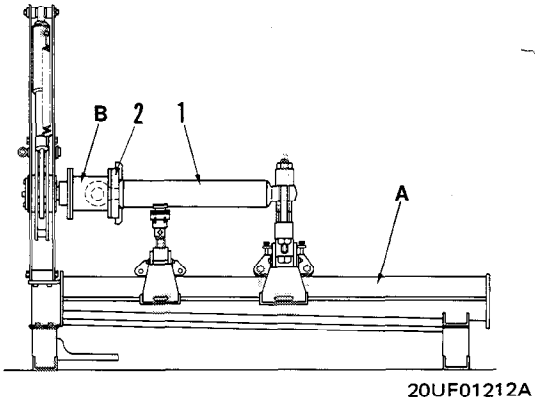


DISASSEMBLY

Special tools

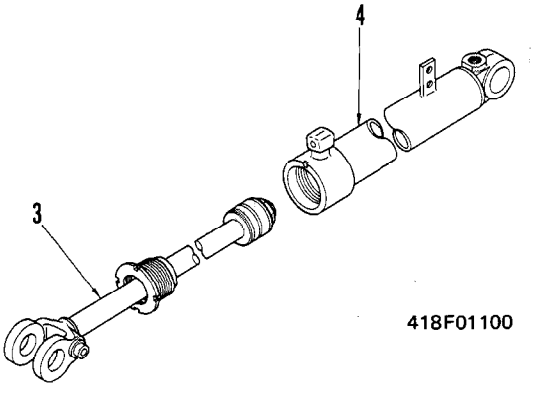
	Part number	Part name	Q'ty
A	790-502-2000 or 790-502-1003	Cylinder repair stand	1
B	790-102-2301	Wrench	1
C	790-102-1520	Adapter	1

1. Set cylinder assembly (1) in tool A.
2. Straighten lock tab of cylinder head (2), then using tool B, remove cylinder head (2) from cylinder.



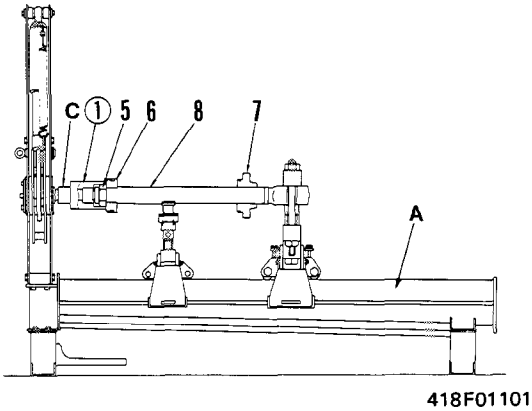
20UF01212A

3. Pull cylinder head and piston rod assembly (3) from cylinder (4), then lift off.
   ★ Oil will come out when the piston rod assembly is removed from the cylinder, so have a container ready.
4. Remove cylinder (4) from tool A.



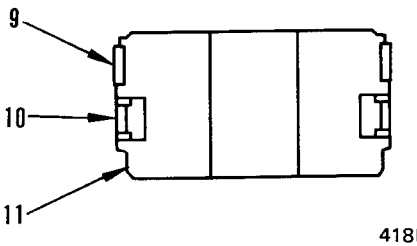
418F01100

5. Set cylinder head and piston rod assembly on tool A, and loosen nut (5) with tool C and socket ①.
   ★ Width across flats of socket ①: 46 mm
6. Remove piston assembly (6) and cylinder head assembly (7) from rod (8).



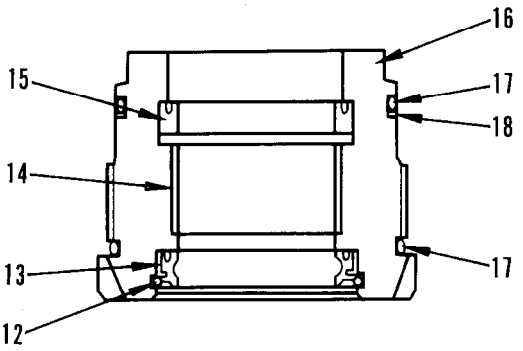
418F01101

7. Disassembly of piston assembly as follows:
   1) Remove wear ring (9).
   2) Remove piston ring (10) from piston (11).



418F01102

8. Disassembly of cylinder head assembly as follows:
   1) Remove snap ring (12), then remove dust seal (13).
   2) Remove rod packing (15).
   3) Remove bushing (14) from cylinder head (16).
   4) Remove O-ring (17) and back-up ring (18).



418F01103

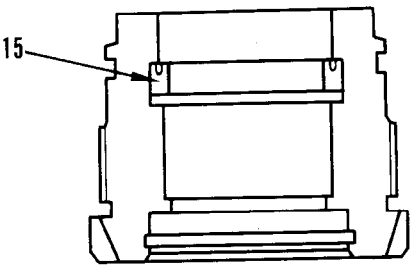
ASSEMBLY

Special tools

	Part number	Part name	Q'ty
A	790-502-2000 or 790-502-1003	Cylinder repair stand	1
B	790-102-2301	Wrench	1
C	790-102-1520	Adapter	1
D	790-720-1000	Expander	1
E	796-720-1640	Ring	1

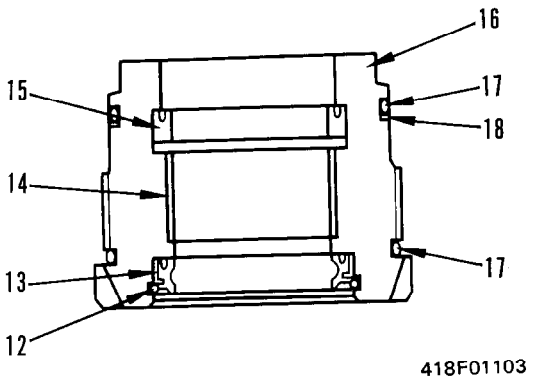
★ Coat the sliding surface of all parts with engine oil. Take care not to damage rod packings and dust seals.

1. Assemble cylinder head assembly as follows:
   1) Using push tool, press fit bushing (14) on cylinder head (16).
      ★ Take particular care not to deform the bushing when press fitting.
   2) Assemble rod packing (15).
      ★ Be careful to install the rod packing facing in the correct direction.



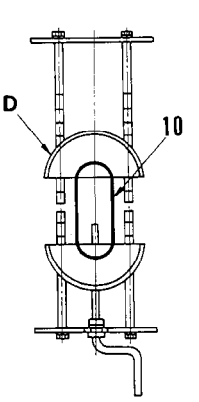
418F01104

   3) Using a push tool, install dust seal (13) on head (16).
   4) Install snap ring (12).
   5) Install back-up ring (18) and O-ring (17).
      ★ Do not force back-up ring. Heat in hot water (50 - 60°C) before inserting.

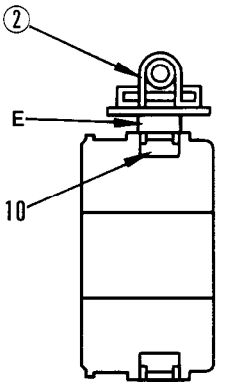


418F01103

2. Assemble piston assembly as follows:
   1) Using tool D, expand piston ring (10).
      ★ After setting the piston ring in tool, rotate the handle 8 to 10 times to expand.
   2) Remove piston ring (10) from tool D and assemble on piston (11).
   3) Fit tool E on piston ring and compress piston ring with clamp ②.
      ★ Part No. of clamp ②
      07281-00809



202F05487A



418F01106

   4) Assemble wear ring (9).

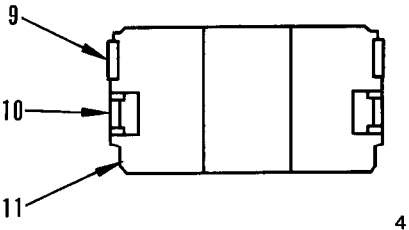
3. Set piston rod (8) in tool A.

4. Assemble cylinder head assembly (7) and piston assembly (6) on rod, then install nut (5).

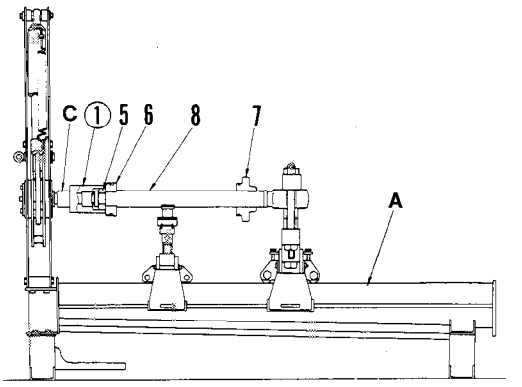
5. Using tool C and socket ①, tighten nut (5) to the following specified torque:


Piston rod thread: Adhesive (LT-2)


Piston nut:
Width across flats of nut (5) 46 mm
Tightening torque of nut 80±8 kgm

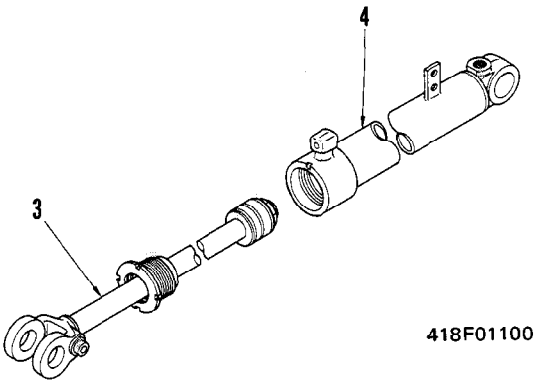


418F01102



418F01101

6. Remove piston rod and cylinder head assembly (3) from tool A.
7. Set cylinder (4) in tool A.
8. Sling piston rod and cylinder head assembly (3), and install in cylinder (4).

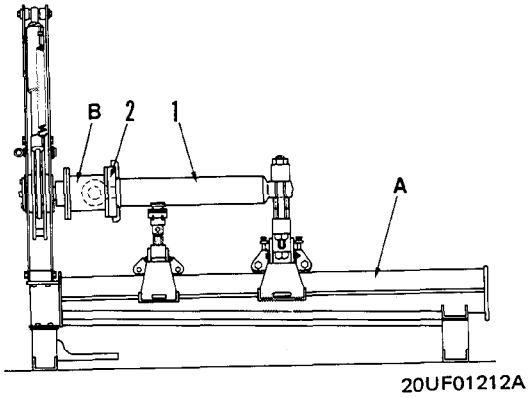


418F01100

9. Using tool B, tighten cylinder head nut (2).

Cylinder head nut: 55±5.5 kgm

10. Remove cylinder assembly (1) from tool A.



20UF01212A

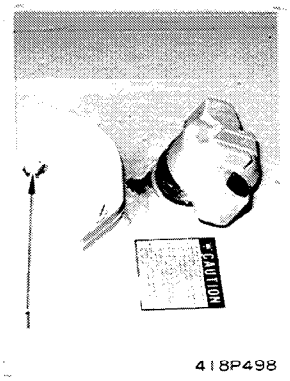
CENTER HINGE PIN
REMOVAL

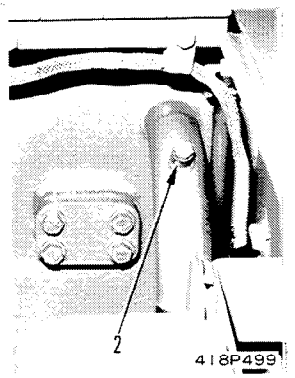
★ Remove the bucket before starting the operation.

⚠ Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.

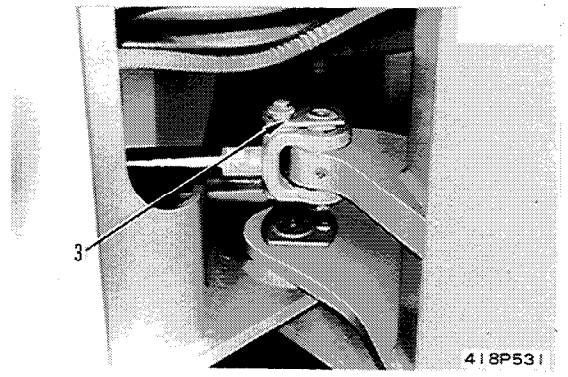
⚠ Loosen the oil filler cap slowly to relieve the pressure in the hydraulic oil tank, then operate the control lever 2 or 3 times to eliminate the residual pressure in the piping.

- Loosen plug (1) at the top of the hydraulic tank filter, and plug (2) of the pump piping to prevent the oil inside the tank from flowing out.



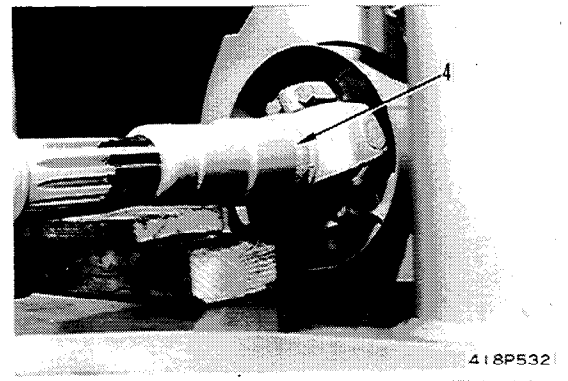


1. **Steering cylinder**
   Remove left and right rod pins (3) of steering cylinder.
   ★ If there are any shims, check the number and thickness of the shims, and keep in a safe place.

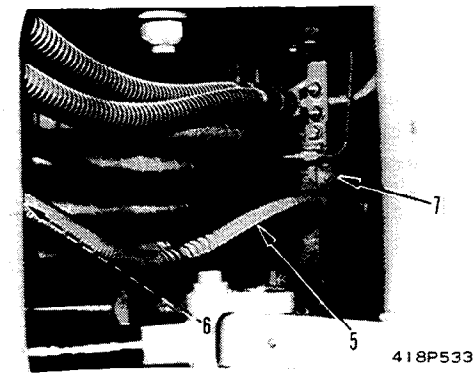


2. **Drive shaft**
   Disconnect center drive shaft (4).
   ★ Set a block under the drive shaft and disconnect.

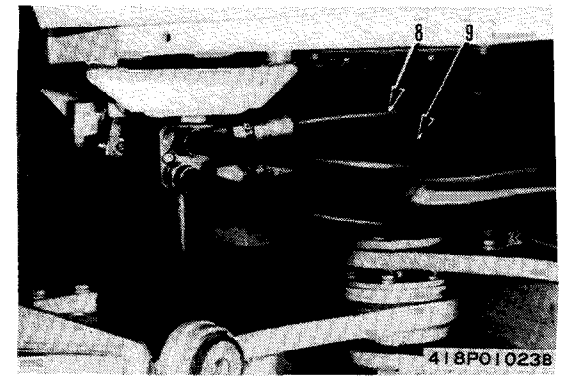
kg Center drive shaft: 20 kg



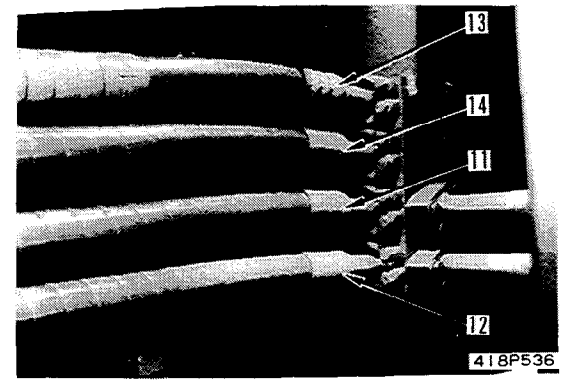
3. **Electric wiring**
   Remove both the clamps (6 and 7) of wiring (5) at the front frame and rear frames.



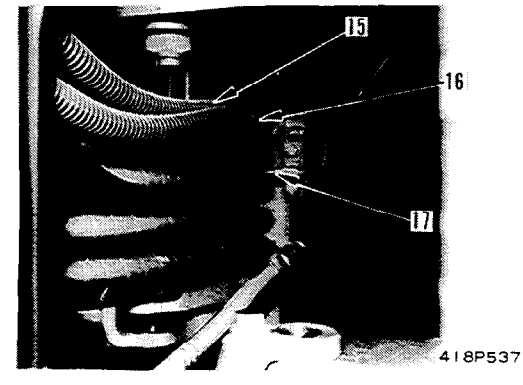
4. **Steering piping**
   Disconnect hoses (8 and 9) between steering valve and steering cylinder.



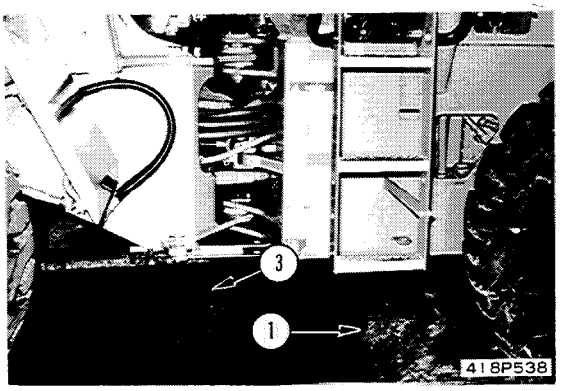
5. **Hydraulic piping**
   Disconnect the following hydraulic piping and brake hose.
   - Disconnect lift cylinder hoses (11 and 12) from joint inside front frame.
   - Disconnect dump cylinder hoses (13 and 14) from joint inside front frame.



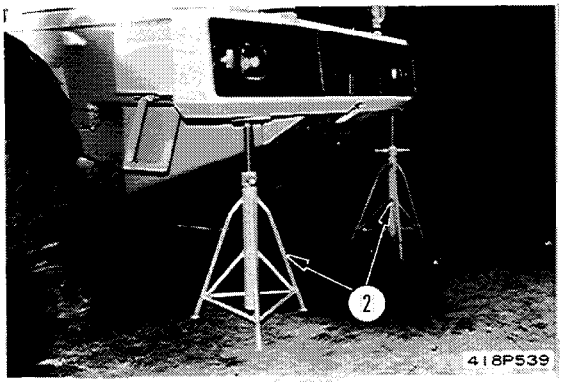
   - Disconnect steering cylinder hoses (15 and 16) from tube connector.
   - Disconnect front axle brake hoses (17) from joint.



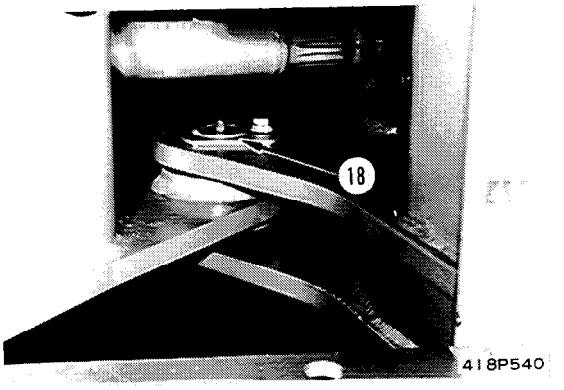
6. **Frame support**
   1) Adjust height of rear frame and insert block ①.
   2) Insert stands ② under counterweight.
   3) Adjust height of left and right front frame, then insert block ③.
      ★ Carefully adjust frame height.



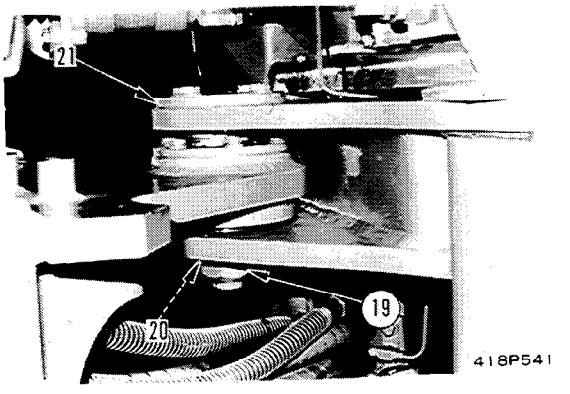
7. **Lower hinge pin**
   Remove lock bolt and take out lower hinge pin (18).
   ★ Adjust the height carefully so that the pin can be removed easily by hand.



8. **Upper hinge pin**
   1) Remove lock nut (19) and washer (20).

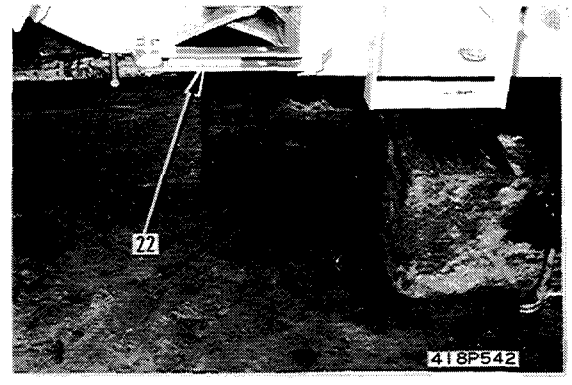


   2) Remove pin mounting bolt, and take out upper hinge pin (21).
      ★ Check the number of shims between the retainer and frame.

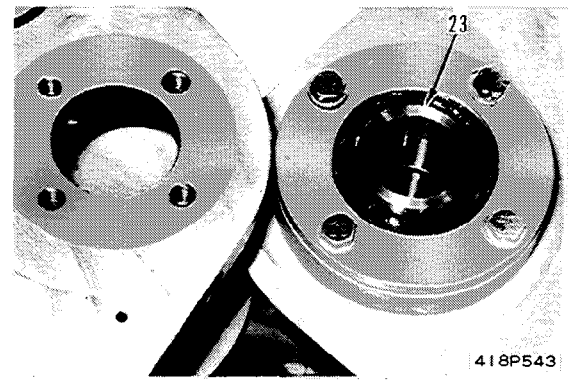


9. Disconnecting frame

1) Remove safety bar (22) and jack up front differential, then pull out front frame to the front.
   - ★ Be careful not to let the spacer at the bottom of the upper hinge get caught on the rear frame. Then, insert bar between rear frame and front frame, and disconnect while lifting front frame.
   - ★ Carry out the operation carefully and be sure to keep the parts in balance.



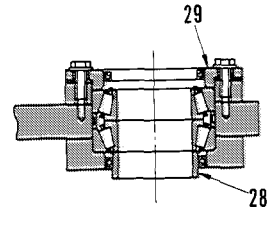
2) After disconnecting frame, remove spacer (23).

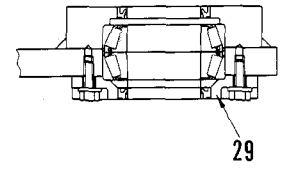


- Upper hinge
- Lower hinge

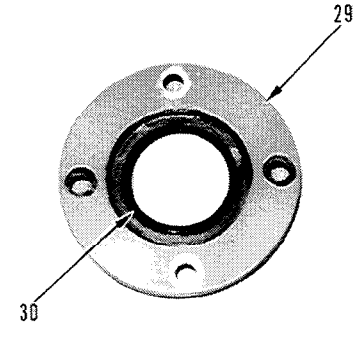
10. Upper hinge, lower hinge

1) Remove spacer (28).
2) Remove mounting bolts, and remove retainer (29).
   - ★ Check the number of shims between the retainer and frame.

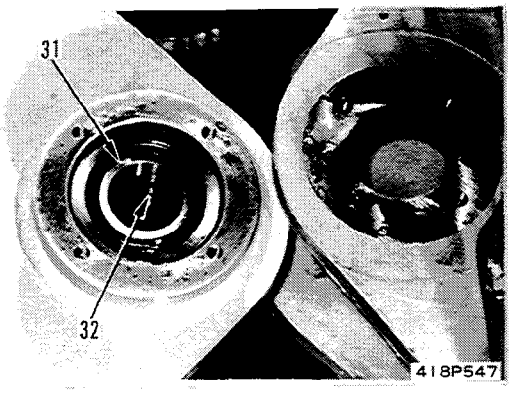




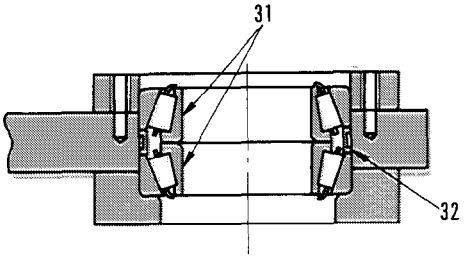
3) Remove dust seal (30) from retainer (29).



4) Remove bearing (31) and spacer (32) from front frame.

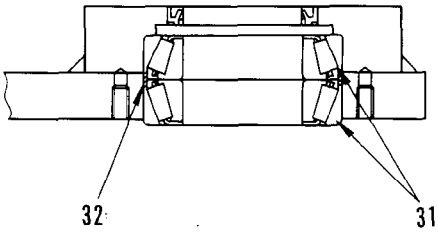


- Upper hinge



418F274

- Lower hinge



F41801112

INSTALLATION

1. **Upper hinge, lower hinge**
   1) Press fit bearing (31) and spacer (32) on front frame.
      ★ The clearance of bearing and spacer are adjusted, so do not change the combination. If the bearing or spacer is replaced, change both parts as a set.
      ★ Press fit the bearing and check that there is no clearance where contact surface of the frame.

      Bearing: Grease (G2-L1)

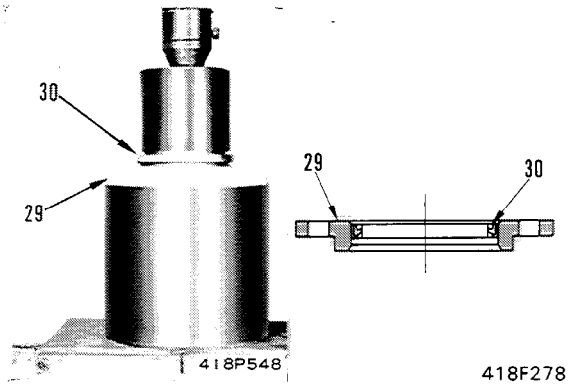
   2) Install dust seal (33) on front frame.
      ★ Install lip on outer side and be careful not to damage seal lip.

      Seal lip: Grease (G2-L1)

      Inside circumference of spacer: Grease (G2-L1)

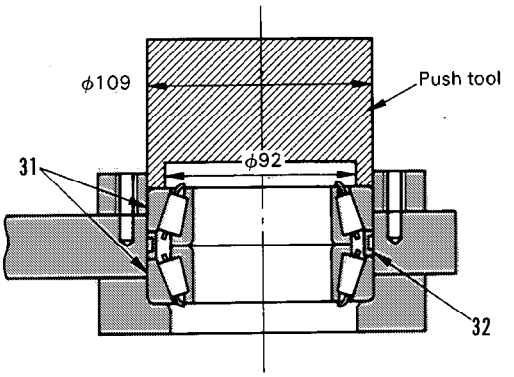
   3) Press fit dust seal (30) on retainer (29).
      ★ Be careful to press fit dust seal so that the lip is faced outward.

      Seal lip: Grease (G2-L1)



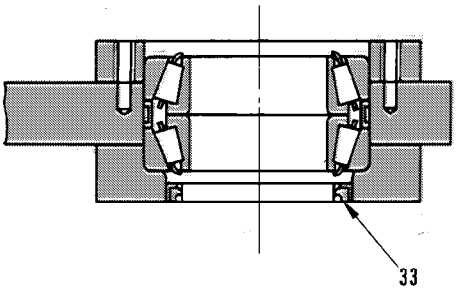
418F278

- Upper hinge



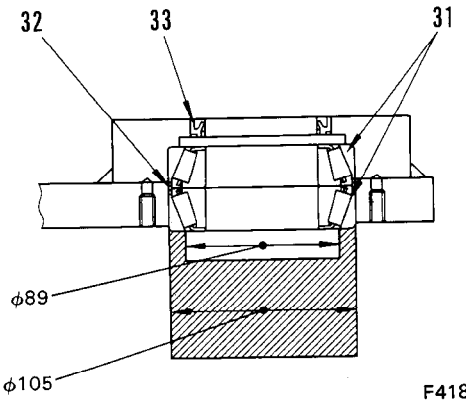
418F276A

- Upper hinge

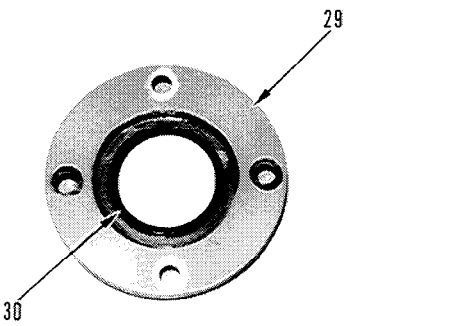


418F277

- Lower hinge



F41801113

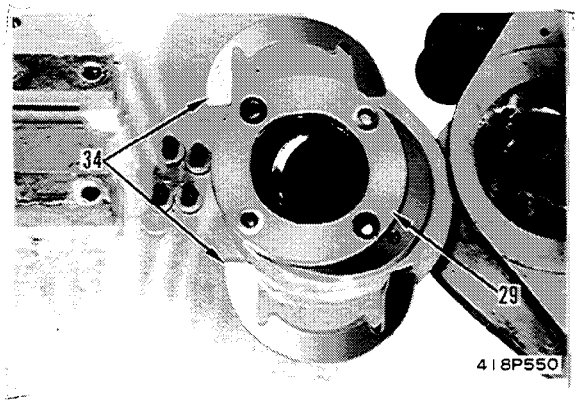


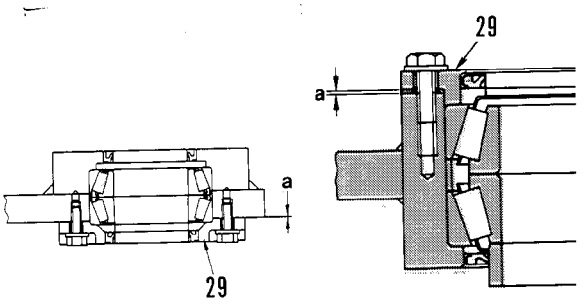
418P546

4) Tighten 4 mounting bolts of retainer (29) then select shims (34) to bring clearance 'a' between retainer and frame to specified value.
Clearance 'a': less than 0.1 mm

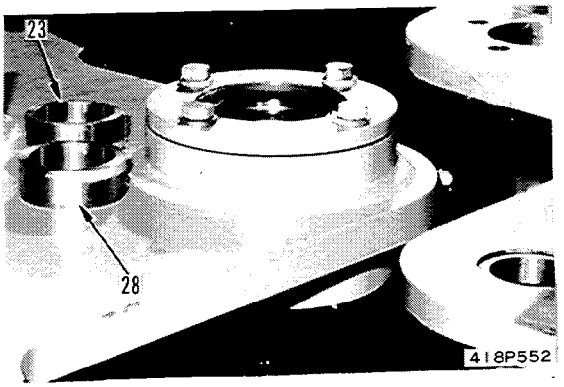
Mounting bolt: 1.5±0.15 kgm
(When checking shims)

Mounting bolt: 6.75±0.75 kgm





F41801114 416F314

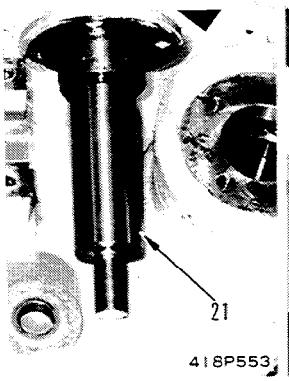


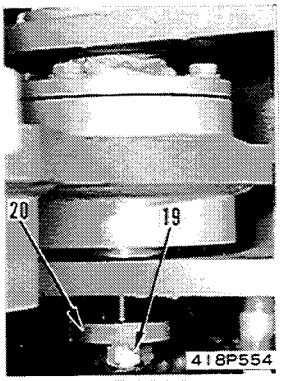
2. Connecting frame

1) Install spacers (28 and 23) on upper and lower front frame.
   ★ Install spacers so that larger chamfered side faces inward.
2) Jack up differential, move front frame towards rear frame, and align pin holes.

Use a bar to align the pin holes. Never use your fingers.

★ Be careful to connect the spacers of the lower part of the upper hinge so that they match.
★ Align the pin holes correctly.
★ Connect safety bar.



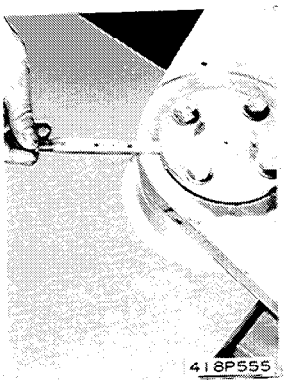


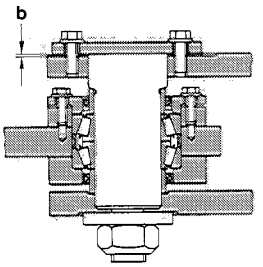
3. Upper hinge pin

1) Insert upper hinge pin (21).
2) Tighten washer (20) and lock nut (19) to specified torque, then select shims to bring clearance 'b' between rear frame and pin to specified value.
   ★ Tighten the mounting bolts temporarily to act as stoppers when tightening the lock nut.
   ★ Clearance 'b': less than 0.4 mm

Lock nut: 58±6 kgm

• Lock nut width across the flat: 55 mm



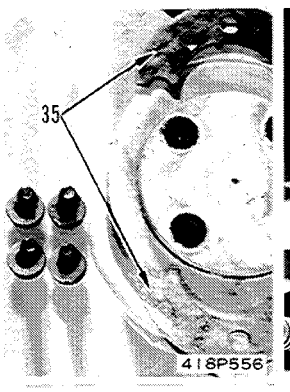


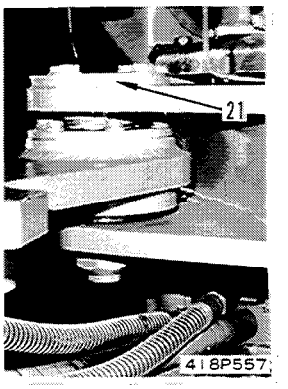
418F281

3) Install selected shims (35) and tighten pin mounting bolts.
   ★ Tighten lock nut to specified torque again before tightening mounting bolts.

Lock nut: 58±6 kgm

Mounting bolt: 11.5±1.0 kgm



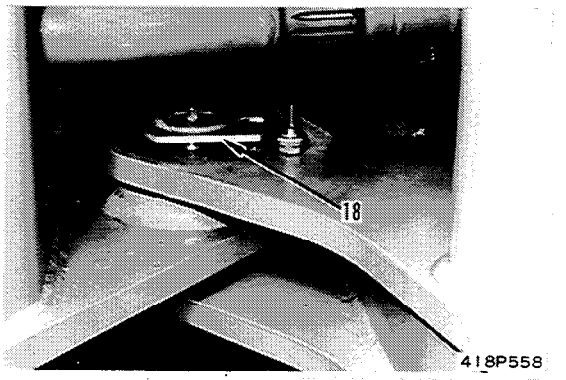


4. **Lower hinge pin**
   Insert lower hinge pin (18), and secure with lock bolt.

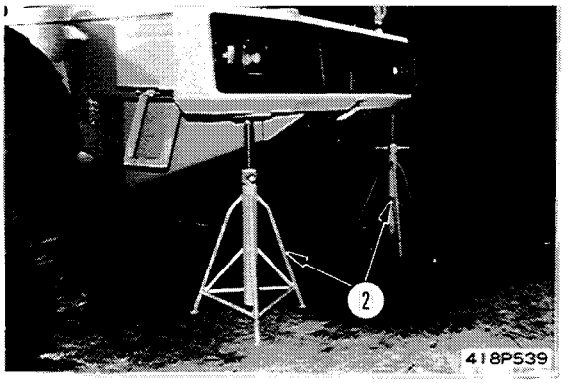
Hinge pin outside circumference: Grease (G2-L1)

Use a bar to align the pin holes. Never use your fingers.

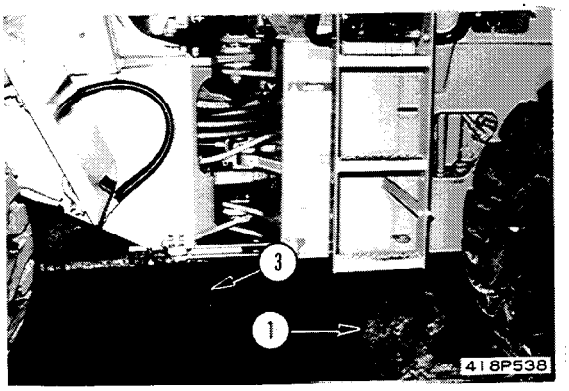
★ Adjust height carefully so pin can easily be inserted by hand.



5. **Frame support**
   1) Remove stands ② from under counterweight.



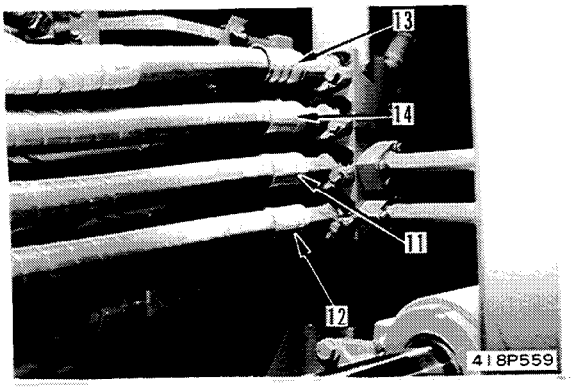
2) Jack up rear frame and remove block ①.
3) Remove right and left blocks ③ from front frame.



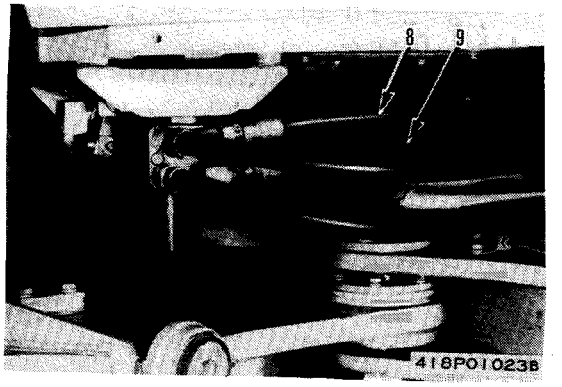
6. **Hydraulic piping**
Connect the following hydraulic piping and brake hose.
- Connect front axle brake hose (17) to joint.

Hose nut: 1.2±0.3 kgm

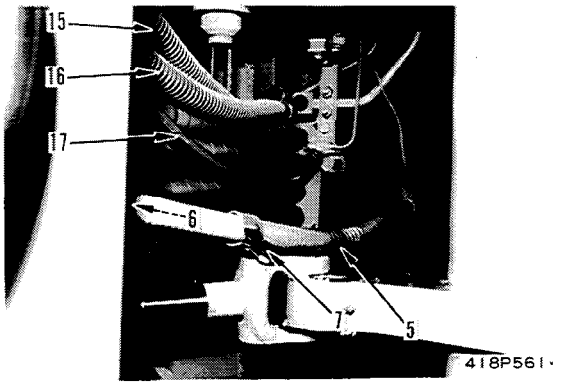
- Connect steering cylinder hoses (15 and 16) to tube.
- Connect dump cylinder hoses (13 and 14) to joint inside front frame.
- Connect lift cylinder hoses (11 and 12) to joint inside front frame.



7. **Steering piping**
Connect hoses (8 and 9) between steering valve and steering cylinder.



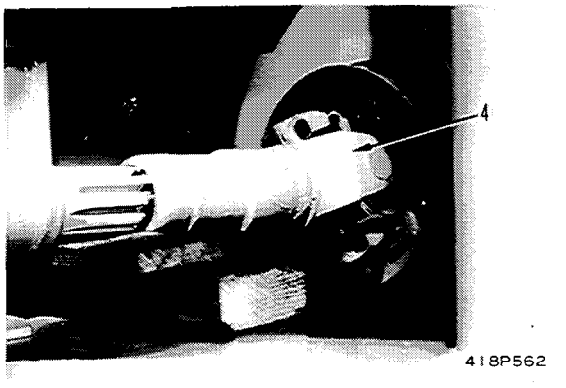
8. **Electric wiring**
Connect clamps (6 and 7) of front frame electrical wiring (5) to front and rear frames.



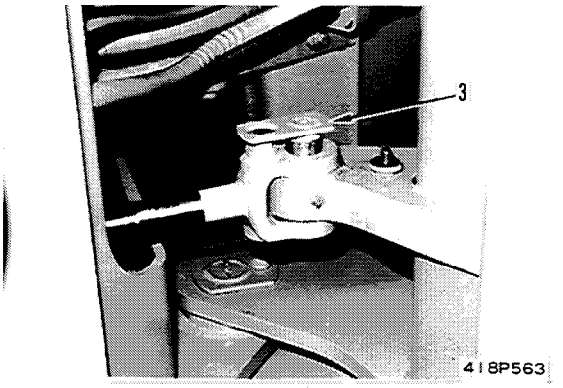
9. **Drive shaft**
Install center drive shaft (4).
★ Be careful to install the coupling facing in the correct direction.

Mounting bolt: 6.75±0.75 kgm

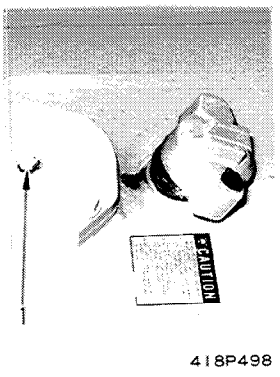
★ Remove block after connecting drive shaft.

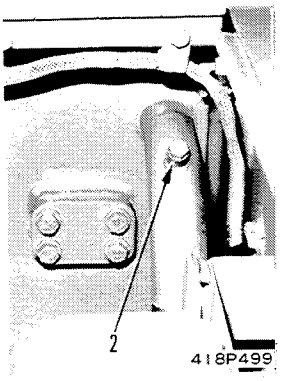


10. Steering cylinder
Install left and right pins (3) at steering cylinder rod end.
★ Adjust with shims so that the clearance is within the specified range.
Clearance: less than 0.5 mm
For details, see page 43-15.

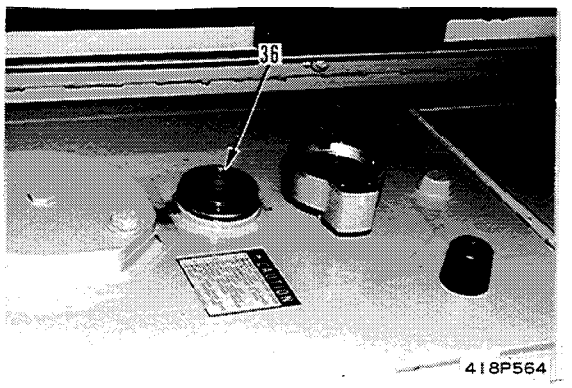


11. Refilling with oil
Tighten plug (1) at top of hydraulic tank filter, and plug (2) of pump piping, then add hydraulic oil through oil filler (36) to the specified level.
★ Run the engine to circulate the oil through the system. Then check the oil level again.



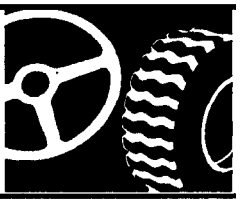


12. Bleeding air from brakes
For details of bleeding air see SECTION 52, TESTING AND ADJUSTING.



STEERING SYSTEM

44 MAINTENANCE STANDARD



HYDRAULIC AND STEERING PUMP 2

STEERING CYLINDER MOUNT 3

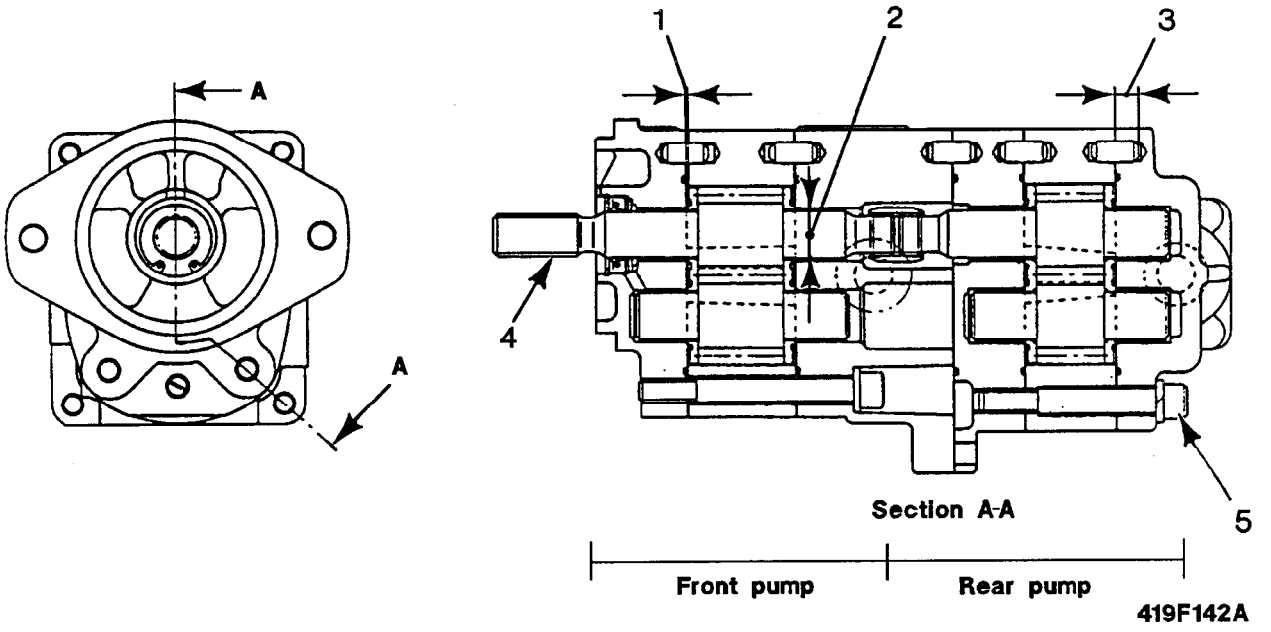
CENTER HINGE PIN 4

STEERING COLUMN AND GEAR BOX 6

PRIORITY VALVE 7

HYDRAULIC AND STEERING PUMP

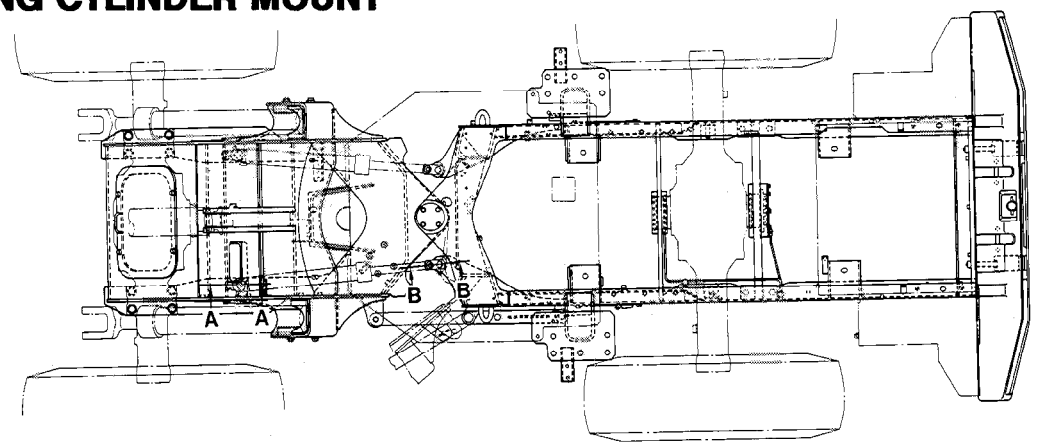
- Model SAL(2)-050 + Model SAL(2)-025

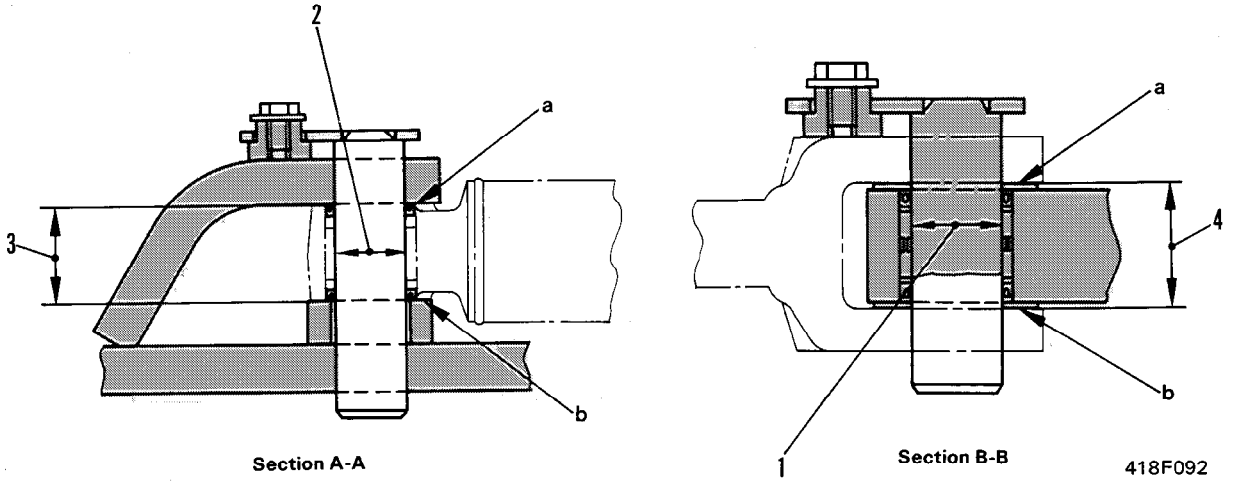


Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between gear case and side plate, gear	Standard clearance		Clearance limit			Replace
		0.10-0.15		0.19			
2	Clearance between inside diameter of plain bearing and outside diameter of gear shaft	0.06-0.125		0.20			
3	Insertion depth of pin	$12.0^{0}_{-0.5}$					
4	Rotating torque of spline shaft	0.5-1.5 kgm					
5	Tightening torque of bolt	11.5±1.0					Retighten
	Discharge Oil: SAE10W-CD Temperature: 45-55°C	Model	Revolution (rpm)	Discharge pressure (kg/cm^2)	Standard discharge (ℓ/min)	Repair limit discharge (ℓ/min)	
		(Front) SAL(2)-050	3000	210	138	128	
		(Rear) SAL(2)-025	3000	210	67	62	

STEERING CYLINDER MOUNT

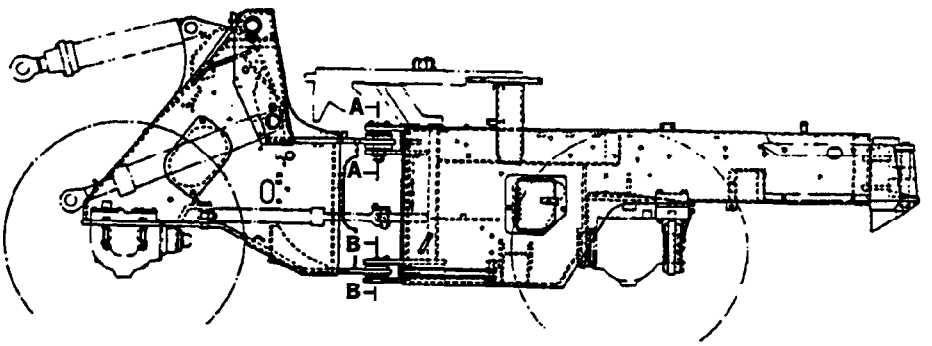


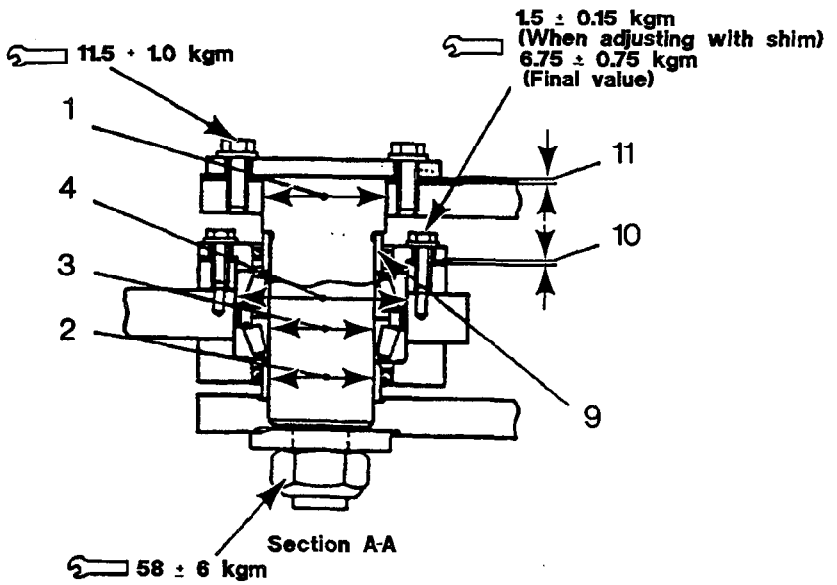


Unit: mm

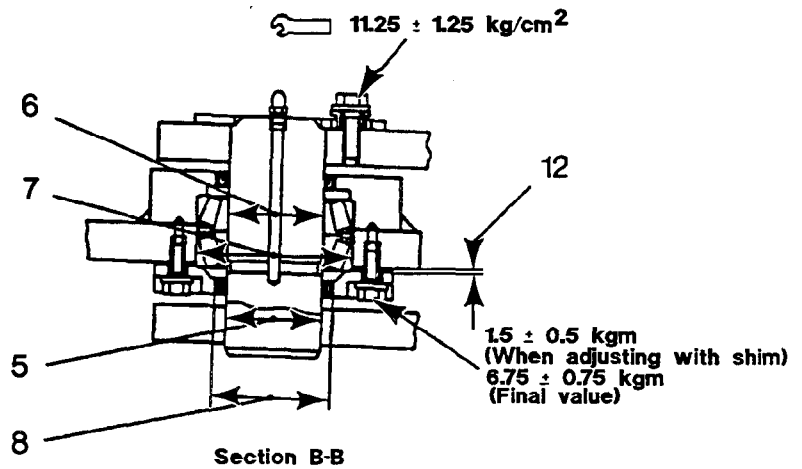
No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between mounting pin and bushing at connection of steering cylinder rod and frame	40	0 -0.025	+0.142 +0.080	0.080- 0.167		Replace
2	Clearance between mounting pin and bushing at connection of steering cylinder bottom and frame	40	0 -0.025	+0.142 +0.080	0.080- 0.167		
3	Connection of steering cylinder and front frame	Width of boss		Width of hinge	Standard clearance (Clearance a+b)		
		$50^{+0.8}_{0}$		53	After adjusting with shim: Less than -		
4	Connection of steering cylinder and rear frame	50		54±0.8	After adjusting with shim: less than 0.5		

CENTER HINGE PIN





418F099A

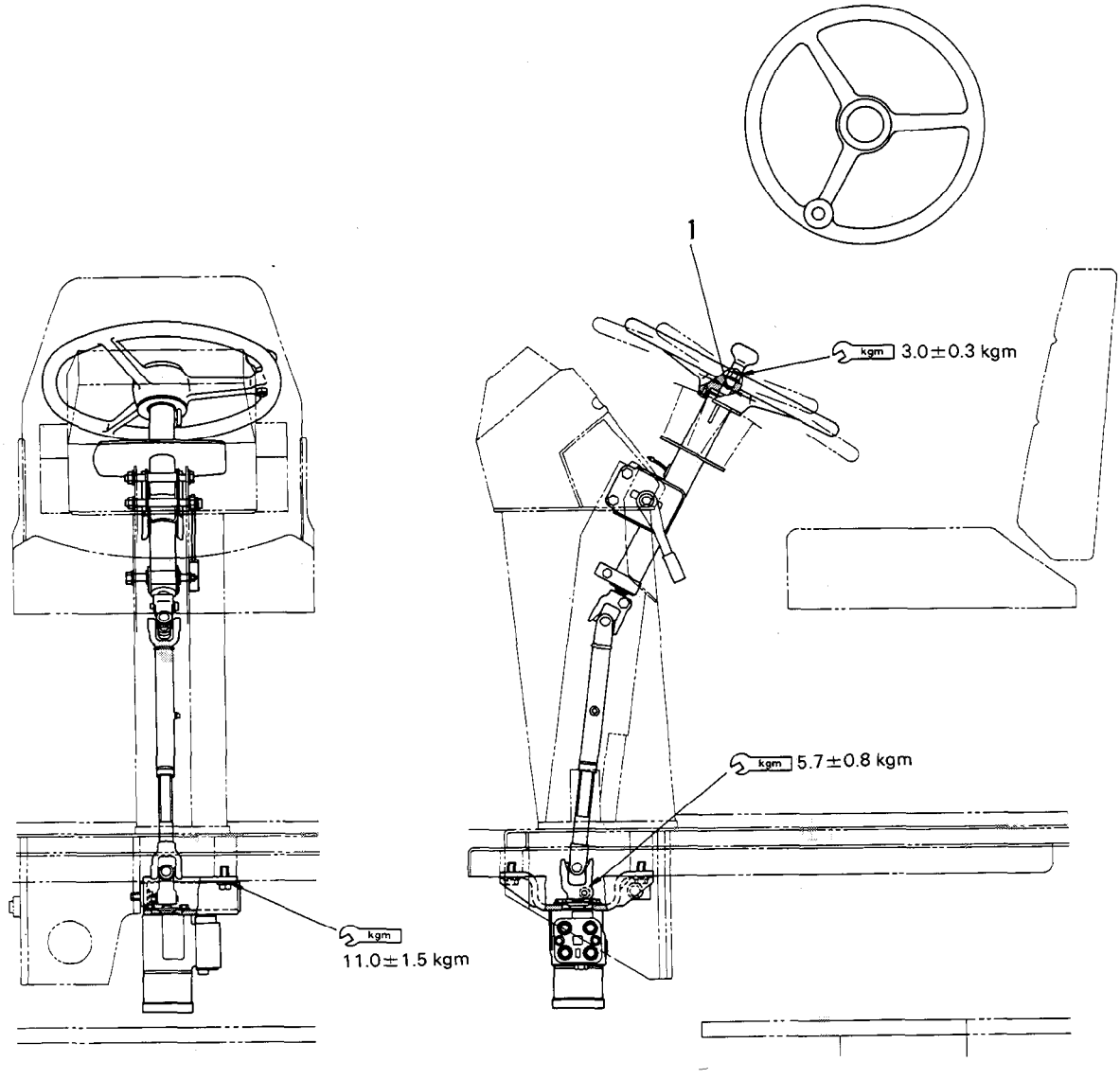


U41801129A

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between upper hinge pin and rear frame	80.5	-0.08 -0.18	±0.05	-0.03- -0.23		Replace
2	Clearance between upper hinge pin and spacer	65	-0.030 -0.049	+0.24 0	-0.030- -0.073		
3	Clearance between upper hinge pin and bearing	65	-0.030 -0.049	0 -0.015	-0.015- 0.049		
4	Clearance between front frame and upper hinge pin	110	0 -0.02	-0.041 -0.076	-0.076- -0.021		
5	Clearance between lower hinge pin and rear frame	65	-0.030 -0.076	+0.046 0	0.030- 0.122		
6	Clearance between lower hinge pin and bearing	65	-0.030 -0.076	0 -0.015	0.015- 0.076		
7	Clearance between front frame and lower hinge bearing	105	0 -0.020	-0.041 -0.076	-0.021 -0.076		
8	Clearance at press fitted part of seal or lower hinge pin	80	+0.26 +0.16	+0.046 0	-0.114- -0.260		
9	Height of upper hinge pin spacer	Standard size	Tolerance		Repair limit		Adjust
		26	0 -0.25				
10	Thickness of standard shim between upper hinge pin and retainer	0.7					
11	Thickness of standard shim between upper hinge pin and retainer	1.5					
12	Thickness of standard shim between lower hinge pin and retainer	0.7					

STEERING COLUMN AND GEAR BOX

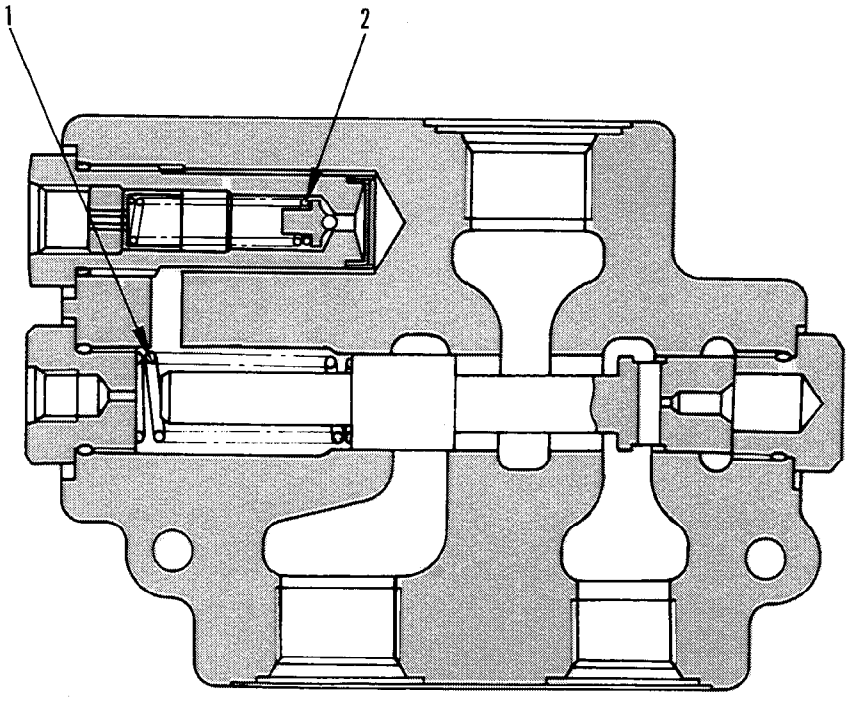


418F515A

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between steering shaft and column bearing	19	0 -0.08	+0.15 -0.05	0.05- -0.23		Replace

PRIORITY VALVE



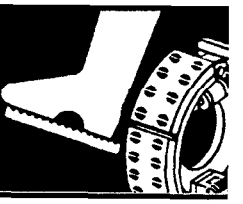
E416F415

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Control spring	Free length	Installation length	Installation load(kg)	Free length	Installation load(kg)	Replace
		61.7	45	27.7	61.7±1	27.7±2.7	
2	Relief spring	31	25.4	14.7		14.5±1.5	

BRAKES

51 STRUCTURE AND FUNCTION



BRAKE PIPING 2

POWER MASTER CYLINDER 3

BRAKE 7

PARKING BRAKE CONTROL 9

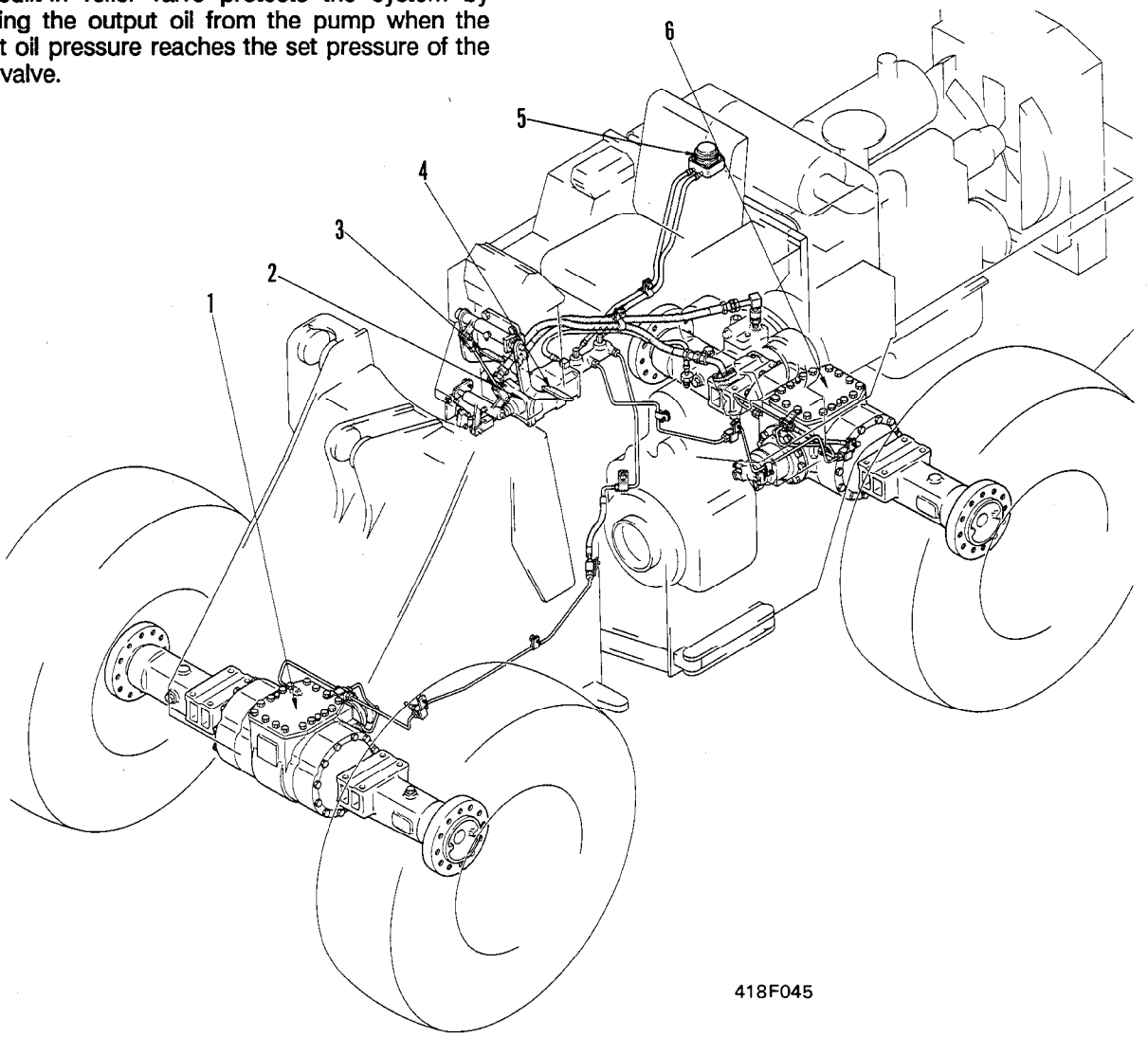
PARKING BRAKE 10

OPERATION OF PARKING BRAKE 11

BRAKE CALIPER 12

BRAKE PIPING

- The power master cylinder consists of a hydraulic booster mechanism. It is constructed so as to reduce the force required to depress the brake pedal and to obtain a large braking force.
- When the brake pedal is depressed, the drain circuit within the valve will close and the output oil from the pump will actuate the piston, thus activating the front and rear brakes.
- The built-in relief valve protects the system by relieving the output oil from the pump when the circuit oil pressure reaches the set pressure of the relief valve.



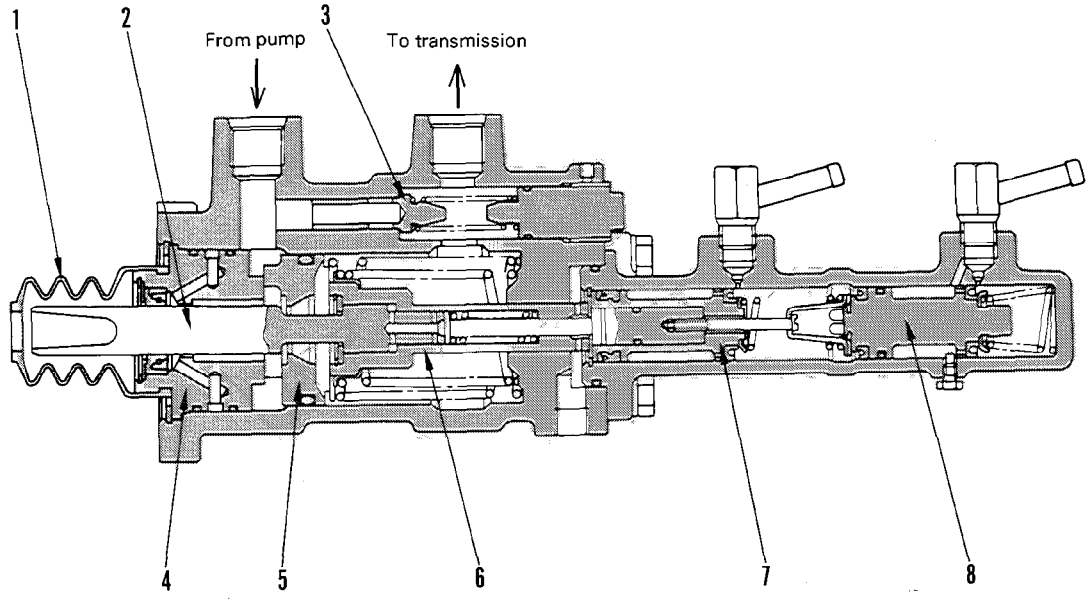
418F045

1. Front brake
2. Power master cylinder
3. Brake pedal for right
4. Brake pedal for left (With transmission cut-off select)
5. Brake tank
6. Rear brake

POWER MASTER CYLINDER

General

- The power master cylinder is a hydraulic booster which serves to augment the pressure of the oil which will be conducted to the wheel cylinders and which acts against the power pistons when the brake pedal is depressed.
- When an abnormally high pressure occurs in the pump circuit, the relief valve will activate to let the oil flow to the transmission circuit.

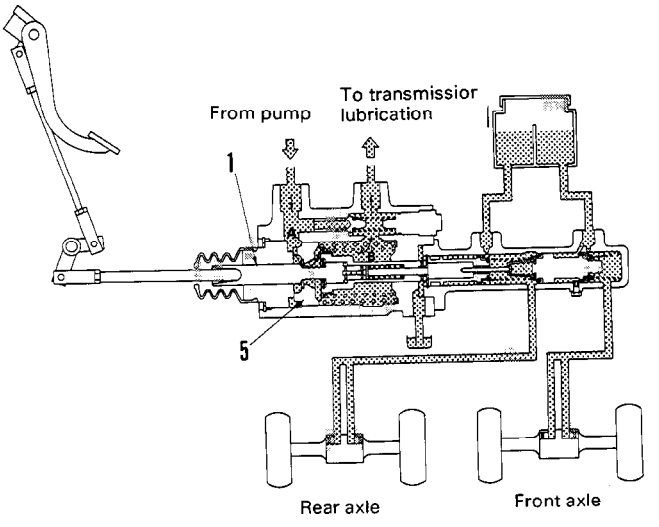


418F506

1. Dust cover
2. Spool
3. Relief valve
4. Cylinder cover
5. Power piston
6. Connector
7. Secondary piston
8. Primary piston

Operation

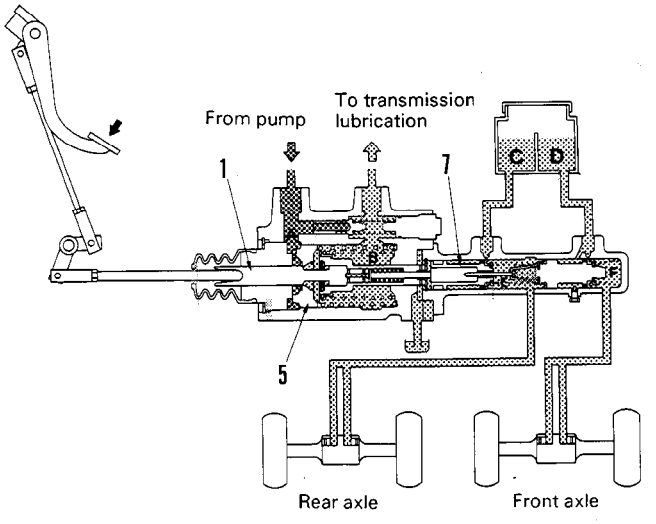
Brake OFF



418F507

- When the brake is OFF, spool (1) and power piston (5) will not be actuated.
- The output oil from the pump flows from port A to port B to the transmission circuit. The oil of the master cylinders is interconnected to the front and rear axles.

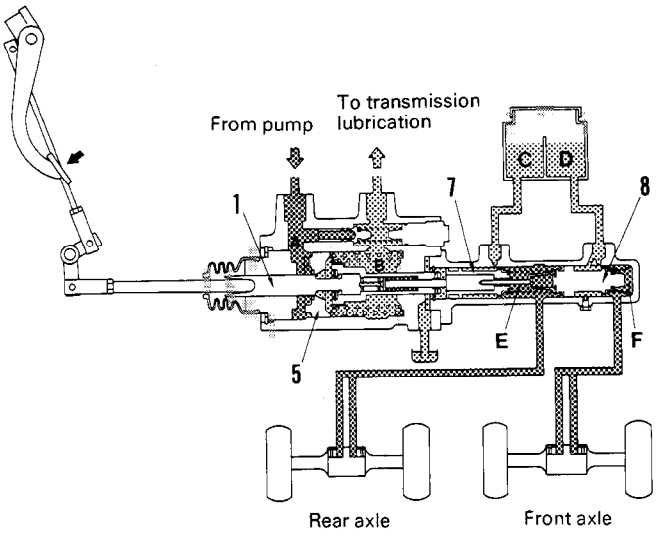
Brake ON



418F508

- When the brake pedal is depressed, spool (1) will be pushed out until it contacts power piston (5), thus blocking out the connection between port A and port B.
- The oil from the pump enters port A, supplying an amount of oil proportional to the distance the spool has moved.
- Spool (1) will contact secondary piston (7).

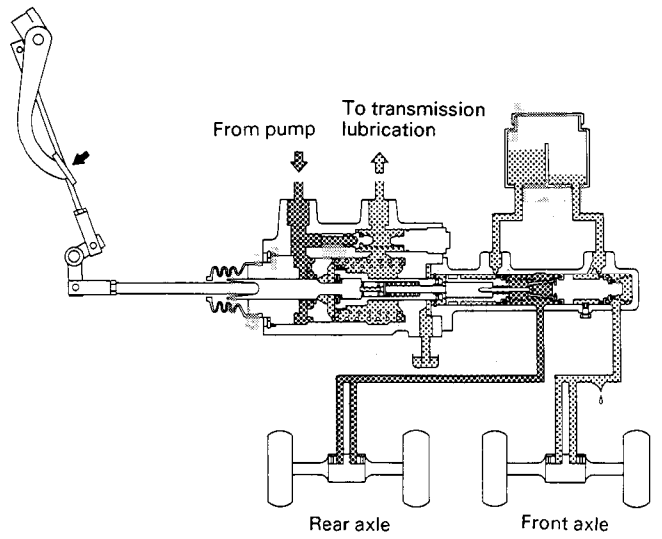
Hydraulic pressure rises



418F509

- The spool pushes secondary piston (7) and the secondary piston pushes primary piston (8). Therefore each piston will block ports A and B, letting the brake oil flow from ports C and D to the front and rear brake systems. Thus the brakes are activated.
- When the brake pedal is depressed further, the power piston moves to the right, the oil pressure at ports C and D rises, reducing the force required to depress the pedal, and causing the brakes to be applied with greater force.

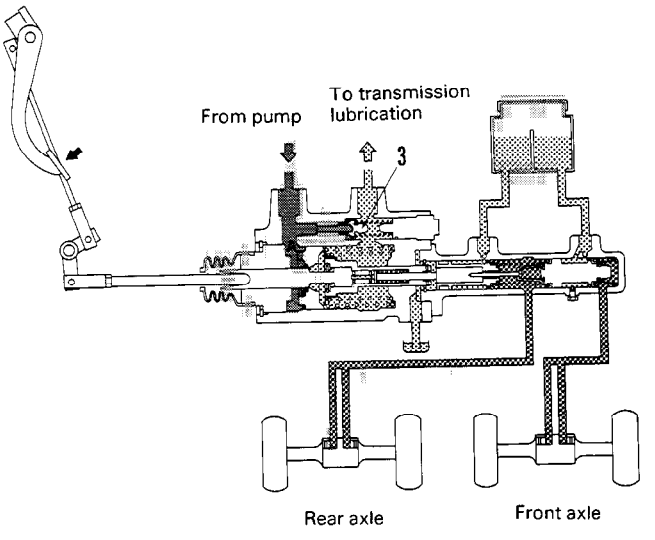
When the brake on one side is broken



418F511

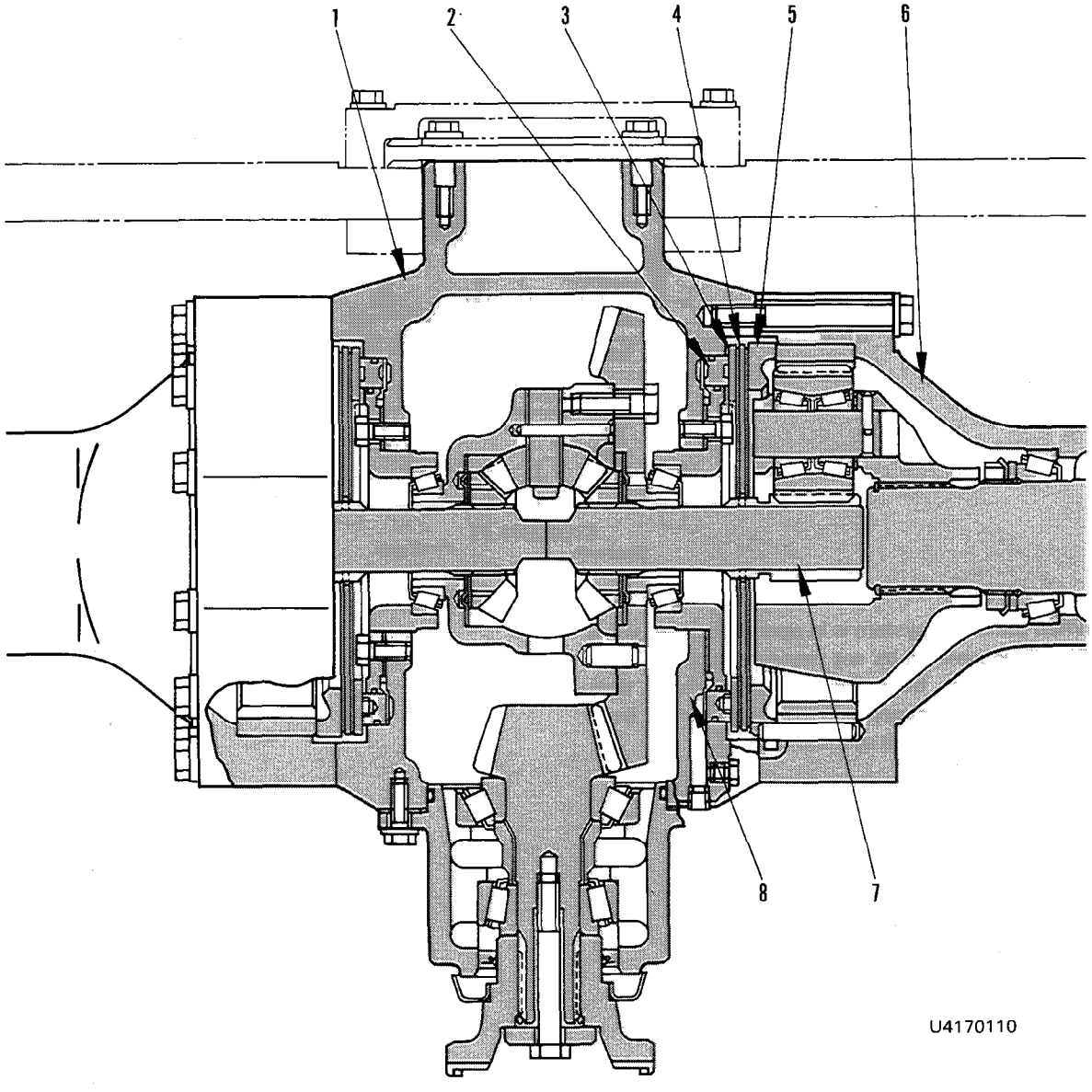
- The front and the rear brake systems are independent of each other and have a separate oil tank so that if oil leaks from one system, the other system will still function to stop the machine, thus ensuring the safety of operation.

Function of relief valve



- When the brake system is in operation, relief valve (3) will activate at its set pressure, letting the oil flow to the transmission circuit and thus preventing an abnormally high pressure from developing within the system.

BRAKE



1. Differential housing
2. Piston
3. Inner ring
4. Disc
5. Outer ring
6. Axle housing
7. Sun gear shaft
8. Bearing carrier

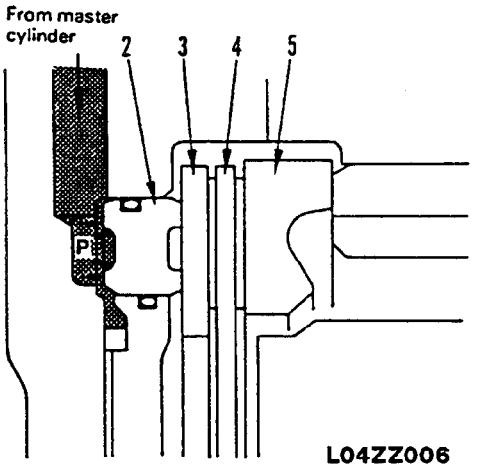
Function

- The brake is a wet-type, single disc brake. It consists of piston (2), inner ring (3), disc (4), and outer ring (5).
- The brake cylinder consists of differential housing (1) and bearing carrier (8). Piston (2) is assembled inside the brake cylinder. Inner ring (3) is installed to the notched part of bearing carrier (8). Outer ring (5) is secured to axle housing (6) by pin.
- Disc (4) has a lining stuck on both faces. It is assembled between inner ring (3) and outer ring (5). It is connected by the spline of the sun gear shaft.

Operation

Brake operated

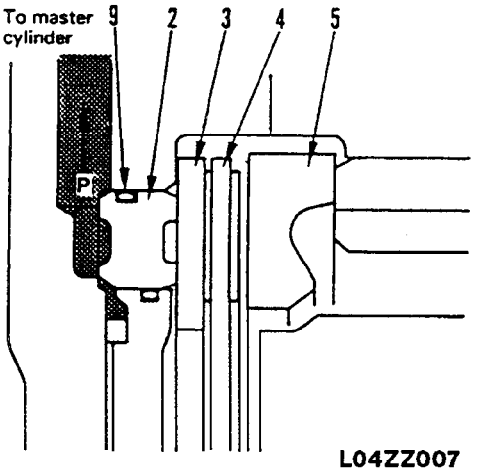
- When the brake pedal is depressed, the rod of the master cylinder is pushed. Oil pressure P is generated, and this acts on the piston inside the brake cylinder to slide piston (2) slightly.
  Therefore, the rotation of disc (4), which is between inner ring (3) and outer ring (5), is stopped, and the brakes are applied to stop the machine.



L04ZZ006

Brake released

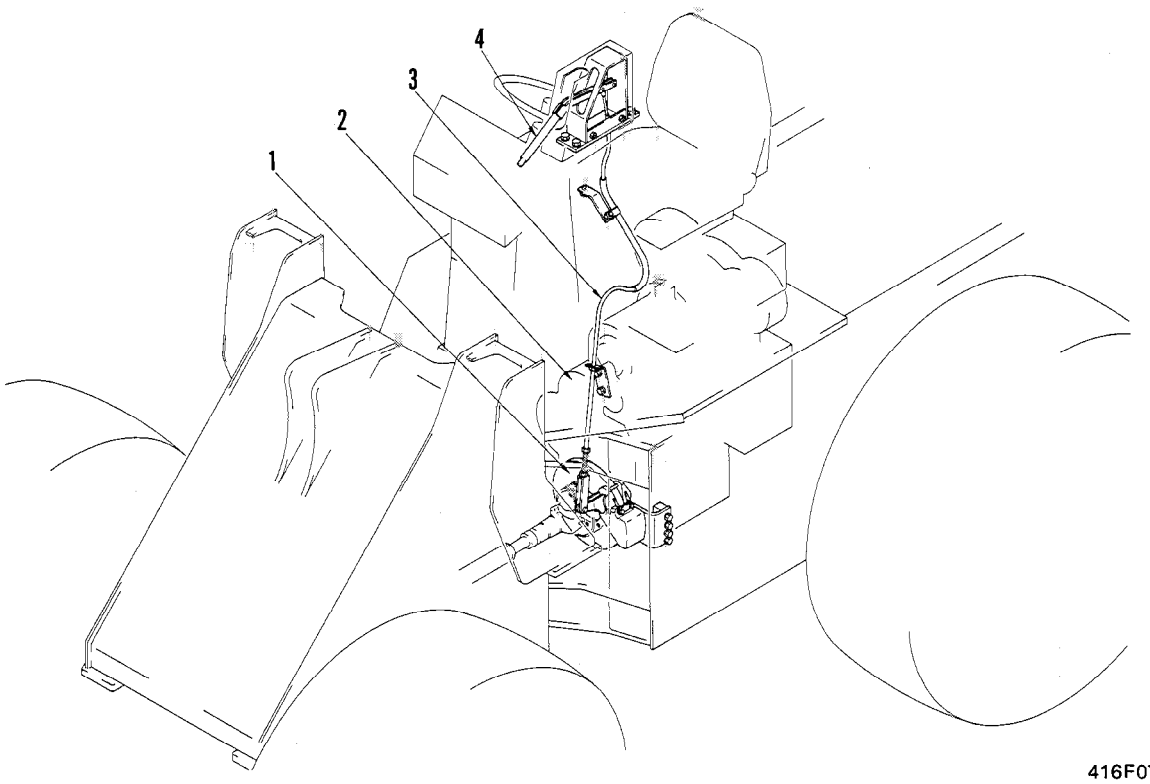
- When the oil pressure is released, piston (2) moves back slightly because of the return force of piston O-ring (9). A gap is created between inner ring (3) and outer ring (5), so disc (4) is free.
  Grooves are cut in a lattice pattern on the lining stuck to disc (4). When the disc is rotating, oil flows in these grooves to cool the lining.



L04ZZ007

PARKING BRAKE CONTROL

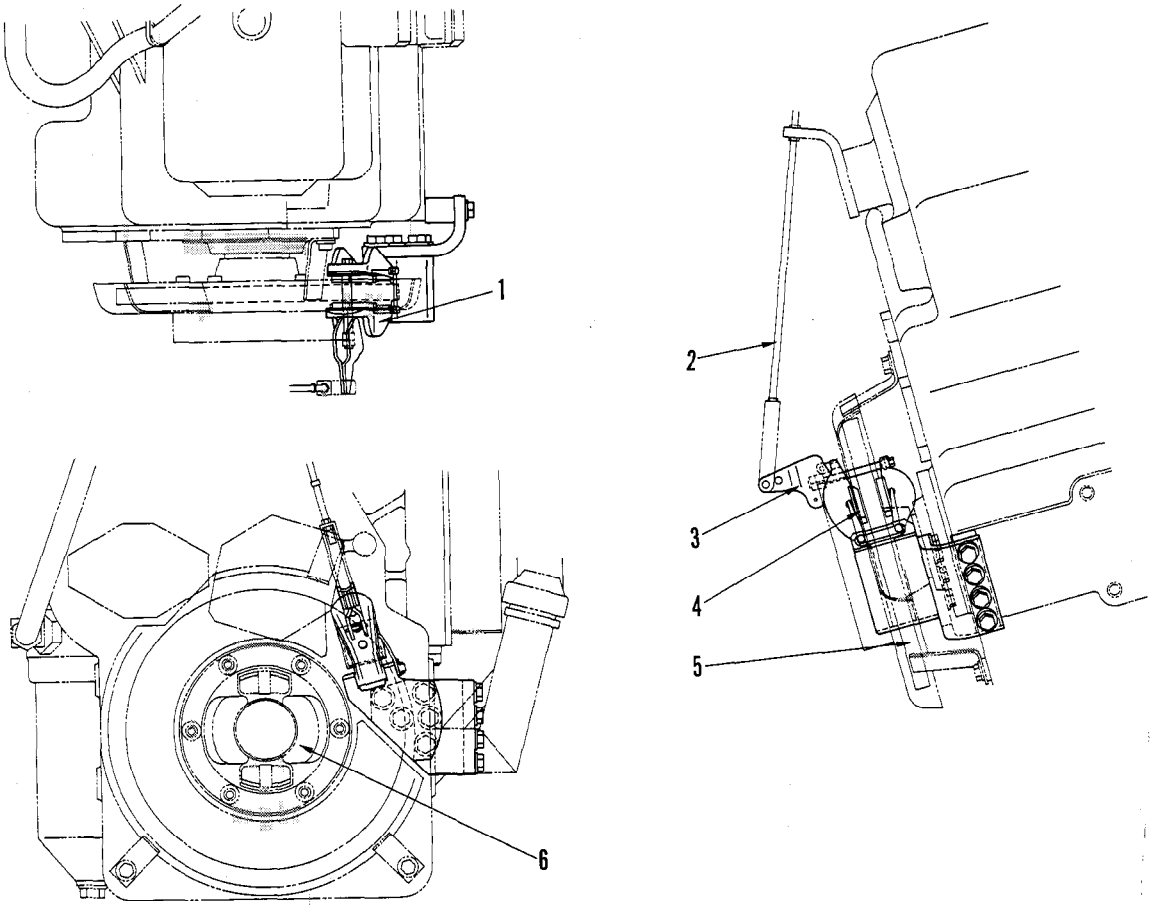
- The parking brake is connected with a wire cable and is constructed to be applied or released mechanically.
- When the lever located inside the operator's cab is pulled upward, the lever will be locked in the BRAKE position by means of a ratchet. When the knob is pushed down, the ratchet will be unlocked and the brake will be released.



416F074

1. Parking brake disc
2. Transmission
3. Wire cable
4. Parking brake lever

PARKING BRAKE



418F050

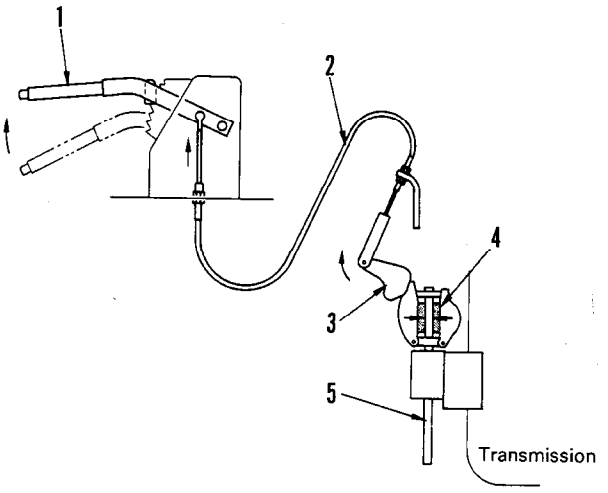
Function

- The parking brake is a disc-type brake and is installed to the transmission output coupling (6) at the front.
- The lever (3) and caliper (1) are connected by wire cable (2). The force of brake can be controlled by the amount of lever pulled.

1. Caliper
2. Cable
3. Lever
4. Pad
5. Disc
6. Coupling

OPERATION OF PARKING BRAKE

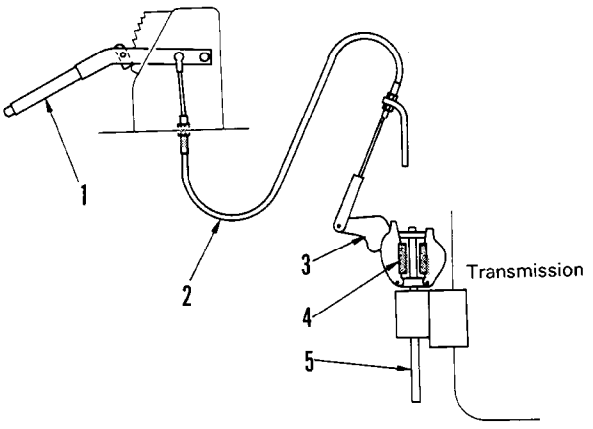
1. **Effecting the parking brake**
   When parking brake lever (1) is pulled, the parking brake will work.
   When parking brake lever (1) is pulled, wire (2) will pull up caliper lever (3), brake pad (4) will squeeze disc (5), and the brake will work.



419F092

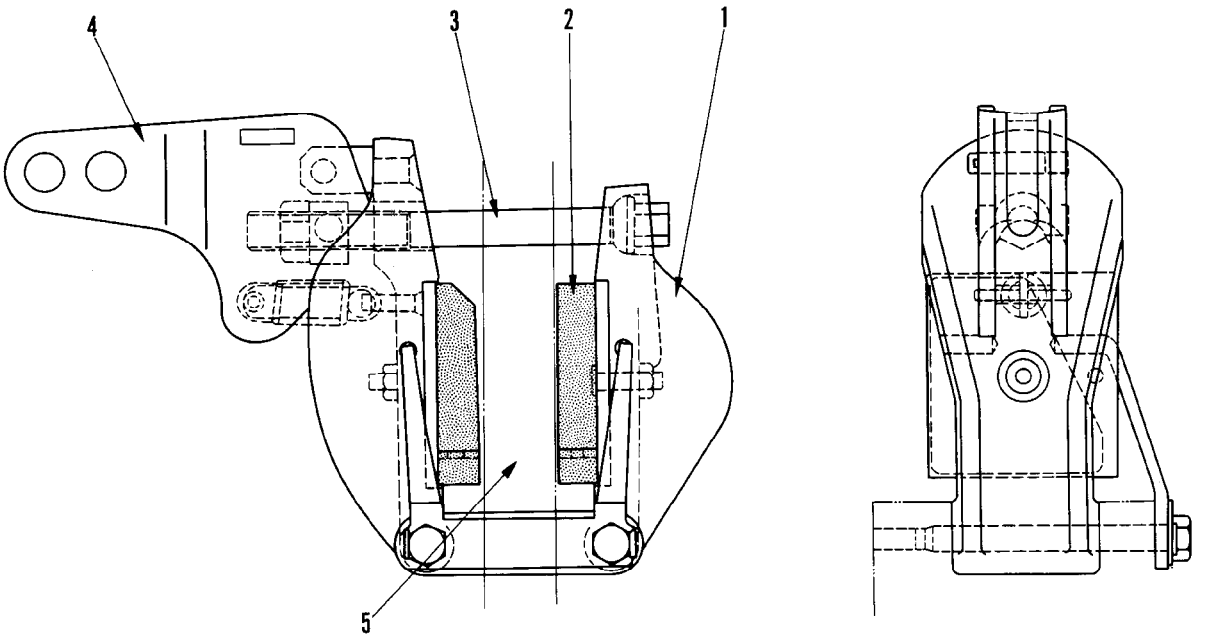
1. Parking brake lever
2. Wire
3. Caliper lever
4. Brake pad
5. Disc

2. **Parking brake operation**
   When parking brake lever (1) is returned to OFF, the parking brake will be released.
   When parking brake lever (1) is returned, wire (2) will push down caliper lever (3), a clearance will be opened between brake pad (4) and disc (5), and the brake will be released.



419F093

BRAKE CALIPER



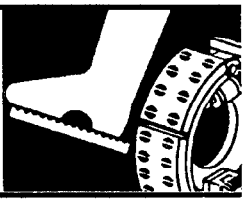
423F123A

1. Pad carrier
2. Pad
3. Adjustment bolt
4. Caliper lever
5. Disc

Outline

- The parking brake caliper is fixed to the front differential case.
  The disc is installed to the differential yoke, and rotates together with the coupling.

BRAKES
52 TESTING AND ADJUSTING



STANDARD VALUE TABLE 2

TOOL LIST 3

MEASURING BRAKE PEDAL 4

BRAKE PEDAL LINKAGE 5

BRAKE PERFORMANCE 7

BRAKE PISTON LEAKAGE 8

BRAKE DISC WEAR 9

AIR BLEEDING FROM BRAKE CIRCUIT 10

PARKING BRAKE PERFORMANCE 11

PARKING BRAKE 12
- CHECKING 12
- ADJUSTING 13
- MEASURING CLEARANCE 14

TROUBLESHOOTING 15
- TROUBLESHOOTING TABLES 16
  1. Brake is ineffective or not very effective. 16
  2. Brake cannot be released or drags. 17

★ The following precautions are necessary when using the Standard Value Tables to make judgements during troubleshooting or during testing and adjusting.

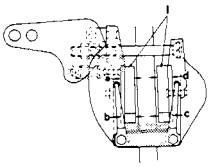
1. The values in these tables are based on the values for new machines leaving the plant, so they should be used as target values when repairing or when estimating wear after a period of use.

2. The standard values in these tables are used when troubleshooting. They are estimated values based on the standard values for the machine when shipped from the plant, and on the results of various tests. Therefore, they should be used as reference in combination with repair and operating records when making judgements.

3. These standard value tables must not be used for standard values when judging claims. In addition, do not use these values alone to make simple judgements.

★ Before carrying out the troubleshooting in this section, read "PRECAUTIONS WHEN TROUBLESHOOTING", "METHOD OF READING TROUBLESHOOTING TABLE" and "PREVENTING RECURRENCE OF TROUBLE" in SECTION 22 TROUBLESHOOTING.

STANDARD VALUE TABLE

Testing and measuring item	Measurement condition	Unit	Standard value	Permissible value
Brake pedal • Operating force • Travel • Play	• Coolant temperature: Inside operating range • Engine speed: Low idling	 kg mm mm	 30±3 85-105 10	 Max. 43 Max. 135 Max. 13
Brake performance	• Road surface: Flat, horizontal, dry, paved surface • Speed when applying brakes: 20 km/h • Time lag when pressing the pedal: 0.1 sec. • Tire inflation pressure: Specified pressure • Pedal operating force: 38 kg	mm	Max. 12.0	Max. 12.0
Drop in brake oil pressure	• Coolant temperature: Inside operating range • Test pressure 42 kg/cm²,5 min.	kg/cm²	Max. 3.5	Max. 3.5
Wear of brake disc	• Coolant temperature: Inside operating range	mm	1.02-1.14	Min. 0.7
Parking brake performance	• Tire inflation pressure: Specified pressure • Road surface: Flat, dry, paved surface with 1/5 (11°20') gradient • Machine: In operating condition		Machine stopped	Machine stopped
• Thickness of pad	 419F315	mm	11.7 (a) 11.3 (b,c,d)	Min. 7.0
• Clearance between disc and pad		mm	0.1-0.4	Max. 2.6
Parking brake lever • Travel	• Brake lever operating force: 25 kg	mm	170-210 (9-11 clicks)	170-210 (9-11 clicks)

⚠ When carrying out testing, adjusting or trouble-shooting, stop the machine on level ground, install the safety bar on the frame, lower the bucket to the ground, and stop the engine. Then apply the parking brake and block the tires.

⚠ When working in groups, use agreed upon signals and do not allow unauthorized persons near the machine.

TOOL LIST

NO.	Testing and measuring item	Tool	Part number	Remark
1	Brake pedal operating force	Push gauge	799-101-1001	0-110 kg
2	Brake oil pressure	Hydraulic tester		0-100 kg
3	Wear of brake disc	Vernier calipers	Commercially available	150-200 mm
4	Brake distance	Tape measure	Commercially available	30 m
5	Clearance of pad	Feeler gauge	Commercially available	0.1-3.0 mm

⚠ When carrying out testing, adjusting or trouble-shooting, stop the machine on level ground, install the safety bar on the frame, lower the bucket to the ground, and stop the engine. Then apply the parking brake and block the tires.

⚠ When working in groups, use agreed upon signals and do not allow unauthorized persons near the machine.

MEASURING BRAKE PEDAL

★ Measurement condition
- Coolant temperature: Inside operating range
- Engine speed: Low idling

Item		Standard value	Permissible value
Brake pedal	Force	30 kg	
	Travel	70-90 mm	Max. 120 mm
	Play	10 mm	Max. 13 mm

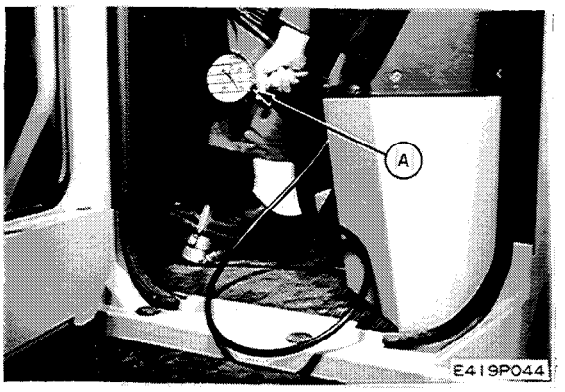
Special tool

	Part number	Part name	Q'ty
A	799-101-1001	Push gauge	1

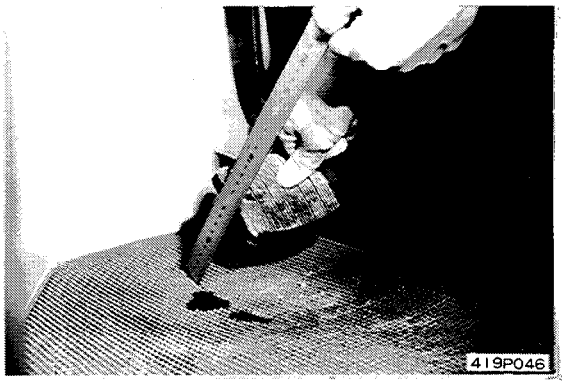
1. **Measuring operating force of pedal**
   1) Fit push gauge A to the operator's foot.
      ★ Align the center of the push gauge with the center of the pedal.
   2) Start the engine and run at low idling, then depress the pedal and measure the operating force.

2. **Measuring travel of pedal**
   1) Fit push gauge A to the operator's foot.
      ★ Align the center of the push gauge with the center of the pedal.
   2) Start the engine and run at low idling. Measure the travel of the pedal when it is operated with an operating force of 30 kg.

3. **Measuring play of pedal**
   1) Start the engine and run at low idling. Measure the travel of pedal when it becomes too heavy when forced by hand.







BRAKE PEDAL LINKAGE

★ Testing conditions
● Engine water temperature: Inside operating range

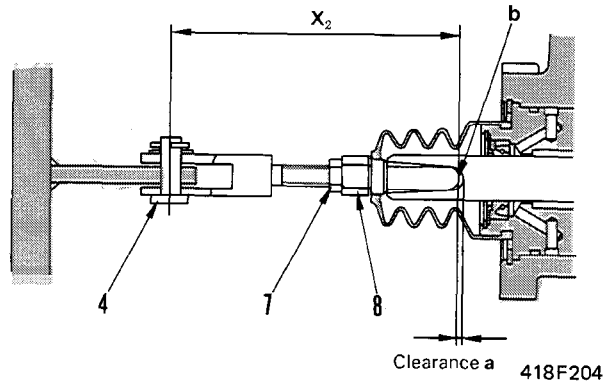
Unit: mm

Item	Standard value (new machine)	Permissible value
Length of link X1	443	
Length of rod X2	180	
Clearance a	0.5-1.5	

★ Remove the cover.

Testing procedure

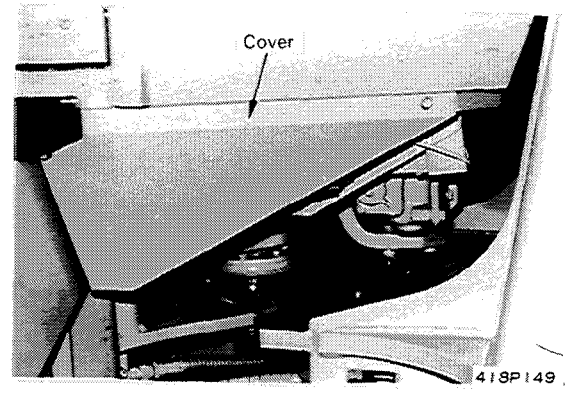
1. Check the play of linkage mounting pin (1), pin hole of lever (2), and lever bushing.
2. Measure length X1 of link, and check that it is within the standard value.
   ★ Measure the distance between the center of pin (1) and the center of pin (3).
3. Remove rod pin (4), and measure the movement of hole. Check that clearance "a" is within the standard value.
   ★ When carrying out this check, make sure that the brake pedal is in contact with the stopper.



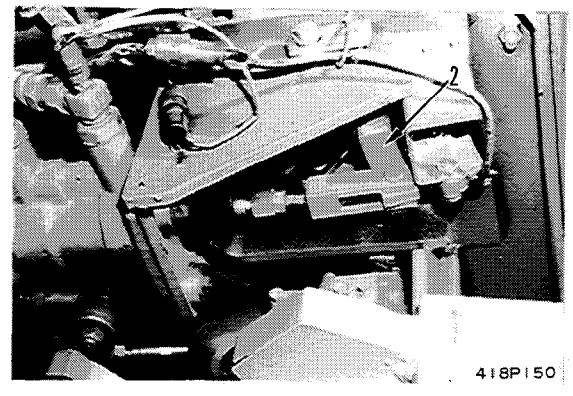
418F204

Adjusting procedure

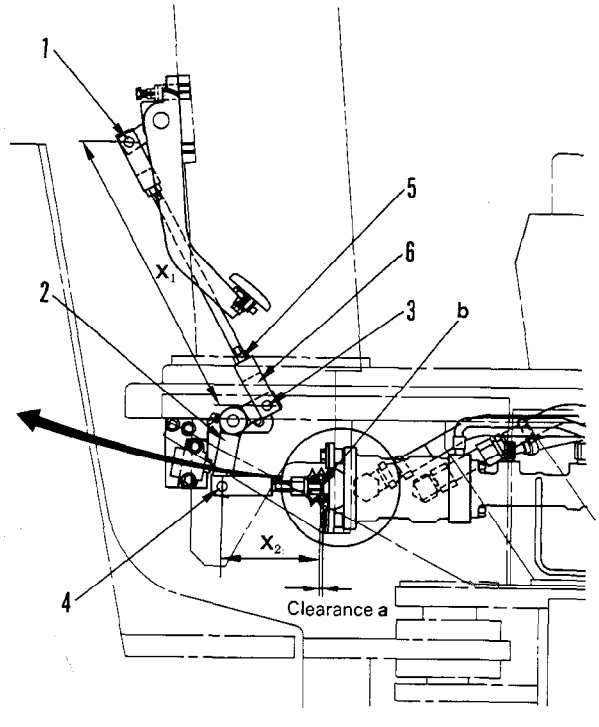
1. **Adjusting link X1**
   1) Remove pins (1 and 3), then remove the rod. Loosen lock nut (5), and turn yoke (6) to adjust the length.
   2) After adjusting the length of link X1, connect it to the brake pedal.



418P149

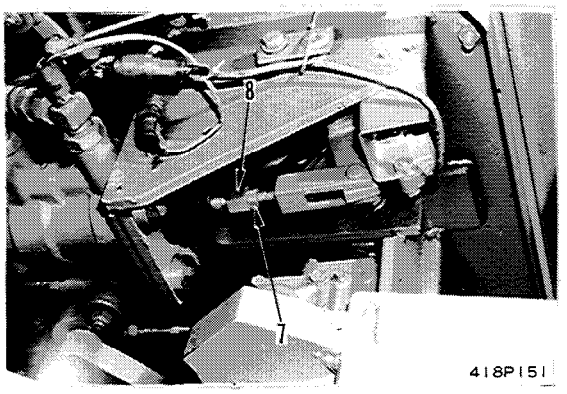


418P150

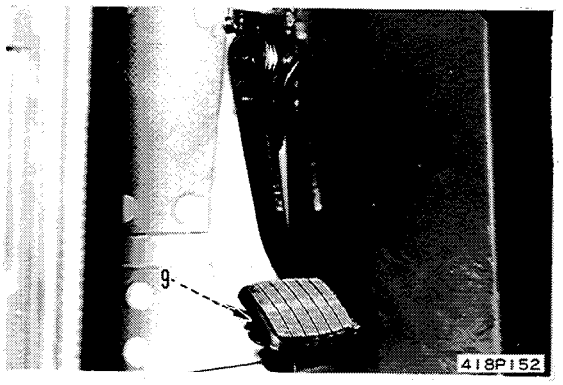


418F205

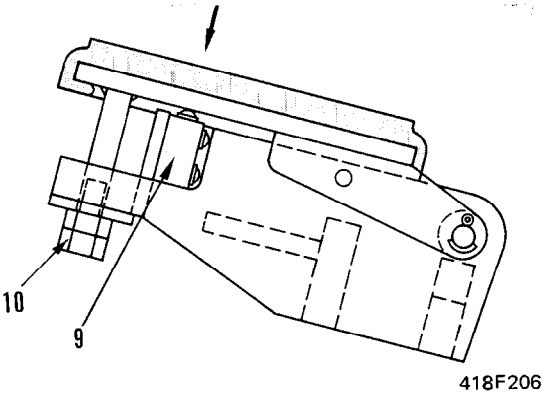
2. **Adjustment of rod X2**
   1) Loosen lock nut (7), turn rod (8) until part "b" at the tip of the rod contacts, the master cylinder piston, then turn back rod (8) half a turn.
   2) Tighten the lock nut to hold the rod in position.



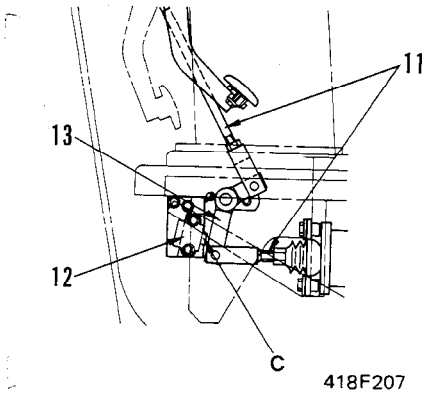
3. **Adjusting switch**
   1) Transmission cut-off switch (L.H. pedal)
   Tighten the nut until transmission cut-off switch (9) comes ON.
   ★ When the switch comes ON, do not tighten the nut any further.

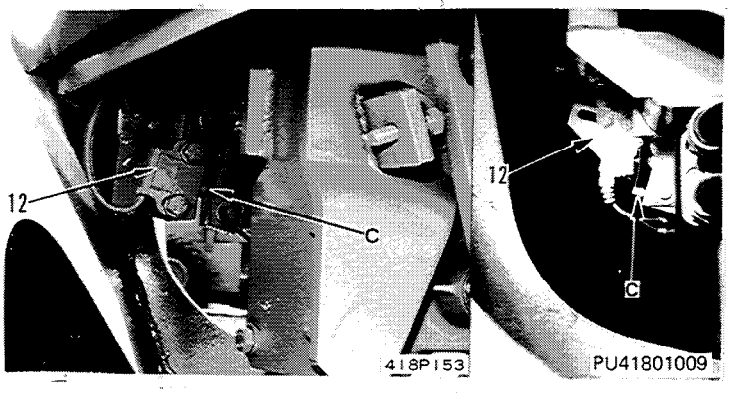


   2) From the position where transmission cut-off switch (9) comes ON, turn back nut (10) 1/4 - 1/2 turns.
   ★ When this is done, check that the switch goes OFF.



   3) Stop lamp switch
   After adjusting brake linkage (11), put tip (c) of stop lamp switch (12) lightly in contact with bellcrank (13), then push in 3 mm, and secure stop lamp switch (13) in position.





BRAKE PERFORMANCE

★ Measurement condition
- Time lag when pressing the pedal: 0.1 sec.
- Pedal force: 38 kg
- Road surface: Flat, horizontal, straight, dry, paved surface
- Machine speed: Speed when applying brakes: 35 km/h
- Tire inflation pressure: Specified pressure

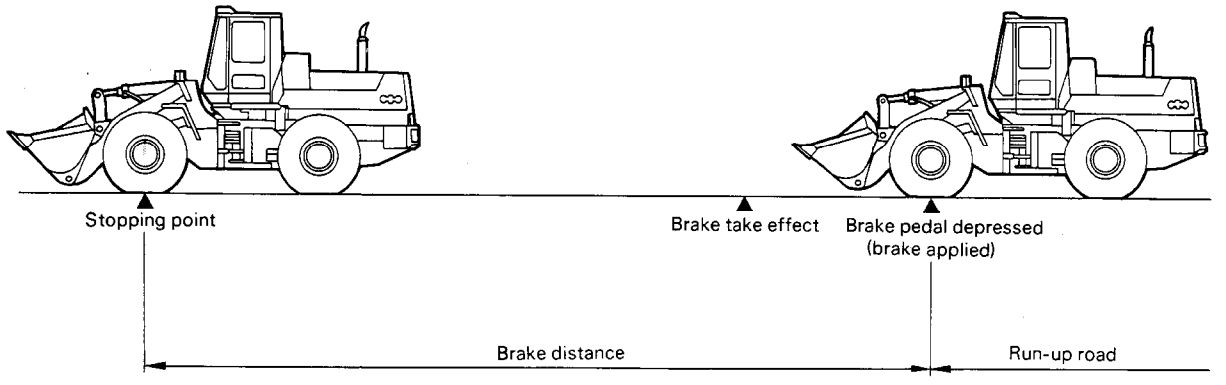
Item	Standard value	Permissible value
Brake performance	Max. 12 m	Max. 12 m

Measuring procedure

1. Start the engine and then start the machine.
2. Place the speed control lever in the highest speed range and drive the machine.
3. When the machine is traveling at 35 km/h, depress the left brake pedal with the specified operating force.
   ★ Decide the run-up road and point to apply the brakes, then apply the brakes when the braking point is reached.
   ★ Turn transmission cut-off selector switch ON.
4. Measure the distance from the braking point to the point where the machine stops.
   ★ Carry out the test three times and take the average value.

Special tool

Part number	Part name	Q'ty
Commercially available	Tape measure	1



423F319

BRAKE PISTON LEAKAGE

★ Measurement condition
- Coolant temperature: Inside operating range
- Test pressure: 42 kg/cm²

Item	Standard value	Permissible value
Drop in pressure	Max. 3.5 kg/cm²	Max. 3.5 kg/cm²

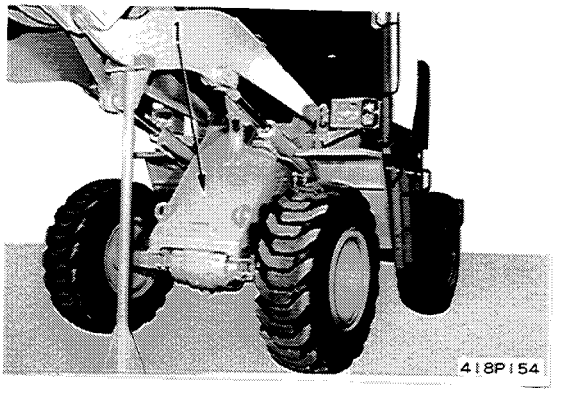
Special tools

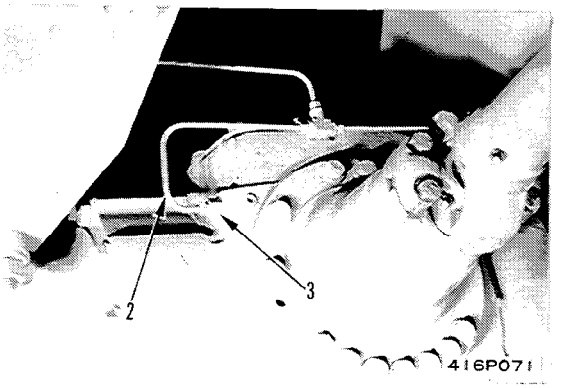
	Part number	Part name	Q'ty
A		Hydraulic tester	1
B	790-101-1102	Pump assembly	1

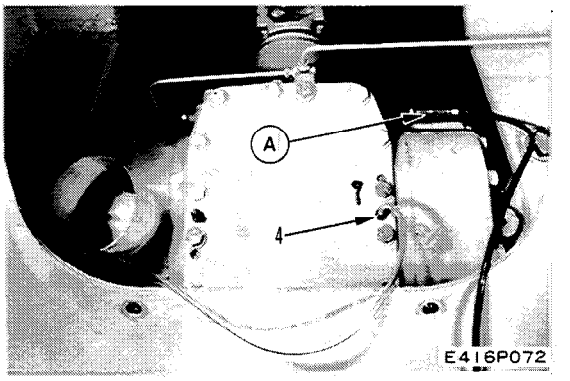
⚠ Apply the parking brake and block the tires.

