Cub Cadet

8454 SERVICE MANUAL

MTD Products, LLC Product Training and Education Department

FORM NUMBER 769-00903

CONTENTS

CHAPTER 1

GENERAL INFORMATION

1. TRACTOR VIEW

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2. TIGHTENING TORQUE FOR STANDARD BOLTS AND NUTS

2.1 TIGHTENING TORQUE

Screws, bolts and nuts whose tightening torques are not specified in this workshop manual should be tightened according to the table below.

A. TIGHTENING TORQUE FOR STANDARD BOLTS AND NUTS

Grade / Unit / Nominal Diameter	No grade 4T (4)			7T (7)			9T (9)		
	N·m	Kgf·m	lbf·ft	N·m	Kgf·m	lbf·ft	N·m	Kgf·m	lbf·ft
M 6 (6 mm, 0.24 in.)	7.85 ~ 9.30	0.80 ~ 0.95	5.79 ~ 6.87	9.80 ~ 11.2	1.00 ~ 1.15	7.24 ~ 8.32	12.3 ~ 14.2	1.25 ~ 1.45	9.1 ~ 10.5
M 8 (8 mm, 0.31 in.)	17.7 ~ 20.5	1.8 ~ 2.1	13.0 ~ 15.2	23.6 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
M 10 (10 mm, 0.39 in.)	39.2 ~ 45.0	4.0 ~ 4.6	29.0 ~ 33.2	48.1 ~ 55.8	4.9 ~ 5.7	35.5 ~ 41.2	60.8 ~ 70.5	6.2 ~ 7.2	44.9 ~ 52.1
M 12 (12 mm, 0.47 in.)	62.8 ~ 72.5	6.4 ~ 7.4	46.3 ~ 53.5	77.5 ~ 90.1	7.9 ~ 9.2	57.2 ~ 66.5	103 ~ 117	10.5 ~ 12.0	76.0 ~ 86.8
M 14 (14 mm, 0.55 in.)	108 ~ 125	11.0 ~ 12.8	79.6 ~ 92.5	124 ~ 147	12.6 ~ 15.0	91.2 ~ 108	167 ~ 196	17.0 ~ 20.2	123 ~ 144
M 16 (16 mm, 0.63 in.)	167 ~ 191	17.0 ~ 19.5	123 ~ 141	196 ~ 225	20.0 ~ 23.0	145 ~ 166	260 ~ 303	26.5 ~ 31.0	192 ~ 224
M 18 (18 mm, 0.71 in.)	245 ~ 284	25.0 ~ 29.0	181 ~ 210	275 ~ 318	28.0 ~ 32.5	203 ~ 235	343 ~ 401	35.0 ~ 41.0	254 ~ 297
M 20 (20 mm, 0.79 in.)	334 ~ 392	34.0 ~ 40.0	246 ~ 289	368 ~ 431	37.5 ~ 44.0	272 ~ 318	490 ~ 568	50.0 ~ 58.0	362 ~ 420

* The figures on the table above are indicated the top of screw of bolt.

B. TIGHTENING TORQUE FOR STUDS

M8	11.7 to 15.7 N·m	1.2 to 1.6 kgf·m	8.6 to 11.5 lbf·ft
M10	24.5 to 31.4 N·m	2.5 to 3.2 kgf·m	18.0 to 23.1 lbf·ft
M12	34.3 to 49.0 N·m	3.4 to 5.0 kgf·m	25.3 to 36.1 lbf·ft

C. TIGHTENING TORQUE FOR HIGH PRESSURE HOSE UNION NUTS

Hose Size (Inside Diameter: Inches)		1/8″	3/16″	1/4″	5/16″	3/8″	1/2″	5/8″, 3/4″	1″
Screw Size (PF)		1/8″	1/4″	1/4″	3/8″	3/8″	1/2″	3/4″	1″
Tightening Torque	(N·m)	9.8	24.5	24.5	49.0	49.0	58.8	117.7	137.3
	(kgf·m)	1	2.5	2.5	5	5	6	12	14
	(lbf·ft)	7.2	18.0	18.0	36.1	36.1	43.3	86.8	101.2

3. SPECIFICATION

MODEL		8454
Maximum PTO power		38 HP
Engine GROSS power		45 HP
Engine	Model	4A220
	Type	Indirect injection, vertical, water-cooled, 4cycle diesel
	Number of cylinders	4
	Bore and stroke	87 x 92.4 (3.425 x 3.638in.)
	Total displacement	2,197
	Rated revolution	2,600 RPM
	Injection timing	18 before T.D.C.
	Injection order	1-3-4-2
	Compression ratio	22:01
	Lubricating system	Forced lubrication by trochoida pump
	Cooling system	Pressurized radiator, Forced circulation with water pump
	Alternator	12V, 50 AMPS
	Weight (Dry)	207 kg (456lb)
Capacities	Fuel tank	40 L (10.6 gal.)
	Engine crankcase	7.0 L (1.9 gal.)
	Engine coolant	8.9 L (2.4 gal.)
	Transmission case	34.0 L (9.0 gal.)
	Front axle case	8.2 L (2.2 gal.)
Dimensions (with std.tires)	Overall length (without 3p)	3,073mm (120.9 in.)
	Overall length (with 3p)	3,323mm (130.8 in.)
	Overall Length (minimum tread)	1,550mm (61.0 in.)
	Overall height (Top of ROPS)	2,235 mm (88.0 in.)
	Overall height (Top of CABIN)	2,337 mm (92.0 in.)
	Overall height (Top of steering wheel)	1,610 mm (63.3 in.)
	Wheelbase	1,820 mm (71.6 in.)
	Ground clearance	370 mm (14.5 in.)
Track width	Front	1,265 mm (49.8 in)
	Rear	1,180 - 1,490mm (46.4 - 58.6 in.)

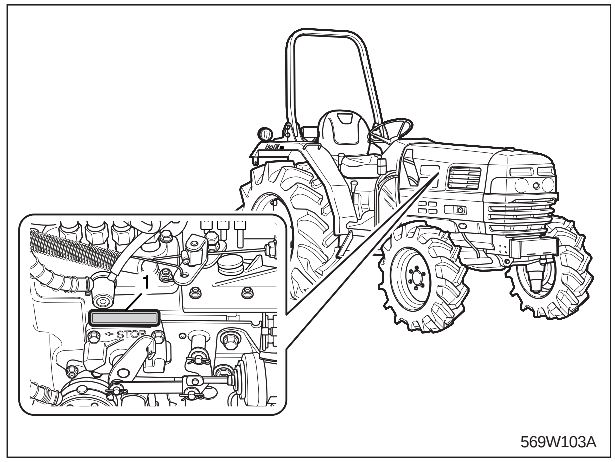
3. SPECIFICATION CON'T

Drive system	Tire size (Std. Tires)	Front	9.5 - 16.6
		Rear	14.9 - 24.8
	Clutch		Dry single disc
	Steering		Hydrostatic steering system
	Transmission		Synchronized shuttle 12 forward and 12 reverse speeds
	Brake	Travel	Wet disc type
		Parking	Connected with the traveling brake
	Differential		Bevel gear
Hydraulic system	Hydraulic lift control system		Position, Draft and Mix control
	Pump Capacity	Main Pump	31.2 L/min (8.2 gal.)
		Power steering pump	18.7 L/min (5.0 gal.)
	Three point hitch		SAE Category 1 & 2
	Maximum lifting capacity		1,800 kg (3,968 lb)
	No. of remote control valve ports (option)		2-4
PTO	PTO shaft		SEA 1 3/8, 6 splines
	Revolution (independent PTO)		560 rpm
Min. turning radius (without Brake)			2,865 mm (112.7 in.)
Traction system			Fixed drawer (or swing drawer Option)
Weight (with ROPS)			1,720 kg (3,792 lb)
Traveling speed (at rated engine speed with Std tires)			0.37 - 24.6 km/h (0.23 - 15.29 mph)

4. IDENTIFICATION

4.1 ENGINE NUMBER

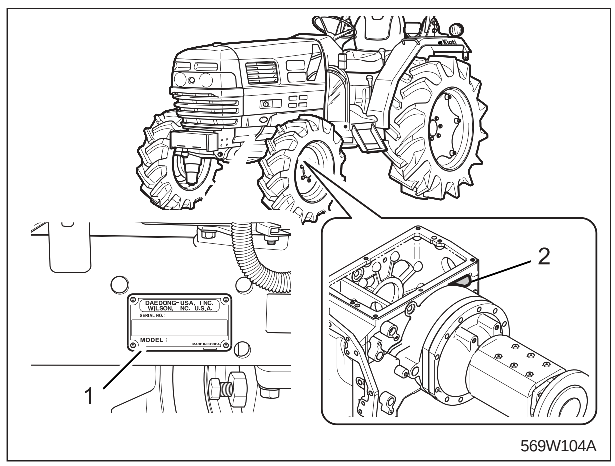
Engine number is engraved in the left side of the cylinder block as shown in the figure.Engine number fills the important role of providing it’s record.



(1) Engine Serial Number

4.2 SERIAL NUMBER OF THE TRACTOR

Serial number of the tractor is stamped on the left side of the front axle frame as shown in the figure.



(1) Tractor Serial Number

(2) Transmission Serial Number

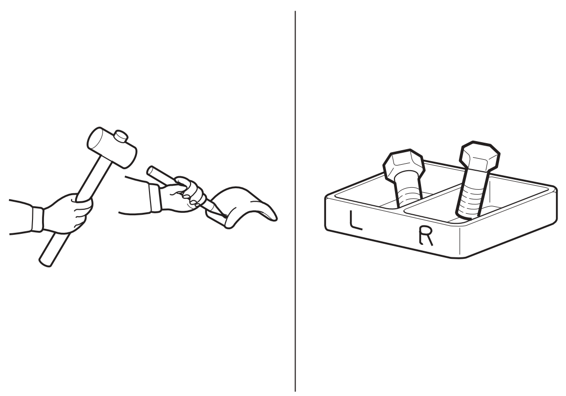
5. CAUTION BEFORE REPAIR

5.1 BEFORE REPAIR OR INSPECTION

1. In case of repair or inspection, locate the tractor on the flat ground and pull the parking brake on.
2. Except for the items to be checked while the engine is running, be sure to stop the engine prior to the work.
3. When washing parts, use parts washing solvent for industrial use (avoid using gasoline so to prevent environmental pollution). For the hydraulic parts, apply designated hydraulic oil in washing.
4. When disassembling and assembling of the hydraulic apparatus, pay special attention not to allow dust or foreign substance to be attached or intermixed.

5.2 ASSEMBLY AND DISASSEMBLY

To check a failure, try to find out its underlying cause. If assembly or disassembly is needed, perform the work in regular sequence as specified in this repair manual.



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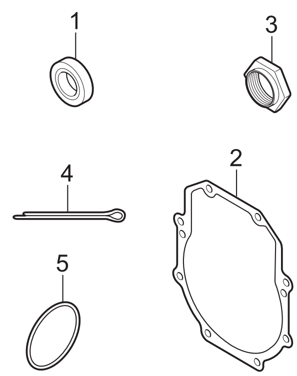
1. Disassembled parts shall be arranged orderly.
2. Sort out the parts to be replaced from the ones to be reused.
3. Be sure to use standard bolts and nuts that are designated.
4. When assembling snap rings or spring pin types, take care of assembling direction.
5. Split pin shall be spread surely not to escape when installed.
6. When using sealant (such as gasket bond) on the assembled surfaces, apply it evenly and consistently in a height of 3 ~ 5 mm (0.12 ~ 0.2 in.) on the contact surface after removing the old bond and cleaning the sealing surface with solvent. Apply sealant on the center of the contact surface for the space between the bolt holes of the contact surface, and on the more inner side than the bolt hole for the bolt area.
7. Finish assembly within 20 minutes after applying sealant, after that, wait approx. 30 minutes later before filling with oil.

5.3 PARTS TO BE REPLACED



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The following parts should be replaced with new ones when removed.

(1) Oil Seal

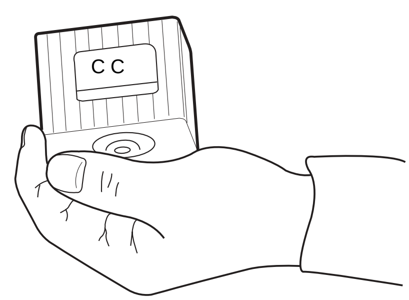
(2) Gasket

(3) Lock Nut

(4) Split Pin

(5) O-Ring

5.4 PARTS



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When replacing part only genuine Cub Cadet parts.

5.5 ASBESTOS PARTS

Since dust out of asbestos fibrous parts is extremely dangerous to your health, be sure to clean such parts carefully, do not use compressed air.

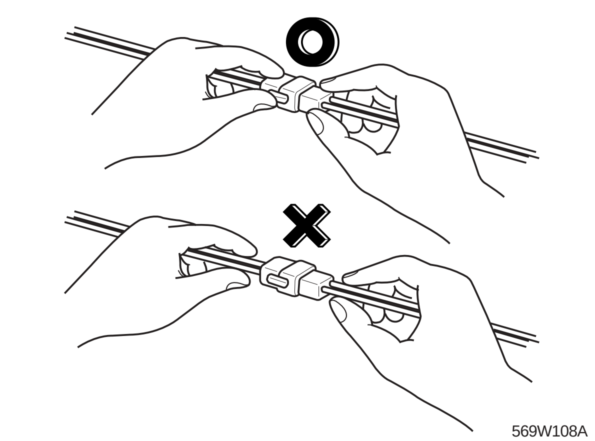
5.6 ELECTRICAL SYSTEM

1. Check electrical wiring every year for any damage or short circuit at the connections. In addition, have your dealer inspection the electric system regularly.
2. Do not modify or reorganize the wiring of the electric field parts.
3. When disconnecting the battery cable, disconnect negative cable first, reinstall the positive cable first when reinstalling.

Disconnect battery negative terminal

CAUTION

- *Be sure to turn the starting key OFF when connecting or disconnecting the cable.*



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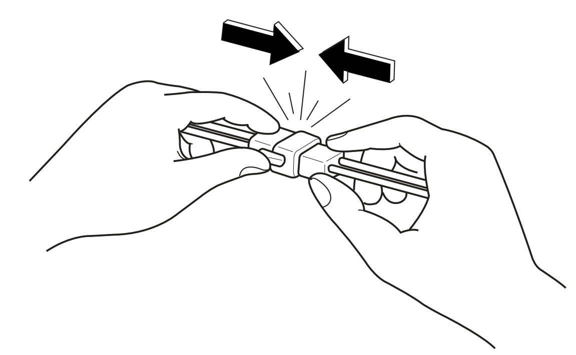
4. Remove the connector by pulling the plastic section, not the wiring.



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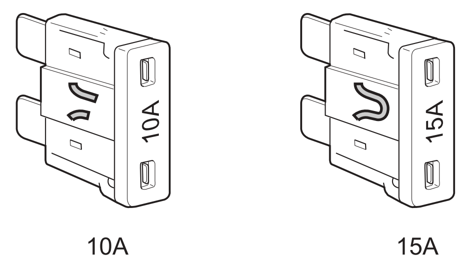
5. When connecting the connector, insert it until it snaps.



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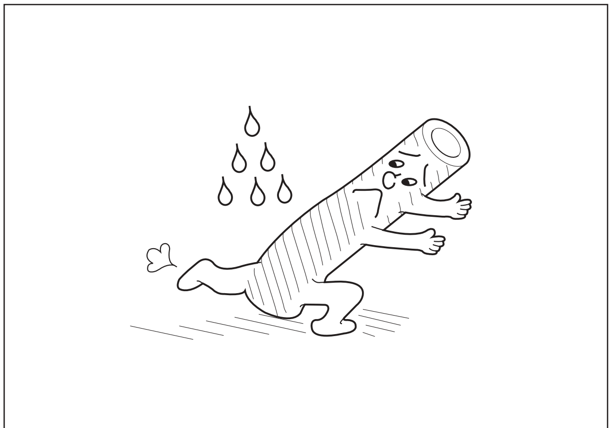
6. Be sure not to drop sensors and relays which are fragile.
7. When replacing a broken fuse with a new one, be sure to use the fuse of capacity as specified.

5.7 TUBES AND RUBBERS



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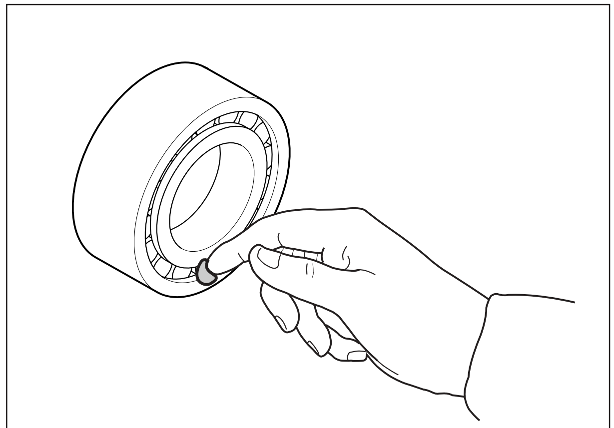
Be cautious of oil or other petroleum products on the hoses and rubber parts, this may cause damage.

5.8 LUBRICANT



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When assembling and fixing, apply designated lubricant where specified in accordance with this repair manual.

6. REGULAR CHECK LIST

◎ the first
○ periodically

Check Items	Indicated Hours By Hour Meter														Since Purchased	
	50	100	150	200	250	300	350	400	450	500	600	700	800	1500hr	1yr	2yr
Engine oil change	◎	○		○		○		○		○	○	○	○			
Engine oil filter cartridge change	◎			○				○			○		○			
Transmission oil change	◎					○					○					
Hydraulic oil filter change	◎			○				○			○		○			
Front axle oil change	◎					○					○					
Applying grease	○	○	○	○	○	○	○	○	○	○	○	○	○			
Clutch pedal deflection	◎		○			○			○		○		○			
Brake pedal deflection			○			○			○		○		○			
Fan belt tension				○				○			○		○			
Fuel filter element change								○					○			
Air cleaner element change		○		○		○		○		○	○	○	○			
Battery electrolyte			○			○			○		○		○			
Oil pressure fuel pipe's inlet screw if loosened	○	○	○	○	○	○	○	○	○	○	○	○	○			
Radiator hose's inlet bands if loosened			○			○			○		○		○			
Fuel pipe change																○
Radiator hose change																○
Hydraulic pipe joint change																○
Steering hose change																○
Toe-in			○			○			○		○		○			
Deflection adjustment in front and rear of the front axle											○					
Direction control section													○			
Bolt, nuts and pins of each part															○	
Battery positive code adjustment & change	○	○	○	○	○	○	○	○	○	○	○	○	○			
Bleeding water in clutch housing	○	○	○	○	○	○	○	○	○	○	○	○	○			
Check injection nozzle*														○		

* Maintenance intervals in basis on the EPA instructions.

7. OIL & WATER SUPPLY LIST

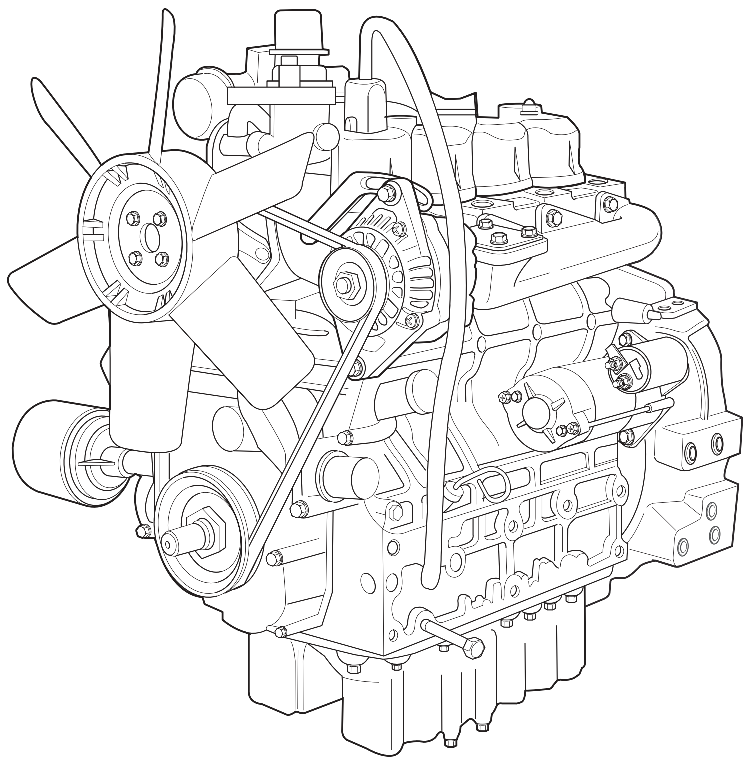
Supply Items		Capacity	Recommended Spec.
Fuel		40 ℓ (42.3 U.S.gal.)	No. 2 - D diesel fuel No. 1 - D diesel fuel if temperature is below - 10 °C (14 °F)
Coolant		8.9 ℓ (2.4 U.S.gal.)	Fresh clean water with antifreeze
Engine oil		7.0 ℓ (1.8 U.S.gal.)	SAE 15 W - 40
Transmission oil		34 ℓ (9.0 U.S.gal.)	Universal tractor/transmission hydraulic oil
Front axle section		8.2 ℓ (2.2 U.S.gal.)	
Applying grease	Hydraulic control lever shaft section	Small quantity	SAE multi-purpose type grease
	3 point link section	Until grease exits	
	Brake pedal link section		
	Bracket section in front and rear of the front axle		
	Clutch release hub	Supply when removed	

CHAPTER 2

ENGINE

1. GENERAL

1.1 APPEARANCE



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The DAEDONG A series engines are vertical, water-cooled, 4-cycle, three or four cylinders diesel engines, they concentrate DAEDONG's foremost technologies.

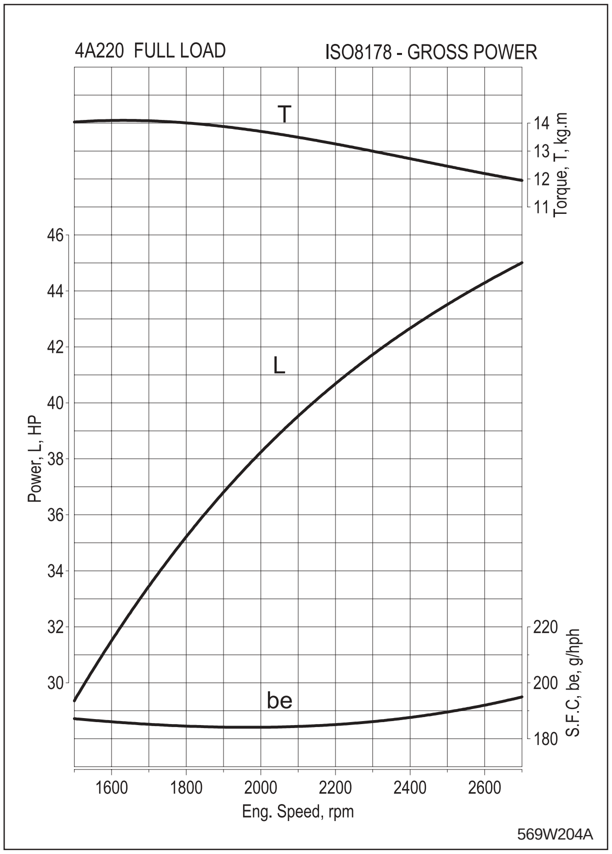
With swirl combustion chamber, bosch K type fuel injection pump, well-balanced designs, they feature greater power, low fuel consumption, less vibration and noise, and low emission.

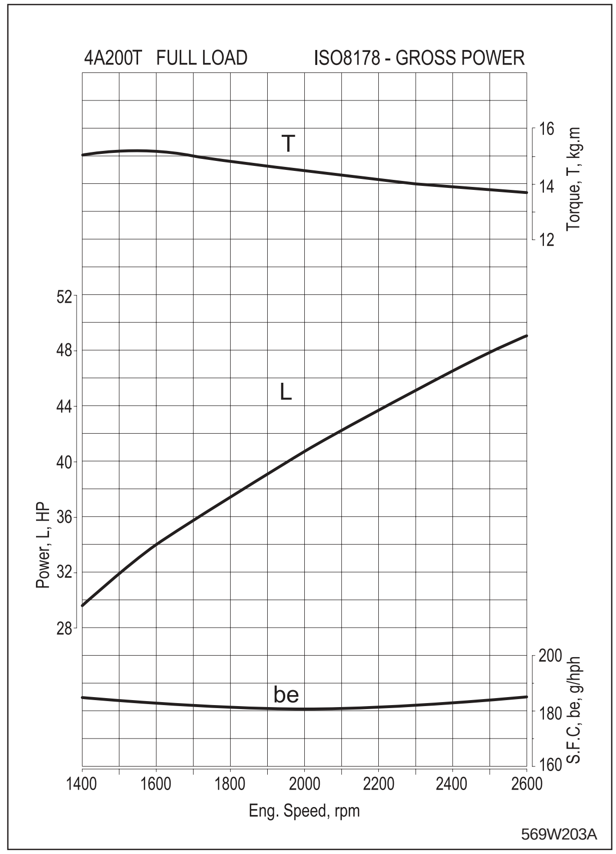
1.2 SPECIFICATIONS

MODEL	4A220	4A200T
Type	Vertical, water-cooled, 4-cycle diesel engine	Vertical, water-cooled, 4-cycle diesel engine (Turbo)
Number of cylinder	4	4
Bore and stroke mm (in.)	87.0 x 92.4 (3.43 x 3.64)	83.0 x 92.4 (3.27 x 3.64)
Total displacement cc (in^3.)	2,197(134.1)	1,999(122.0)
Combustion chamber	vortex chamber	vortex chamber
POWER (NET) PS/rpm (kW. rpm)	43/2,700 (30.9/2,700)	47/2,600 (34.6/2,600)
Maximum idling speed rpm	2,900	2,800
Minimum idling speed rpm	850 ~ 900	850 ~ 900
Order of firing	1-3-4-2	1-3-4-2
Direction of rotation	Counterclockwise (viewed from flywheel side)	Counterclockwise (viewed from flywheel side)
Injection pump	Bosch K TYPE mini pump	Bosch K TYPE mini pump
Injection pressure	140 ~ 150 kgf/cm^2 (13.73 ~ 14.71 MPa, 1991 ~ 2133 psi)	140 ~ 150 kgf/cm^2 (13.73 ~ 14.71 MPa, 1991 ~ 2134 psi)
Injection timing (Before T.D.C)	18°	12°
Compression ratio	22 : 1	22 : 1
Fuel	Diesel fuel	Diesel fuel
Lubricant	Engine oil SAE 15W-40	Engine oil SAE 15W-40
Dimensions mm (length x width x height) (in.)	817.3 x 488.1 x 735.8 (32.2 x 19.2 x 29.0)	817.3 x 542.0 x 735.8 (32.2 x 19.2 x 29.0)
Dry weight kg (kg, lbs.)	207 (456)	211 (465)

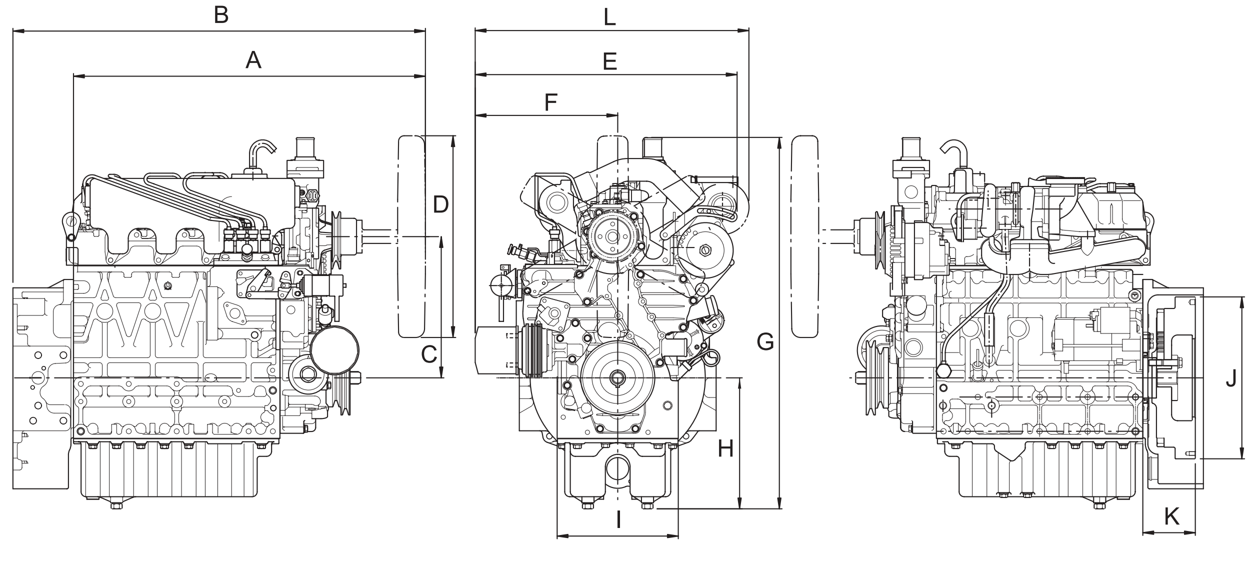
*** NOTE:** Change of parts are not subject to advance notice.

1.3 PERFORMANCE CURVE





1.4 DIMENSIONS



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Sample/td Spec.

mm (in.)

	A	B	C	D	E	F
4A220	697.3 (27.45)	817.3 (32.18)	280 (11.02)	ϕ 400 (15.75)	502.6 (19.79)	262.5 (10.33)
4A200T	697.3 (27.45)	817.3 (32.18)	280 (11.02)	ϕ 400 (15.75)	519 (20.43)	282.4 (11.12)
	G	**H**	**I**	**J**	**K**	**L**
4A220	736 (28.98)	260 (10.24)	240 (9.45)	ϕ 321 (12.64)	104.5 (4.11)	-
4A200T	736 (28.98)	260 (10.24)	240 (9.45)	ϕ 321 (12.64)	104 (4.09)	542 (21.34)

1.5 GENERAL WARNING

- When disassembling, arrange each part on a clean place. Do not mix them up. Replace bolts and nuts where they were.
- When connecting instruments to electrical equipment, first disconnect battery negative terminal.
- Replace gaskets or O-rings with new ones when reassembling, and apply grease on a O-rings and the oil seals when reassembling.
- When exchanging parts, use genuine DAEDONG parts to maintain engine performance and safety.
- To prevent oil and water leakage, apply non-drying adhesive to the gaskets according to this manual before reassembling.
- When hoisting up the engine, use the hook provided on the cylinder head.
- When installing the engine, use the hook provided on the cylinder head.
- When installing external cir-clips or internal cir-clips, direct corner end to the non- loosening direction.

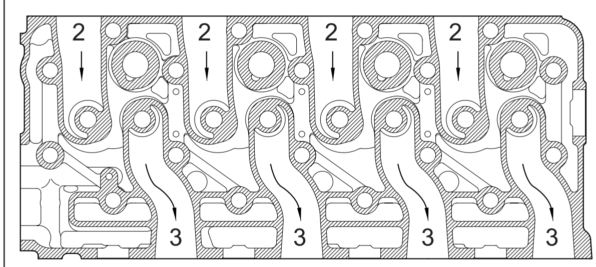
2. STRUCTURE AND FUNCTION

2.1 BODY

A. CYLINDER HEAD

The cylinder head is made of special alloy cast iron which can resist high temperature and pressure caused by combustion. The intake and exhaust ports are arranged cross-flow type to get high combustion efficiency by protecting the suction air from being heated and expanded by heated exhaust air.

The Daedong vortex type combustion chamber is designed for high efficiency combustion and reducing fuel consumption. The glow plugs assures easy engine starts even at (-) 15 °C (5 °F).



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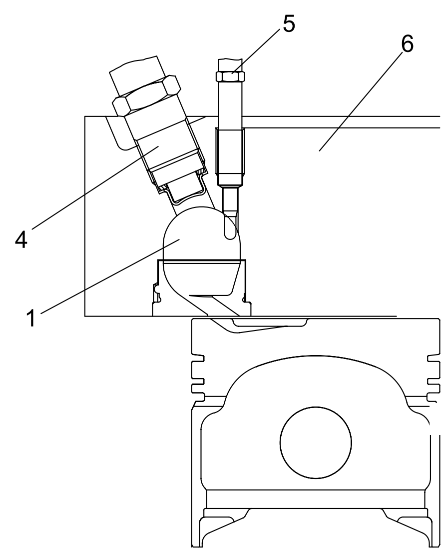
(1) Combustion Chamber
(2) Inlet Port
(3) Exhaust Port
(4) Injection Nozzle
(5) Glow Plug
(6) Cylinder Head



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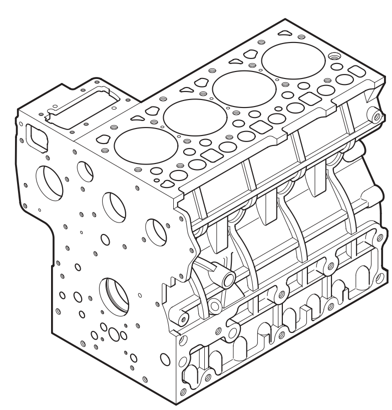
B. CYLINDER BLOCK

The engine has a high durability tunnel-type cylinder block. Furthermore, liner less type, allows effective cooling, less distortion, and greater wear-resistance using special material. The noise is reduced to a minimum because each cylinder had its chamber.



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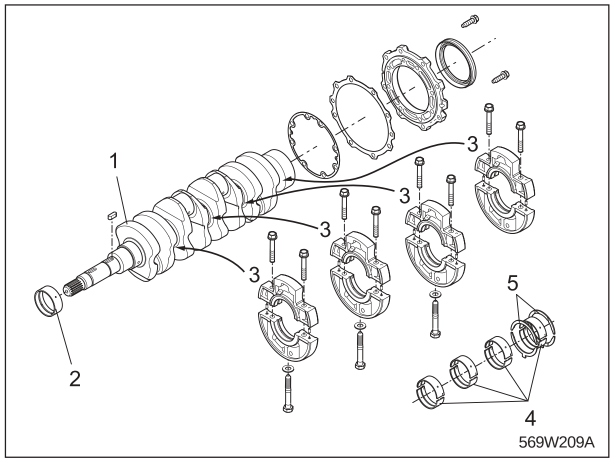
C. CRANKSHAFT

The crankshaft is made of forged steel and the journals, the crankpins and the bearing surface for the oil seal are induction-hardened to increase wear resistance. Each crankshaft journal is supported by the main bearing case (3) having a bearing inside.

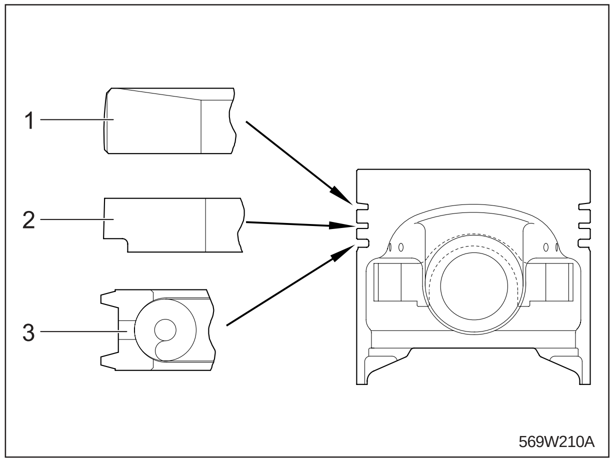
The front crankshaft bearing (2) is a solid type bushing and rear and intermediate bearings are a split type. The crankshaft's bearings have oil holes for lubricant flow.



(1) Crankshaft
(2) Crankshaft Bearing
(3) Main Bearing Case
(4) Crankshaft Bearing 2
(5) Thrust Bearing

D. PISTON AND PISTON RINGS

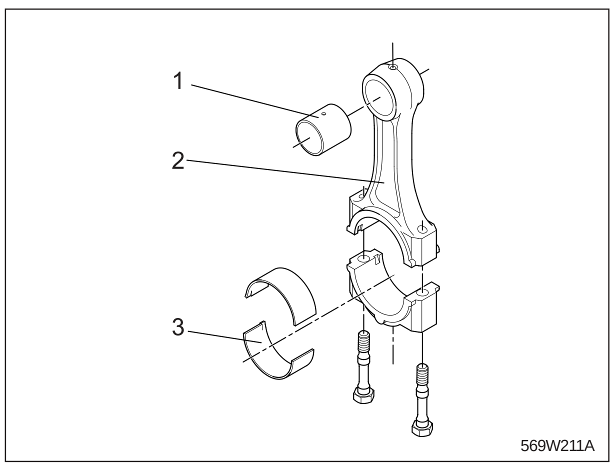
The piston are made of an aluminum alloy which is temperature and pressure resistant. Three rings installed in grooves of the piston. The top ring (1) is a keystone type, which can withstand heavy loads, and the barrel face on the ring fits well to the cylinder wall. The second ring (2) is an undercut type, which prevents the oil from being carried up. The oil ring (3) has chambered contact faces and an expander ring, which increase the pressure of the oil ring against the cylinder wall to scrape the oil. The top ring is plated with hard chrome to increase wear resistance (The ring of 4A200T engine is mode of a special steel).



(1) Top Ring
(2) Second Ring
(3) Oil Ring

E. CONNECTING ROD

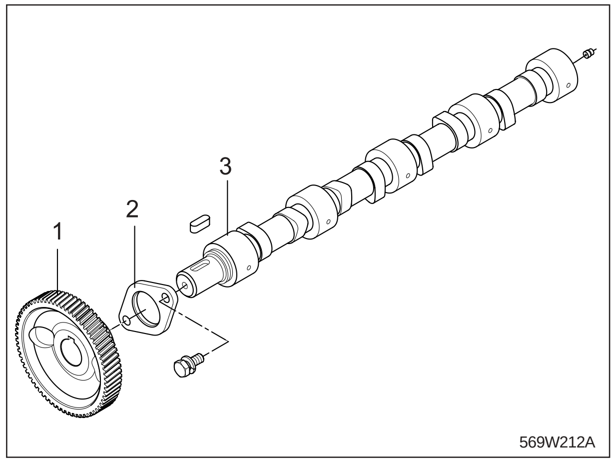
The connecting rod (2), which converts the reciprocating motion of the pistons caused by the fuel combustion into the rotating motion of the crankshaft, is made of harden forged steel. The connecting rod has bearings at both ends. The small end has a solid type bearing (small end bushing (2)) and the big end has a split type bearing (crankpin bearing (3)).



(1) Small End Bushing
(2) Connecting Rod
(3) Crankpin Bearing

F. CAMSHAFT

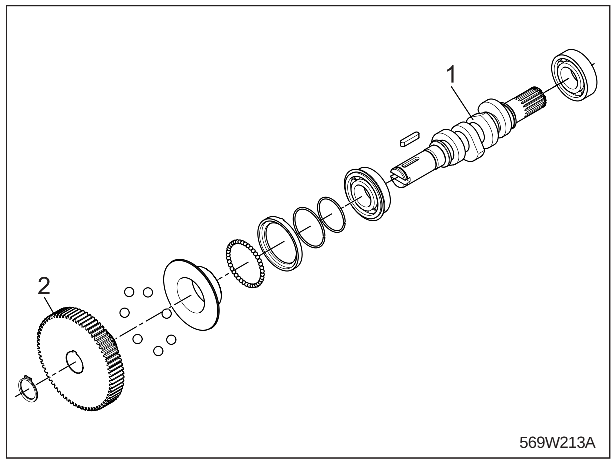
The camshaft (3) is made of forged steel and it's journals and cams are hardened to increase wear resistance. The cams on the camshaft open and close the intake and exhaust valves with the push rods and rocker arms. The journals and their bearings are force-lubricated.



(1) Cam Gear
(2) Camshaft Stopper
(3) Camshaft

G. FUEL CAMSHAFT

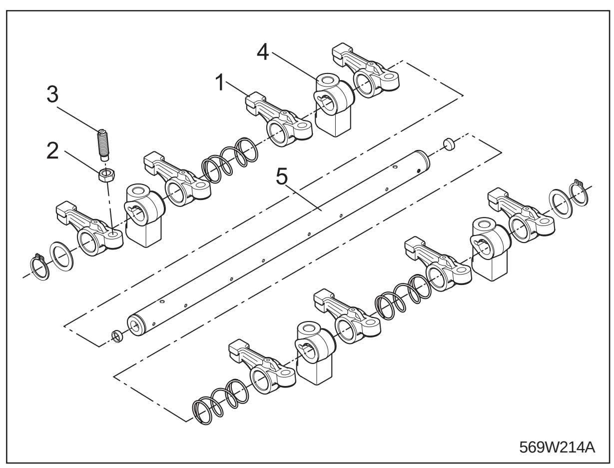
This fuel camshaft is made of forged steel and its cams are hardened and tempered to increase wear resistance. The cams on the fuel camshaft (1) drive the injection pump and the fuel transfer pump. The governor balls are installed on the fuel camshaft to control the engine speed.



(1) Fuel Camshaft
(2) Injection Pump Gear

H. ROCKER ARM ASSEMBLY

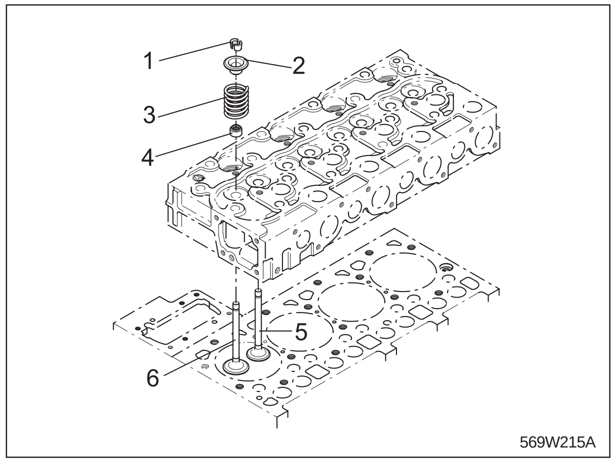
The rocker arm assembly includes the rocker arms (1) and an adjusting screw (3), which is at the end of rocker arm and rests on the push rod, rocker arm brackets (4) and rocker arm shaft (5). The rocker arms are activated by the reciprocating motion of the push rods and open or close the intake and exhaust valves. The rocker arm and other parts are lubricated through the drilled holes of the brackets and the rocker arm shaft.



(1) Rocker Arm
(2) Lock Nut
(3) Adjusting Screw
(4) Rocker Arm Bracket
(5) Rocker Arm Shaft

I. INTAKE AND EXHAUST VALVES

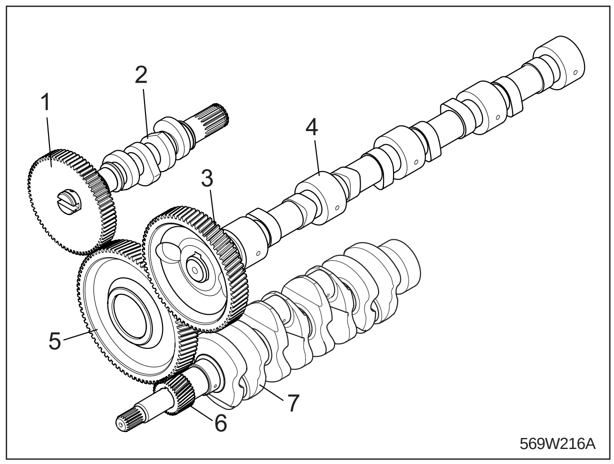
The valve and its guide of the intake are different from those for the exhaust. Other parts, such as the spring, spring retainers, valve spring collets, valve stem seals are the same for both the intake and the exhaust. All contact or sliding surfaces are hardened to increase wear resistance.



(1) Valve Spring Collet
(2) Valve Spring Retainer
(3) Valve Spring
(4) Valve Stem Seal
(5) Exhaust Valve
(6) Intake Valve

J. TIMING GEARS

The crankshaft drives the oil pump and the idle gear engaged fuel camshaft and camshaft. The timing for opening and closing the valves is extremely important to achieve effective air intake and sufficient gas exhaust. The appropriate timing can be obtained by aligning the mark on the crankshaft gear (6) with one the idle gear (5), idle gear with camshaft gear, idle gear with injection pump gear, when assembling.

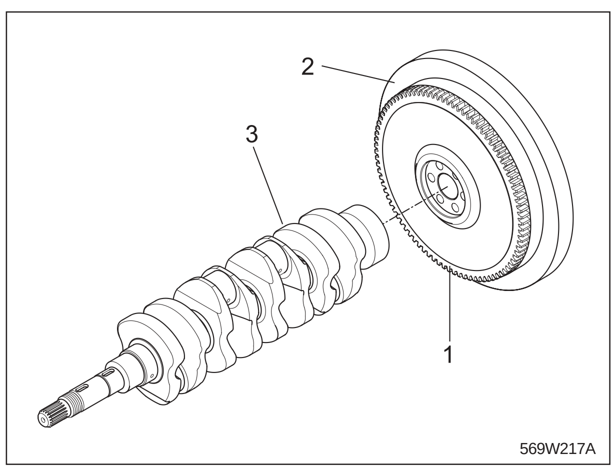


(1) Injection Pump Gear
(2) Fuel Camshaft
(3) Camshaft Gear
(4) Camshaft
(5) Idle Gear
(6) Crankshaft Gear
(7) Crankshaft

K. FLYWHEEL

The flywheel is installed on the rear end of the crankshaft. Its inertia keeps the engine turning at a constant speed, while the crankshaft tends to speed up during the power stroke and to slow down during other stokes. The flywheel has a ring gear (1), which meshes with the drive pinion of the starter.

The flywheel has marks "TC" and "FI" on its outer rim. The mark TC shows the piston's top dead center and the mark FI shows the fuel injection timing, when they are aligned with the mark of window on the clutch housing.

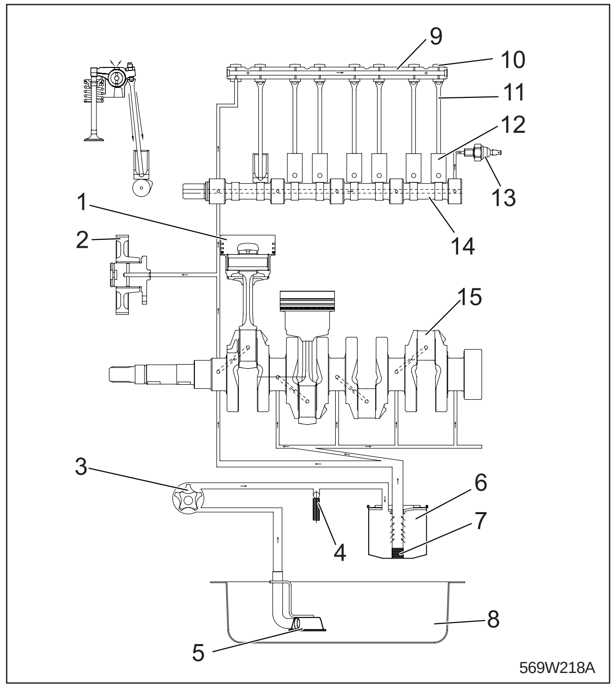


(1) Ring Gear
(2) Flywheel
(3) Crankshaft

2.2 LUBRICATING SYSTEM

A. FLOW OF LUBRICATING OIL

The lubricating oil is forced to each journal through the oil passages of the cylinder block, cylinder head and shafts. The oil, splashed by the crankshaft or thrown off from the bearings, lubricates other engine parts such as the push rods (11), tappets (12), piston pins and timing gears.

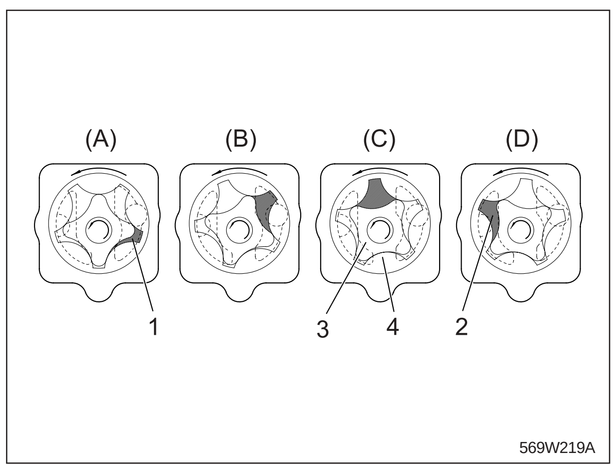


(1) Piston
(2) Idle Gear
(3) Oil Pump
(4) Relief Valve
(5) Strainer
(6) Oil Filter Element
(7) Bypass Valve
(8) Oil Pan
(9) Rocker Arm Shaft
(10) Rocker Arm
(11) Push Rod
(12) Tappet
(13) Oil Pressure Switch
(14) Camshaft
(15) Crankshaft

B. OIL PUMP

The oil pump is a gear type. Whose rotors have trochoid lobes. The inner rotor (3) has 4 lobes and the outer rotor (4) has 5 lobes, and they are eccentrically engaged to each other. The inner rotor, which is driven by the crankshaft through the gears, rotates the outer rotor in the same direction, varying the space between the lobes.

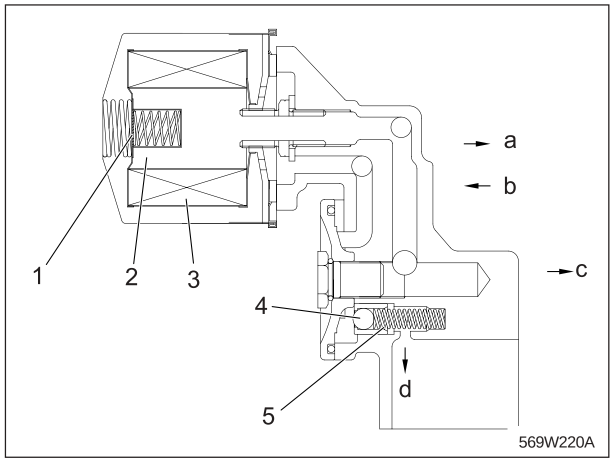
While the rotors rotate from (A) to (B), the space leading to the inlet port increases, which causes the oil to flow through the inlet port. When the rotors rotate to (C), the port to which the space leads is changed from inlet to outlet. At (D), the space decreases and oil is discharged though the outlet port.



(1) Inlet
(2) Outlet
(3) Inner Rotor
(4) Outer Rotor

C. OIL FILTER AND RELIEF VALVE

The lubricating oil force-fed by the pump is filtered by the filter cartridge, passing through the filter element from the outside to the inside. When the filter element accumulates dirt and the pressure difference between the inside and the outside rises more than 98 kPa (1.0 kgf/cm^2, 14 psi), the bypass valve (1) opens to allow the oil to flow from the inlet line to outlet line, bypassing the filter element. The relief valve ball (4) in the inlet line allows oil to prevent damage to the lubricating system, when the oil pressure rises more than 441 kPa (4.5 kgf/cm^2, 64 psi).

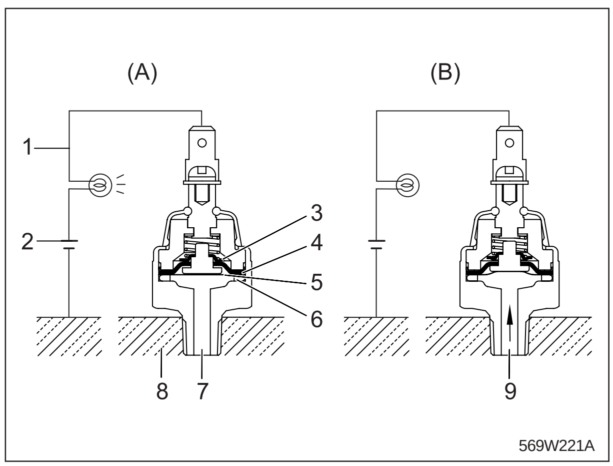


(1) Bypass Valve
(2) Bypass Adjusting Spring
(3) Filter Element
(4) Relief Valve Ball
(5) Relief Adjusting Spring

(a) To Idle Gear, Camshaft and Rocker Arm
(b) From Oil Pump
(c) To Crankshaft Journal Crankpin
(d) Drain of Relief Valve

D. OIL PRESSURE SWITCH

The oil pressure switch is installed on the cylinder block and leads to the oil passage of the lubricating oil. When the oil pressure falls below the specified value, the contacts of the oil pressure switch closes to turn on the warning lamp (1).



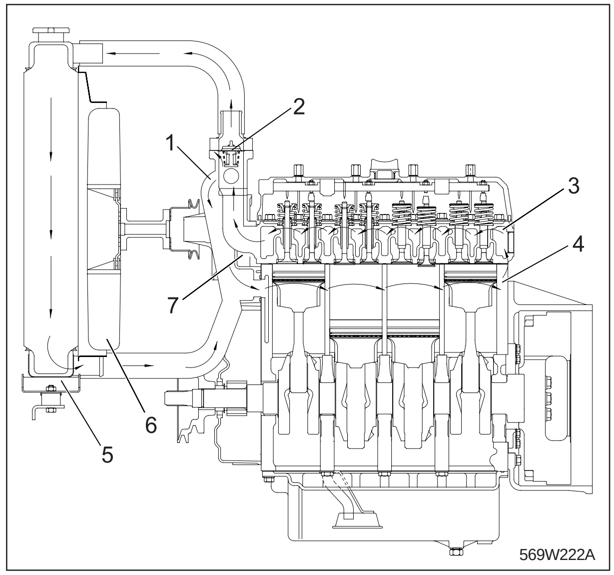
(A) At lower Oil Pressure
(49 kPa (0.5 kgf/cm^2, 7 psi) or less)
(B) At Proper Oil Pressure

(1) Warning Lamp
(2) Battery
(3) Contact Movable
(4) Contact Cup
(5) Diaphragm
(6) Rubber washer
(7) Oil Pressure
(8) Cylinder Block
(9) Pressure

2.3 COOLING SYSTEM

A. FLOW OF COOLING WATER

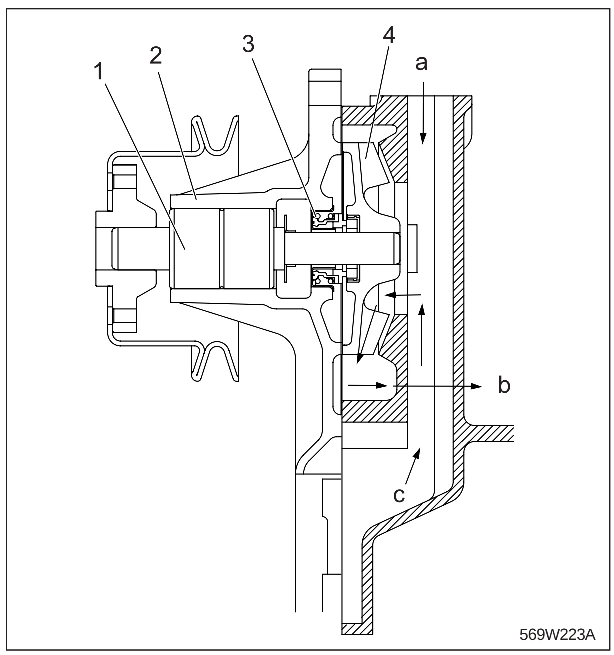
The cooling system consists of a radiator (5), a centrifugal water pump (7), a cooling fan (6) and a thermostat (2). The water is cooled as it flows through the radiator core, and the fan behind the radiator pulls the cooling air through the radiator core. The water pump receives water from the radiator or from the cylinder head and forces it into cylinder block. The thermostat open or closes according to the water temperature. When the water temperature is high, the thermostat opens to allow the water to flow from the cylinder block to the radiator. When the water temperature is low, the thermostat closes and the flow stays within the block. The opening temperature of the thermostat is approx. 70 °C (160 °F).



(1) Water Return Pipe
(2) Thermostat
(3) Cylinder Head Water Jacket
(4) Cylinder Block Water Jacket
(5) Radiator
(6) Cooling Fan
(7) Water Pump

B. WATER PUMP

The water pump is driven with the fan drive pulley, which is on the water pump shaft and driven by the crankshaft with a belt. The water pump sucks the cooled water, forces into the cylinder block and draws out the hot water to the radiator repeatedly. The mechanical seal (3) prevents the water from entering the bearing (1).



(a) From the Thermostat
(b) To the Cylinder Block
(c) From the Radiator

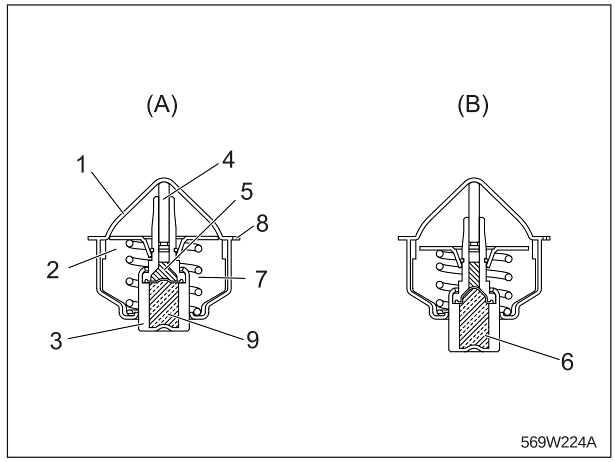
(1) Bearing
(2) Pump Body
(3) Mechanical Seal
(4) Pump Impeller

C. THERMOSTAT

The thermostat is wax pellet type, which controls the flow of the cooling water to the radiator to keep the proper temperature. The case has a seat (1) and the pellet has a valve (2). The spindle attached to the case is inserted into the synthetic rubber in the pellet. The pellet is charged with wax.

(A) At low temperature (lower than 71 °C (160 °F)). The valve (2) is seated by the spring (7) and the cooling water circulates in the engine through the water return pipe but does not enter the radiator.

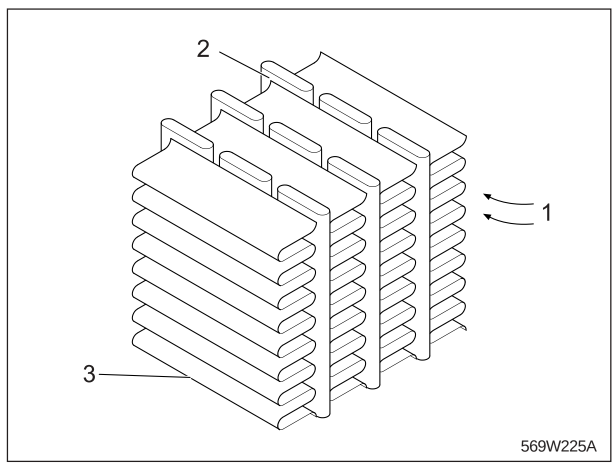
(B) At high temperature (higher than 71 °C (160° F)). As the water temperature rises, the wax in the pellet (3) turns liquid and expands, repelling the spindle. The pellet lowers and the valve (2) opens to send the cooling water to the radiator.



(1) Seat
(2) Valve
(3) Pellet
(4) Spindle
(5) Synthetic Rubber
(6) Wax (Solid)
(7) Spring
(8) Leak Hole
(9) Wax (Liquid)

D. RADIATOR

The radiator core consists of water carrying tubes (2) with fins (3) at a right angle to it. The water in the radiator is cooled by the air flowing through between the tube wall and the fin.



(1) Cooling Air
(2) Tube
(3) Fin

E. RADIATOR CAP

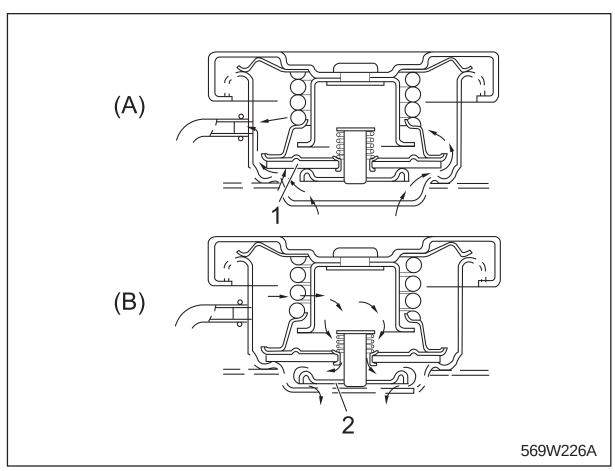
The pressure type cap is installed on the radiator, which prevents the pressure difference between the inside and the outside of the radiator from deforming the radiator.

(A) At high pressure

Higher than 88 kPa (0.9 kgf/cm^2, 13 psi) when the coolant temperature rises and the pressure in the radiator increase above the specified pressure, the pressure valve (1) opens to reduce the internal pressure.

(B) At low pressure

When the coolant temperature falls and a vacuum is formed in the radiator, the vacuum valve (2) opens to allow coolant stored in the over flow tank to enter the radiator.

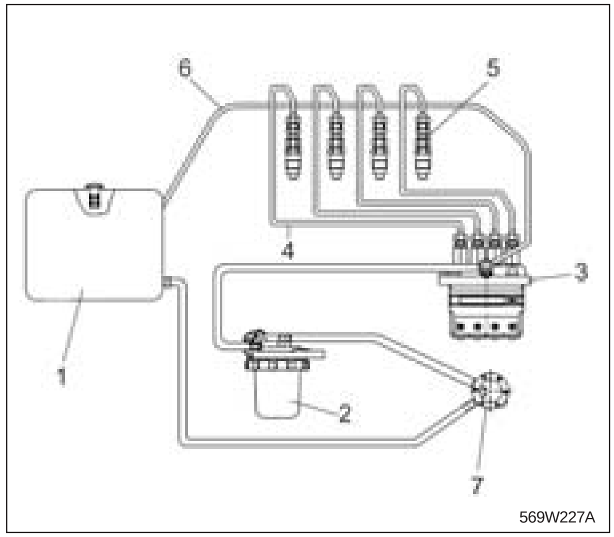


(1) Pressure Valve
(2) Vacuum Valve

2.4 FUEL SYSTEM

A. FLOW OF FUEL

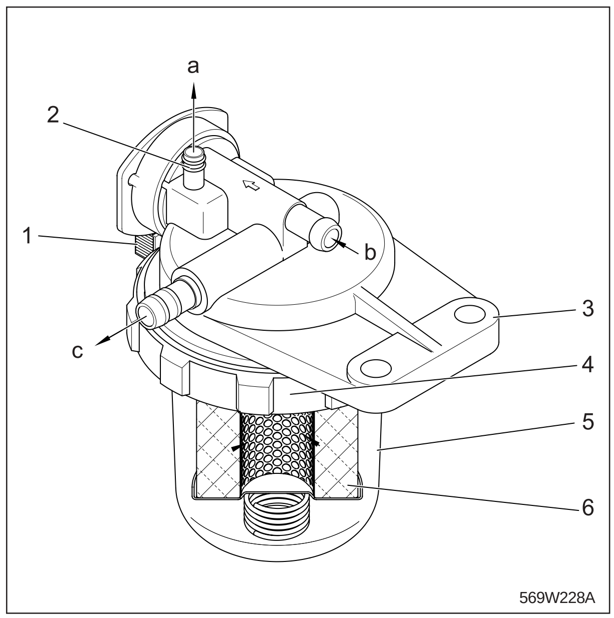
The fuel is fed from the fuel tank (1) through the fuel feed pump (7) to the injection pump (3) thru the fuel filter (2). The injection pump force-feds the fuel through the injection nozzles (5), which inject the fuel into the cylinders for combustion. The excessive fuel from the injection pump to the injection nozzles is collected in the fuel overflow pipes (6) and returns to the fuel tank.



(1) Fuel Tank
(2) Fuel Filter
(3) Injection Pump
(4) Injection Pipe
(5) Injection Nozzle
(6) Fuel Overflow Pipe
(7) Fuel Feed Pump

B. FUEL FILTER

The fuel filter removes dirt and water with its fine filter paper, which collects particles of 90 microns (0.0034 in.) at 20 kPa (0.2 kgf/cm^2, 3 psi). The fuel from the fuel feed pump is filtered by the filter element (6), while flowing through the filter body (3). The air vent (2) returns the air in the fuel to the fuel tank to prevent the engine from stopping or running irregularly.



(a) To Fuel Tank
(b) From Fuel Feed Pump
(c) To Injection Pump

(1) Cock
(2) Air Vent
(3) Filter Body
(4) Retainer Ring
(5) Pot
(6) Filter Element

C. FUEL FEED PUMP

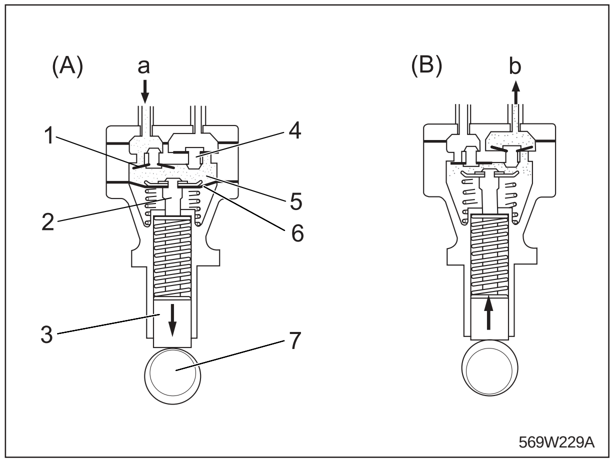
The diaphragm (6) is linked to the tappet (3) with a push rod (2). The tappet is reciprocated by the eccentric cam on the fuel camshaft (7).

(A) Inlet stroke

When the diaphragm is pulled down by the spring, vacuum in the chamber (5) causes the outlet valve (4) to close and the atmospheric pressure in the fuel tank forces the fuel into the chamber, opening the inlet valve (1).

(B) Discharge stroke

When the diaphragm is pushed up by the cam, the pressure in the chamber causes the inlet valve to close and forces out the fuel, opening the outlet valve.

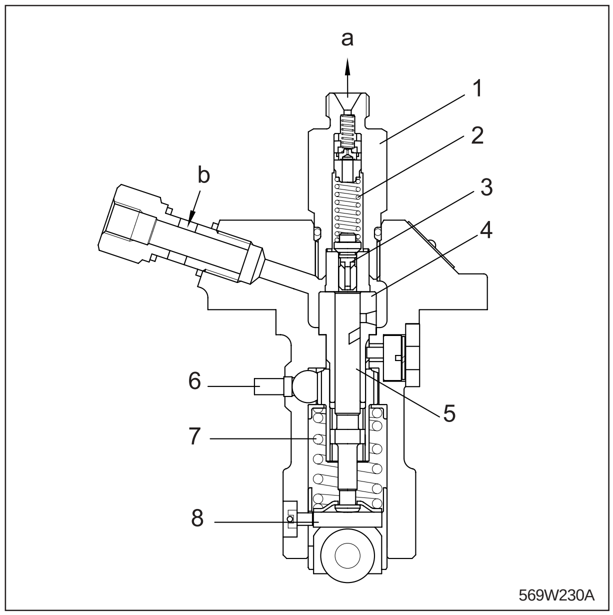


(a) From Fuel Tank
(b) To Fuel Filter

(1) Inlet Valve
(2) Push Rod
(3) Tappet
(4) Outlet Valve
(5) Chamber
(6) Diaphragm
(7) Fuel Camshaft

D. FUEL INJECTION PUMP

The injection pump is bosch K type mini injection pump. It features a compact and light weight design.

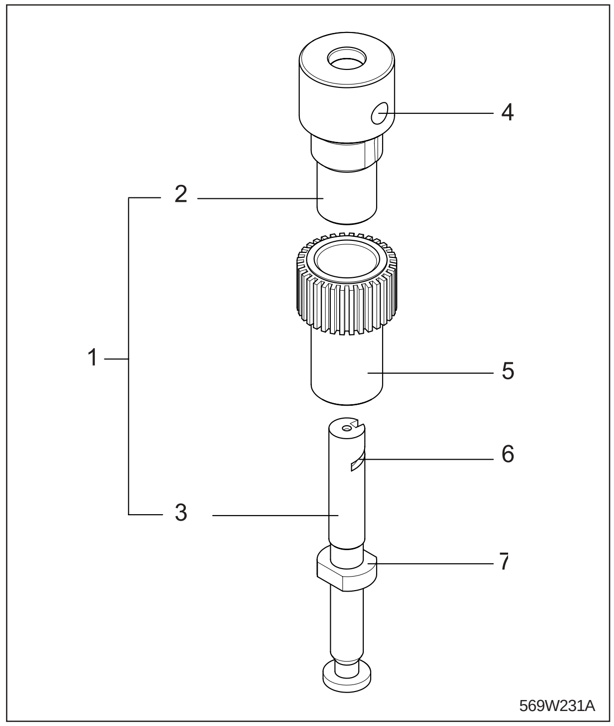


(a) To Injection Nozzle
(b) From Fuel Filter

(1) Delivery Valve Holder
(2) Delivery Valve Spring
(3) Delivery Valve
(4) Cylinder
(5) Plunger
(6) Control Rack
(7) Plunger Spring
(8) Tappet

a. Pump Element

The pump element (1) consists of a plunger (3) and cylinder (2), their sliding surfaces are precision machined to maintain fuel tightness. The plunger (3) fits in the control sleeve (5) at the driving surface (7). The sleeve is engaged with the control rack, which rotate the plunger in the cylinder to control the amount of fuel delivery.



(1) Pump Element
(2) Cylinder
(3) Plunger
(4) Feed Hole
(5) Control Sleeve
(6) Control Groove
(7) Driving Surface

b. Operation of Pump Element

(A) Before delivery

As the taper lowers, the plunger (2) lowers and fuel is drawn into the delivery chamber (1) through the feed hole (4) from the fuel chamber (5).

(B) Beginning of delivery

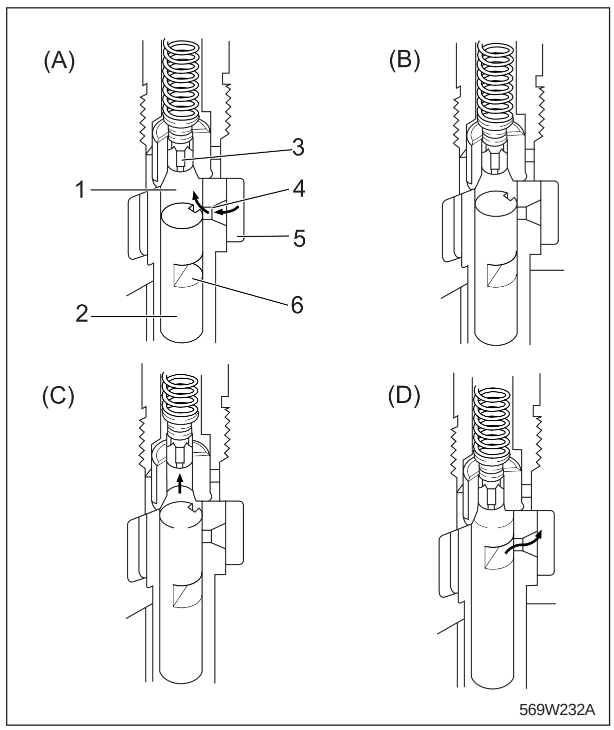
When the plunger is pushed up by the cam and the head of the plunger closes the feed hole (4), the pressure in the delivery chamber (1) rises to push the delivery valve (3) open.

(C) Delivery

While the plunger (2) is rising, delivery of fuel continues.

(D) End of delivery

When the plunger rises further and the control groove (6) on its periphery meets the feed hole, the fuel returns to the fuel chamber (5) from the delivery chamber (1) through the control groove (6) and the feed hole (4).



(1) Delivery Chamber
(2) Plunger
(3) Delivery Valve
(4) Feed Hole
(5) Fuel Chamber
(6) Control Groove

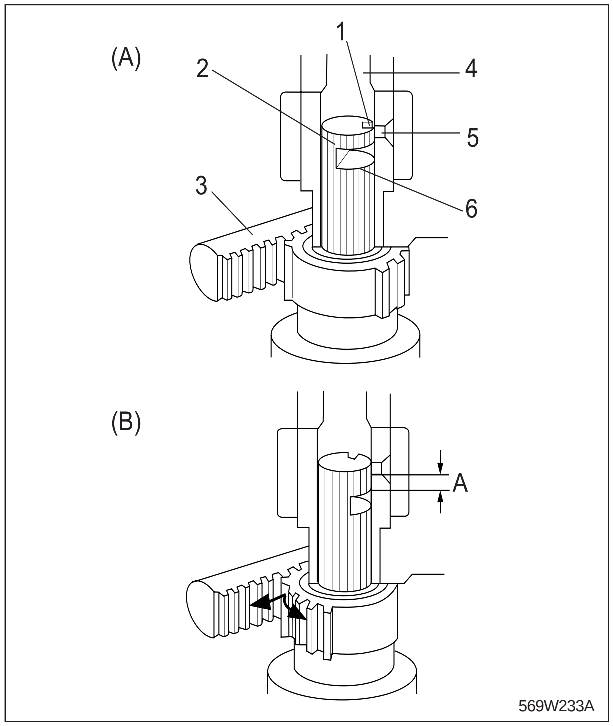
c. Amount of Fuel Delivery

(A) No fuel delivery

At the engine stop position of the control rack (3), the lengthwise slot (1) on the plunger (2) aligns with the feed hole (5). The delivery chamber (4) is led to the feed hole during the entire stroke of the plunger. The pressure in the delivery chamber does not build up and no fuel is forced to the injection nozzle.

(B) Fuel delivery

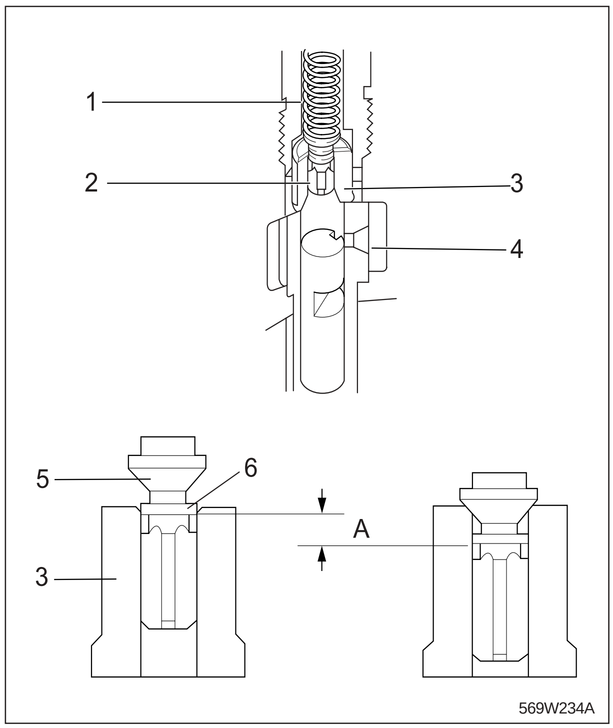
The plunger is rotated by the control rack and the feed hole is not aligned with the lengthwise slot. When the plunger is pushed up, the feed hole is closed by the plunger. The pressure in the delivery chamber builds up and forces the fuel to the injection nozzle until the control groove (6) meets the feed hole. The amount of the fuel to be forced into the nozzle corresponds to distance A.



(1) Slot
(2) Plunger
(3) Control Rack
(4) Delivery Chamber
(5) Feed Hole
(6) Control Groove

d. Delivery Valve

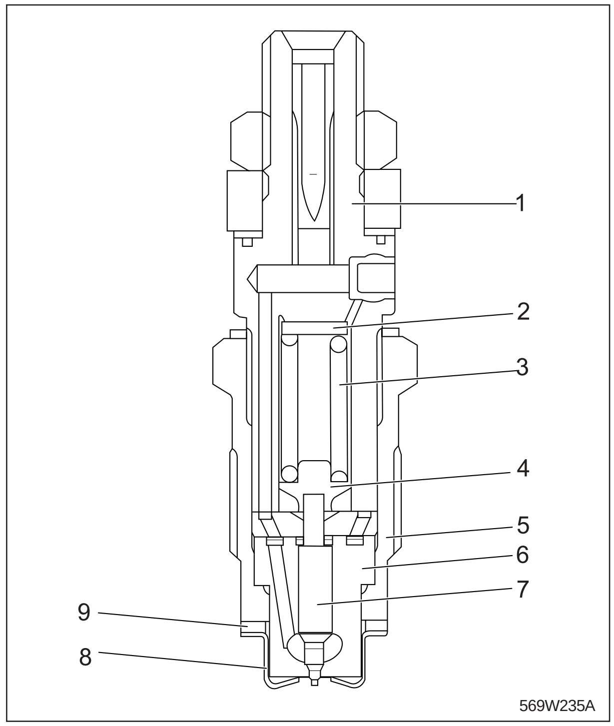
The delivery valve prevents the fuel in the injection pipe from flowing back into the delivery chamber and the fuel in the injection nozzle from dribbling after injection.



(1) Valve Spring
(2) Valve
(3) Valve Seal
(4) Fuel Chamber
(5) Valve Face
(6) Relief Plunger

E. FUEL INJECTION NOZZLE

The nozzle is a throttle-type. It features low fuel consumption and works well with DAEDONG combustion chamber. The nozzle valve opening pressure is about 13.7 to 14.7 MPa (140 to 150 kgf/cm^2, 1,991 to 2,134 psi), the pressure overcomes the counterforce of nozzle valve spring, and push the valve up instantly, the fuel is then injected in a proper quantity into the swirling air in the combustion chamber for combustion. Addition or reduction of adjusting shims can adjust the opening pressure. A washer of 0.1 mm corresponds to 980 kPa (10 kgf/cm^2, 142 psi) change in opening pressure. The heat seal is employed to improve the durability and reliability of the nozzle.

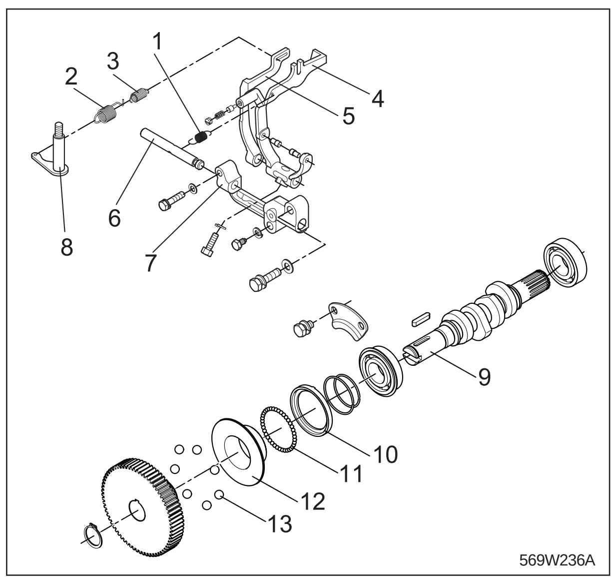


(1) Nozzle Holder Ass'y
(2) Adjusting Washer
(3) Nozzle Spring
(4) Push Rod
(5) Retaining Nut
(6) Nozzle Body
(7) Needle Valve
(8) Heat Seal
(9) Packing

F. GOVERNOR AND IDLE COMPENSATING

a. Disassembled View

The governor serves to keep engine speed constant by automatically adjusting the amount of fuel supplied to the engine according to changes in the load. The engine employs an all-speed governor which is controlled by the centrifugal force of the steel ball (13) weights, produced by rotation of the fuel camshaft (9), and tension of the governor spring 1 (2) and 2 (3) are balanced.

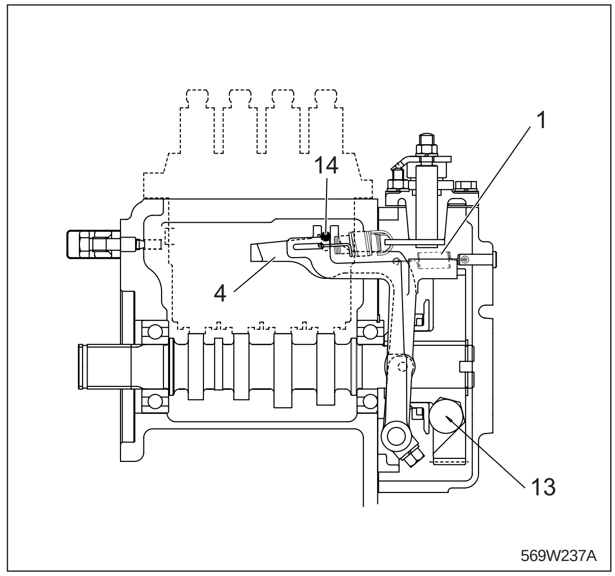


(1) Start Spring
(2) Governor Spring 1
(3) Governor Spring 2
(4) Fork Lever 1
(5) Fork Lever 2
(6) Fork Lever Shaft
(7) Fork Lever Holder
(8) Governor Lever
(9) Fuel Camshaft
(10) Governor Ball Case
(11) Steel Ball
(12) Governor Sleeve
(13) Steel Ball

b. Operation of Governor

a) At start

The steel balls (13) have no centrifugal force. As the fork lever 1 (4) is pulled by the start spring (1), the control rack (14) moves to the maximum injection position. At start, the sufficient injection of the fuel enables easy starting.



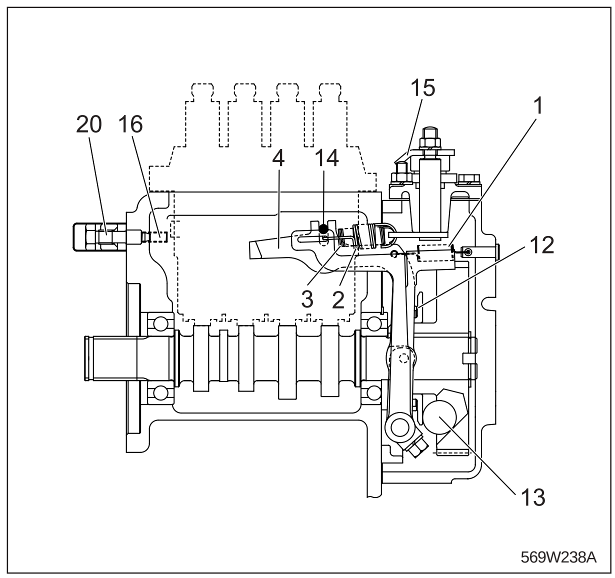
(1) Start Spring
(4) Fork Lever 1
(13) Steel Ball
(14) Control Rack

b) At idling

At the idling position of the speed control lever (15), the governor spring 1 (2) is free and the governor spring 2 (3) only acts slightly. The governor sleeve (12) is pushed leftward by a centrifugal force of steel ball (13). Therefore, the fork lever 1 (4) and control rack (14) are moved to the rear by the governor sleeve (12) and then the idling adjusting spring (16) is compressed by the control rack (14). As a result, the control rack (14) is kept at a position where the centrifugal force of steel ball (13) and forces of the start spring (1), governor spring 2 (3) and idling limit spring are balanced, providing stable idling.

IMPORTANT:

- *The idling speed has been factory-set. The idling adjusting screw (20) and spring (16) should not be disassembled and readjusted.*

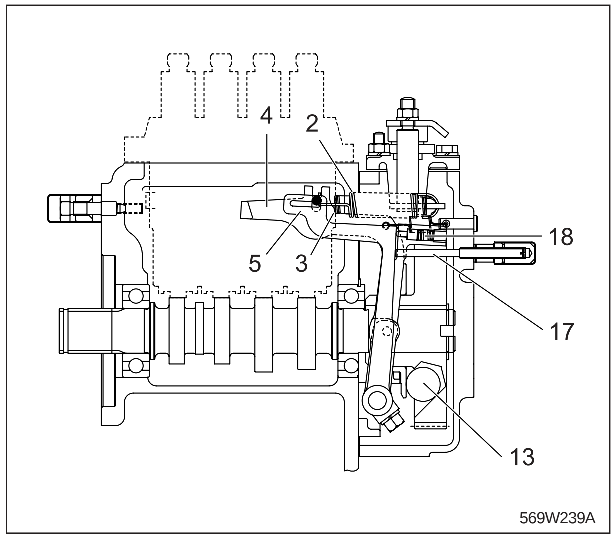


(1) Start Spring
(2) Governor Spring 1
(3) Governor Spring 2
(4) Fork Lever 1
(12) Governor Sleeve
(13) Steel Ball
(14) Control Rack
(15) Speed Control Lever
(16) Idle Adjusting Spring
(20) Idle Adjusting Screw

c) At High Speed Running with a Load

When a load is applied to an engine running at high speed, the engine speed drops and the centrifugal force of steel ball (13) becomes less, the fork lever 2 (5) is pulled forward by the governor spring 1 (2) and 2 (3), this increases the amount of fuel injected.

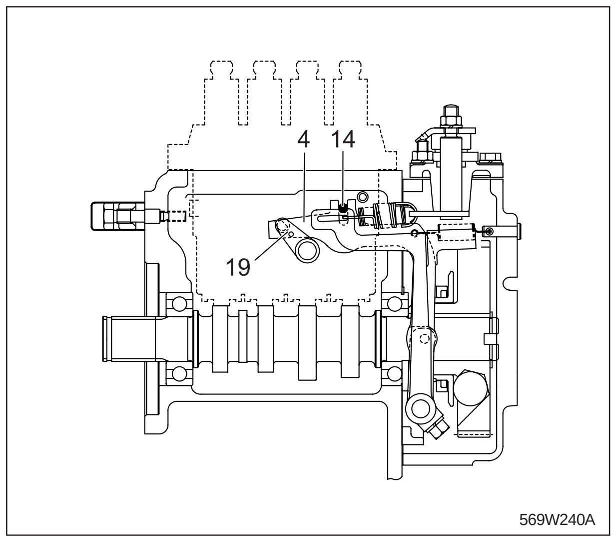
The fork lever 2 (5) becomes ineffective in increasing the fuel injection when it is stopped by the adjusting bolt (17). After that, when the force of torque spring (18) becomes greater than the centrifugal force of the steel balls, fork lever 1 (4) moves forward to increase fuel injection, causing the engine to run continuously at a high torque.



(2) Governor Spring 1
(3) Governor Spring 2
(4) Fork Lever 1
(5) Fork Lever 2
(13) Steel Ball
(17) Adjusting Bolt
(18) Torque Spring

d) To stop engine

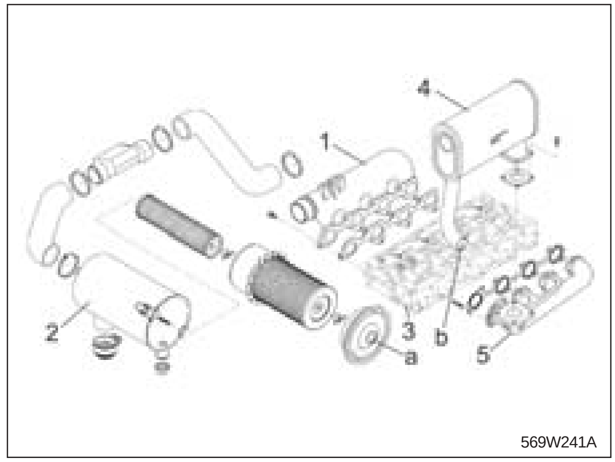
When the stop lever (19) is moved to the STOP position, fork lever 1 (4) is moved rearward and the control rack (14) is moved to the non-injection position, causing the engine to stop.



(4) Fork Lever 1
(14) Control Rack
(19) Stop Lever

2.5 INTAKE AND EXHAUST SYSTEM

A. FLOW OF INTAKE AIR AND EXHAUST GAS

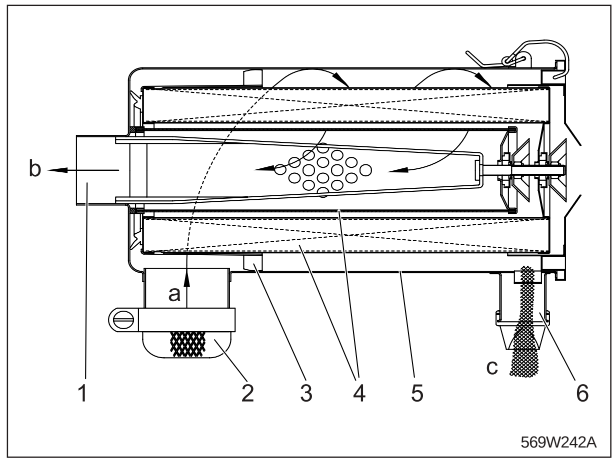


(a) Intake Air
(b) Exhaust Gas

(1) Intake Manifold
(2) Air Cleaner
(3) Cylinder Head
(4) Muffler
(5) Exhaust Manifold

B. AIR CLEANER

The air cleaner is dry-cyclone type and easy to maintain. The air from the inlet port (2) circulates along the fin (3) and around the air cleaner element (4) and the heavier dust is carried to the evacuator (6), to the dust exhaust port. The fine dust in the air is filtered with the air cleaner element (4), and the filtered air flows to the outlet port (1).

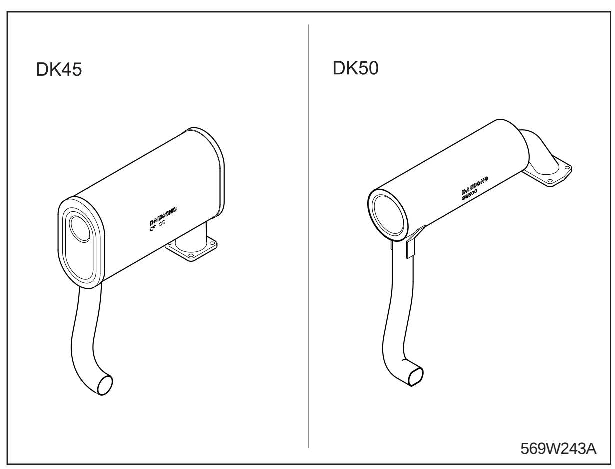


(a) Inlet Air
(b) To Intake Manifold
(c) Heavier Dust

(1) Outlet Port
(2) Inlet Port
(3) Fin
(4) Air Cleaner Element
(5) Body
(6) Evacuator

C. MUFFLER

The exhaust noises are absorbed, while the gases are passed through a series of holes on the inner tube and glass wool of the muffler.