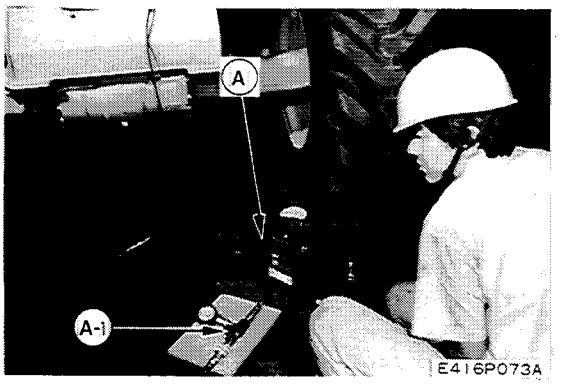
Measuring procedure

1. Raise the lift arm, put a support in position, then remove front cover (1).
   ★ When leaving the operator's compartment, lock the control lever securely.
2. Stop the engine.
3. Remove brake tube (2) on the side to be measured, then remove adapter (3).
4. Install hydraulic tester A after removing the adapter.
   ★ Connect the quick coupler of hydraulic tester A.
5. Loosen bleeder screw (4) and bleed the air.
   ★ To bleed the air, operate pump B.
6. Tighten the bleeder screw and operate pump B to raise the pressure to 42 kg/cm², then tighten the stop valve A-1.
7. Leave for 5 minutes with the pressure applied, then check the drop in pressure.
   ★ Do not move the hose when measuring the pressure. If the hose is moved, the pressure will change.
   ★ When removing hydraulic tester A after testing, operate pump B to lower the pressure in the hydraulic tester A before removing.
   ★ After completing inspection, install the brake tube and bleed the air from the brake circuit. For details, see AIR BLEEDING FROM BRAKE CIRCUIT.









BRAKE DISC WEAR

★ Measurement condition
● Coolant temperature: Inside operating range

Item	Standard value	Permissible value
Disc wear (one side)	1.02-1.14	Min. 0.7

Special tool

Part number	Part name	Q'ty
Commercially available	Feeler gauge	1

⚠ Apply the parking brake and block the tires.

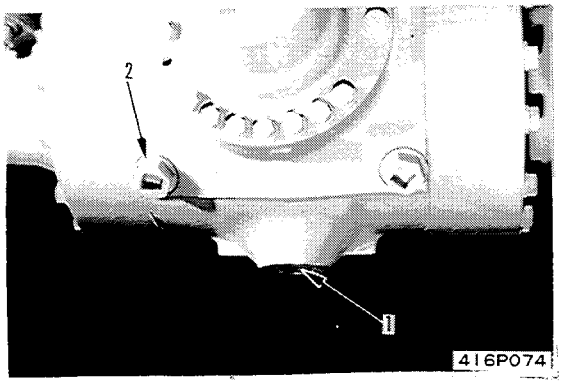
Measuring procedure

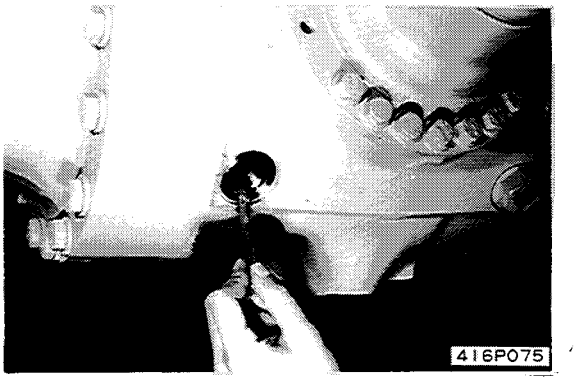
1. Loosen drain plug (1) and drain the axle oil.

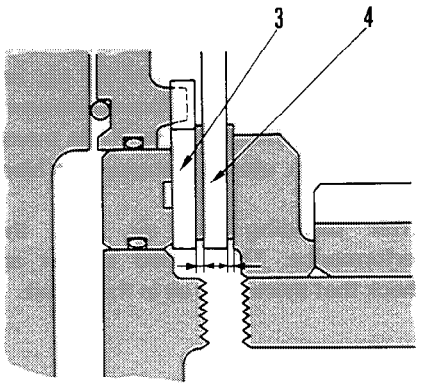
   Axle oil: 16ℓ

2. Remove measuring plug (2).
3. Depress the brake pedal lightly.
   ★ Check that the piston is in close contact with the disc.
4. Insert a feeler gauge between disc (4) and plate (3), and measure the clearance.
5. Tighten the drain plug (1) and measuring plug (2), then add axle oil through the oil filler to the specified level.

   Axle oil: 16ℓ







419F308

AIR BLEEDING FROM BRAKE CIRCUIT

⚠ Block the tires securely.

Procedure

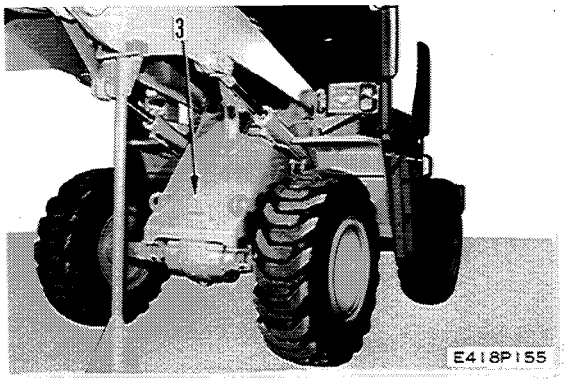
1. Raise the lift arm, put a support in position, then remove front cover (3).

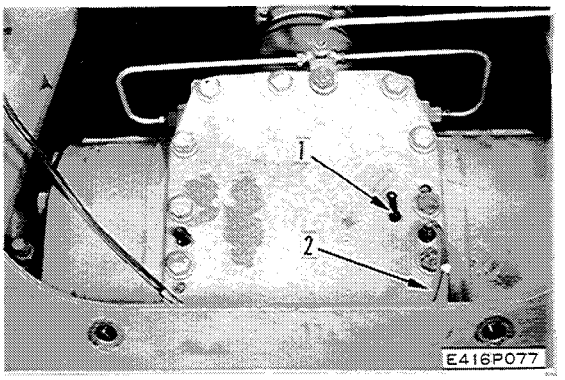
2. Remove cap (1) of the bleeder screw, insert vinyl hose (2) into the screw and put the other end in a container.

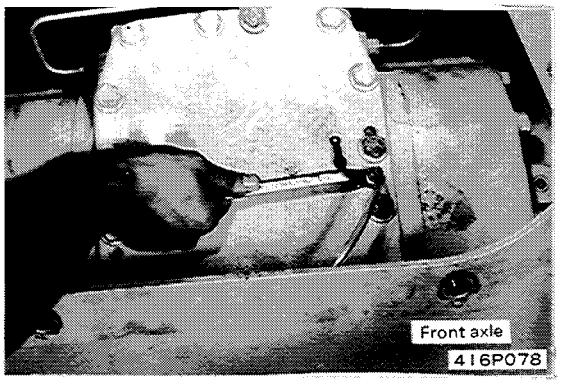
3. Start the engine.

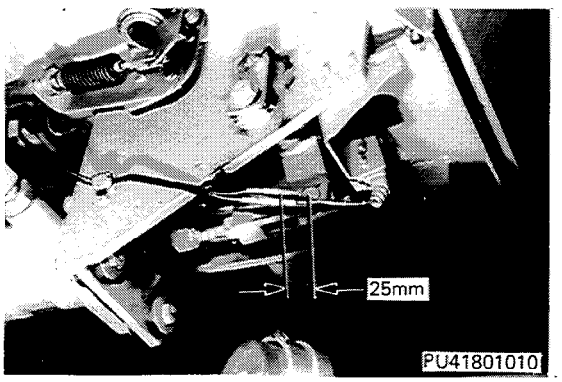
4. Two workers are needed for this operation: one depresses the pedal and the other bleeds the air from bleeder screw.
   Tighten the bleeder screw, then release the brake pedal slowly.
   - ★ Depress the left brake pedal.
   - ★ Keep adding brake oil so that the oil circuit is always full.

5. Repeat this operation until no more bubbles come out from the hose. Then depress the pedal fully and tighten the bleeder screw while oil is flowing out.
   - ★ Follow the same procedure to bleed the air from each cylinder.
     After bleeding all the cylinders, check the level of the oil tank and add oil.
   - ★ To bleed the air completely, bleed the air first from the cylinder furthest from the master cylinder.
   - ★ After bleeding the air, depress the brake pedal with an operating force of 50 kg, and check that the travel of the power master cylinder spool is less than 25 mm. If the travel is more than 25 mm, stop the engine and bleed the air again.
   - ★ After bleeding the air, test the brake performance. Then bleed the air again and check that there is no air in the circuit.









PARKING BRAKE PERFORMANCE

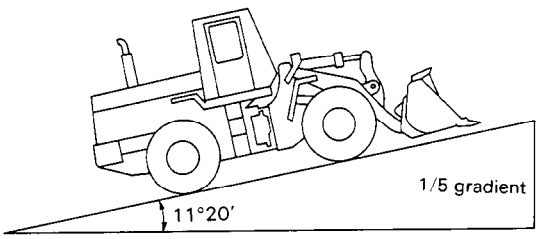
★ Measurement condition
- Tire inflation pressure: Specified pressure
- Road surface: Flat, dry, paved surface with 1/5 (11°20') gradient.
- Machine: In operating condition
- Parking lever operating force: Max. 25 kg

Unit: kg/cm^2

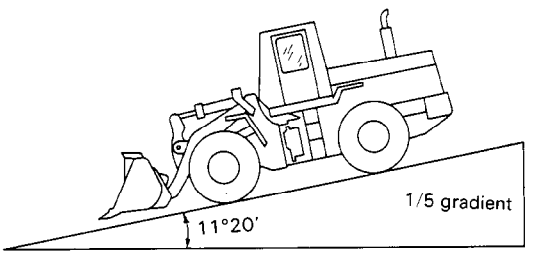
Item	Standard value	Permissible value
Parking brake performance	Machine stopped on 1/5 (11°20') gradient	

Measuring procedure

1. Start the engine and drive the machine straight up a 1/5 gradient with bucket unloaded.
2. Depress the brake, place the directional lever in neutral, then stop the engine.
3. Turn the parking brake lever, then slowly release the brake pedal and the machine must not move at all.
   - The measurement must be made with the machine facing either up or down the slope.



423F321



423F322

PARKING BRAKE
CHECKING

Unit: mm

Item	Standard value	Permissible value
Thickness of pad	11.7 (a) 11.3 (b,c,d)	Min. 7.0

Special tool

Part number	Part name	Q'ty
Commercially available	Vernier calipers	1

⚠ Block the tires securely.

1. **Measuring pad**
   1) Stop the engine and operate the parking brake lever to release the brake.
   2) Remove pad (1) from the caliper, and measure the thickness of the pad to the backing plate.
      If the measurement is not within the standard value, replace the two pads as a set.
      For details of replacing the pads, see DISASSEMBLY AND ASSEMBLY.

2. **Measuring lever**
   ★ Measurement condition
   ★ Lower operating force: 25 kg

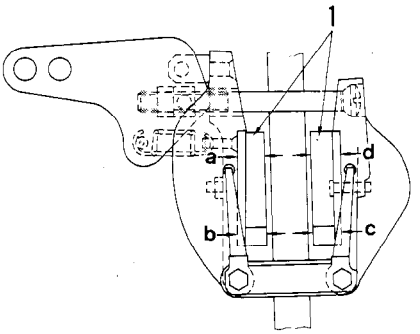
Unit: mm

Item	Standard value	Permissible value
Travel	170-210 mm (9-11 clicks)	

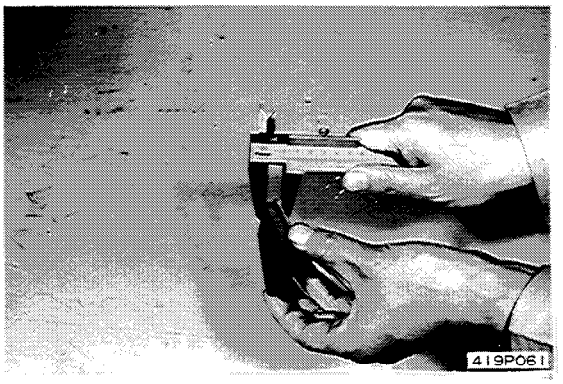
Special tool

Part number	Part name	Q'ty
Commercially available	Push-pull scale	1
	Convex scale	1

   1) Install a push-pull scale 50 mm from the tip of lever (2), and measure operating force.
   2) Measure the movement of the lever tooth when the lever is operated at the standard value.



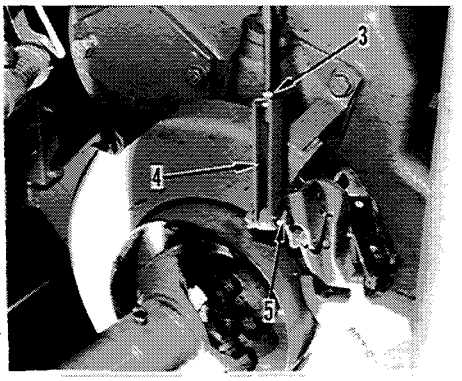
419F309





ADJUSTING

1. **Adjusting procedure**
   - ★ If the operating force is not within the standard value, check the linkage and cable.
   1) Insert the lever tooth at the bottom.
   2) Loosen lock nut (3) and pull out clevis pin (4).
   3) Screw in clevis (5) to remove the lever play.
   4) Assemble clevis pin (4) and tighten lock nut (3).
      - ★ The caliper should be completely released when the lever tooth is in the bottom groove.



418P157

MEASURING CLEARANCE

Unit: mm

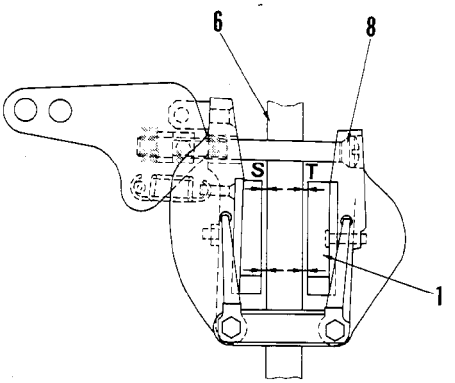
Item	Standard value	Permissible value
Clearance between disc and pad	0.1-0.4	Max. 2.6

Special tool

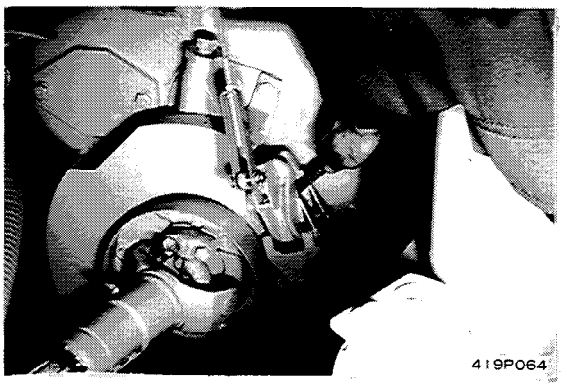
Part number	Part name	Q'ty
Commercially available	Feeler gauge	1

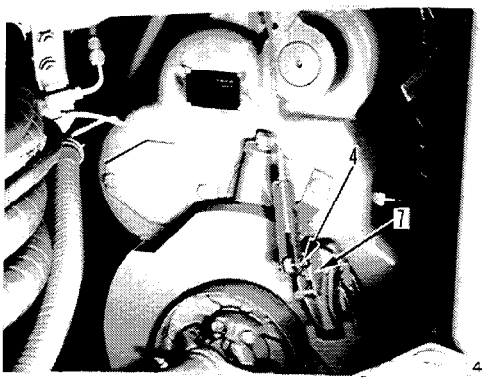
1. **Measuring procedure**
   1) Move the parking brake back and release the brake.
   2) Insert a feeler gauge between disc (6) and pad (1), and measure the clearance (S) and (T).
      ★ Measure the clearance at 4 points on the pad.

2. **Adjusting procedure**
   1) Move the parking brake lever back to release the brake.
   2) Remove clevis pin (4) and leave caliper lever (7) free.
   3) Tighten adjustment bolt (8) and adjust the clearance to within the standard value.
      ★ Be careful not to tighten the adjustment bolt too far.
      ★ After adjusting, there should be no play of the adjustment bolt in the axial direction.
      ★ After adjusting, there should be clearance S and T.
   4) Align the hole of caliper lever (7), and assemble clevis pin (4).
      ★ After making the adjustment, measure the operating force and travel of the parking brake lever. If it is not within the standard value, adjust the lever.

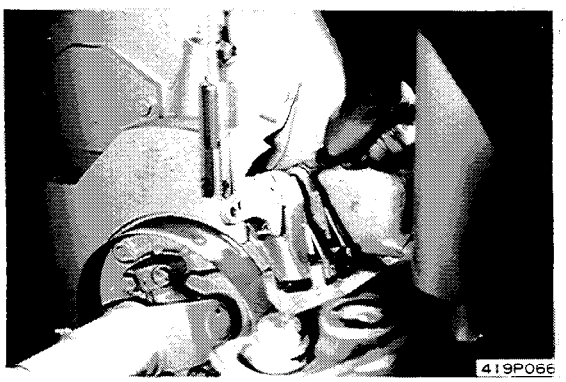


419F310


419P064



419P065


419P066

TROUBLESHOOTING

TROUBLESHOOTING TABLES

1. Brake is ineffective or not very effective.

Ask the operator the following questions.
- Did the brake suddenly cease to be effective? → Damage in brake equipment.
- Did brake gradually deteriorate? → Deterioration of seals, or wear of lining or discs.

Checks before troubleshooting.
- Was the proper oil used for the axle?
- Was the proper oil used for the master cylinder?
- Is the quantity of brake fluid correct?
- Is the play of brake pedal proper?
- Does oil leak from the brake tube or connectors? Is the brake tube damaged?
- Check tire pressure and tire read.

Check the abnormalities.
Measure the braking force and check it against the standard value table to see whether or not braking performance is bad.

No.	Problem \ Remedy	△ X	△ X	△ X	△ X	△ X	△ X	△	△ X	△ X
	Cause	a	b	c	d	e	f	g	h	i
1	Operating force of Brake pedal is too light.	○	○					○		
2	Operating force of Brake pedal is too heavy.	○							○	○
3	Too much pressing force is required to obtain the specified braking force.	○		○		○	○			○
4	When braking, abnormal noise comes from axle brake section.					○	○			
5	Machine does not travle normally (lacks traction)									○
6	With the four wheels jacked up, the axles plaud on blocks, and the gear speed at F1, if the brake is applied, only certain wheels rotate fast.		○	○	○	○	○	○		
7	Air is released by bleeding the air, and the brake works normally after that.							○		
8	Brake fluid leaks abnormally.		○							
9	Too much metal powder is in the axle oil (as shown by oil clinic test)						○			

a: Internal damage of powwer master cylinder (Damaged piston cup or scuffed piston)
b: Defective brake piston seal in axle
c: Faulty operation of brake piston in axle
d: Defective brake section in axle
e: Wear or abnormality of brake lining in axle
f: Brake lining in axle is worn out and the disc plate contacts the piston or plate
g: Air in brake circuit
h: Internal damage of power master cylinder
i: Faulty operation of charging pump

L04ZZ004

The following symbols are used to indicate the action to be taken when a cause of failure is located.
X: Replace △: Repair
A: Adjust C: Clean

2. Brake cannot be released or drags.

Check before troubleshooting.
- Is the play of the brake pedal proper?

Check for abnormalities.
- Check for smooth travel by inertia on a flat place.
- Check the rotating resistance of the jacked-up wheels.

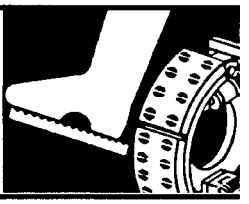
No.	Problems \ Remedy				
	Cause				
		a: Internal damage of power master cylinder (Clogged oil ports or scuffed piston)	b: Internal damage of power master cylinder (Scuffed spring, power piston, or spool)	c: Faulty return of brake piston in axle	d: Defective brake section in axle (Inner ring or other parts)
		△ X	△ X	△ X	△ X
1	If fluid is drained from the air bleeder in the pressure circuit of brake fluid, the pressure in the circuit will decrease and the brake will be released.	○	○		
2	With the four wheels placed on blocks the engine stopped and parking brake released, if the wheels are rotated by hand, only certain tires are heavy.			○	
3	With the four wheels placed on blocks, the engine stopped the parking brake released, and the gear speed in neutral, if the wheels are rotated by hand, they can be rotated easily. However they cannot be rotated if the engine is running.		○		

L04ZZ005

The following symbols are used to indicate the action to be taken when a cause of failure is located.
X: Replace △: Repair
A: Adjust C: Clean

BRAKES

53 DISASSEMBLY AND ASSEMBLY



POWER MASTER CYLINDER 2
REMOVAL 2
INSTALLATION 3
DISASSEMBLY 4
ASSEMBLY 7

PARKING BRAKE 12
REMOVAL 12
INSTALLATION 14

PARKING BRAKE PAD 16
REMOVAL 16
INSTALLATION 16

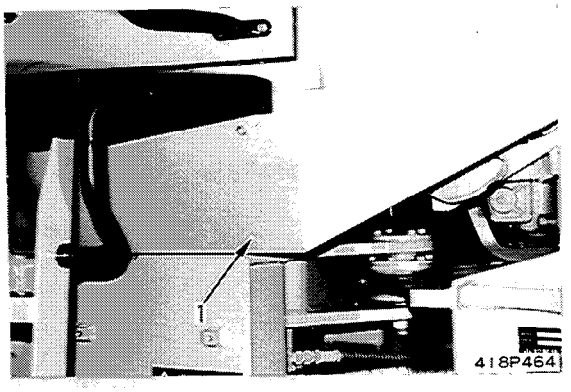
★ Take the following method for air bleeding when you start to operate hydraulic cylinders after reassembling cylinders, pumps and pipings.

1. Start engine, keep idling.
2. Operate hydraulic cylinder 4 - 5 cycles, but do not exceed beyond 100 mm of stroke end.
3. Continue to operate cylinder 3 - 4 cycles until stroke end.
4. After finishing above steps, keep normal engine speed.

   NOTE: After long storage, same procedure is required.

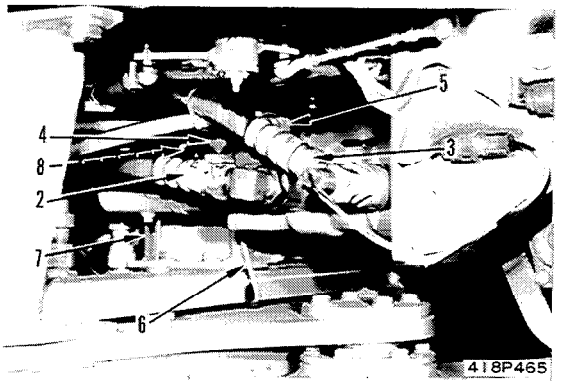
POWER MASTER CYLINDER
REMOVAL

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

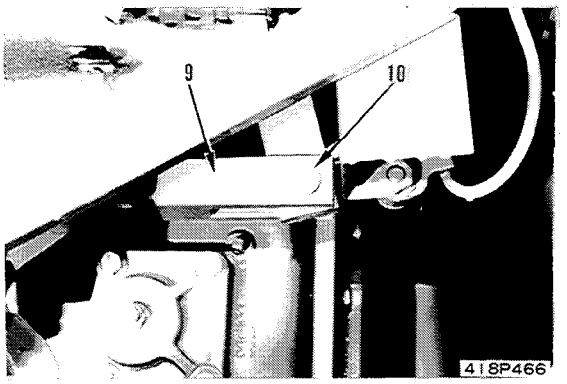


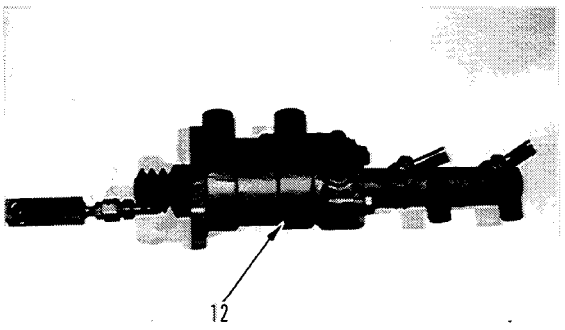
1. **Cover**
   Remove side cover (1).

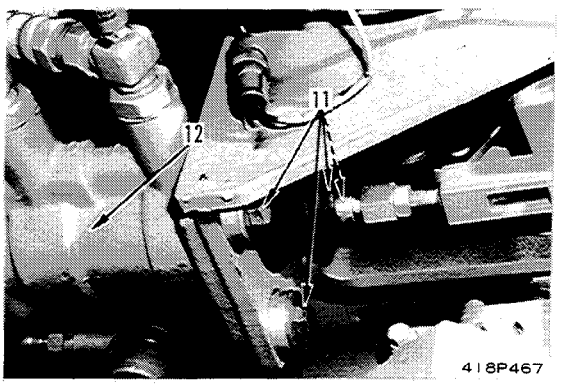
2. **Brake piping**
   1) Disconnect hose (2) between power master cylinder and transmission at power master cylinder end.
   2) Disconnect hose (3) between power master cylinder and hydraulic and steering pump at power master cylinder end.
   3) Disconnect hoses (4 and 5) between brake oil tank and power master cylinder at power master cylinder end.
   4) Disconnect tubes (6 and 7) between power master cylinder and front and rear brake at power master cylinder end.
   5) Disconnect hose (8) between power master cylinder and transmission at power master cylinder end.



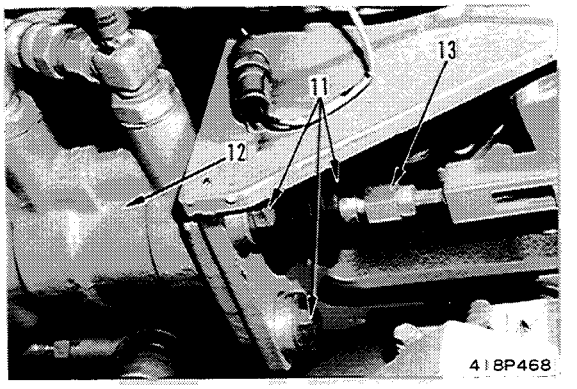
3. **Power master cylinder**
   1) Remove cotter pin of brake linkage (9), then remove pin (10).
   2) Remove mounting bolts (11), then remove power master cylinder (12).







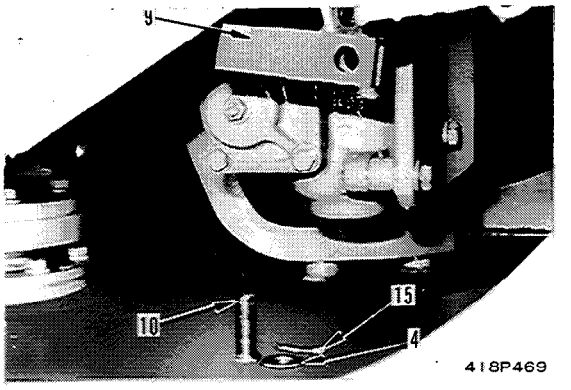
INSTALLATION



1. **Power master cylinder**
   1) Set mounting position of power master cylinder (12), tighten mounting bolt (11), then insert rod (13) into groove of piston of power master cylinder.

   Mounting bolt: 11.5±1.0 kgm

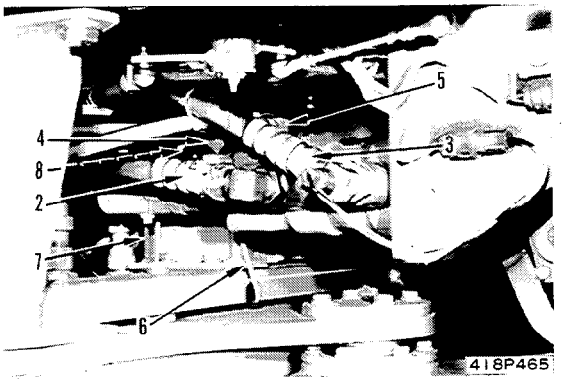
   2) Install pin (10) of brake linkage (9), then install washer (14) and cotter pin (15).



2. **Brake piping**
   1) Connect hose (8) between power master cylinder and transmission at power master cylinder end.
   2) Connect tubes (6 and 7) between power master cylinder and front and rear brake at power master cylinder end.

   Mounting nut: 1.2±0.3 kgm

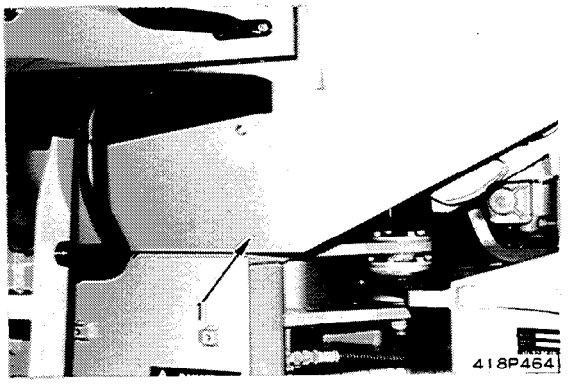
   3) Connect hoses (4 and 5) between brake oil tank and power master cylinder at power master cylinder end.
   4) Connect hose (3) between power master cylinder and hydraulic and steering pump at power master cylinder end.
   5) Connect hose (2) between power master cylinder and transmission at power master cylinder end.



3. **Cover**
   Install side cover (1).

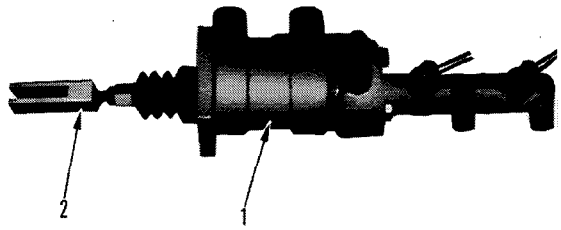
4. **Bleed air from brakes**
   For details of bleeding air, see SECTION 52, TESTING AND ADJUSTING.

5. **Adjusting rod**
   For details of adjusting rod, see SECTION 52, TESTING AND ADJUSTING.



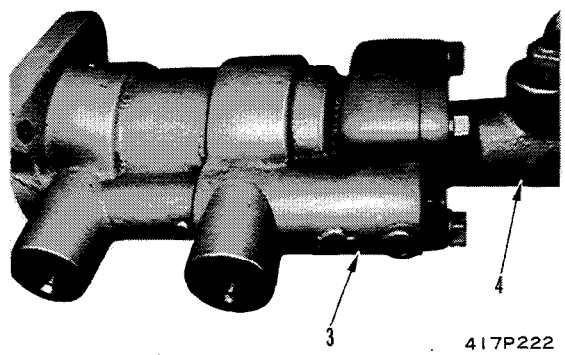
DISASSEMBLY

1. **Power master cylinder**
   1) Remove linkage rod (2) from power master cylinder (1).
      ★ Protect and store insertion end of piston of linkage rod from damage with masking tape.



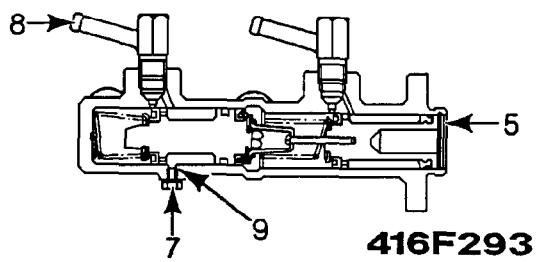
418P470

   2) Disconnect power cylinder (3) and master cylinder (4).

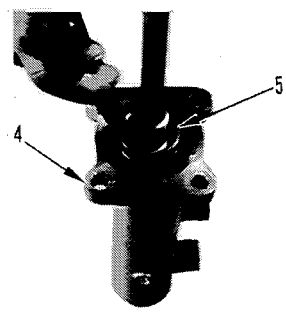


417P222

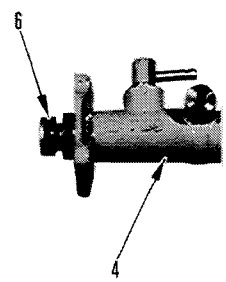
2. **Disassembly of master cylinder**
   1) Remove C-ring (5) from body (4) and take out secondary piston (6).



416F293

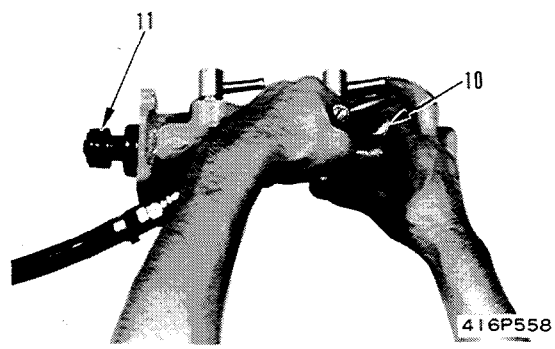


416P556



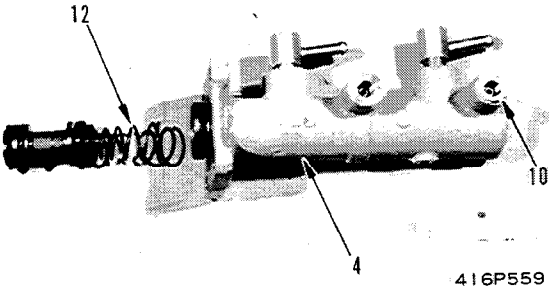
416P557

   2) Remove stopper bolt (7). Hold brake oil hole (8) and stopper bolt hole (9) with finger, then blow air from brake oil holder (10) to take out primary piston (11).
      ★ Do not blow air in suddenly as the piston will fly out.



416P558

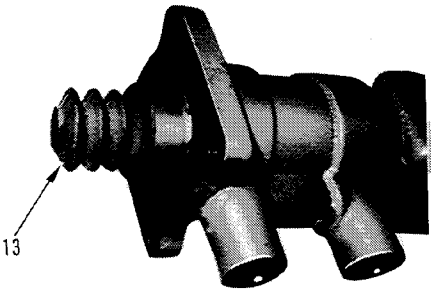
3) Remove spring (12) from inside body (4).
   - ★ When removing the piston, be careful not to damage the inside of the body or the sliding surface of the piston.
   - ★ If there is any problem with the primary or secondary pistons, replace the master cylinder assembly.



416P559

3. Disassembly of power cylinder

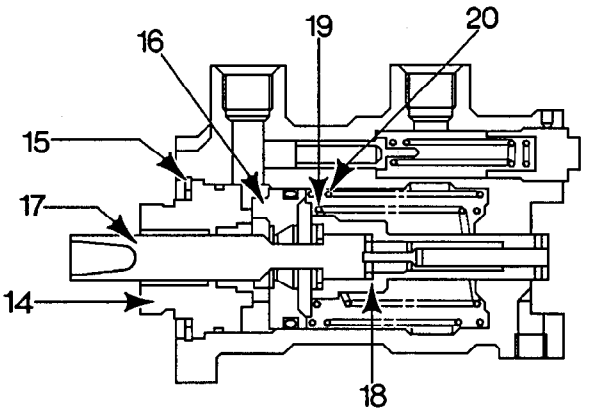
1) Remove dust cover (13).
   - ★ Remove the elbow first.



417P223

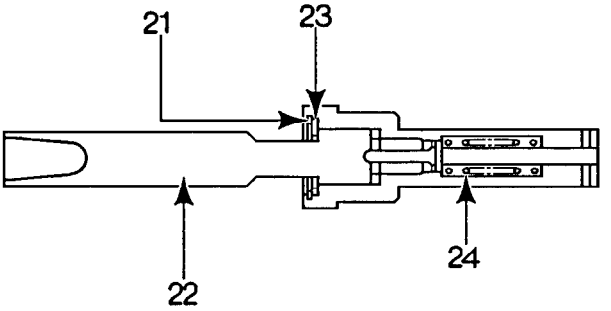
2) Push in cylinder cover (14), remove snap ring (15), then remove power piston (16), connector assembly (17), spring seat (18), and springs (19 and 20).

⚠ When removing the snap ring, the cylinder cover is pushed out by the spring, so remove carefully.



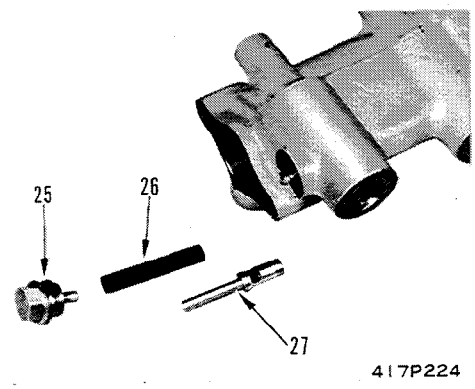
417F208

3) Remove power piston (16) from connector assembly (17).
4) Remove snap ring (21), disconnect spool (22) and connector, then remove thrust washer (23) and spring (24).

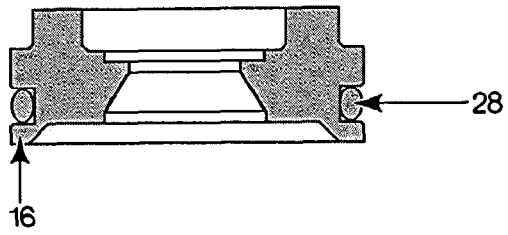


417F209

4. **Relief valve**
   Remove plug (25), then remove spring (26) and spool (27).



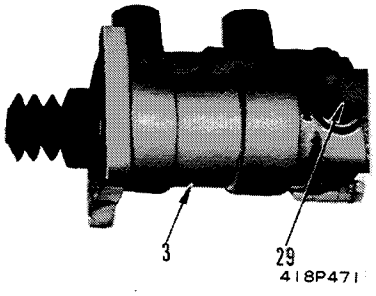
5. **Power piston**
   Remove seal ring (28) from piston (16).



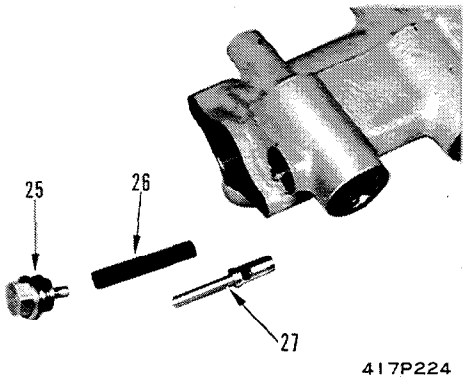
417F210

ASSEMBLY

1. **Elbow**
   Install elbow (29) to power cylinder body (3).

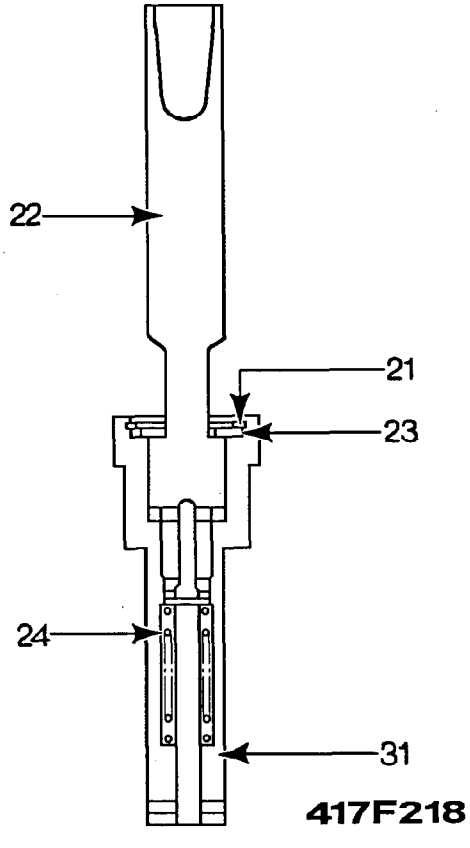


2. **Relief valve**
   Insert spring (26) in spool (27), assemble in power cylinder body, then install plug (25).

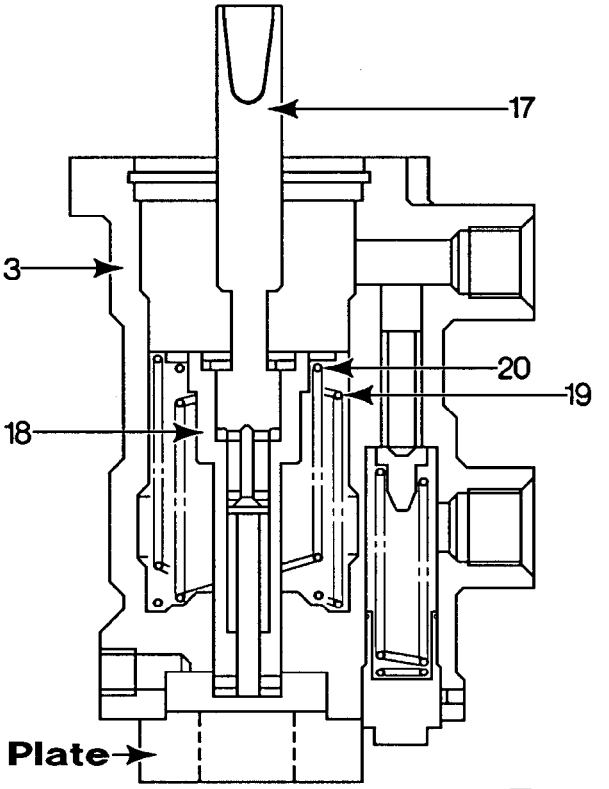


3. **Assembly of power cylinder**
   1) Assemble spring (24) in connector (31).

   2) Insert spool (22) in connector (31), assemble thrust washer (23), then secure with snap ring (21).



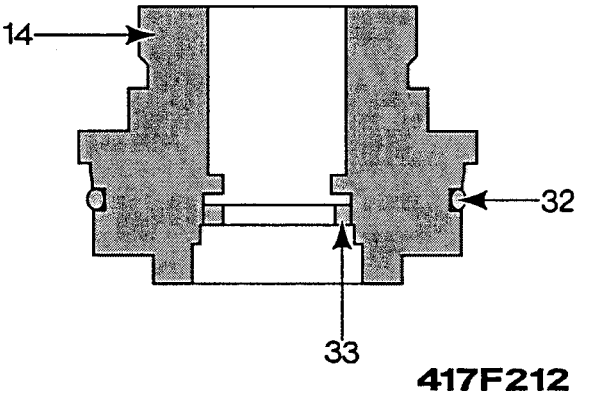
3) Set body (3) on block.
4) Insert springs (19 and 20), and spring seat (18) inside body (3).
5) Assemble connector assembly (17).



417F211

6) Assemble O-ring (32) and seal (33) in cylinder cover (14).

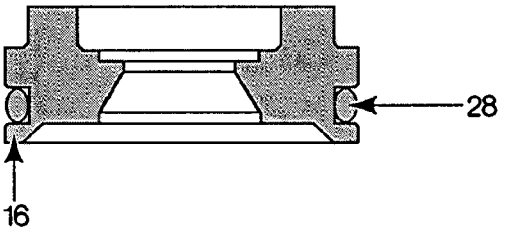
Seal: Oil (brake oil)



417F212

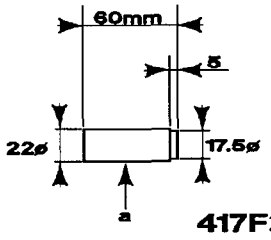
7) Assemble seal ring (28) in power piston (16).

Seal ring: Oil (brake oil)



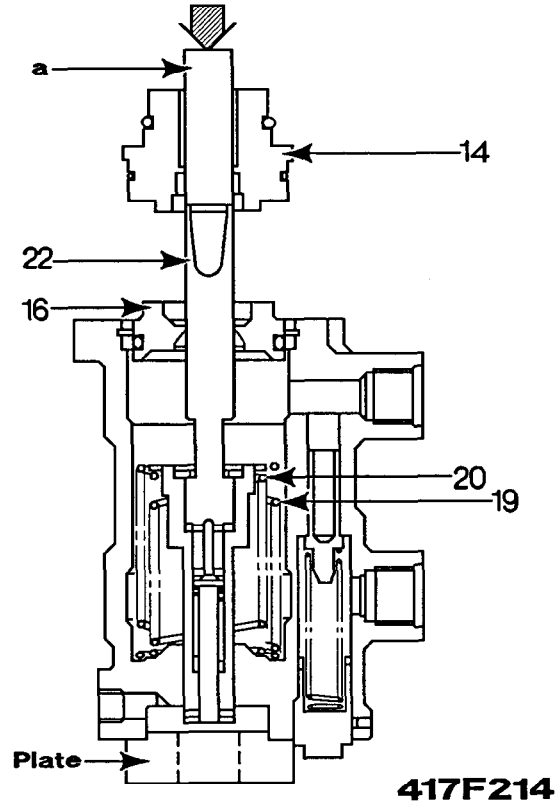
417F210

8) Assemble power piston (16) and cylinder cover (14) to spool (22), then set guide shaft "a" in position.
   ★ To prevent power piston (16) and cylinder cover (14) from dropping inside the body, stop them at the top of the body.



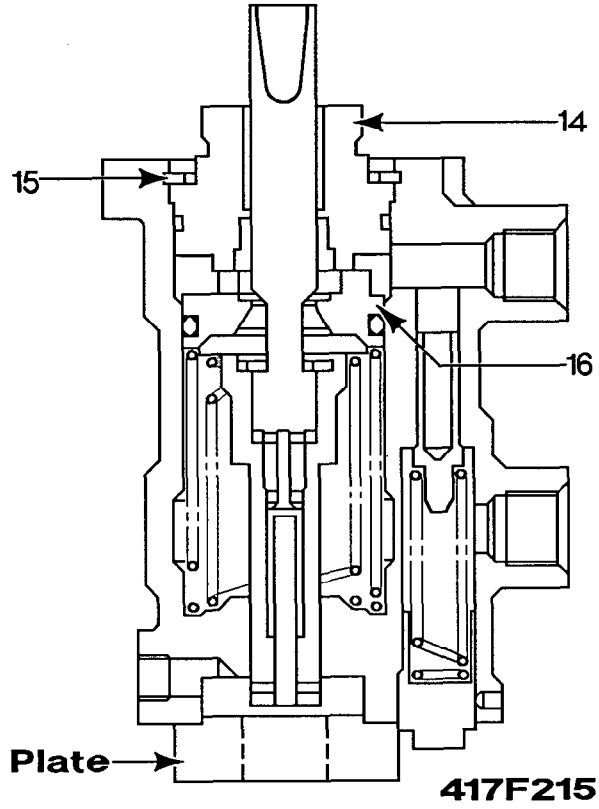
417F219

9) Push in guide shaft "a" with a press, bend springs (19 and 20), and keep in position.
   ★ Keep snap ring (15) until the completion of assembly.



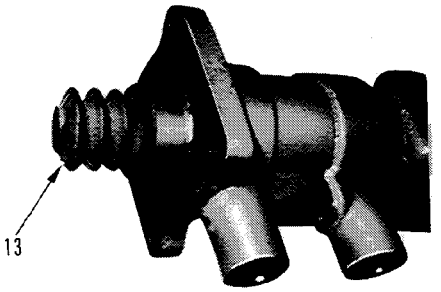
417F214

10) Lower power piston (16) only, and push in evenly on the left and right with both thumbs.
   ★ When assembling the power piston, do not hit it in with a hammer.
   ★ When assembling power piston (16), apply the force evenly. Never use excessive force.
11) Check that there is no damage to O-ring of power piston (16), then assemble cylinder cover (14).
12) Secure cylinder cover (14) with snap ring (15).



417F215

13) Install dust cover (13).

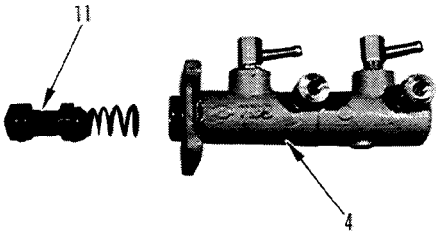


417P223

4. Assembly of master cylinder

1) Insert primary piston (11) in body (4).
   ★ Insert the piston carefully to prevent damage to the seal cup. Never force it into position.

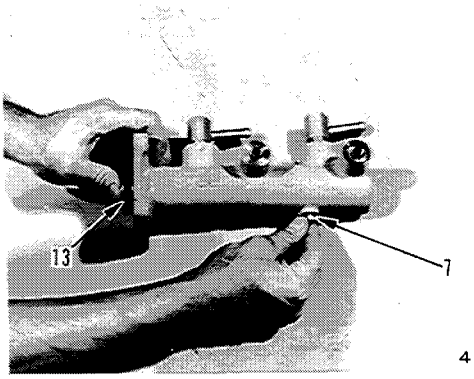
Body and piston: Oil (brake oil)



416P560

2) Push piston (13) and tighten stopper bolt (7) by hand.
   ★ After tightening as far as possible by hand, tighten fully.

Stopper bolt: 1.1±0.2 kgm



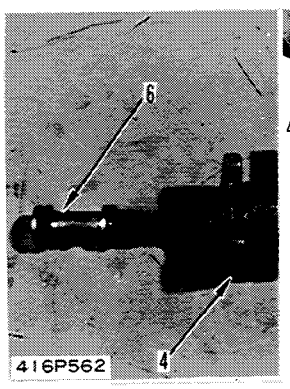
416P561

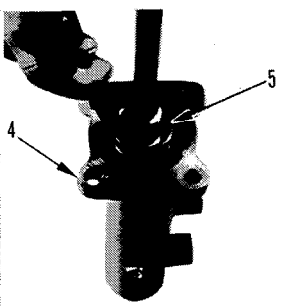
3) Insert secondary piston (6) in body (4).

Body and piston: Oil (brake oil)

   ★ When assembling the piston, be careful not to damage the inside of the body and the outside of the piston.
   ★ Be careful not to get the O-ring caught.

4) Push in secondary piston (6), then install C-ring (5).
   ★ Fit the C-ring properly in the groove.



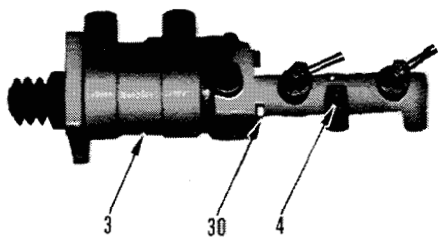


416P556

5. Power master cylinder

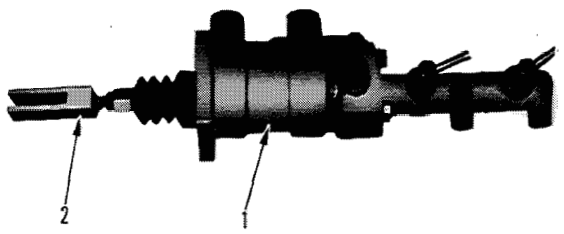
1) Connect power master cylinder (3) and master cylinder (4).
   ★ Use new O-ring at connecting portion of master cylinder.

Connecting bolt (30): 3.3±0.2 kgm



418P472

2) Install linkage rod (2) in power master cylinder.
   ★ For details of adjustment of brake linkage, see SECTION 52, TESTING AND ADJUSTING.



418P470

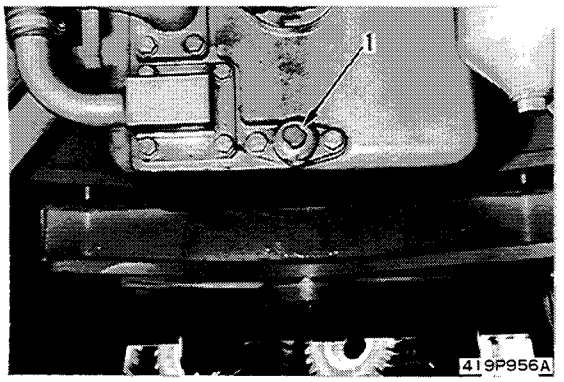
PARKING BRAKE
REMOVAL

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

1. **Draining oil**
   Loosen drain plug (1) and drain transmission oil.

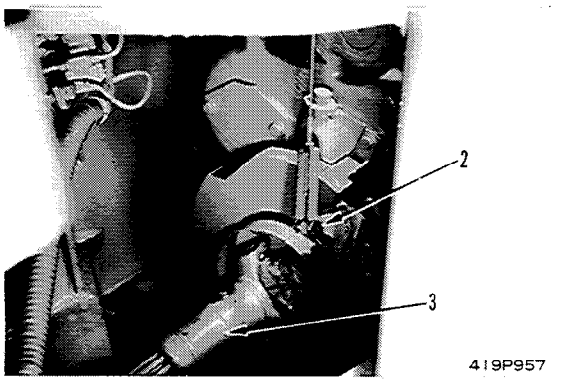
   Transmission oil: 30ℓ

   ★ After loosening the drain plug, gradually pull it out and drain the oil.



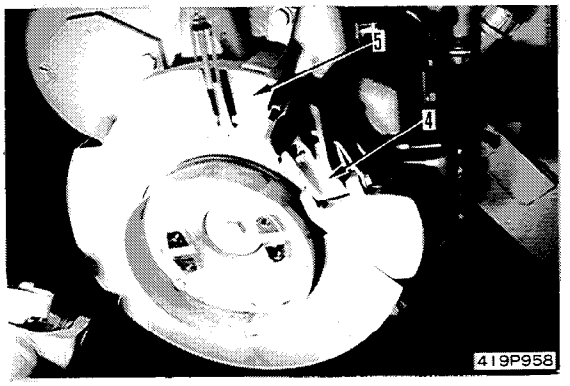
2. **Linkage**
   Remove lever pin (2).
   ★ Check that the parking brake is in the RELEASED position.

3. **Center drive shaft**
   Disconnect drive shaft (3) from transmission.

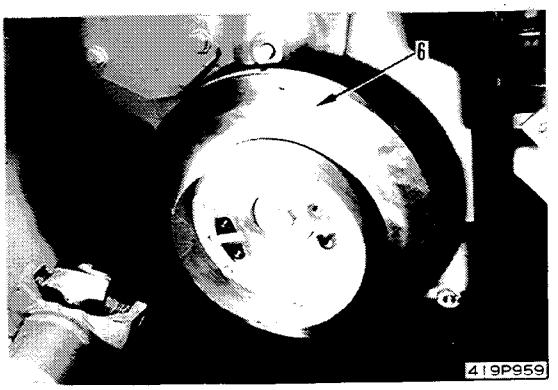


4. **Caliper assembly**
   Remove mounting bolts, then remove caliper assembly (4) together with spacer.

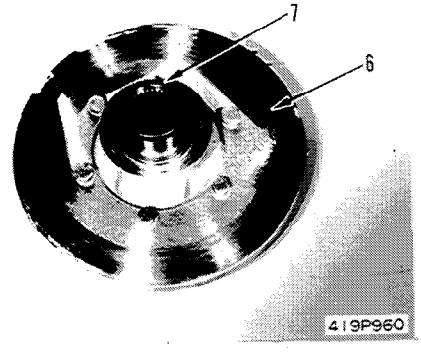
5. **Cover**
   Remove mounting bolts, then remove cover (5).



6. **Disc**
   1) Remove mounting bolts, then remove coupling and disc (6).
      ★ There is an O-ring installed, so be careful not to damage it.
      ★ Pull the coupling and disc out straight to prevent damage to the seal of the transmission case.

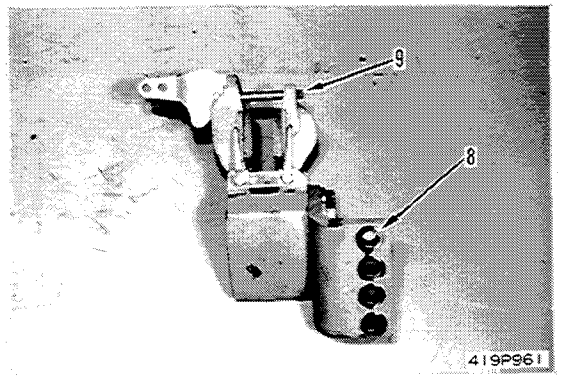


2) Remove mounting bolts, then disconnect coupling (7) and disc (6).

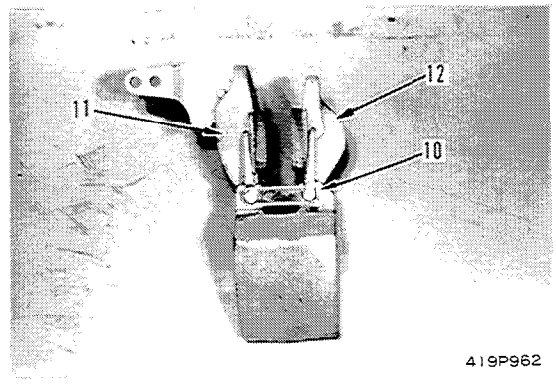


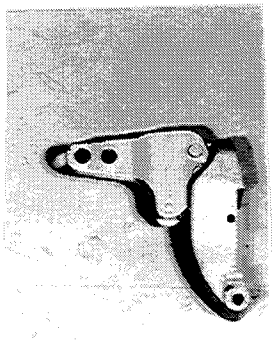
7. Disassembly of caliper

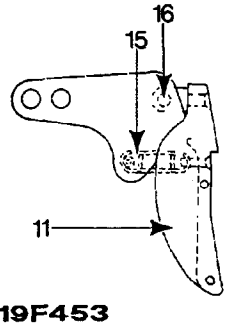
1) Remove support (8) from caliper assembly.
2) Remove adjustment screw (9).

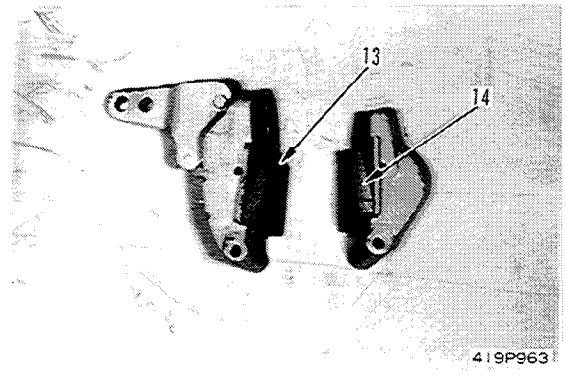


3) Extend lock plate (10) with a chisel, remove bolts, then disconnect calipers (11 and 12).
4) Remove nut from caliper, then remove pads (13 and 14).
5) Remove spring (15) and pin (16) from caliper.



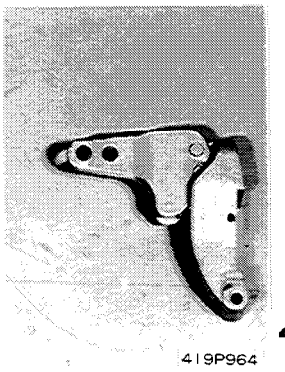


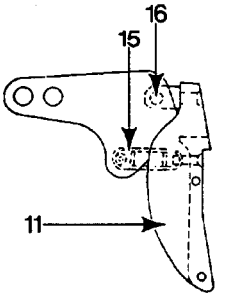




INSTALLATION

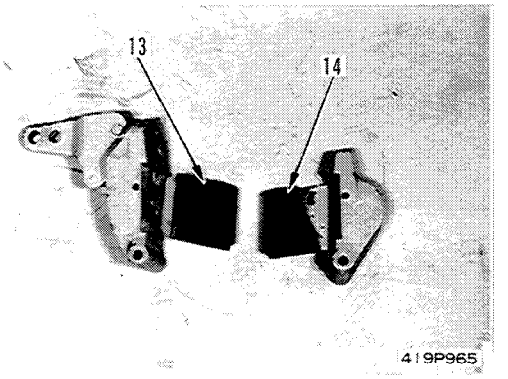
1. **Detail assembly of caliper**
   1) Install pin (16) and spring (15) on caliper (11).



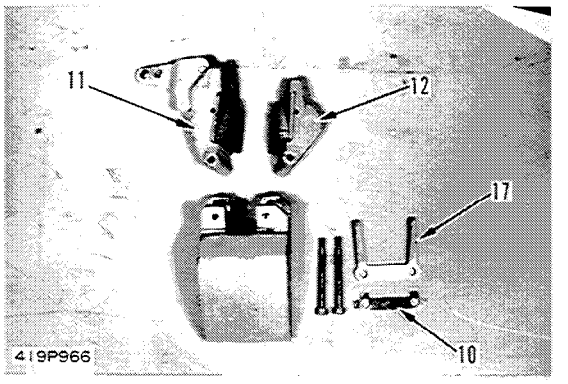


419F453

   2) Install pads (13 and 14) to caliper, then secure with nut.



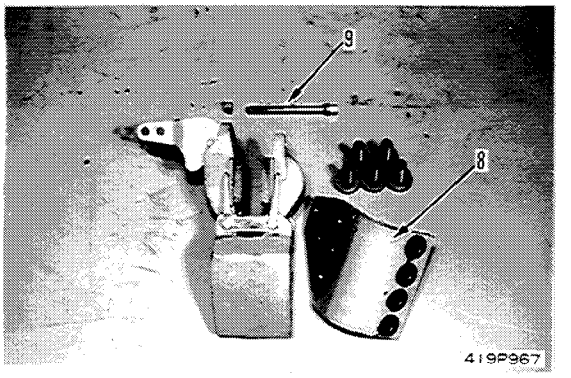
   3) Set calipers (11 and 12) in mounting position, install retraction plate (17) and lock plate (10), then tighten mounting bolts.
      ★ Knock the tip of the retraction plate into the caliper mount hole up to the root.



Mounting bolt: 1.2±0.1 kgm

   4) Bend lock plate with a chisel to lock bolt.
      ★ Bend the lock plate securely.

   5) Install adjustment screw (9).
   6) Install support (8) on caliper assembly.

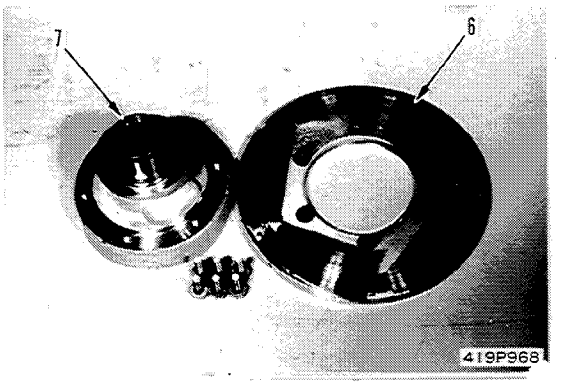


Mounting bolt: 18±2 kgm

2. Disc

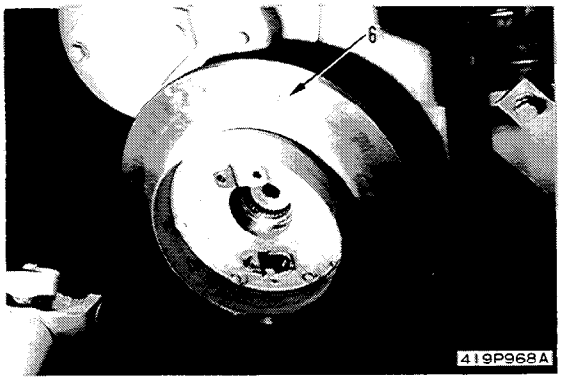
1) Set disc (6) in position on mount of coupling (7), then tighten mounting bolt.

Mounting bolt: 11.5±1.0 kgm



2) Set coupling and disc (6) in mounting position, then tighten mounting bolts.
   ★ Install straight to prevent damage to the transmission seal.

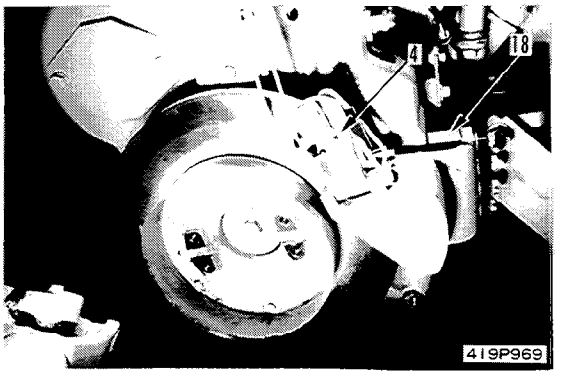
Insertion portion of coupling: Transmission oil



3. Caliper assembly

Set caliper assembly (4) in mounting position, then install together with spacer (18).

Mounting bolt: 11.5±1.0 kgm



4. Cover

Set cover (5) in mounting position, and install.

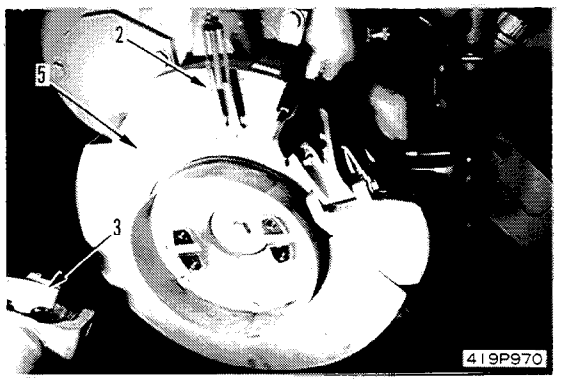
5. Center drive shaft

Connect center drive shaft (3) to transmission.

Mounting bolt: 6.75±0.75 kgm

6. Linkage

Install lever pin (2).
   ★ Bend the cotter pin securely.
   ★ For details of adjusting the disc and pad clearance, see SECTION 52, TESTING AND ADJUSTING.



7. Refilling with oil

Install drain plug and add transmission oil through oil filler to the specified level.

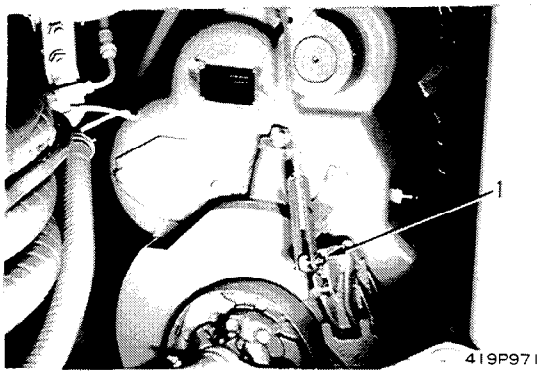
Transmission oil: 30ℓ

PARKING BRAKE PAD

REMOVAL

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

1. **Linkage**
   Remove pin (1).
   ★ Check that the parking brake is in the RELEASED position.

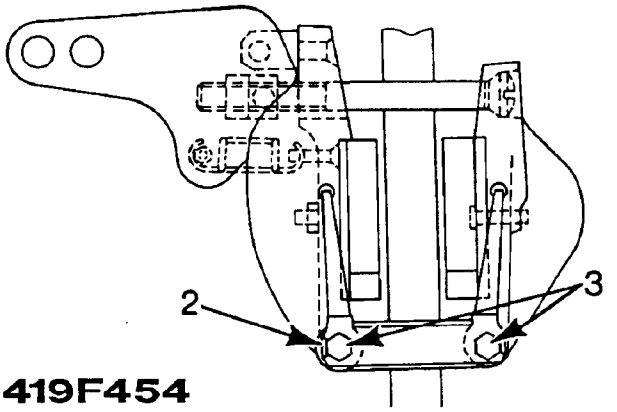


2. **Pads**
   1) Extend lock plate (2) with a chisel, and remove bolts (3).
   2) Remove calipers (4 and 5).
   3) Remove nut from calipers (4 and 5), then remove pads (6 and 7).

INSTALLATION

1. **Pads**
   1) Set pads (6 and 7) in mounting position, then secure with nut.
   2) Set calipers (4 and 5) in mounting position, install lock plate (2), then tighten mounting bolts.
      ★ Knock the tip of the lock plate into the caliper mount hole up to the root.

   Mounting bolt: 1.2±0.1 kgm

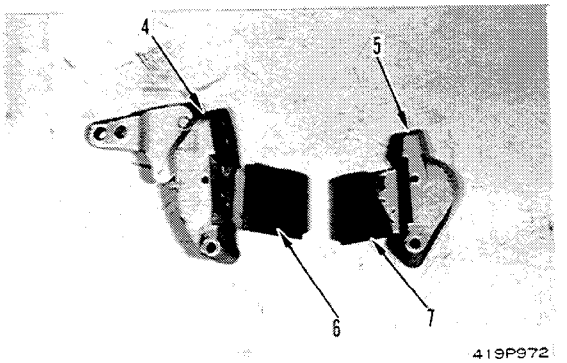


419F454

   3) Bend lock plate (2) with a chisel to lock bolt (3).

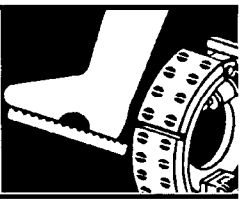
2. **Linkage**
   Install pin (1).
   ★ Bend the cotter pin securely.

3. **Adjusting linkage**
   ★ For details of adjusting the linkage, see SECTION 52, TESTING AND ADJUSTING.



BRAKES

54 MAINTENANCE STANDARD

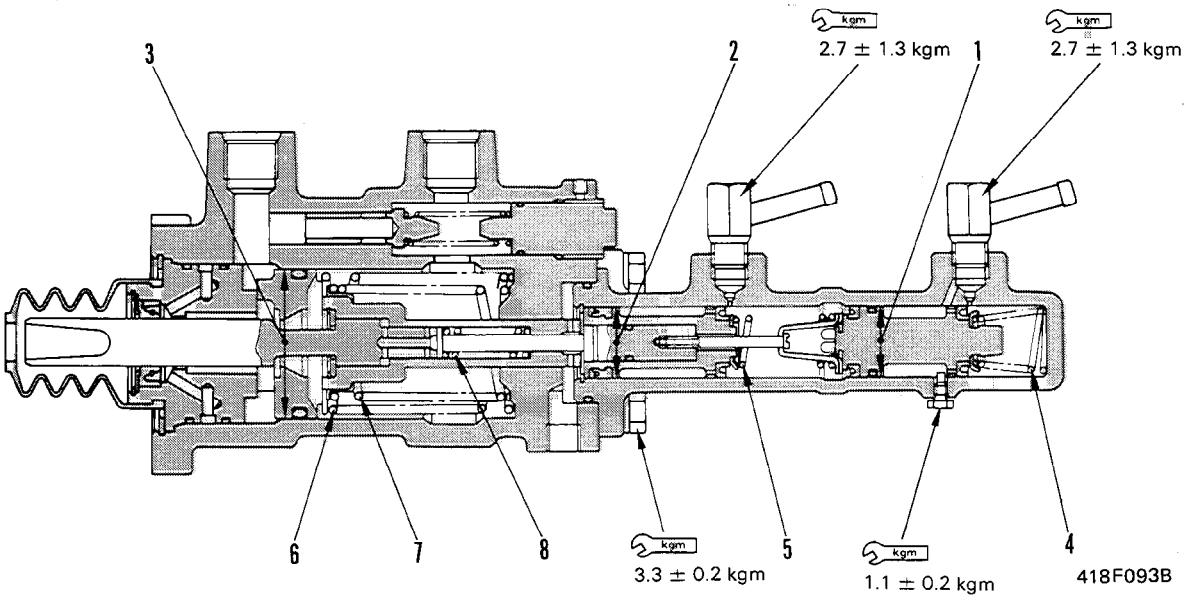


POWER MASTER CYLINDER 2

BRAKE 3

PARKING BRAKE 4

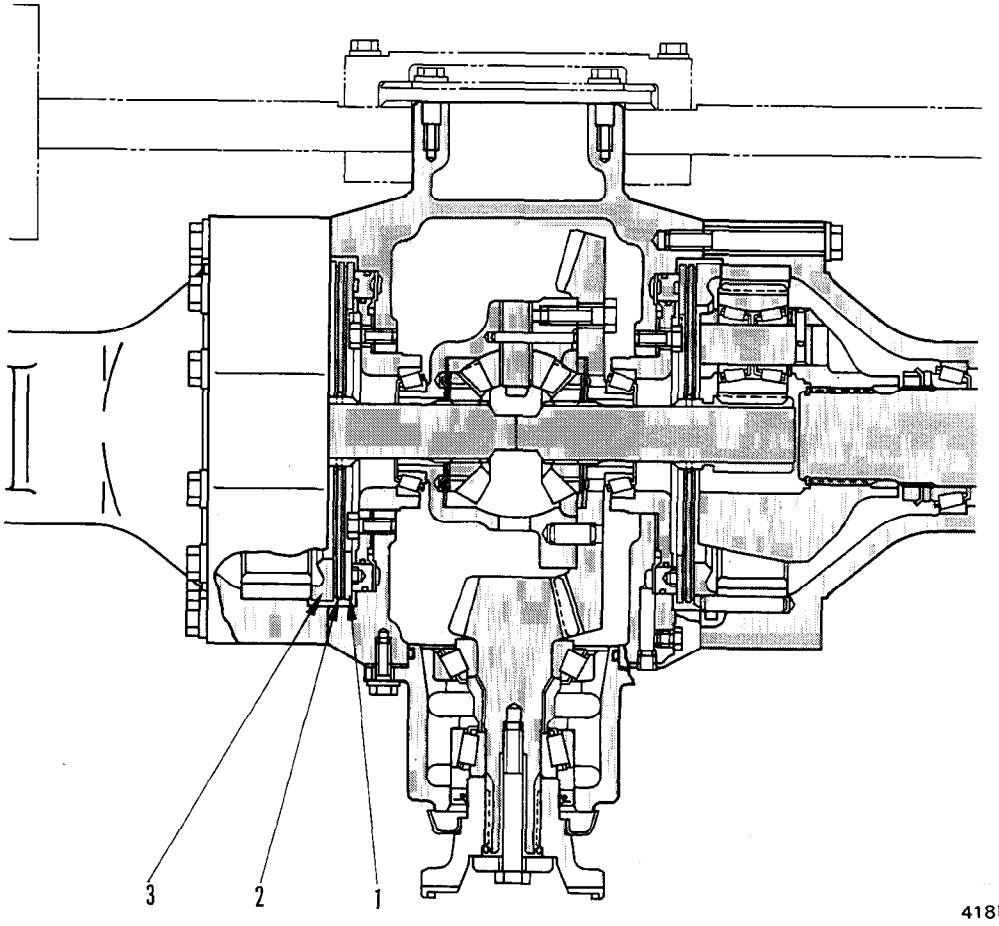
POWER MASTER CYLINDER



Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between primary piston and body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		33.34	-0.025 -0.064	+0.062 0	0.025- 0.126	0.15	
2	Clearance between secondary piston and body	33.34	-0.025 -0.065	+0.062 0	0.025- 0.126	0.15	
3	Clearance between power piston and body	70	-0.060 -0.106	+0.074 0	0.060- 0.180	0.20	
4	Primary piston spring	Standard size			Repair limit		
		Free length	Installation length	Installation load (kg)	Free length	Installation load (kg)	
		57.1	35.1	8.7		8.7±1.3	
5	Secondary piston spring	72.8	48.3	13.2		13.2±1.9	
6	Spring	199.2	86	30		30±4.5	
7	Spring	143.75	80.25	20		20±3.0	
8	Spring	48	40	13		13±1.9	

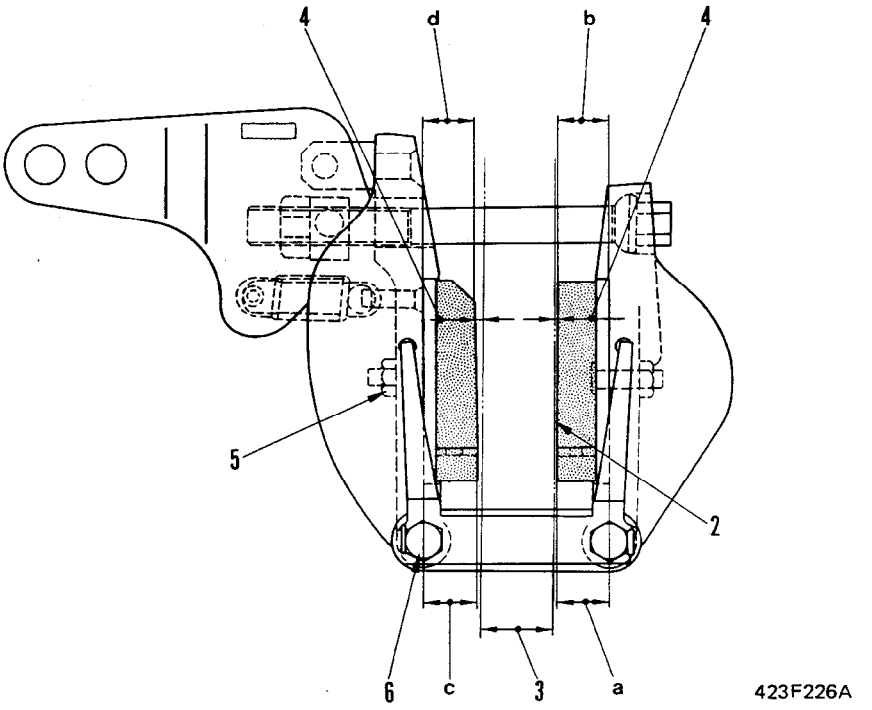
BRAKE



Unit: mm

No.	Check item	Criteria			Remedy
		Standard size	Tolerance	Repair limit	
1	Thickness of inner ring	9.6	0 -0.5	8.8	Replace
2	Thickness of brake disc	8.697	±0.063	7.9	
	Groove depth of brake disc	0.838	±0.2	0.4	
	Thickness of brake disc lining	1.08	More than 0.98		
3	Thickness of brake outer ring	19.5	±0.12	19.1	

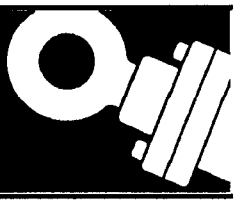
PARKING BRAKE



Unit: mm

No.	Check item	Criteria		Remedy
1	Wear of pad (Remaining thickness of friction material)	Standard size	Repair limit	Replace
		8.5 (d), 10.5 (a, b, c)	3.8	
	(Including backing plate)	11.7 (d), 13.7 (a, b, c)	7.0	
2	Face runout of disc	0.25	0.5	Rebuild
3	Thickness of disc plate	20.0±0.2	Thickness of plate must not be under 18 mm	
			Less than 18 mm	Replace
4	Clearance between pad and disc	0.1-0.4		Adjust
5	Tightening torque of nut	0.27±0.5 kgm		Retighten
6	Tightening torque of bolt	1.2±0.1 kgm		

WORK EQUIPMENT SYSTEM
61 STRUCTURE AND FUNCTION



HYDRAULIC PIPING 2

HYDRAULIC CIRCUIT 3

HYDRAULIC CIRCUIT DIAGRAM 4

WORK EQUIPMENT LEVER LINKAGE 5

BUCKET LINKAGE 6

BUCKET POSITIONER AND BOOM KICK-OUT 8

HYDRAULIC TANK 10
- OIL FILTER BYPASS VALVE 11
- BREATHER 11

HYDRAULIC AND STEERING PUMPS 12

MAIN CONTROL VALVE 13

RELIEF VALVE 15

SAFETY VALVE W/SUCTION VALVE 16
- As a safety valve 16
- As a suction valve 17

SUCTION VALVE 17

LIFT AND DUMP SPOOLS AT "NEUTRAL POSITION" 18

LIFT SPOOL AT "RAISE POSITION" 19

LIFT SPOOL AT "LOWER POSITION" 20

LIFT SPOOL AT "FLOAT POSITION" 21

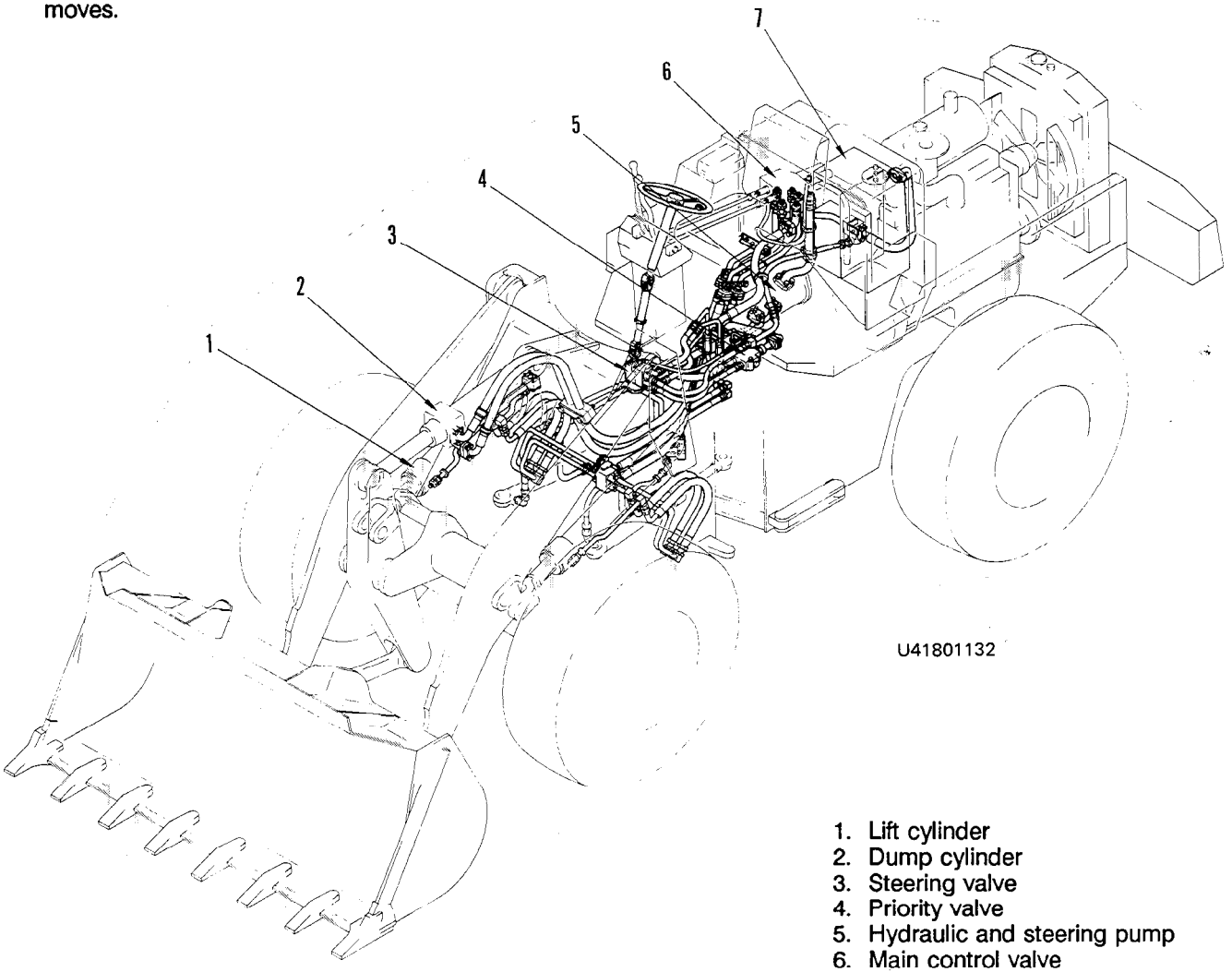
DUMP SPOOL AT "TILT BACK POSITION" 22

DUMP SPOOL AT DUMP "POSITION" 23

HYDRAULIC CYLINDER 24

HYDRAULIC PIPING

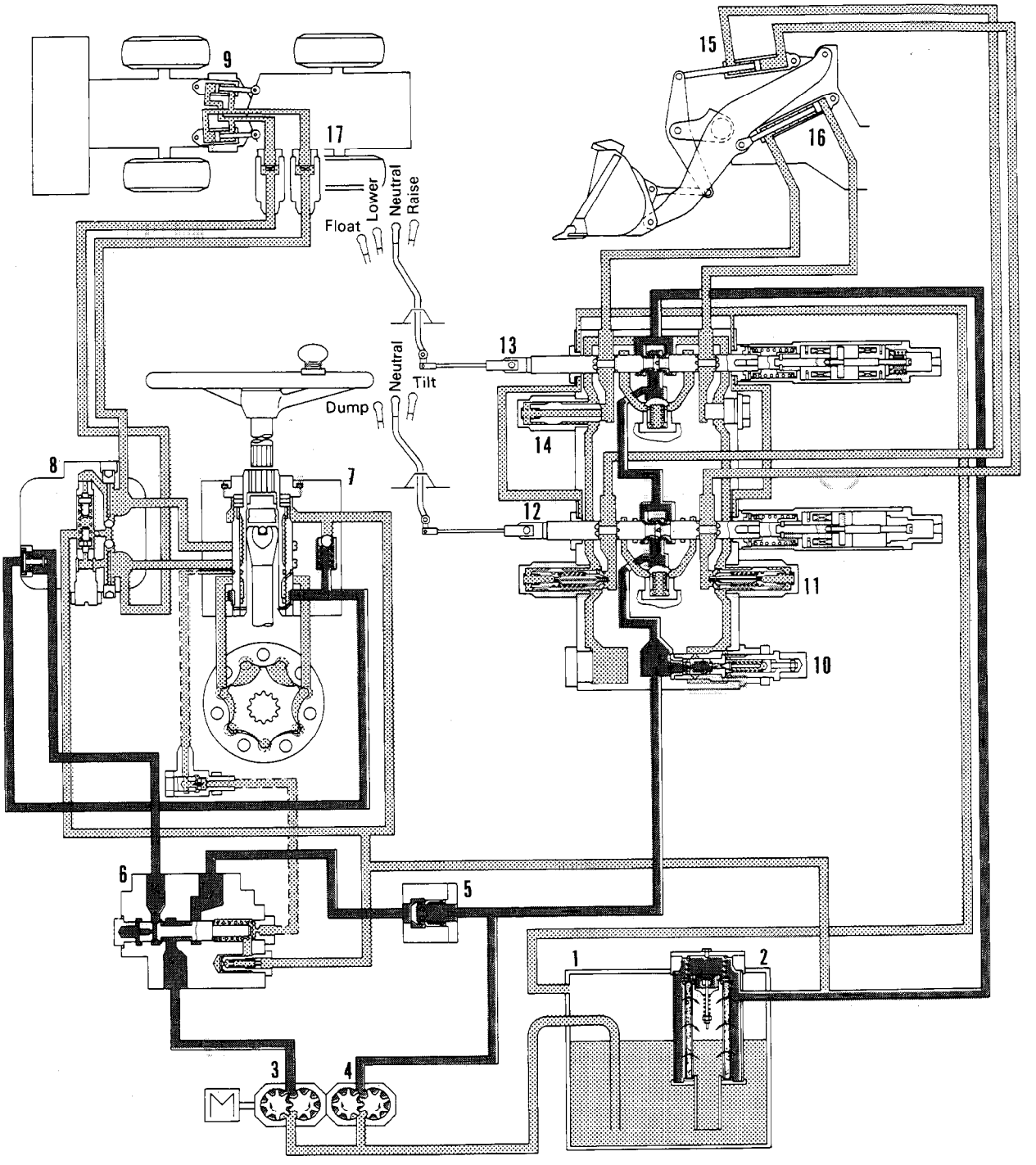
- The work equipment system consists of the hydraulic circuit and steering circuit. The hydraulic circuit controls the operation of the bucket and attachment.
- The oil in the hydraulic tank (7) is sent by hydraulic pump (5) to the main control valve (6). When the dump and lift spools of the main control valve are at neutral, the oil passes through the drain circuit of the main control valve. It is then filtered by the filter in the hydraulic tank, and returns to the tank.
- When the levers are operated, the dump spool or lift spool in the main control valve moves, and oil flows from the main control valve to lift cylinder (1) or dump cylinder (2). The lift arm or bucket then moves.
- The maximum pressure of the hydraulic circuit is regulated by the relief valve inside the main control valve. There is a safety valve (with suction valve) in the dump cylinder circuit to protect the circuit.
- Hydraulic tank (7) is a pressurized, sealed type and has a breather with a relief valve. This acts to pressurize the tank and at the same time prevents negative pressure. This protects the pump from cavitation.



1. Lift cylinder
2. Dump cylinder
3. Steering valve
4. Priority valve
5. Hydraulic and steering pump
6. Main control valve
7. Hydraulic tank

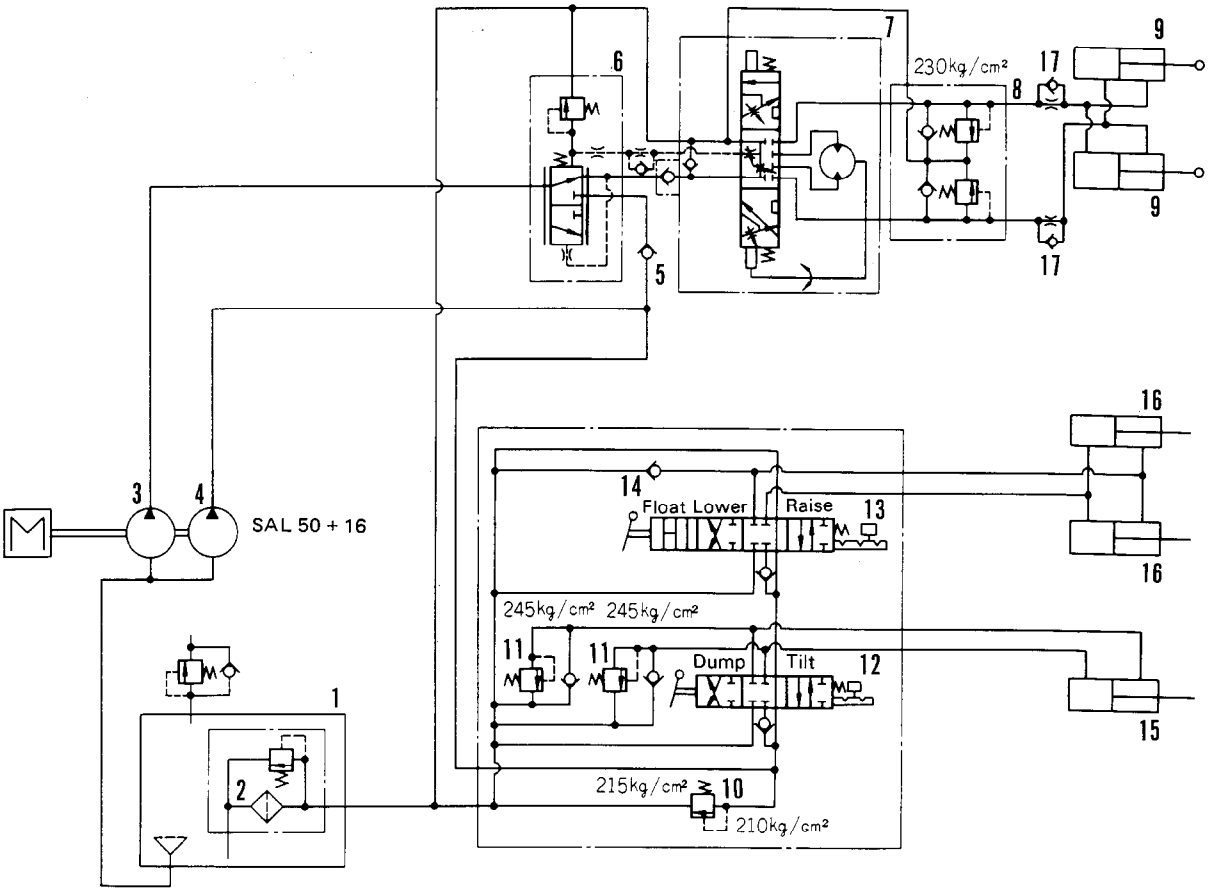
HYDRAULIC CIRCUIT

Engine running, hydraulic control lever in "HOLD"



F41801101

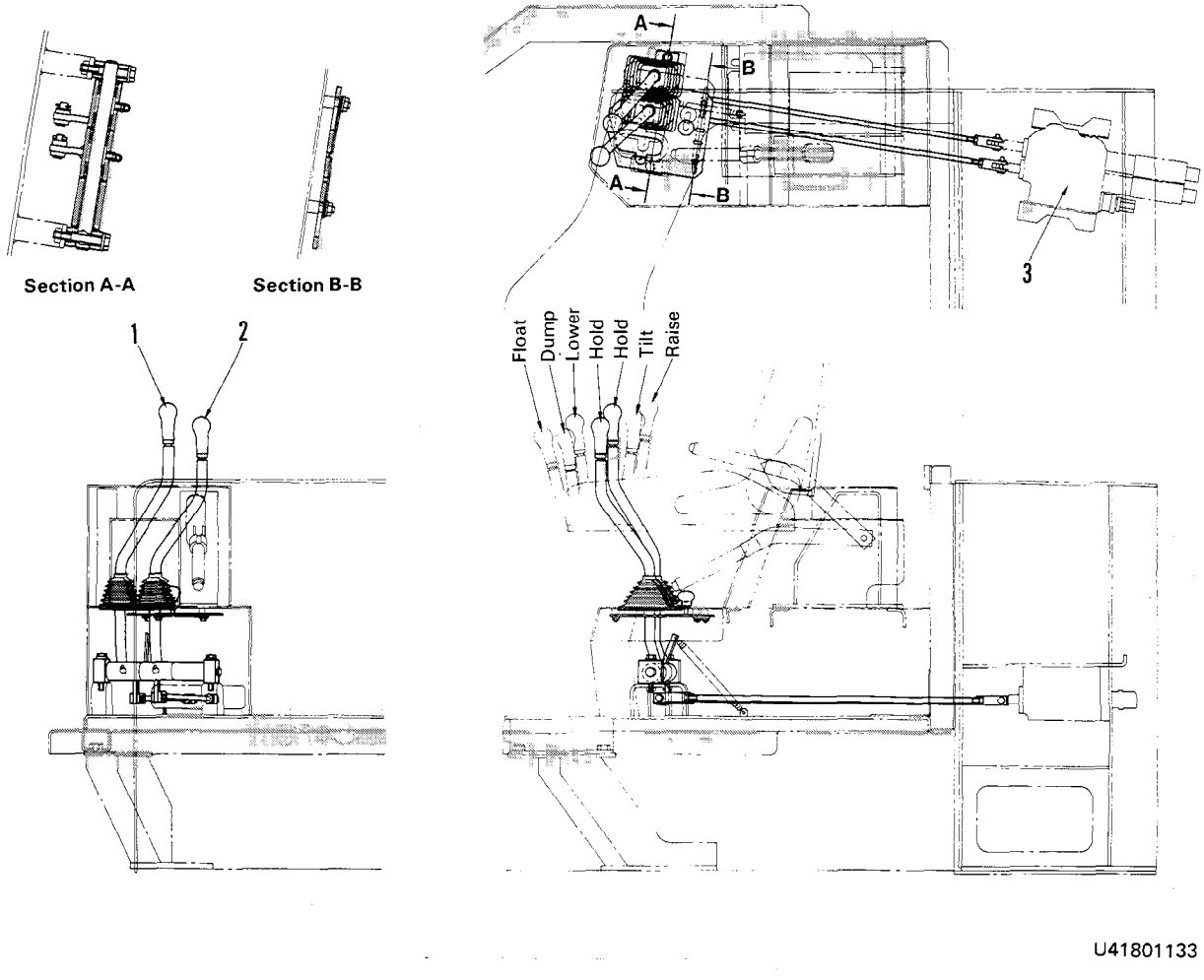
HYDRAULIC CIRCUIT DIAGRAM



F41801102

1. Hydraulic tank
2. Oil filter
3. Hydraulic pump (Steering)
4. Hydraulic pump (Work equipment)
5. Check valve
6. Priority valve
7. Steering valve (Orbitrol)
8. Overload valve
9. Steering cylinder
10. Relief valve
11. Safety valve (With suction)
12. Dump spool
13. Lift spool
14. Suction valve
15. Dump cylinder
16. Lift cylinder
17. Two-way restrictor valve

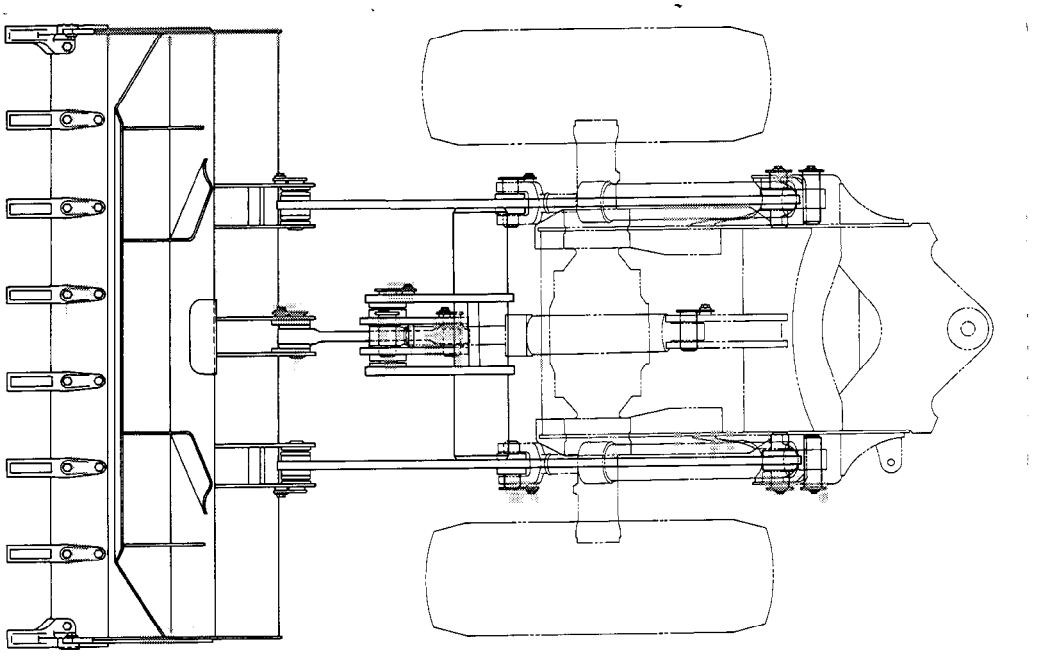
WORK EQUIPMENT LEVER LINKAGE

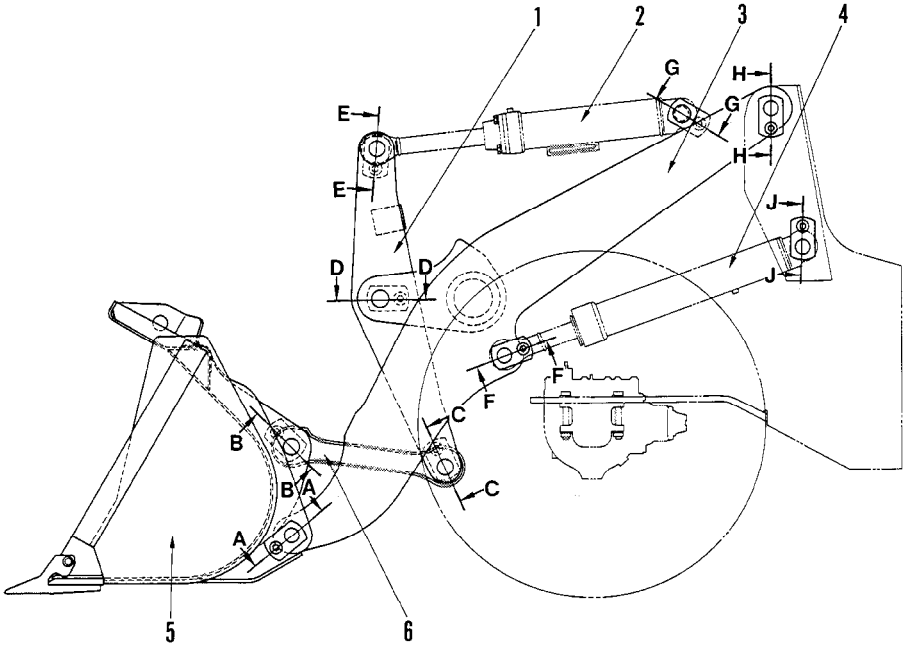


U41801133

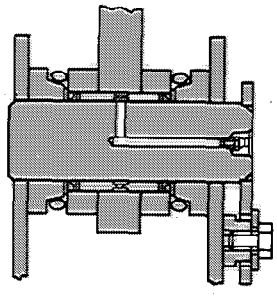
1. Lift lever
2. Dump lever
3. Main control valve

BUCKET LINKAGE

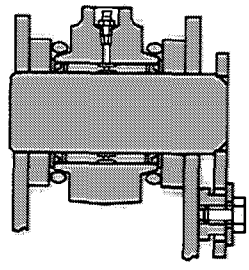




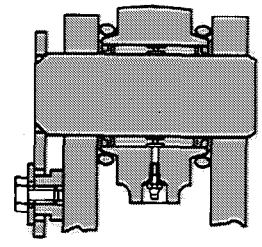
1. Tilt lever
2. Dump cylinder
3. Lift arm
4. Lift cylinder
5. Bucket
6. Bucket link



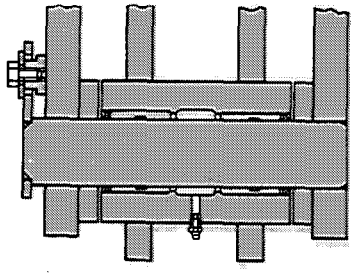
Section A-A



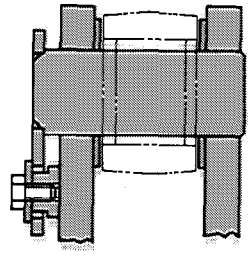
Section B-B



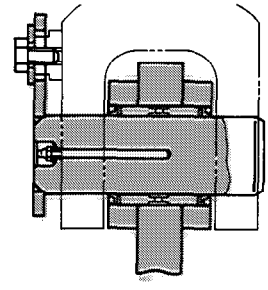
Section C-C



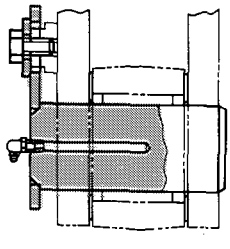
Section D-D



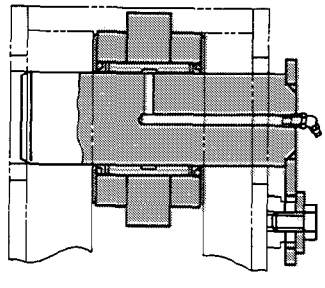
Section E-E



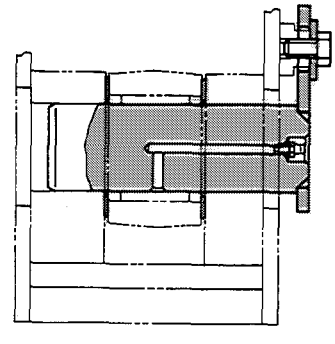
Section F-F



Section G-G



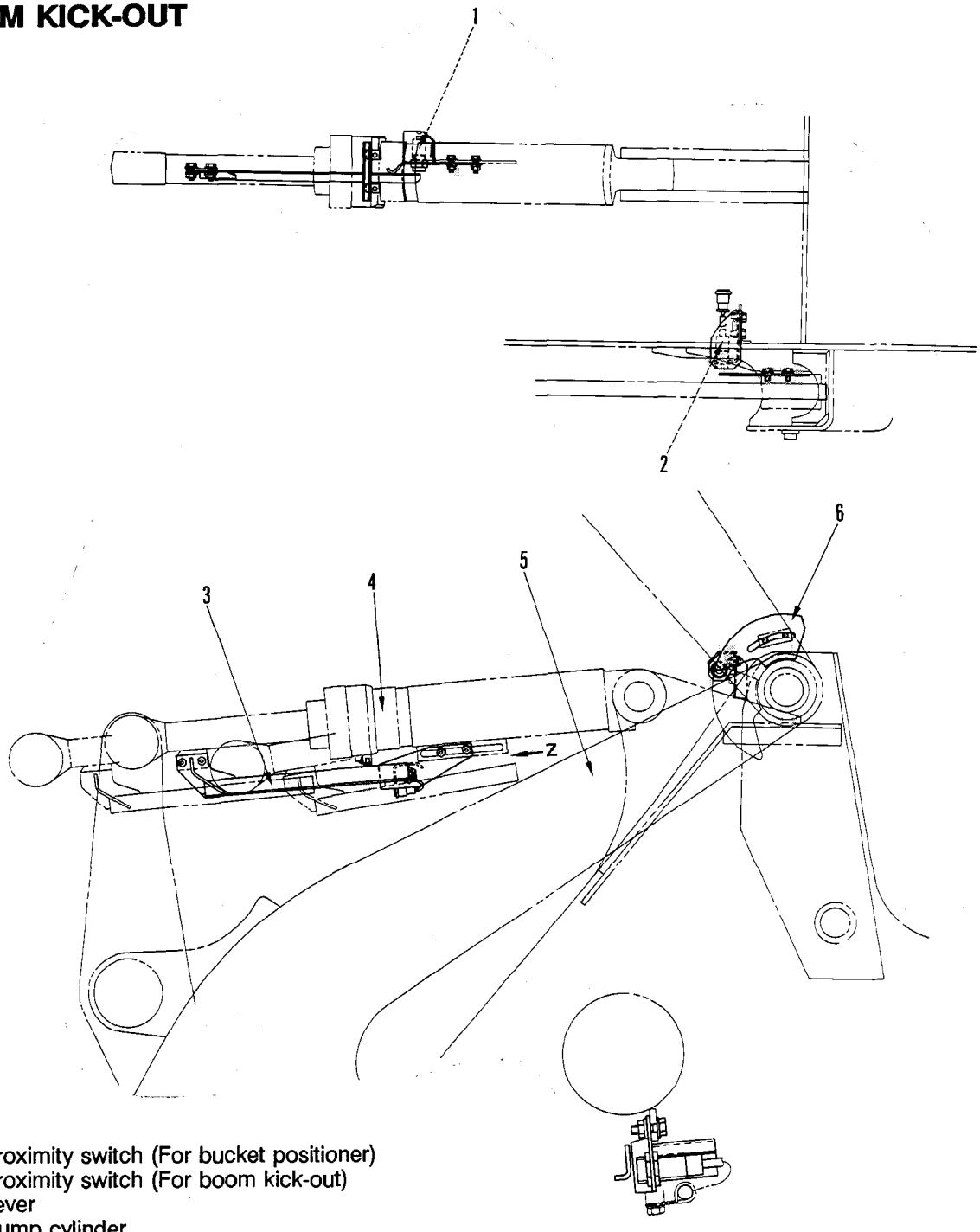
Section H-H



Section J-J

418F069

BUCKET POSITIONER AND BOOM KICK-OUT



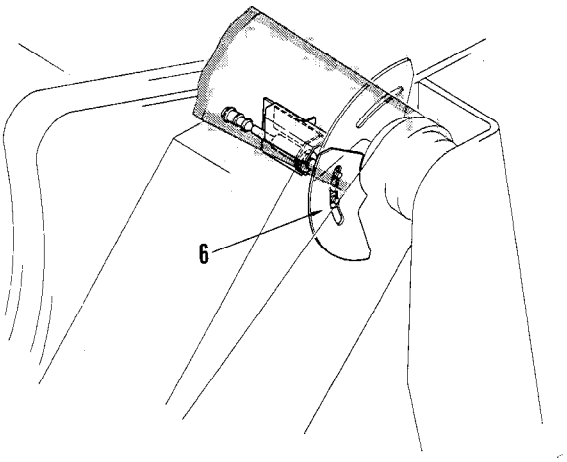
1. Proximity switch (For bucket positioner)
2. Proximity switch (For boom kick-out)
3. Lever
4. Dump cylinder
5. Lift arm
6. Plate

View Z

418F070

Boom kick-out

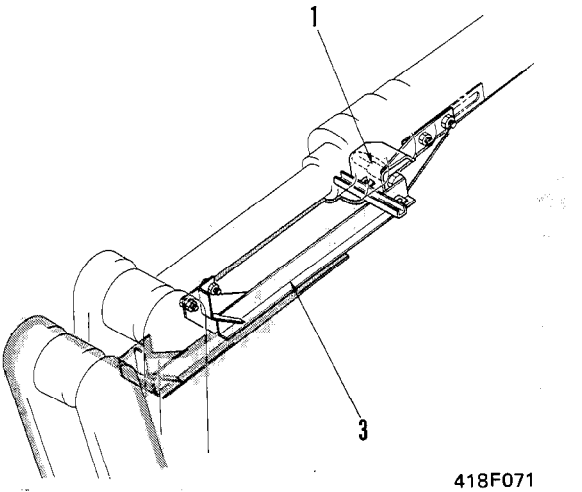
- The boom kick-out is electrically operated and acts to stop the lift arm. When the lift arm reaches the desired position before the maximum height, the lift arm lever is returned to neutral.
- Plate (6) is secured to the lift arm (5). A proximity switch (2) is fixed to the frame. When the lift arm is moved from the LOWER position to the RAISE position, the lift arm rises. When it reaches the desired position, the proximity switch and lever come into contact and the lift arm lever is returned to neutral.



418F072

Bucket positioner

- The bucket positioner is electrically actuated and is used to automatically obtain the optimum digging angle for the bucket.
  When the bucket is moved from the DUMP position to the TILT position, and it reaches the desired angle, the dump lever is automatically moved from the TILT position to the neutral.
- Lever (3) is secured by bolts to dump cylinder rod. A proximity switch (1) is fixed by bolts to the cylinder (4).
- When the bucket is moved from the DUMP position to the TILT position, the dump cylinder rod moves to the left. At the same time, lever (3) also moves to the left. When it reaches the desired position, lever (3) separates from proximity switch (1), and the bucket lever returns to neutral.

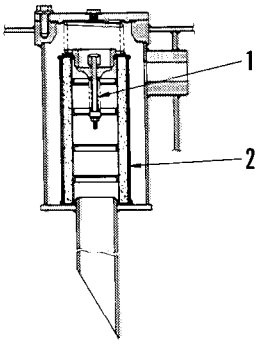


418F071

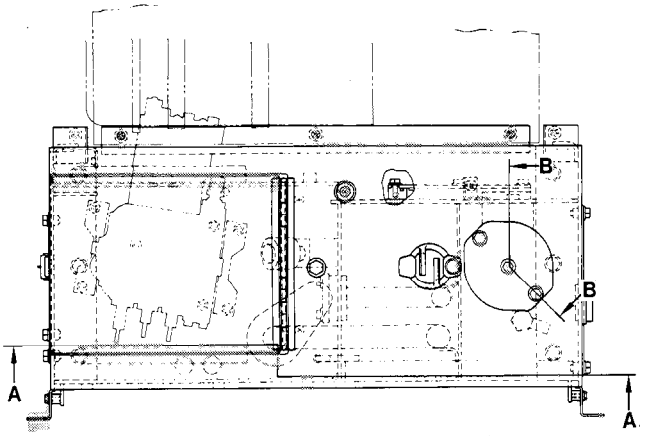
HYDRAULIC TANK

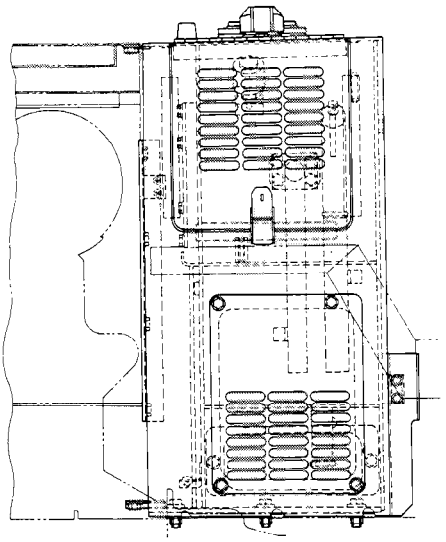
Outline

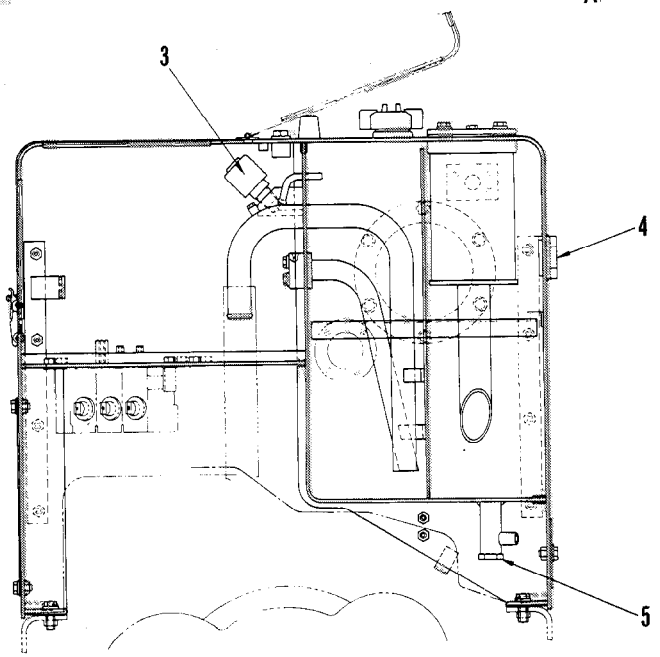
- The oil from the hydraulic tank is sent from the pump through the control valve to the cylinders. In return circuit, the oil from various parts merges. Passes through the oil filter (2) and returns to the tank.
- The oil filters (2) filters all the oil in the circuit. If the oil filter (2) becomes clogged, a bypass valve (1) acts to allow the oil to return directly to the tank. This prevents damage to the oil filter (2). The bypass valve (1) is also actuated when negative pressure is generated in the circuit.



Section B-B







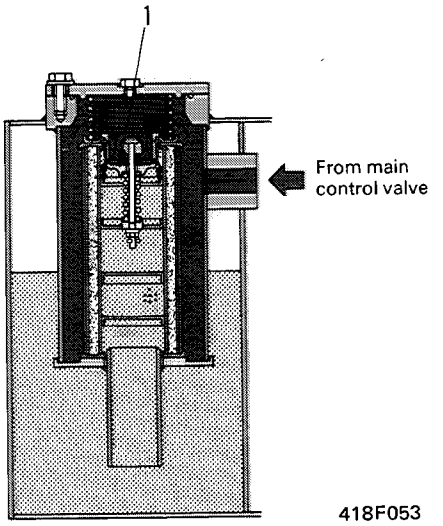
Section A-A

U41801134

1. Filter by-pass valve
2. Oil filter
3. Breather
4. Oil level gauge
5. Drain valve

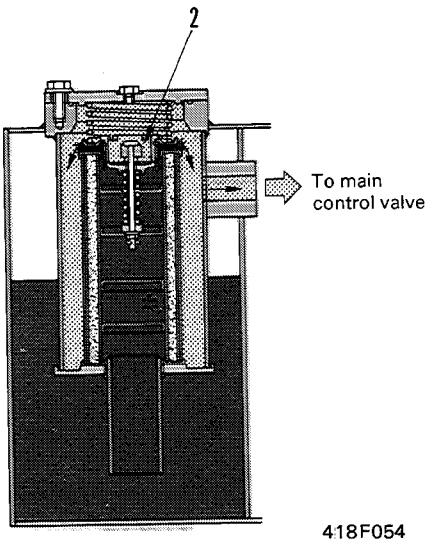
OIL FILTER BYPASS VALVE

When the filter is clogged
Bypass valve (1) opens and the oil returns directly to the tank without passing through the filter.
Bypass valve set pressure: 1.27 kg/cm^2



418F053

When negative pressure is formed in the return circuit
Valve (2) moves up and acts a check valve.
Check valve set pressure: 0.26 kg/cm^2

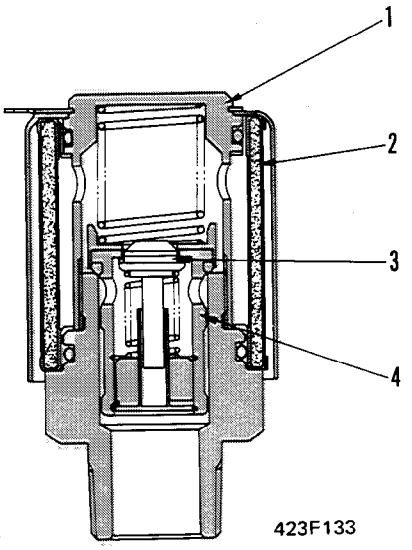


418F054

BREATHER

Preventing negative pressure inside the tank
The tank is a pressurized, sealed type, so negative pressure is formed inside the hydraulic tank when the oil level drops during operations. When this happens, the difference in pressure between the tank and the outside atmospheric pressure opens the poppet (3), and air from the outside is let into the tank to prevent negative pressure.

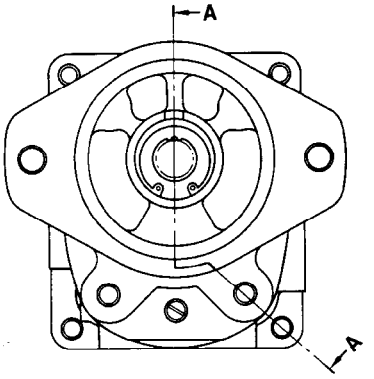
Preventing rise in pressure inside the tank
When the hydraulic cylinders are being used, the oil level in the hydraulic circuit changes and the temperature rises. If the hydraulic pressure rises above the set pressure, the breather is actuated to release the hydraulic pressure inside the tank.

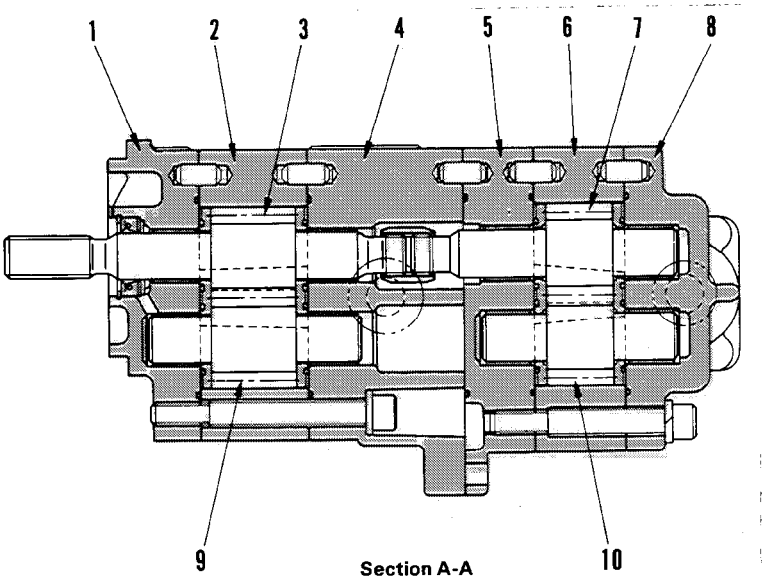


423F133

1. Body
2. Filter element
3. Poppet
4. Sleeve

HYDRAULIC AND STEERING PUMPS





Section A-A

419F096

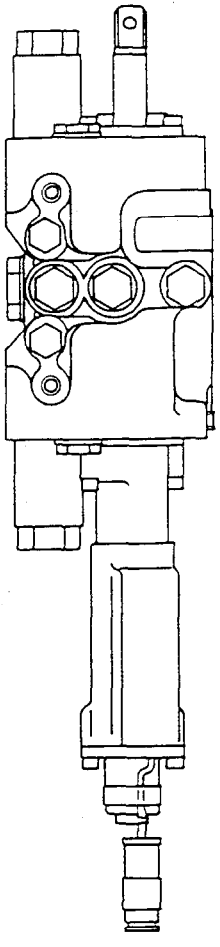
Hydraulic pump	Steering pump
SAL(2)-32 SAL(2)-50 SAL(2)-50	SAL(2)-32 SAL(2)-16 SAL(2)-25

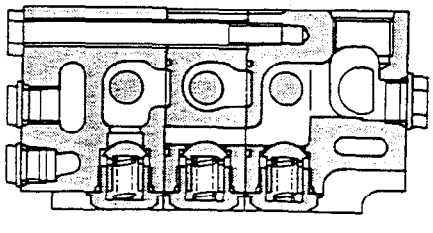
1. Front cover
2. Gear case
3. Drive gear (Teeth 12)
4. Rear cover
5. Front cover
6. Gear case
7. Drive gear (Teeth 12)
8. Rear cover
9. Driven gear (Teeth 12)
10. Driven gear (Teeth 12)

Specification

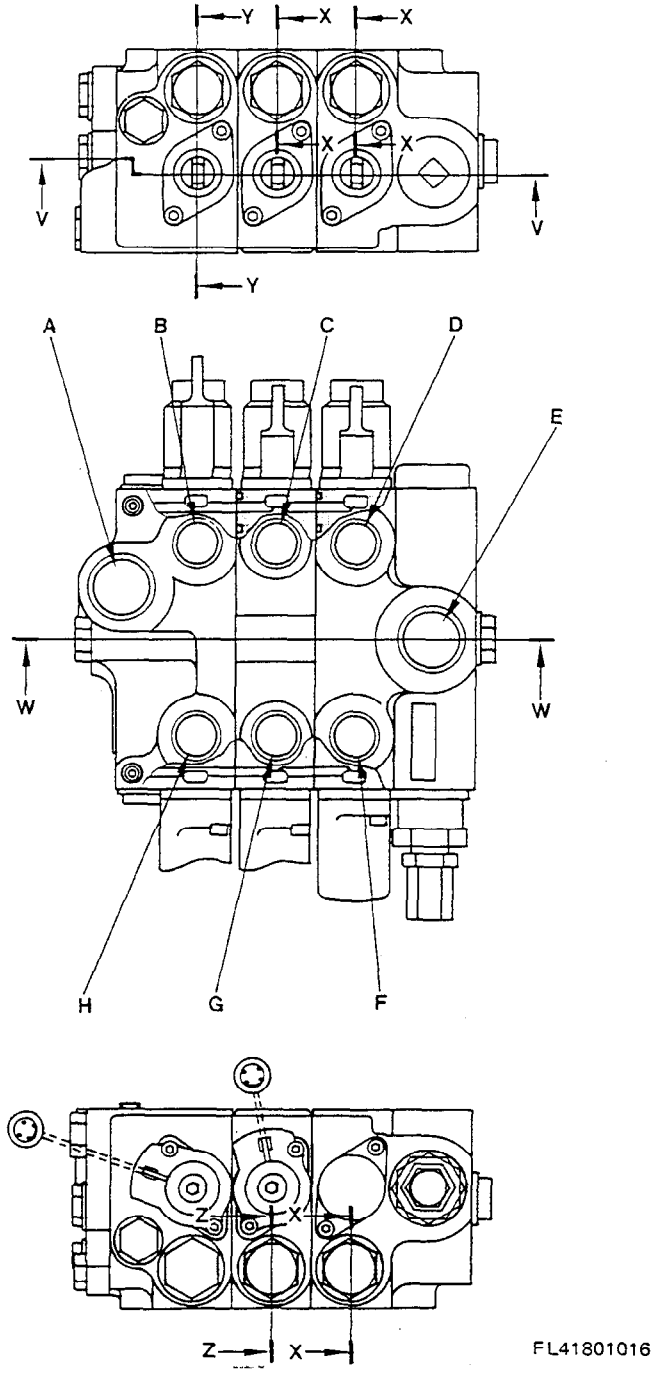
	Hydraulic pump	Steering pump
Model	SAL(2)-050 (Front)	SAL(2)-025 (Rear)
Theoretical discharge	50.0 cc/rev	25.0 cc/rev
Max. pressure	210 kg/cm^2	210 kg/cm^2
Max. pump speed	3,000 rpm	3,000 rpm

MAIN CONTROL VALVE

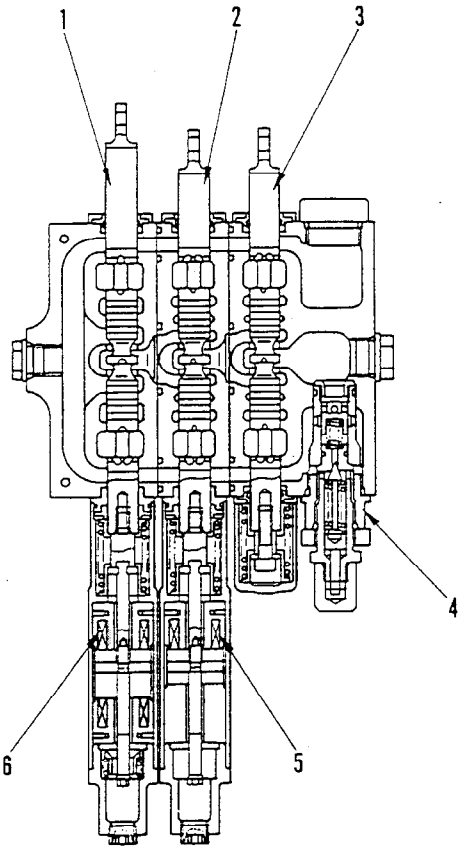




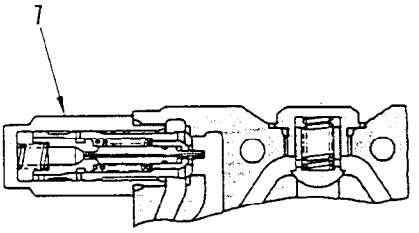
Section W-W



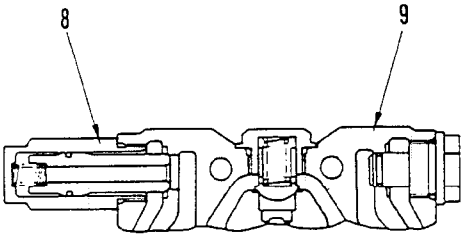
A. T port (To tank)
B. A_3 port (To lift cylinder head)
C. A_2 port (To dump cylinder bottom)
D. A_1 port (Service)
E. P port (From pump)
F. B_1 port (Service)
G. B_2 port (To dump cylinder head)
H. B_3 port (To lift cylinder bottom)



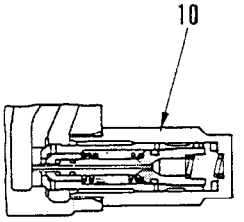
Section V-V



Section X-X



Section Y-Y



Section Z-Z

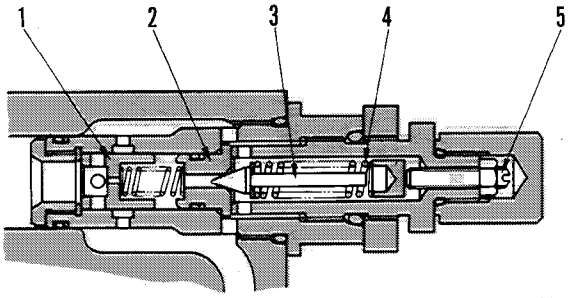
FL41801017

1. Lift spool
2. Dump spool
3. Service spool
4. Main relief valve
5. Magnet (For dump)
6. Magnet (For lift)
7. Safety valve (With suction)
8. Suction valve
9. Check valve
10. Safety valve (With suction)

Outline

- The main control valve controls the actuation of the attachments and the buckets in the hydraulic system. It has a tandem circuit which gives priority to the bucket circuit.
- The oil from the pump enters port E. The maximum pressure is set by the relief valve. The oil passes through the bypass circuit of dump spool (2) and lift spool (1). It then flows from port A to the drain circuit, passes through the filter and returns to the tank. If the dump and lift spools are actuated, the oil flows to the dump and lift cylinders. However, the circuit gives priority to the bucket, so when the dump spool is being operated, even if the lift spool is operated, the lift arm will not move.
- There are two safety valves (with suction valves) (7 and 10) to protect the circuit if abnormal pressure is generated in the bucket circuit. If one of the two safety valves is acting as a relief valve, the other valve acts as a suction valve to make up any lack of oil.

RELIEF VALVE

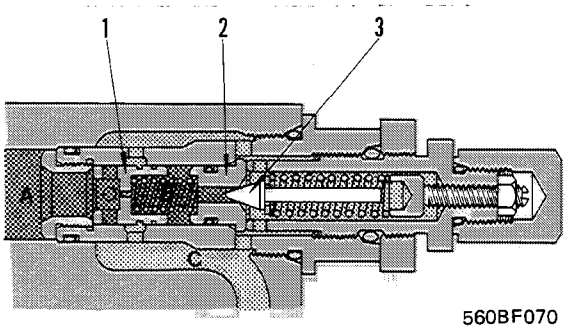


423F137

1. Main valve
2. Valve seat
3. Pilot poppet
4. Pilot poppet spring
5. Adjustment screw

Function

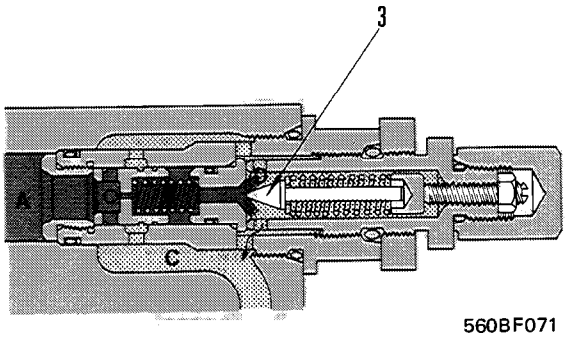
- The relief valve is installed at the inlet of the main control valve. When the oil goes above the set pressure, the relief valve drains the oil to the tank. In this way, it sets the maximum pressure in the hydraulic circuit and protects the circuit.



560BF070

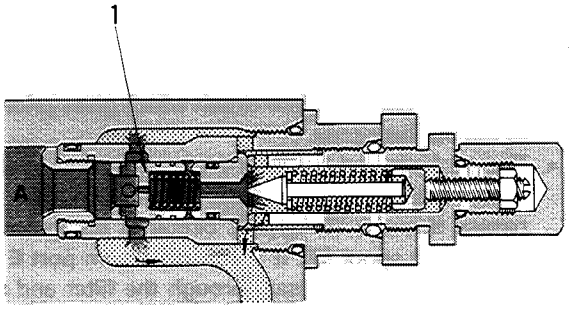
Operation

- Port A is connected to the pump circuit and port C is connected to the drain circuit. The oil passes through the orifice of main valve (1) and flows to port B. Pilot poppet (3) is in close contact with valve seat (2).
- When the hydraulic pressure in the circuit inside port A and port B reaches the set pressure of the pilot poppet spring (4), pilot poppet (3) opens, and the pressurized oil from port B flows from port D to port C, so the pressure at port B drops.



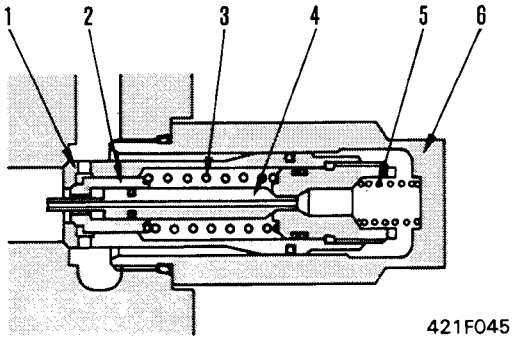
560BF071

- When the pressure at port B drops, the orifice effect of main valve (1) generates a difference in pressure between port A and port B. The main valve is pushed open and the oil from port A passes through port C and flows to the drain circuit to release the abnormal pressure.
- The set pressure can be varied by changing the tension of pilot poppet spring (4). To change the set pressure, remove cap nut, loosen lock nut and turn adjustment screw (5) as follows.



560BF072

SAFETY VALVE W/SUCTION VALVE



421F045

1. Suction valve
2. Main valve
3. Main valve spring
4. Pilot piston
5. Suction valve spring
6. Valve body

Function

- The safety valve (with suction valve) is in the dump cylinder circuit in the main valve. If shock causes any abnormally high pressure in the cylinder when the main valve is at neutral, the safety valve (with suction valve) releases the abnormal pressure and protects the cylinder from damage.

Operation

As a safety valve

- Port A is the cylinder circuit and port B is the drain circuit.
  The oil pressure in port A flows to port D through a hole in the pilot piston (4). It also flows to port C through an orifice consisting of the main valve and the pilot piston (4).
  The pilot piston (4) is secured to the suction valve by lock nut. The diameter of the cross section (cross-sectional area) gives a relationship of $d_2 > d_1 > d_3 > d_4$. (Fig. 1)
- If abnormally high oil pressure occurs in port A, the suction valve (1) is not actuated because of the relationship $d_2 > d_1$.
  However, because of the relationship $d_3 > d_4$ in ports A and C, the hydraulic pressure on the main valve (2) is equivalent to the area difference between d_3 and d_4. If this pressure goes up to the main valve spring force (set pressure), the main valve (2) is actuated, and the oil in port A flows into port B. (Fig. 2)

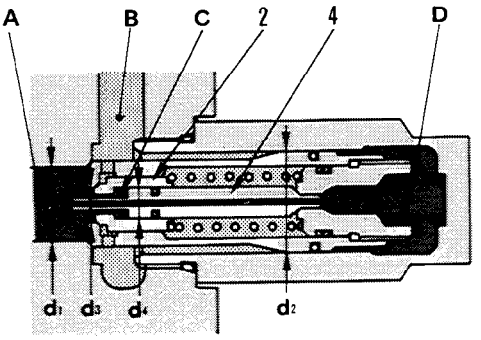


Fig. 1 421F046

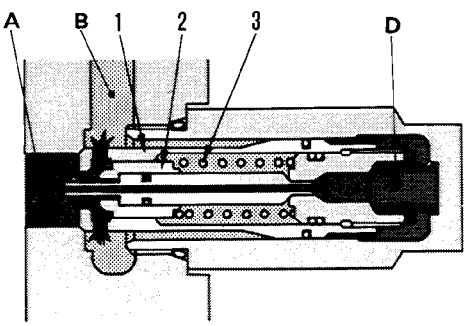
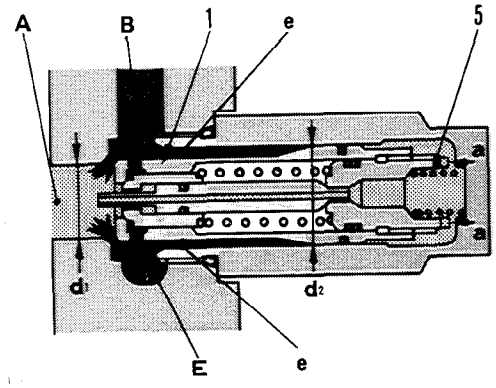


Fig. 2 421F047

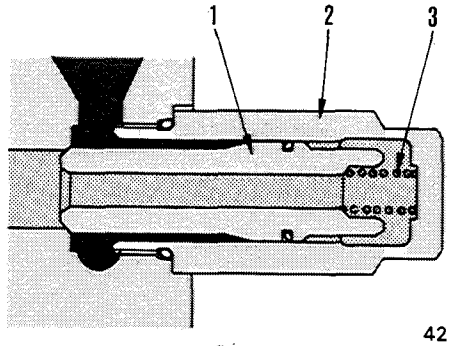
As a suction valve

- If negative pressure is generated in port A, port D also has negative pressure, because ports D and A are connected with each other. The tank pressure in port B is applied to port E.
  Hydraulic pressure "a" equivalent to the area difference between d_2 and d_1 is applied to the safety valve because of the tank pressure in port E. Therefore, hydraulic pressure "e" acts to open the valve and hydraulic pressure "a" acts to close the suction valve (1).
- If the pressure in port A drops, (approaching negative pressure) hydraulic pressure "a" becomes smaller than oil pressure "e".
  When oil pressure "e" becomes larger than oil pressure "a" + valve spring (5) force, the suction valve (1) opens, causing the oil to flow from port B into port A. This prevents negative pressure from building up in port A.



421F048

SUCTION VALVE

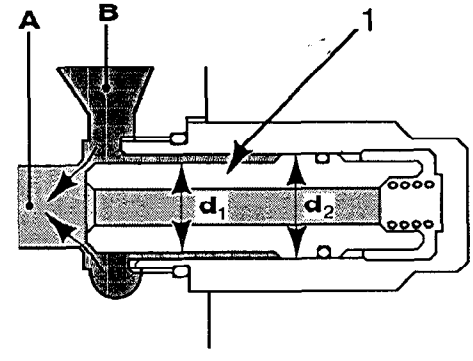


421F088

1. Main poppet
2. Sleeve
3. Spring

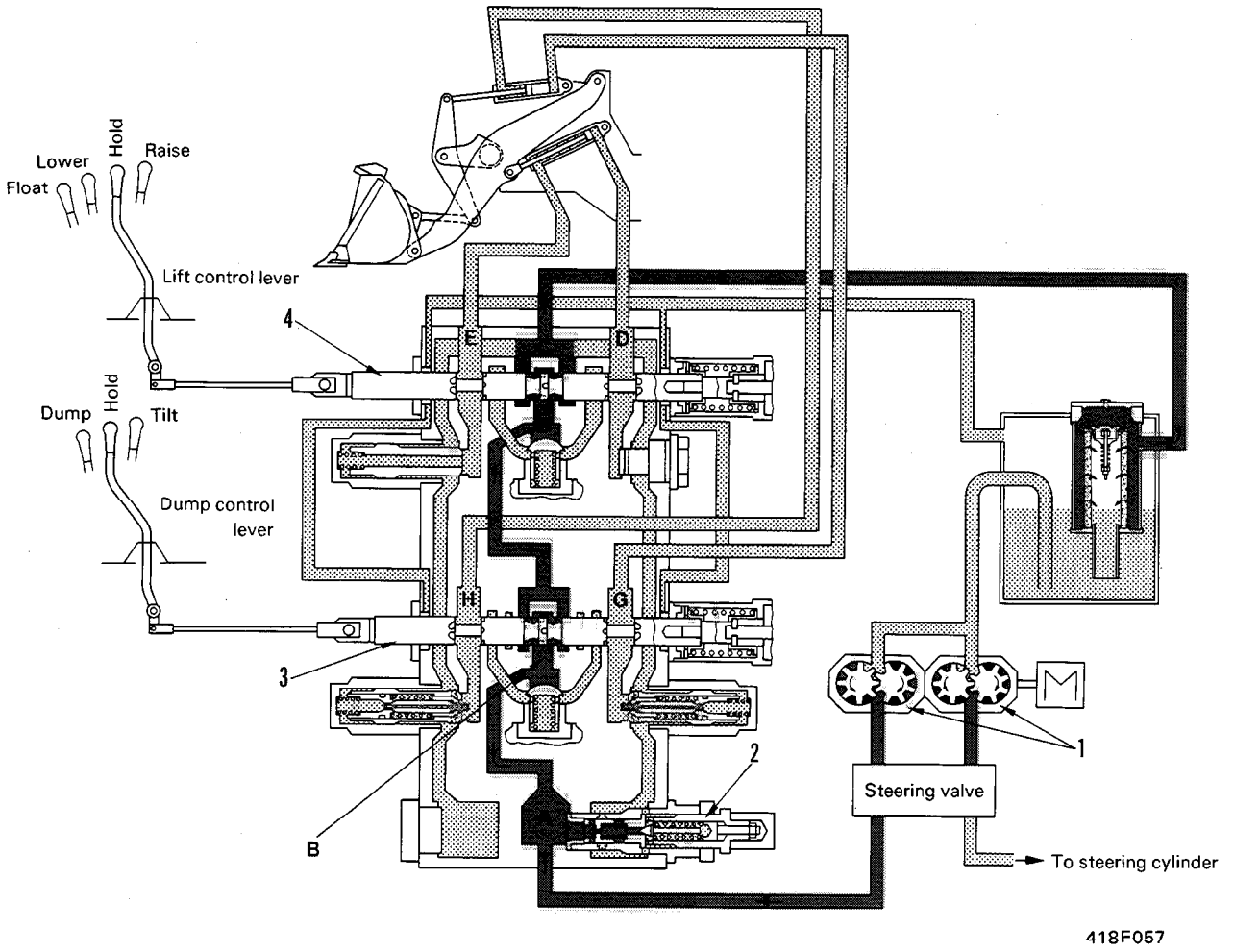
Operation

- If negative pressure is generated in port A (lift cylinder rod end) (if the pressure is lower than in port B in the tank circuit), the main poppet (1) opens because oil then flows from port B at the tank end to port A at the cylinder port end.



421F089A

LIFT AND DUMP SPOOLS AT "NEUTRAL POSITION"

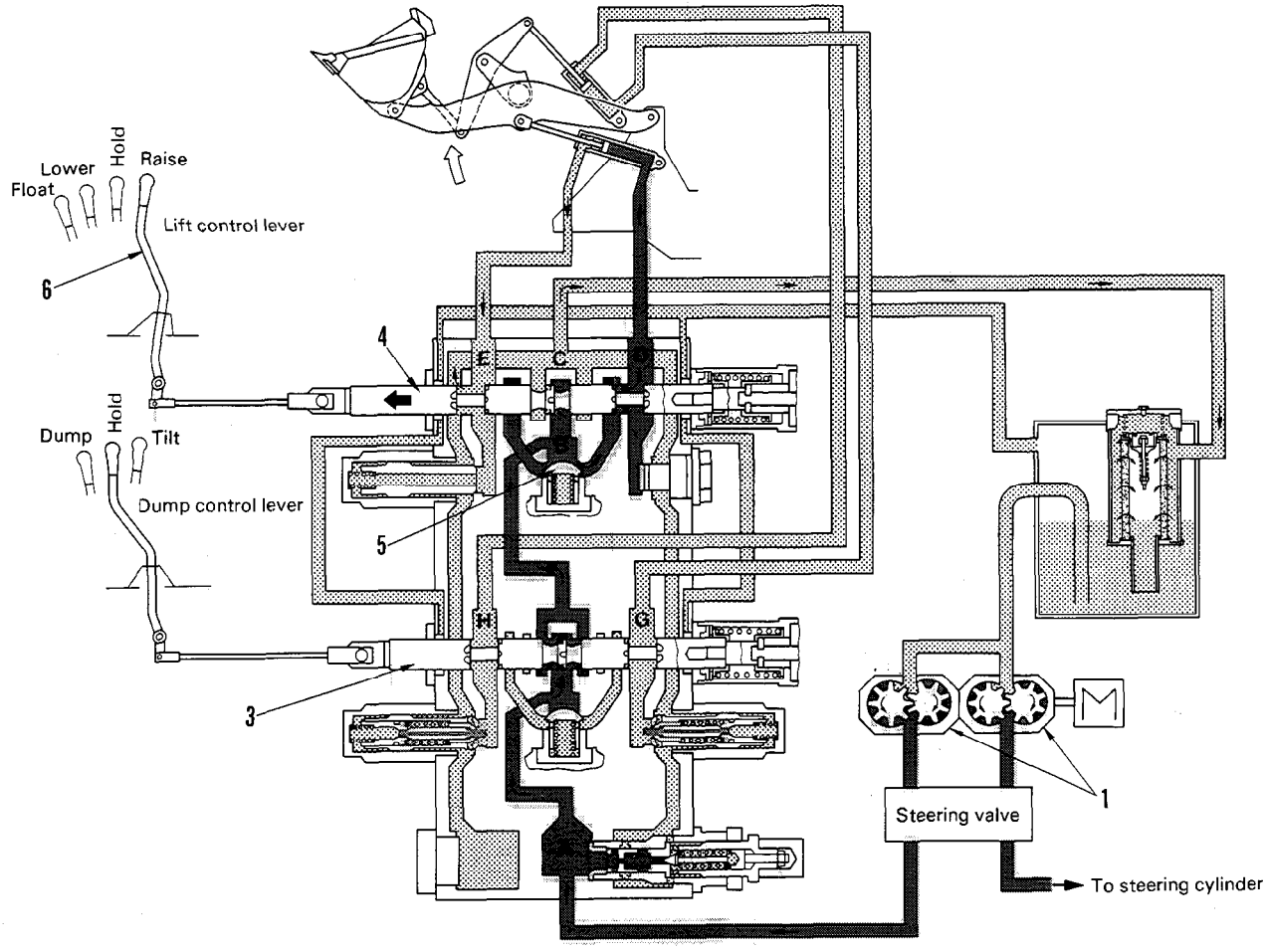


Operation

- The oil flows from pump (1) through the steering valve and enters port **A**.
- Dump spool (3) is at neutral, so the bypass circuit is open and the oil from port A passes around the spool and flows to port **B**.

The lift spool (4) is also at neutral, so the bypass circuit is open. The oil from port **B** passes around the spool, flows from the drain circuit through the oil cooler and filter, and goes back to the tank.

LIFT SPOOL AT "RAISE POSITION"

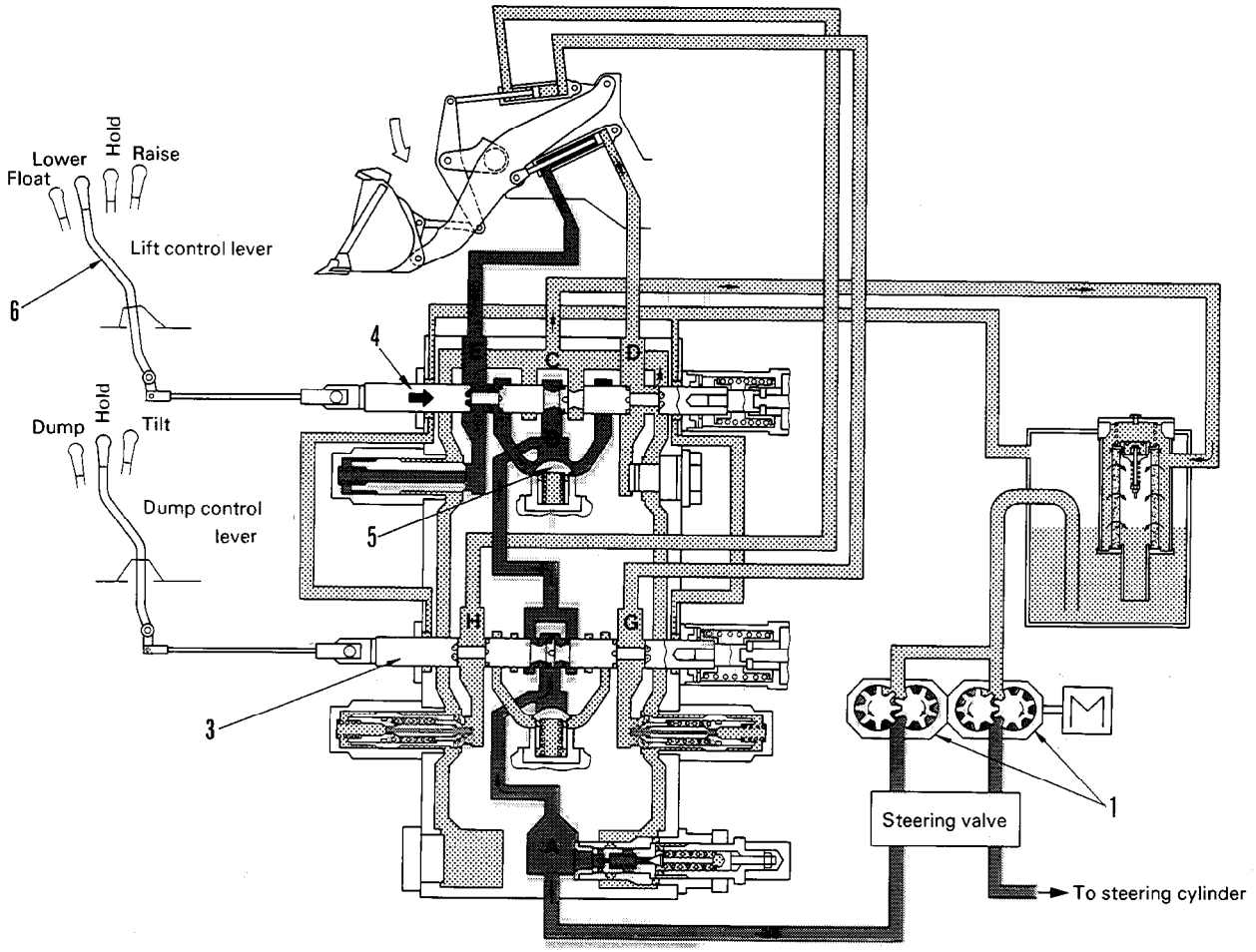


418F058

Operation

- When lift control lever (6) is pulled, lift spool (4) is pulled into the RAISE position.
- The oil flows from pump (1) through the steering valve. It then passes through the bypass circuit of lift spool (4) and flows to the bypass circuit of lift spool (4). The bypass circuit is closed by dump spool (3), so the oil pushes open check valve (5). The oil from check valve (5) flows to port E and enters the cylinder bottom.
- At the same time, the oil from the cylinder rod end flows from port **D** to drain port **C** and returns through the oil cooler to the tank. When this happens, the lift arm goes up.

LIFT SPOOL AT "LOWER POSITION"

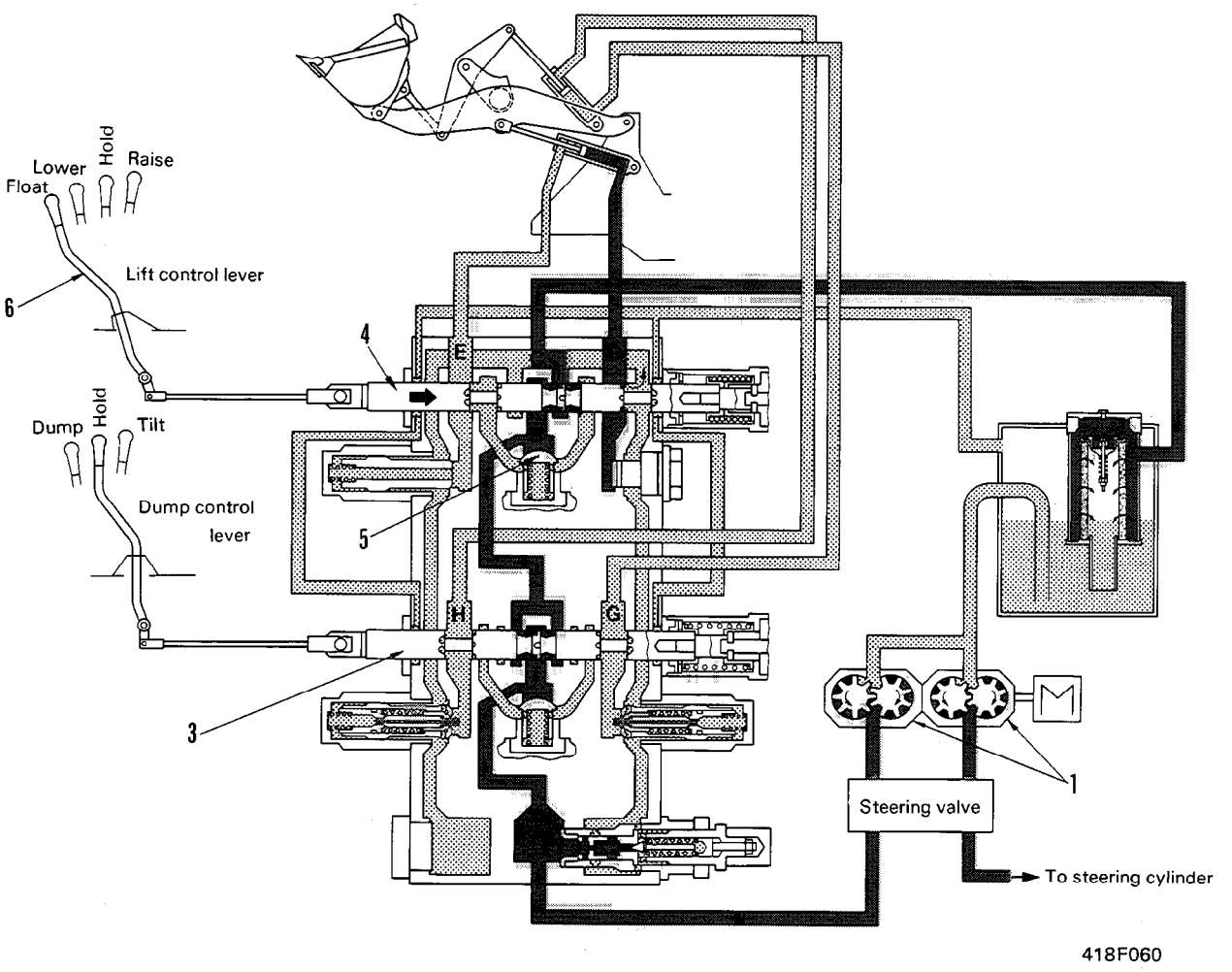


418F059

OPERATION

- When lift control lever (6) is pushed, lift spool is pushed out to the Lower position.
- The oil flows from pump (1) through the steering valve. It then passes through the bypass circuit of dump spool (3) and flows to the bypass circuit of lift spool (4). The bypass circuit is closed by lift spool (4), so the oil pushes open check valve (5). The oil then flows from check valve (5) to port D and enters the rod end of cylinder.
- At the same time the oil from the cylinder bottom flows from port **E** and enters drain port **C**. It then passes through the oil cooler and returns to the hydraulic tank. When this happens, the lift arm goes down.

LIFT SPOOL AT "FLOAT POSITION"



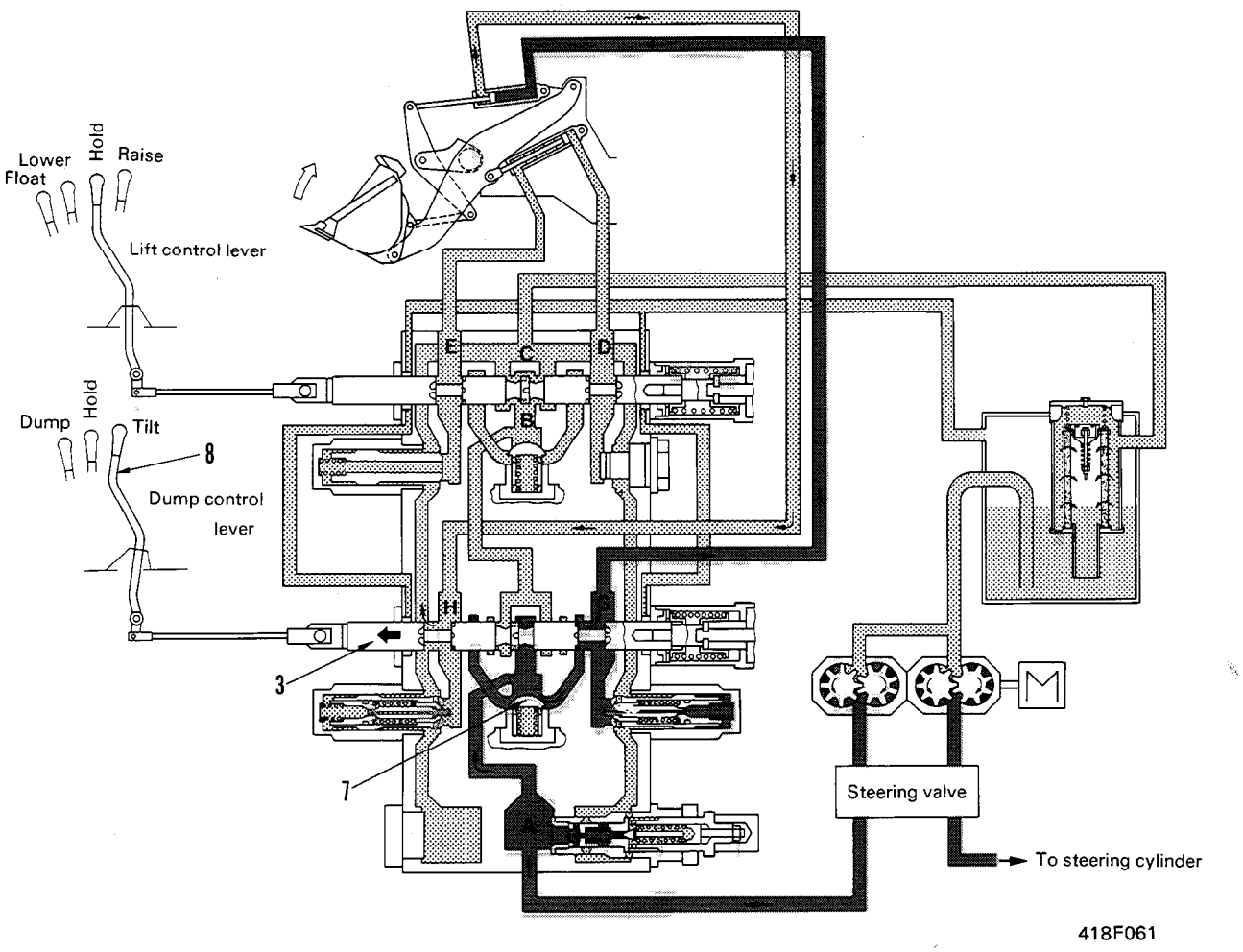
Operation

- When lift control lever (6) is pushed down further from the LOWER position, lift spool (4) is pushed into the FLOAT position.
- The oil flows from pump (1) through the steering valve. It then flows around the bypass circuit of dump spool (3) to the lift spool bypass circuit. The oil in the bypass circuit flows to the drain circuit because of the spool, but it cannot push open check valve (5).

In addition, RAISE circuit **E** and LOWER circuit **D** of the lift cylinder are connected to the drain circuit, so the lift arm goes down under its own weight.

- When the bucket is in contact with the ground, it can move up and down in accordance with the shape of the ground.

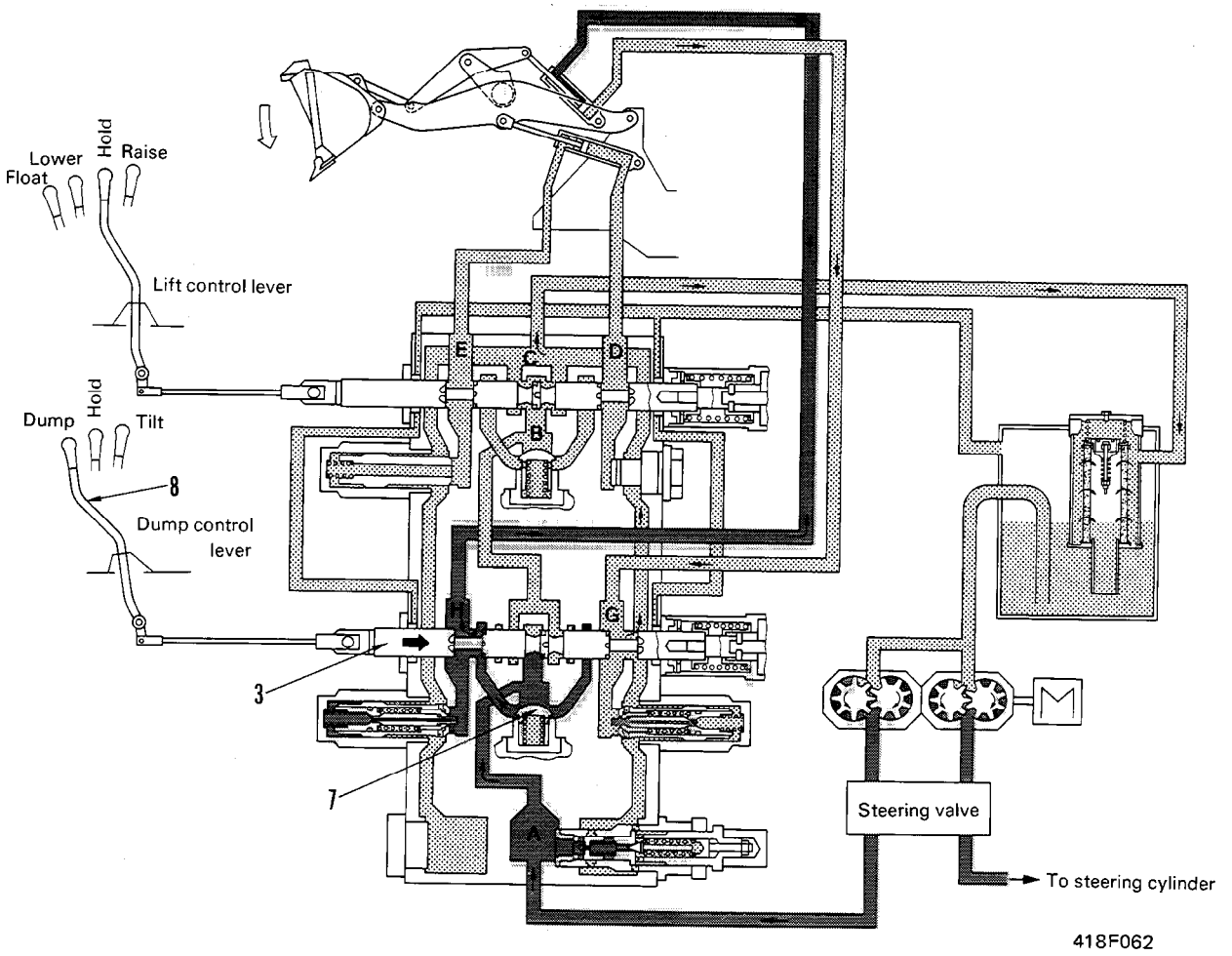
DUMP SPOOL AT "TILT BACK POSITION"



OPERATION

- When dump control lever (8) is pulled, dump spool (3) is pulled into the tilt position.
- The bypass circuit is closed by dump spool (3), so oil from port **A** pushes open check valve (7). The oil from port **A** flows from check valve (7) through port **H** to the cylinder bottom.
- At the same time, the oil at the cylinder rod end flows from port **H** to drain port **C**. It then passes through oil cooler, and flows back to the hydraulic tank. When this happens, the bucket tilts.

DUMP SPOOL AT DUMP "POSITION"

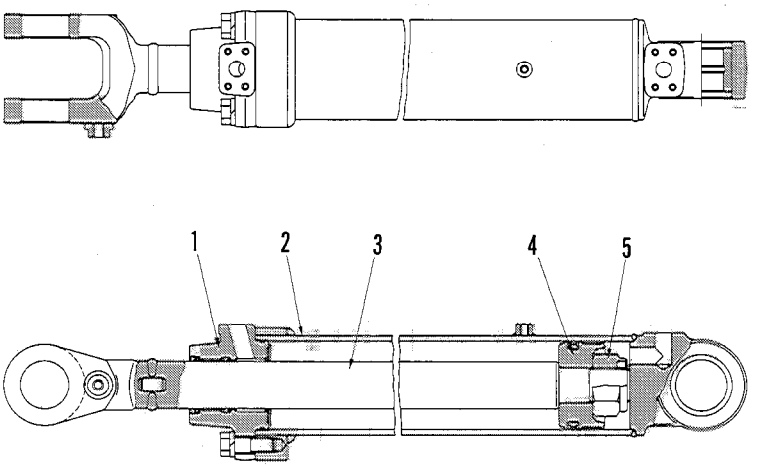


Operation

- When the dump control lever (8) is pushed, dump spool (3) is pushed into the DUMP position.
- The bypass circuit is closed by the dump spool (8), so the oil front port **A** pushes up check valve (7). The oil from port **A** flows from port **G** into the spool. It then flows to the cylinder rod end.
- At the same time, the oil at the cylinder bottom end flows from port **H** to drain port **C** and then returns to the tank. As a result, the bucket is dumped.

HYDRAULIC CYLINDER

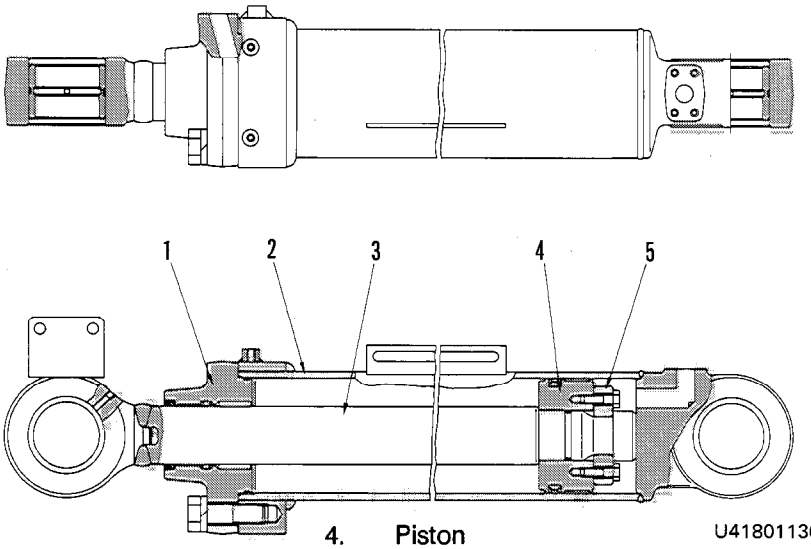
LIFT CYLINDER



U41801135

1. Cylinder head
2. Cylinder
3. Rod
4. Piston
5. Piston nut (80mm)

DUMP CYLINDER

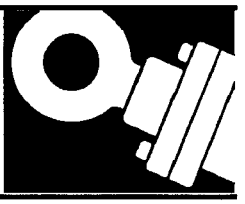


U41801136

1. Cylinder head
2. Cylinder
3. Rod
4. Piston
5. Piston lock bolt

	Lift cylinder	Dump cylinder
Cylinder I.D.	130mm	150mm
Rod dia.	70mm	75mm
Stroke	700mm	474mm
Cylinder max. length	1,940mm	1,445mm
Cylinder min. length	1,240mm	971mm

WORK EQUIPMENT SYSTEM
62 TESTING AND ADJUSTING



STANDARD VALUE TABLE 3

DUMP AND LIFT CONTROL LEVERS 4

HYDRAULIC PRESSURE 7

LIFT ARM AND BUCKET 9

HYDRAULIC DRIFT OF LIFT ARM AND BUCKET 10

BUCKET POSITIONER 11

BOOM KICK-OUT 12

TROUBLESHOOTING 14
TROUBLESHOOTING TABLES 15
1. Lift arm does not rise. 15
2. Lift arm moves slowly or does not have sufficient lifting power. 16
3. Lift arm movement becomes slow after it reaches a certain height. 17
4. Bucket cannot be held down with lift arm cylinder. 17
5. Lift arm has large hydraulic drift. 17
6. Lift arm movement is unsteady during work. 17
7. Lift arm descends momentarily when control lever is shifted from "Hold" to "Raise". 17
8. Bucket does not tilt back. 18
9. Bucket moves slowly or has insufficient tilt back power. 19
10. Bucket movement becomes slow during tilt back. 20
11. Bucket cannot be held down by the bucket cylinder. 20
12. Bucket has large hydraulic drift. 20
13. Bucket moves unsteadily when machine travels under load. (Main control valve in "Hold"). 20
14. Bucket dumps momentarily when control lever is shifted from "Hold" to "Tilt back". 20
15. Control levers of lift arm and dump move stiffly and sluggishly. 21

★ The following precautions are necessary when using Standard Value Tables to make judgements during troubleshooting or during testing and adjusting.

1. The values in these tables are based on the values for new machines leaving the plant, so they should be used as target values when repairing or when estimating wear after a period of use.

2. The standard values in these tables are used when troubleshooting. They are estimated values based on the standard values for the machine when shipped from the plant, and on the results of various tests. Therefore, they should be used as reference in combination with repair and operating records when making judgements.

3. These standard value tables must not be used for standard values when judging claims. In addition, do not use these values alone to make simple judgements.

★ Before carrying out the troubleshooting in this section, read "PRECAUTIONS WHEN TROUBLESHOOTING", "METHOD OF READING TROUBLESHOOTING TABLES" and "PREVENTING RECURRENCE OF TROUBLE" in SECTION 22.

STANDARD VALUE TABLE
• FOR CHASSIS

Testing and measuring item	Measuring condition	Unit	Standard value	Permissible value
Dump lever and lift lever • Lift lever operating force (Hold - Raise) (Raise - Hold) (Hold - Lower) (Lower - Hold) (Lower - Float) (Float - Hold • Dump lever operating force (Hold - Dump) (Hold - Tilt) (Tilt - Hold • Lift lever travel (Hold - Raise) (Hold - Lower) (Hold - Float) • Dump lever travel (Hold - Dump) (Hold - Tilt)	Hydraulic temperature: 45 - 55°C Engine speed: Low idling	 kg kg mm mm 	 1.5 - 4.5 1.7 - 4.7 1.5 - 4.5 1.5 - 4.5 2.1 - 5.1 1.7 - 4.7 1.5 - 4.5 1.5 - 4.5 2.1 - %.1 70 - 90 70 - 90 150 - 170 70 - 90 70 - 90	 Max 6.8 Max 7.1 Max 6.8 Max 6.8 Max 7.7 Max 7.1 Max 6.8 Max 6.8 Max 7.7 60 - 100 60 - 100 140 - 180 60 - 100 60 - 100
Main control valve • Main relief oil pressure	Hydraulic temperature: 45 - 55°C Engine speed: High idling	kg/cm^2	210+8 -0	210±20
Lift arm and bucket operating speed • Lift arm lifting time • Lift arm lowering time • Bucket dumping time • Bucket tilt back time (full stroke) • Bucket tilt back time (Horizontal position of bucket)	Hydraulic temperature: 45 - 55°C Engine speed: High idling Steering position: Neutral Coolant temperature: Inside operating range Bucket: Unloaded	 seconds	 5.5 - 6.1 2.7 - 3.7 1.2 - 1.8 1.5 - 2.1 0.9 - 1.5	 Max 7.6 Max 4.4 Max 2.2 Max 2.5 Max 1.8
Hydraulic drift to lift arm and bucket • Retraction of lift cylinder rod • Retraction of dump cylinder rod	Hydraulic temperature: 45 - 55°C Coolant temperature: Inside operating range Stop engine, leave for 5 minutes, then measure for next 15 minutes. Lift arm horizontal Bucket horizontal Unloaded	 mm mm	 Max 4.0 Max 4.0	 Max 20 Max 20
Bucket positioner and Boom kick-out • Clearance of switches	Hydraulic temperature: 45 - 55°C	 mm	 Max 5.0	

DUMP AND LIFT CONTROL LEVERS

★ Measurement condition
- Coolant temperature: Inside operating range
- Hydraulic oil temperature: 45 - 55°C
- Engine speed: Low idling

Item			Standard value	Permissible value
Operating force (kg)	Lift control lever	Hold→ Raise	1.5-4.5	Max. 6.8
		Raise→ Hold	1.7-4.7	Max. 7.1
		Hold→ Lower	1.5-4.5	Max. 6.8
		Lower→ Hold	1.5-4.5	Max. 6.8
		Lower→ Float	2.1-5.1	Max. 7.7
		Float→ Hold	1.7-4.7	Max. 7.1
	Dump control lever	Hold→ Dump	1.5-4.5	Max. 6.8
		Hold→ Tilt	1.5-4.5	Max. 6.8
		Tilt→ Hold	2.1-5.1	Max. 7.7
Travel (mm)	Lift control lever	Hold→ Raise	70-90	60-100
		Hold→ Lower	70-90	60-100
		Hold→ Float	150-170	140-180
	Dump control lever	Hold→ Dump	70-90	60-100
		Hold→ Tilt	70-90	60-100

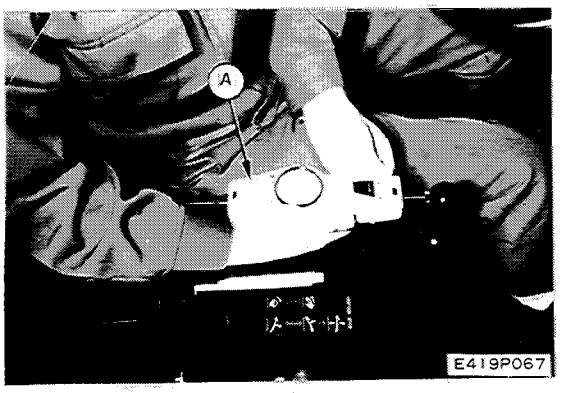
Special tool

	Part number	Part name	Q'ty
A	79A-264-0020	Push-pull scale	1

⚠ Install the safety bar on the frame.

Measuring procedure

1. **Operating force of dump and lift control levers**
   - Fit push-pull scale A on dump and lift control levers and measure operating force.
     - ★ Hook the push-pull scale on the center of the knob.
     - ★ Operate at the same speed as normal and measure the minimum force needed to operate the knob.

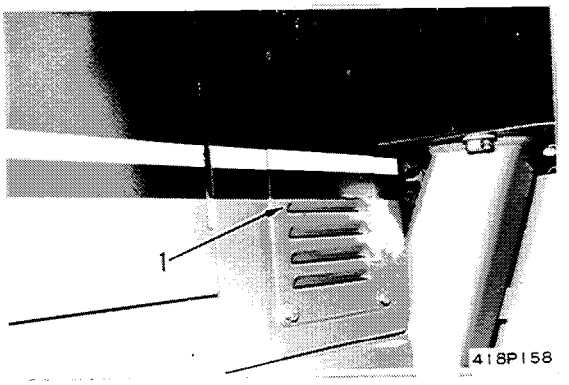


2. **Travel of dump and lift control levers**
   - Measure the travel of the control levers at each position.
     - ★ Mark the knob of the lever and use a scale to measure.
     - ★ If the lever travel is not within the specified value, check the linkage for play and the bushing for wear.

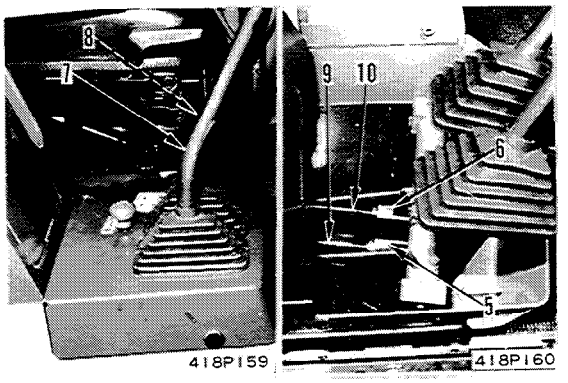


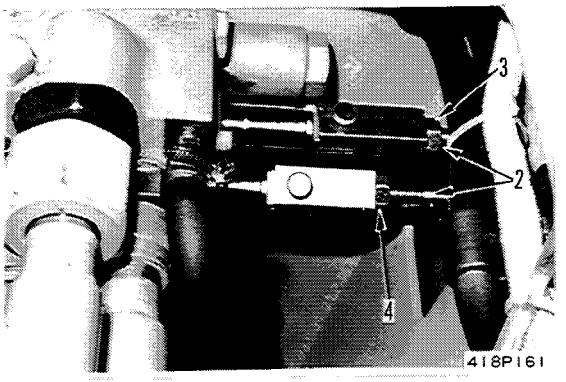
Adjusting procedure

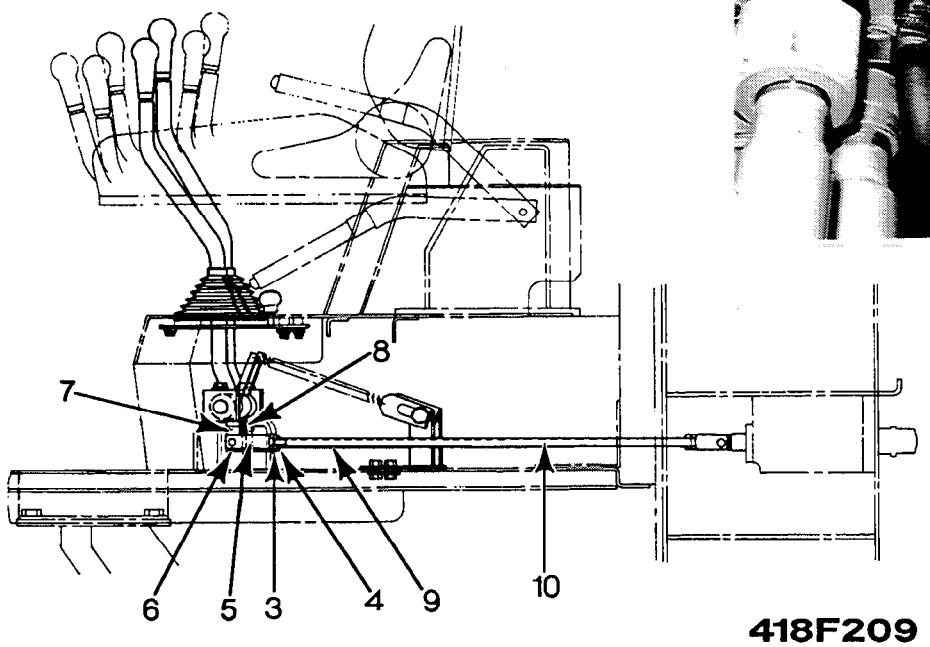
1. **Adjusting linkage rod of control lever**
   1) Remove cover (1) at the bottom of the hydraulic tank.
   2) Loosen lock nuts (3 and 4) of control lever linkage (2).



   3) Disconnect yokes (5 and 6) from levers (7 and 8).
   4) Set the lift and dump levers at neutral (lock the levers), then adjust rods (9 and 10).
   5) Screw the yokes in or out to adjust the length of rods (9 and 10).
      ★ Standard length of rod:
      Rod (9) = 723.4 mm
      Rod (10) = 740.4 mm







418F209

HYDRAULIC PRESSURE

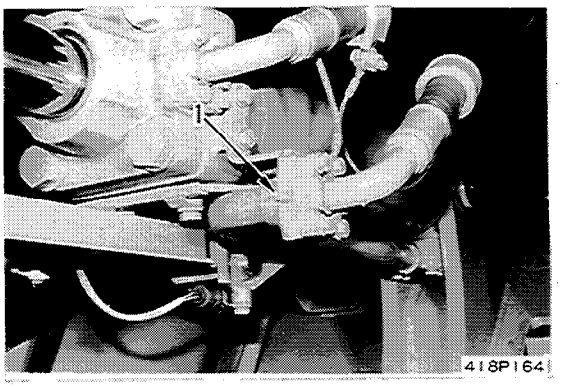
★ Measurement condition
- Coolant temperature: Inside operating range
- Hydraulic oil temperature: 45 - 55°C
- Engine speed: High idling

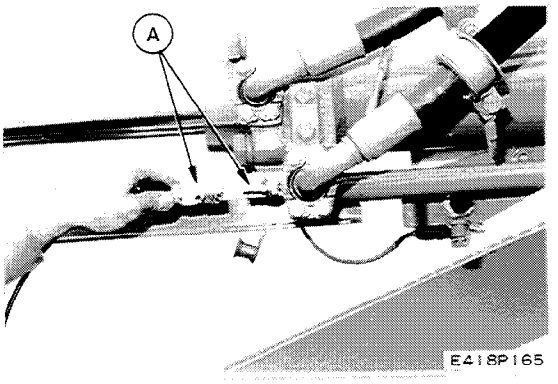
Unit: kg/cm^2

Item	Standard value	Permissible value
Main relief pressure	215^{+8}_{-0}	215±20

Special tool

	Part number	Part name	Q'ty
A	799-101-5000	Hydraulic tester	1





1. Measuring procedure (Main relief valve)

Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the control levers several times to release the remaining pressure in the hydraulic piping.

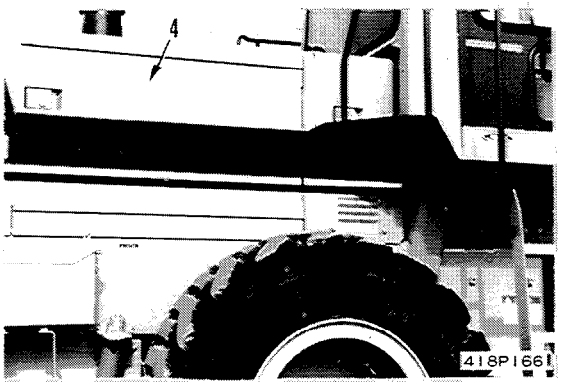
1) Remove plug (1) for measuring pressure of dump cylinder circuit.
2) Install hydraulic tester A to the measuring port.
   ★ Check that there is no oil leakage from any connection.
   ★ Use a hose which is long enough to reach the operator's compartment.
3) Start the engine, raise the lift arm 400 mm from the ground and operate the dump control lever (TILT). Measure the pressure when the relief valve is actuated.
   ★ Be careful not to apply any sudden pressure to the pressure gauge.

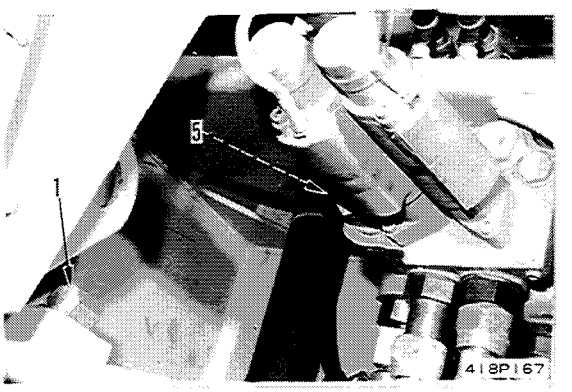
When removing the hydraulic pressure gauge, release the pressure inside the circuit in the same way as when installing.

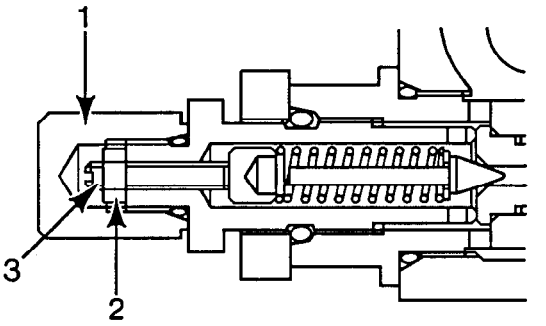
2. Adjusting procedure

⚠ Always stop the engine before adjusting the hydraulic pressure.

1) Stop the engine, open the engine side hood (4).
2) Remove cap nut (1) of the relief valve (5).
3) Loosen lock nut (2), and turn adjustment screw (3) to adjust.
   - ★ Amount of adjustment for 1 turn of screw: 1 turn: Approx. 35.7 kg/cm^2
   - ★ Turn the adjustment screw to adjust as follows:
     To INCREASE pressure, TIGHTEN screw.
     To DECREASE pressure, LOOSEN screw.
   - ★ If the relief pressure cannot be measured accurately, do not try to adjust the pressure.







423F315A

LIFT ARM AND BUCKET

★ Measurement condition
- Coolant temperature: Inside operating range
- Steering position: Neutral
- Hydraulic temperature: 45 - 55°C
- Bucket: Unloaded
- Engine speed: High idling

Unit: sec.

Item	Standard value	Permissible value
Lifting time of lift arm	5.5-6.1	Max. 7.6
Lowering time of lift arm	2.7-3.7	Max. 4.4
Dumping time of bucket	1.2-1.8	Max. 2.2
Tilt back time of bucket (Full stroke)	1.5-2.1	Max. 2.5
Tilt back time of bucket (From horizontal position of bucket)	0.9-1.5	Max. 1.8

Special tool

	Part number	Part name	Q'ty
A	7A0-262-0550	Stop watch	1

Measuring procedure

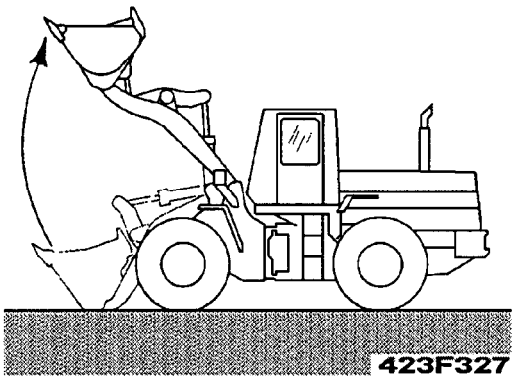
1. **Lifting time of lift arm**
   Set the bucket near the maximum tilt back position and at the lowest position on the ground. Raise the bucket and measure the time taken for bucket to reach the maximum height of the lift arm.

2. **Lowering time of lift arm**
   Set the bucket horizontal with the lift arm at the maximum height, lower the bucket and measure the time taken for the bucket to reach the lowest position on the ground.

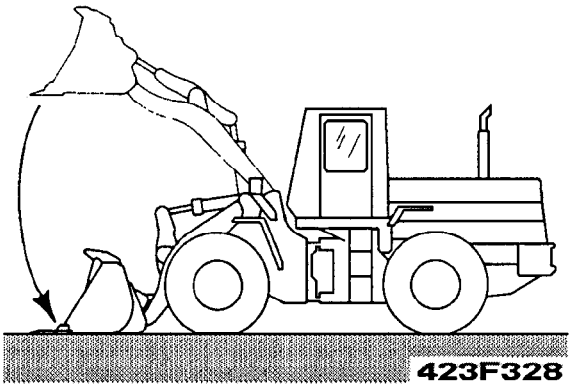
3. **Dumping time of bucket**
   Raise the lift arm to the maximum height and measure the time taken for the bucket to move from the maximum tilt back position to the maximum dump position.

4. **Tilt back time of bucket**
   1) Raise the lift arm to the maximum height and measure the time taken for the bucket to reach the maximum tilt back position.
   2) Set the bucket horizontal and measure the time taken for the bucket to move from the horizontal position to the maximum tilt back position.

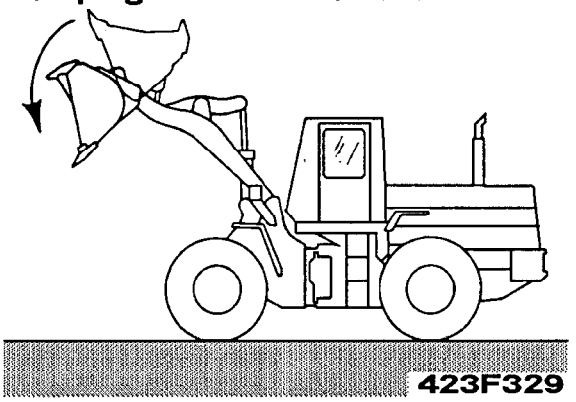
Lifting time of lift arm



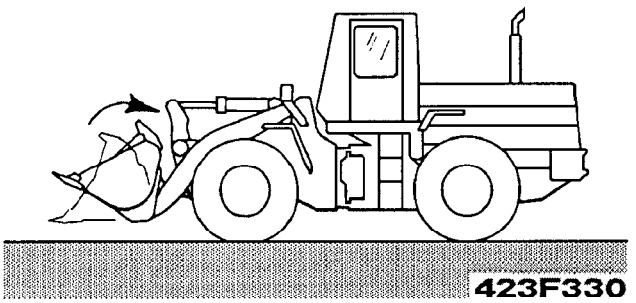
Lowering time of lift arm



Dumping time of bucket



Tilt back time of bucket



HYDRAULIC DRIFT OF LIFT ARM AND BUCKET

★ Measurement condition
- Coolant temperature: Inside operating range
- Hydraulic temperature: 45 - 55°C
- Stop engine, leave for 5 minutes, then measure for next 15 minutes.
- Lift arm horizontal
- Bucket horizontal
- Unloaded

Unit: mm

Item	Standard value	Permissible value
Retraction of lift cylinder rod	Max. 4.0	Max. 20
Retraction of dump cylinder rod	Max. 4.0	Max. 20

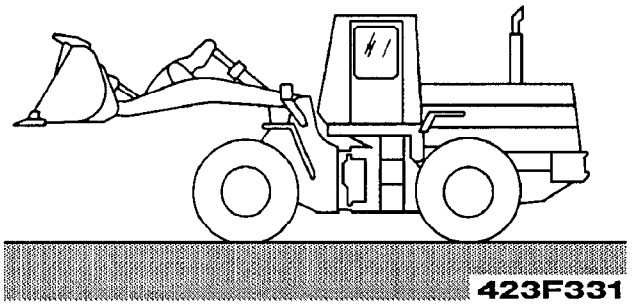
Special tool

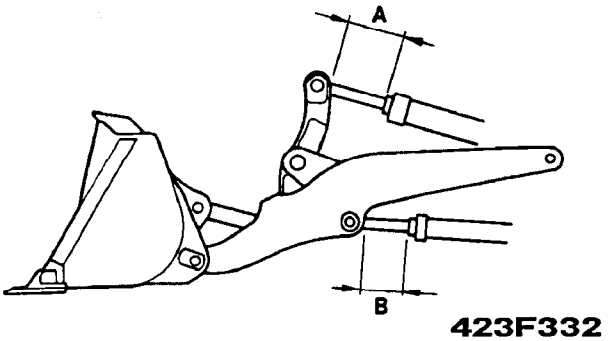
Part number	Part name	Q'ty
Commercially available	Convex scale	1

⚠ Fit the safety locks on the control levers.

⚠ Do not go under the work equipment.

Measuring procedure
1. Set the lift arm and bucket horizontal, then stop the engine.
2. Stop the engine, wait for 5 minutes, then start measuring.
3. Measure the amount that the lift and dump cylinder rods retract during 15 minutes.
   A. Retraction of dump cylinder rod
   B. Retraction of lift cylinder rod


423F331



423F332

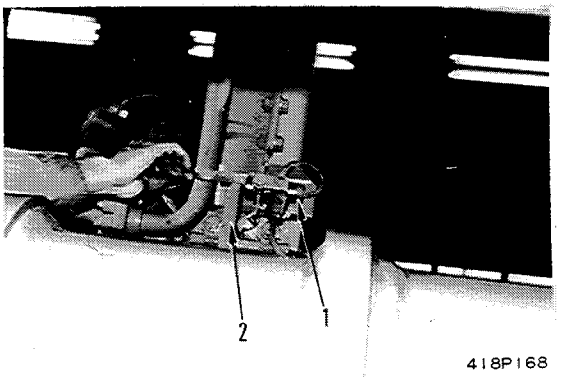
A. Retraction of dump cylinder rod.
B. Retraction of lift cylinder rod.

BUCKET POSITIONER

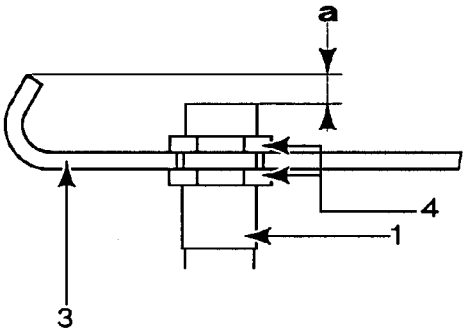
★ Measurement condition
- Coolant temperature: Inside operating range
- Hydraulic oil temperature: 45 - 55°C

Unit: mm

Item	Standard value	Permissible value
Clearance "b" between proximity switch and angle	3-5	



418P168



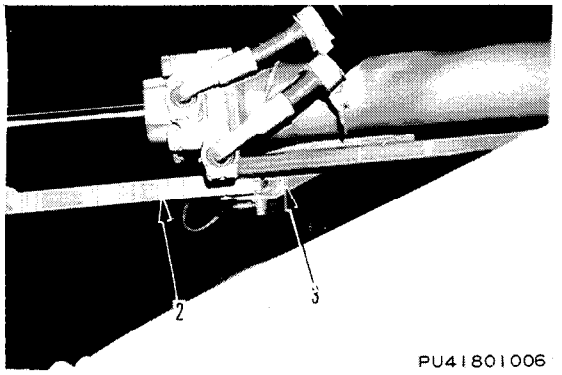
L10CH008

1. Inspection procedure
1) With the engine stopped, check that the clearance "b" between switch (1) and angle (2) is within the standard value.
2) Start the engine, run at high idling and check the actuation position. (Measure three times and take the average.)

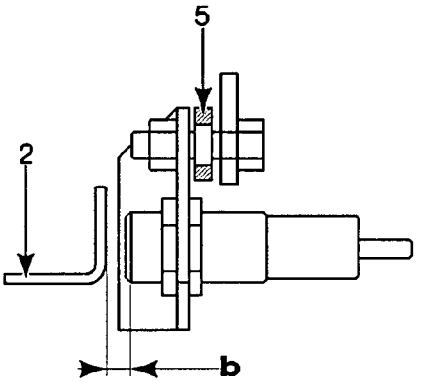
2. Adjusting procedure
1) Lower the bucket to the ground and operate the bucket to the desired digging angle. Return the lever to the hold position and stop the engine.
2) Adjust nut (4) of the proximity switch so that clearance "a" between the tip of protector (3) of proximity switch (1) and the face of the proximity switch sensor is the standard value, then lock in position.
   ★ Clearance "a": 0.5 - 1.0 mm

Nut: 1.8±0.2 kgm

3) Use shim (5) and adjust protector (3) so that clearance "b" between angle (2) and the tip of protector (3) is the standard value.
   ★ Check that protector (3) and angle (2) are not in contact.
   ★ Adjust with shims so that the clearance between angle (2) and the tip of protector (3) is the standard value at the full stroke of the angle, then lock in position.
   ★ Check that the centers of the sensing surface of the proximity switch and angle (2) are in line, then lock in position.
   ★ After adjusting, operate the bucket lever and check that the bucket positioner is actuated at the desired position.



PU41801006



L10CH009

BOOM KICK-OUT

Unit: mm

Item	Standard value	Permissible value
Clearance between proximity switch and bar	3-5	

1. Inspection procedure

1) With the engine stopped, check that the clearance between switch (1) and plate (2) is within the standard value.
2) Start the engine, run at high idling and check the actuation position. (Measure three times and take the average.)

2. Adjusting procedure

1) Raise the lift arm to the desired position. Make a mark on lift arm where switch (1) center aligns plate (2) lower end.

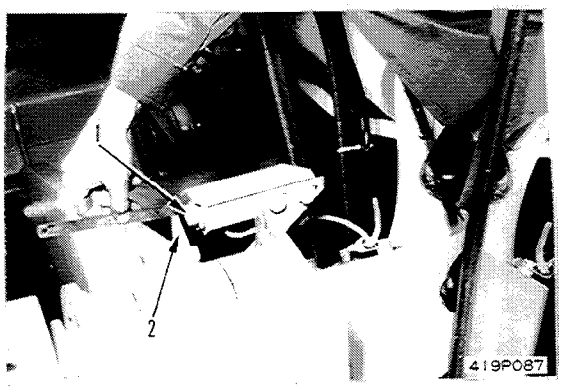
⚠ Always apply the safety lock to the control levers.

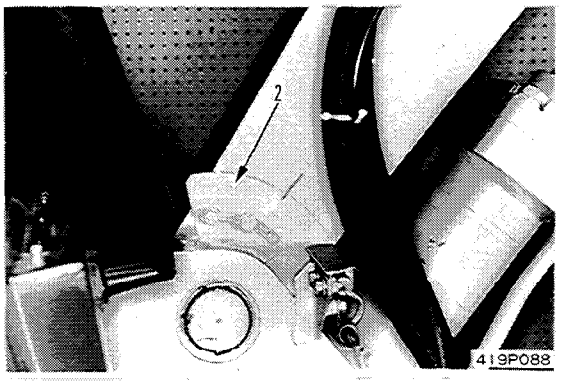
2) Lower the lift arm and stop the engine.
3) Align the marking with the switch (1) center and adjust the plate (2) position so that the switch (1) center and the plate lower end are in line with each other.

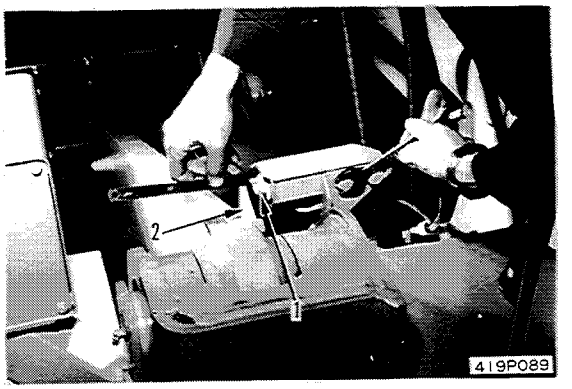
Plate mounting bolt: 9.5±3.5 kgm

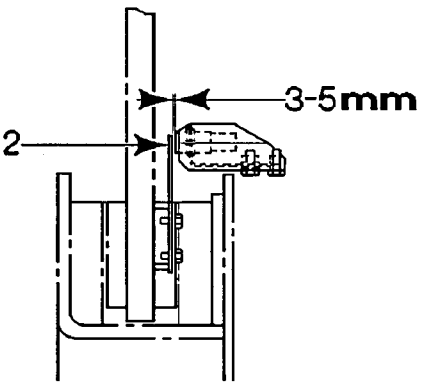
4) Fix the switch so that the clearance between the sensing surface of the switch and plate (2) is 3 - 5 mm.

★ After adjusting, operate the lift lever and check that the kick-out is actuated at the desired position.









419F314A

TROUBLESHOOTING

TROUBLESHOOTING TABLES

1. Lift arm does not rise.

Ask the operator the following questions.
- Did the lift arm suddenly fail to raise? → Seizure or damage to various units.
- Was an unusual noise produced? (Where did it emanate from?)
- Were there previous signs of the lift arm slowing down? → Wear of parts or flattening of spring.

Checks before troubleshooting.
- Is oil level in hydraulic tank correct?
- Is travel of lift arm control lever and spool correct?

No.	Problem \ Remedy / Cause	Blockage on suction side of pump or excessive amount of air contained in oil	Pump PTO is not being driven	Faulty work equipment pump or steering pump	Faulty demand spool (Faulty priority valve) *	Faulty main relief valve	Internal damage to valve body (lift spool)	Damaged lift cylinder piston seal
		Tank to pump		Demand valve (Priority valve)*	Control valve		Cylinder	
		a	b	c	d	e	f	g
		C △	△ X	△ X	C X	△ X	X	X
1	Bucket cannot operate and lift arm is unable to rise.	○	○	○	○	○		
2	The machine body can be lifted up by the lift arm, however the lift arm is unable to rise. Or the bucket operates but the boom is unable to rise.						○	○
3	The lift arm can rise under no load but cannot rise under load.	○		○		○		
4	The hydraulic pump produces an unusual noise.	○		○				
5	Lift cylinder has large amount of hydraulic drift.						○	○
6	When the engine is at high idling, steering action is light and excessively fast.				○			
7	When the engine is at high idling, steering action is heavy and slow.	○		○	(○)*			

L10DD008

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace △: Repair
A: Adjust C: Clean

2. Lift arm moves slowly or does not have sufficient lifting power.

Checks before troubleshooting.

- Is the amount and type of oil in the hydraulic tank correct?
- Is the travel of the lift arm control lever and also the spool of the main control valve correct?
- Seizure of work equipment linkage bushing.

Fault check.

There is a strong relationship between faults involving lifting force and lifting speed. Such faults appear initially in the form of insufficient lifting speed. Measure the lifting speed of the lift arm when loaded and refer to the judgement criterion table to determine whether or not there is a fault.

No.	Problem \ Remedy	C △	△ X	△ X	△ X	A X	X	△ X
	Cause	Tank to pump			Demand valve (Priority valve)*	Control valve		Cylinder
		a	b	c	d	e	f	g
1	Bucket tilt back force and speed are abnormal and lift arm lifting speed is low.	○	○	○	○	○		
2	Bucket tilt back force and speed are normal but lift arm lifting speed is low.						○	○
3	Same as item 1 except that lift arm lifting speed becomes particularly low when oil temperature rises.		○	○				
4	Hydraulic pump emits unusual noise.	○	○	○				
5	When the engine is at high idling, steering action is light and excessively fast.				○			
6	When the engine is at high idling, steering action is heavy and slow.	○		○				
7	Lift arm cylinder has a large amount of hydraulic drift.						○	○
8	The relief pressure of maine relief valve is low					○	○	○

Causes: a Blockage on suction side of pump or excessive amount of air contained in oil; b Faulty work equipment pump; c Faulty steering pump; d Faulty demand spool (Faulty priority valve)*; e Faulty or improperly adjusted main relief valve; f Worn or damaged valve body (lift arm spool); g Damaged lift arm cylinder piston seal

L10DD009

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace △: Repair
A: Adjust C: Clean

3. **Lift arm movement becomes slow after it reaches a certain height.**

   Check before troubleshooting.
   - Visible deformation of lift cylinder.

   Cause
   - Swollen or internally damaged lift cylinder tube.
   - ★ Regarding other faults occurring during lift arm ascent, refer to item "2. Lift arm moves slowly or does not have sufficient lifting power".

4. **Bucket cannot be held down with lift arm cylinder.**
   If the relief pressure in the circuit at the bottom of the lift cylinder is insufficient, refer to item "2. Lift arm moves slowly or does not have sufficient lifting power".

   Checks before troubleshooting.
   - Is level of oil in the hydraulic tank correct?
   - Is travel of main control valve and lift arm spool correct?

   Cause
   - Faulty main control valve or suction valve seat on lift arm cylinder rod side.
   - Oil leakage from lift cylinder piston seal.

5. **Lift arm has large hydraulic drift.**

   Ask the operator the following questions.
   - Did the hydraulic drift suddenly become large? → Dirt lodged in valve or damaged parts.
   - Did the hydraulic drift gradually become large? → Worn parts.

   Checks before troubleshooting.
   - Is the type and temperature of the oil in the hydraulic tank correct?
   - Is the lift arm spool in the neutral position? → Seized link bushing, faulty spool detent.

   Problem and cause
   - When measuring hydraulic drift, internal of lift cylinder produces oil leak noise. → Damaged piston packing.

6. **Lift arm movement is unsteady during work.**
   During excavation or ground leveling when the lift arm control lever is in the "Hold" position, the bucket and lift arm move up and down in accordance with the terrain.

   Problem and cause
   Check the amount of hydraulic drift and whether or not the machine body can be lifted up by the lift cylinder.
   1) If the amount of hydraulic drift is greater than the standard value, refer to item "5. Lift arm has large hydraulic drift".
   2) If the machine body can not be lifted up by the lift cylinder, refer to item "4. Bucket cannot be held down with lift arm cylinder".
   3) If the amount of hydraulic drift is normal and the machine body can be lifted up by the lift cylinder after the lift arm is moved several times to cause the lift cylinder to move through its entire stroke → the trouble is due to the generation of a vacuum in the cylinder.
      - ★ If a vacuum is generated frequently, → faulty suction valve on lift cylinder rod side.

7. **Lift arm descends momentarily when control lever is shifted from "Hold" to "Raise".**
   The lift arm descends momentarily under its own weight when the lift arm control lever is gradually shifted from the "Hold" position to the "Raise" position while the engine is at low idling. When the control lever is put completely into the "Raise" position, the lift arm behaves normally.

   Cause
   - Faulty seating of main control valve or lift arm check valve.

8. Bucket does not tilt back.

Ask the operator the following questions.
- Did the bucket suddenly cease to move? → Seized or damaged equipment.
  Was any unusual noise emitted? Where did it emanate from?
- Were there previous signs of the bucket slowing down? → Worn parts or flattened spring.

Checks before troubleshooting.
- Is amount of oil in hydraulic tank satisfactory?
- Is the travel of the bucket control lever and spool correct?

No.	Problem \ Remedy / Cause	Blockage on suction side of pump or excessive amount of air contained in oil	Pump PTO is not being driven	Faulty work equipment pump and steering pump	Faulty demand spool (Faulty priority valve)*	Faulty main relief valve	Faulty safety valve on dump cylinder bottom side (with suction valve)	Internally damaged valve body (dump spool)	Damaged dump cylinder piston seal
		Tank to pump			Steering valve (Priority valve)*	Control valve			Cylinder
		a	b	c	d	e	f	g	h
		C X	△ X	△ X	X	A X	△ X	X	X
1	Lift arm cannot operate and bucket is unable to tilt back.	○	○	○	○	○			
2	The machine can be lifted up by the bucket but the bucket cannot tilt back. Or the lift arm operates but the bucket cannot tilt back.						○		○
3	The bucket can tilt back under no load but cannot excavate or scoop.	○		○					
4	The hydraulic pump produces an unusual noise.	○		○					
5	Dump cylinder has large hydraulic drift.						○		○
6	Steering action is light and excessively fast when the engine is at high idling.				○				
7	Steering action is heavy and slow when the engine is at high idling.	○			(○)*				

L10DD010

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace △: Repair
A: Adjust C: Clean

9. Bucket moves slowly or has insufficient tilt back power.

Checks before troubleshooting.
- Is the quantity and type of oil in the hydraulic tank satisfactory?
- Is the travel of the bucket control lever and the main control valve spool correct?
- Seizure of bushing in work equipment linkage. (Was an unusual noise produced?)

Fault checks.
- Check the amount of deficient tilt force by performing actual work.
- Measure the operating speed of the bucket and check it against the judgement criterion table to determine whether or not it is normal.

No.	Problem \ Remedy	C △	△ X	△ X	△ X	△A X	△ X	X	X
	Cause	Tank to pump			Demand valve (Priority valve)*	Control valve			Cylinder
		a	b	c	d	e	f	g	h
1	Lift arm lifting force and lifting speed are abnormal and also bucket tilt back force and tilt back speed are abnormal.	○	○	○	○	○			
2	Lift arm lifting force and lifting speed are normal but bucket tilt back force and tilt back speed are abnormal.						○	○	○
3	Phenomena of item 1 become particularly bad when the oil temperature rise.		○	○					
4	The hydraulic pump emits an unusual noise.	○	○	○					
5	Steering action is light and excessively fast when the engine is at high idling.				○				
6	Steering action is heavy and slow when the engine is at high idling.	○		○	(○)*				
7	The dump cylinder has a large amount of hydraulic drift.						○	○	○
8	The relief pressure of main relief valve is low when the engine is at high idling.					○	○	○	○
9	The discharge volume of the hydraulic pump is low.		○	○					

Blockage on suction side of pump ro excessive amount of air contained in oil
Faulty work equipment pump
Faulty steering pump
Faulty demand spool (Faulty priority valve)*
Faulty or incorrectly adjusted main relief valve
Faulty safety with suction valve on bottom of the bucket cylinder
Internally worn or damaged valve body (dump spool)
Damaged dump cylinder piston seal

L10DD011

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace △: Repair
A: Adjust C: Clean

10. Bucket movement becomes slow during tilt back.

Check before troubleshooting.
- External deformation of dump cylinder.

Cause
- Swollen or internally damaged dump cylinder tube.
- Regarding other faults which occur when the bucket operates, refer to item "9. Bucket moves slowly or has insufficient tilt back power".

11. Bucket cannot be held down by the bucket cylinder.
Refer to item "9. Bucket moves slowly or has insufficient tilt back power".

Checks before troubleshooting.
- Is oil level in the hydraulic tank satisfactory?
- Is the travel of the main control valve dump spool correct?

Cause
- Faulty seat of safety with suction valve of control valve for the bottom side of dump cylinder.
- Oil leakage from seal of dump cylinder piston.

12. Bucket has large hydraulic drift.

Ask the operator the following questions.
- Did the hydraulic drift suddenly become large? → Dirt lodged in valve or damaged parts.
- Did the hydraulic drift gradually become large? → Worn parts.

Checks before troubleshooting.
- Is the type and temperature of the oil in the hydraulic tank correct?
- Is the dump spool in the neutral position? → Seized link bushing, faulty spool detent.

Fault check.
- Use the judgement criterion table to check whether or not the hydraulic drift of the bucket is actually large.

Cause
- Oil leakage in dump cylinder.
- Faulty seating of safety valve with suction valve on bottom side.
- Faulty oil sealing on spool of dump control valve.

13. Bucket moves unsteadily when machine travels under load. (Main control valve in "Hold").

Checks before troubleshooting.
- Is oil level and type of oil in the hydraulic tank correct?
- Excessive play in pin and bushing of work equipment linkage.
- Was an unusual noise produced?

Cause
- Faulty piston seal of dump cylinder.
- Faulty safety valve with suction valve for the rod side of dump cylinder.
  If the above symptoms occur together with other symptoms, refer to the problem items corresponding to each fault.

14. Bucket dumps momentarily when control lever is shifted from "Hold" to "Tilt back".
The bucket dumps momentarily under its own weight when the dump control lever is gradually shifted from the "Hold" position to the "Tilt back" position while the engine is at low idling. When the control lever is put completely into the "Tilt back" position, the bucket behaves normally.

Cause
- Faulty seating of main control valve dump spool check valve.

15. Control levers of lift arm and dump move stiffly and sluggishly.

Fault check.
Using the judgement criterion table, check whether or not the operating force of the lever is large.

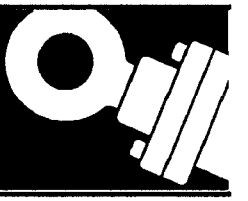
No.	Problem \ Remedy	Lever	Main control valve					
	Cause	a	b	c	d	e	f	g
		Seizure of control lever or rotating parts of link	Distortion of valve body due to non-uniform tightening of valve mounting bolts	Bent main control valve spool	Sticking of detent of main control valve spool	Incorrect clearance between main control valve body and spool	Poor roundness of main control valve body and spool	Foreign matter lodged in main control valve spool
		△ X	△ X	X	△ X	X	X	△ X
1	Movement of lift arm and bucket control levers becomes sluggish when load is applied and oil pressure increases.		○			○		
2	Movement of lift arm and bucket control levers becomes sluggish along with change in oil temperature.		○			○		
3	Movement of lift arm and bucket control levers becomes generally sluggish irrespective of oil pressure and temperature.				○			
4	Movement of lift arm and bucket control levers becomes partially sluggish irrespective of oil pressure and temperature.	○	○	○			○	
5	Movement of lift arm and bucket control levers does not become light even when the link of the control lever is disconnected at the valve connection part and the lever operated.	○						

L10DD012

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace △: Repair
A: Adjust C: Clean

WORK EQUIPMENT SYSTEM
63 DISASSEMBLY AND ASSEMBLY



HYDRAULIC TANK 3
REMOVAL 3
INSTALLATION 5

HYDRAULIC FILTER 7
REMOVAL 7
INSTALLATION 7

HYDRAULIC, STEERING PUMP 8
REMOVAL 8
INSTALLATION 9

MAIN CONTROL VALVE 10
REMOVAL 10
INSTALLATION 12
DISASSEMBLY 15
ASSEMBLY 16

DUMP CYLINDER 17
REMOVAL 17
INSTALLATION 19
DISASSEMBLY 20
ASSEMBLY 22

LIFT CYLINDER 24
REMOVAL 24
INSTALLATION 25
DISASSEMBLY 26
ASSEMBLY 28

WORK EQUIPMENT 30
REMOVAL 30
INSTALLATION 33

COUNTERWEIGHT 36
REMOVAL 36
INSTALLATION 36

★ For details of disassembly and assembly of the gear pump, see SECTION 97.

★ Take the following method for air bleeding when you start to operate hydraulic cylinders after reassembling cylinders, pumps and pipings.

1. Start engine, keep idling.
2. Operate hydraulic cylinder 4 - 5 cycles, but do not exceed beyond 100 mm of stroke end.
3. Continue to operate cylinder 3 - 4 cycles until stroke end.
4. After finishing above steps, keep normal engine speed.

   NOTE: After long storage, same procedure is required.

HYDRAULIC TANK
REMOVAL

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Open the hood and fit the lock.

⚠ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the control lever 2 or 3 times to eliminate the residual pressure in the piping.

- Loosen plug (1) at the top of the hydraulic tank filter, and plug (2) of the pump piping to prevent the oil inside the tank from flowing out.
  ★ First remove right side ladder.

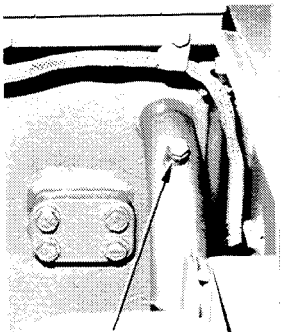
1. **Hood**
   Remove engine side hood (3), left and right side panels (4), exhaust pipe (5) and center hood (6).

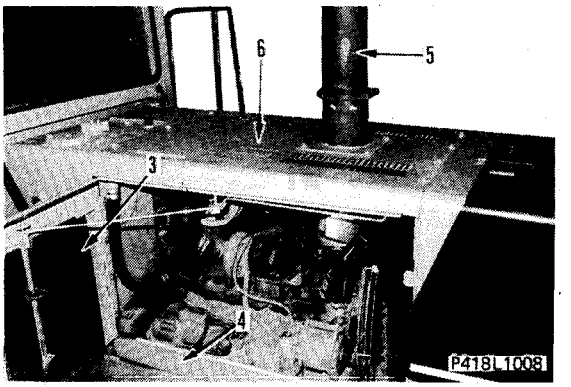
2. **Brake hose**
   Disconnect hoses (7 and 8) between brake oil tank and power master cylinder at brake oil tank end, and remove lower section clamp.

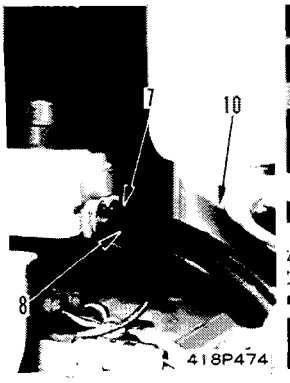
3. **Electrical wiring connector, washer vinyl hose**
   1) Disconnect electric wiring from connector (9).
   2) Disconnect washer vinyl hose (10).

4. **Hydraulic piping**
   Disconnect the following hydraulic piping.
   - Loosen U-clamp nut (11) of the main control piping.
   - Disconnect tube (12) between main control valve and hydraulic tank at main control valve end, then remove hydraulic tank support.
   - Disconnect lift cylinder tubes (13 and 14) from main control valve.
   - Disconnect dump cylinder tubes (15 and 16) from main control valve.
   - Disconnect steering valve hose (17) from main control valve.

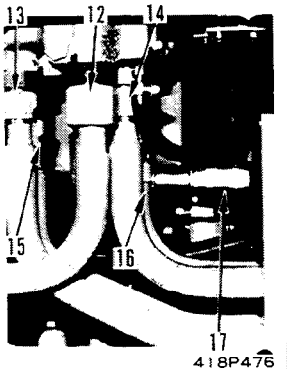






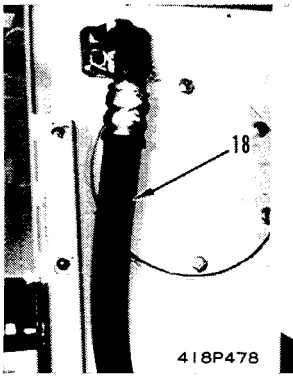


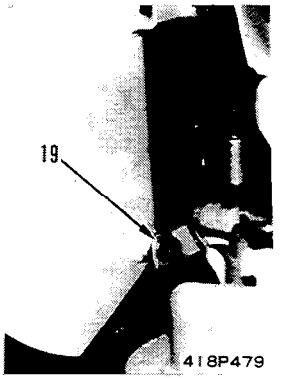


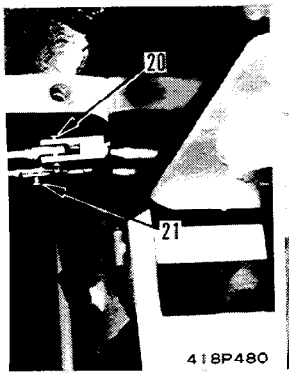


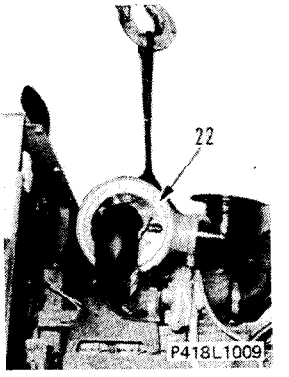


- Disconnect hose (18) between main control valve and hydraulic tank at hydraulic tank end.
  - ★ Remove hose support (19).

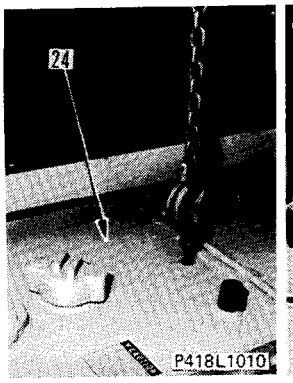


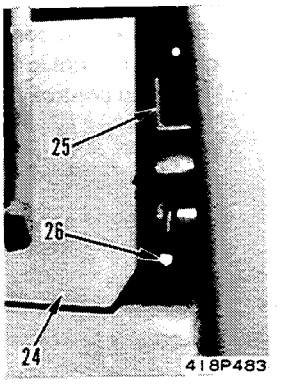






5. **Work equipment control linkage**
   Disconnect work equipment control linkage (20 and 21) at main control valve end.

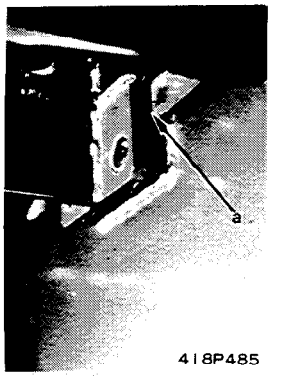




6. **Air cleaner**
   Remove air cleaner (22).

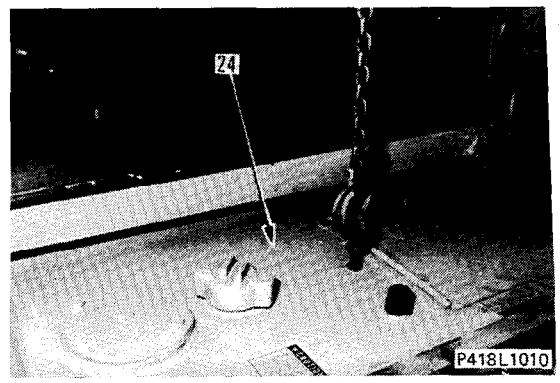
7. **Hydraulic tank**
   1) Using eye bolt, lift hydraulic tank (24), move to the right and remove U-clamp supports (25 and 26) of the main control piping.
      - ★ When lifting the hydraulic tank (24), check that part 'a' is free from interference.
   2) Sling and remove hydraulic tank (24).
      - ★ Remove slowly because there are glass windows in the cab.

kg Hydraulic tank: 140 kg

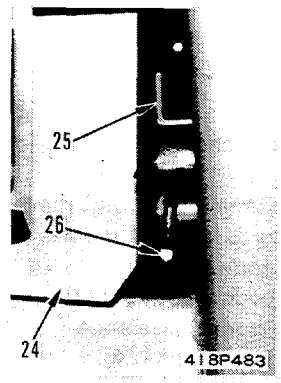


INSTALLATION

1. **Hydraulic tank**
   1) Using eye bolts, raise hydraulic tank (17), set in mounting position, then install mounting bolts.
      - ★ Tighten the mounting bolts temporarily, then tighten them fully after installing all sections of hood.
      - ★ Before setting hydraulic tank in mounting position, temporarily attach U-clamp supports (25 and 26) of piping to hydraulic tank.
      - ★ When installing hydraulic tank, first install hose (27) between hydraulic tank and hydraulic and steering pump.

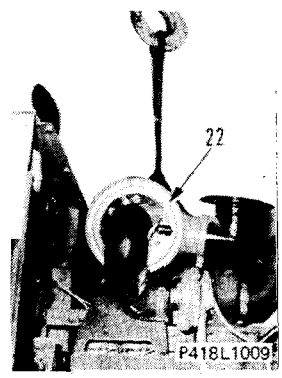


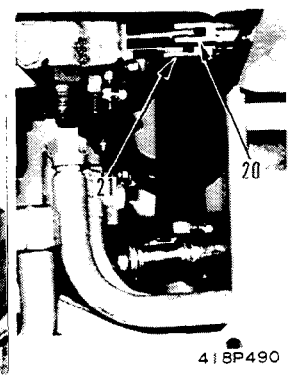
2. **Air cleaner**
   Install air cleaner (22).



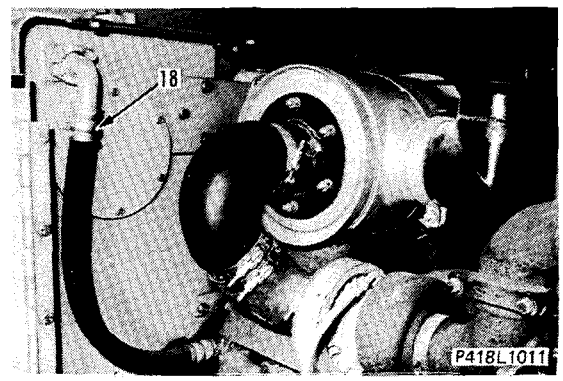


3. **Work equipment control linkage**
   Connect work equipment control linkage (20 and 21) at main control valve end.

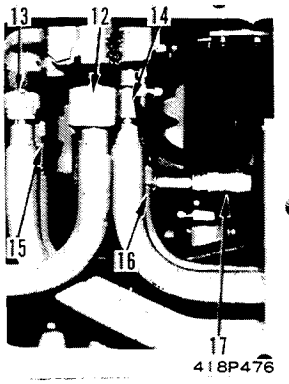




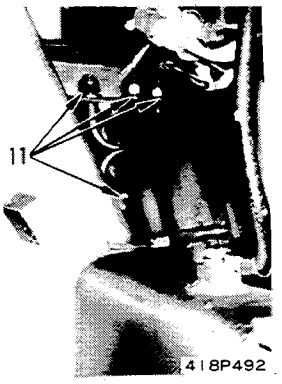
4. **Hydraulic piping**
   Connect the following hydraulic piping.
   - Install hose (18) between main control valve and hydraulic tank at hydraulic tank end.



- Connect steering valve hose (17) at main control valve.
- Connect dump cylinder tubes (15 and 16) at main control valve.
- Connect lift cylinder tubes (13 and 14) at main control valve.
- Tube nut width across the flat: 36 mm
- Connect tube (12) between main control valve and hydraulic tank at main control valve end. Then, install support (19) to hydraulic tank.
- Tube nut width across the flats: 41 mm
- ★ Be careful not to over-tighten U-clamp nut (11) of piping.



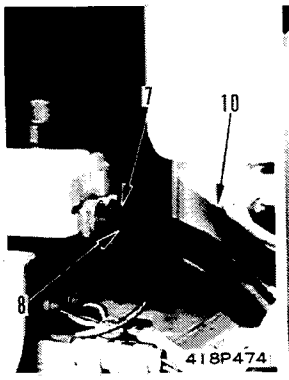
418P476



418P492

5. **Electrical wiring connector, washer vinyl hose**
   1) Connect washer vinyl hose (10).
   2) Connect electric wiring connector (9).

6. **Brake hose**
   Connect hoses (7 and 8) between brake oil tank (24) and power master cylinder at brake oil tank end.

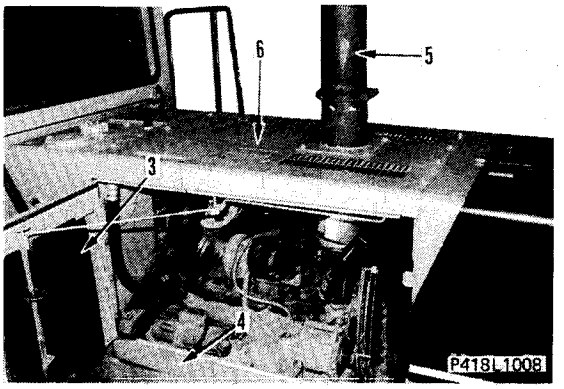


418P474



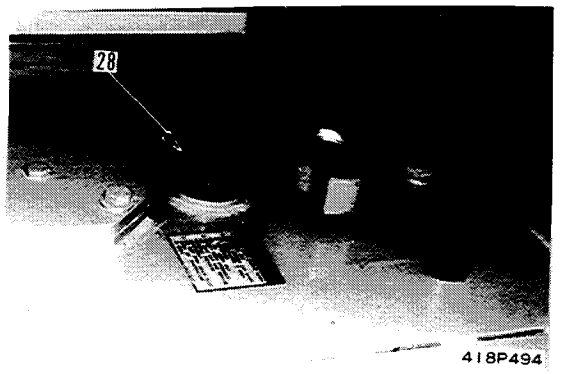
418P493

7. Install engine side hood (3) and side panels (4) on left and right sides, install engine center hood (6) and exhaust pipe (5), then tighten mounting bolt of hydraulic tank.



P418L1008

8. **Refilling with oil**
   Tighten plug at top of hydraulic tank filter, and plug of pump piping, then add hydraulic oil through oil filler (28) to the specified level.
   - ★ Run the engine to circulate the oil through the system. Then check the oil level again.
   - ★ Install right side ladder.
   - ★ For details of bleeding air from brakes, see SECTION 52, TESTING AND ADJUSTING.



418P494

HYDRAULIC FILTER

REMOVAL

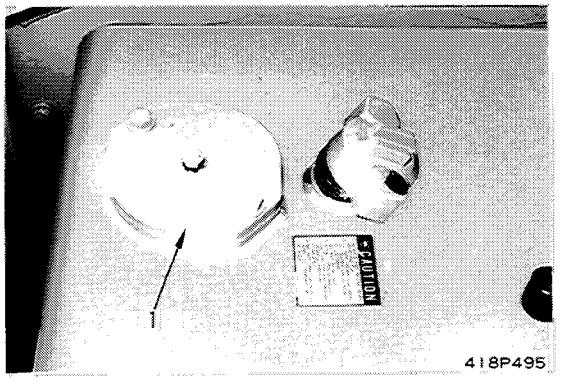
Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

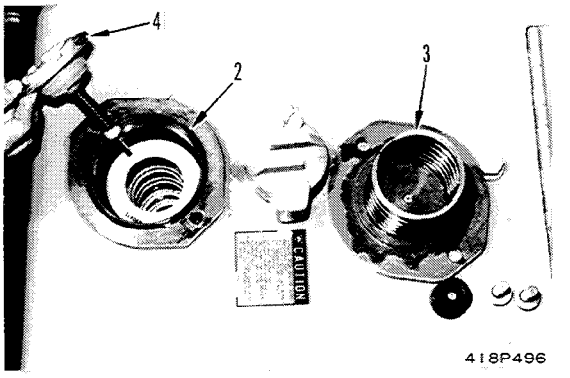
1. **Cover**
   Remove mounting bolts, then remove cover (1).

The tension of the spring is pushing the cover, so be careful when removing.

★ Be careful not to damage the O-ring (2) and the contact faces of the cover and tank.

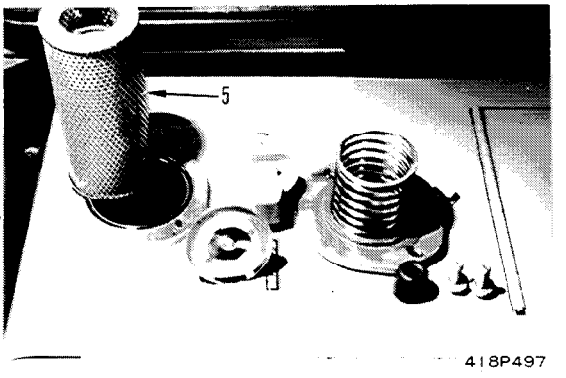
2. **Filter**
   Remove spring (3) and bypass valve (4), then remove filter (5).





INSTALLATION

1. **Filter**
   Install filter (5), then install bypass valve (4) and spring (3).



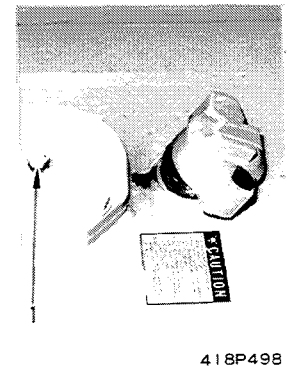
2. **Cover**
   Fit O-ring (2) in groove of cover, then install cover (1) to tank.
   ★ Replace the O-ring with a new part.
   ★ Fit the O-ring securely in the groove, and make sure that it is not caught when installing.

HYDRAULIC, STEERING PUMP
REMOVAL

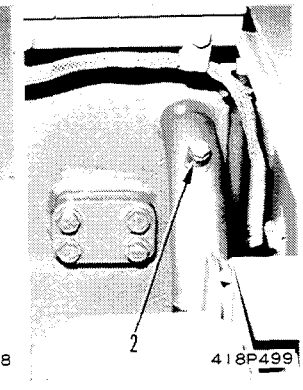
⚠ Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.

Loosen the oil filler cap to relieve the pressure in the hydraulic oil tank, then operate the control lever 2 or 3 times to eliminate the residual pressure in the piping.

- Loosen plug (1) at the top of the hydraulic tank filter, and plug (2) of the pump piping to prevent the oil inside the tank from flowing out.



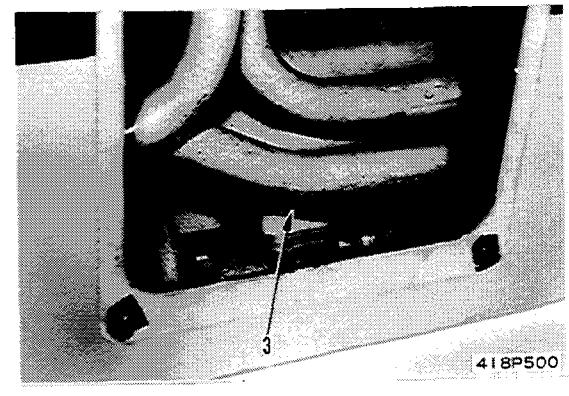
418P498



418P499

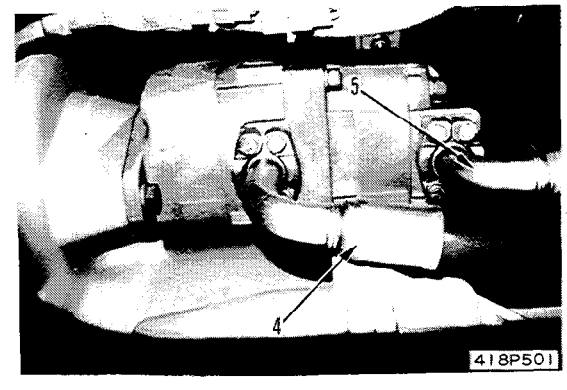
1. Hydraulic piping

1) Disconnect tube (3) between hydraulic tank and hydraulic and steering pump at pump end.



418P500

2) Disconnect hose (4 and 5) between hydraulic and steering pump and steering valve at pump end.



418P501

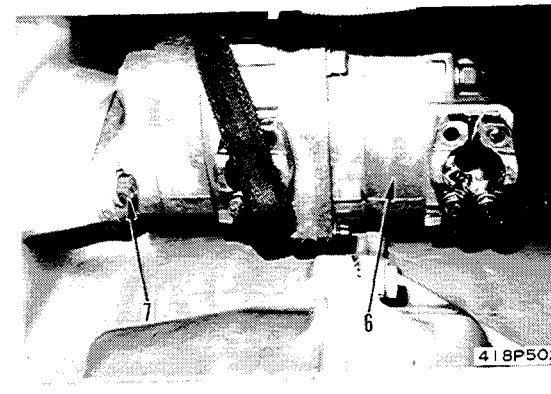
2. Hydraulic, steering pump

Sling hydraulic and steering pump (6), remove mounting bolts (7), then remove pump (6).