D. TURBOCHARGER (8454)

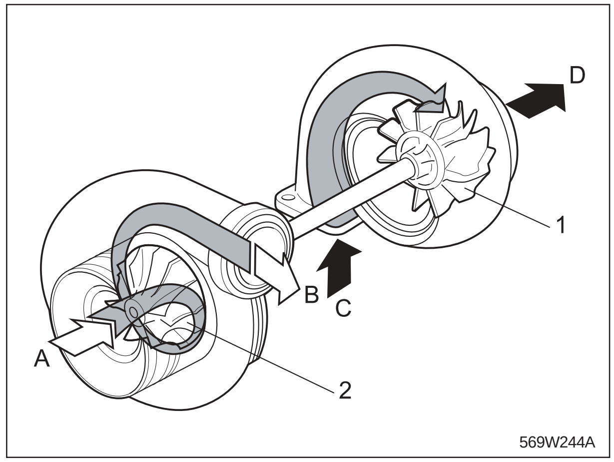
The mechanism of turbocharger is the use of exhaust gas energy which rotates turbine and the power is transmitted to air compressor by a shaft. So it is possible to supply more fuel to a cylinders and this will increase the power.

It is recommended not to accelerate suddenly just about starting or stopping the engine suddenly after driving. Since the turbocharger runs above 100,000 rpm it is necessary to allow the engine to idle for 1 or 2 minutes before stopping, this protect the bearings of the turbocharger.

To keep a capacity of turbocharger you should check the engine oil and air cleaner periodically. Turbocharger is composed of precision parts. Do not disassemble or repair without permission.

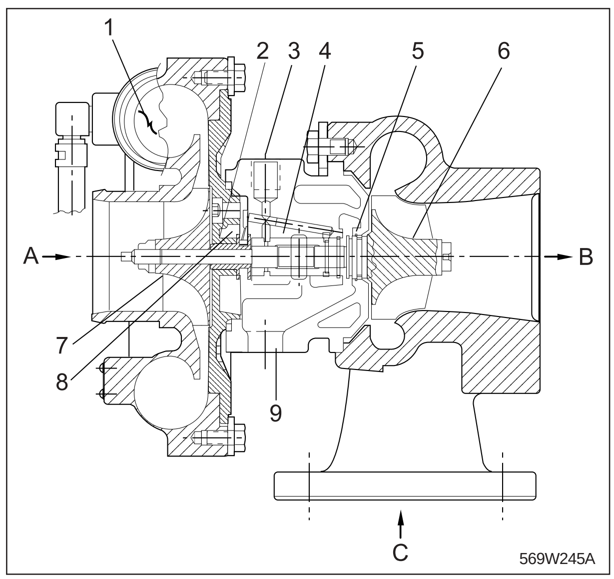
Turbocharger actuator pressure is 460 mmHg.

The structure of turbocharger is as above.



(A) Compressor Ambient Air Inlet
(B) Compressor Air Discharge
(C) Turbine Exhaust Gas Inlet
(C) Turbine Exhaust Gas Inlet

(1) Turbine Wheel
(2) Compressor Wheel



(A) Fresh Air Inlet
(B) Exhaust Outlet
(C) Exhaust Inlet

(1) Compressed Air Outlet
(2) Compressor Seal
(3) Oil Inlet
(4) Journal Bearing
(5) Turbine Seal
(6) Turbine Wheel
(7) Compressor Wheel
(8) Thrust Bearing
(9) Oil Drain

3. DISASSEMBLING AND SERVICING

3.1 TROUBLESHOOTING

Symptom	Probable Cause	Solution
Engine Does Not Start	• Not fuel	Replenish fuel
	• Air in the fuel system	Vent air
	• Water in the fuel system	Change fuel and repair or flush fuel system
	• Fuel pipe clogged	Clean
	• Fuel filter clogged	Clean or replace
	• Excessively high viscosity of fuel or engine oil at low temperature	Use the specified fuel or engine oil
	• Fuel with low cetane number	Use the specified fuel
	• Fuel leak due to loose injection pipe retaining nut	Tighten nut
	• Incorrect injection timing	Adjust
	• Fuel camshaft worn	Replace
	• Injection nozzle clogged	Clean or replace
	• Injection pump malfunctioning	Repair or replace
	• Fuel transfer pump malfunctioning	Repair or replace
	• Seizure of transfer pump malfunctioning piston, cylinder bore or bearing	Repair or replace
	• Compression leak from cylinder	Replace head gasket, tighten cylinder head screws, glow plug and nozzle holder
	• Improper valve seating, valve spring broken, valve seized	Repair or replace
	• Improper valve timing	Correct or replace timing gear
	• Piston ring and bore worn	Repair or replace
	• Excessive valve clearance	Adjust
(Starter Does Not Run)	• Battery discharged	Charge
	• Starter malfunction	Repair or replace
	• Starter switch malfunction	Repair or replace
	• Wiring disconnected	Connect
Engine Revolution is Not Smooth	• Fuel filter clogged or dirty	Clean or replace
	• Air cleaner clogged	Clean or replace
	• Fuel leak due to loose injection pipe retaining nut	Tighten nut
	• Injection pump malfunctioning	Repair or replace
	• Incorrect nozzle opening pressure	Adjust
	• Nozzle stuck or clogged	Repair or replace
	• Fuel over flow pipe clogged	Clean
	• Governor malfunctioning	Repair

Symptom	Probable Cause	Solution
Either White or Blue Exhaust Gas is Observed	• Excessive engine oil • Piston ring and bore worn or piston ring stuck • Incorrect injection timing • Insufficient compression	Reduce to the specified level Repair or replace Adjust Adjust top clearance
Either Black or Dark Gray Exhaust Gas is Observed	• Over heated • Low grade fuel used • Fuel filter clogged • Air cleaner clogged	Lessen the load Use the specified fuel Clean or replace Clean or replace
Insufficient Output	• Incorrect injection timing • Engine's moving parts seem to be seizing • Uneven fuel injection • Insufficient nozzle injection • Compression leak	Adjust Repair or replace Repair or replace the injection pump Repair or replace the nozzle Replace head gasket, tighten cylinder head screws and nuts, glow plug and nozzle holder
Excessive Lubrication Oil Consumption	• Piston ring's gap facing the same direction • Oil ring worn or stuck • Piston ring groove worn • Valve stem and guide worn • Crankshaft bearings, and crank pin bearings worn	Shift ring gap direction Replace Replace the piston Replace Replace
Fuel Mixed into Lubricating Oil	• Injection pump plunger worn • Fuel transfer pump broken	Replace pump element or pump Replace
Water Mixed Into Lubricating oil	• Head gasket defective • Cylinder block or cylinder head cracked	Replace Replace
Low Oil Pressure	• Engine oil insufficient • Oil strainer closed • Oil filter cartridge clogged • Relief valve stuck with dirt • Relief valve spring weak or broken • Excessive oil clearance of crankshaft bearings • Excessive oil clearance of crank pin bearings • Excessive oil clearance of rocker arm bushings • Oil passage closed • Improper type of oil • Oil pump defective	Replenish Clean Replace Clean Replace Replace Replace Replace Clean Use the specified type of oil Repair or replace

Symptom	Probable Cause	Solution
High Oil Pressure	• Improper type of oil	Use the specified type of oil
	• Relief valve defective	Replace
Engine Overheating	• Engine oil insufficient	Replenish
	• Fan belt broken or tensioned improperly	Replace or adjust
	• Cooling water insufficient	Replenish
	• Radiator net and radiator fin clogged with dirt	Clean
	• Inside of radiator corroded	Clean or replace
	• Cooling water flow route corroded	Clean or replace
	• Radiator cap defective	Replace
	• Water pipe damaged	Replace
	• Thermostat defective	Replace
	• Water pump defective	Replace
	• Mechanical seal defective	Replace
	• Overload running	Lesson the load
	• Head gasket defective	Replace
	• Incorrect injection timing	Adjust
	• Unsuitable fuel used	Use the specified fuel
Battery Quickly Discharge	• Battery electrolyte insufficient	Replenish distilled water and charge
	• Fan belt slips	Adjust belt tension or replace
	• Wiring disconnected	Connect
	• Regulator defective	Replace
	• Alternator defective	Replace
	• Battery defective	Replace

3.2 SERVICING SPECIFICATIONS

A. ENGINE BODY

a. Cylinder Head

Item		Factory Specification	Allowable Limit
Cylinder Head Surface Flatness			0.05 mm / 100 mm 0.002 in. / 3.94 in.
Top Clearance		0.75 ~ 0.9 mm 0.0295 ~ 0.0354 in.	-
Cylinder Head Gasket Thickness	Free	1.3 ~ 1.5 mm 0.0512 ~ 0.0591 in.	-
	Tightened	1.15 ~ 1.25 mm 0.0453 ~ 0.0492 in.	
Compression Pressure (When cranking with starting motor)		3.24 ~ 3.73 MPa 33 ~ 38 kgf/cm^2 469 ~ 540 psi	2.55 MPa 26 kgf/cm^2 370 psi

* Variance of compression pressure among cylinders should be 10% or less.

b. Valves

Item		Factory Specification		Allowable Limit
		4A220	4A200T	
Valve Clearance (Cold)	IN.	0.25 mm 0.0098 in.	015 mm 0.0059 in.	
	EX.	0.30 mm 0.0118 in.	0.15 mm 0.0059 in.	
Valve Seat Angle	IN.	1.047 rad. 60°	1.047 rad. 60°	
	EX.	0.785 rad. 45°	0.785 rad. 45°	
Valve Face Angle	IN.	1.047 rad. 60°	1.047 rad. 60°	
	EX.	0.785 rad. 45°	0.785 rad. 45°	
Valve Recessing		0.2 ~ 0.5 mm 0.0079 ~ 0.0197 in.	0.2 ~ 0.5 mm 0.0079 ~ 0.0197 in.	0.8 mm 0.0315 in.
Clearance Between Valve Stem and Valve Guide		0.040 ~ 0.070 mm 0.00157 ~ 0.00276 in.	0.040 ~ 0.070 mm 0.00157 ~ 0.00276 in.	0.10 mm 0.0039 in.
Valve Stem O.D		7.960 ~ 7.975 mm 0.31339 ~ 0.31398 in.	7.960 ~ 7.975 mm 0.31339 ~ 0.31398 in.	-
Valve Stem I.D		8.015 ~ 8.030 mm 0.31555 ~ 0.31614 in.	8.015 ~ 8.030 mm 0.31555 ~ 0.31614 in.	-

c. Valve Timing

Item		Factory Specification	Allowable Limit
Inlet Valve	Open	0.140rad 8° before T.D.C	-
	Close	0.611rad 35° after B.D.C	
Exhaust Valve	Open	0.785rad 45° before B.D.C	-
	Close	0.140rad 8° after T.D.C	

d. Cylinder Bore

Item		Factory Specification	Allowable Limit
Cylinder bore inner diameter	4A220	87.000 ~ 87.022 mm 3.4252 ~ 3.4261 in.	0.15 mm 0.0059 in.
	4A200T	83.000 ~ 83.022 mm 3.2677 ~ 3.2690 in.	

e. Valve Spring

Item	Factory Specification	Allowable Limit
Free length	41.7 ~ 42.2 mm 1.6417 ~ 1.6614 in.	41.2 mm 1.6220 in.
Assembling load / assembling length	12.0 kgf / 35.15 mm 26.46 lbs / 1.3839 in.	10.2 kgf / 35.15 mm 22.49 lbs / 1.3839 in.
Squareness	-	1.0 mm 0.0394 in.

f. Rocker Arm

Item	Factory Specification	Allowable Limit
Rocker arm shaft O.D	18.955 ~ 18.980 mm 0.74600 ~ 0.74724 in.	-
Rocker arm bushing I.D	19.0 ~ 19.035 mm 0.74803 ~ 0.74941 in.	-

g. Tappet

Item	Factory Specification	Allowable Limit
Clearance between tappet and guide	0.020 ~ 0.062 mm 0.00079 ~ 0.00244 in.	0.07 mm 0.0028 in.
Tappet O.D	23.959 ~ 23.980 mm 0.94327 ~ 0.94410 in.	-
Tappet guide I.D	24.000 ~ 24.021 mm 0.94488 ~ 0.94571 in.	-

h. Camshaft

Item		Factory Specification	Allowable Limit
Camshaft alignment		0.01 mm 0.0004 in.	0.05 mm 0.0020 in.
Cam height	IN. (4A200T, 4A220)	33.90, 33.59 mm 1.3346, 1.3224 in.	33.85, 33.54 mm 1.3327, 1.3205 in.
	EX. (4A200T, 4A220)	33.70, 33.69 mm 1.3268, 1.3264 in.	33.65, 33.64 mm 1.3248, 1.3244 in.
Clearance between camshaft		0.050 ~ 0.091 mm 0.00197 ~ 0.00358 in.	0.15 mm 0.0059 in.
Camshaft journal O.D		39.934 ~ 39.950 mm 1.57221 ~ 1.57284 in.	39.88 mm 1.5701 in.
Camshaft counter bore I.D		40.000 ~ 40.025 mm 1.57480 ~ 1.57579 in.	-

I. Timing Gear

Item		Factory Specification	Allowable Limit
Timing gear backlash		0.04 ~ 0.11 mm 0.0016 ~ 0.0043 in.	0.15 mm 0.0059 in.
Idle gear side clearance		0.20 ~ 0.51 mm 0.0079 ~ 0.0201 in.	0.9 mm 0.035 in.
Clearance between	Idle gear shaft and idle gear bushing	0.025 ~ 0.066 mm 0.00098 ~ 0.00260 in.	0.1 mm 0.0039 in.
	Idle gear shaft O.D	37.959 ~ 37.975 mm 1.49445 ~ 1.49508 in.	-
	Idle gear bushing I.D	38.000 ~ 38.025 mm 1.49606 ~ 1.49705 in.	-

j. Piston Ring

Item		Factory Specification	Allowable Limit
Piston pin-bore I.D		25.000 ~ 25.006 mm 0.98425 ~ 0.98448 in.	25.03 mm 0.9854 in.
Clearance between	Oil ring and ring groove	0.020 ~ 0.060 mm 0.00079 ~ 0.00236 in.	0.15 mm 0.0059 in.
	Oil ring groove width	3.010 ~ 3.030 mm 0.11850 ~ 0.11929 in.	-
	Oil ring width	2.97 ~ 2.99 mm 0.11693 ~ 0.11772 in.	-
Clearance between	2nd ring and ring groove	0.04 ~ 0.08 mm 0.00157 ~ 0.00315 in.	0.15 mm 0.0059 in.
	2nd ring groove width	2.03 ~ 2.05 mm 0.07992 ~ 0.08070 in.	-
	2nd ring width	1.97 ~ 1.99 mm 0.07756 ~ 0.07834 in.	-
Top ring, oil ring end gap		0.25 ~ 0.40 mm 0.0098 ~ 0.01570 in.	1.25 mm 0.0492 in.
2nd ring end gap		0.55 ~ 0.70 mm 0.0217 ~ 0.0276 in.	1.25 mm 0.0492 in.

k. Connecting Rod

Item		Factory Specification	Allowable Limit
Connecting rod misalignment		-	0.05 mm 0.0020 in.
Clearance between	Piston and small end bushing	0.014 ~ 0.038 mm 0.00055 ~ 0.00150 in.	0.15 mm 0.0059 in.
	Piston pin O.D	25.002 ~ 25.011 mm 0.98433 ~ 0.98469 in.	-
	Small end bushing I.D	25.025 ~ 25.040 mm 0.98524 ~ 0.98583 in.	-

I. Crankshaft

Item		Factory Specification	Allowable Limit
Crankshaft Misalignment		-	0.08 mm 0.0031 in.
Clearance between	Crankshaft and crank-shaft bearing 1	0.040 ~ 0.118 mm 0.00157 ~ 0.00465 in.	0.20 mm 0.0079 in.
	Crankshaft O.D	51.921 ~ 51.940 mm 2.04414 ~ 2.04489 in.	-
	Crankshaft bearing 1 I.D	51.980 ~ 52.039 mm 2.04646 ~ 2.04878 in.	-
Clearance between	Crankshaft and crank-shaft bearing 2	0.040 ~ 0.104 mm 0.00157 ~ 0.00409 in.	0.20 mm 0.0079 in.
	Crankshaft O.D	51.921 ~ 51.940 mm 2.04414 ~ 2.04488 in.	-
	Crankshaft bearing 1 I.D	51.980 ~ 52.025 mm 2.04646 ~ 2.04823 in.	-
Clearance between	Crank pin and crank pin bearing	0.025 ~ 0.087 mm 0.00098 ~ 0.00343 in.	0.20 mm 0.0079 in.
	Crank pin O.D	46.959 ~ 46.975 mm 1.84876 ~ 1.84947 in.	-
	Crank pin bearing I.D	47.000 ~ 47.046 mm 1.85040 ~ 1.85221 in.	-
Crankshaft side clearance		0.15 ~ 0.31 mm 0.0059 ~ 0.0122 in.	0.5 mm 0.020 in.

B. LUBRICATING SYSTEM

a. Oil Pump

Item		Factory Specification	Allowable Limit
Engine oil pressure (oil temp. 85 ~ 95 °C, 185 ~ 203 °F)	At idle speed	more than 49.0 kPa 0.5 kgf/cm^2 7.11 psi	-
	At rated speed	245 ~ 441 kPa 2.5 ~ 4.5 kgf/cm^2 35.6 ~ 64.0 psi	245 kPa 2.5 kgf/cm^2 35.6 psi
Clearance between inner rotor and outer rotor		0.10 ~ 0.16 mm 0.0039 ~ 0.0063 in.	0.2 mm 0.0079 in.
Radial clearance between outer rotor and pump		0.11 ~ 0.19 mm 0.0043 ~ 0.0078 in.	0.25 mm 0.0098 in.
End clearance between inner rotor and cover		0.105 ~ 0.150 mm 0.00413 ~ 0.00591 in.	0.2 mm 0.00787 in.

C. COOLING SYSTEM

a. Thermostat

Valve opening temperature at beginning	69.5 ~ 72.5 °C (157.1 ~ 162.5 °F)
Opened completely (height 8 mm 0.315 in.)	85 °C (185 °F)

b. Radiator

Radiator tightness	No leak at 137 kPa, 1.4 kgf/cm², 20 psi
Radiator cap tightness	10 seconds or more for pressure falling from 88 ~ 59 kPa from 0.9 ~ 0.6 kgf/cm² from 13 ~ 9 psi
Fan belt tension [deflection at 98 N (10 kgf, 22 lbs) of force]	7 ~ 9 mm 0.28 ~ 0.35 in.

D. FUEL SYSTEM

a. Inject Pump

Injection timing (BTDC)	4A220	18°
	4A200T	12°

b. Injection Nozzle

Fuel injection pressure	13.73 ~ 14.715 MPa 140 ~ 150 kgf/cm² 1,991 ~ 2,134 psi
Fuel tightness of nozzle valve seat	No fuel leak for 5 sec. at pressure 12.74 MPa 130 kgf/cm² 1,849 psi

NOTE:

- *Injection Sequence Four Cylinders: 1 → 3 → 4 → 2 (The cylinder number is given in order from the gear case end.)*

E. TIGHTENING TORQUES

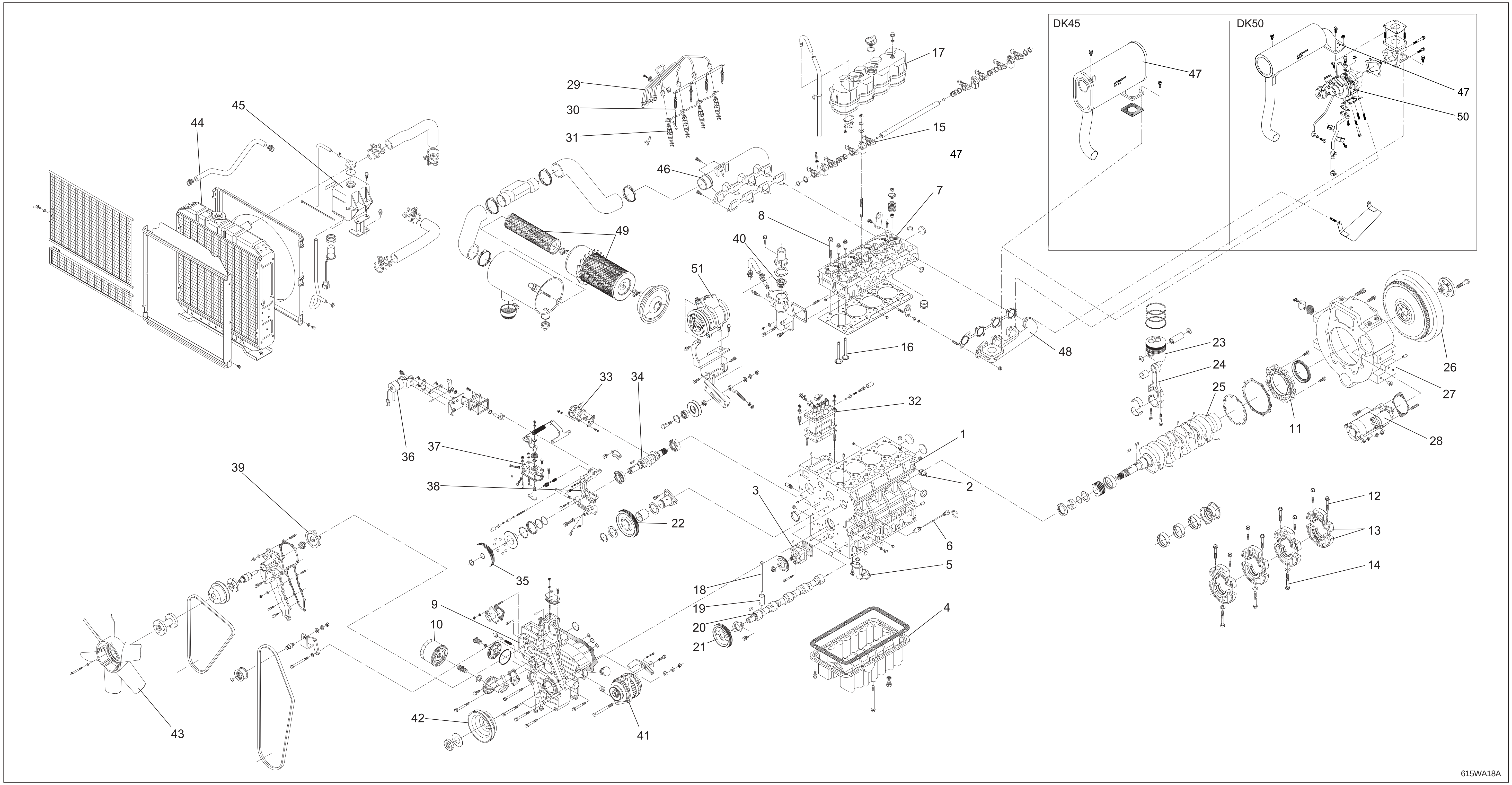
Item	Size x Pitch	N•m	kgf•m	lbf·ft
Cylinder head screws	M11 x 1.25	103.0 ~ 107.9	10.5 ~ 11.0	75.9 ~ 79.6
Head cover nuts	M10 x 1.25	8.8 ~ 10.8	0.9 ~ 1.1	6.5 ~ 8.0
* Bearing case screw 1	M9 x 1.25	46.1 ~ 51.0	4.7 ~ 5.2	34.0 ~ 37.6
* Bearing case screw 2	M10 x 1.25	68.6 ~ 73.6	7.0 ~ 7.5	50.6 ~ 54.2
* Flywheel screw	M12 x 1.25	98.1 ~ 107.9	10.0 ~ 11.0	72.3 ~ 79.6
* Connecting rod screws	M8 x 1.0	46.1 ~ 51.0	4.5 ~ 5.0	34.0 ~ 37.6
Rocker arm bracket studs	M10 x 1.25	48.1 ~ 55.9	4.9 ~ 5.7	35.4 ~ 41.2
Drain plug	M12 x 1.25	32.4 ~ 37.3	3.3 ~ 3.8	23.9 ~ 37.3
Glow plugs	M10 x 1.25	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Oil switch	PT1/8	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Nozzle locating screws	M20 x 1.5	49.1 ~ 68.7	5.0 ~ 7.0	36.2 ~ 50.6
Injection pipe nuts	M12 x 1.5	24.5 ~ 34.3	2.5 ~ 3.5	18.1 ~ 25.3

NOTE:

- *For *marked screw, bolts and nuts on the table, apply engine oil to their threads and seats before tightening.*
- *The letter "M" in Size x Pitch means that the screw, bolt or nut dimension stands for metric. The size is the nominal outside diameter in mm of the threads. The pitch is the nominal distance in mm between two threads.*

3.3 CHECKING, DISASSEMBLING AND SERVICING

A. ENGINE DISASSEMBLED VIEW



(1) Cylinder Block
(2) Oil Pressure Switch
(3) Oil Pump
(4) Oil Pan
(5) Oil Strainer
(6) Oil Gauge
(7) Cylinder Head
(8) Head Bolt
(9) Gear case
(10) Oil Filter
(11) Main bearing Case Cover
(12) Bearing Case Bolt 1
(13) Main Bearing Case
(14) Bearing Case Bolt 2
(15) Rocker Arm
(16) Inlet, Exhaust Valve
(17) Cylinder Hear Cover
(18) Push Rod
(19) Tappet
(20) Camshaft
(21) Camshaft Gear
(22) Idle Gear
(23) Piston
(24) Connecting Rod
(25) Crankshaft
(26) Flywheel
(27) Flywheel Housing
(28) Starter
(29) Injection Pipe
(30) Glow Plug
(31) Nozzle
(32) Fuel Injection Pump
(33) Fuel Feed Pump
(34) Fuel Camshaft
(35) Fuel Camshaft Gear
(36) Engine Stop Solenoid
(37) Speed Control Plate
(38) Fork Lever (Governor)
(39) Impeller
(40) Thermostat
(41) Alternator
(42) Fan Drive Pulley
(43) Cooling Fan
(44) Radiator
(45) Reserve Tank Ass'y
(46) Inlet Manifold
(47) Muffler
(48) Exhaust Manifold
(49) Air Cleaner
(50) Turbo Charger
(51) Air Conditioner Compressor

B. EXTERNAL COMPONENTS

a. Checking and Adjusting

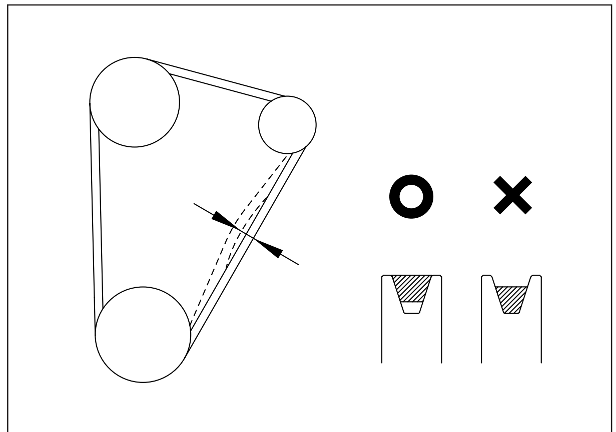
1) Fan belt

Measure the deflection, depressing the belt halfway between the fan drive pulley and the alternator pulley at 98 N (10 kgf, 22 lbs) of force.

If the deflection is not between the factory specifications, loosen the bolts and nuts, and relocate the alternator to adjust.

If the belt is damaged or worn (see figure), replace the belt.

Belt tension (deflection)	Factory spec	7 ~ 9 mm 0.28 ~ 0.35 in.



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b. Disassembly and Assembly

1) Engine body

Drain the oil and the water, if disassemble the engine body.

1. Remove the muffler and exhaust manifold (7).
2. Remove the starter (9) and the oil pressure switch (8).
3. Pull out the oil gauge (6).
4. Remove the alternator (5) and the fan belt (1).
5. Remove the hour meter unit (2).
6. Loosen the oil filter (3) with a filter wrench and remove it and the oil filter flange (4).

* This figure does not show Hour meter Unit (2) covered with the cooling fan.

(When reassembling)

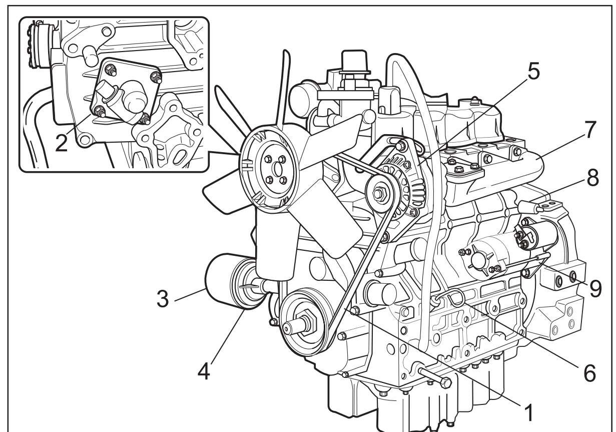
Apply liquid gasket (three bond 1,215 or equivalent) on the thread of the oil pressure switch (8).

Apply liquid gasket to the both sides of the hour meter gasket.

Apply oil to the O-ring and tighten the oil filter not with wrench but by hand.

Adjust the fan belt tension (See fan belt).

Tightening torque	Oil pressure switch	14.7 ~ 19.6 N·m 1.5 ~ 2.0 kgf·m 10.8 ~ 14.4 lbf·ft



569W250A

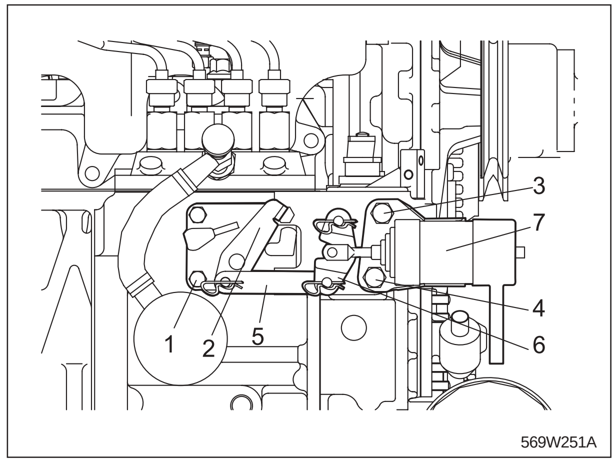
(1) Fan Belt
(2) Hour Meter Unit
(3) Oil Filter Switch
(4) Oil Filter Flange
(5) Alternator
(6) Oil Gauge
(7) Exhaust Manifold
(8) Oil Pressure
(9) Starter

2) Solenoid

1. Disconnect the stop lever 1 (5) from the engine stop lever (2).
2. Remove the screw (3) and (4).
3. Remove the solenoid (7) with its support.

(When reassembling)

- Loosen the solenoid mounting screws.
- Install the support and complete the linkage between the solenoid (7) and the engine stop lever (2).
- Pushing the solenoid (7) plunger to the bottom, pull the stop lever 2 (6) until the engine stop lever (2) is turned to the end, then tighten the screws.



(1) Screw
(2) Engine Stop Lever
(3) Screw
(4) Screw
(5) Stop Lever 1
(6) Stop Lever 2
(7) Solenoid

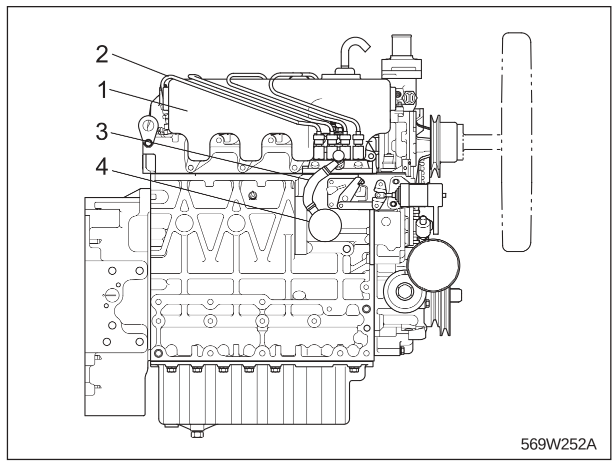
3) Intake manifold and fuel pipes

1. Disconnect the fuel pipe (3).
2. Loosen the injection pipe fitting with two wrenches and remove the injection pipes (2).
3. Remove the intake manifold (1) and the fuel feed pump (4).

IMPORTANT:

- *Tighten or loosen injection pipe fittings using the one-hand two-wrench squeeze method.*
- *Cap the nozzle hole to prevent entrance of foreign materials.*

Tightening torque	Injection pipe nut 19 mm (0.75 in.) cross flats	24.5 ~ 34.3 N·m 2.5 ~ 3.5 kgf·m 18.0 ~ 25.3 lbf·ft



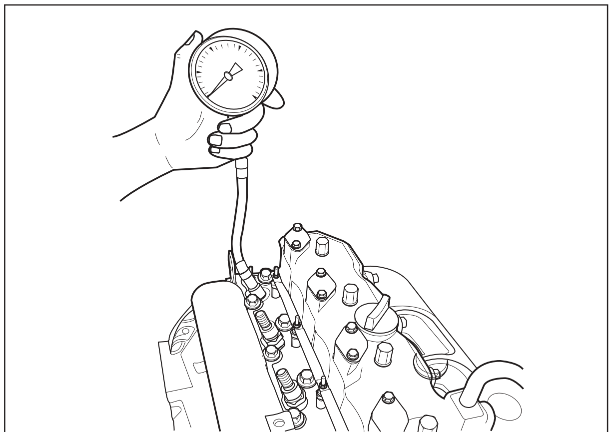
(1) Intake Manifold
(2) Injection Pipe
(3) Fuel Pipe
(4) Fuel Feed Pump

C. ENGINE BODY

a. Checking and Adjusting

1) Compression pressure

1. Run the engine until warmed up.
2. Stop the engine and remove the air cleaner, the muffler and all nozzle holders.
3. Connect a compression tester to the nozzle holder hole.
4. Pull the stop lever to cut the fuel and run the engine with the starter at 250 ~ 350 rpm for 5 ~ 10 seconds.
5. Measure the maximum pressure while running, several times.
6. If the pressure does not reach the allowable limit, apply a small amount of oil to the cylinder wall through the nozzle holder hole and check the pressure again.
7. If the pressure raises after oil is apply, check the cylinder wall and piston ring.
8. If the pressure is still low, check the top clearance, valve clearance and cylinder head.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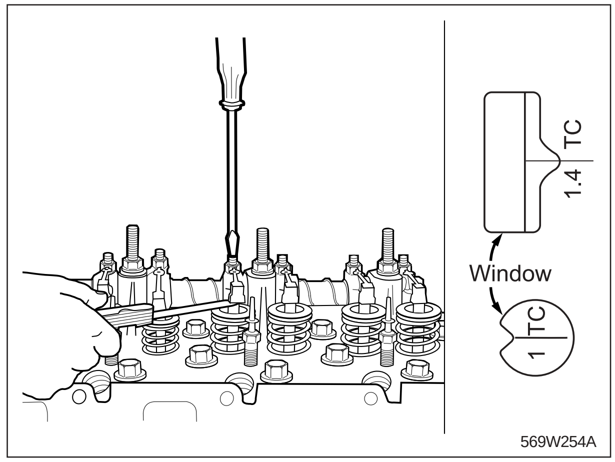
Compression pressure	Factory spec.	3.24 ~ 3.73 MPa 33 ~ 38 kgf/cm^2 469 ~ 540 psi
	Allowable limit	2.55 MPa 26 kgf/cm^2 370 psi
Difference between two cylinders	Allowable limit	10 %

NOTE:

- *Check the compression pressure with the specified valve clearance for proper air in taking.*

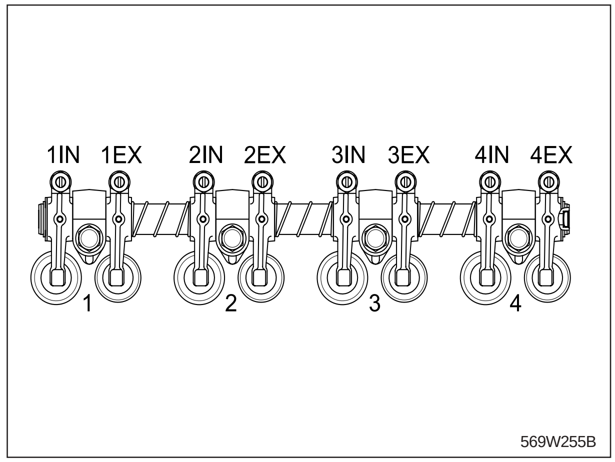
2) Valve clearance

1. Remove the cylinder head cover and the timing window cover on the flywheel housing and all glow plugs.
2. Turn the flywheel and align the 1 TC or 1.4 TC mark mark with the timing mark of window on the flywheel housing to position the 1st cylinder valves at the top head center during compression.
3. Measure the clearance at the valves marked with ○ in the table below with a feeler gauge.
4. If the clearance is not within the factory specifications, turn the adjusting screw to adjust.
5. Turn the flywheel just one turn to position the 1st cylinder valves at the top head center during overlap.
6. Measure the clearance at the valves marked with ● in the table below with a feeler gauge.
7. If the clearance is not within the factory specifications, adjust it.



Valve clearance	Factory spec.	4A220	In. : 0.25 mm 0.0098 in.
			Ex. : 0.30 mm 0.0118 in.
		4A200T	In. : 0.15 mm 0.0059 in.
			Ex. : 0.15 mm 0.0059 in.

Cylinder NO.	1	2	3	4
Valve	IN. EX.	IN. EX.	IN. EX.	IN. EX.
Checking	○ ○	○ ●	● ○	● ●



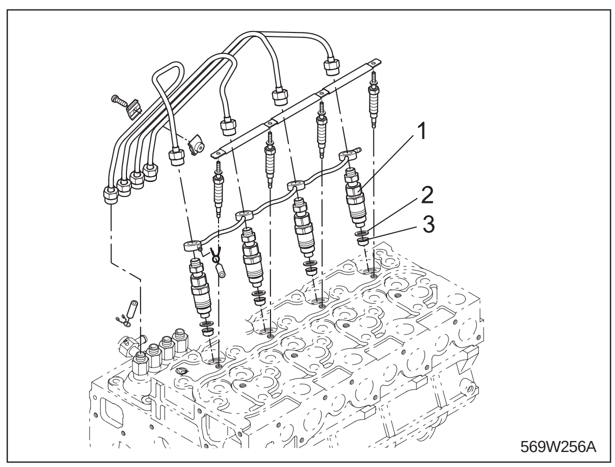
b. Disassembling and Assembling

1) Cylinder head cover, glow plugs and fuel overflow pipes.

1. Remove the injection pipes and over flow pipe.
2. Remove the glow plugs.
3. Remove the injection nozzles and gaskets, heat seals.
4. Remove the cylinder head cover.

(When reassembling)

- Check that the cylinder head cover gasket is not defective.
- Tighten the cylinder head cover cap nuts in several steps.



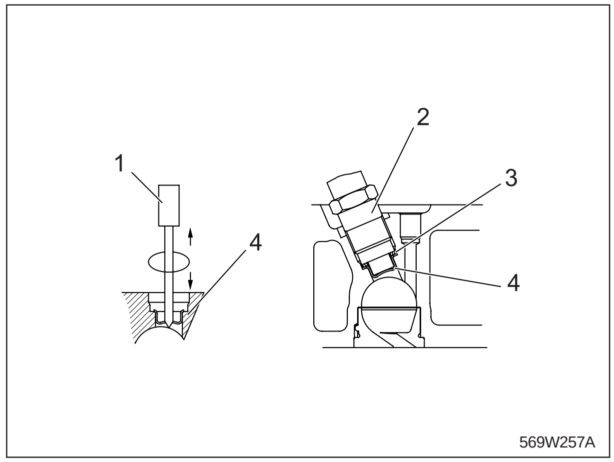
(1) Injection Nozzle
(2) Gasket
(3) Heat Seal

2) Heat seal removal procedure

1. Drive screw driver lightly into the heat seal hole.
2. Turn screw driver three or four times each way.
3. While turning the screw driver, slowly pull the heat seal put together with the injection nozzle gasket. If the heat seal drops, repeat the above procedure.
4. Heat seal and injection nozzle gasket must be changed when the injection nozzle is removed for cleaning or for service.

NOTE:

- *Use a philips screw driver that has a diameter which is bigger than the heat seal hole 1/4 in. (approx. ϕ 6mm).*



(1) Philips Screw Driver (2) Nozzle
(3) Injection Nozzle Gasket (4) Heat Seal

3) Rocker arm assembly

1. Loosen the nuts in several steps and the specified sequence shown in the figure and remove them.
2. Remove the rocker arm assembly and the push rod.

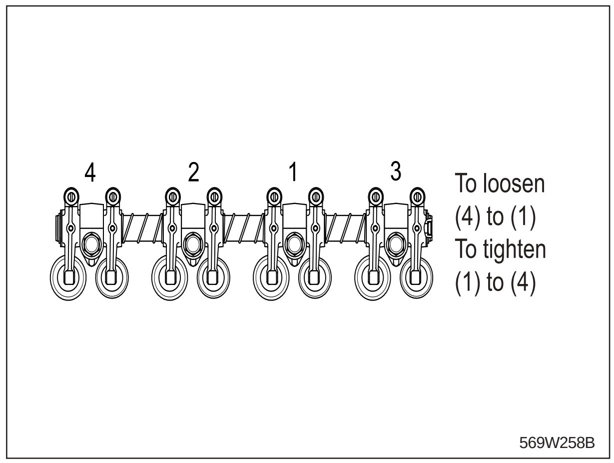
(When reassembling)

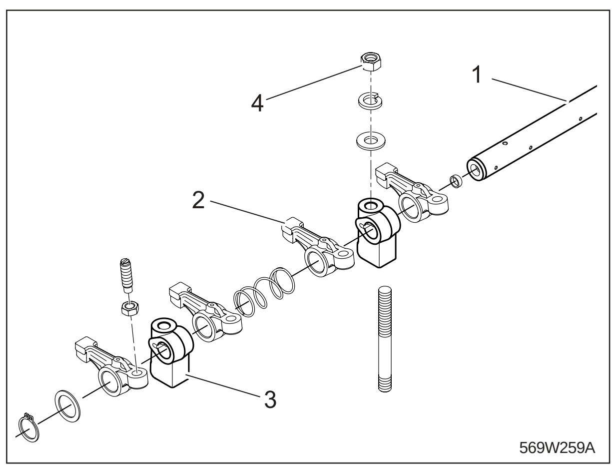
- Rest the end of push rod at the indent of tappet and install the rocker arm assembly.
- Tighten the nuts in several steps and in the specified sequence to the specified torque. As shown in the figure.
- Adjust the valve clearance after assembling the rocker arm assembly.

IMPORTANT:

- *When assembling the rocker arm assembly, locate the groove of rocker arm shaft on stud bolt.*

Tightening torque	Stud, nut	48.1 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.3 ~ 41.2 lbf·ft





(1) Rocker Arm Shaft (3) Rocker Arm Bracket
(2) Rocker Arm (4) Screw

4) Cylinder head

1. Remove the screw in the specified sequence shown in the figure and remove the cylinder head (1) and head gasket.
2. Remove the water flange (2).
3. Take out the tappets from the cylinder block.

NOTE:

- *Mark the cylinder number to the tappets to prevent interchanging.*

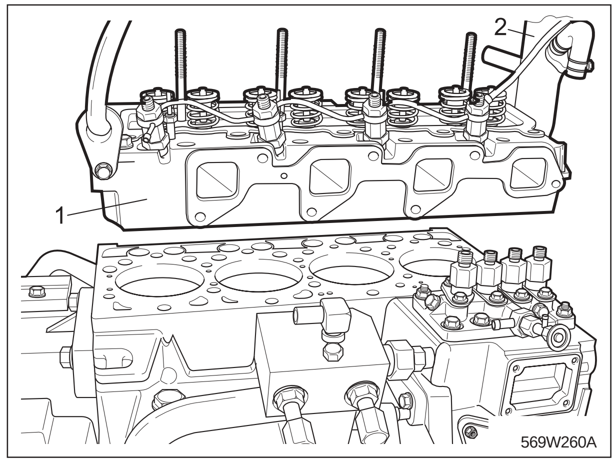
(When reassembling)

- Apply liquid gasket (Three bond 1215 or equivalent) on the both sides of water flange gasket.
- Replace the head gasket with new one and place on the cylinder block, be careful of its direction and side.
- When using the head gasket shim, assemble the shim first on the cylinder head.
- Before installing the tappets apply engine oil around them.

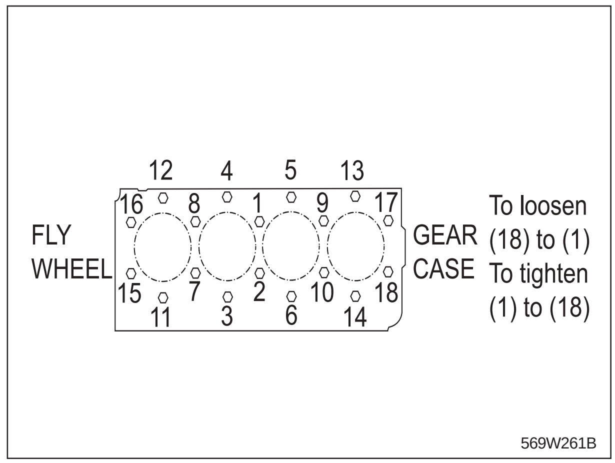
IMPORTANT:

- *Apply oil to the thread of screws and tighten in several steps and the specified sequence shown in the figure to the specified torque.*
- *Check the torque after 30 minutes operation of the assembled engine, and adjust valve clearance.*

Tightening torque	Cylinder head screws	103.0 ~ 107.9 N·m 10.5 ~ 11.0 kgf·m 75.9 ~ 79.6 lbf·ft



(1) Cylinder Head (2) Water Flange



5) Valve

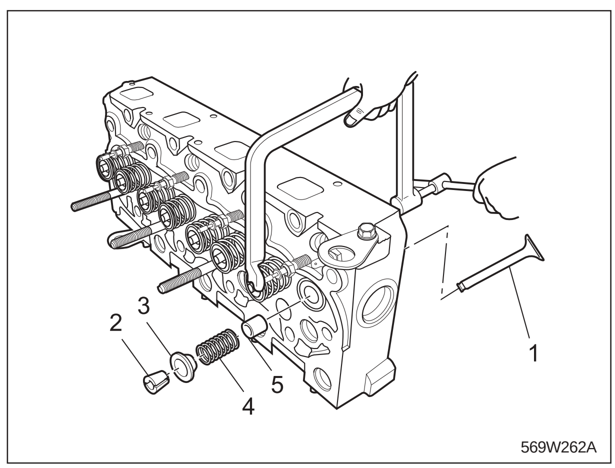
1. Compress the valve spring with a replaces and remove the collect (2).
2. Remove the retainer (3), valve spring (4), valve stem seal (5) and the valve (1).

IMPORTANT:

- *Do not interchange valves and valve parts.*
- *Mark the cylinder number on the valve and the parts to prevent interchanging.*

(When reassembling)

- Apply oil to the stem of valve and install in the cylinder head.
- Lubricate the valve and the parts after reassembling.



(1) Valve
(2) Collect
(3) Retainer
(4) Valve Spring
(5) Valve Stem Seal

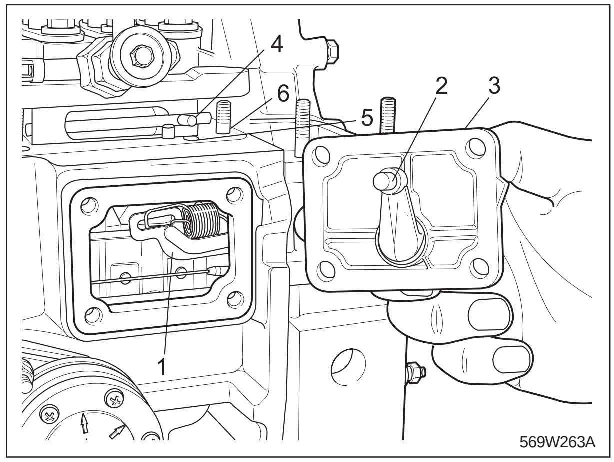
c. Timing Gears and Camshafts

1) Injection pump

1. Remove the injection pump cover (3) with the engine stop lever (2).
2. Remove the injection pump.

(When reassembling)

- Apply liquid gasket to the both sides of injection pump cover gasket and install it.
- Install the injection pump so that its control rack pin (4) engages with the groove (5) of fork lever 1 (1).
- Install the injection pump cover with the arm of engine stop lever (2) at the right of the arm of fork lever 1 (1).



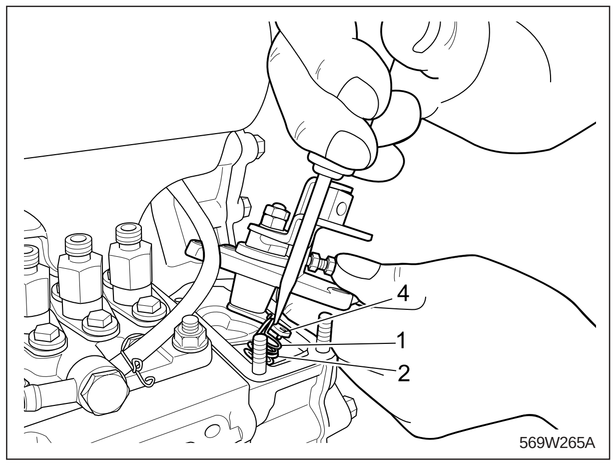
(1) Fork Lever 1
(2) Engine Stop Lever
(3) Injection Pump Cover
(4) Control Rack Pin
(5) Groove
(6) Shim

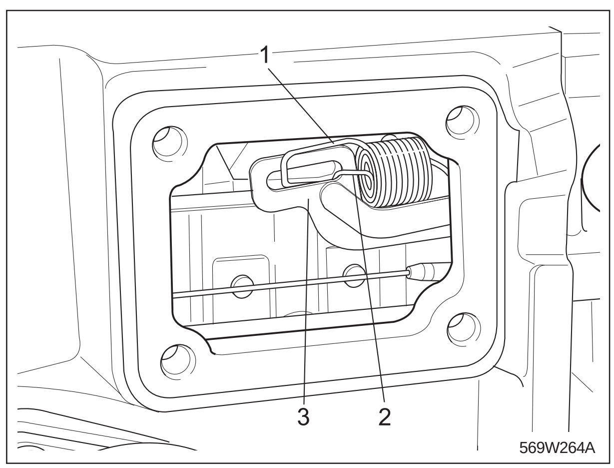
2) Governor spring and Speed control plate

1. Disconnect the governor spring 1 (1) and 2 (2) from the governor lever (4).
2. Remove the speed control plate.
3. Remove the governor spring.

(When reassembling)

- Be careful not to drop the governor springs 1, 2 into the gear case.
- Fix the governor springs (1), (2) to the fork lever 2 (3) and pull the springs, hook on to the governor lever(4).
- Apply a liquid gasket both side of speed control plate gasket.





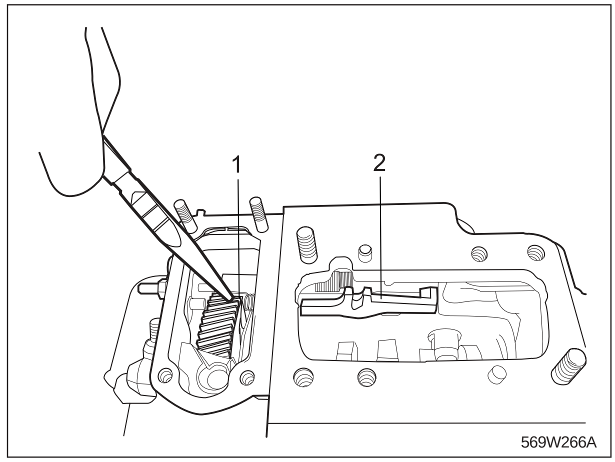
(1) Governor Spring 1
(2) Governor Spring 2
(3) Fork Lever 2
(4) Governor Lever

3) Start spring

1. Remove the start spring (1) from the fork lever 1 (2).

(When reassembling)

- Be careful not to drop the start spring into the gear case.
- Hook the start spring so that the longer hook is on the fork lever side.

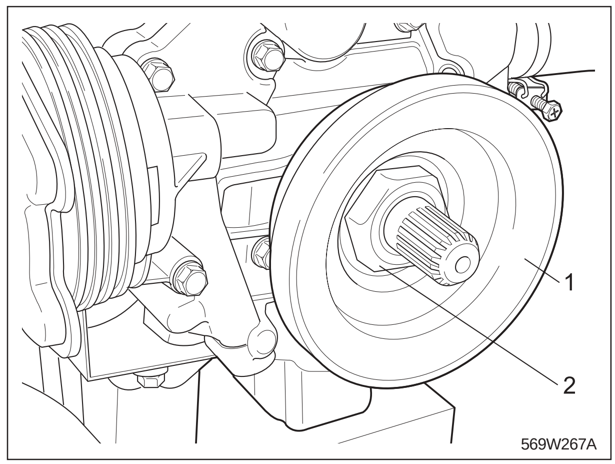


(1) Start Spring (2) Fork Lever 1

4) Fan drive pulley

1. Install the stopper to the flywheel so that the crankshaft may not turn.
2. Flatten the metal lock and loosen the crankshaft nut (2).
3. Remove the fan drive fan drive pulley (1).

Tightening torque	Crankshaft nut	137.3 ~ 156.9 N·m 14.0 ~ 16.0 kgf·m 101.3 ~ 115.7 lbf·ft



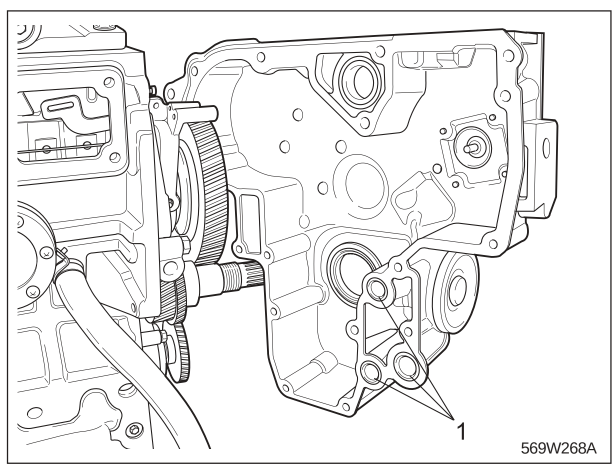
(1) Fan Drive Pulley (2) Crankshaft Nut

5) Gear case

1. Remove the gear case.

(When reassembling)

- Stick the O-ring (1) to the gear case with thin grease to prevent from coming off during reassembling.
- Apply grease to the crankshaft oil seal lip on the gear case and take care not to damage it when installing.
- Apply liquid gasket (three bond 1215 or equivalent) to the both sides of gear case gasket.



(1) O-Ring

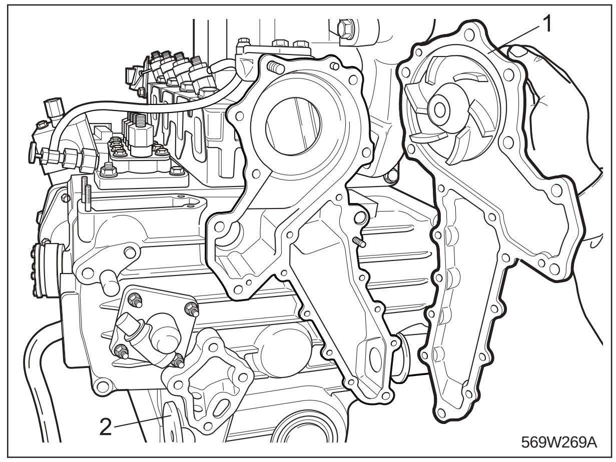
6) Water pump and relief valve

1. Remove the water pump body (1).
2. Remove the relief valve cover (2) and take out the ball, spring and seat.

(When reassembling)

- Install the relief valve cover (2) with its mark up.

Tightening torque	Relief valve cover screw	32.4 ~ 36.3 N·m 3.3 ~ 3.7 kgf·m 23.9 ~ 26.8 lbf·ft



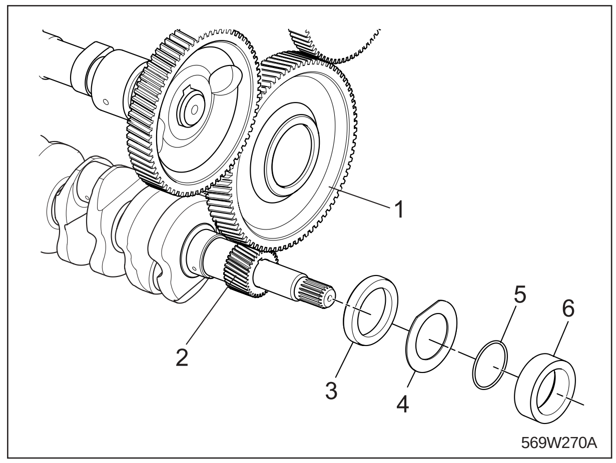
(1) Water Pump Body (2) Relief Valve Cover

7) Idle gear and crank gear

1. Remove the crankshaft collar (6), O-ring (5), oil slinger (4) and crank gear collar (3) in the order.
2. Remove the idle gear (1).
3. Remove the crankshaft gear (2) with a special use puller set.

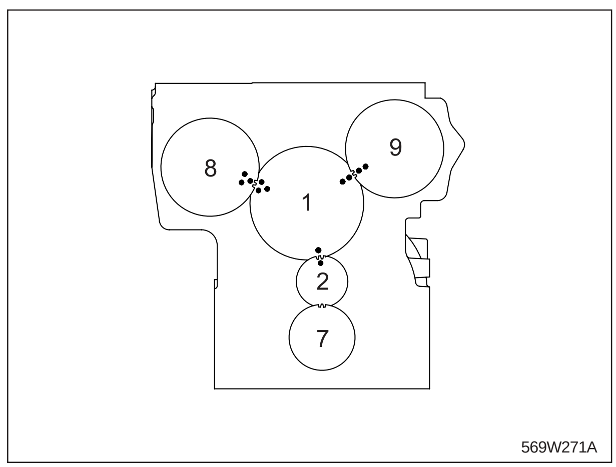
(When reassembling)

- Heat the crankshaft gear to approx. 80 °C (176 °F) and insert the crankshaft.
- Apply oil to the O-ring (5).



IMPORTANT:

- *Install the idle gear, aligning the alignment marks referring to the figure.*



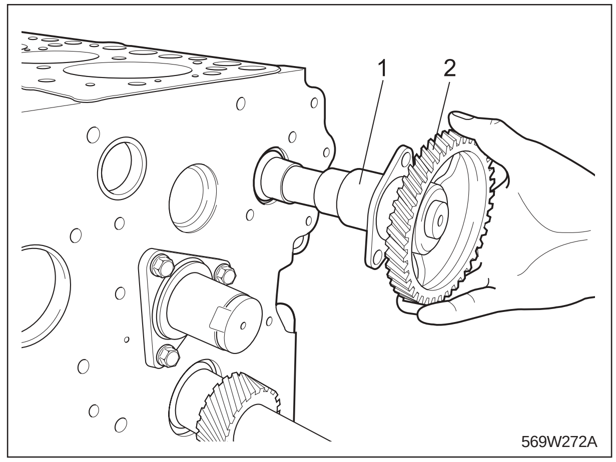
(1) Idle Gear
(2) Crankshaft Gear
(3) Crank Gear Collar
(4) Oil Slinger
(5) O-Ring
(6) Crankshaft Collar
(7) Oil Pump Gear
(8) Injection Pump Gear
(9) Cam Gear

8) Camshaft

1. Align the holes on the cam gear (2) with the crews to loosen them through the holes with a T handle wrench.
2. Draw out the camshaft (1).
3. Remove the cam gear (2).

(When reassembling)

- Heat the cam gear to approx. 80 °C (176 °F) and insert the camshaft (1).



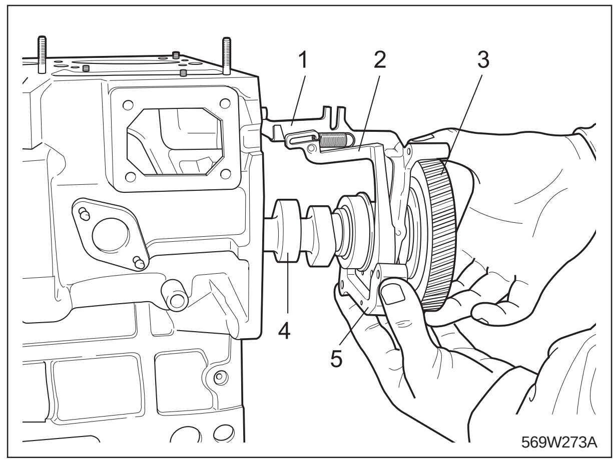
(1) Camshaft (2) Cam Gear

9) Fuel camshaft

1. Remove the fuel camshaft stopper.
2. Loosing the fork lever holder screws, remove the fuel camshaft (4) with fork lever holder (5), fork lever 1 (1) and 2 (2).
3. Remove the Injection pump gear (3).

(When reassembling)

- Heat the injection pump gear to approx. 80 °C (176 °F) and insert the camshaft (4).



(1) Fork Lever 1 (4) Camshaft
(2) Fork Lever 2 (5) Fork Lever Holder
(3) Injection Pump Gear

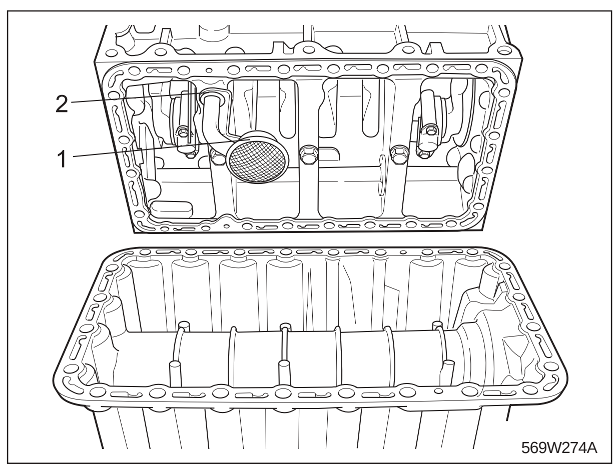
d. Connecting Rod and Piston

(A) Oil pan and oil filter

1. Remove the engine stand and the oil pan.
2. Remove the oil strainer (1).

(When reassembling)

- Be sure to install the O-ring (2) between the oil strainer and the cylinder block.



(1) Oil Strainer (2) O-Ring

(B) Piston and connecting rod

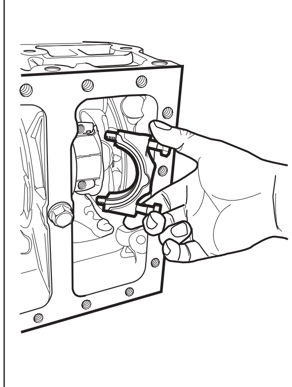
1. Remove the screws and the connecting rod cap.
2. Push out the rod and piston assembly.

(When reassembling)

- Apply oil to the crankpin bearing, cylinder wall and connecting rod cap screw.
- Insert the rod and piston assembly with the mark on the rod facing the injection pump, using a piston ring compressor.

IMPORTANT:

- *Mark the cylinder number on the piston and connecting rod to prevent interchanging.*
- *Carefully insert the piston and ring assembly in the cylinder, compressing the rings not to damage the chrome-plate on the piston rings.*
- *If connecting rod cap screws can not be screwed to the end by hand, replace the screw.*



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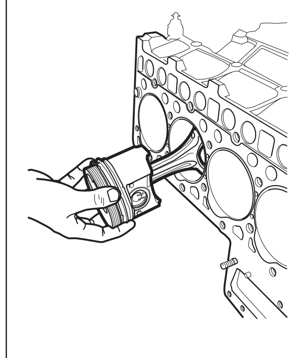

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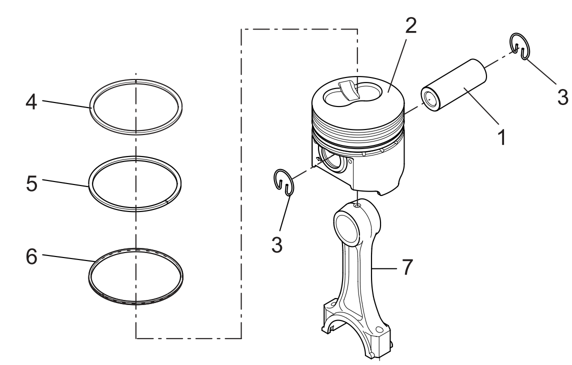
(C) Piston ring and piston pin

1. Remove the piston rings with a piston ring replacing tool.
2. Remove the piston pin.

(When reassembling)

- Clean all the parts before assembling.
- Heat the piston in approx. 80 °C (176 °F) of oil for 10 to 15 minutes, when inserting the piston pin into the piston.



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(1) Piston Pin

(2) Piston

(3) Piston Pin Snap Ring

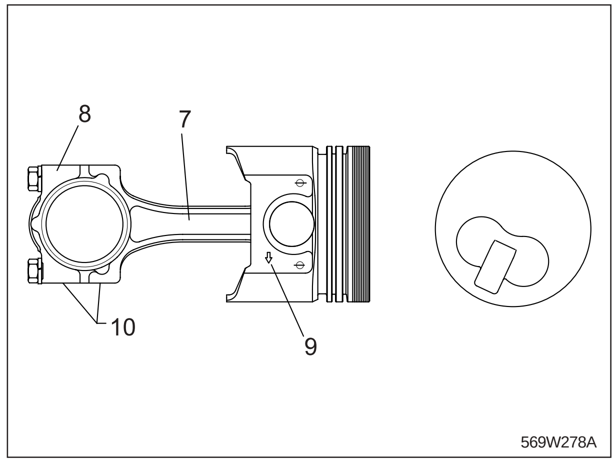
(4) Compression Ring 1 = Top Ring

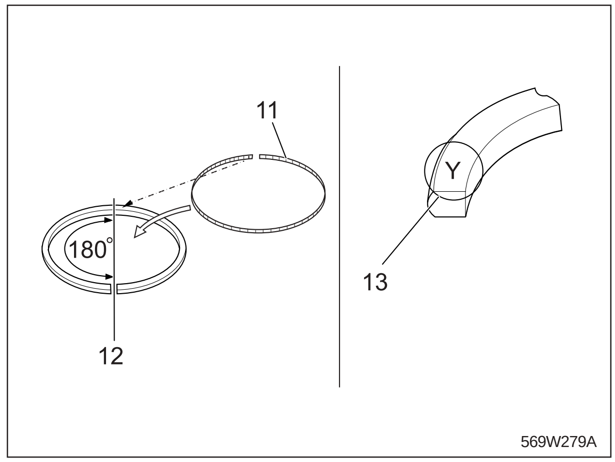
(5) Compression Ring 2 = Second Ring

(6) Oil Ring

(7) Connecting Rod

- Install the piston and connecting rod with the mark FW on the piston to the flywheel and the mark on the connecting rod to the injection pump.
- Install the piston rings with their manufacture's mark to the top of the piston.
- Install the expander in the oil ring with its gap opposite to the gap of oil ring.
- Install the top ring with its gap at 1.57 rad (90°) from the piston pin to the exhaust port.
- Install the second ring and oil ring with their gap at every 2.09 rad (120°).





(7) Connecting Rod
(8) Connecting Rod Cap
(9) Casting Mark
(10) Mark(The Side Face)
(11) Expander Joint
(12) Oil Ring Gap
(13) Manufacturer's Mark

e. Crankshaft

(A) Flywheel

1. Install the stopper to the flywheel and loosen the screw.
2. Remove the flywheel stopper and the flywheel.

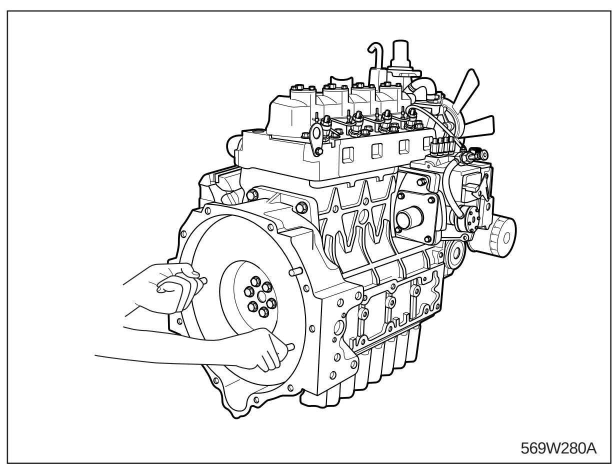
(When reassembling)

- Clean the end of the crankshaft and the mating surface of the flywheel.
- Apply oil to flywheel screws.
- Fit the flywheel hole to crankshaft hole and lighten the flywheel bolts to specified torque.

NOTE:

- *Screw longer screws into the flywheel to carry. It if needed.*

Tightening torque	Flywheel screw	98.1 ~ 107.9 N·m 10.0 ~ 11.0 kgf·m 72.3 ~ 79.6 lbf·ft



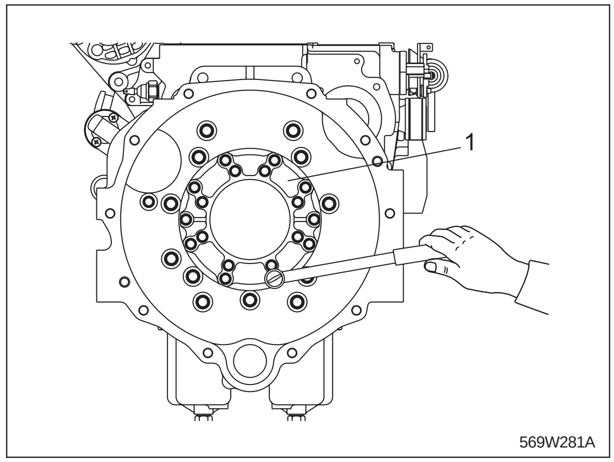
(B) Bearing case cover

Loosen the screw first inside and next outside, and lift the cover (1) by screwing two screws gradually and evenly, referring to the photo.

(When reassembling)

- Apply grease to the oil seal lip and take care that it is not rolled when installing.

Tightening torque	Bearing case cover screw	23.5 ~ 27.5 N·m 2.4 ~ 2.8 kgf·m 17.4 ~ 20.3 lbf·ft



(1) Bearing Case Cover

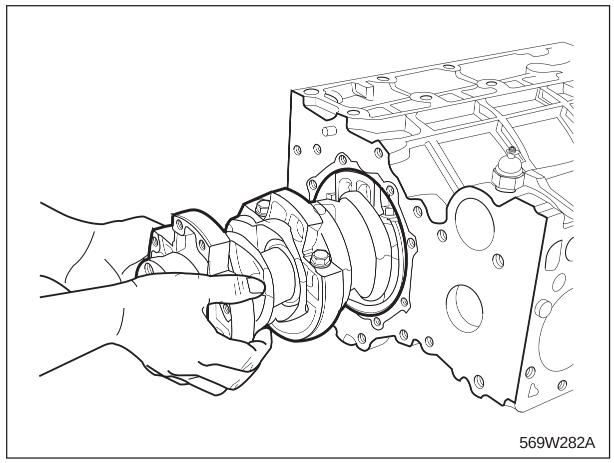
(C) Crankshaft

1. Remove the bearing case screw 2.
2. Pull out the crankshaft, taking care not to damage the crankshaft bearing 1.

(When reassembling)

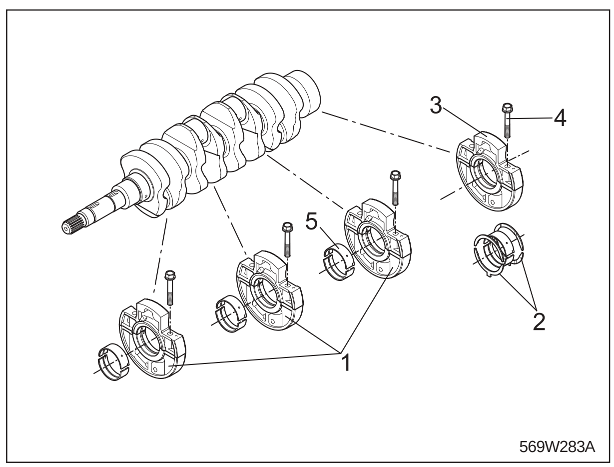
- Apply oil to the bearing case screw 2.
- Clean the oil passage of the crankshaft with compressed air.

Tightening torque	Main bearing case screw 2	68.7 ~ 73.6 N·m 7.0 ~ 7.5 kgf·m 50.6 ~ 54.2 lbf·ft



(D) Main bearing case

1. Remove the bearing case screws 1 (4) and remove the main bearing case 1, 2, 3 (1).
2. Remove the thrust bearing from the flywheel end of the bearing case.



(1) Main Bearing Case 1, 2, 3
(2) Thrust Bearings
(3) Main Bearing Case Assembly 1
(4) Bearing Case Screw 1
(5) Crankshaft Bearing 2

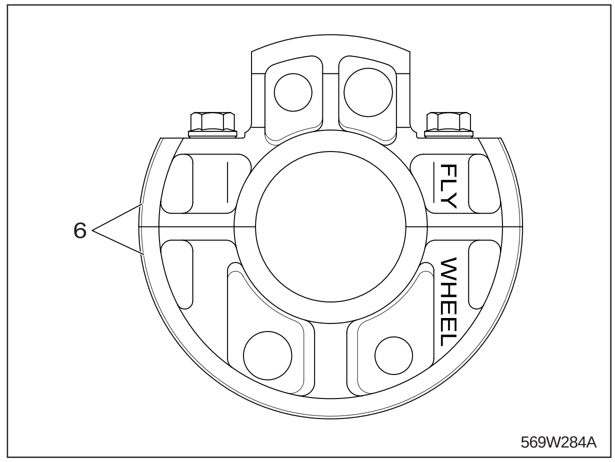
IMPORTANT:

- *Mark a location line (6) to the bearing case, to prevent interchanging.*

(When reassembling)

- Clean the parts and the oil passage of the bearing case.
- Apply oil to the journal, bearing inserts and the bearing case screws.
- Place the thrust bearings on the bearing case with their oil groove outside.
- Install the main bearing case with the mark “FLY WHEEL” toward the flywheel.

Tightening torque	Bearing case screw 1	46.1 ~ 51.0 N·m 4.7 ~ 5.2 kgf·m 34.0 ~ 37.6 lbf·ft



(6) Bearing Case

D. SERVICING

a. Cylinder Head and Valve

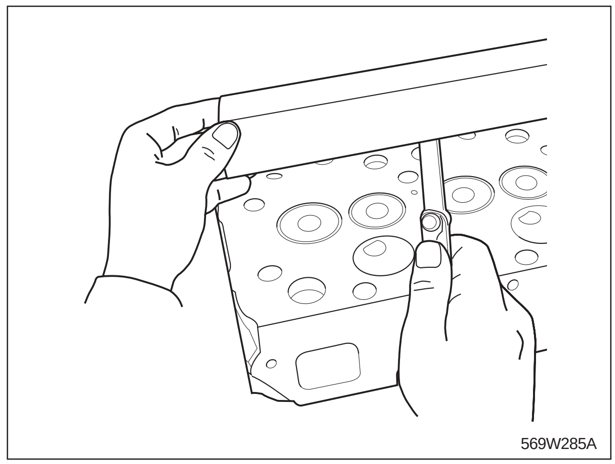
(A) Cylinder head surface flatness

1. Thoroughly clean the cylinder head surface.
2. Place a straight edge on the cylinder head and measure the clearance with a feeler gage as shown in the figure.
3. If the measurement exceeds the allowable limit, replace the cylinder head.

IMPORTANT:

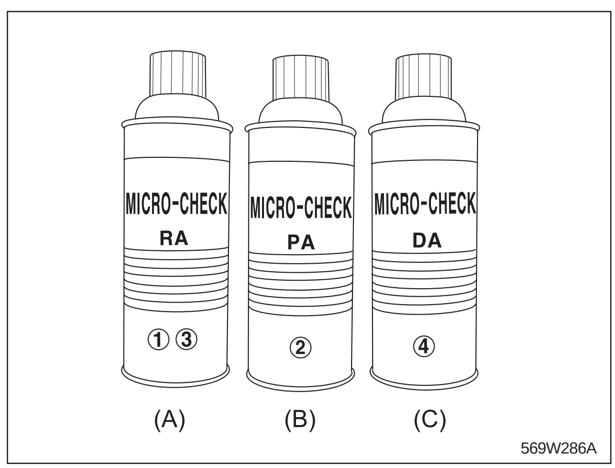
- *Do not place the straight edge on the combustion camber.*

Flatness	Allowable limit	0.05 mm 0.0019 in.



(B) Cylinder head surface flaw

1. Prepare an air spray red check.
2. Clean the cylinder head surface with the detergent (B).
3. Spray the cylinder head surface with the red permeative liquid (A).
4. Wash away the red permeative liquid on the cylinder head surface with the detergent (B) after ten minutes.
5. Spray the cylinder head surface with the white developer (C).
6. If any flaw is found such as a red mark, replace the cylinder head.

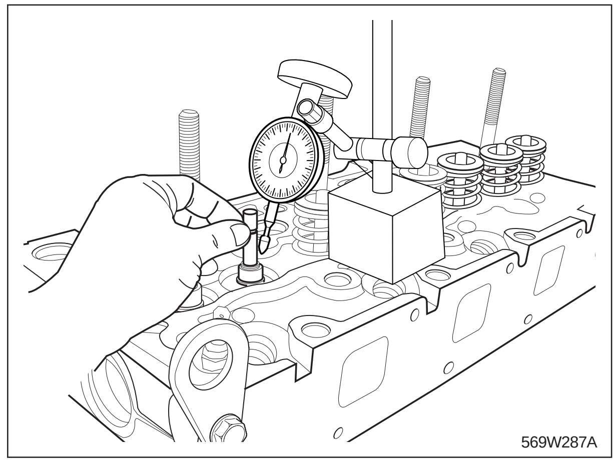


(A) Red Permeative Liquid (C) White Developer
(B) Detergent

(C) Valve stem clearance

1. Remove the carbon from the valve guide.
2. Measure the valve stem O.D. with an outside micrometer.
3. Measure the valve guide I.D. of cylinder head, and calculate the clearance.
4. If the measurement exceeds the allowable limit, replace the valve guide of the valve.

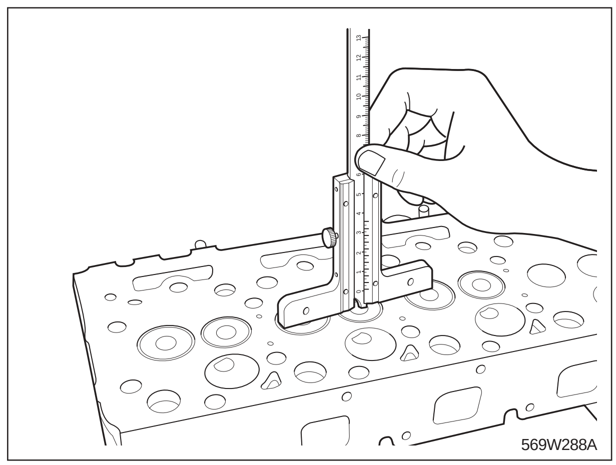
Valve stem clearance	Factory spec.	0.040 ~ 0.070 mm 0.00157 ~ 0.00276 in.
	Allowable limit	0.1 mm 0.004 in.
Valve guide bore I.D.	Factory spec.	8.015 ~ 8.030 mm 0.31555 ~ 0.31614 in.
Valve stem O.D.	Factory spec.	7.960 ~ 7.975 mm 0.31339 ~ 0.31398 in.



(D) Valve recessing

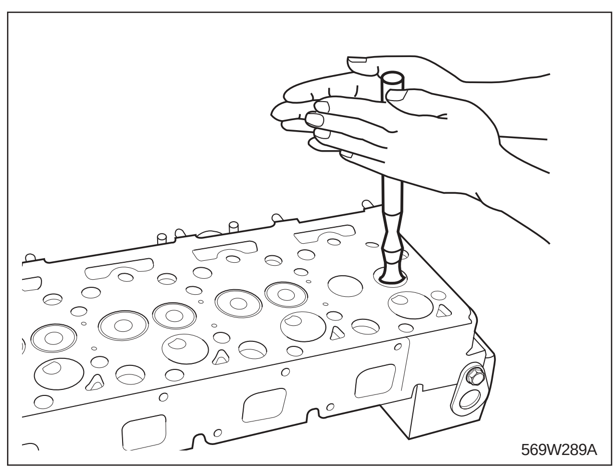
1. Clean the cylinder head, the valve face and the seat.
2. Insert the valve in the guide.
3. Measure the valve recessing with a depth gauge.
4. If the recessing exceeds the allowable limit, replace the valve and check the valve seating.

Valve recessing	Factory spec.	0.2 ~ 0.5 mm 0.0078 ~ 0.0197 in.
	Allowance	0.8 mm 0.0315 in.



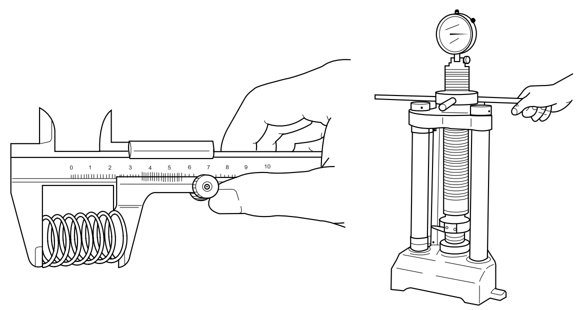
(E) Valve seat

1. Coat the valve face lightly with red lead and put the valve on its seat to check the contact.
2. If the valve does not seat all the way around the valve seat or the valve contact is less than 70%, correct the valve seating as follows.
3. Apply compound on the valve face evenly.
4. Put the valve on its seat hold it with the valve flapper.
5. Turn and flap the valve back and forth on the valve seat to lap.
6. Remove the compound and clean the valve and the seat.
7. Apply oil on the valve face and finish to complete fitting.
8. Repeat lapping until the valve seats correctly.



(F) Valve spring

1. Measure the free length of the spring with venire calipers.
2. Place the spring on a spring compression tester and compress to the specified length, and get the tension.
3. If the measurement is less than the allowable limit, replace the valve spring.



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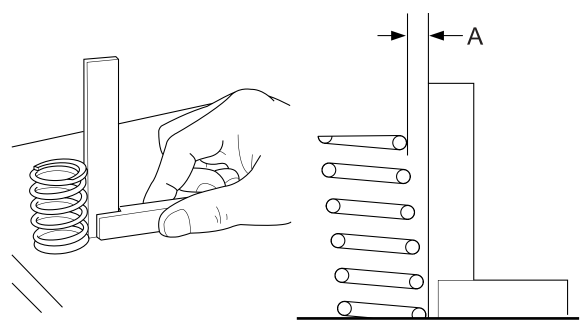
Tension	Factory spec.	117 N/35.15 mm 12.0 kgf/35.15 mm 26.5 lbs/1.3839 in.
	Allowable limit	100 N/35.15 mm 10.2 kgf/35.15 mm 22.5 lbs/1.3839 in.
Free length	Factory spec.	41.7 ~ 42.2 mm 1.6417 ~ 1.6614 in.
	Allowable limit	41.2 mm 1.622 in.

(G) Valve spring squareness (Tilt)

1. Place the spring on the surface plate, and a square at its side.
2. Measure the maximum distance “A” (see figure), rotating spring.
3. If the measurement exceeds the allowable limit replace.



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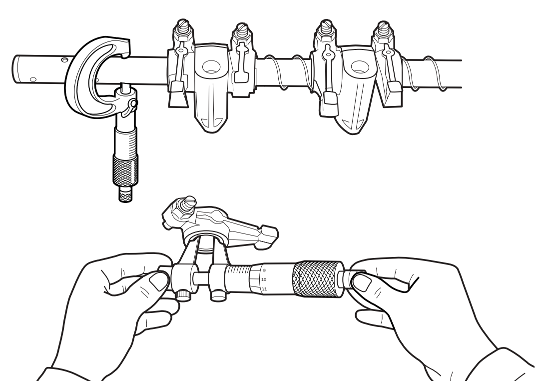
Valve spring square ness	Allowable limit	1.0 mm 0.039 in.

(H) Rocker arm bushing and shaft clearance

1. Measure the rocker arm I.D. with an inside micrometer.
2. Measure the rocker arm shaft O.D. with an outside micrometer.
3. If the clearance exceeds the allowable limit, replace the rocker arm.
4. If the clearance still exceeds the allowable limit after replacing the rocker arm replace the rocker arm shaft.



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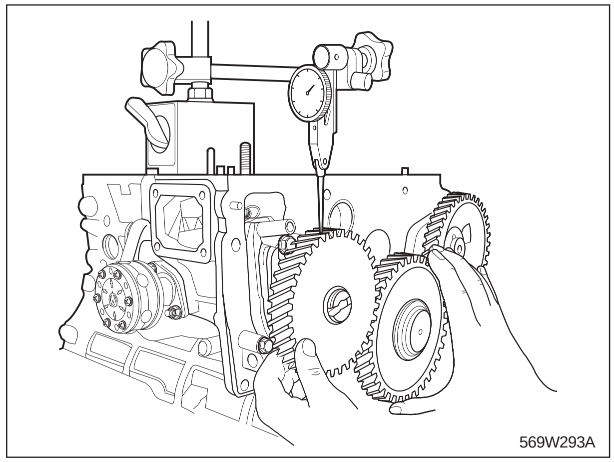
Clearance	Factory spec.	0.020 ~ 0.070 mm 0.00079 ~ 0.00276 in.
	Allowable limit	0.15 mm 0.0059 in.
Rocker arm shaft O.D.	Factory spec.	18.955 ~ 18.980 mm 0.74626 ~ 0.74724 in.
Rocker arm I.D.	Factory spec.	19.000 ~ 19.025 mm 0.74803 ~ 0.74902 in.

b. Timing Gears and Camshafts

(A) Timing gear backlash

1. Set a dial indicator (lever type) with its tip on the gear tooth.
2. Move the gear to measure the backlash, holding its mating gear.
3. If the backlash exceeds the allowable limit, check the oil clearance of the shafts and the gear.
4. If the oil clearance is proper, replace the gear.

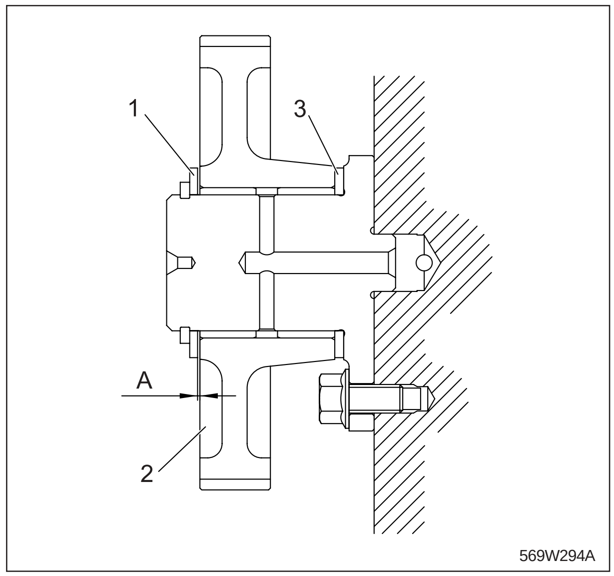
Clearance	Factory spec.	0.04 ~ 0.11 mm 0.0016 ~ 0.0043 in.
	Allowable limit	0.15 mm 0.0059 in.



(B) Idle gear side clearance

1. Pull the idle gear collar 2 (1) and push the idle gear (2) to each end.
2. Measure the clearance A between the idle gear and the idle gear collar 2 (1) with a feeler gauge.
3. If the clearance exceeds the allowable limit, replace the idle gear collar 1 (3).

Side clearance	Factory spec.	0.20 ~ 0.51 mm 0.0079 ~ 0.021 in.
	Allowable limit	0.9 mm 0.035 in.

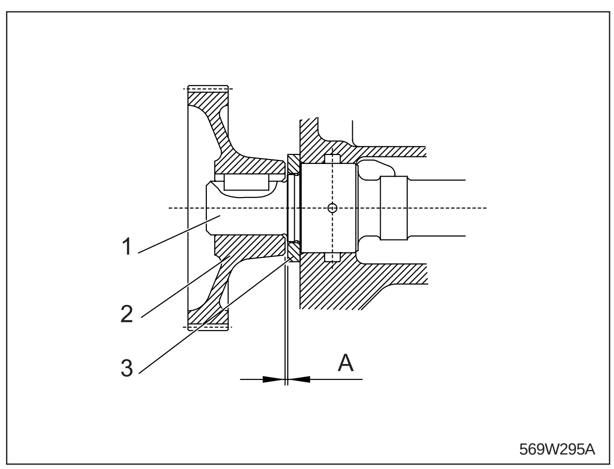


(1) Idle Gear Collar 2
(2) Idle Gear
(3) Idle Gear Collar 1

(C) Cam gear side clearance

1. Pull the cam gear (2) with the camshaft (1) to its end.
2. Measure the clearance A between the cam gear (2) and the camshaft stopper (3).
3. If the clearance exceeds the allowable limit, replace the camshaft stopper (3).

Side clearance	Factory spec.	0.07 ~ 0.22 mm 0.0028 ~ 0.0087 in.
	Allowable limit	0.3 mm 0.0118 in.

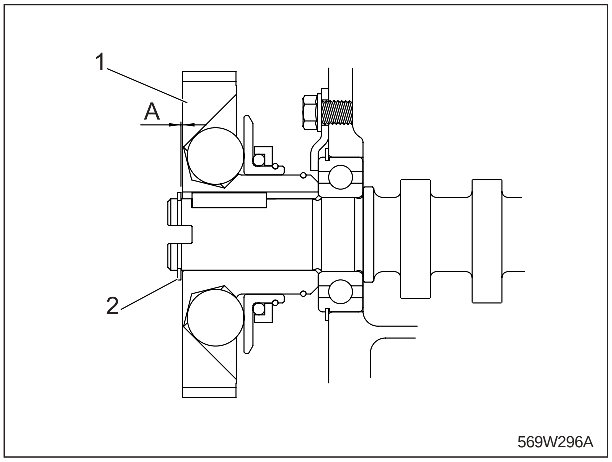


(1) Camshaft
(2) Cam Gear
(3) Camshaft Stopper

(D) Injection pump gear side clearance

1. Pull the fuel camshaft and pull the injection pump gear (1) to each end.
2. Measure the clearance (A) between the injection pump gear (1) and the snap ring (2) on the fuel camshaft.
3. If the clearance exceeds the allowable limit, check the gear, the bearing and the key.

Side clearance	Factory spec.	0.15 ~ 0.57 mm 0.0059 ~ 0.0224 in.
	Allowable limit	0.9 mm 0.035 in.