★ The removal of the pump should be carried out by two workers. Remove pump from lower inspection access port.

★ There is little space to work, so be careful.

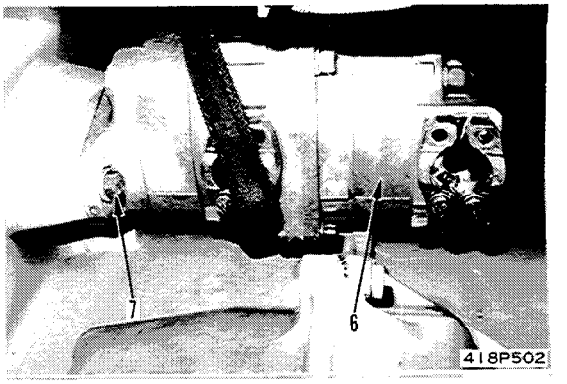
kg Hydraulic and steering pump: 13 kg



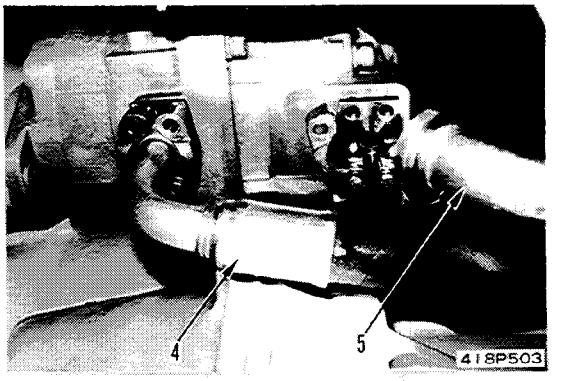
418P502

INSTALLATION

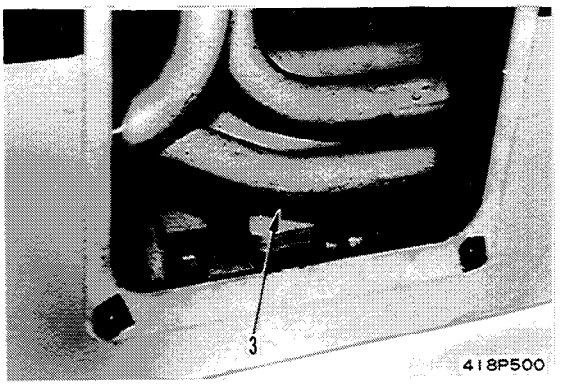
1. **Hydraulic and steering pump**
   Set pump (6) in mounting position, then tighten mounting bolts (7).
   - ★ Check that there is an O-ring installed between the pump and housing.
   - ★ This operation should be carried out by two workers.
   - ★ There is little space, so be careful when working.



2. **Hydraulic piping**
   1) Connect hoses (4 and 5) between hydraulic and steering pump and steering valve at pump end.

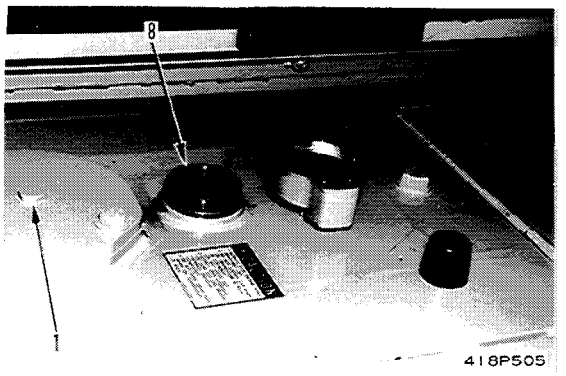


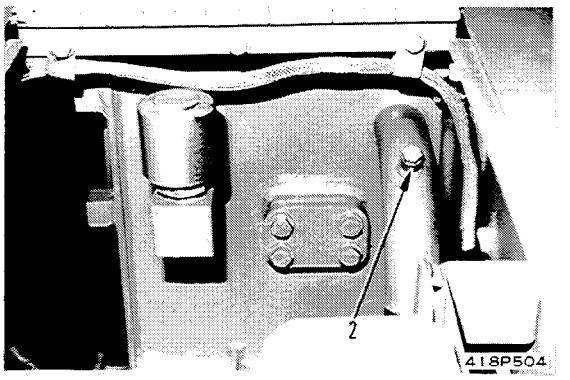
   2) Connect tube (3) between hydraulic tank and hydraulic and steering pump at pump end.



3. **Cover**
   Install inspection access cover.

4. **Refilling with oil**
   Tighten plug (1) at top of hydraulic tank filter, and plug (2) of pump piping, then add hydraulic oil through oil filler (8) to the specified level.
   - ★ Run the engine to circulate the oil through the system. Then check the oil level again.

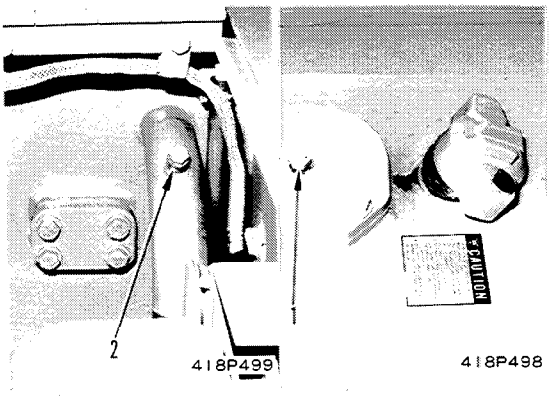




MAIN CONTROL VALVE
REMOVAL

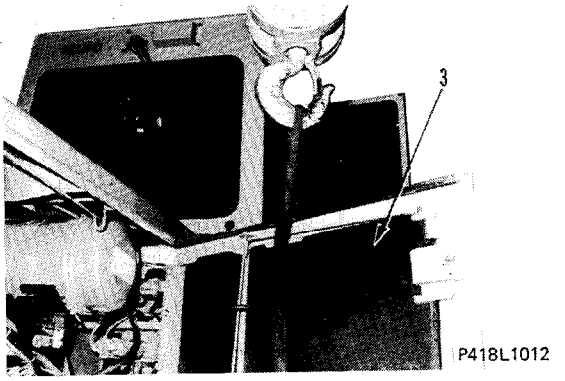
⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Loosen the oil filler cap to relieve the pressure in the hydraulic oil tank. Then operate the control levers 2 or 3 times to eliminate the residual pressure in the piping.

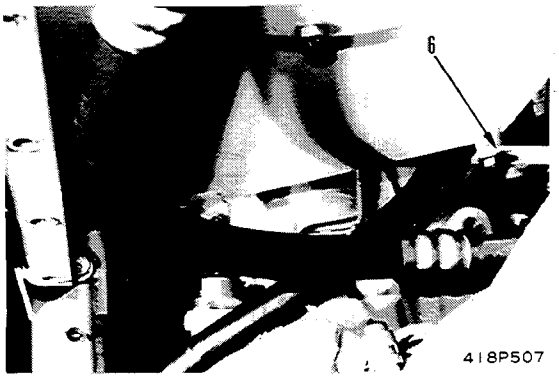


- Loosen plug (1) at the top of the hydraulic tank filter, and plug (2) of the pump piping to prevent the oil inside the tank from flowing out.

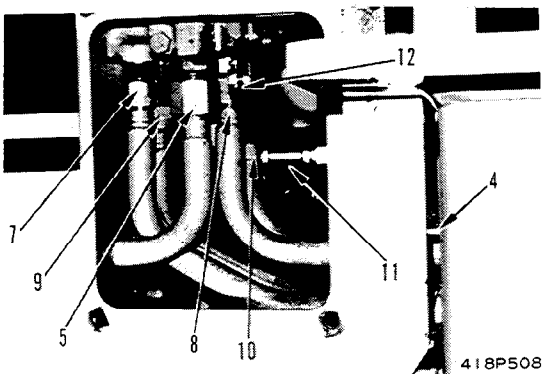
1. **Hood**
   Sling engine right side hood (3) and remove.



2. **Hydraulic piping**
   Disconnect the following hydraulic piping.
   - Remove mounting bolts of upper side of hose support (4) and loosen U-clamp nut that secures work equipment piping.
   - Disconnect tube (5) between main control valve and hydraulic tank at main control valve end.
     ★ Remove mounting bolts of support (6) of hydraulic tank.

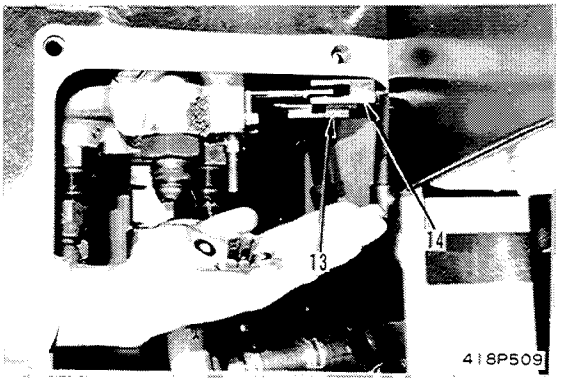


   - Disconnect lift cylinder tubes (7 and 8) from main control valve.
   - Disconnect dump cylinder tubes (9 and 10) from main control valve.
   - Disconnect hose (11) between steering valve and main control valve at main control valve end.
   - Disconnect hose (12) between main control valve and hydraulic tank at main control valve end.

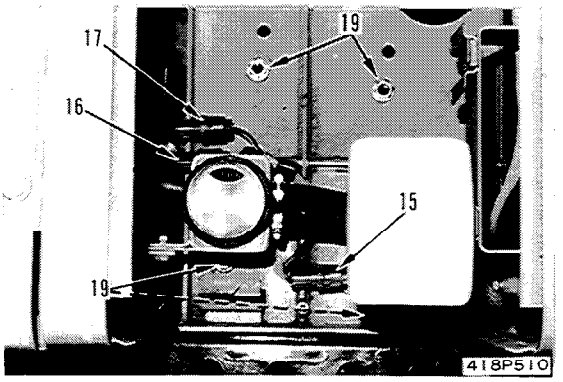


3. Main control valve

1) Disconnect main control valve linkage (13 and 14) at main control valve end.



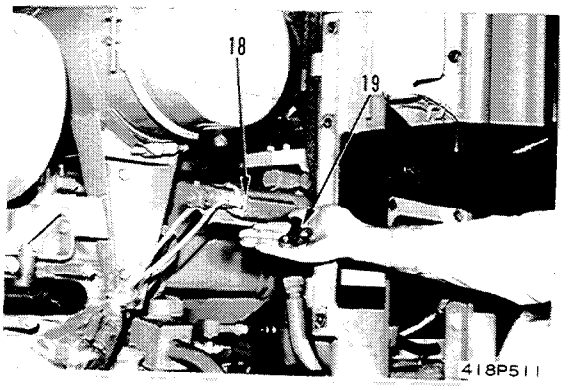
2) Disconnect connector (15) of brake oil level sensor and connectors (16 and 17).

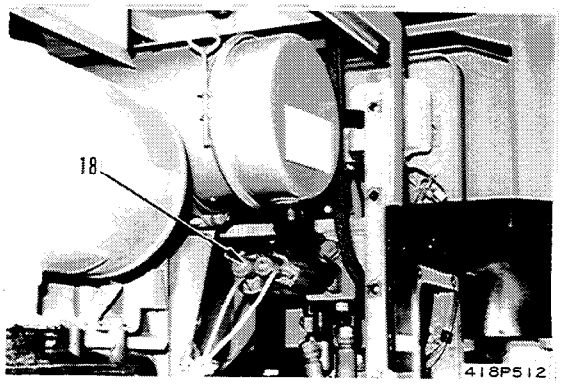


3) Sling main control valve (18), remove mounting bolts (19), then lift off.

kg Main control valve: 20 kg

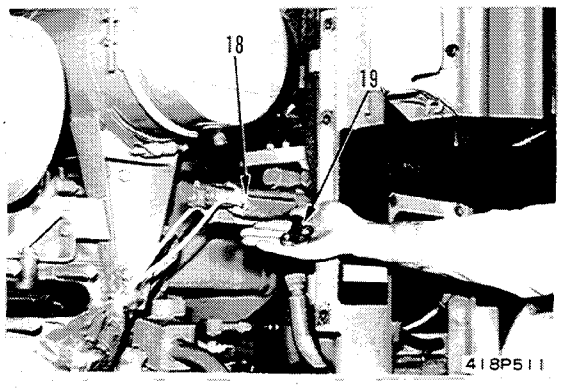
★ Be careful not to let the lifting tool slip when raising the main control valve.



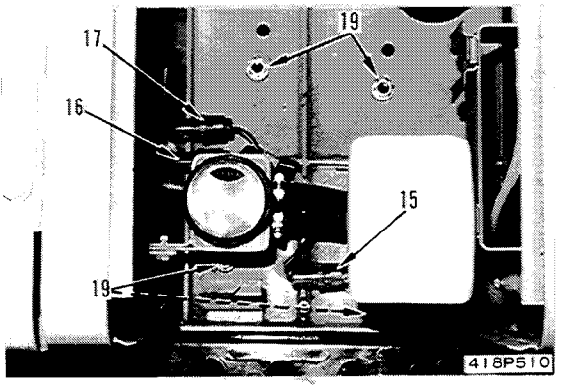


INSTALLATION

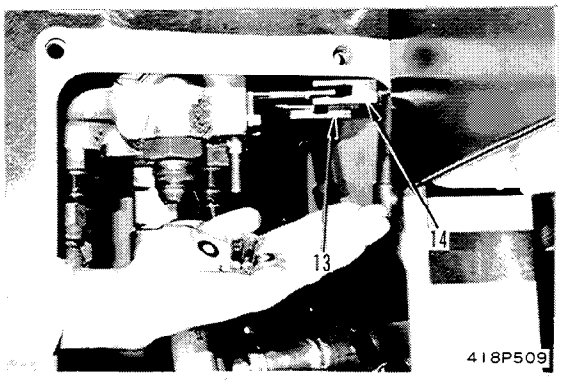
1. **Main control valve**
   1) Set main control valve (18) in mounting position, then tighten mounting bolts (19).
      ★ Tighten the mounting bolts on diagonally opposite sides and be careful not to deform the valve.



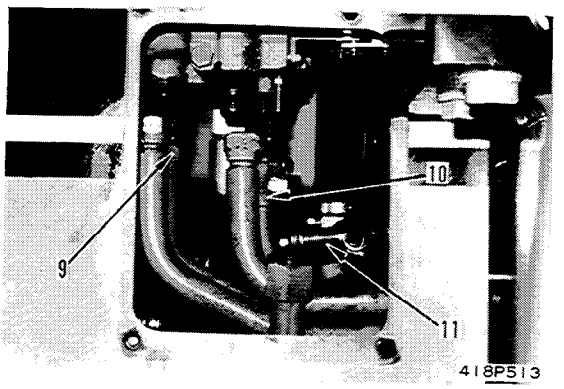
   2) Connect connector (15) of brake oil level sensor and connectors (16 and 17).



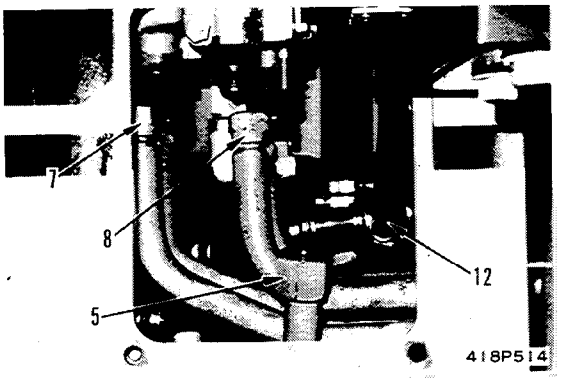
   3) Connect main control valve linkage (13 and 14) to main control valve.



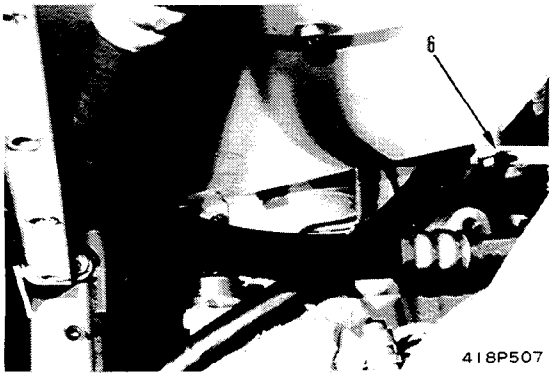
2. **Hydraulic piping**
   Connect the following hydraulic piping.
   - Connect hose (11) between steering valve and main control valve at main control valve end.
   - Connect dump cylinder tubes (9 and 10) to main control valve.



- Connect lift cylinder tubes (7 and 8) to main control valve.
- Tube nut width across the flat: 36 mm
- Connect tube (5) between main control valve and hydraulic tank at main control valve end.
- Tube nut width across the flat: 41 mm
- Connect hose (12) between hydraulic tank and main control valve at hydraulic tank end.
- Install hose support (6) at hydraulic tank side face.
- Secure upper side of hose support (4) with mounting bolts, then tighten U-clamp nuts of main control piping.
  ★ Be careful not to over-tighten U-clamp nuts.

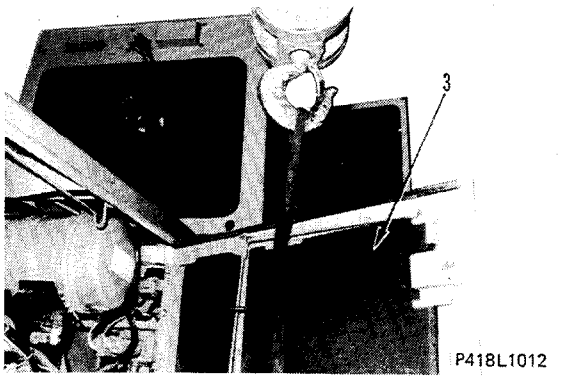


418P514



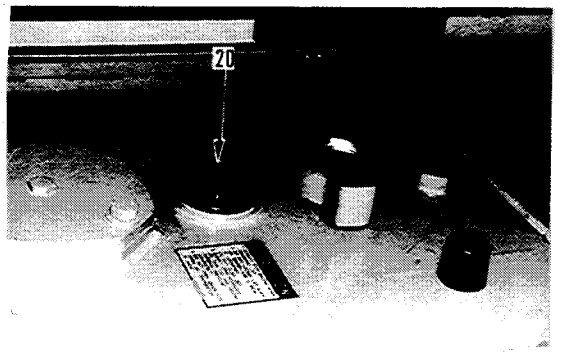
418P507

3. Hood
Mount right engine side hood (3).

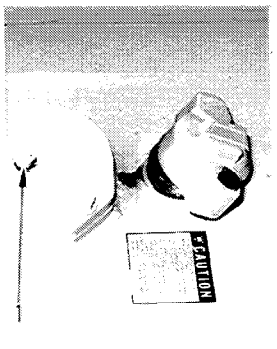


P418L1012

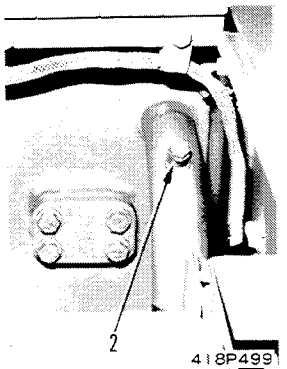
4. Refilling with oil
Tighten plug (1) at top of hydraulic tank filter, and plug (2) of pump piping, then add hydraulic oil through oil filler (20) to the specified level.



418P515

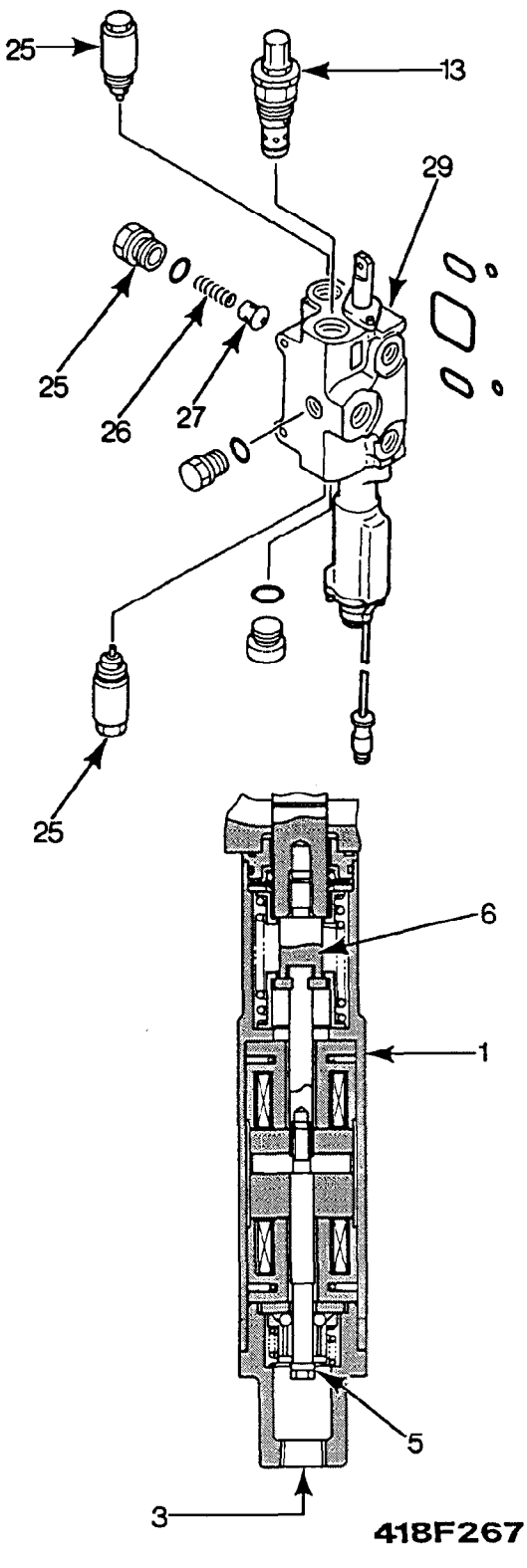


418P498

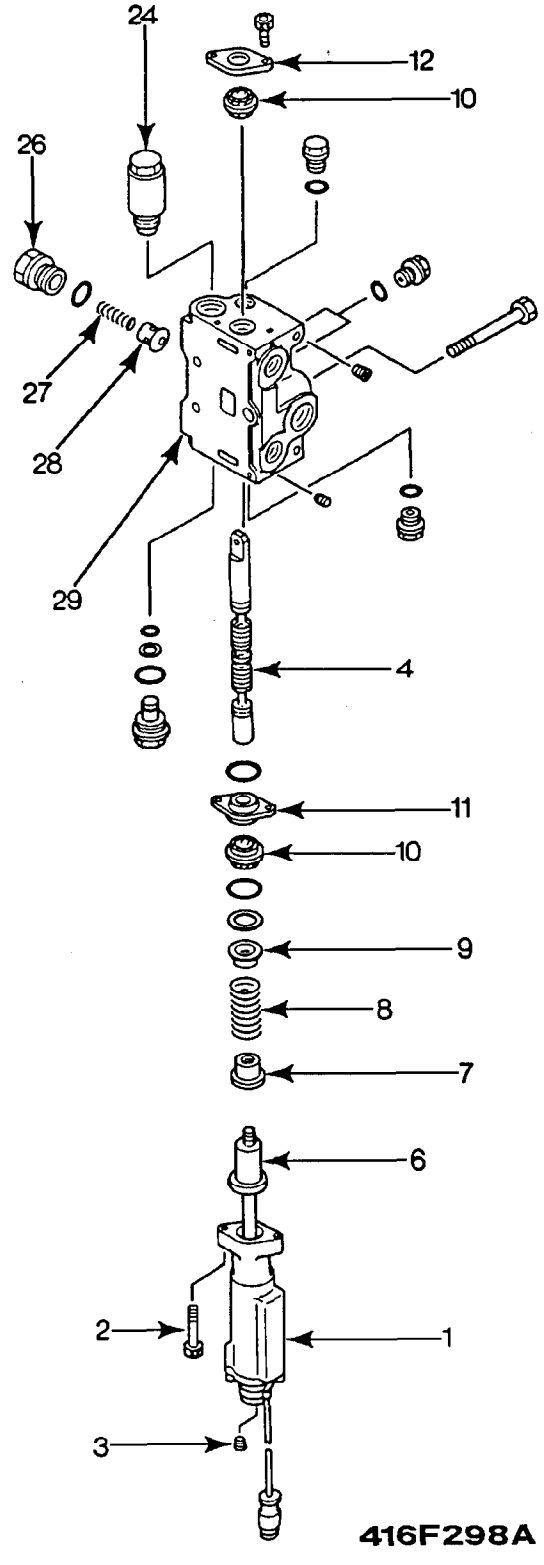


418P499

DISASSEMBLY AND ASSEMBLY OF MAIN CONTROL VALVE



418F267



416F298A

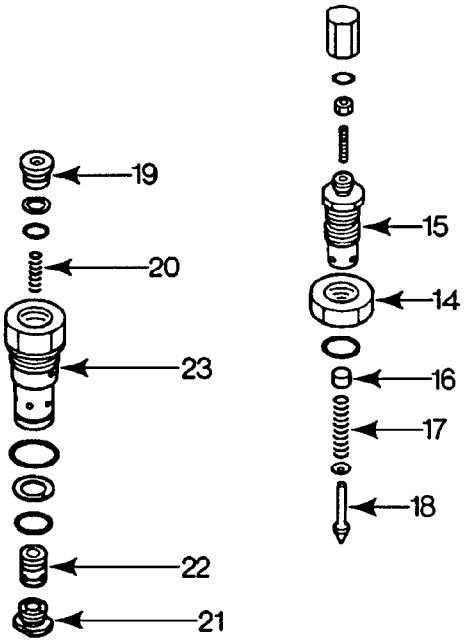
DISASSEMBLY

1. **Spool assembly**
   1) Remove mounting bolt (2) and plug (3) of detent assembly (1).
   2) Hold spool (4) from moving, loosen bolt (5) inside detent assembly (1), then remove detent assembly (1).
      ★ Remove joint (6) from spool (4).
   3) Remove retainer (7), spring (8), retainer (9), oil seal (10) and plate (11).
   4) Remove retainer (12), then remove oil seal (10) and spool (4).

2. **Main relief valve assembly**
   1) Remove main relief valve assembly (13).
   2) Loosen nut (14), and screw out holder (15), then remove retainer (16), spring (17), poppet (18), seat (19) and spring (20).
   3) Remove plug (21), then remove valve (22) from sleeve (23).
      ★ Valve (22) and sleeve (23) are not available as individual parts, so replace them as a set.

3. Remove safety valve assembly (25) with suction valve and suction valve assembly (24).

4. Remove plug (26), then remove spring (27) and valve (28).



416F300

ASSEMBLY

1. Assembly valve (28) and spring (27) in body (29), then fit O-ring and tighten plug (26).

   Plug: 11±1.5 kgm

2. Fit O-ring and install suction valve assembly (24) and safety valve assembly (25) with suction valve.

   Safety valve: 14.5±2 kgm

   Suction valve: 14.5±2 kgm

3. **Main relief valve assembly**
   1) Assemble valve (22) in sleeve (23), then tighten plug (21).
   2) Assemble spring (20), seat (19), poppet (18), spring (17) and retainer (16) in sleeve.
   3) Screw nut (14) into holder (15), fit O-ring on holder, then install the holder into sleeve (23) and tighten nut (14).
   4) Fit O-ring and back-up ring and install main relief valve assembly (13).

   Main relief valve: 8.5±1.5 kgm

4. **Spool assembly**
   1) Assemble spool (4) in body, then install oil seal (10) and retainer (12).
   2) Pull out spool slightly, then assemble retainer (11), oil seal (10), retainer (9), spring (8), and retainer (7).
   3) Hold spool from moving, turn bolt inside detent assembly (1), and install joint (6) to spool (4).

   Joint: 1.5±0.5 kgm

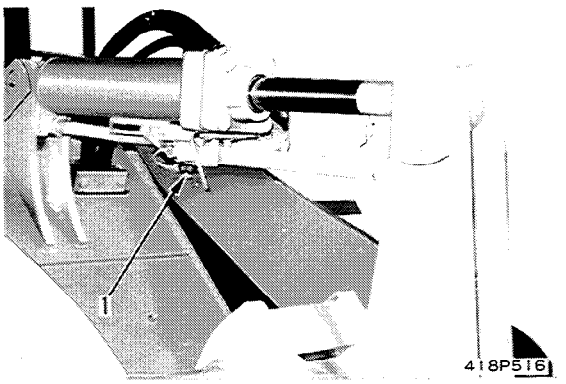
   4) Tighten bolt (5), then install detent assembly (1).

DUMP CYLINDER
REMOVAL

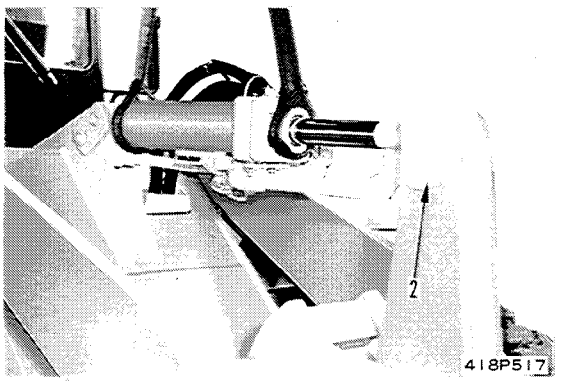
⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Loosen the oil filler cap slowly to relieve the pressure in the hydraulic oil tank. Then operate the control lever 2 or 3 times to eliminate the residual pressure in the piping.

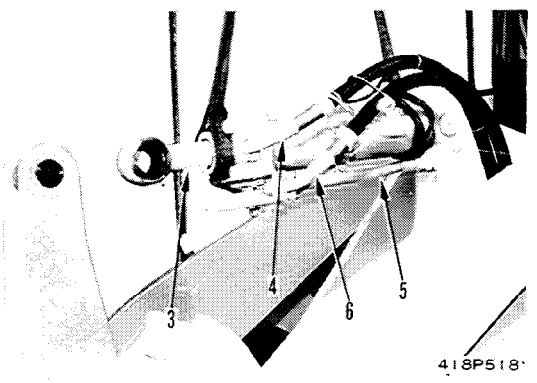
1. **Bucket positioner**
   Disconnect connector (1).
   ★ Remove the wiring clamps and brackets.



2. **Rod pin**
   Sling cylinder, remove lock bolt, then remove pin (2).
   ★ When raising the cylinder, sling at two places and be careful to maintain the balance.

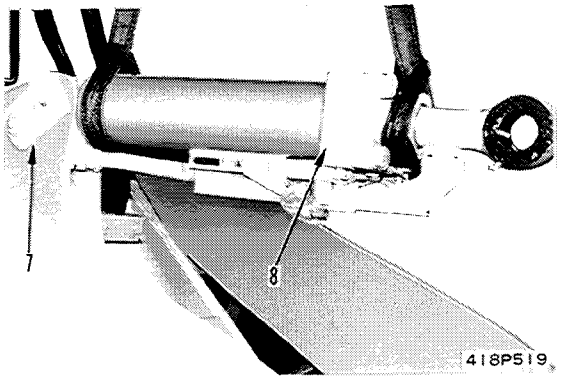


3. **Hydraulic piping**
   1) Start engine, and operate control levers to retract cylinder rod (3).
      ★ Do not retract the rod fully. Stop about 20 mm from end of stroke.
   2) Disconnect hose (4) at rod end from cylinder.
   3) Disconnect tube (5) and hose (6) at bottom end from connection part.



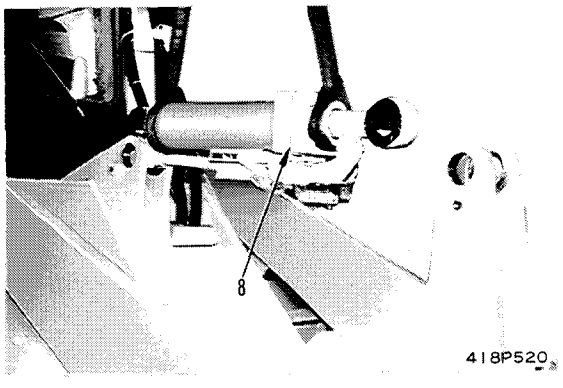
4. Dump cylinder

1) Remove lock bolt, then remove bottom pin (7).
   ★ When shims are installed, check the number and thickness of the shims, and keep in a safe place.



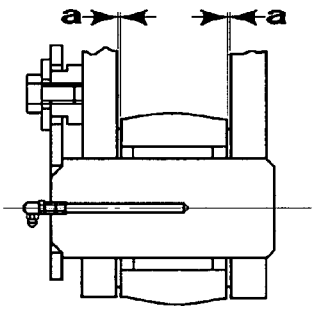
2) Lift off dump cylinder (8).
   ★ Be careful not to damage the cylinder rod.

kg Dump cylinder: 77 kg

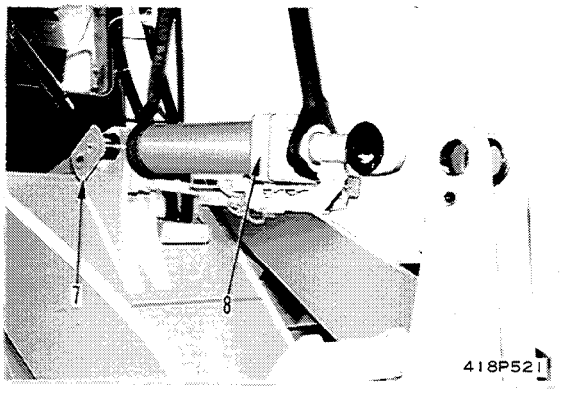


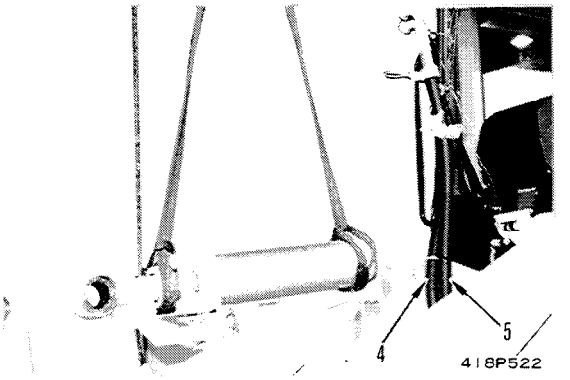
INSTALLATION

1. **Dump cylinder**
   1) Raise dump cylinder (8) and set in mounting position.
   2) Align pin hole at bottom end, assemble shim so that total clearance 'a' between cylinder and frame is within specified range, then install pin (7) and lock with bolt.
   Clearance 'a': Less than 1.5 mm



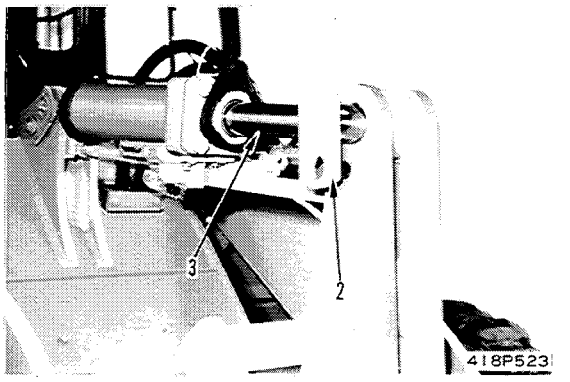
418F268



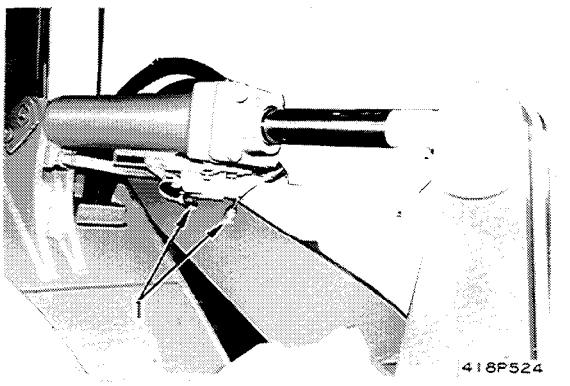


2. **Hydraulic piping**
   1) Connect tube and hose (5) at bottom end.
   2) Connect hose (4) at rod end.
      ★ Fit the O-rings securely in the grooves.
      ★ Install the hose without twisting or interference.
   3) Start engine, and operate control levers to extend rod (3), then align pin hole.
   4) Align pin hole, install pin (2), then lock with bolt.

⚠ Use a bar to align the pin holes. Never use your fingers.



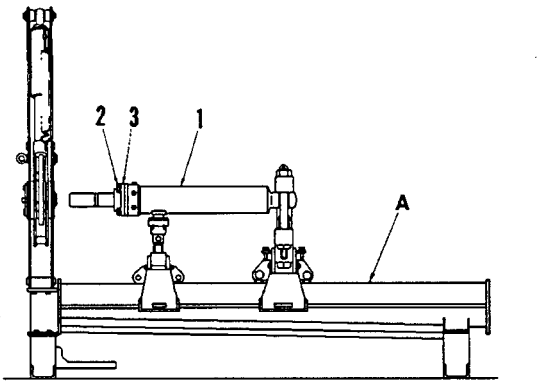
3. **Bucket positioner**
   Connect connector (1).
   1) For details of adjusting bucket positioner, see SECTION 62, TESTING AND ADJUSTING.
   2) Install wiring clamps and brackets.



DISASSEMBLY

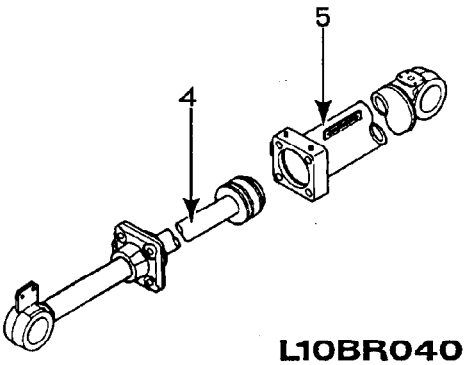
Special tool

	Part number	Part name	Q'ty
A	790-502-2000 or 790-502-1003	Cylinder repair stand	1



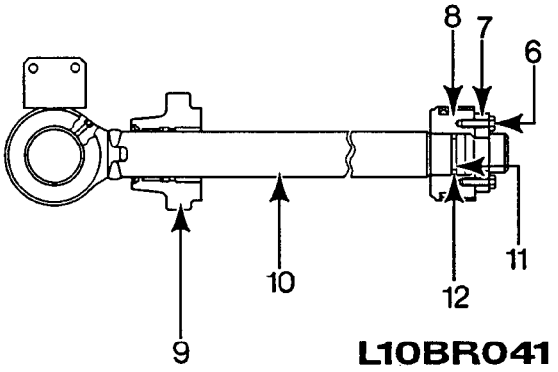
L10BR039

1. Set cylinder assembly (1) on tool A.
2. Screw out cylinder head mounting bolt (2) and remove cylinder head (3) from cylinder.



L10BR040

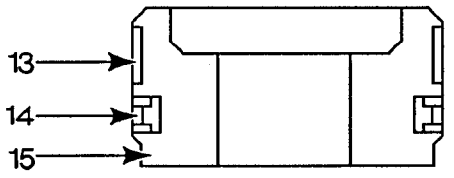
3. Pull cylinder head and piston rod assembly (4) out of cylinder (5), and sling and remove them.
   ★ Oil will come out when the piston rod assembly is removed from the cylinder, so place a container in position to catch the oil.
4. Remove cylinder (5) from tool A.



L10BR041

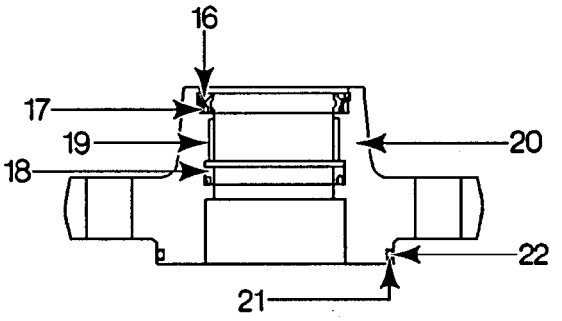
5. **Cylinder head, piston rod assembly**
   1) Screw out mounting bolt (6) and remove retainer (7), piston assembly (8) and cylinder head assembly (9) from rod (10).
   2) Remove O-ring (11) and back-up ring (12) from rod (10).

6. **Disassembly piston assembly as follows:**
   1) Remove wear ring (13).
   2) Remove piston ring (14) from piston (15).



L10BR042

7. **Disassemble cylinder head assembly as follows:**
   1) Remove snap ring (16), then remove dust seal (17).
   2) Remove rod packing (18).
   3) Remove bushing (19) from cylinder head (20).
   4) Remove O-ring (21) and back-up ring (22).



L10BR043

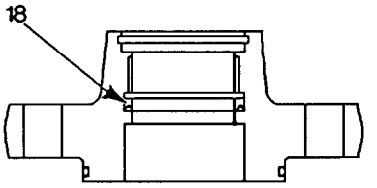
ASSEMBLY

Special tools

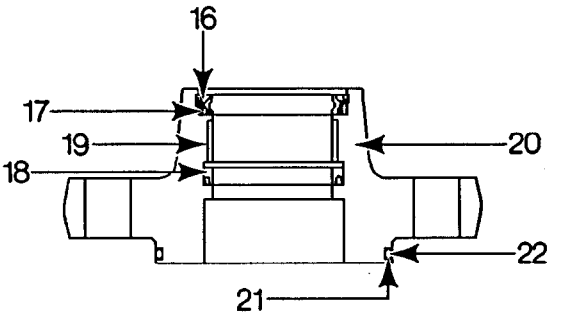
	Part number	Part name	Q'ty
A	790-502-2000 or 790-502-1003	Cylinder repair stand	1
B	790-720-1000	Expander	1
C	796-720-1670	Ring	1

★ Coat the sliding surfaces of all parts with engine oil before installing. Be careful not to damage U-packing, dust seals or O-rings when installing.

1. **Assemble cylinder head assembly as follows:**
   1) Using push tool, press fit bushing (19) on cylinder head (20).
      ★ Be careful not to deform the bushing when press fitting.
   2) Assemble rod packing (18).
      ★ Be careful to install the rod packing facing in the right direction.



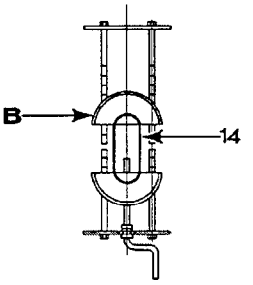
L10BR044



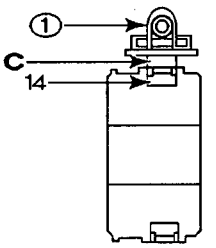
L10BR043

   3) Install back-up ring (22) first, then O-ring (21).
      ★ Do not try to force the back-up ring into position. Warm it in warm water (50 - 60°C) before fitting it.
   4) Using push tool ④, install dust seal (17) on cylinder head, then secure with snap ring (16).

2. **Assemble piston assembly as follows:**
   1) Using tool B, expand piston ring (14).
      ★ Set the piston ring on the tool and turn the handle 8 to 11 times to expand the ring.
   2) Remove piston ring (14) from tool B and assemble on piston (15).
   3) Fit tool C on piston ring and compress piston ring with clamp ①.
      Clamp ① Part No.: 07281-01589
   4) Assemble wear ring (13) on piston.



L10BR046



L10BR045

3. **Cylinder head, piston rod assembly**
   1) Install back-up ring (12) and O-ring (11) to rod (10).
      ★ Do not try to force the back-up ring into position.
      Warm it in warm water (50 - 60°C) before fitting it.
   2) Assemble cylinder head assembly (9), piston assembly (8), and retainer (7) to rod (10), then tighten with bolt (6).

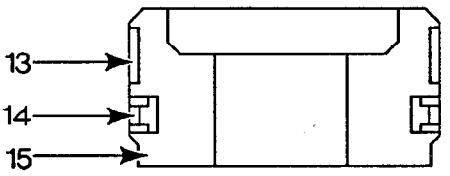


Piston thread: Piston thread: Adhesive (LT-2)

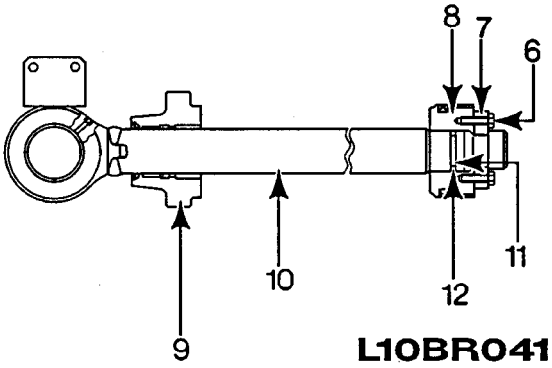


Bolt: 11.25±1.75 kgm

★ Leave for approx. 30 minutes after tightening.

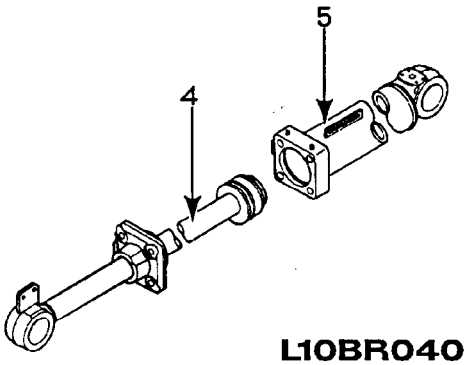


L10BR042



L10BR041

4. Set cylinder (5) in tool A, then raise cylinder head and piston rod assembly (4) and install in cylinder.



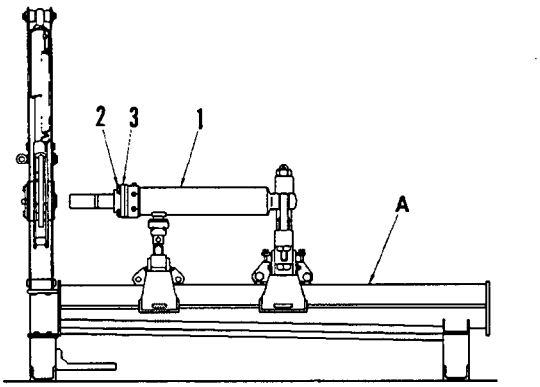
L10BR040

5. Set cylinder head (3) in cylinder and install cylinder head mounting bolt (2).



Cylinder head mounting bolt: 117.5±12.5 kgm

6. Remove cylinder assembly (1) from tool A.

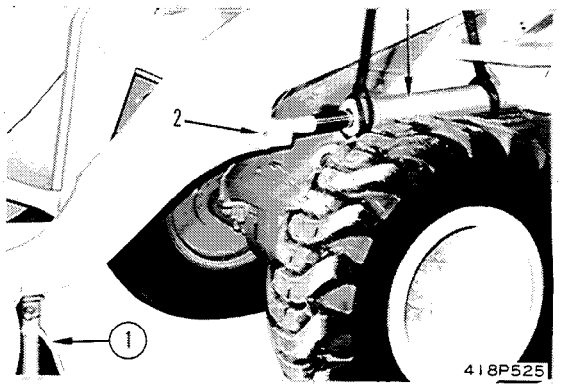


L10BR039

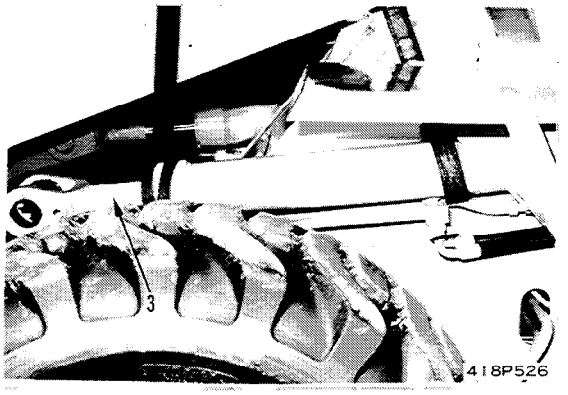
LIFT CYLINDER
REMOVAL

Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

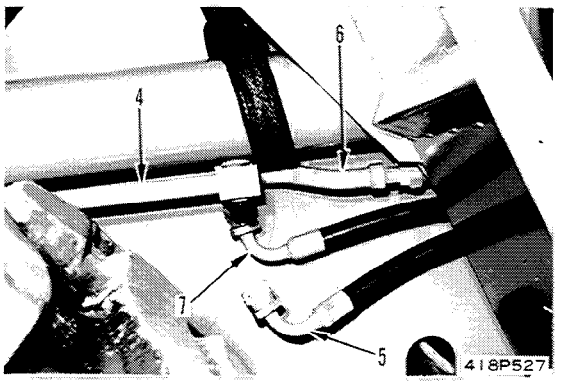
Loosen the oil filler cap relieve the pressure in the hydraulic tank. Then operate the control levers 2 or 3 times to eliminate the residual pressure in the piping.



1. Rod pin
1) Sling lift cylinder (1), remove lock bolt, then remove pin (2).
   ★ Set support ① on end of lift arm that was removed pin (2).
2) Start engine, and operate control levers to retract cylinder rod (3) on side where pin has been removed.
   ★ Do not retract the rod fully. Stop about 20 mm from the end of the stroke.

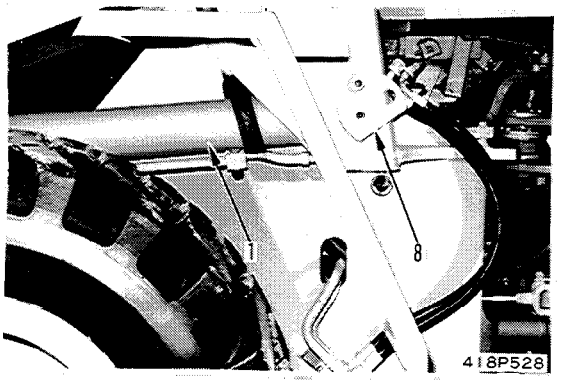


2. Hydraulic piping
1) Disconnect rod end tube (4) from connection of hose (5).
2) Disconnect bottom end tube (6) from connection of hose (7).
   ★ Fit covers to prevent dirt or dust from entering the hoses or connections.

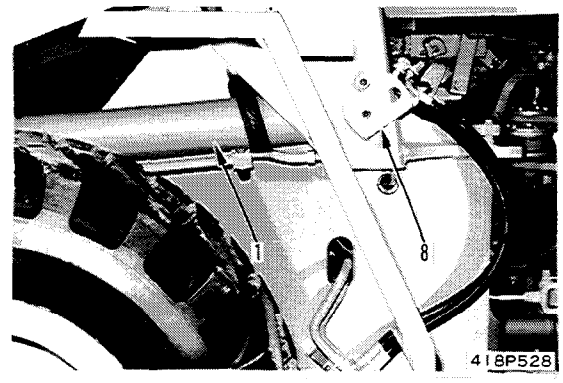


3. Lift cylinder
1) Remove lock bolt, then remove pin (8) at bottom end.
   ★ There are shims installed, check the number and thickness of the shims, and keep in a safe place.
2) Lift off left cylinder (1).
   ★ Be careful of the center of gravity, and remove slowly.
   ★ Be careful not to damage the cylinder rod.

kg Lift cylinder: 80 kg



INSTALLATION



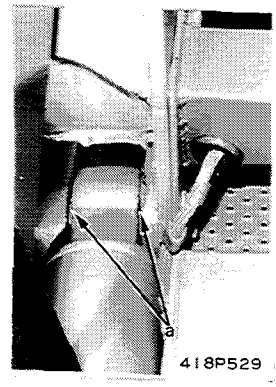
1. Lift cylinder

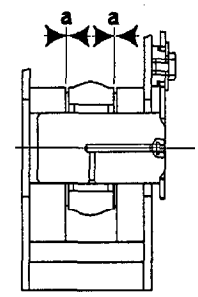
1) Sling lift cylinder (1) and set in mounting position.

2) Align pin hole at bottom end, assemble shim so that total clearance 'a' between cylinder and frame is within specified range, then install pin (8) and lock with bolt.

⚠ Use bar to align the pin holes. Never use your fingers.

Clearance 'a': Less than 1.5 mm

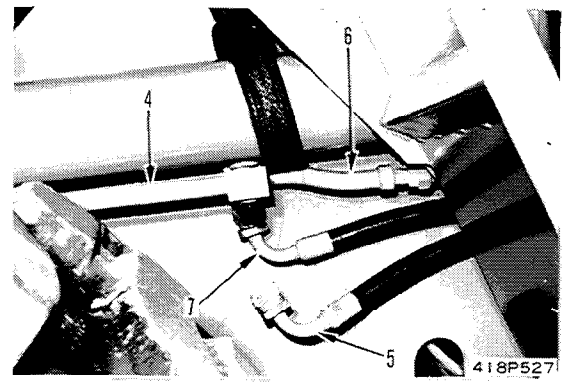




418F269

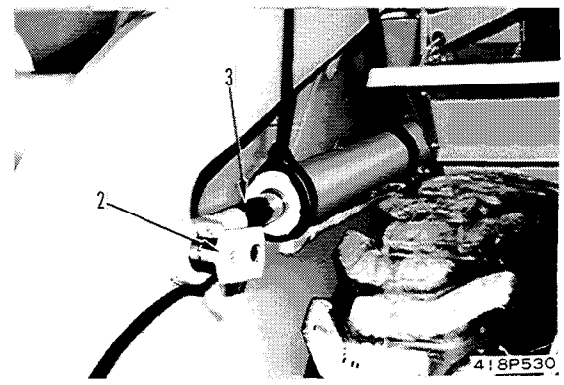
2. Hydraulic piping

1) Connect tube (6) and hose (7) at bottom end.
2) Connect tube (4) and hose (5) at rod end.
   - ★ Fit the O-rings securely in the grooves.
   - ★ Install the hoses without twisting or interference.
   - ★ Hose nut width across the flat: 36 mm



3. Rod pin

Start engine and operate control levers to extend rod (3).
Align pin hole, install pin (2), then lock with bolt.

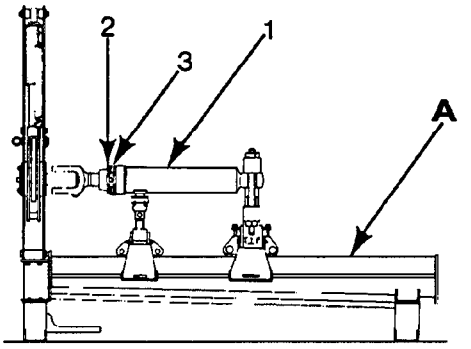


DISASSEMBLY

Special tool

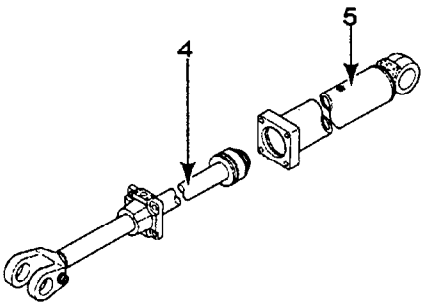
	Part number	Part name	Q'ty
A	790-502-2000 or 790-502-1003	Cylinder repair stand	1
B	790-302-1340	Socket (width across flats: 80 mm	1

1. Set cylinder assembly (1) on tool A.
2. Screw out cylinder head mounting bolt (2) and remove cylinder head (3) out of cylinder.



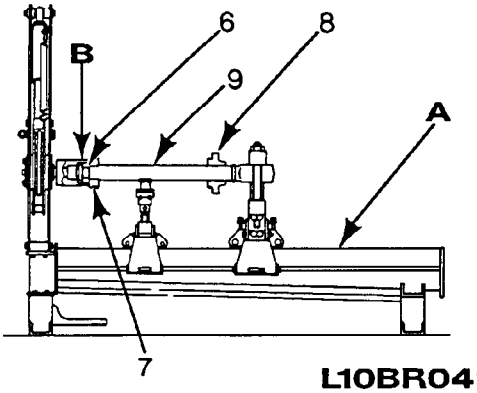
L10BR047

3. Pull cylinder head and piston rod assembly (4) from cylinder (5) and lift off.
   - ★ Oil will come out when the piston rod assembly is removed from the cylinder, so have a container in position to catch the oil.
4. Remove cylinder (5) from tool A.



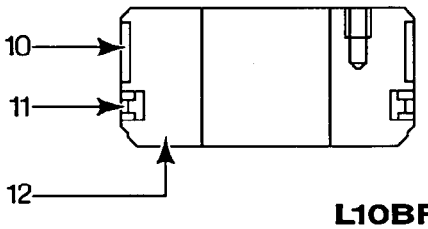
L10BR048

5. Set cylinder head and piston rod assembly on tool A, and loosen nut (6) with tool B.
6. Remove piston assembly (7) and cylinder head assembly (8) from rod (9).



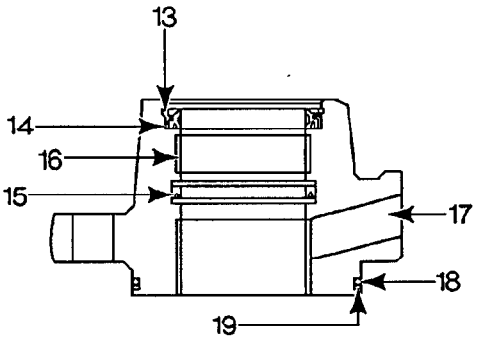
L10BR049

7. **Disassemble piston assembly as follows:**
   1) Remove wear ring (10).
   2) Remove piston ring (11) from piston (12).



L10BR050

8. **Disassemble cylinder head assembly as follows:**
   1) Remove snap ring (13), then remove dust seal (14).
   2) Remove rod packing (15).
   3) Remove bushing (16) from cylinder head (17).
   4) Remove O-ring (18) and back-up ring (19).



L10BR051

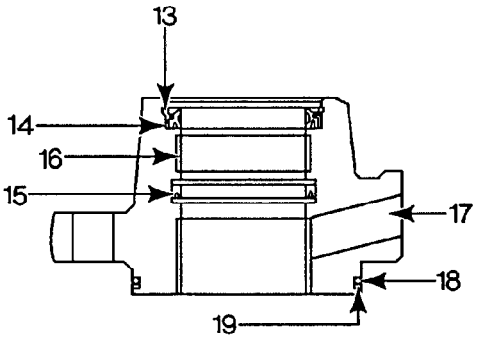
ASSEMBLY

Special tools

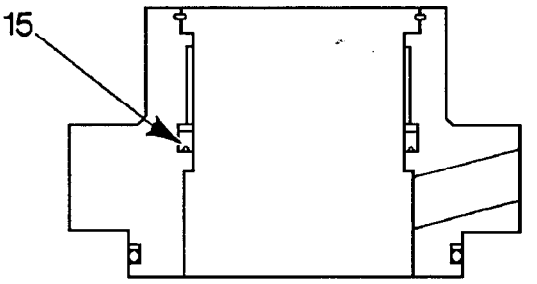
	Part number	Part name	Q'ty
A	790-502-2000 or 790-502-1003	Cylinder repair stand	1
B	790-302-1340	Socket (width across flats: 80 mm)	1
C	790-720-1000	Expander	1
D	796-720-1670	Ring	1

★ Coat the sliding surfaces of all parts with engine oil. Be careful not to damage U-packings, dust seals or O-ring, then install nut.

1. **Assemble cylinder head assembly as follows:**
   1) Using a push tool, press fit bushing (16) on cylinder head (17).
      ★ Take particular care not to deform the bushing when press fitting.
   2) Assemble rod packing (15).
      ★ Be careful to install the rod packing facing in the correct direction.
   3) Install back-up ring (19) and O-ring (18).
      ★ Do not force back-up ring. Heat in hot water (50 - 60°C) before inserting.
   4) Using a push tool, install dust seal (14) on head, then install snap ring (13).

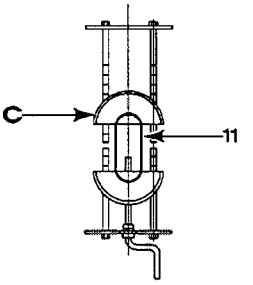


L10BR051

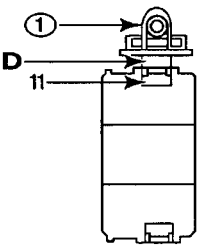


L10BR053

2. **Assemble piston assembly as follows:**
   1) Using tool C, expand piston ring (11).
      ★ After setting the piston ring in tool, rotate the handle 8 to 10 times to expand.
   2) Remove piston ring (11) from tool C and assemble on piston (12).
   3) Fit tool D on piston ring and compress piston ring with clamp ①.
      ★ Parts No. of clamp ①
      07281-01279

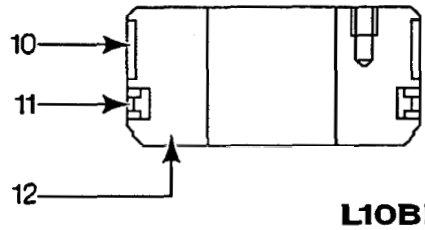


L10BR054



L10BR052

4) Assemble wear ring (10).

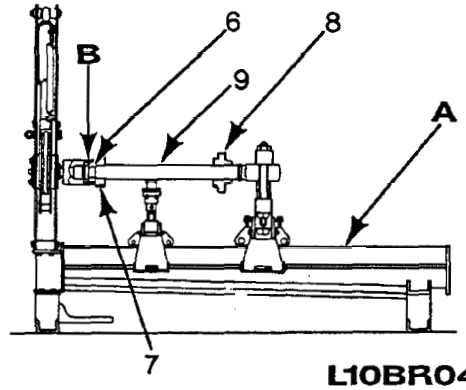


L10BR050

3. Set piston rod (9) in tool A.
4. Assemble cylinder head assembly (8) and piston assembly (7) on rod, then install nut (6).
5. Using tool B, tighten nut (6) to the following specified torque.

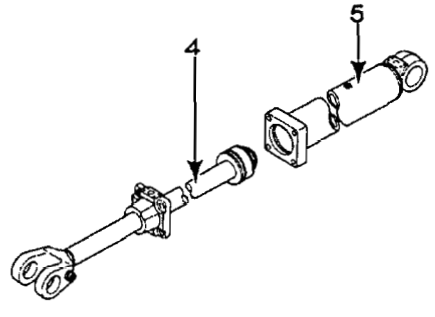
Piston rod thread: Adhesive (LT-2)

Nut: 405±40.5 kgm



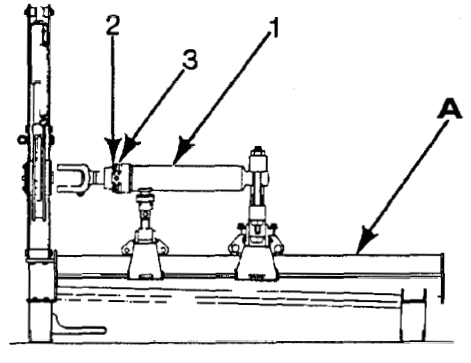
L10BR049

6. Remove piston rod and cylinder head assembly (5) from tool A.
7. Set cylinder (4) in tool A.
8. Sling piston rod and cylinder head assembly (5) and install in cylinder (4).



L10BR048

9. Set cylinder head (3) into cylinder and install cylinder head mounting bolt (2).
10. Remove cylinder assembly (1) from tool A.



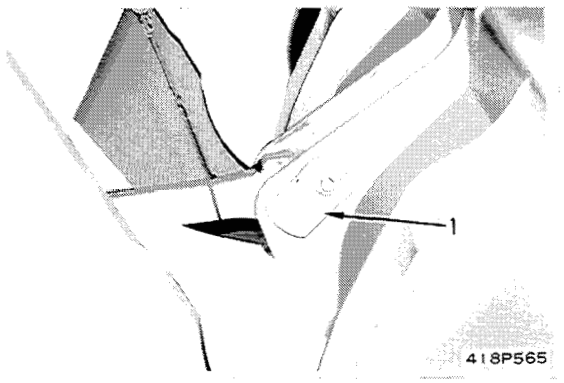
L10BR047

WORK EQUIPMENT
REMOVAL

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

1. Bucket link

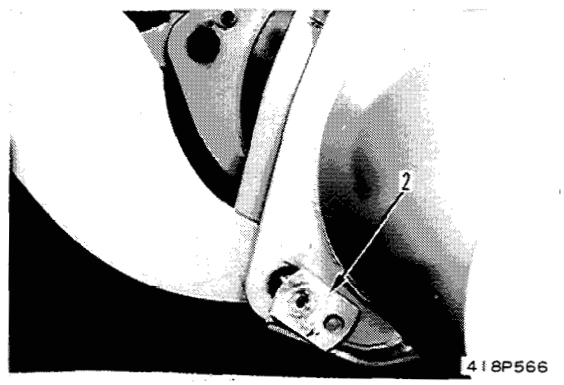
1) Remove mounting pin (1) of bucket link.
   ★ Tie the bucket link to the tilt lever with wire.



2) Remove mounting pins (2) of bucket hinge.

⚠ Do not put your fingers in the pin hole.

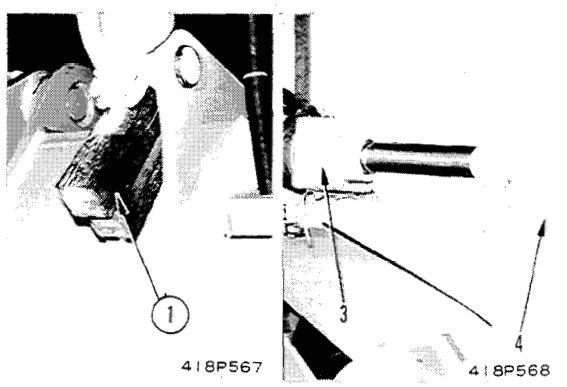
3) Drive machine in reverse to disconnect bucket.



2. Dump cylinder mounting pin

Sling dump cylinder (3), remove pin (4), then disconnect cylinder rod and tilt lever.
   ★ Insert a block ① between the cylinder bottom and frame.

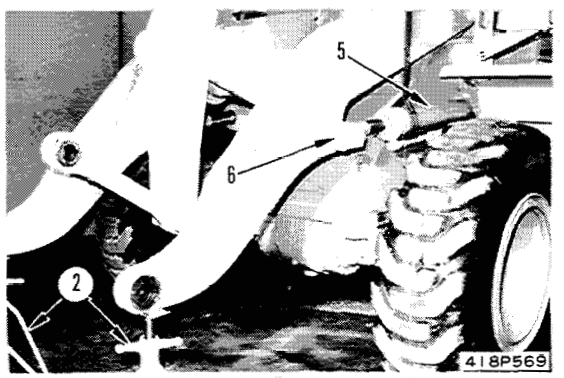
kg Dump cylinder: 77 kg



3. Lift cylinder pin

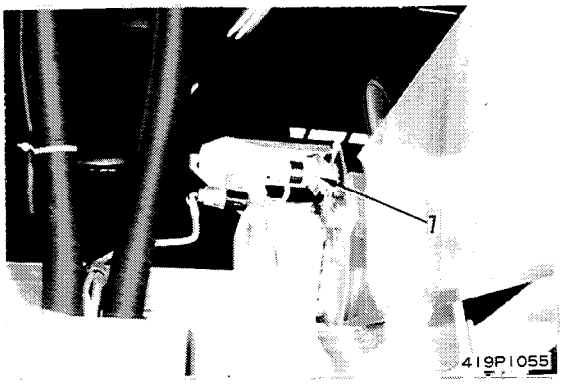
Sling lift cylinder (5), then remove mounting pin (6).
   ★ Place a support under the tip of the lift arm.
   ★ Place a block ② on top of the axle, and lower the cylinder onto it.

kg Lift cylinder: 80 kg



4. Lift arm, tilt lever, bucket link

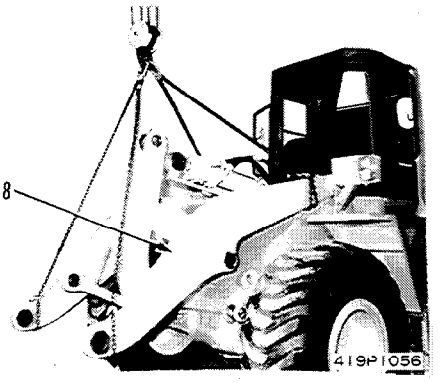
1) Remove boom kick-out switch (7).



2) Sling lift arm, tilt lever and bucket link (8), remove mounting pin of lift arm, then lift off lift arm.

kg Lift arm, tilt lever, bucket link assembly: 833 kg

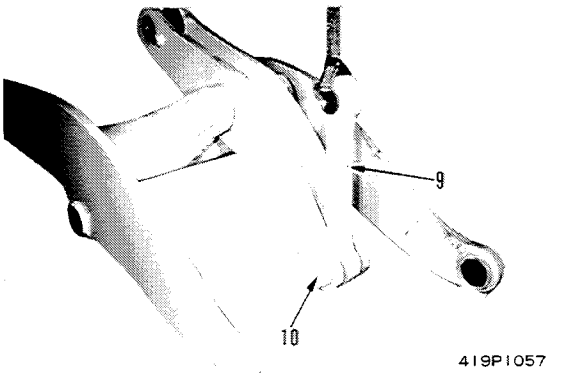
★ If there are any shims, check the number and thickness of the shims, and keep in a safe place.



5. Tilt lever, bucket link

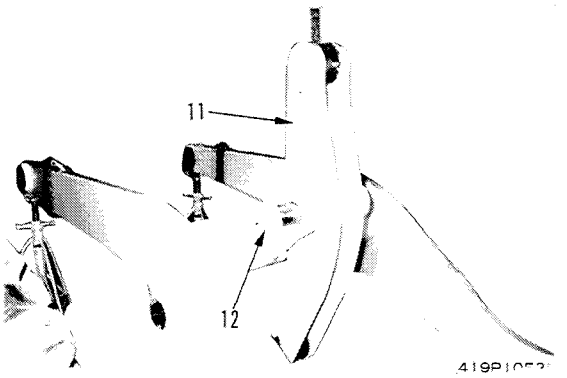
1) Sling bucket link (9), remove mounting pin (10), then remove bucket link from tilt lever.

kg Bucket link: 23 kg



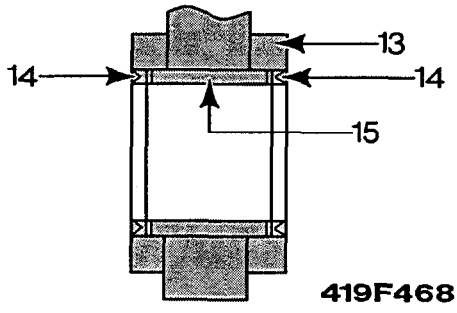
2) Sling tilt lever (11), remove mounting pin (12), then lift off from lift arm.

kg Tilt lever: 150 kg

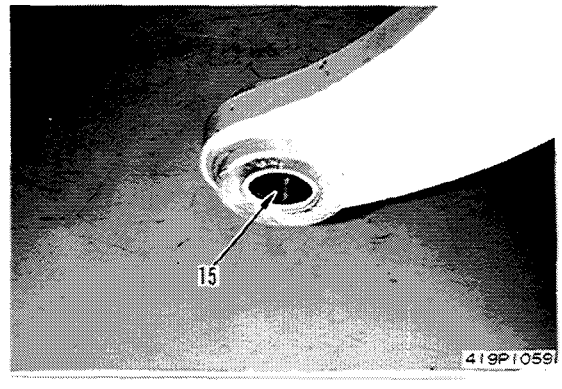


6. Dust seal, bushing

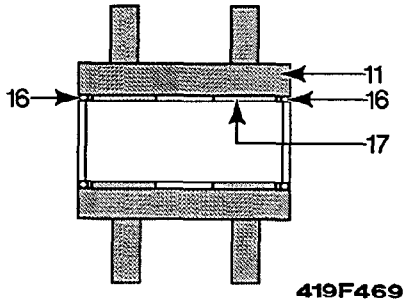
1) Remove dust seal (14) and bushing (15) from lift arm (13).



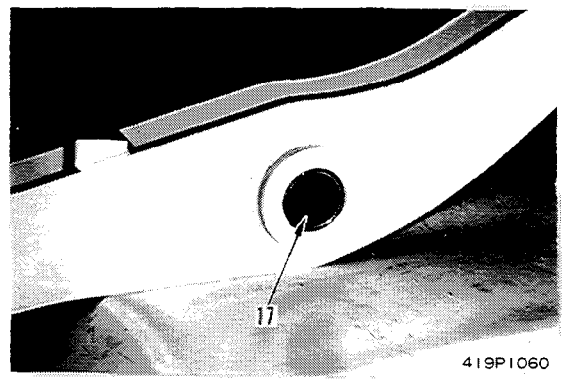
419F468



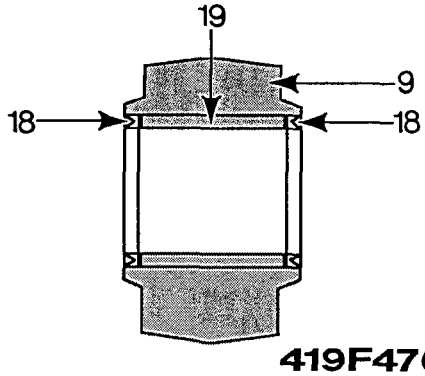
2) Remove dust seal (16) and bushing (17) from tilt lever (11).



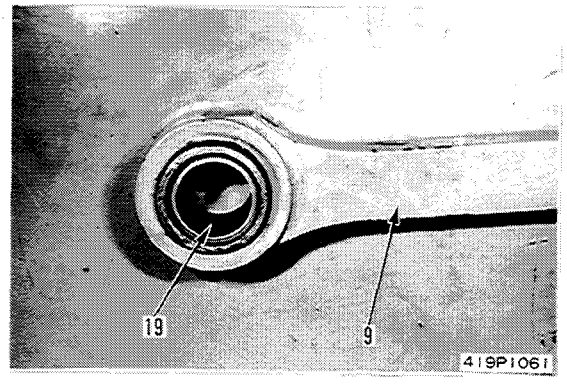
419F469



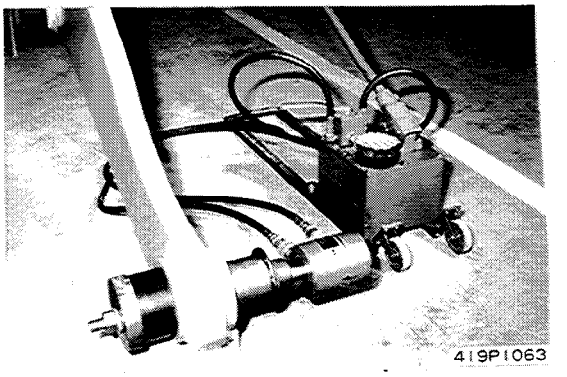
3) Remove dust seal (18) and bushing (19) from bucket link (9).



419F470



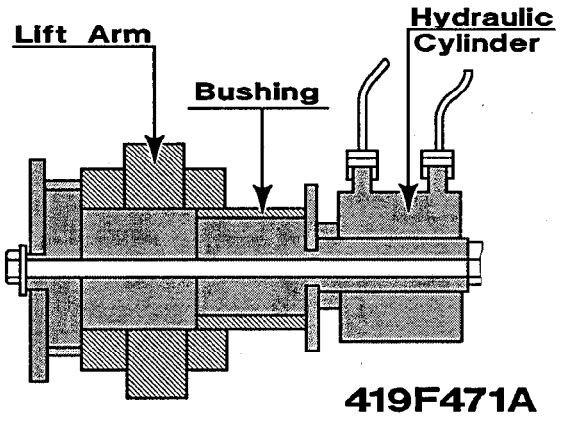
INSTALLATION

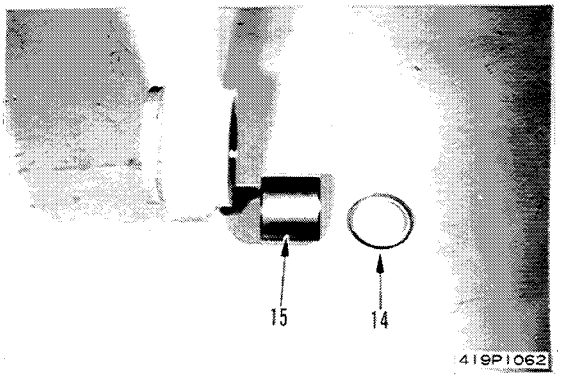


⚠ Use a bar to align the pin holes. Never use your fingers.

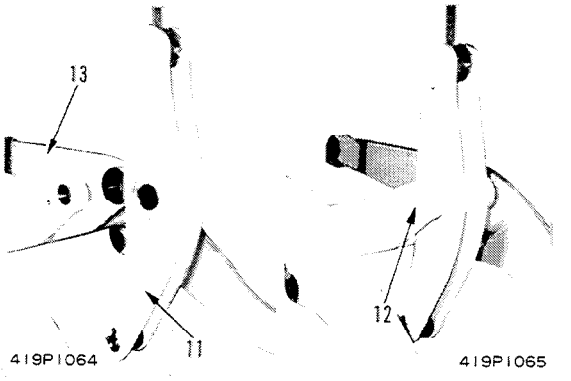
1. **Dust seal, bushing**
   Press fit bushings (15) in bucket link, tilt lever, and lift arm, then assemble dust seal (14).

   Bushing: Grease (G2-L1)

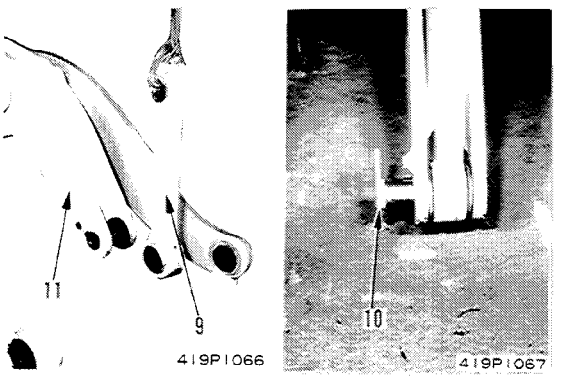




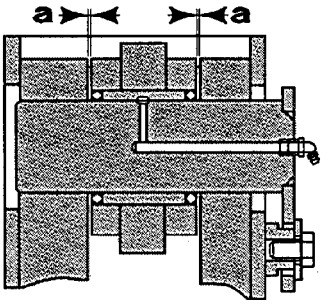
2. **Tilt lever, bucket link**
   1) Align holes of tilt lever (11) and lift arm (13), then install mounting pin (12) and lock with bolt.



   2) Assemble cord ring on bucket link (9), align holes of tilt lever (11), then install pin (10) and lock with bolt.
      - ★ Tie the bucket link to the tilt lever with wire.
      - ★ Be careful not to let the cord ring get caught when installing.



3. **Lift arm, tilt lever, bucket link assembly**
   1) Raise lift arm, tilt lever, and bucket link (8), and set in mounting position. Align holes at mount of front frame and lift arm, assemble shim so that clearance 'a' on left and right is equal, then install mounting pin and lock with bolt.
      ★ Clearance 'a': Less than 1.5 mm
      ★ After installing the pin, set a support under the tip of the boom.



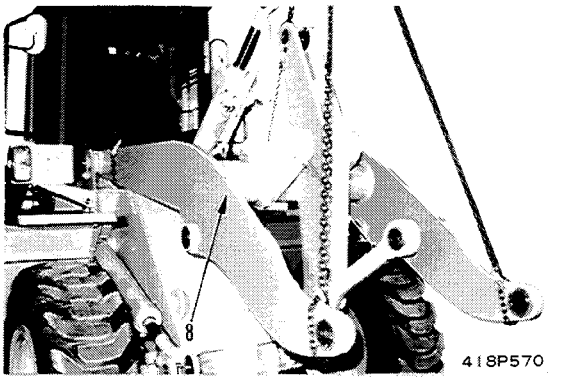
418F282

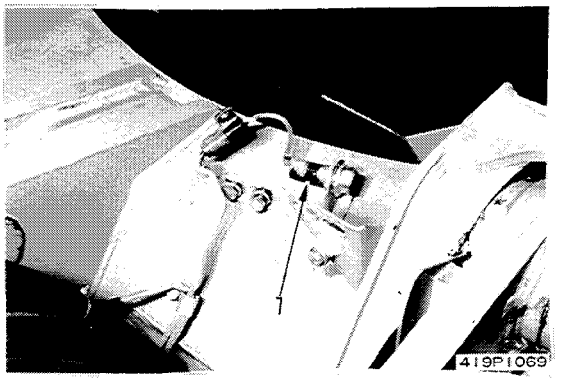
   2) Install boom kick-out switch (7).

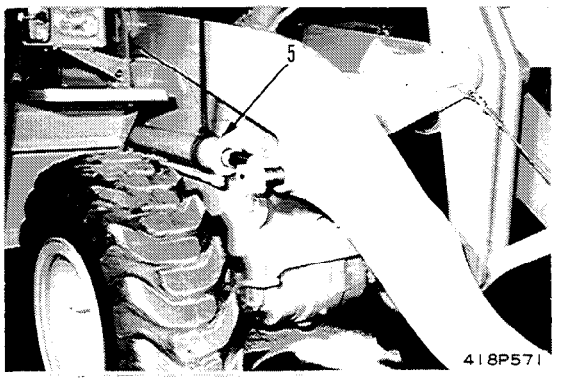
4. **Lift cylinder**
   Sling lift cylinder (5), start engine and align cylinder rod with lift arm mounting hole. Install mounting pin, then lock with bolt.

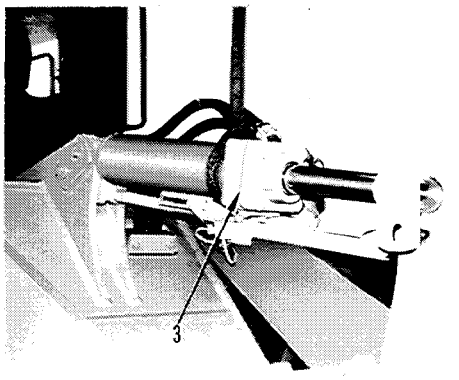
⚠ Before starting the engine, check that the directional lever is at neutral, and the parking brake engaged.

5. **Dump cylinder**
   Sling dump cylinder (3) and operate control lever to align pin holes. Install mounting pin, then lock with bolt.
   ★ After installing the mounting pin, remove the block.

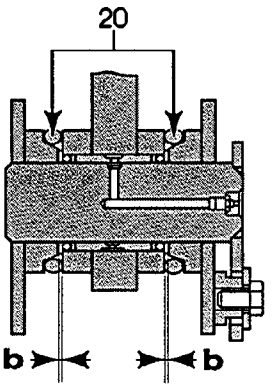




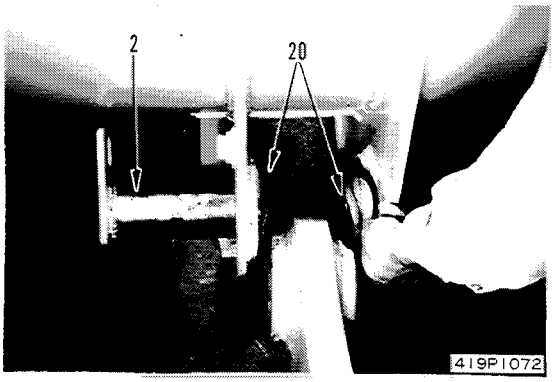




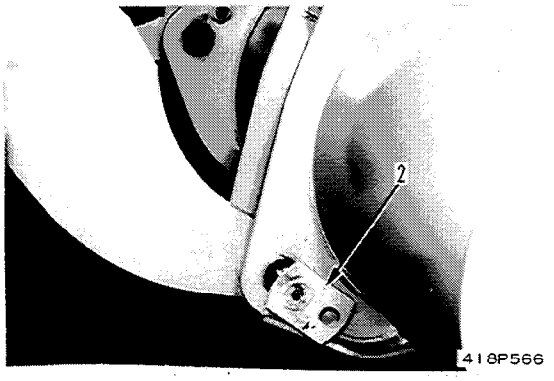
6. **Bucket**
   1) Operate control lever to align hole of bucket mounting pin (2). Install cord ring (20) and assemble shim so that clearance 'b' on left and right is equal, then install mounting pin and lock with bolt.
      ★ Be careful not to let the cord ring get caught when installing.
      ★ Clearance 'b': Less than 1.5 mm

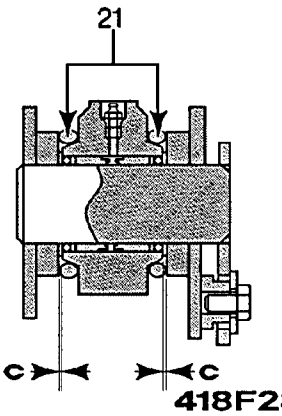


418F283

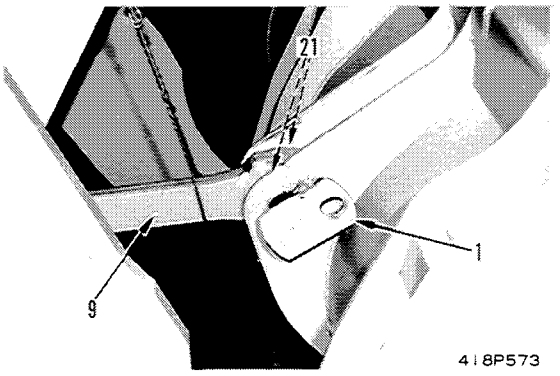


7. **Bucket link**
   1) Align hole of mounting pin (1) of bucket link (9). Install cord ring (21) and assemble shim so that clearance 'c' on left and right is equal, then install mounting pin, and lock with bolt.
      ★ Be careful not to let the cord ring get caught when installing.
      ★ Clearance 'c': Less than 1.5 mm





418F284



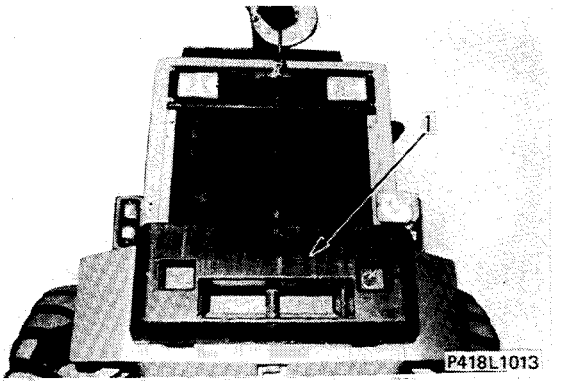
8. **Greasing**
   Grease all pins.

COUNTERWEIGHT

REMOVAL

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

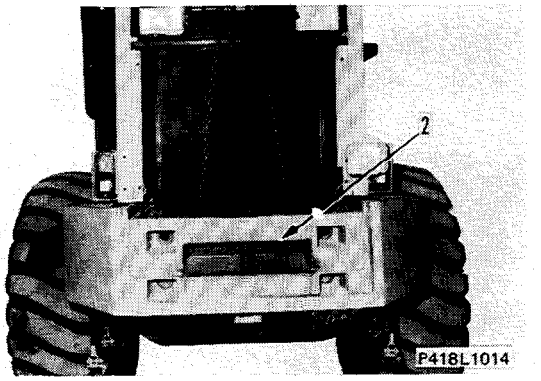
1. Remove radiator grill.



2. Sling additional counterweights (1 and 2), remove mounting bolts, then lift off counterweight.
   ★ Be careful to maintain the balance when removing the counterweight.

kg Additional counterweight (1): 305 kg
Counterweight (2): 1020 kg

   ★ Be careful not to damage the lamps when removing the counterweight.



INSTALLATION

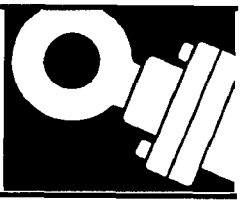
1. **Counterweight**
   Raise counterweights (1 and 2), set in mounting position, then tighten mounting bolts.
   ★ When setting in the mounting position, be careful not to damage the lamps.
   • Mounting bolt width across the flat: 36 mm

Mounting bolt: 95±10 kgm

2. Install radiator grill.

MEMO

WORK EQUIPMENT SYSTEM
64 STRUCTURE AND FUNCTION



HYDRAULIC AND STEERING PUMP 2

MAIN CONTROL VALVE 4

DUMP CYLINDER 6

LIFT CYLINDER 7

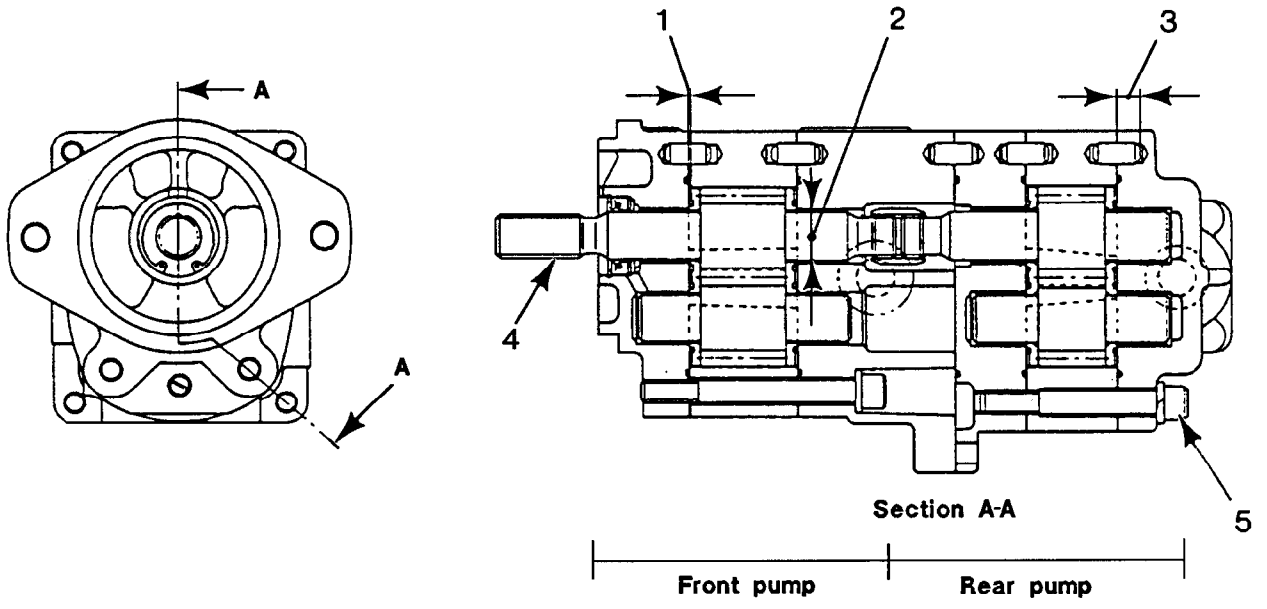
BUCKET LINKAGE 8

BUCKET POSITIONER AND BOOM KICK-OUT 11

BUCKET 12

HYDRAULIC AND STEERING PUMP

- Model SAL(2)-050 + Model SAL(2)-025



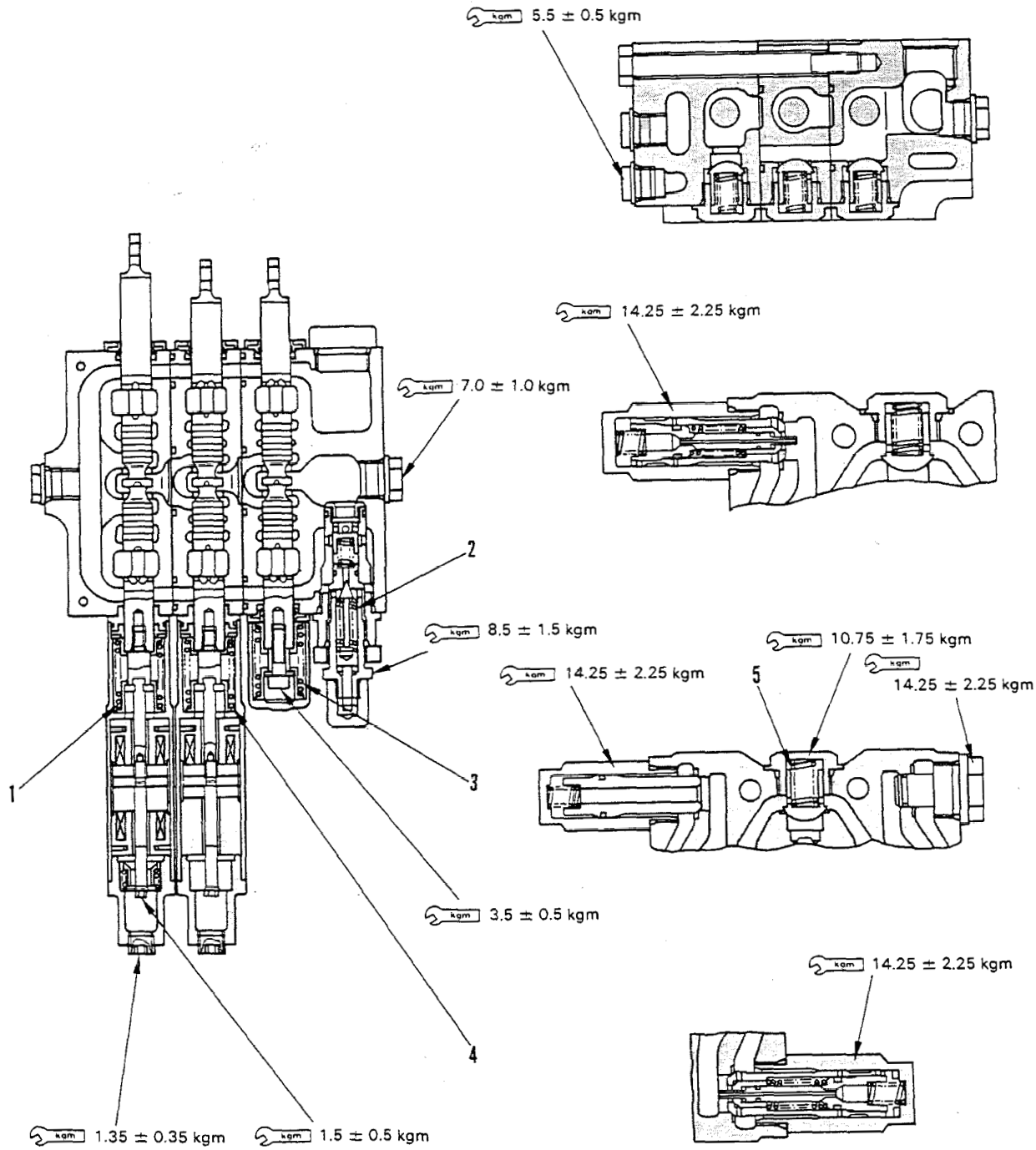
419F142A

Unit: mm

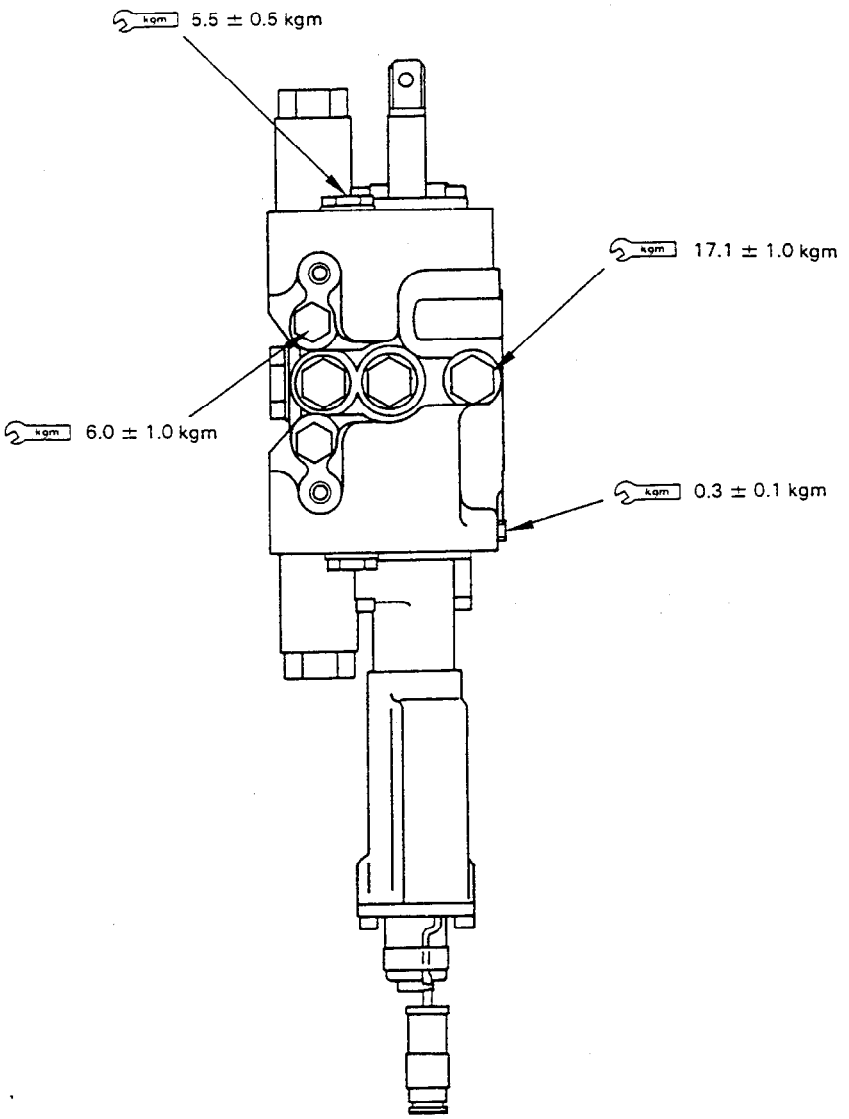
No.	Check item	Criteria					Remedy
1	Clearance between gear case and side plate, gear	Standard clearance		Clearance limit			Replace
		0.10-0.15		0.19			
2	Clearance between inside diameter of plain bearing and outside diameter of gear shaft	0.06-0.125		0.20			
3	Insertion depth of pin	$12.0^{0}_{-0.5}$					
4	Rotating torque of spline shaft	0.5-1.5 kgm					
5	Tightening torque of bolt	11.5±1.0					Retighten
	Discharge Oil: SAE10W-CD Temperature: 45-55°C	Model	Revolution (rpm)	Discharge pressure (kg/cm²)	Standard discharge (ℓ/min)	Repair limit discharge (ℓ/min)	
		(Front) SAL(2)-050	3000	210	138	128	
		(Rear) SAL(2)-025	3000	210	67	62	

This page is blank.

MAIN CONTROL VALVE



FL41801028

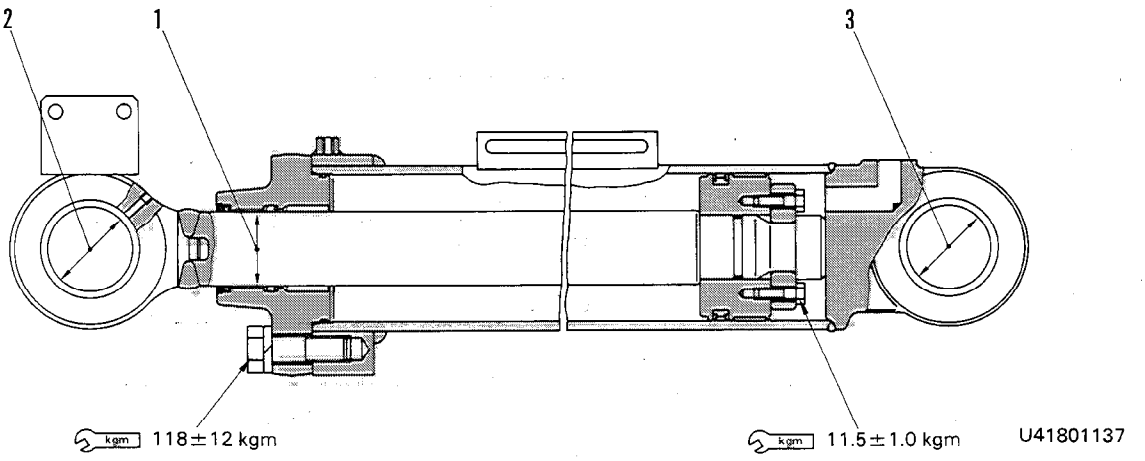


FL41801029

Unit: mm

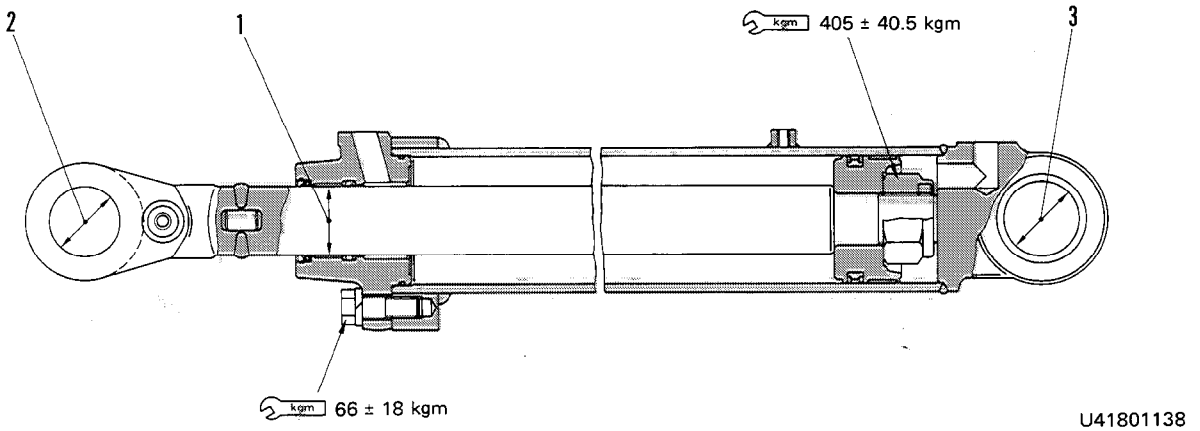
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length	Installation length	Installation load (kg)	Free length	Installation load (kg)	
1	Spring of lift spool		45	13.6			Replace
2	Spring of main relief valve	41.1	32.6	26.4	39.4	21.1	
3	Spring of service spool		45.2	18.0			
4	Spring of dump spool		45	18.1			
5	Spring of check valve		25	2.8			

DUMP CYLINDER



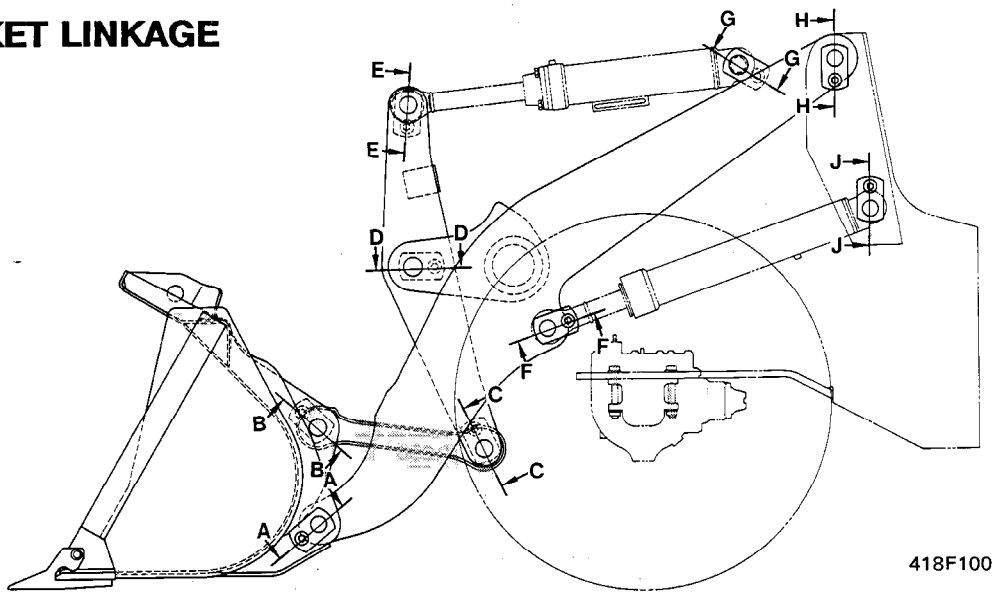
No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between rod and bushing	75	-0.100 -0.171	+0.291 +0.077	0.465 0.177	0.745	Replace bushing
2	Clearance between piston rod and mounting pin	85	–	+0.207 +0.120	–	–	
3	Clearance between cylinder bottom mounting pin and bushing	85	–	+0.207 +0.120	–	–	

LIFT CYLINDER

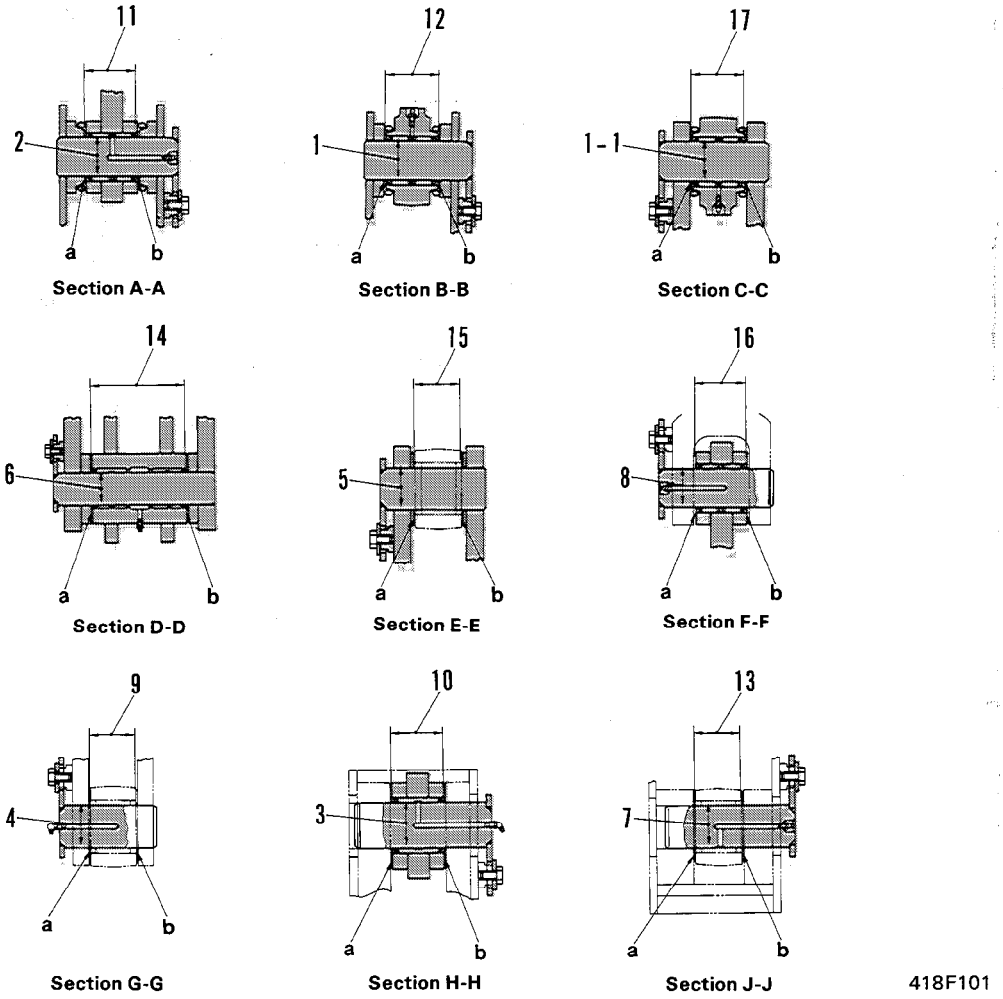


No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between rod and bushing	70	-0.100 -0.174	+0.271 +0.075	0.445 0.175	0.745	Replace bushing
2	Clearance between piston rod mounting pin and inside diameter of hole	70	–	+0.350 +0.200	–	–	
3	Clearance between cylinder bottom mounting pin and bushing	75	–	+0.174 +0.100	–	–	

BUCKET LINKAGE



418F100



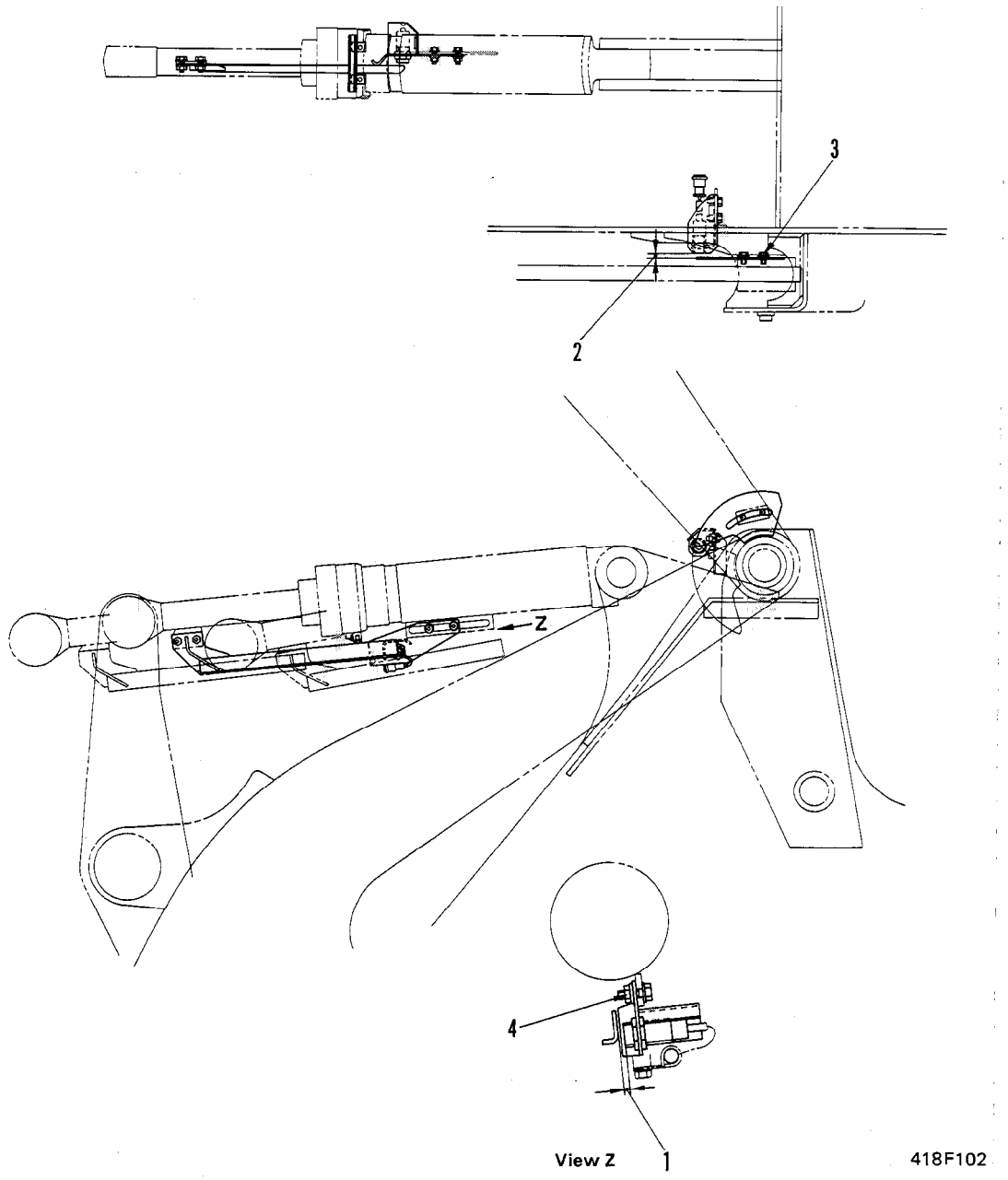
418F101

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between pin and bushing at boss ends of bucket link	65	-0.030 -0.076	+0.174 +0.100	0.130- 0.250	1.0	Replace also if other parts are biting into pin
1-1	Clearance between pin and bushing at boss ends of bucket link	75	-0.030 -0.076	+0.174 +0.100	0.130- 0.250	1.0	
2	Clearance between pin and bushing at joint of lift arm and bucket	65	-0.030 -0.076	+0.174 +0.100	0.130- 0.250	1.0	
3	Clearance between pin and bushing at joint of lift arm and frame	75	-0.030 -0.076	+0.174 +0.100	0.130- 0.250	1.0	
4	Clearance between pin and bushing at joint of dump cylinder bottom and frame	85	-0.036 -0.090	+0.207 +0.120	0.156- 0.297	1.0	
5	Clearance between pin and bushing at joint of dump cylinder rod and tilt lever	85	-0.036 -0.090	+0.207 +0.120	0.156- 0.297	1.0	
6	Clearance between pin and bushing at joint of tilt lever and lift arm	85	-0.036 -0.090	+0.207 +0.120	0.156- 0.297	1.0	
7	Clearance between pin and bushing at joint of lift cylinder bottom and frame	75	-0.030 -0.076	+0.174 +0.100	0.130- 0.250	1.0	
8	Clearance between pin and bushing at joint of lift cylinder rod and lift arm	70	-0.030 -0.076	+0.350 +0.200	0.230- 0.420	1.0	
		Width between bosses	Width of hinge		Standard clearance (Clearance a + b)		
9	Joint of dump cylinder and frame	$90^{+0.8}_{0}$	93±1.5		0.7-4.5		Insert shims on both sides to make clearance on both left and right sides less than 1.5 mm
10	Joint of lift arm and frame	101±1.8	$104^{+1.5}_{0}$		1.2-6.3		
11	Joint of lift arm and bucket	85±1.8	88^{+3}_{0}		1.2-7.8		
12	Joint of bucket link and bucket	85±1	88^{+3}_{0}		2.0-7.0		
13	Joint of lift cylinder and frame	$85^{+0.8}_{0}$	88±1.5		0.7-4.5		

No.	Check item	Criteria			Remedy
		Width between bosses	Width of hinge	Standard clearance (Clearance a + b)	
14	Joint of tilt lever and lift arm	250±0.5	253±1.5	1.0-5.0	Replace
15	Joint of dump cylinder and tilt lever	$90^{+0.8}_{0}$	93±1.5	0.7-4.5	
16	Joint of lift cylinder and lift arm	85±1.8	89±0.8	1.4-6.6	Insert shims on both sides to make clearance on both left and right sides less than 1.5 mm
17	Joint of tilt lever and bucket link	106±1	109±1.5	0.5-5.5	Replace

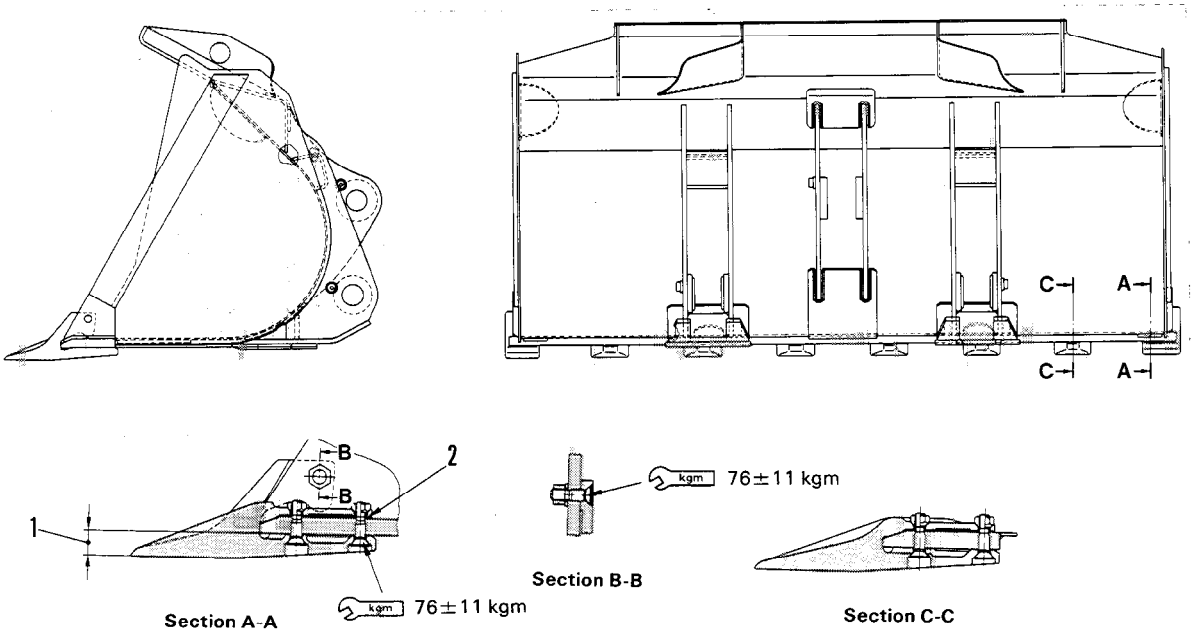
BUCKET POSITIONER AND BOOM KICK-OUT



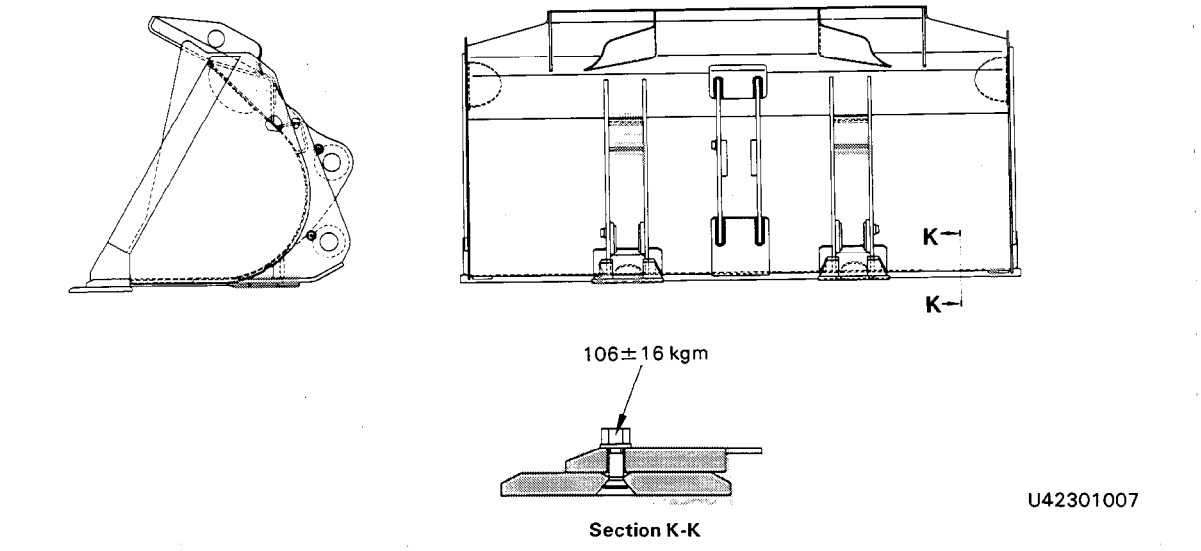
Unit: mm

No.	Check item	Criteria	Remedy
1	Clearance of bucket positioner switch	3-5	Adjust
2	Clearance of boom kick-out switch		
3	Tightening torque of mounting bolt for adjuster	9.0±3.5 kgm	Retighten
4	Tightening torque of mounting bolt for bucket wear plate	1.8±0.2 kgm	

BUCKET



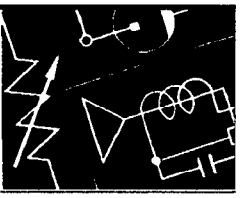
423F234



U42301007

No.	Check item	Criteria		Remedy
1	Wear of bucket tooth	Standard size	Repair limit	Replace
		35mm	18mm	
2	Clearance of bucket tooth mounting	Less than 0.5mm		Replace or adjust

ELECTRIC AND ELECTRONIC SYSTEM



81 STRUCTURE AND FUNCTION

ELECTRICAL WIRING CIRCUIT DIAGRAMS 2

ENGINE STARTING CIRCUIT 3

ENGINE STOP CIRCUIT 5
- COMBINATION SWITCH 6

ELECTRICAL TRANSMISSION CONTROL 7
- TRANSMISSION CUT-OFF SELECTOR SWITCH 8
- NEUTRALIZER RELAY 9

ELECTRONIC VEHICLE MONITORING SYSTEM (EVMS) 10

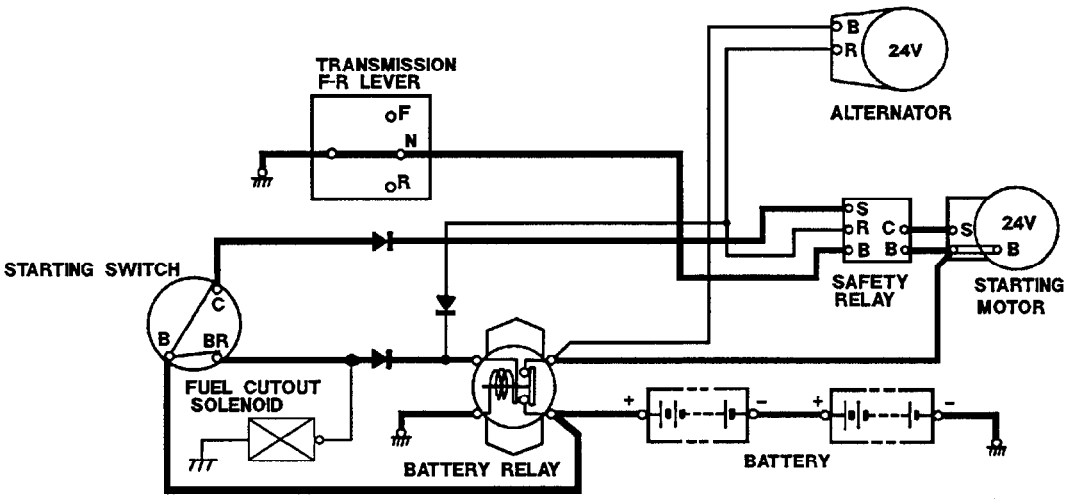
MONITOR PANEL 11
- INDICATION ON MONITOR PANEL 12
- WIRING HARNESS 14
- SENSORS 15
  - ENGINE OIL LEVEL SENSOR 16
  - COOLANT LEVEL SENSOR 16
  - BRAKE OIL LEVEL SENSOR 17
  - FUEL GAUGE SENSOR 18
  - COOLANT TEMPERATURE SENSOR 19
  - TORQUE CONVERTER OIL TEMPERATURE SENSOR 19
  - ENGINE OIL PRESSURE SENSOR 20
  - ROTATIONAL SPEED SENSOR 20
- PROXIMITY SWITCH 21

ELECTRICAL WIRING CIRCUIT DIAGRAMS

See the electrical wiring circuit diagrams located at the end of this book. Foldouts No. 1, 2 & 3.

The rest of this page is blank.

ENGINE STARTING CIRCUIT



Function

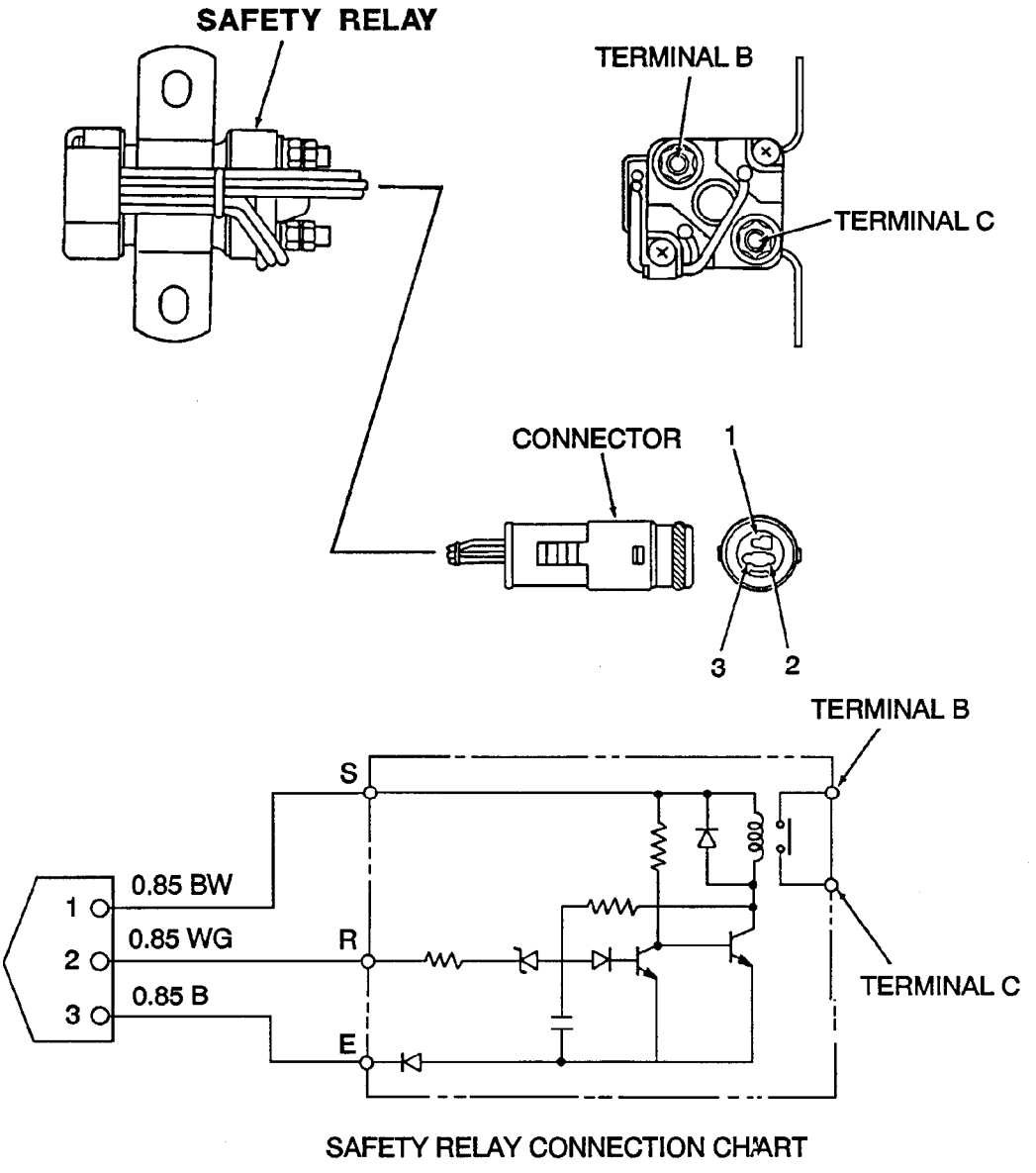
- To ensure safety when starting the engine, the system is equipped with a neutral safety circuit. This makes it impossible for the engine to start if the directional lever is not at the N (Neutral) position.

Operation

- When the directional lever is placed at the N (Neutral) position, the neutral contacts of the directional lever switch are closed. In this condition, if the starting switch is turned to the START position, current flows in the following circuit.

① Battery (+) → starting switch terminal B → starting switch terminal C → safety relay terminal S → safety relay terminal B → directional lever switch terminal N → ground, so the safety relay switch is closed.
In addition, current flows from starting switch terminal BR → battery relay coil → ground, so the battery relay switch is closed. This forms the following circuit.
② Battery (+) → battery relay → starting motor terminal B → safety relay terminal B → safety relay terminal C → starting motor terminal S, and the engine starts.
If the directional lever is at any position other than N (Neutral), circuit ① is not formed, and the engine does not start.

a) Safety relay



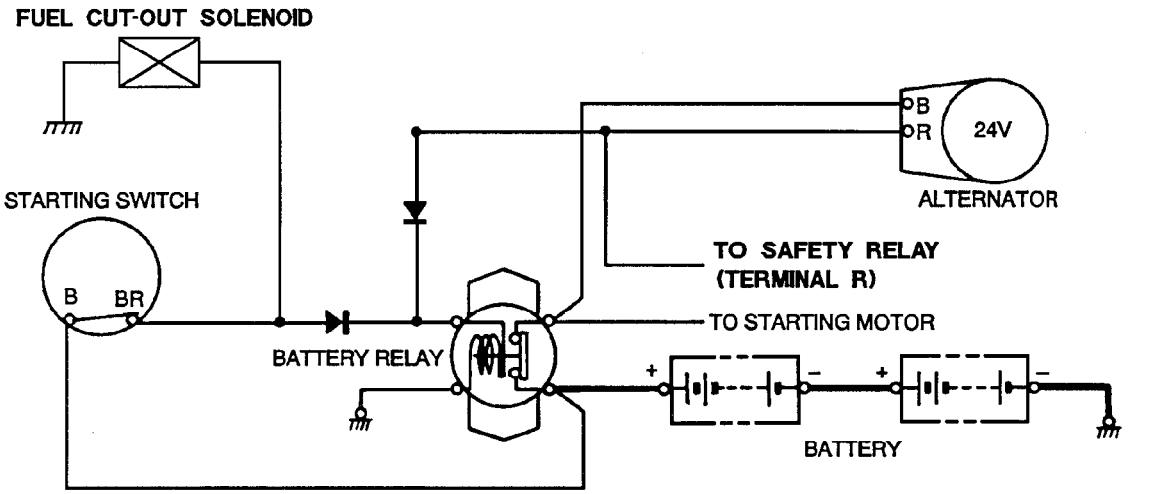
SAFETY RELAY CONNECTION CHART

L08CD064

ENGINE STOP CIRCUIT

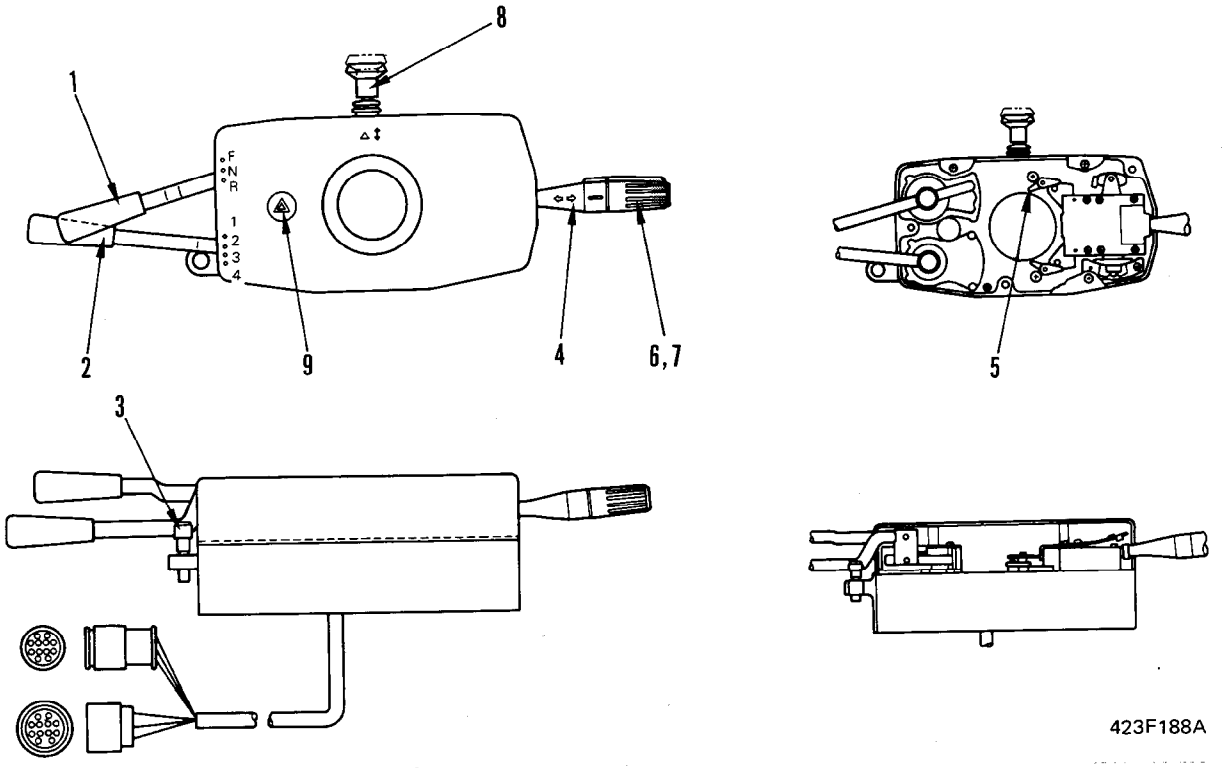
Operation

- When the starting switch is turned ON, electric current flows in the following circuit.
  ① Battery (+) → starting switch terminal B → starting switch terminal BR → fuel cut solenoid → ground connection.
  When electric current flows to the fuel cut solenoid, the fuel governor is put in the FREE position by the fuel control linkage.
  Fuel flows to the fuel injection pump and the engine starts.
- When the starting switch is turned OFF, circuit ① is shut off, but the engine is rotating, so there is still voltage at terminal R of the alternator. For this reason, the following circuit is formed.
  ② Alternator terminal R → battery relay terminal BR → ground connection.
  The battery relay is maintained, but because of the diode inserted into the circuit, no electric current flows to the fuel cut solenoid, so the engine stops.



L08DD092

COMBINATION SWITCH



Outline

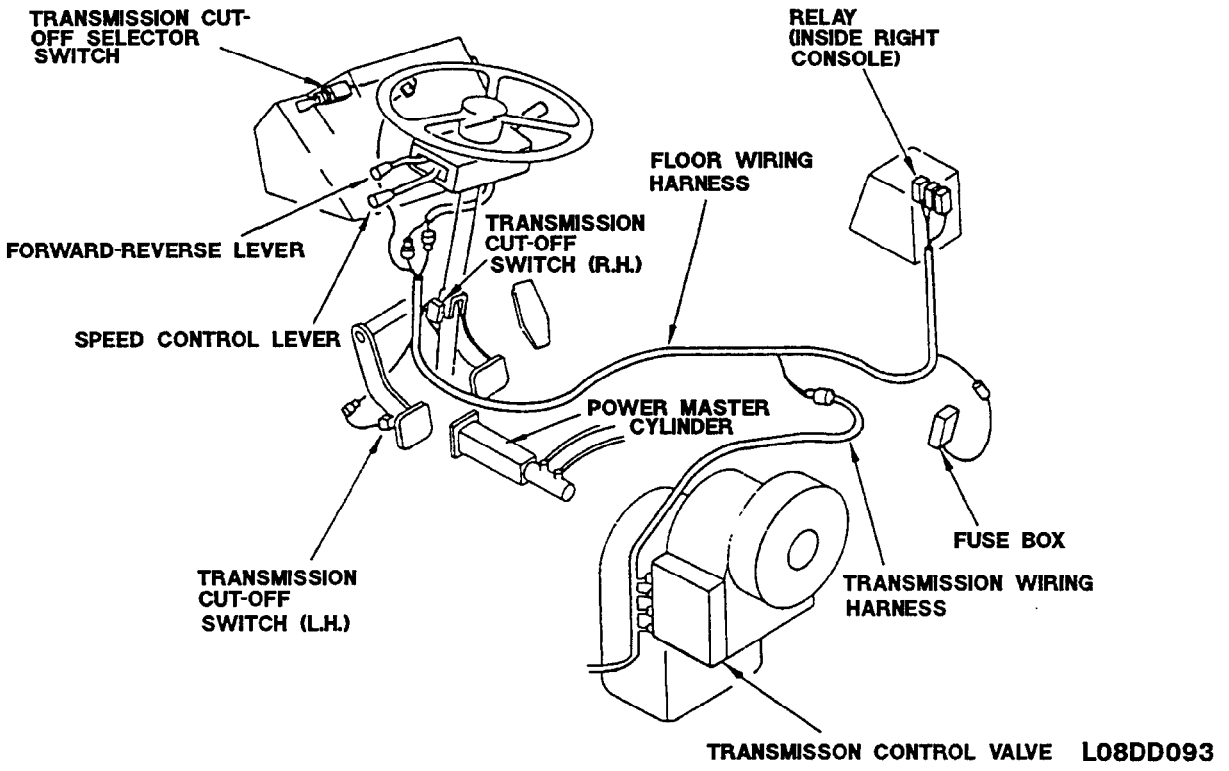
- The FORWARD-REVERSE lever has three contacts; the speed control lever switch has four contacts. The switch alone has no detent mechanism. The detent mechanism is in the combination switch itself. Each switch is held at two places by pins. In addition, each switch is secured to the base by three screws.

When the lever is moved to the desired position, the switch, which is connected by a shaft, moves and electric current flows in only that circuit to move the machine.

Function

1	FORWARD-REVERSE lever switch	Selecting FORWARD, REVERSE or NEUTRAL
2	Speed control lever switch	Selecting machine speed range
3	Speed control lever stopper	Prevents speed control lever from going into 3rd or 4th speed during operations
4	Direction indicator lamp	Indicates direction when turning left or right
5	Self cancel	Returns direction indicator lamp lever to neutral automatically after turning left or right
6	Lamp switch	Selects clearance lamps, headlamps, parking lamps
7	Dimmer switch	Selects travel beam, low beam
8	Emergency flasher switch	Makes left and right turn signal lamps operate at the same time
9	Emergency flasher pilot lamp	Flashes when emergency flasher lamp is ON

ELECTRICAL TRANSMISSION CONTROL



Function

1	Selection of FORWARD, REVERSE and NEUTRAL	FORWARD-REVERSE lever
2	Selection of travel speed range	Speed control lever
3	Transmission cut-off function	Transmission returned to neutral when left brake pedal is operated.
4	Transmission cut-off selection function	Selects if transmission cut-off function is used or not used. With this function, the left brake pedal can be used to get even better performance than conventional loaders in digging operations or ease of steering when loading on to trailers.
5	Neutralizer function	To prevent the operator from driving off when the parking brake is still applied and causing seizure of the parking brake, the transmission is returned to neutral when the parking brake is applied.
6	Neutral safety function	The engine can only be started if the FORWARD-REVERSE lever is in neutral. In any other position the engine will not start. This prevents the machine from starting suddenly. (For details, see STARTING CIRCUIT.)
7	Warning function	When the machine is driven in reverse, a back-up lamp lights up and a back-up horn sounds to warn people standing near the machine.

TRANSMISSION CUT-OFF SELECTOR SWITCH

Outline

- The transmission cut-off selector switch is a 2-circuit waterproof toggle switch. It is installed in series with the transmission cut-off switch at the power supply side of the transmission FORWARD-REVERSE circuit.

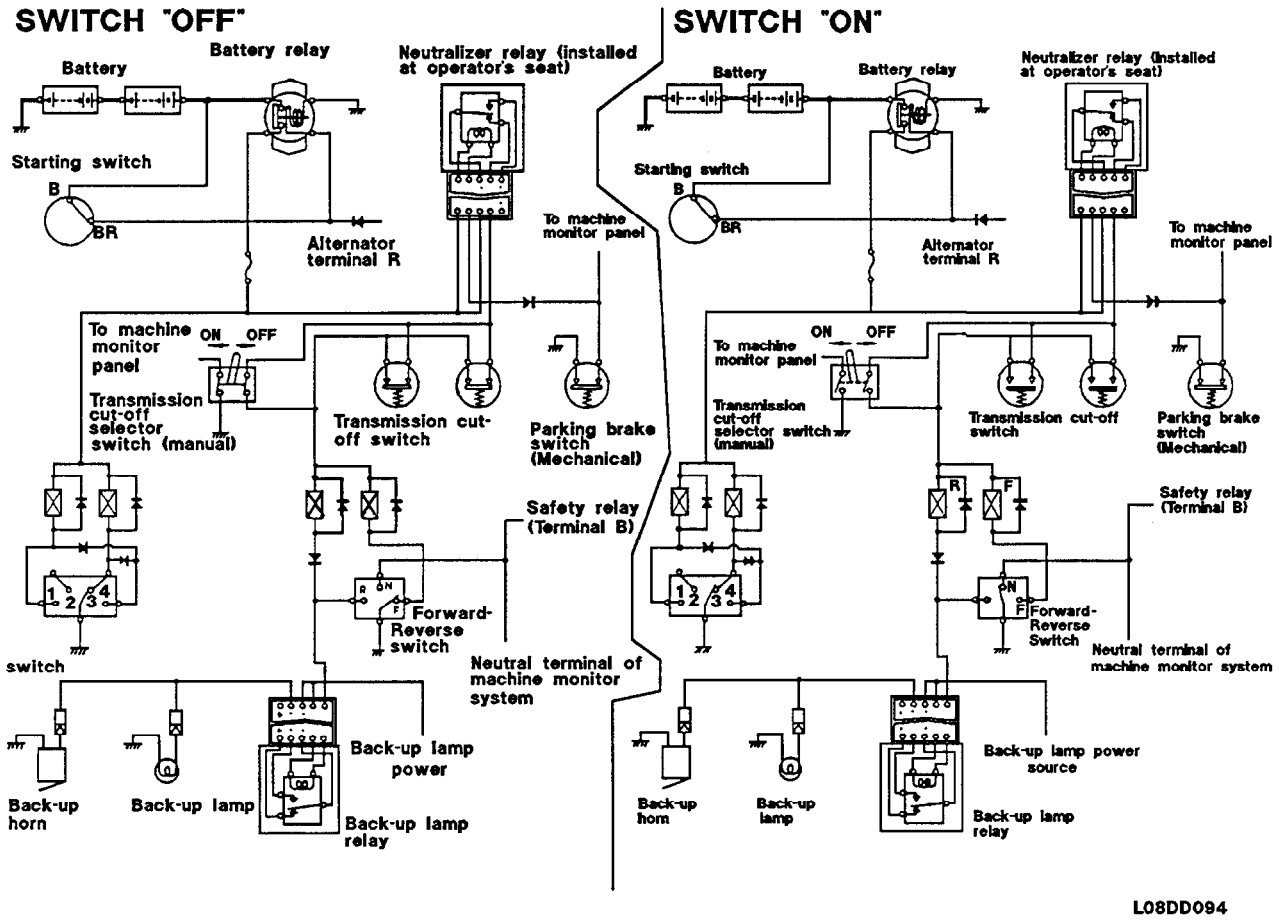
Operation

OFF

- If the transmission cut-off selector switch is put to CLOSED, there is always the (+) 24V in the circuit of the FORWARD-REVERSE clutch solenoid valve passing through this switch. Therefore, although the left brake is operated and the transmission cut-off switch is moved to OPEN, electric current will flow to the solenoid valve through the transmission cut-off switch, and the transmission will not be placed in neutral.

ON

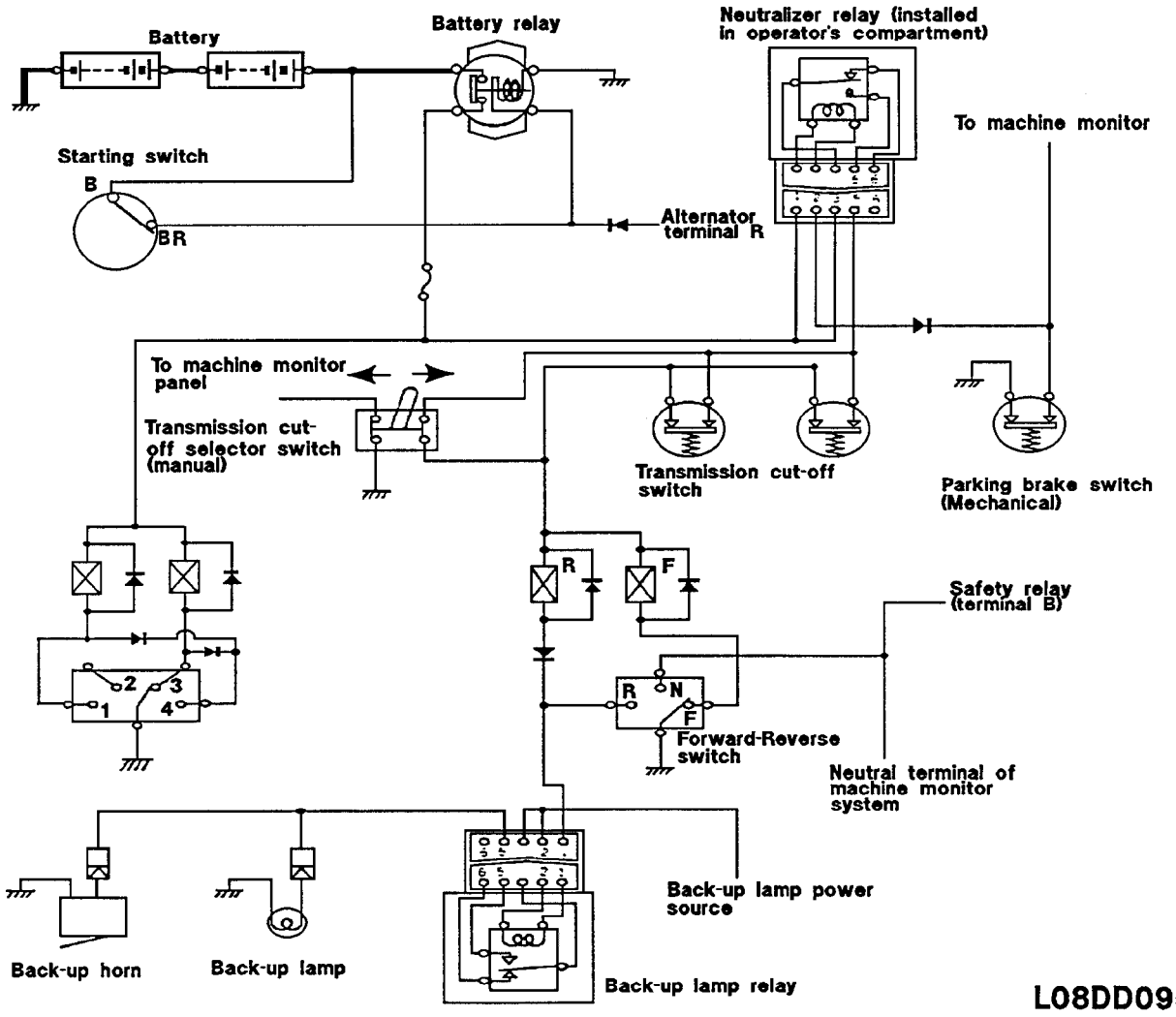
- If the transmission cut-off selector switch is put to OPEN, the electric current power passing through this switch to the FORWARD-REVERSE clutch solenoid valve is the (+) 24V passing through the transmission cut-off switch. Therefore, if the left brake is actuated and the travel of the brake is the standard travel, when the transmission cut-off switch is moved to OPEN, electric current stops flowing to the solenoid valve and the transmission is placed in neutral.



NEUTRALIZER RELAY

- When the parking brake is being used, no electric current flows to the relay coil. The input terminal is connected to output terminal "6".

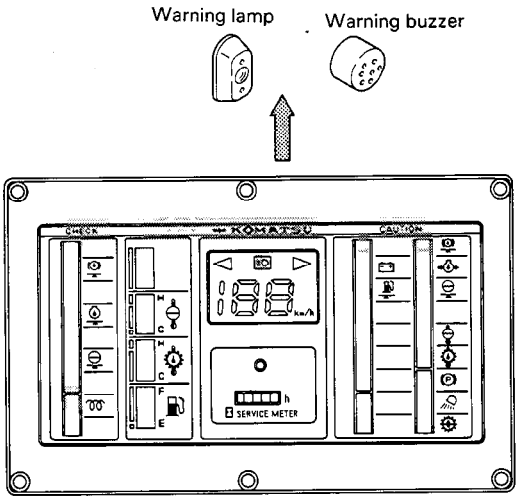
For this reason, no electric current flows to the FORWARD-REVERSE circuit of the transmission which is connected to output terminal "5". When the parking brake is being used, the transmission is kept in neutral.

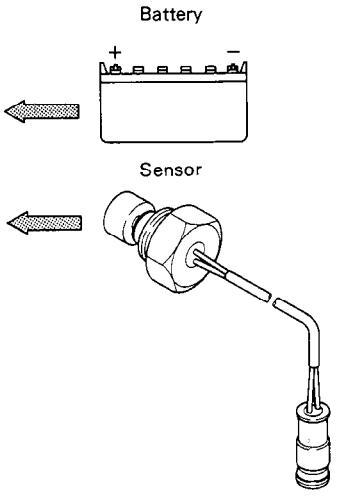


ELECTRONIC VEHICLE MONITORING SYSTEM (EVMS)

Outline

- The electronic vehicle monitoring system is a system to inform the operator of the condition of the machine. It consists of sensors installed in various parts of the machine, which observe the condition of the machine and process the information speedily, and display the situation on the monitor panel.
- The electronic vehicle monitoring system consists of the monitor panel, sensors, warning buzzer, warning lamp and power source.
- The display can be broadly divided into CHECK items and CAUTION items, which display warnings if any abnormality arises in the machine; and gauges, speedometer, and service meter, which always display the condition of the machine.



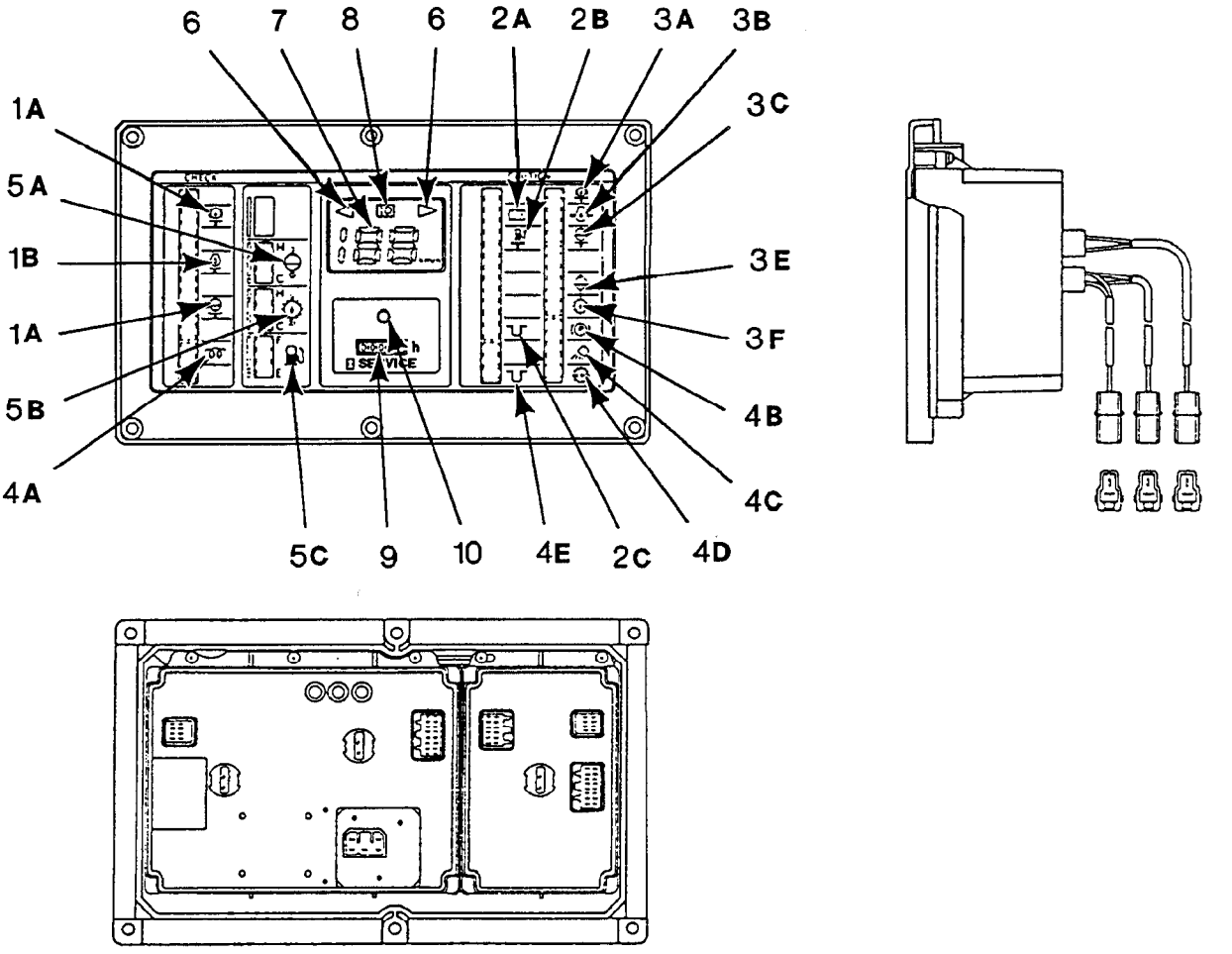


U41901059

MONITOR PANEL

- The monitor panel consists of the following components: MONITOR and GAUGE module, SPEEDOMETER and MONITOR module, (including service meter), the case and various other components.
- Each module (excluding the service meter) has its own microcomputer which processes the signals from the sensor and gives a display.

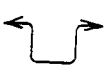
The panel uses a liquid crystal display.

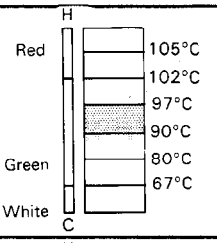
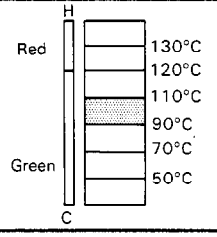
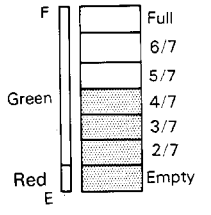


L11AJ004

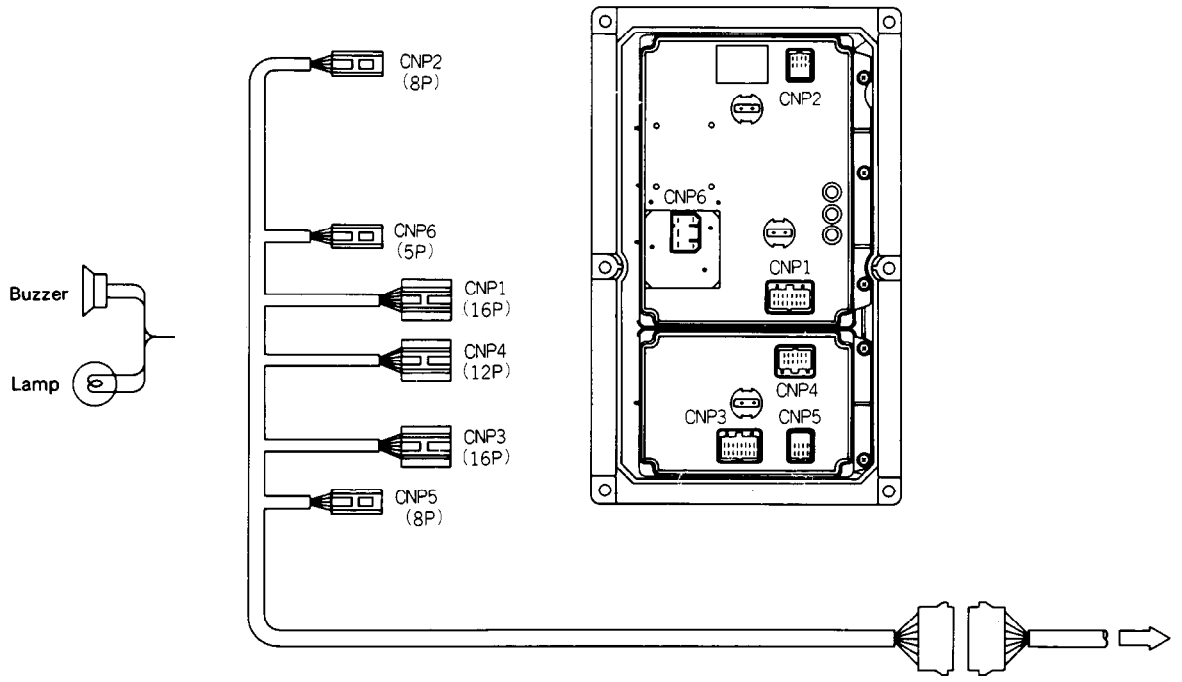
1. Check (Before starting)
   - 1A. Brake oil level
   - 1B. Engine oil level
   - 1C. Coolant level
2. Caution (Warning)
   - 2A. Battery charge
   - 2B. Fuel level
   - 2C. Main steering failure
3. Caution (Emergency warning)
   - 3A. Brake oil level
   - 3B. Engine oil pressure
   - 3C. Coolant level
   - 3D.
   - 3E. Coolant temperature
   - 3F. Torque converter oil temperature
4. Pilot indicator
   - 4A.
   - 4B. Parking brake
   - 4C. Work lamp
   - 4D. Transmission cut-off selector
   - 4E. Ground driven steering (If installed)
5. Gauge
   - 5A. Coolant temperature
   - 5B. Torque converter oil temperature
   - 5C. Fuel
6. Signal lamps
7. Speedometer
8. Headlamp (High beam)
9. Service meter
10. Service meter indicator

INDICATION ON MONITOR PANEL

Category	Symbol	Indication item	Indication range	Description
Checks before starting		Brake oil level	Below low mark	Displayed when starting switch is turned to ON with engine stopped. Display goes out when normal Display flashes when abnormal
		Engine oil level	Below low mark	
		Coolant level	Below low mark	
Caution 1		Battery charge	When charging is defective	Displays when engine is running. Display goes out when normal Display flashes when abnormal and lamps flash at the same time
		Fuel level	Below low mark	
		Main steering failure	When ground steering is operated	Display when steering switch is turned on; Display flashes when operated
Caution 2		Brake oil level	Below low mark	Display when engine is running. Display goes out when normal Display flashes when abnormal; buzzer and lamp actuated
		Engine oil pressure	Below specified pressure	
		Coolant level	Below low mark	
		Coolant temperature	Above 105°C	
		Torque converter oil temperature	Above 130°C	
Pilot		Parking brake	When operated	Display when starting switch is turned ON; Lights up when operated
		Work lamp	When operated	
		Transmission cut-off	When operated	
		Ground steering normal	When operated	Displays when ground steering is normal (If installed)

Category	Symbol	Indication item	Indication range	Description
Speed-ometer		Travel speed	0-100 km/h or 0-100 MPH	Digital display
		High beam	When operated	Displays when starting switch is turned ON; Lights up when operated
		Signal lamp (right, left)	When operated	
		Hazard	When operated	Lights up when operated
Service meter		Service meter	0-99999/h displayed	Actuated when engine oil pressure is normal. Advances 1 for every hour of operation
		Service meter indicator		Flashes when service meter is operating
Gauge		Coolant temperature		One lamp lights up to indicate level
		Torque converter oil temperature		One lamp lights up to indicate level
		Fuel level		All lamps light up below indicated level

WIRING HARNESS



U41901066

Operation of monitor panel

If the monitor panel is working normally, the lamps on the monitor panel will work as follows:

1) When the starting switch is turned to ON.
   a) All monitor lamps will light up for 3 seconds.
   b) The warning buzzer will sound for 2 seconds.
2) CHECK MONITOR GROUP
   a) All monitor lamps will light up for 3 seconds, then if there is any abnormality in any check item, that item will flash. (About 0.8 seconds ON, then 0.8 seconds OFF repeated.)
   b) If the outside air temperature is low (below about -10°C), the flashing interval will change slightly, but this is not an abnormality.
   c) The CHECK item lamps will go out when the engine is started. (Judge whether the engine is running by the rise in the engine oil pressure, or see if there is a voltage of over 10V from the alternator.)
3) CAUTION MONITOR GROUPS
   a) All monitors are working from the time the engine starts to the time the engine stops and the starting switch is turned to OFF.
   If there is any abnormality in the machine, the lamp for that item will start to flash (0.8 seconds ON, then 0.8 seconds OFF).

SENSORS

Function

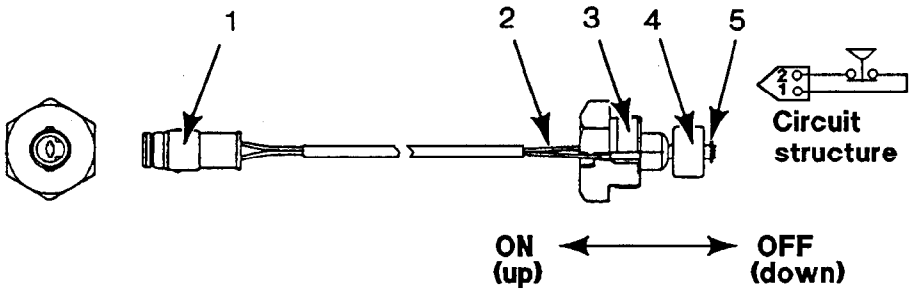
- There are three types of sensors: contact, resistor and solenoid.
- With contact type sensors, one end of the wiring is grounded at the chassis end, and the other end sends the signal from the sensor directly to the monitor or sends it through a relay.

If the contact of the sensor that sends the signal directly to the monitor is closed, the monitor judges the signal to be normal.
If the contact of the sensor that sends the signal to the monitor through a relay is opened, the monitor judges the signal to be normal. (The signal is reversed by the relay.)

Sensor actuation table

Check item	Sensor type	When normal	When abnormal
Engine oil level	Contact	ON	OFF
Coolant level	Contact	ON	OFF
Brake oil level	Contact	OFF	ON
Fuel level	Resistor		
Coolant temperature	Resistor		
Torque converter oil temperature	Resistor		
Engine oil pressure	Contact	OFF	ON
Travel speed	Solenoid		

ENGINE OIL LEVEL SENSOR



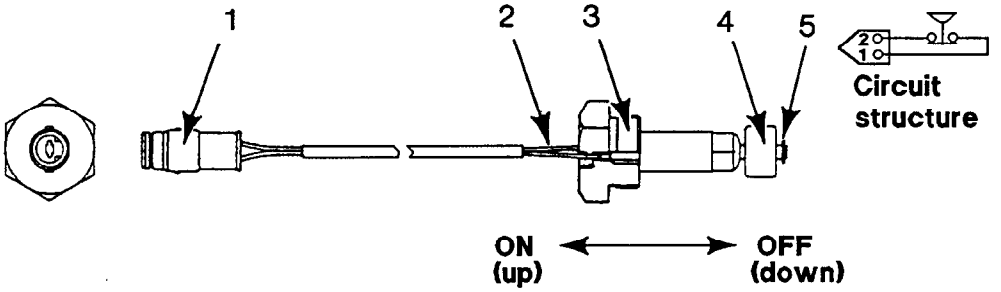
L08CD071

Function

- The engine oil level sensor is installed on the engine oil pan. When the engine oil goes below the specified level, the float goes down and the switch is turned OFF. The machine monitor lamp then lights up to indicate the abnormality.

1. Connector
2. Wire
3. Plug
4. Float
5. Switch

COOLANT LEVEL SENSOR



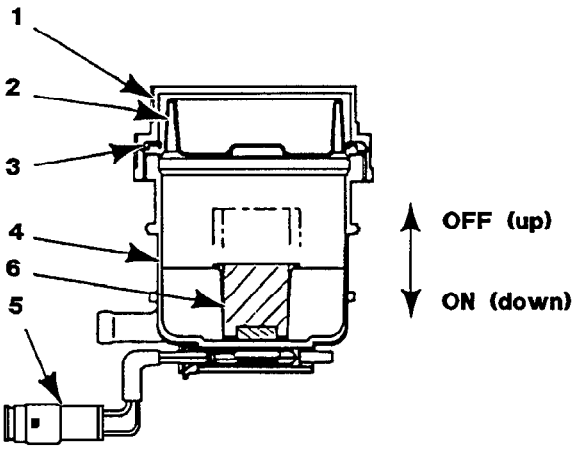
L08CD072

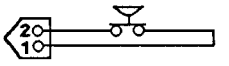
Function

- The coolant level sensor is installed on top of the radiator. When the coolant level goes down, the float goes down and the electric current is shut off. The machine monitor lamp then lights up to indicate the abnormality.

1. Connector
2. Wire
3. Plug
4. Float
5. Switch

BRAKE OIL LEVEL SENSOR





Circuit structure

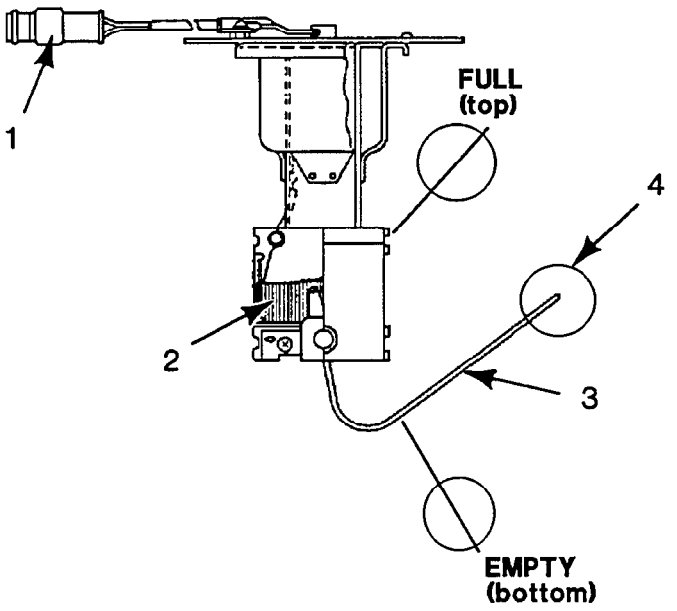
L08CD065

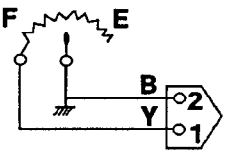
Function

- This is installed to the bottom of the brake oil tank, and when the brake oil goes below the specified level, the float goes down and turns the switch ON. This actuates the relay and turns the relay output OFF. The machine monitor lamp then flashes to indicate the abnormality.

1. Cap
2. Ring
3. Diaphragm
4. Tank
5. Connector
6. Float

FUEL GAUGE SENSOR





Circuit structure

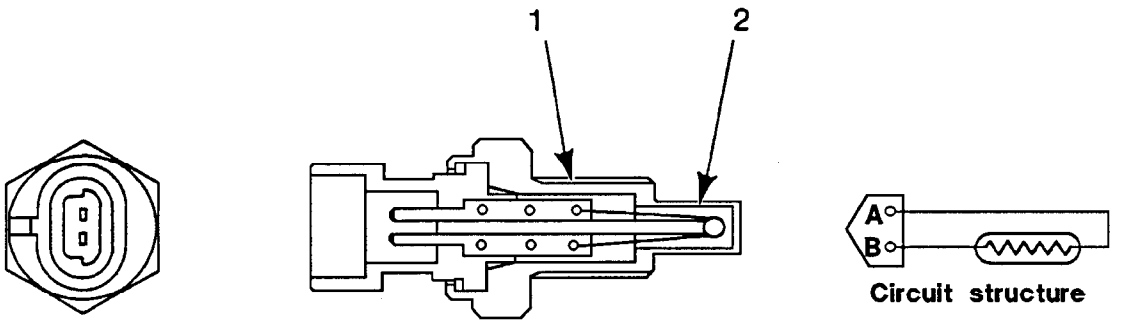
L08CD066

Function

- The fuel gauge is installed on top of the fuel tank. The float moves up and down according to the fuel level. The movement of the float is sent through a gear to actuate a variable resistor. This sends a signal to the machine monitor to display the fuel level.
  When the display on machine monitor drops to a certain level, a signal is generated between the modules inside the machine monitor, and the warning lamp flashes.

1. Connector
2. Variable resistor
3. Arm
4. Float

COOLANT TEMPERATURE SENSOR



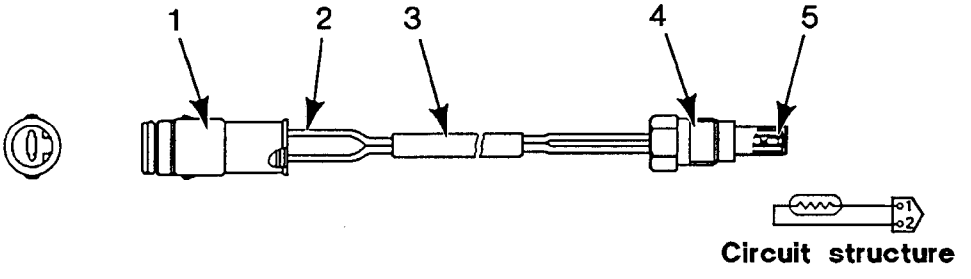
L08CD067

Function

- These sensors are installed on the engine thermostat housing. They use a thermistor to detect the temperature, and when the temperature goes above the specified temperature, the machine monitor lamp lights up to indicate the abnormality.

1. Plug
2. Thermistor

TORQUE CONVERTER OIL TEMPERATURE SENSOR



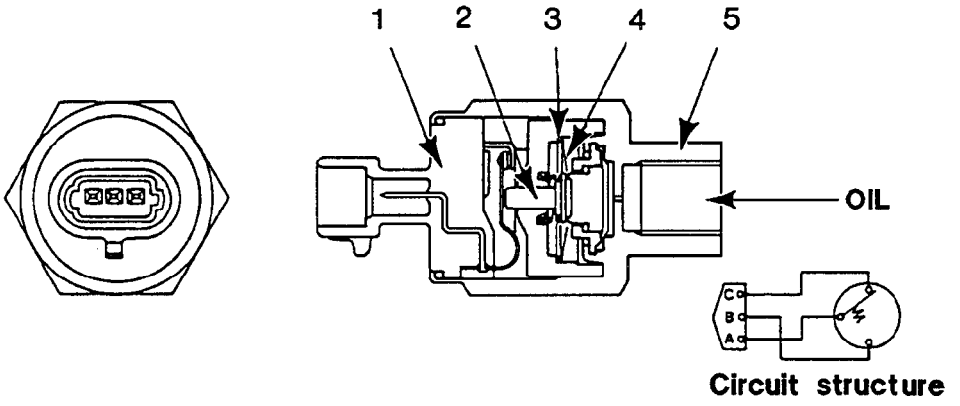
L08C068

Function

- These sensors are installed on the transmission case. They use a thermistor to detect the temperature, and when the temperature goes above the specified temperature, the machine monitor lamp lights up to indicate the abnormality.

1. Connector
2. Wire
3. Tube
   (Yellow: Coolant temperature)
   (Black: Torque converter oil temperature)
4. Plug
5. Thermistor

ENGINE OIL PRESSURE SENSOR



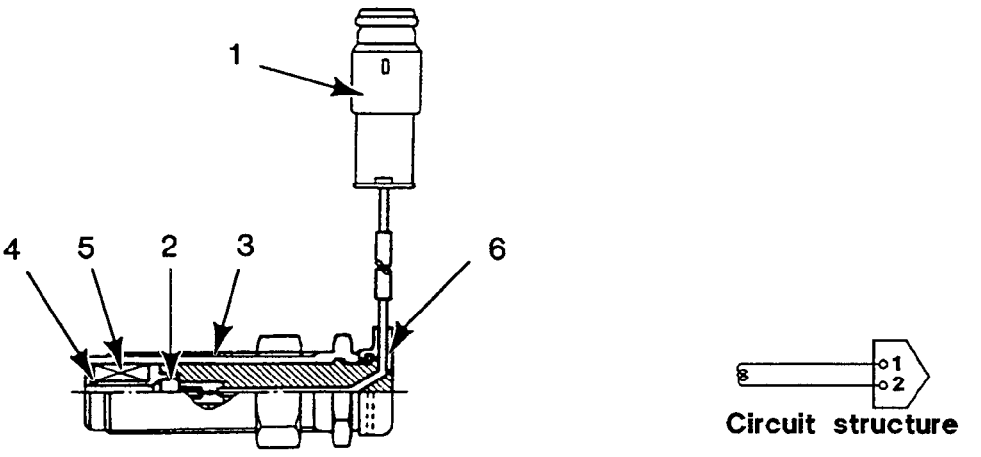
L08CD069

1. Cap
2. Button
3. Wire ring
4. Snap disc
5. Connector assembly

Function

- The engine oil pressure sensor is installed to the engine block. The snap disc detects the oil pressure, and when it drops below the set pressure, the switch comes ON. This actuates the relay to turn the output OFF, and the machine monitor lamp flashes to warn of the abnormality.

ROTATIONAL SPEED SENSOR



L08CD070

1. Connector
2. Magnet
3. Case
4. Core
5. Wiring
6. Boot

Function

- The speedometer sensor is installed on the transmission output gear. A pulse voltage is generated by the rotation of the gear teeth, a signal is then sent to the machine monitor, and this displays the travel speed.

PROXIMITY SWITCH

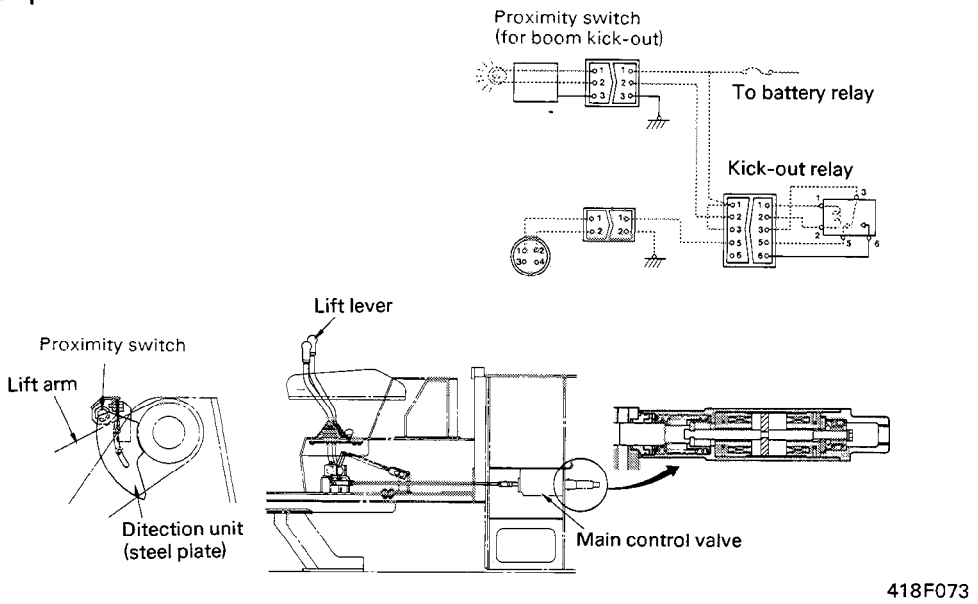
Function

- Proximity switches are installed by a support to the lift and dump cylinders. The lift arm RAISE position and the TILT BACK position can be selected to match the operating conditions. When these positions are reached, a pulse is generated from the switch, the electric current flows to a magnet and the lift or dump lever is returned to the neutral position. When this happens, the main control valve is also returned to neutral and the movement of the lift arm or bucket stops.

OPERATION

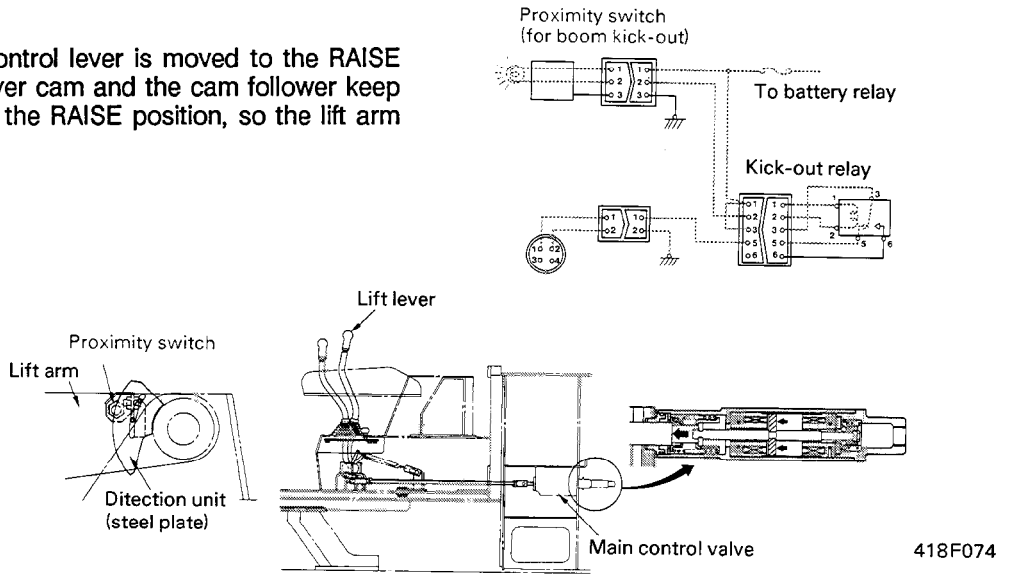
Lift arm RAISE

- When the lift arm is lower than the set position for the boom kick-out, the detection unit (steel plate) is on the sensing surface of the proximity switch. Electricity flows through the proximity switch. The relay switch is at OFF and the electric current of the magnet switch coil is shut off.



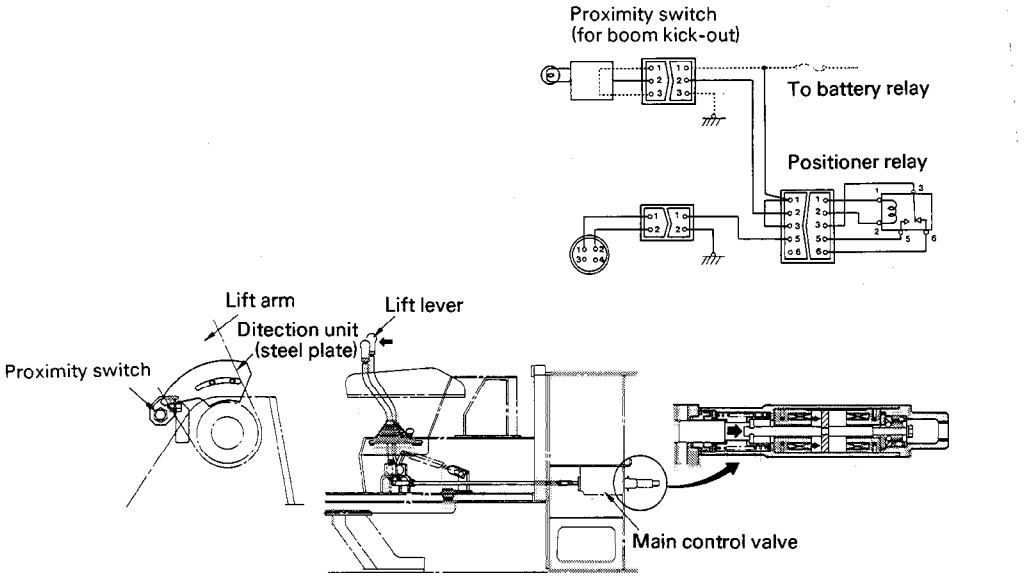
418F073

- When the lift control lever is moved to the RAISE position, the lever cam and the cam follower keep the lift spool in the RAISE position, so the lift arm goes up.



418F074

- When the lift arm goes up and reaches the set position for the kick-out (that is, the detection unit [steel plate] is separated from the sensing surface of the proximity switch), the proximity switch and relay circuit act to send electric current to the magnet coil. This actuates the magnet, the cam is pulled out of the cam detent, and the lift spool is returned to the neutral position by the return spring.



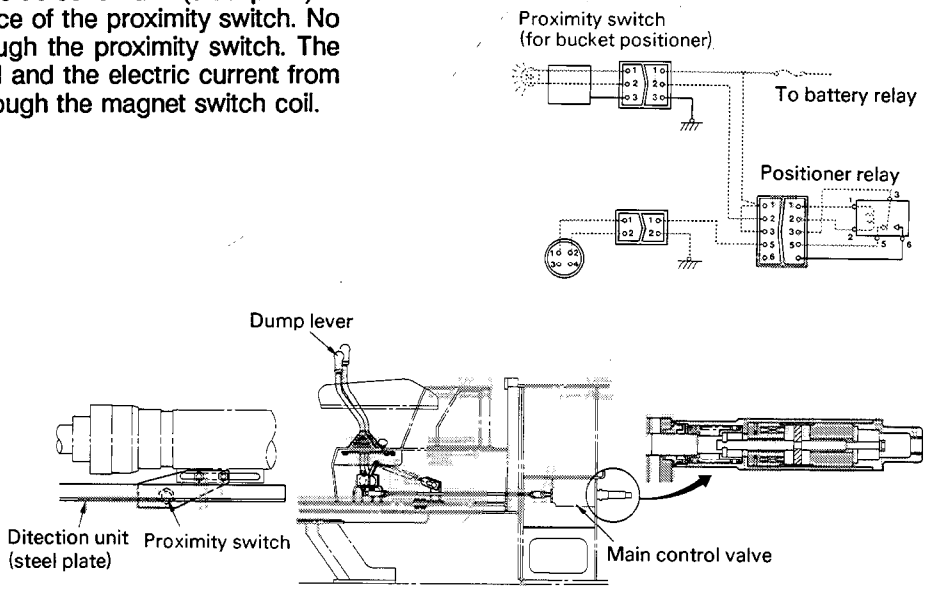
418F075

Movement of proximity switch

Position	Sensing surface of magnet switch is in contact with detection unit	Sensing surface of proximity switch is separated from detection unit
Magnet switch display	ON	OFF
Proximity switch load circuit (Relay switch circuit)	Current flows	Current shut off
Relay switch load circuit (Magnet circuit)	Current shut off	Current flows

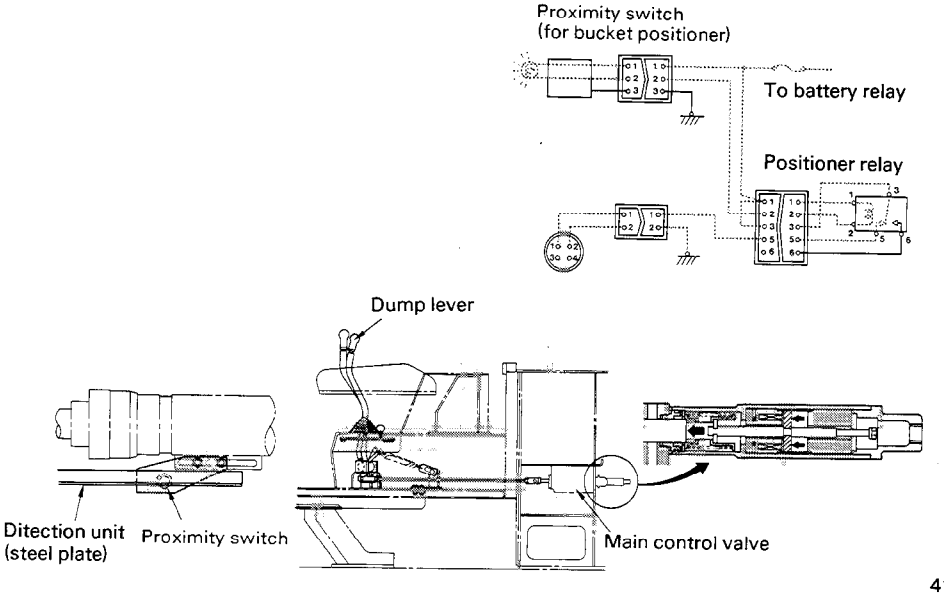
Bucket TILT

- When the bucket is lower than the set position for the bucket leveler, the detection unit (steel plate) is on the sensing surface of the proximity switch. No electricity flows through the proximity switch. The relay switch is at ON and the electric current from the battery flows through the magnet switch coil.



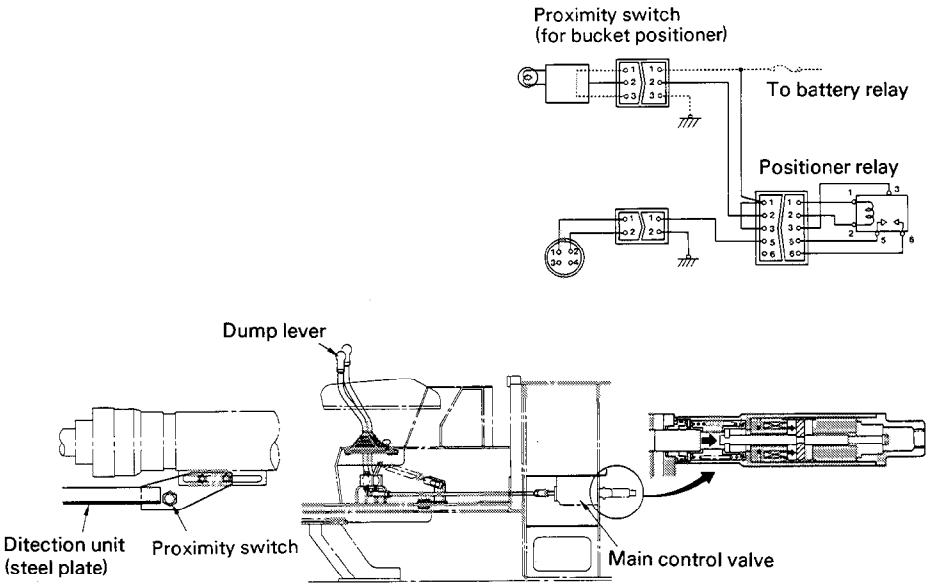
418F076

- When the bucket control lever is moved to the TILT position, the lever cam and the cam follower keep the dump spool in the TILT position, so the bucket tilts.



418F077

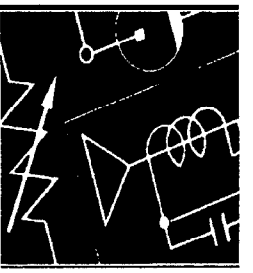
- When the bucket tilts and reaches the set position for the bucket leveler (that is, the detection unit [steel plate] is separated from the sensing surface of the proximity switch), the proximity switch and relay circuit act to send electric current to the magnet coil. This actuates the magnet, the cam is pulled out of the cam detent, and the dump spool is returned to the neutral position by the return spring.



418F078

ELECTRIC AND ELECTRONIC SYSTEM

82 TESTING AND ADJUSTING



ADJUSTING SPEEDOMETER MODULE 4

TROUBLESHOOTING 5
ELECTRICAL CIRCUIT SYSTEM 7
1. ENGINE STARTING CIRCUIT SYSTEM 7
2. ENGINE STOP CIRCUIT SYSTEM 8
3. TRANSMISSION CONTROL AND PARKING BRAKE SYSTEM 9

CONNECTION TABLE FOR CONNECTOR PIN NUMBER 10
PRECAUTION WHEN HANDLING CONNECTOR 15
METHOD OF USING YES-NO TROUBLESHOOTING FLOW CHART 17
ELECTRICAL SCHEMATIC 20
CHECKS BEFORE TROUBLESHOOTING 21
TROUBLESHOOTING CHARTS FOR ELECTRIC SYSTEM 23
POSITION OF CONNECTORS 24
E-1 ENGINE DOES NOT START. 29
E-2 ENGINE DOES NOT STOP. 30
E-3 ENGINE STOPS WHEN MACHINE IS TRAVELING. 30
E-4 TRANSMISSION IS NOT RETURNED TO NEUTRAL WHEN PARKING BRAKE IS APPLIED. 31
E-5 MACHINE MOVES IN REVERSE BUT NOT IN FORWARD. 31
E-6 MACHINE MOVES NEITHER IN FORWARD NOR REVERSE. 32
E-7 MACHINE MOVES IN FORWARD BUT NOT IN REVERSE. 34
E-8 MACHINE MOVES FORWARD EVEN WHEN TRANSMISSION CONTROL LEVERS ARE IN NEUTRAL. 34
E-9 MACHINE MOVES IN REVERSE EVEN WHEN TRANSMISSION CONTROL LEVERS ARE IN NEUTRAL. 35
E-10 MACHINE ALWAYS TRAVELS IN 2ND. 35
E-11 TRANSMISSION DOES NOT CHANGE GEAR (But F-R changeable). 36
E-12 TRANSMISSION CANNOT BE CUT-OFF EVEN WHEN L.H. BRAKE PEDAL IS DEPRESSED WITH TRANSMISSION CUT-OFF SELECTOR SWITCH ON. 37
E-13 TRANSMISSION DOES NOT RETURN TO NEUTRAL. 38
TROUBLESHOOTING CHARTS FOR ELECTRONIC VEHICLE MONITORING SYSTEM 41
ELECTRONIC VEHICLE MONITORING SYSTEM (EVMS) SCHEMATIC 42
POSITION OF CONNECTORS 43
M-1 EVEN WHEN ENGINE IS STOPPED, (BRAKE OIL LEVEL) FLASHES. 49
M-2 EVEN WHEN ENGINE IS STOPPED, (ENGINE OIL LEVEL) FLASHES. 49
M-3 EVEN WHEN ENGINE IS STOPPED, (COOLANT LEVEL) FLASHES. 50
M-4 (BATTERY CHARGE) FLASHES WHEN ENGINE IS RUNNING. 50
M-5 (FUEL LEVEL) FLASHES. 51
M-6 WHEN ENGINE IS RUNNING, EVEN THOUGH THERE IS NO ABNORMALITY IN MACHINE, (BRAKE OIL LEVEL) FLASHES. 51

M-7 WHEN ENGINE IS RUNNING, EVEN THOUGH THERE IS NO ABNORMALITY IN MACHINE, (ENGINE OIL PRESSURE) FLASHES. ... 51
M-8 WHEN ENGINE IS RUNNING, EVEN THOUGH THERE IS NO ABNORMALITY IN MACHINE, (COOLANT LEVEL) FLASHES. ... 52
M-9 WHEN ENGINE IS RUNNING, EVEN THOUGH THERE IS NO ABNORMALITY IN MACHINE, (BRAKE SERVO PRESSURE) FLASHES (IF EQUIPPED). ... 52
M-10 WHEN ENGINE IS RUNNING, EVEN THOUGH THERE IS NO ABNORMALITY IN MACHINE, (COOLANT TEMPERATURE) FLASHES. ... 52
M-11 WHEN ENGINE IS RUNNING, EVEN THOUGH THERE IS NO ABNORMALITY IN MACHINE, (TORQUE CONVERTER OIL TEMPERATURE) FLASHES. ... 53
M-12 (PARKING BRAKE) LIGHTS UP OR DOES NOT LIGHT UP. ... 53
M-13 (WORKING LAMP) LIGHTS UP ABNORMALLY, OR DOES NOT LIGHT UP. ... 54
M-14 NOT USED ... 55
M-15 (FAILURE IN MAIN STEERING) LIGHTS UP OR DOES NOT LIGHT UP (IF EQUIPPED). ... 55
M-16 (EMERGENCY STEERING NORMAL) LIGHTS UP OR DOES NOT LIGHT UP (IF EQUIPPED). ... 56
M-17 (TRANSMISSION CUT-OFF) LIGHTS UP OR DOES NOT LIGHT UP. ... 57
M-18 TURN SIGNAL LAMPS, HIGH BEAM LIGHT UP OR DO NOT LIGHT UP. ... 58
M-19 SPEEDOMETER DISPLAY DOES NOT WORK. ... 60
M-20 SERVICEMETER DOES NOT WORK NORMALLY. ... 61
M-21 ALL OR PART OF MONITOR PANEL DOES NOT WORK. ... 62
M-22 EVEN WHEN ENGINE IS STOPPED, (BATTERY CHARGE) FLASHES, OR (ENGINE OIL PRESSURE) FLASHES. ... 63
M-23 NO LAMPS ON MONITOR LIGHT UP (IMMEDIATELY AFTER TURNING STARTING SWITCH TO ON, ENGINE STOPPED). ... 63
M-24 CENTRAL WARNING LAMP DOES NOT GO OUT. ... 64
M-25 CENTRAL WARNING BUZZER DOES NOT STOP. ... 64
M-26 NONE OF PANEL LAMPS ON MACHINE MONITOR LIGHT UP. ... 65
M-27 SOME OF PANEL LAMPS ON MACHINE MONITOR DO NOT LIGHT UP. ... 67
M-28 EMERGENCY ITEM IS FLASHING, BUT ALARM BUZZER DOES NOT SOUND. ... 68
M-29 EMERGENCY ITEM OR NON-EMERGENCY ITEM IS FLASHING, BUT WARNING LAMP DOES NOT FLASH. ... 68
M-30 ABNORMALITY IN (FUEL GAUGE). ... 69
M-31 ABNORMALITY IN (COOLANT TEMPERATURE GAUGE). ... 70
M-32 ABNORMALITY IN (TORQUE CONVERTER OIL TEMPERATURE GAUGE). ... 71
TABLE OF MONITOR REFERENCE VALUES ... 72

★ The following precautions are necessary when using the Standard Value Tables to make judgements during troubleshooting or during testing and adjusting.

1. The values in these tables are based on the values for new machines leaving the plant, so they should be used as target values when repairing or when estimating wear after a period of use.

2. The standard values in these tables are used when troubleshooting. They are estimated values based on the standard values for the machine when shipped from the plant, and on the results of various tests. Therefore, they should be used as reference in combination with repair and operating records when making judgements.

3. These standard value tables must not be used for standard values when judging claims. In addition, do not use these values alone to make simple judgement calls.

★ Before carrying out the troubleshooting in this section, read "PRECAUTIONS WHEN TROUBLESHOOTING", "METHOD OF READING TROUBLESHOOTING TABLES" and "PREVENTING RECURRENCE OF TROUBLE" - all in SECTION 22.

★ When carrying out troubleshooting of the power train, it is necessary to distinguish if the breakdown is in the power train itself or in the electrical system. See "JUDGEMENT ON POWER TRAIN" in SECTION 22.

★ When disconnecting or connecting the T-adapter (or socket adapter) or short socket adapter or when disconnecting the connector for checking, turn the starting switch OFF to prevent accidents.

★ When connecting the T-adapter (or socket adapter), connect to the connector specified. (CNxx ( )).

★ When disconnecting connectors or connecting T-adapters, return them to the original condition immediately after checking, then go to the next check.

★ If the head lamps and other electrical parts are not working normally, check battery - battery relay - starting switch first.

NOTE: When checking the diodes for continuity by using an analog or digital tester, be sure to use the red and black colored test rods reversely because of different polarity of batteries.

ADJUSTING SPEEDOMETER MODULE

★ Adjustment to be done when power supply is OFF.

Adjustment procedure

- Remove the machine monitor, and adjust at the adjustment portion at the back of the speedometer. Measurement condition: Starting switch OFF
  1) Remove rubber caps 1 and 2 at the rear of the speedometer.
  2) When the rubber caps are removed, rotary switches can be seen inside. Using a flatheaded screwdriver, turn the switch to adjust as shown in the figure on the right.
     ★ Switch 3 has no connection with adjustment of the speedometer, so do not touch it under any circumstances.

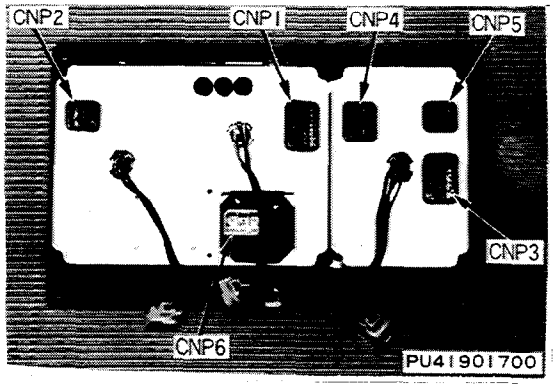
Tire size	Switch 1		Switch 2
	km/H type	MPH type	
17.5-25-12PR (L-2)(L-3)	0	8	7 (or 8)
20.5-25-12PR (L-2)(L-3)	0	8	2

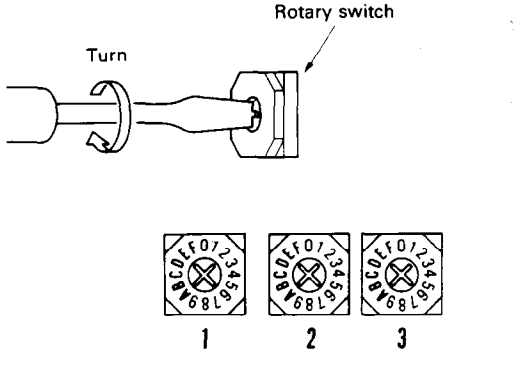
  3) After completing adjustment, fit the rubber caps back on securely and install the machine monitor.

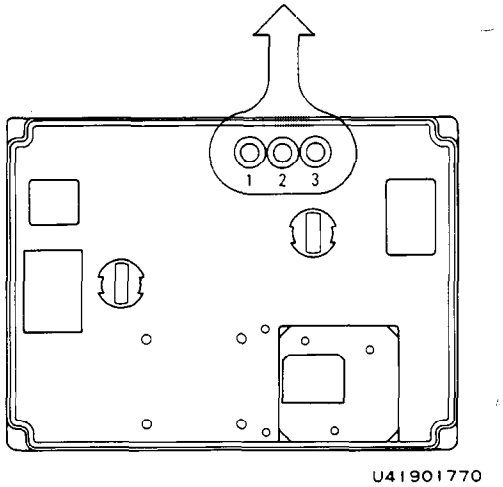
Reference
Amount of compensation for switch (2)

Switch position	0	1	2	3	4	5	6	7
Correction factor (%)	+14	+12	+10	+8	+6	+4	+2	0

Switch position	8	9	A	B	C	D	E	F
Correction factor (%)	0	-2	-4	-6	-8	-10	-12	-14





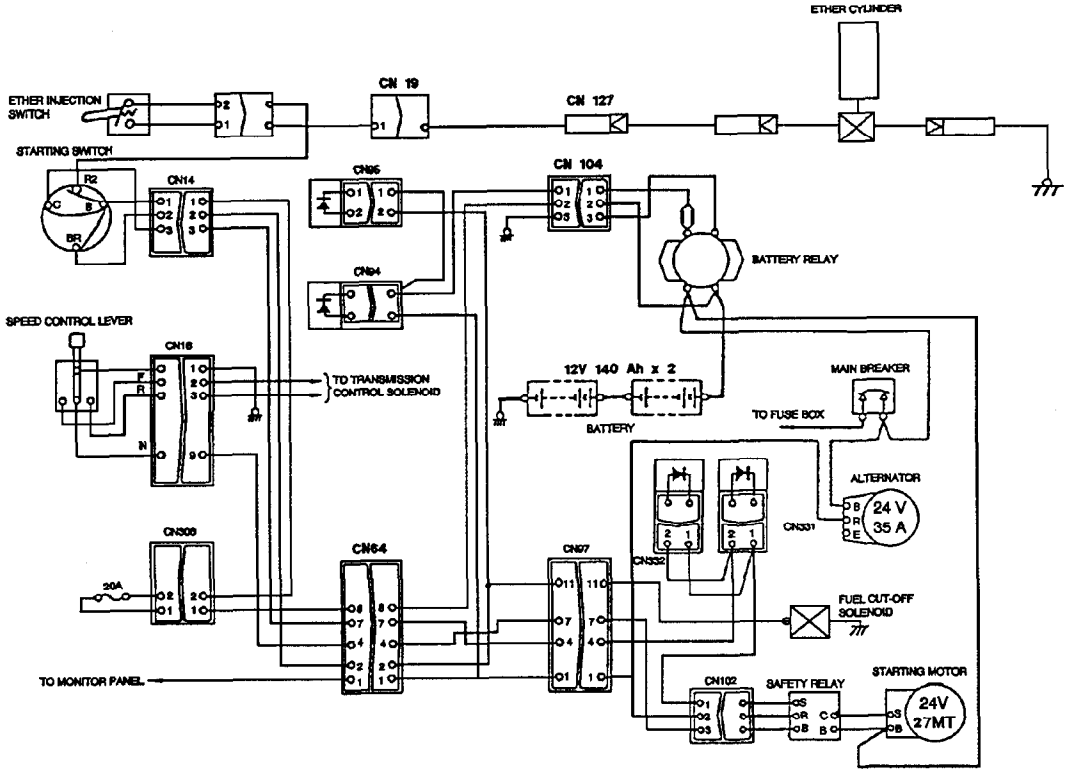


TROUBLESHOOTING

This page is blank.

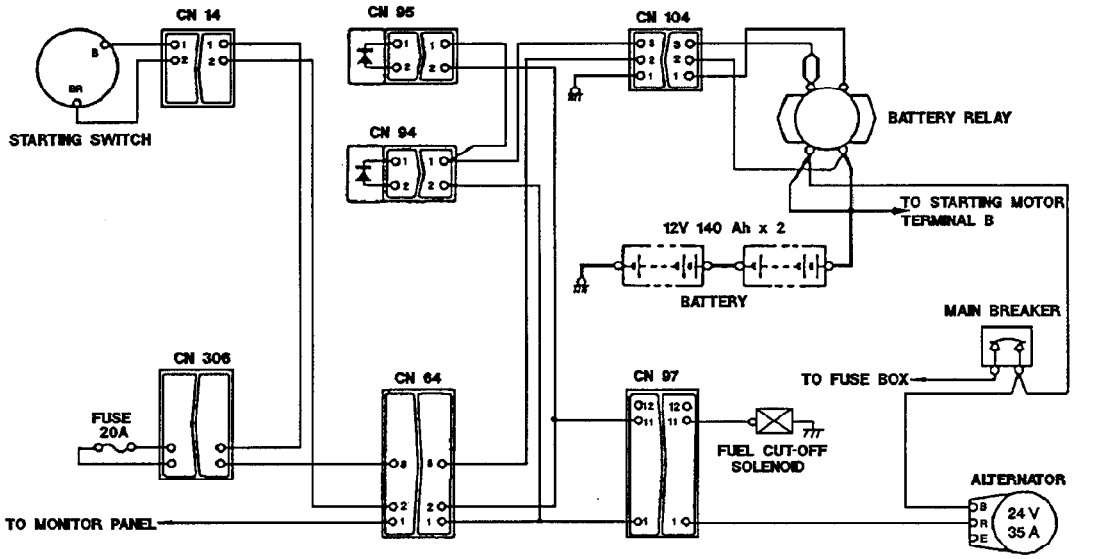
ELECTRICAL CIRCUIT SYSTEM

1. ENGINE STARTING CIRCUIT SYSTEM



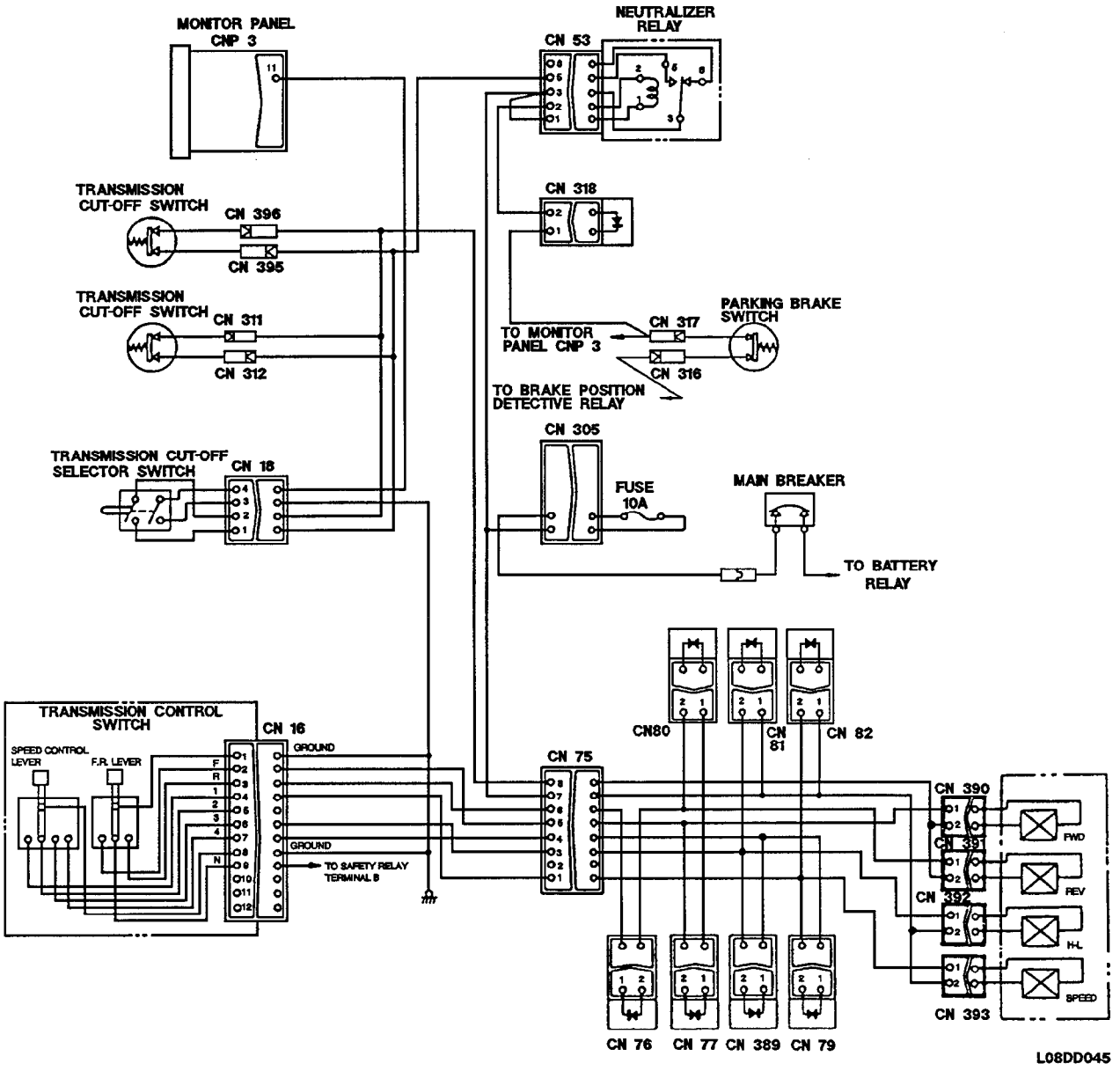
L08DD089

2. ENGINE STOP CIRCUIT SYSTEM

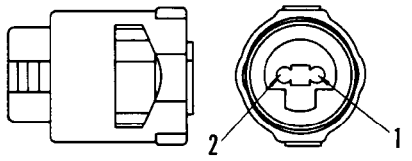
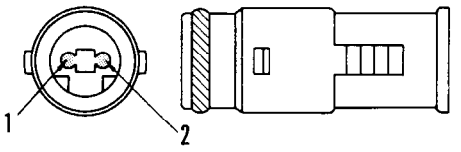
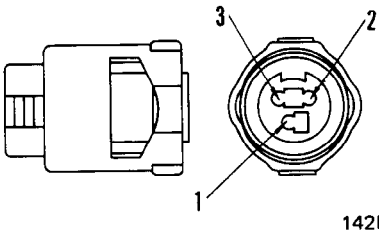
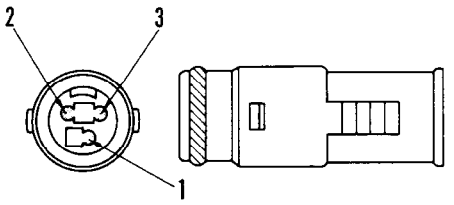
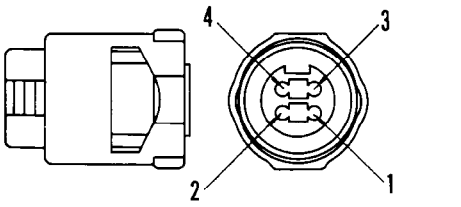
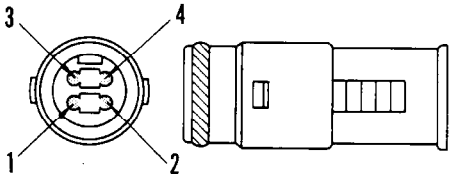
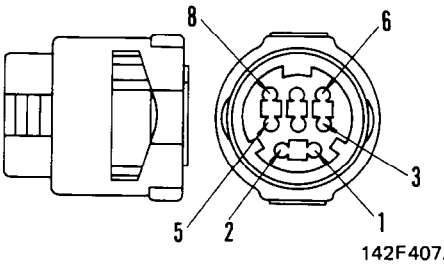
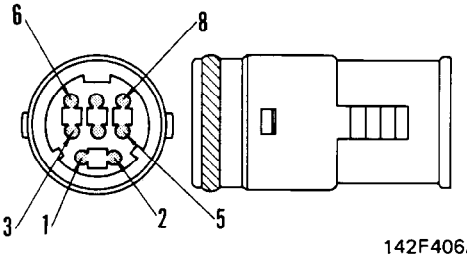
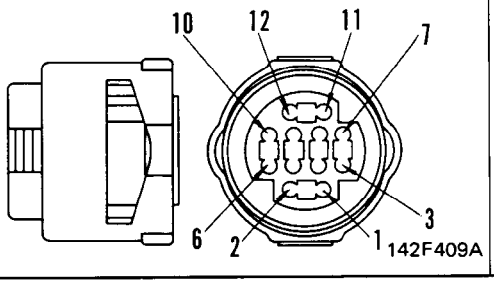
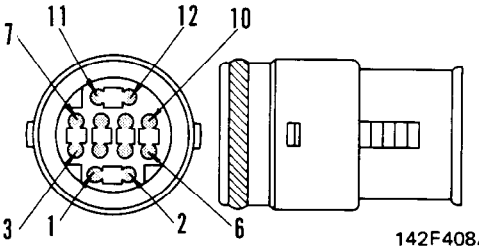


L08DD090

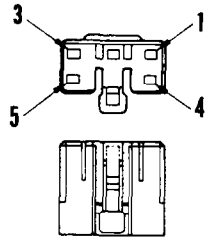
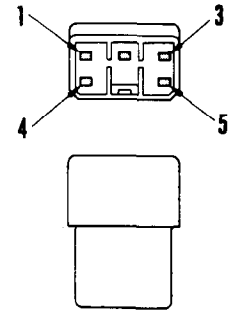
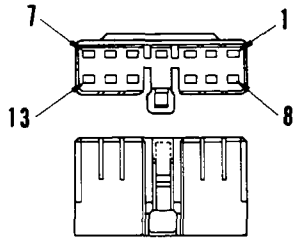
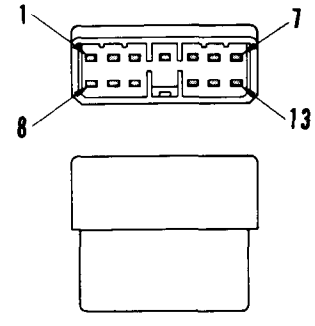
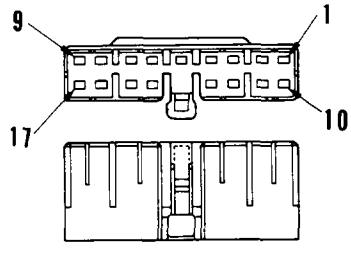
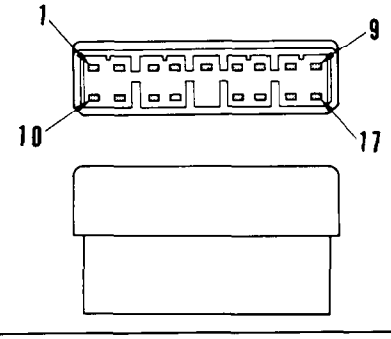
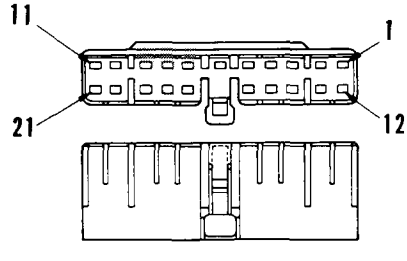
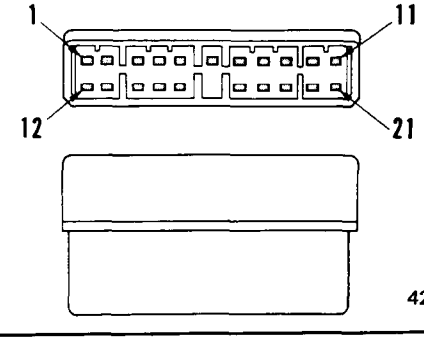
3. TRANSMISSION CONTROL AND PARKING BRAKE SYSTEM



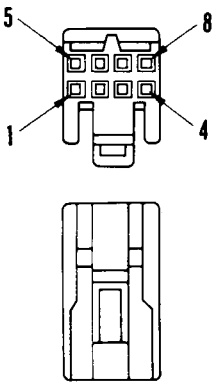
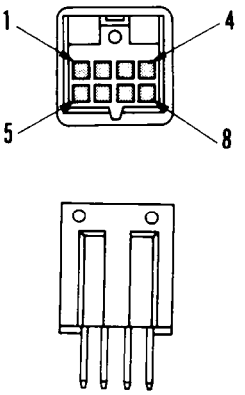
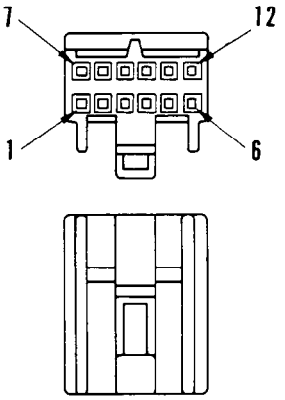
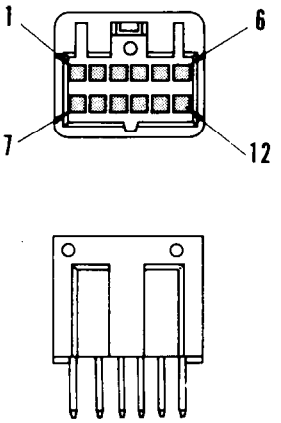
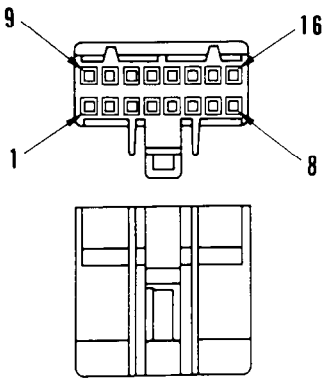
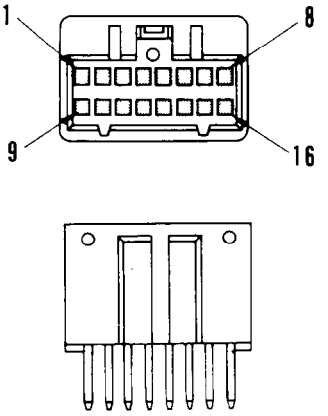
CONNECTION TABLE FOR CONNECTOR PIN NUMBER

No. of Pins	ECONOSEAL CONNECTOR	
	Female terminal (Socket)	Male terminal (Pin)
2	 142F401A	 142F400A
3	 142F403A	 142F402A
4	 142F405A	 142F404A
8	 142F407A	 142F406A
12	 142F409A	 142F408A

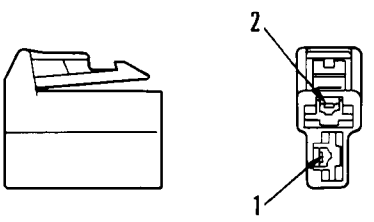
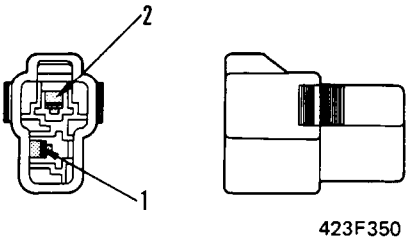
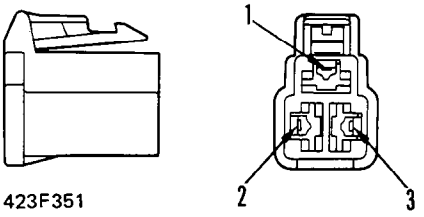
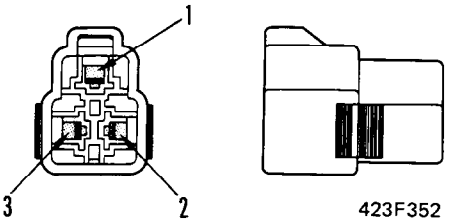
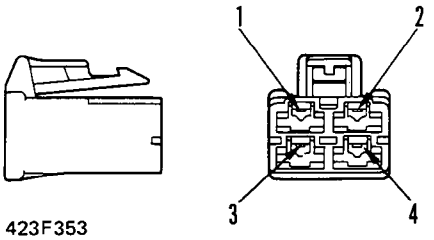
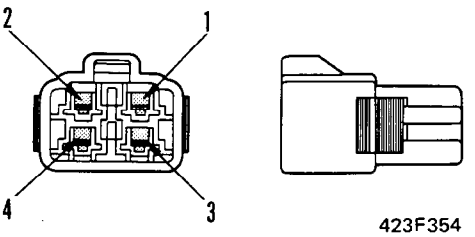
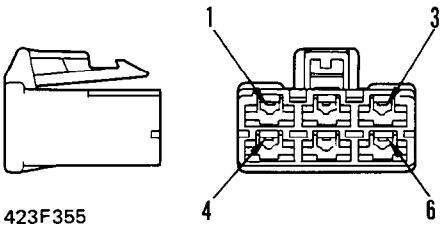
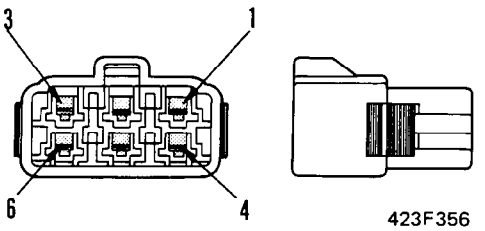
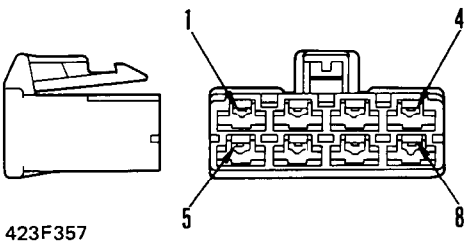
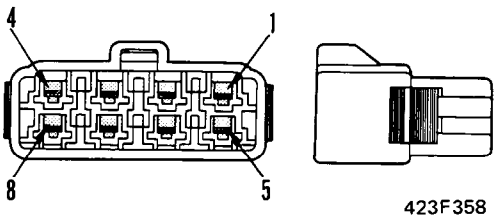
L08ZZ009

No. of Pins	MIC CONNECTOR	
	Female terminal (Socket)	Male terminal (Pin)
5	 142F410	 142F411
13	 142F412	 142F413
17	 142F414	 142F415
21	 142F416	 423F417

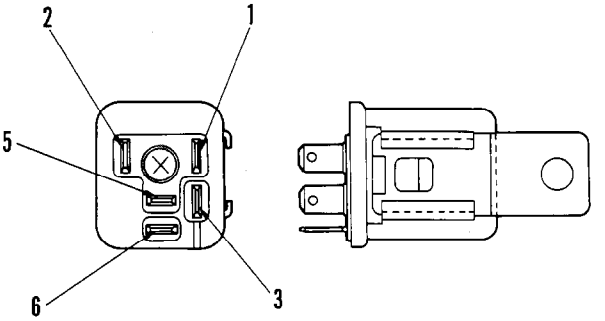
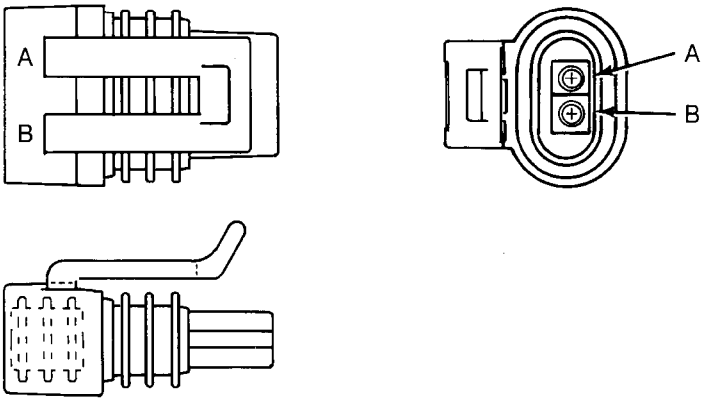
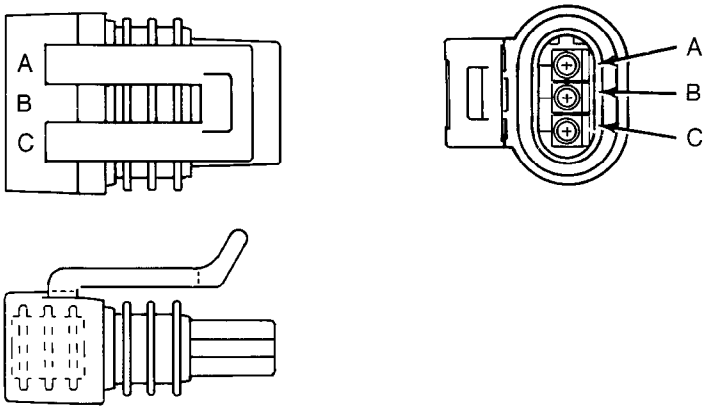
L08ZZ011

No. of Pins (Connector)	DLI CONNECTOR (For monitor panel)	
	Female terminal (Socket)	Male terminal (Pin)
8 (CNP2) (CNP5)	 142F418	 142F419
12 (CNP4)	 142F420	 142F421
16 (CNP1) (CNP3)	 142F422	 142F423

L08ZZ007

No. of Pins	N-SLC CONNECTOR	
	Female terminal (Socket)	Male terminal (Pin)
2	 423F349	 423F350
3	 423F351	 423F352
4	 423F353	 423F354
6	 423F355	 423F356
8	 423F357	 423F358

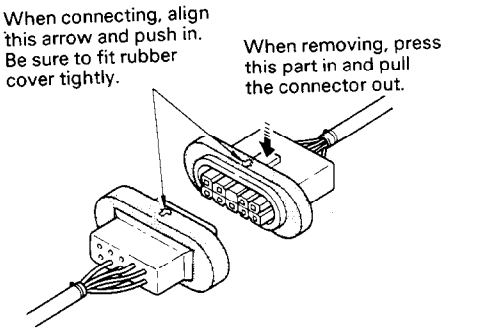
L08ZZ010

No. of pins	RELAY CONNECTOR
5	 L08ZZ012
	METRI-PACK CONNECTOR
	Female terminal (Socket)
2	
3	

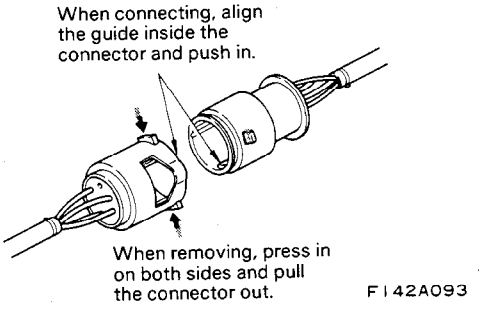
L08ZZ013

PRECAUTION WHEN HANDLING CONNECTOR

1. If the connector has a lock, always release the lock before disconnecting the connector.

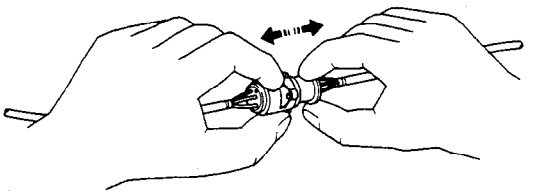


F142A092

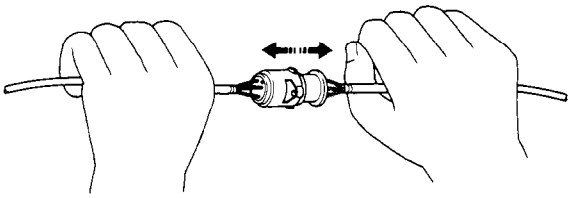


F142A093

2. Never pull the cord to disconnect the connector.

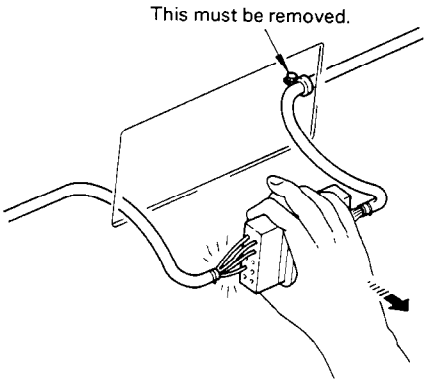


F142A094



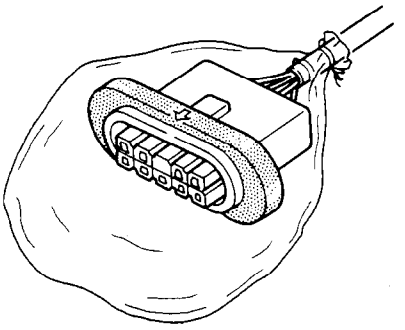
F142A095

3. If the connector is difficult to disconnect, do not try to pull it out.
   (If it is difficult to reach by hand, remove the clamp and move the wiring harness.)



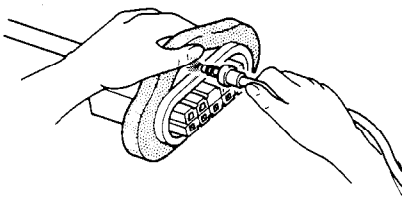
F142A096

4. After pulling out the connector, cover with a vinyl bag to protect the contacts from dirt or oil.



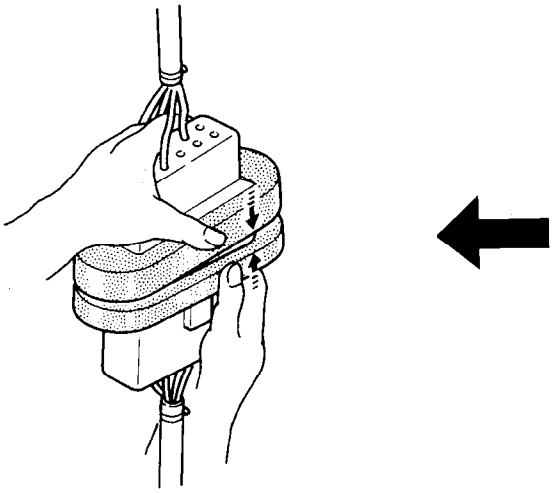
F142A097

5. When cleaning the connector, never use cleaning agents such as trichloroethane or trichloroethylene. If the connector is very dirty, use a neutral cleaning agent. After cleaning, wash well and dry completely immediately. (Do not use any connector which has deposits left on it after drying.)
Coat with contact restorer.
(When drying, be particularly careful to dry the gaps in the rubber.)

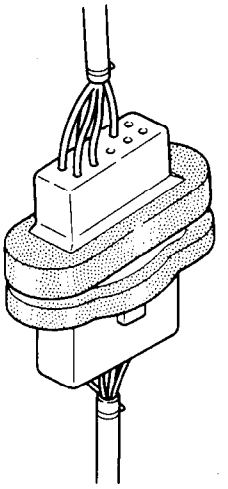


F142A098

6. When assembling the connector, be sure to fit it correctly.
(For connectors with locks, it should be possible to hear the locks click as they fit completely into position.)



F142A099



F142A100

- Correct any protrusion of the boots.

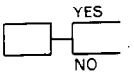
METHOD OF USING YES-NO TROUBLESHOOTING FLOW CHART

The electrical system can be broadly divided into the following two parts.

1. Starting system, transmission electrical control system, and brake system.
2. ELECTRONIC VEHICLE MONITORING SYSTEM.
   The charts for these systems are marked as E-xx, and M-xx respectively.

Troubleshooting chart No.	Item
E-xx	Troubleshooting of starting system, transmission electrical control system, and brake system.
M-xx	Troubleshooting of electronic vehicle monitoring system.

1. **Method for troubleshooting**
   - Check or measure the items inside the rectangle



L08ZZ029

   According to the result, follow the YES arrow or the NO arrow and proceed to the next rectangle. (Note: The number given at the top right of the rectangle is a reference number. It does not indicate the order for troubleshooting.)
   - If the result of the check or measurement leads directly to the CAUSE column, note the cause and take the action given in the REMEDY column.
   - The value for the check and the measurement method is given inside the rectangle. If the value is correct, or the answer is yes, follow the YES arrow; if the value is not correct or the answer is no, follow the NO arrow.
   - Below the rectangle, there is a list given preparatory work, methods of operating and handling, and judgement values needed for checking and measuring. If the preparatory work is ignored, or the wrong method of operating or handling is used, or the judgement is wrong, this could result in damage to the equipment. Therefore, always read the procedure carefully before starting the check or measurement, and carry out the operation in the order given.

2. **Precautions when carrying out troubleshooting**
   The precautions to be followed when carrying out troubleshooting for each failure is marked ★ under the description of the failure. Always follow these precautions when making measurements.

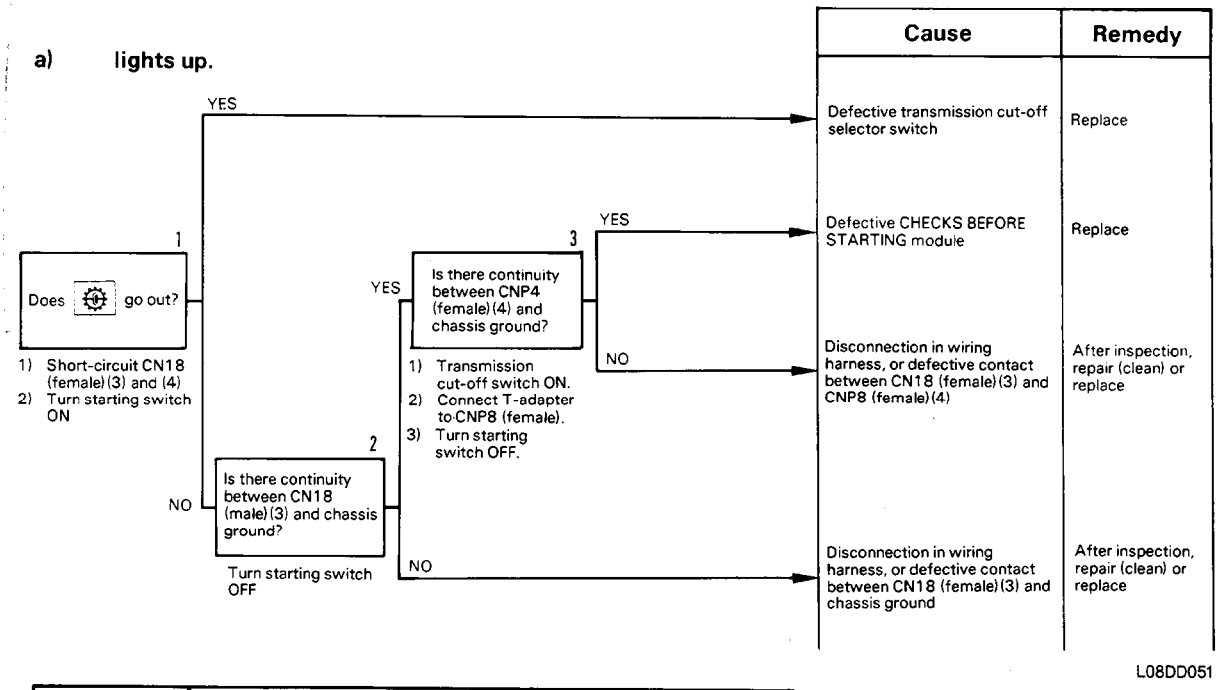
3. **Tools needed for troubleshooting**
   The tools needed for troubleshooting for each problem are listed as follows.