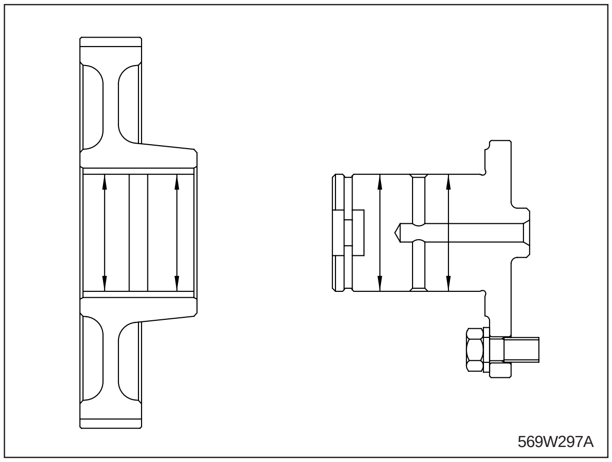
(1) Injection Pump Gear (2) Snap Ring

(A) Clearance

(E) Idle gear oil clearance

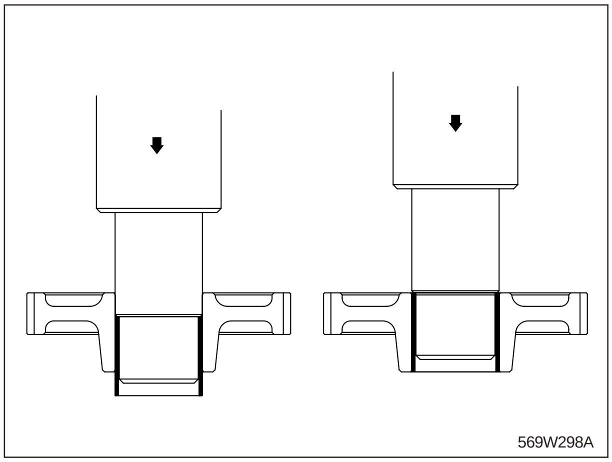
1. Measure the idle gear shaft O.D. with an outside micrometer.
2. Measure the idle gear bushings I.D. with an inside micrometer.
3. If the clearance exceeds the allowable limit, replace the bushing.

Oil clearance	Factory spec.	0.025 ~ 0.066 mm 0.00098 ~ 0.00259 in.
	Allowable limit	0.1 mm 0.004 in.
Shaft O.D.	Factory spec.	37.959 ~ 37.975 mm 1.4944 ~ 1.4950 in.
Bushing I.D.	Factory spec.	38.000 ~ 38.025 mm 1.4961 ~ 1.4970 in.



(F) Replacing idle gear bushings

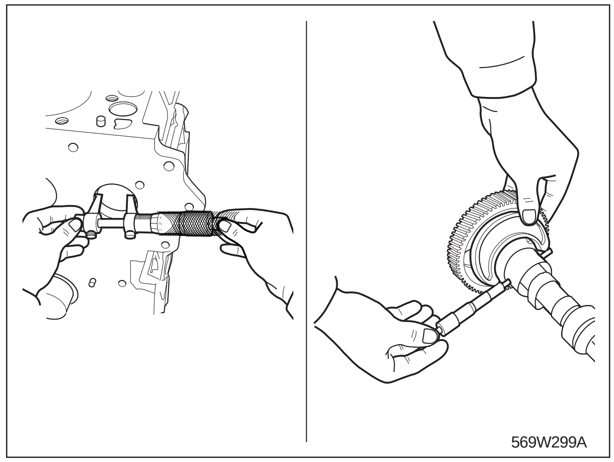
1. Press out the bushings using an idle gear bushing replacing tool.
2. Clean the bushings and the bore, and apply oil to them.
3. Press in the bushing using the replacing tool.



(G) Camshaft oil clearance

1. Measure the I.D. of the camshaft bore on the crank-case with an inside micrometer.
2. Measure the O.D. of the camshaft journal with an outside micrometer.
3. If the clearance exceeds the allowable limit, replace the shaft.

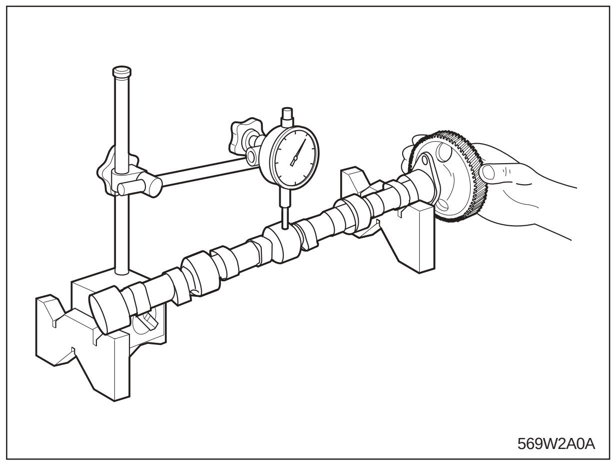
Oil clearance	Factory spec.	0.050 ~ 0.091 mm 0.00197 ~ 0.00358 in.
	Allowable limit	0.15 mm 0.0059 in.
Journal O.D.	Factory spec.	39.934 ~ 39.950 mm 1.57221 ~ 1.57284 in.
Bore I.D.	Factory spec.	40.000 ~ 40.025 mm 1.57480 ~ 1.57579 in.



(H) Camshaft alignment

1. Support the camshaft with V blocks on the surface plate at both end journals and set a dial indicator with its tip on the intermediate journal.
2. Rotate the camshaft in the V block and get the eccentricity (half of the measurement).
3. If the eccentricity exceeds the allowable

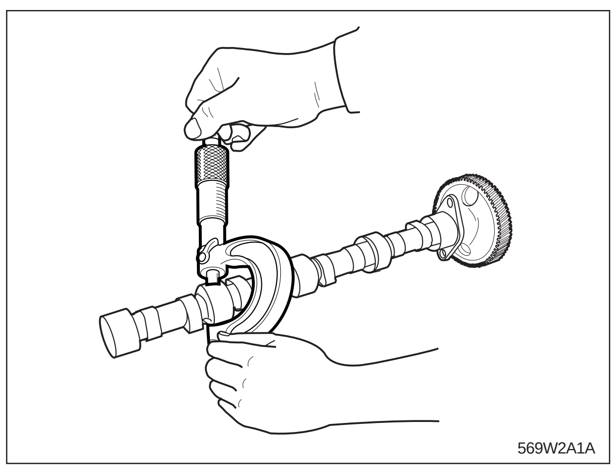
Eccentricity	Allowable limit	0.05 mm 0.002 in.



(I) Cam height

1. Measure the height of the camshaft lobes at their largest. O.D. with an outside micrometer.
2. If the measurement is less than the allowable limit, replace the camshaft.

Cam height	4A220	(IN.)	specification	33.59 mm 1.322 in.
			allowable limit	33.54 mm 1.320 in.
		(EX.)	specification	33.69 mm 1.326 in.
			allowable limit	33.64 mm 1.324 in.
	4A200T	(IN.)	specification	33.90 mm 1.335 in.
			allowable limit	33.85 mm 1.333 in.
		(EX.)	specification	33.70 mm 1.327 in.
			allowable limit	33.65 mm 1.325 in.

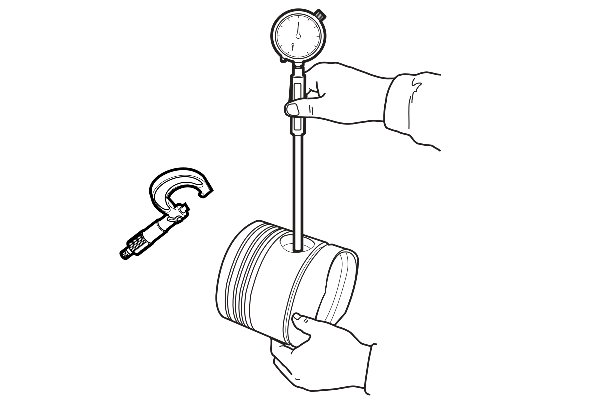


c. Connecting Rod and Piston

(A) Piston pin bore

1. Measure the I.D. of the piston pin bore in piston (lengthwise and widthwise of the piston) with a cylinder gauge.
2. If the measurement exceeds the allowable limit, replace the piston.

Piston pin bore I.D.	Factory spec.	25.000 ~ 25.006 mm 0.9843 ~ 0.9845 in.
	Allowable limit	25.03 mm 0.9854 in.



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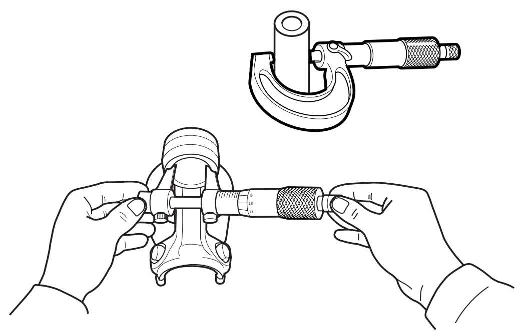
(B) Piston pin and brushing clearance

1. Measure the piston pin O.D. with an outside micrometer.
2. Measure the piston pin busing I.D. with an inside micrometer.
3. If the clearance exceeds the allowable limit with new bushing, replace the piston pin.

Piston pin and bushing clearance	Factory spec.	0.014 ~ 0.038 mm 0.00055 ~ 0.00150 in.
	Allowable limit	0.15 mm 0.0059 in.
Piston pin O.D.	Factory spec.	25.002 ~ 25.011 mm 0.98433 ~ 0.98469 in.
Bushing I.D.	Factory spec.	25.025 ~ 25.040 mm 0.98524 ~ 0.98583 in.



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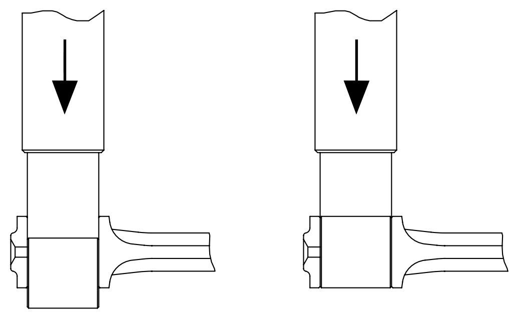
(C) Replacing the piston pin bushing

1. Press out the bushing, using a piston pin bushing replacing tool.
2. Clean the new bushing and the bore and apply oil to them.
3. Press in the bushing, using the replacing tool.

IMPORTANT:

- *Align the oil holes of the connecting rod and the bushing.*



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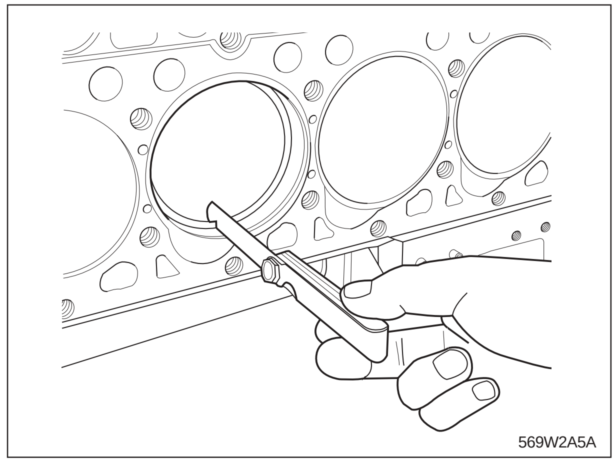
(D) Piston ring end gap

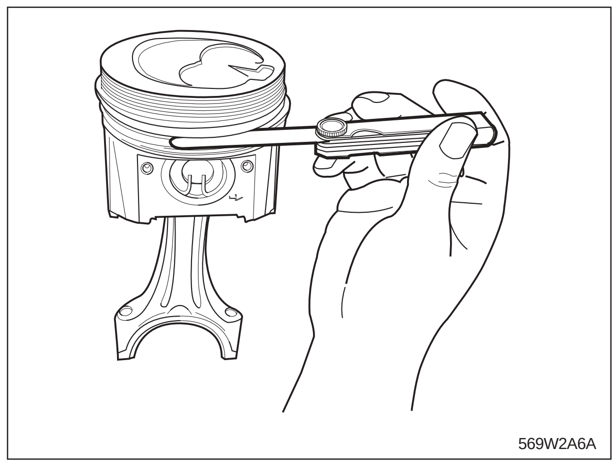
1. Push the ring into the cylinder to the lower limit of the ring travel in the assembled engine with a piston.
2. Measure the ring gap with a feeler gauge.
3. If the gap exceeds the allowable limit, replace the piston ring.



Piston ring end gap	2nd ring	Factory spec.	0.55 ~ 0.70 mm 0.0217 ~ 0.0276 in.
		Allowable limit	1.25 mm 0.0492 in.
	Top ring, oil ring	Factory spec.	0.25 ~ 0.40 mm 0.0098 ~ 0.0157 in.
		Allowable limit	1.25 mm 0.0492 in.

(E) Piston ring clearance

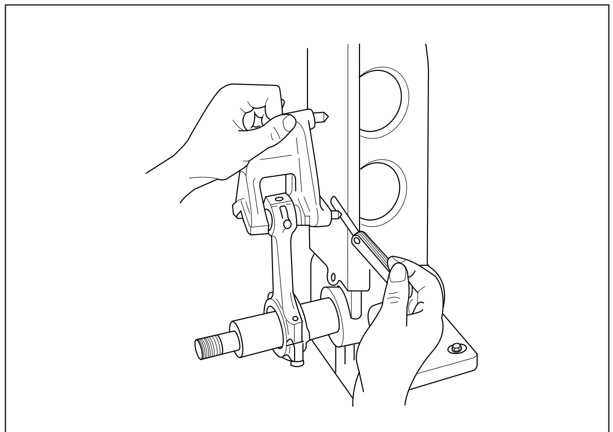
1. Clean the ring and the ring grooves, and install each ring into its groove.
2. Measure the clearance between the ring and the groove with a feeler gauge.
3. If the clearance exceeds the allowable limit, replace the piston ring.
4. If the clearance still exceeds the allowable limit with a new ring, replace the piston.



Piston ring clear-ance	2nd ring	Factory spec.	0.04 ~ 0.08 mm 0.00157 ~ 0.00314 in.
		Allowable limit	0.15 mm 0.0059 in.
	Oil ring	Factory spec.	0.02 ~ 0.06 mm 0.00079 ~ 0.00236 in.
		Allowable limit	0.15 mm 0.0059 in.

(F) Connecting rod alignment

1. Remove the connecting rod bearing and install the bearing cap.
2. Install the piston pin in the connecting rod.
3. Install the connecting rod on the connecting rod alignment tool.
4. Put a gauge over the piston pin and move it against the face plate.
5. If the gauge does not fit squarely against the face plate, measure the space between the pin of the gauge and the face plate.
6. If the measurement exceeds the allowable limit, replace the connecting rod.



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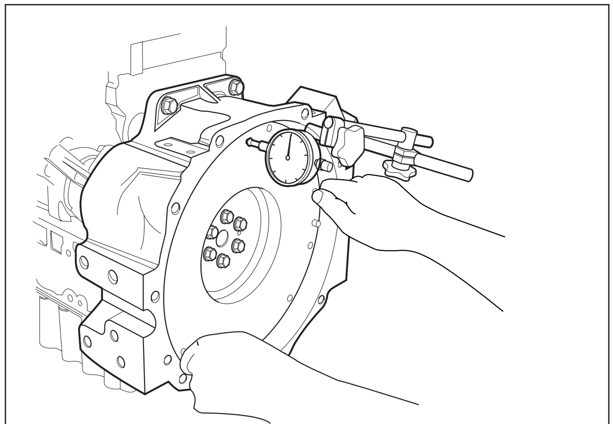
Space between gauge pin and face plate	Allowable limit	0.05 mm (0.0020 in.) at 100 mm (3.94 in.) of gauge pin span

d. Crankshaft

(A) Flywheel deflection and crankshaft end play

1. Set a dial indicator with its tip on the rear friction face of the flywheel near the edge.
2. Turn the flywheel and measure the deflection or the uneven wear.
3. If the measurement exceeds the allowable limit, remove the flywheel and check the mating faces of the crankshaft and flywheel.
4. If scored of worn excessively, resurface or replace the flywheel.
5. Move the crankshaft with flywheel back and forth to each end and measure the end play.
6. If the play exceeds the allowable limit, replace the side bearing.



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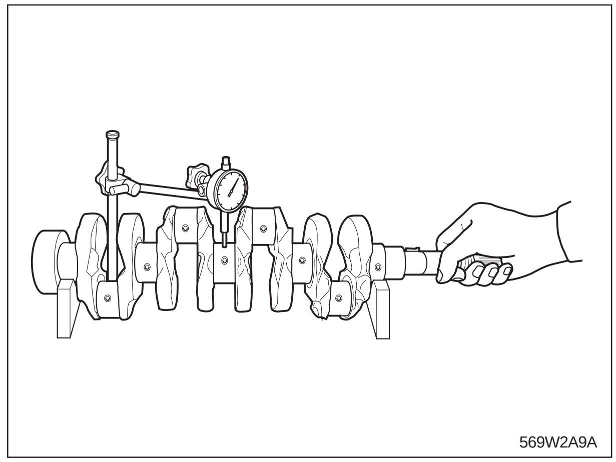
Deflection	Allowable limit	0.05 mm 0.0020 in.
End play	Factory spec.	0.15 ~ 0.31 mm 0.0059 ~ 0.0122 in.
	Allowable limit	0.5 mm 0.020 in.

(B) Crankshaft alignment

1. Support the crankshaft with V blocks on the surface plate at its front and rear journals and set a dial indicator with its tip on the intermediate journal.
2. Rotate the crankshaft in the V blocks and get the misalignment (half of the measurement).
3. If the misalignment exceeds the allowable limit, replace the crankshaft.

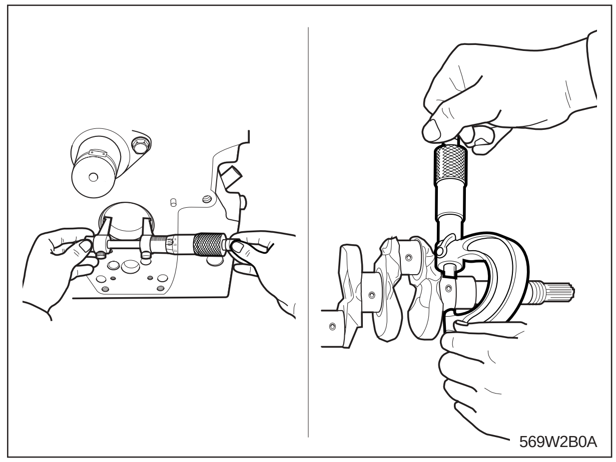
Misalignment	allowable limit	0.08 mm 0.0031 in.



(C) Crankshaft journal and bearing 1 oil clearance

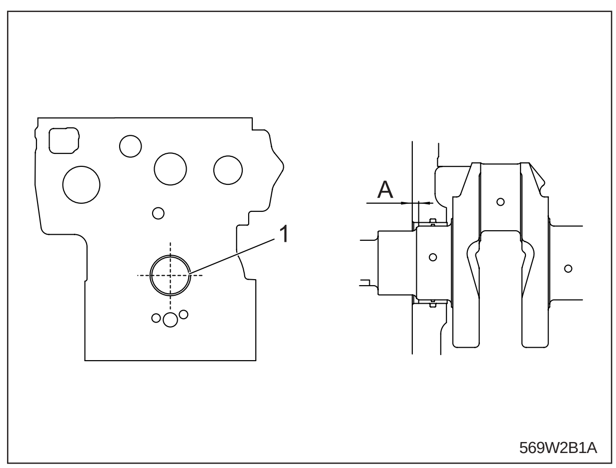
1. Measure the I.D. of the crankshaft bearing 1 with an inside micrometer.
2. Measure the O.D. of the crankshaft journal with an outside micrometer.
3. If the clearance exceeds the allowable limit, replace the bearing referring to Replacing Crankshaft Bearing 1.

Oil clearance	Factory spec.	0.040 ~ 0.118 mm 0.00157 ~ 0.00465 in.
	Allowable limit	0.20 mm 0.0079 in.
Journal O.D.	Allowable limit	51.921 ~ 51.940 mm 2.04413 ~ 2.04488 in.
Bearing 1 I.D.	Allowable limit	51.980 ~ 52.039 mm 2.04646 ~ 20.4878 in.



(D) Replacing crankshaft bearing 1

1. Press out the crankshaft bearing 1 with replacing tool.
2. Clean a new crankshaft bearing 1 and bore, and apply engine oil to them.
3. Press fit a new bearing 1 using a inserting tool, taking due care to see that the seam of bearing 1 faces the exhaust manifold side.



(1) Seam

(E) Crankshaft Journal and Bearing 2 Oil Clearance

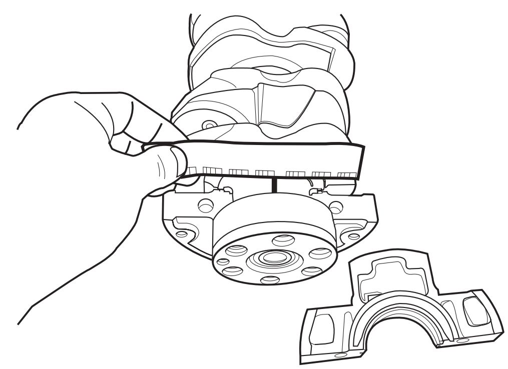
1. Put plastic gauge lengthwise in the center of the journal.
2. Install the bearing cap and tighten the screw to the specified torque once, and remove the cap again.
3. Measure the amount of the flattening with the scale and get the oil clearance.
4. If the clearance exceeds the allowable limit, replace replace the bearing.

Oil clearance	Factory spec.	0.040 ~ 0.104 mm 0.00157 ~ 0.00409 in.
	Allowable limit	0.20 mm 0.0079 in.
Journal O.D.	Allowable limit	51.921 ~ 51.940 mm 2.04413 ~ 2.04488 in.
Bearing 2 I.D.	Factory spec	51.980 ~ 52.025 mm 2.04646 ~ 2.04823 in.

(F) Crankpin and connecting rod bearing 2 oil clearance

1. Put a strip of PLASTIGAGE lengthwise in the center of the crankpin.
2. Install the connecting rod and tighten the screws to the specified torque once, and remove the cap again.
3. Measure the amount of the flattening with the scale and get the oil clearance.
4. If the clearance exceeds the allowable limit, replace the bearing.

Oil clearance	Factory spec.	0.025 ~ 0.087 mm 0.00098 ~ 0.00343 in.
	Allowable limit	0.20 mm 0.0079 in.
Journal O.D.	Factory spec.	46.959 ~ 46.975 mm 1.84878 ~ 1.84941 in.
Bearing 1 I.D.	Factory spec.	47.000 ~ 47.046 mm 1.85040 ~ 1.85221 in.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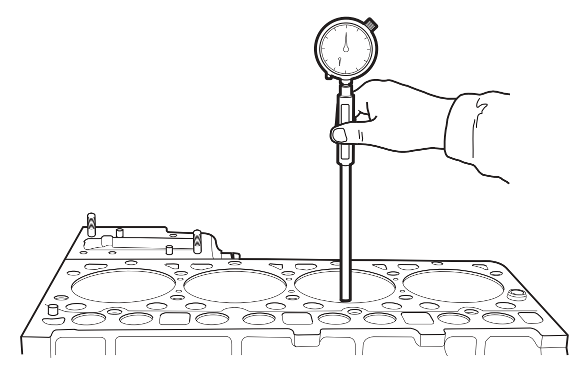
e. Cylinder Bore

(A) Cylinder bore diameter

1. Measure the cylinder liner I.D. at sit positions shown in the figure to find the maximum wear.

4A200T	83.000 ~ 83.022 mm 3.2677 ~ 3.269 in.
4A220	87.000 ~ 87.022 mm 3.4252 ~ 3.4261 in.



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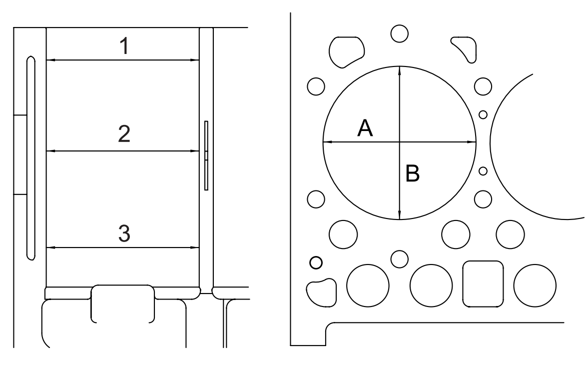

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(A) Axial Direction

(B) Transverse Direction

1,2,3 Measuring Points

E. LUBRICATING SYSTEM

a. Checking

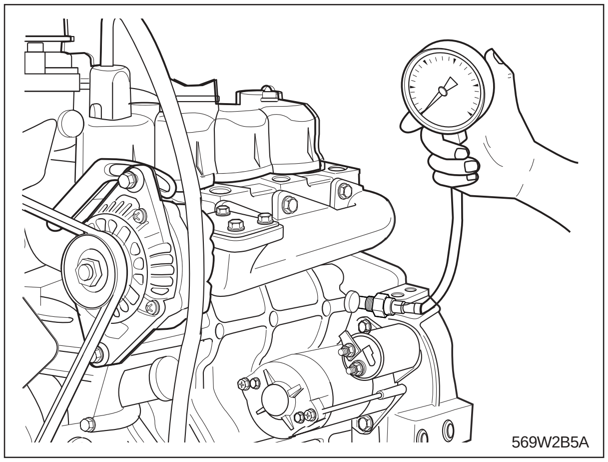
(A) Engine oil pressure

1. Remove the oil pressure switch and install adaptors and pressure tester.
2. Start the engine and run it until it is warmed up, and measure the oil pressure both at idling and rated speed.
3. If the oil pressure is less than the allowable limit, check the amount of oil, oil filter, oil pump relief valve, oil passages and oil clearance.

Engine oil pressure	At idle speed	Factory spec.	more than 49 kPa 0.5 kgf/cm^2 7.11 psi
	At rated speed	Factory spec.	294 ~ 441 kPa 2.5 ~ 4.5 kgf/cm^2 35.6 ~ 64.0 psi
		Allowable limit	245 kPa 2.5 kgf/cm^2 35.6 psi

(Reference)

Tightening torque	Oil pressure switch	14.7 ~ 19.6 N·m 1.5 ~ 2.0 kgf·m 10.8 ~ 14.5 lbf·ft



(B) Oil filter and relief valve

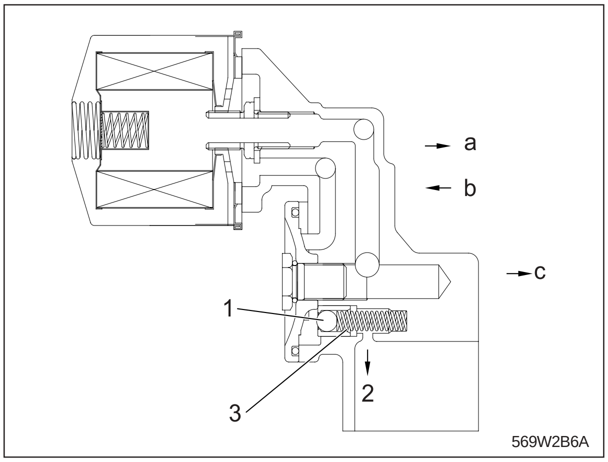
1. Drain the engine oil and remove the oil filter to check it.
2. Check the relief valve for dirt, and the seat (2) and ball (1) for damage.
3. If damaged, replace.
4. Check the free length of spring (3).
5. If it is less than the allowable limit, replace it.

Spring free length	Factory spec	35 mm 1.38 in.
	Allowable limit	30 mm 1.18 in.

NOTE:

- *Install the relief valve cover with the mark up.*

Tightening torque	Relief cover	32.4 ~ 36.3 N·m 3.3 ~ 3.7 kgf·m 23.9 ~ 36.8 lbf·ft



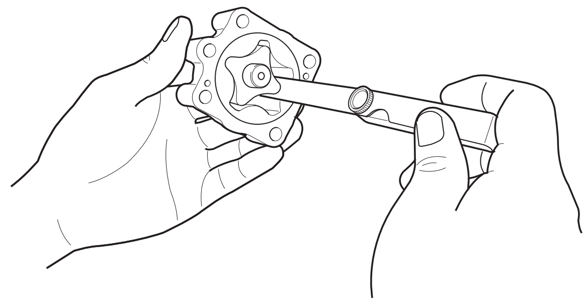
(1) Relief Valve Ball
(2) Relief Valve Seat
(3) Relief Valve Spring

b. Servicing

(A) Rotor and lobe clearance of oil pump

1. Measure the clearance between the outer and inner rotor with a feeler gauge.
2. Measure the clearance between the outer and the housing with a feeler gauge.
3. If the clearance exceeds the allowable limit, replace the pump.

Outer and inner rotor clearance	Factory spec.	0.10 ~ 0.16 mm 0.0039 ~ 0.0063 in.
	Allowable limit	0.20 mm 0.0079 in.
Outer and inner housing clearance	Factory spec.	0.11 ~ 0.19 mm 0.0043 ~ 0.0075 in.
	Allowable limit	0.25 mm 0.0098 in.



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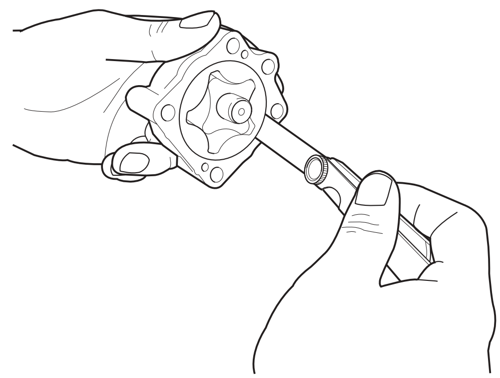

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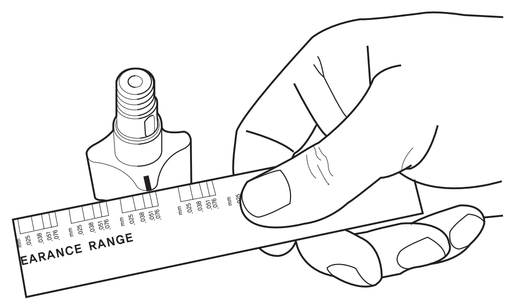
(B) Rotor end clearance of oil pump

1. Put a strip of PLASTIGAGE on the rotor and assemble the pump.
2. Disassemble the pump and measure the amount of the flattening with the scale to get the clearance.
3. If the clearance exceeds the allowable limit, replace the pump.

End clearance	Factory spec.	0.105 ~ 0.150 mm 0.00423 ~ 0.00591 in.
	Allowable limit	0.20 mm 0.0079 in.



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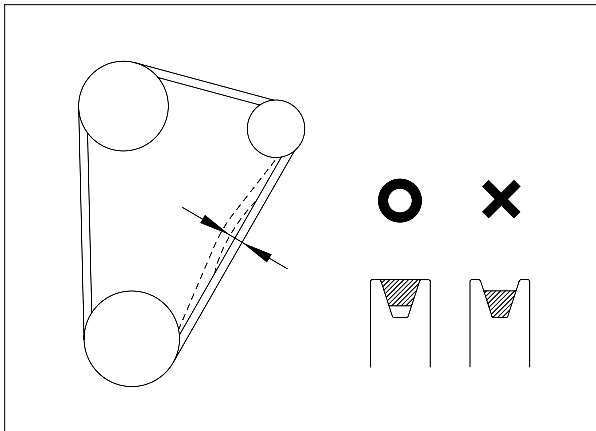
F. COOLING SYSTEM

a. Checking Adjusting

(A) Fan belt

1. Measure the deflection, by depressing the belt half-way between the fan drive pulley and the alternator pulley at 98 N (10 kgf, 22 lbs) of force.
2. If the deflection is not between the factory specifications, loosen the bolts and nuts, and relocate the alternator to adjust.
3. If the belt is damaged or worn (see figure), replace the belt.



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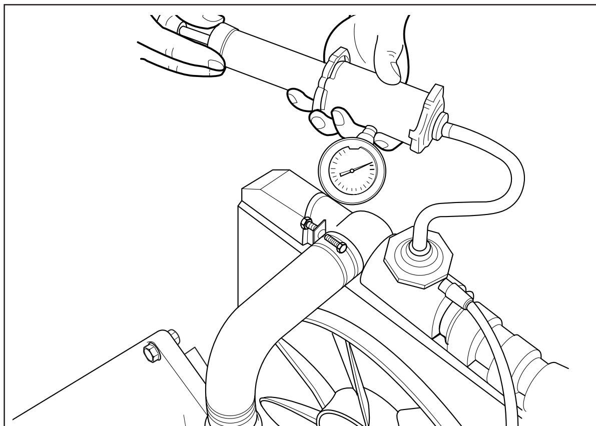
Belt tension (direction)	Factory spec	7 ~ 9 mm 0.28 ~ 0.35 in. at 98 N (10 kgf, 22 lbs) of force

(B) Radiator water tightness

1. Fill the radiator with water to the specified amount and warm up the engine.
2. Set a radiator tester and raise the water pressure to the specified pressure.
3. Check the radiator for water leaks.
4. For water leaks from a pin hole, repair it with radiator cement, and for larger leaks, replace the radiator.



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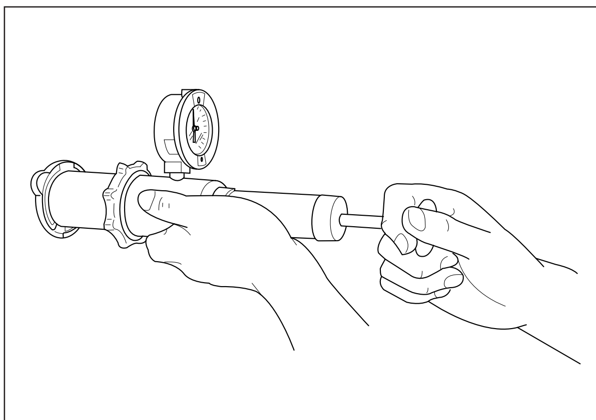
Radiator water tightness	Factory spec	No leaks at 137 kPa (1.4 kgf/cm^2, 20 psi)

(C) Radiator cap tightness

1. Set a radiator tester on the radiator cap.
2. Apply 88 kPa (0.9 kgf/cm^2, 13 psi) of pressure and measure the pressure for 10 seconds.
3. If the pressure falls below 59 kPa (0.6 kgf/cm^2, 9 psi),replace the radiator cap.



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Radiator cap tightness	Factory spec	more than 10 seconds for pressure fall from 88 ~ 59 kPa (0.9 ~ 0.6 kgf/cm^2, 13 ~ 9 psi)

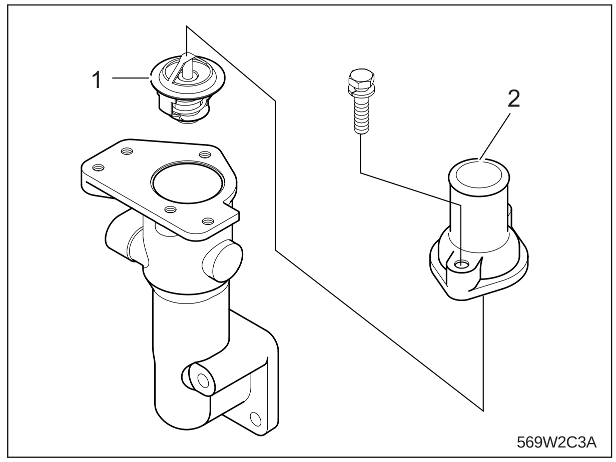
b. Disassembling and Assembling

(A) Thermostat

1. Remove the thermostat cover (2).
2. Take out the thermostat (1).

(When reassembling)

- Apply liquid gasket (Three Bond 1215 or equivalent) to the gasket.



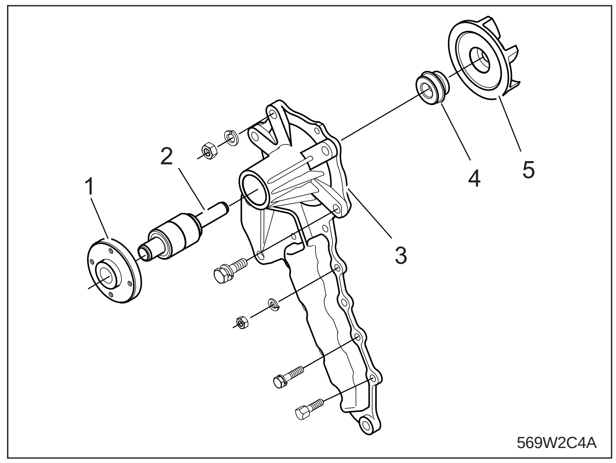
(1) Thermostat (2) Thermostat Cover

(B) Water pump

1. Remove the fan and fan pulley.
2. Remove the water pump body from gear case cover.
3. Remove the water pump flange (1).
4. Remove the impeller and water pump shaft (3).
5. Remove the impeller from the water pump shaft.
6. Remove the mechanical seal (5).

(When reassembling)

- Replace the mechanical seal (5) with new one.



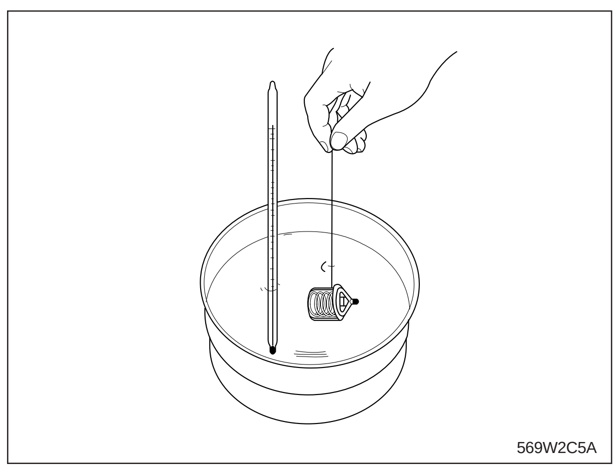
(1) Water Pump Flange (4) Water Pump Body
(2) Water Pump Bearing (5) Mechanical Seal
(3) Water Pump Shaft (6) Impeller

c. Servicing

(A) Thermostat valve opening temperature

1. Suspend the thermostat in the water by a string with its end inserted between the valve and seat.
2. Heating the water gradually, read the temperatures when the valve starts to opens and when the valve is completely opened approx 8 mm (0.315 in.).
3. If the measurements are not within the factory specifications, replace the thermostat.

Opening temperature	Factory spec.	71 ± 1.5 °C (160 ± 3 °F) at beginning
		Lower than 85 °C (185 °F) at 8 mm (0.315 in.) of opening



G. FUEL SYSTEM

a. Checking and Adjusting

1) Injection pump

(A) Injection term (Injection timing)

1. Remove the injection pipes.
2. Set the speed control lever to the maximum fuel discharge position.
3. Turn the flywheel counterclockwise (facing the flywheel) until the fuel flows through the hole of the delivery valve holder (1).
4. Turn the flywheel further and stop turning when the fuel stops to flow, to check the injection timing.
5. If the Fl mark does not align with the mark of the window on flywheel housing, add or remove the shim (2) to adjust.

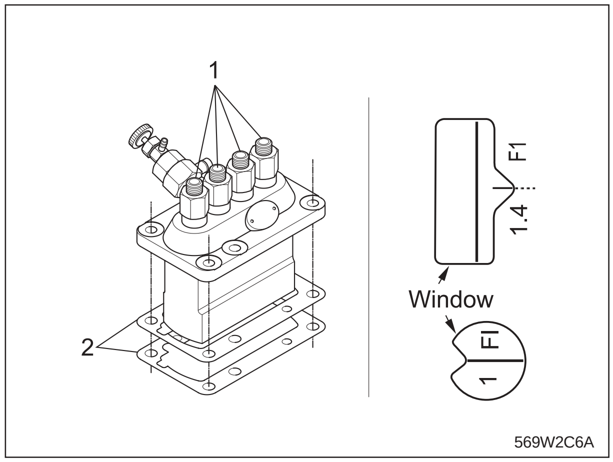
Injection timing	4A220	0.31 rad, 18° before T.D.C
	4A200T	0.21 rad, 12° before T.D.C

NOTE:

- *Apply liquid gasket (There Bond 1215 or equivalent) to the shim, when reassembling.*

(Reference)

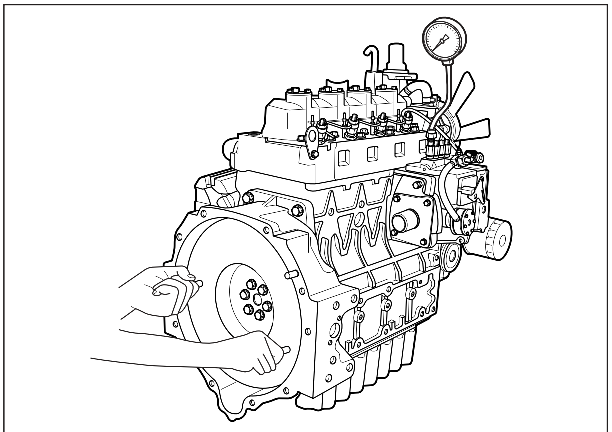
- The timing advances by removing 0.15 mm (0.006 in.) of shim and retards by adding one, approx 0.26 rad (1.5°) of crank angle.
- Approx 3.6 mm (0.142 in.) of turn at outer rim of flywheel equals 0.26 rad (1.5°) of crank angle.



(1) Delivery Valve Holder (2) Shim

(B) Delivery valve fuel tightness

1. Remove the injection pipes, glow plugs and the inlet manifold, and install a pressure tester.
2. With the speed control lever at the fuel injection position, turn the crankshaft counterclockwise (facing the flywheel) until the pressure builds up to the fuel injection pressure.
3. Release the pressure in the delivery chamber by moving down the plunger to bottom dead center (turn the crankshaft clockwise approx 1.57 rad (90°) from the FI timing).
4. If the pressure drops for 5 seconds exceeds the allowable limit, replace the delivery valve or pump assembly.
5. If the pressure does not built up, replace the pump element with new one and test again.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Fuel injection pressure	Factory spec.	14.71 MPa 150 kgf/cm^2 2134 psi
Pressure drop	Allowable limit	0.98 MPa 10 kgf/cm^2 142 psi

b. Injection Nozzle

CAUTION

- *Never come in contact with spraying diesel fuel under pressure, which can have sufficient force to penetrate the skin, causing serious personal injury.*
- *Be sure nobody is in direction of the spray.*

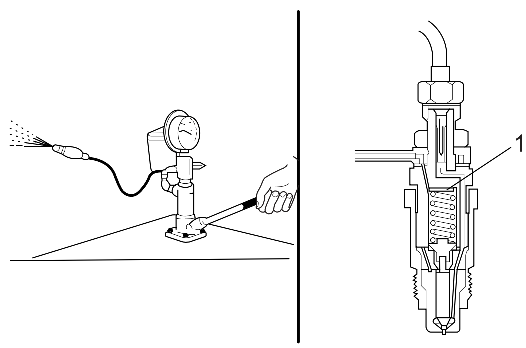
(A) Fuel injection pressure

1. Set the injection nozzle to the nozzle tester.
2. Measure the injection pressure.
3. If the measurement is not within the factory specifications, adjust with the adjustment washer (1) inside the nozzle holder.

(Reference)

Pressure variation with 0.1 mm (0.004 in.) difference of adjusting washer thickness is approx. 10 kgf/cm^2.

Fuel injection pressure	Factory spec.	13.73 ~ 14.71 MPa 140 ~ 150 kgf/cm^2 1991 ~ 2134 psi



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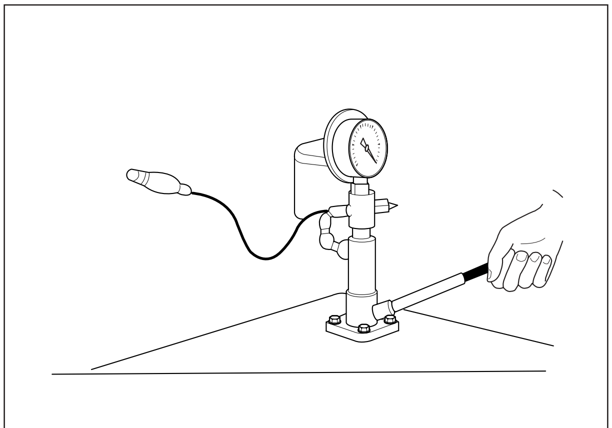
(1) Adjustment Washer

(B) Fuel tightness of needle valve seat tightness

1. Set the injection nozzle to the nozzle tester.
2. Apply a pressure 130 kgf/cm^2 (12.75 mPa, 1,849 psi). After keeping the nozzle under this pressure for 10 seconds. Check to see if fuel leaks from the nozzle.
3. If the fuel should leak, replace the nozzle.



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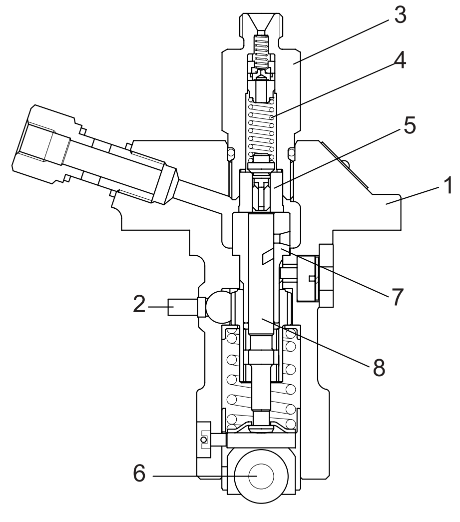
c. Disassembling and Assembling

1) Injection pump

IMPORTANT:

- *If replacing the pump element, the amount of fuel injection should be adjusted on specified bench.*



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(1) Pump Body	(5) Delivery Valve
(2) Control Rack	(6) Tappet Roller
(3) Delivery Valve Holder	(7) Cylinder
(4) Delivery Valve Spring	(8) Plunger

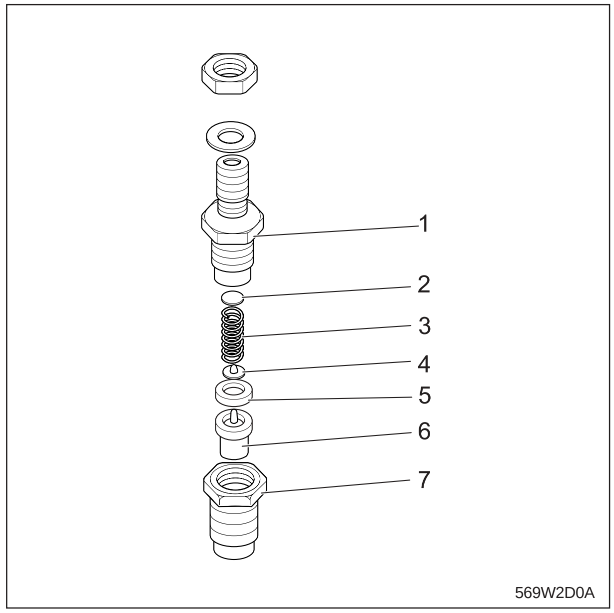
2) Injection nozzle

Nozzle Holder

1. Secure the nozzle retaining nut (7) with a vise.
2. Remove the nozzle holder (1), and take out the parts inside.

(When reassembling)

- Assemble the nozzle in clean fuel oil.
- Install the push rod (4), nothing its direction.



(1) Nozzle Holder
(2) Adjusting Washer
(3) Nozzle Spring
(4) Push Rod
(5) Distance Piece
(6) Nozzle
(7) Nozzle Nut

CHAPTER 3

CLUTCH

1. TROUBLESHOOTING

Symptom	Provable Causes	Solution
Clutch slip	• Clutch pedal play too small	Adjust
	• Clutch disc facing worn	Replace
	• Grease or oil on clutch disc facing	Clean or replace
	• Distortion or damaged in clutch pressure plate and flywheel	Correct or replace
	• Missing or feeble spring of clutch pressure plate	Replace
Clutch disconnection abnormal	• Excessive clutch pedal defection	Adjust
	• Grease or oil on clutch disc facing	Clean or replace
	• Vibration or distortion in clutch disc	Replace
	• Rust developed in clutch disc hub and shaft splice part	Remove rust or replace
	• Clutch lever deformation, defective adjustment	Adjust or replace
	• Abrasion and breakage in release bearing	Replace
	• Fixation of clutch disc and flywheel or pressure plate, rust developed	Remove rust or replace
	• Foreign substance intermixed in clutch	Clean
Starting is not smooth	• Grease or oil on clutch disc facing	Clean or replace
	• Loosened riveting in clutch disc facing	Replace
	• Distortion or damage in clutch disc, pressure plate and flywheel	Correct or replace
	• Defective adjustment of clutch lever	Adjust
	• Missing or feeble spring of pressure plate	Replace
	• Rust or wear in clutch disc hub and shaft spline part	Remove rust or replace
Clutch noise	• Wear and Abrasion in release bearing	Replace
	• Wear in clutch disc hub and shaft spline part	Replace
	• Missing torsion spring of clutch disc	Replace
Clutch vibration	• Clutch disc damaged	Replace
	• Bending in shuttle shaft or PTO drive shaft	Replace
	• Defective dynamic balance in clutch assembly	Replace
	• Damages on other clutch related parts	Replace
Clutch gets connected suddenly	• Grease or oil on clutch disc facing	Clean or replace
	• Distortion in clutch pressure plate and flywheel	Correct or replace
	• Damage on torsion spring of clutch disc	Replace

2. SPECIFICATIONS, TIGHTENING TORQUES AND SPECIAL TOOLS

2.1 SPECIFICATIONS

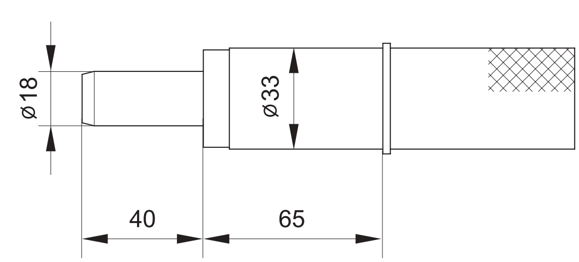
Item		Factory Specifications	Allowable Limit
Clutch pedal	Free Play	20 ~ 30 mm 0.79 ~ 1.18 in.	-
Safety switch	Clearance	2 ~ 5 mm 0.079 ~ 0.197 in.	-
Clutch disc spline boss to shuttle shaft	Backlash	-	2.0 mm 0.079 in.
Clutch disc surface to rivet	Depth	-	0.3 mm 0.012 in.
Pressure plate	Flatness	-	0.2 mm 0.008 in.

2.2 TIGHTENING TORQUES

Item	Nominal Diameter (Type)	Tightening Torques		
		N·m	kgf·m	lbf·ft
• Inlet bolts between flywheel housing and clutch housing	M12 (9T)	10.3 ~ 117.7	10.5 ~ 12.0	76.0 ~ 86.8
• Inlet nuts between flywheel housing and clutch housing	M12 (7T)	77.5 ~ 90.2	7.9 ~ 9.2	57.2 ~ 66.5
• Inlet bolts between clutch housing and middle case	M12 (9T)	103.0 ~ 117.7	10.5 ~ 12.0	76.0 ~ 86.8
• Inlet nuts between clutch housing and middle case	M12 (7T)	77.5 ~ 90.2	7.9 ~ 9.2	57.2 ~ 66.5
• Inlet bolts of clutch cover	M8 (7T)	23.5 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2
• Clutch release fork mounting bolts	M8 (7T)	23.5 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2

2.3 SPECIAL TOOLS

Clutch center guide



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3. STRUCTURE AND OPERATION

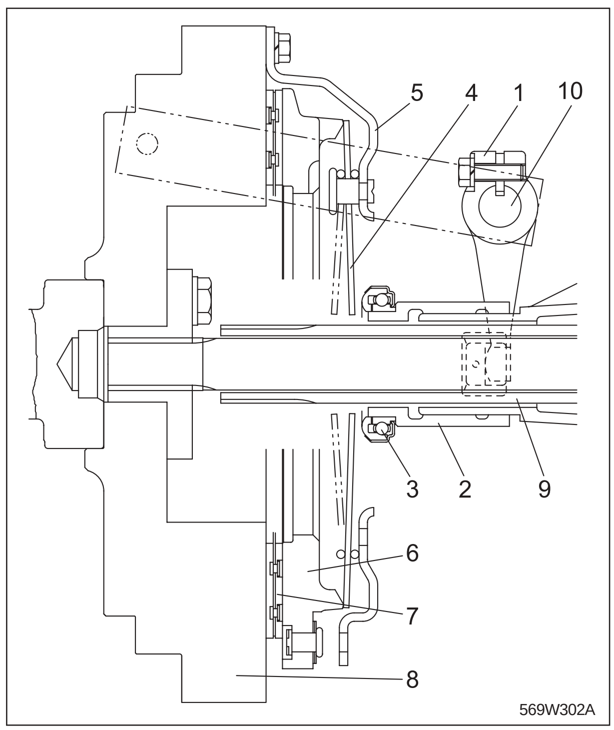
The clutch is located between the engine and the transmission and is operated by stepping on the clutch pedal. When the clutch pedal is depressed, the clutch is disengaged and when it is released, the clutch is engaged and power from the engine is transmitted to the transmission. These tractors are equipped with a single plate clutch.

3.1 FEATURES

- Ind. styled clutch is applied available to operate the travel power and PTO power independently.
- Travel clutch: As dry-single plated clutch, traveling power is disconnected if the clutch pedal is stepped down.
- PTO clutch: As wet-multi plated clutch based on oil pressure control, PTO power is disconnected and connected by PTO switch over control.

3.2 STRUCTURE

(1) Clutch Release Fork
(2) Release Hub
(3) Release Bearing
(4) Diaphragm Spring
(5) Clutch Cover
(6) Clutch Pressure Plate
(7) Clutch Disc
(8) Flywheel
(9) Shuttle Shaft
(10) Clutch Lever Shaft



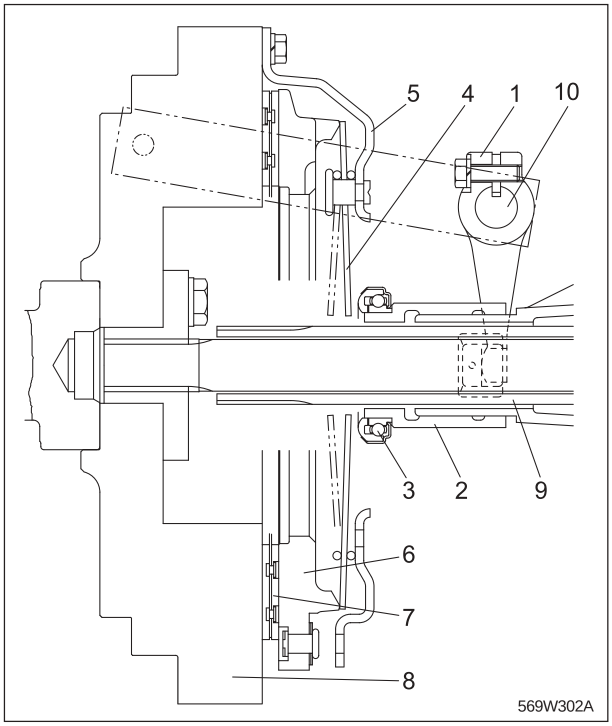
3.3 OPERATION

CLUTCH "ENGAGED"

When the clutch pedal is not depressed, the clutch release bearing (3) and the fingers of diaphragm spring (4) are not connected to each other.

Accordingly, the pressure plate (6) is tightly pressed against the flywheel (8) by the diaphragm spring (4).

As a result, rotation of the flywheel (8) is transmitted to the transmission through the shuttle shaft (9) due to the frictional force among the flywheel (8), clutch disc (7) and pressure plate (6).

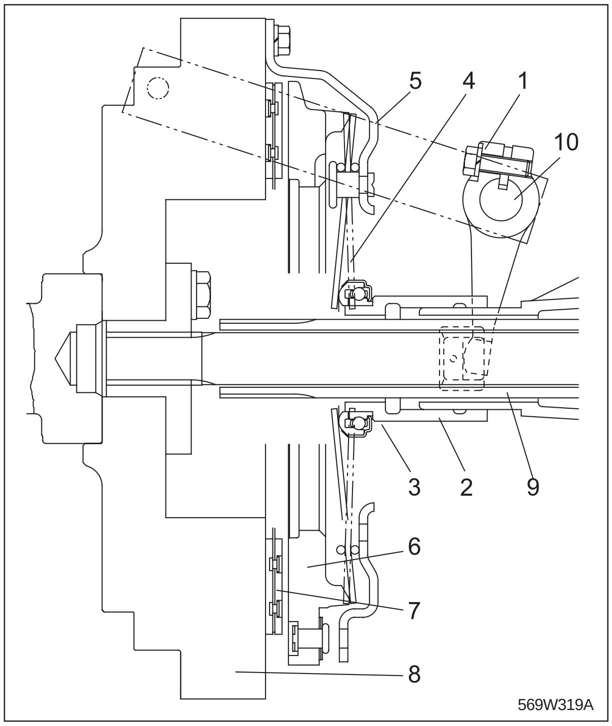


(1) Clutch Release Fork
(2) Release Hub
(3) Release Bearing
(4) Diaphragm Spring
(5) Clutch Cover
(6) Clutch Pressure Plate
(7) Clutch Disc
(8) Flywheel
(9) Shuttle Shaft
(10) Clutch Lever Shaft

CLUTCH "DISENGAGED"

When the clutch pedal is depressed, the clutch rod is pulled to rotate the clutch lever shaft (10). Then, the release fork (1) pushes the release hub (2) and release bearing (3) toward the flywheel. Simultaneously the release bearing pushes the diaphragm spring (4), the frictional force among the flywheel (8), clutch disc (7) and pressure plate (6) disappears.

Therefore, rotation of the flywheel (8) is not transmitted to the clutch disc (7) stopping the rotation of the shuttle shaft (9).



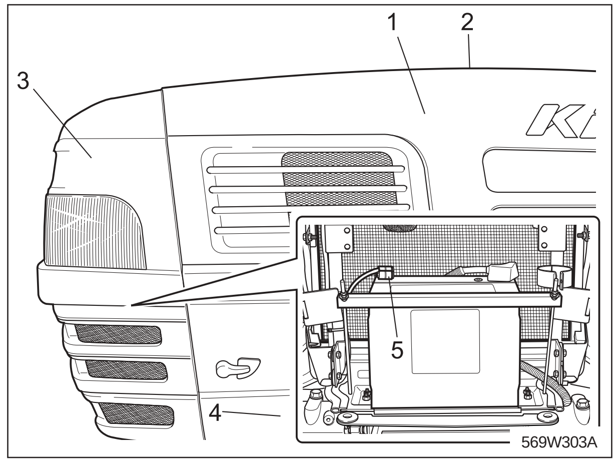
(1) Clutch Release Fork
(2) Release Hub
(3) Release Bearing
(4) Diaphragm Spring
(5) Clutch Cover
(6) Clutch Pressure Plate
(7) Clutch Disc
(8) Flywheel
(9) Shuttle Shaft
(10) Clutch Lever Shaft

4. PREPARATION STAGE FOR DISASSEMBLING AND ASSEMBLING

4.1 SEPARATING PANEL FRAME ASSEMBLY

PREPARATION 1

1. Removing the following parts.
   - Bonnet
   - Side Cover (RH, LH)
   - Side Skirt (RH, LH)
   - Battery Negative Code

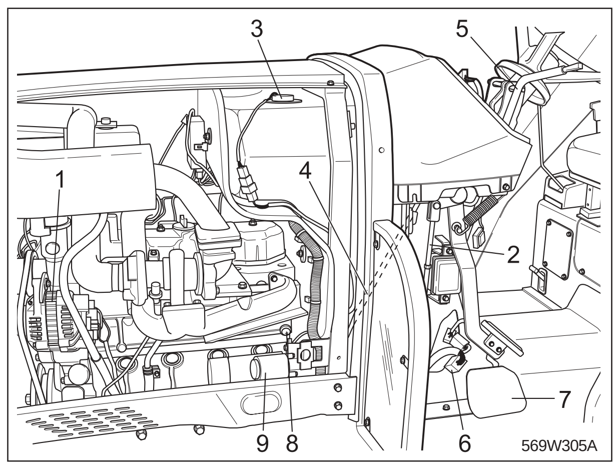


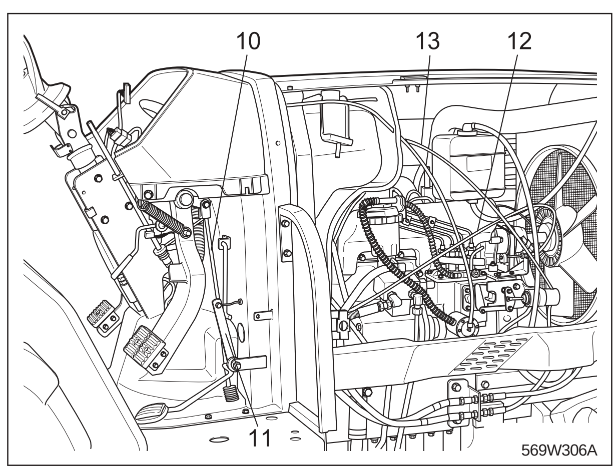
(1) Side Cover (RH, LH)
(2) Bonnet
(3) Front Grille
(4) Side Skirt (RH, LH)
(5) Battery Negative Code

PREPARATION 2

1. Disconnect the brake rods (4), (10).
2. Disconnect the clutch rod (2).
3. Remove the accelerator cable (12).
4. Disconnect the foot accelerator rod (11).
5. Remove the panel frame cover (7) and disconnect the connectors (6).
6. Remove the shuttle shaft lever (5) after disconnecting limit switch wire harness.
7. Disconnect the 2P connector of alternator (1), jumper for fuel level sensor (3) and starter (9).
8. Disconnect the meter cable (13) at the engine side.

(1) 2P Connector for Alternator
(2) Clutch Rod
(3) Jumper Lead For Fuel Level Sensor
(4) Brake Rod (LH)
(5) Shuttle Shift Lever
(6) Connectors
(7) Panel Frame Cover
(8) Jumper Lead For Oil Switch
(9) Jumper Lead For Starter
(10) Brake Rod (RH)
(11) Food Accelerator Rod
(12) Accelerator Cable
(13) Meter Cable





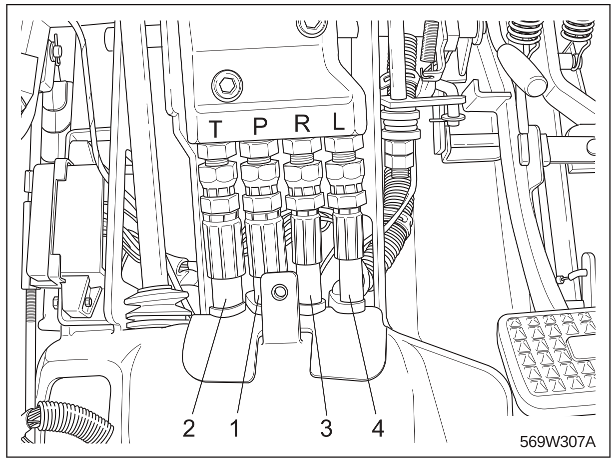
HYDRAULIC HOSES

1. Disconnect the main delivery hose (1), return hose (2), right turning delivery hose (3) and left turning delivery hose (4).

(When reassembling)

- In assembling the turning delivery hoses to the steering controller, connect the delivery hose with identification mark (type) "A" to the L port of the steering controller.

Tightening torque	Main delivery hose retaining nut	46.6 ~ 50.9 N·m 4.8 ~ 5.2 kgf·m 34.4 ~ 37.6 lbf·ft
	Turning delivery hose retaining nut	24.5 ~ 29.4 N·m 2.5 ~ 3.0 kgf·m 18.1 ~ 21.7 lbf·ft



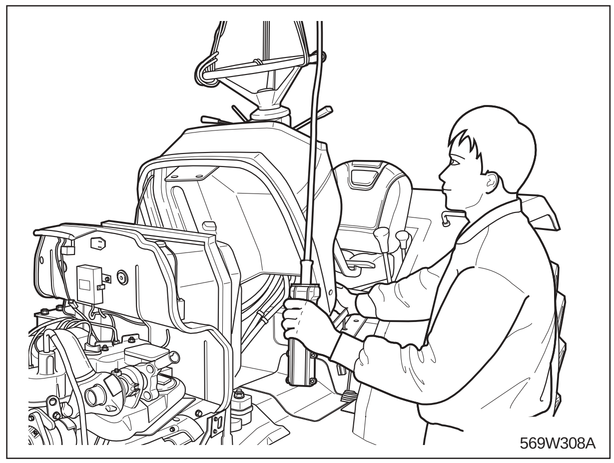
(1) Steering Hose P
(2) Steering Hose T
(3) Steering Hose R
(4) Steering Hose L

PANEL FRAME AND STEERING ASSEMBLY

1. Remove the panel frame mounting crews (Two screws a upper part. Seven screws at lower part).
2. Take out the panel frame and steering assembly as a unit.

(When reassembling)

- Do not get in the wiring harness between panel frame and platform.



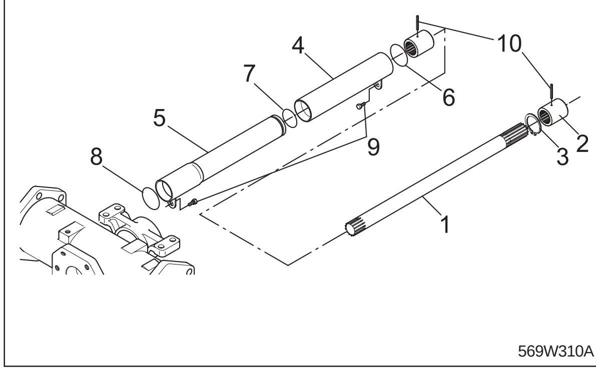
4.2 SEPARATING ENGINE AND CLUTCH HOUSING CASE

PROPELLER SHAFT

1. Slide the propeller shaft covers (4), (5) after removing to bolt (9).
2. Tap out the spring pin (10), and then slide the coupling (2) the front.

(When reassembling)

- Apply grease to the splines of the propeller shaft.



(1) Propeller Shaft
(2) Coupling
(3) Cir-Clip
(4) Propeller Shaft Cover
(5) Propeller Shaft Cover
(6) O-Ring
(7) O-Ring
(8) O-Ring
(9) Bolt
(10) Spring Pin

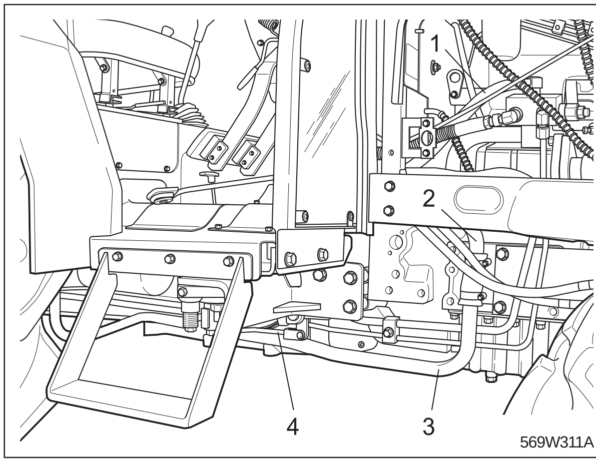
HYDRAULIC PIPES

1. Remove the brake rod (4) and suction pipe (3).
2. Remove the rubber hose (2).
3. Slide the return hose (1).

(When reassembling)

- Reinstall the pipe clamp securely.

Tightening torque	Joint bolt for delivery pipe (3) and hydraulic block	49.0 ~ 58.8 N·m 5.0 ~ 6.0 kgf·m 36.2 ~ 43.4 lbf·ft
	Joint bolt for delivery pipe (2)	34.3 ~ 39.2 N·m 3.5 ~ 4.0 kgf·m 25.3 ~ 28.9 lbf·ft



(1) Return hose
(2) Rubber Hose
(3) Suction Pipe
(4) Brake Rod

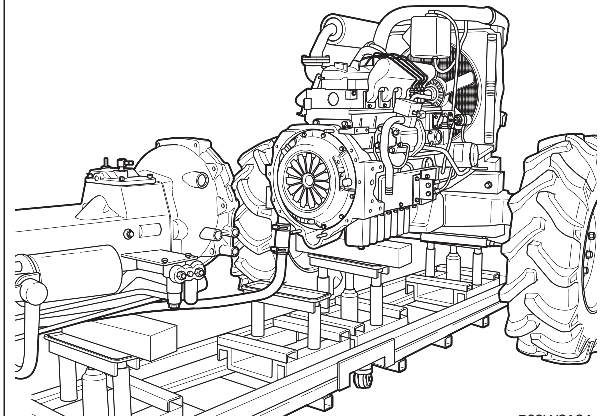
SEPARATION THE ENGINE FROM CLUTCH HOUSING

1. Place the jack under the clutch housing case.
2. Hoist the engine by the nylon lift strap at the tank support.
3. Remove the engine mounting screws, and then pull the engine to the front.

(When reassembling)

1. Apply grease to the splines.
2. Apply liquid gasket (Three Bond 1,208D or equivalent) to joint face of the engine and clutch housing.

Tightening torque	Engine and clutch housing mounting screws, nuts	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.1 ~ 66.5 lbf·ft
	Engine and clutch housing mounting stud bolts	39.2 ~ 49.0 N·m 4.0 ~ 5.0 kgf·m 28.9 ~ 36.2 lbf·ft



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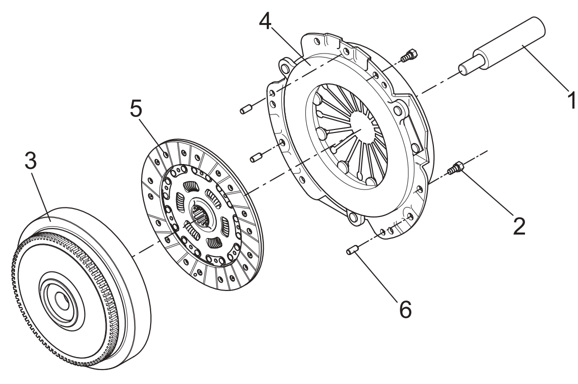
4.3 DISASSEMBLY

A. Insert clutch center guide (1) up to the spline hub and fix it not to be come off even though clutch inlet bolt (2) is removed.

B. Remove clutch inlet bolts (2) and separate clutch cover assembly (4).

CAUTION

- *When attaching or detaching clutch, slowly remove and slowly tighten the clutch inlet bolts diagonally to secure operational safety and to prevent deformation of the clutch cover and clutch pressure plate.*



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ASSEMBLY

A. Thoroughly remove worn dust attached on clutch cover (4), clutch disc (5) and flywheel (3).

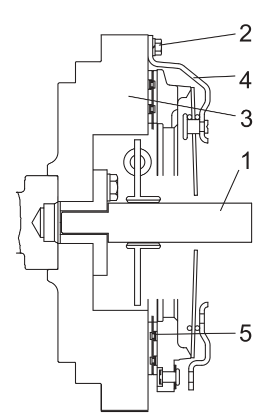
B. Insert clutch center guide (1) into the flywheel and then fix.

C. When assembling clutch disc, face the shorter spline boss toward flywheel side.

D. Tighten the clutch cover with bolts after confirming the locations of lock pin holes (2 places).

Tightening torque	Clutch cover assembling bolts	23.5 ~ 27.5 N·m 2.4 ~ 2.8 kgf·m 17.4 ~ 20.3 lbf·ft

(1) Clutch Center Guide (4) Clutch Cover
(2) Bolt (5) Clutch Disc
(3) Flywheel (6) Straight Pin



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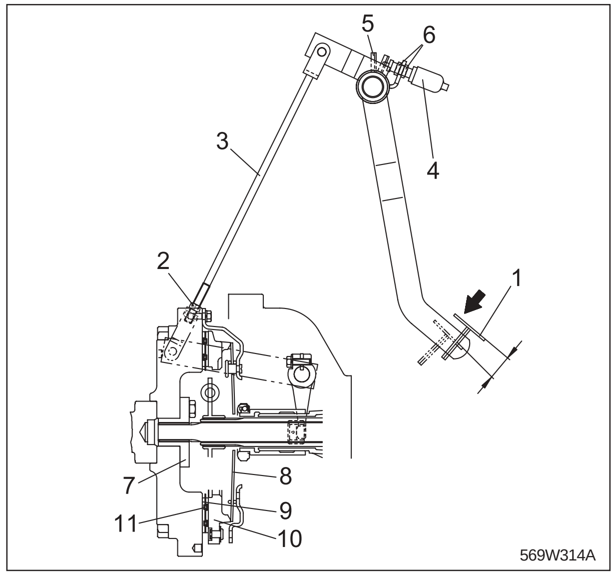
5. ADJUSTMENT OF PEDAL

5.1 DEFLECTION OF CLUTCH PEDAL

A. Measure deflection of pedal by pushing clutch pedal (1) with hand.

B. If the measurement is out of the factory spec, remove lock nut (2) on clutch wire and adjust the length.

Deflection of clutch pedal (A)	Factory spec	20 ~ 30 mm 0.79 ~ 1.18 in.



(1) Clutch Pedal
(2) Lock Nut
(3) Rod
(4) Safe Starting Switch
(5) Bracket
(6) Lock Nut
(7) Spline Hub
(8) Spring
(9) Clutch Disc
(10) Plate, Pressure
(11) Rivet

5.2 CLEARANCE BETWEEN SAFE STARTNIG SWITCH AND LINK

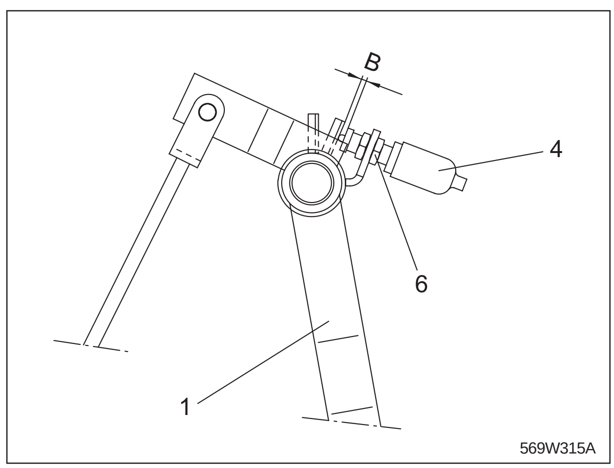
A. While clutch pedal (1) is stepped down, measure the clearance between safe starting switch (4) and clutch pedal link section.

B. If the measurement is out of the factory spec. remove lock nut (6) and adjust while shifting the safe starting switch.

C. In the state of stepped clutch pedal after adjustment : started if the starting key is ON.

In the state of clutch pedal not stepped : confirm the start is impossible if the starting key is ON.

Clearance in joint between safe starting switch and clutch pedal (B)	Factory spec.	2 ~ 5 mm 0.079 ~ 0.197 in.



(1) Clutch Pedal
(4) Safe Starting Switch
(6) Lock Nut

6. INSPECTION AND REPAIR

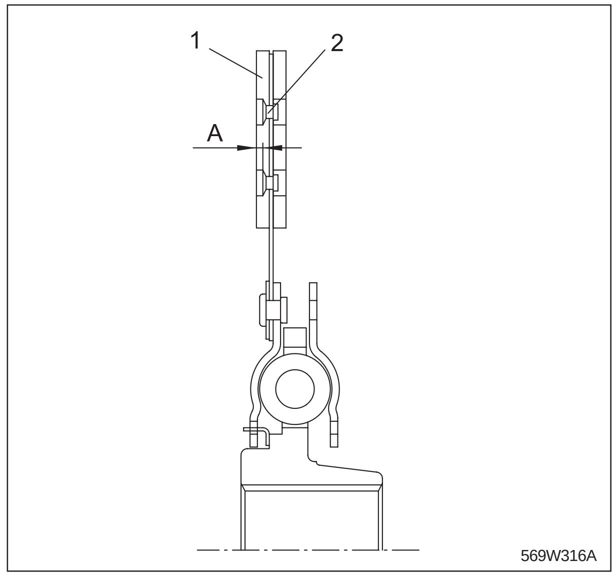
6.1 WEAR AND DAMAGE ON CLUTCH DISC

A. Measure the depth from clutch disc facing surface (1) to rivet (2).

B. If the measurement is out of the allowable limit, replace it.

C. If oil is sticking to clutch disc, or disc surface is carbonized, replace the disc. In this case, inspect transmission gear shift oil seal, engine rear oil seal and other points for oil leakage.

Depth to rivet (A)	Allowable limit	0.3 mm 0.0118 in.



(1) Disc (2) Rivet

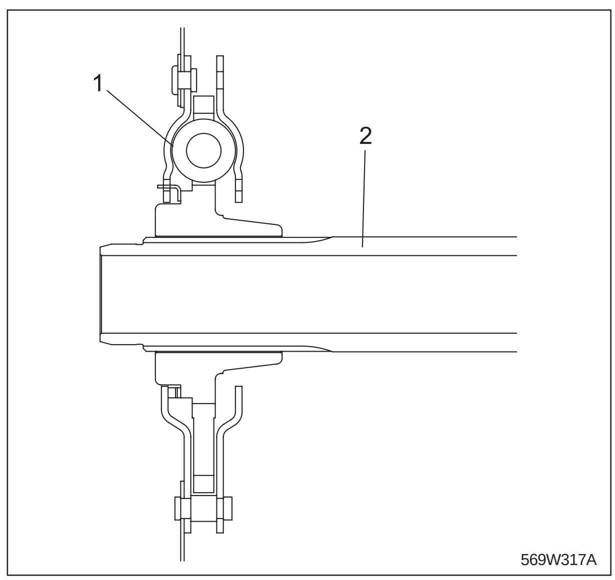
6.2 CLEARANCE BETWEEN SPLINE BOSS OF THE CLUTCH DISC AND SHUTTLE SHAFT SPLINE

A. Install clutch disc (1) to shuttle shaft (2).

B. Fix shuttle shaft not to shift and slightly move clutch disc to measure the clearance of spline by swinging of the clutch disc's circumference.

C. If the measurement is out of the allowable limit, replace it.

Swinging of the clutch disc's circumference	Allowable limit	0.2 mm 0.0078 in.



(1) Clutch Disc (2) Shuttle Shaft

6.3 FLATNESS OF CLUTCH PRESSURE PLATE, DAMAGES

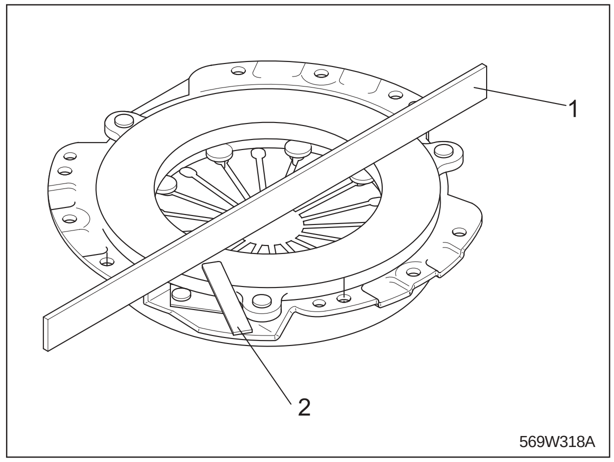
A. Measure several clearances with a space gauge along with a feeler gauge placed on the surface of the clutch pressure plate.

B. If the measurement is out of the allowable limit, replace clutch cover assembly.

C. In case only the outer circumference of the pressure plate has been worn and the inner circumference is being contacted with the feeler gauge, just replace it regardless of the clearance size.

D. Check friction surface of the pressure plate for abnormal wear, damage or score.

Clearance between the pressure plate and the measuring ruler	Allowable limit	0.5 mm 0.0196 in.



(1) Straight Ledge (2) Space Qauge

6.4 DAMAGES ON FLYWHEEL, ADJUSTMENT OF RELEASE BEARING

A. Check friction surface of the flywheel for abnormal wear, damage or scoring defect.

B. Correct with specified sandpaper (#180 or so) if they are found slight but replace it if found remarkable.

6.5 WEAR OR DAMAGES ON RELEASE BEARING, RELEASE FORK AND RELEASE HUB

A. Check contact surface of the release diaphragm and diaphragm spring for wear or damage.

B. Check release bearing while pushing to the axle direction and rotating by hand for deflection and abnormal noise.

C. Replace what is worn or damaged remarkably, rusted, rotated roughly, or noised.

D. Check contact surface of the release fork and release hub for wear or damage.

E. Replace what is damaged remarkably.

6.6 CLEARANCE BETWEEN CLUTCH PEDAL SHAFT AND CLUTCH PEDAL BUSHING

A. Measure the outer diameter of clutch pedal shaft.

B. Obtain the clearance by measuring the inner diameter of clutch pedal bushing.

C. If the measurement is out of the allowable limit, replace it.

Clearance between clutch pedal shaft and clutch pedal bushing.	Factory spec.	0.007 ~ 0.101 mm 0.0003 ~ 0.00 4 in.
	Allowable limit	0.4 mm 0.0157 in.

Outer diameter of clutch pedal shaft	Factory spec.	24.980 ~ 24.993 mm 0.9834 ~ 09839 in.

Inner diameter of clutch pedal bushing	Factory spec.	25.000 ~ 25.081 mm 0.9842 ~ 09874 in.