Troubleshooting tools	Tool	Tool
	Item	Item

   Prepare these tools before starting troubleshooting.

4. **Place to install connectors, connector pin numbers**
   When troubleshooting some problems, measurements have to be made of continuity, voltage and resistance at each step during the troubleshooting procedures. The location for measurement at each step (location of connector, connector pin number) is shown in a photograph or diagram. For this reason, use these photographs together with the YES-NO type troubleshooting flow charts to carry out troubleshooting quickly and accurately.

Example
- ★ When disconnecting or connecting the T-adapter (or socket adapter) or short socket adapter, or when disconnecting the connector for checking, turn the starting switch OFF to prevent accidents.
- ★ When connecting the T-adapter (or socket adapter), connect to the connector specified. (CNxx ( ))
- ★ When disconnecting connectors or connecting T-adapters, return them to the original condition immediately after checking, then go to the next check.

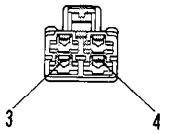


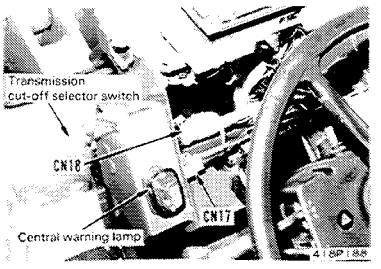
L08DD051

Troubleshooting tools	Tester	
	T-adapter (for DLI)	T-adapter or socket adapter (for Econoseal)

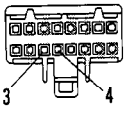
POSITION OF CONNECTOR

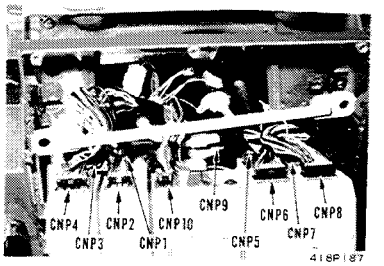
CN18 (female) (Transmission cut-off selector switch)





CNP8 (female) (Monitor module)





ELECTRICAL SCHEMATIC

See Foldouts #'s 1, 2 and 3, at the end of this book.

CHECKS BEFORE TROUBLESHOOTING

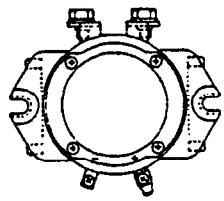
xxxxxxxx	xxxxxxxxx	Item	Standard value	Remedy
Checks before starting	Lubricating oil, cooling water	1. Check fuel level		Add fuel
		2. Check for dirt or water in fuel		Clean, drain
		3. Check hydraulic oil level		Add oil
		4. Check hydraulic oil strainer		Clean, drain
		5. Check brake oil level		Add oil
		6. Check engine oil level (Level of oil in oil pan)		Add oil
		7. Check cooling water level		Add water
		8. Check condition of dust indicator		Clean or replace
		9. Check air pressure in air reservoir		See Troubleshooting
Item	Electrical Equipment	10. Check for loose or corroded battery terminals		Tighten or replace
		11. Check for loose or corroded alternator terminals		Tighten or replace
		12. Check for loose or corroded starting motor terminals		Tighten or replace
Other check items	Hydraulic, mechanical components	13. Check for abnormal noise or smell		Repair
		14. Check for oil leakage		Repair
		15. Bleed air from system		Bleed air
	Electrical components	16. Check battery voltage (engine stopped)	20 - 30V	Replace
		17. Check level of battery electrolyte		Add or replace
		18. Check for discolored, burnt, or bare wires		Replace
		19. Check for missing wiring clamps, hanging wires		Repair
		20. Checks for water leaking onto wiring (check carefully water leakage at connectors and terminals)		Disconnect connector and dry connection
		21. Check for broken or corroded fuses		Replace
		22. Check alternator voltage (engine running at over half throttle)	27.5 - 29.5V	Replace
		23. Noise when battery relay is operated (switch starting switch from on to off)		Replace

This page is blank.

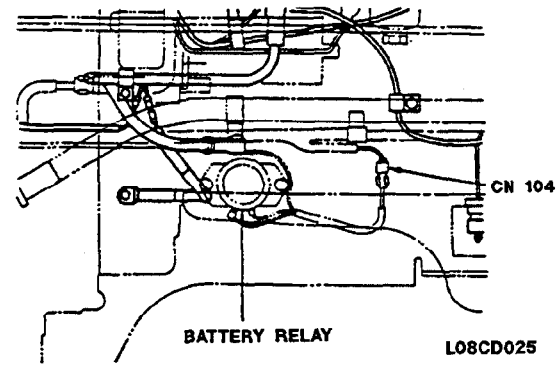
TROUBLESHOOTING CHARTS FOR ELECTRIC SYSTEM

POSITION OF CONNECTORS

Battery relay

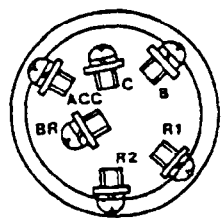


L08CD021

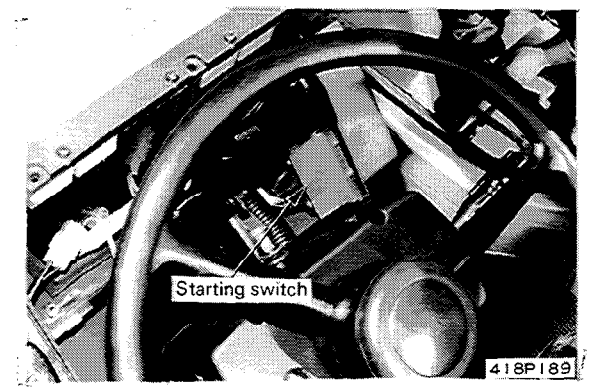


L08CD025

Starting switch



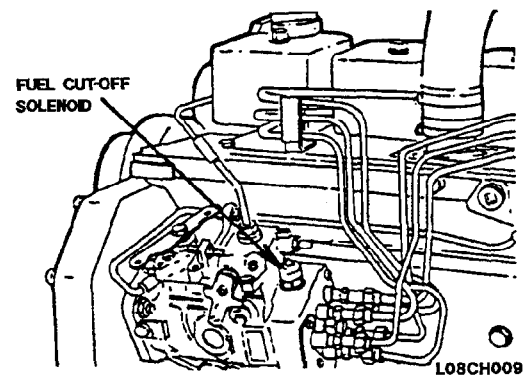
L08CD022



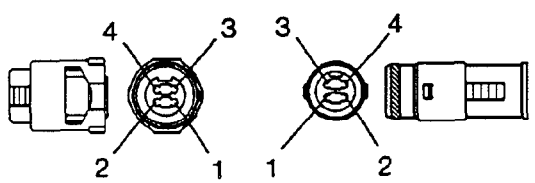
(Fuel cut solenoid)



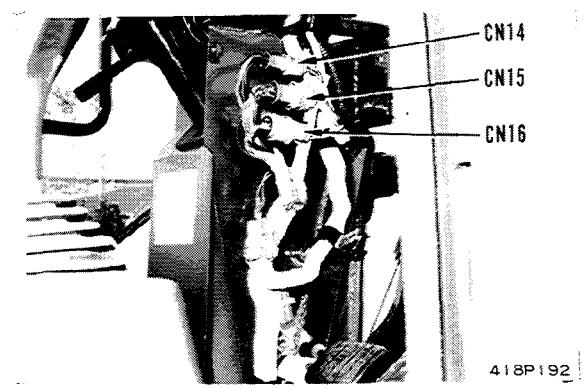
L08CD023



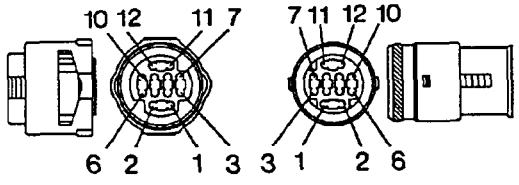
CN14 (Starting switch)



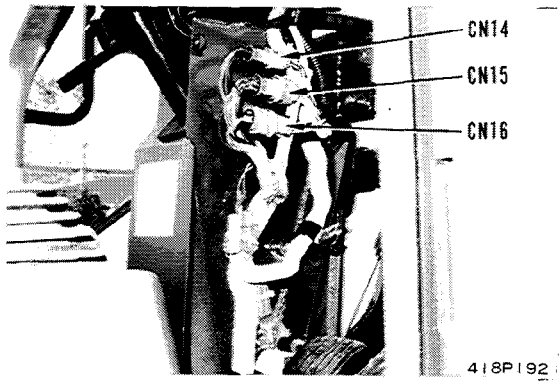
L08CD024



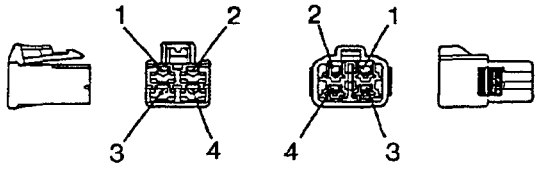
CN16 (Transmission control switch)



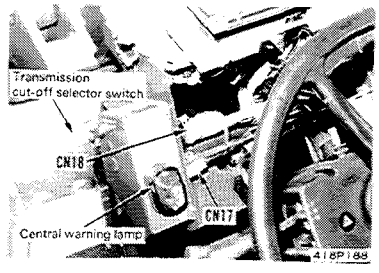
L08CD026



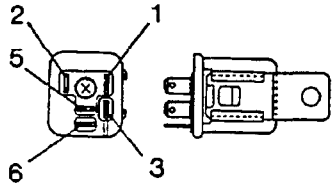
CN18 (Transmission cut-off selector switch)



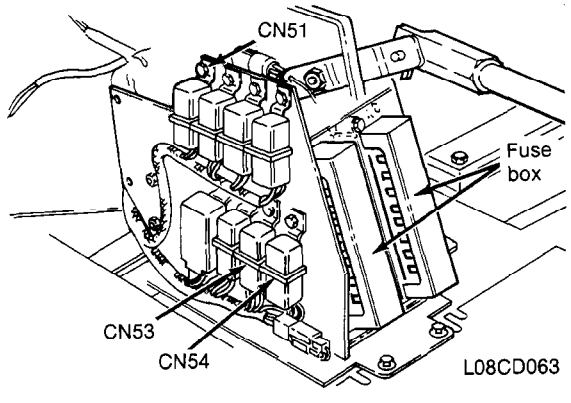
L08CD027



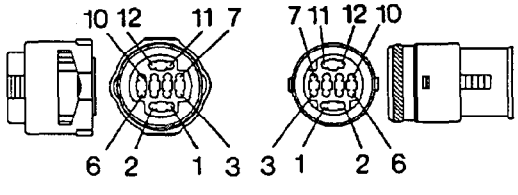
CN53 (Neutralizer relay)
CN54 (Back up lamp relay)



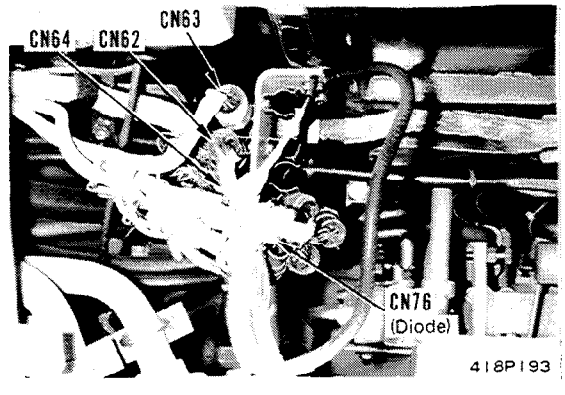
L08CD028



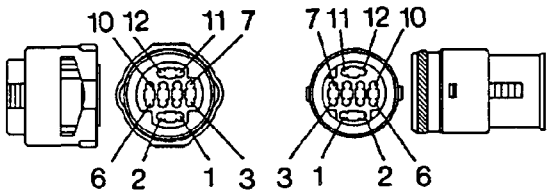
CN64 (Rear wiring harness to floor wiring harness)



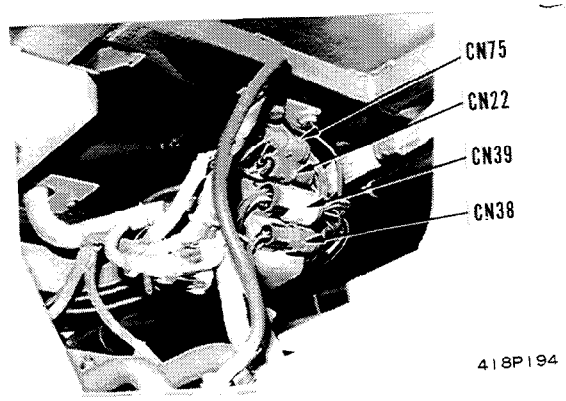
L08CD029



CN75 (Transmission control valve)

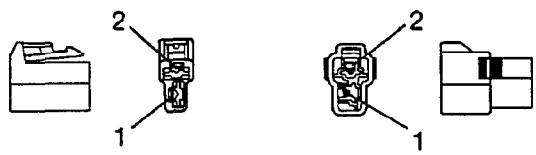


L08CD030

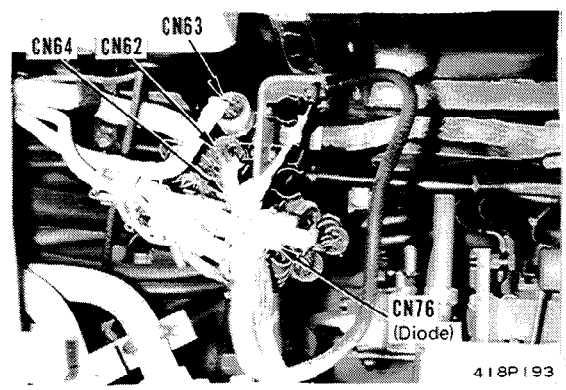


418P194

CN76 (Diode)

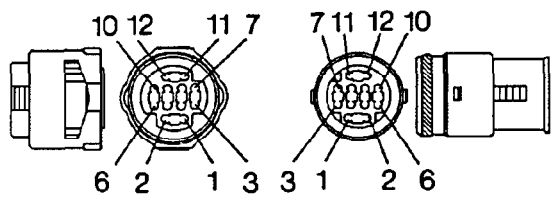


L08CD031

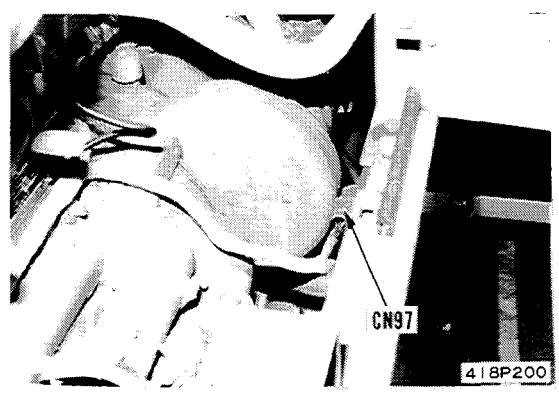


418P193

CN97 (Rear wiring harness to engine wiring harness)

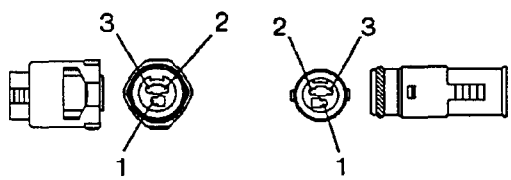


L08CD032

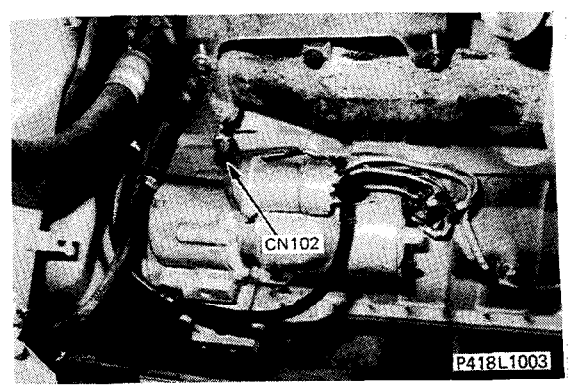


418P200

CN102 (Safety relay)

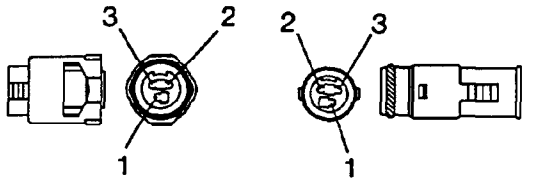


L08CD033

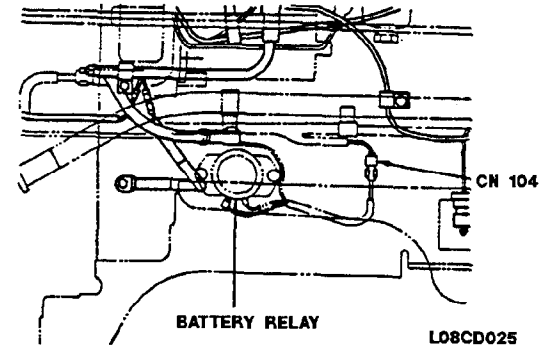


P418L1003

CN104 (Battery relay)



L08CD034

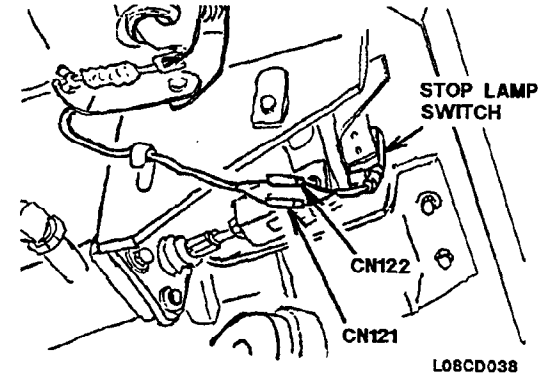


L08CD025

CN121, CN122 (Stop lamp switch)

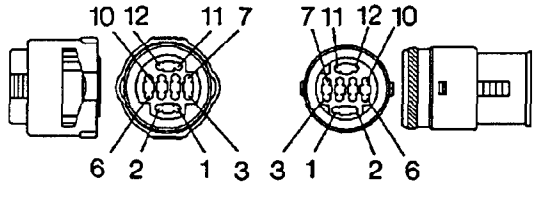


L08CD035.PCC

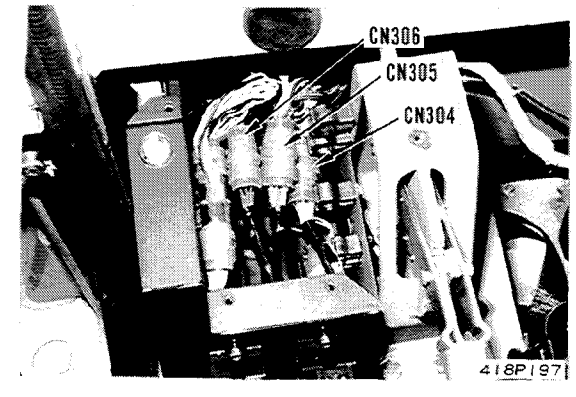


L08CD038

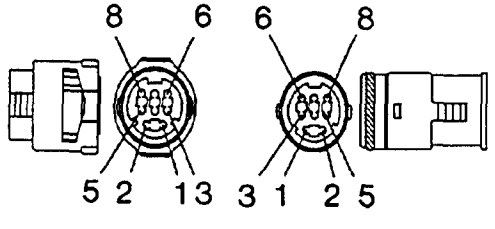
CN305 (Fuse box)



L08CD036



CN306 (Fuse box)



L08CD037.PCC

CN311, CN312 (Transmission cut-off switch)



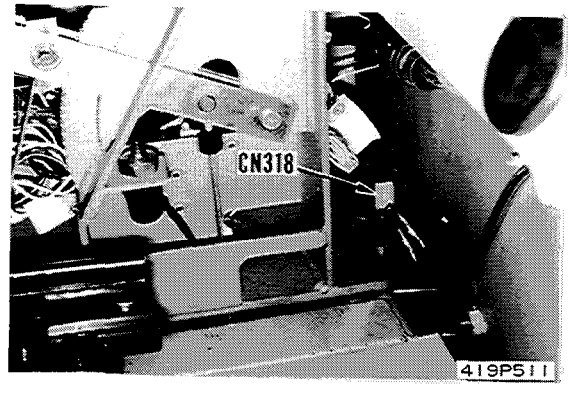
L08CD039.PCC



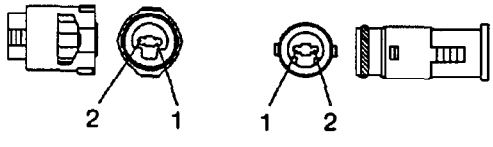
CN318 (Diode)



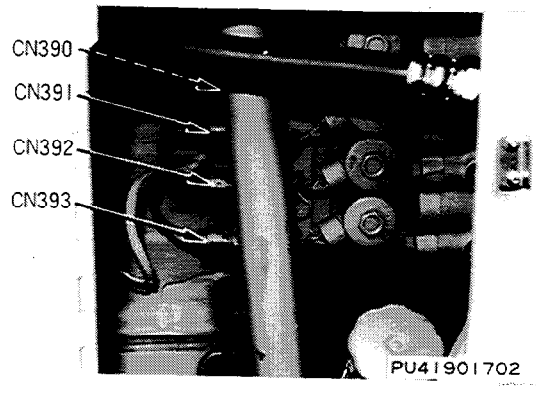
L08CD040



CN390, CN391, CN392, CN393
(Transmission control valve solenoid)

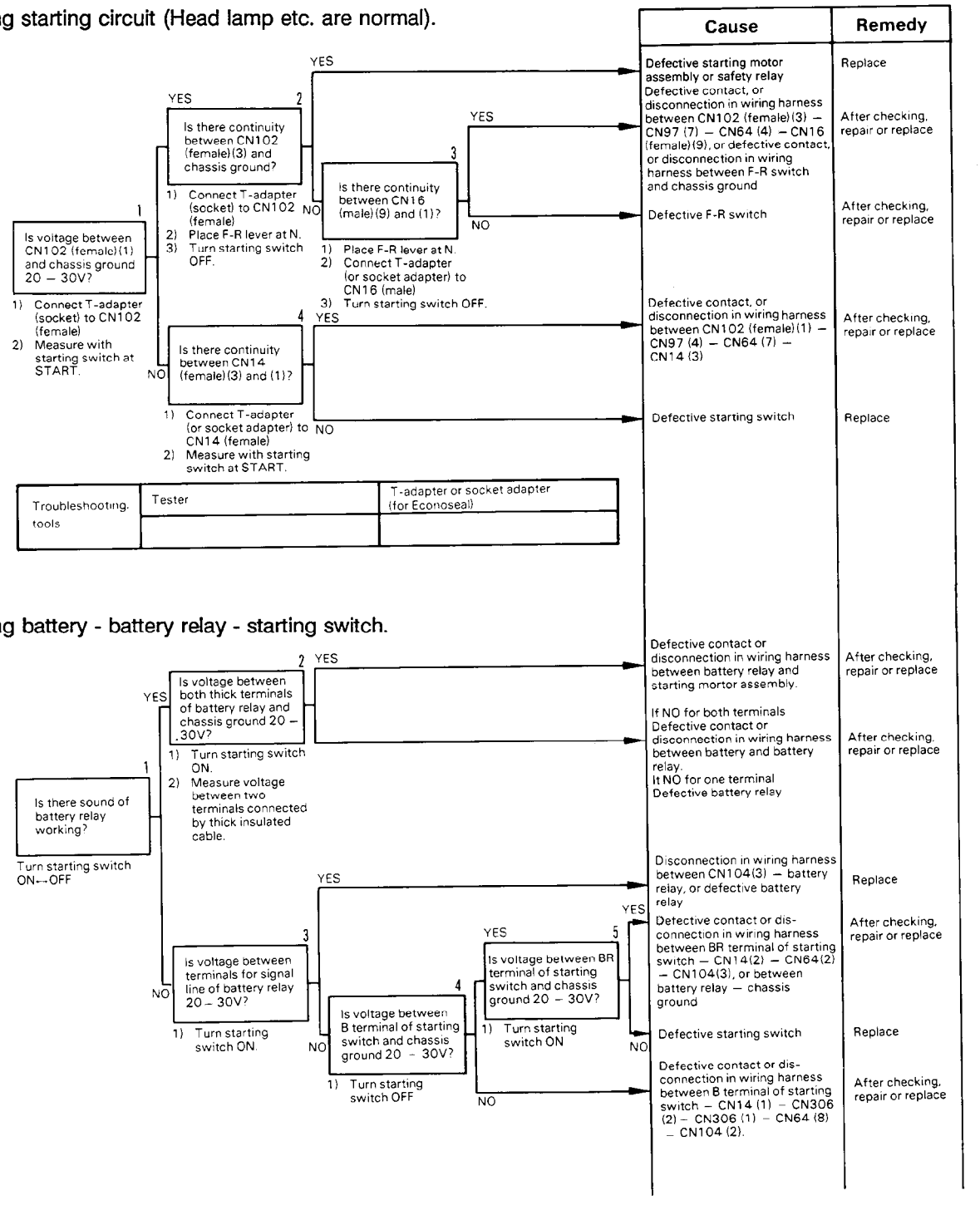


L08CD041



E-1 ENGINE DOES NOT START.

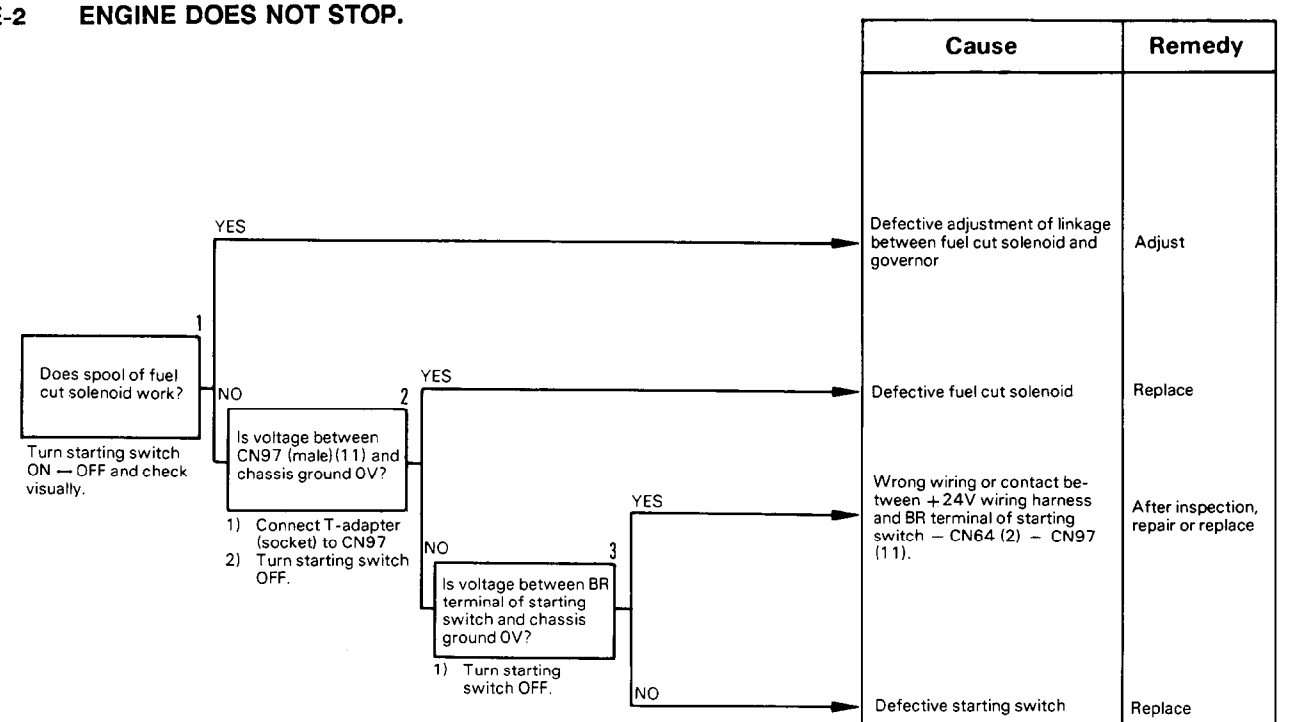
(a) Checking starting circuit (Head lamp etc. are normal).



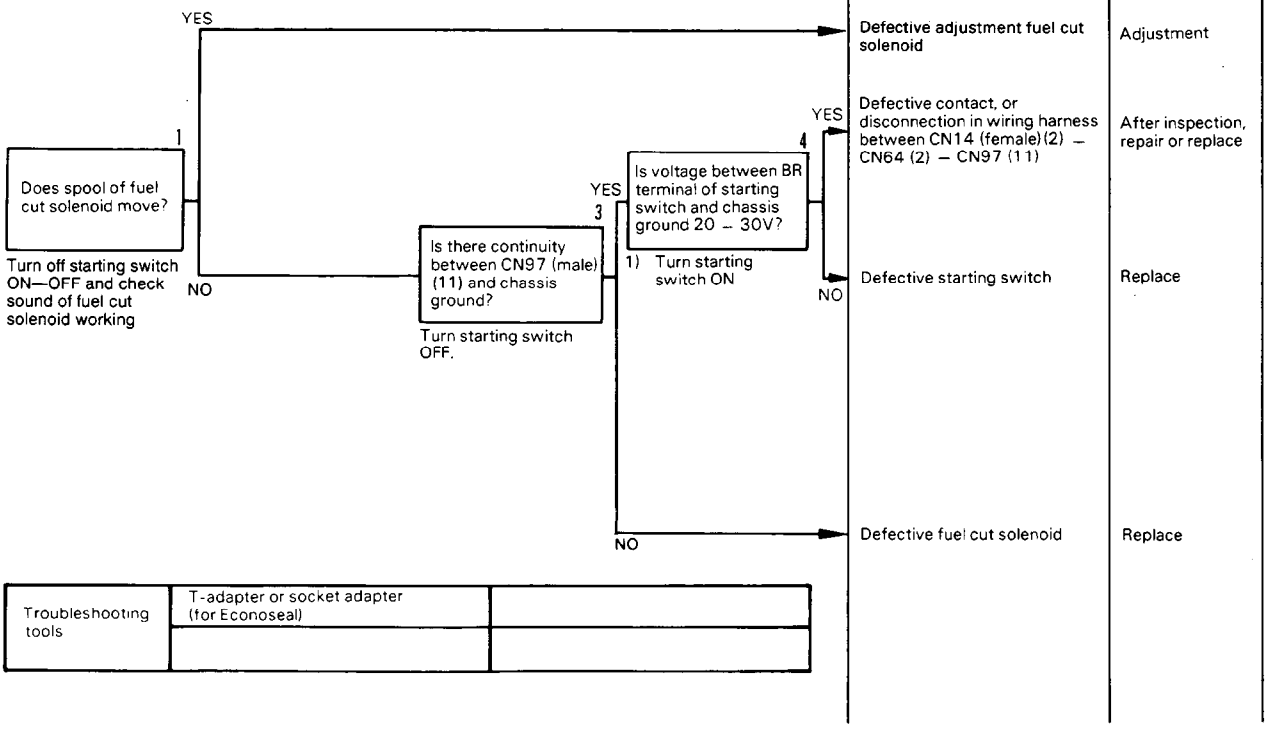
(b) Checking battery - battery relay - starting switch.

L08DD052

E-2 ENGINE DOES NOT STOP.



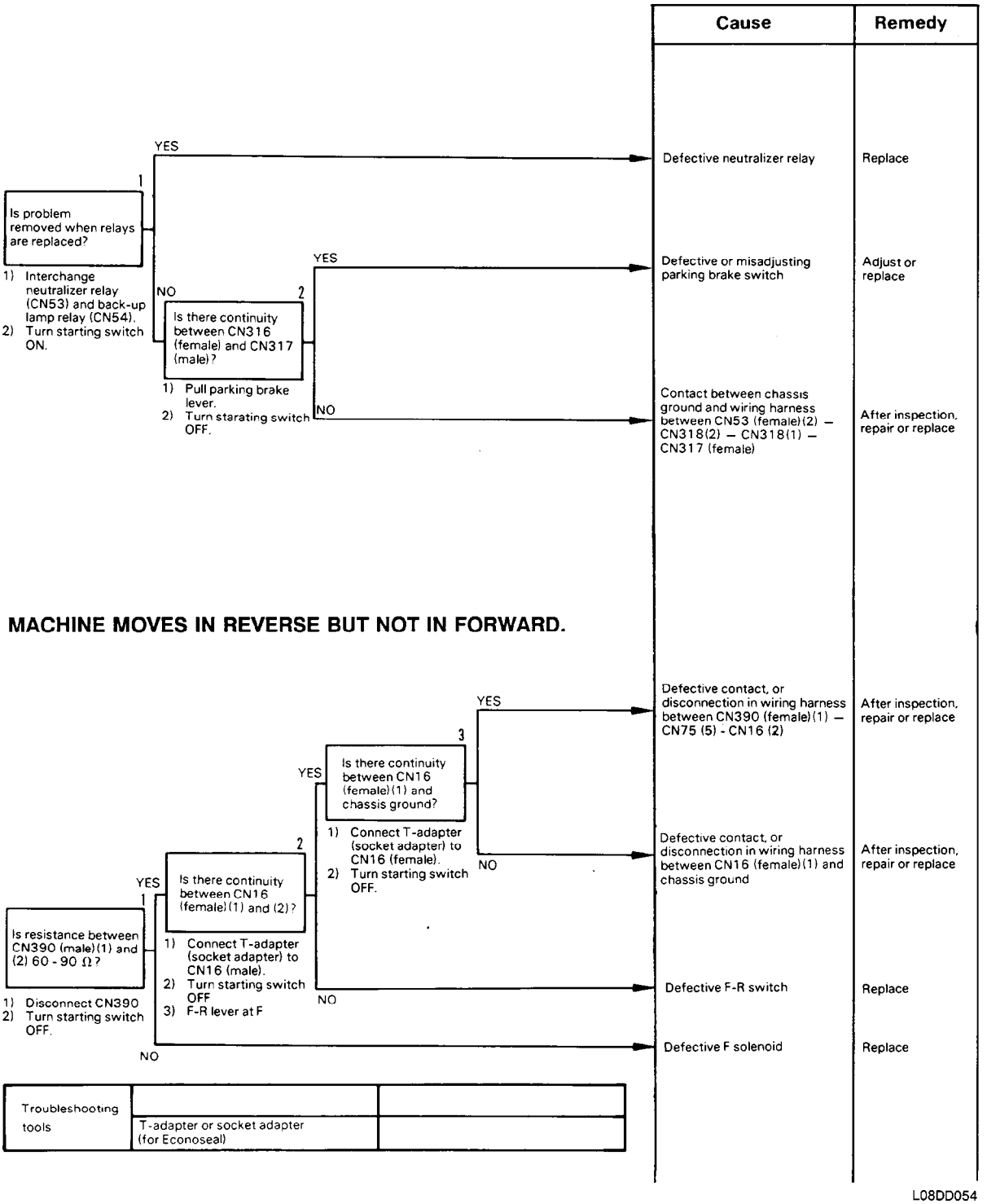
E-3 ENGINE STOPS WHEN MACHINE IS TRAVELING.



Troubleshooting tools	T-adapter or socket adapter (for Econoseal)	

L08DD053

E-4 TRANSMISSION IS NOT RETURNED TO NEUTRAL WHEN PARKING BRAKE IS APPLIED. (TRANSMISSION CUT-OFF NORMAL)

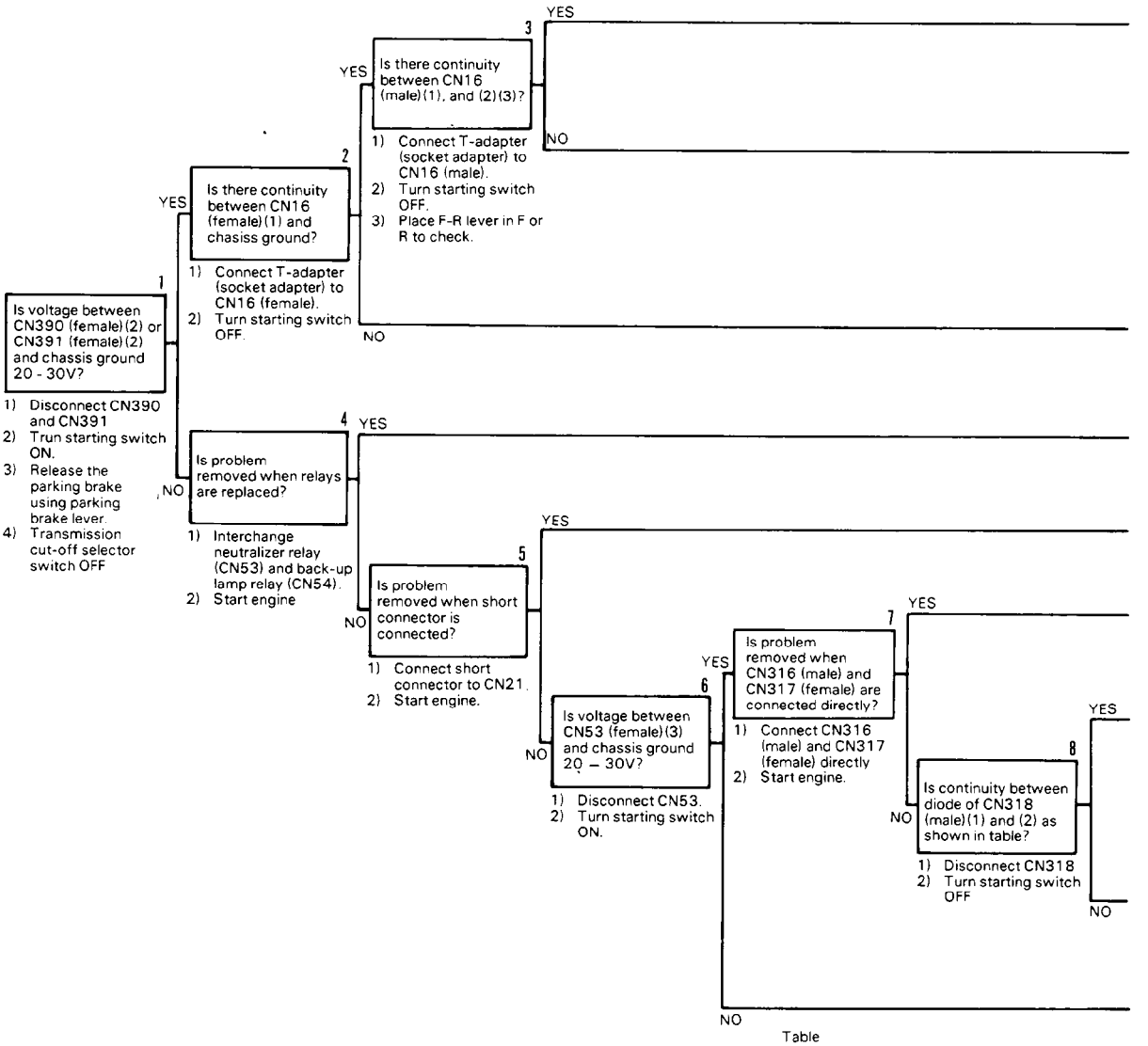


E-5 MACHINE MOVES IN REVERSE BUT NOT IN FORWARD.

Troubleshooting tools		
	T-adapter or socket adapter (for Econoseal)	

L08DD054

E-6 MACHINE MOVES NEITHER IN FORWARD NOR REVERSE.



Table

	Continuity
Black rod of tester to CN318 (2) Red rod of tester to CN318 (1)	Yes
Red rod of tester to CN318 (2) Black rod of tester to CN318 (1)	No

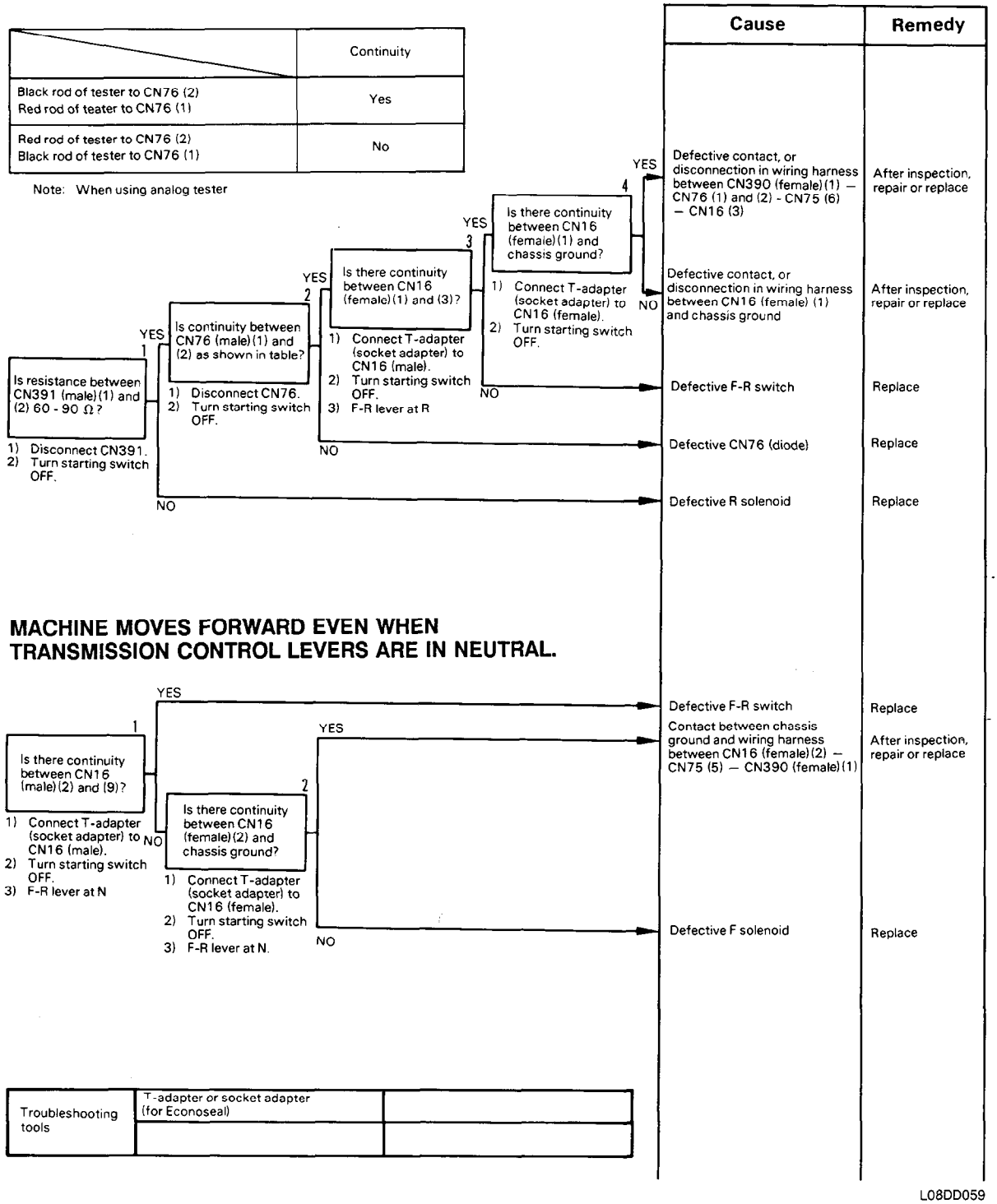
Note: When using analog tester L08DD055

Troubleshooting tools	T-adapter or socket adapter (for Econoseal)	
	Short connector	

Cause	Remedy
Defective F solenoid and R solenoid, or defective contact, or disconnection in wiring harness between CN390(1) – CN16(2) and CN391(1) – CN16(3)	Replace
Defective F-R switch	Replace
Defective chassis ground, or defective contact, or disconnection in wiring harness between CN16 (1)(female) and chassis ground	After inspection, repair or replace
Defective neutralizer relay	Replace
Defective transmission cut-off switch	Replace
Defective parking brake switch or defective adjustment	Replace or adjust
Defective contact, or disconnection in wiring harness between CN53 (male)(2) – CN318(1),(2) – CN317 – CN316, or CN53(5)(female) – CN390, CN391(2) (female)	After inspection, repair or replace
Defective diode	Replace
Defective contact, or disconnection in wiring harness between CN53 (3)(female) and main breaker	After inspeciton, repair or replace

L08DD056

E-7 MACHINE MOVES IN FORWARD BUT NOT IN REVERSE.

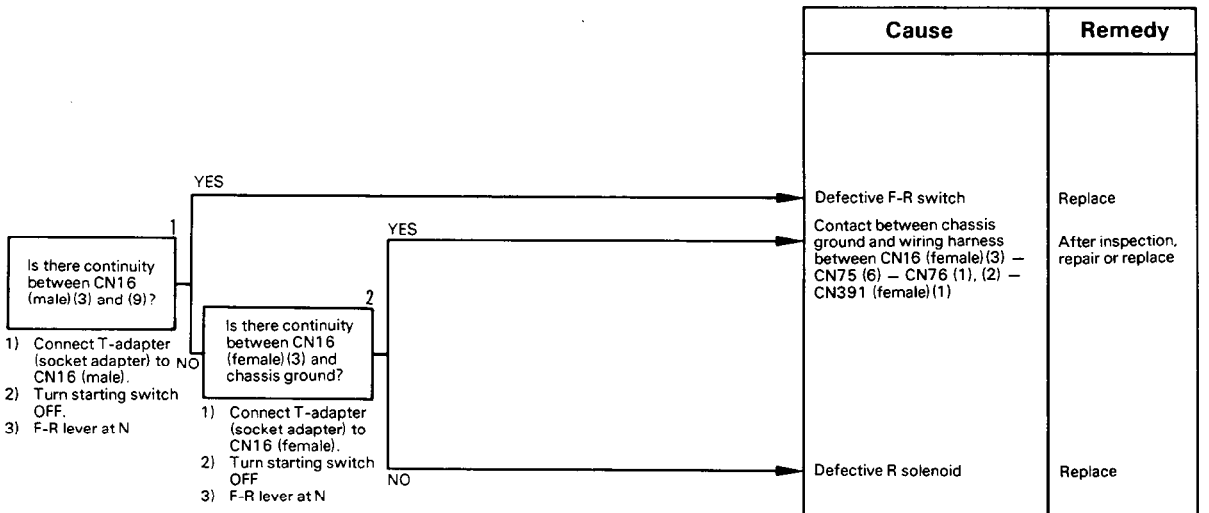


E-8 MACHINE MOVES FORWARD EVEN WHEN TRANSMISSION CONTROL LEVERS ARE IN NEUTRAL.

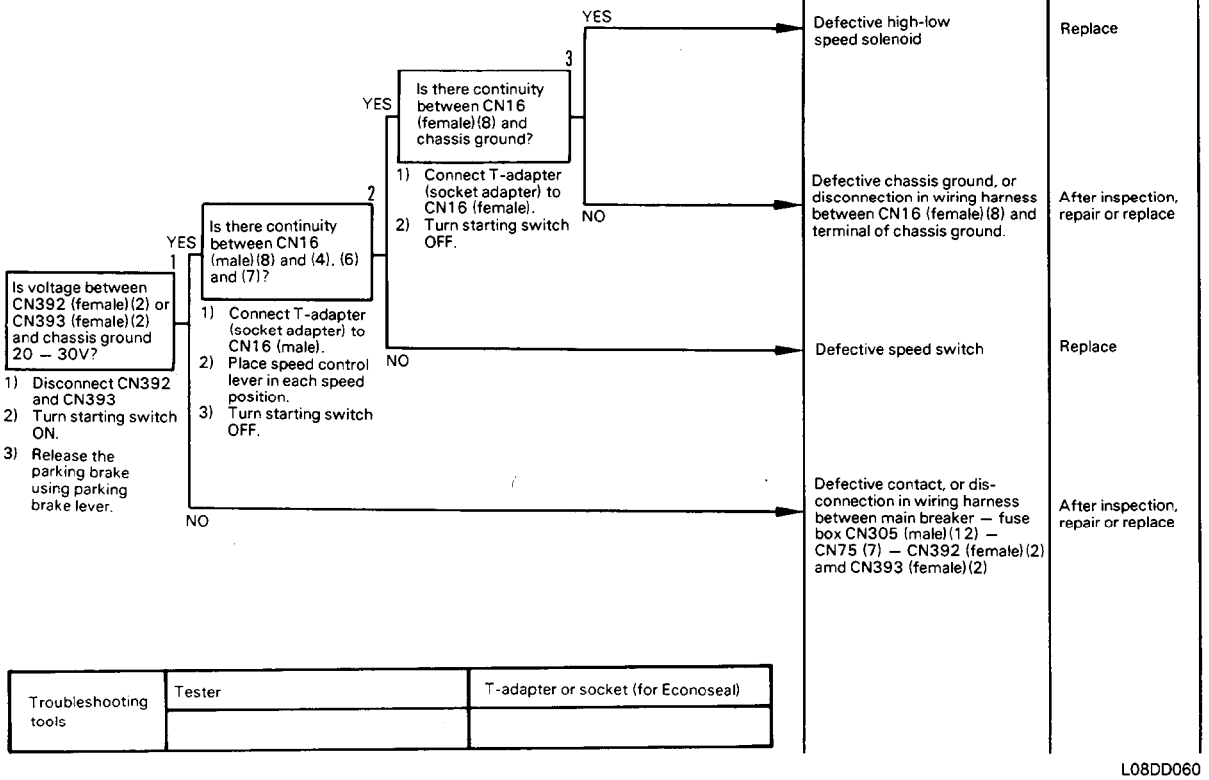
Troubleshooting tools	T-adapter or socket adapter (for Econoseal)	

L08DD059

E-9 MACHINE MOVES IN REVERSE EVEN WHEN TRANSMISSION CONTROL LEVERS ARE IN NEUTRAL.



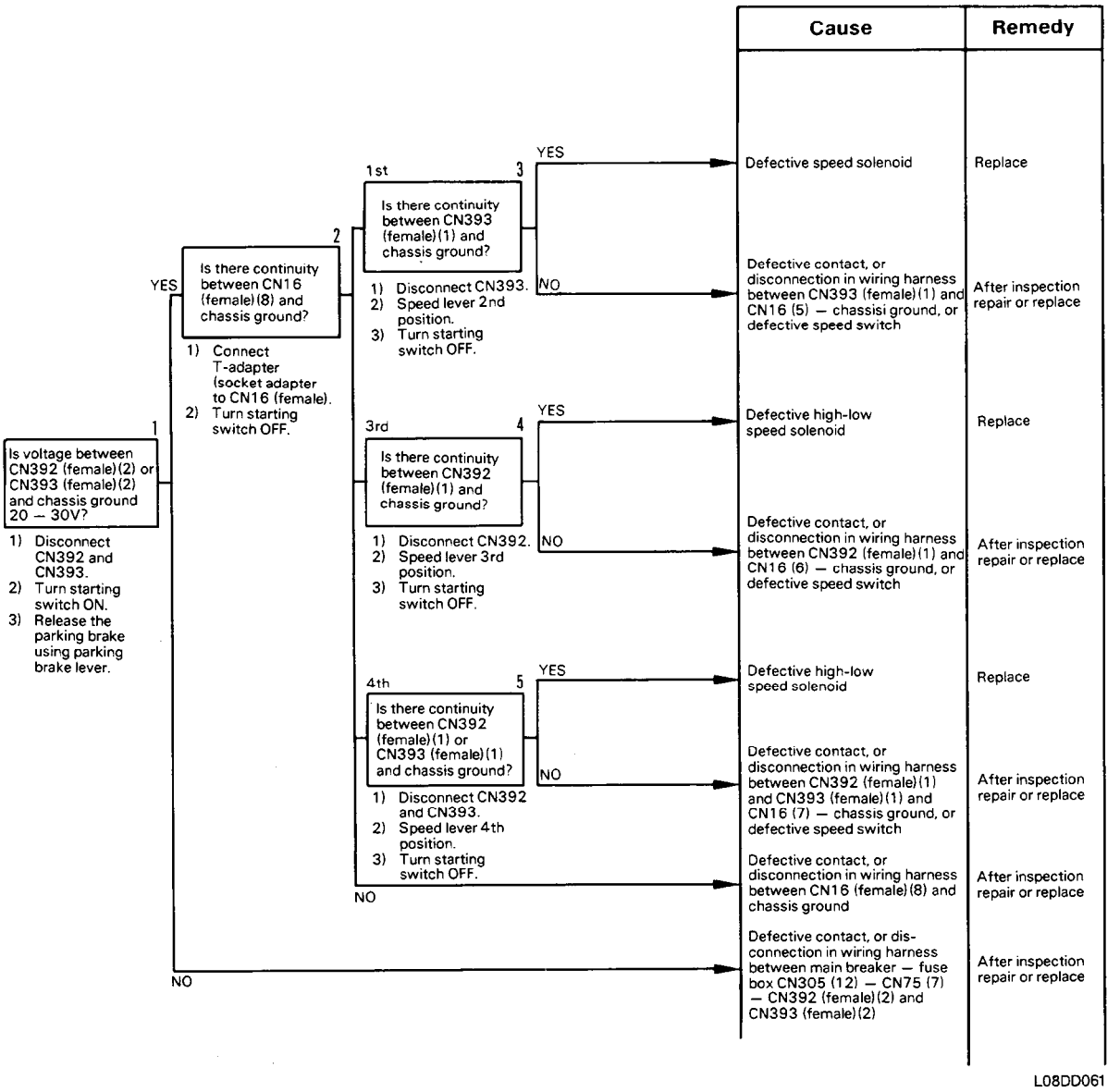
E-10 MACHINE ALWAYS TRAVELS IN 2ND.



Troubleshooting tools	Tester	T-adapter or socket (for Econoseal)

L08DD060

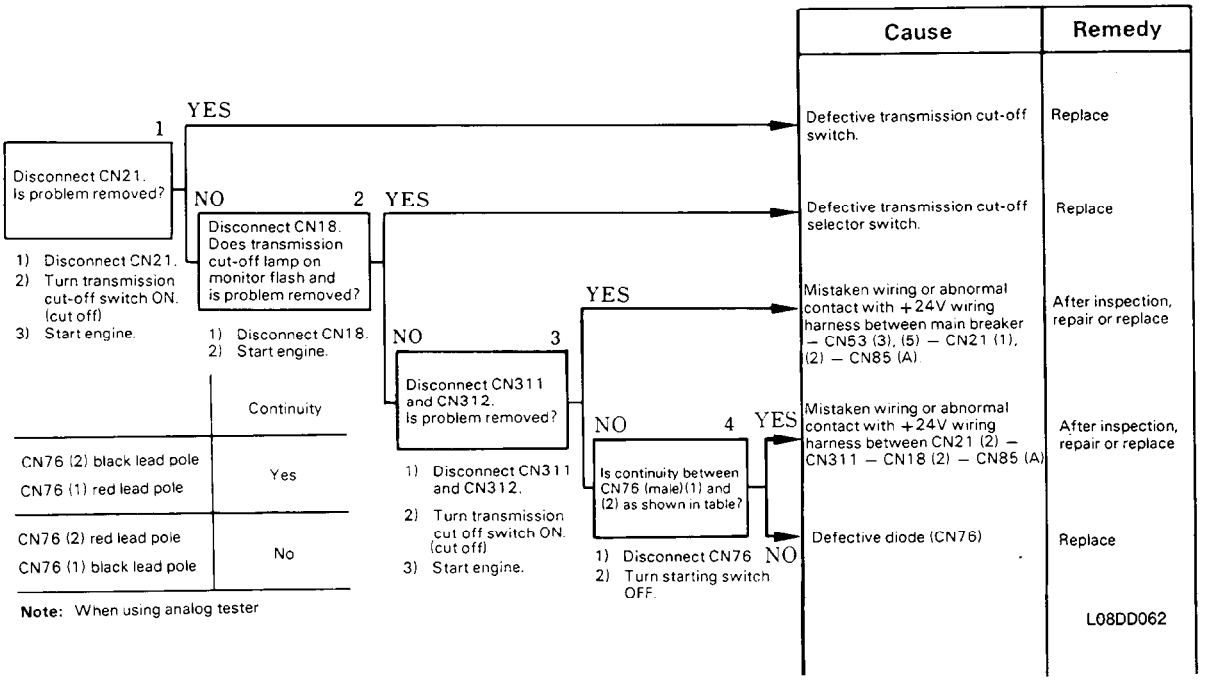
E-11 TRANSMISSION DOES NOT CHANGE GEAR (But F-R changeable).



L08DD061

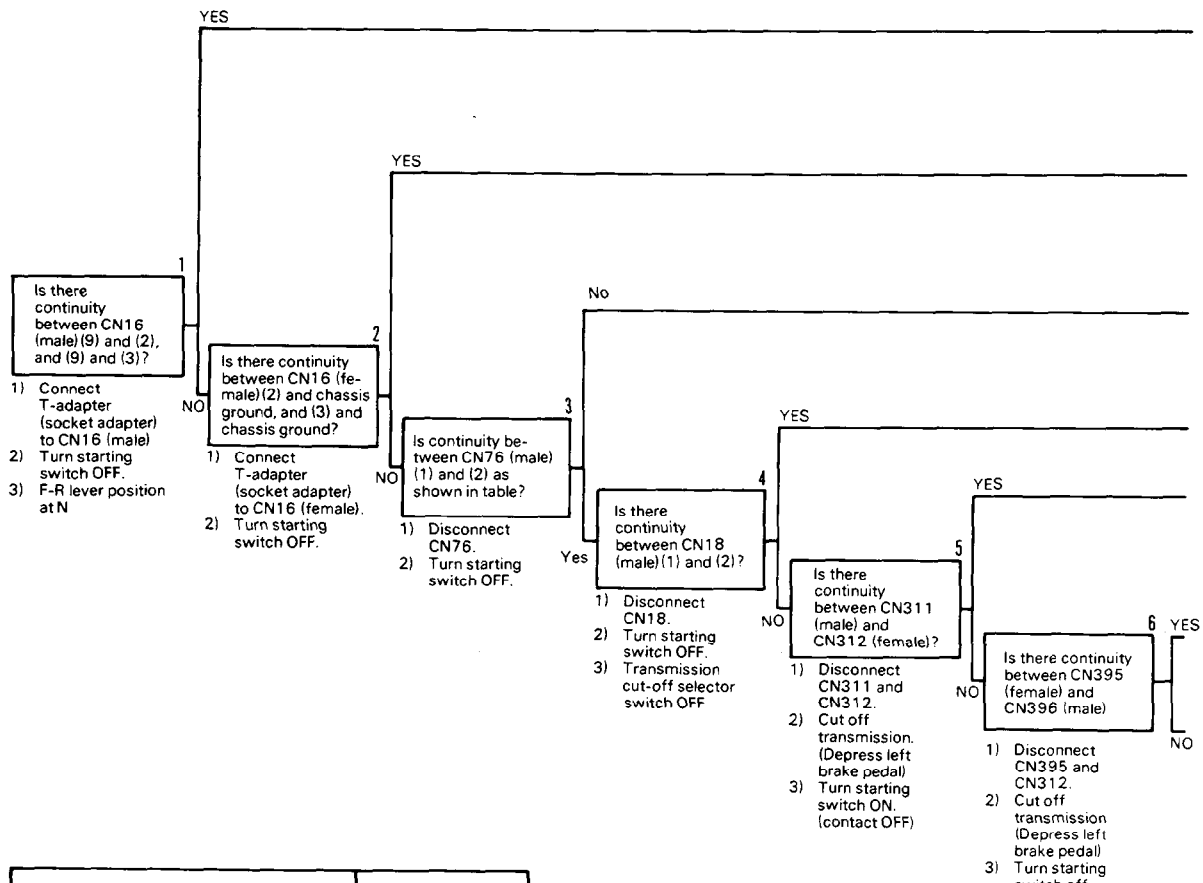
Troubleshooting tools	T-adapter or socket adapter (for Econoseal)	

E-12 TRANSMISSION CANNOT BE CUT-OFF EVEN WHEN L.H. BRAKE PEDAL IS DEPRESSED WITH TRANSMISSION CUT-OFF SELECTOR SWITCH ON.



Troubleshooting tools	Tester	

E-13 TRANSMISSION DOES NOT RETURN TO NEUTRAL.



	Continuity
Red rod of tester to CN76 (1) Black rod of tester to CN76 (2)	Yes
Black rod of tester to CN76 (1) Red rod of tester to CN76 (2)	No

L08DD063

Note: When using analog tester

Troubleshooting tools	Tester	T-adapter or socket adapter (for Econoseal)

Cause	Remedy
Defective F-R switch, or defective contact in wiring harness between CN16 (male) (9) and (2), and (9) and (3).	After inspection, repair or replace
Contact with chassis ground and wiring harness between CN16 (2) – CN75 (5) – CN390 (1) or CN16 (3) – CN75 (6) – CN391 (1).	After inspection, repair or replace
Defective CN76 (diode)	Replace
Defective transmission cut-off selector switch	Replace
Defective transmission cut-off switch (behind L.H. brake padel) or switch mounting mal adjustment.	Adjust or replace
Defective transmission cut-off switch on brake booster.	Replace
Defective contact, or contact between +24 and wiring harness between transmission cut-off switch – CN390(2),CN391	After inspection, repair or replace

L08DD064

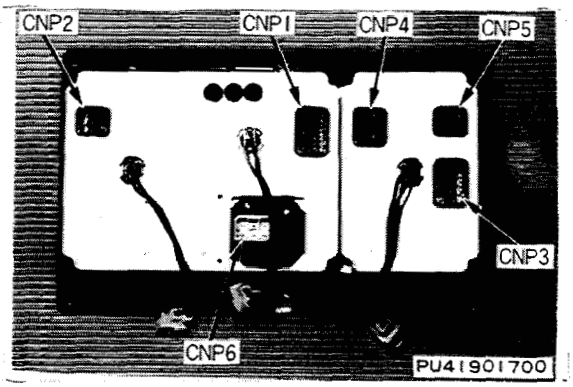
This page is blank.

TROUBLESHOOTING CHARTS
FOR ELECTRONIC VEHICLE MONITORING SYSTEM

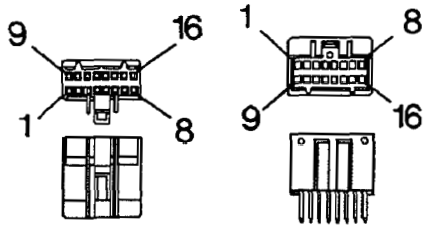
ELECTRONIC VEHICLE MONITORING SYSTEM (EVMS) SCHEMATIC

See Foldout # six (6), at the end of this book.

POSITION OF CONNECTORS

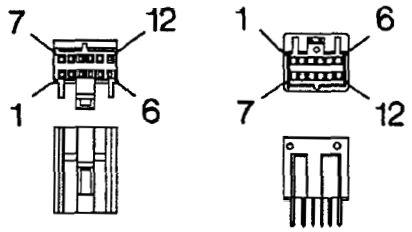


CNP1, CNP3 (Monitor module)



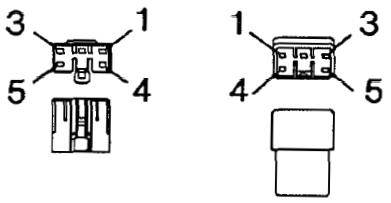
L08CD047

CNP4 (Monitor module)



L08CD048

CNP6 (Service meter)

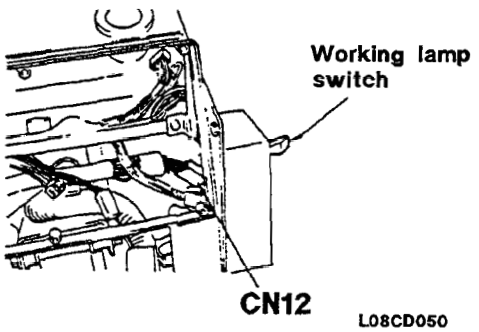


L08CD049

CN12 (Work lamp switch)

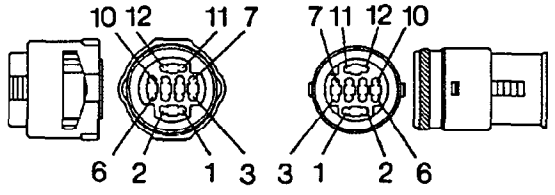


L08CD040

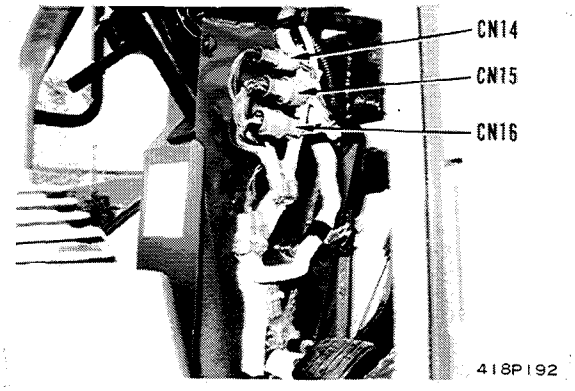


L08CD050

CN15 (Head lamp and turn signal lamp switch)



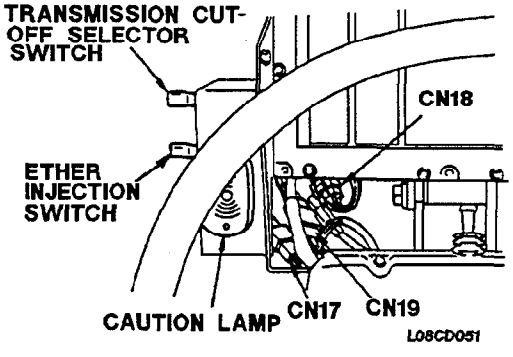
L08CD026



CN17 (Caution lamp)

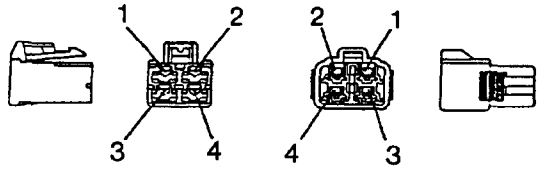


L08CD040



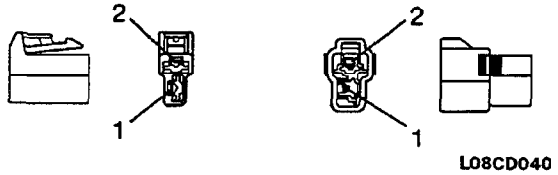
L08CD051

CN18 (Transmission cut-off switch)

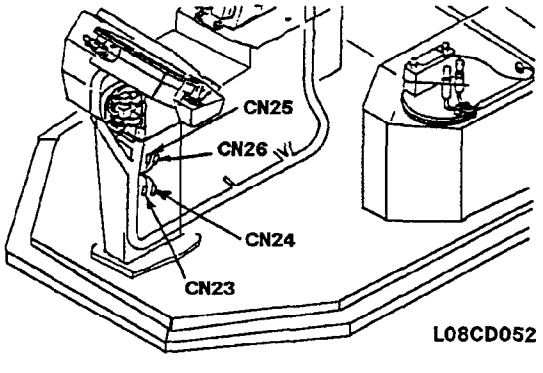


L08CD027

CN25 (Diode)

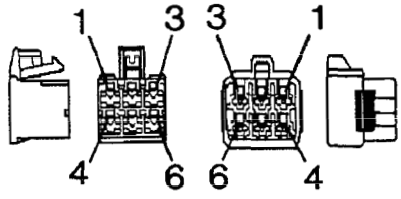


L08CD040

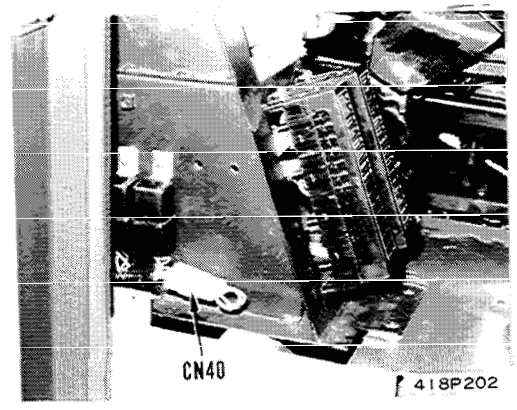


L08CD052

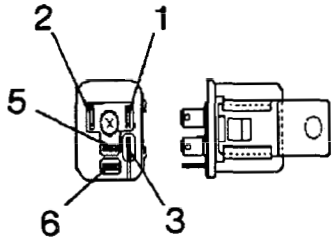
CN40 (Adapter harness)



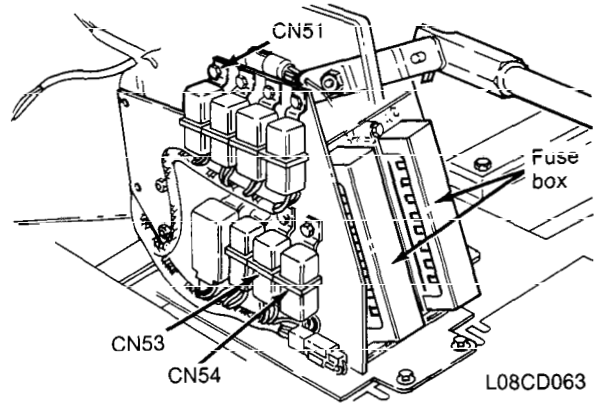
L08CD053



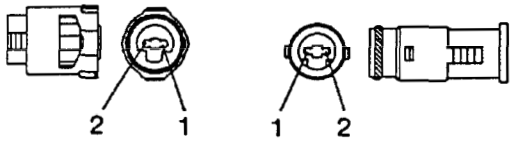
CN51 (Brake oil level detection relay)



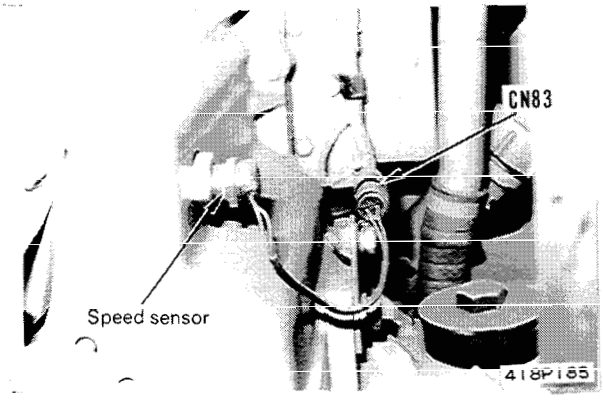
L08CD054



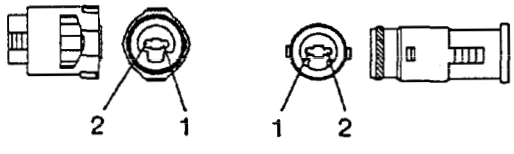
CN83 (Speed meter sensor)



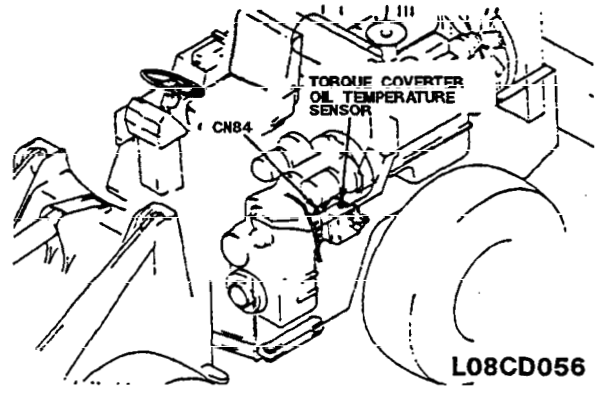
L08CD041



CN84 (Torque converter oil temperature sensor)

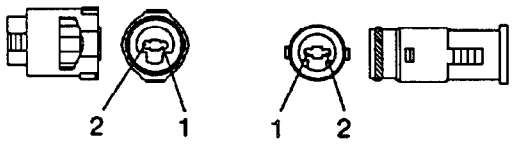


L08CD041

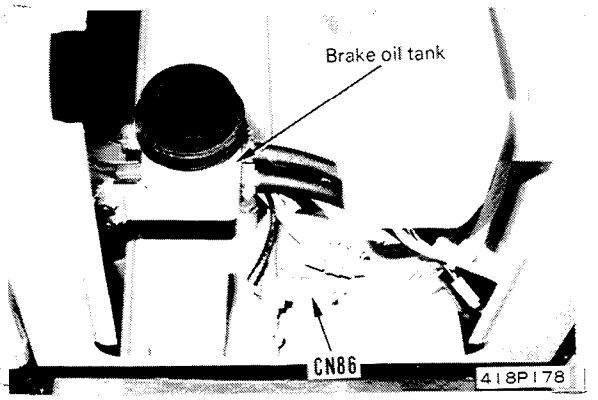


L08CD056

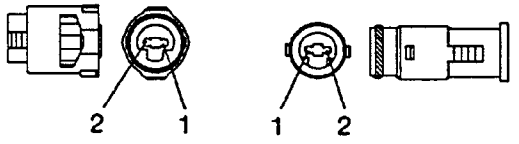
CN86 (Brake oil level sensor)



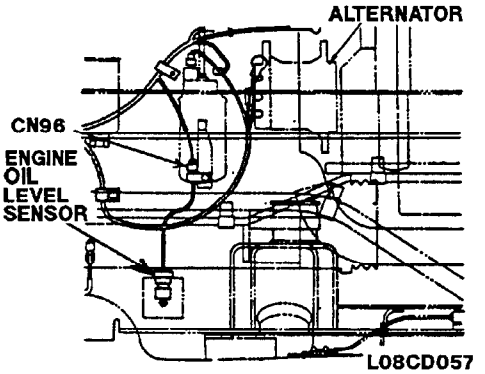
L08CD041



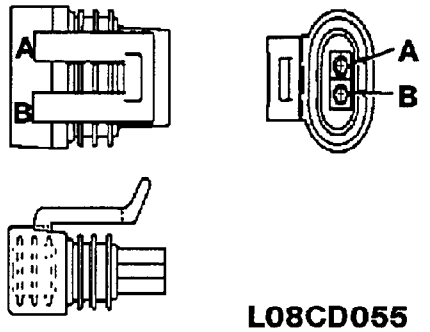
CN96 (Engine oil level sensor)



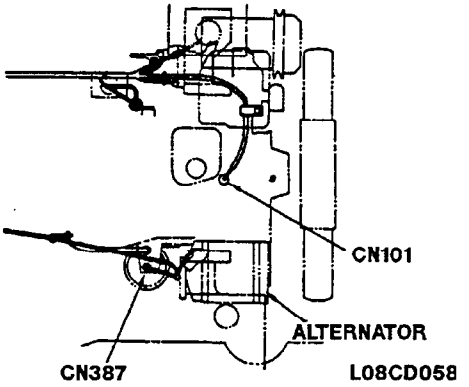
L08CD041



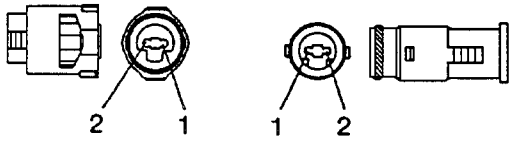
CN101 (Engine water temperature sensor)



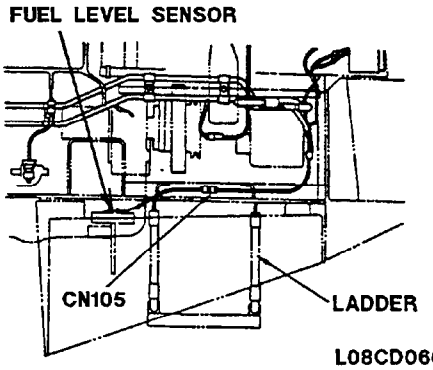
L08CD055



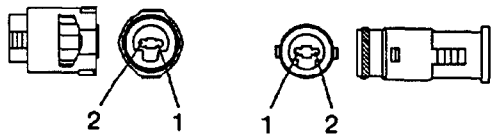
CN105 (Fuel level sensor)



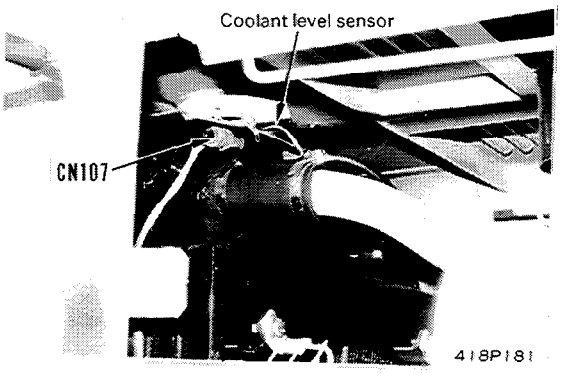
L08CD041



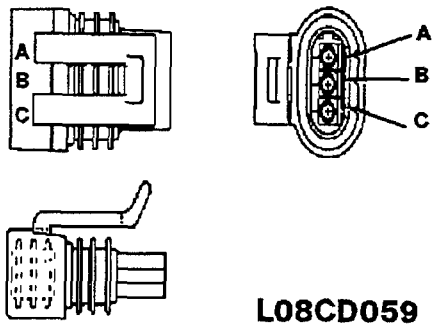
CN106 (Coolant level sensor)



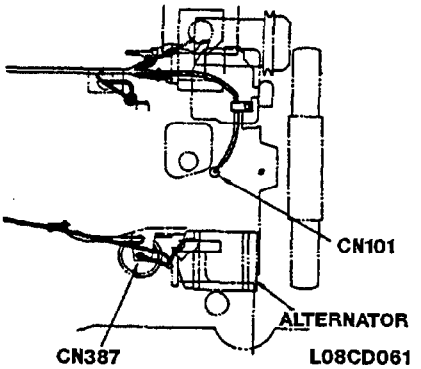
L08CD041



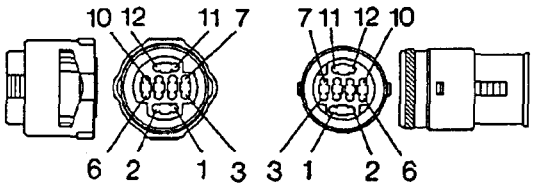
CN387 (Engine oil pressure sensor)



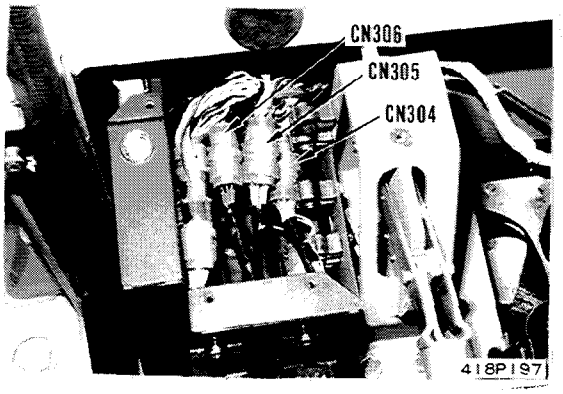
L08CD059



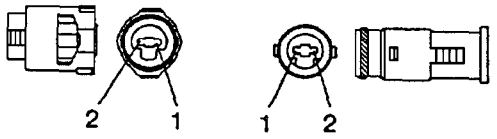
CN304 (Fuse box)



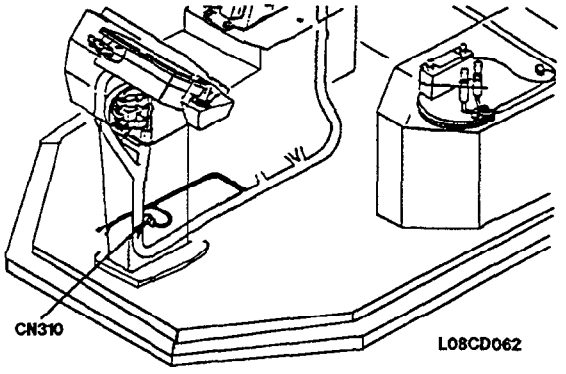
L08CD026



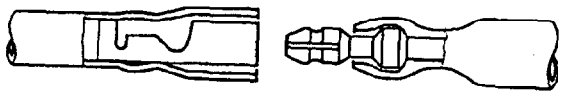
CN310 (Adapter harness)



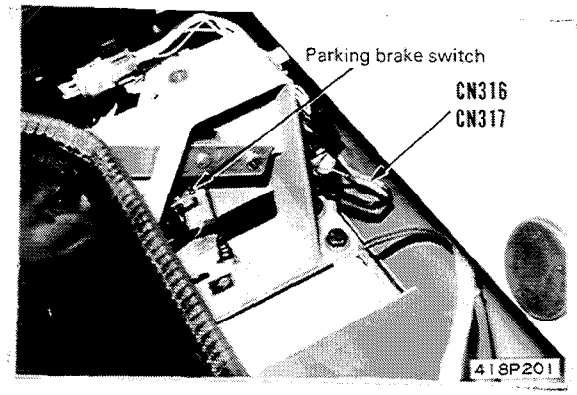
L08CD041



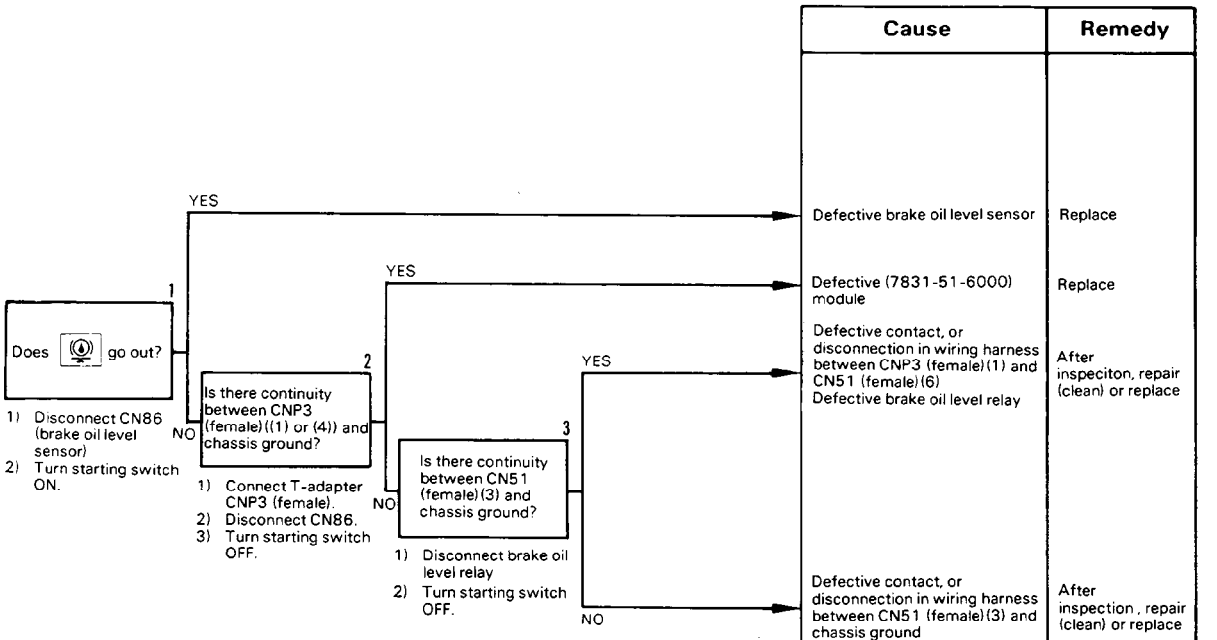
CN316, CN317 (Parking brake switch)



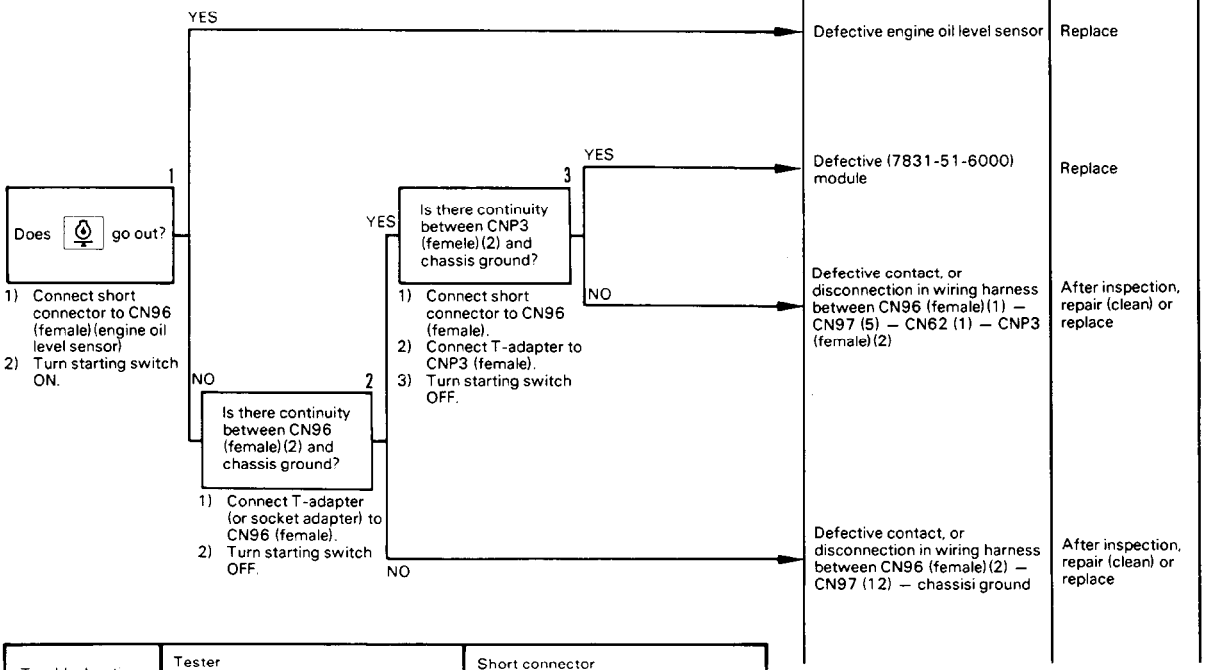
L08CD035.PCC



M-1 EVEN WHEN ENGINE IS STOPPED, (BRAKE OIL LEVEL) FLASHES.



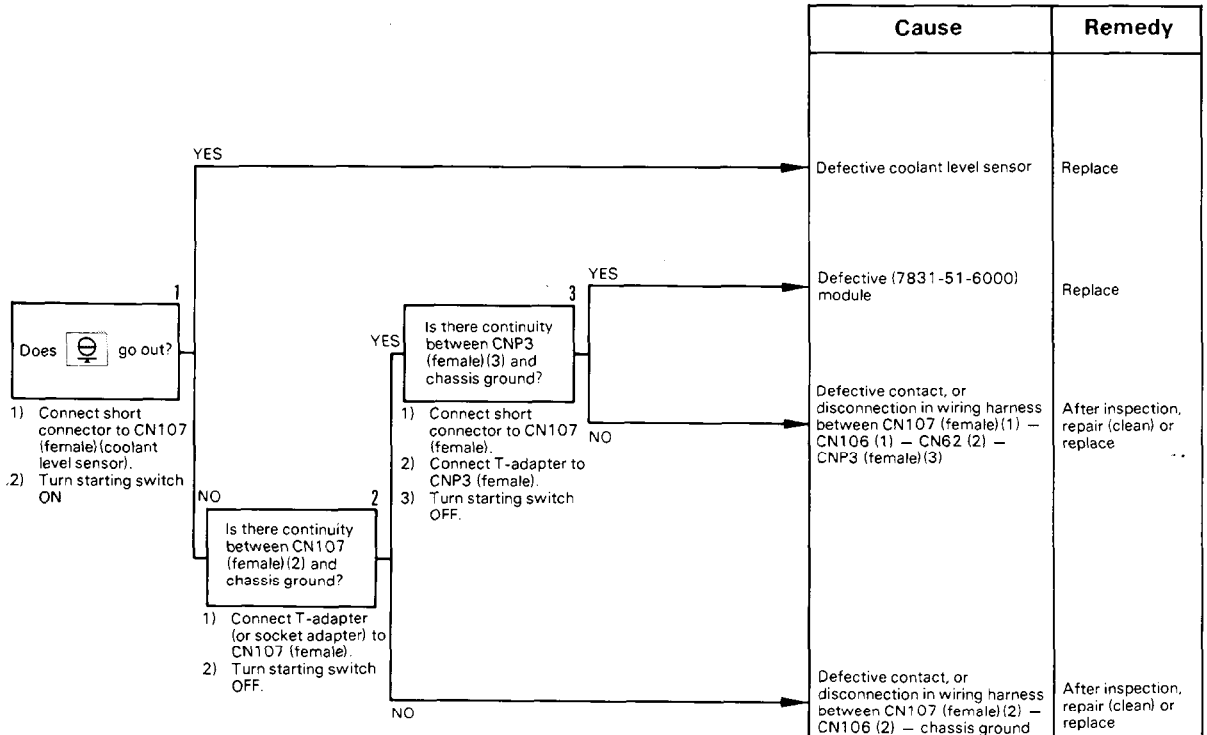
M-2 EVEN WHEN ENGINE IS STOPPED, (ENGINE OIL LEVEL) FLASHES.



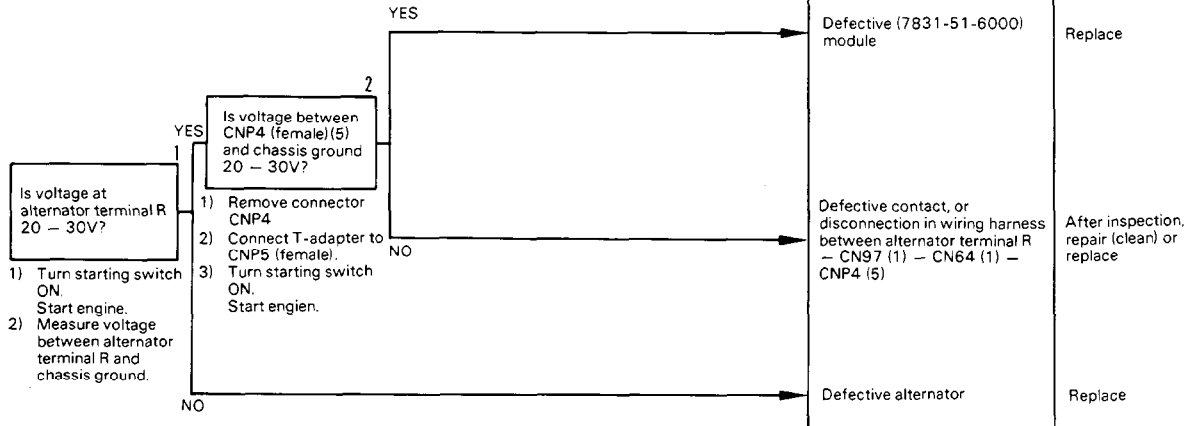
Troubleshooting tools	Tester	Short connector
	T-adapter (for DLI)	T-adapter or socket adapter (for Econoseal)

L08DD065

M-3 EVEN WHEN ENGINE IS STOPPED, (COOLANT LEVEL) FLASHES.



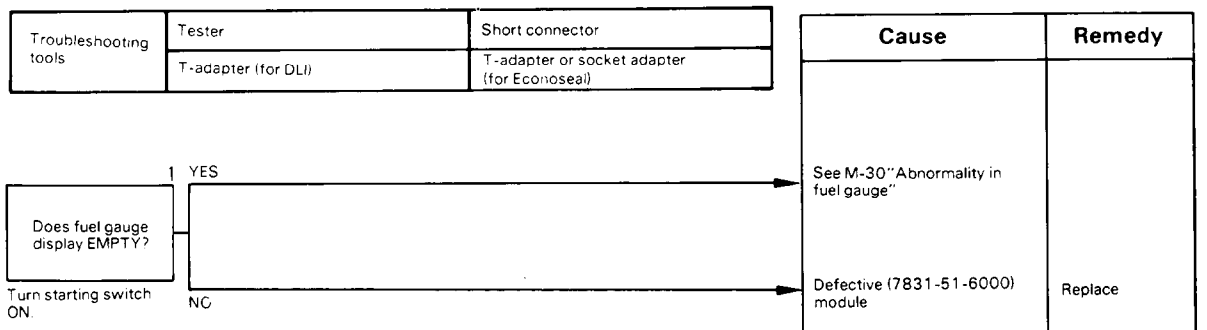
M-4 (BATTERY CHARGE) FLASHES WHEN ENGINE IS RUNNING.



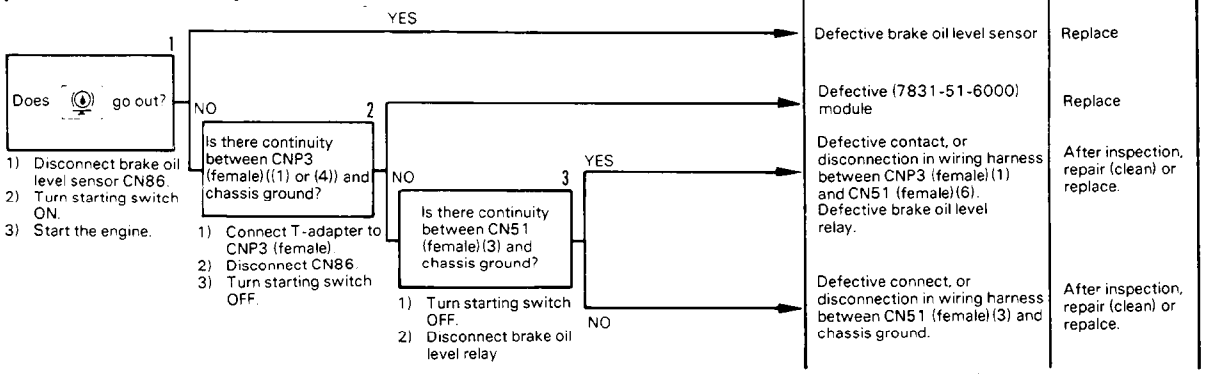
Troubleshooting tools	Tester	Short connector
	T-adapter (for DLI)	T-adapter or socket adapter (for Econoseal)

L08DD066

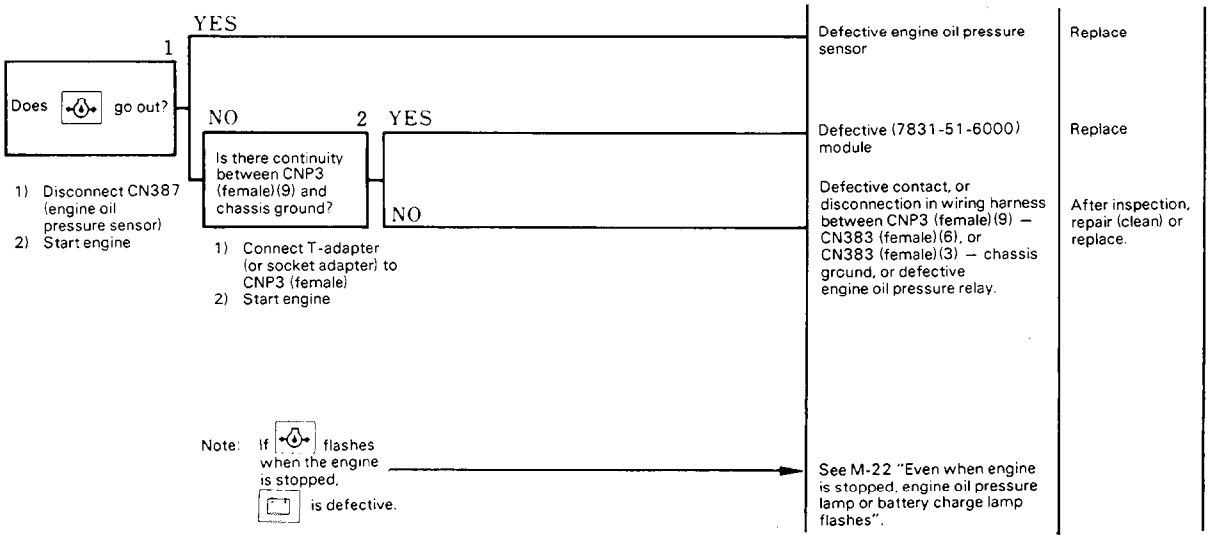
M-5 (FUEL LEVEL) FLASHES.



M-6 WHEN ENGINE IS RUNNING, EVEN THOUGH THERE IS NO ABNORMALITY IN MACHINE, (BRAKE OIL LEVEL) FLASHES.

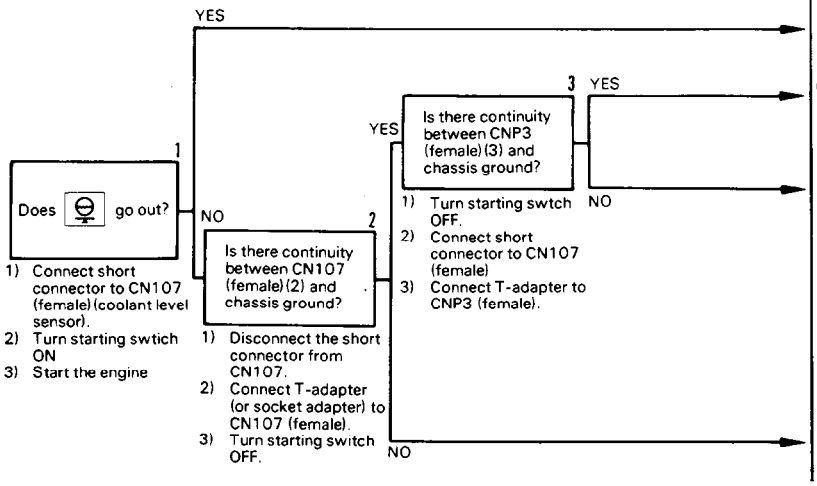


M-7 WHEN ENGINE IS RUNNING, EVEN THOUGH THERE IS NO ABNORMALITY IN MACHINE, (ENGINE OIL PRESSURE) FLASHES.



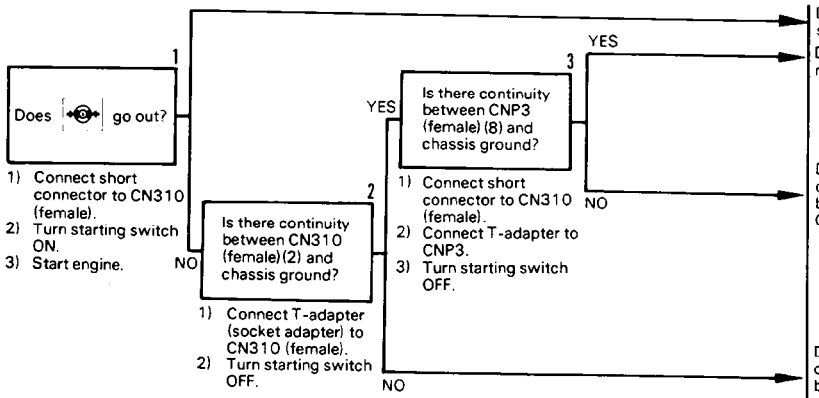
L08DD067

M-8 WHEN ENGINE IS RUNNING, EVEN THOUGH THERE IS NO ABNORMALITY IN MACHINE, (COOLANT LEVEL) FLASHES.



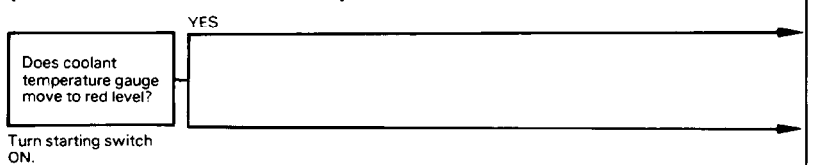
Cause	Remedy
Defective coolant level sensor	Replace
Defective (7831-51-6000) module	Replace
Defective contact, or disconnection in wiring harness between CN107 (female) (1) — CN106 (1) — CN62 (2) — CNP3 (female) (3)	After inspection, repair (clean) or replace
Defective contact, or disconnection in wiring harness between CN107 (female) (2) — CN106 (2) — chassis ground.	After inspection, repair (clean) or replace.

M-9 WHEN ENGINE IS RUNNING, EVEN THOUGH THERE IS NO ABNORMALITY IN MACHINE, (BRAKE SERVO PRESSURE) FLASHES (IF



Cause	Remedy
Defective brake servo pressure sensor	Replace
Defective (7381-51-6000) module	Replace
Defective contact, or disconnection in wiring harness between CNP3 (female) (8) and CN310 (female) (1)	After inspection, repair (clean) or replace.
Defective contact, or disconnection in wiring harness between CN310 (female) (2) and chassis ground	After inpsection repair (clean) or replace

M-10 WHEN ENGINE IS RUNNING, EVEN THOUGH THERE IS NO ABNORMALITY IN MACHINE, (COOLANT TEMPERATURE) FLASHES.

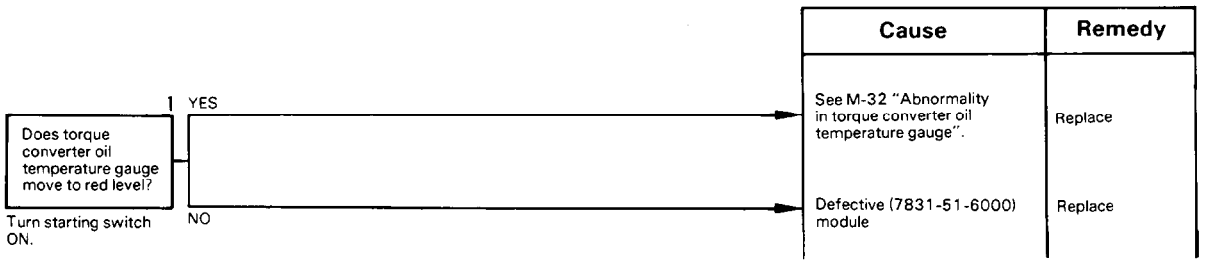


Cause	Remedy
See M-31 "Abnormality in coolant temperature gauge"	Replace
Defective (7831-51-6000) module	Replace

Troubleshooting tools	Tester	Short connector
	T-adapter (for DLI)	T-adapter or socket adapter (for Econoseal)

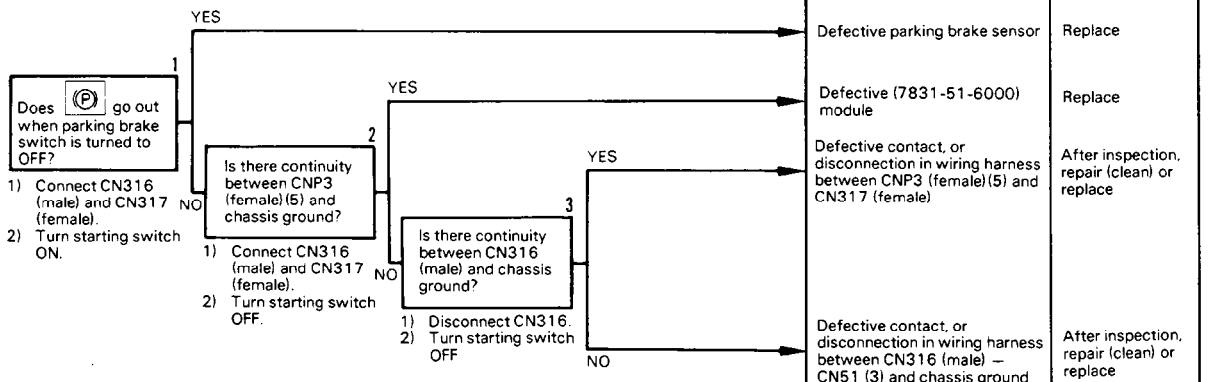
L08DD068

M-11 WHEN ENGINE IS RUNNING, EVEN THOUGH THERE IS NO ABNORMALITY IN MACHINE, (TORQUE CONVERTER OIL TEMPERATURE) FLASHES.

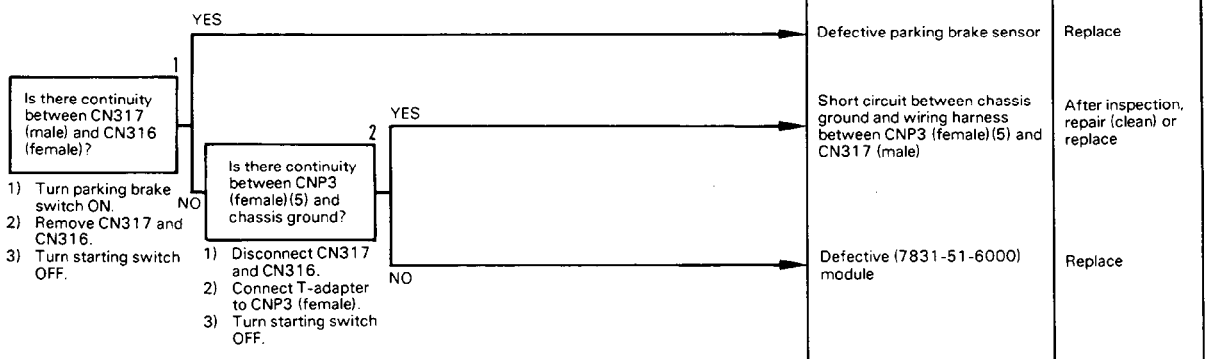


M-12 (PARKING BRAKE) LIGHTS UP OR DOES NOT LIGHT UP.

a) Does not go out.



b) Does not light up.



Troubleshooting tools	Tester	
	T-adapter (for DLI)	

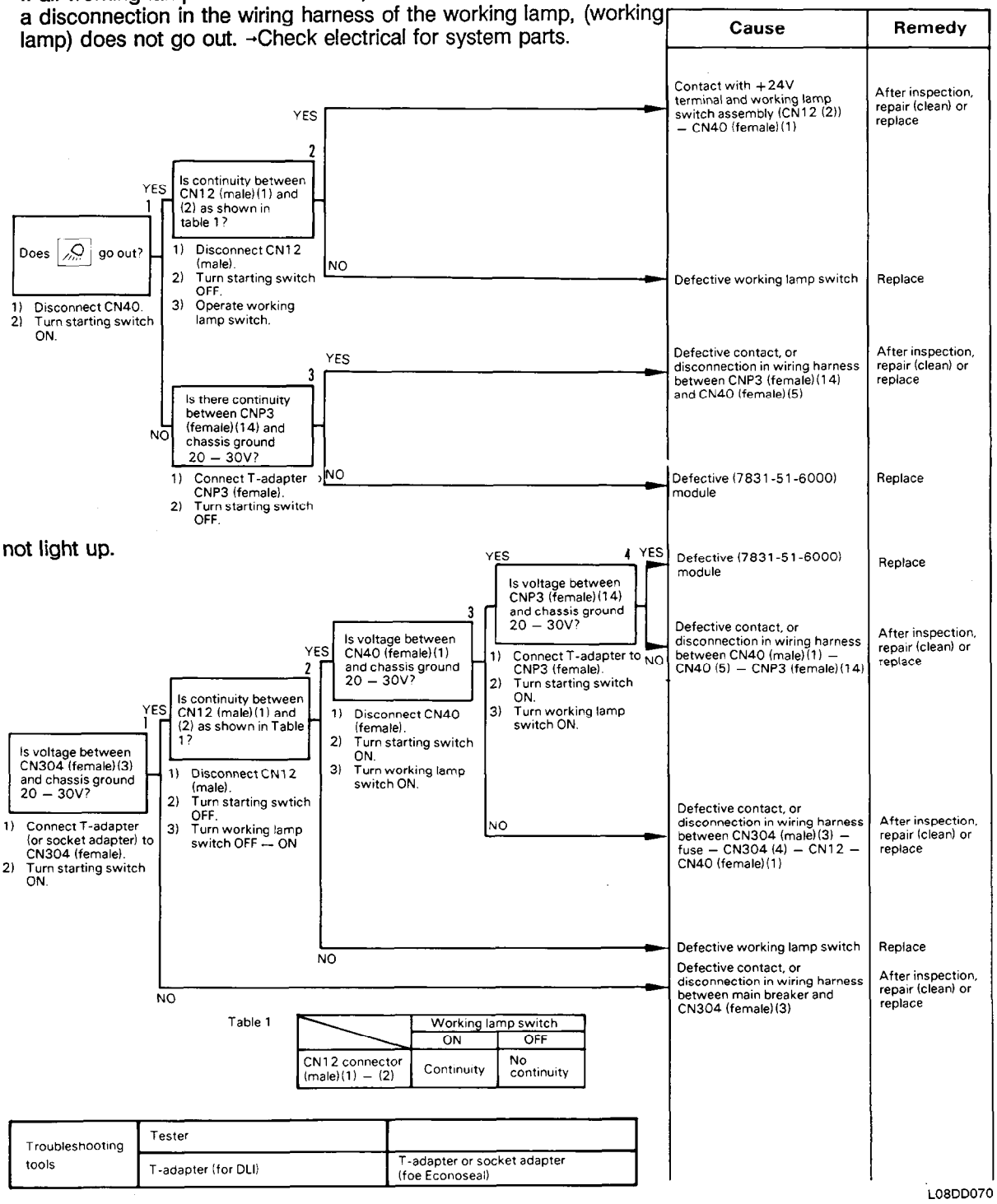
L08DD069

M-13 (WORKING LAMP) LIGHTS UP ABNORMALLY, OR DOES NOT LIGHT UP.

a) Does not go out.

Note: If all working lamp bulbs are broken, or there is defective contact or a disconnection in the wiring harness of the working lamp, (working lamp) does not go out. →Check electrical for system parts.

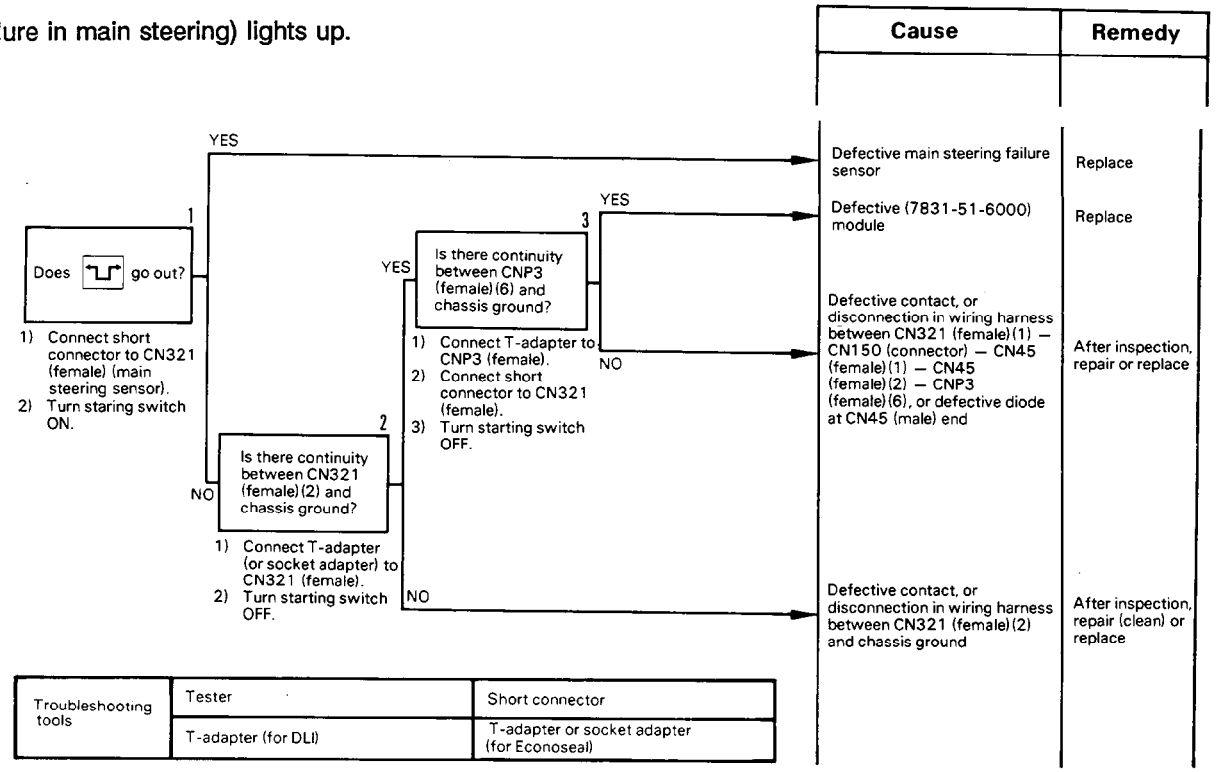
b) Does not light up.



M-14 NOT USED

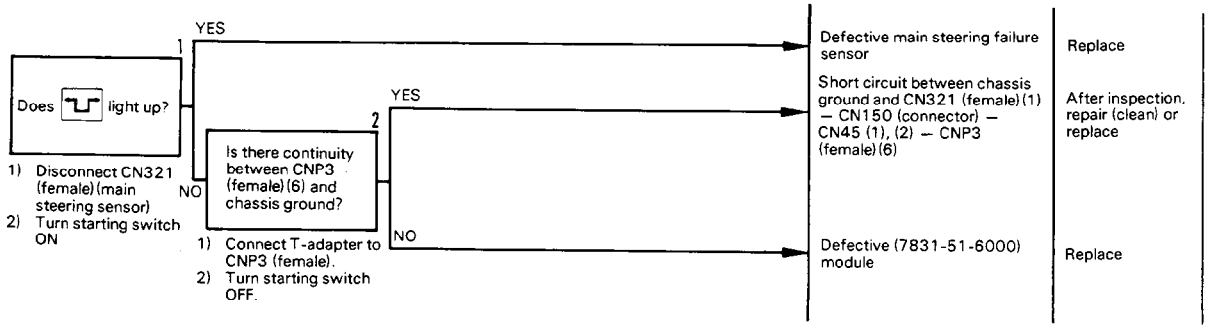
M-15 (FAILURE IN MAIN STEERING) LIGHTS UP OR DOES NOT LIGHT UP (IF EQUIPPED).

a) (Failure in main steering) lights up.



L08DD071

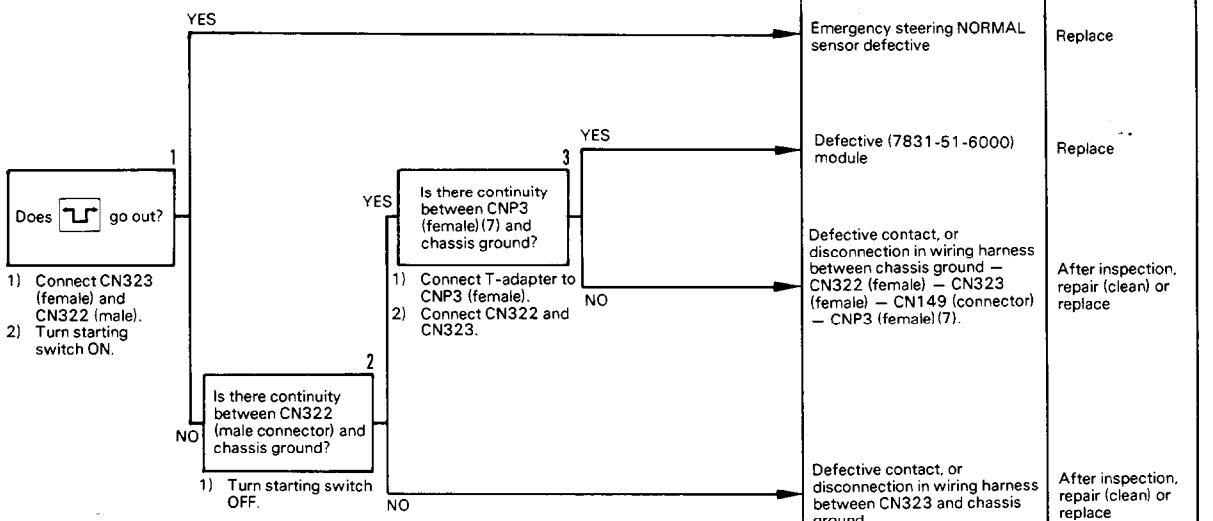
b) (Failure in main steering) does not light up.



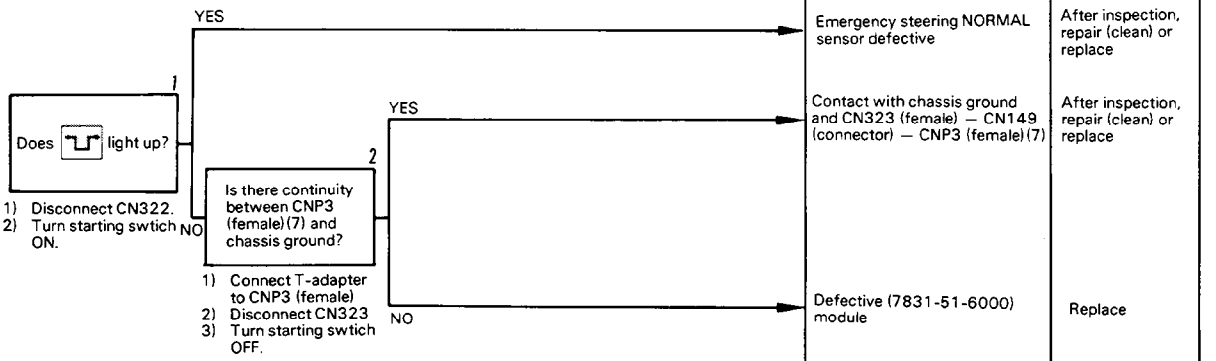
L08DD072

M-16 (EMERGENCY STEERING NORMAL) LIGHTS UP OR DOES NOT LIGHT UP (IF EQUIPPED).

a) (Emergency steering normal) lights up.



b) (Emergency steering normal) does not light up.

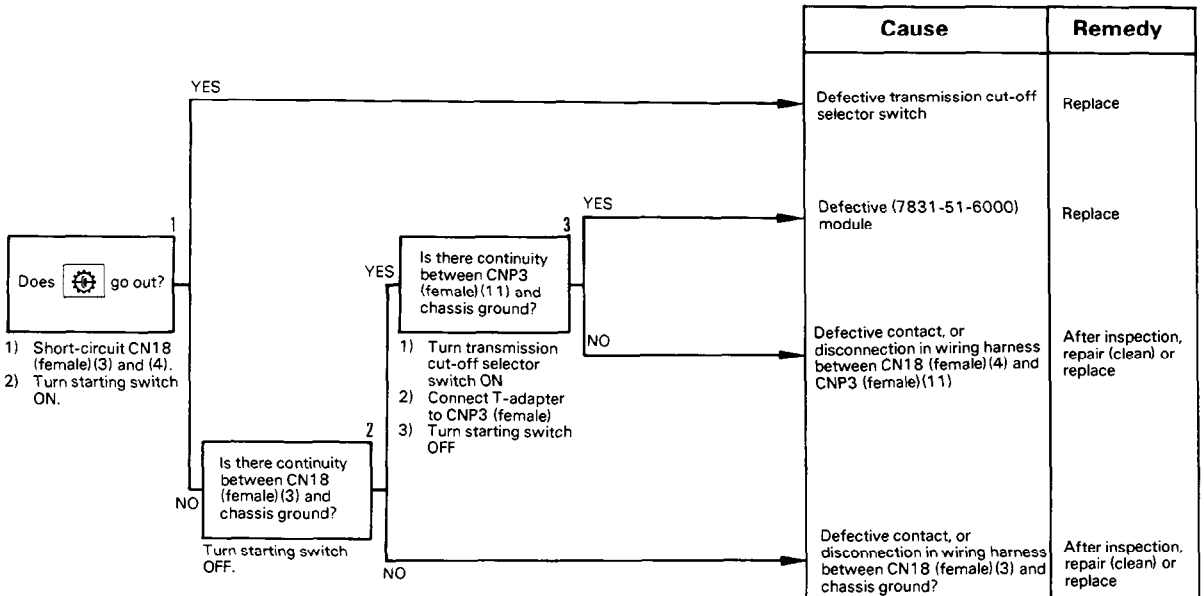


Troubleshooting tools	Tester	
	T-adapter (for DLI)	

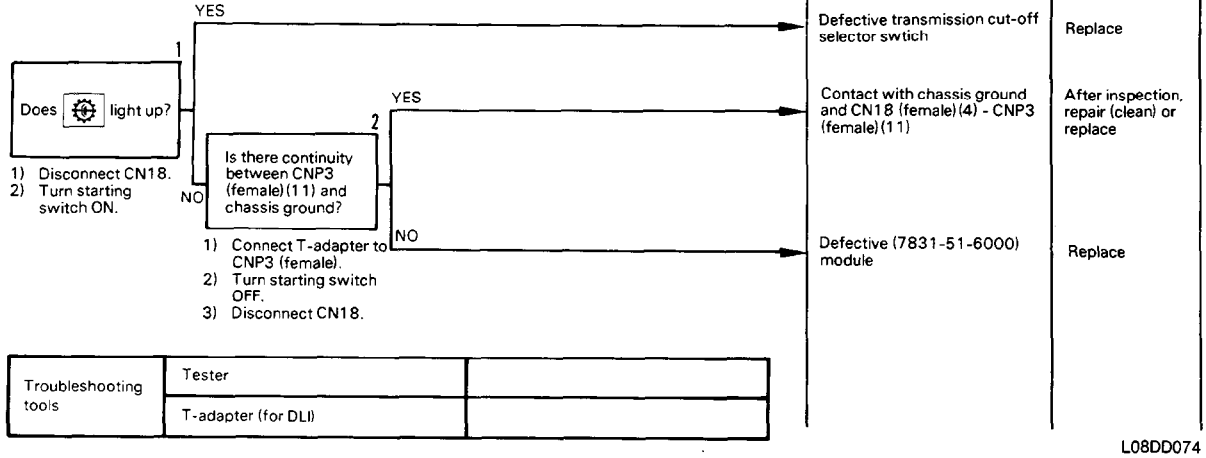
L08DD073

M-17 (TRANSMISSION CUT-OFF) LIGHTS UP OR DOES NOT LIGHT UP.

a) Does light up.



b) Does not light up.

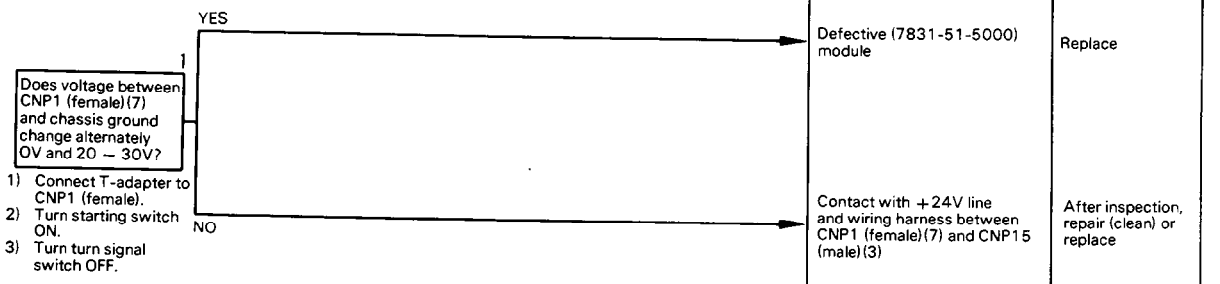


Troubleshooting tools	Tester	
	T-adapter (for DLI)	

L08DD074

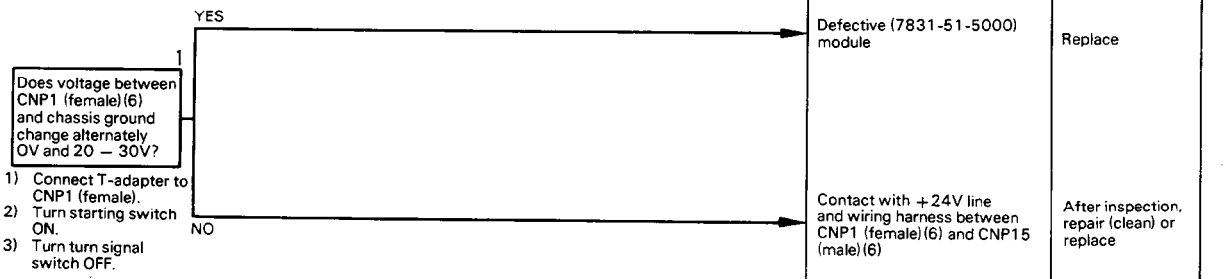
M-18 TURN SIGNAL LAMPS, HIGH BEAM LIGHT UP OR DO NOT LIGHT UP.

a) Pilot display of turn signal lamp (right) lights up.
Note: If turn signal lamp (right) lights up on machine, check turn signal lamp.



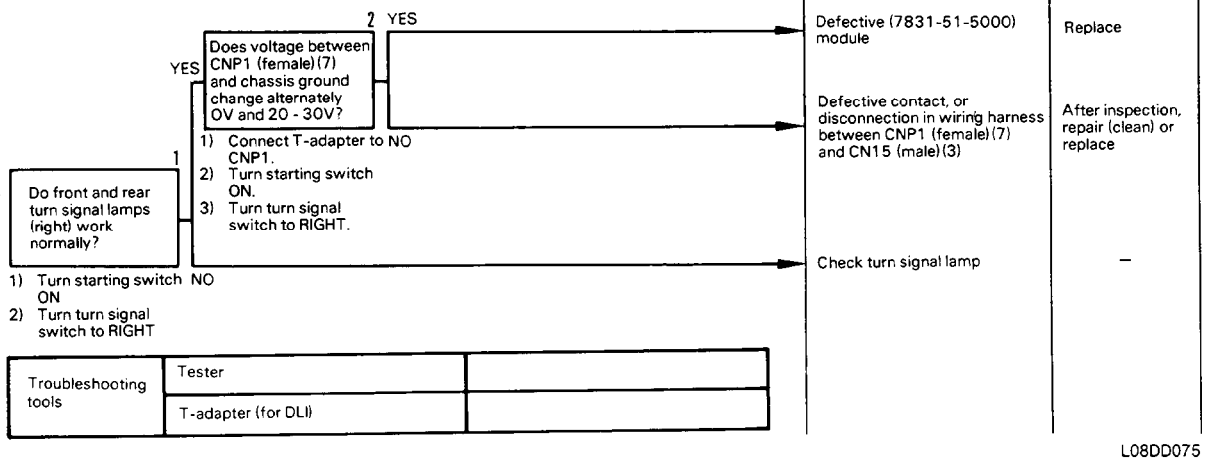
Cause	Remedy
Defective (7831-51-5000) module	Replace
Contact with +24V line and wiring harness between CNP1 (female)(7) and CNP15 (male)(3)	After inspection, repair (clean) or replace

b) Pilot display of turn signal lamp (left) lights up.
Note: If turn signal lamp (left) lights up on machine, check turn signal lamp.



Cause	Remedy
Defective (7831-51-5000) module	Replace
Contact with +24V line and wiring harness between CNP1 (female)(6) and CNP15 (male)(6)	After inspection, repair (clean) or replace

c) Pilot display of turn signal lamp (right) does not light up.
Note: If turn signal lamp (right) does not flash on machine, check turn signal lamp.

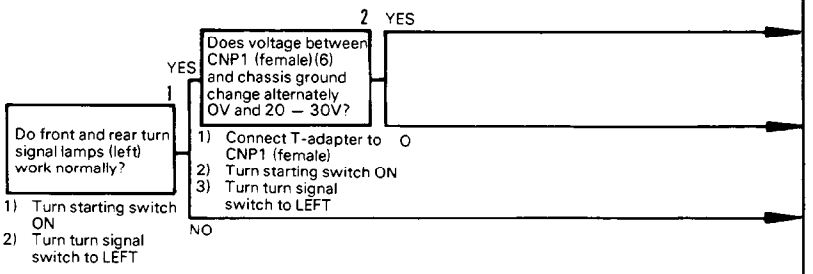


Cause	Remedy
Defective (7831-51-5000) module	Replace
Defective contact, or disconnection in wiring harness between CNP1 (female)(7) and CN15 (male)(3)	After inspection, repair (clean) or replace
Check turn signal lamp	–

Troubleshooting tools	Tester	
	T-adapter (for DLI)	

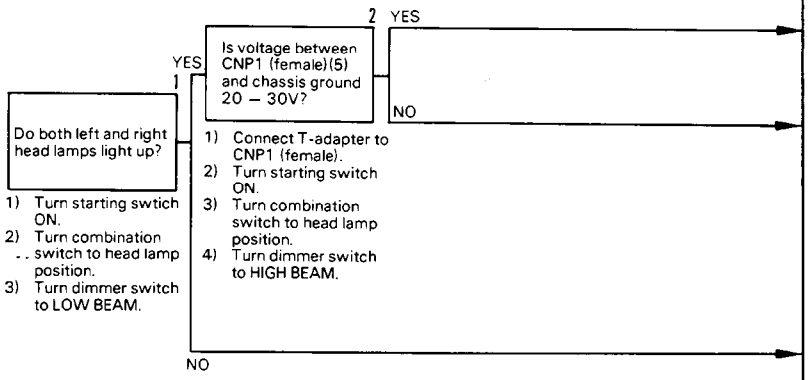
L08DD075

d) Pilot display of turn signal lamp (left) does not light up.
Note: If turn signal lamp (left) does not flash on machine, check turn signal lamp.



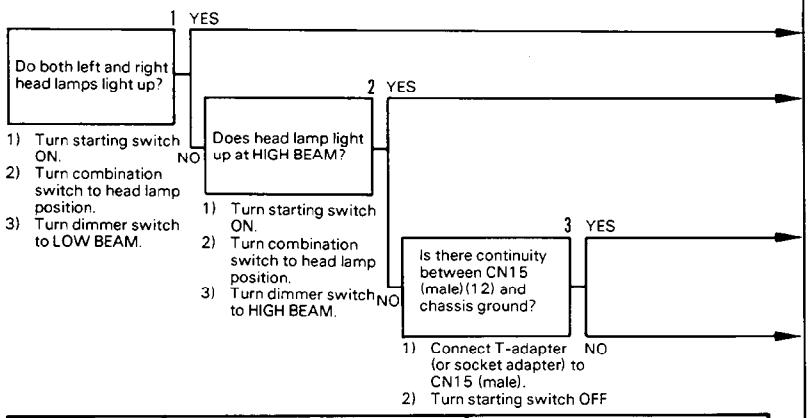
Cause	Remedy
Defective (7831-51-5000) module	Replace
Defective contact, or disconnection in wiring harness between CNP1 (female)(6) and CN15 (male)(6)	After inspection, repair (clean) or replace
Check turn signal lamp	–

e) HIGH BEAM pilot lamp does not light up.
Note: If the head lamp cannot be switched to HIGH BEAM, check head lamp.



Cause	Remedy
Defective (7831-51-5000) module	Replace
Defective contact, or disconnection in wiring harness between CNP1 (female)(5) and CN39 (female)(1)	After inspection, repair (clean) or replace
Bulbs broken in both head lamps (low beam lamps) (If the low beam bulb is broken, the pilot lamp will not light up even if the switch is turned to HIGH BEAM).	After inspection, repair (clean) or replace

f) HIGH BEAM pilot lamp does not go out.

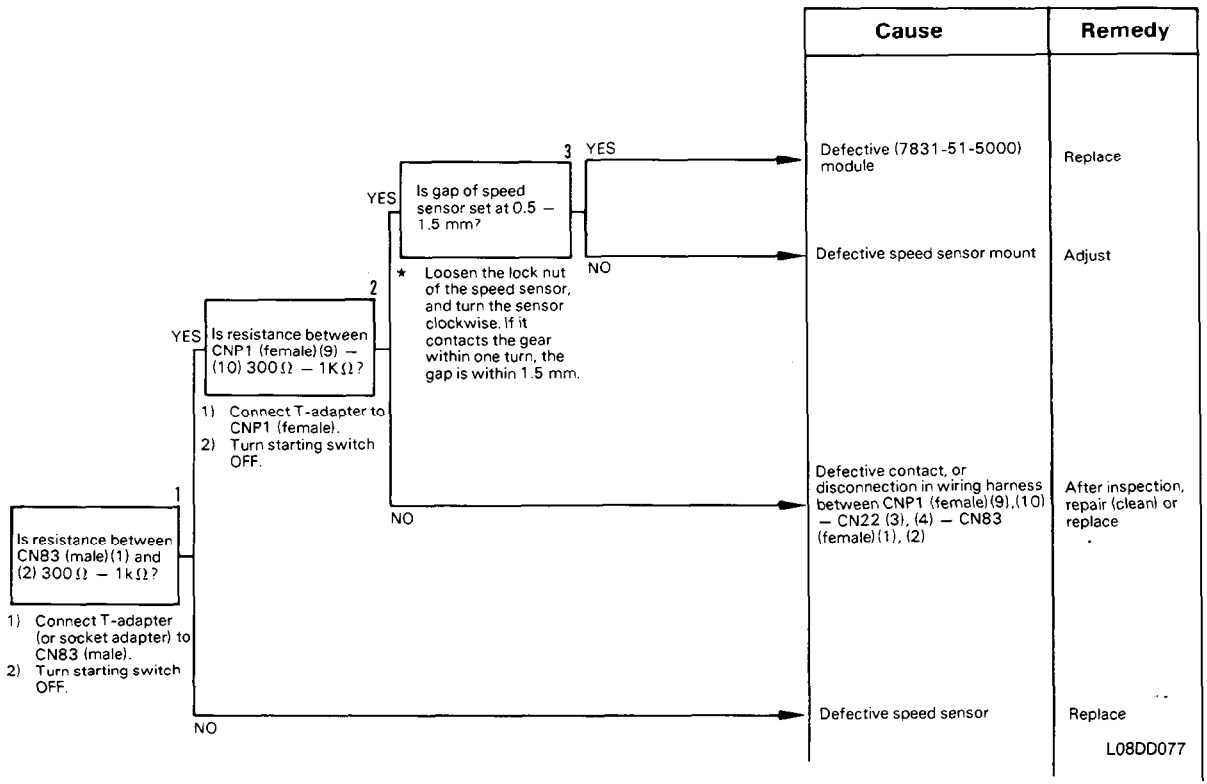


Cause	Remedy
Defective (7831-51-5000) module	Replace
Defective contact, or disconnection in wiring harness between CN15 (female)(9) and combination switch	After inspection, repair (clean) or replace
Defective contact, or disconnection in wiring harness between CN15 (female)(12) and combination switch	After inspection, repair (clean) or replace
Defective contact, or disconnection in wiring harness between CN15 (male)(12) chassis ground	After inspection, repair (clean) or replace

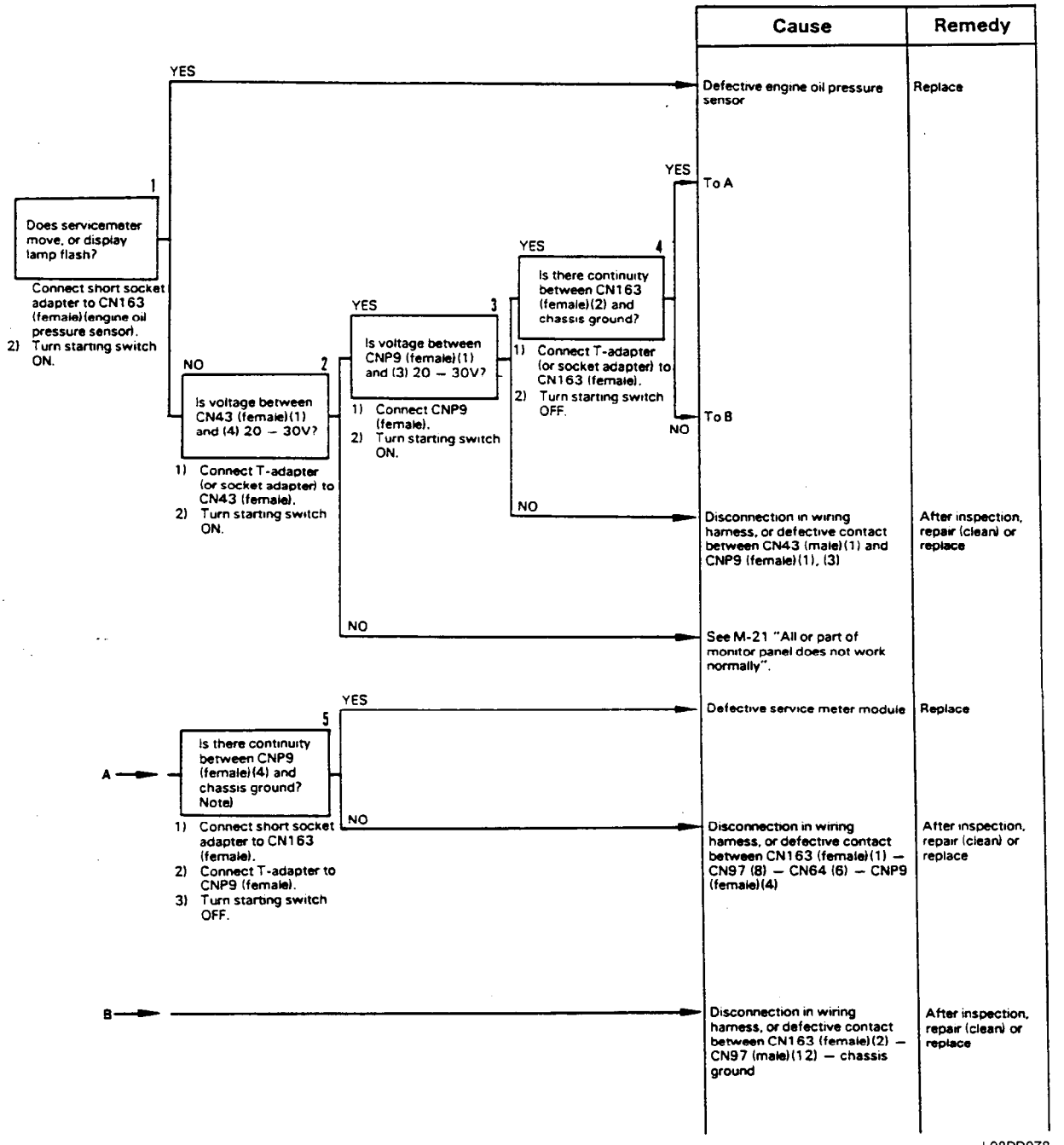
Troubleshooting tools	Tester	
	T-adapter (for DLI)	T-adapter or socket adapter (for Econoseal)

L08DD076

M-19 SPEEDOMETER DISPLAY DOES NOT WORK.



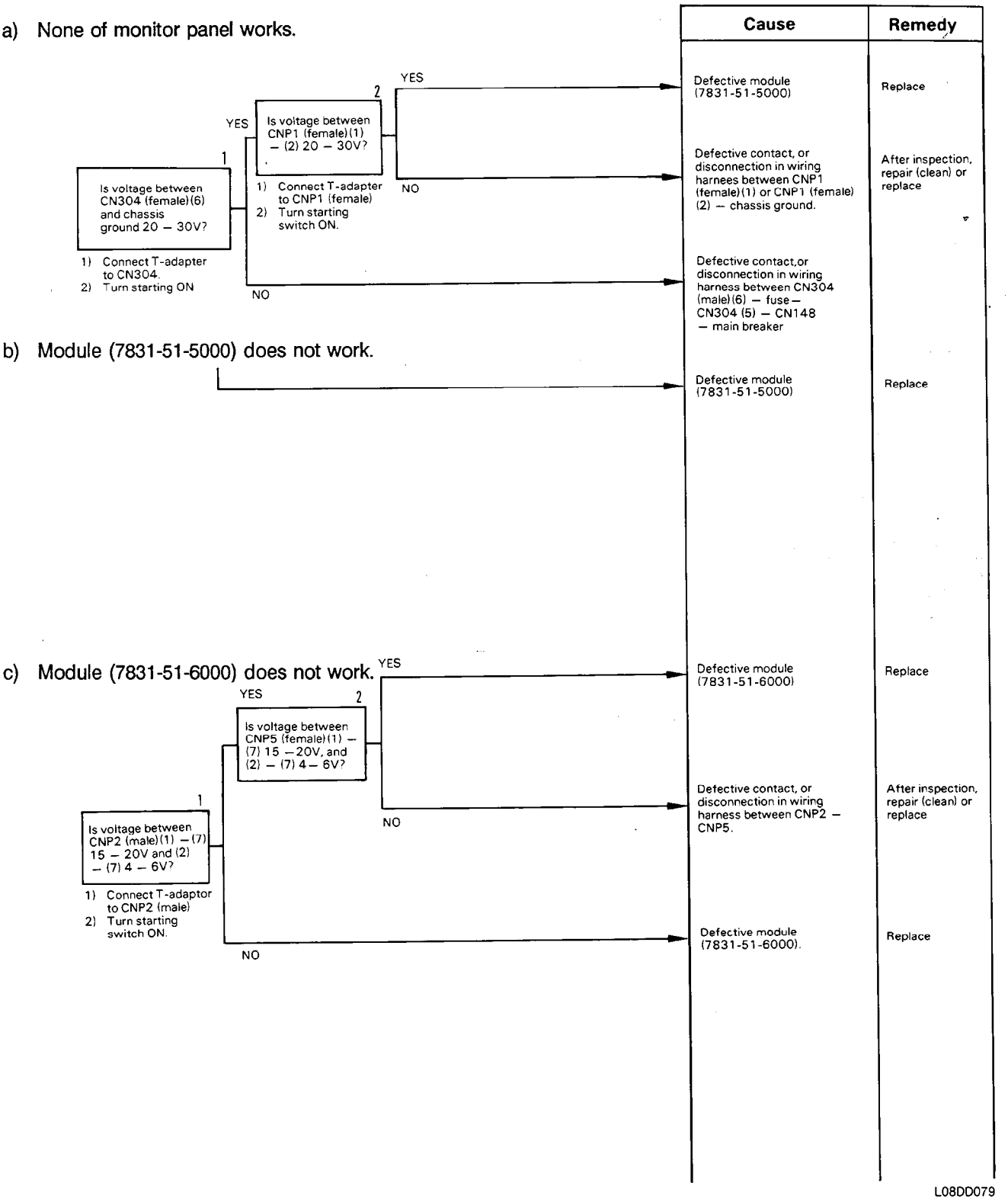
M-20 SERVICEMETER DOES NOT WORK NORMALLY.



L08DD078

Troubleshooting tools	Tester	Short socket adapter
	T-adapter (for DLI)	T-adapter or socket adapter (for Econoseal)

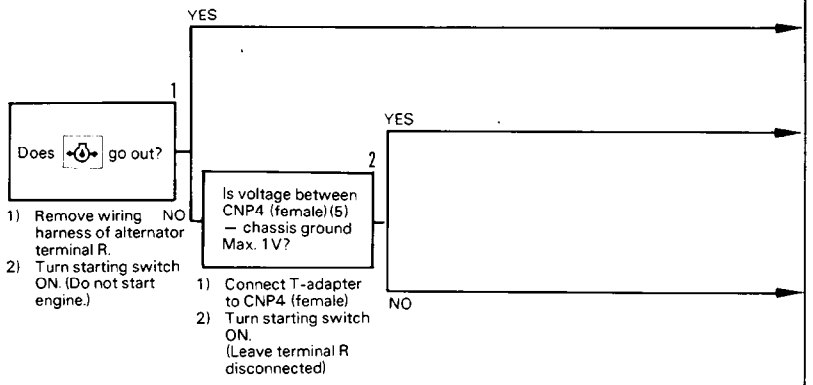
M-21 ALL OR PART OF MONITOR PANEL DOES NOT WORK.



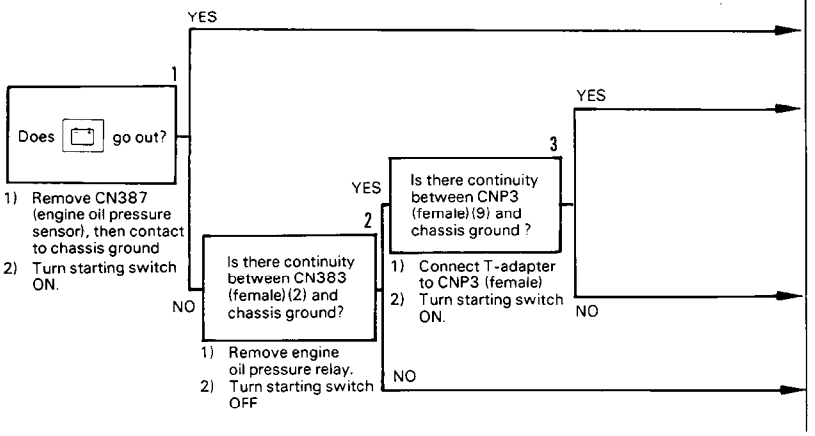
L08D0079

M-22 EVEN WHEN ENGINE IS STOPPED, (BATTERY CHARGE) FLASHES, OR (ENGINE OIL PRESSURE) FLASHES.

a) (Battery charge) flashes and warning lamp lights up.



b) (Engine oil pressure) flashes, alarm buzzer sounds, lamp also lights up.



M-23 NO LAMPS ON MONITOR LIGHT UP (IMMEDIATELY AFTER TURNING STARTING SWITCH TO ON, ENGINE STOPPED).

a) No lamps on any module light up when starting switch is turned ON.

All lamps goes out when engine is started.

See M-21 and M-22

b) Lamps on some modules do not light up.

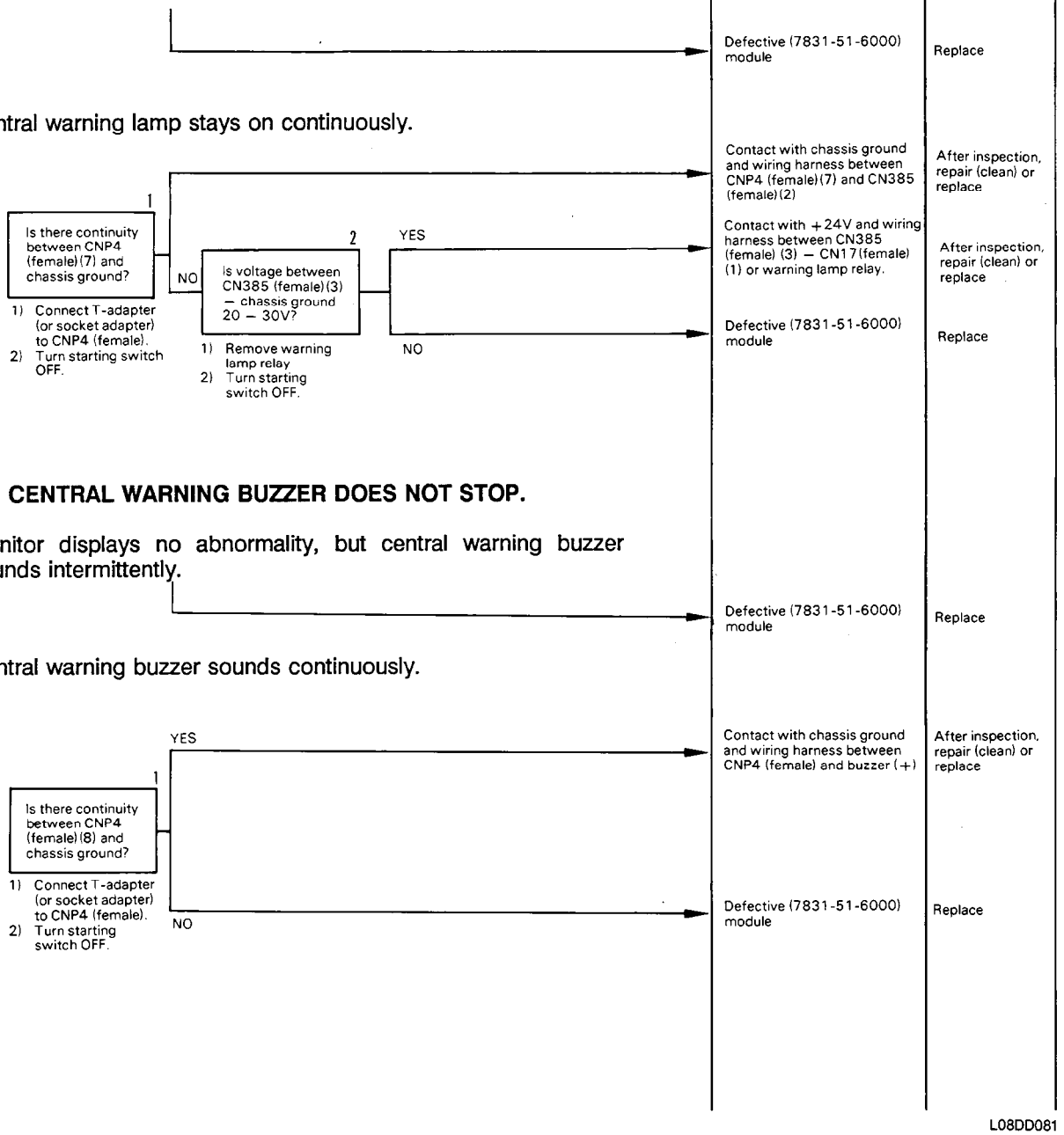
Defective module

L08DD080

M-24 CENTRAL WARNING LAMP DOES NOT GO OUT.

a) Monitor displays no abnormality, but central warning lamp light up intermittently.

b) Central warning lamp stays on continuously.



M-25 CENTRAL WARNING BUZZER DOES NOT STOP.

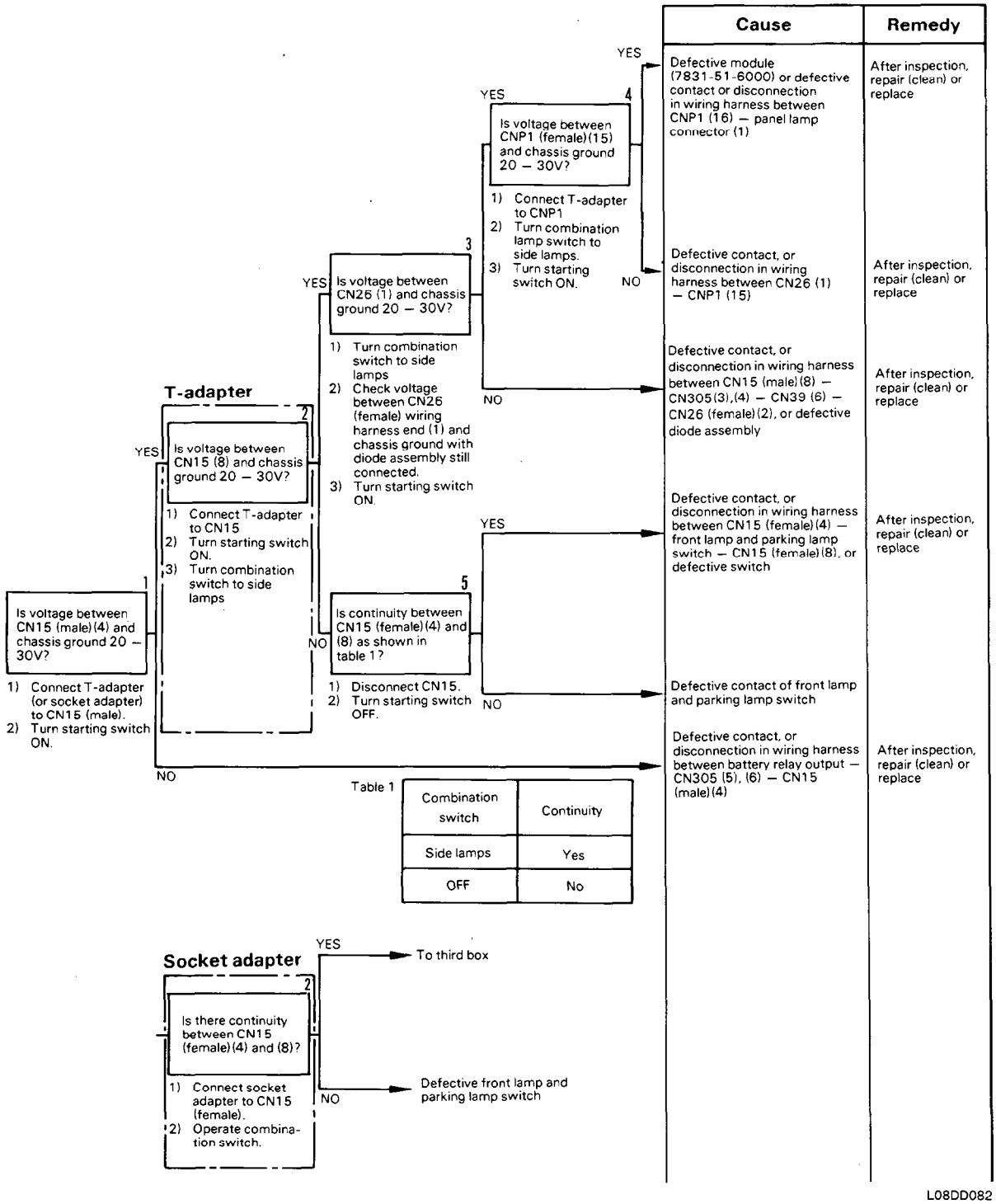
a) Monitor displays no abnormality, but central warning buzzer sounds intermittently.

b) Central warning buzzer sounds continuously.

L08DD081

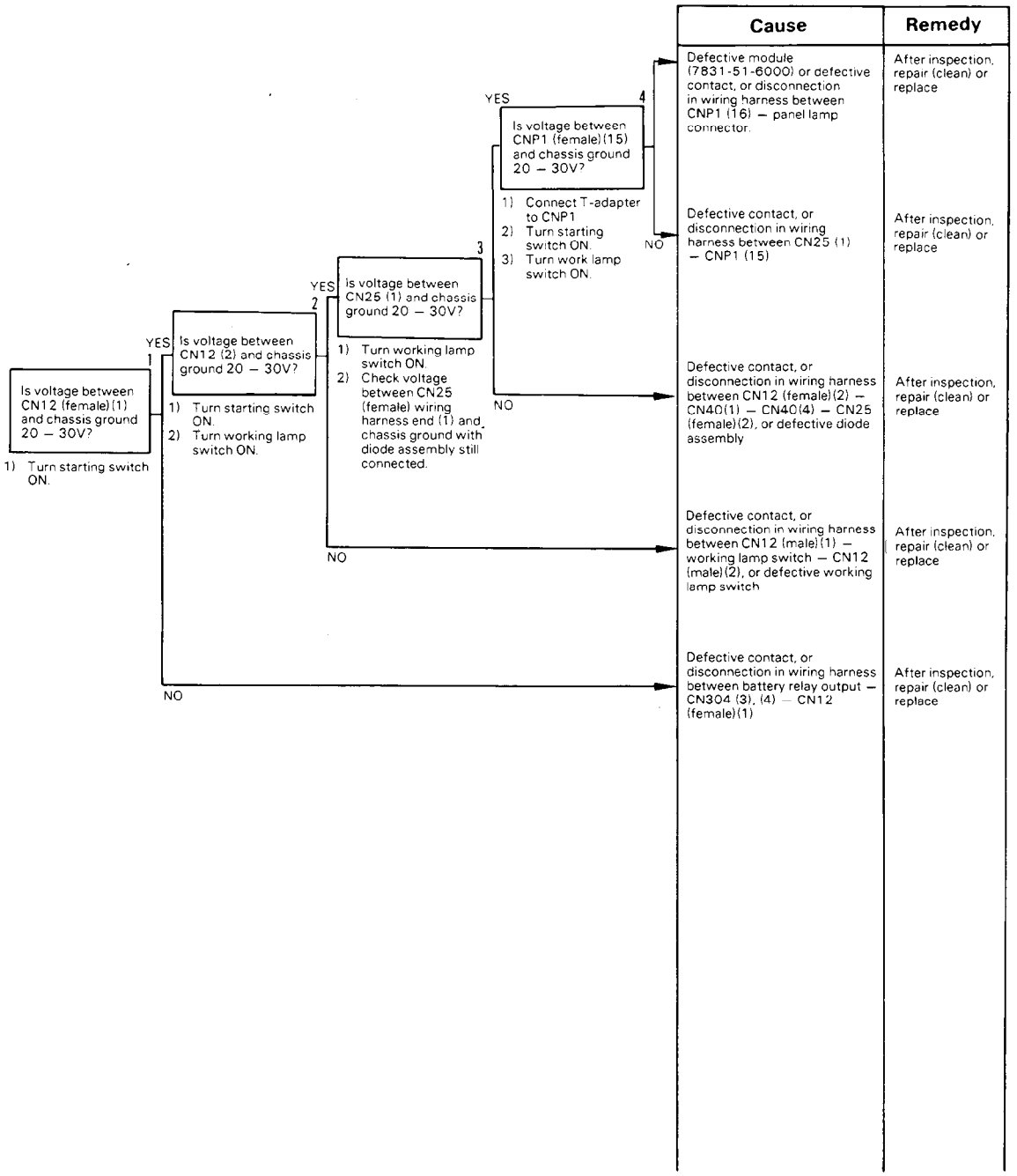
M-26 NONE OF PANEL LAMPS ON MACHINE MONITOR LIGHT UP.

a) No panel lamps light up even when only side lamp in combination switch is used.



L08DD082

b) No panel lamps light up even working lamp is switched on.

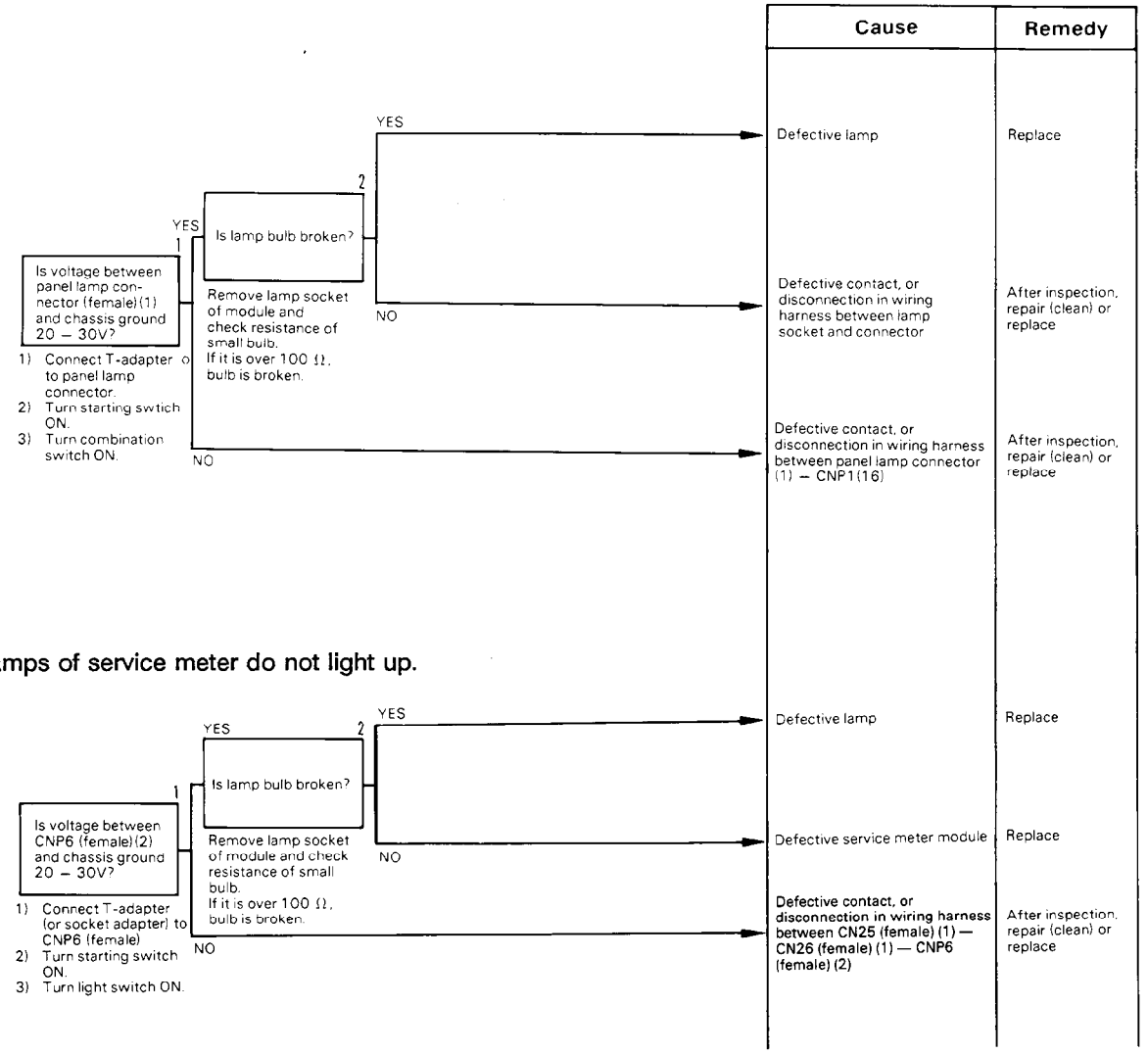


Troubleshooting tools	Tester	
	T-adapter (for DLI)	T-adapter or socket adapter (for Econoseal)

L08DD083

M-27 SOME OF PANEL LAMPS ON MACHINE MONITOR DO NOT LIGHT UP.

a) Panel lamps of monitor module do not light up.

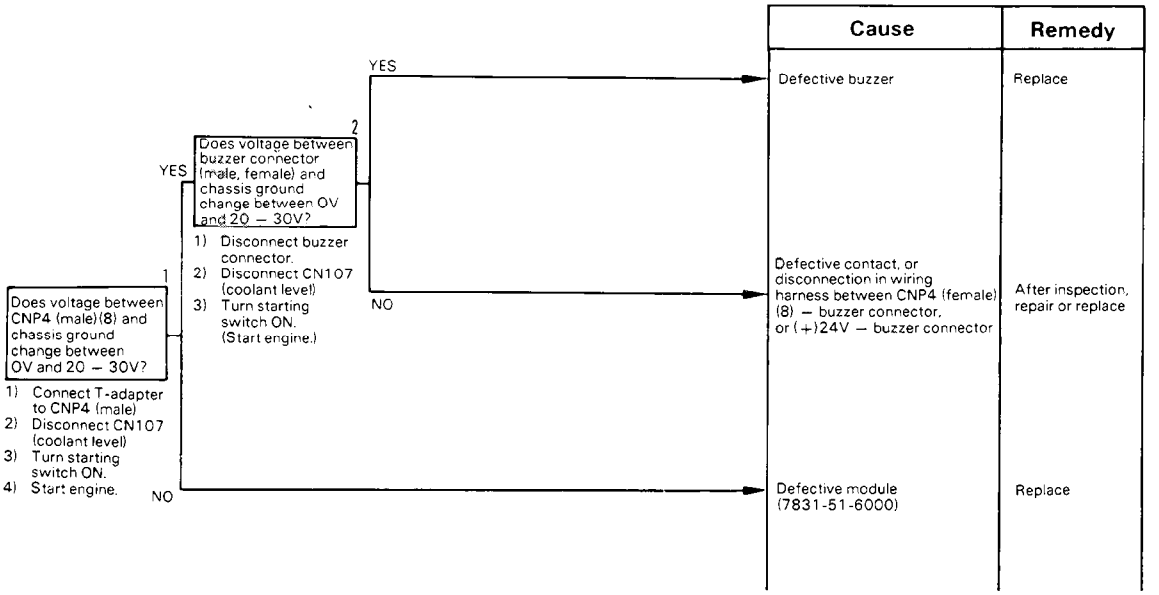


b) Panel lamps of service meter do not light up.

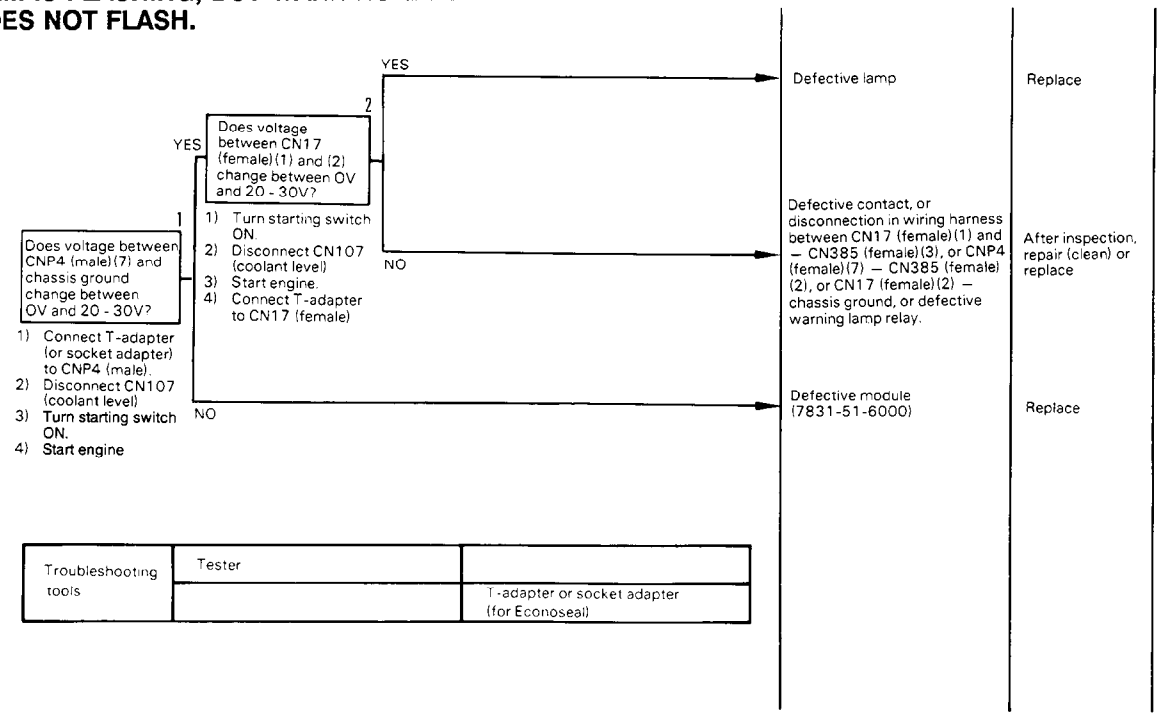
Troubleshooting tools	Tester	T-adapter or socket adapter (for MIC)
	T-adapter (for DLI)	T-adapter or socket adapter (for Econoseal)

L08DD084

M-28 EMERGENCY ITEM IS FLASHING, BUT ALARM BUZZER DOES NOT SOUND.



M-29 EMERGENCY ITEM OR NON-EMERGENCY ITEM IS FLASHING, BUT WARNING LAMP DOES NOT FLASH.

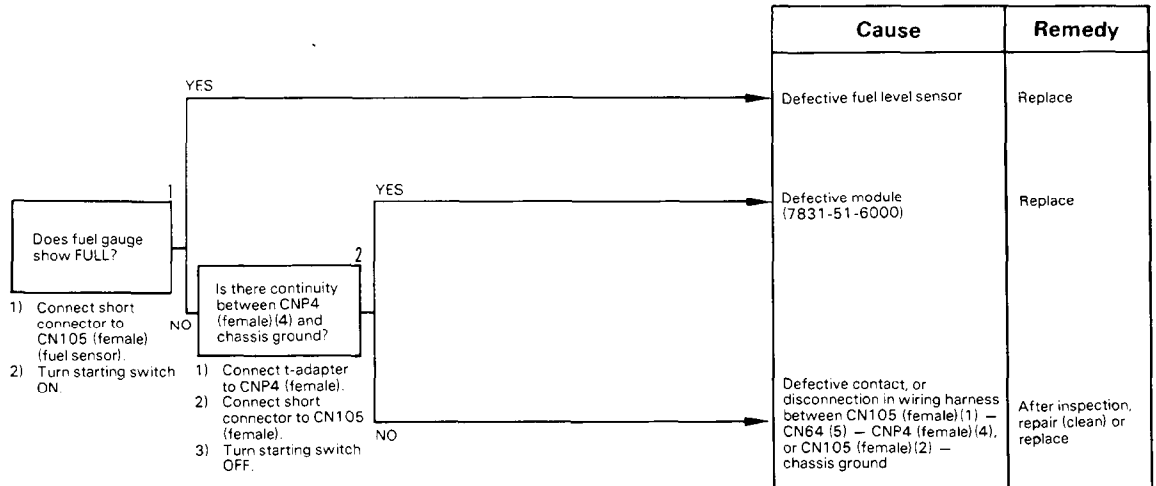


Troubleshooting tools	Tester	
		T-adapter or socket adapter (for Econoseal)

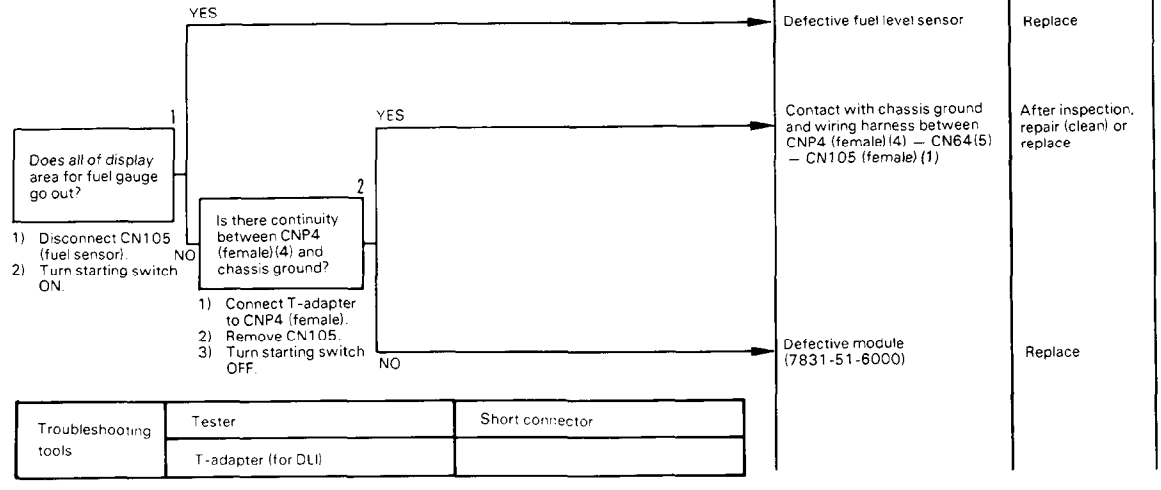
L08DD085

M-30 ABNORMALITY IN (FUEL GAUGE).

a) Nothing shown in display area.



b) Stay at FULL and does not move.

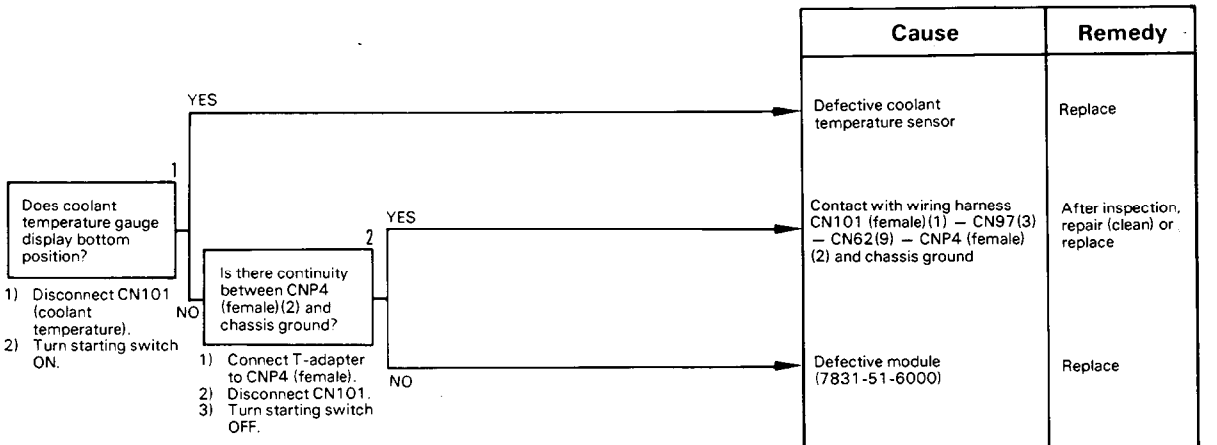


Troubleshooting tools	Tester	Short connector
	T-adapter (for DLI)	

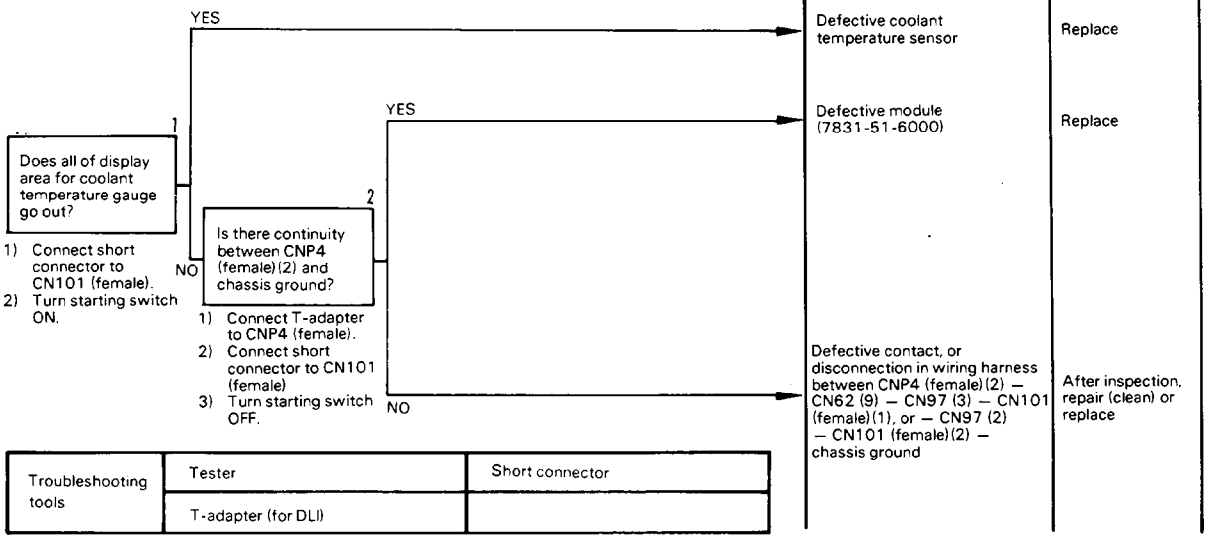
L08DD086

M-31 ABNORMALITY IN (COOLANT TEMPERATURE GAUGE).

a) Nothing shown in display area.



b) Stay at bottom position and does not move.

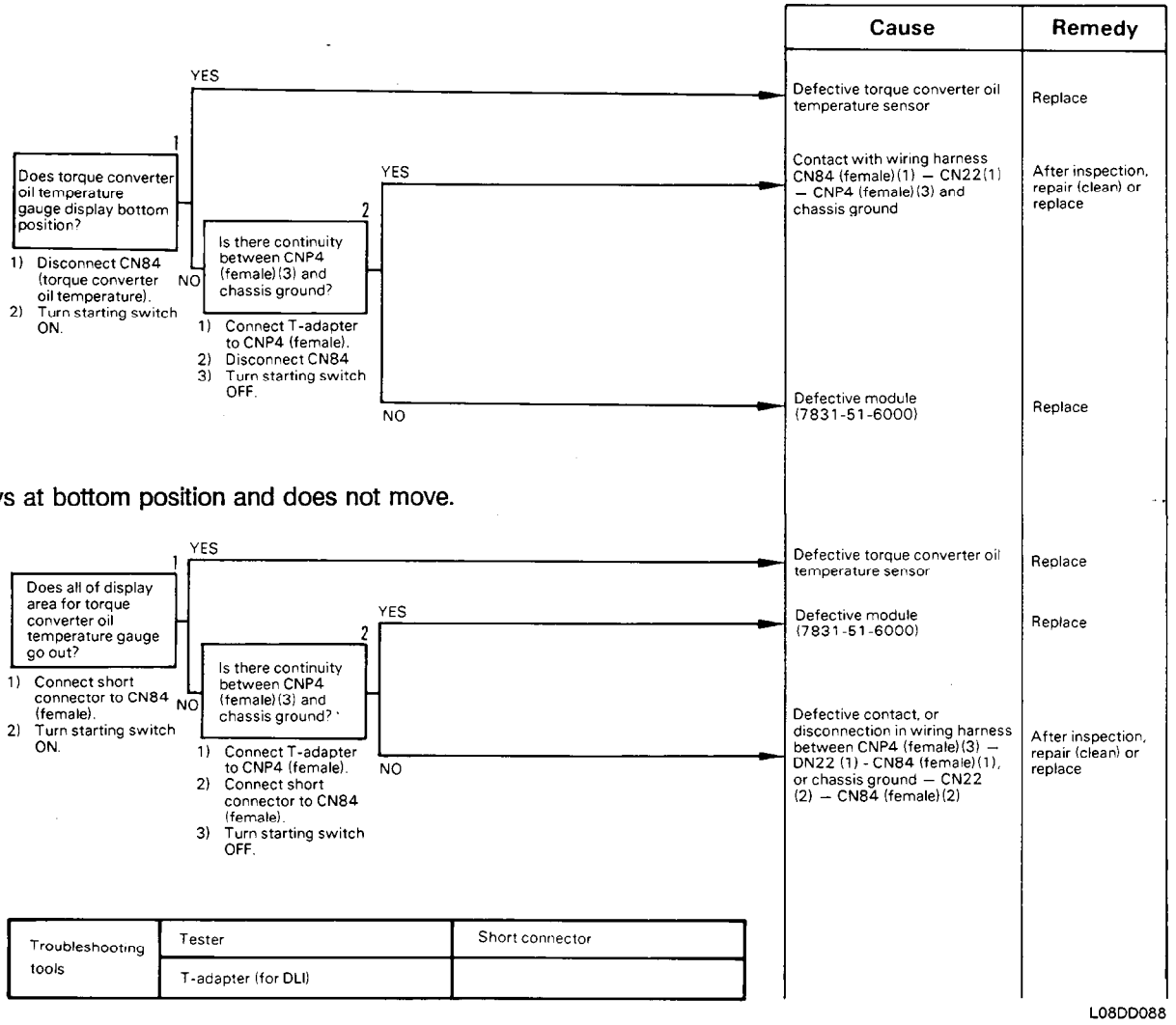


Troubleshooting tools	Tester	Short connector
	T-adapter (for DLI)	

L08DD087

M-32 ABNORMALITY IN (TORQUE CONVERTER OIL TEMPERATURE GAUGE).

a) Nothing shown in display area.



b) Stays at bottom position and does not move.

Troubleshooting tools	Tester	Short connector
	T-adapter (for DLI)	

L08DD088

TABLE OF MONITOR REFERENCE VALUES

System: Vehicle monitor

Equipment name	Connector No.	Inspection method, Judgement		Condition for measurement
Brake fluid level sensor	CN86 (male)	**Shorting connector** 1) Case where a shorting connector is used; The sensor is faulty if the indication is as follows:		1) Starter switch "ON"
		When shorting connector is connected	Monitor is lit	
		When CN86 is disconnected	Monitor is out	
		Continuity 1) Case of continuity test; The sensor is normal if the indication is as follows:		1) Starter switch "OFF"
		When brake fluid level is normal	No continuity	
		When brake fluid level is low	Continuity	
Engine oil level sensor	CN96 (male)	**Shorting connector** 1) Case where a shorting connector is used; The sensor is faulty if the indication is as follows:		1) Starter switch "ON"
		When shorting connector is connected	Monitor is out	
		When CN96 is disconnected	Monitor is lit	
		Continuity 1) Case of continuity test; The sensor is normal if the indication is as follows:		1) Starter switch "OFF"
		When engine oil level is normal	Continuity	
		When engine oil level is low	No continuity	
Radiator water level sensor	CN107 (male)	**Shorting connector** 1) Case where a shorting connector is used; The sensor is faulty if the indication is as follows:		1) Starter switch "ON"
		When shorting connector is connected	Monitor is out	
		When CN107 is disconnected	Monitor is lit	
		Continuity 1) Case of continuity test; The sensor is normal if the indication is as follows:		1) Starter switch "OFF"
		When radiator water level is normal	Continuity	
		When radiator water level is low	No continuity	

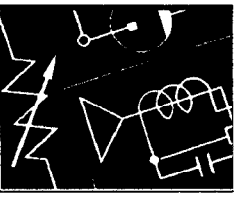
Equipment name	Connector No.	Inspection method, Judgement		Condition for measurement
Engine water temperature sensor (engine water temperature gauge)	CN101 (male)	**Resistance measurement** The sensor is normal if the indication is as follows:		Starter switch "OFF"
		100°C	Approx. 3.0kΩ	
Torque converter oil temperature sensor (Torque converter oil temperature gauge)	CN84 (male)	**Resistance measurement** The sensor is normal if the indication is as follows:		Starter switch "OFF"
		100°C	Approx. 3.0kΩ	
Fuel level sensor (Fuel gauge)	CN105 (male)	**Resistance measurement** The sensor is normal if the indication is as follows:		Starter switch "OFF"
		The tank is full.	Approx. 12Ω or less	
		The tank is empty.	Approx. 85-100kΩ	
Alternator		**Voltage measurement** While the engine is running (with throttle opening 1/2 or higher) →27.5 - 29.5V ● If the battery was deteriorated or in a cold area where are cases where the voltage will not rise for a while.		With engine running
Engine oil pressure sensor	CN387 (male)	**Shorting connector** 1) Case where a shorting connector is used; The sensor is faulty if the indication is as follows:		With engine running
		When between connector CN387 (male) (A) and (C) is shorted.	Monitor is out	
		When CN387 is disconnected	Monitor is lit	
		Continuity 1) Case of continuity test; The sensor is normal if the indication is as follows:		With engine running
		When engine oil pressure is 1.3kg/cm^2 or higher	No continuity	
		When engine oil pressure is 0.8kg/cm^2 or lower	Continuity	

<table>
<tr><th>Equipment name</th><th>Connector No.</th><th colspan="3">Inspection method</th><th>Judgement</th><th>Condition for measurement</th></tr>
<tr><td rowspan="16">H and L shown in the table represent the following voltage levels.
1) Engine oil pressure signal
H: 3.5-30V
L: Approx. 0V
2) Alternator signal
H: 3.5-30V
L: Approx. 0V
3) Sensor signal
H: 3.5-30V
L: Approx. 0V</td><td colspan="5">The monitor is normal if the indication is as shown in Table 1 and Table 2.
Table 1</td><td rowspan="16">1) Engine is running
2) T branch connection</td></tr>
<tr><td colspan="2">Monitor item</td><td>Signal</td><td>Monitor auxiliary signal input</td><td>Monitor panel connector signal input</td></tr>
<tr><td colspan="2" rowspan="2">Brake fluid level CNP3(1)</td><td>Flickers</td><td rowspan="2">Engine oil pressure signal H and alternator signal L</td><td>H</td></tr>
<tr><td>Out</td><td>L</td></tr>
<tr><td colspan="2" rowspan="2">Engine oil level CNP3(2)</td><td>Flickers</td><td rowspan="2">Engine oil pressure signal H and alternator signal L</td><td>H</td></tr>
<tr><td>Out</td><td>L</td></tr>
<tr><td colspan="2" rowspan="2">Radiator water level CNP3(3)</td><td>Flickers</td><td rowspan="2">Engine oil pressure signal H and alternator signal L</td><td>H</td></tr>
<tr><td>Out</td><td>L</td></tr>
<tr><td colspan="2" rowspan="2">Charging rate CNP4(5)</td><td>Flickers</td><td rowspan="2">Engine oil pressure signal L and alternator signal L</td><td>L</td></tr>
<tr><td>Out</td><td>H</td></tr>
<tr><td colspan="2" rowspan="2">Engine oil pressure CNP3(9)</td><td>Flickers</td><td rowspan="2">Alternator signal H</td><td>H</td></tr>
<tr><td>Out</td><td>L</td></tr>
<tr><td colspan="2" rowspan="2">Parking brake CNP3(5)</td><td>Lit</td><td rowspan="2"></td><td>H</td></tr>
<tr><td>Out</td><td>L</td></tr>
<tr><td colspan="2" rowspan="2">Work lamp CNP4(14)</td><td>Lit</td><td rowspan="2"></td><td>H</td></tr>
<tr><td>Out</td><td>L</td></tr>
<tr><td colspan="2" rowspan="2">T/M cut-off CNP3(11)</td><td>Lit</td><td rowspan="2"></td><td>H</td></tr>
<tr><td>Out</td><td>L</td></tr>
</table>

Equipment name	Connector No.	Inspection method	Judgement	Condition for measurement
			Table 2	1) Engine is running 2) T branch connection
	A	CNP1(8),(11),(12),(13),(14) CNP3(12) CNP4(9),(10),(11),(12) CNP6(5) (Open terminals)	Open (No connection wiring)	
	B	CNP1(2) CNP3(6),(7),(8),(10) CNP4(1), CNP6(3) (Connected to GND)	CNP1(1) - each terminal 20-30V	
	C	Voltage between CNP1(1) and body (+24V input)	Starter switch ON 20-30V	
			Starter switch OFF 0V	
	D	CNP4(7),(8)(alarm output) CN107 (Radiator water level sensor) Disconnection - Connection of shorting connector	With the connector disconnected; buzzer ringing (Lamp flickering) or repeating of 1.2V or higher 0.8 sec. approx. 0V 0.8 sec	
			With shorting connector connected; Buzzer stop (Lamp flickering) or voltage 1.2V or higher	

Equipment name	Connector No.	Inspection method		Judgement			Condition for measurement
	Table 3						1) Engine is running 2) T branch connection
		Gauge indicating position		Indication level resistance (kΩ) (Module input resistance)			
		Starter switch ON		Starter switch OFF			
Engine water temperature gauge Measurement of resistance between CNP4(2) (female) and body				Minimum - Maximum			
		Upward ↑	All out	0	-	0.36	
			7	0.25	-	3.20	
			6	2.89	-	3.75	
		indicating position	5	3.40	-	4.26	
			4	3.86	-	5.13	
			3	4.65	-	6.94	
		↓	2	6.28	-	10.27	
		Downward	1	9.20	-	Open circuit	
Torque converter oil temperature gauge Measurement of resistance between CNP4(3) (female) and body		Upward ↑	All out	0	-	0.36	
			7	0.25	-	1.89	
			6	1.68	-	2.40	
		indicating position	5	2.15	-	3.04	
			4	2.75	-	5.13	
			3	4.65	-	9.38	
		↓	2	8.44	-	18.2	
		Downward	1	15.9	-	Open circuit	
Fuel level gauge Measurement of resistance between CNP4(4) (female) and body				Minimum - Maximum			
		Upward ↑	7	0	-	16.8	
			6	11.7	-	28.4	
			5	22.5	-	38.7	
		indicating position	4	32.2	-	43.6	
			3	36.8	-	53.9	
			2	46.5	-	80.4	
		↓	1	71.1	-	695	
		Downward	All out	614	-	Open circuit	

ELECTRIC AND ELECTRONIC SYSTEM



83 DISASSEMBLY AND ASSEMBLY

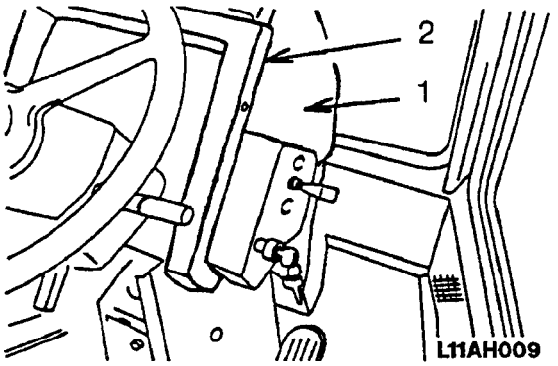
ELECTRONIC VECHICLE MONITOR SYSTEM (EVMS) 2
REMOVAL 2
INSTALLATION 3

ELECTRONIC VECHICLE MONITOR SYSTEM (EVMS)
REMOVAL

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the work equipment to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

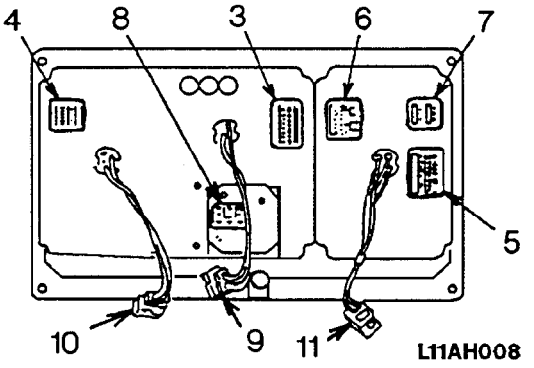
⚠ Disconnect the cable from the negative (-) terminal of the battery.

1. **Covers.**
   Remove covers (1) and (2) of the monitoring system.



2. **Electric wiring.**
   Disconnect the following electric wiring from connector.
   - Connector (3) for CNP1
   - Connector (4) for CNP2
   - Connector (5) for CNP3
   - Connector (6) for CNP4
   - Connector (7) for CNP5
   - Connector (8) for CNP6
   - Connector (9) for CNP7 (lighting)
   - Connector (10) for CNP8 (lighting)
   - Connector (11) for CNP9 (lighting

   ★ After disconnecting the connectors, mark with a tag to distinguish when installing.



3. **EVMS.**
   Remove mounting bolts, then remove monitor (12).

   ★ When removing the machine monitor, be careful not to give it any sudden shock.

ELECTRONIC VECHICLE MONITOR SYSTEM (EVMS)
INSTALLATION

★ After inserting the connectors, apply the connector lock securely. Assemble so that there is no strain on the wiring.

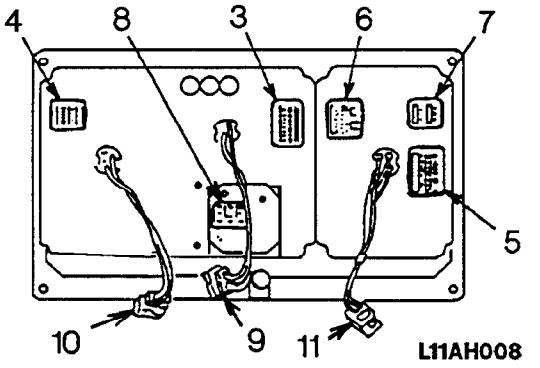
1. **EVMS**
   Set monitor (12) in mounting position and install.

   ★ Be careful not to tighten the screws too much.

2. **Electric wiring.**
   Connect the following electric wiring to the machine monitor.

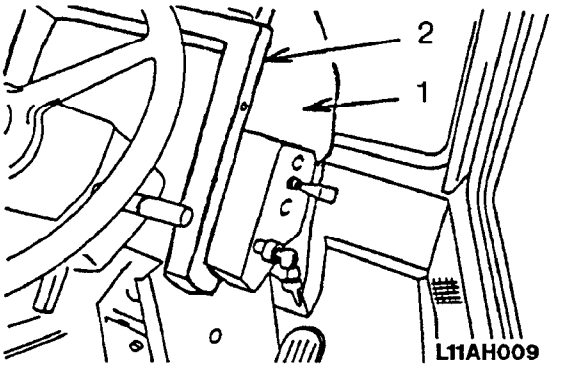
   - Connector (11) for CNP9 (lighting)
   - Connector (10) for CNP8 (lighting)
   - Connector (9) for CNP7 (lighting)
   - Connector (8) for CPN6
   - Connector (7) for CPN5
   - Connector (6) for CPN4
   - Connector (5) for CPN3
   - Connector (4) for CPN2
   - Connector (3) for CPN1

   ★ After inserting the connectors, apply the connector lock securely. Assemble so that there is no strain on the wires.



3. **Covers.**
   Install covers (1) and (2) of the monitoring system.

   - Connect cable to the negative (-) terminal of the battery.

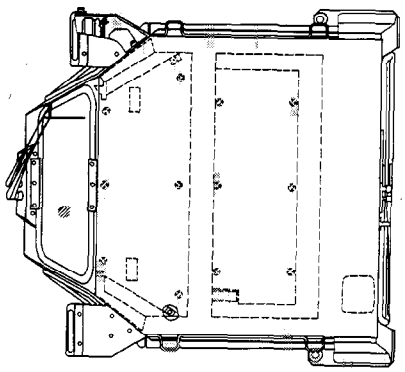


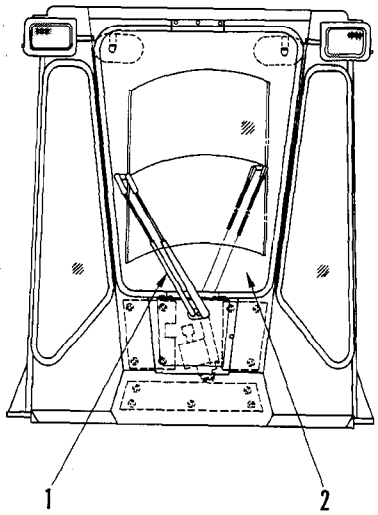
OTHER
91 STRUCTURE AND FUNCTION

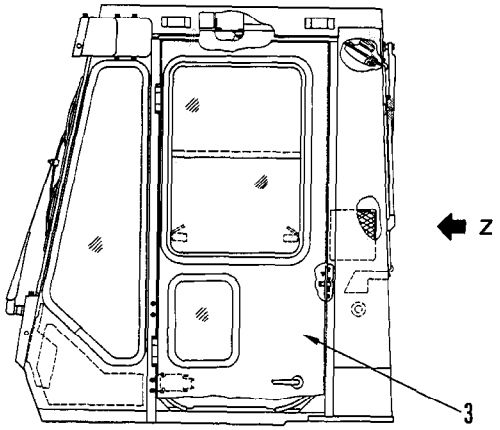
CAB 2

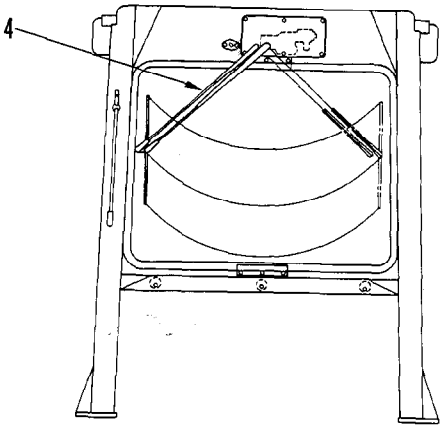
AIR CONDITIONER 4
PIPING, ENGINE TO HEATER CORE 4
PIPING, CONDENSER AND COMPRESSOR 5
ELECTRICAL DIAGRAM 6
AIR CONDITIONER UNIT 7
HEATING 7
COOLING 7
AIR CONDITIONER COMPRESSOR 8
AIR CONDITIONER CONDENSER 8
AIR CONDITIONER DRY RESERVOIR 9

CAB









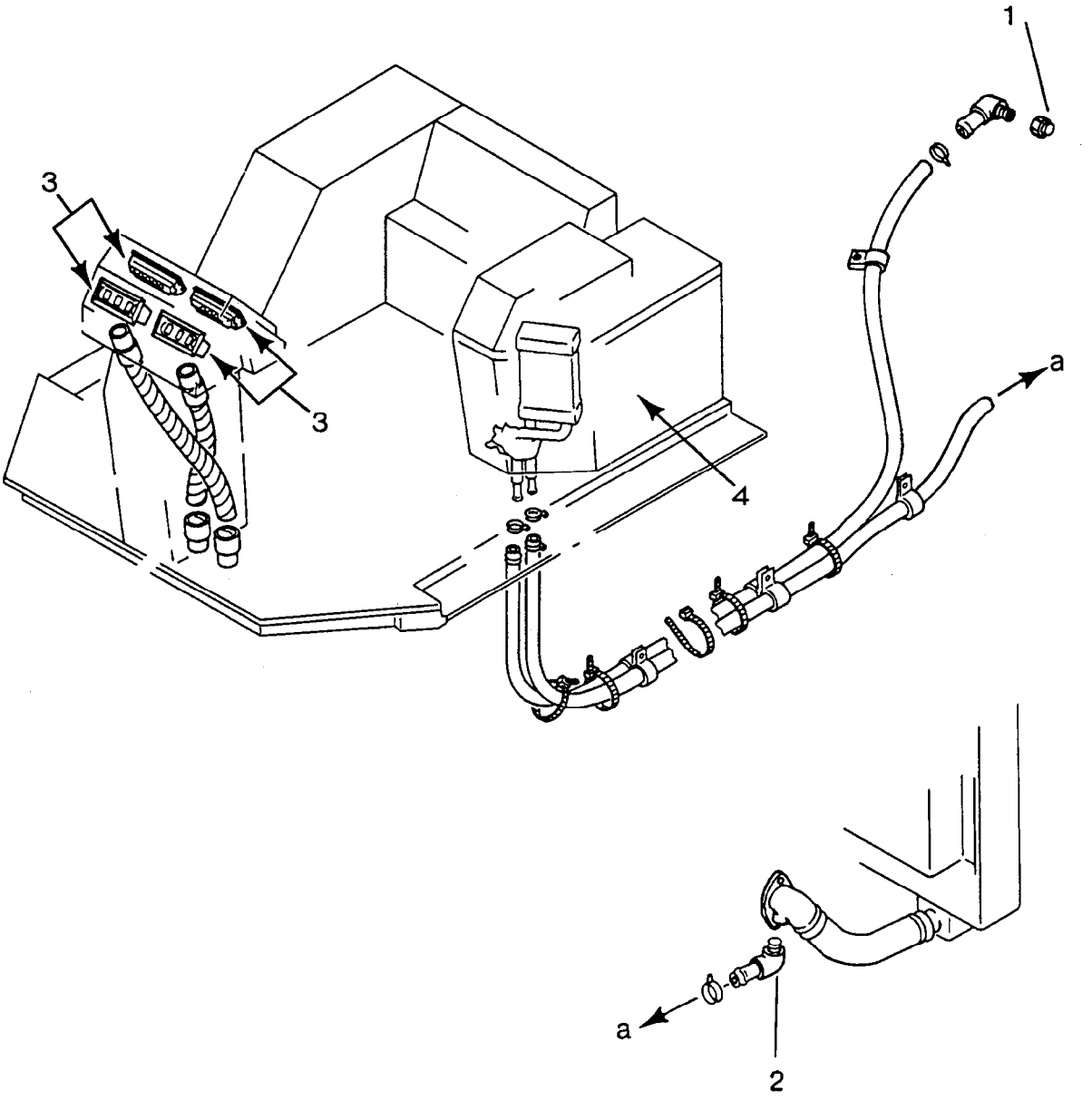
1. Front wiper
2. Front glass
3. Door
4. Rear wiper

418F079

MEMO

AIR CONDITIONER

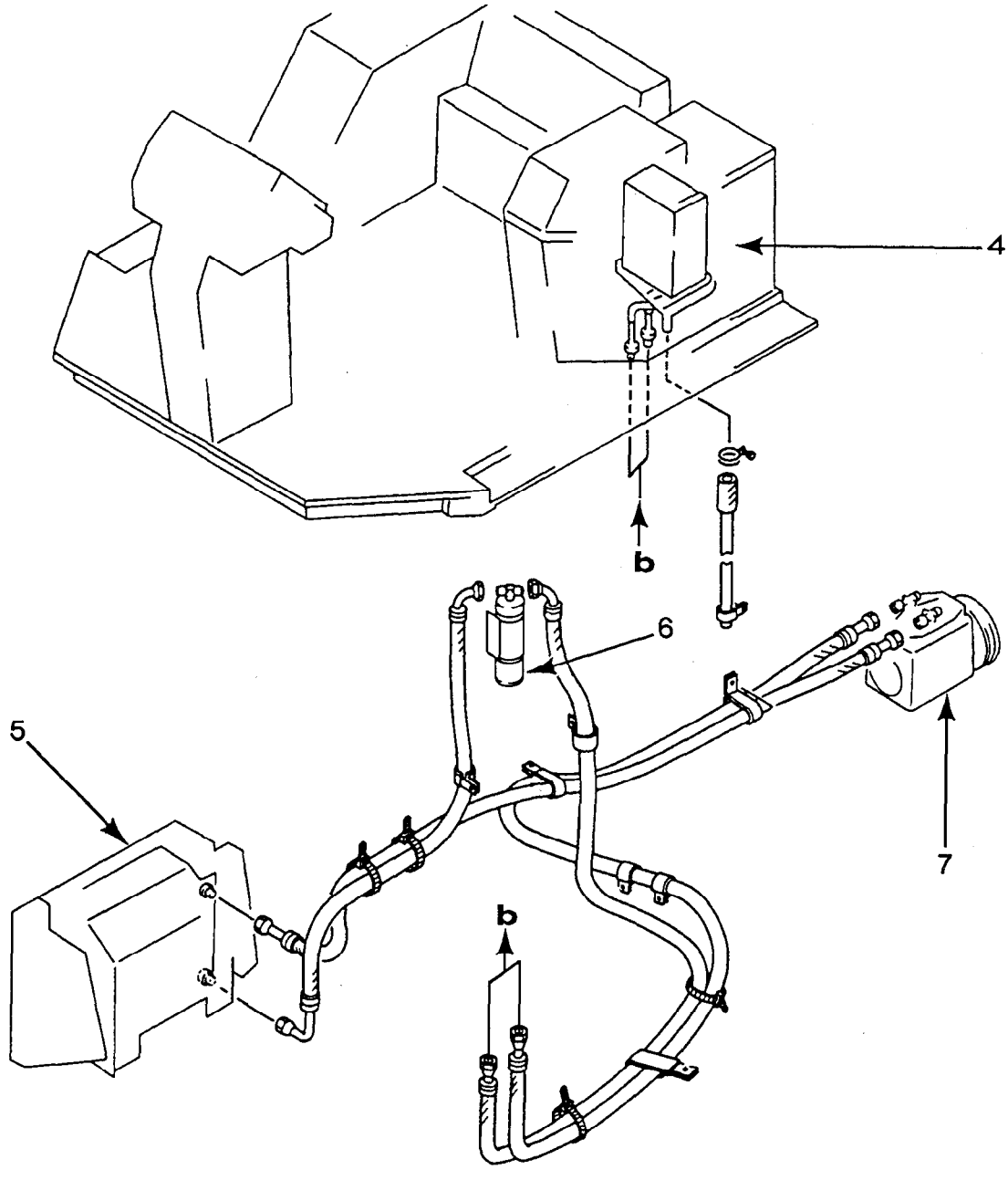
PIPING, ENGINE TO HEATER CORE



L13ED011

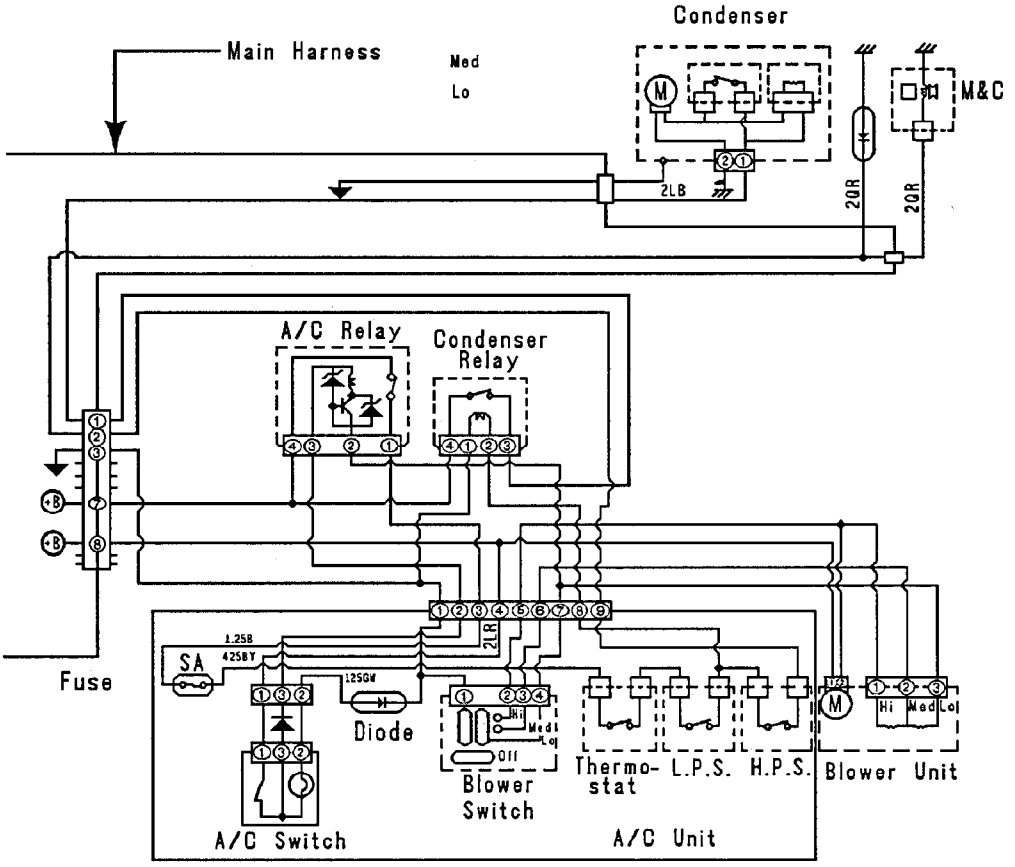
1. Hot water inlet port
2. Hot water outlet port
3. Air vent
4. Air conditioner and heater unit
5. Air conditioner condenser
6. Dry reservoir
7. Compressor

PIPING, CONDENSER AND COMPRESSOR



L13ED012

ELECTRICAL DIAGRAM



L08AD099

AIR CONDITIONER UNIT

FUNCTION

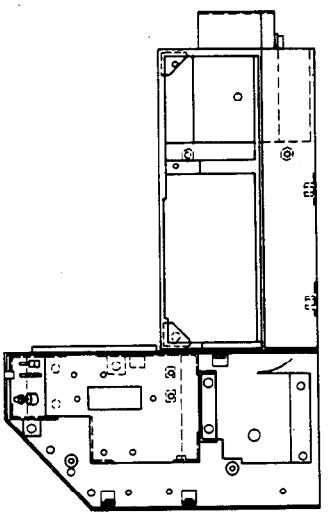
- The air conditioner acts to reduce operator fatigue by providing the operator with comfortable operating environment.

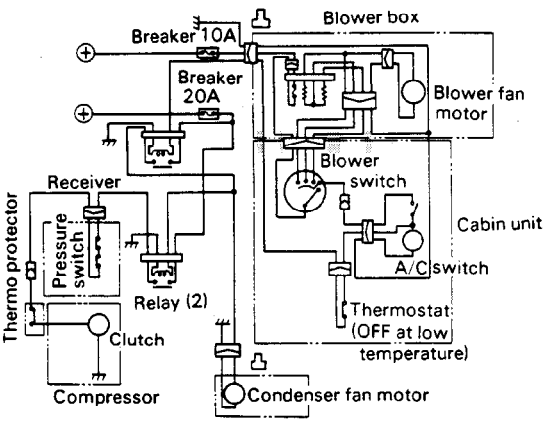
HEATING

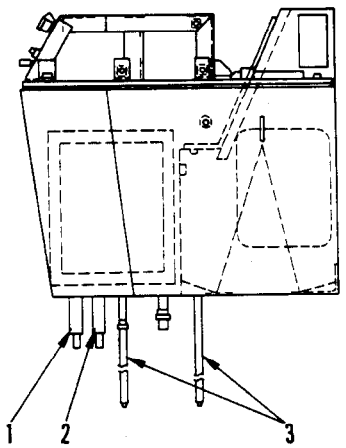
- The heating system uses the engine cooling water. Hot water enters the air conditioner unit from hot water outlet port (2). A fan blows hot air out. The temperature of the cooling water goes down, it returns to inlet port (1) and then flows back to the engine cooling circuit.

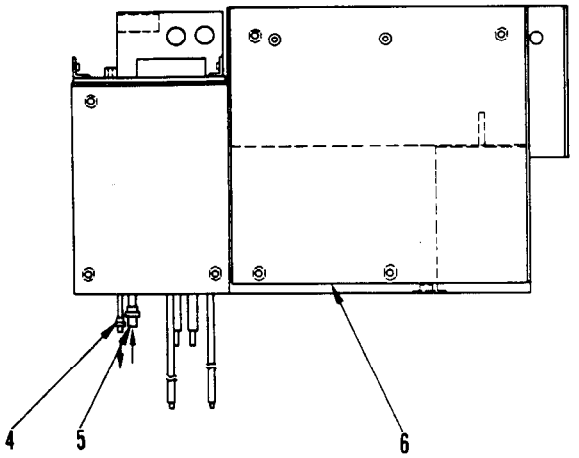
COOLING

- The refrigerant gas is compressed and pressurized in the air conditioner compressor. It then enters the air conditioner condenser where it is cooled, and goes to the air conditioner unit. The fan blows out cold air, the temperature of the refrigerant gas raises and it returns to the compressor.





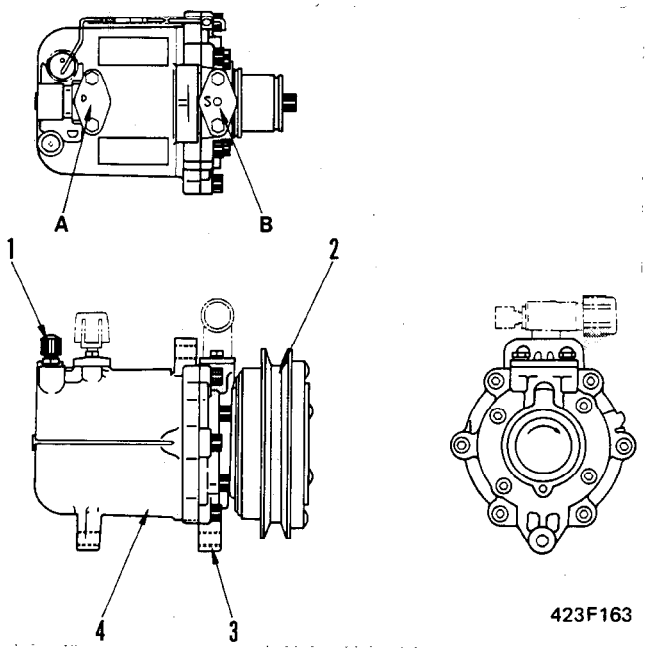




419F116

1. Hot water inlet port
2. Hot water outlet port
3. Condensation drain port
4. Refrigerant gas outlet port
5. Refrigerant gas inlet port
6. Blower box

AIR CONDITIONER COMPRESSOR

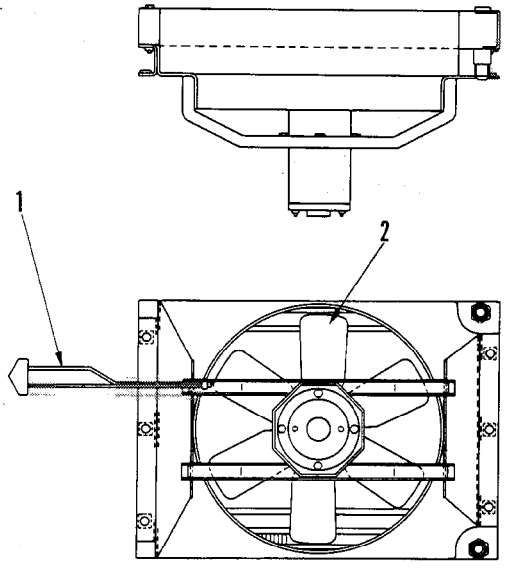


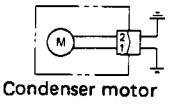
423F163

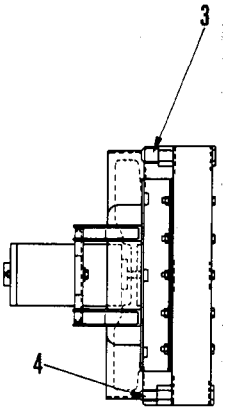
1. Charging valve
2. Clutch
3. Front head
4. Case

A. Air outlet port
B. Air inlet port

AIR CONDITIONER CONDENSER



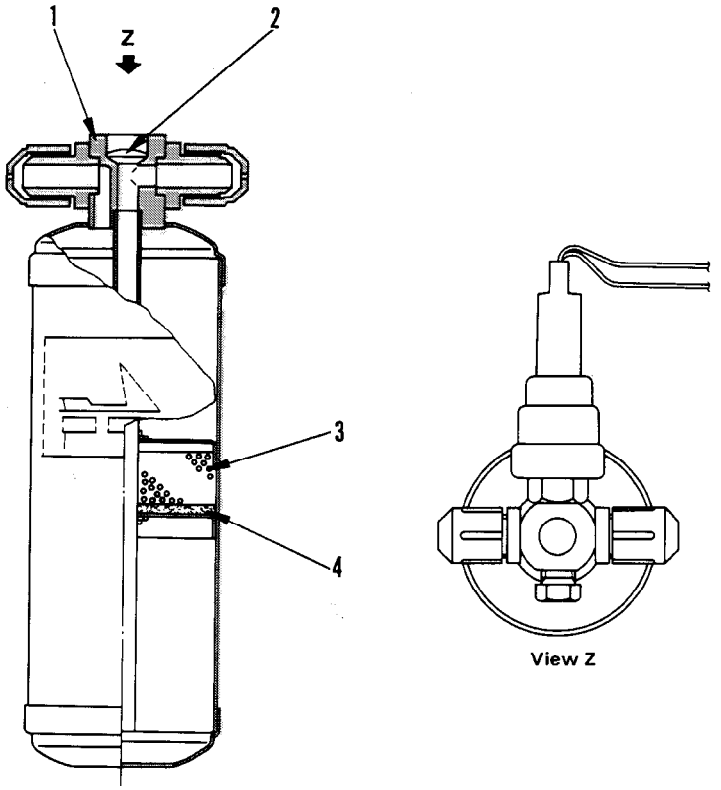




423F162

1. Electrical wiring
2. Fan
3. Refrigerant gas inlet port
4. Refrigerant gas outlet port

AIR CONDITIONER DRY RESERVOIR



423F164

1. Body
2. Sight glass
3. Drier
4. Filter

MEMO

OTHER

93 DISASSEMBLY AND ASSEMBLY

CAB 2
REMOVAL 2
INSTALLATION 3

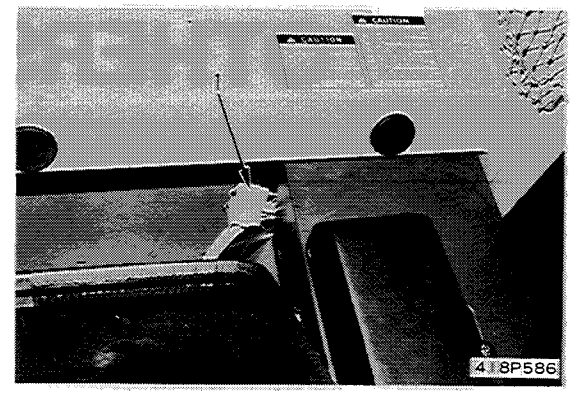
AIR CONDITIONER UNIT 4
REMOVAL 4
INSTALLATION 6

CONDENSER (AIR CONDITIONER) 8
REMOVAL 8
INSTALLATION 8

DRY RECEIVER (AIR CONDITIONER) 9
REMOVAL 9
INSTALLATION 9

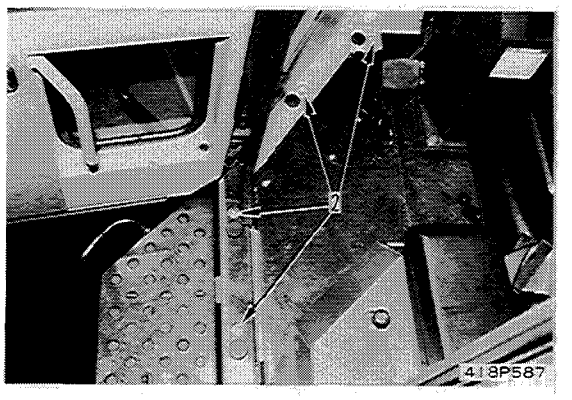
COMPRESSOR (AIR CONDITIONER) 10
REMOVAL 10
INSTALLATION 10

CAB
REMOVAL

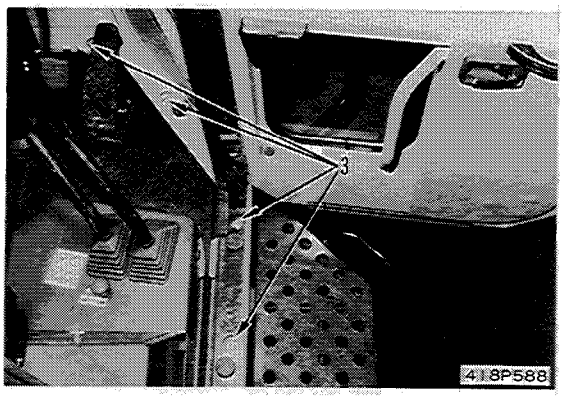


⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

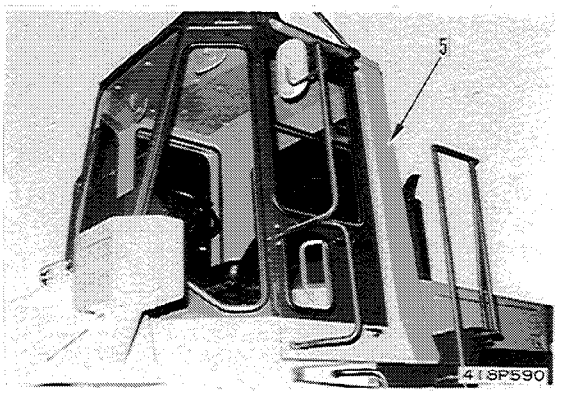
1. **Electrical wiring**
   Disconnect electric wiring connector (1).

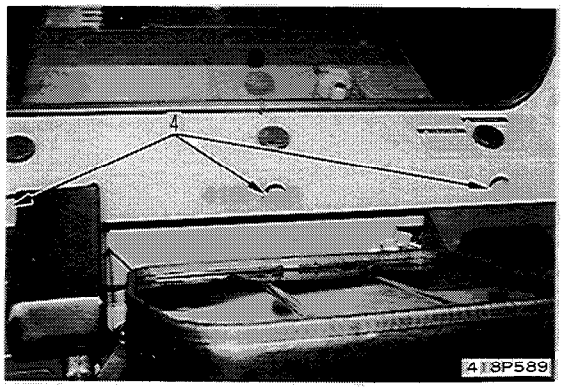


2. **Cab**
   1) Raise floor mat, remove caps, then remove mounting bolts (2), (3), and (4).
   2) Lift off cab (5).
      ★ Lift the cab off slowly and horizontally.



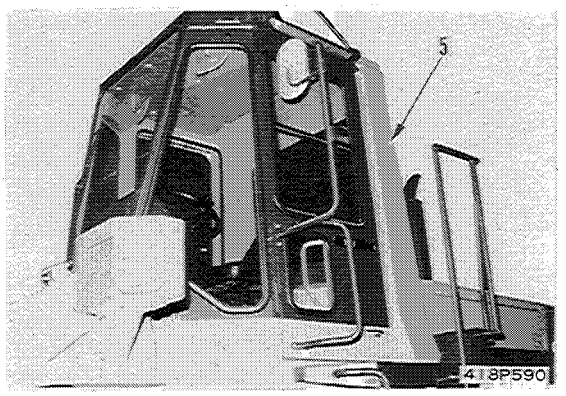
kg Cab: 310kg.



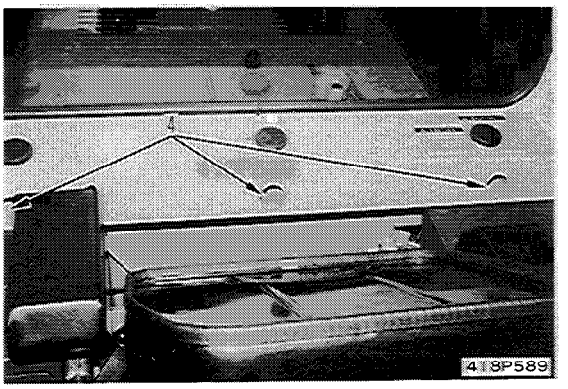


INSTALLATION

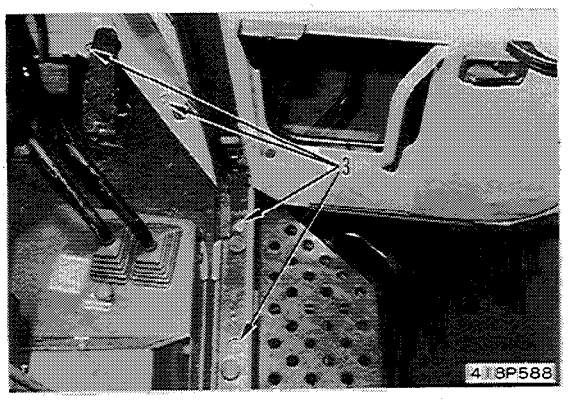
1. **Cab**
   1) Raise cab (5) and set in mounting position.
      ★ Coat all seals evenly with gasket sealant.

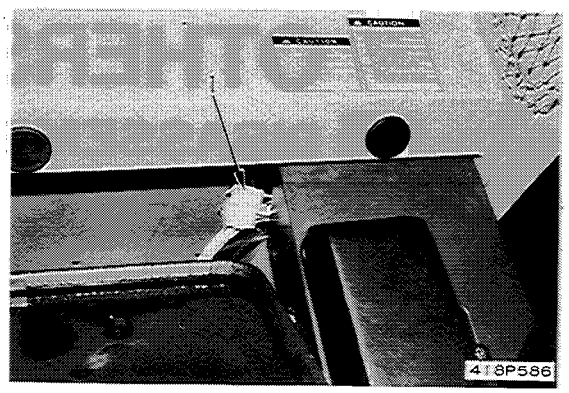


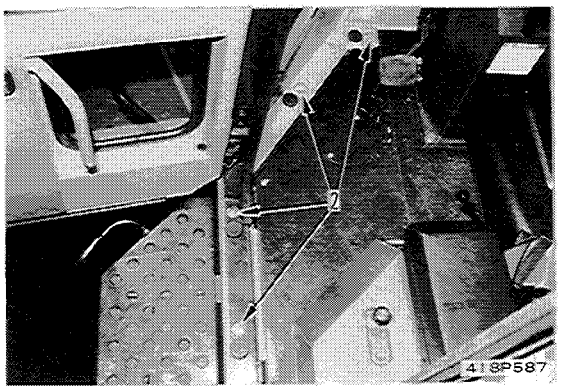
   2) Tighten mounting bolts (4), (3), and (2), install caps and return floor mat to original position.



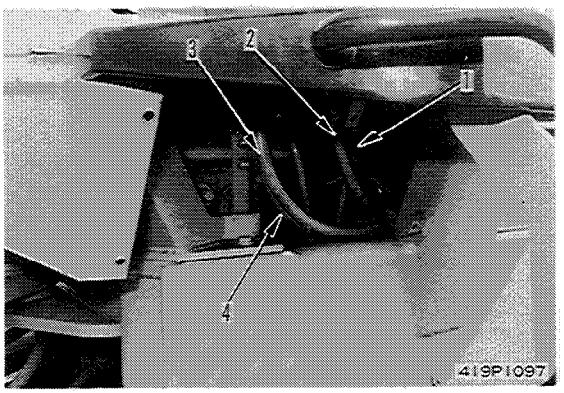
2. **Electrical wiring.**
   1) Connect electric wiring connector (1).







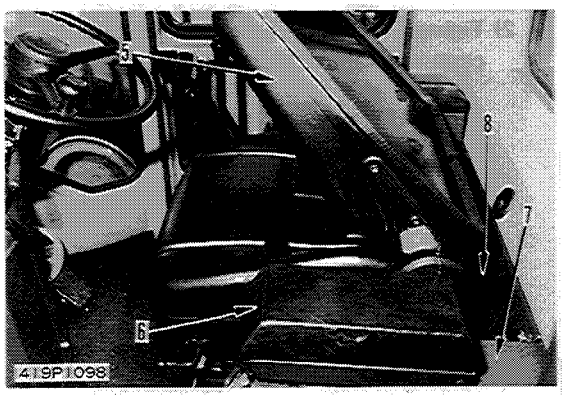
AIR CONDITIONER UNIT REMOVAL



⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and place blocks under the wheels to prevent the machine from moving.

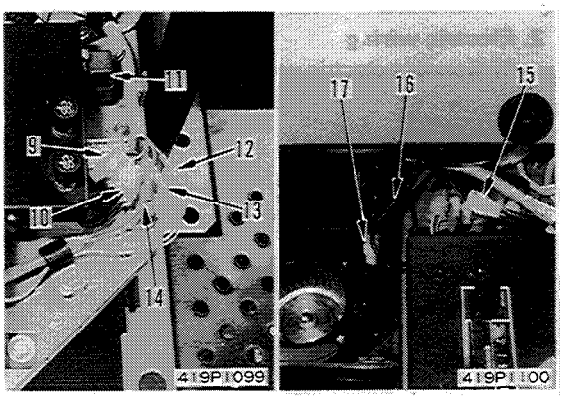
- Disconnect the lead from the (-) battery terminal.
- Loosen air conditioner hoses (1) and (2), then drain the gas from the air conditioner.

  ★ When draining the refrigerant, **DO NOT** completely disconnect the hoses. Loosen them slightly.



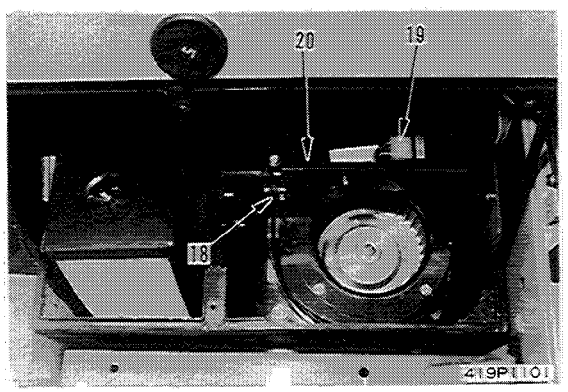
1. **Air conditioner - Heater hoses**
   1) Disconnect air conditioner hoses (1) and (2) from the bottom of the air conditioner unit.
      ★ After disconnecting the air conditioner hoses, cover the openings to prevent dirt and water from entering.
   2) Loosen clamps heater hoses (3) and (4), then disconnect the hoses.

2. **Operator's seat**
   Remove the operator's seat.
   kg Operator's seat: 40kg.



3. **Arm rest, covers**
   Remove arm rest (6), then remove covers (7) and (8).

4. **Electrical wiring**
   Disconnect the following wiring from the connectors.
   - Wiper wiring (9) and (10).
   - Air conditioner relay wiring (11).
     ★ After disconnecting the connectors, disconnect the clamps.
   - Radio wiring (12), (13), and (14).
   - Air conditioner unit wiring (15).
   - Radio antenna wiring (16).
   - Air blower wiring (17).

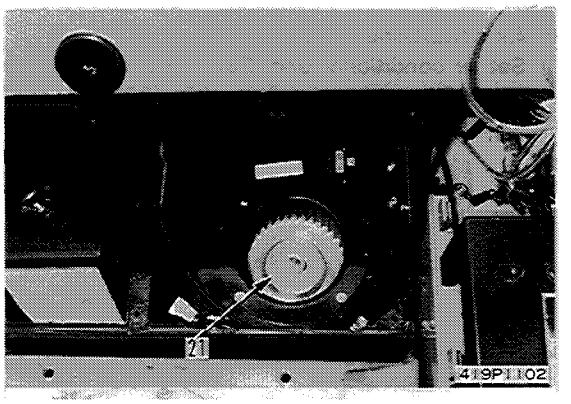


5. **Air duct**
   Disconnect clamp (18) of cable, and connector (19) of blower wiring, then remove air duct (20).

6. Air blower

Remove mounting bolts, then remove air blower (21).

★ Be careful not to damage the seal at the contact face between the air blower and the air conditioner unit.



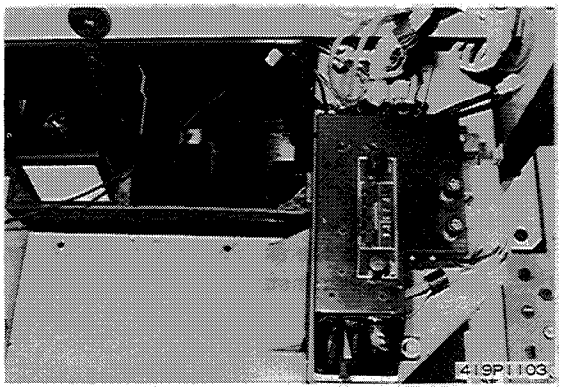
7. Air conditioner unit

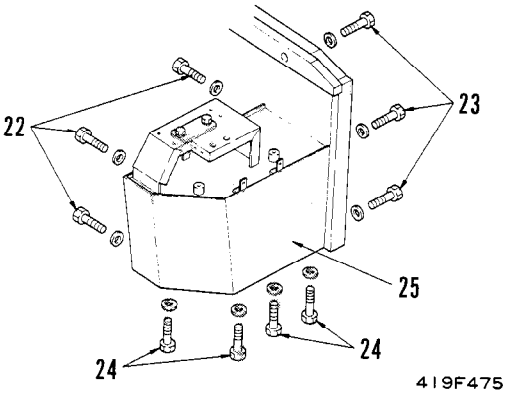
Remove mounting bolts (22), (23), and (24), then remove air conditioner unit (25).

★ Move the air conditioner unit outside the cab, then lift off.

★ Be careful not to damage the connector of the air conditioner hoses.

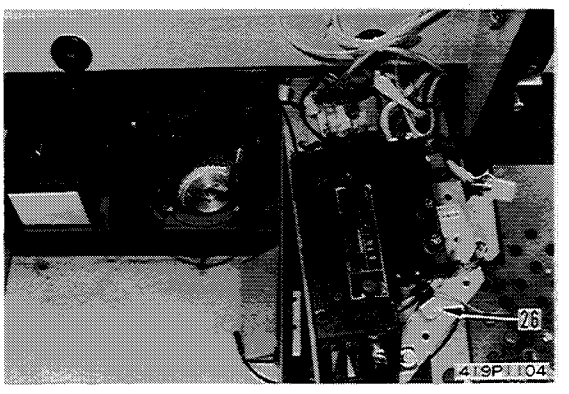
kg Air conditioner unit: 80kg.