CHAPTER 4

TRANSMISSION SYSTEM

1. TROUBLESHOOTING

1.1 TROUBLESHOOTING FOR SHUTTLE SHIFT IN OPERATION ERROR

Symptom	Provable Causes	Solution
Noise when the shuttle is shifted	1. Excessive deflection in the shuttle synchro assembly (SPEC: 78.2)	Replace
	2. Chamfering section damaged in the forward gear (29 gear) and the reverse gear (24 gear)	Replace
Gear is disconnected when shifted	1. Improper adjustment of the exterior lever	Adjust
	2. Improper shift traveling distance (traveling distance: 11 mm)	Remove the case and restructure
	3. Excessive deflection in the shuttle synchro assembly (SPEC: 78.2)	Replace
	4. Unstable position of shuttle fork transformed	Replace
	5. Insufficient tension due to transformed spring which holds the ball (1 place) inside shuttle fork	Replace
Difficult to shift	1. Retained burr or damages on chamfering section in the forward gear (29 gear) and the reverse gear (24 gear)	Regenerate, Replace
	2. Held when shifted due to damages on spline part of the shifter's inside diameter	Replace
	3. Inclined when shifted due to transformation of shuttle shift fork	Replace

1.2 TROUBLESHOOTING FOR MAIN SHIFT SECTION IN OPERATION ERROR

Symptom	Provable Causes	Solution
Gear shift disconnected	1. Damaged jaw at chamfering section of main shift gear	Replace
	2. Deficient traveling distance due to interference with the exterior lever (traveling distance: 11 mm)	Correct interference
	3. Unfixed ball and spring when assembling fork rod of main shift cover section	Assemble
Starting gets OFF when starting with	1. Double gear shifted due to unfixed pin to prevent double gear at main shift cover section	Assemble
	2. Impossible drive due to little engagement with gear of gear shifted main shift section	Replace
Difficult to shift the main shift gear	1. Deficient operation due to interference with the exterior lever	Remove the cause
	2. Damaged synchro gear	Replace
	3. Key separation due to excessive over shift capacity traveling distance: 11 mm (0.43 in.) over shift distance: 13 mm (0.51 in.)	Remove the cause and assemble as replaced
	4. Inclined when shifted due to transformation of main shift fork	Replace

1.3 TROUBLESHOOTING FOR AUXILIARY AND CREEP SHIFTS IN OPERATION ERROR

Symptom	Provable Causes	Solution
Gear shift disconnected	1. Damaged jaw at chamfering section of auxiliary shift gear	Replace
	2. Deficient traveling distance due to interference with the exterior lever auxiliary shift: 10 mm, creep shift (if equipped): 10.5 mm	Correct interference
	3. Unfixed ball and spring at the side of transmission case	Adjust
Starting gets OFF when starting with gear shifted	1. Double gear activated due to unfixed steel ball to prevent double which is engaged between creep (if equipped) and auxiliary shift fork rods	Assemble
	2. Impossible drive due to little engagement with gear of auxiliary shift section	Replace
Difficult to shift the auxiliary and creep shift gears (if equipped)	1. Deficient operation due to interference with the exterior lever	Remove the cause
	2. Damaged jaw at chamfering section of auxiliary shift gear	Replace
	3. Inclined when shifted due to transformation of auxiliary shift fork	Replace

1.4 TROUBLESHOOTING FOR REAR DIFFERENTIAL GEAR IN OPERATION ERROR

Symptom	Provable Causes	Solution
Loose rear differential pedal	1. Unfixed mounting spring	Assemble
	2. Unfixed head pin which is assembled at differential mounting fork	Assemble
Impossible returning of differential pedal	1. Unfixed mounting spring	Assemble
	2. Differential mounting fork held	Replace
	3. Differential fork rod held by transmission case	Replace
Noise in rear differential section, Differential pedal lock incapable	1. Damaged pin at differential mounting shift section	Replace
	2. Improper adjustment of backlash in spiral bevel gear and pinion gear	Adjust
	3. Damaged brim of spiral bevel gear and pinion gear	Replace
	4. Damaged differential pinion shaft, damaged differential bevel gear	Replace

1.5 TROUBLESHOOTING FOR REAR DIFFERENTIAL IN OPERATION ERROR

Symptom	Provable Causes	Solution
Noise in rear axle	1. Damages on 13 gear shaft, 68 internal gear or 27 planetary gear	Replace
	2. Deflection in 13 gear shaft and planetary gear support due to unfixed mounting plate	Assemble
Oil leakage in rear axle	1. Damaged O-ring of brake case and rear axle case assembly section	Replace
	2. Damaged O-ring of rear axle bearing cover section	Replace
	3. Damaged oil seal of rear axle bearing cover	Replace

1.6 TROUBLESHOOTING FOR FRONT WHEEL DRIVE IN OPERATION ERROR

Symptom	Provable Causes	Solution
Gear shift disconnected	1. Separated or unfixed ϕ 25 snap ring of front wheel drive shaft 2. Deficient traveling distance due to interference with the exterior lever traveling distance: 20 mm (0.78 in.)	Assemble
Difficult to shift the front wheel drive lever	1. Held when shifted due to damages on spline part of the shifter's inside diameter 2. Held by retained burr installed in the shifter's inside diameter 3. Inclined due to transformation of front wheel drive fork	Replace Correct Replace

1.7 TROUBLESHOOTING FOR PTO CLUTCH IN OPERATION ERROR

Symptom	Provable Causes	Solution
PTO shaft does not rotate when PTO is activated	1. Separated snap ring	Replace
	2. Foreign substance intermixed in modulator valve	Replace
	3. No power supply to solenoid valve	Re-assemble
	4. Damaged O-ring mounted on connecting pipe	Replace
	5. Piston operation impossible due to O-ring held between PTO clutch body and piston	Replace
	6. Slipped due to clutch disc worn	Replace
	7. Declined pressure due to oil leakage in sealed section	Replace the damaged parts

1.8 TROUBLESHOOTING FOR PTO IN OPERATION ERROR

Symptom	Provable Causes	Solution
PTO gear shift disconnected	1. Deficient traveling distance of the exterior lever traveling distance: 7.5 mm (0.29 in.)	Remove the cause
	2. Interfered when shifted due to improper angle of PTO shift fork	Replace
Heat in PTO	Little engagement due to PTO gear held	Replace
Noise in PTO	Worn or damaged parts installed inside	Replace
Oil leakage in PTO shaft	1. Damaged oil seal in PTO shaft section	Replace
	2. Cut on oil seal or sleeve	Replace

1.9 TROUBLESHOOTING FOR PARKING BRAKE IN OPERATION ERROR

Symptom	Provable Causes	Solution
Excessive or insufficient deflection in parking brake	Adjustment of brake rod length	Readjust
Parking brake not activated	Parking brake lever damaged	Reassemble

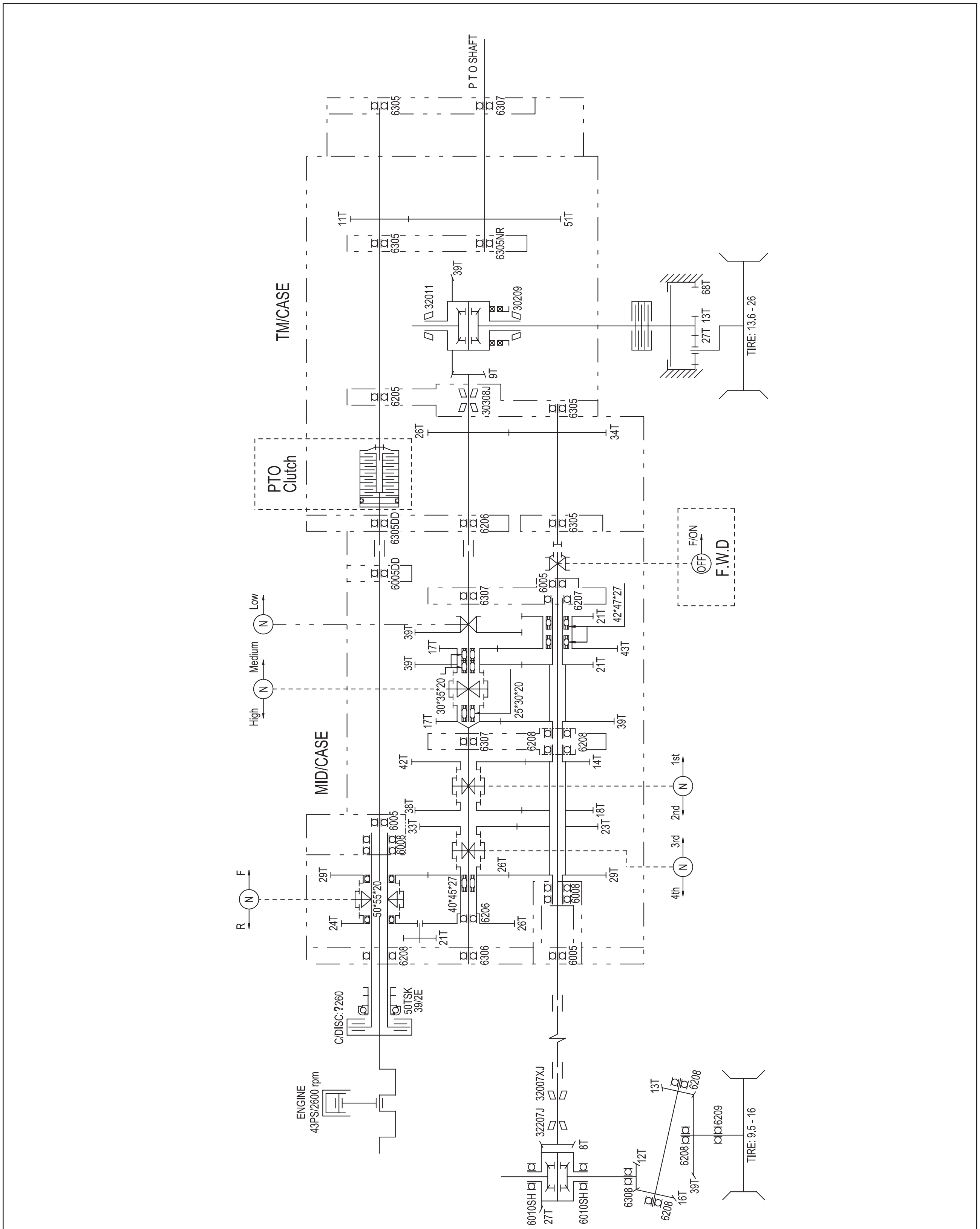
2. SPECIFICATIONS

2.1 TIGHTENING TORQUES

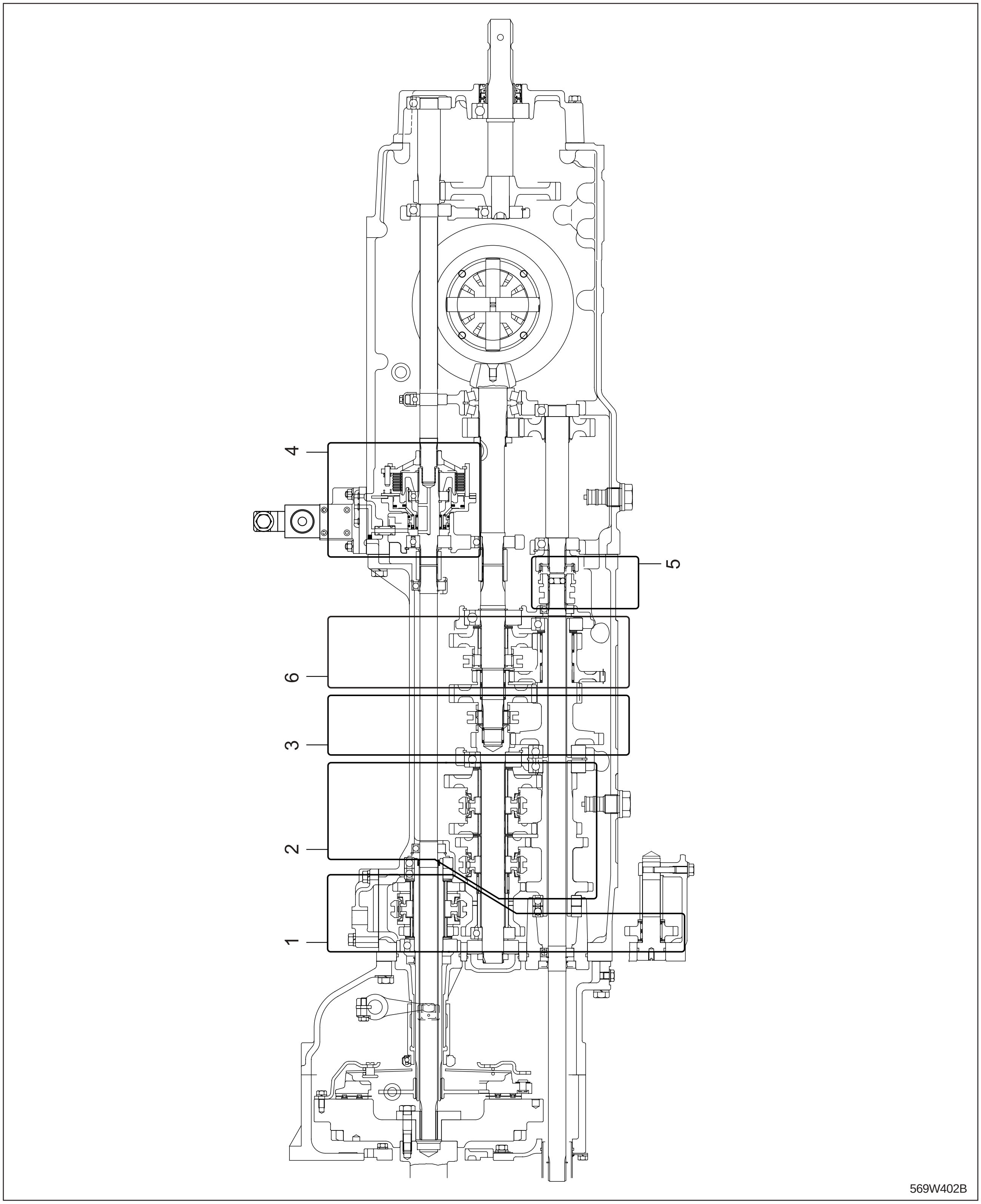
			N·m	kgf·m	lbf·ft
Middle case	• Inlet bolts and nuts between middle case and transmission case.	M12 (9T)	103.0 ~ 117.7	10.5 ~ 12.0	75.9 ~ 86.8
	• 17 gear shaft lock nuts.	M12 (6T)	77.5 ~ 90.2	7.9 ~ 9.2	57.1 ~ 66.5
	• Inlet bolts of bearing cover and bearing case (Main gear shift section).	M20	127.5 ~ 176.5	13.0 ~18.0	94.0 ~ 130.1
		M8 (7T)	23.5 ~ 27.4	2.4 ~ 2.8	17.3 ~ 20.2
	• Inlet bolts of bearing case (Auxiliary gear shift section).	M12 (7T)	77.5 ~ 90.2	7.9 ~ 9.2	57.1 ~ 66.5
	• Inlet bolts of main, auxiliary & shuttle shift covers.	M10 (7T)	48.0 ~ 55.9	4.9 ~ 5.7	35.4 ~ 41.2
Transmission case	• Inlet nuts of PTO clutch valve.	M8 (6T)	23.5 ~ 27.4	2.4 ~ 2.8	17.3 ~ 20.2
	• Inlet bolt of rear cover (PTO cover).	M10 (7T)	48.0 ~ 55.9	4.9 ~ 5.7	35.4 ~ 41.2
	• Inlet bolt of PTO clutch bracket.	M12 (7T)	77.5 ~ 90.2	7.9 ~ 9.2	57.1 ~ 66.5
	• Inlet bolt of differential bearing case.	M10 (7T)	48.0 ~ 55.9	4.9 ~ 5.7	35.4 ~ 41.2
	• Inlet bolt of lower link bracket.	M14 (7T)	123.6 ~ 147.1	12.6 ~ 15.0	91.1 ~ 108.4
	• Inlet bolt and nuts of hitch.	M14 (7T)	123.6 ~ 147.1	12.6 ~ 15.0	91.1 ~ 108.4
		M12 (6T)	77.5 ~ 90.2	7.9 ~ 9.2	57.1 ~ 66.5
Rear axle/ brake	• Inlet bolt of brake case and rear axle case.	M12 (7T)	77.5 ~ 90.2	7.9 ~ 9.2	57.1 ~ 66.5
	• Inlet bolt of spiral bevel gear.		60.8 ~ 70.6	6.2 ~ 7.2	44.8 ~ 52.0
	• Lock nuts of rear axle.		196.2 ~ 245.2	20.0 ~ 25.0	144.5 ~ 180.8
	• Inlet nuts of rear wheel.	M16 (9T)	260.0 ~ 304.1	26.5 ~ 31.0	191.7 ~ 224.2

3. STRUCTURE

3.1 POWER TRAIN DIAGRAM



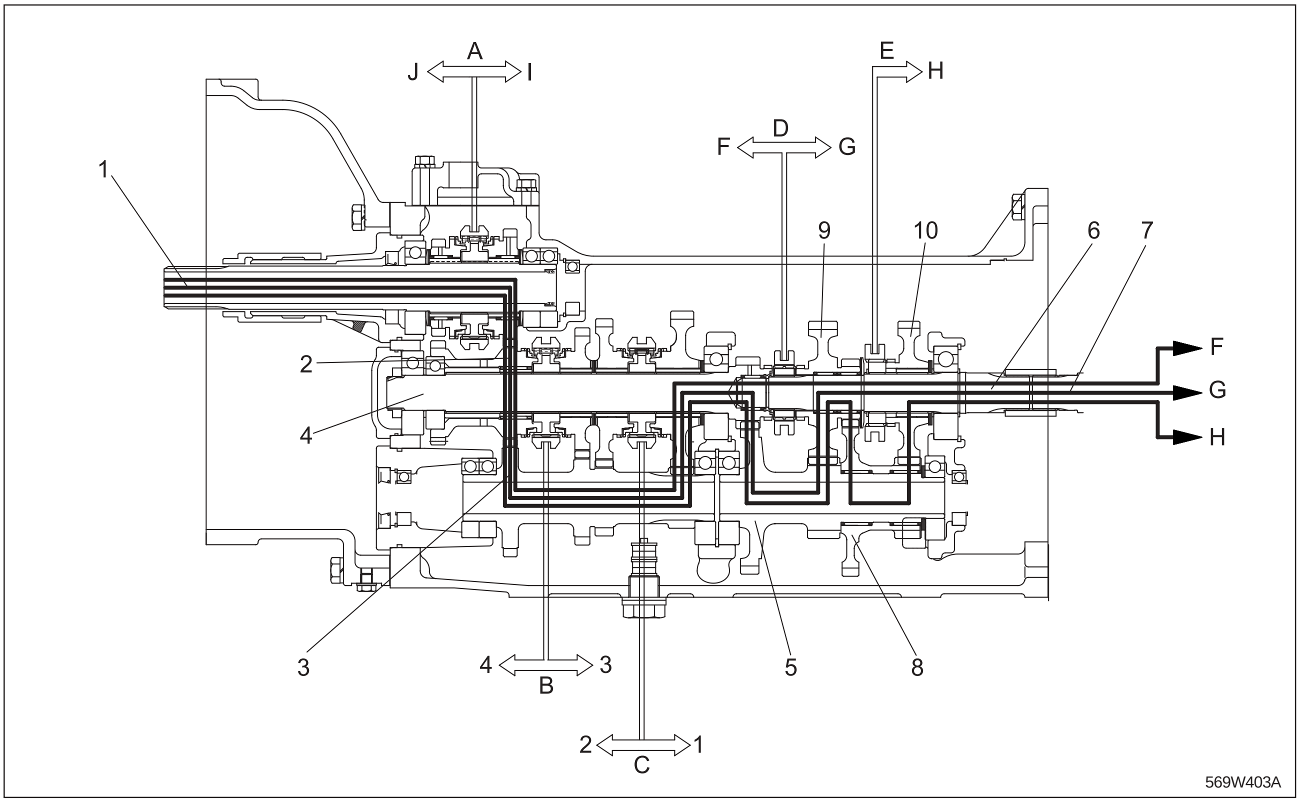
3.2 STRUCTURE



(1) Shuttle Shift Section
(2) Main Gear Shift Section
(3) Hi-Low Range Shift Section
(4) Clutch Pack for PTO
(5) Front Wheel Drive Shift Section
(6) Creep Shift Section

3.3 POWER TRAIN

3.3.1 TRANSMISSION



(1) Shuttle Shaft
(2) 26-26 Gear
(3) 29-23-18-14 Gear
(4) 17 gear Shaft
(5) 39-21 Gear
(6) Auxiliary Shift Shaft
(7) Spiral Bevel Pinion
(8) 43-21 Gear
(9) 39-17 Gear
(10) 39 Gear

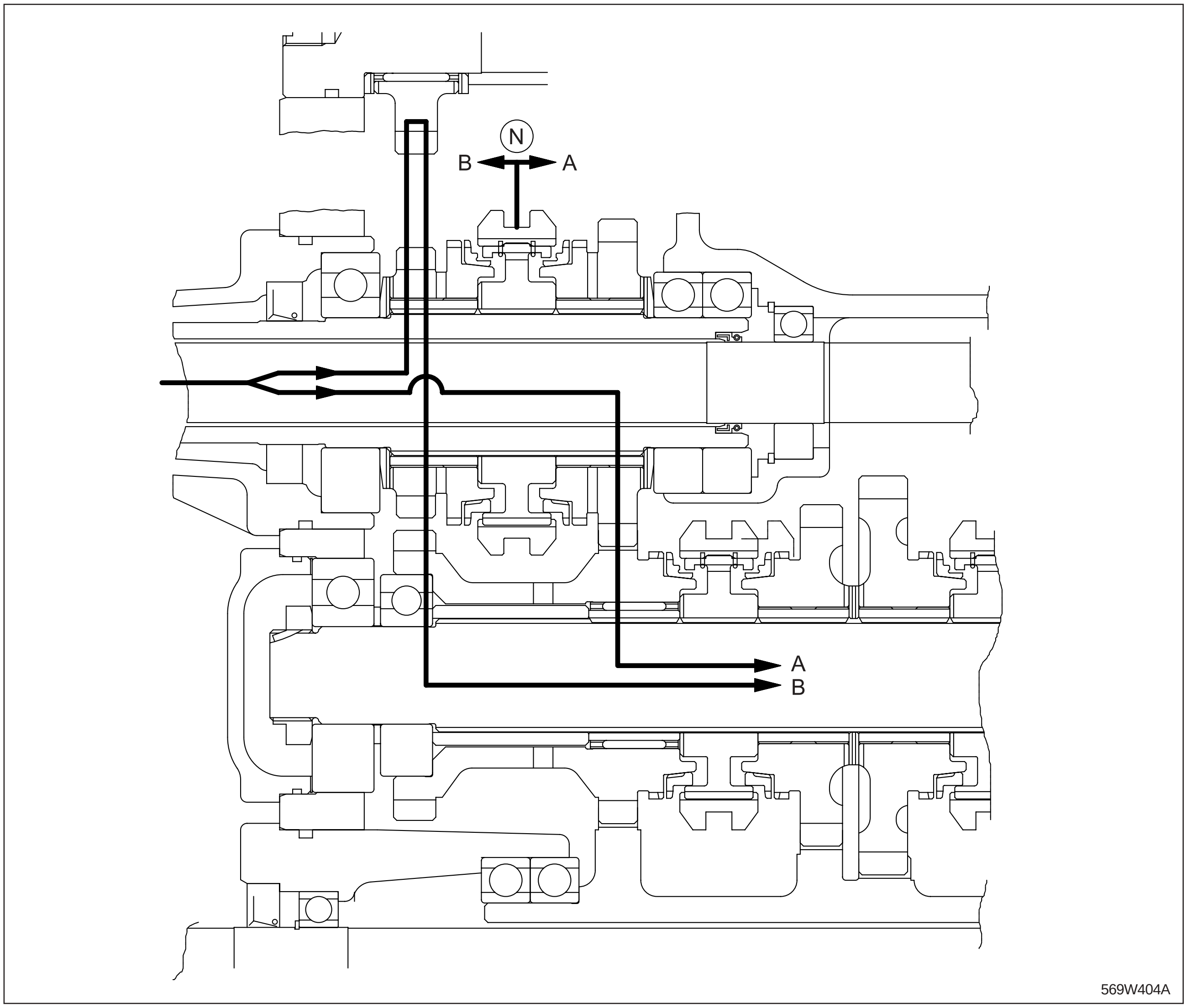
(A) Shifter (Shuttle Shift)
(B) Shifter (Main Shift 3-4 Stage)
(C) Shifter (Main Shift 1-2 Stage)
(D) Shifter (Auxiliary Shift, Hi-Low)
(E) Shifter (Auxiliary Shift, Creep)
(F) High
(G) Low
(H) Creep
(I) Forward
(J) Reverse

Power transmitted to shuttle shaft (1) via the clutch in the engine is transmitted according to the operation of shifter (A) from 26-26 gear (2) to 29-23-18-14 gear (3) which main shift gears gets rotated as engaged. Main shift stage is decided according to the operation of shifter (B), (C) and the revolution is transmitted to 17 gear shaft (4) and then to 39-21 gear (5).

Auxiliary shift stage is decided according to the operation of shifter (D), (E) and the power is transmitted to auxiliary shift shaft (6) and finally to spiral bevel pinion (7).

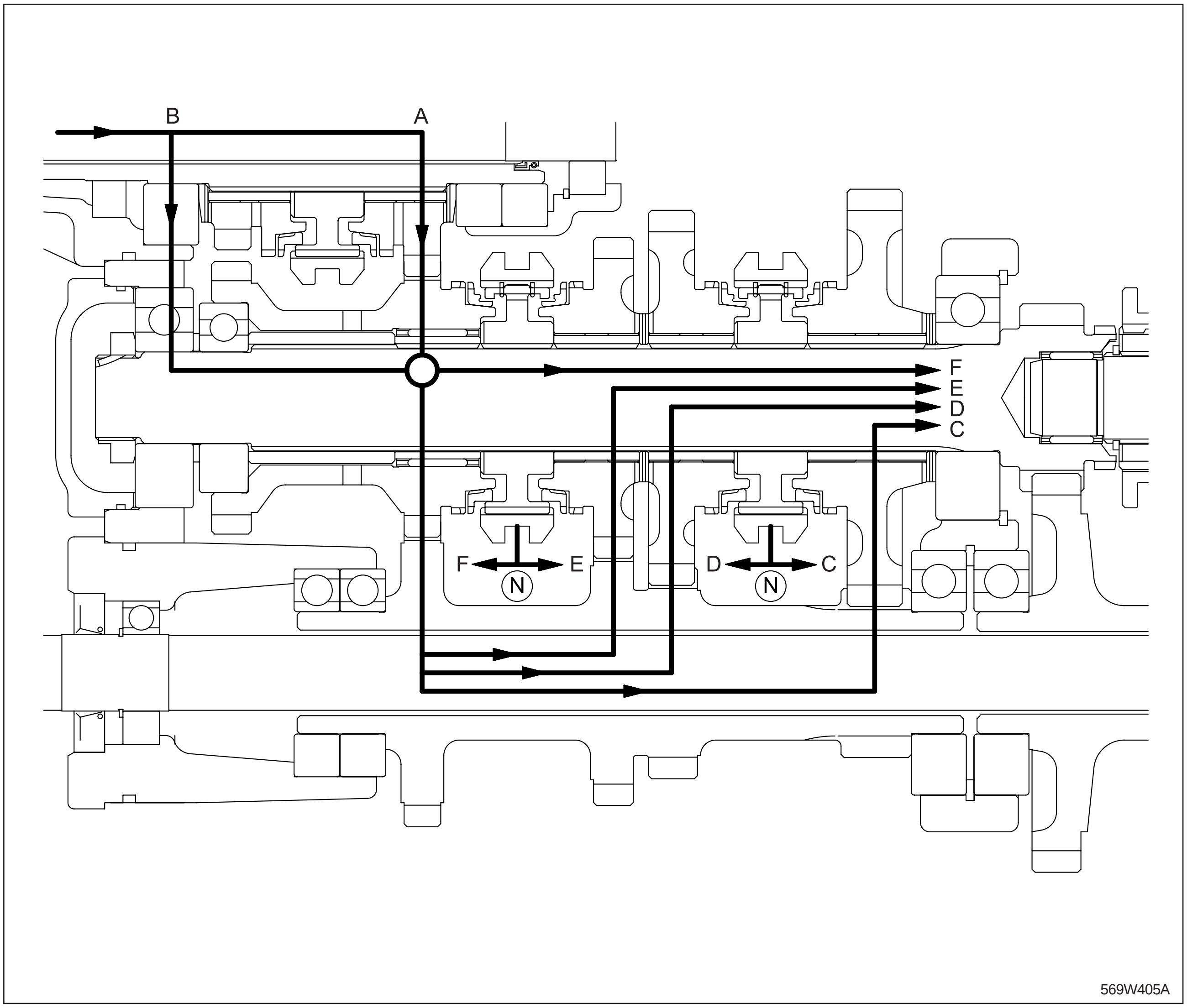
If auxiliary shift is for creep, the transmitted power to 39-21 gear (5) is transmitted to 43-21 gear (8) via 39-17 gear (9) of auxiliary shift shaft (6) and finally to auxiliary shift shaft (6) via 39 gear (10).

3.3.2 SHUTTLE SHIFT SECTION



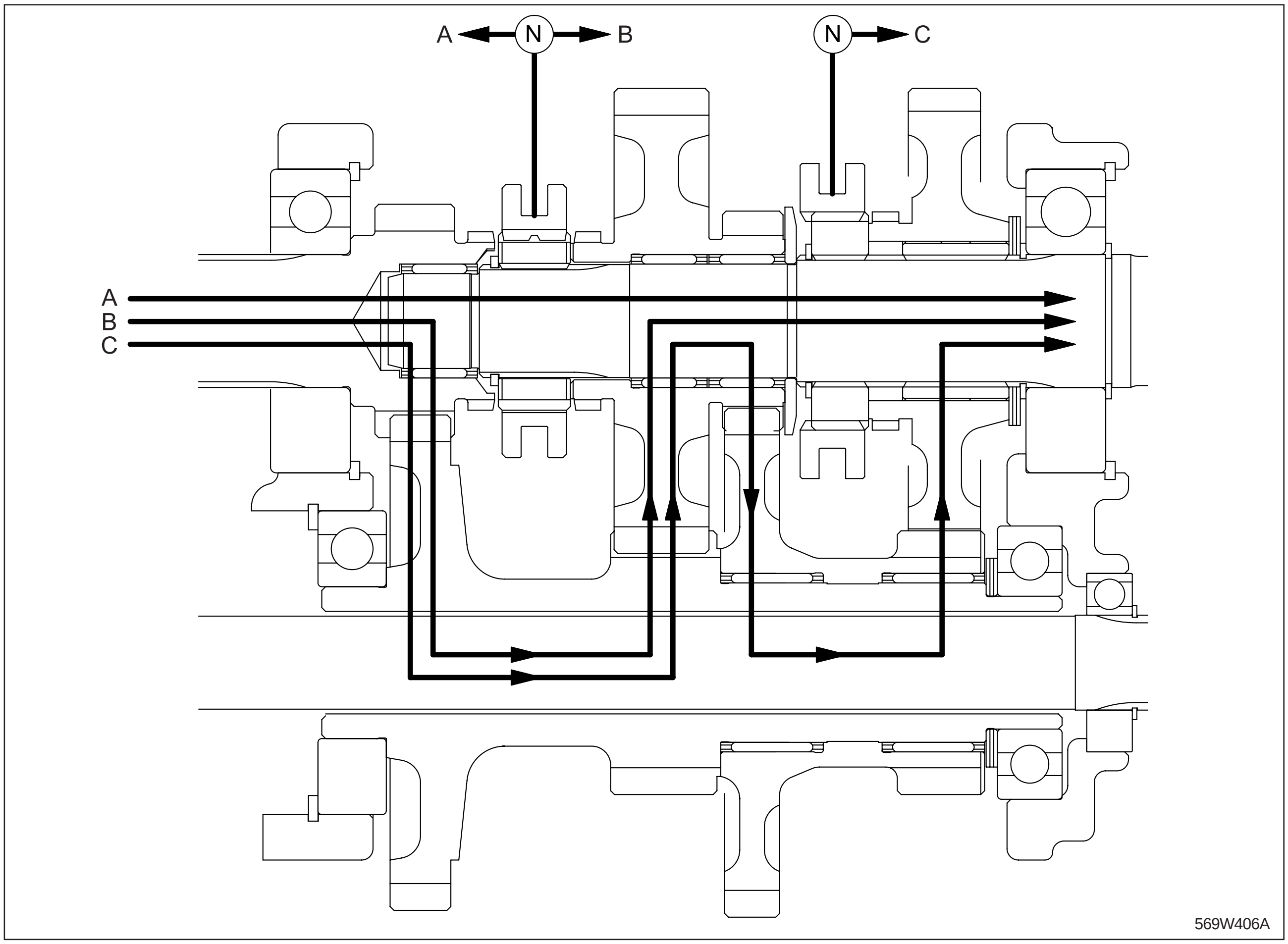
(A) Forward (B) Reverse

3.3.3MAIN SHIFT



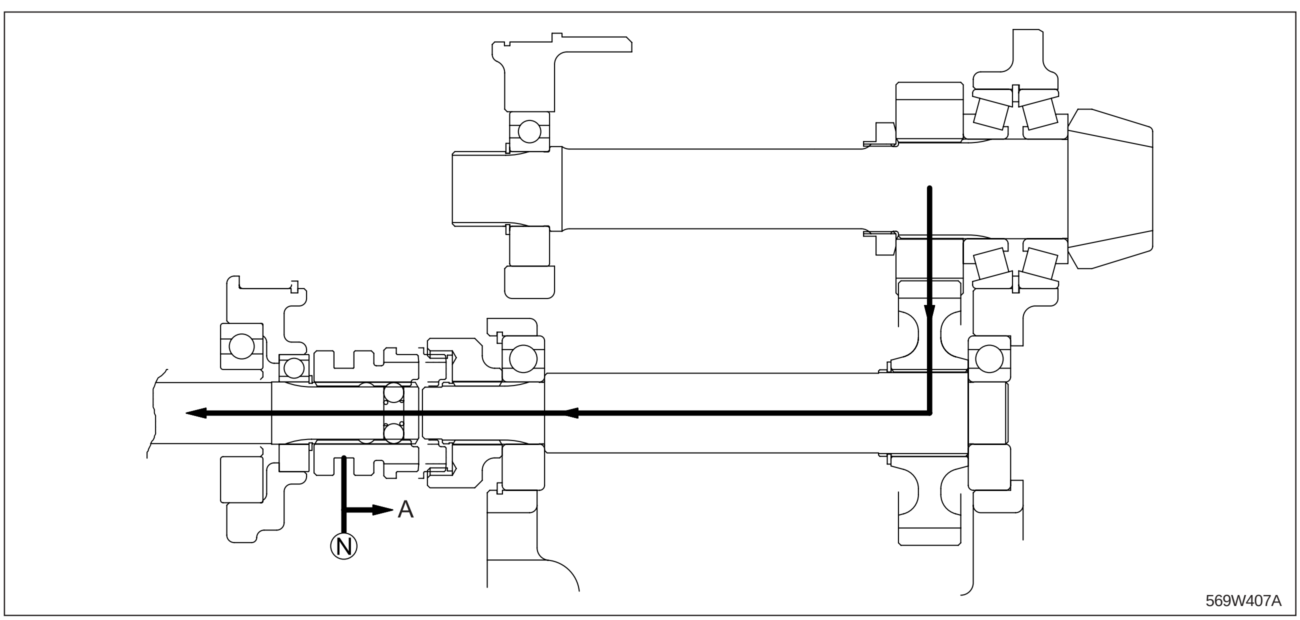
(A) Forward
(B) Reverse
(C) 1st
(D) 2nd
(E) 3rd
(F) 4th

3.3.4 AUXILIARY SHIFT



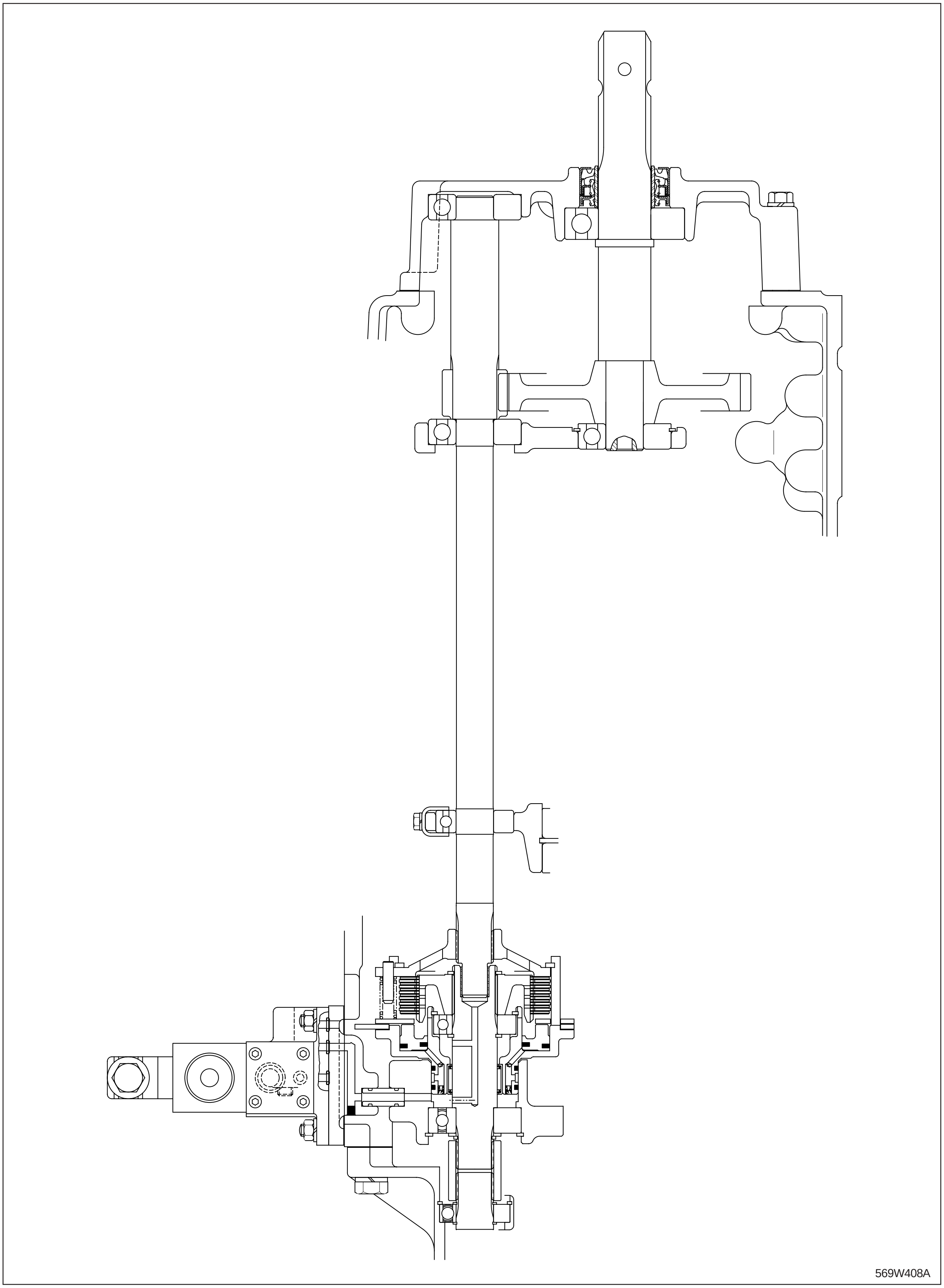
(A) High (B) Low (C) Creep

3.3.5 FRONT WHEEL DRIVE



(A) Engaged

3.3.6PTO SHIFT



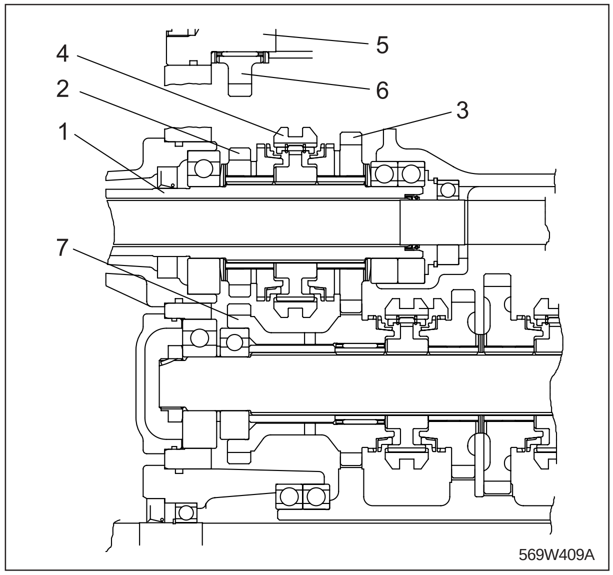
3.4 OPERATION

3.4.1 FEATURES

A. SHUTTLE

- Synchro shuttle is applied with the features as below.

1. As for forward reverse switching over, the same stage in forward and reverse can be obtained if raising slightly the shuttle lever from neutral and moving forward and reverse straightly.
2. Structure is so applied conveniently to operate the shuttle lever as installed on the steering column side.
3. In consideration of endurance for the shuttle (forward ↔ reverse) shift section, synchronizer ring which is coated with molybdenum is applied on the taper section.



<Shuttle shift section>

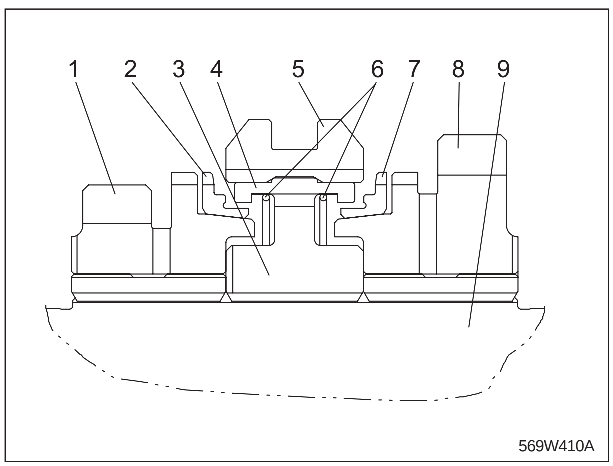
(1) Shuttle Shaft
(2) 24 Gear
(3) 29 Gear
(4) Shifter
(5) Reverse Shaft
(6) 21 Gear (Idle Gear)
(7) 26-26 Gear

Block-type Synchromesh Mechanism

(For Main Gear Shift, Hi-Lo Range Shift Section)

The hub (3) is splined to the counter shaft (9) and the shifter (5) is mounted on the synchronizer keys (4) out against the shifter (5). The bronze synchronizer rings (2), (7) are cone-shaped and match the conical shape of the gear (1), (8) shoulders which they contact.

These cone-shaped surfaces provide the frictional force to synchronized the speed of the first shaft with the gears (1), (8).

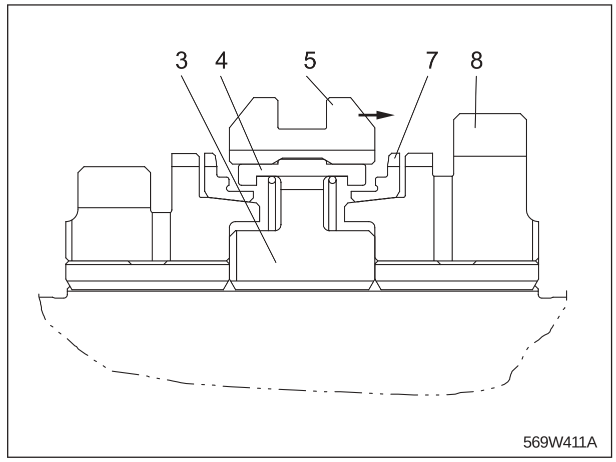


(1) Gear
(2) Synchronizer Ring
(3) Hub
(4) Synchronizer Key
(5) Shifter
(6) Synchronizer Spring
(7) Synchronizer Ring
(8) Gear
(9) Shuttle Shaft

First Stage

An effort to place the main gear shift lever to the 3rd or 4th speed causes the shifter (5) and synchronizer keys (4) to move slightly.

Then, the end surface of the synchronizer key (4) presses the synchronizer ring (7) against the cone-shaped portion of the gear (8). The frictional force generated at the cone-shaped portion rotates the synchronizer ring (7), synchronizer keys (4) and hub (3) which is splined to the counter shaft.



(3) Hub
(4) Synchronizer Key
(5) Shifter
(7) Synchronizer Ring
(8) Gear

Second Stage

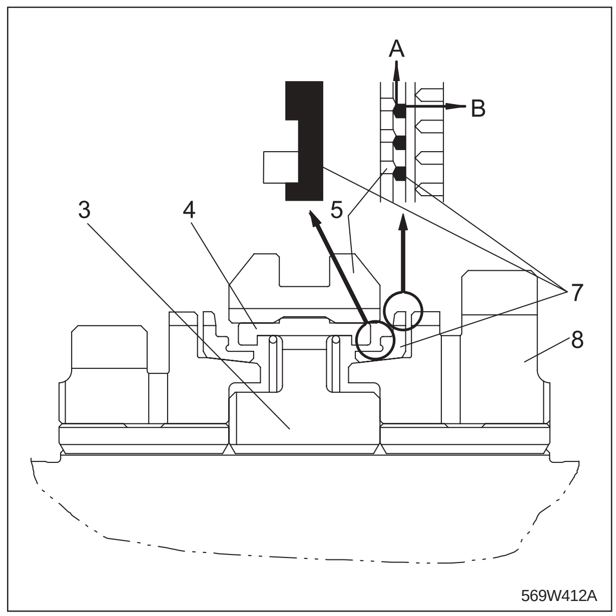
When the synchronizer keys (4) are prevented by the synchronizer ring (7) from sliding.

The synchronizer keys (4) are disengaged from the shifter (5).

The synchronizer keys (4) go into the grooves provided in the synchronizer ring (7).

However, since the width of the grooves is wider than that of the keys, the synchronizer keys begin rotating at the same speed with the shifter (5) and hub (3) with a time lag.

In the meantime, the shifter (5) in its sliding direction and the synchronizer ring (7) in its rotating direction press each other at their chamfered portions to synchronizer ring (7) with that of the gear (8).

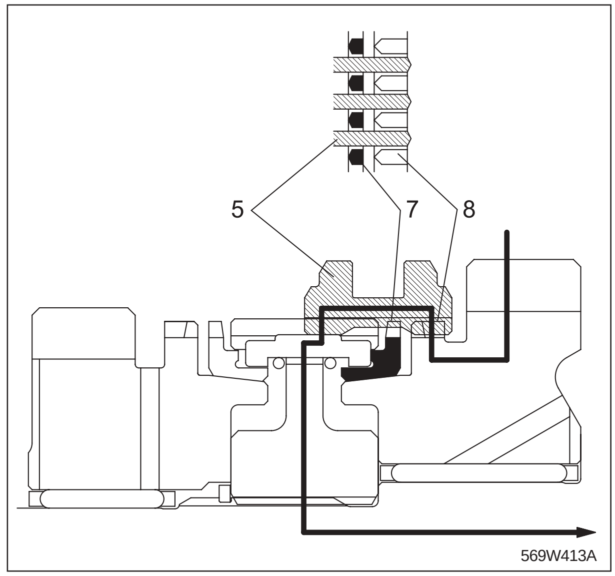


(3) Hub
(4) Synchronizer Key
(5) Shifter
(7) Synchronizer Ring
(8) Gear

Final Stage

When the speed of the shifter (5) becomes the same as that of the gear (8), the force of the synchronizer ring (7) in its rotating direction is not applied to the shifter (5) and the rotation of the synchronizer ring (7) is no longer transmitted to the shifter (5).

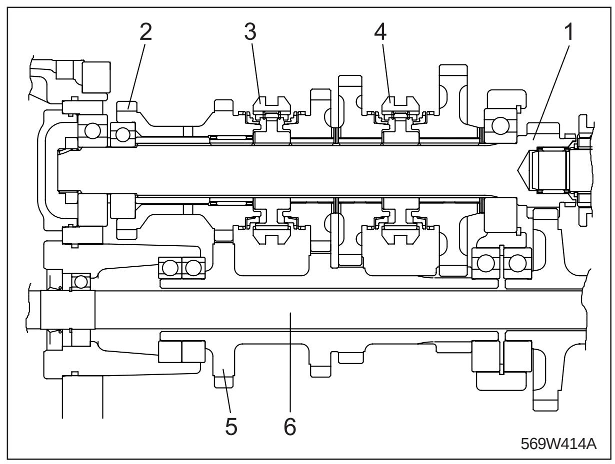
Therefore, the shifter (5) engages with the synchronizer ring (7) and further engages with the gear (8) for complete connection.



(5) Shifter
(7) Synchronizer Ring
(8) Gear

B. MAIN GEAR SHIFT

- Composed of full synchro mesh with key type applied to the synchro.

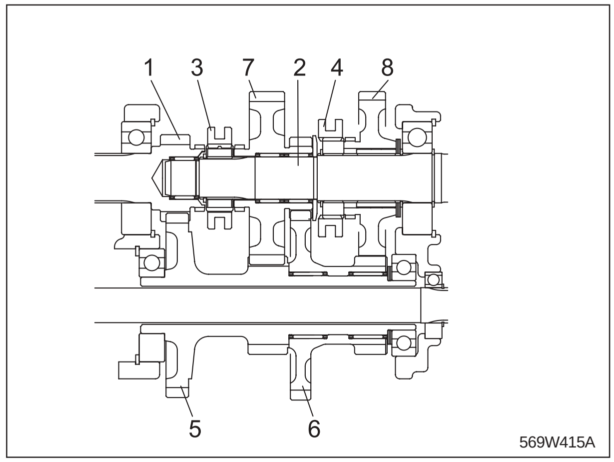


<Main gear shift section>

(1) 17 Gear Shaft
(2) 26-26 Gear
(3) Shifter (3-4 Stage)
(4) Shifter (1-2 Stage)
(5) 29-23-18-14 Gear
(6) Propeller Shaft 1

C. AUXILIARY GEAR SHIFT

- Composed of constant mesh with Hi/Low/Creep (option) rang shift available.



<Hi-Lo range shift section>

(1) 17 Gear Shaft
(2) Auxiliary Gear Shifter Shaft
(3) Shifter (Hi/Low)
(4) Shifter (Creep)
(5) 39-21 Gear
(6) 43-21 Gear
(7) 39-17 Plain Gear
(8) 39 Gear

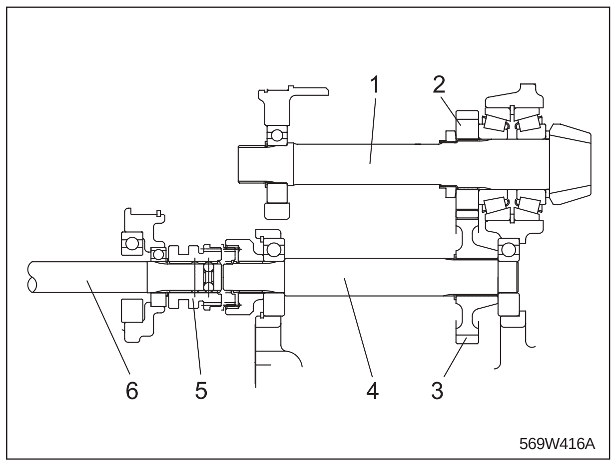
D. OPERATION OF THE FRONT WHEEL DRIVE

- Front wheel drive shift is structured simply to connect or disconnect shafts where power is transmitted to by the shift.

<Front wheel drive shift section>

Operation principle of the front wheel drive Power is transmitted to 34 gear (3) fixed on front wheel drive shaft (4) via 26 gear (2) engaged with spiral bevel pinion (1) and front wheel drive shaft (4) rotates as 34 gear (3) rotates.

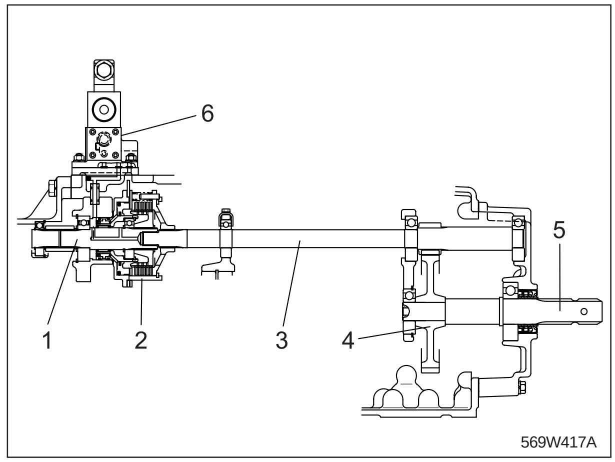
If the front wheel drive lever is operated, shift (front wheels) (5) is connected with front wheel drive shaft (4) and power is transmitted to propeller shaft 1 (6) via the front wheel drive shaft so to drive the 4 wheels.



(1) Spiral Bevel Pinion
(2) 26 Gear
(3) 34 Gear
(4) Front Wheel Drive Shaft
(5) Shifter (Front Wheels)
(6) Propeller Shaft 1
(7) Coupling

E. PTO

- PTO gear shift composed of constant mesh is available to shift gear while PTO clutch is OFF.



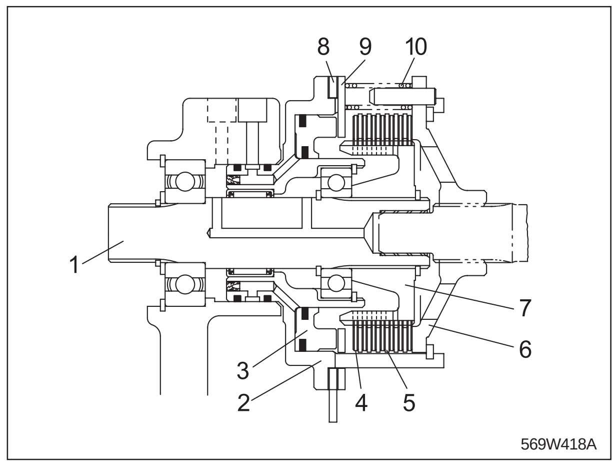
<Power flow diagram>

(1) PTO Clutch Shaft
(2) PTO Clutch
(3) PTO Drive Shaft
(4) 51 Gear
(5) PTO Shaft
(6) PTO Clutch Valve

F. PTO CLUTCH SYSTEM

INTRODUCTION

- PTO clutch valve on the main body of the PTO clutch as of the hydraulic wet multi-disc type can be turned ON and OFF by the PTO switch control to disconnect and connect power to PTO.
- If the PTO clutch is turned ON, auto or manual mode can be selected. In case the PTO switch is turned “auto” PTO power is automatically disconnected when locating the hydraulic lift arm at up position and in case the PTO switch is turned “manual” PTO power is connected regardless of the position of the hydraulic lift arm, as structured as convenient for application according to the work conditions.
- Modulator valve is equipped in the PTO clutch valve available to display the same effect as semi-clutched while increasing slowly the clutch pressure.
- In addition, the brake installation on the main body of the PTO clutch is structured to prevent the clutch body from inertial rotating together and to stop the PTO surely at OFF.



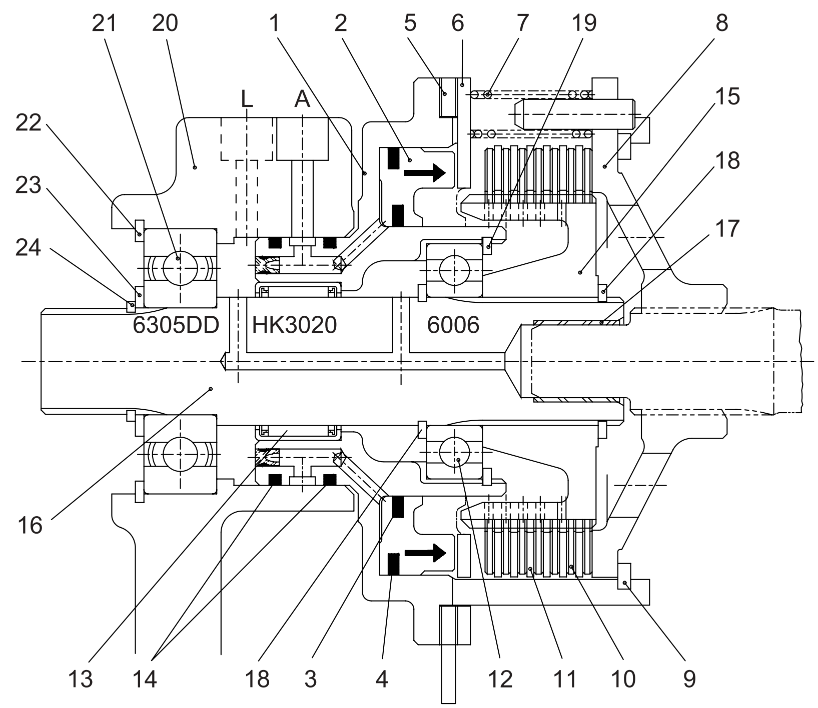
<PTO clutch valve>

(1) PTO Clutch Shaft
(2) Clutch Body
(3) Piston
(4) Clutch Disc
(5) Clutch Plate
(6) Pressure Plate
(7) Spline Boss
(8) Brake Disc
(9) Return Plate
(10) Return Spring

[PTO CLUTCH VALVE]

A. OPERATION

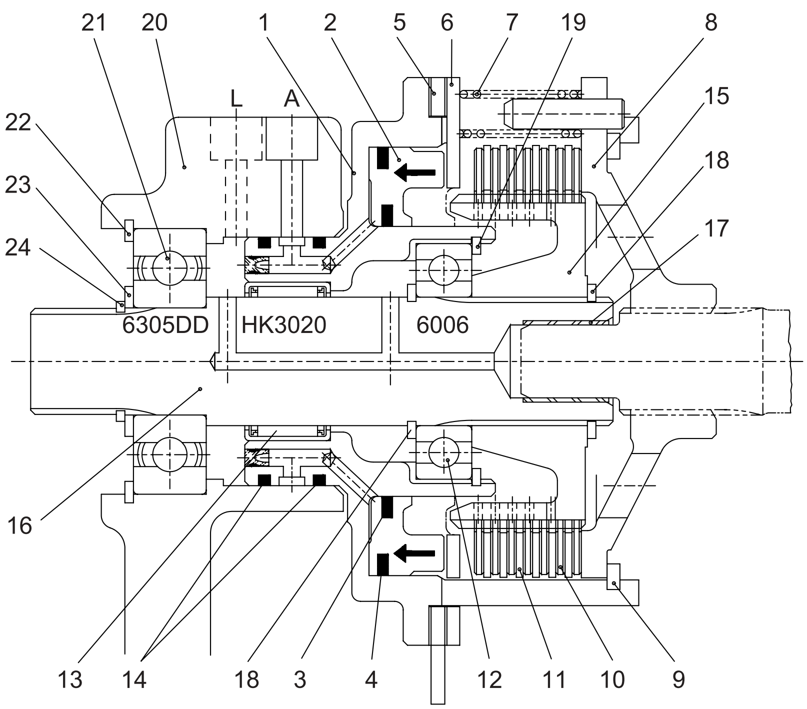
- In case PTO clutch switch is ON



(1) Clutch Body	(8) Pressure Plate	(14) Seal Ring	(20) Bracket
(2) Piston	(9) Snap Ring	(15) Spline Hub	(21) Ball Bearing
(3) Piston Ring	(10) Clutch Disk	(16) PTO Clutch Shaft	(22) Snap Ring
(4) Piston Ring	(11) Clutch Plate	(17) Bush	(23) Spacer
(5) Brake Plate	(12) Ball Bearing	(18) Snap Ring	(24) Snap Ring
(6) Return Plate	(13) Needle Bearing	(19) Snap Ring	(25) PTO Drive Shift
(7) Spring			

1. If PTO switch on the instrument board is turned ON (auto or manual), constant oil amount of 7 ℓ/min regulated at Port P of priority valve ass'y flows into Port A of PTO clutch via the solenoid valve and the modulating valve.
2. This oil flows into the rear of piston (2) and pushes the piston out as directed by the arrow above while pressing return spring (7). Power transmitted from PTO propeller shaft and PTO clutch shaft (16) as return plate (6), clutch disc (10) and clutch plate (11) are pushed toward pressure plate (8), is transmitted to PTO drive shaft (25).
3. Pressure in PTO clutch circuit increases as the modulating valve is shifted, slowly up to 16 ~ 18 kgf/cm^2 controllable by the relief valve. And oil after the PTO clutch is ON flows to Port L of PTO clutch and lubricates the shaft and bearing parts.

- In case PTO clutch switch is OFF



(1) Clutch Body	(8) Pressure Plate	(14)Seal Ring	(20) Bracket
(2) Piston	(9) Snap Ring	(15) Spline Hub	(21) Ball Bearing
(3) Piston Ring	(10) Clutch Disk	(16) PTO Clutch Shaft	(22) Snap Ring
(4) Piston Ring	(11) Clutch Plate	(17) Bush	(23) Spacer
(5) Brake Plate	(12) Ball Bearing	(18) Snap Ring	(24) Snap Ring
(6) Return Plate	(13) Needle Bearing	(19) Snap Ring	(25) PTO Drive Shift
(7) Spring			

1. If PTO switch on the instrument board is turned OFF (neutral), the circuit returning from the priority valve via the solenoid valve and the modulating valve to Port A of PTO clutch is disconnected.
2. Piston (2) of PTO clutch is moved by the tension of return spring (7) as directed by the arrow above. As the force to push the clutch disc disappears, the power transmitted from PTO clutch shaft (16) to PTO drive shaft is disconnected.
3. And oil after clutch is OFF lubricates the shaft and bearing parts of PTO clutch just like at ON.

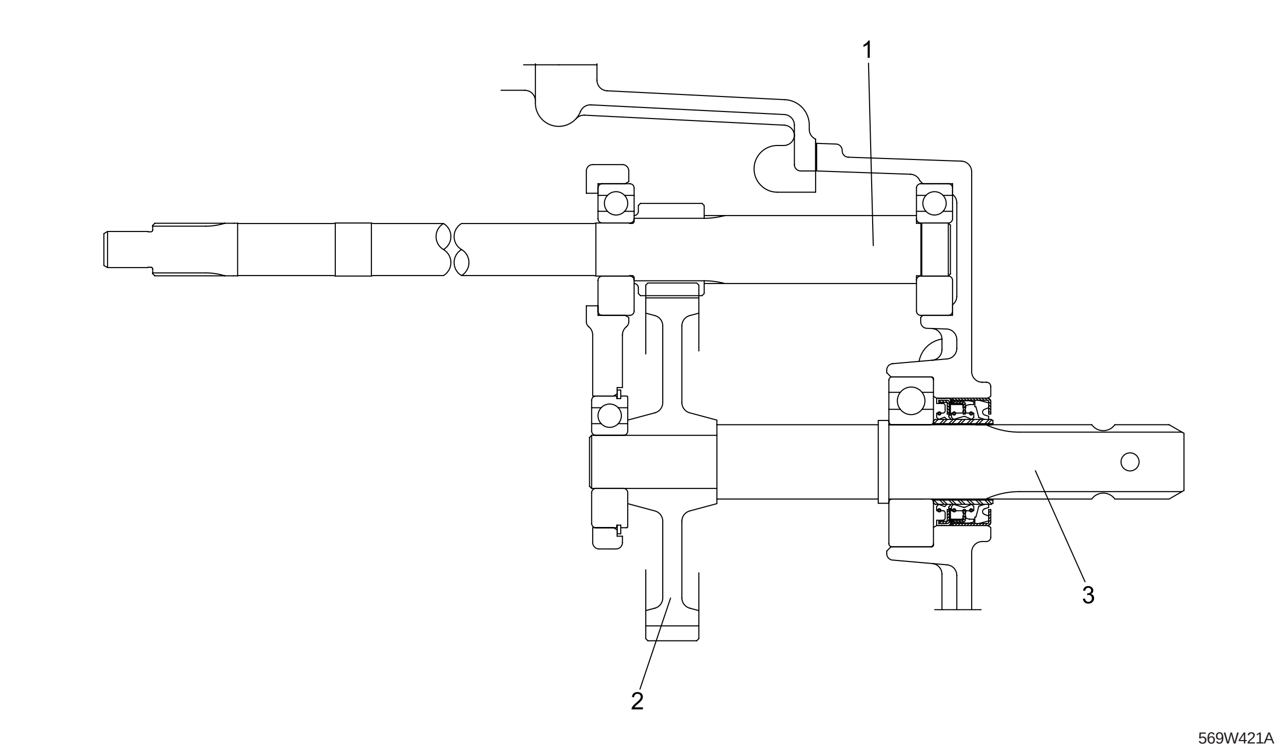
Inertial Brake

Brake disc (5) with a protuberance at one section there of is installed on PTO clutch. Clutch disc (10) is pushed to clutch case (1) by return spring (7) and PTO clutch is surely stopped by the protuberance of the brake ring in contact with the rib of the transmission case if PTO is OFF.

In addition, this brake application has an advantage of convenience for installing PTO shaft on the universal joint while PTO is stopped, because PTO shaft is turned approx. 60 ~ 80° when PTO is stopped.

F. PTO SYSTEM

a. Related Parts With the PTO Operation



(1) PTO Drive Shaft (2) 51 Gear (3) PTO Shaft

b. Operation Principle of PTO

If PTO switch is activated PTO clutch is engaged and then power from the engine is transmitted to PTO drive shaft (1) via PTO drive shaft 1.

51 gear (2) is rotated as engaged with PTO drive shaft (1) which gets rotated subsequently.

If PTO switch is connected to automatic or manual control, the tractor will not start (as a safety device).

4. PREPARATION STAGE FOR DISASSEMBLING AND ASSEMBLING TRANSMISSION

4.1 DRAINING THE TRANSMISSION FLUID

Draining the Transmission Fluid

1. Place oil pans underneath the transmission case.
2. Remove the drain plugs.
3. Drain the transmission fluid.
4. Reinstall the drain plugs

(When refilling)

- Fill up from filling port after removing the filling plug (1) until reaching the gauge (2).
- After running the engine for few minutes, stop it and check the oil level again, add the fluid to prescribed level if it is not correct level.

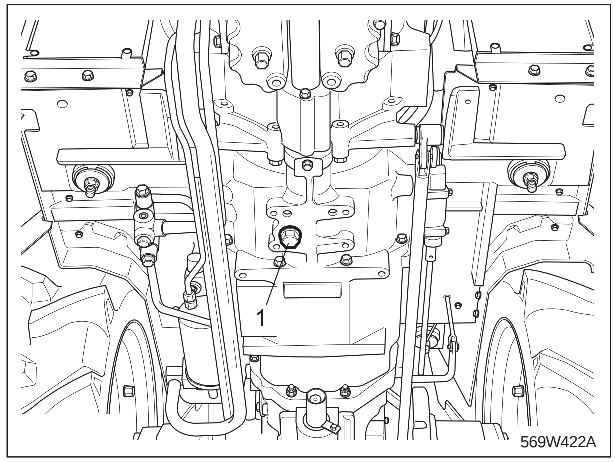
Capacity	Transmission fluid	34.0 ℓ 9.0 U.S.gal

IMPORTANT:

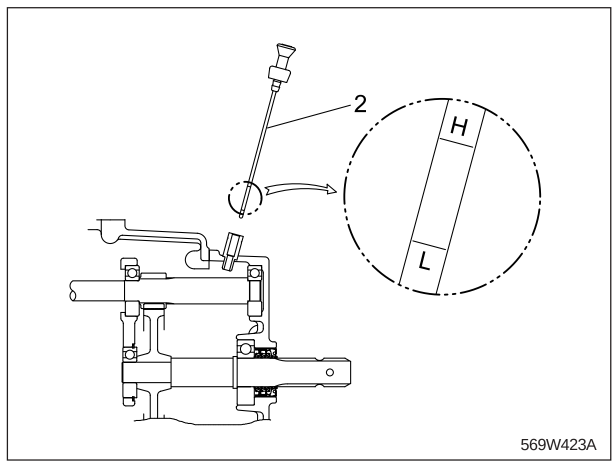
- *Use only SAE 80, 90 gear oil. Use of other oils may damage the transmission or hydraulic system.*

  Refer to “LUBRICANTS, FUEL AND COOLING WATER” (See page 4-10).
- *Do not mix different blends fluid together.*

[A] Oil Level is Acceptable Between Hi and Lo.



(1) Drain Plugs

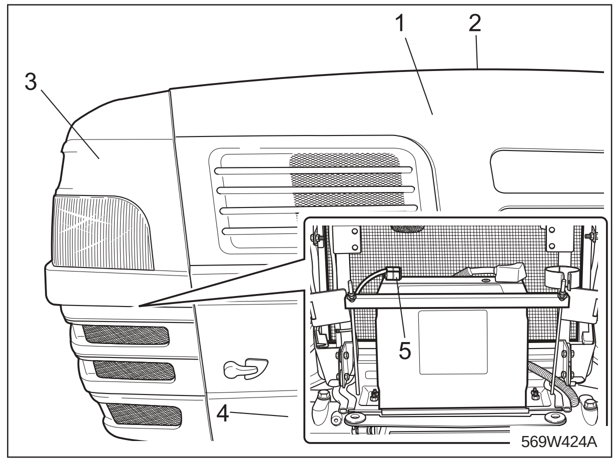


(2) Gauge

4.2 SEPARATING PANEL FRAME ASSEMBLY

Preparation 1

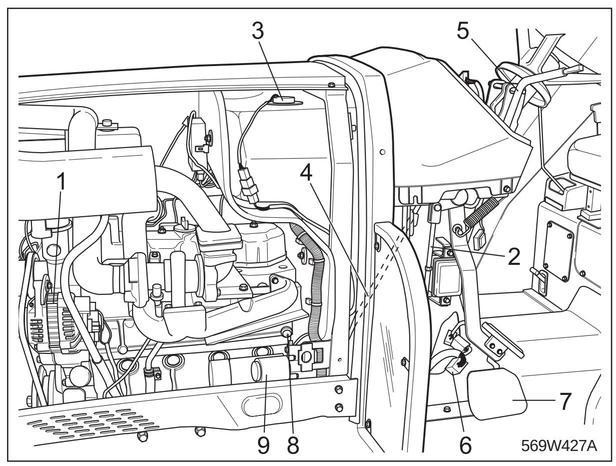
1. Removing the following parts.

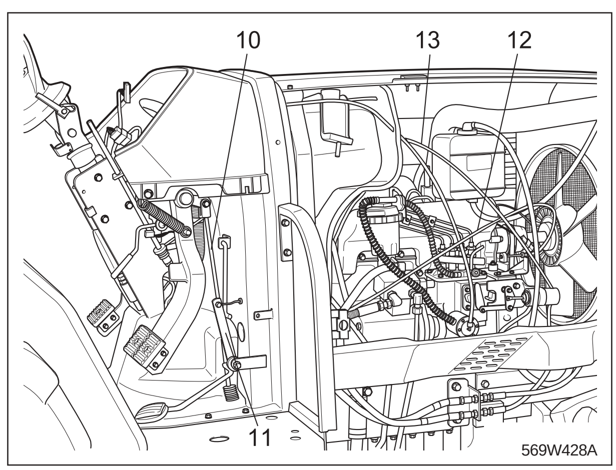


(1) Side Cover (RH, LH)
(2) Bonnet
(3) Front Grille
(4) Side Skirt (RH, LH)
(5) Battery Negative Code

Preparation 2

1. Disconnect the brake rods (4).
2. Disconnect the clutch rod (2).
3. Remove the accelerator cable (12).
4. Disconnect the foot accelerator rod (11).
5. Remove the panel frame cover (7) and disconnect the connectors (6).
6. Remove the shuttle shaft lever (5) after disconnecting limit switch wire harness.
7. Disconnect the 2P connector of alternator (1), jumper for fuel level sensor (3) and starter (9).
8. Disconnect the meter cable (13) at the engine side.





(1) 2P Connector For Alternator
(2) Clutch Rod
(3) Jumper Lead For Fuel Level Sensor
(4) Brake Rod (LH)
(5) Shuttle Shaft Lever
(6) Connectors
(7) Panel Frame Cover
(8) Jumper Lead For Oil Switch
(9) Jumper Lead For Starter
(10) Brake Rod (RH)
(11) Food Accelerator Rod
(12) Accelerator Cable
(13) Meter Cable

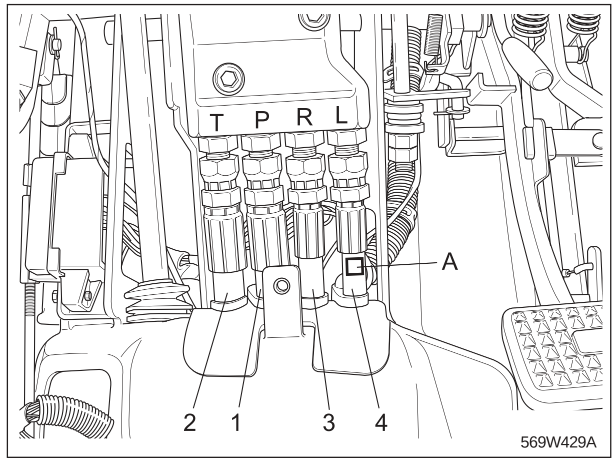
Hydraulic Pipes

1. Disconnect the main delivery hose (1), return hose (2), right turning delivery hose (3) and left turning delivery hose (4).

(When reassembling)

- In assembling the turning delivery hoses to the steering controller, connect the delivery hose with identification mark (tape) to the L port of the steering controller.

Tightening torque	Main delivery hose retaining nut	46.6 ~ 50.9 N·m 4.8 ~ 5.2 kgf·m 34.4 ~ 37.6 lbf·ft
	Turning delivery hoses retaining nut	24.5 ~ 29.4 N·m 2.5 ~ 3.0 kgf·m 18.1 ~ 21.7 lbf·ft



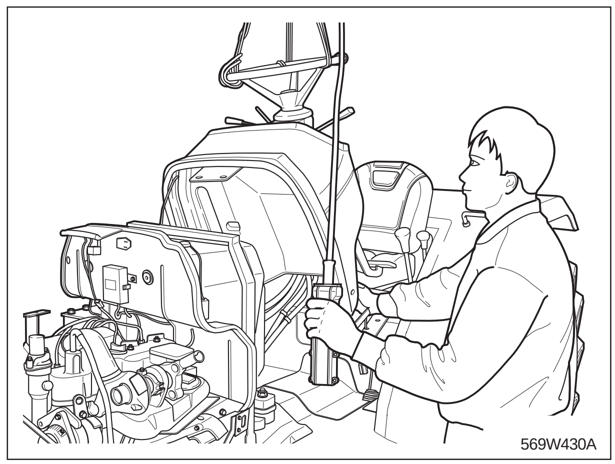
[A] Identification Mark (Tape)
(1) Main Delivery Hose
(2) Return Hose
(3) Right Turning Delivery Hose
(4) Left Turning Delivery Hose

Panel Frame and Steering Assembly

1. Remove the panel frame mounting crews (Two screws a upper part. Seven screws at lower part).
2. Take out the panel frame and steering assembly as a unit.

(When reassembling)

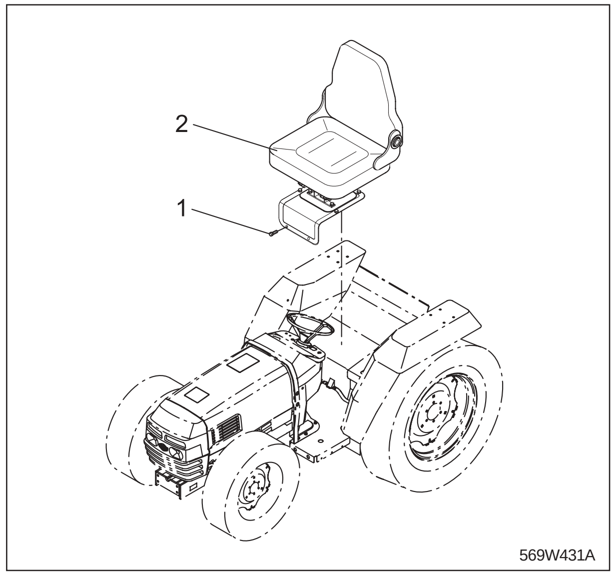
- Do not get in the wiring harness between panel frame and platform.



4.3 SEPARATING REAR FENDERS AND PLATFORM ASSEMBLY

Preparation

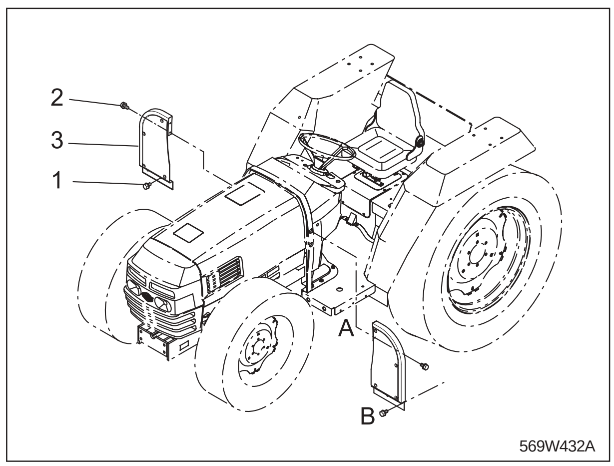
1. Remove the Rops.
2. Remove the Bolts (1) and take out the seat Assembly (2).



(1) Bolt (2) Seat Assembly

Cover

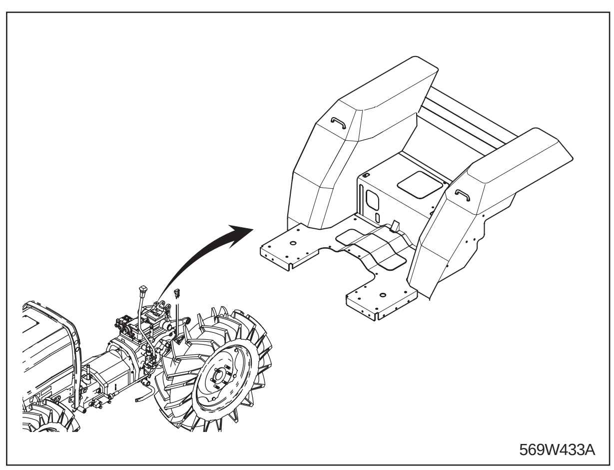
1. Remove the bolts (1), (2) and the cover assembly (3).



(1) Bolt (3) Cover
(2) Bolt

Fender, Floor Seat and Platform Assembly

1. Remove the fender (1, 2), floor seat and platform as a unit.



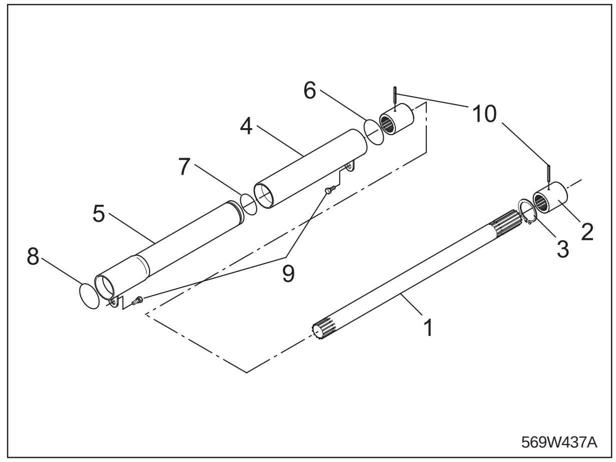
D. SEPARATING CLUTCH HOUSING

Propeller Shaft

1. Slide the propeller shaft cover (4), (5) after removing the bolt (9).
2. Tap out the spring pin (10) and then slide the coupling (2) to the front.

(When reassembling)

- Apply grease to the splines of the propeller shaft.



(1) Propeller Shaft
(2) Coupling
(3) Cir-Clip
(4) Propeller Shaft Cover
(5) Propeller Shaft Cover
(6) O-Ring
(7) O-Ring
(8) O-Ring
(9) Bolt
(10) Spring Pin

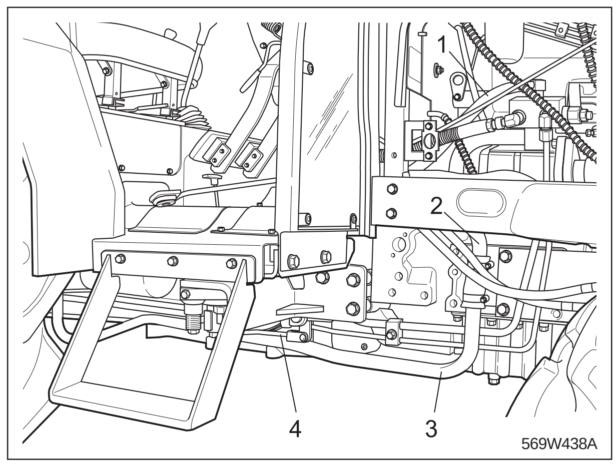
Hydraulic Pipes

1. Remove the brake rod (4) and delivery pipe (3).
2. Remove the delivery pipe (2).
3. Slide the rubber hose (1).

(When reassembling)

- Reinstall the pipe clamps securely.

Tightening torque	Join bolt for delivery pipe (3) and front hydraulic block	49.0 ~ 58.8 N·m 5.0 ~ 6.0 kgf·m 36.2 ~ 43.4 lbf·ft
	Joint bolt for delivery pipe (2) and regulator valve	34.3 ~ 39.2 N·m 3.5 ~ 4.0 kgf·m 25.3 ~ 28.9 lbf·ft



(1) Rubber hose
(2) Delivery pipe
(3) Delivery pipe
(4) Brake rod

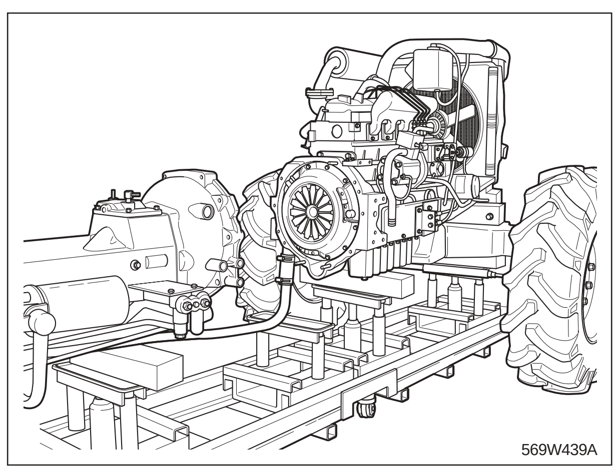
Separating the Engine From Clutch Housing

1. Place the jack under the clutch housing case.
2. Hoist the engine by the nylon lift strap at the tank support.
3. Remove the engine mounting screws, and then pull the engine to the front.

(When reassembling)

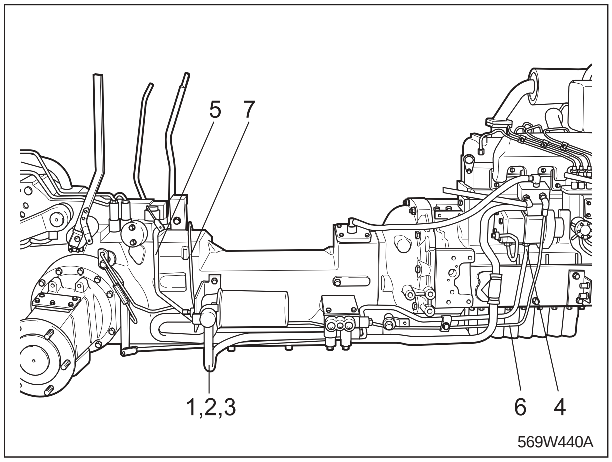
- Apply grease to the splines.
- Apply liquid gasket (There Bond 1208D or equivalent) to joint face of the engine and clutch housing.

Tightening torque	Engine and clutch housing mounting screws, nuts	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.1 ~ 66.5 lbf·ft
	Engine and clutch housing mounting stud bolts	39.2 ~ 49.0 N·m 4.0 ~ 5.0 kgf·m 28.9 ~ 36.2 lbf·ft



Hydraulic Pipes

1. Loosen the screws (1), Bolt (2) and remove the suction pipe (3).
2. Remove the pipe (4), (5), (6), (7).



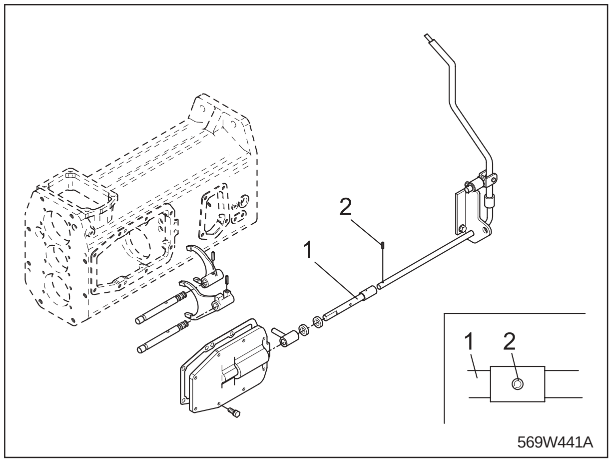
(1) Screw
(2) Bolt
(3) Suction Pipe
(4) PTO Pipe 1
(5) Pipe 1
(6) Pipe 2
(7) PTO Pipe 2

Shift Levers

1. Tap out the spring pins (2) of main shift rod 1 (1).

(When reassembling)

- Tap in the spring pins (2) so that their split portion may face forward.



(1) Main Shift Rod 1
(2) Spring Pins

5. TO DISASSEMBLING AND TO ASSEMBLE

5.1 STANDARD TABLE FOR REPAIR

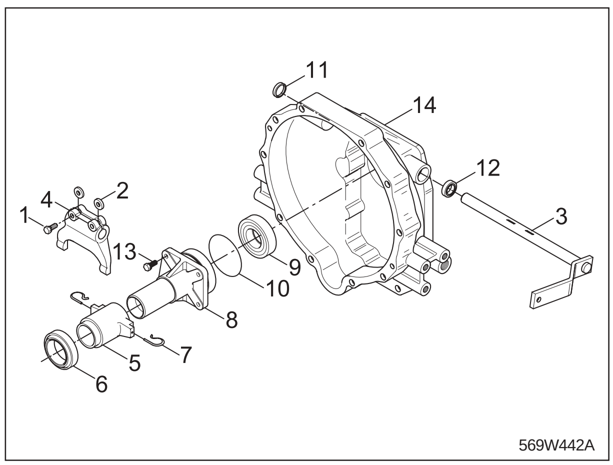
Item	Factory Spec	Allowable limit
1. Clearance between thrust directions of shuttle shaft and 17 gear shaft	0 ~ 0.1 mm 0 ~ 0.0039 in.	
2. Backlash of gear	0.1 ~ 0.2 mm 0.0039 ~ 0.0078 in.	0.4 mm 0.0157 in.
3. Clearance between shift fork and shift groove	0.2 ~ 0.4 mm 0.0078 ~ 0.0157 in.	0.8 mm 0.0314 in.
4. Synchronizer ring wear of synchronizer ring contact on corn part (tapered) of synchronizer ring	- - -	0.35 mm 0.0137 in. 80 % min
5. Turning torque of spiral bevel pinion	0.88 ~ 1.17 N·m 0.09 ~ 0.12 kgf·m 0.65 ~ 0.86 lbf·ft	-
6. Turning torque after assembling spiral bevel pinion and spiral bevel gear	4.9 ~ 7.85 N·m 0.5 ~ 0.8 kgf·m 3.61 ~ 5.79 lbf·ft	-
7. Backlash of spiral bevel pinion and spiral bevel gear	0.15 ~ 0.25 mm 0.006 ~ 0.0098 in.	-
8. Reaching up degree of spiral bevel pinion and spiral bevel gear	30% min (center is 1/3 ~ 2/3 away from minor section)	-

5.2 TO DISASSEMBLING AND TO ASSEMBLE

A. CLUTCH HOUSING

a. To Disassembling

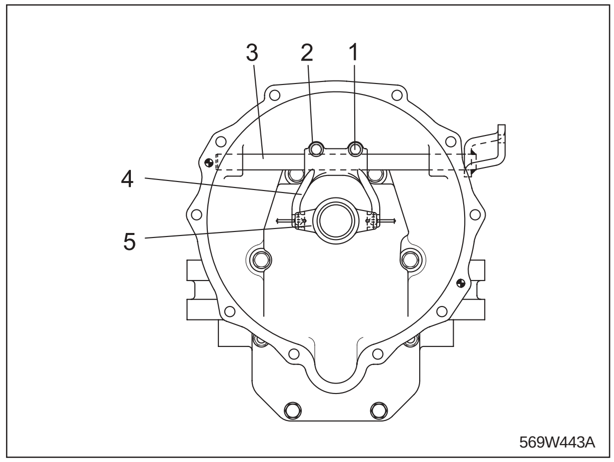
1. Loosen release fork mounting bolt (1) and remove key (2).
2. Remove clutch release fork (4) and release hub (5) while drawing out clutch lever (3).



(1) Bolt
(2) Key
(3) Clutch Lever
(4) Release Fork
(5) Release Hub
(6) Release Bearing
(7) Clamp
(8) Case
(9) Oil Seal
(10) O-Ring
(11) Seal Cap
(12) Oil Seal
(13) Bolt
(14) Clutch Housing

b. To Assemble

1. Assemble seal cap (11) and oil seal (12) using a jig on both sides of the clutch housing.
2. Assemble clutch lever (3) and release fork (4) after greasing the lip area of oil seal (12).
3. Assemble mounting bolt (1) and fork key (2) while aligning the position of clutch release fork (4) and clutch lever (3).



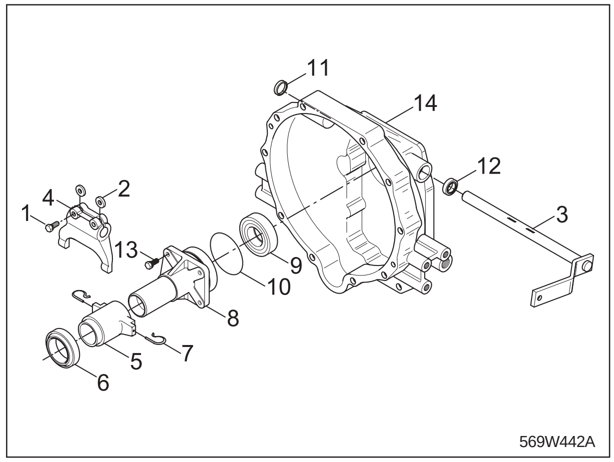
4. Assemble propeller shaft case (8) while greased enough after sub-assembled with oil seal (9) and O-ring (10) on clutch housing (14) with M8 washer mounting bolts (4 places) (13).
5. Connect and assemble clutch release fork (4) with Clamp (7) after sub-assembling clutch release hub (5) and release bearing (6).

Diameter of main shift clutch lever	Factory spec.	20.000 ~ 19.967 mm 0.787 ~ 0.786 in.

Tightening torque	Clutch release fork mounting bolt (1)	23.5 ~ 27.5 N·m 2.4 ~ 2.8 kgf·m 17.3 ~ 20.3 lbf·ft
	Propeller shaft case mounting bolt (13)	23.5 ~ 27.5 N·m 2.4 ~ 2.8 kgf·m 17.3 ~ 20.3 lbf·ft
	Tightening bolt of the engine and clutch housing	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.1 ~ 66.5 lbf·ft

CAUTION

- *Assembling direction of oil seal (9, 12): lip area is to face toward center of the clutch housing.*
- *Tighten 2 bolts at both places evenly and slowly when fixing the tightening bolt (1).*

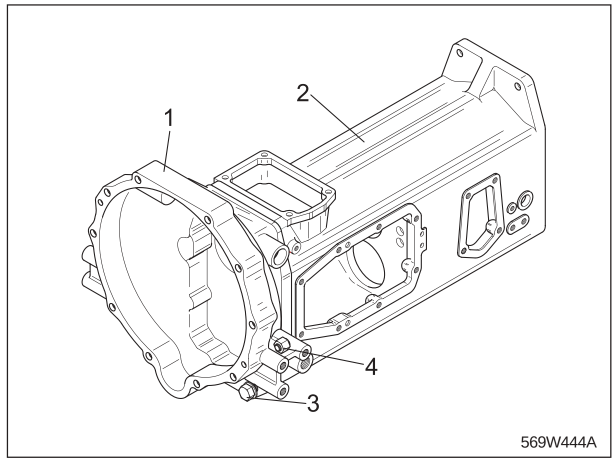


(1) Bolt
(2) Key
(3) Clutch Lever
(4) Release Fork
(5) Release Hub
(6) Release Bearing
(7) Clamp
(8) Case
(9) Oil Seal
(10) O-Ring
(11) Seal Cap
(12) Oil Seal
(13) Bolt
(14) Clutch Housing

B. CLUTCH HOUSING AND MIDDLE CASE

a. To Disassembling

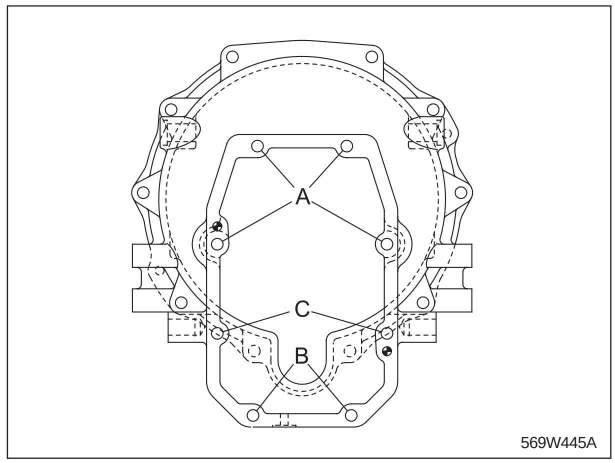
1. Remove M12 bolts (3) at six places and nuts (4) at two places to loosen clutch housing (1) and middle case (2).



(1) Clutch Housing (3) Bolt
(2) Middle Case (4) Bolt

b. To Assemble

1. Remove any foreign substance cleanly out of assembling surfaces of clutch housing (1) and middle case (2) and replace the packing with new one for assembly.
2. Tighten nuts at two places and M12 bolts at six places while aligning the position of parallel pins at two places and stud bolts at two places.



Tightening torque	Tightening stud of clutch housing and middle case (A)	34.3 ~ 49.0 N·m 3.5 ~ 5.0 kgf·m 25.3 ~ 36.1 lbf·ft
	Tightening bolt of clutch housing and middle case (B)	128.5 ~ 145 N·m 13.1 ~ 14.8 kgf·m 94.7 ~ 106.9 lbf·ft
	Tightening nut of clutch housing and middle case (C)	103 ~ 117.7 N·m 10.5 ~ 12.0 kgf·m 78.9 ~ 86.8 lbf·ft

CAUTION

1. *Carefully tighten M12 bolts when assembling*

   M12 x 40 (four places): middle case, part A

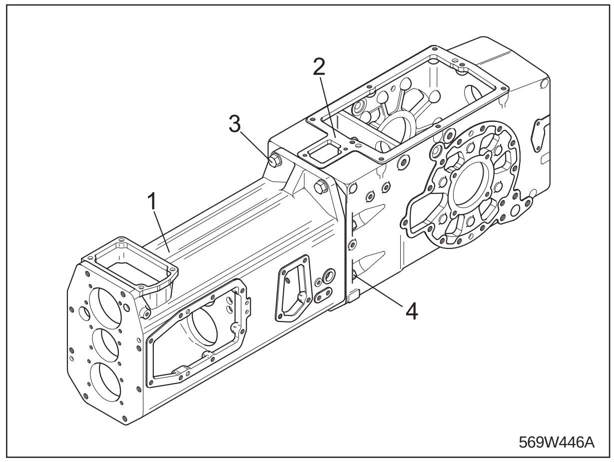
   M12 x 60 (two places): middle case, part B

   M12 stud bolts (two places): middle case, part C
2. *Parallel pin spec. (outer diameter x length): 10 x 20 mm (0.393 to 0.787 in.)*

C. MIDDLE CASE AND TRANSMISSION CASE

a. To Disassembling

1. Remove bolt (3) at 4 places and nuts (4) at 4 places on assembling surfaces of middle case (1) and transmission case (2), and separate the middle case and the transmission case.

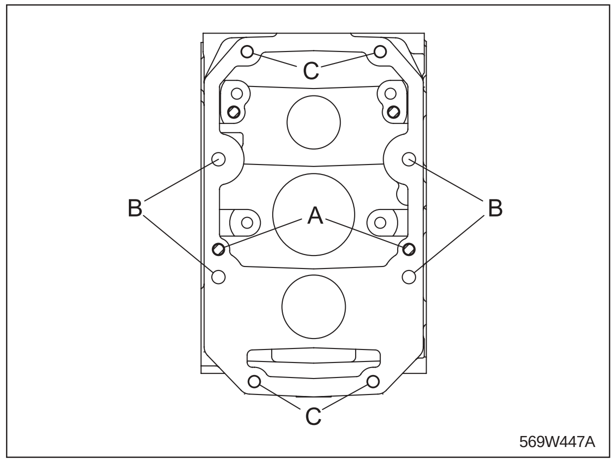


(1) Middle Case (3) Bolt
(2) Transmission Case (4) Nut

b. To Assemble

1. Remove any foreign substance cleanly out of assembling surfaces of middle case (1) and transmission case (2) and replace the gasket with new one.
2. Tighten nuts at 4 places and bolts (part C) at 4 places while aligning the position of parallel pins (part A) at 2 places and stud bolts (parts B) at 4 places.

Tightening torque	Tightening stud (A) of middle case and transmission case	34.3 ~ 49.0 N·m 3.5 ~ 5.0 kgf·m 25.3 ~ 36.1 lbf·ft
	Tightening bolt (C) of middle case and transmission case	128.5 ~ 145 N·m 13.1 ~ 14.8 kgf·m 94.7 ~ 106.9 lbf·ft
	Tightening nut (B) of middle case and transmission case	103 ~ 117.7 N·m 10.5 ~ 12.0 kgf·m 75.9 ~ 86.8 lbf·ft



CAUTION

Carefully tighten M12 bolts when assembling

M12 x 45 (four places): part C

M12 stud bolts: part B

Parallel pin (10 x 20 mm): part A

D. SHUTTLE SHIFT COVER

a. To Disassembling

1. Remove washer mounting bolts (12), (13) at 4 place to loosen shuttle shift cover (11).
2. Loosen snap ring (9) to draw shift arm (8) out of shift cover (11).
3. Remove mounting bolt (5) to Disassembling shift fork (1), fork rod (4), spring (2) and steel ball (3).

b. To Assemble

1. Insert spring (2), steel ball (3) and fork rod replacing tool into shift fork (1) .
2. Place shift fork (1) inside shift cover (11), insert fork rod (4) into fork rod (1) and then tighten plug (6) at 2 places on shift cover (11).
3. Tighten mounting bolt (5) shift cover (11) to fix fork rod (4).
4. Tighten O-ring (7) on shift arm (8), where greased to insert into shift cover hole as aligned and to fix with snap ring (9).
5. Replace the gasket with new one to locate on the assembly section and insert shift fork (1) into shuttle shift groove to tighten shift cover (11) with M10 bolt (12), (13).

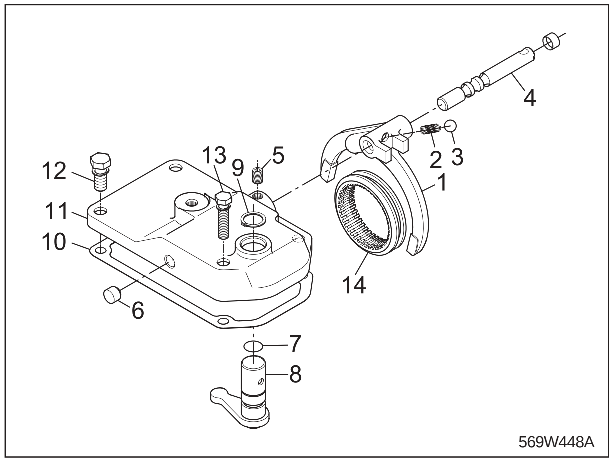
Tightening torque	Tightening bolt of shuttle shift cover	48.0 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.4 ~ 41.2 lbf·ft

CAUTION

- *Replace O-ring (7) with a new one, where is greased on the surface for assembly.*
- *Tighten mounting bolt (5) after applying adhesive on.*

→ *Three Bond 1324B or its equivalent.*

• Outer diameter of the shuttle fork rod	Factory spec.	• 11.994 ~ 11.976 mm (0.472 ~ 0.471 in.)
• Inner diameter of the shuttle fork		• 12.027 ~ 12.000 mm (0.473 ~ 0.472 in.)
• Outer diameter of the shuttle shifter		• 95.50 ~ 95.30 mm (3.759 ~ 3.752 in.)
• Outer diameter of the shuttle shift arm		• 20.000 ~ 19.967 mm (0.787 ~ 0.786 in.)
• Free motion field of shift fork mounting spring		• 22 mm (0.866 in.)

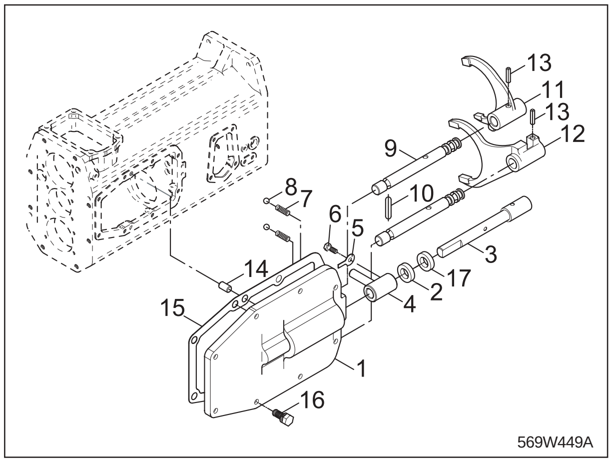


(1) Fork
(2) Spring
(3) Ball
(4) Fork Rod
(5) Mounting bolt
(6) Plug
(7) O-Ring
(8) Shift Arm
(9) Snap Ring
(10) Gasket
(11) Shift Cover
(12) Bolt
(13) Bolt
(14) Shifter

E. MAIN SHIFT FORK

a. To Disassembling

1. Remove main shift cover bolts (16) at 8 places on the middle case side to loosen main shift cover (1).
2. Loosen fork mounting spring pin (13).
3. Remove fork rod (9) to Disassembling pin (10), steel ball (8) and spring (7).
4. Remove the caulking on tongue mounting washer (5) and Disassembling mounting bolts (6).
5. Draw shift rod (3) outside or be separated from shift arm (4).



(1) Shift Cover	(9) Fork Rod
(2) Oil Seal	(10) Spring Pin
(3) Shift Rod	(11) Fork (1 ~ 2 Stage)
(4) Shift Arm	(12) Fork (3 ~ 4 Stage)
(5) Washer	(13) Spring Pin
(6) Bolt	(14) Straight Pin
(7) Spring	(15) Gasket
(8) Ball	(16) Bolt

b. To Assemble

1. After fixing oil seal (2), (17) on main shift cover (1) as facing the lip area toward inside, apply grease on the lip area.
2. Place shift arm (4) inside main shift cover (1) and fix shift rod (3) with shift arm (4) through oil seal area.
3. Place tongue mounting washer (5) as aligned with the hole position of shift arm (4) and shift rod (3) to fix with mounting bolt (6), while corked surely with tongue mounting washer (5).
4. Insert spring (7) and steel ball (8) in due order into main shift cover (1) and fix main shift 3-4 fork (12) with fork rod (9).
5. Fix main shift fork rod (9) at the neutral position and insert pin (10).
6. Insert spring (7) and steel ball (8) in due order into main shift cover (1) and fix main shift 1-2 fork (11) with fork rod (9).
7. Place shift arm and main shift 1 ~ 2 stage & 3 ~ 4 stage fork at the neutral position as aligned with the hole position of fork and fork rod to insert spring pin (13).
8. Replace the gasket (15) with new one and tighten main shift cover ass'y with M10 x 30 washer mounting bolt (16) on the side assembling area of the middle case.

Tightening torque	Tightening bolt (16) of man shift cover	48.0 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.4 ~ 41.2 lbf·ft
	Mounting bolt (6) of shift arm	23.5 ~ 27.5 N·m 2.4 ~ 2.8 kgf·m 17.3 ~ 20.3 lbf·ft

• Outer diameter of the fork rod, main shift 1-2 stage & 3-4 stage	Factory spec.	• 5.994 ~ 15.976 mm (0.629 ~ 0.628 in.)
• Inner diameter of the main shift 1-2 stage fork		• 16.027 ~ 16.000 mm (0.631 ~ 0.629 in.)
• Inner diameter of the main shift 3-4 stage fork		• 16.027 to 16.000 mm (0.631 to 0.629 in.)
• Free motion field of fork mounting spring		• 22 mm (0.866 in.)
• Outer diameter of the shift rod		• 18.000 ~ 17.973 mm (0.708 ~ 0.707 in.)
• Inner diameter of the shift arm		• 18.10 ~ 18.05 mm (0.712 ~ 0.710 in.)

CAUTION

- *Be sure to check if pin (10) to prevent double gear is fixed.*

F. AUXILIARY SHIFT COVER

a. To Disassembling

1. Remove auxiliary shift cover bolt (11) on the middle case side to loosen auxiliary shift cover (10) in a body.
2. Disassembling the shifting arm (7) from the auxiliary shift cover (10).

b. To Assemble

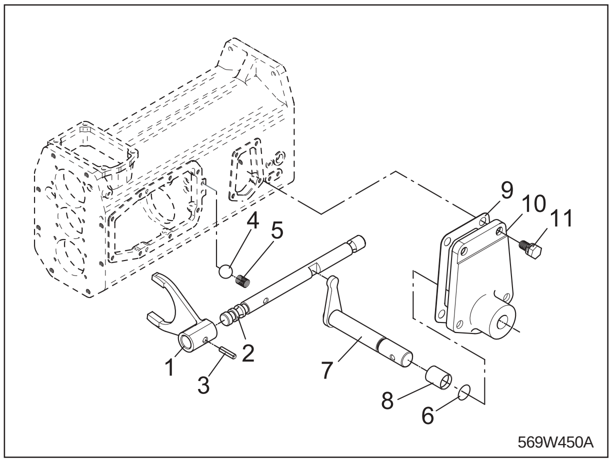
1. Fix bush (8) with shift arm (7).
2. After fixing O-ring (6) with shift arms (7), where greased, insert shift arms (7), into the hole of auxiliary shift cover (10).
3. Fix auxiliary shift cover with M10 washer mounting bolt (11) as aligning shift arms (7), of auxiliary shift cover (10) ass'y with the fork groove.

Tightening torque	Tightening bolt of auxiliary shift cover	48.0 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.4 ~ 41.2 lbf·ft

• Outer diameter of the shift arm of the auxiliary shift • Inner diameter of the shift arm of the auxiliary shift • Outer diameter of the shift arm of the creep shift	Factory spec.	• 17.975 ~ 17.957 mm (0.707 ~ 0.706 in.) • 30.000 ~ 29.979 mm (1.181 ~ 1.180 in.) • 20.021 ~ 20.000 mm (0.788 ~ 0.787 in.)

CAUTION

- *Be sure to apply grease on O-rings before fixed with shift arms.*
- *If the packing (2) has been damaged, surely replace it with new one.*



(1) Shift Fork
(2) Fork Rod
(3) Spring Pin
(4) Ball
(5) Spring
(6) O-Ring
(7) Shift Arm
(8) Spacer
(9) Gasket
(10) Shift Cover
(11) Bolt

G. FRONT WHEEL DRIVE LEVER

a. To Disassembling

1. Loosen shifter (front wheel) (5), and Disassembling 2 shift mounting steel balls (6) and spring (7).
2. Loosen stopper mounting bolt (4) and remove stopper (3).
3. Draw out shift arm (1) by pushing inside the middle case.

b. To Assemble

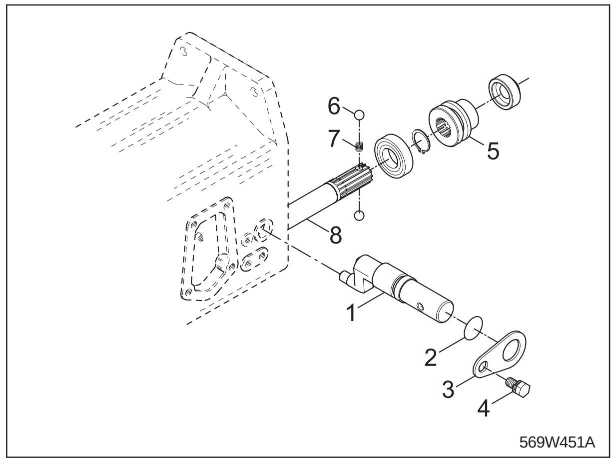
1. Insert spring (7) and steel ball (6) into propeller shaft 1 (8) and fix shift (front wheel) (5).
2. Insert shift arm (1) outward from the middle case to be fixed with O-ring (2).
3. After greasing O-ring (2), install shift arm (1) into the groove of shift (front wheel) (5).
4. Install shift arm mounting stopper (3) to be fixed with washer mounting bolt (4).

Tightening torque	Tightening bolt of front wheel shift arm stopper	23.5 ~ 27.4 N·m 2.4 ~ 2.8 kgf·m 17.3 ~ 20.2 lbf·ft

CAUTION

- *Replace O-ring with a new one to be installed after greased on its surface.*

• Outer diameter of the front wheel shift arm • Free motion field of shift mounting spring	Factory spec.	• 18.00 ~ 17.90 mm (0.708 ~ 0.704 in.) • 10.6 mm (0.417 in.)

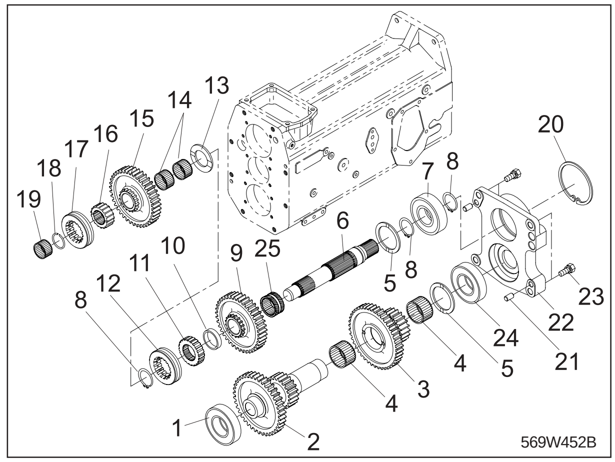


(1) Shift Arm
(2) O-Ring
(3) Stopper
(4) Bolt
(5) Shifter
(6) Ball
(7) Spring
(8) Propeller Shaft 1

H. AUXILIARY SHIFT GEAR

a. To Disassembling

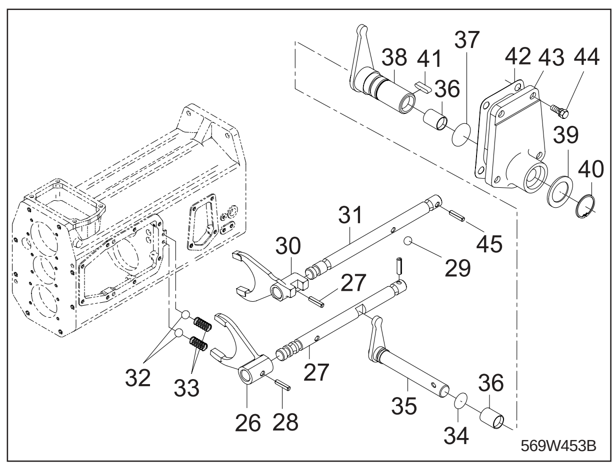
1. Remove middle case and transmission case.
2. Remove middle case and main shift cover.
3. Loosen with washer bolt (23) and Disassembling the auxiliary shift gear fixed on middle case and bearing case (for auxiliary shift) (22).



(1) Ball Bearing
(2) 39-21 Gear
(3) 43-21 Gear
(4) Needle Bearing
(5) Collar
(6) Hi-Lo Shaft
(7) Ball Bearing
(8) Snap Ring
(9) 39 Gear
(10) Spacer
(11) Spline boss
(12) Shifter
(13) Collar
(14) Needle Bearing
(15) 39-17 Gear
(16) Spline Boss
(17) Shifter
(18) Snap ring
(19) Needle Bearing
(20) Snap Ring
(21) Straight Pins
(22) Bearing Case
(23) With Washer Bolt
(24) Ball Bearing
(25) Needle Bearing

b. To Assemble

1. Tighten bearing case (22) with 2 straight pins (21).
2. Install 6307 ball bearing (7) on the top hole of bearing case and 6207 ball bearing (24) on the bottom hole of hole snap ring (20).
3. Fix auxiliary shift shaft (6) on 6,307 ball bearing (7) and snap ring (8) on bearing side to tighten Hi-Lo shaft (6).
4. Install needle bearing (25), 39 gear (9), spline boss (11) and shifter (12) in due order.
5. Install 43-21 gear (3) needle bearing (4) and collar (5) on 39-21 gear (2).
6. Locate the sub-assembled of 39 gear (9), spacer (10), spline boss (11), shifter (12) 39-17 gear (15), needle bearing (14), spline boss (16), shifter (17), needle bearing (19) and thrust collar (13) on Hi-Lo shaft (5) section, and the sub-assembled of 39-21gear (2) on the bottom part to be fixed with the sub-assembled of bearing case at a time.
7. Install and fix snap ring (18) in front of spline boss (16).
8. Install 6208 ball bearing (1) on 39-21 gear (2).
9. Insert shift fork (for Hi-Lo shift) (26) into fork rod (for Hi-Lo shift) (27) to be located on the groove of shifter (17) shift fork (for creep shift)(30) into fork rod (for creep shift)(31) to be located on the groove of shifter (12) and install fork rod (for Hi-Lo shift) (27) on the bottom hole of bearing case (22) for fork rod assembling.



(26) Shift fork
(27) Fork rod
(28) Spring pin
(29) Ball
(30) Shift Fork
(31) Fork Rod
(32) Ball
(33) Stopper Spring
(34) O-Ring
(35) Shift Arm
(36) Du Bush
(37) O-Ring
(38) Shift Arm
(39) Collar
(40) Cir-Clip
(41) Key
(42) Packing
(43) Shift Cover
(44) Bolt
(45) Spring Pin

10. Locate fork rod (for Hi-Lo shift) (27) and shift fork (for Hi-Lo shift) (26) at right position.
11. After pushing the sub-assembled of bearing case (22) forward from the back of the middle case to be aligned with the position of parallel pin (21), knock in and fix it with four with washer bolts (23).
12. Insert steel ball (32) and stopper spring (33) into the hole area of middle case for main shift cover assembling.

Tightening torque	Tightening bolt of the bearing case	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.1 ~ 66.5 lbf·ft
	Tightening bolt of the auxiliary shift cover	48.0 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.4 ~ 41.2 lbf·ft

• Auxiliary shift	Factory spec.	• 15.994 ~ 15.976 mm (0.629 ~ 0.628 in.)

I. SHUTTLE SHAFT SECTION

a. To Disassembling

1. Remove clutch lever, release hub and release fork.
2. Loosen inlet bolt (1) of the propeller shaft case and remove propeller shaft case (2).
3. Draw out shuttle shaft (3) to the front of the middle case.

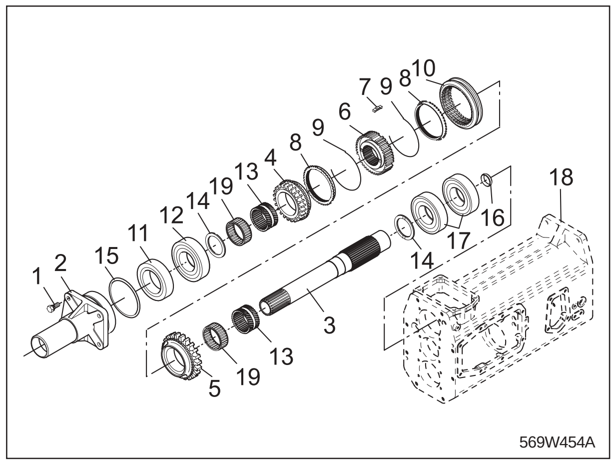
b. To Assemble

1. Install 6008 ball bearing (17) on middle case (18).
2. Install oil seal (16) on the inner bore of shuttle shaft (3) and apply grease.
3. Sub-assemble synchro hub (6), synchronizer key (7), spring (9) and shifter (10).
4. Locate shuttle shaft (3) on the assembling area of middle case (18) and fix inner ring (13), 29 gear (5), needle bearing (19), synchronizer ring (8) and synchro hub which have been sub-assembled in due order, and then install shuttle shaft (3) on ball bearing (17) after inserting thrust collar (14).
5. Install needle bearing (19) and inner ring (13) on the inner bore of 24 gear (4) of the shuttle shaft.
6. Sub-assemble oil seal (19), ball bearing (12) and O-ring (15) on propeller shaft case (2), and apply grease.
7. After inserting thrust collar (14) into shuttle shaft (3), place the sub-assembly of propeller shaft case (2) in shuttle shaft (3) to tighten 4 washer mounting bolts (1) on middle case (18).

Tightening torque	Inlet bolt of the propeller shaft case	23.5 ~ 27.5 N·m 2.4 ~ 2.8 kgf·m 17.3 ~ 20.2 lbf·ft

CAUTION

- *When assembling, let the oil groove of the thrust collar faced toward the gear.*



(1) Bolt
(2) Propeller Bearing Shaft Case
(3) Shuttle Shaft
(4) 29 Gear
(5) 24 Gear
(6) Synchro Hub
(7) Synchronizer Key
(8) Synchronizer Ring
(9) Spring
(10) Shifter
(11) Ball Bearing
(12) Ball Bearing
(13) Inner Ring
(14) Collar
(15) O-Ring
(16) Oil Seal
(17) Ball Bearing
(18) Middle Case
(19) Needle Bearing

J. REVERSE IDLE SHAFT AND IDLE GEARS

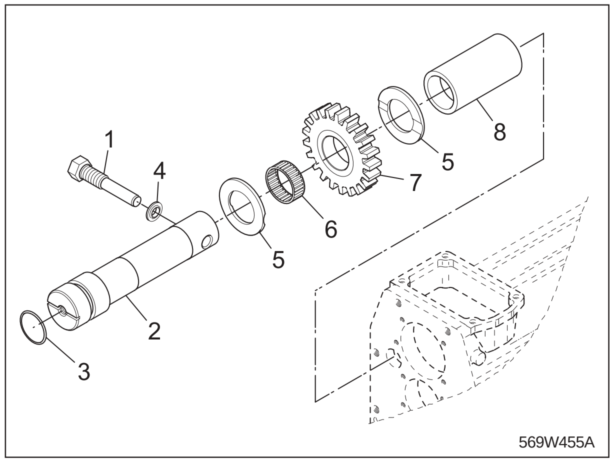
a. To Disassembling

1. Remove mounting bolt (1) and seal washer (4) at the side of the middle case.
2. Remove thrust collar (5), needle bearing (6), 21 gear (7) and spacer (8) in due order with M8 x P 1.25 replacing tool led to the side of the rear idle axle, while drawing out rear idle shaft (2) to the front of the middle case.

b. To Assemble

1. Locate spacer (8), thrust collar (5), rear idle 21 gear (7), and needle bearing (6) inside the middle case.
2. Install O-ring (3) on the groove of rear idle shaft (2) and apply grease. Insert thrust collar (5) into the rear idle axle.
3. When assembling, align the fixing hole of rear idle shaft (2) with the inlet hole of mounting bolt (1) at the side of the middle case.
4. When assembling, replace mounting bolt (1) and seal washer (4) with new one respectively.

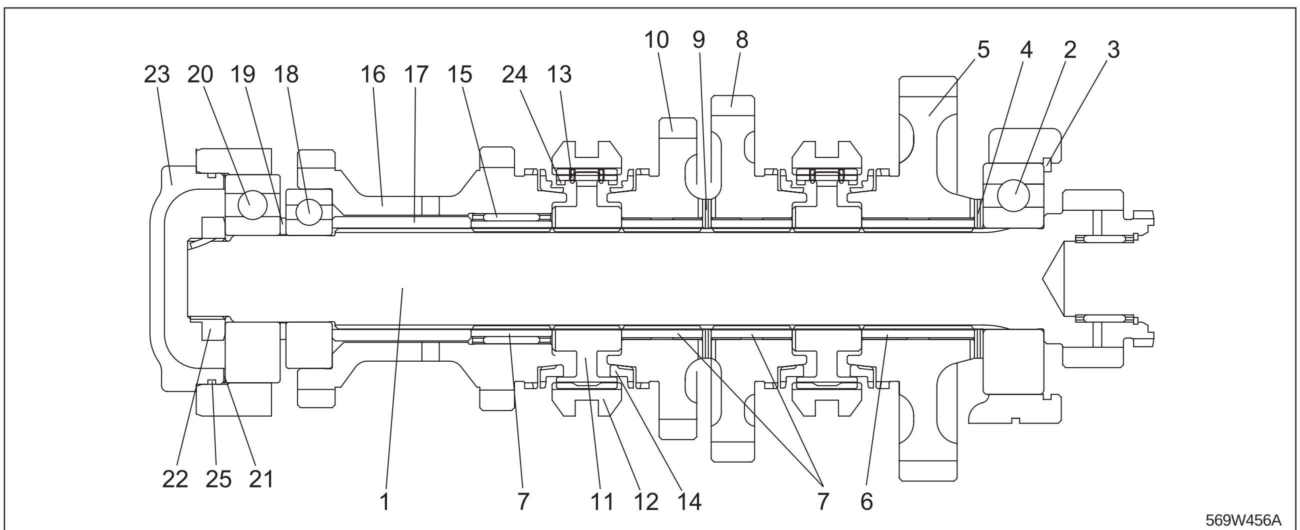
• Outer diameter of the reverse idle shaft • Inner diameter of the 21 gear	Factory spec.	• 25.00 ~ 24.987 mm (0.984 ~ 0.983 in.) • 30.020 ~ 30.007 mm (1.1818 ~ 1.1813 in.)



569W455A

(1) Mounting Bolt
(2) Idle Shaft
(3) O-Ring
(4) Seal Washer
(5) Collar
(6) Needle Bearing
(7) 21 Gear
(8) Spacer

K. SHAFT 1



569W456A

(1) 17 Gear Shaft
(2) Ball Bearing
(3) Snap Ring
(4) Collar
(5) 42 Gear
(6) Inner Ring
(7) Inner Ring
(8) 38 Gear
(9) Collar
(10) 33 Gear
(11) Synchro Hub
(12) Shifter
(13) Synchronizer Spring
(14) Synchronizer Ring
(15) Needle Bearing
(16) 26-26 Gear
(17) Spacer
(18) Ball Bearing
(19) Washer
(20) Ball Bearing
(21) Shim
(22) 28 Nut
(23) Bearing Cover
(24) Synchronizer Key
(25) O-Ring

a. To Disassembling

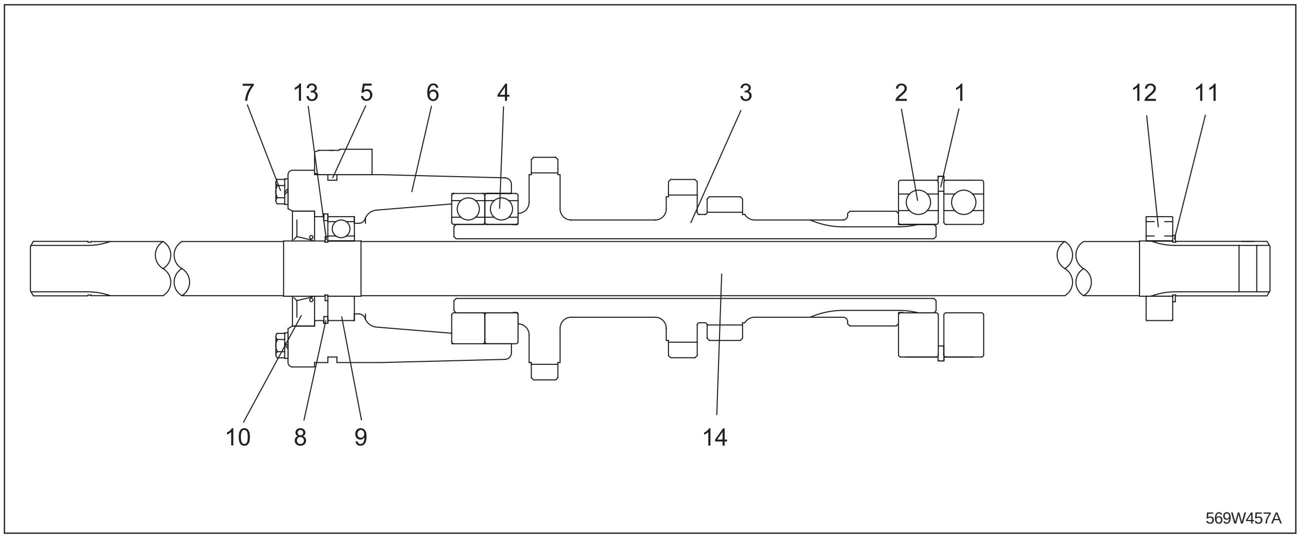
1. Remove four M8 washer mounting bolts to loosen bearing cover (23).
2. Remove the caulking on 28 nut (22) to loosen the nut.
3. Slightly knock the end part of 17 gear shaft (1) backward (toward the transmission case) to remove 17 gear shaft (1).

b. To Assemble

1. Install 6307HL ball bearing (2) on 17 gear shaft (1).
2. Sub-assemble 6206 ball bearing (18), spacer (17), needle bearing (15) and synchronizer ring (14) on the inner bore of 26-26 gear (16).
3. Sub-assemble spring (13), synchronizer key (24) and sliding clutch (12) on synchro hub of the main shift.
4. Sub-assemble synchronizer ring (14) and inner rings (6), (7) on 33 gear (10), 38 gear (8) and 42 gear (5).
5. Locate in due order each sub-assembled gear on the transmission case upside down (as the engine faces toward the ground).
6. Install thrust collar (9) between 33 gear (10) and 38 gear (8).
7. Insert thrust collar (4) into 17 gear shaft (1) and fix downward.
8. Tighten washer (19), 6306 ball bearing (20), shim (21) and 28 nut (22) after placing the transmission case at the right position.
9. Apply caulking around 28 nut (22) surely not to be released after checking each gear per stage for its smooth running while rotated by hand.
10. Located the specified shim (21) in front of 6306 ball bearing (20) and fix bearing cover (23) with O-ring (25), where greased to insert into the middle case and tighten with four M8 washer mounting bolts.

Tightening torque	Tightening bolt of the bearing cover	23.5 ~ 27.4 N·m 2.4 ~ 2.8 kgf·m 17.3 ~ 20.2 lbf·ft
	28 nut	127.5 ~ 176.5 N·m 13 ~ 18 kgf·m 94.0 ~ 130 lbf·ft

L. SHAFT 2



(1) Snap Ring	(5) O-Ring	(9) Ball Bearing	(12) Ball Bearing
(2) Ball Bearing	(6) Bearing Case	(10) Oil Seal	(13) Snap Ring
(3) 29-23-18-14 Gear	(7) Bolt	(11) Snap Ring	(14) Propeller Shaft 1
(4) Ball Bearing	(8) Snap Ring		

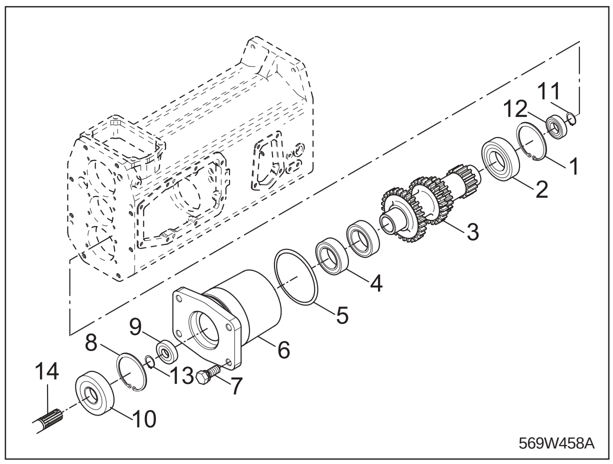
a. To Disassembling

1. Remove the middle case and the transmission case and Disassembling snap ring (11) fixed on propeller shaft 1 (14).
2. Remove four M8 washer mounting bolts (7) to Disassembling bearing case (6) and front wheel propeller shaft (14) in a body.
3. Remove 29-23-18-14gear (3).
4. Remove oil seal (10) on the bearing case to draw front wheel propeller shaft 1 (14) out.

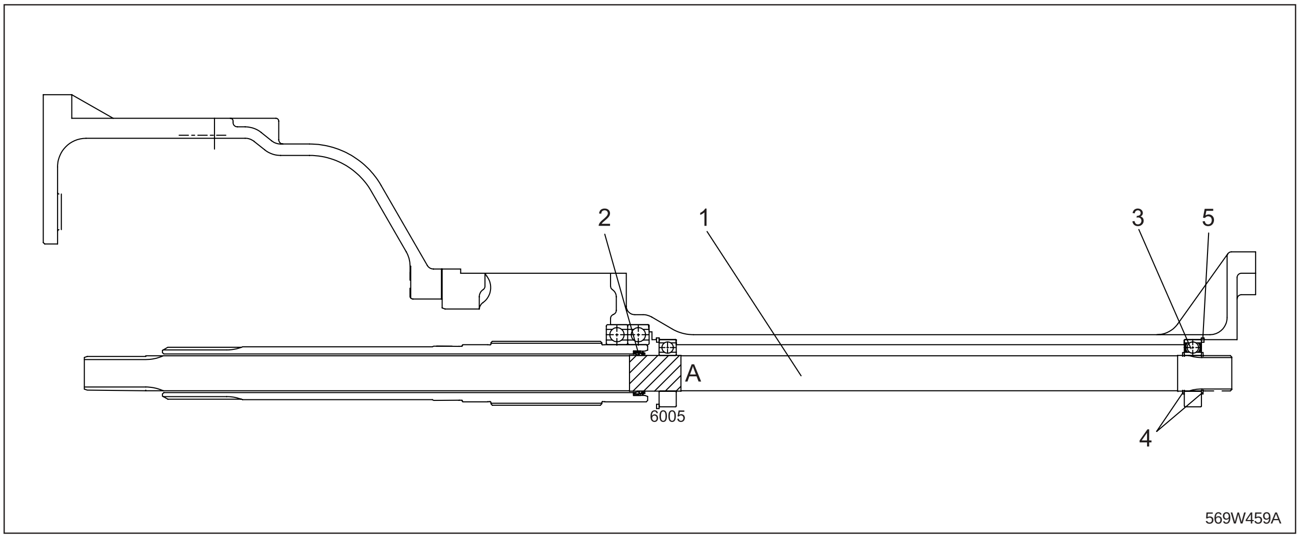
b. To Assemble

1. Install snap ring (1) and 6208 ball bearing (2) on the middle case.
2. Sub-assemble two 6008 ball bearings (4) on 29-23-18-14 gear (3) to be fixed on 6208 ball bearing (2).
3. Install O-ring (5) on bearing case (6), where greased, to insert into the middle case and tighten with four M8 washer mounting bolts (7).
4. Install 6005 ball bearing (9) on the hole of bearing case (6) and fix hole snap ring (8).
5. Fix shaft snap ring (13) on propeller shaft 1 (14) to be installed on the hole of bearing case (6).
6. Install oil seal (10) on the hole of bearing case (6), while facing its lip area toward the middle case.

Tightening torque	Tightening bolt of the bearing case (7)	23.5 ~ 27.5 N·m 2.4 ~ 2.8 kgf·m 17.3 ~ 20.2 lbf·ft



M. PTO DRIVE SHAFT



(1) PTO Drive Shaft
(2) Oil Seal
(3) Ball Bearing
(4) Snap Ring
(5) Snap Ring

a. To Disassembling

1. Separate the middle case and the transmission case.
2. Remove snap ring (5) on the back of PTO drive shaft (1).
3. Slightly knock PTO drive shaft to the back of the middle case to remove 6005 ball bearing (3) and snap ring (4) at a time.

b. To Assemble

1. Sub-assemble snap ring (4), 6005DD ball bearing (3) and snap ring (4) on PTO drive shaft.
2. After applying grease on the oil seal (2) contacted section (A) of PTO drive shaft (1), perform assembly by pushing forward from the back of the middle case while slowly rotating.
3. Install mounting snap ring (5) of 6005DD ball bearing (3).

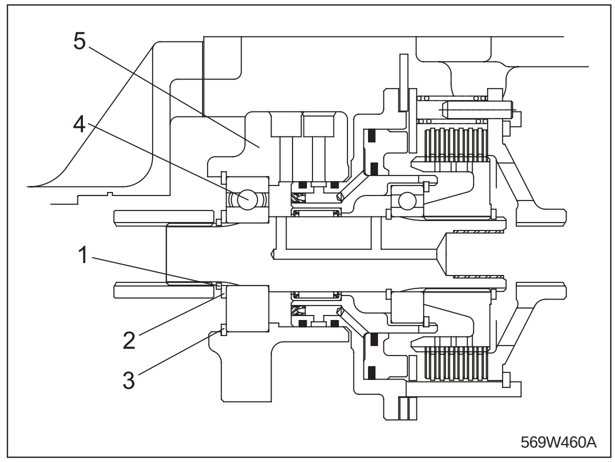
CAUTION

- *For assembling the PTO drive shaft, grease the section A (where oil seal is applied) previously.*

N. PTO CLUTCH

a. To Disassembling

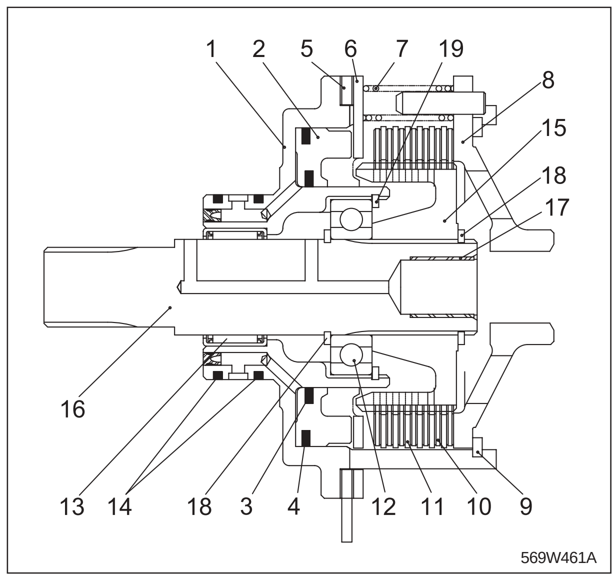
1. Remove the middle case and the transmission case.
2. Remove snap ring (1) and spacer (2) fixed of the PTO clutch shaft.
3. Loosen ϕ 62 snap ring (3) on PTO clutch bracket (5).
4. Loosen four M12 bolts on PTO clutch bracket (5) and the transmission case to Disassembling PTO clutch bracket.
5. Take out the PTO clutch ass'y.



(1) Snap Ring
(2) Spacer
(3) Snap Ring
(4) Ball Bearing
(5) PTO Clutch Bracket

To Disassembling PTO Clutch Ass'y

1. Push down pressure plate (8) with an exclusive tool and take out snap ring (9).
2. Take out clutch disc (10), clutch plate (11), spring (7), return plate (6) and brake disc (5).
3. Separate snap ring (18) from the PTO clutch shaft section and take out spline hub (15).
4. Take out snap ring (19) in the PTO clutch, and slightly knock PTO clutch shaft (16) backward to remove.
5. Inflate the PTO clutch with air to take out piston (2).



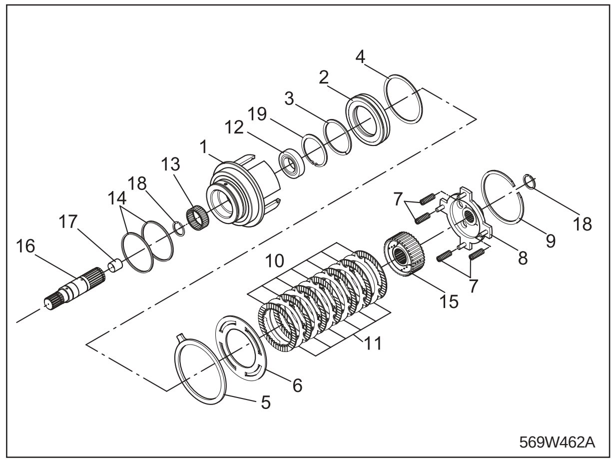
(1) PTO Clutch Body
(2) Piston
(3) Piston Ring
(4) Piston Ring
(5) Brake Disc
(6) Return Plate
(7) Spring
(8) Pressure Plate
(9) Snap Ring
(10) Clutch Disc
(11) Clutch Plate
(12) Ball Bearing
(13) Needle Bearing
(14) Seal Ring
(15) Spline Hub
(16) PTO Clutch Shaft
(17) Bushing
(18) Snap Ring
(19) Snap Ring

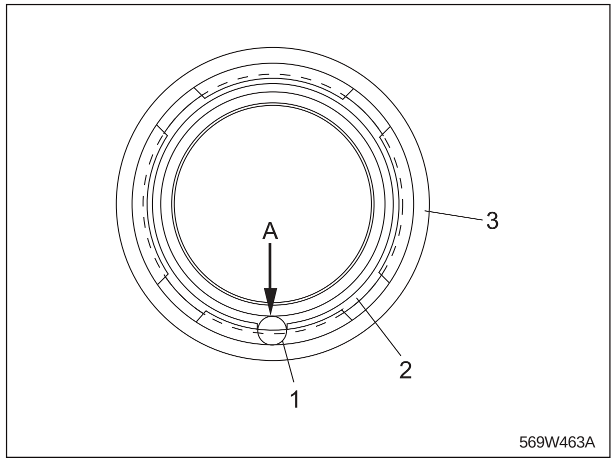
b. To Assemble

1. Install piston rings (3), (4) on the inner and outer sections of the piston bore, and apply grease.
2. Fix piston (2) on PTO clutch body (1).
3. Install needle bearing (13) on the inner bore and sealing (14) on the outer bore of PTO clutch body (1), and apply grease.
4. Install snap ring (18) and 6006 ball bearing (12) on PTO clutch shaft (16), push the PTO clutch body forward to fix, and then tighten with snap ring (19). Install bushing (17) on the inner bore.
5. Push spline hub (15) into PTO clutch shaft (16) and tighten with snap ring (18).
6. Install brake disc (5), return plate (6), clutch disc (10), clutch plate (11) and spring (7) on PTO clutch body (1) in due order, and push pressure plate (8) through with a replacing tool then to tighten with snap ring (9).

CAUTION

- *Let the opening of snap ring (9) located between the spring pins fixed on PTO clutch body (1) when assembling.*



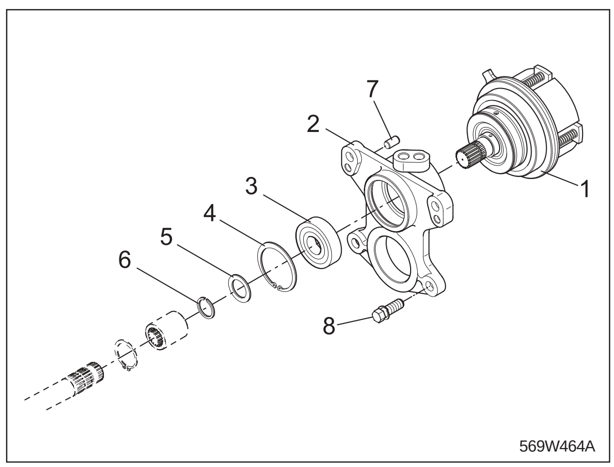


(A) Split Part Of The Snap Ring
(1) Spring Pin
(1) Snap Ring
(3) Snap Ring PTO Clutch Body

To Assemble PTO Clutch Bracket and PTO Clutch Ass'y

1. Install 6305DD ball bearing (3) on PTO clutch bracket (2) to tighten with ϕ 62 snap ring (4).
2. Push PTO clutch ass'y (1) through the top of the transmission case to be laid across the hole of the transmission case.
3. Insert PTO clutch ass'y (1) onto the hole of PTO clutch bracket (2) and install PTO clutch bracket (2) on the transmission case.
4. With a replacing tool, slightly knock the PTO shaft end of PTO clutch ass'y (1) forward to install.
5. Install thrust collar (5) and snap ring (6) on the PTO shaft end of PTO ass'y (1).

Tightening torque	Assembling bolt of the PTO clutch bracket	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.1 ~ 66.5 lbf·ft

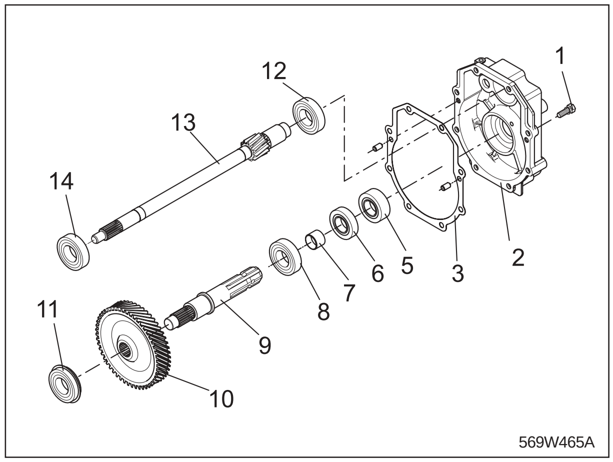


(1) PTO Clutch Ass'y
(2) PTO Clutch Bracket
(3) Ball Bearing
(4) Snap Ring
(5) Collar
(6) Snap Ring
(7) Parallel Pin

O. PTO SHAFT

a. To Disassembling

1. Loosen the bolts (1) and remove the PTO shaft assembly (2) ~ (13) as a unit.
2. Remove 6305 NR bearing (11) fixed on PTO shaft (9).
3. Remove 6305 ball bearing (14), 51 gear (10), PTO shaft (9), PTO drive shaft (13).

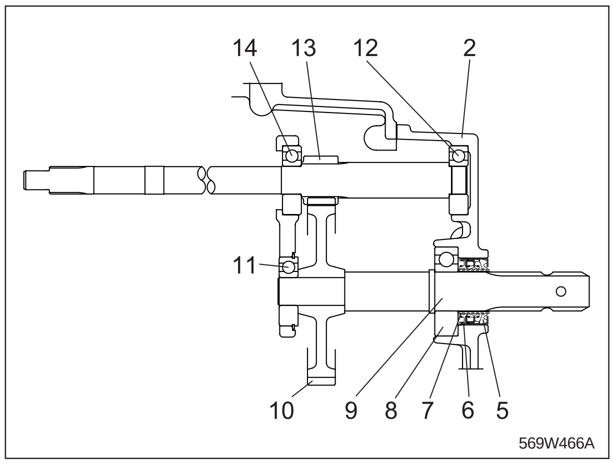


(1) Bolt
(2) Rear Case
(3) Packing
(4) Parallel Pin
(5) Oil Seal
(6) Oil Seal
(7) Sleeve
(8) Ball Bearing
(9) PTO Shaft
(10) 51 Gear
(11) Ball Bearing
(12) Ball Bearing
(13) PTO Drive Shaft
(14) Ball Bearing

b. To Assemble

1. Sub-assemble 6305 ball bearing (12), oil seal (5), (6) on the rear case (2).
2. Sub-assemble 6305 ball bearing (14) on the PTO drive shaft (13).
3. Sub-assemble the 51 gear (10) into the PTO shaft (9).
4. Sub-assemble the 6307 ball bearing on the PTO shaft (9), and then assemble the sleeve (7).
5. Install the sub-assembled of PTO shaft (9), and PTO drive shaft (13), at a time on rear cover (2).

Tightening torque	Tightening bolt of the rear cover	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.1 ~ 66.5 lbf·ft



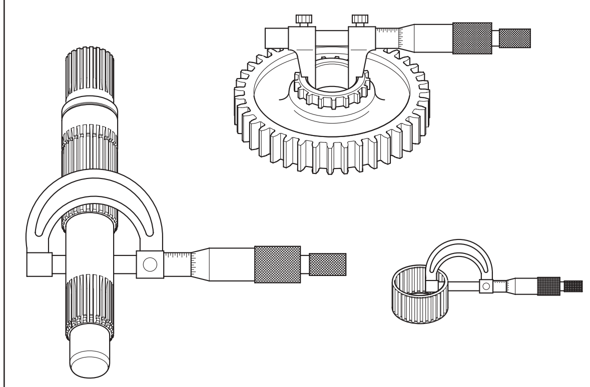
Clearance Between Gear and Shaft

1. Measure the shaft O.D. (rubbing surface).
2. Measure the gear I.D. (rubbing surface).
3. Measure the O.D. of the two needles installed diagonally in the needle bearing.
4. Calculate the clearance.

(Clearance=Gear I.D.-{ (2 x needle O.D.)+shaft O.D.}

5. If the clearance exceeds the allowable limit, replace them.

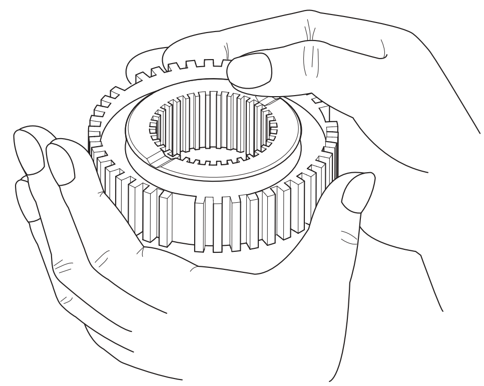
Clearance between gear and shaft	Factory spec.	0.021 ~ 0.054 mm 0.00083 ~ 0.00213 in.
	Allowable limit	0.1 mm 0.004 in.



569W467A

Checking Contact Between Coupling and Shifter

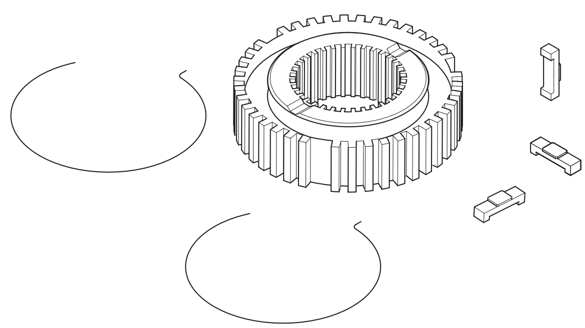
1. Check to see if there is any flaw or wear on the spline of the coupling and shifter, and the key groove on the coupling.
2. Engage the shifter with the coupling, and check that they slide smoothly.
3. Similarly, check that there is any flaw or wear on the gear splines.
4. If there is any defect, replace them.



569W468A

Flaw on Synchronizer Key and Spring

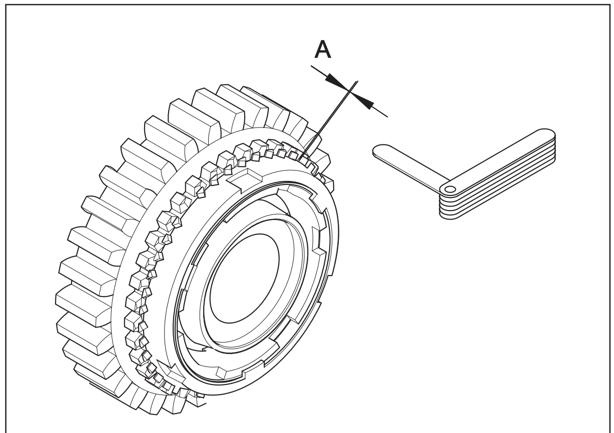
1. Check the projection in the center of the synchronizer key for wear.
2. Check the spring for fatigue of wear on the area where the spring contacts with the keys.
3. If there is any defect, replace them.



569W469A

Side Clearance Between Synchronizer Ring and Gear (In Contact)

1. Press the synchronizer ring against the tapered portion of the gear, and measure the side clearance.
2. Apply thin film of red lead to the tapered portion, press the ring against it by hand, rub them together a few times, and check the contact.
3. Check the tooth surface and key grooves of the ring for wear.
4. If the side clearance exceeds the allowable limit or if there is any defect, replace the synchronizer ring.



569W470A

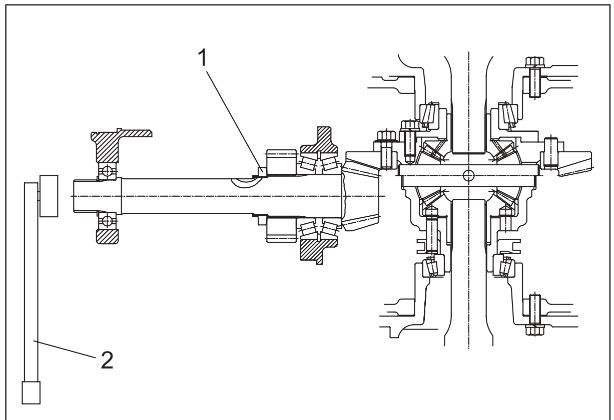
Side clearance	Allowable limit	0.35 mm 0.0138 in.

Contact condition of tapered portion	Allowable limit	More than 80%

Spiral Bevel Pinion Turning Torque (With Differential Gear)

1. Grip the spiral bevel pinion nut (1) with a torque wrench (2) and measure the turning torque.
2. If the turning torque is not within the factory specifications, check the differential gear turning force, backlash and tooth contact again.

Turning torque (with differential gear)	Factory spec.	3.92 ~ 6.37 N·m 0.40 ~ 0.65 kgf·m 2.89 ~ 4.70 lbf·ft

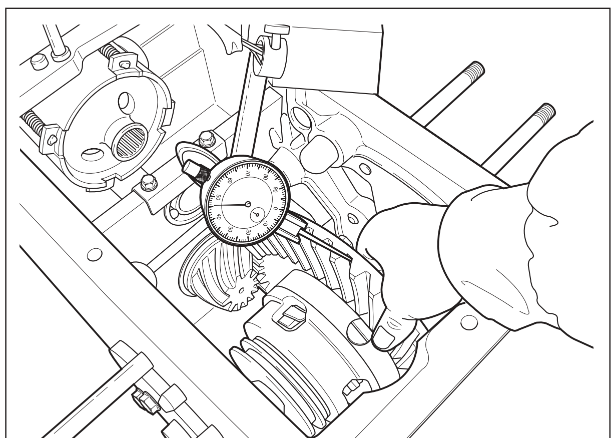


569W471A

(1) Nut (2) Torque Wrench

Backlash and Tooth Contact Between Spiral Bevel Gear and Spiral Bevel Pinion

1. Set a dial gauge (lever type) with its finger on the tooth surface of spiral bevel gear.
2. Measure the backlash by fixing the spiral bevel pinion (1) and moving spiral bevel gear (3) by hand.
3. If the backlash exceeds the factory specifications, decrease the number of shims (4) and insert the removed shims to the differential support (6). If the backlash is less than the factory specification, decrease the number of shims (5) at differential support (6) and insert the removed shims to the opposite side.
4. Adjust the backlash properly by repeating the procedures.



569W472A

Backlash between spiral bevel gear and spiral bevel pinion	Factory spec.	0.15 ~ 0.307 mm 0.006 ~ 0.012 in.

5. Apply red lead lightly over several teeth at three positions equally spaced on the spiral bevel gear (3).
6. Turn the spiral bevel pinion (1) while pressing a wooden piece against the periphery of the spiral bevel gear (3).
7. Check the tooth contact. If not proper, adjust according to the instructions below.

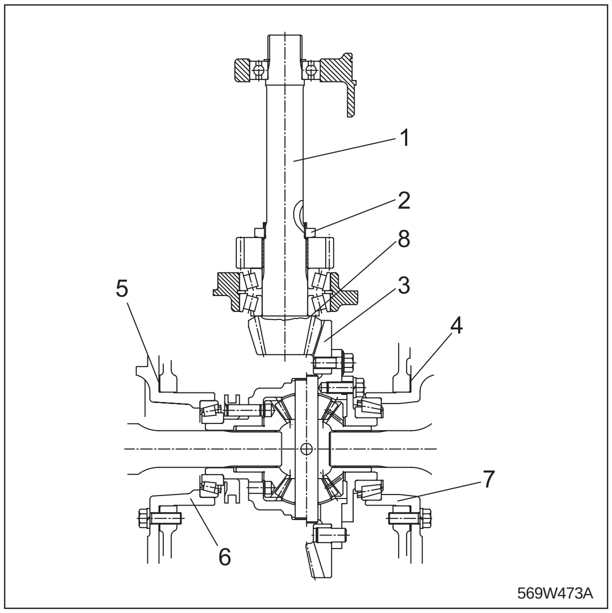
(Reference)

- Thickness of shims (4):

0.4 mm (0.016 in.)	0.9 mm (0.035 in.)
0.5 mm (0.020 in.)	1.0 mm (0.039 in.)
0.6 mm (0.024 in.)	1.2 mm (0.047 in.)
0.7 mm (0.028 in.)	1.4 mm (0.055 in.)
0.8 mm (0.031 in.)	

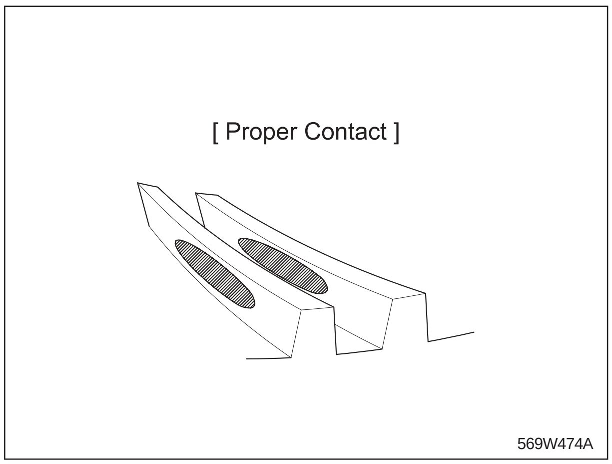
- Thickness of shims (5):

0.4 mm (0.016 in.)	1.0 mm (0.039 in.)
0.6 mm (0.024 in.)	1.2 mm (0.047 in.)
0.8 mm (0.031 in.)	1.6 mm (0.063 in.)

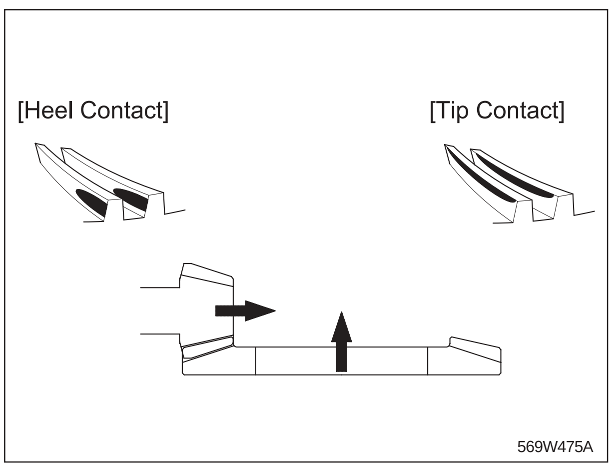


(1) Bevel Pinion Shaft
(2) Nut
(3) Bevel Gear
(4) Shims
(5) Shims
(6) Bearing Support L
(7) Bearing Support R
(8) Shims

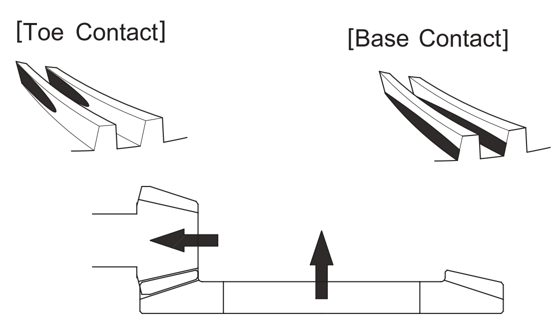
More than 35 % red lead contact area on the gear tooth surface. The center of tooth contacts at 1/3 of the entire width from the small end.



Replace adjusting shim (8) with thicker one to move the bevel pinion shaft backward. And place the left side shim (4) to the right to move the bevel gear rightward. Repeat above until the proper tooth contact and backlash are achieved.



Replace adjusting shim (8) with thinner one to move the bevel pinion shaft forward. And place the right side shim (5) to the left to move the bevel gear leftward. Repeat above until the proper tooth contact and backlash are achieved.



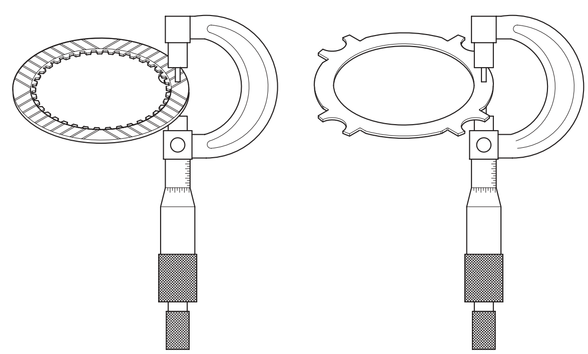
569W476A

Clutch Disc, Steel Plate Wear

1. Measure the thickness of clutch disc with venire calipers.
2. If the measurement less than the allowable limit, replace it.
3. If the thickness is less than the allowable limit, replace it.

Thickness of independent PTO clutch disc	Factory spec.	2.10 ~ 2.3 mm 0.082 ~ 0.090 in.
	Allowable limit	1.9 mm 0.074 in.

Thickness of independent PTO clutch disc	Factory spec.	1.52 ~ 1.68 mm 0.059 ~ 0.066 in.
	Allowable limit	1.2 mm 0.047 in.

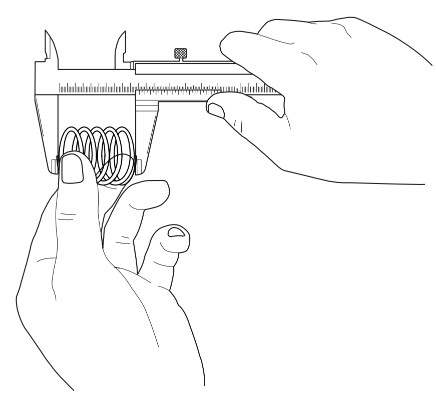


569W477A

Piston Return Spring Free Length

1. Measure the free length of spring with venire calipers.
2. If the measurement is less than the allowable limit, replace it.

Independent PTO return spring free length	Factory spec.	36 mm 1.41 in.
	Allowable limit	33 mm 1.30 in.

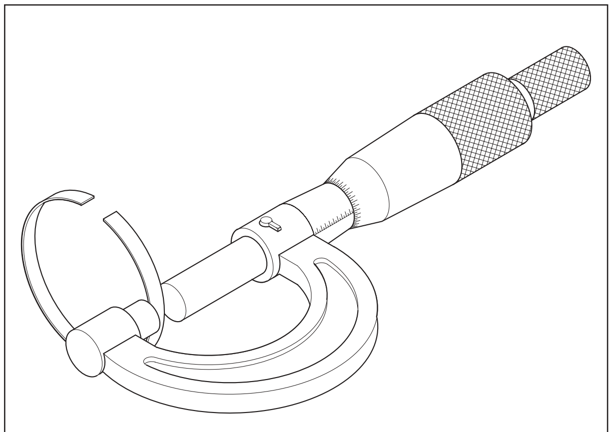


569W479A

Thickness of Seal Ring

1. Measure the thickness of seal rings with an outside micrometer.
2. If the measurement is less than the allowable limit, replace it

Thickness of seal ring	Factory spec.	2.95 ~ 3.0 mm 0.116 ~ 0.118 in.
	Allowable limit	2.5 mm 0.098 in.



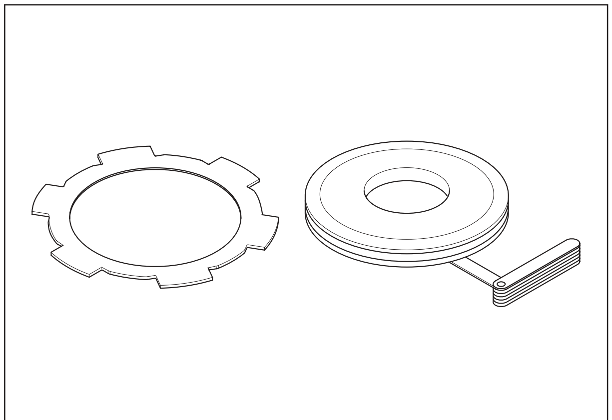
569W480A

Flatness of Piston and Steel Plate

1. Place the part of a surface plate.
2. Check it unable to insert a feeler gauge (allowable limit size) underneath it at least four points.
3. If the gauge can be inserted, replace it.

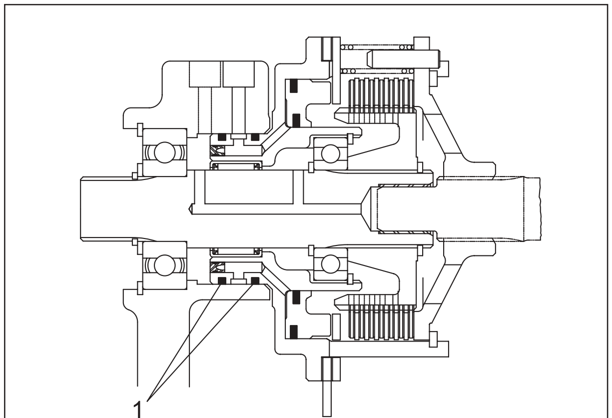
Flatness of independent PTO piston	Allowable limit	0.10 mm 0.004 in.

Flatness of independent PTO piston	Allowable limit	0.20 mm 0.007 in.



569W481A

PTO Clutch Pack



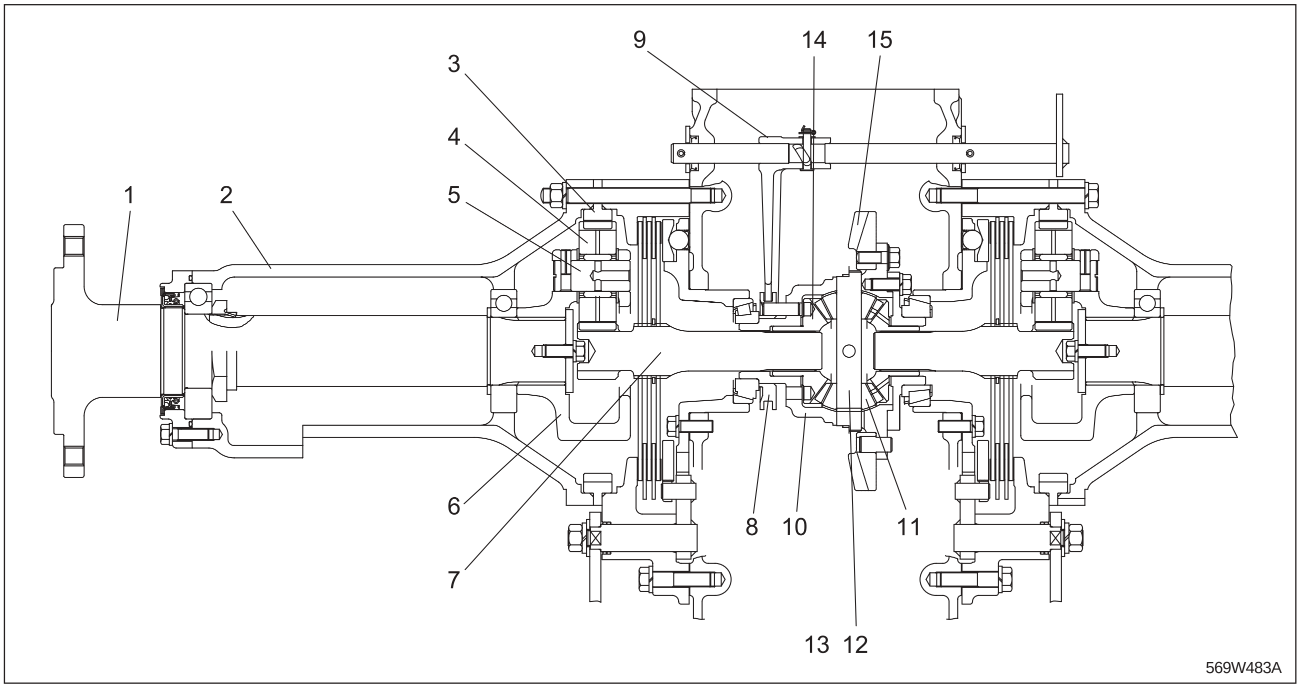
569W482A

(1) Seal Ring

P. REAR AXLE

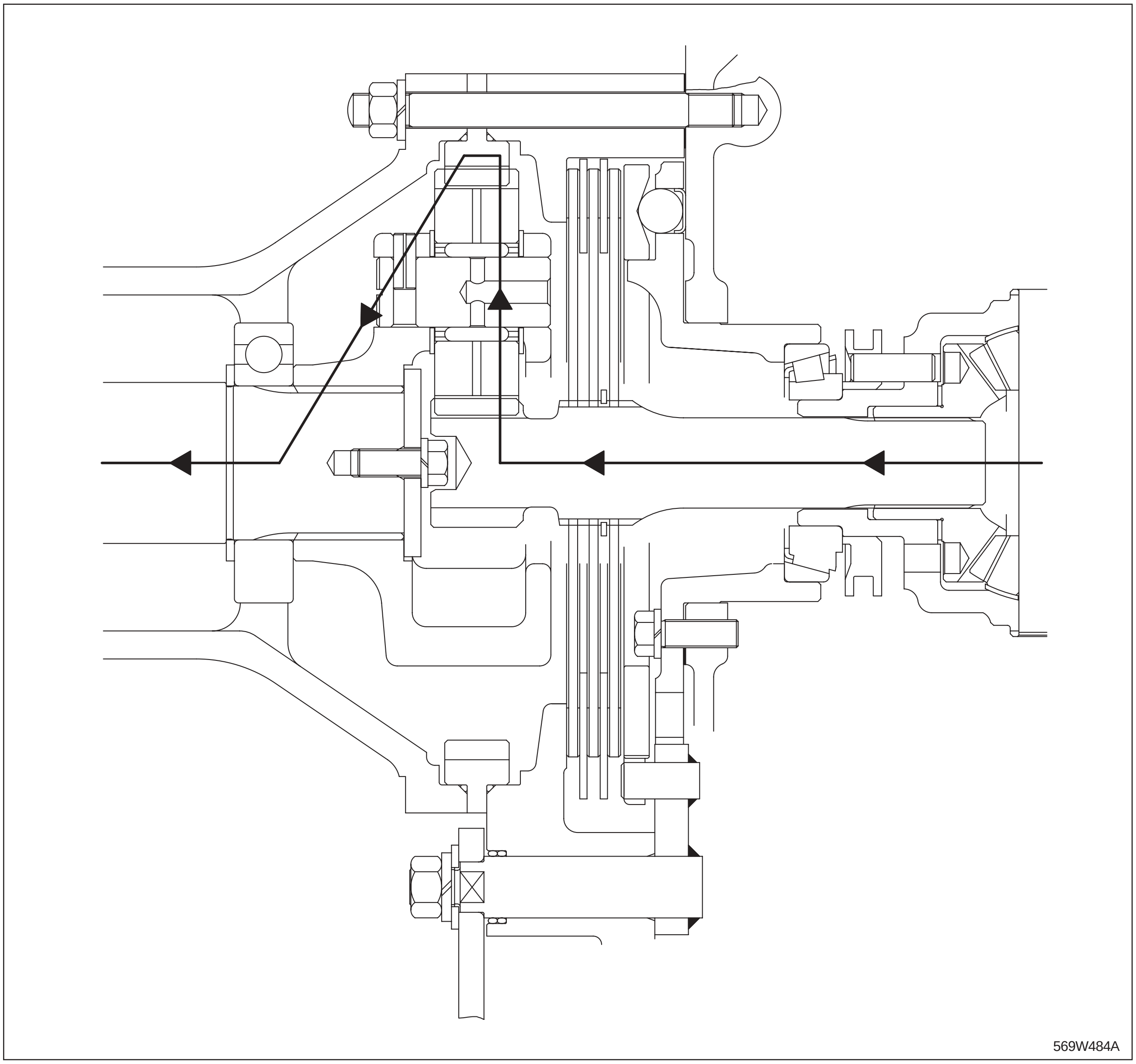
- Rear axle to transmit power shifted at the transmission to the rear wheels finally is composed of brake, differential lock and final reduction gear.
- Rear axle is driven as decelerated much by the planetary gear, while differential gear is applied to distribute suitable revolution considering related road and traveling conditions for the rear wheels left and right by the differential gear after decelerating power transmitted from the transmission at the bevel gear shaft and spiral bevel gear.

<Rear Axle Section>



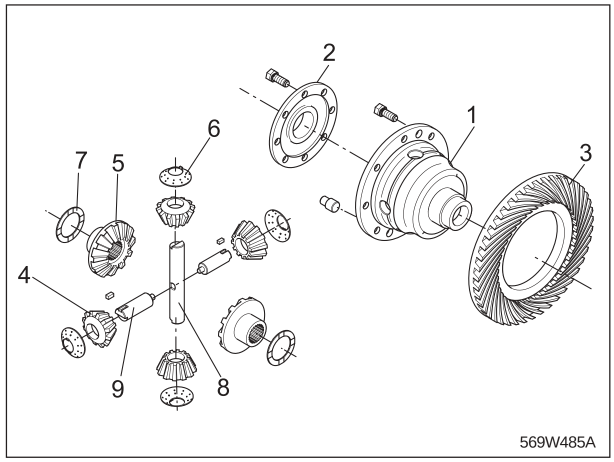
(1) Rear Axle
(2) Rear Axle Case
(3) Internal Gear
(4) Planetary Gear
(5) Planetary Gear Shaft
(6) Planetary Gear Support
(7) 13 Gear Shaft (Brake shaft)
(8) Differential Mounting Shift
(9) Differential Mounting Fork
(10) Differential Gear Case
(11) Differential Pinion
(12) Differential Pinion Shift 1
(13) Differential Pinion Shift 2
(14) Differential Side Gear
(15) Spiral Bevel Gear

A. REAR AXLE



DIFFERENTIAL GEAR

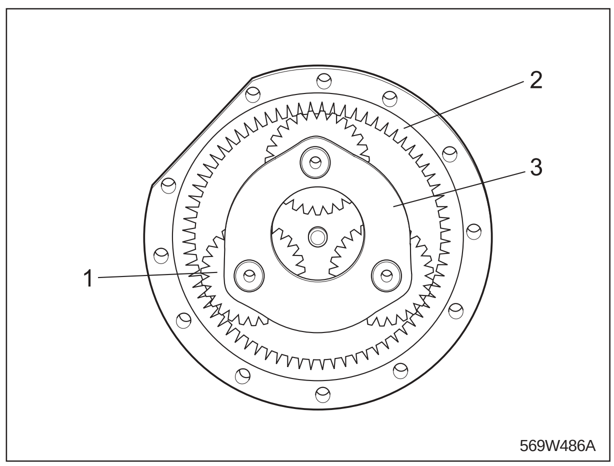
- Differential gear is structured with four pin type.
- Differential gear is operated by sharing out suitable revolution considering related conditions for the wheels left and right to lead turning of the tractor and traveling on curved or uneven road to be smooth.
- A pin type deferential lock is mounted to stop the differential function so not to allow just one wheel to be slipped and moved considering of road surface and pavement.



(1) Differential Case
(2) Cap
(3) 39 Spiral Bevel Gear
(4) Differential Pinion
(5) Differential Side Gear
(6) Differential Pinion Washer
(7) Differential Washer
(8) Differential Pinion Shaft 1
(9) Differential Pinion Shaft 2

FINAL REDUCTION GEAR

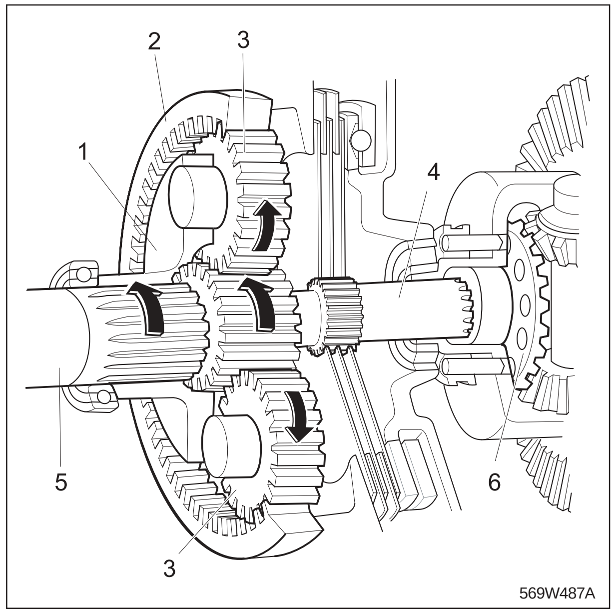
- Planetary gear to transmit power transmitted from the differential gear to the brake shaft (13 gear shaft) to the rear axle as decelerated once again is applied to the final reduction gear.
- Internal gear mounted on the case is drawing revolution power using planetary gear support (carrier) with planetary gear thereon by driving the brake shaft (linear gear).
- Since revolution force loaded on the rear axle of the tractor is transmitted as divided to 3 planetary gears, this planetary gear equipment is compact, excellently endurable and capable of high deceleration ratio without being much forced.

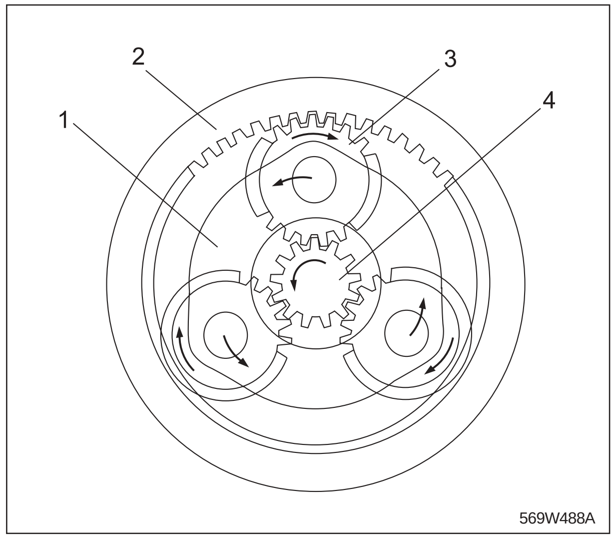


(1) Planetary Gear
(2) Internal Gear
(3) Planetary Gear Support

B. OPERATION OF THE REAR AXLE

The final reduction system has a planetary gear system. It is compact, and is durable under heavy loads since torque loads are spread over three gears, decreasing the load on each tooth. And this system also spreads the load evenly around the circumference of the system, eliminating the sideways stress on the shafts. Power, transmitted from the differential side gear (6) to the brake shaft (4), drives the three planetary gears (3). Since the internal gear (2) is fixed to the rear axle case, the planetary gears (3) move around the teeth of the internal gear (2) while rotating on their axes. The movement of the planetary gears around the internal gear is transmitted to the rear axle (5) through the planetary gear support (1). As a result, the planetary gear support (1) and rear axle (5) rotate in the same direction as the brake shaft (4), but at a reduced speed and increased torque.





(1) Planetary Gear Support

(2) Internal Gear

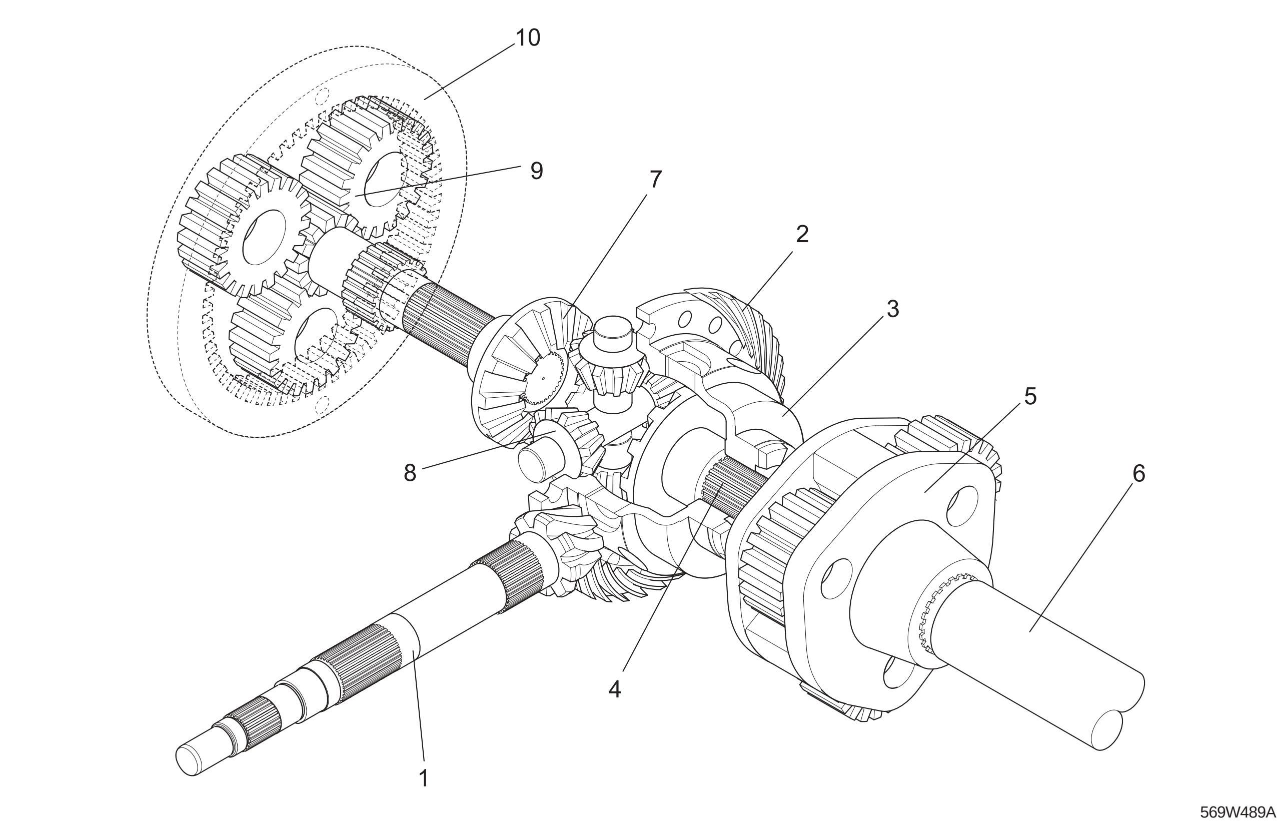
(3) Planetary Gear

(4) Brake Shaft (13 Gear Shaft)

(5) Rear Axle

(6) Differential Side Gear

C. POWER FLOW OF THE REAR DIFFERENTIAL GEAR



a. Related Parts with the Rear Differential Gear

(1) Spiral Bevel Pinion
(2) 39 Spiral Bevel Gear
(3) Differential Gear Assembly
(4) 13 Gear Shaft
(5) Planetary Gear Assembly
(6) Rear Axle
(7) Differential Side Gear
(8) Differential Pinion
(9) Planetary Gear
(10) 68 Internal Gear

b. Operation Principle of the Rear Differential Gear

Power is transmitted from spiral bevel pinion (1) via 39 spiral bevel gear (2) and through differential gear assembly (3) to 13 gear shaft (4).

13 gear shaft (4) is engaged with the gears of planetary gear assembly (5). Planetary gears are operated in 68 internal gear (10). Consequently, power transmitted to 13 gear shaft (4) is transmitted to rear axle (6) via planetary gear assembly (5).

Differential gear assembly (3) is composed of two deferential side gear (7) and four differential pinion (8) in the differential case.

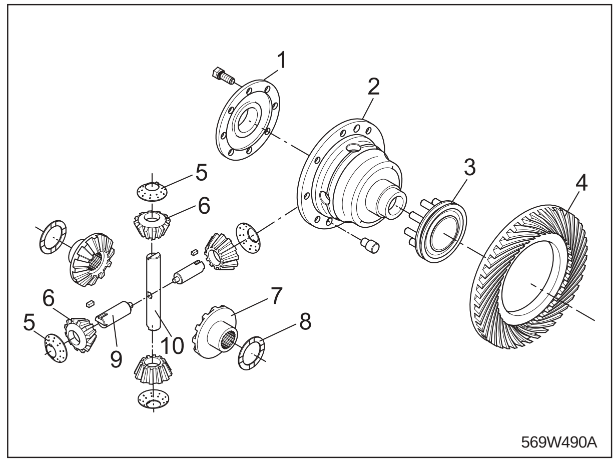
6. DIFFERENTIAL GEAR

6.1 STRUCTURE

The differential gear assembly is a mechanism to provide smooth steering.

It automatically provides different optimum torques to the right and left wheels according to road resistance and braking friction at the wheels.

The differential gear assembly is composed of the differential case, differential pinions, differential side gears, differential pinion shaft, spiral bevel gear, etc.



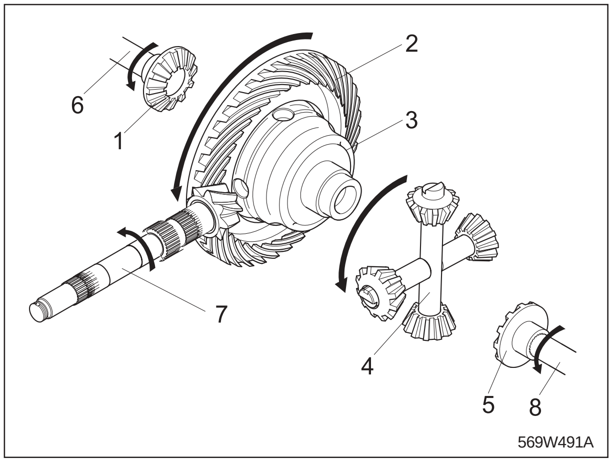
(1) Differential Case Cover
(2) Differential Case
(3) Differential Lock Shifter
(4) Spiral Bevel Gear
(5) Differential Pinion Washer
(6) Differential Pinion
(7) Differential Side Gear
(8) Differential Side Gear Washer
(9) Differential Pinion Shaft 2
(10) Differential Pinion Shaft

6.2 OPERATION

TRAVELING STRAIGHT AHEAD

<The Condition of Engaged the Diff. Lock Gear>

Rotation of the spiral bevel pinion (7) is transmitted to the spiral bevel gear (2) bolted to the differential case (3). When road resistance to the right and left wheels are equal, the differential pinions (4), and differential side gears (1), (5) are carried around by the spiral bevel gear (2), and differential case (3) rotate as a unit. Differential gear shaft (6), (8) receive the same rotation and both wheels travel at the same speed.

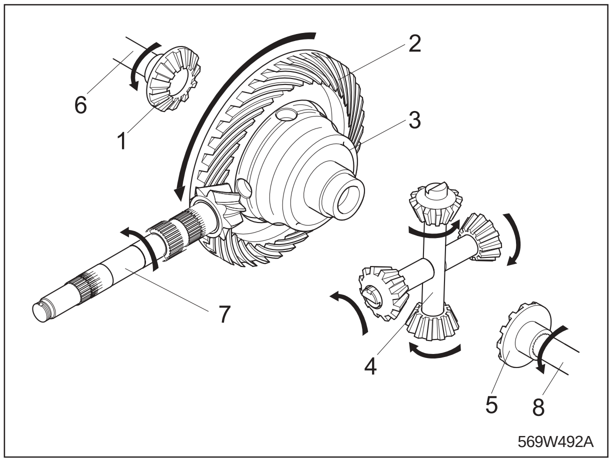


(1) Differential Side Gear
(2) Spiral Bevel Gear
(3) Differential Case
(4) Differential Pinion
(5) Differential Side Gear
(6) Differential Gear Shaft
(7) Spiral Bevel Pinion
(8) Differential Gear Shaft

TURNING THE CORNER

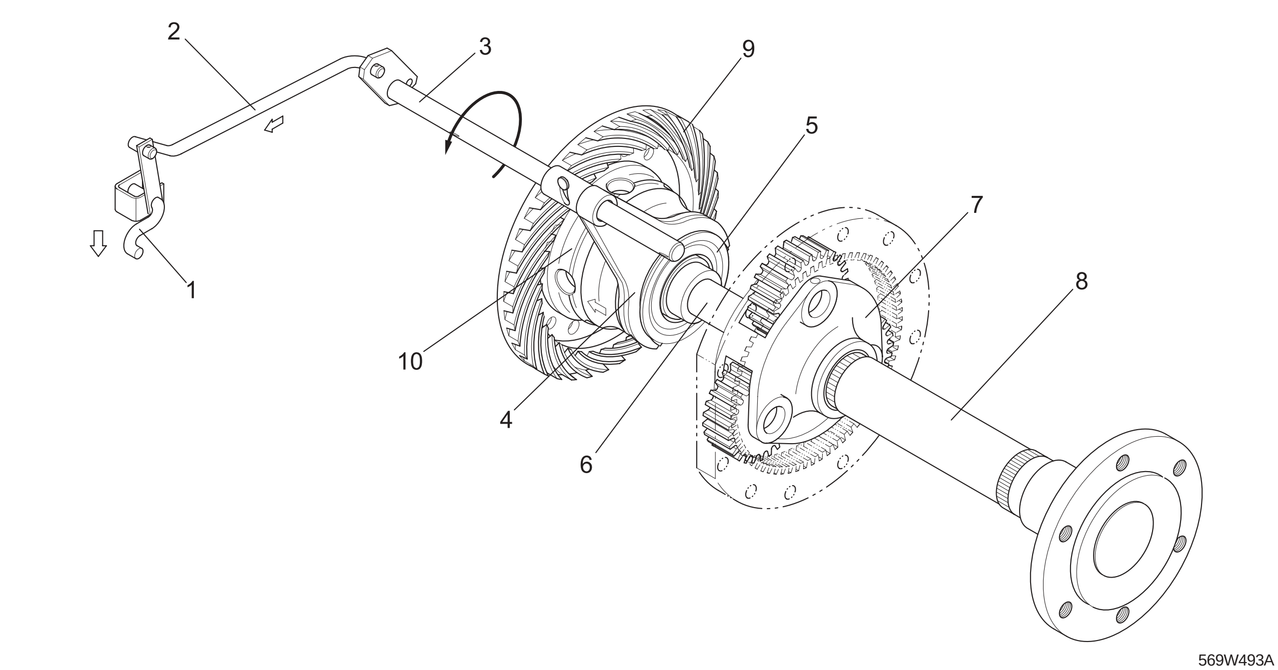
<The Condition of not Engaged the Diff. Lock Gear>

The power from the engine on spiral bevel pinion (7) rotates spiral bevel gear (2). When turning a corner, the outer wheel must travel farther than the inner one. While differential pinions (4) rotate with the differential case (3), they spin on differential pinion shaft to transmit more rotation to one differential side gear than to the other. As one differential gear shaft rotates faster, the other rotates slower by the same amount.



(1) Differential Side Gear
(2) Spiral Bevel Gear
(3) Differential Case
(4) Differential Pinion
(5) Differential Side Gear
(6) Differential Gear Shaft
(7) Spiral Bevel Pinion
(8) Differential Gear Shaft

6.3 LOCKING OF THE DIFFERENTIAL GEAR



a. Related Parts with the Operation of the Differential Gear

(1) Differential Pedal
(2) Differential Rod
(3) Differential Mounting Fork Shaft
(4) Differential Mounting Fork
(5) Differential Mounting Shift
(6) 13 Gear Shaft
(7) Planetary Gear Assembly
(8) Rear Axle
(9) 39 Spiral Bevel Gear
(10) Differential Gear Assembly

b. Operation Principle of the Differential Gear

If differential pedal (1) is pressed down, the differential rod connected to the pedal gets pulled forward and differential mounting fork shaft (3) gets rotated. Since differential mounting fork (4) is moved to the left and connected with the dog of differential mounting shift (5) through the dog's groove of differential gear assembly (10), while differential function is not operated, along with 13 gear shafts (left and right) (6) revolved together. If differential lock is operated, 13 gear shafts both left and right rotate at the same speed and transmit the same capacity of power to the rear axle.

CAUTION

- *When running while the differential lock is operated, do not turn the steering wheel to toe left or right.*
- *If the steering wheel is turned to the left or right, the differential lock may be damaged because the rotation speed differs between the left and the right wheel.*

Differential Lock

When resistances to the right and left tires are different due to ground conditions or type of work, the wheel with less resistance slips and prevents the tractor from moving ahead.

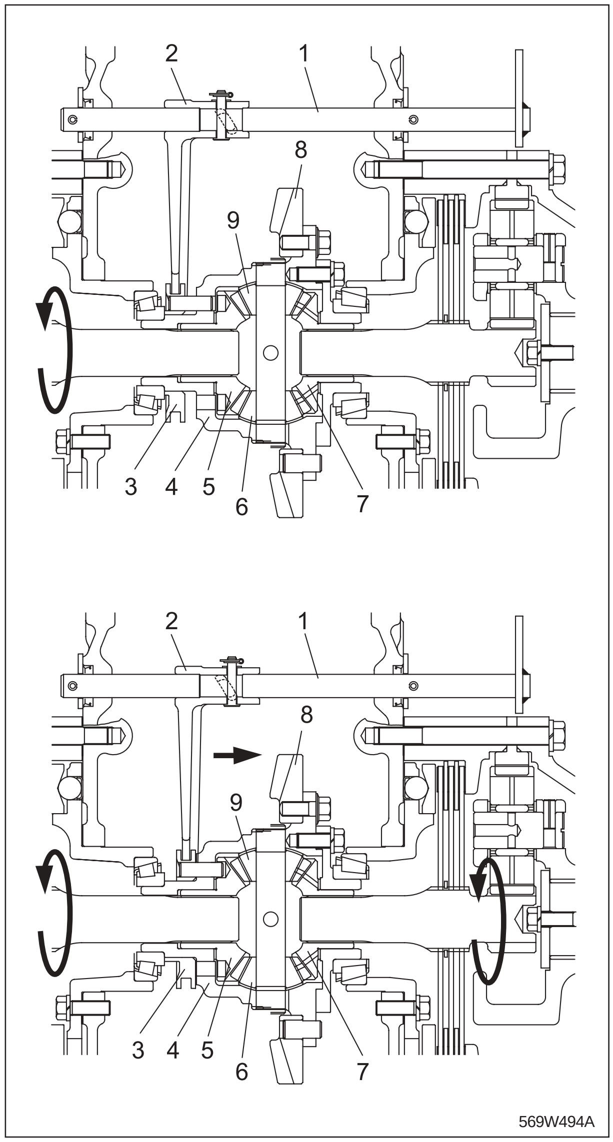
To compensate for this, the differential lock restricts the differential function and causes both rear axles to rotate as a unit.

When the differential lock pedal is stepped on, it causes the differential lock cam shaft (1), differential lock shift fork (2) and differential lock shifter (3) are moved forward the spiral bevel gear (8).

The pins on the differential lock shifter (3) go into the holes in the differential side gear (5) through the holes in the differential case (4) to cause the differential case, differential lock shifter and differential side gear to rotate as a unit.

Therefore the differential pinions (6) (9), can not rotate on their axles, and the rotation of the spiral bevel pinion is transmitted to the both rear axles evenly. It means the tractor going straight ahead.

When the drive wheels regain equal traction, the lock will disengage automatically by the force of differential lock pedal return spring, while released differential lock pedal



(1) Differential Lock Cam Shaft

(2) Differential Lock Shift Fork

(3) Differential Lock Shifter

(4) Differential Case

(5) Differential Side Gear

(6) Differential Pinion

(7) Differential Side Gear

(8) Spiral Bevel Gear

(9) Differential Pinion

A. DIFFERENTIAL LOCK ASSEMBLY

a. To Disassembling

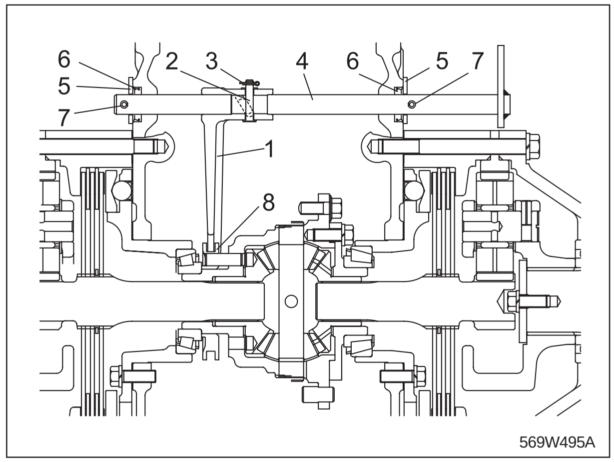
1. Remove spring pin (7).
2. Take out snap pin (3) and Disassembling plane washer and pin (2).
3. Take out differential lock fork shaft (4) and remove differential lock fork (1).

b. To Assemble

1. Install oil seal (6) on both sides of the transmission case and apply grease on the lip area.
2. Insert differential lock fork (1) into differential lock shift (8).
3. Insert washer (5) into differential lock fork shaft (4) to tighten differential lock fork (1) through the side hole of the transmission case.
4. Fix spring pin (2), plane washer and snap pin (3).
5. Insert plane washer into the outside of the transmission case and fix two spring pins (7).

CAUTION

- *Assembling direction of the oil seal shall allow the lip area to be located inside the transmission case.*



(1) Differential Lock Fork
(2) Spring Pin
(3) Snap Pin
(4) Differential Lock Fork Shaft
(5) Washer
(6) Oil Seal
(7) Spring Pin
(8) Shift

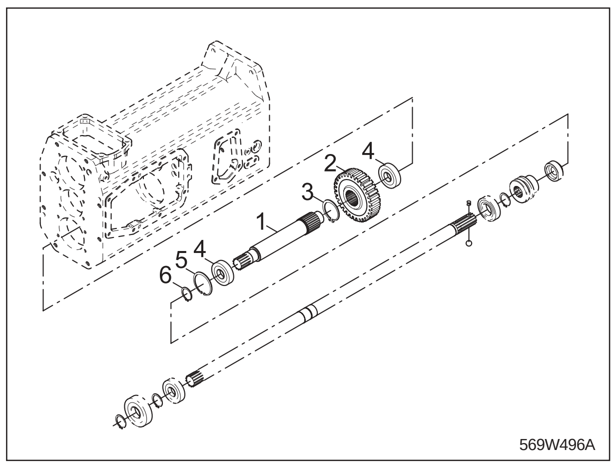
B. FRONT WHEEL DRIVE

a. To Disassembling

1. Remove snap ring (5) on the transmission case.
2. Slightly knock front wheel drive shaft (1) at the back of the transmission case to remove at a time with 6305 ball bearing (4).

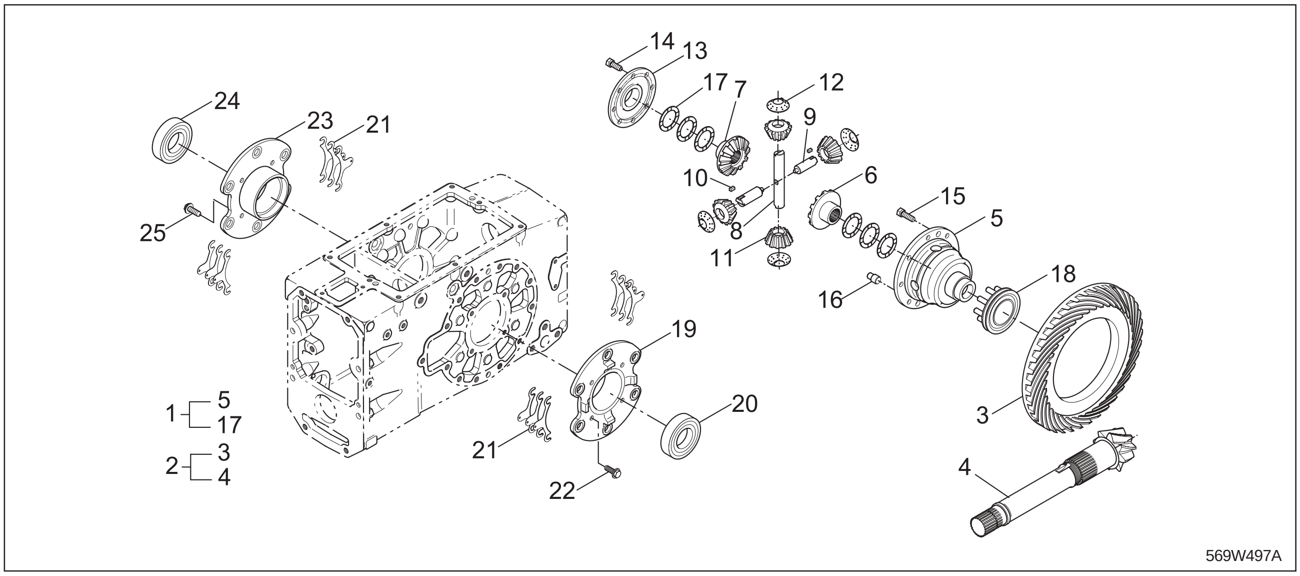
b. To Assemble

1. Install 6305 ball Bearing (4) on the transmission case.
2. After sub-assembly of snap ring (3) on front wheel rive shaft (1), push through the assembled area and insert into the spline of 34 gear (2) to fix front wheel drive shaft (1) with 6305 ball bearing (4).
3. After installing 6305 ball bearing (4) on the assembled area of the middle case and front wheel drive shaft (1), fix the middle case with hole snap ring (5) and tighten 6305 ball bearing (4).
4. Install snap ring (6) on the end of front wheel drive shaft (1).



(1) Front Wheel Drive Shaft
(2) 34 Gear
(3) Snap Ring
(4) Ball Bearing
(5) Snap Ring
(6) Snap Ring

C. REAR DIFFERENTIAL GEAR GROUP



(1) Differential Gear Ass'y	(10) Key	(18) Differential Lock Shift
(2) Spiral Bevel Gear Ass'y	(11) Differential Pinion	(19) Differential Bearing Case (LH)
(3) Spiral Bevel Gear	(12) Differential Pinion Washer	(20) Ball Bearing
(4) Spiral Bevel Pinion	(13) Cover	(21) Shim
(5) Differential Gear Case	(14) Bolt	(22) Bolt
(6,7) Differential Side Gear	(15) Bolt	(23) Differential Bearing Case (RH)
(8) Differential Pinion Shaft 1	(16) Straight Pin	(24) Ball Bearing
(9) Differential Pinion Shaft 2	(17) Shim	(25) Bolt

a. To Disassembling

1. Loosen four M10 bolt (25) on right side of the transmission case to Disassembling differential bearing case (RH) (23) and shim (21).
2. Loosen four M10 bolts (22) on the left side of the transmission case to Disassembling differential bearing case (LH) (19) and shim (21).
3. Remove differential lock shift (18).
4. Draw out differential gear assembly (1) backward the transmission case.

b. To Assemble

1. Push differential gear assembly (1) forward the transmission case.
2. Install ball bearing (24) on differential bearing case (RH) (23) and insert shim (21) to be fixed on the right side of the transmission case with differential case assembly (1).
3. Install taper roller bearing (20) on differential bearing case (LH) (19) and insert seam (21) to be fixed on the left side of the transmission case with differential case assembly (1).
4. Decide the shim amount (17) so to allow the turning torque of spiral bevel gear (3) to be 0.2 to 0.45 kgf·m.
5. Decide the shim amount (21) left and right so to allow the turning torque to be 0.09 to 0.12 kgf·m after assembling spiral bevel pinion (4) and spiral bevel gear (3).
6. Fix spiral bevel pinion (4) and drive spiral bevel gear (3) to its turning direction to measure backlash.

   [Two place min.: Factory spec. of backlash is 0.15 to 0.25 mm]

Adjustment of BacKlash

If backlash is over the specified value, shift the shim of the spiral bevel gear side to the opposite side to the spiral bevel gear to adjust without changing the whole shim amount. To the contrary, if backlash is under the specified value, shift the opposite shim to the spiral bevel gear to the spiral bevel gear side to adjust as specified.

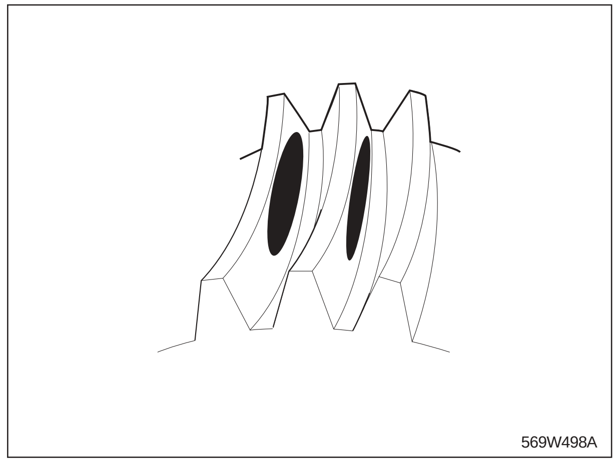
7. Check for reaching up between spiral bevel pinion (4) and spiral bevel gear (3).
8. Install the differential fork on the shift after inserting differential mounting shift (18) toward the differential bearing (left).

Confirmation of Reaching Up

Apply minimum lightly on several thrashing faces at 3 equally divided positions in the circle circumference of the spiral bevel gear and turn the shaft of the spiral bevel pinion with a load on the spiral bevel gear, then to confirm its reaching up.

- Degree of reaching up:

  As of 35 % min. the center is 1/3 ~ 2/3 away from minor section



Tightening torque	Tightening bolt of the differential bearing case	48.0 ~ 55.9 N·m 4.90 ~ 5.70 kgf·m 35.4 ~ 41.2 lbf·ft
	Tightening bolt of the differential gear case	48.0 ~ 55.9 N·m 4.90 ~ 5.70 kgf·m 35.4 ~ 41.2 lbf·ft
	Tightening bolt of the differential gear case and the cap	60.8 ~ 90.2 N·m 6.20 ~ 7.20 kgf·m 44.8 ~ 66.5 lbf·ft

D. DIFFERENTIAL GEAR ASSEMBLY

a. To Disassembling

1. Loosen eight UBS bolts (14) on differential case (right) (13) to Disassembling shim (17), differential side gear 22 (7) and 39 spiral bevel gear (4).
2. Disassembling parallel key (10), differential pinion shaft 1 & 2 (8), (9), differential pinion (11), differential pinion washer (12), shim (17) and differential side gear 22 (6) in the differential case in due order.

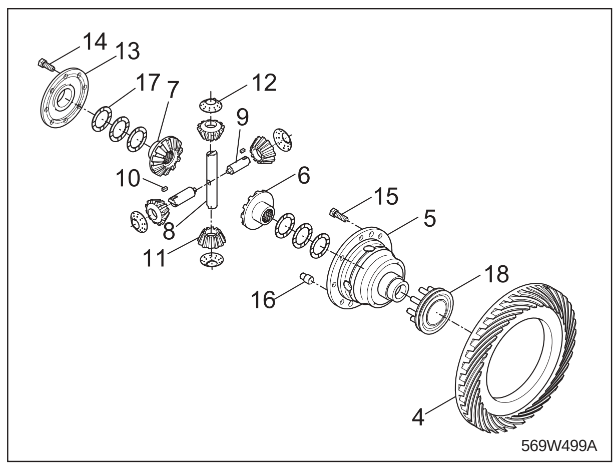
b.To Assemble

1. Install shim (17), differential side gear (6), differential pinion washer (at four places) (12), differential pinion (at four place) (11), differential pinion shaft1 & 2 (8), (9) and parallel key (16) in the differential case (5) in due order.
2. Insert 37 spiral bevel pinion (4) onto differential case (left) (5).
3. Place differential side gear (7) and shim (17) on the right side of differential case (5), and tighten right differential case (13), left differential case (5) and 37 spiral bevel pinion (4) with eight UBS bolts (14) after applying LOCTITE on.
4. Fix two parallel pins (16) at right differential case (13).

Tightening torque	UBS bolt (14) tightening of the differential case	60.8 ~ 90.2 N·m 6.20 ~ 9.20 kgf·m 44.8 ~ 66.5 lbf·ft

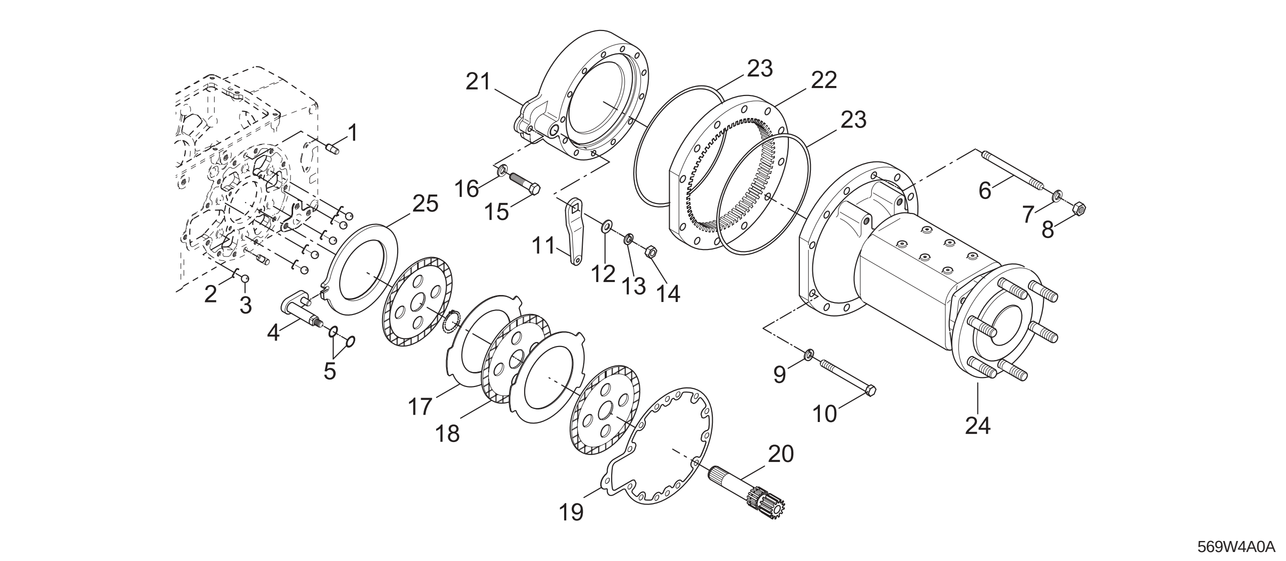
CAUTION

- *When assembling, decide the number of shim (17) so to allow backlash between differential side gear (6) and differential pinion (11) to be 0.13 ~ 0.25 mm (0.005 ~ 0.0098 in.) → Shim thickness: t1.5, t1.6, t11.7.*



(4) Spiral Bevel Gear
(5) Differential Gear Case
(6,7)Differential Side Gear
(8) Differential Pinion Shaft 1
(9) Differential Pinion Shaft 2
(10) Key
(11) Differential Pinion
(12) Differential Pinion Washer
(13) Differential Case
(14) Bolt
(15) Bolt
(16) Parallel Pin
(17) Shim
(18) Differential Lock Shift

E. BRAKE CASE



(1) Straight Pin
(2) Ball Sheet
(3) Ball
(4) Brake Cam
(5) O-Ring
(6) Stud Bolt
(7) Spring Washer
(8) Nut
(9) Spring Washer
(10) Bolt
(11) Brake Cam Lever
(12) Washer, Plain
(13) Spring Washer
(14) Nut
(15) Bolt
(16) Spring Washer
(17) Plate
(18) Brake Disk
(19) Packing
(20) 13 Gear Shaft
(21) Brake Case
(22) 68 Internal Gear
(23) O-Ring
(24) Rear Axle Case
(25) Cam

a. To Disassembling

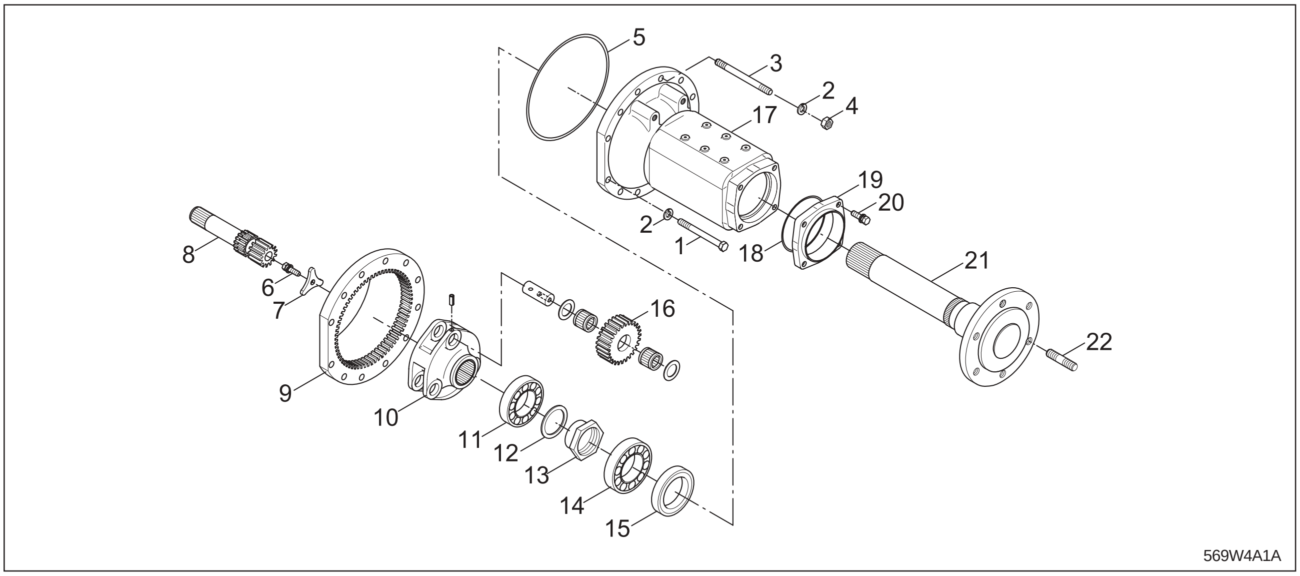
1. Remove eight bolts (10) and four nuts (8) on both sides of the transmission case to Disassembling rear axle ass'y (24).
2. Take out left and right of 13gear shaft (20).
3. Remove 68 internal gear (22).
4. Remove O-ring (23) on both sides of 68 internal gear (22).
5. Lightly knock brake case (21) with a hammer to remove out of the transmission case.
6. Remove brake disc (18), plate (17) and cams (left and right) (25).

b. To Assemble

1. Install steel ball sheet (2), steel ball (3), parallel pin (1) and stud bolt (6) on left and right of the transmission case.
2. Install cams (left and right) (25), brake disc (18), plate (17) and 13 gear shaft (left and right) (20) in due order on the side of the transmission case.
3. Sub-assemble brake cam (4) and brake cam lever (11) on brake case (21).
4. Insert packing (19) into the side of the transmission case and fix brake case ass'y (21).
5. Install O-ring (23) on both sides of 68 internal gear (22) and apply grease to fix with rear axle ass'y (24).
6. Insert the rear axle ass'y as aligned with the hole of brake case (21) to tighten with bolt (10) and nut (8).

Tightening torque	Tightening nut (14) of the brake cam lever	123.6 ~ 147.1 N·m 12.6 ~ 15.0 kgf·m 91.1 ~ 108.4 lbf·ft
	Tightening bolt (10) of the rear axle ass'y	77.5 ~ 90.2 N·m 7.90 ~ 9.20 kgf·m 57.1 ~ 66.5 lbf·ft
	Tightening nut (8) of the rear axle ass'y	77.5 ~ 90.2 N·m 7.90 ~ 9.20 kgf·m 57.1 ~ 66.5 lbf·ft

F. REAL AXLE ASSEMBLY



(1) Bolt	(7) Plate	(13) Nut	(18) O-Ring
(2) Spring Washer	(8) 13 Gear Shaft	(14) Ball Bearing	(19) Bearing Cover
(3) Stud	(9) 68 Internal Gear	(15) Oil Seal	(20) Bolt
(4) Nut	(10) Planetary Gear Support	(16) Planetary Gear	(21) Rear Axle
(5) O-Ring	(11) Ball Bearing	(17) Rear Axle Case	(22) Stud
(6) Bolt	(12) Collar		

a. To Disassembling

1. Remove side bolt (1) and nut (4) of the transmission case to loosen the rear axle case assembly.
2. Draw out O-ring (5) on the outside of 68 internal gear (9).
3. Loosen one UBS bolt (6) to draw out fixing plate (7) and planetary gear support assembly (10).
4. Remove 68 internal gear (9).
5. Loosen four washer mounting bolts (20) fixed on bearing cover (19) of the rear axle.
6. Remove rear axle (21) by knocking outward from rear axle case (17).
7. Remove 6211 ball bearing (11).
8. Remove the caulking to Disassembling nut (13).
9. Remove O-ring (18) on the side of bearing cover (19) of the rear axle.
10. Remove 6212 ball gearing (14), oil seal (15) and bearing cover (19) of the rear axle.

b. To Assemble

1. Sub-assemble oil seal (15), 6212 ball Bearing (14) and O-ring (18) on bearing cover (19) of the rear axle and apply grease on the oil sealed inner bore and O-ring (18) assembly to fix on rear axle (21).
2. Tighten nut (13) and apply caulking surely.
3. Install rear axle case (17) and tighten bearing cover (19) of the rear axle with four M10 washer mounting bolts.
4. Insert spacer (12) and install 6211 ball bearing (11).
5. Fix planetary gear support assembly (10) on the spline section of rear axle (21) and place fixing plate (7) to be tightened with UBS bolt (6) after applying LOCTITE on it.
6. Insert O-ring (5) between both sides of 68 internal gear (9) and apply grease.
7. Fix 68 internal gear (9) on rear axle case (17).
8. Locate 13 gear shaft (8) inside three 27 planetary gears of planetary gear support (10) and align the holes of transmission case, brake case and rear axle case to tighten with bolt (1) and nut (4).

Tightening torque	Stud for assembly of the rear axle and the rim	196.2 ~ 225.6 N·m 20.0 ~ 23.0 kgf·m 144.7 ~ 166.3 lbf·ft
	Mounting bolt of the bearing cover of the rear axle	48.0 ~ 55.9 N·m 4.90 ~ 5.70 kgf·m 35.4 ~ 41.2 lbf·ft
	Mounting bolt of the rear axle assembly	77.5 ~ 90.2 N·m 7.90 ~ 9.20 kgf·m 57.1 ~ 66.5 lbf·ft
	Mounting nut of the rear axle assembly	77.5 ~ 90.2 N·m 7.90 ~ 9.20 kgf·m 57.1 ~ 66.5 lbf·ft
	Mounting bolt of the 13 gear shaft and the fixing plate	48.0 ~ 55.9 N·m 4.90 ~ 5.70 kgf·m 35.4 ~ 41.2 lbf·ft
	Stud for assembly of the transmission case and the rear axle case	77.5 ~ 90.2 N·m 7.90 ~ 9.20 kgf·m 57.1 ~ 66.5 lbf·ft

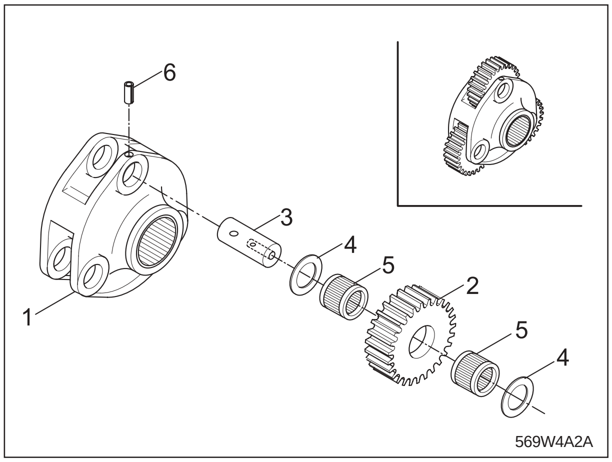
G. PLANETARY GEAR ASSEMBLY

a. To Disassembling

1. Knock three spring pins (6) to be located in planetary gear shaft.
2. Draw planetary gear shaft (3) using a replacing tool and remove thrust collar (4), needle bearing (5) and 21 planetary gear (2) (three places).

b. To Assemble

1. Insert needle bearing (5) into the inner bore of 21 planetary gear (2) place thrust collar (4) between the both sides to be located on planetary gear support (1).
2. Insert planetary gear shaft (3) on to the hole of planetary gear support (1) and locate thrust collars (4), needle bearings (5) and 21 planetary gear (2) to planetary gear assemble (three places) (3). Align planetary gear support (1) with the spring pin hole of planetary gear shaft (2) and fix spring pin (6) to be at the same height as of the surface of the planetary gear support (three places).



(1) Planetary Gear Support
(2) Planetary Gear
(3) Planetary Gear Shaft
(4) Collar
(5) Needle Bearing
(6) Spring Pin

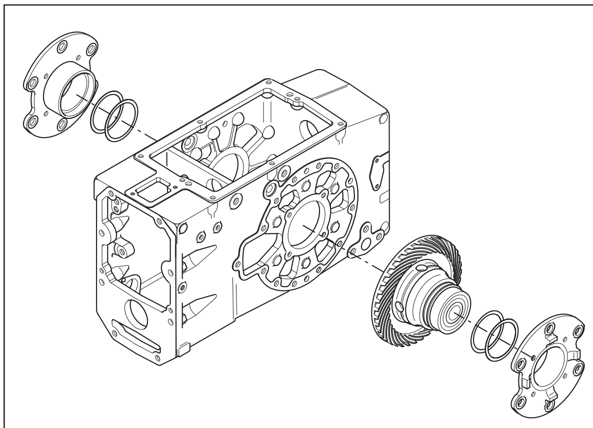
• **Differential Gear Assembly**

1. Remove the differential support, nothing the number of left shims.
2. Take out the differential gear assembly, nothing the number of right shims.

(When reassembling)

- Check the spiral bevel gear for wear or damage. If it is no longer serviceable, replace it.
- Then, also replace the spiral bevel pinion.
- Be sure to install the differential support to position the casting mark “⊥” on it upward.
- Use the same number of shims as before disassembling.

Tightening torque	Differential support mounting screws	48.1 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.5 ~ 41.2 lbf·ft



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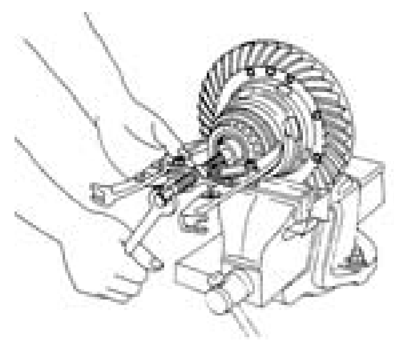
• **Bearing and Differential Lock Shifter**

1. Secure the differential gear in a vise.
2. Remove the differential lock shifter and taper roller bearing as a unit with a puller.



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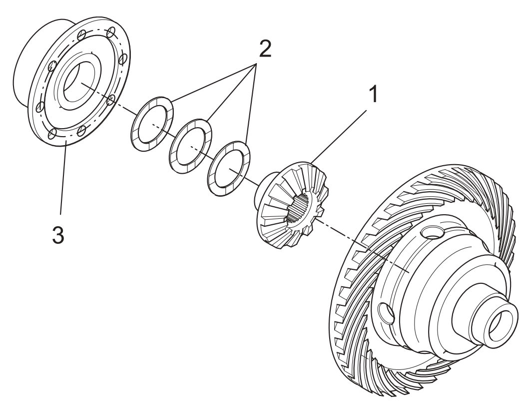
• **Differential Case Cover and Differential Side Gear**

1. Remove the differential case cover (3).
2. Remove the differential side gear (1) and differential side gear washer (2).

(When reassembling)

- Apply Liquid lock (Three Bond 1372 or equivalent) to the differential case cover mounting screws.

Tightening torque	Differential case mounting screws	48.1 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.5 ~ 41.2 lbf·ft



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(1) Differential Side Gear

(2) Differential Side Gear Washer

(3) Differential Case Cover

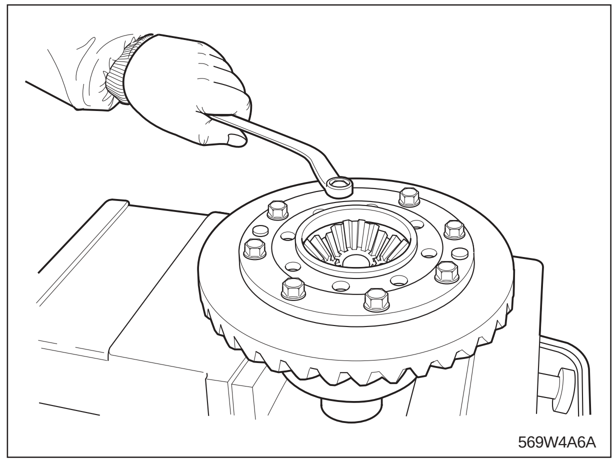
- **Spiral Bevel Gear**

1. Remove the spiral bevel gear.

(When reassembling)

- Check the spiral bevel gear for wear or damage. If it is no longer serviceable, replace it. Then, also replace the spiral bevel pinion.
- Apply liquid lock (Three Bond 1372 or equivalent) to the spiral bevel gear UBS screws.

Tightening torque	Spiral bevel gear UBS Screws	68.6 ~ 88.3 N·m 7.0 ~ 9.0 kgf·m 50.6 ~ 65.1 lbf·ft

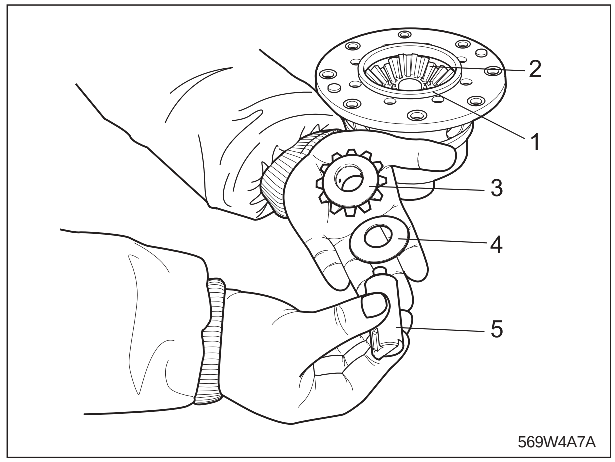


- **Differential Pinion Shaft and Differential Pinion**

1. Draw out the differential pinion shaft 2 (5), and take out the differential pinion (3) and differential pinion washer (4).
2. Draw out the differential pinion shaft (1), and take out the differential pinion (2) and differential pinion washer (4).

NOTE:

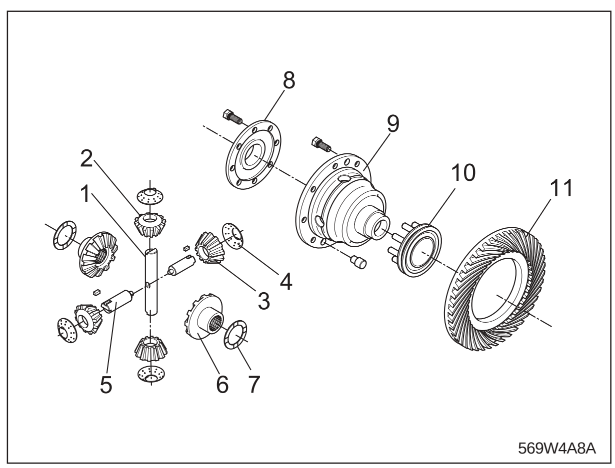
- *Arrange the parts to know their original position.*

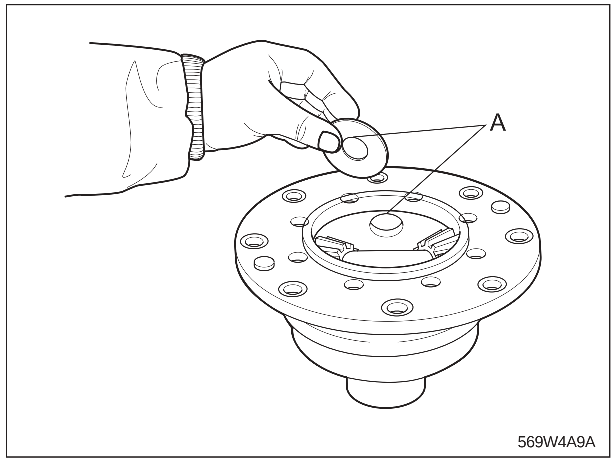


(1) Differential Pinion Shaft
(2) Differential Pinion
(3) Differential Pinion
(4) Differential Pinion Washer
(5) Differential Pinion Shaft

(When reassembling)

- Check the differential pinion (2), (3) and pinion shaft (1), (5) or excessive wear. If these parts are damaged or excessively worn, replace their parts they are in mesh with, or they sliding on.
- Apply molybdenum disulfide (Three bond 1901 or equivalent) to the inner circumferential surface of the differential pinion.
- Install the parts to their original position.
- Install the differential opinion washer (4), nothing its groove position.





[A] FIT Groove

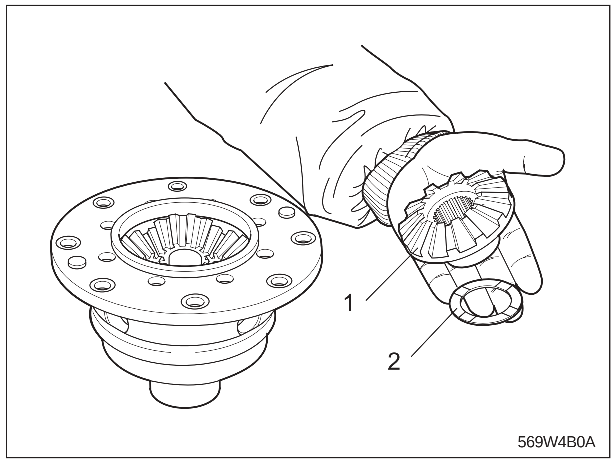
(1) Differential Pinion Shaft
(2) Differential Pinion
(3) Differential Pinion
(4) Differential Pinion Washer
(5) Differential Pinion Shaft 2
(6) Differential Side Gear
(7) Differential Side Gear Washer
(8) Differential Cover
(9) Differential Case
(10) Differential Lock Shifter
(11) Spiral bevel Gear

- **Differential Side Gear**

1. Take out the differential side gear (2) and differential side washer (1).

(When reassembling)

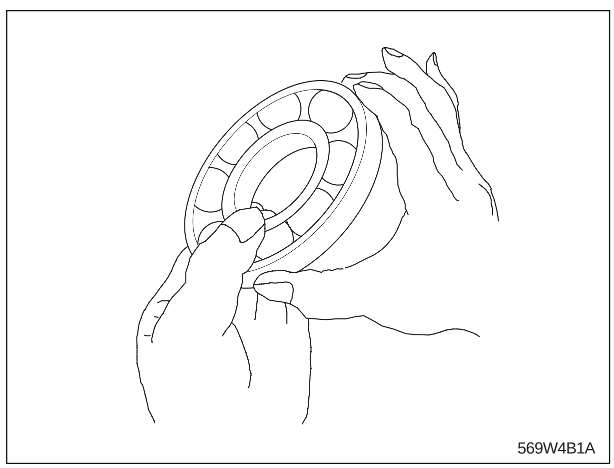
- Check the thrust and bearing surface of both differential side gears (2). If they are worn or damaged, bores in the differential case may also be damaged. Be sure to replace their parts.



(1) Differential Side Gear Washer
(2) Differential side Gear

- **Checking Bearing**

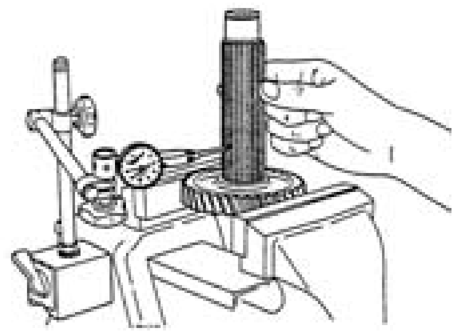
1. Hold the inner race, and push and pull the outer race in all directions to check for wear and roughness.
2. Apply transmission fluid to the bearing, and hold the inner race. Then, turn the outer race to check rotation.
3. If there is any defect, replace it.



- **Clearance Between Gear and Spline or Hub and Spline**

1. Select the gear or the hub in a vise.
2. Set a dial gauge (lever type) with its finger on the spline.
3. Move the shaft (or hub) to measure the clearance.
4. If the clearance exceeds the allowable limit, replace them.

Clearance between gear and spline or hub and spline	Factory spec.	0.030 ~ 0.078 N·m 0.00118 ~ 0.00307 in.
	Allowable limit	0.2 mm 0.008 in.



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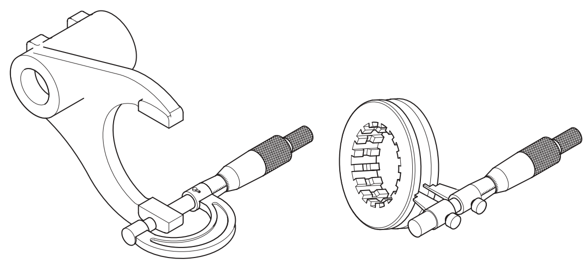
- **Clearance Between Shift Fork and Shifter Groove**

1. Measure the width of shift fork.
2. Measure the shifter groove width, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace them.

Clearance between shift fork and shifter groove	Factory spec.	0.1 ~ 0.3 N·m 0.004 ~ 0.012 in.
	Allowable limit	0.8 mm 0.031 in.



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- **Clearance Between Differential Case Bore (Differential Case Cover Bore) and Differential Side Boss**

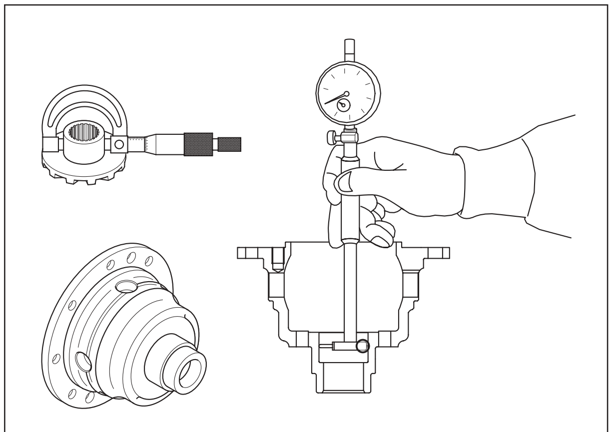
1. Measure the bore I.D. of the differential case and differential case cover.
2. Measure the differential side gear boss O.D. and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace them.

Clearance between differential case bore and differential side gear boss	Factory spec.	0.05 ~ 0.151 mm 0.00197 ~ 0.00594 in.
	Allowable limit	0.035 mm 0.0138 in.

Clearance between differential case bore and differential side gear boss	Factory spec.	40.5000 ~ 40.550 mm 1.59449 ~ 1.59646 in.
	Allowable limit	40.388 ~ 40.450 mm 1.59008 ~ 1.59252 in.

Clearance between differential case cover bore and differential side gear boss	Factory spec.	0.05 ~ 0.151 mm 0.00197 ~ 0.00594 in.
	Allowable limit	0.035 mm 0.0138 in.

Differential case cover bore I.D	Factory spec.	40.5000 ~ 40.550 mm 1.59449 ~ 1.59646 in.
Differential side gear bore O.D	Allowable limit	40.388 ~ 40.450 mm 1.59008 ~ 1.59252 in.



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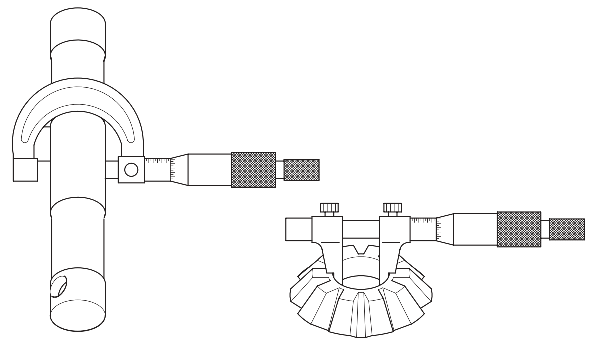
- **Clearance Between Differential Pinion Shaft and Differential Pinion**

1. Measure the differential pinion shaft O.D
2. Measure the differential pinion I.D and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace them.



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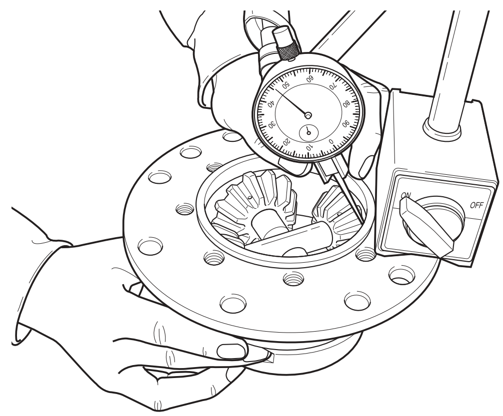
Clearance between differential pinion shaft and differential pinion	Factory spec.	0.05 ~ 0.151 mm 0.00236 ~ 0.00402 in.
	Allowable limit	0.25 mm 0.0098 in.

Differential pinion shaft O.D	Factory spec.	19.959 ~ 19.980 mm 0.78579 ~ 0.78661 in.
Differential pinion I.D	Allowable limit	20.040 ~ 20.061 mm 0.78898 ~ 0.78980 in.

- **Backlash Between Differential Pinion and Differential Side Gear**

1. Set a deal indicator (lever type) on the tooth of the differential pinion.
2. Hold the differential side gear and move the differential pinion to measure the backlash.
3. If the measurement is not within the factory specifications, adjust with the differential side gear washer.



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Backlash between differential pinion and differential side gear	Factory spec.	0.15 ~ 0.30 mm 0.003 ~ 0.012 in.
	Allowable limit	0.40 mm 0.016 in.

(Reference)

- Thickness of differential side gear washers:

  1.5 mm (0.059 in.)

  1.6 mm (0.063 in.)

  1.7 mm (0.067 in.)

CHAPTER 5

FRONT AXLE

1. TROUBLESHOOTING

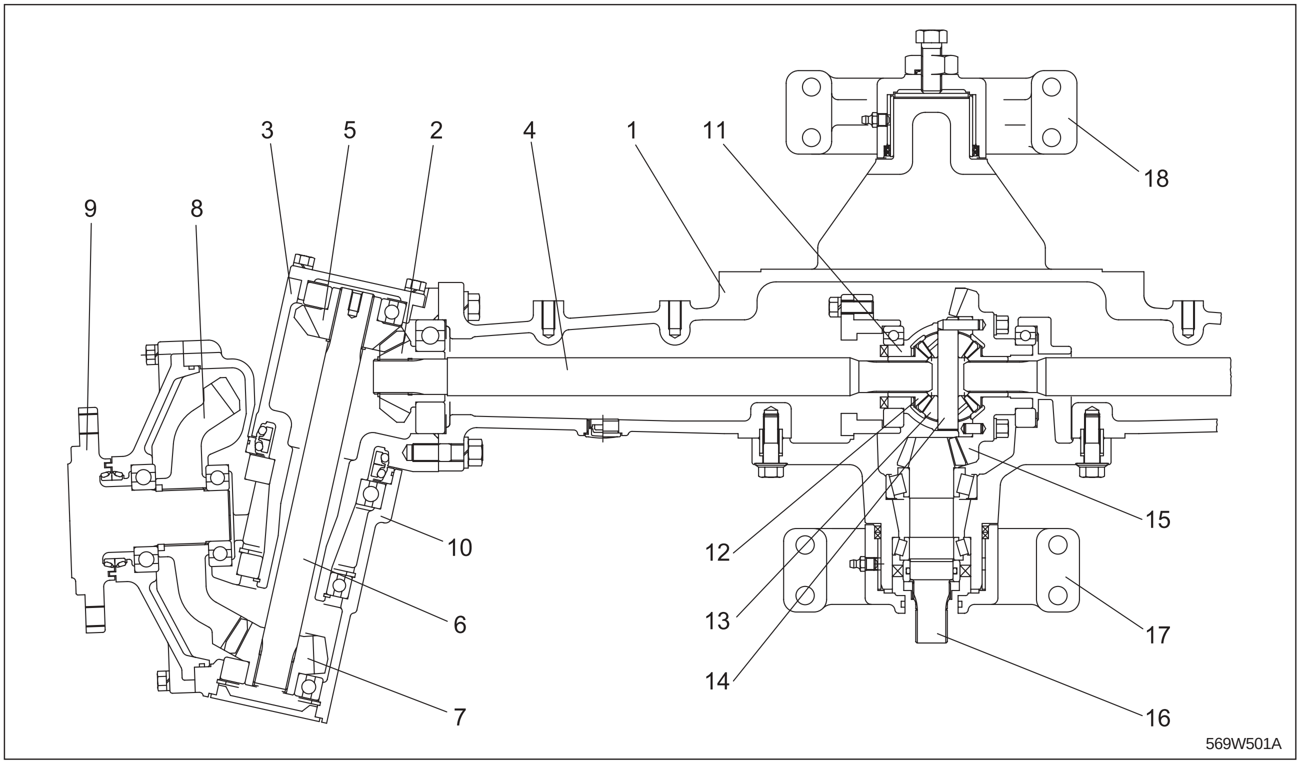
Symptom	Provable causes	Solution	Reference page
Front wheels wander to right or left	- Tire pressure uneven	Adjust	
	- Improper toe-in adjustment (improper alignment)	Adjust	
	- Clearance between front axle case boss and front axle bracket (front, rear) bushing excessive	Replace	
	- Front axle rocking force too small	Adjust	
	- Front wheel sway excessive	Replace	
	- Tie-rod end loose	Tighten	
	- Air sucked in power steering circuit	Bleed	
Front wheel can not be driven	- Propeller shaft broken	Replace	
	- Front wheel drive gears in transmission broken	Replace	
	- Front differential gear broken	Replace	
	- Shift fork broken	Replace	
	- Coupling displaced	Reassemble	
Noise	- Gear backlash excessive	Adjust or replace	
	- Oil insufficient	Replenish	
	- Bearings damaged or broken	Replace	
	- Gears damaged or broken	Replace	
	- Spiral bevel pinion shaft turning force improper	Adjust	

Item		Factory Specification	Allowable Limit
Front wheel alignment	Toe-in	2 ~ 8 mm 0.08 ~ 0.32 in.	-
Front wheel	Axial sway	Less than 5 mm 0.20 in.	-
Front axle	Rocking force	49.0 ~ 117.7 N 5.0 ~ 12.0 kgf 11.0 ~ 26.5 lbf	-
Front axle case boss (front) to bracket bushing	Clearance	0.025 ~ 0.160 mm 0.00098 ~ 0.00630 in.	0.35 mm 0.0138 in.
Front axle case boss (front)	O.D.	70.000 ~ 70.030 mm 2.75590 ~ 2.75708 in.	-
Busing	I.D.	70.095 ~ 70.145 mm 2.75964 ~ 2.76161 in.	-
Front axle case boss (rear) to bracket bushing	Clearance	0.025 ~ 0.190 mm 0.00098 ~ 0.00748 in.	0.35 mm 0.0138 in.
Front axle case boss (rear)	O.D.	85.000 ~ 85.035 mm 3.34645 ~ 3.34783 in.	-
Busing	I.D.	85.100 ~ 85.165 mm 3.35039 ~ 3.35295 in.	-
Differential case, 27 bevel gear to differential side gear	Clearance	0.016 ~ 0.052 mm 0.00063 ~ 0.00204 in.	0.25 mm 0.0098 in.
Differential case	I.D.	32.025 ~ 32.050 mm 1.26082 ~ 1.26181 in.	-
27 bevel gear	I.D.	32.025 ~ 32.050 mm 1.26082 ~ 1.26181 in.	-
Differential side gear	O.D.	31.959 ~ 31.975 mm 1.25822 ~ 1.25885 in.	-
Pinion shaft to differential pinion	Clearance	0.016 ~ 0.052 mm 0.00063 ~ 0.00204 in.	0.25 mm -
Pinion shaft	O.D.	15.966 ~ 15.984 mm 0.62858 ~ 0.62929 in.	-
Differential pinion	I.D.	16.000 ~ 16.018 mm 0.62992 ~ 0.63063 in.	-

Item		Factory Specification	Allowable Limit
Differential pinion to differential side gear shim	Backlash	0.1 ~ 0.3 mm 0.004 ~ 0.012 in.	-
	Thickness	0.1 mm 0.0039 in.	-
		0.1mm 0.0078 in.	-
		0.2 mm 0.0157 in.	-
		1.6 mm 0.0630 in.	-
Spiral bevel pinion shaft (Pinion shaft only)	Turning Torque	1.27 ~ 1.667 N·m 0.13 ~ 0.17 kgf·m 0.94 ~ 1.23 lbf·ft	-
Spiral bevel pinion shaft to spiral bevel gear	Backlash	0.2 ~ 0.3 mm 0.0078 ~ 0.0118 in.	-
12 T bevel gear to 16 T bevel gear shim	Backlash	0.15 ~ 0.35 mm 0.0059 ~ 0.0138 in.	- -
	Thickness	0.1 mm 0.0039 in.	-
		0.2 mm 0.0078 in.	-
		0.4 mm 0.0157 in.	-
		0.8 mm 0.03149 in.	-
		1.0 mm 0.0393 in.	-
13 T bevel gear to 39 T bevel gear shim	Backlash	0.15 ~ 0.35 mm 0.0059 ~ 0.0138 in.	-
	Thickness	0.1 mm 0.0039 in.	-
		0.2 mm 0.0078 in.	-
		0.4 mm 0.0157 in.	-
		0.8 mm 0.03149 in.	-
		1.0 mm 0.0393 in.	-
		1.2 mm 0.0472 in.	-

3. STRUCTURE

3.1 OPERATION



(1) Front Axle Support
(2) Bevel Gear
(3) Bevel Gear Case
(4) Differential Shaft
(5) 16 Bevel Gear
(6) Bevel Gear Shaft
(7) 13 Bevel Gear
(8) 39 Bevel Gear
(9) Front Axle
(10) Front Axle Case
(11) Front Differential Case
(12) Differential Side Gear
(13) Differential Pinion
(14) Differential Pinion Shaft
(15) Spiral Bevel Gear
(16) Spiral Bevel Pinion Shaft
(17) Rear Bracket
(18) Front Bracket

- The front axle of this is constructed as shown above. Power is transmitted from the transmission through the propeller shaft and to the spiral bevel pinion shaft (16), then to the spiral bevel pinion gear (15) after that to the differential gear. The power through the differential is transmitted to the differential shaft (4), and to the bevel gear shaft (6) in the bevel gear case (3).

  The revolution is greatly reduced by the bevel gear (7), (8), then the power is transmitted to the front axle (9).

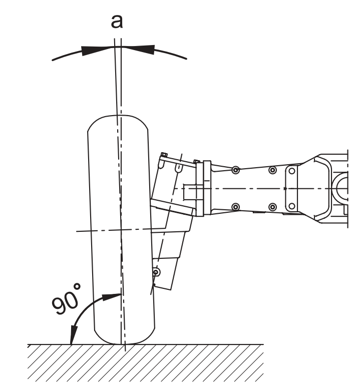
  The differential system allows each wheel to rotate at a different speed to make turning easier.

3.2 FRONT WHEEL ALIGNMENT

Front wheel alignment is a term given to mean four angle settings in three dimensions: camber, kingpin inclination, toe-in and caster angle. These angle settings are made for the following purposes.

(1) Camber

The front wheels are tilted from the vertical as viewed from the front, the wheels are farther apart at the top than at the bottom. This inclination is called camber. Camber reduces rolling resistance of the wheels, and also minimizes bending or twisting of the front axle.



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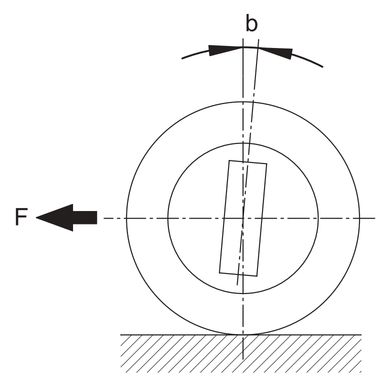
(2) Caster

The kingpin is tilted backward as viewed from the side. That is, the intersection (a) made by the center line of the kingpin shaft and the ground is ahead of the intersection (b) made by the center line of the wheel and ground. This inclination is called caster. Caster helps provide steering stability. As with the kingpin inclination, caster reduces steering effort.



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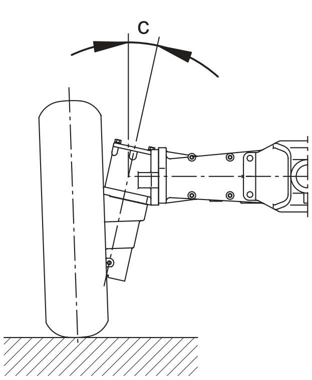
(3) King pin inclination

The kingpin is tilted from the vertical as viewed from the front. This inclination is called kingpin inclination. As with the camber, king pin inclination reduces rolling resistance of the wheels, and prevents any shimmy motion of the steering wheel. It also reduces steering effort.



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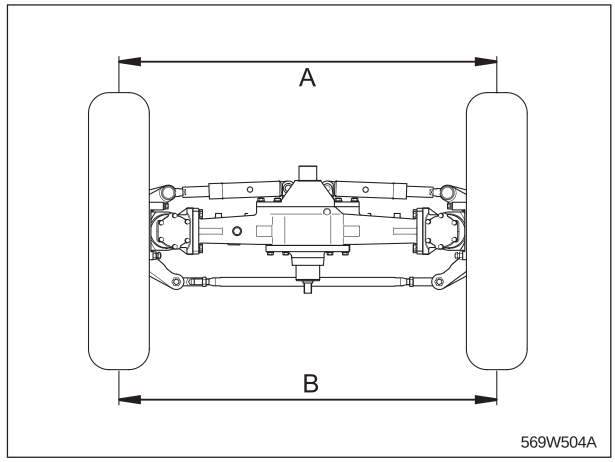
(4) Toe-in

Viewing the front wheels from above reveals that the distance between the front wheels is less at the front than at the rear. This turning in of the front wheels is called toe-in.

The front wheels tend to roll outward due to the camber, but toe-in offsets this and ensures parallel rolling of the front wheels. Another purpose of toe-in is to prevent excessive and uneven wear of tires.



(A) Front Width (B) Rear Width

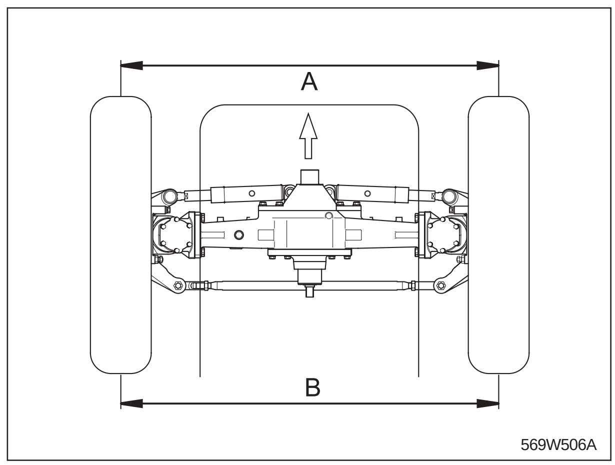
3.3 TOE IN ADJUSTMENT

(1) Apply air pressure as specified to tires.

(2) Measure the front width (A) and the rear width (b) between the front wheels while straightened to obtain the difference (toe-in).

(3) For other than specified, loosen the tightening nut on the ball joint for adjustment while turning the screw on the ball joint. Be sure to make the exposure of left and right rods in the steering cylinder equal this time.

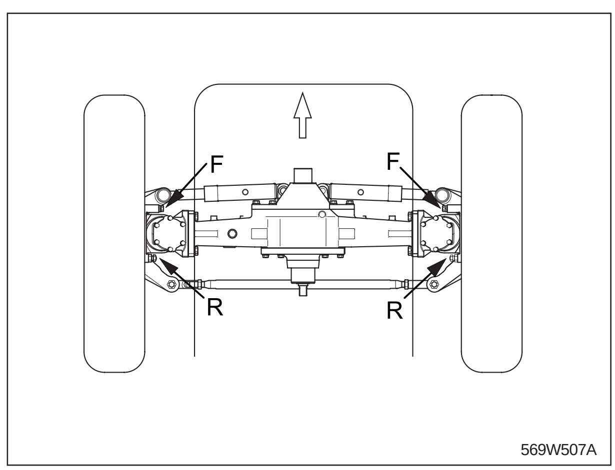
Toe-in (B-A)	Factory spec.	2 ~ 8 mm, 0.0787 ~ 0.3149 in.



(A) Front Width (B) Rear Width

3.4 DIRECTION CONTROL ANGLE FOR THE FRONT WHEEL

1. Adjust and set the clearance between the tightening bolt in (R) and the bevel gear case to be 2 mm (0.0787 in.) or less with the tightening bolts in (F) and (R) as contacted simultaneously with the bevel gear case or with the bolt in (F) as contacted with the bevel gear case when maximizing the direction control angle for the front wheel.

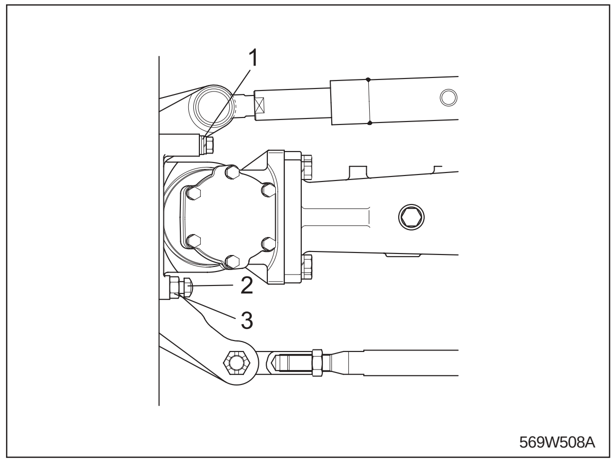


2. If the difference between direction control angles left and right exceeds 1.5 °, adjust it with adjusting washer (1) in F. The direction control angle increases, if the number of adjusting washers decreases, and vice versa.

CAUTION

- *Adjustment of the direction control angle shall be achieved under the range of the maximum control angle.*
- *Fix firmly the tightening bolt (2) in R with the tightening nut (3) after adjusted.*

Tightening torque	Nut	98.1 ~ 125.5 N·m 10.0 ~ 12.8 kgf·m 72.3 ~ 92.5 lbf·ft



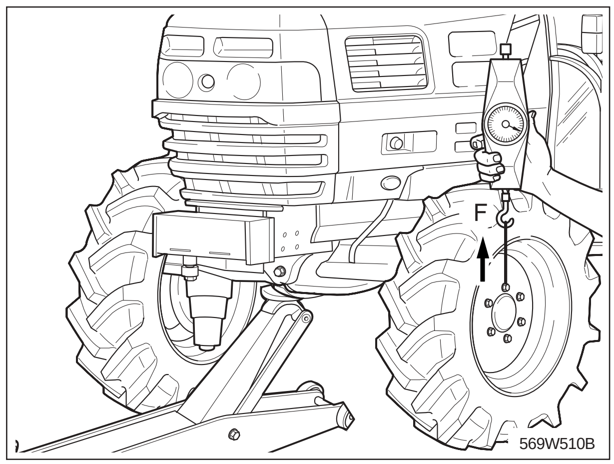
(1) Washer (3) Nut
(2) Bolt

3.5 ROCKING FORCE OF THE FRONT AXLE, DEFLECTION IN FRONT & REAR DIRECTIONS

1. Life the body to float both of front wheels off the ground.
2. Loosen the mounting nut on the front bracket and tighten the adjusting bolt at the specified torque.
3. After confirmation of rocking force, fix with the mounting nut.

Front axle rocking force	Factory spec.	49.0 ~ 117.7 N 5.0 ~ 12.0 kgf 11.0 ~ 26.5 lbf

Tighten-ing torque	Adjusting bolt	19.6 ~ 29.4 N·m 2 ~ 3 kgf·m 14.4 ~ 21.6 lbf·ft
	Lock nut	98.1 ~ 147.1 N·m 10 ~ 15 kgf·m 72.3 ~ 108.4 lbf·ft



4. PREPARATION STAGE FOR DISSEMBLING AND ASSEMBLING

4.1 SEPARATING FRONT AXLE

DRAINING FRONT AXLE CASE OIL

1. Place oil pans underneath the front axle case.
2. Remove the drain plug (1) both sides and filling port plug (3) to drain the oil.
3. After draining, reinstall the drain plugs (1) and filling port plug (3).

(When refilling)

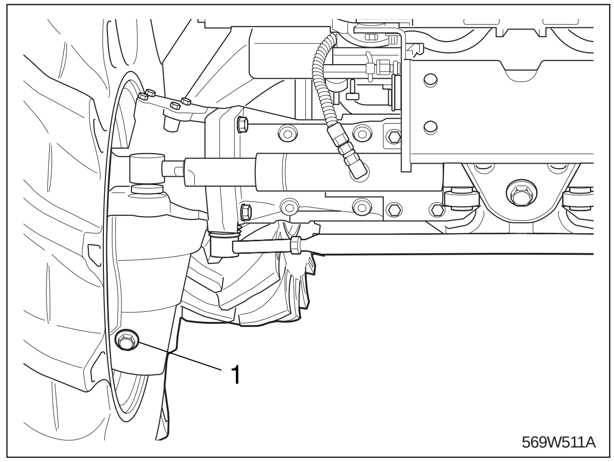
- Remove the filling port plug (3) and check gauge (2).
- Fill with the new oil up to the check plug port.
- After filling, reinstall the check gauge (2) and filling port plug (3).

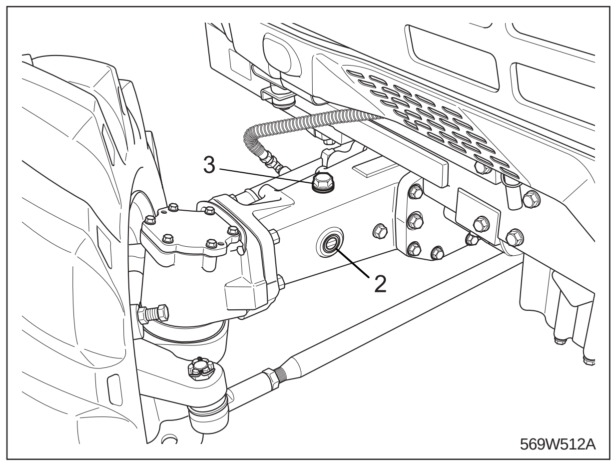
Capacity	Front axle case oil	8.2 ℓ 2.2 U.S. gal.

IMPORTANT:

- *Use SAE 80, 90 gear oil. Refer to "LUBRICANTS, FUEL AND COOLING WATER" (Chapter 1).*

(1) Drain Plug
(2) Gauge
(3) Filling Port Plug





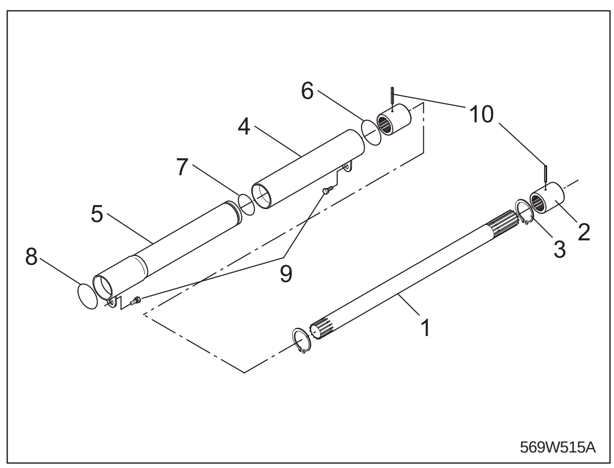
PROPELLER SHAFT (4), (5)

1. Slide the propeller shaft cover (4), (5) after removing the bolt (9).
2. Tap out the spring pin (10), and then slide the coupling (2) to the front.

(When reassembling)

- Apply grease to the splines of the propeller shaft.

(1) Propeller Shaft
(2) Coupling
(3) Cir-Clip
(4) Propeller Shaft Cover
(5) Propeller Shaft Cover
(6) O-Ring
(7) O-Ring
(8) O-Ring
(9) Bolt
(10) Spring Pin

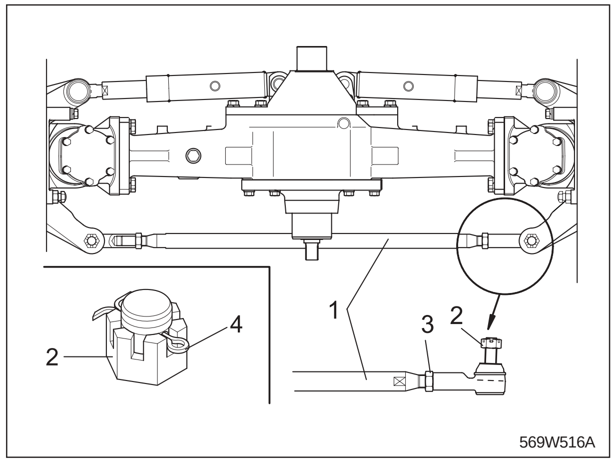


TIE-ROD

1. Remove the tie-rod. In this case, take special care not to damage the tie-rod (1) and slotted nuts (2).

(When reassembling)

Tightening torque	Slotted nut	245.2 ~ 284.5 N·m 25.0 ~ 29.0 kgf·m 180.8 ~ 209.8 lbf·ft
	Tie-rod lock nut	245.2 ~ 284.5 N·m 25.0 ~ 29.0 kgf·m 180.8 ~ 209.8 lbf·ft

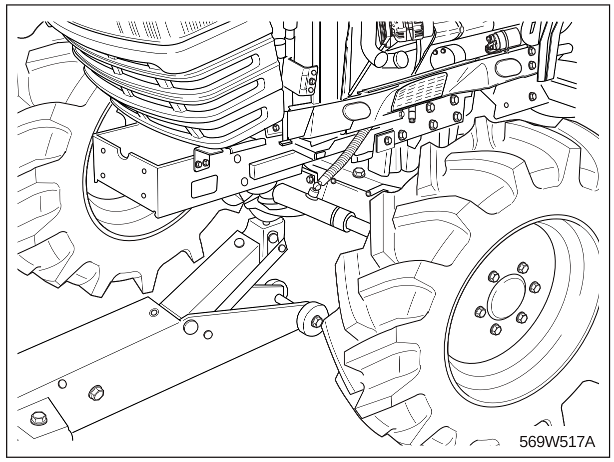


(1) Tie-Rod
(2) Slotted Nut
(3) Tie-Rod Lock Nut
(4) Split Pin

FRONT AXLE

1. Place the jacks under the front axle, and hang up the bumper by the hoist to support it.
2. Remove the shaft bracket 1 mounting screws and shaft bracket 2 mounting screws.
3. Separate the front axle from the front support.
4. Remove the front wheels.

Tightening torque	Front bracket bolts	123.6 ~ 147.1 N·m 12.6 ~ 15.0 kgf·m 91.1 ~ 108.5 lbf·ft
	Rear bracket bolts	123.6 ~ 147.1 N·m 12.6 ~ 15.0 kgf·m 91.1 ~ 108.5 lbf·ft
	Front wheel mounting nuts	166.7 ~ 186.4 N·m 17.0 ~ 19.0 kgf·m 122.9 ~ 137.4 lbf·ft
	Front wheel mounting stud	88.3 ~ 107.9 N·m 9.0 ~ 11.0 kgf·m 65.1 ~ 79.5 lbf·ft

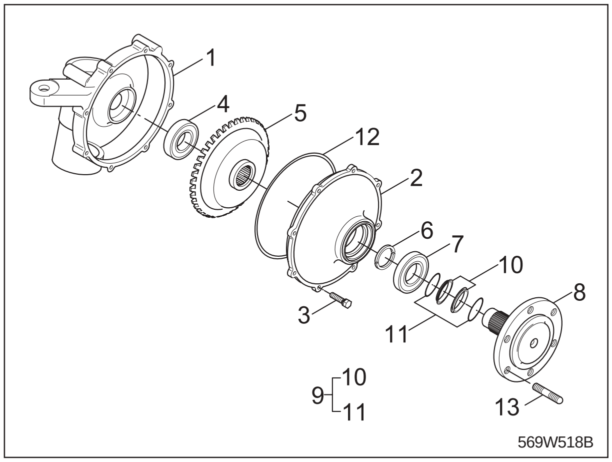


5. TO DISASSEMBLING AND TO ASSEMBLE

5.1 FRONT AXLE CASE AND FRONT AXLE

A. TO DISASSEMBLING

1. Remove sixteen M8 washer mounting bolts (3) on front axle case (1) and front axle cover (2) to Disassembling the front axle group out of front axle case (1).
2. Remove 6208 ball bearing (4) and Disassembling 39 bevel gear (5).
3. Take mounting snap ring (6) out of 6209 ball bearing.
4. Lightly knock front axle (8) forward to Disassembling.
5. Disassembling floating seal ass'y (9) on front axle (8) and front axle cover (2).



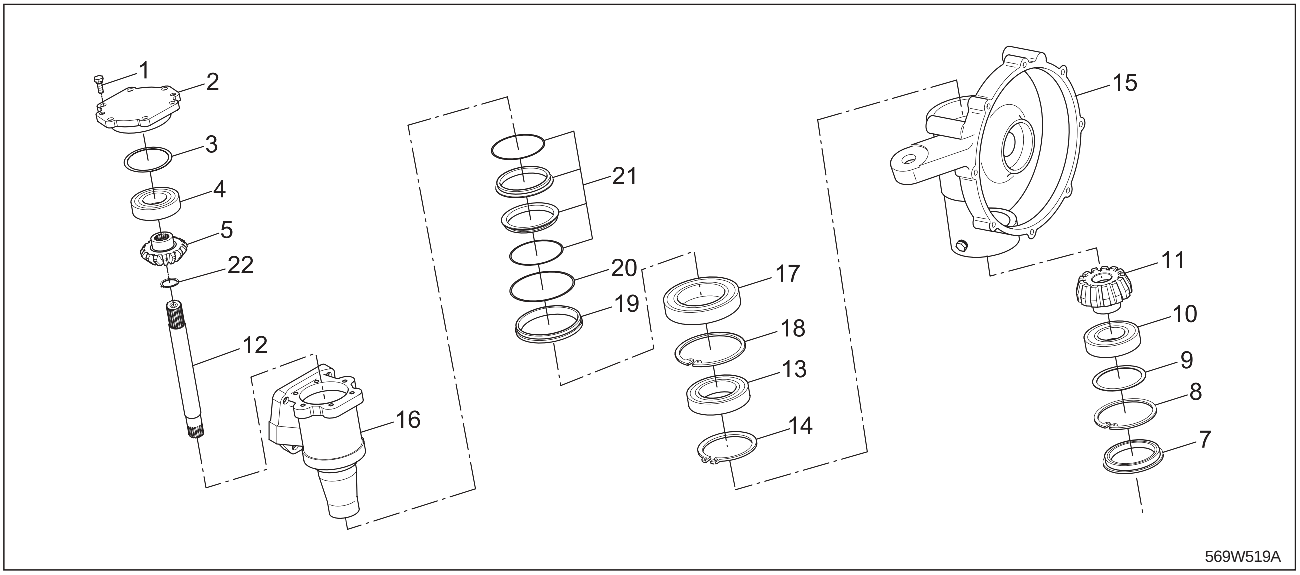
(1) Front Axle Case
(2) Front Axle Cover
(3) Bolt
(4) Ball Bearing
(5) 39 Bevel Gear
(6) Snap Ring
(7) Ball Bearing
(8) Front Axle
(9) Float Seal Ass'y
(10) Seal Ring
(11) O-Ring
(12) O-Ring
(13) Stud

B. TO ASSEMBLE

1. Install 6209 ball bearing (7) on front axle cover (2).
2. Install float seal ass'y (9) on the opposite to 6209 ball bearing (7) of front axle cover (2).
3. Install floating seal ass'y (9) on the front axle with front axle (8) inserted to fix with 6209 ball bearing (7).
4. Install mounting snap ring (6) of 6209 ball bearing (7) on front axle (8).
5. Install 39 bevel gear (5) and then 6208 ball bearing (4).
6. Install O-ring (12) on the circumference of the front axle cover and apply grease 7. Insert front axle case (1) and front axle cover (2) into the assembly holes as aligned to tighten with sixteen M8 washer mounting bolts (3).

Tightening torque	Stud (13) for assembly of the front axle ass'y and the rim	196.2 ~ 225.6 N·m 20.0 ~ 23.0 kgf·m 144.6 ~ 166.3 lbf·ft
	Tightening bolt of the front axle cover	23.5 ~ 27.4 N·m 2.40 ~ 2.80 kgf·m 17.3 ~ 20.2 lbf·ft

5.2 BEVEL GEAR CASE AND FRONT AXLE CASE



(1) Bolt	(8) Snap Ring	(13) 6011 Ball Bearing	(18) Snap Ring
(2) Bearing Cover	(9) Shim	(14) Snap Ring	(19) Housing
(3) Shim	(10) 6208 Ball Bearing	(15) Front Axle Case	(20) O-Ring
(4) Ball Bearing	(11) 13 Bevel Gear	(16) Bevel Gear Case	(21) Floating Seal
(5) 16 Bevel Gear	(12) Bevel Gear Shaft	(17) 6014 Ball bearing	(22) Snap Ring
(7) Plug			

A. TO DISASSEMBLING

1. Remove six M8 washer mounting bolts to loosen bearing cover (2).
2. Remove shim (3), 6208 ball bearing (4) and 16 bevel gear (5) at the top of bevel gear case (16).
3. Remove plug (7) at the bottom of front axle case (15).
4. Remove snap ring (8) and Disassembling shim (9), 6208 ball bearing (10), 13 bevel gear (11) and bevel gear shaft (12).
5. Remove mounting snap ring (14) of 6011 ball bearing (13).
6. Separate front axle case (15) and bevel gear case (16).
7. Remove 6014 ball bearing (17), snap ring (18) and 6011 ball bearing (13) inside front axle case (15).
8. Remove housing (19), O-ring (20) and floating seal (21) at the bottom of bevel gear case (16).

B. TO ASSEMBLE

1. Install 6011 ball bearing (13), snap ring (18) and 6014 ball bearing (17) on front axle case (15).
2. Install O-ring (20), housing (19) and floating seal (21) on the assembled of front axle case (15) and bevel gear case (16).
3. Install front axle case (15) on bevel gear case (16) and tighten snap ring (14) at the bottom of 6011 ball bearing (13).
4. Install 13 bevel gear (11), 6208 ball bearing (10), shim (9) and snap ring (8) on front axle case (15).
5. Install plug (7) after greased on its contacted surface on front axle case (15).
6. Sub-assemble snap ring (22), 16 bevel gear (5) and 6208 ball bearing (4) on bevel gear shaft (12) and fix bevel gear shaft (12) and 13 bevel gear (11) as splined by pushing downward from the top of the bevel gear case (16).
7. Place shim (3) on the top of 6208 ball bearing (4) and fix bearing cover (2) with M8 washer mounting bolt (1).

Tightening torque	Mounting bolt (1) of the bearing cover	23.5 ~ 27.4 N·m 2.40 ~ 2.80 kgf·m 17.3 ~ 20.2 lbf·ft

CAUTION

- *Support the bottom when disassembling front axle case to keep the case from falling down.*
- *Install plug (7) after applying sealant on.*

→ *Three Bond 1216 or its equivalent.*

5.3 BEVEL GEAR CASE AND FRONT AXLE SUPPORT

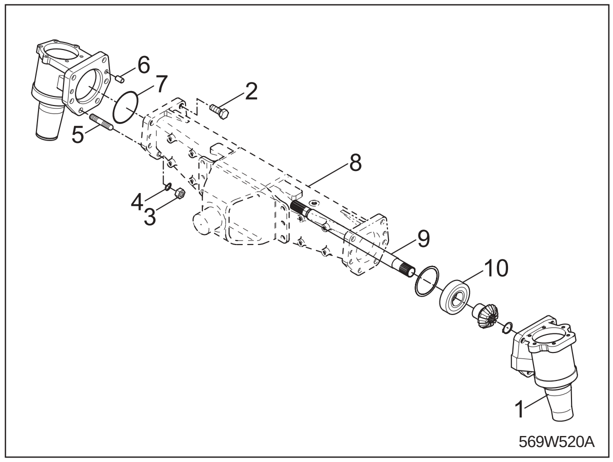
A. TO DISASSEMBLING

1. Remove four M14 bolt and two nuts (3) to separate separate bevel gear case (1) and front axle support (8).

B. TO ASSEMBLE

1. Install two parallel pins (6) and two stud (5) on bevel gear case (1).
2. Install O-ring (7) on the rim of 6309 ball bearing (10) in the bevel gear case ass'y and apply grease.
3. Push differential gear shaft (9) in the bevel gear case ass'y into the splined section of the differential side gear inside front axle support (8) as aligned.
4. Tighten bevel gear case (1) and front axle support (8) with four bolt (2) and two nuts (3).

Tightening torque	Stud bolt (5) for assembly of the front axle support and the bevel gear case	123.6 ~ 147.1 N·m 12.6 ~ 15.0 kgf·m 91.1 ~ 108.5 lbf·ft
	Assembling bolt (2) of the front axle support and the bevel gear case	123.6 ~ 147.1 N·m 12.6 ~ 15.0 kgf·m 91.1 ~ 108.5 lbf·ft
	Assembling nut (3) of the front axle support and the bevel gear case	123.6 ~ 147.1 N·m 12.6 ~ 15.0 kgf·m 91.1 ~ 108.5 lbf·ft



(1) Bevel Gear Case
(2) Bolt
(3) Nut
(4) Spring Washer
(5) Stud
(6) Parallel Pin
(7) O-Ring
(8) Front Axle Support
(9) Differential Gear Shaft
(10) Ball Bearing

5.4 FRONT AXLE SUPPORT AND DIFFERENTIAL GEAR CASE

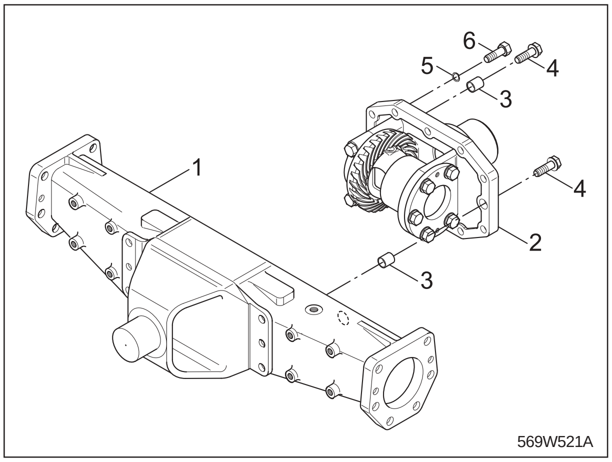
A. TO DISASSEMBLING

1. Remove bolts (4), (6) on the assembly of front axle support (1) and differential gear case to Disassembling differential gear case ass'y (2) in a body.

B. TO ASSEMBLE

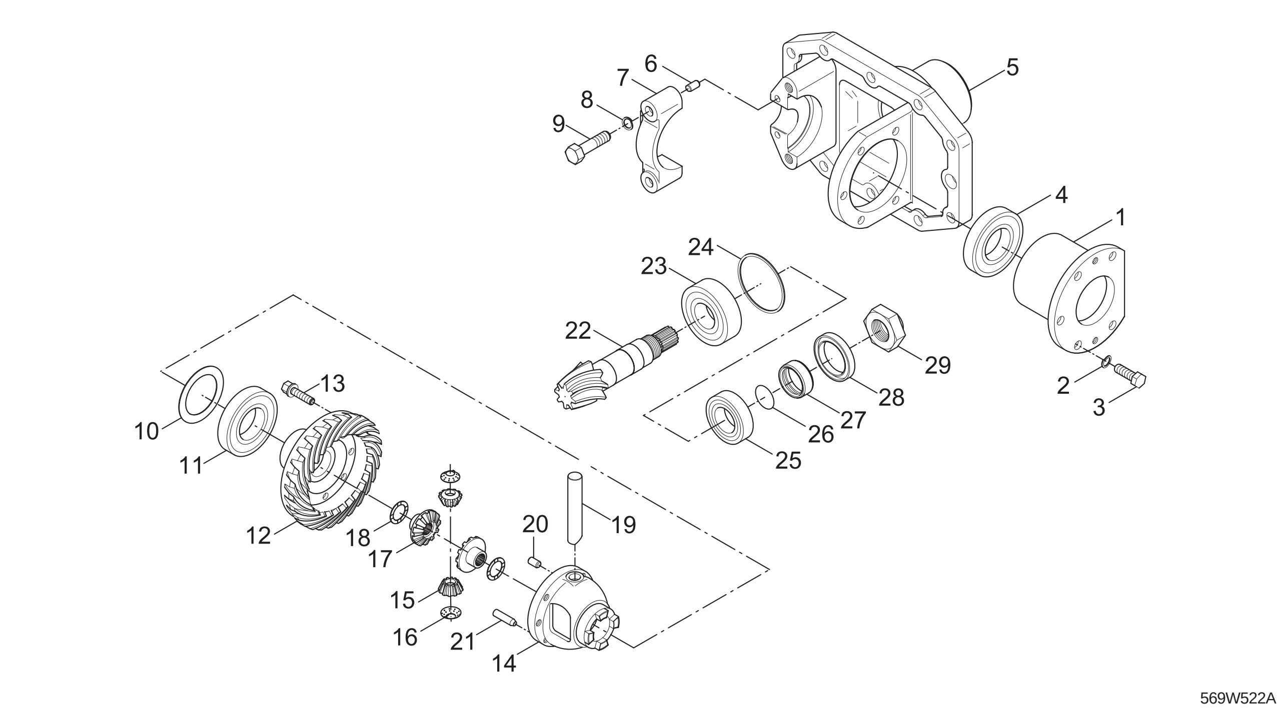
1. Apply liquid gasket evenly on the assembling surface of front axle support (1) and differential gear case (2).
2. Install two pipe pins (3) on front axle support.
3. Fix front axle support (1) and differential gear case ass'y (2) with inlet bolts (4), (6).
4. Install the bevel gear case ass'y on both sides of front axle support.

Tightening torque	Tightening bolt of the differential gear case ass'y	77.9 ~ 90.2 N·m 7.90 ~ 9.20 kgf·m 57.4 ~ 66.5 lbf·ft
	UBS bolt tightening of the differential gear case ass'y	103.0 ~ 117.7 N·m 10.5 ~ 12.0 kgf·m 75.9 ~ 86.8 lbf·ft



(1) Front Axle Support
(2) Differential Gear Case Ass'y
(3) Pipe Pin
(4) Bolt
(5) Spring Washer
(6) Bolt

5.5 FRONT DIFFERENTIAL GEAR



(1) Front Differential Bearing Support	(11) Ball Bearing	(21) Parallel Pin
(2) Spring Washer	(12) 27 Bevel Gear	(22) 8 Bevel Pinion Shaft
(3) Bolt	(13) UBS Bolt	(23) Taper Roller Bearing
(4) Ball Bearing	(14) Front Differential Case	(24) Shims
(5) Differential Gear Case	(15) Differential Pinion	(25) Taper Roller Bearing
(6) Parallel Pin	(16) Differential Side Washer	(26) O-Ring
(7) Case Cover	(17) Differential Side Gear	(27) Oil Seal Collar
(8) Spring Washer	(18) Shims	(28) Oil Seal
(9) Bolt	(19) Differential Pinion Shaft	(29) Nut
(10) Shims	(20) Parallel Pin	

A. TO DISASSEMBLING

1. Remove inlet bolt (3) on front differential bearing support (1) to Disassembling front differential bearing support (1) while tightening with a suitable bolt for the screw hole of M8×P1.25.
2. Loosen two M12 bolts (9) of differential gear case ass'y (5) and remove case cover (7) to Disassembling the front differential gear ass'y.
3. Remove shim (10) and ball bearing (11) out of 27 bevel gear (12).
4. Loosen six UBS bolts (13) to Disassembling front differential case (14) and 27 bevel gear (12).
5. Take parallel pin (21) out of front differential case (14) and remove differential pinion shaft (19), differential side washer (16), differential pinion (15), differential side gear (17) and shim (18).
6. Remove ball bearing (4) out of front differential case (14).
7. Remove the caulking to loosen nut (29).
8. Slightly knock the shaft part of 8 bevel pinion shaft (22) to take out, and remove oil seal (28), oil seal collar (27), O-ring (26), taper roller bearing (25), shim (24) and taper roller bearing (23) in due order.

B. TO ASSEMBLE

1. Sub-assemble the inner rim of taper roller bearing (23) on 8 bevel pinion shaft (22).
2. Sub-assemble the outer rim of taper roller bearing (23), shim (24) and the outer rim of taper roller bearing (25) on differential gear case ass'y (5).
3. Install the sub-assembled 8 bevel pinion shaft (22) on differential gear case ass'y (5).
4. Support the gear side of 8 bevel pinion shaft (22) and knock the inner rim of taper roller bearing (25) into the opposite side.
5. Install O-ring (26) on the inner bore of oil seal collar (27) and apply grease to fix on 8 bevel pinion shaft (22) with a replacing tool.
6. Apply grease on the inner rim of oil seal (28) to install on the outer rim of oil seal collar (27) with a replacing tool.
7. While tightening nut (29) to allow the turning torque of 8 bevel pinion shaft (22) to be 0.13 ~0.17 kgf·m, apply caulking after the adjustment. Turning torque: 0.13 ~0.17 kgf·m (1.27 ~ 1.667 N·m, 0.94 ~ 1.23 lbf·ft)
8. Sub-assemble front differential case (14) section.

- Install shim (18), differential side gear (17), differential side washer (16), differential pinion (15) in due order and then differential pinion shaft (19) inside front differential case (14).

CAUTION

- *When assembling differential pinion shaft (19), let the section area located opposite to 27 bevel gear (12).*

  Decide such installing shim (18) as to allow backlash of differential pinion (15) and differential side gear (17) to be 0.1 ~ 0.3 mm (0.0039 ~ 0.0118 in.)
- *Install parallel pin (21) on differential pinion shaft (19).*
  - *Install parallel pin (20) on front differential case (14).*
  - *Install shim (18), differential side gear (17) on the inner bore of 27 bevel gear (12) and tighten 27 bevel gear (12) and front differential case (14) with 6 UBS bolts (13) as aligned with the position of parallel pin (20).*

CAUTION

- *Apply adhesive on the UBS bolt (Three Bond 1324B) and fix at a tightening torque of 3.0 ~ 3.5 kgf·m (29.4 ~ 34.3 N·m, 21.6 ~ 25.3 lbf·ft)*

9. Install shim (10), ball bearing (11), two parallel pins (6) on differential gear case (5) and tighten case cover (7) with two M12 bolts (9).
10. Sub-assemble ball bearing (4) on front differential bearing support (1) and push into differential gear case ass'y (5) to tighten with five M10 bolts (3).

CAUTION

- *Check for backlash and reaching up of 27 bevel gear (12) and 8 bevel pinion shaft (22).*

Adjustment of Backlash

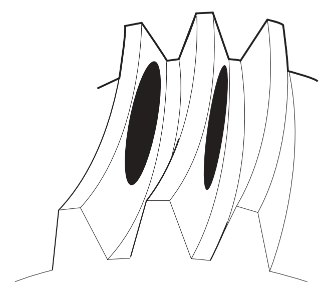
- Use the adjusting shim for 27 bevel gear (12) and 8 bevel pinion shaft (22).

  Backlash: 0.2 ~ 0.3 mm (0.0078 ~ 0.0118 in.)

Confirmation of Reaching Up

Apply minimum lightly on several thrashing faces at three equally divided positions in the circle circumference of 27 bevel gear (12) and turn 8 bevel pinion shaft (22) with a load on 27 bevel gear (12), then to confirm its reaching up (Degree of reaching up is at least 35 % the thrashing face of the gear without load, and 1/3 ~ 1/2 away from minor section).

Tightening torque	Tightening bolt (3) of the front differential bearing support	48.0 ~ 55.9 N·m 4.90 ~ 5.70 kgf·m 35.4 ~ 41.2 lbf·ft
	Tightening bolt (9) of the differential gear case cover	77.5 ~ 90.2 N·m 7.90 ~ 9.20 kgf·m 57.1 ~ 66.5 lbf·ft
	Tightening UBS bolt (13) of the front differential case and the 27 bevel gear	29.4 ~ 34.3 N·m 3.0 ~ 3.5 kgf·m 21.6 ~ 25.3 lbf·ft
	Turning torque of 8 bevel pinion shaft (22)	1.27 ~ 1.667 N·m 0.13 ~ 0.17 kgf·m 0.94 ~ 1.23 lbf·ft



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5.6 FRONT BRACKET

A. TO DISASSEMBLING

1. Remove mounting nut (7), bolt (6) and seal washer (8).
2. Separate front bracket (2) from front axle support (1).
3. Remove two oil seals (5), DX bush (4) and adjusting plate (3) in front bracket (2).
4. Remove grease nipple (9).

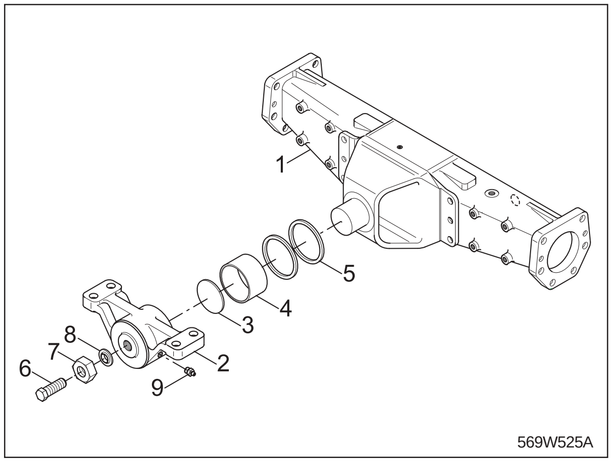
B. TO ASSEMBLE

1. Insert adjusting plate (3) into the inner bore of front bracket (2).
2. Install DX bushing (4) with a replacing tool
3. Install two oil seals (5) with a replacing tool and apply grease.
4. Install grease nipple (9), seal washer (8), mounting nut (7) and bolt (6).
5. Install front bracket ass'y (2) on front axle support (1).
6. Apply grease to the inner bore of front bracket (2) via grease nipple (9).

Tightening torque	Tightening nut (7) of the front bracket	98.1 ~ 147.1 N·m 10.0 ~ 15.0 kgf·m 72.3 ~ 108.4 lbf·ft
	Tightening bolt (6) of the front bracket	19.6 ~ 29.4 N·m 2.0 ~ 3.0 kgf·m 14.4 ~ 21.6 lbf·ft

CAUTION

- *Knock the groove of DX bushing (4) into the nipple's groove of front bracket (2) aligned.*
- *Install the lip area of oil seal (5) outward.*



(1) Front Axle Support
(2) Front Bracket
(3) Adjusting Plate
(4) DX Bushing
(5) Oil Seal
(6) Bolt
(7) Nut
(8) Seal Washer
(9) Grease Nipple

5.7 REAR BRACKET

A. TO DISASSEMBLING

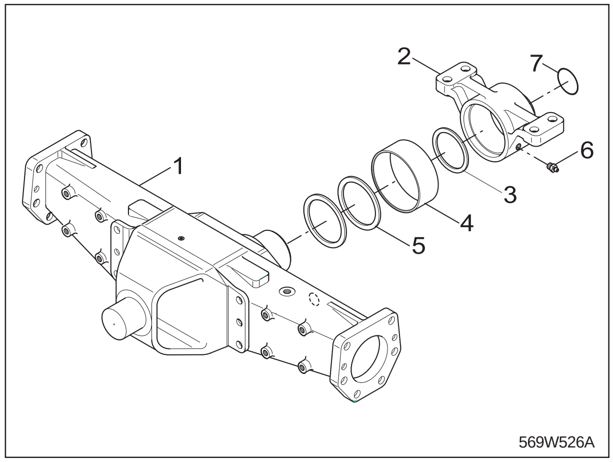
1. Separate front axle support (1) and rear bracket ass'y (2).
2. Remove thrust collar (3), DX bushing (4) and two oil seals (5).
3. Remove O-ring (7).
4. Remove grease nipple (6).

B. TO ASSEMBLE

1. Insert thrust collar (3) into the inner bore of rear bracket (2).
2. Install DX bushing (4) with a replacing tool.
3. Install two oil seals (5) with a replacing tool and apply grease.
4. Install grease nipple (6).
5. Install Ø42 O-ring (7) on the inner bore of rear bracket (2) and apply grease.
6. Apply grease to the inner bore of rear bracket (2) via grease nipple (6).

CAUTION

- *Knock the groove of DX bushing (4) into the nipple's groove of rear bracket (2) as aligned.*
- *Install the lip area of oil seal (5) outward.*

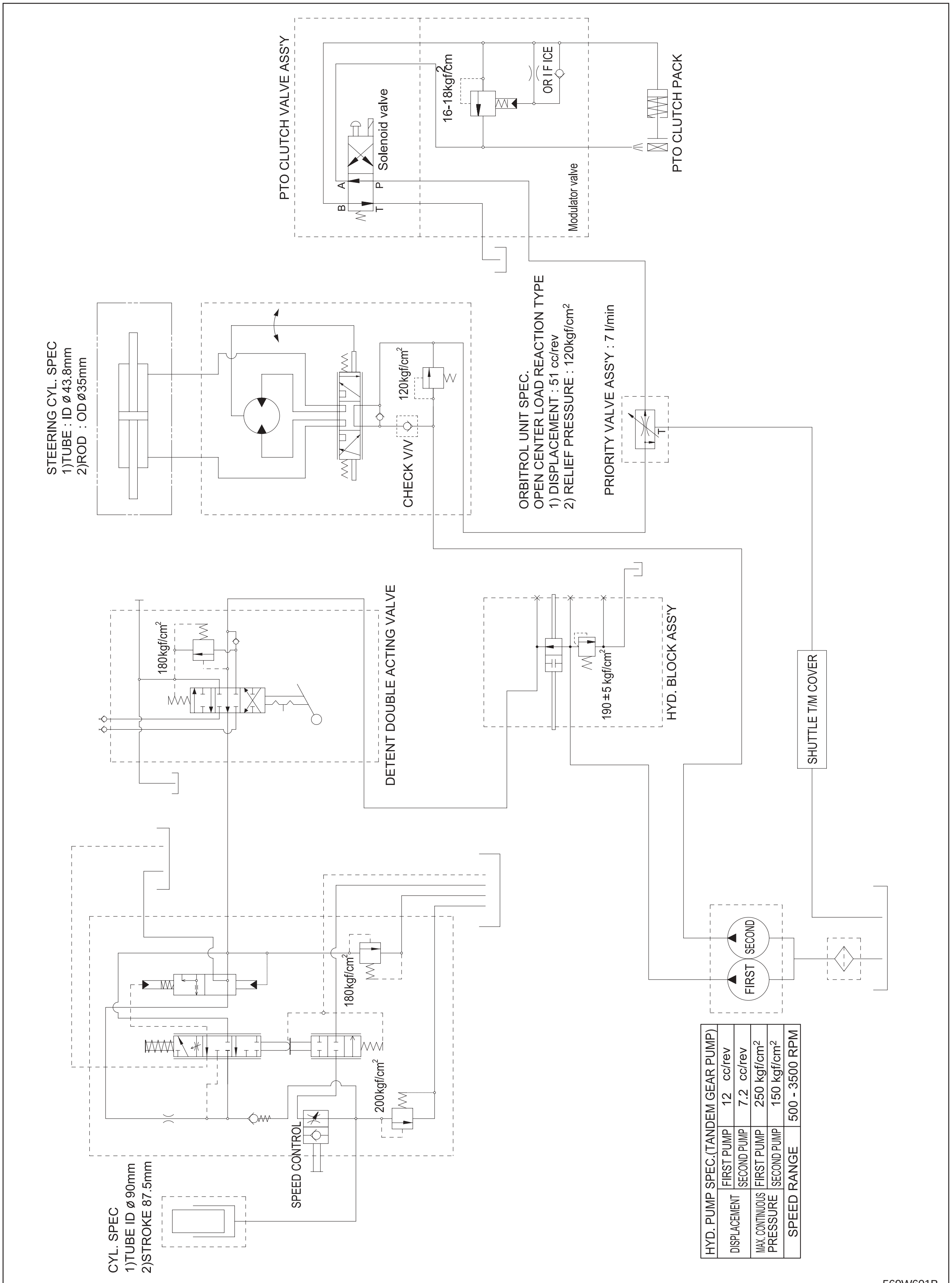


(1) Front Axle Support
(2) Rear Bracket
(3) Thrust Collar
(4) DX Bushing
(5) Oil Seal
(6) Grease Nipple
(7) O-Ring

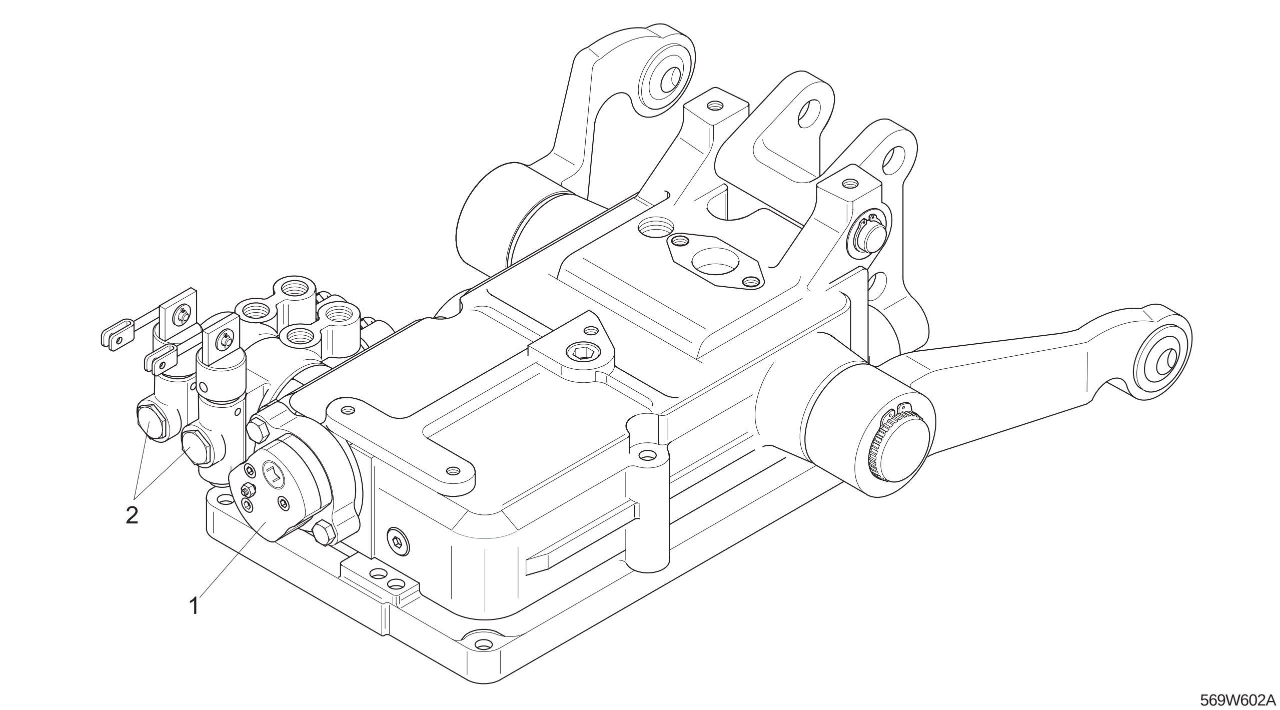
CHAPTER 6

HYDRAULIC SYSTEM

1. HYDRAULIC POWER LIFT SYSTEM



HYD. PUMP SPEC.(TANDEM GEAR PUMP)		
DISPLACEMENT	FIRST PUMP	12 cc/rev
	SECOND PUMP	7.2 cc/rev
MAX. CONTINUOUS PRESSURE	FIRST PUMP	250 kgf/cm²
	SECOND PUMP	150 kgf/cm²
SPEED RANGE		500 - 3500 RPM



(1) Control Valve (2) Double Acting Valve

Hydraulic lift system to raise the implement connected to the 3 point link provides three applications of position control, draft control and mixed control by the control valve and the linkage installed on the hydraulic cylinder body. Since main control valve is available to control oil flowing in and out of the hydraulic cylinder so to control the implement up and down at a constant speed regardless of the implement load, high work performance can be achieved without impact while raised or lowered. Several implements can be attached at a time for their applications owing to the outlet valve of the exterior oil pressure equipped on the rear of the power lift body in 8454.

1.1 TROUBLESHOOTING

Symptom	Probable Cause	Solution
The Rockshaft lifts jerkily.	• Insufficient oil level in the tank. • Pump inlet filter clogged. • Infiltration of air into the pump inlet pipe.	• Top up the level. • Clean or replace the filter. • Check the inlet pipe and any couplings and gaskets.
Rockshaft does not operate.	• Adjusting piston sticked.	• Remove the distributor and clear the adjusting piston.
The rockshaft start to lift but stops as soon as if feels the load, but the overpressure valve does not intervene.	• Badly adjusted force transmission tie-rod (7).	• Adjust the controlled draft.
The Rockshaft does not descend.	• Outlet valve stuck.	• Remove the distributor and clear the outlet valve.
Lifting capacity does not match that prescribed.	• Deterioration of the distributor box seal rings. • Safety and overpressure valve out of calibration. • Poor pump efficiency. • Poor distributor box efficiency.	• Remove the distributor box and replace the external seal rings. • Calibrate the valves. • Replace the pump. • Overhaul the distributor box.
The rockshaft supports load with difficulty : There is a rhythmic oscillation when the motor is on : the load descends when motor is off.	• Piston gasket worn. • Defective sensitivity valve. • Defective overpressure valve. • Non return valve defective.	• Replace the gasket. • Adjust sensitivity or replace the valve. • Remove the distributor box and overhaul the valve. • Remove the distributor box and overhaul the valve.
With the booms in the upper end stop position and the motor is on, a rhythmic oscillation occurs : the load does not descend with the motor off.	• Faulty adjustment of controlled position lever limit switch.	• Adjust controlled position, limiting the upward boom ravel.
When operating under controlled draft, the implements in too much or else comes out of the furrow.	• Badly adjusted distributor sensitivity.	• Adjust sensitivity.
Controlled draft does not function : the rockshaft goes up and down only with position lever.	• Badly adjusted draft control lever.	• Adjust controlled draft operation.
Controlled position does not function and the rockshaft goes up and down only with the draft control lever.	• Position lever completely out of adjustment. • Internal leverage faults.	• Adjust controlled draft operation. • Overhaul the Rockshaft.

1.2 SPECIFICATIONS

A. TECHNICAL FEATURES

a. Operation with drawbar pull and position control.

b. Drawbar pull survey at hitch point.

c. Implement lowering speed adjusted by control valve lowering regulator.

d. Automatic hydraulic limit stop of angular excursion of lifting arms.

e. Dual lever sector control: One positioning lever plus one drawbar pull lever.

f. Oil feeding: By transmission oil.

g. Oil filter not built-in.

h. Required degree of filtering: 30µ

B. DIMENSIONAL FEATURES

a. Piston diameter .... 110 mm (4.33 in.)

b. Working stroke .... 102 mm (4.01 in.)

c. Piston displacement .... 969 cm^3

d. Angular excursion of lifting arms.
under drawbar pull control conditions .... 70° + 2

e. Intervention value of automatic
hydraulic limit stop .... 75°

f. Internal mechanical limit stop .... 78°

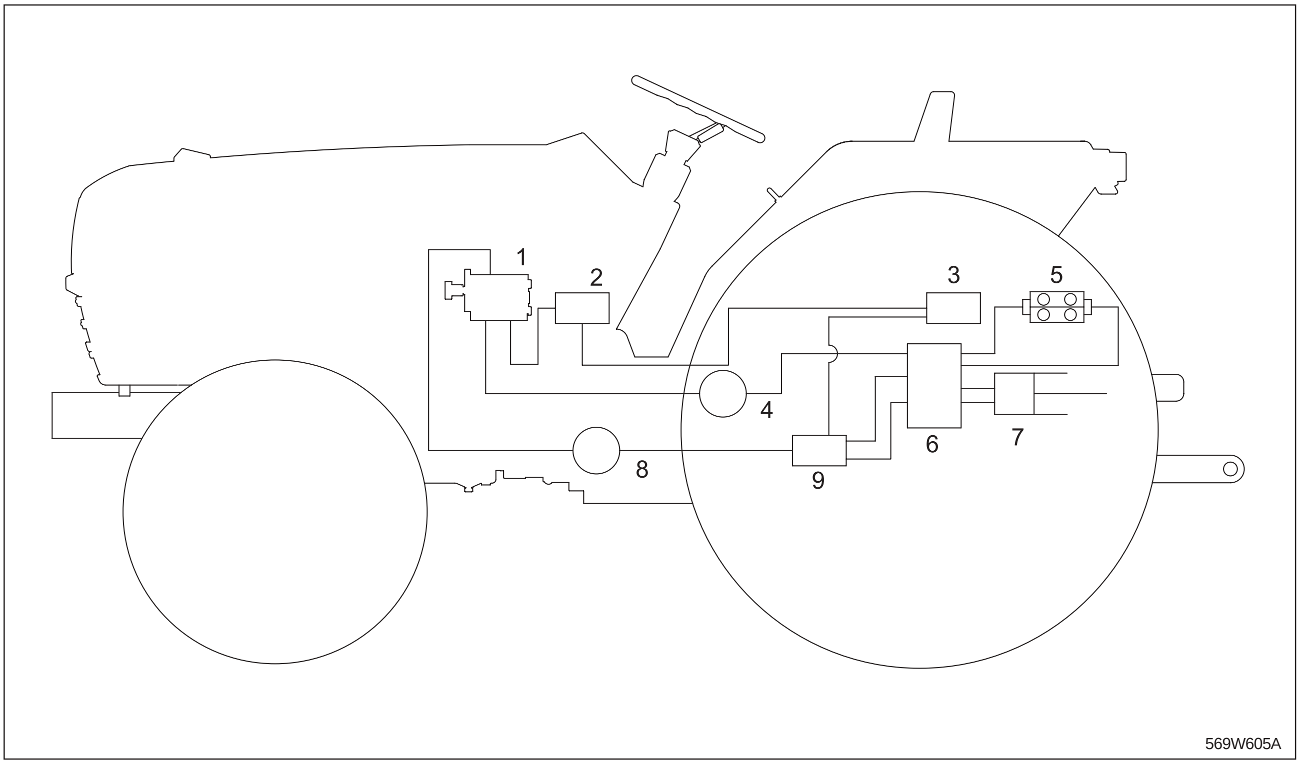
C. CALIBRATION SETTINGS OF LIFTING DEVICE VALVES

a. Safety valve calibration .... 180 + 5 bar

b. Calibration of cylinder protection
valve .... 200 + 5 bar

1.3 STRUCTURE AND OPERATION

A. STRUCTURE

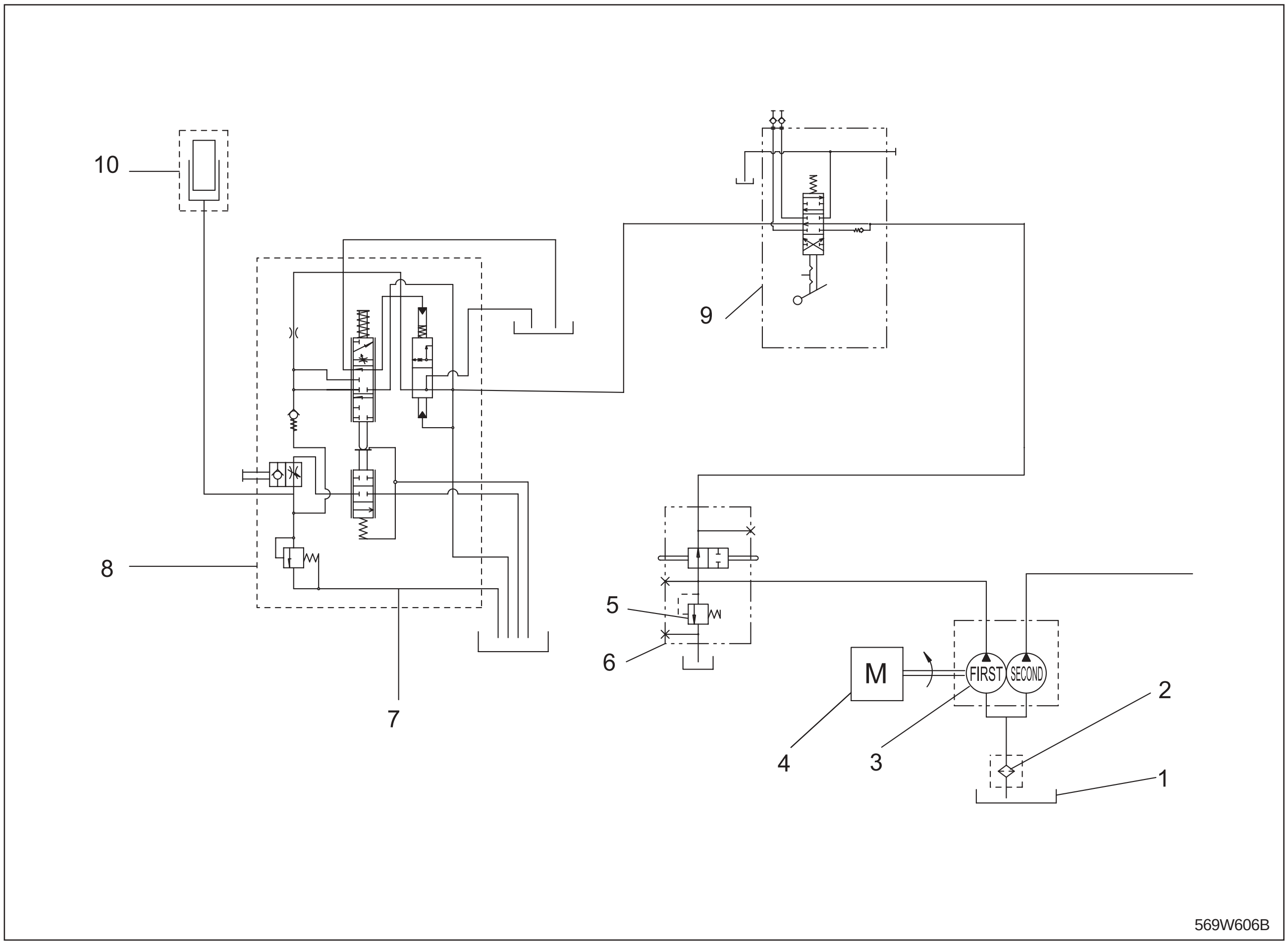


(1) Gear Pump
(2) Orbital Unit
(3) PTO Clutch Valve
(4) Front Hydraulic Block
(5) Quick Couplers (If Equipped)
(6) Control Valve
(7) Hydraulic Cylinder
(8) Oil Filter Cartridge
(9) Oil Tank (Transmission Case)

The hydraulic system of the 8454 tractor is composed of the main components as shown in the figure.
This system has the following three functions.

1. To raise and lower the implement connected to the three point hitch. For this motion, the control valve (6) and the linkage installed on the hydraulic cylinder body provide three different applications' position control, draft control, and mixed control.
2. Take out hydraulic power from the front hydraulic block assembly (4) to operate an implement's hydraulic actuator.
3. Take out hydraulic power from the quick couplers (5) included in the auxiliary control valve assembly (if equipped) for the implements with actuators. In this case, the implement's cylinders can be actuated by pirating the auxiliary control valves.

B. HYDRAULIC CIRCUIT FOR THREE POINT HYDRAULIC SYSTEM



(1) Oil Tank (Transmission Case)
(2) Hydraulic Oil Filter Cartridge
(3) Hydraulic Pump
(4) Engine
(5) Relief Valve
(6) Front Hydraulic Block
(7) Position Control Valve
(8) Hydraulic Cylinder
(9) Auxiliary Control Valve (If Equipped)
(10) Hydraulic Cylinder Block

Hydraulic Oil Flow

1. When the engine (4) is started, the hydraulic pump (3) is rotated to draw oil from the transmission case (1) through the suction pipe. Supplied oil is filtered by the hydraulic oil filter cartridge (2).
2. Filtered oil is forced out by the hydraulic pump to the front hydraulic block (6). When a front end loader is equipped with the tractor, oil pressure is taken from the front end loader flows back to this front hydraulic block (6), to be returned into the oil hydraulic circuit.
3. After that oil into the position control valve (7) through the delivery pipe.
4. The position control valve (7) switches the oil flow, and oil is channeled to the hydraulic cylinder (8) for the three-point hydraulic system or returned to the oil tank (transmission case) (1).

* The hydraulic system has a relief valve (5) which restricts the maximum pressure in the circuit.

* When hydraulic power is taken out to use a hydraulically operated implement, implement's cylinders can be actuated by operating the double acting auxiliary control valve (9).

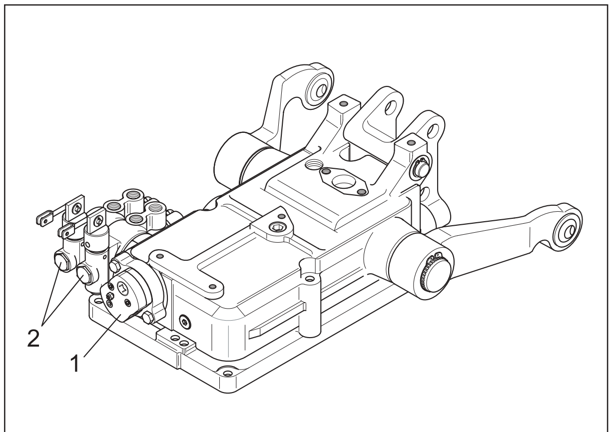
C. HYDRAULIC CYLINDER VALVES

a. Control Valve

Control valve detects load on the implement as composed of such valve to control the lifting and lowering of the lift arm at a constant speed always. Since blocking of valve oil leakage is available inside, oil lock gripper is necessary.

b. Double Acting Valve

This is generally applied to the implement attached on the double load cylinder, while used for operation of the boom cylinder with a loader.

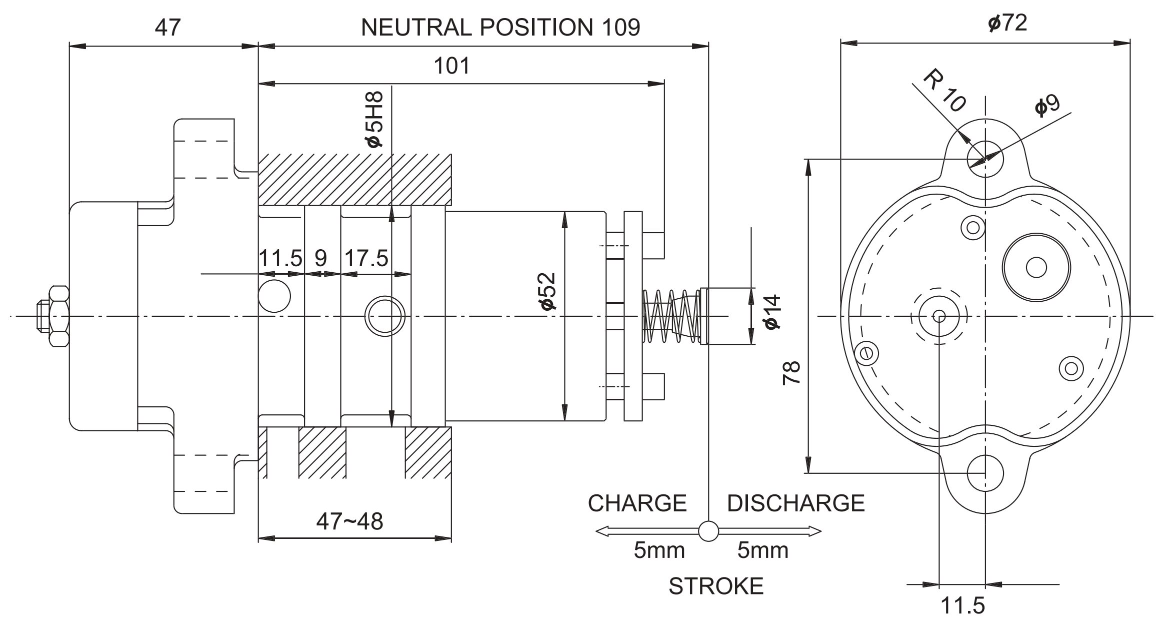


(1) Control Valve

(2) Double Acting Valve

c. Control Valve

1. Structure



MAX OIL TEMPERATURE	90˚
OIL FILTERING	20
OIL VISCOSITY	20~70 cst

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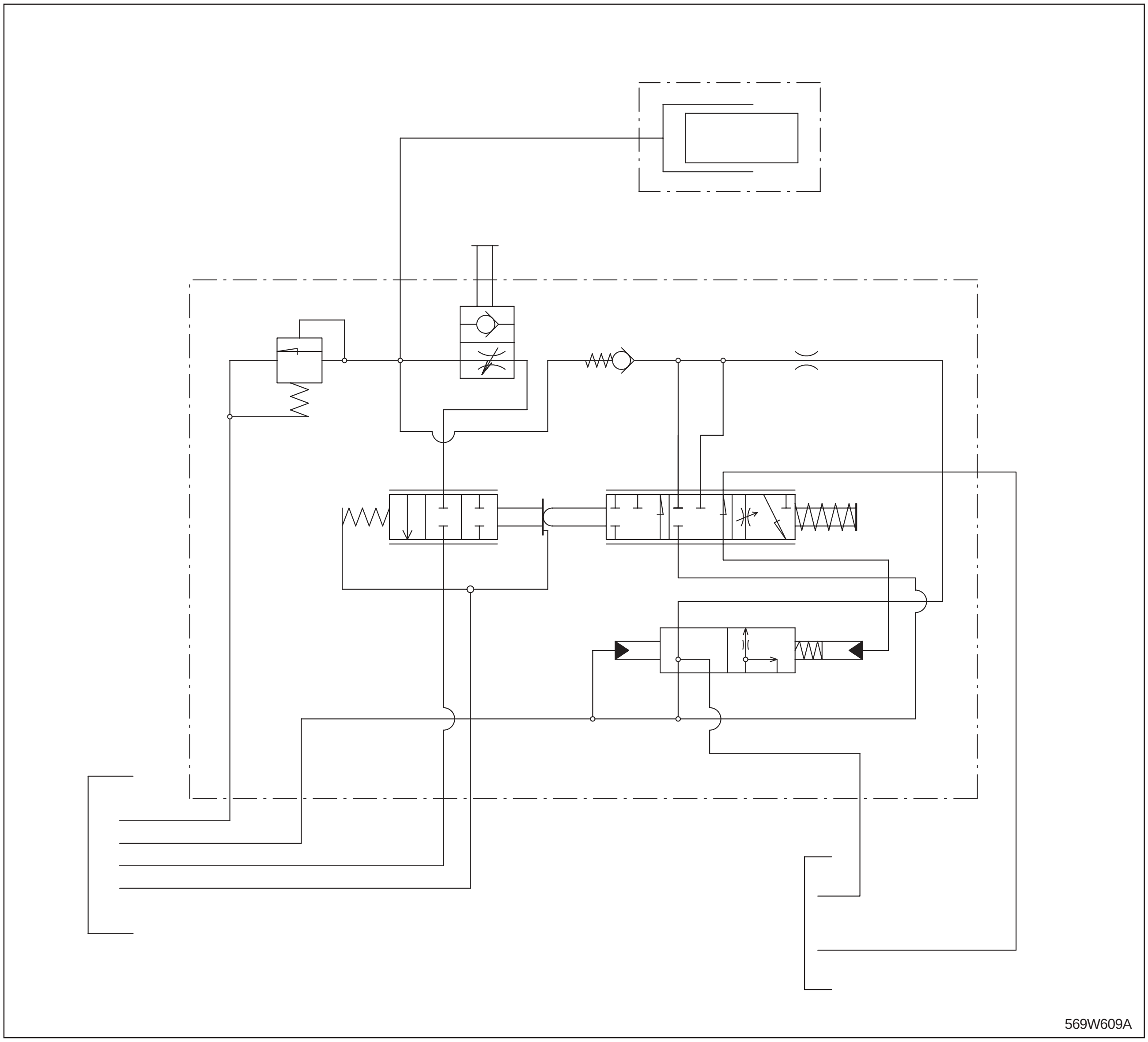
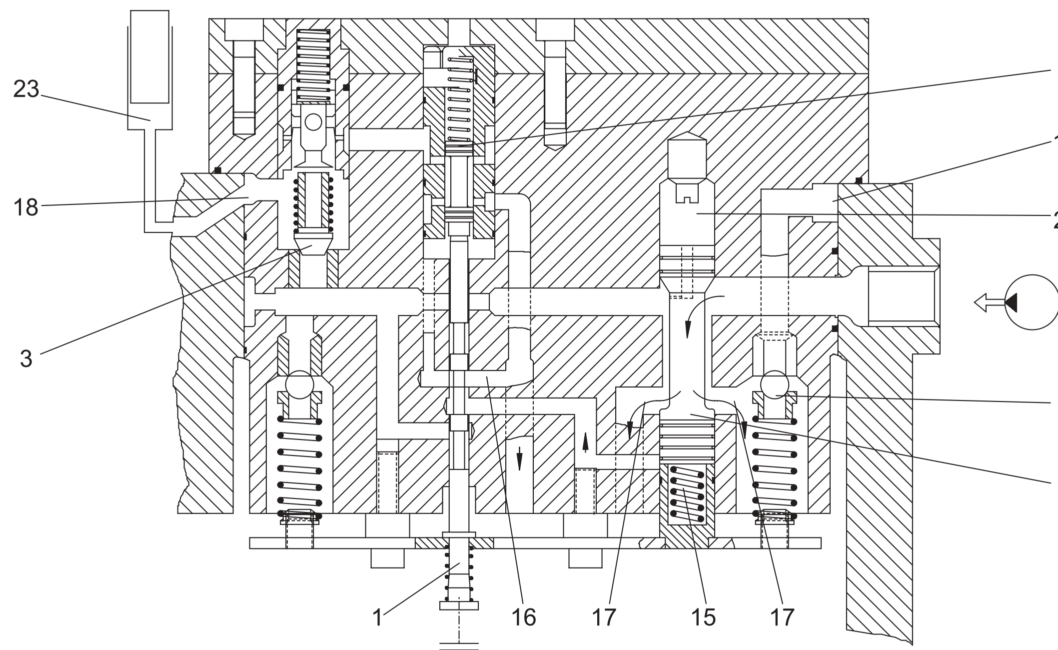
2. Circuit Diagram



3. Operation Principle

Since the control valve of the hydraulic cylinder is available to control oil flowing in and out of the hydraulic cylinder so to control the implement up and down at a constant speed regardless of the implement load, high work performance can be achieved without impact, along with the operation principle classified into 3 phases of neutral, delivery and discharge.



(1) Spool	(6) Fixed Throat	(17) Hole	(22) Chamber
(2) Piston	(7) Safety Valve	(18) Annular Duct	(23) Cylinder Chamber
(3) Check Valve	(8) Regulator	(19) Annular Duct	(24) Hole
(4) Valve	(15) Chambers	(20) Hole	(25) Hole
(5) Relief Valve	(16) Hole	(21) Hole	

a. Neutral Phase

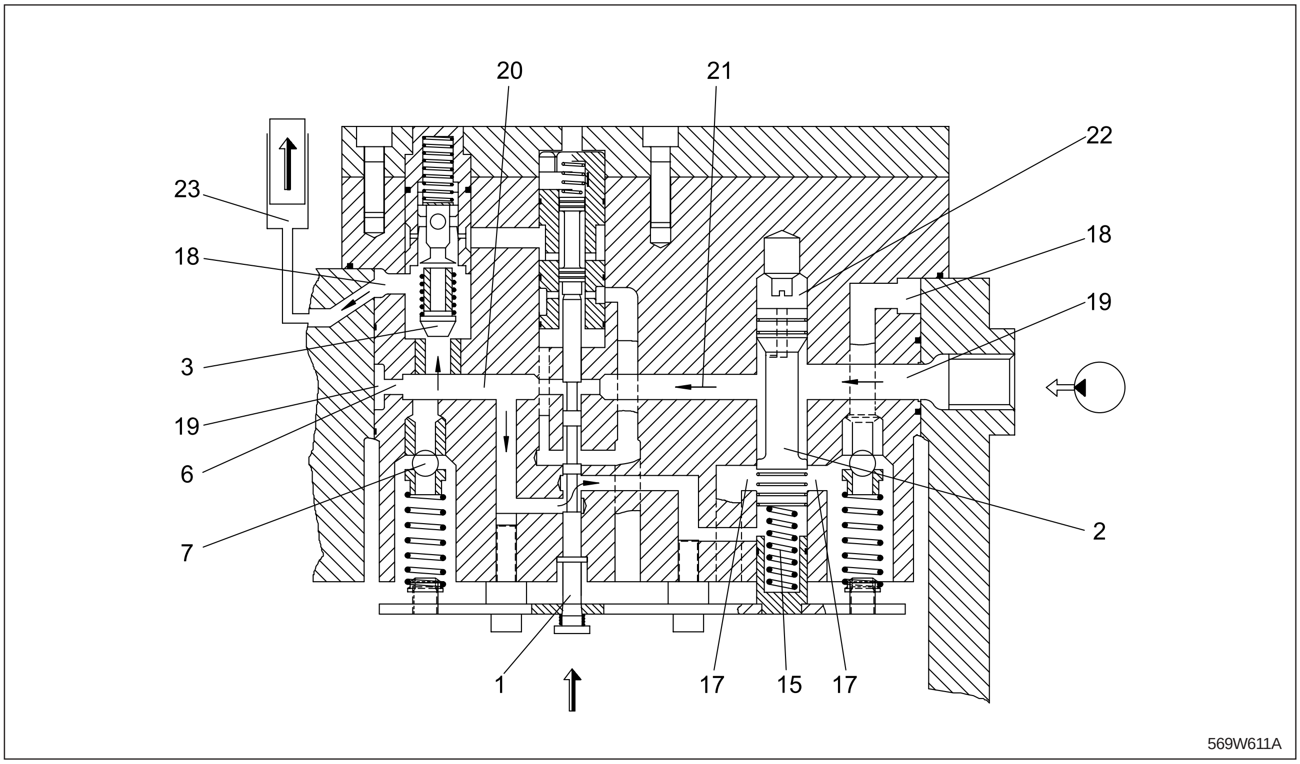
In this phases the control valve keeps on pressure the oil contained in the cylinder thus allowing the oil coming from the pump flow freely to the tank.

In this phase the control spool (1) is in such a position to connect the chamber (15) directly to the discharge through hole (16).

The oil coming from the pump will thus be able to move downward the small regulator piston (2) and thus flow to the chamber (22) and by opening the holes (17) it will flow to the tank.

The oil contained in the cylinder (Chamber 23) is kept on pressure by the check valve (3), by the discharge valve (4) and by the relief valve (5) connected to the cylinder by annular duct (18) thus holding the load applied to the lifting.

The relief valve (15) secures protection from any possible overpressure.



(1) Control Spool
(2) Regulator Piston
(3) Check Valve
(6) Fixed Throat
(7) Safety Valve
(15) Chamber
(17) Hole
(18) Annular Duct
(19) Annular Duct
(20) Hole
(21) Hole
(22) Chamber
(23) Cylinder Chamber

b. Delivery Phase

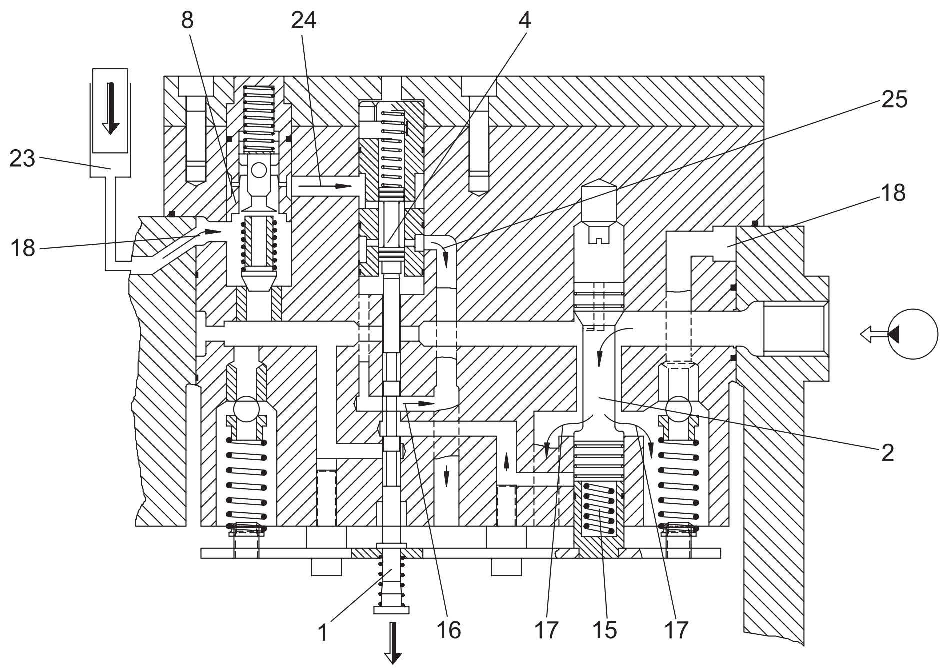
During this phase the control valve supplies the oil on pressure to the cylinder and it consequently lifts the arms. The control spool (1) is in such a position to connect the chamber (15) with the oil coming from the pump through annular duct (19) and holes (20) and (21).

In this way chambers (15) and (22) have the same pressure and the small regulator piston (2) close discharge holes (17) due to the upward push of return spring.

The oil on pressure flows to the cylinder through the annular duct (19), it enters the hole (20) through the fixed throat (6) and the variable throat made by the control spool (1) with the hole (21), it opens the check valve (3), it enters in annular duct (18) and flows into the cylinder chamber (23).

The small regulator piston (2) adjust the oil flow to the cylinder because chambers (15) and (22) are subject to the difference of pressure made by the oil passage through the fixed throat (6) and the variable throat made by the control spool (1), depending on its upward movement caused by he internal levers of power lift. The excessive flow is deviated at the lifting pressure by holes (17), in this way it regulates the maximum lifting speed and allows a slow starting and arrival of arms.

In this phase the maximum lifting pressure is controlled by the safety valve (7) that is connected to the annular duct (19) through holes (20) and (21).



(1) Control Spool
(2) Regulator Piston
(4) Exhaust Valve
(8) Regulator
(15) Chamber
(16) Exhaust Hole
(17) Hole
(18) Annular Duct
(23) Cylinder Chamber
(24) Hole
(25) Hole

c. Discharge Phase

During this phases the control valve supplies at the same time the oil coming from the pump and the oil contained in the cylinder to the discharge causing the lowering of the arms.

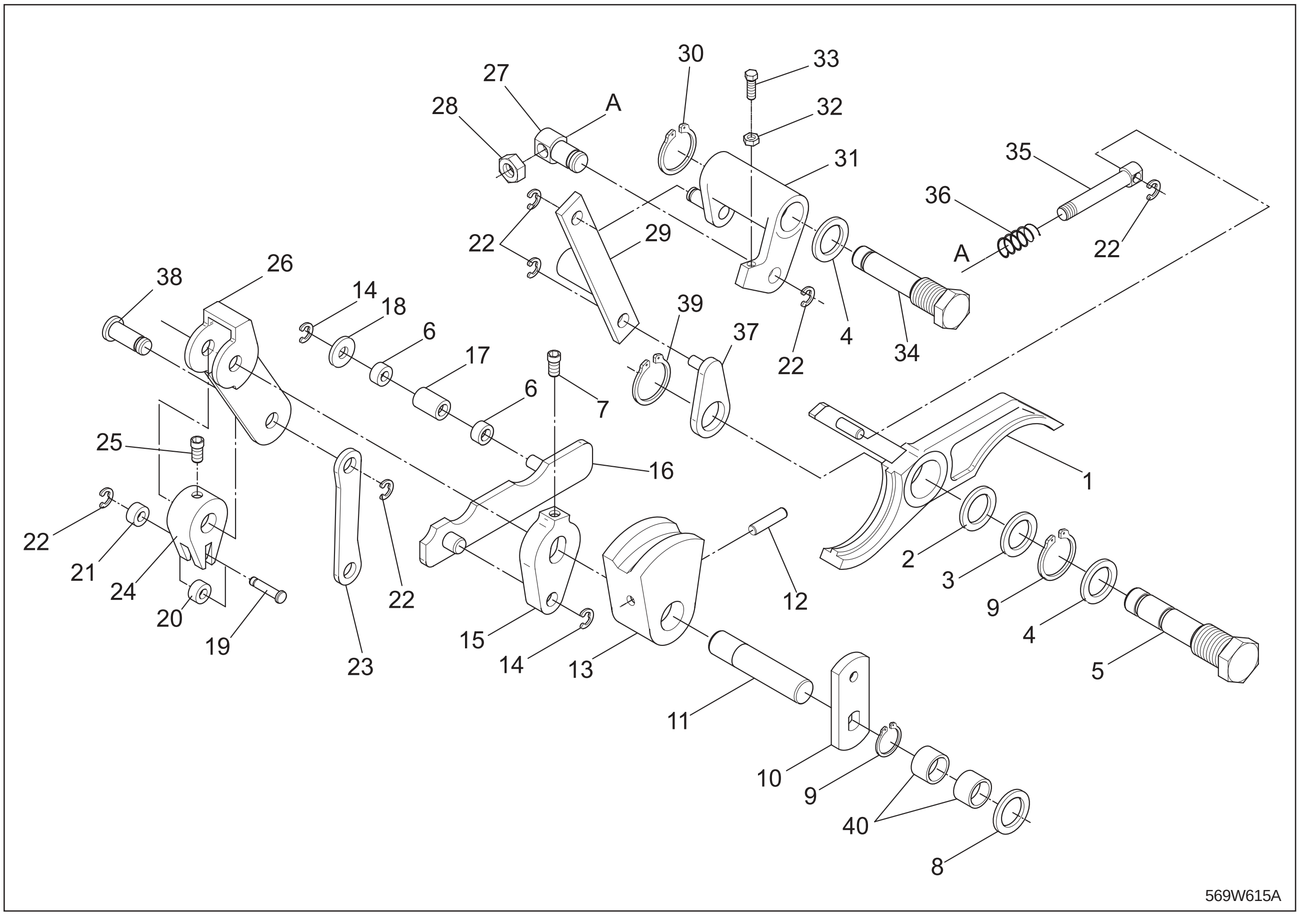
The control spool (1) is in such a position to connect chamber (15) directly to the discharge through hole (16). The oil coming from the pump, as in the neutral phase, is able to move downward the small regulator piston (2) and to flow to the discharge through holes (17).

At the same time the oil contained in the cylinder chamber (23) flows from annular duct (18) to the lowering regulator (8) and through hole (24) it enters the discharge valve (4), flowing to the discharge from the hole (25) therefore causing the lowering of arms.

In this phases the lowering speed of the implement is controlled automatically by the lowering regulator (8) that is sensible to the dynamic force of the discharge oil, consequently modifying the throat that keeping constant, into acceptable limits, the lowering speed even if the cylinder pressure varies.

D. CONNECTION SYSTEM OF THE INTERNAL LEVERAGE

a. Structure



(1) Lever	(11) Shaft	(21) Roller 2	(31) Arm
(2) Needle Bearing	(12) Spring Pin	(22) Snap Ring	(32) Nut
(3) Washer	(13) Cam	(23) Link 3	(33) Bolt
(4) Packing	(14) Snap Ring	(24) Arm	(34) Pin
(5) Pin	(15) Link 1	(25) Lock Screw	(35) Pin
(6) Roller 3	(16) Link 2	(26) Cam 1	(36) Spring
(7) Lock Screw	(17) Roller 4	(27) Pin	(37) Link
(8) Oil Seal	(18) Plain Washer	(28) Nut	(38) Pin
(9) Snap Ring	(19) Pin	(29) Link	(39) Snap Ring
(10) Link 4	(20) Roller 1	(30) Snap Ring	(40) Bush

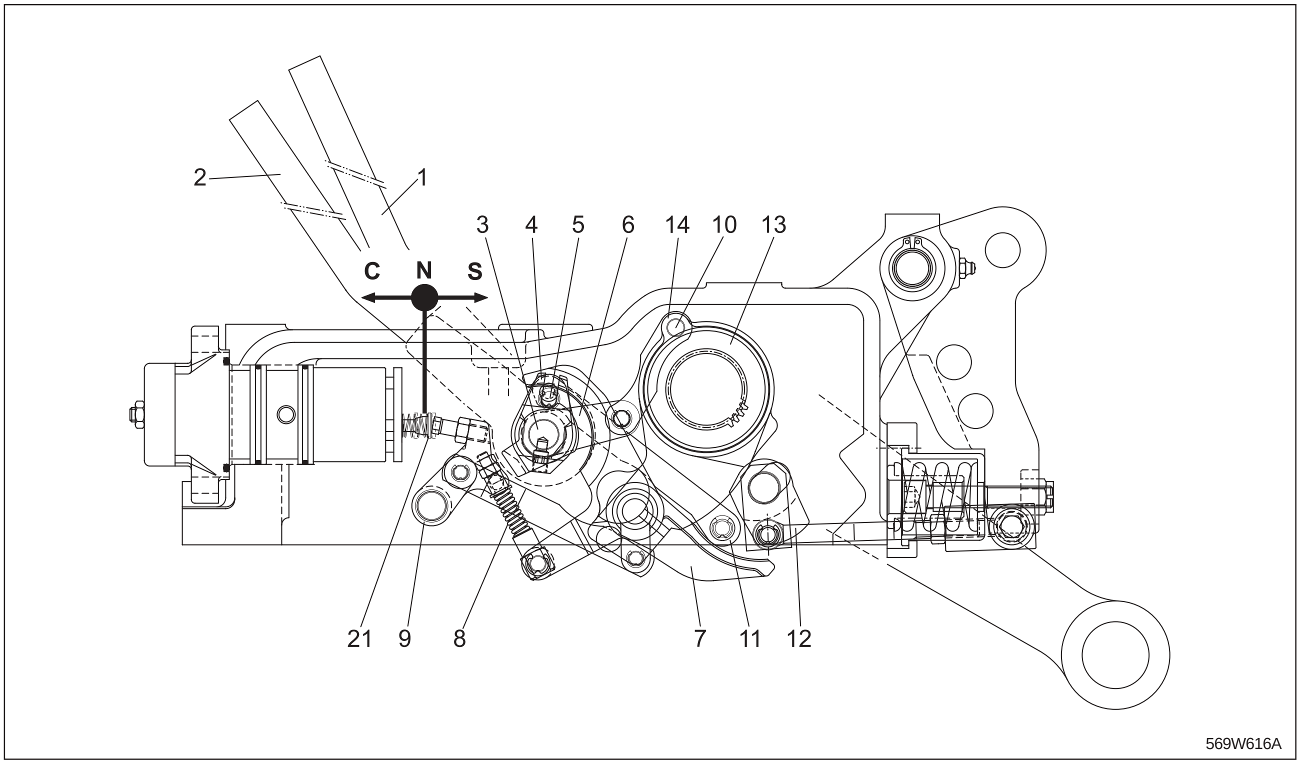
b. How the Internal Leverage System Works

Application is classified into three of position control, draft control and position & draft mixed control.

E. OPERATION

Operation is Divided Into Position Control, Draft Control and Mixed Operation.

a. Position Control



(1) Position Control Lever	(6) Cam 1	(11) Roller 4
(2) Draft Control Lever	(7) Lever	(12) Cam
(3) Shaft	(8) Friction Shock Absorber	(13) Crank
(4) Arm	(9) Arm	(14) Link 3
(5) Roller 1	(10) Pin	(21) Shaft

By moving the drawbar pull control lever (2) toward the backstop on the lower sector part, the roller 4 (11) sliding on the lever (7) of drawbar pull cam (12) will be moved away completely.

In that manner, the drawbar pull levers will not in any way interfere with the operation of the position control.

The raising movement of the arms is obtained by moving the position control lever (1) upward, and the leverage system will act in the following way.

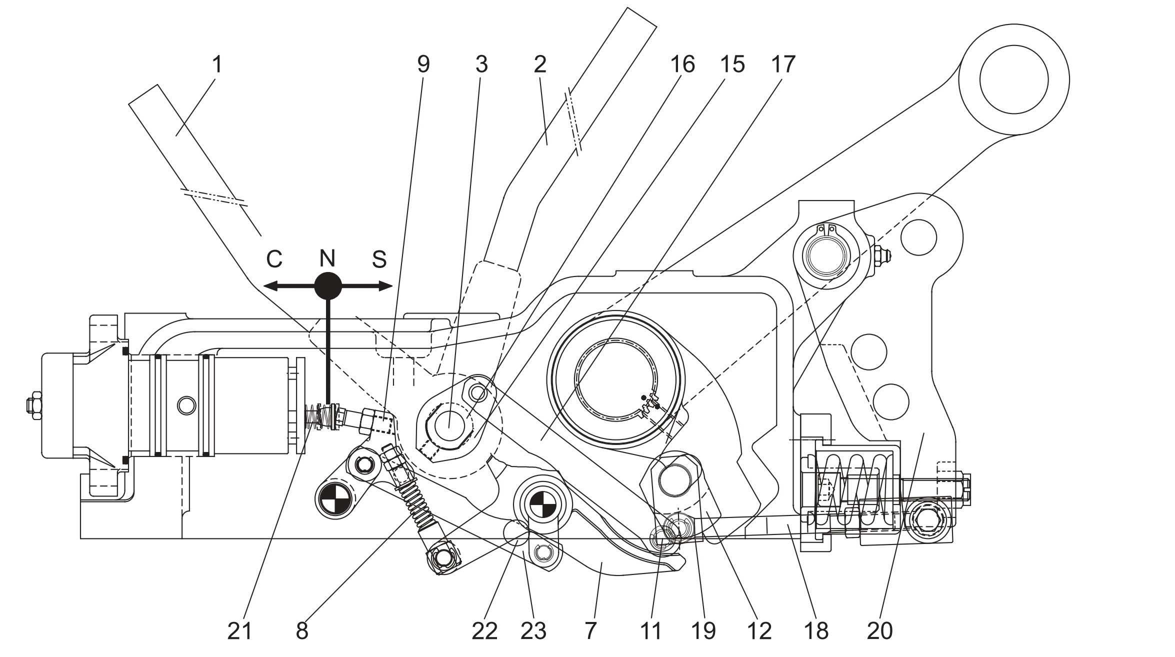
The arm (4) being an integral part of shaft (3) turns in a clockwise direction and causes the roller 1 (5) to slide on the positioning cam 1 (6), in turn causing the clockwise rotation of lever (7); the lever will transmit a counter-clockwise rotation, by means of friction shock absorber (8), to the transmission arm (9) that will bring the distributor shaft (21) into delivery position (C), thus causing the arms to be lifted.

During the lifting movement of the arms; crank (13) with pin (10) will rotate in a counter-clockwise direction, and via link 3 (14) will cause the positioning cam 1 (6) to rotate clockwise. When roller 1 (5) meets the inclined plane of cam 1 (6) this will allow a counter-clockwise rotation of the lever (7) causing the transmission arm (9) to rotate in a clockwise direction, via the friction shock absorber (8). Arm (9) is pushed by the spring of the distributor shaft (21) which will pass into the neutral position "N" there by stopping the movement of the lifting arms.

During the lowering phase of the arms, all leverage movements as described above will occur in the opposite sense.

Both during lifting or lowering movements, the position of the arms will conform to a specific position of the control lever (1) on the sector.

b. Draft Control **(Fig. 632W616A,632W617A)**



(1) Position Control Lever	(11) Roller 4	(19) Fly Wheel
(2) Draft Control Lever	(12) Cam	(20) Hitch Point
(3) Shaft	(15) Crank	(21) Shaft
(7) Lever	(16) Shaft	(22) Pin
(8) Friction Shock Absorber	(17) Rod	(23) Rod
(9) Arm	(18) Tension Rod	

By positioning the control lever (1) for position control against the lower backstop on the sector, arm (4) reaches the utmost position of counter-clockwise rotation.

In said position the roller 1 (5) is totally lowered from the inclined plane of the positioning cam 1 (6) allowing the counter-clockwise rotation of lever (7) as well as the clockwise rotation of the transmission arm (9) that is pushed by the spring of shaft (21) which in turn will position itself for the discharge of drawbar pull control.

By positioning the drawbar pull control lever (2) against the back stop in the upper part of the sector, the drawbar pull control shaft (16), will reach its extreme of tension rod (17) will move roller 4 (11) the latter acting on drawbar pull cam (12).

This causes the lever (7) to rotate clockwise of transmission arm (9) thus setting the distributor shaft (21) in delivery position “C” and consequently lifting the arms. The arms will come to a stop only as soon as the piston comes into contact with the pin of the limit stop (22).

The axis limit stop, by means of the tension rod (23), causes arm (9) to rotate clockwise, thereby compressing the spring of the friction shock absorber (8) and thus releasing shaft (21) which now can move to the neutral position “N” where it is pushed outward by its spring.

Moving the drawbar pull control lever (2) downward, the leverage system will function in the following manner.

Being an integral part of drawbar pull shaft (16), crank (15) rotates counter-clockwise and by means of tension rod (17) causes the roller 4 (11) to slide on lever (7).

When roller 4 (11) meets the inclined plane of the drawbar pull cam (12), it permits the counterclockwise rotation of lever (7) which by means of shock absorbers (8) will rotate transmission arm (9) in a clockwise manner thus releasing the distributor shaft (21) to move into neutral position “N”.

In discharge position “S”, the lever (2) will continue its downward movement and cause the arms to lower. In fact, during the initial part of the downward movement of the drawbar pull control lever (2), no lowering of the cam arms can be noticed.

The force of traction at the hitch point (20) acts on tension rod (18) in the direction indicated by arrow “RP” causing the flywheel (19) to rotate clockwise together with the drawer pull cam (12) which is fastened to the same stud.

When the inclined plane of the drawbar pull cam (12) meets roller 4 (11), clockwise rotation of the lever (7) is achieved. By means of the shock absorber (8) it causes the transmission arm (9) to rotate counterclockwise thereby brining the distributor shaft (21) into neutral position “N” and stopping all movement of the arms.

As the force of traction is increased, the drawbar pull cam (12) will further move roller 4 (11) incrementing the movement as described above.

Distributor shaft (21) will move from the neutral position “N” toward delivery position “C” causing the arms to be lifted.

When the force of traction diminishes, it will cause an inverted action of the leverage system as previously explained.

c. Combined Operation of Positioning and Drawbar Pull (Fig. 569W616A,569W617A)

To utilize the lifting device in this condition, it is necessary to observe the following instructions; Move the positioning control lever (1) upwards (in relation to the lower backstop on the sector) until the maximum working depth has been attained. Determine the desired minimum working depth by operating the drawbar pull control lever and raising it from zero position so that roller 4 (11) by acting on drawbar pull cam (12) will get distributor shaft (21) into lifting position “C”, and cam (12) should also cause a further upward movement of the lifting arms.

Due to the position previously established by the position control lever (1), the lever (7), arm (4) and position cam 1 (6) will prevent the distributor shaft (21) from entering the lowering position “S” and therefore the arms cannot sink, even though the force of traction acting on the hitch point (20) will tend to diminish by stressing tension rod (18) in the direction of arrow “N”.

Such condition will not keep the lifting device from operating under drawbar pull control, providing the work is carried on in reasonably consistent soil. The traction force acting on hitch point (20) will then tend to increase exerting stress on tension rod (18) in the direction of arrow “RP”.

Consequently the combined operation of the position control and drawbar pull control will limit variations in height toward the ground as they intervene during use of controlled drawbar pull, at the same time ensuring the maximum possible depth desirable.

F. HYDRAULIC POWER TAKE OFF

If necessary, hydraulic power for implements can be taken out from front hydraulic block or using auxiliary control valves and quick couplers.

- Hydraulic power for the front loader can be taken out from hydraulic block.
- On 8454tractor's auxiliary control valve assembly.

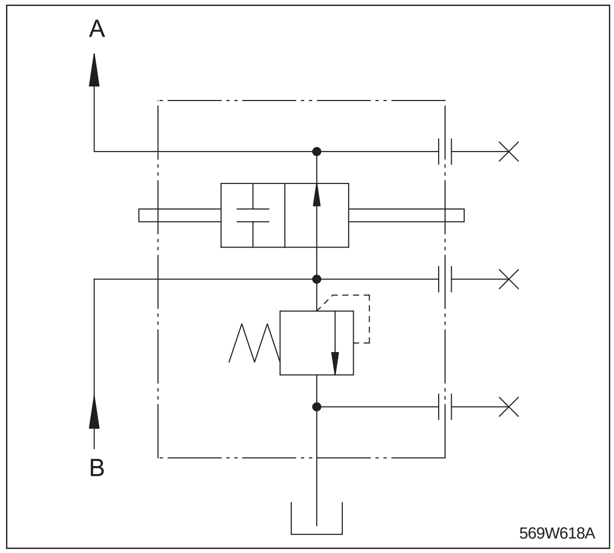
IMPORTANT:

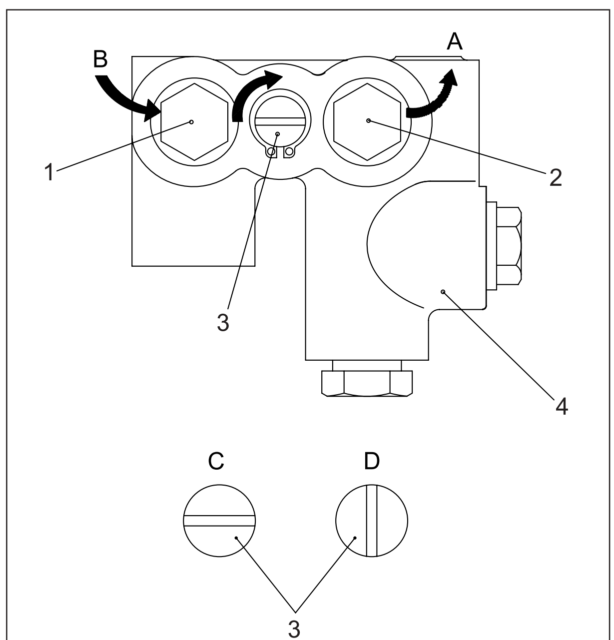
- *When taking out hydraulic power, replenish transmission oil in the quantity equal to the flow rate required for* the implement cylinder.

NOTE:

- *Before attaching the implement, check the type and contamination of oil in the implement hydraulic circuit.*

a. Front Hydraulic Block





1. Remove the plugs from OUT port (2) and IN port (1) of the front hydraulic block (4).
2. Install the hydraulic take off adaptors (screw size PT3/8′′) to OUT port and IN port.
3. Connect the hydraulic hose to the adaptor (OUT port side) and to the implement control valve IN port.
4. Connect the other hydraulic hose to the adaptor (IN port side) an to the implement control valve TANK (RETURN) port.
5. Turn the slit on the spool (3) end to the arrow side fully as shown in the figure.

NOTE:

- *When implement is not attached, turn the slit on the spool end to the horizontal position fully.*

A: To implement Control Valve IN Port
B: From implement Control Valve TANK Port
C: When implement is not attached position
D: When implement is attached position

(1) In Port Plug
(2) OUT Port Plug
(3) Spool
(4) Front Hydraulic Block

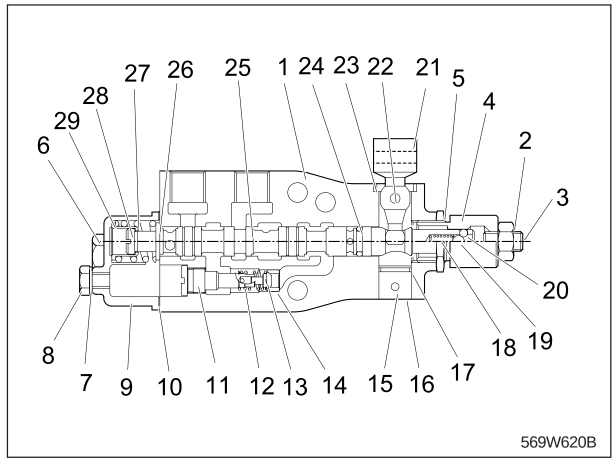
b. Auxiliary Control Valve

A double acting detent type auxiliary control valve is used, and the construction is shown in the figure right.

When the auxiliary control valve operating lever is moved to the implement cylinder actuating position, the spool is moved and the oil from the pump port flows into A to B, causing the implement cylinder to operate.

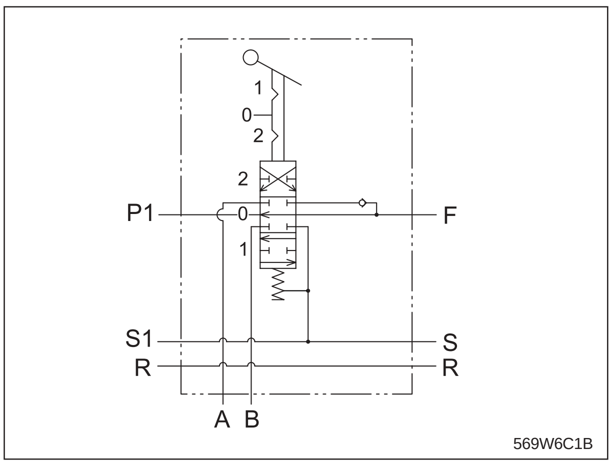
The return oil from the implement cylinder flows out of the tank port through A of B and returns to the transmission case.

This type is equipped with a special non-return valve which ensures that oil under pressure is held where required. This guarantees that implements will be held at a steady height which no change of lowering.



(1) Body
(2) Nut
(3) Screw
(4) Cover
(5) Nut
(6) O-Ring
(7) O-Ring
(8) Screw
(9) Washer
(10) Screw
(11) Cover
(12) Seal Cover
(13) Valve Seat
(14) Spring
(15) Valve
(16) Valve Seat
(17) Elastic Pin
(18) Plug
(19) O-Ring
(20) Spring
(21) Ball
(22) Ball
(23) Articulation
(24) Pin
(25) Seal Ring
(26) O-Ring
(27) Pilot Spool
(28) Washer
(29) Spring
(30) Screw
(31) Spacer

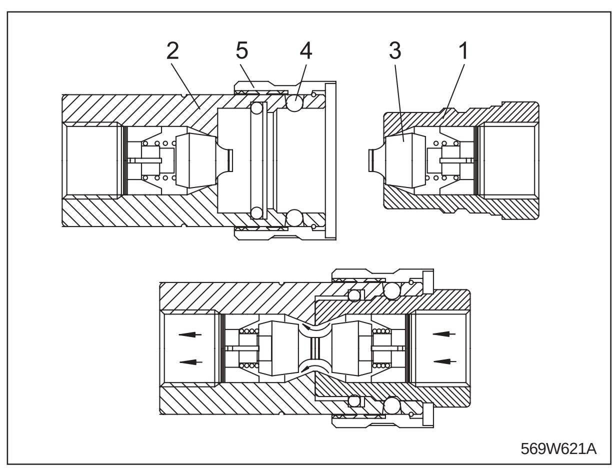
- **Circuit diagram**



c. Quick Couplers

Quick couplers provided with these tractors are connectable even under pressure with both halves or either half pressurize. To connect the male half (1) to the body (2), slide the sleeve (5) to the rear on the body half and insert the male half into the body half.

Move the sleeve (5) forward to send the steel balls (4) for locking the male half (1) into the body (2). The male half (1) is locked in place by a ring of steel balls (4) which is held in a groove on the inserted male half by the outer sleeve (5).

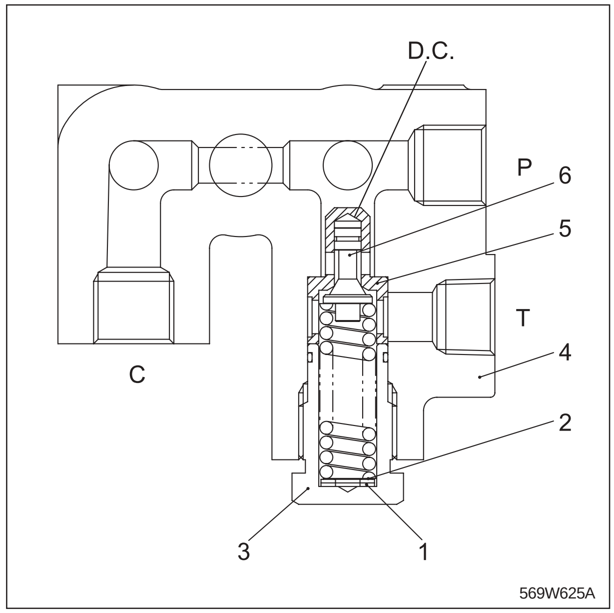


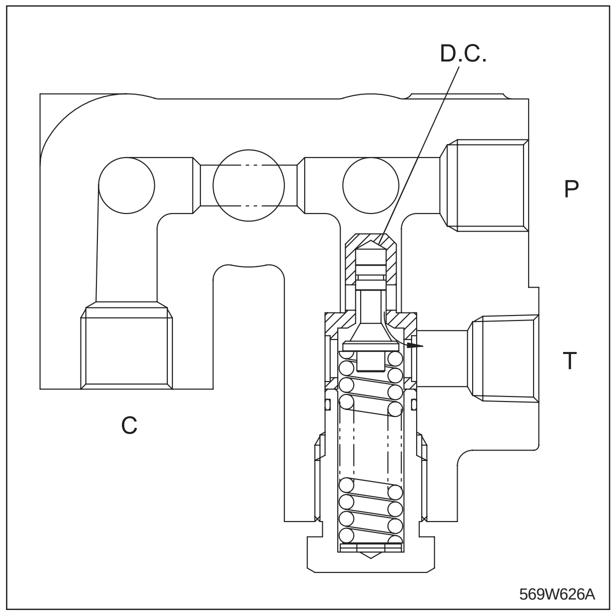
(1) Male half
(2) Body
(3) Pocket
(4) Steel Ball
(5) Sleeve

e. Relief Valve (Hydraulic Block)

- As shown in the figure, a guide is attached at poppet (6) and valve chamber D.C (damping chamber) located at the bottom of the guide piston. Intake of valve enable through sliding part of guide and clearance of seat (5) to chamber and minimizes valve vibration as damping effect of chamber.
- If oil pressure does not exceed the specified pressure of the relief valve, relief valve will not operate and oil flows from the hydraulic pump to the inlet of hydraulic cylinder.
- As the oil pressure of circuit increases, that of damping chamber D.C. increases. If pressure exceeds the specified valve and the spring tension, the valve will open to flow oil through port T to transmission case. If oil is discharged sufficiently and its pressure is less than the specified, the valve will be closed.

Relief valve setting pressure	16.2 ~ 17.2 Mpa 16.5 ~ 175 kgf/cm^2 2.347 ~ 2.489 psi
Engine speed	Max.
Oil temperature	40 ~ 60 °C 104 ~ 140 °F



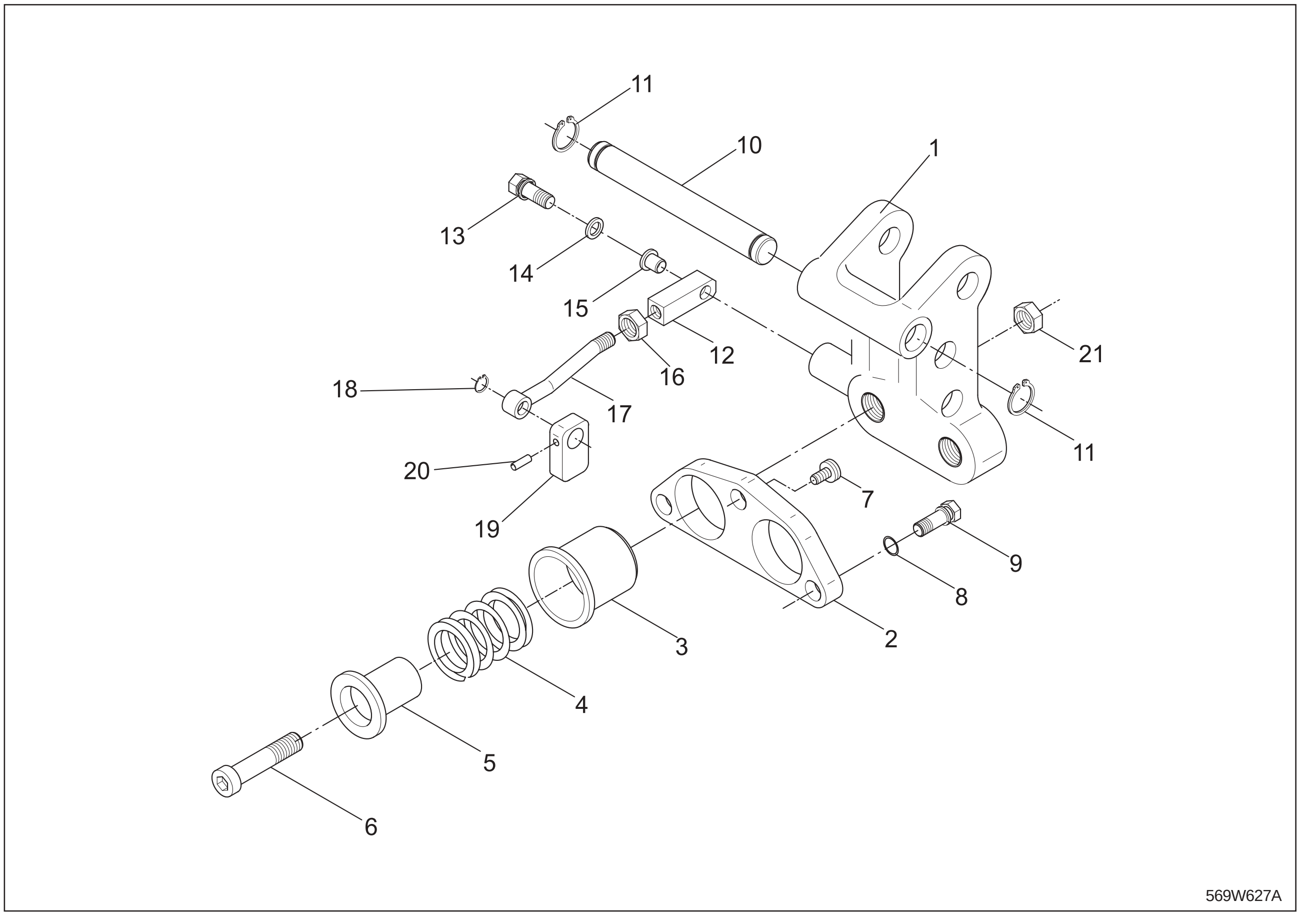


D.C: Damping Chamber
C: Cylinder Port
P: Pump Port
T: Tank Port

(1) Washer
(2) Shim
(3) Plug
(4) Front Hydraulic B Lock
(5) Seat
(6) Poppet

G. TOP LINKAGE BRACKET

a. Structure



(1) Top Linkage bracket	(7) Bolt	(12) Plate	(17) Tie Rod
(2) Flange	(8) Lock Washer	(13) Bolt	(18) Spring Peaks
(3) Cover	(9) Bolt	(14) Lock Washer	(19) Crank
(4) Spring	(10) Pin	(15) Roller	(20) Pin
(5) Roller	(11) Snap Ring	(16) Nut	(21) Nut
(6) Bolt			

b. How the Top Linkage Bracket Works

If impact is applied on the implement, cover (3) and spring (4) absorb the impact with the top link while connected to the linkage by plate (12) and tie rod (17) to raise the implement.

And oil flowing line is changed by the linkage of the control valve this time.

1.4 PREPARATION STAGE FOR DISASSEMBLING AND ASSEMBLING

A. DRAINING THE TRANSMISSION FLUID

1. Place oil pans underneath the transmission case.
2. Remove the drain plugs.
3. Drain the transmission fluid.
4. Reinstall the drain plugs

(When refilling)

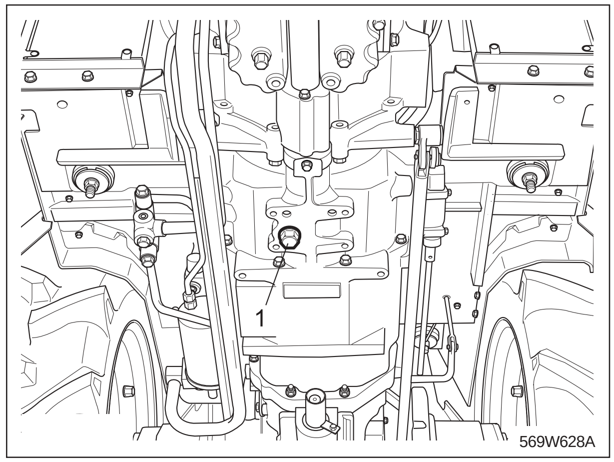
- Fill up from filling port after removing the filling plug (1) until reaching the gauge (2).
- After running the engine for few minutes, stop it and check the oil level again, add the fluid to prescribed level if it is not correct level.

Capacity	Transmission fluid	38.0 ℓ 40.1 U.S.gal.

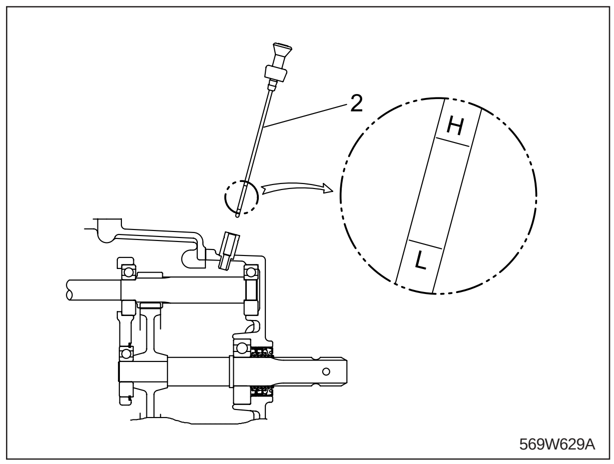
IMPORTANT

- *Use only SAE 80, 90 gear oil. Use of other oils may damage the transmission or hydraulic system.*

  Refer to "LUBRICANTS, FUEL AND COOLING WATER" (Refer to the chapter 1)
- *Do not mix different brands fluid together.*



(1) Drain Plugs

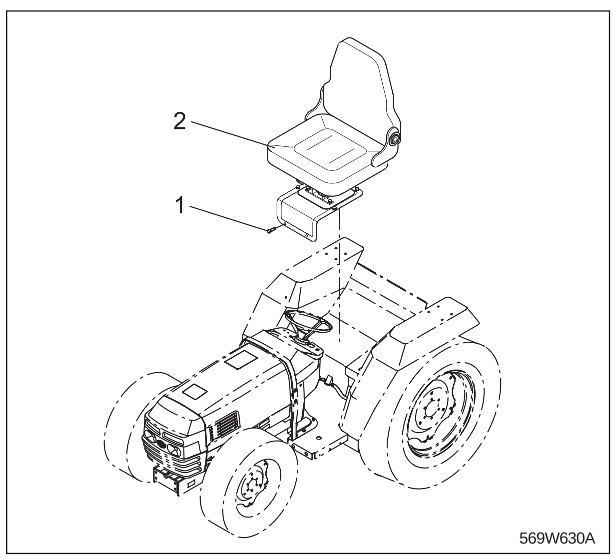


(2) Gauge

B. SEPARATING REAR FENDERS AND PLATFORM ASSEMBLY

Preparation

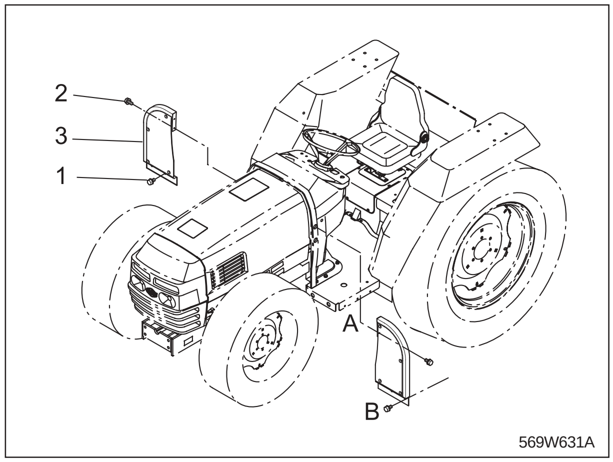
1. Remove the Rops.
2. Remove the Bolts (1) and take out the seat Assembly (2)



(1) Bolt (2) Seat Assembly

Cover

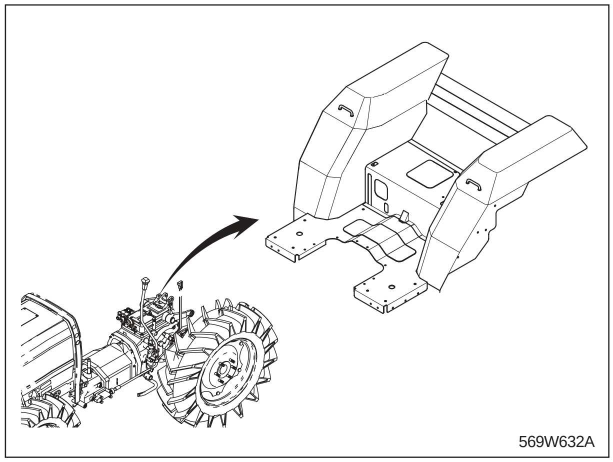
1. Remove the bolts (1), (2) and the cover assembly (3).



(1) Bolt (3) Cover
(2) Bolt

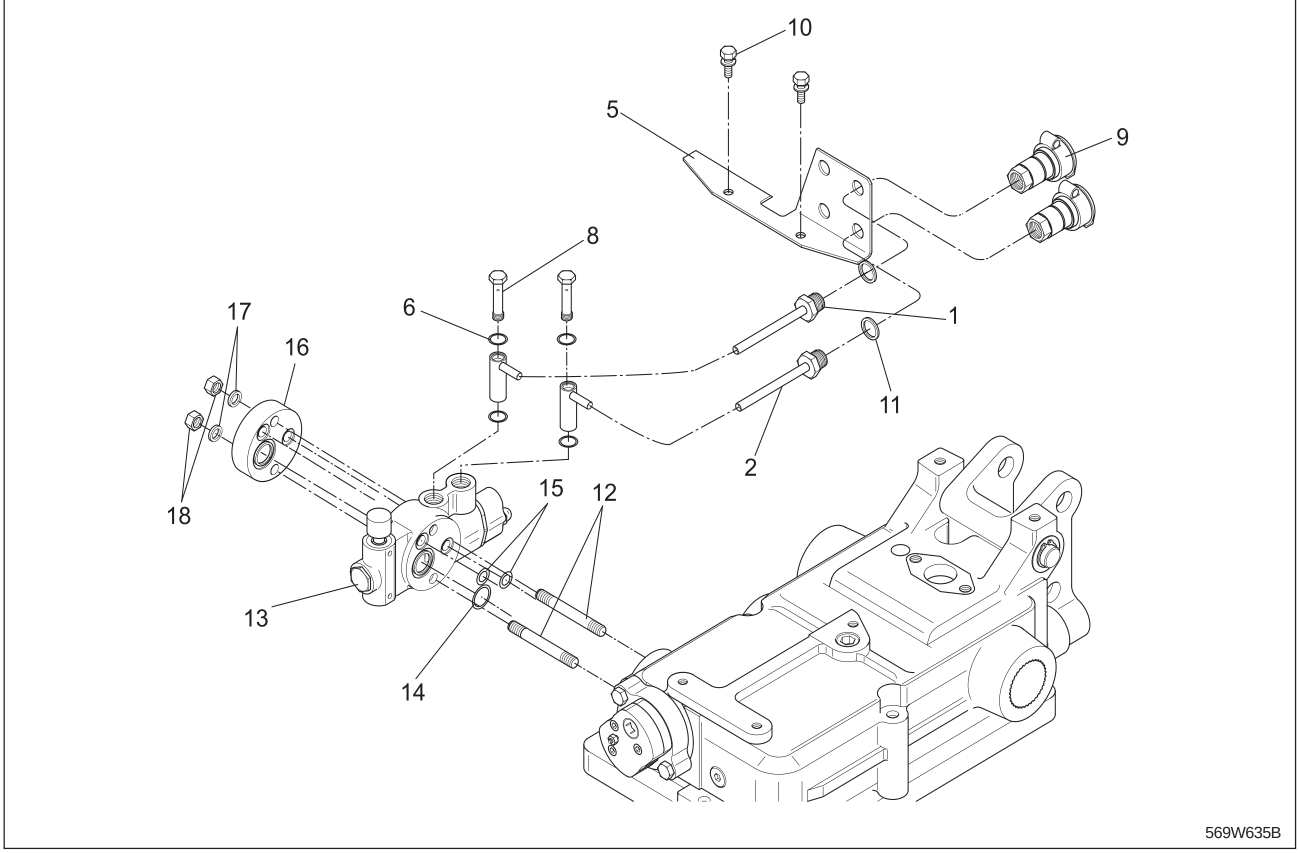
C. FENDER, FLOOR SEAT AND PLATFORM ASSEMBLY

1. Remove the fender (1, 2), floor seat and platform as a unit.



1.5 DISASSEMBLING AND ASSEMBLING

A. AUXILIARY CONTROL VALVES



(1) Pipe A	(8) Joint Bolt 2	(15) O-Ring	(16) Flange
(2) Pipe B	(9) Quick Coupler	(12) Stud	(17) Washer
(5) Bracket	(10) Bolt	(13) Auxiliary Valve	(18) Nut
(6) O-Ring	(11) Seal Washer	(14) O-Ring	

(if equipped)

1. Loosen and remove the joint bolt 2 (8), hydraulic pipes ((1), (2)), bracket (5) and quick couplers (9) as a unit.
2. Loosen and remove the auxiliary control valve mounting two nuts (18), washer (17) and take out the auxiliary valves (13) from the power lift body.

(When refilling)

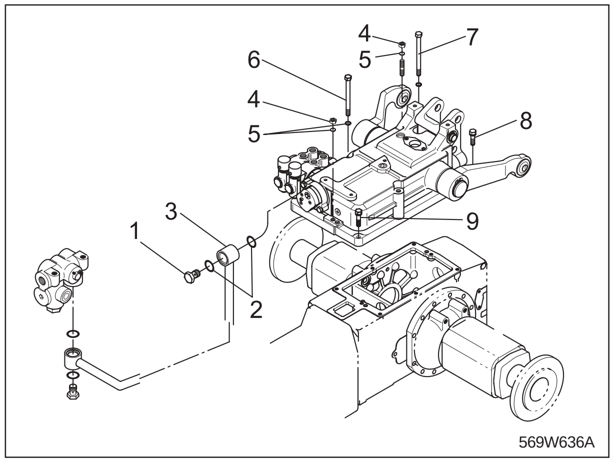
- Take care not to damage the O-rings.

B. HYDRAULIC CYLINDER ASSEMBLY

1. Loosen the joint bolt (1).
2. Loosen and remove the hydraulic cylinder assembly mounting bolts ((6), (7), (8), (9)), spring washers (5) and nuts (4).
3. Support the hydraulic cylinder assembly with nylon lift strap and hoist, and then take out it.

(When reassembling)

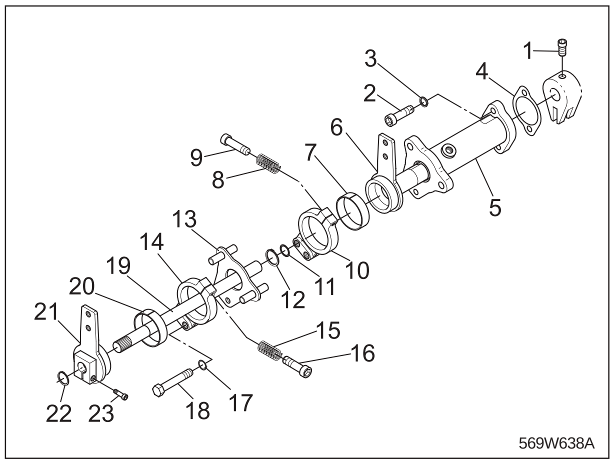
Tightening torque	Hydraulic cylinder mounting bolts and nuts	48.1 ~ 55.8 N·m 4.9 ~ 5.7 kgf·m 35.5 ~ 41.2 lbf·ft



(1) Joint Bolt
(2) O-Ring
(3) Delivery Pipe 2
(4) Nut
(5) Spring Washer
(6) Bolt
(7) Bolt
(8) Bolt
(9) Bolt

C. HYDRAULIC LIFT CONTROL LEVERS

1. Remove the screw (1).
2. Loosen and remove the bolts (2) and take out the composed parts as a unit.



(1) Screw
(2) Bolt
(3) Lock Washer
(4) Seal
(5) Support
(6) Pitman Arm
(7) Clutch
(8) Spring
(9) Screw
(10) Clutch Hub
(11) O-Ring
(12) Snap Ring
(13) Flange
(14) Clutch Hub
(15) Spring
(16) Screw
(17) Lock Washer
(18) Bolt
(19) Shaft
(20) Clutch
(21) Control Lever
(22) Snap Ring
(23) Screw

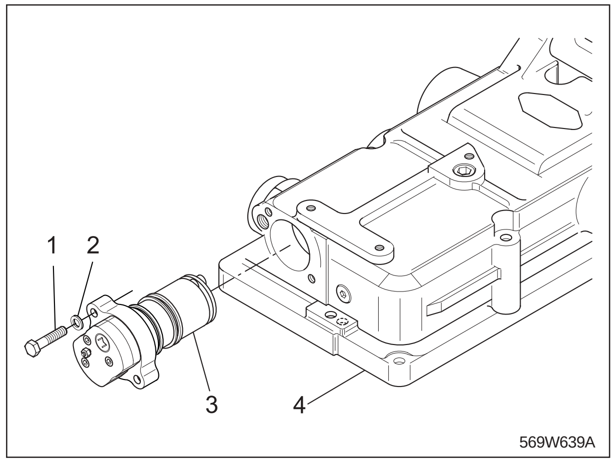
D. DISTRIBUTOR VALVE (CONTROL VALVE)

1. Loosen and remove the control valve (distributor valve) mounting screws (1).
2. Take out the control valve (3).

(When reassembling)

- Take care not to damage the O-ring.

Tightening torque	Mounting bolt	23.6 ~ 27.4 N·m 2.4 ~ 2.8 kgf·m 17.4 ~ 20.2 lbf·ft



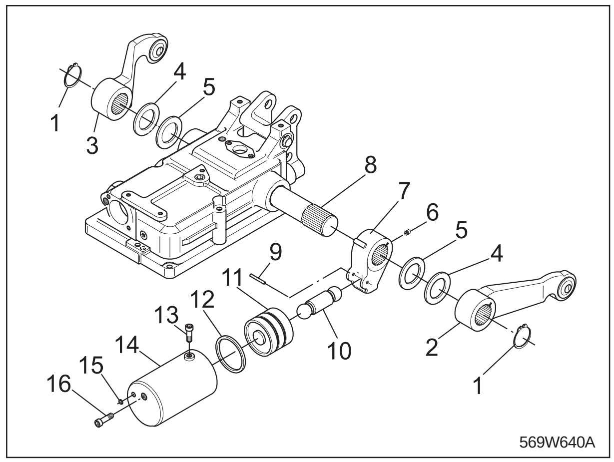
(1) Screw
(2) Lock Washer
(3) Distributor Valve (Control Valve)
(4) Power Lift Body (Hydraulic Cylinder Block)

E. LIFT ARM, HYDRAULIC ARM AND HYDRAULIC ARM SHAFT

1. Remove the cylinder mounting screws (13), (16) and the crank mounting screw (6).
2. Draw out the hydraulic arm shaft (8) and lift arm (3) as a unit.
3. Take out the hydraulic cylinder (14), piston (11), connecting rod (10) and crank (7).

(When reassembling)

- Install the piston, seal (12).
- Apply transmission oil to the cylinder, and then install the piston.
- Apply grease to the piston button contacts with connecting rod.
- Align the hole of the shaft (8) and crank (7).
- Apply grease to the right and left bushings of power lift (hydraulic cylinder block) body.



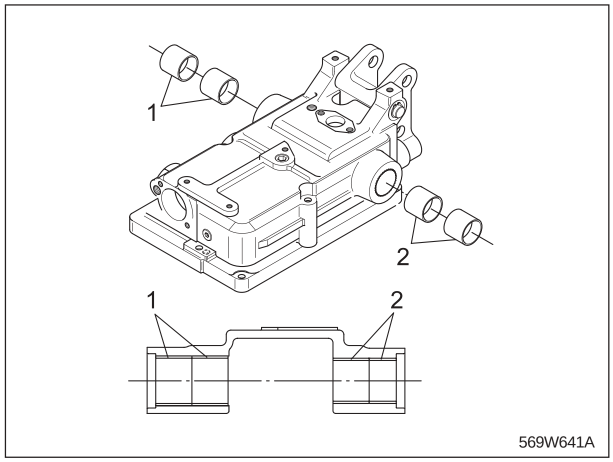
(1) Snap Ring	(9) Pin
(2) Lift Arm (LH)	(10) Connecting Rod
(3) Lift Arm (RH)	(11) Piston
(4) Was Her	(12) Seal
(5) Seal	(13) Screw
(6) Screw	(14) Cylinder
(7) Crank	(15) Seal
(8) Shaft	(16) Screw

F. BUSHINGS

1. Remove the bushings (1) and (2).

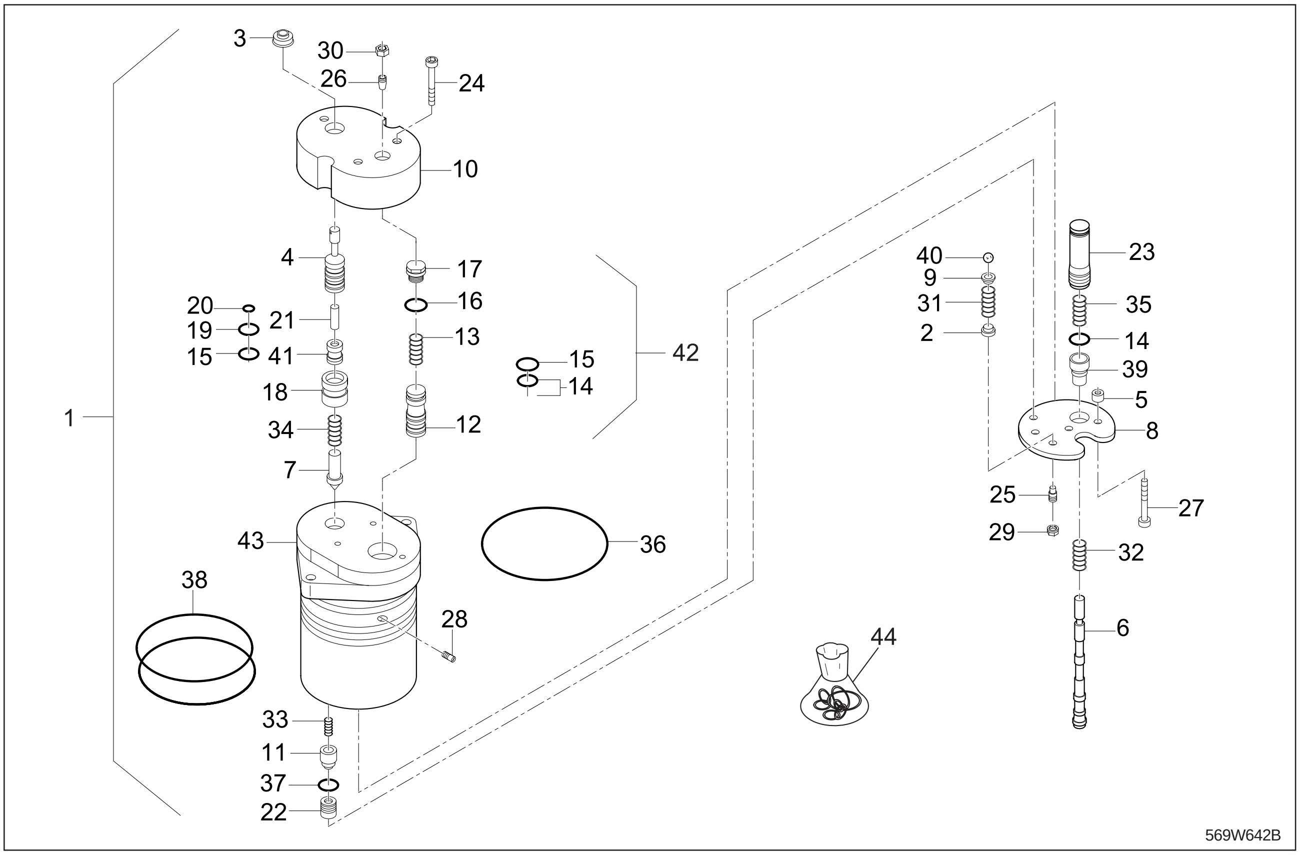
(When reassembling)

- Apply transmission oil to the hydraulic cylinder boss and bushings.



(1) Bushing (2) Bushing

G. CONTROL



(1) Control Valve Ass'y	(10) Cover	(19) O-Ring	(28) Screw	(37) O-Ring
(2) Spacer	(11) Valve	(20) O-Ring	(29) Nut	(38) O-Ring
(3) Rubber	(12) Valve	(21) Pin	(30) Nut	(39) Plug
(4) Lever Ass'y	(13) Spring	(22) Valve Seat	(31) Spring	(40) Ball
(5) Spacer	(14) O-Ring	(23) Valve	(32) Spring	(41) Valve
(6) Spool	(15) O-Ring	(24) Screw	(33) Spring	(42) Valve Ass'y
(7) Valve	(16) O-Ring	(25) Screw	(34) Spring	(43) Valve Body
(8) Plate	(17) Plug	(26) Screw	(35) Spring	(44) Ass'y Seal
(9) Spacer	(18) Valve Seat	(27) Screw	(36) O-Ring	

a. To Disassembling

1. Loosen 3 adjusting screws (27) with a 5mm wrench.
2. Remove disc (8), spool (6) and spring (32) at a time.
3. Remove spacer (9), spring (31) and ball (40).
4. Loosen plug (39) without causing damage on the O-ring and remove spring (35) and adjusting screw (23).
5. Turn adjusting valve body (43) of the power lift up-side down and loosen three adjusting screws (24) to remove the cover.
6. Loosen lever Ass'y (4) at a time without causing damage on the O-ring.
7. Remove pin (21), valve (41), valve seat (18) spring (34) and valve (7) in due order.
8. Remove valve (12).

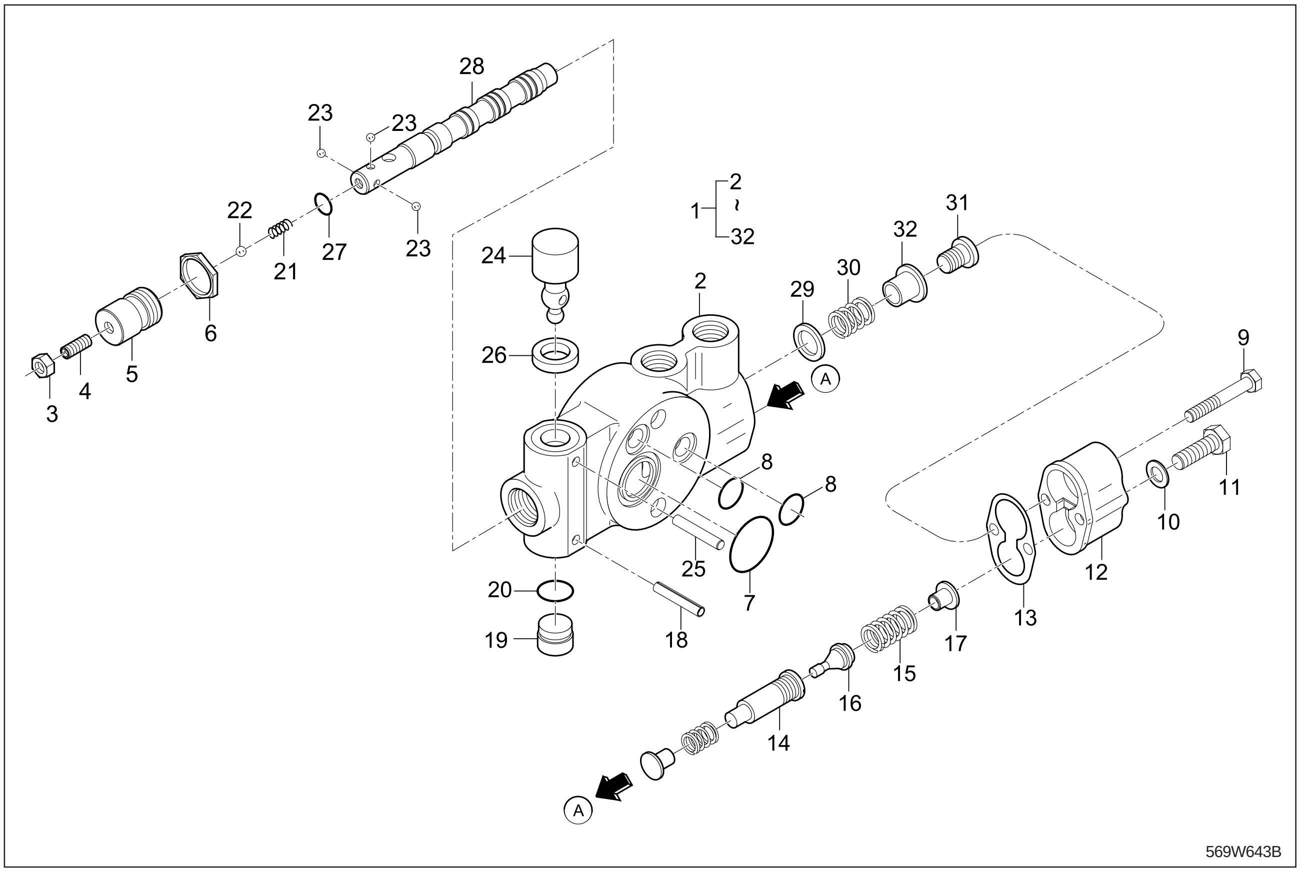
b. To Assemble

1. Apply grease sufficiently on bolt (26) inside cover (10).
2. Let all the parts applied with oil sufficiently when assembling.

CAUTION

- *Since disc (8) might fly away due to the spring tension, be careful not to lose spacer (5).*
- *Do not remove valve (23) concerning any damage expected.*
- *Pay attention to cover (10) which might fly up due to the spring tension.*
- *Be careful not to drop the spool inside when dismantling.*

H. DOUBLE ACTING VALVE



(1) Double Acting Valve Ass'y	(9) Valve	(17) Screw	(24) Roller
(2) Valve Body	(10) Spring	(18) Screw	(25) Plug
(3) Spool	(11) Valve Sheet	(19) Nut	(26) O-Ring
(4) O-Ring	(12) Valve	(20) Lock Washer	(27) Pin
(5) Washer	(13) Spring	(21) Nut	(28) O-Ring
(6) Spring	(14) Spacer	(22) Ring	(29) O-Ring
(7) Spacer	(15) Gasket	(23) Bent Arm	(30) Plug
(8) Adjusting Screw	(16) Cover		

a. To Disassembling

1. Remove O-rings (7), (8).
2. Remove Roller (25) and pin (18) and then Disassembling bent arm (24) and ring (26).
3. Remove 2 screws, gasket (13) and cover (12) and then loosen bolt (11), and washer (10) on the cover.
4. Remove spacer (17), spring (15) and valve (14).
5. Loosen nut (6) and cover (5).
6. Disassembling spool (28), washer (29), spring (30), spacer (32) and adjusting screw (31) ass'y.
7. Loosen plug (19) without causing damage on the O-ring.

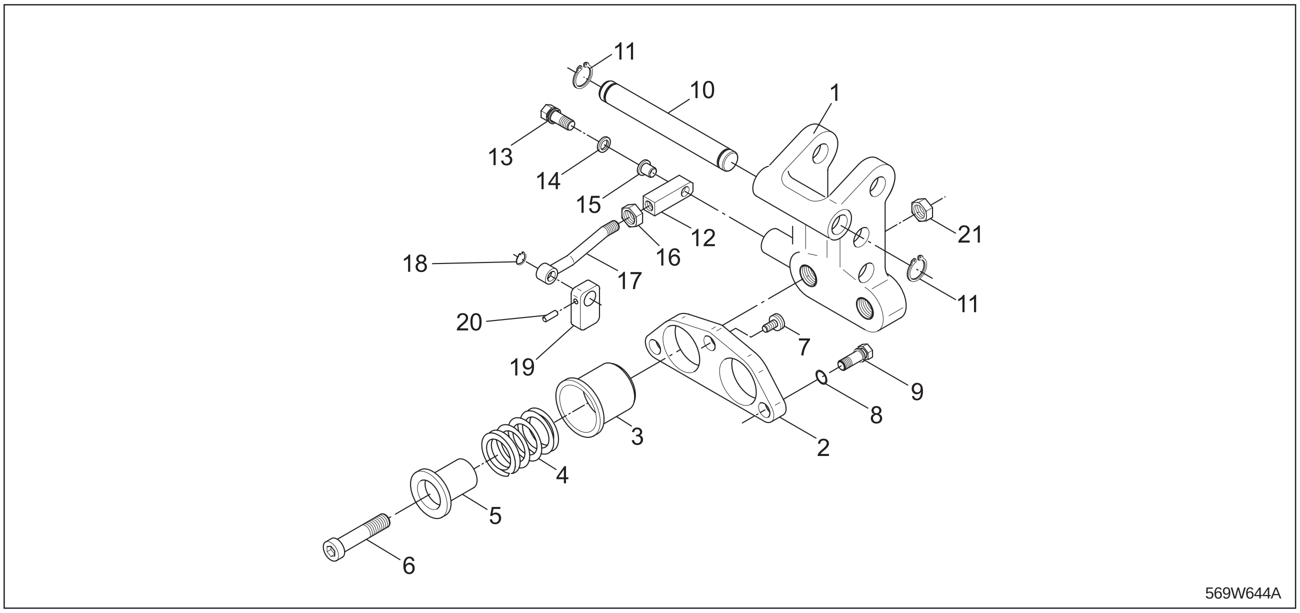
b. To Assemble

1. Clean with detergent oil thoroughly not to allow any foreign substance in when assembling.
2. Apply grease sufficiently inside when assembling bent arm (24) and plug (19).

CAUTION

- *Pay attention to gasket (13) and cover which might fly away due to the spring tension when dismantling the Screw.*
- *Take out the valve body as erected when dismantling valve (16).*
- *Be careful not to cause damage on the spool.*

I. TOP LINK BRACKET



(1) Top Link Bracket	(7) Bolt	(12) Plate	(17) Tie Rod
(2) Flange	(8) Lock Washer	(13) Bolt	(18) Spring Peaks
(3) Cover	(9) Bolt	(14) Lock Washer	(19) Crank
(4) Spring	(10) Pin	(15) Roller	(20) Pin
(5) Roller	(11) Snap Ring	(16) Nut	(21) Nut
(6) Bolt			

a. To Disassembling

1. Remove the socket support and coupler socket ass'y prior to the top link bracket ass'y.
2. Remove bolt (13), lock washer (14), roller (15) and plate (12).
3. Remove nut (21).
4. Disassembling snap ring (11) and remove pin (10).
5. Disassembling top link bracket (1).
6. Loosen bolts (7), (9) to remove flange (2).
7. Remove cover (3), spring (4), roller (5) and bolt (6) as a unit.

b. To Assemble

1. Apply grease sufficiently when assembling bolt (6) and spring (4).

CAUTION

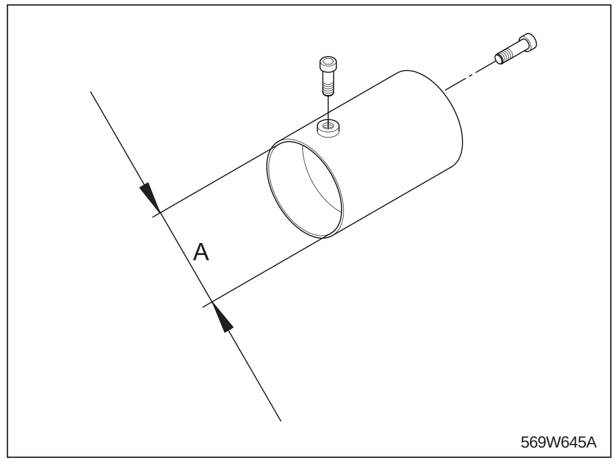
- *Do not change the former assembling position of the plate when dismantling as in the clause of (2) above.*
- *Be careful not to drop top link bracket (1) to the ground when dismantling pin (10).*
- *Previously check if the draft function is available when assembling as in the clause of above while repeating several times.*

J. CHECK AND ADJUSTMENT

a. Hydraulic Cylinder Bore

1. Check the cylinder inside surface for scratches or damage.
2. Using a cylinder gauge, measure cylinder I.D.
3. If the measured exceeds the allowable limits, replace the hydraulic cylinder block.

Cylinder I.D. "A"	Reference dimension	90.000 ~ 90.050 mm 3.54330 ~ 3.54527 in.
	Allowable limit	90.150 mm 3.54921 in.



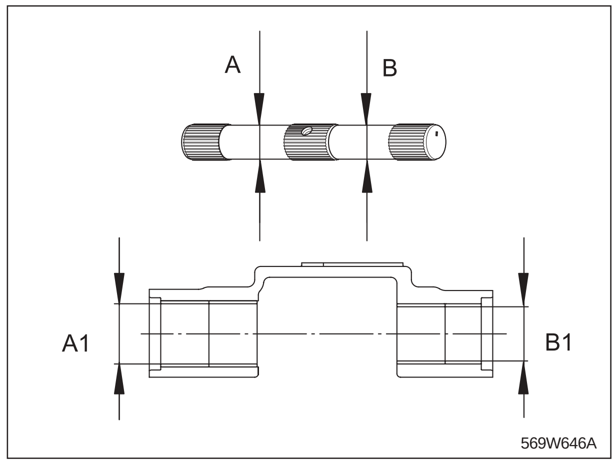
b. Clearance Relationship Between Hydraulic Arm Shaft and Bush

1. Using a O.D. micrometer, measure the hydraulic arm O.D.
2. Using a I.D. micrometer, measure the bush I.D. and then calculate the clearance.
3. If the calculated clearance exceeds the allowable limits, replace the bush.

Clearance between hydraulic arm shaft and limit bush	Right	Reference allowable	0.125 ~ 0.230 mm 0.00492 ~ 0.00906 in.
		Allowable limit	0.50 mm 0.0197 in.
	Left	Reference dimension	0.125 ~ 0.220 mm 0.00492 ~ 0.00866 in.
		Allowable limit	0.50 mm 0.0197 in.

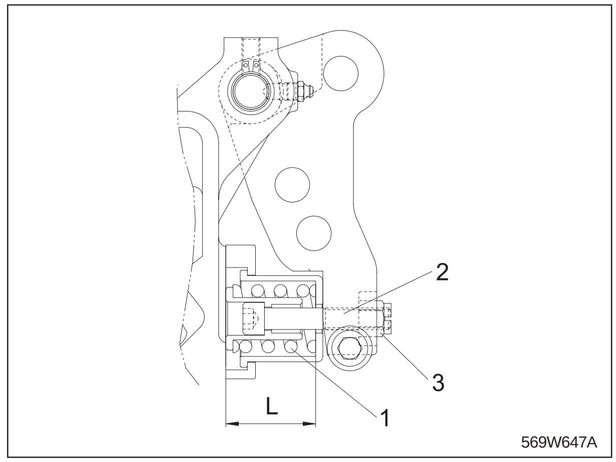
Hydraulic arm shaft O.D.	Right (B)	49.970 ~ 49.940 mm 1.96732 ~ 1.96614 in.
	Left (A)	44.975 ~ 44.950 mm 1.77066 ~ 1.76968 in.

Bush I.D. (After assembled)	Right (B1)	50.075 ~ 50.115 mm 1.97145 ~ 1.97303 in.
	Left (A1)	45.075 ~ 45.115 mm 1.77460 ~ 1.77618 in.



c. Reaction Spring Assembly Reference Dimension

Reaction spring assembly initial length (L)	Reference dimension	50 mm 1.9685 in.



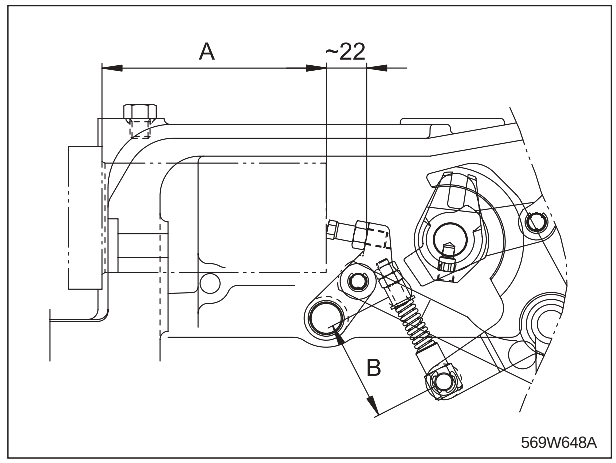
(1) Spring
(2) Hex. Bolt
(3) Nut

d. Dimensional Setting of Position Control Bolt

1. When assembling the control valve (MLS valve) into power lift body, "A" dimension will be 112 mm.
2. If adjusting control bolt (1), loosen nut (2) and then tighten-lock nut (2).

"A" Setting length	Reference dimension	112 mm 4.4094 in.

"B" Setting length	Reference dimension	50.5 mm 1.9881 in.

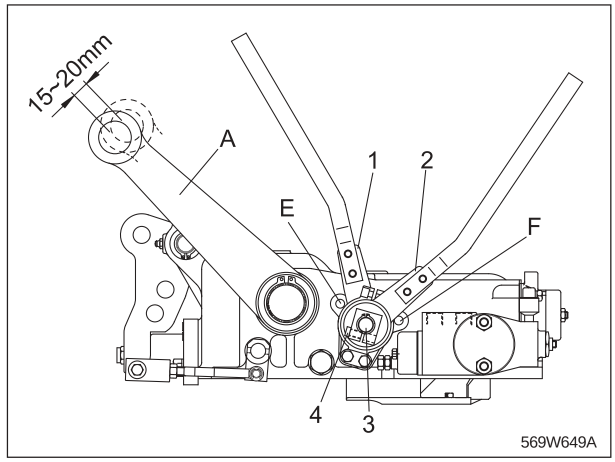


e. Lever Position Setting

Adjustment of Position Control Lever

The position control lever can be adjusted with a little load applied to the elevating arm.

1. Loosen the position control shaft (3), and lever tightening bolt (4).
2. Using a 13 mm spanner, rotate the position control shaft (3) counterclockwise until the elevating arm has stopped to climb by inside hydraulic limit. Because of safety, the area remained though the elevating arm moved to its max. angle while elevating it, is never contacted with hydraulic limit switch.
3. With elevating the lever up and down two or three times, check it for operation and make sure it is located at the same position at the highest.



(1) Position Control Lever
(2) Draft Control Lever
(3) Position Control Shaft
(4) Hex. Bolt
(5) Lifting Arm

[A] Hydraulic Lifting Arm at End of Stroke
[E] Back Stop
[F] Back Stop

Draft Control Lever

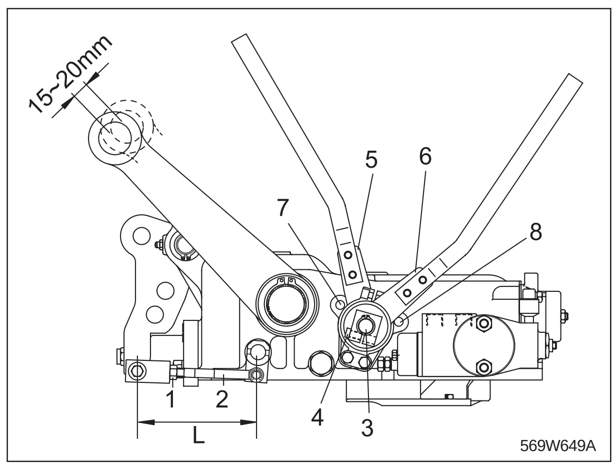
1. Lower elevating arm, loosen lock nut (1) and push backward.
2. Disengage lock bolt (2).
3. Adjust the length of the feedback rod.

Length of feedback rod (L)	Reference dimension	135 mm 5.3149 in.

4. With minimum rpm, lower the position control lever (6) to stopper (8), and then slowly raise the Draft control lever (5) toward stopper (7) so that the elevating arm might be raised.
5. Until smooth down of elevating arm is obtained, decrease and adjust the length (L) of feedback rod gradually one rotation a time.
6. After a completion of adjustment, tighten nut (1) and lock bolt (2).

(Ref.)

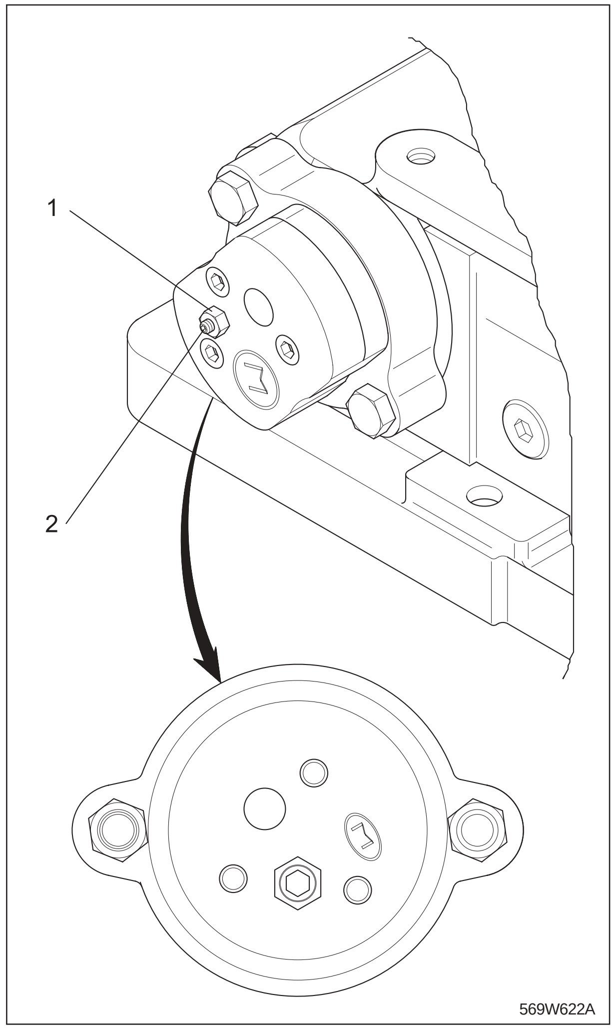
When raised to max. using the Draft control lever, height (H) will be higher between 15 and 20 mm (0.59 ~ 0.79 in.) than the max, using the position control lever.



(1) Nut
(2) Bolt
(3) Position Control Shaft
(4) Hex. Bolt
(5) Draft Control Lever
(6) Position Control Lever
(7) Stopper
(8) Stopper

f. Sensitivity Control of Control Valve (MLS)

1. Apply the elevating arm with load of 500 kg (1100 lbs) and move control lever upward to be the center. This time, the MLS valve is positioned at neutral.
2. Perform a sensitivity control while rotating the preventative screw (2) counterclockwise using a hex. wrench until elevating arm is swung.
3. Rotate the preventative screw (2) clockwise until the elevating arm stops moving and make sure it is locked at that position.
4. After a completion of the adjustment mentioned above, rotate the preventative screw (2) 1/4 turns clockwise to set into position firmly. This time the sensitivity of the MLS valve will be set to the max.



(1) Lock Nut

(2) Looseness Preventative Screw

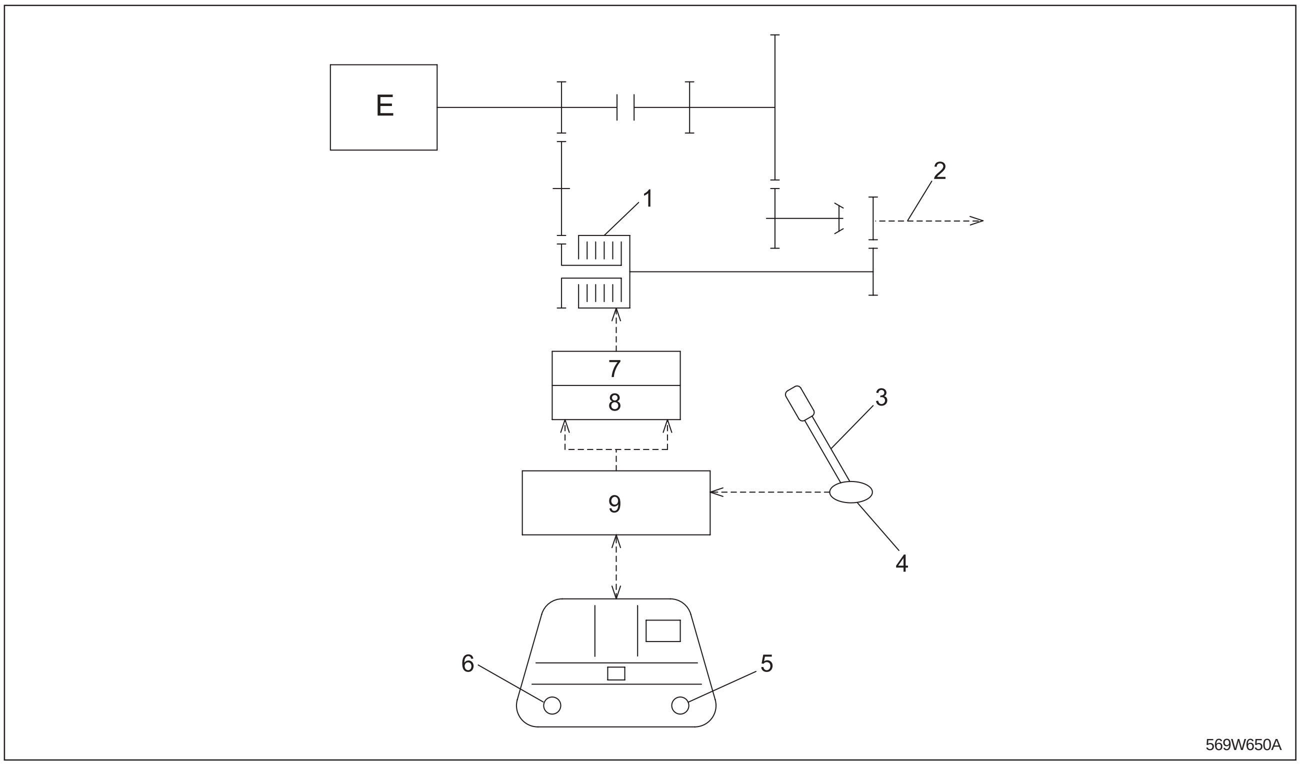
2. PTO CLUTCH VALVE SYSTEM

2.1 SPECIFICATIONS AND DIAGRAM

A. SPECIFICATION

8454		
Solenoid valve	Maximum oil flowing (ℓ/min, gal/min)	65 (17.17)
	Rated oil flowing (ℓ/min, gal/min)	7.1 (1.88)
Modulating valve	Relief pressure (kgf/cm², psi)	16 ~ 18 (228 ~ 256)
	Oil flowing (ℓ/min, gal/min)	7 (1.85)

B. DIAGRAM



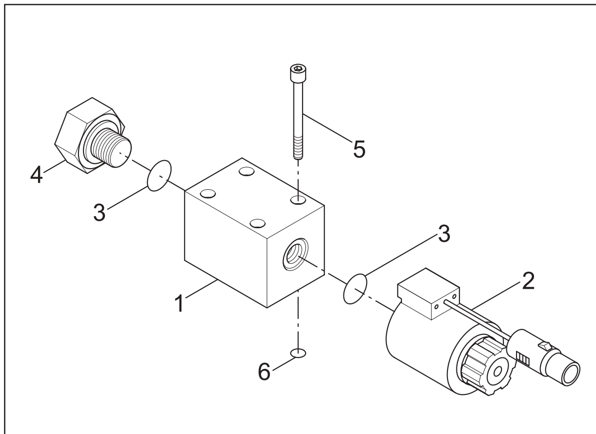
(1) PTO Clutch
(2) PTO Shaft
(3) Position Control Lever
(4) Detecting Sensor of the Implement
(5) PTO Switch
(6) PTO Monitor Lamp
(7) Modulating Valve
(8) Solenoid Valve
(9) Interlocking Relay (PTO at Neutral, CLUTCH at Neutral)
(E) Engine

2.2 STRUCTURE AND OPERATION

A. SOLENOID VALVE

a. Structure

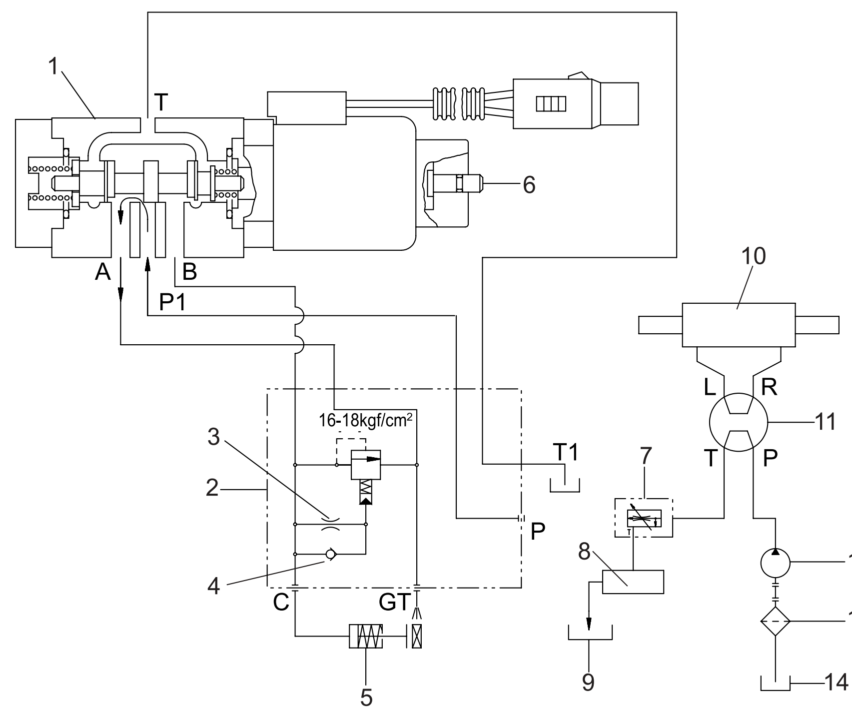
(1) Block
(2) Solenoid
(3) Ring
(4) Plug
(5) Bolt
(6) O-Ring



569W651A

b. Operation

- In case PTO clutch switch is OFF

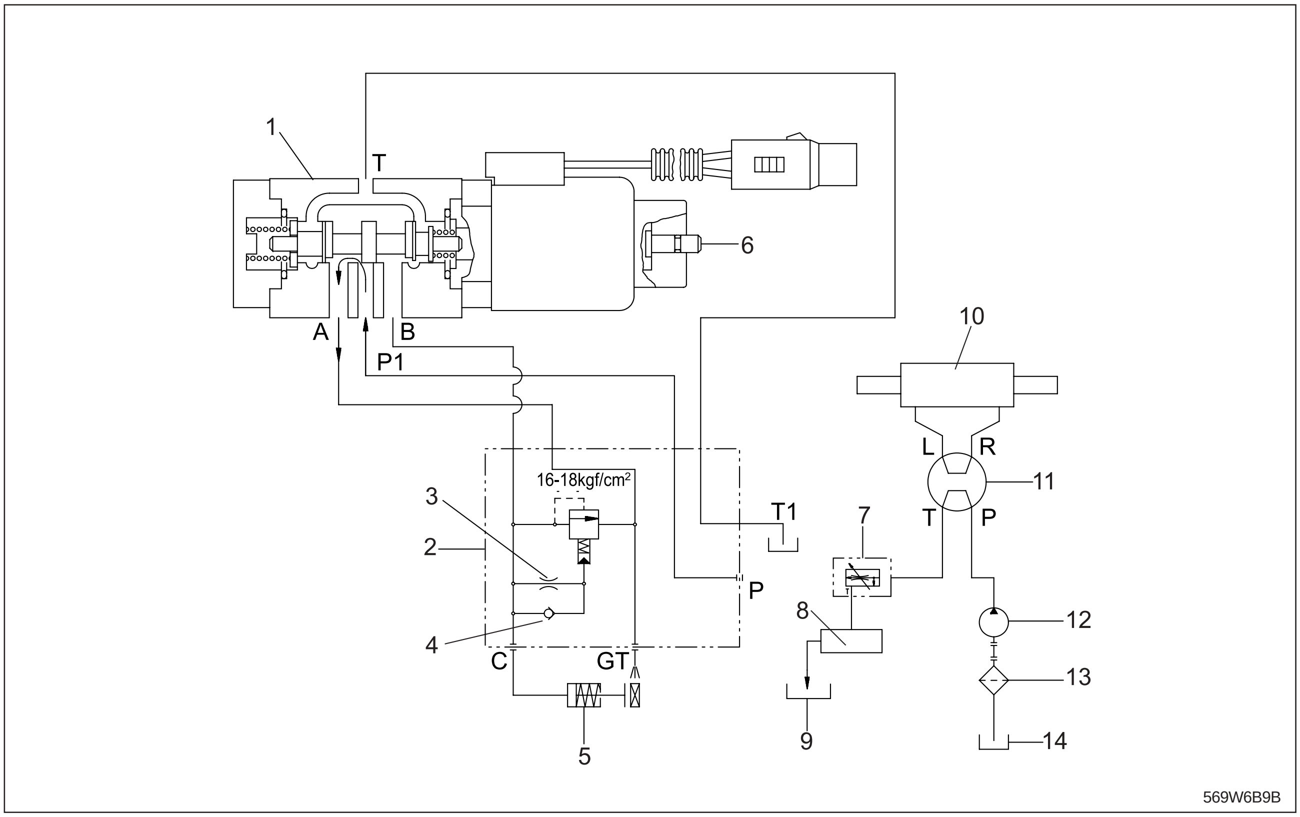


569W652B

(1) Tank (Transmission Case)
(2) Filter
(3) Pump
(4) Shuttle Shift Cover
(5) Solenoid Valve
(6) Priority
(7) Priority Valve

Oil at Port PI (gear pump) returns from Port A to the tank (transmission case) after lubrication the idly rotated PTO clutch via the modulating valve through inner of the spool. The spool is blocked by the springs at both ends from Port PI toward Port B in case of OFF.

- In case PTO clutch switch is ON



(1) Tank (Transmission Case)
(2) Filter
(3) Pump
(4) Shuttle Shift Cover
(5) Solenoid Valve
(6) Spool
(7) Priority Valve

The spool (6) gets moved to the left by electric current on the solenoid valve (5).

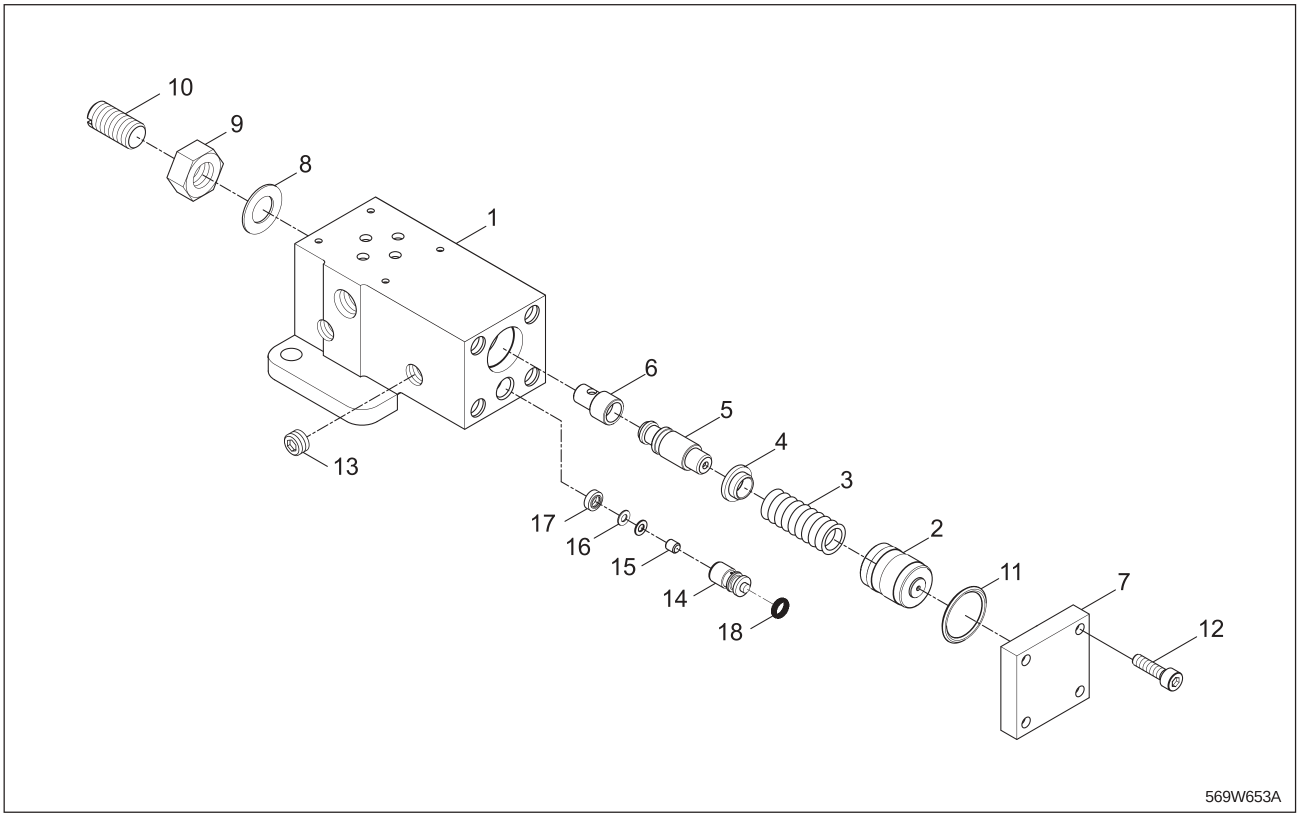
Oil at Port PI (gear pump) returns from Port B to the modulating valve through inner of the spool (6) as forced. Oil at the modulating valve coming from Port A, returns from Port T to the transmission case.

The spool (6) can be hardly operated only by the solenoid valve (5) if dust or the like is attached on the spool (6).

In this case, insert the manually operated pushpin to reinstate the normal application as available.

B. MODULATING VALVE

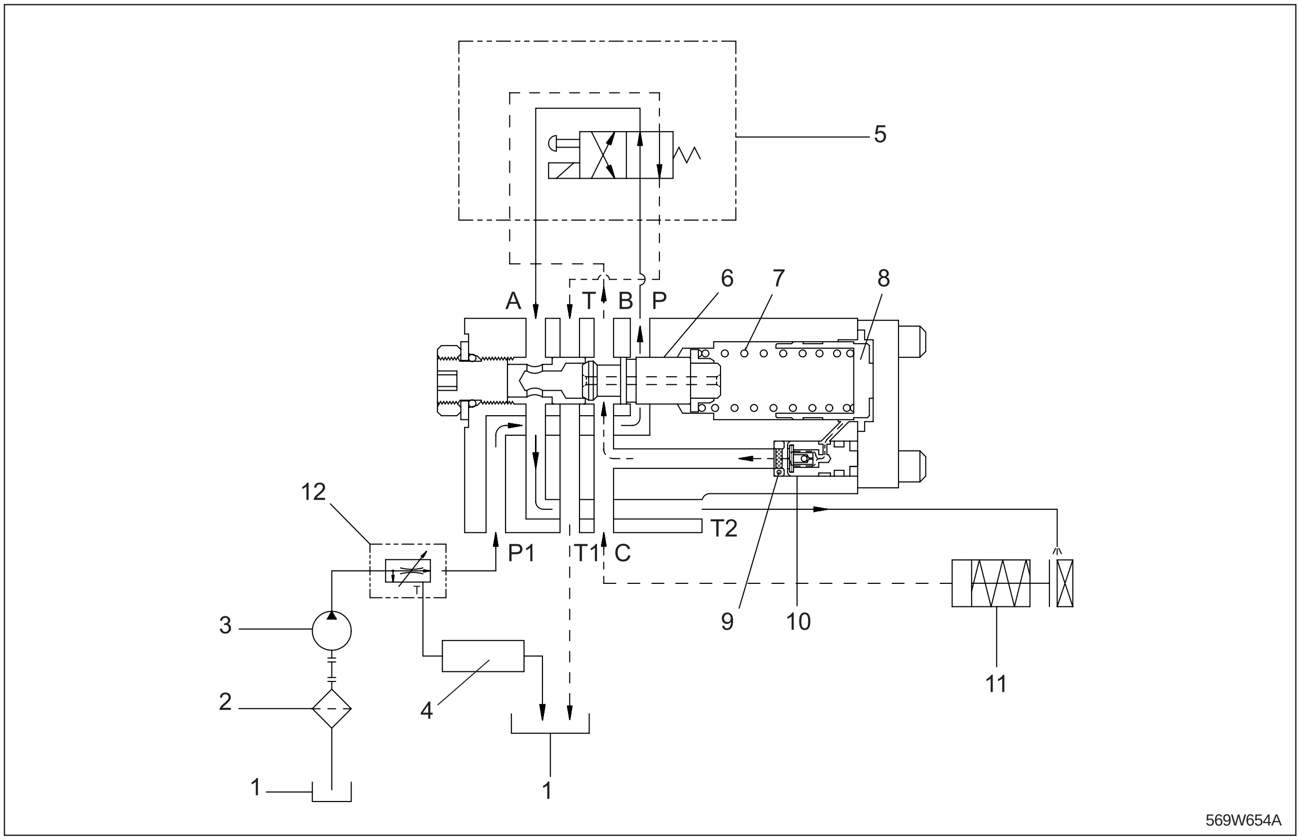
a. Structure



(1) Body	(6) Valve Seat	(11) O-Ring	(15) Orifice
(2) Piston	(7) Cover	(12) Bolt	(16) Washer
(3) Spring	(8) Packing	(13) Plug	(17) Filter
(4) Spring Gripper	(9) Lock Nut	(14) Check Valve	(18) O-Ring
(5) Spool	(10) Adjusting Bolt		

b. Operation

- In case PTO clutch switch is OFF

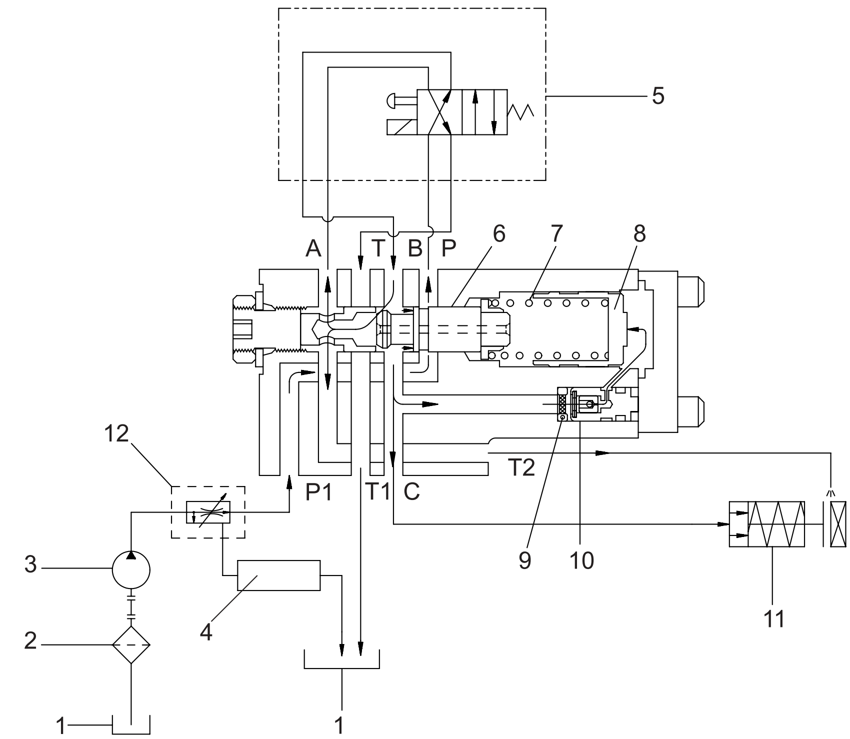


(1) Tank (Transmission Case)	(5) Solenoid Valve	(9) Filter
(2) Filter	(6) Spool	(10) Check Valve
(3) Gear Pump	(7) Spring	(11) PTO Clutch
(4) Shuttle Shift Cover	(8) Piston	(12) Priority Valve

Oil at Port PI (gear pump) returns from Port T2 to the tank (1) after lubricating the PTO clutch via the solenoid valve (5) through the valve inside. Right after the PTO clutch switch is turned ON to OFF, the oil inside the hydraulic clutch comes back to Port C and returns from Port T1 via the solenoid valve (5) to the tank.

Meanwhile, as the circuit for pressing the piston (8) gets closed, the piston (8) moves to the right as forced by the spring (7). At this moment, the oil pressing the piston (8) leaves through the around of the check valve (10) to return to the tank while joined the oil from the hydraulic clutch.

- In case PTO clutch switch is ON



Oil at Port PI comes back to Port P of the solenoid valve through the valve inside returns as forced from Port B to the valve. Right after the PTO clutch switch is turned ON, the oil from Port B of the valve returns from Ports T2 and A by moving the spool to the right with the oil applied to the spool.

And the oil via the around of the spool is not only applied from Port C to the piston of the PTO hydraulic clutch but also returned to the check valve as forced owing to the low pressure.

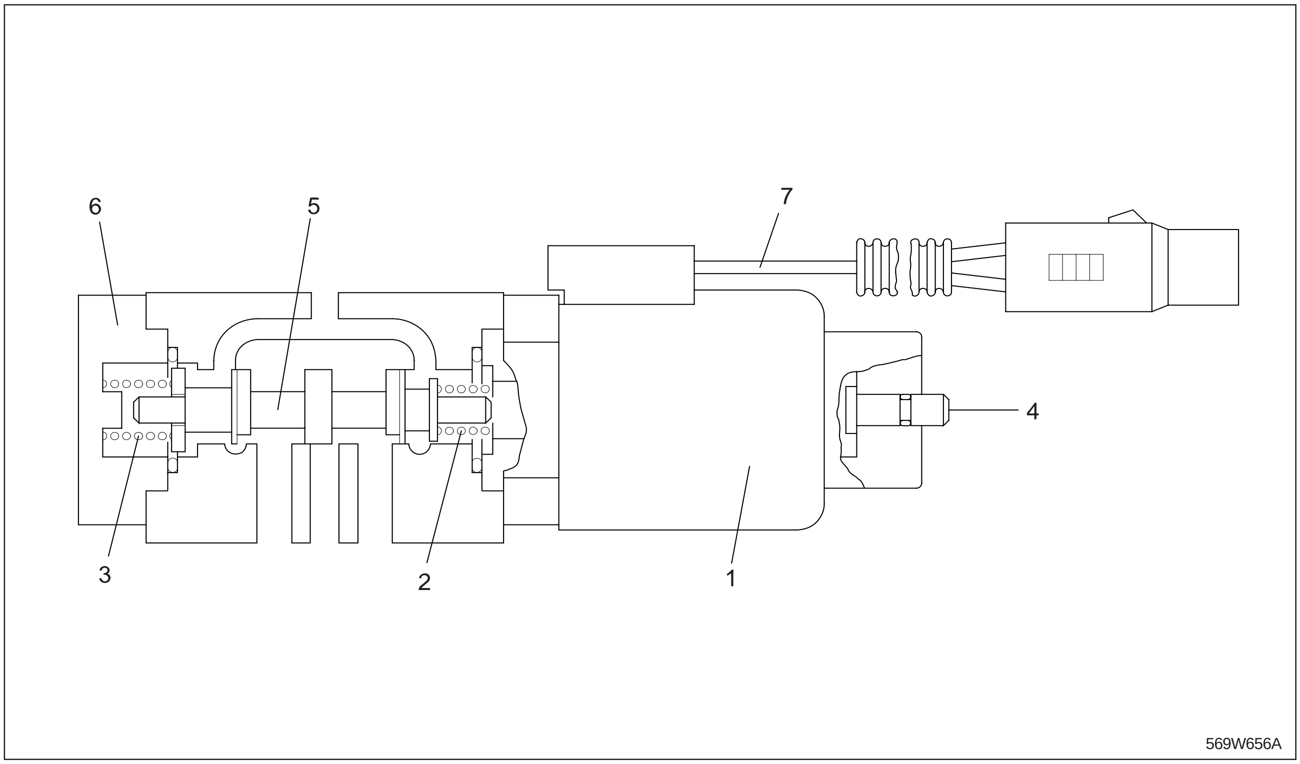
Oil in amount constantly regulated at the orifice of the check valve through the filter compresses the inner spring of the piston by moving the piston to the left slowly.

Thus, open and reinstated passage by pressing the spool is not returning back from Port B if not high pressurized. The pressure at Port C as high-pressurized proportionately is returning from Ports T2 and A while kept at a constantly high pressure of 16 ~ 18 kgf/cm². Since the orifice moves the piston with a constant oil amount, PTO is slowly connected. This is called the modulating time as of approx. 0.8 second.

2.3 ASSEMBLING AND DISASSEMBLING

A. SOLENOID VALVE

a. To Disassembling



(1) Solenoid Ass'y
(2) Spring
(3) Spring
(4) Spool
(5) Spool
(6) Plug
(7) Wire Lead

Spool

1. Loosen the bolt on the cover (1) and remove the cover.
2. Take out the spring and spool.

CAUTION

- *Hold the body to Disassembling the cover (however, do not hold the solenoid section).*

Solenoid

1. Loosen the sectional end of the solenoid with a spanner.
2. Take out the solenoid ass'y and the spring.

CAUTION

- *Be careful of the direction of the solenoid lead line when assembling.*

CAUTION FOR ASSEMBLY:

- *Be careful of the direction of the spool when assembling.*
- *Apply oil sufficiently to the spool body after washed, not to cause damage thereon when assembling.*

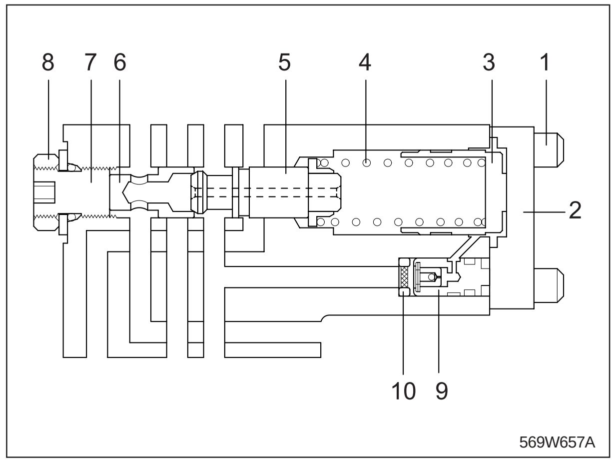
C. MODULATING VALVE

a. To Disassembling

1. Loosen bolt (1) to remove cover (2).
2. Take out piston (3), spring (4), spool (5) and valve sheet (6).
3. Take out check valve ass'y (8) and filter (9).

CAUTION

- *Do not loosen the adjusting kit located to the cover. Because the adjusting kit has set the relief pressure, the lock nut shall not be removed if not required for adjustment of the pressure. If the adjusted value is changed, the modulating time may be shorter (PTO clutch gets connected in haste) or the PTO clutch may be hardly connected. In case the adjusting kit is removed by mistake, perform adjustment as specified with a pressure gauge.*



(1) Bolt
(2) Cover
(3) Piston
(4) Spring
(5) Spool
(6) Valve Seat
(7) Adjusting Screw
(8) Lock Nut
(9) Check Valve
(10) Filter

b. Caution for Assembly

Apply oil sufficiently to all the parts after washed, not to cause damage thereon when assembling.

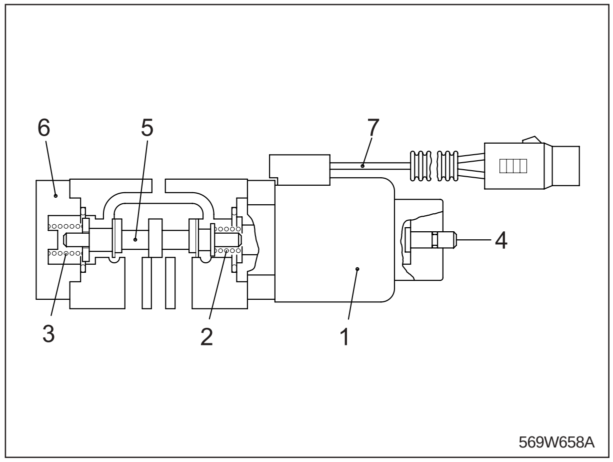
Relief pressure set	Factory spec.	16 ~ 18 kgf/cm^2

Tightening torque of bolt (1)	Factory spec.	5.8 ~ 7.8 N·m 0.6 ~ 0.8 kgf·m 4.2 ~ 5.7 lbf·ft

2.4 TO CHECK AND TO REPAIR

A. SOLENOID VALVE

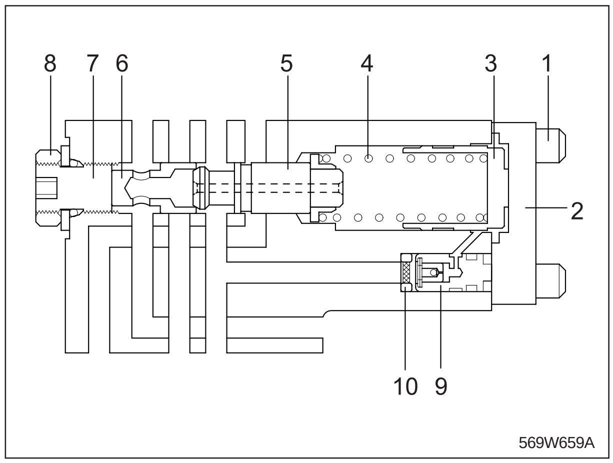
1. Replace the solenoid valve ass'y if the wet-drive sFurface of the spool is worn out or damaged.
2. Perform electric conduction test on the solenoid with a tester and if not conductive, replace the solenoid valve ass'y.
3. Replace the O-ring if worn out or damaged.



(1) Solenoid
(2) Spring
(3) Spring
(4) Spool
(5) Spool
(6) Plug
(7) Wire Lead

B. MODULATING VALVE

1. Check valve: Replace the modulating valve ass'y if the wet-drive surface or the sheet is worn out or damaged.
2. Filter: Clean out dust (or foreign substance) if any thereon.
3. Piston and spool: Replace the modulating valve ass'y if the wet-drive surface or the sheet is worn out or damaged.
4. O-ring: Replace if worn out or damaged.



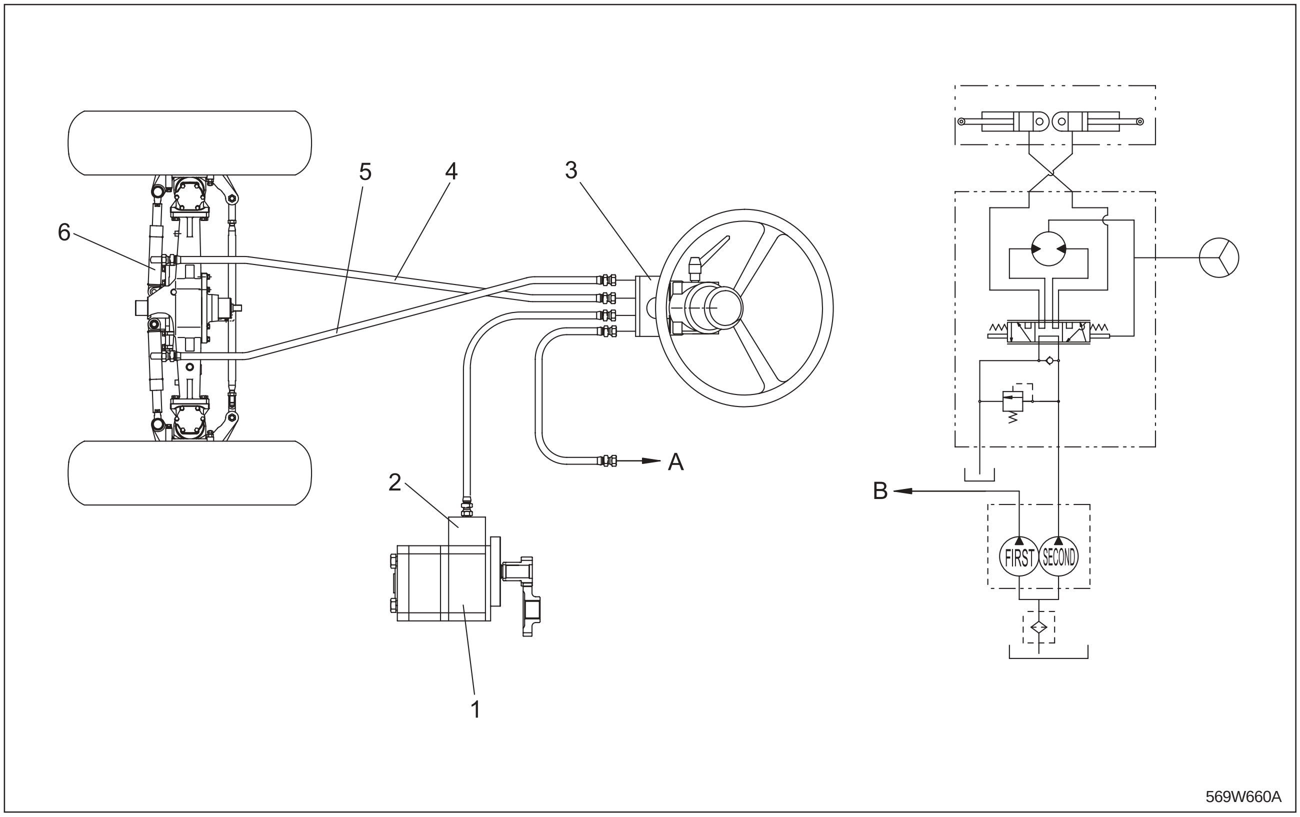
(1) Bolt
(2) Cover
(3) Piston
(4) Spring
(5) Spool
(6) Valve Seat
(7) Adjusting Screw
(8) Lock Nut
(9) Check Valve
(10) Filter

3. POWER STEERING SYSTEM

3.1 TROUBLESHOOTING

Symptom	Probable Cause	Solution
- Steering wheel is heavy to operate	1) Orbitrol unit (1) Deflected center from the column. (2) Abrasion due to dust on spool or sleeve. (3) Excessive tightening torque of bolts (7 places) on end cover. 2) Pump (1) Incapable drive. (2) Worn out or in error. (3) Defectively rated. 3) Relief valve (1) In error (defective operation). (2) Low pressure set.	• Correct (cause if the tightening bolt with orbitrol is loosened free). • Replace • Tighten at the torque as specified evenly. • Repair • Replace • Reset pressure and oil amount. • Replace • Reset
- No returning to neutral even if hand is off steering wheel or turning as it pleases	1) Orbitrol unit (1) Abrasion due to dust on spool or sleeve. (2) Deflected center from the column.	• Replace • Correct
- Defective or incapable operation of the cylinder against the turning of steering wheel	1) Orbitrol unit (1) Air flowed in the gerotor, inlet or engagement parts due to long term unemployed. 2) Cylinder (1) Air flowed in. (2) Piston seal damaged.	• Bleed air • Bleed air • Replace
- Steering wheel turns reversibly	1) Orbitrol unit (1) Improper adjustment of valve timing (when dismantling and reassembling). 2) Pipe (1) Improper piping of port 4.	• Correct • Correct
- Oil leakage 1. Shaft area (circumference of spline in spool) 2. Assembled area (among housing, spacer plate, gerotor and end cover)	1) Oil seal worn out (1) Contaminated delivering oil. 2) O-ring damaged (1) Damaged when dismantling and reassembling term unemployed.	• Replace • Replace

3.2 INTRODUCTION



(1) Gear Pump
(2) Priority Valve
(3) Power Steering Unit
(4) Hydraulic Hose (RH)
(5) Hydraulic Hose (LH)
(6) Steering Cylinder

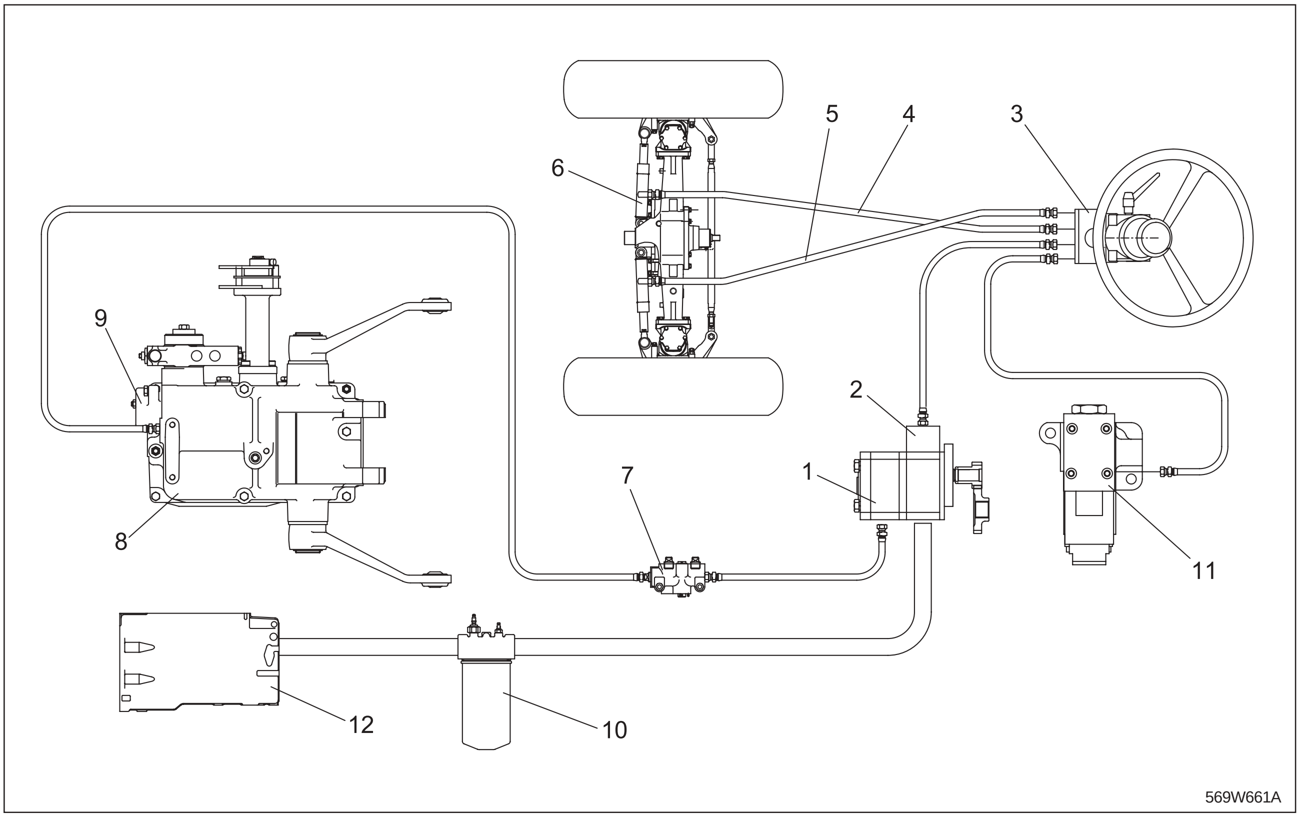
(A) To the Transmission Case
(B) To the Hydraulic Block

An exclusively hydraulic load reaction type of power steering is applied to this system, and as the exclusively hydraulic model connects the steering controller and the steering cylinder with only a hydraulic pipe, the control is available also only with hydraulic power transmitted to the cylinder.

Thus there is no mechanical conveyance such as steering gear, pitman arm or drag link for simple implement.

The exclusively hydraulic type of power steering is classified into Non-Load Reaction model and Load Reaction model according to the cylinder port disconnected or connected with the control valve at neutral position, and the latter model is applied to the tractor. For this model, the steering wheel returns almost as straightened as that of an automobile when the hand is off the steering wheel if not exactly though.

Oil Flow



(1) Gear Pump	(5) Hydraulic Hose (LH)	(9) Control Valve
(2) Priority Valve	(6) Steering Cylinder	(10) Filter
(3) Power Steering Unit	(7) Hydraulic Block	(11) PTO Clutch Valve
(4) Hydraulic Hose (RH)	(8) Power Lift Ass'y	(12) Transmission Case

1. If the engine starts and the hydraulic pump turns, oil in T/M case is absorbed and delivered compulsorily to the steering controller via the priority valve.
2. This valve protects the hydraulic circuit by governing the maximum pressure (approx. 120 kgf/cm², 1, 707 psi) of the steering circuit delivered to the steering valve.
3. The steering valve controls the direction of the front wheels by switching over the oil flow delivered by operation of the steering wheel and by moving the rod of the steering cylinder.

3.3 STRUCTURE AND OPERATION

A. MAIN PARTS

a. Power Steering Unit

The steering controller is composed of steering valve and relief valve.

b. Hydraulic Pump

Hydraulic pump for power steering employs a gear pump that is of efficient capacity and mechanism, and power is delivered from the cam shaft gear on the right of the engine.

c. Hydraulic Filter

As an absorption filter with a case as installed on the inlet side of the gear pump, it employs a permanent on the center of the element made of paper.

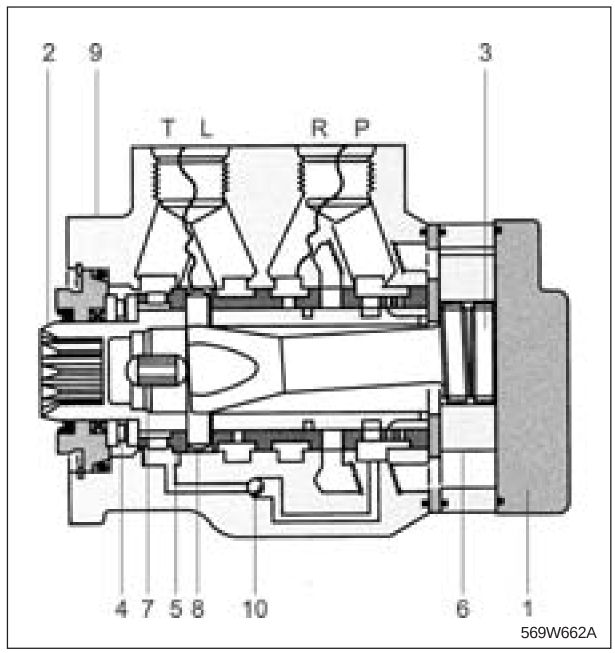
d. Steering Cylinder

Double-acting cylinder of double-load type is applied.

B. STRUCTURE

a. Power Steering Unit

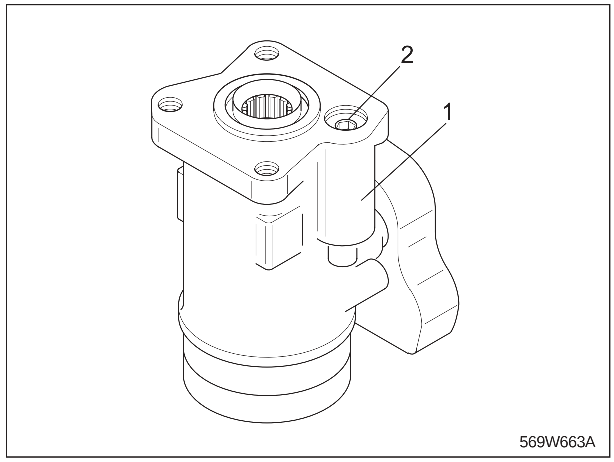
The steering controller for power steering is composed of steering valve and relief valve.



(1) End Cap	(6) GEROTOR
(2) Spool	(7) Centering Spring
(3) Spacer	(8) Pin
(4) Bearing	(9) Housing
(5) Sleeve	(10) Emergency Check Valve

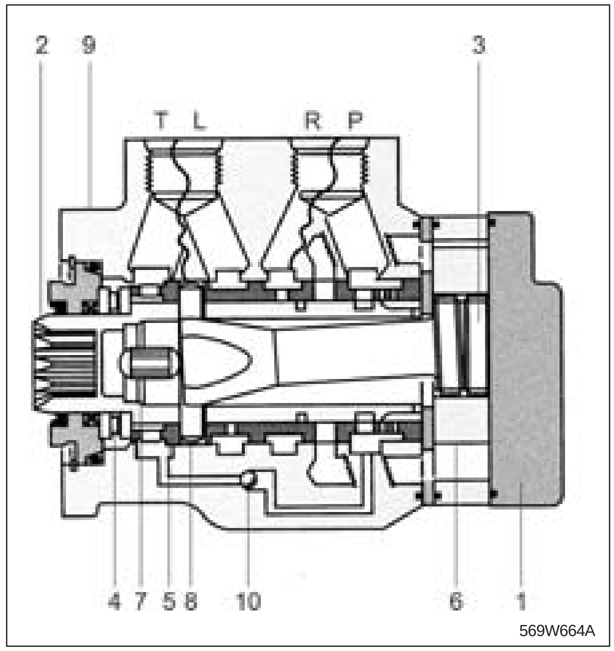
b. Steering Valve

The steering valve is divided into valve and metering installation. The control valve is composed of housing (9), spool (2) and sleeve (5), and the metering installation is composed of the trochoid pump called as GEROTOR (6).



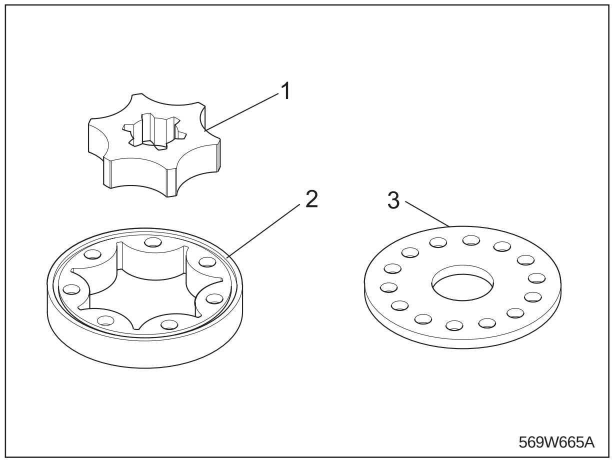
(1) Steering Valve (Orbitrol Unit)
(2) Relief Valve

1. Control valve: Control valve of rotary type is kept at neutral by the centering spring if the valve is not operated. It switches over the oil flow into the steering cylinder along with the GEROTOR against the turning direction if the steering wheel is operated.



(1) End Cap
(2) Spool
(3) Spacer
(4) Bearing
(5) Sleeve
(6) GEROTOR
(7) Centering Spring
(8) Pin
(9) Housing
(10) Emergency Check Valve

2. Metering installation oil delivered from the hydraulic pump to the steering cylinder passes this metering installation. The metering installation composed of the trochoid pump, while absorbing oil at 3 rooms, sends out oil at different 3 rooms according to the capacity change of the pump room made up between the rotor and the GEROTOR if the rotor gets started. Meanwhile, to the rotor, oil is directly delivered via the steering shaft for turning of the steering wheel. Consequently, the GEROTOR transmits corresponding amount of oil to the turning to the steering cylinder. By this operation, the direction of wheels can be controlled as much as the angle corresponding to the turning degree of the steering wheel. In case the engine stops or the hydraulic pump gets in error, manual control of the direction is allowable because the gerotor can be operated as a little engaged trochoid pump.



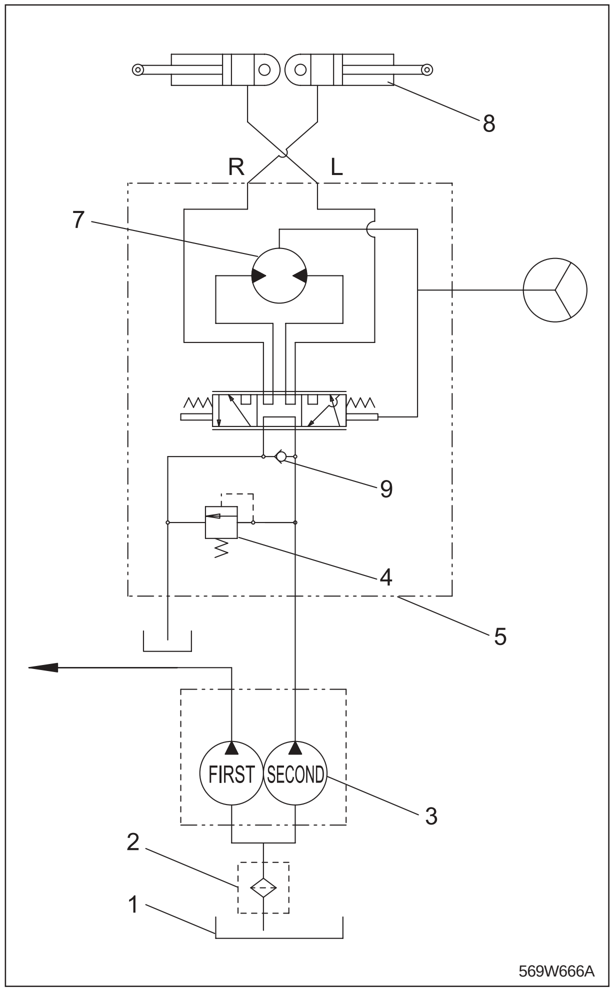
(1) Rotor (3) Plate
(2) Stator

C. OPERATION

a. Hydraulic Circuit for Power Steering System

1. Power steering pump (3), driven by the engine sucks oil from transmission case (1), and it to steering controller (5) through the hose.
2. The oil which has entered steering controller (5) is directed to control valve (6). As the steering wheel is turned, control valve (6) operates and oil passes through GEROTOR (7) and into steering cylinder (8). The cylinder rod them moves to control the directional movement of the front wheels.
3. Return oil from steering cylinder (8) passes through control valve (6) and back into transmission case (1).
4. When the engine is not operating, and the steering wheel is turned GEROTOR (7) rotates to supply oil in the pipe to steering cylinder (8).

   Thus the machine can be steered manually. Under this condition check valve (9) opens and oil returning from the steering cylinder which would otherwise return to transmission case (1) flow to the pipe leading to the hydraulic system.

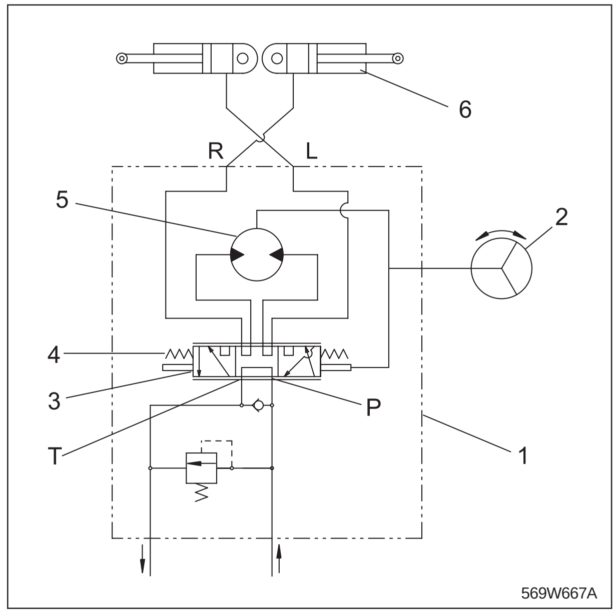


(1) Transmission Case (6) Control Valve
(2) Oil Filter (7) GEROTOR
(3) Power Steering Pump (8) Steering Cylinder
(4) Relief Valve (9) Check Valve
(5) Steering Controller

OIL FLOW

Neutral Position

When the steering wheel (2) is not being turned valve plate (3) is held in the neutral position by centering springs (4). Under this condition an oil passage is formed between port P (from pump) and port T (to transmission case) in the control valve and all oil from the hydraulic pump flows to port T. Also the passage from cylinder ports R and L are closed off in the control valve. Consequently steering cylinder does not operate even if subjected to an external force and the front wheels are held in the straight ahead position or an a given angle of turn.



P: Pump Port
T: Tank Port
R: Cylinder Port R
L: Cylinder Port L

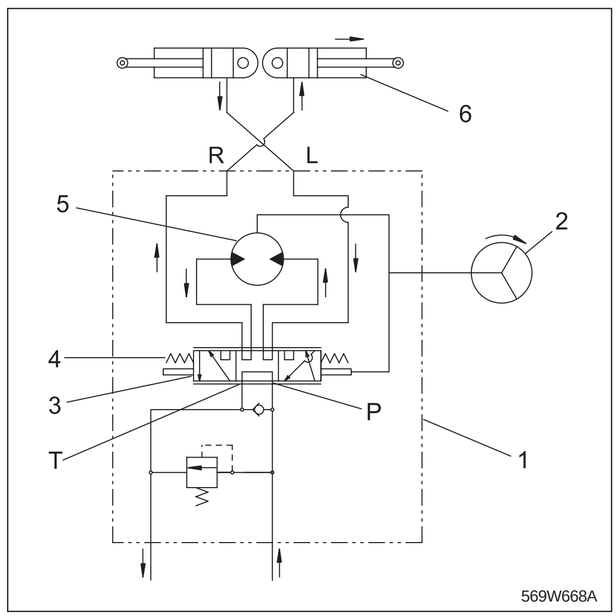
(1) Steering Controller
(2) Steering Wheel
(3) Valve Plate
(4) Centering Spring
(5) GEROTOR
(6) Steering Cylinder

Right Turn

When the steering wheel is turned to the right, the action is transmitted through the drive plate gerotor and drive link to the control valve. Valve plate (3) then rotates to the right on manifolds locates on the opposite faces of the valve plate (3).

Thus the port P passage in the control valve is connected with GEROTOR (5). The stator of gerotor (5) turns by the amount corresponding to the turn of the steering wheel (2) and the gerotor performs the metering function and lets oil through it, the amount of which corresponds to the turn of the steering wheel (2). The oil which has passed through GEROTOR (5) flows back to the control valve, in which it is directed to cylinder port R to operate steering cylinder (6). Consequently, The front wheels are moved to the right through the angle corresponding to the amount of the oil.

When steering cylinder (6) operates, oil returning to cylinder port L flows back to the transmission case through the passage connected to port T in the control valve.

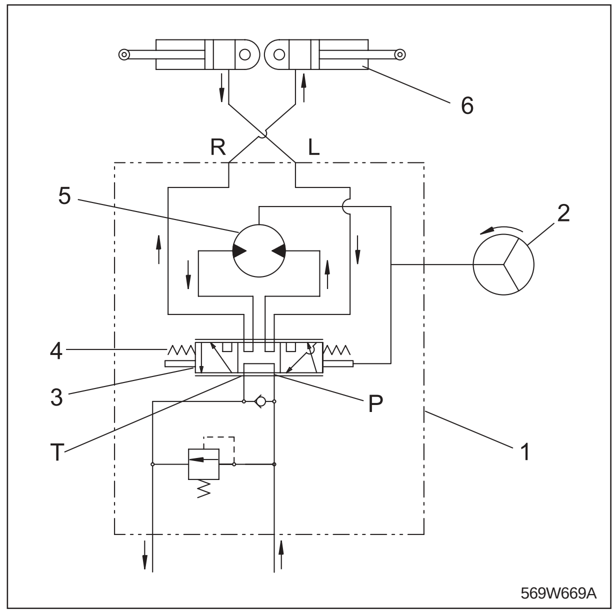


P: Pump Port
T: Tank Port
R: Cylinder Port R
L: Cylinder Port L

(1) Steering Controller
(2) Steering Wheel
(3) Valve Plate
(4) Centering Spring
(5) GEROTOR
(6) Steering Cylinder

Left Turn

The steering system operates in this same way at a left-turn as well, except that oil flows into and out of steering cylinder in the directions opposite to those at a right-turn.



P: Pump Port
T: Tank Port
R: Cylinder Port R
L: Cylinder Port T

(1) Steering Controller
(2) Steering Wheel
(3) Valve Plate
(4) Centering Spring
(5) GEROTOR
(6) Steering Cylinder

3.4 PREPARATION STAGE FOR DISASSEMBLING AND ASSEMBLING

DRAINING THE TRANSMISSION FLUID

Draining the Transmission Fluid

1. Place oil pans underneath the transmission case.
2. Remove the drain plugs.
3. Drain the transmission fluid.
4. Reinstall the drain plugs.

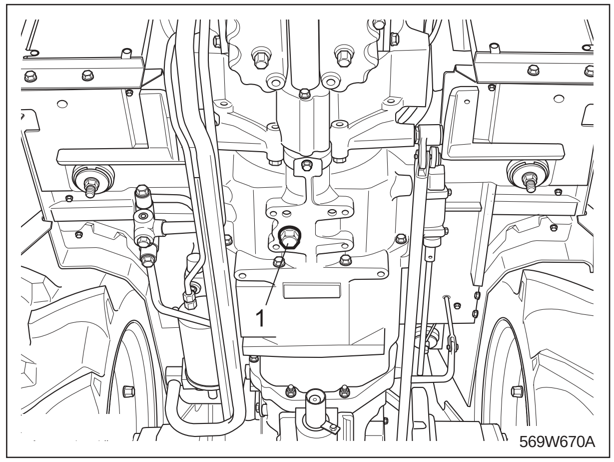
(When refilling)

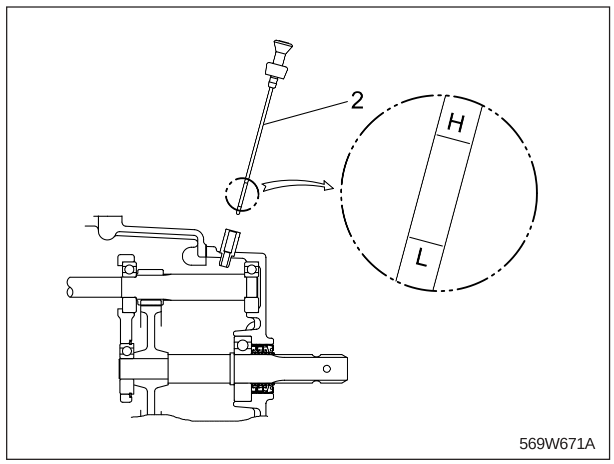
- Fill up from filling port after removing the filling plug (1) until reaching the gauge (2).
- After running the engine for few minutes, stop it and check the oil level again, add the fluid to prescribed level if it is not correct level.

Capacity	Transmission fluid	34.0 ℓ 9.0 U.S.gal.

IMPORTANT

- *Use only SAE 80, 90 gear oil. Use of other oils may damage the transmission or hydraulic system. Refer to "LUBRICANTS, FUEL AND COOLING WATER" (Refer to chapter 1)*
- *Do not mix different brands fluid together.*



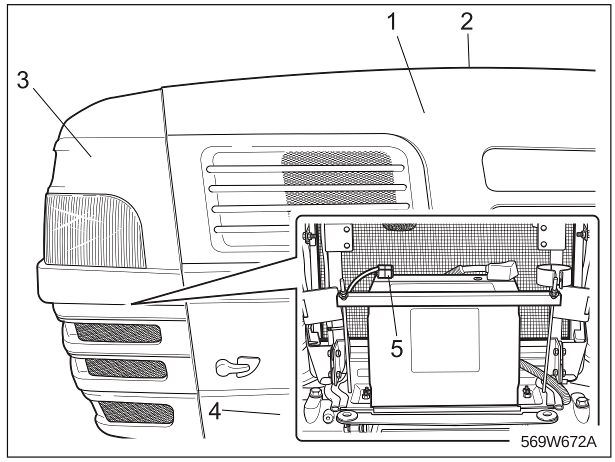


(1) Drain Plugs

(2) Gauge

Preparation 1

1. Removing the following parts.



(1) Side Cover (RH, LH)

(2) Bonnet