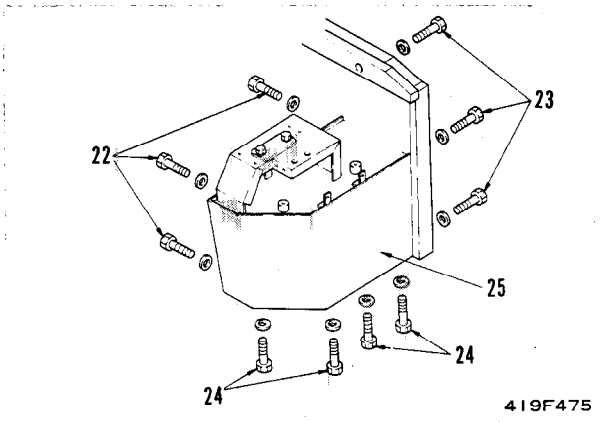
★ When repairing the inside of the air conditioner unit, follow steps 1 - 4, then remove cover (26).

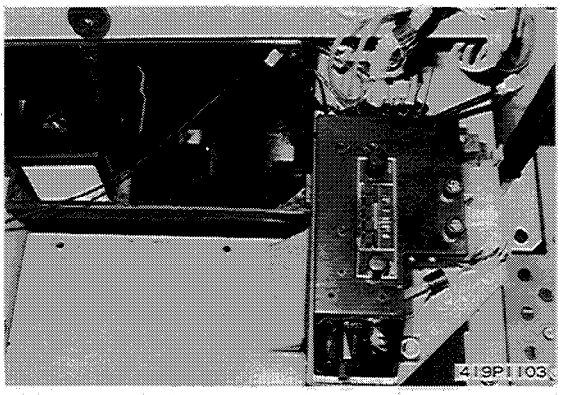
- When removing the cover, disconnect the connectors of the air conditioner wiring and the temperature regulator cable, then remove the cover.



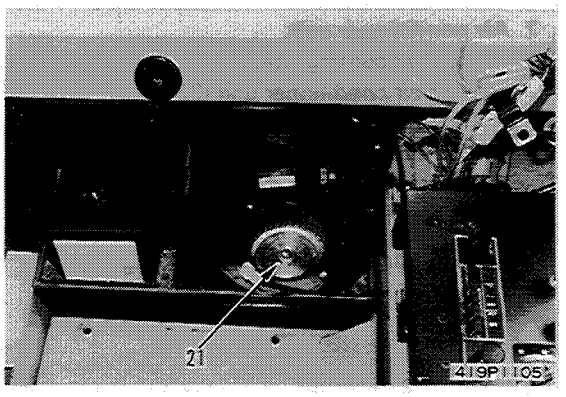
INSTALLATION

1. **Air conditioner unit**
   Set air conditioner unit (25) in mounting position, then tighten mounting bolts (22), (23), and (24).

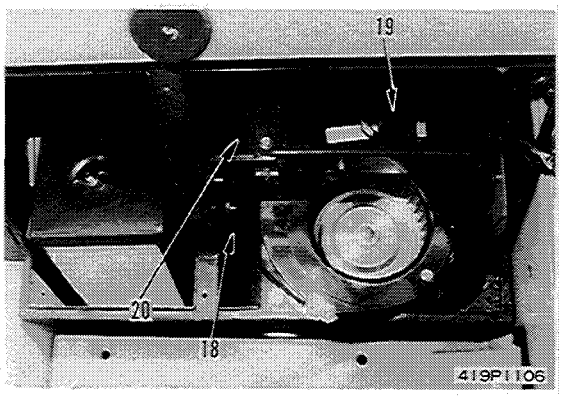




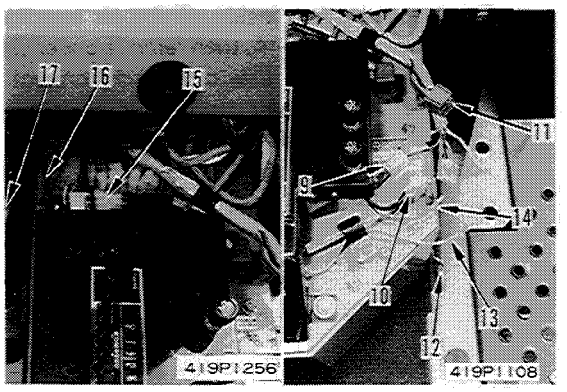
2. **Air blower**
   Set air blower (21) in mounting positioner, then tighten the mounting bolts.
   ★ Be careful not to damage the seal at the contact face between the air blower and the air conditioner unit when installing.



3. **Air duct**
   Set air duct (20) in mounting position, then connect clamp (18) of cable and connector (19) of blower wiring.



4. **Electrical wiring**
   Connect the following wiring to the connectors.
   - Air blower wiring (17).
   - Radio antenna wiring (16).
   - Radio wiring (14).
   - Air conditioner unit wiring (15).
   - Air conditioner relay wiring (11).
     ★ After connecting the connectors, install the clamps.
   - Wiper wiring (9) and (10).



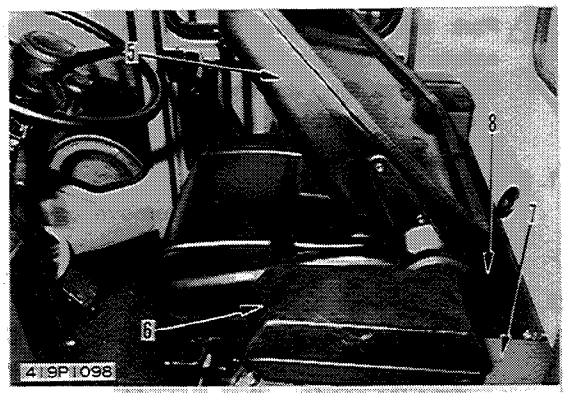
5. Arm rest, covers
Install covers (7) and (8), then install arm rest (6).

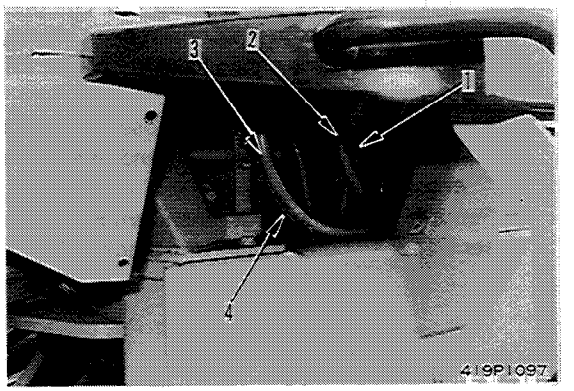
6. Operator's seat
Install operator's seat (5).

7. Air conditioner - Heater hoses
1) Connect heater hoses (3) and (4), then tighten clamps.
2) Connect air conditioner hoses (1) and (2) to bottom of air conditioner unit.
   ★ To prevent dirt and water from entering the hoses, do not remove the covers until just before installing.
   ★ To prevent hoses from twisting, hold them securely with a wrench and tighten.

Hose connector, flare: Compressor oil

Hose nut (1): 7.0±1.0kgm
Hose nut (2): 3.7±0.4kgm





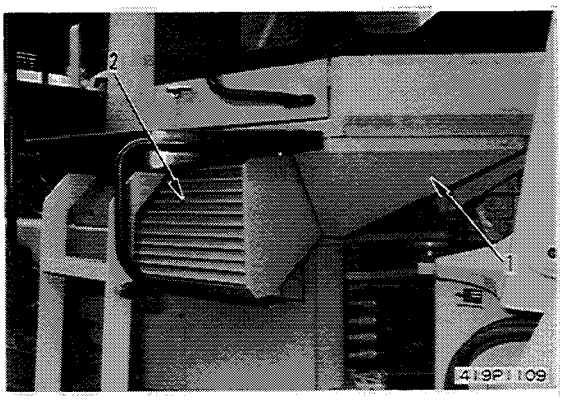
8. Refilling with refrigerant
Fill air conditioner with refrigerant.
- Connect cable to negative (-) terminal of battery.

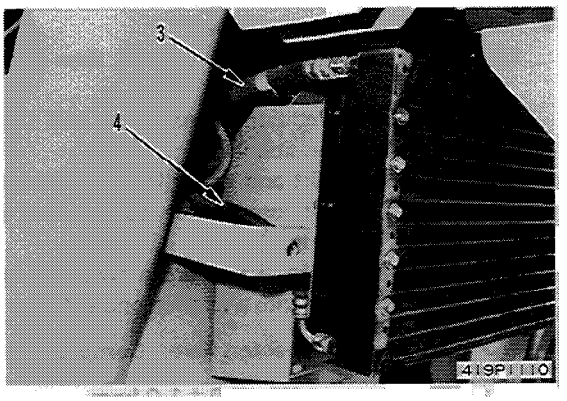
CONDENSER (AIR CONDITIONER) REMOVAL

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and place blocks under the wheels to prevent the machine from moving.

1. **Cover**
   Remove mounting bolts, then remove cover (1) under the cab.

2. **Condenser for air conditioner**
   1) Remove mounting bolts, then remove cover (2).
      ★ Loosen air conditioner hoses (3) and (4), and drain the refrigerant from the air conditioner.
      ★ When draining the refrigerant, do not completely disconnect the hoses. Loosen them slightly.
   2) Disconnect electric wiring from connector (5).
   3) Disconnect hoses (3) and (4).
      ★ After disconnecting the hoses, cover the openings to prevent dirt and water from entering.
   4) Remove mounting bolts, then remove condenser (7) for air conditioner from bracket (6).





INSTALLATION

1. **Condenser for air conditioner**
   1) Set condenser (7) of air conditioner in mounting position, then tighten the mounting bolts.
   2) Connect hoses (3) and (4).
      ★ To prevent dirt and water from entering the hoses, do not remove the covers until just before installing.
      ★ To prevent the hoses from twisting, hold them securely with a wrench when tightening.

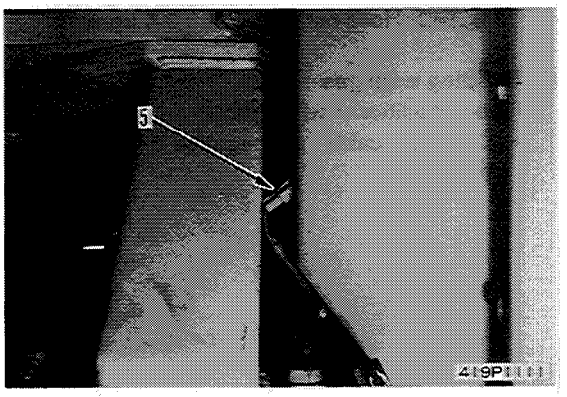
      Hose connector, flare: Compressor oil

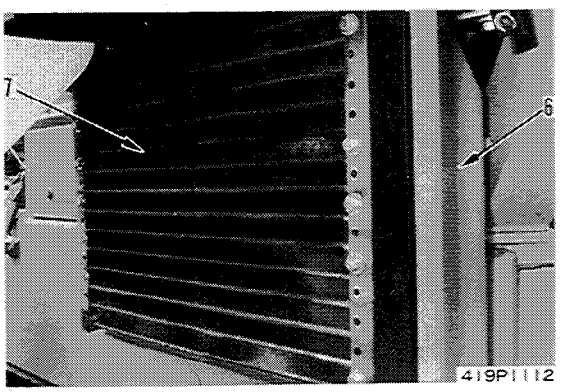
      Hose nut (3): 5.6±0.6kgm
      Hose nut (4): 3.7±0.4kgm

   3) Connect electric wiring at connector (5).
   4) Set cover (2) in mounting position, then tighten the mounting bolts.

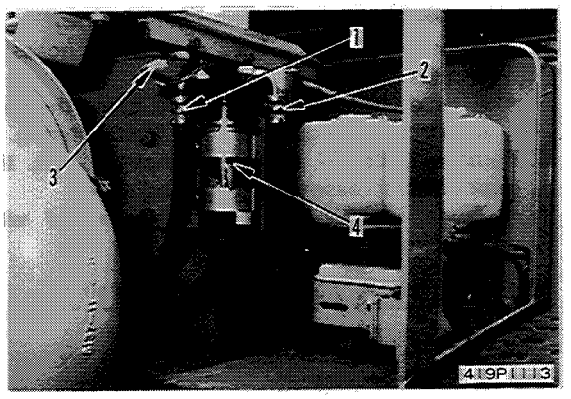
2. **Cover**
   Set cover (1) in mounting position, then tighten the mounting bolts.

3. **Refill air conditioner with refrigerant**





DRY RECEIVER (AIR CONDITIONER) REMOVAL



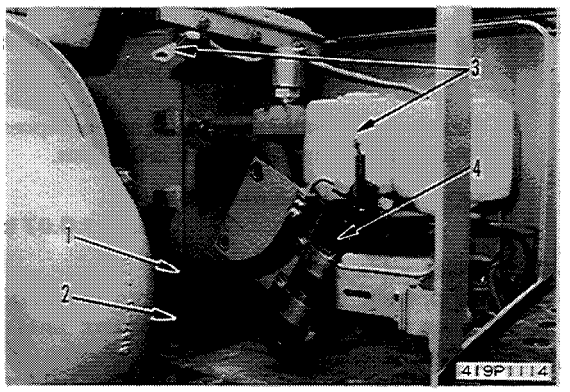
⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and place blocks under the wheels to prevent the machine from moving.

⚠ Open the engine hood and lock it.

- Loosen air conditioner hoses (1) and (2), and drain the refrigerant from the air conditioner.
  - ★ When draining the refrigerant, do not completely disconnect the hoses. Loosen them slightly.

1. Disconnect electric wiring from connector (3).
2. Disconnect hoses (1) and (2).
   - ★ After disconnecting the hoses, cover the openings to prevent dirt and water from entering.
3. Remove mounting bolts, remove dry receiver (4) from plate, and then remove the dry receiver.

INSTALLATION



1. Install dry receiver (4) on plate with clamp, set in mounting position, the tighten the mounting bolts.
2. Connect hoses (1) and (2).
   - ★ To prevent dirt and water from entering the hoses, do not remove the covers until just before installing.
   - ★ To prevent the hoses from twisting, hold them securely with a wrench when tightening.

   Hose connector, flare: Compressor oil

   Hose nut: 3.7±0.4kgm

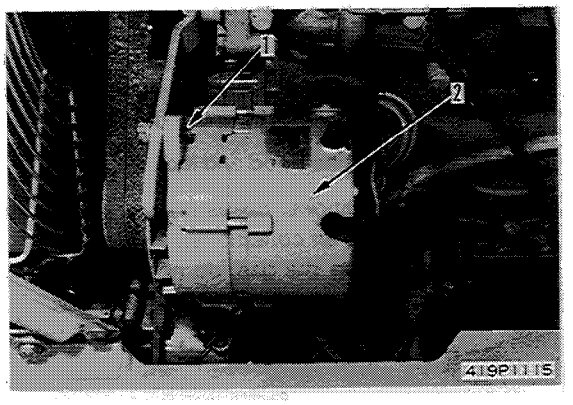
3. Connect electric wiring at connector (3).
4. Fill air conditioner with refrigerant.

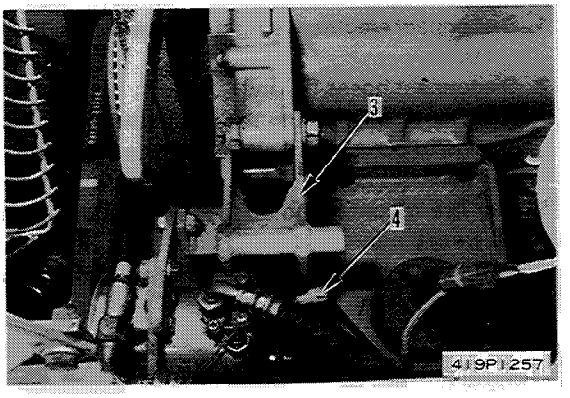
COMPRESSOR (AIR CONDITIONER) REMOVAL

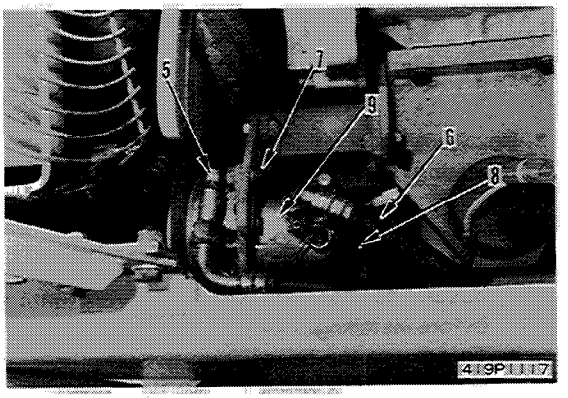
⚠ Open the engine hood and lock it.

⚠ Disconnect the lead from the negative (-) battery terminal.

1. Remove bolt (1) and V-belt, then remove the alternator (2).
   ★ To remove the alternator without removing the wiring, locate the clamps so that there is no strain on the wiring.
2. Remove bracket (3) of the alternator.
4. Loosen hoses (5) and (6), and drain refrigerant from the air conditioner.
   ★ When draining the refrigerant, do not completely disconnect the hoses. loosen them slightly.
   ★ After draining refrigerant, disconnect hoses (5) and (6).
   ★ After disconnecting the hoses, cover the openings to prevent dirt and water from entering.
5. Remove bolts (7) and (8), remove V-belt, then remove compressor (9) of air conditioner.
   ★ There is little space, so be careful when working.





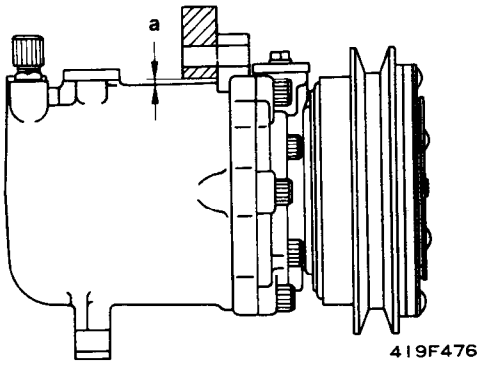


INSTALLATION

1. Set compressor (9) of air conditioner in mounting position, fit V-belt, then secure with bolts (7) and (8).
   ★ Clearance "a" = Within 0.6mm.
   Bracket mounting bolts: 0.45±0.07kgm

2. Connect hoses (5) and (6).
   ★ To prevent dirt and water from entering hoses, do not remove covers until just before installing.
   ★ to prevent the hoses from twisting, hold them securely with a wrench when tightening.
   Hose connector thread, flare: Compressor oil
   Hose nut (5): 7.0±0.7kgm
   Hose nut (6): 5.6±0.6kgm

3. Connect electric wiring at connector (4).
4. Set alternator (2) in mounting position, fit V-belt, then tighten bolt (1).
   ★ Refer to the "ENGINE SHOP MANUAL" for belt installation.
5. Fill air conditioner with refrigerant.



GEAR PUMP

97 SA SERIES

GENERAL 2
PRINCIPLE OF OPERATION 3
PRESSURE LOADED TYPE GEAR PUMP 6
FIXED SIDE PLATE TYPE GEAR PUMP 8

SA SERIES 9
STRUCTURE 9
TESTING AND ADJUSTING 13
DISASSEMBLY 16
ASSEMBLY 20
MAINTENANCE STANDARD 25

GENERAL

The hydraulic pump is a device which receives mechanical energy from a prime mover such as an engine, converts the energy into fluid energy, and functions as the source of energy in a hydraulic system.

The fluid energy can be divided into the energy of velocity, pressure, and potential. Almost all of the fluid energy used for hydraulic pressure is pressure energy.

The hydraulic pump receives and transmits the energy through the static pressure of a fluid, and easily produces a high pressure since its delivery is determined by the transfer of volumetric displacement enclosed by the fixed walls. Therefore, the pump delivery is not changed significantly with variations in the load.

It follows that the pump itself is a device which makes the oil flow, rather than a device to produce pressure. The pump pressure is generated by the resistance (the load) against the oil flow. Therefore, when there is no resistance, no pressure is produced.

Structurally, hydraulic pumps can be broadly classified into rotary pumps and reciprocating pumps. Functionally, They can be classified into fixed displacement pumps and variable displacement pumps.

The hydraulic pumps used in construction machinery are external gear pumps and are classified as fixed displacement rotary pumps.

External gear pumps employ involute spur gears, and can be structurally classified into the following types.

- Type of side plate adjustment
  - Fixed side plate type (FAL, FAR, GAL, GAR)
  - Pressure loaded type (PAL, PAR, KAL, KAR)
  - Pressure plate type
- Type of bearing
  - Ball or roller bearing type
  - Plain bearing type

Gear pumps installed on installed on the machines are called standard pumps. They are designed as follows:

"PAL 160"

PAL 160							
P=		A=		L=		160=	
S:	For high pressure: 210 kg/cm-², pressure loaded type	A:	Flange type mount section	L:	Counter-clockwise rotation	Theoretical pump delivery at 1,000 rpm (liters/min)	
K:	For high pressure: 175 kg/cm-², (210 kg/cm² for some pumps) pressure loaded type	B:	Foot type mount section	R:	Clockwise rotation		
P:	For medium pressure: 140 kg/cm² (155 kg/cm² for some pumps) pressure loaded type						
C:	For medium pressure: 125 kg/-cm², fixed side plate type						
F:	For low pressure: 30 kg/cm², fixed side plate type						

PRINCIPLE OF OPERATION

- MECHANISM FOR DELIVERING OIL

The drawing at right shows the operational principle of an external gear pump in which two gears are rotating in mesh.

The oil entering through the suction port is trapped in the space between two gear teeth, and is delivered to the discharge port as the gear rotates.

Except for the oil at the bottom of the gear teeth, the oil trapped between the gear teeth is prevented from returning to the suction side with the gears in mesh.

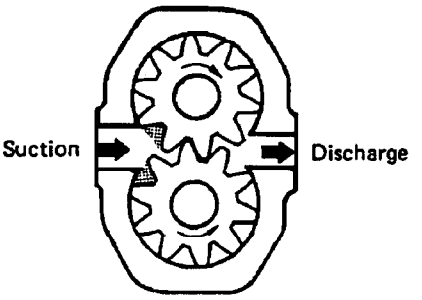
Since the gears are constantly delivering oil, the oil delivered to the discharge port is forced out of the port.

The amount of discharge increases with the speed of rotation of the gear.

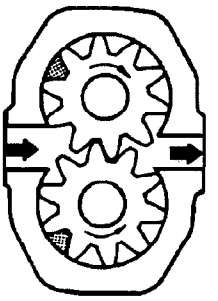
If there is no resistance in the oil passage into which the discharged oil flows, the oil merely flows through the passage, producing no increase in pressure.

If, however, the oil passage is blocked with some thing like a hydraulic cylinder, there will be no other place for the oil to flow, so the oil pressure will rise. But the pressure which rises in this way will never go higher, once the hydraulic cylinder piston starts moving because of the oil pressure.

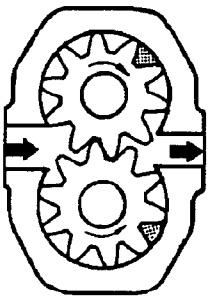
As described earlier, the pump produces the oil flow, but not the oil pressure. We can therefore conclude that pressure is a consequence of load. In other words, the pressure depends on a counterpart.



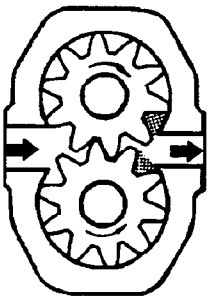
230F137



230F138



230F139



230F140

- INTERNAL OIL LEAKAGE

  Oil leaks from a place under higher pressure to a place under lower pressure, provided that a gap or a clearance exists in between.

  In the gear pump, small clearances are provided between the gear and the case and between the gear and the side plate to allow the oil to leak out and to serve as a lubricant so that the pump will be protected from seizure and binding.

  The drawing at right shows how the leaked oil flows in the pump. As such, there is always oil leakage in the pump from the discharge side (under higher pressure) to the suction side. The delivery of the pump is reduced by an amount equal to the pump discharge.

  In addition, the delivery of the pump will also decrease as the amount of oil leakage increases because of expanded radial clearance resulting from the wear of pump parts, the lower oil viscosity resulting from increases in the oil temperature, and the initial use of low viscosity oil.

- FORCES ACTING ON THE GEAR

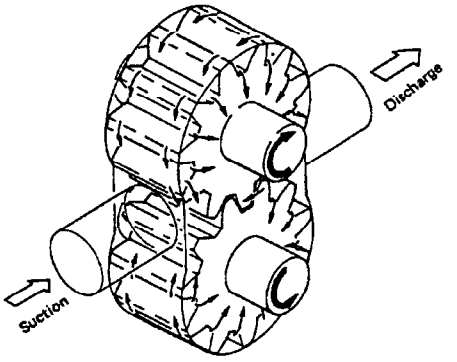
  The gear, whose outer surface is subjected to oil pressure, receives forces pointing towards its center.

  Due to the action of the delivery pressure, the oil pressure is higher on the delivery side of the pump, and due to suction pressure, is lower on the suction side. In the intermediate section, the pressure will gradually lower as the position moves from the delivery side to the suction side. This phenomenon is shown in the drawing at right.

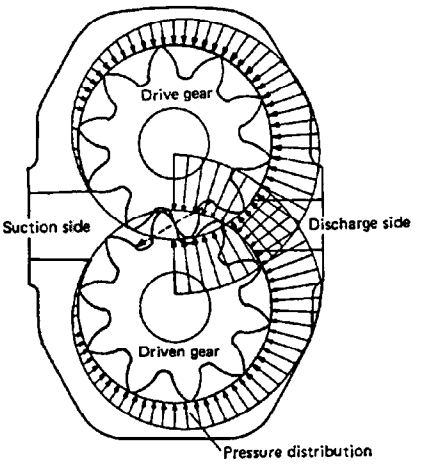
  In addition, the gears in mesh will receive interacting forces.

  These forces pushing the gears toward the suction side are received by the bearings. Since the gears are pressed toward the suction side by theses forces, the radial clearance becomes smaller on the suction side in the case. In some pumps (PAL, PAR, KAL, KAR), the clearance may become zero, thus allowing the gear teeth and the case to come into light contact.

  For this reason, an excessive increase in the delivery pressure must be avoided, since it will produce a large force which will act on the gears, placing an overload on the bearings, and resulting in a shortened service life of the bearing or interference of the gear with the case.



230F141



230F142

- "TRAPPING" PHENOMENON OF THE OIL

When a gear pump is rotating with the gears in mesh as shown in the drawing at right, in some instances two sets of gear teeth are in mesh while in other instances only one set of the gear teeth is in mesh.

When two sets of the teeth are in mesh simultaneously, the oil in the space between the meshed gear teeth will be trapped inside - the front and rear exits will be completely shut.

This is called the "trapping" phenomenon of oil.

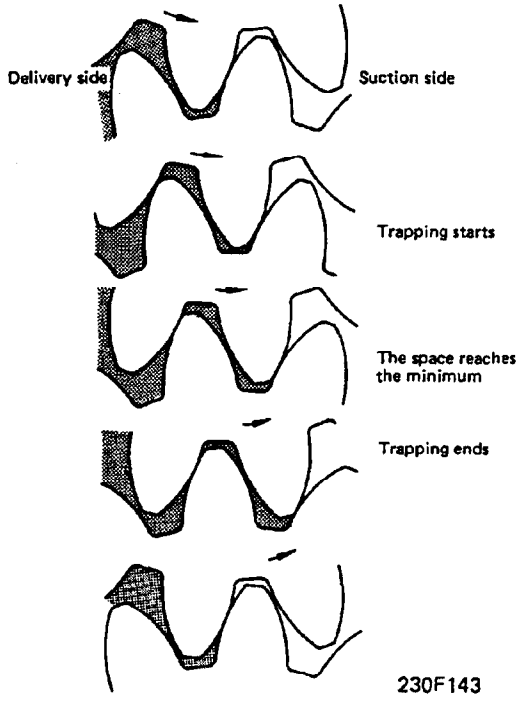
The space in which the oil is trapped moves from the suction side to the delivery side as the gears rotate. The volume of the space gradually decreases from the start of trapping until the space reaches the center section, and then gradually increases after leaving the center section until the end of trapping.

Since the oil itself is non-shrinkable, a reduction of the volume of space will greatly increase the oil pressure, unless some provision is made to relieve oil pressure. The high pressure oil will cause the pump to make noise and vibrate.

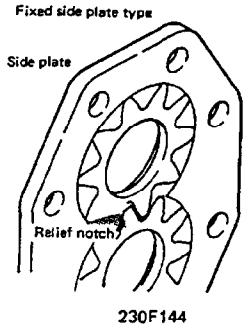
To prevent this, relief notches are provided on the side plates to release the oil to the delivery side.

As shown in the drawing below, the relief notches are provided in such a way that the oil can be relieved from the trapping space tot he delivery side when the volume of the space is reduced.

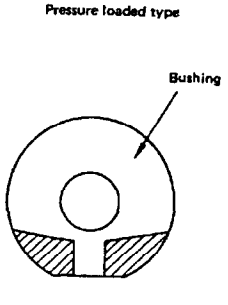
Relief notches are also provided on the suction side to prevent the formation of a vacuum in the space by allowing the oil to enter the space from the suction side when the space is expanded.



230F143

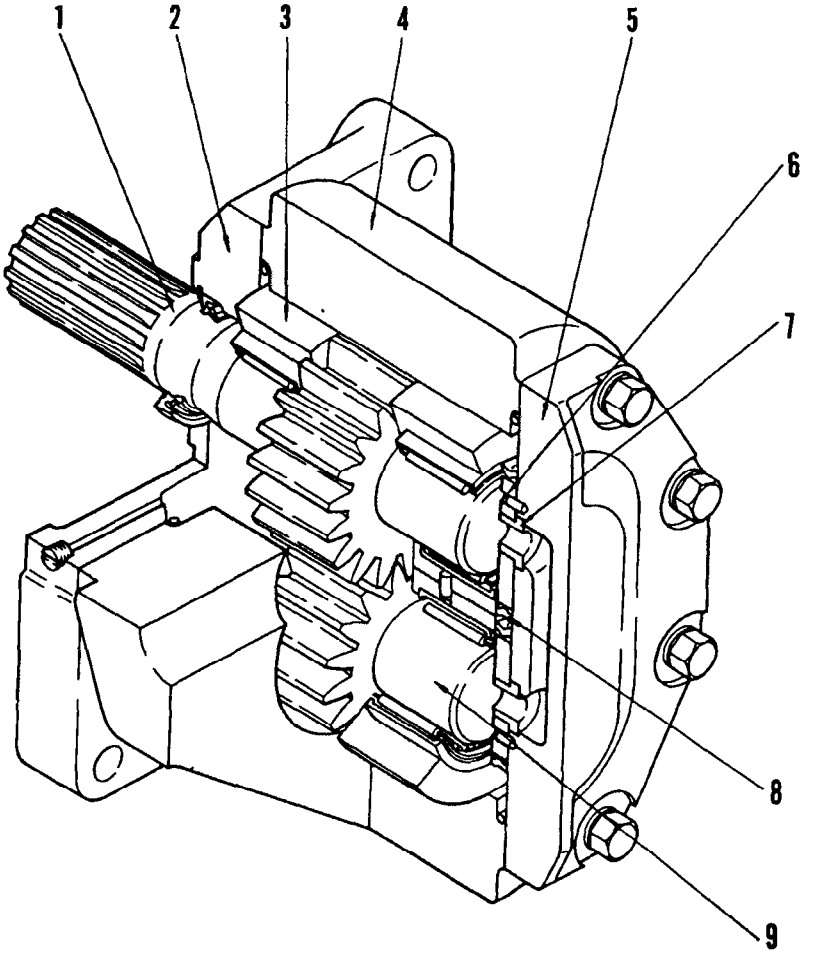


230F144



230F145

PRESSURE LOADED TYPE GEAR PUMP



230F146

GENERAL DESCRIPTION

Hydraulic pumps used for the work equipment hydraulic units on construction machinery are pressure loaded type gear pumps. Some gear pumps of this type have a maximum delivery pressure of 210 kg/cm² or higher.

The pressure loaded type gear pump is designed so that the clearance between the gear and the side plate can be automatically adjusted according to the delivery pressure. Therefore, the oil leakage from the side plate is less than in the case of the fixed side plate type under a high discharge pressure. Consequently, no significant reduction of the pump delivery occurs, even when the pump is operated under high pressure.

1. Drive gear
2. Bracket
3. Bushing
4. Gear case
5. Cover
6. Seal plate
7. Collar
8. Bach-up ring
9. Driven gear

STRUCTURE AND OPERATION

In a pressure loaded type pump, two bushings acting as side plates are inserted into the pump case, and are pressed toward the sides of the gears. The oil leakage from the gear sides is thus minimized.

Since the bushings are constantly pressed toward the gears by the oil pressure, there is no fear of an increase on oil leakage, even when the bushings are worn out and the clearances are expanded many hours of operation.

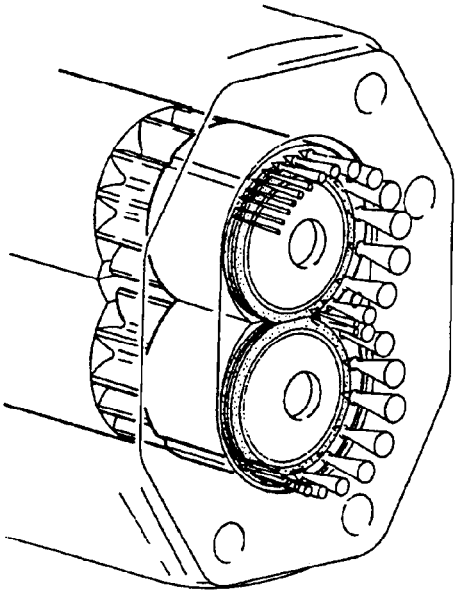
The bushings are pushed towards the gears from the cover side by the oil pressure, and they are pushed from the gear side by the pressure of oil trapped between the gear teeth and that which has leaked out from the clearance between the gear and the bushing.

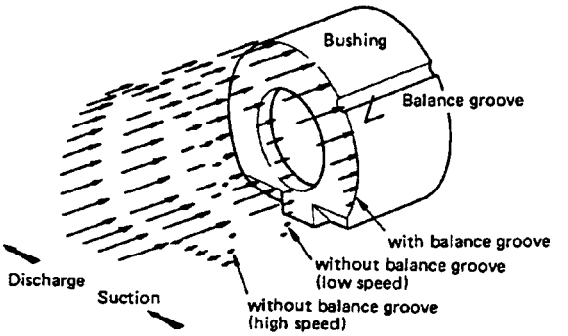
Since the oil pressure in the gears is higher on the pump delivery side and is lower on the suction side, provisions are made so that the pressing force acting on the bushings from the cover side is regulated in such a way that the delivery side is pressed harder and the suction side weaker to match the counter pressure.

More specifically, the area of the bushing on the discharge side is made larger than that on the suction side by partitioning the area of the bushing subjected to pressure on the cover side, with a back-up ring installed to the seal plate as shown in the drawing at right.

When the pump is operated at high speed, the pressure on the suction side is lowered and the distribution of pressure around the periphery of the gear will change into the state shown in the drawing at right below.

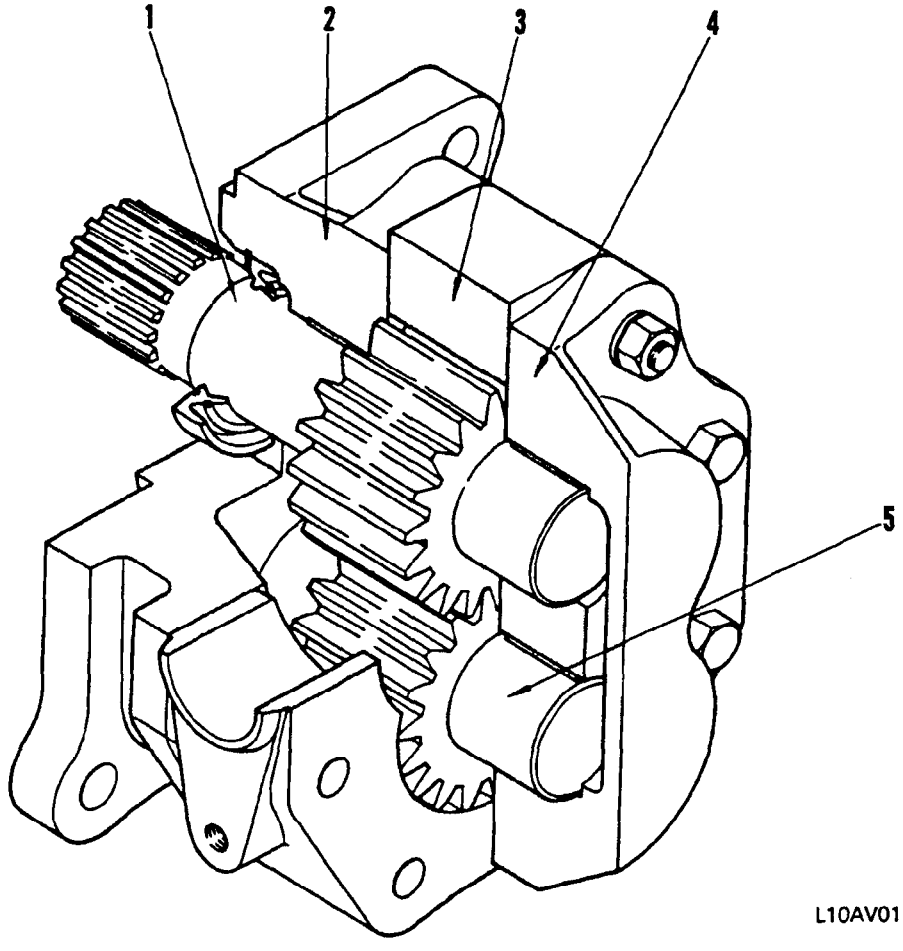
Pressure balance grooves are therefore provided on the bushings to keep the balance of the force on the cover side against the pressure acting on the bushing from the gear side that varies with the pump rotation and the pressure distribution. Thus the delivery pressure is led as shown in the drawing and the pressure distribution is stabilized at any rotational speed.





05F140

FIXED SIDE PLATE TYPE GEAR PUMP



L10AV018

1. Drive gear
2. Bracket
3. Gear case
4. Cover
5. Driven gear

GENERAL DESCRIPTION

Hydraulic pumps used for the main clutch, transmission, and steering system on bulldozers are fixed side plate type gear pumps which can be classified as follows: pumps generally called FAL or FAR pumps having a maximum delivery pressure of 30 kg/cm² and pumps generally called GAL or GAR pumps having a maximum delivery pressure of 125 kg/cm².

Since the bracket and the case cover serve as the side plates and the gear teeth bottom land is closer to the outer race of the bearing in the case of the fixed side plate type gear pump, oil leakage is liable to occur at the clearance between the gear and the side plate. However, this is only a small problem, as the pump is used for steering control which is operated at a low service pressure.

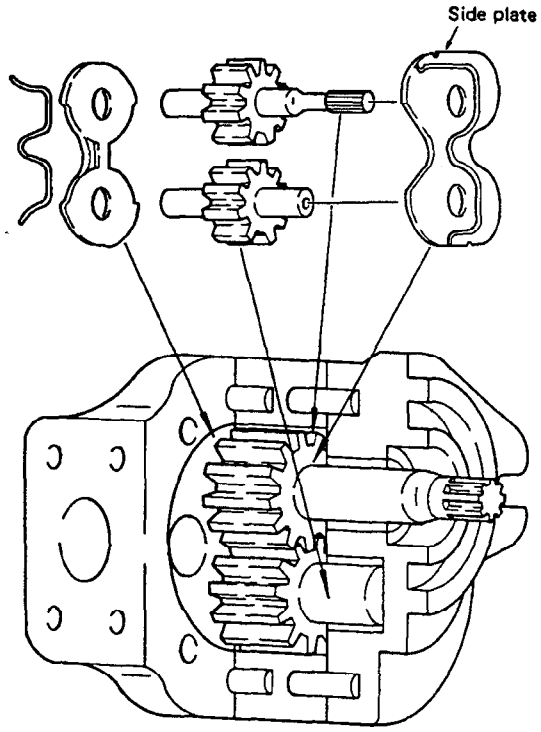
SA SERIES

STRUCTURE

FEATURES

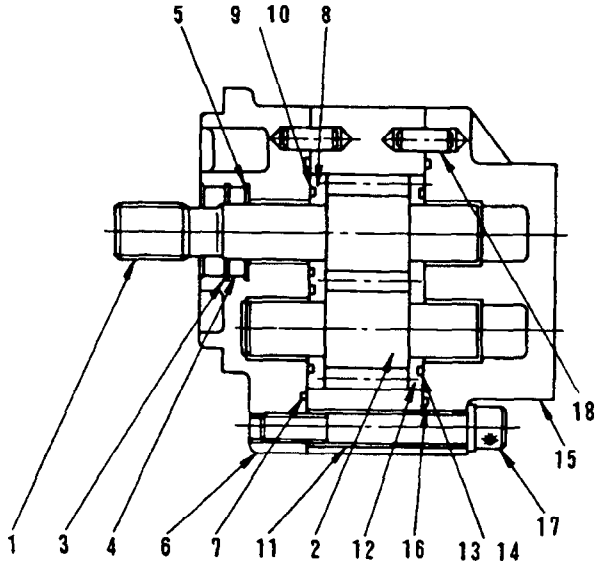
The gear pump is a high quality, reliable product that is specially designed for use in construction equipment which works under severe conditions.

- The side plate, given surfaces treatment to improve its matching characteristics with the special copper alloy, ensures minimum torque loss and excellent wear resistance.
- With the improved hydraulic balance mechanism, the pump offers stable performance and high durability.



200F132

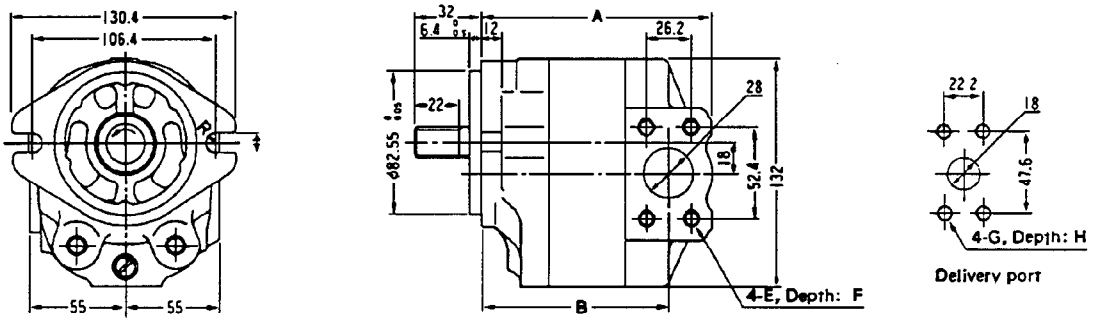
STRUCTURE



21F023

1. Drive gear
2. Driven gear
3. Snap ring
4. Oil seal
5. Plate
6. Bracket
7. O-ring
8. Side plate
9. Back-up ring
10. Seal ring
11. Gear case
12. Side plate
13. Back-up ring
14. Seal ring
15. Cover
16. O-ring
17. Bolt
18. Dowel pin

SA-1 Series single pump

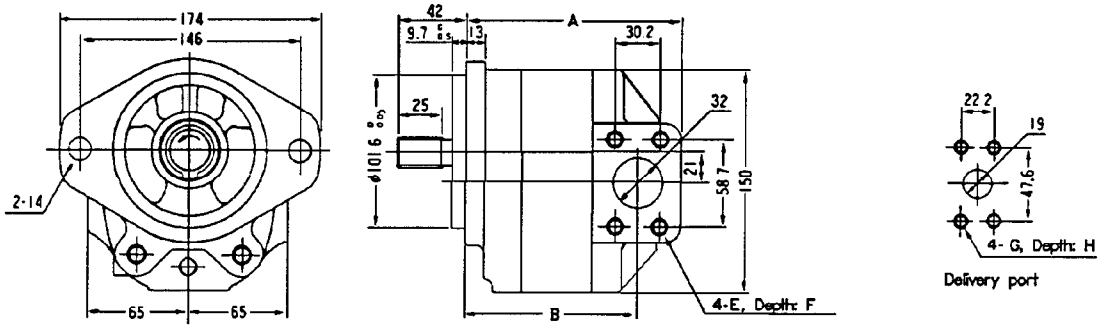


L10AV019

(The drawing above shows a pump of the counter-clockwise rotation type. In a clockwise rotation pump, the positions of the suction and delivery ports are reversed.)

SA-2 Series single pump

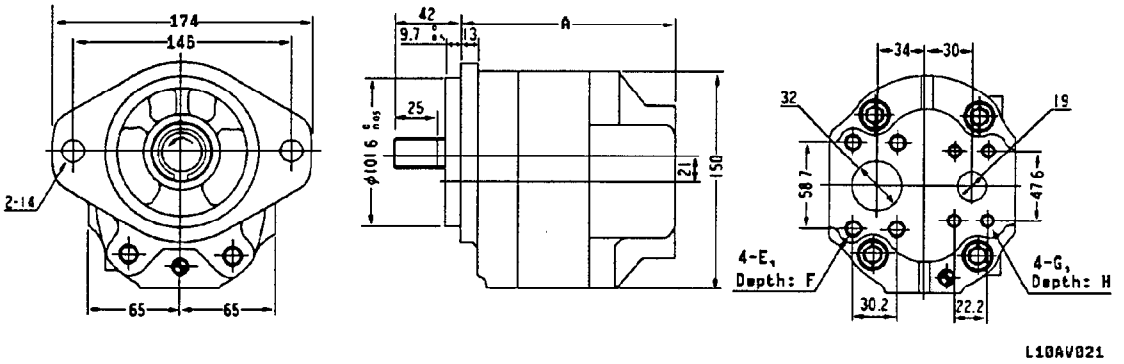
- Side port type



L10AV020

(The drawing above shows a pump of the counter-clockwise rotation type. In a clockwise rotation pump, the positions of the suction and delivery ports are reversed.)

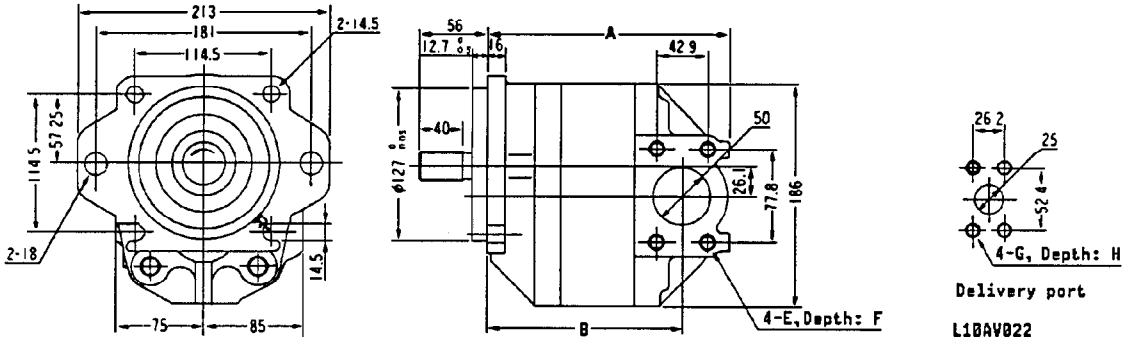
- Rear port type



(The drawing above shows a pump of the counter-clockwise rotation type. In a clockwise rotation pump, the positions of the suction and delivery ports are reversed.)

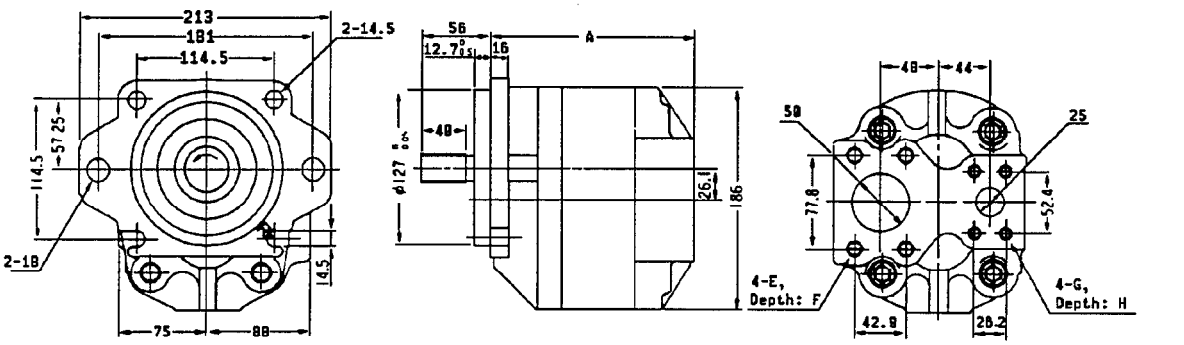
SA-3 Series single pump

- Side port type



(The drawing above shows a pump of the counter-clockwise rotation type. In a clockwise rotation pump, the positions of the suction and delivery ports are reversed.)

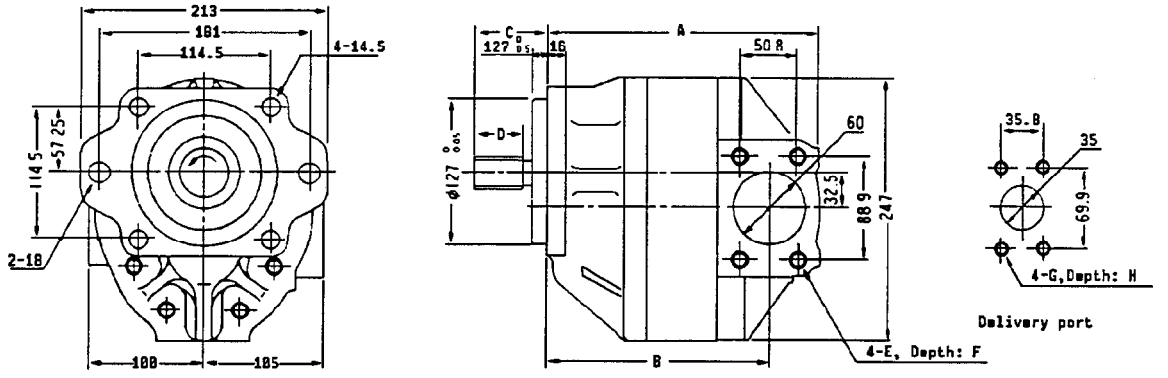
- Rear port type



L10AV023

(The drawing above shows a pump of the counter-clockwise rotation type. In a clockwise rotation pump, the positions of the suction and delivery ports are reversed.)

SA-4 Series single pump



L10AV024

(The drawing above shows a pump of the counter-clockwise rotation type. In a clockwise rotation pump, the positions of the suction and delivery ports are reversed.)

NOTE: Dimensions A through H in the drawings vary with pump capacity.

TESTING AND ADJUSTING

Measure the pump delivery with a bench or flow meter kit (790-303-1001).

For SA pumps operating at a service pressure of 50 kg/cm² or less, see the standard and the repair limit in Table No. 2. (Examples: Pumps for power trains and servo-hydraulic pumps for excavators)

* See Notes on page following table 1 & 2. The capacity codes marked ★ are for triple pumps.

No	Check item	Series No	Capacity Code	Delivery pressure (kg/cm²)	Standard		Repair limit	
					Rotation (rpm)	Delivery (liters/min)	Rotation (rpm)	Delivery (liters/min)
1	Performance Hydraulic oil: EO10-CD Oil temperture: 50°C	1	008	210	3500	25	3500	23
			010			32		29
			012			38		34
			014			47		43
			016			52		48
			020			66		61
			025			83		76
		2	★016	210	3000	44	3000	40
			★020			55		50
			★025			67		62
			028			77		71
			032			88		82
			036			100		92
			040			111		103
			045			121		111
			050			138		128
		3	★020	210	2500	45	2500	42
			★025			55		51
			★040			90		82
			★050			112		102
			056			129		119
			063			145		134
			071			158		146
			080			184		170
			100			231		214
			112	140	2000	212	2000	192
			125			236		213
		4	112	210	2200	233	2200	215
			125			253		234
			140			287		266
			160			328		303
					---	---	---	---
			180		2000	336	2000	310
			200			373		345
			224			411		385
			250			460		425

No	Check item	Series No	Capacity Code	Delivery pressure (kg/cm²)	Standard		Repair limit	
					Rotation (rpm)	Delivery (liters/min)	Rotation (rpm)	Delivery (liters/min)
2	Performance Hydraulic oil: EO10-CD Oil Tempera-ture: 50°C	1	008 010 012 014 016 020 025	30	3500	27 33 40 48 54 68 86	3500	25 30 37 44 50 63 79
		2	★008 ★016 ★020 ★025 028 032 036 040 045 050	30	3000	23 47 59 72 80 92 104 115 126 144	3000	21 43 53 66 74 84 95 106 115 132
		3	★020 ★025 ★040 ★050 056 063 071 080 100	30	2500	49 60 96 119 134 151 164 192 241	2500	44 55 88 109 123 138 150 176 221
			112 125	30	2000	217 240	2000	198 220
		4	112 125 140 160 180 200 224 250	30	2200 ---------- 2000	242 264 300 342 ---------- 350 389 434 480	2200 ---------- 2000	222 242 275 314 ---------- 321 257 398 440

For SA pumps operating at a service pressure of 50 kg/cm² or less, see the standard and the repair limit in table, No. 2. (Examples: Pumps for power trains and servo-hydraulic pumps for excavators).

Note 1.) If it is impossible to raise the pump speed to the value shown in the table because of limitations of the test bench, calculate the allowance for the delivery from the following formula:

$$Q = Qo - \frac{(No - N)\ Qth}{1000}$$

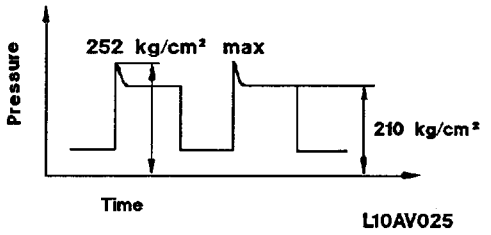
however, $N \geq$ 1000 rpm
where, N: RPM of test bench
Q: Repair limit for delivery at N rpm (liters/min)
No: RPM in the table
Qo: Repair limit for delivery in the table (liters/min)
Qth: Capacity code

Note 2.) If the test bench allows the pump to raise its delivery pressure above 140 kg/cm² but not above 210 kg/cm², use the repair limit for delivery given in Table, No 1

Note 3.) For pumps whose service pressure exceeds 50 kg/cm² in operation, use Table, No 1. (do not use Table, No 2)

Note 4.) The volumetric efficiency of a pump decreases after the pump is reassembled. After reassembly, therefore, perform the following tests with a test bench or flowmeter kit (790-303-1001).

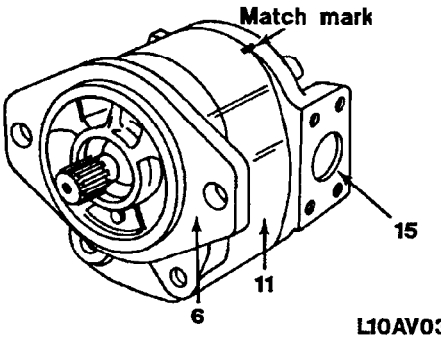
(1) Shock test
20 times



(2) Performance test (measure the delivery)

DISASSEMBLY

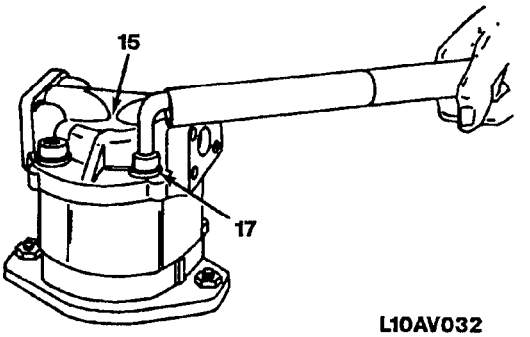
1. **Single pump**
   ★ Cautions before disassembly
   To avoid confusion in the reassembly, stamp match marks on connecting sections of bracket (6) to gear case (11) and gear case (11) to cover (15).



L10AV031

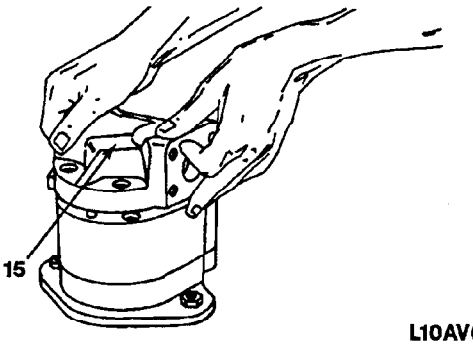
1) Put the pump assembly on a work bench with the bracket side facing down, and loosen mounting bolts (17) for cover (15).

★ Use the bracket mounting bolt holes to secure the pump assembly.



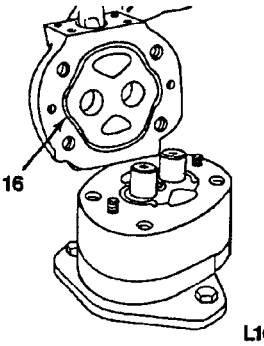
L10AV032

2) Remove cover assembly (15).
★ Place the internal parts in line in the order of removal, taking care not to damage the contacting surfaces or sliding surfaces of the parts.
★ Pull out cover assembly (15), taking care not to damage the hole for the dowel pin. Do not pry the cover.



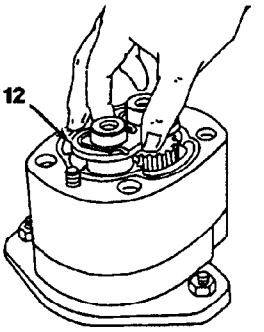
L10AV033

3) Remove O-ring (16) from the cover.



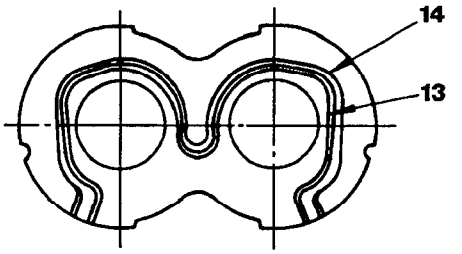
L10AV034

4) Pull out side plate (12) on the cover side.



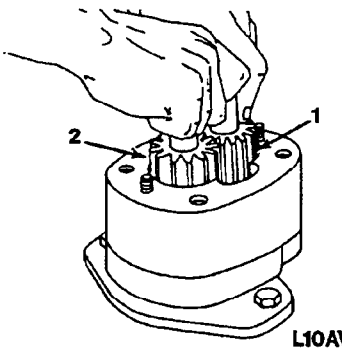
L10AV036

5) Remove backup ring (13) and seal ring (14).



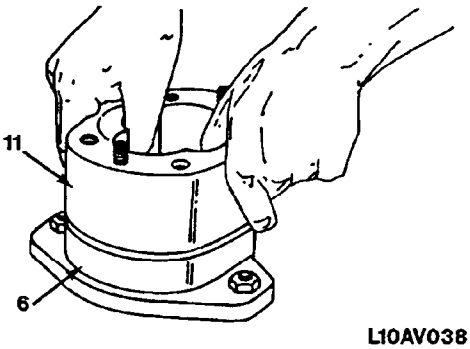
230F221

6) Remove drive gear (1) and driven gear (2).
★ Pull out the gears by hand. Do not use a hammer.
★ If the oil seal is not replaced, tape the drive gear and the spline section to protect the oil seal from damage.



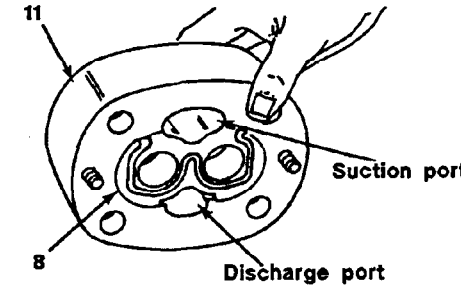
L10AV037

7) Remove bracket (6) from gear case (11).
★ When removing bracket (6) from gear case (11), take care not to let side plate (8) on the bracket side fall down and leave the side plate-installed as is to the gear case.
★ Do not hit the side plate surface.



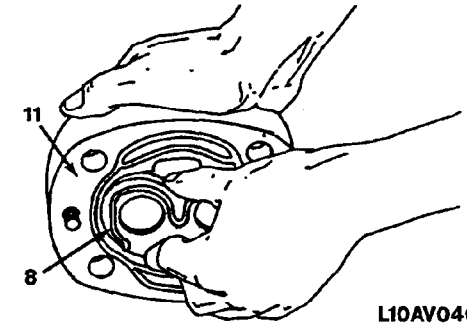
L10AV038

8) Pull outside side plate (8) from gear case (11).



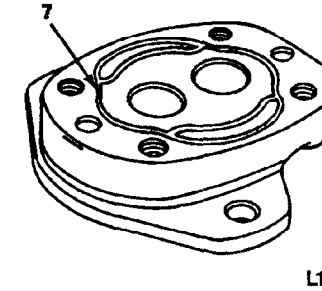
L10AV039

9) Remove backup ring (13) and seal ring (14).



L10AV040

10) Remove O-ring (7) from bracket.

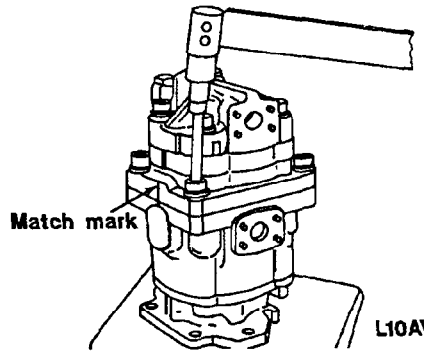


L10AV041

2. Tandem pump

1) Stamp match marks.

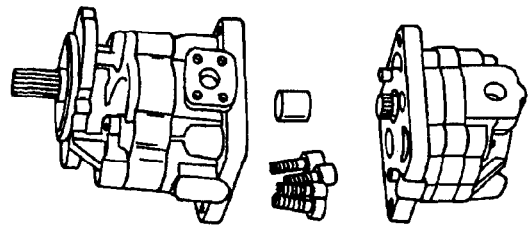
2) Put the pump on a work bench with the front pump bracket surface facing down, and remove the four bolts that connect the front pump to the rear pump.



L10AV057

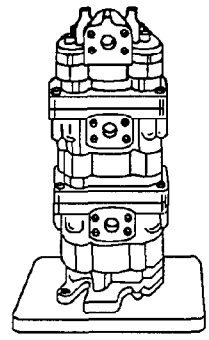
3) Disconnect the front pump from the rear pump.

4) For the disassembly of single pumps, see the section on single pumps.


L10AV055

3. Triple pump

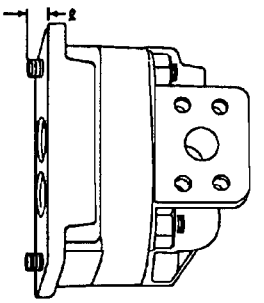
Follow the same procedure for tandem pumps.


L10AV056

ASSEMBLY

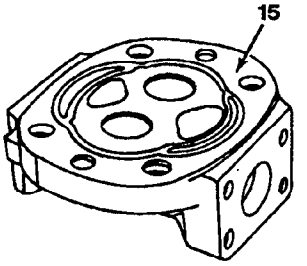
1. **Single pump**
   - ★ When a used gear case is assembled, remove the burrs from the case and make sure that the side plate can be sided smoothly.
   - ★ Make sure that the dowel pin on the case has specified length (ℓ).

$$\ell \fallingdotseq \frac{\text{Length of dowel pin}}{2}$$



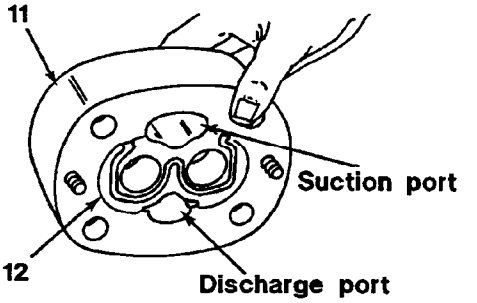
L10AV042

1) Put cover (15) on a work bench.



L10AV043

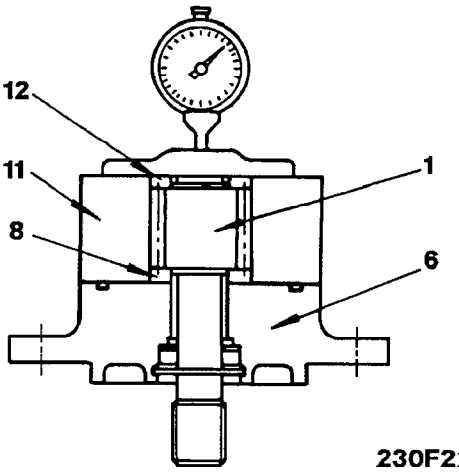
2) Install side plate (12) into gear case (11) with the seal groove facing outside.
   - ★ Do not install the backup ring and the seal to side plate (12) at this stage.
   - ★ Do not confuse the suction side of the side plate with the delivery side.
   - ★ Do not damage the periphery of the side plate, especially around the seal section.



L10AV044

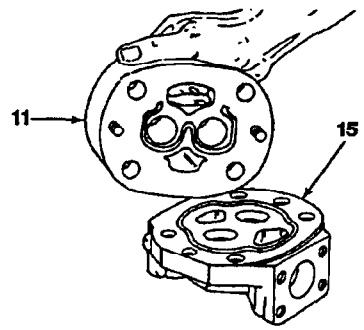
Measurement of side clearance
Temporarily assemble bracket (6) and gear case (11) as shown in the drawing at right. Place the assembly on a work bench and measure the difference between the stack height including drive gear (1), side plates (8) and (12) and the height of gear case (11).
Measure with a depth dial gauge or depth micrometer.

Judgement criteria
Confirm that the measurements conform to the standard clearance given in the Maintenance Standard Table.



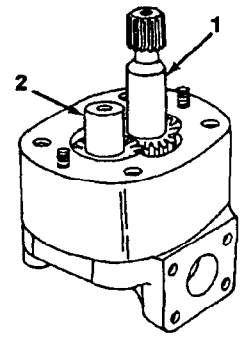
230F222

3) Install gear case (11) to cover (15) with the match marks aligned.



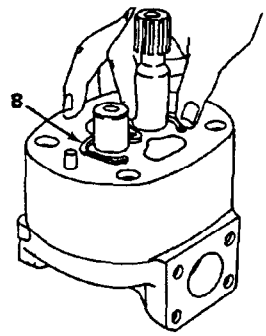
L10AV045

4) Install drive gear (1) and driven gear (2).



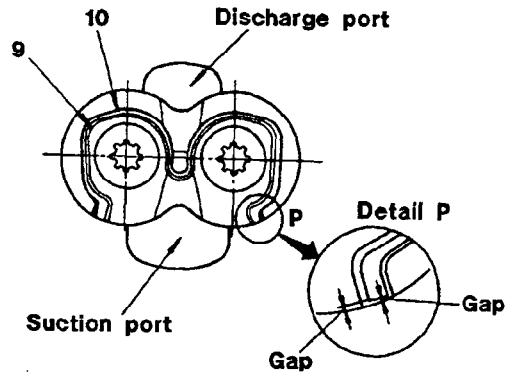
L10AV046

5) Install side plate (8) with the backup and seal ring grooves facing upward.



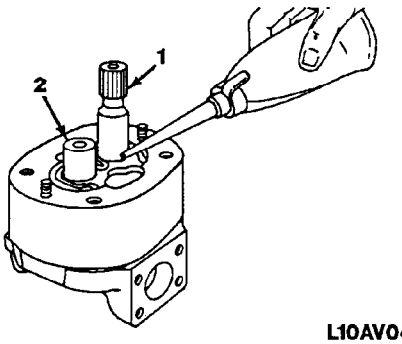
L10AV047

6) Install backup ring (9) and seal ring (10).
★ Install them with care to prevent gaps between the ring and the gear case.
★ If it is impossible to eliminate the gap, replace the seal ring and the backup ring.



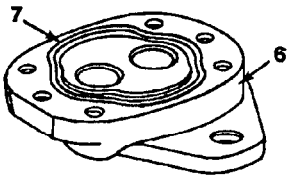
230F223

7) Apply some hydraulic oil to the shafts of gears (1 and 2) and also to the sliding section of the side plate.
★ Take care to keep gear case free from oil.



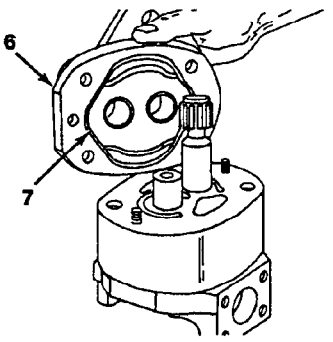
L10AV048

8) Install O-ring (7) to bracket (6).



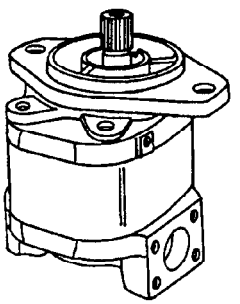
L10AV049

9) Install bracket (6).
★ Align the match marks when installing the bracket.
★ Before installing the bracket, make sure that the seal and backup rings are properly installed according to the precautions in item 6.
★ Make sure O-ring (7) is fit properly.
★ Confirm that the contact surface is free from dirt and dust.



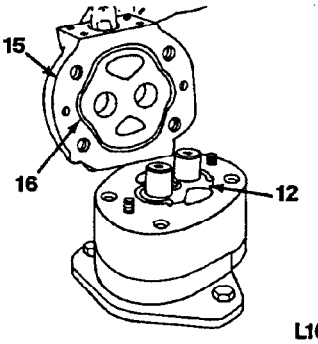
L10AV050

10) Carefully turn the gear pump assembly upside down so that the bracket side will face downward, and put the gear pump assembly on a work bench.
★ When turning the pump upside down, take care not to let the contact surfaces open out and not to let the O-ring and seal come off.



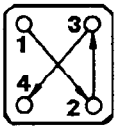
L10AV051

11) Remove the cover (15) and install O-ring (16).
12) Install backup ring and seal ring to side plate (12) in the manner described in item 6.
13) Install cover (15).
★ Align the match marks when installing the cover.
★ Before installing the cover, make sure backup ring and seal ring are properly installed according to the precautions given in item 6.
★ Make sure O-ring (16) is fit properly.

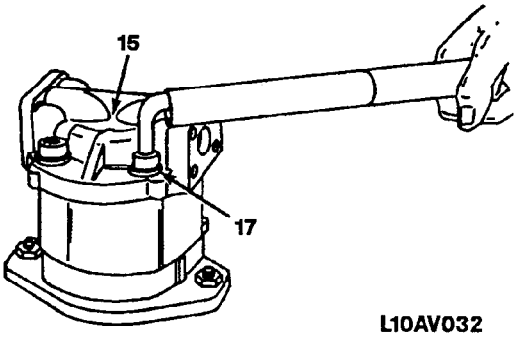


L10AV035

14) Tighten mounting bolts (17).
★ Use a torque wrench and tighten the bolts to the specified torque in the order shown in the drawing.
For the tightening torque, see the Maintenance Standard Table, this section.



Tightening order
L10AV026



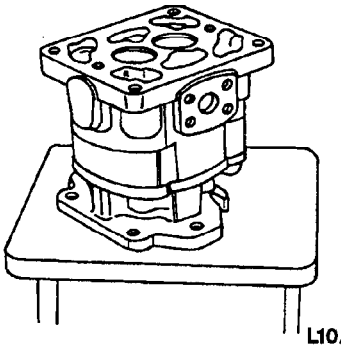
L10AV032

15) After assembly, check the rotational torque of the pump shaft to see if it conforms to the value given in the table.
★ After the pump is assembled, carry out the performance test (measure the pump delivery) with a test bench or flow meter kit (790-303-1001). Confirm that the performance is with the repair limits.

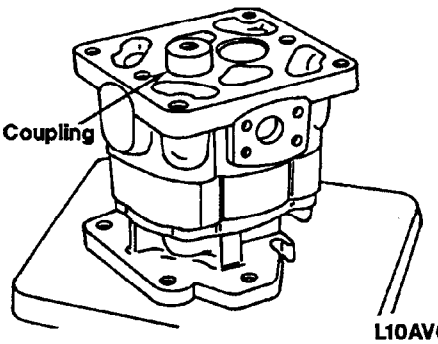
Series	Rotational torque
1	0.2 - 0.5 kgm
2	0.3 - 0.7 kgm
3	0.7 - 1.2 kgm
4	1.0 - 1.5 kgm

2. Tandem pump

1) For the assembly of individual units of the front and rear pump, follow the same assembly procedure as for the single pump.
2) Put the front pump on a work bench.

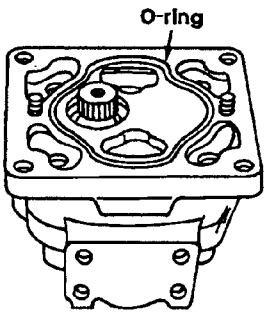

L10AV054

3) Install the coupling to the front pump.



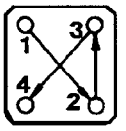
L10AV053

4) Fit the O-ring to the rear pump bracket.
5) Put the rear pump on top of the front pump.
★ Take care not to let the O-ring come off.
★ Align the match marks.



L10AV052

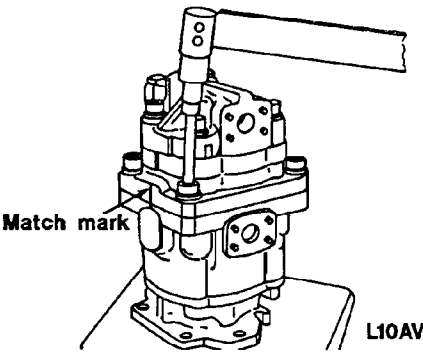
Series	Tightening torque
1-2	4-7 kgm
3	16-20 kgm



Tightening order

L10AV027

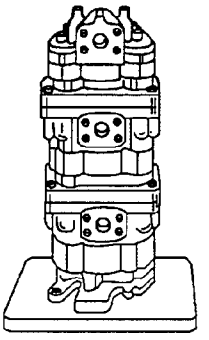
6) Tighten four mounting bolts.
★ Tighten the bolts with a torque wrench to the specified torque in the order shown in the drawing below.



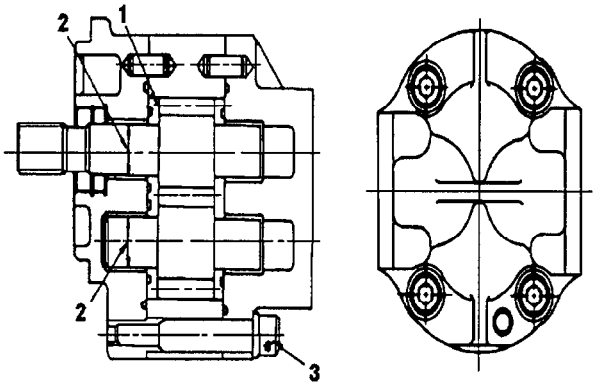
L10AV057

★ After the pump is assembled, carry out the performance test (measure the pump delivery) with a test bench or flow-meter kit (790-303-1001). Confirm that the performance is within the repair limits.

3. Triple pump
Follow the same assembly procedure as for the tandem pump.


L10AV056

MAINTENANCE STANDARD



L10AV028

Unit: mm

No	Check item	Series No	Criteria		Remedy
			Standard clearance	Clearance limit	
1	Clearance between the gear case and the gear plus the side plate	1 2	0.10 - 0.15	0.19	Replace the side plate or the pump assembly
		3	SAL & SAR = 020 - 080	0.10 - 0.15	0.19
			SAL & SAR = 100 - 125	0.13 - 0.18	0.20
		4	SAL & SAR = 112 - 180	0.11 - 0.16	0.19
			SAL & SAR = 200 - 250	0.14 - 0.19	0.22
2	Clearance between the I.D. of the plain bearing and the O.D. of the gear shaft	1	SAL & SAR = 008 - 014	0.06 - 0.144	0.22	Replace
			SAL & SAR = 016 - 025	0.06 - 0.119	
		2	0.06 - 0.125		
		3	0.06 - 0.149		
		4	0.06 - 0.140		

No	Check item	Series No	Criteria		Remedy
			Standard clearance	Clearance limit	
3	Tightening torque for the case mounting bolts	1	10 - 12.5 kgm		
		2	10 - 12.5 kgm		
		3	23.5 - 27 kgm		
		4	15 - 18 kgm		

OTHER

99 METRIC CONVERSIONS

METRIC CONVERSIONS

UNIT	MULTIPLY BY	TO GET	MULTIPLY BY	TO GET
AREA				
square inch (in^2)	645.16	square millimeter (mm^2)	0.001550003	square inch
	6.4516	square centimeter (cm^2)	0.1550003	square inch
	0.00064516	square meter (m^2)	1550.003	square inch
square foot (ft^2)	0.09290304	square meter (m^2)	10.76391	square foot
square yard (yd^2)	0.8361274	square meter (m^2)	1.195990	square yard
square rod (rod^2)	25.29285	square meter (m^2)	0.03953686	square rod
	0.002529285	square hectometer (hm^2)	395.3686	square rod
acre	4046.856	square meter (m^2)	0.0002471054	acre
	0.4046856	square hectometer (hm^2)	2.471054	acre
square mile ($mile^2$)	2589988.0	square meter (m^2)	0.0000003861022	square mile
	2.589988	square kilometer (km^2)	0.386102175	square mile

UNIT	MULTIPLY BY	TO GET	MULTIPLY BY	TO GET
DENSITY (Mass Density)				
pound per cubic yard (lb/yd^3)	0.5932763	kilogram per cubic meter (kg/m^3)	1.685555	(lb/yd^3)
pound per cubic foot (lb/ft^3)	16.01846	kilogram per cubic meter (kg/m^3)	0.06242797	(lb/ft^3)
pound per cubic inch (lb/in^3)	27.67990	gram per cubic centimeter (g/cm^3)	0.03612730	(lb/in^3)
pound per US gallon (lb/US gal)	0.1198264	kilogram per liter (kg/l)	8.345406	(lb/US gal)
pound per UK gallon (lb/UK gal)	0.09977633	kilogram per liter (kg/l)	10.02242	(lb/UK gal)

UNIT	MULTIPLY BY	TO GET	MULTIPLY BY	TO GET
FORCE				
pound, pound-force (lbf)	4.448222	newton (N)	0.2248089	pound-force
	0.004448222	kilonewton (kN)	224.8089	pound-force
ounce-ounce-force (ozf)	0.2780139	newton (N)	3.596942	ounce force

METRIC CONVERSIONS

UNIT	MULTIPLY BY	TO GET	MULTIPLY BY	TO GET
FORCE PER LENGTH				
pound, force per inch (lbf/in)	0.1751268	newton per millimeter (N/mm)	5.710148	pound-force per inch
	175.1268	newton per meter (N/m)	0.005710148	pound-force per inch
pound-force per foot) (lbf/ft)	14.5939	newton per meter (N/m)	0.06852178	pound-force per foot

UNIT	MULTIPLY BY	TO GET	MULTIPLY BY	TO GET
HEAT				
British thermal unit (Btu)	1.055056	kilojoule (kj)	0.9478170	(Btu)
	1055.056	joule (J)	0.0009478170	(Btu)
Btu per hour* (Btu/h)	0.2930711	watt (W)	3.412141	(Btu/h)
Btu per minute* (Btu/min)	17.58427	watt (W)	0.05686902	(Btu/min)
Btu per gallon (Btu/gal)	0.2787163	kilojoule per liter (kJ/l)	3.5878777	(Btu/gal)

*Heat flow rate. Also see POWER.

UNIT	MULTIPLY BY	TO GET	MULTIPLY BY	TO GET
LENGTH				
inch (in)	25.4	millimeter (mm)	0.03937008	(in)
	2.54	centimeter (cm)	0.3937008	(in)
	0.0254	meter (m)	39.37008	(in)
microinch (μin)	0.0254	micrometer (μm)	39.37008	(μm)
mil	25.4	micrometer (μm)	0.03937008	mil
micron (μ)	(same as micrometer one for one)			
foot (ft)	0.3048	meter (m)	3.280840	(ft)
yard (yd)	0.9144	meter (m)	1.093613	(yd)
mile	1.609344	kilometer (km)	0.6213712	mile
	1609.344	meter (m)	0.0006213712	mile
rod	5.0292	meter (m)	0.1988388	rod

METRIC CONVERSIONS

UNIT	MULTIPLY BY	TO GET	MULTIPLY BY	TO GET
MASS (WEIGHT)				
ounce	28.34952	gram (g)	0.03527397	(oz)
	0.02834952	kilogram	35.27397	(oz)
grain	0.06479891	gram (g)	15.43236	grain
pound (lb)	0.4535924	kilogram (kg)	2.204622	(lb)
short ton (2000 lb)	907.1847	kilogram (kg)	0.001102311	short ton
	0.9071847	megagram (Mg)	1.102311	short ton
long ton	1016.047	kilogram (kg)	0.0009842064	long ton
	1.016047	megagram (Mg)	0.9842064	long ton

UNIT	MULTIPLY BY	TO GET	MULTIPLY BY	TO GET
POWER				
horsepower (hp)	0.7456999	kilowatt (kW)	1.341022	(hp)
	745.6999	watt (W)	0.001341022	(hp)
Btu per hour* (Btu/h)	0.2930711	watt (W)	3.412141	(Btu/h)
Btu per minute* (Btu/min)	17.58427	watt (W)	0.05686902	(Btu/min)

*Also heat flow rate. See HEAT.

UNIT	MULTIPLY BY	TO GET	MULTIPLY BY	TO GET
PRESSURE				
pound force per square inch (psi)	6.894757	kilopascal (kPa)	0.1450377	(psi)
	0.006894757	megapascal (Mpa)	145.0377	(psi)
inch of mercury (in Hg)	3.37685	kilopascal (kPa)	0.296134	(in Hg)
inch of water (in H_2O)	0.24884	kilopascal (kPa)	4.0186	(in H_2O)
bar	100.0	kilopascal (kPa)	0.01	bar

METRIC CONVERSIONS

UNIT	MULTIPLY BY	TO GET	MULTIPLY BY	TO GET
TEMPERATURE				
degree Fahrenheit (°F)	(°F-32) ÷ 1.8	degree Celsius (°C)	(1.8x°C) + 32	(°F)

UNIT	MULTIPLY BY	TO GET	MULTIPLY BY	TO GET
TEMPERATURE INTERVAL OR TOLERANCE				
degree Fahrenheit (°F)	divide by 1.8	degree Celsius (°C)	1.8	(°F)

UNIT	MULTIPLY BY	TO GET	MULTIPLY BY	TO GET
VOLUME				
cubic yard (yd^3)	0.7645549	cubic meter (m^3)	1.307951	(yd^3)
cubic foot (ft^3)	0.02831685	cubic meter (m^3)	35.31466	(ft^3)
cubic inch (in^3)	16.38706	cubic centimeter (cm^3)	0.06102376	(in^3)
	0.01638706	liter (l)	61.02376	(in^3)
US liquid gallon (US gal)	3.785412	liter (l)	0.2641720	(US gal)
	0.003785412	cubic meter (m^3)	264.1720	(US gal)
US liquid quart (US qt)	0.9463529	liter (l)	1.056688	(US qt)
US liquid pint (US pt)	0.4731765	liter (l)	2.113376	(US pt)
cup	0.2365882	liter (l)	4.226753	cup
US fluid ounce (US fl oz)	0.02957353	liter (l)	33.81402	(US fl oz)
	29.57353	cubic centimeter (cm^3)	0.03381402	(US fl oz)
tablespoon	14.78676	milliliter (ml)	0.06762807	tablespoon
teaspoon	4.928922	milliliter (ml)	0.2028841	teaspoon
UK liquid gallon (UK gal)	4.546092	liter (l)	0.2199692	(UK gal)
	0.004546092	cubic meter (m^3)	219.9692	(UK gal)
UK fluid ounce (UK fl oz)	0.02841307	liter (l)	35.19507	(UK fl oz)
	28.41307	cubic centimeter (cm^3)	0.03519507	(UK fl oz)

METRIC CONVERSIONS

UNIT	MULTIPLY BY	TO GET	MULTIPLY BY	TO GET
TORQUE				
pound-force foot (lbf ft) (ft lb)	1.355818	newton meter (N•m)	0.7375621	(ft lb)
pound-force inch (lbf in) (in lb)	0.1129848	newton meter (N•m)	8.850748	(in lb)
ounce force inch (ozf in)	0.007061552	newton meter (N•m)	141.6119	(ozf in)

UNIT	MULTIPLY BY	TO GET	MULTIPLY BY	TO GET
VELOCITY				
mile per hour (mph)	1.609344	kilometer per hour (km/h)	0.6213712	(mph)
foot per minute (ft/min)	0.3048	meter per minute (m/min)	3.280840	(ft/min)
	0.00508	meter per second (m/s)	196.8504	(ft/min)
foot per second (ft/s)	0.3048	meter per second (m/s)	3.280840	(ft/s)
inch per second (in/s)	25.4	millimeter per second (mm/s)	0.03937008	(in/s)
	0.0254	meter per second (m/s)	39.37008	(in/s)

FOLDOUT NO. 1 (See Foldout 2 & 3)
ELECTRICAL CIRCUIT DIAGRAM

CNP1
1. +24V
2. Ground
3. Hazard power supply
4. Start switch
5. High beam
6. Flasher (L.H.)
7. Flasher (R.H.)
8.
9. Car speed (+)
10. Car speed (-)
11.
12.
13.
14.
15. Night light
16.

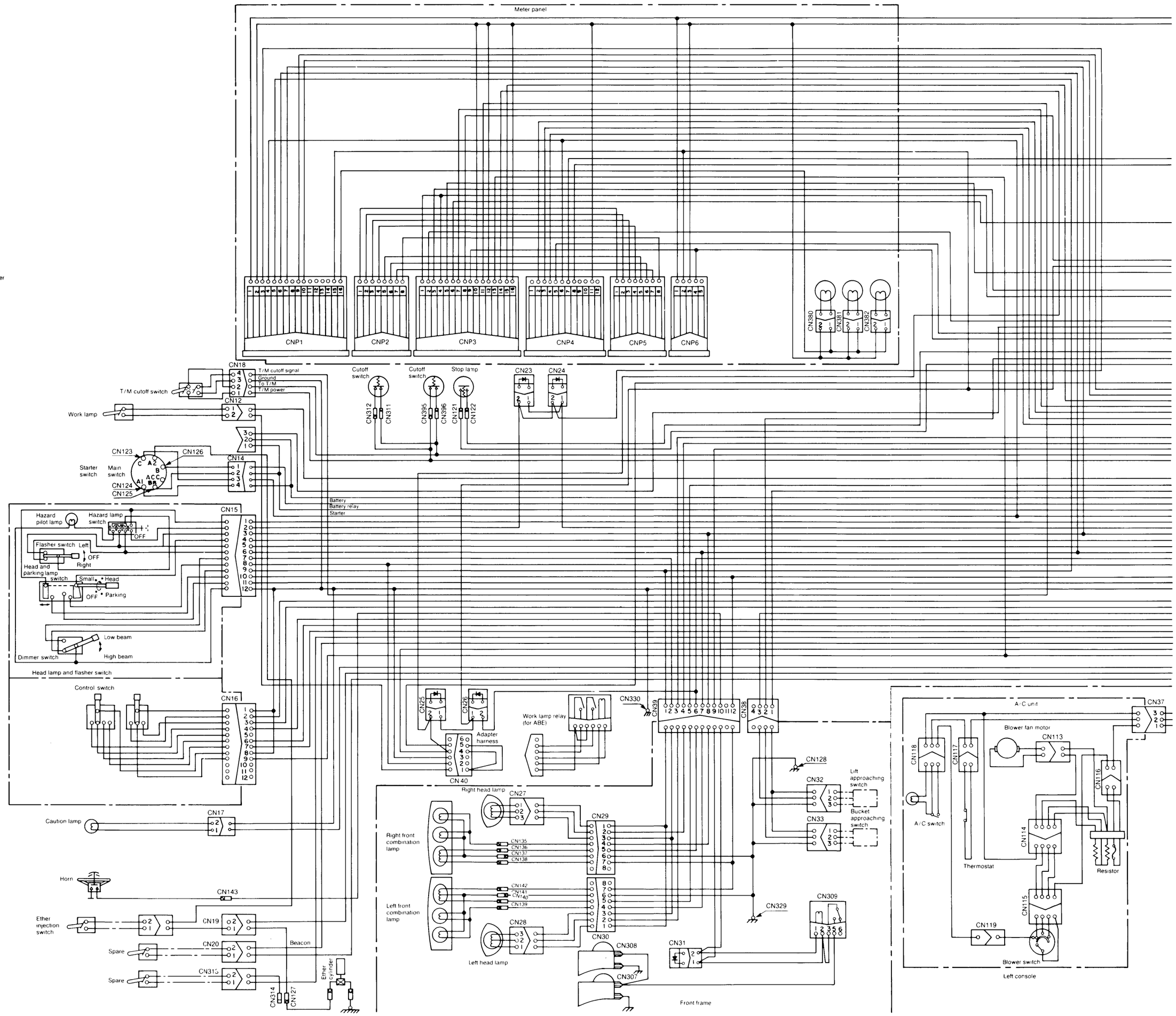
CNP2
1. VB
2. VCC
3. TX
4. SCL
5. LOAD
6. RES
7. GROUND
8. VIN

CNP3
1. Brake oil level
2. Engine oil level
3. Coolant level
4. Brake oil level
5. Parking brake
6. EM S/T operating
7. EM S/T normal
8. Brake oil pressure
9. Engine oil pressure
10. Ground
11. T/M cutoff
12. Ground
13. T/M neutral
14. Work lamp
15. Pre-heating
16. Ground

CNP4
1.
2. Coolant temp
3. T/C oil temp
4. Fuel volume
5. Charge amount
6. Start switch
7. Centralized alarm lamp
8. Centralized alarm buzzer
9.
10.
11. Ground
12.

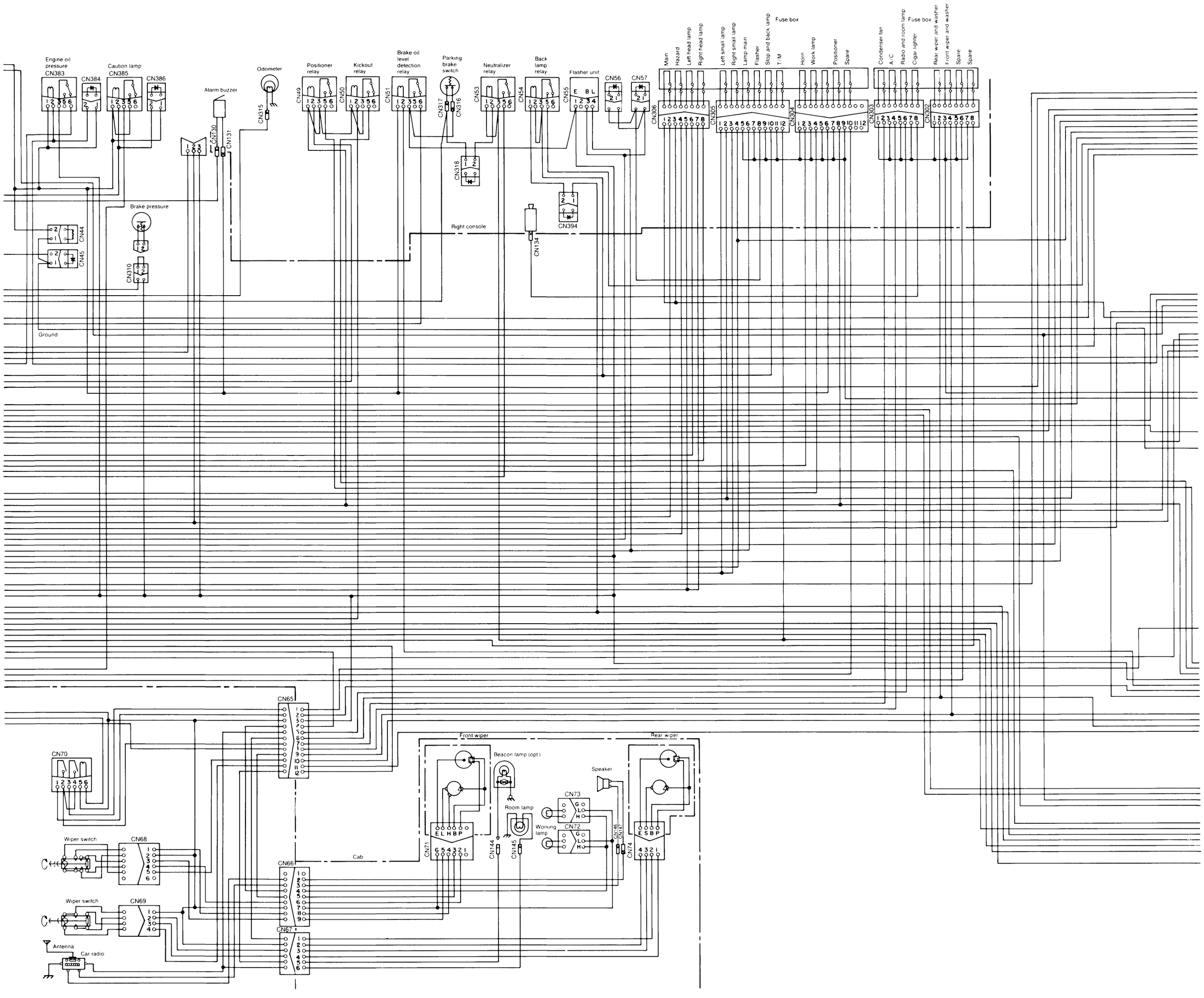
CNP5
1. VB
2. VCC
3. TX
4. SCL
5. LOAD
6. RES
7. GROUND
8. VIN

CNP6
1. +24V
2. Night light
3. Ground
4. Engine oil pressure
5.



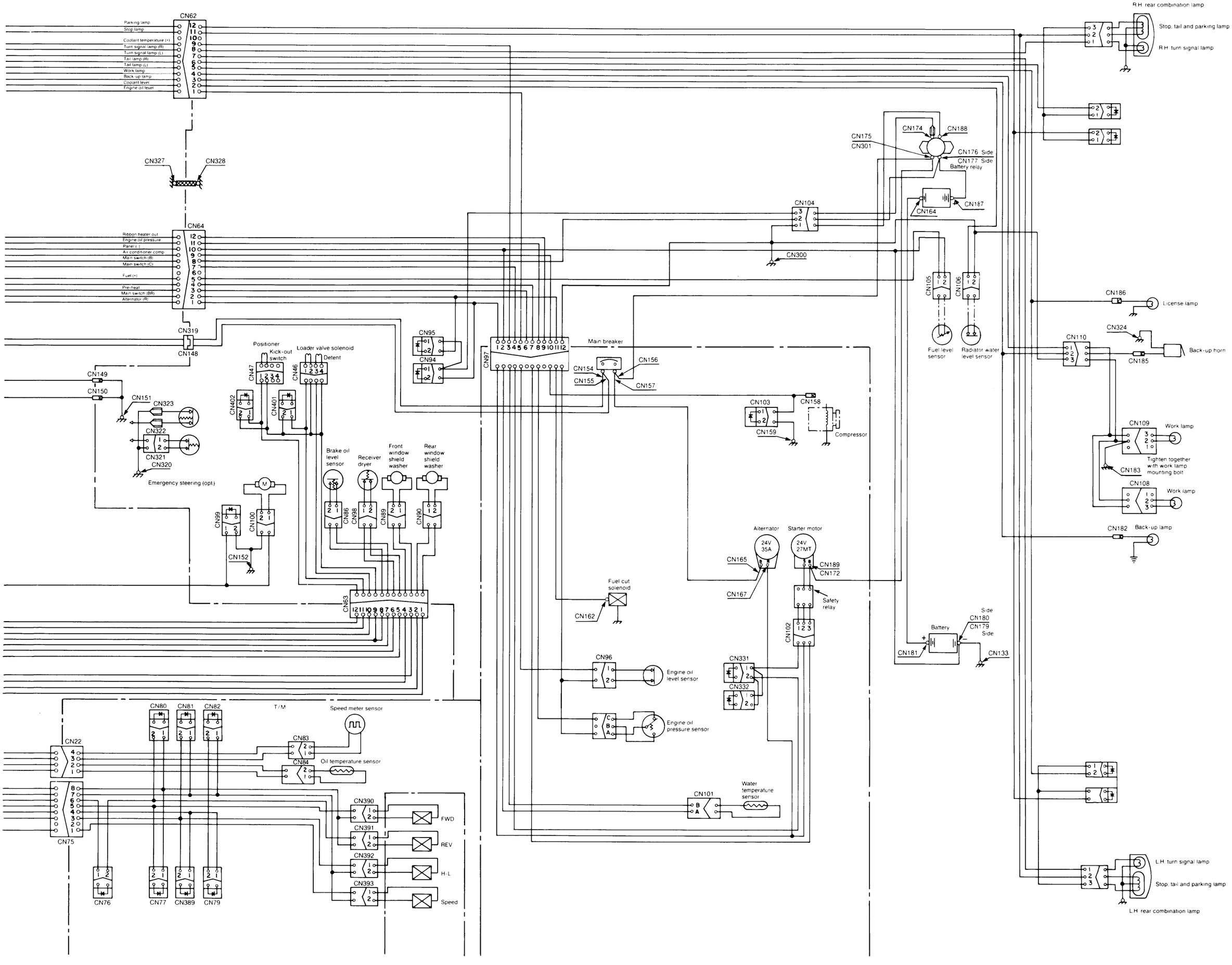
L08DD047

FOLDOUT NO. 2 (See Foldout 1 & 3)
ELECTRICAL CIRCUIT DIAGRAM



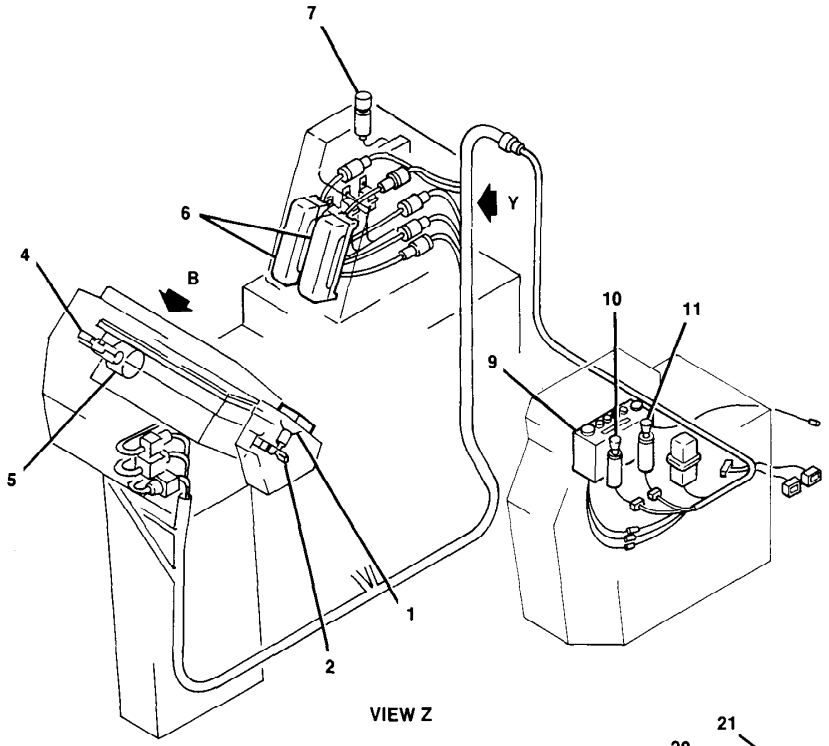
L08DD047

FOLDOUT NO. 3 (See Foldout 1 & 2)
ELECTRICAL CIRCUIT DIAGRAM

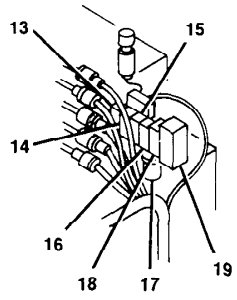


L08DD047

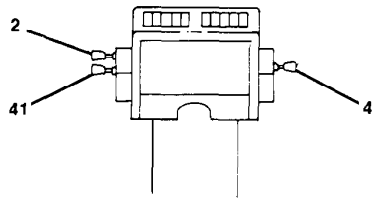
FOLDOUT NO. 4
ELECTRICAL WIRING DIAGRAM (3D) CIRCUIT



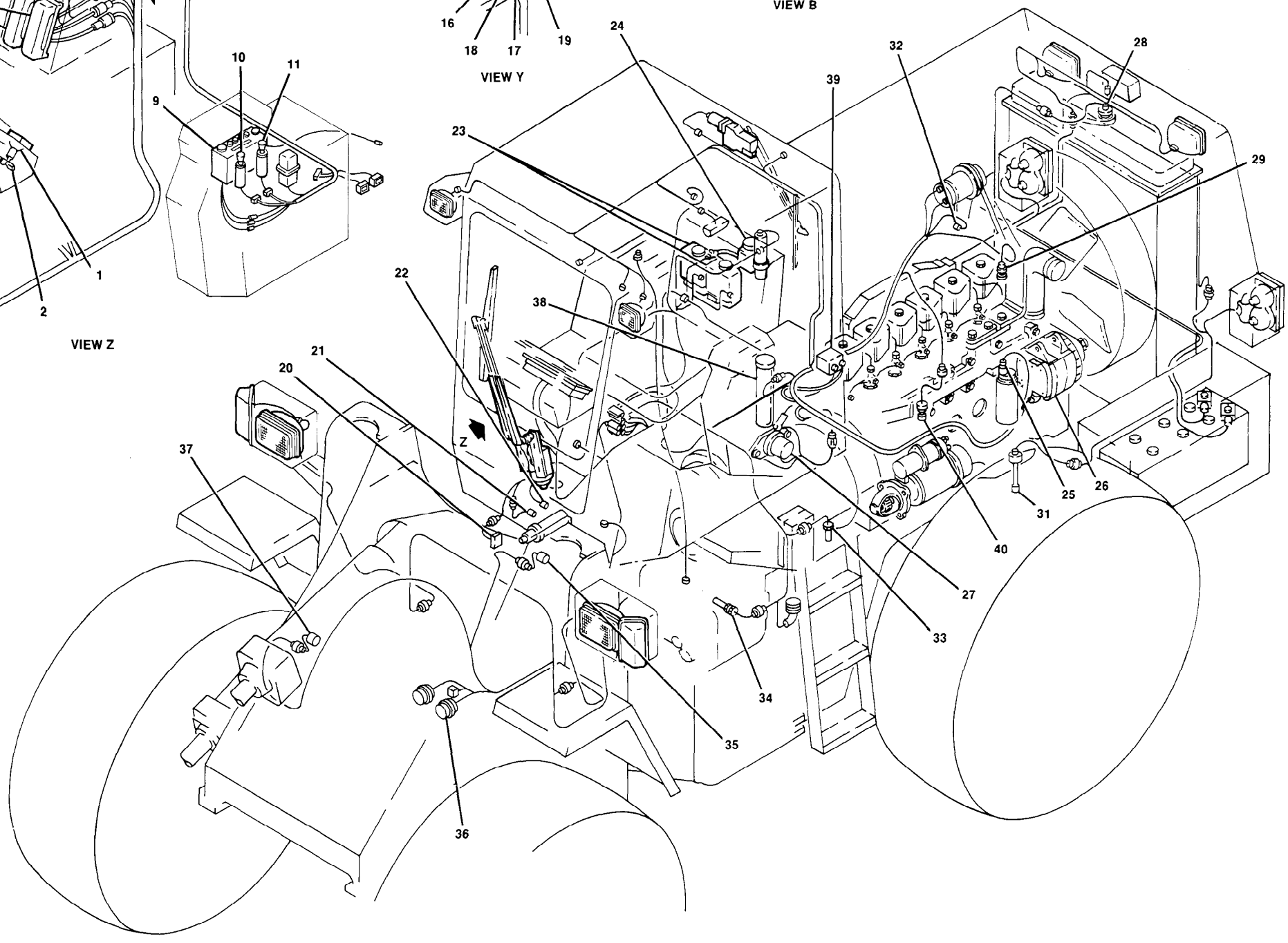
VIEW Z



VIEW Y



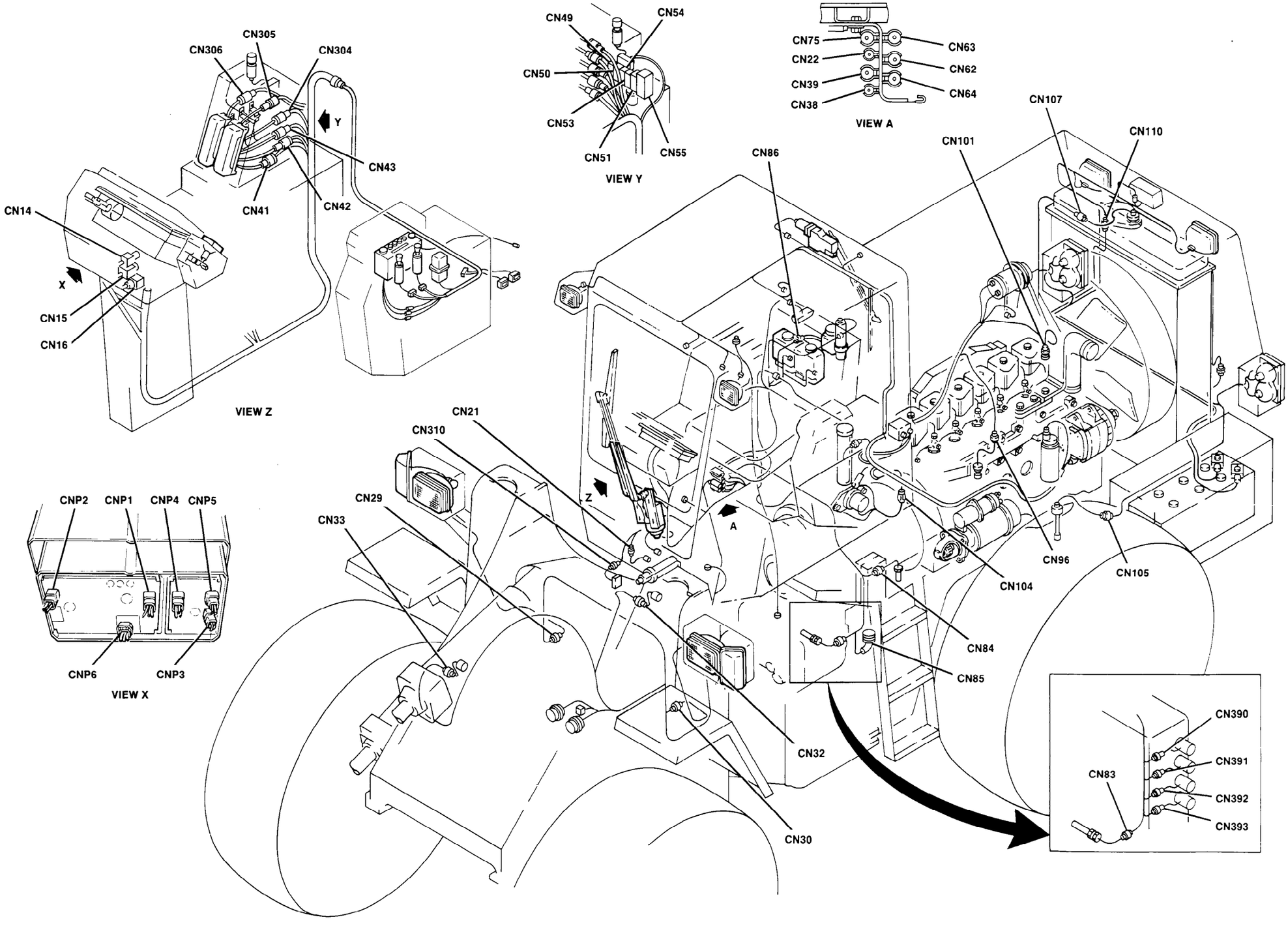
VIEW B



1. Warning lamp
2. Transmission cutoff selector switch
3. Not used
4. Working lamp switch
5. Starting switch
6. Fuse box
7. Cigar lighter
8. Not used
9. Radio
10. Front wiper switch
11. Rear wiper switch
12. Not used
13. Positioner relay
14. Kick-out relay
15. Back-up lamp relay
16. Neutralizer relay
17. Warning buzzer
18. Brake oil level relay
19. Flash unit
20. Stop lamp switch
21. Transmission cutoff switch
22. Brake oil pressure sensor
23. Window washer tank
24. Brake oil level sensor
25. Engine oil pressure sensor
26. Alternator
27. Battery relay
28. Coolant level sensor
29. Coolant temperature sensor
30. Not used
31. Fuel level sensor
32. Fuel cut solenoid
33. Torque converter temperature sensor
34. Speedometer sensor
35. Proximity switch for lift
36. Horn
37. Proximity switch for bucket
38. Ether cylinder
39. Main breaker
40. Engine oil level sensor
41. Ether injection switch

L08DD049

FOLDOUT NO. 5
ELECTRICAL WIRING DIAGRAM CONNECTOR (CN)



L08DD048

FOLDOUT NO. 6
ELECTRONIC VEHICLE MONITORING SYSTEM

CNP1

1. +24V
2. GND
3. Hazard P/S
4. Starting switch
5. High beam
6. Turn signal lamp (L.H.)
7. Turn signal lamp (R.H.)
8.
9. Machine speed (+)
10. Machine speed (–)
11.
12.
13.
14.
15. Flicker out power
16. Flicker in power

CNP2

1. VB
2. VCC
3. T
4. SCL
5. LOAD
6. RES
7. GNA
8. VIN

CNP3

1. Brake oil level
2. Engine oil level
3. Coolant level
4. Brake oil level
5. Parking brake
6. EM steering active
7. EM steering normal
8. Brake oil pressure
9. Engine oil pressure
10. T/M oil filter
11. T/M cutoff
12. Spare
13. Transmission neutral
14. Working lamp
15. Pre-heating
16. After-heating

CNP4

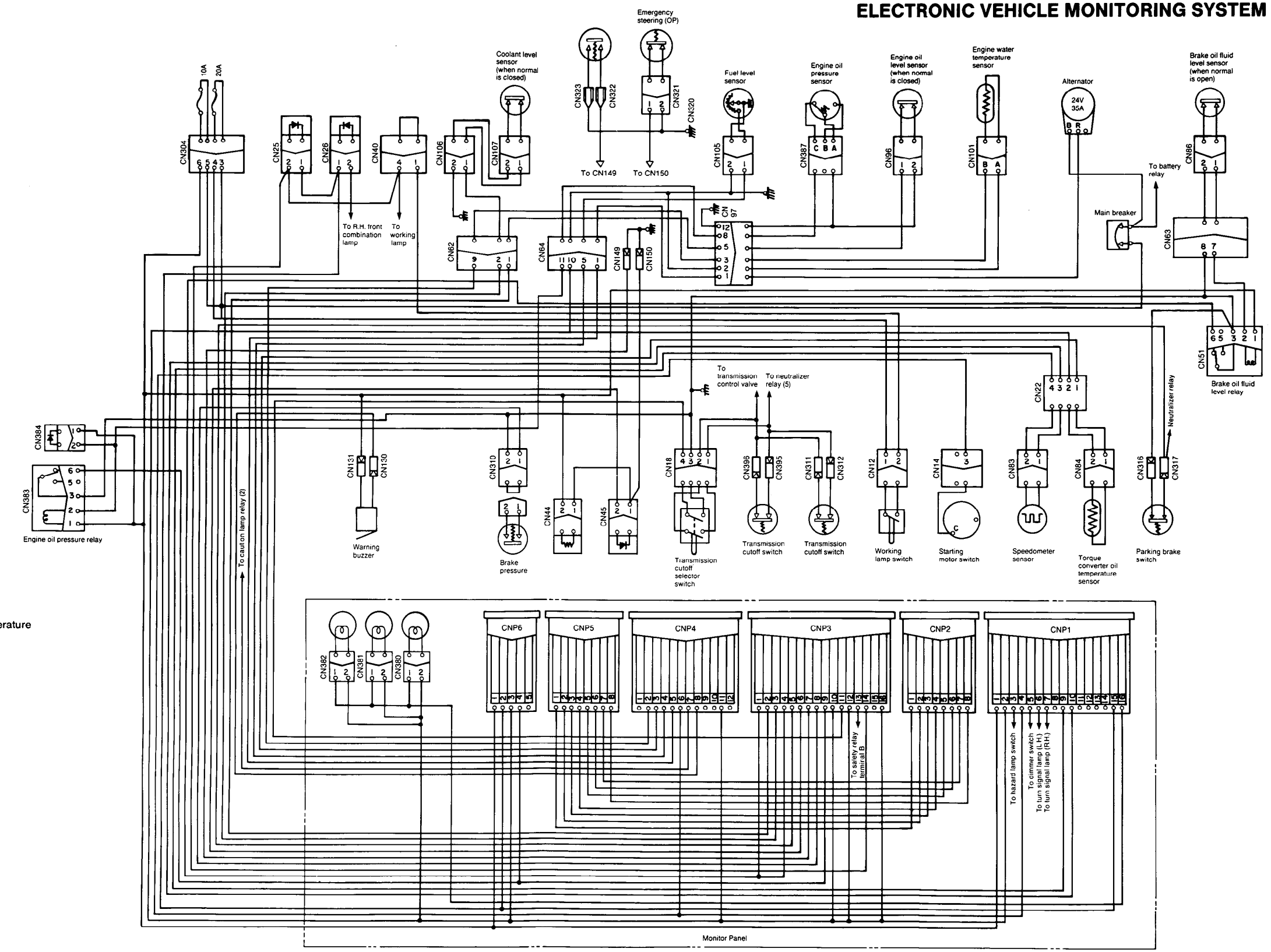
1.
2. Coolant temperature
3. Torque converter oil temperature
4. Fuel level
5. Charge
6. Starting switch
7. Warning lamp
8. Warning buzzer
9.
10.
11. Spare
12.

CNP5

1. VB
2. VCC
3. T
4. SCL
5. LOAD
6. RES
7. GND
8. VIN

CNP6

1. +24V
2. Flicker in power
3. GND
4. Engine oil level
5.



L08DD050

Komatsu America International Company
440 North Fairway Drive
Vernon Hills, IL 60061-8112 U.S.A.
Attn: Technical Publications
Fax No. (847) 970-4186

PROPOSAL FOR MANUAL REVISION

FOR INTERNAL USE ONLY -- No. PMR

PROPOSER		
	NAME OF COMPANY:	LOCATION: PHONE NO:
	DEPARTMENT:	DATE:
	NAME:	

MANUAL NAME:

MANUAL NO:

MACHINE MODEL:
S/N IF APPLICABLE:

PAGE NO:

PROBLEM:

Attach photo or sketch.
If more space is needed, use another sheet.

FOR INTERNAL USE ONLY

CORRECTIVE ACTION: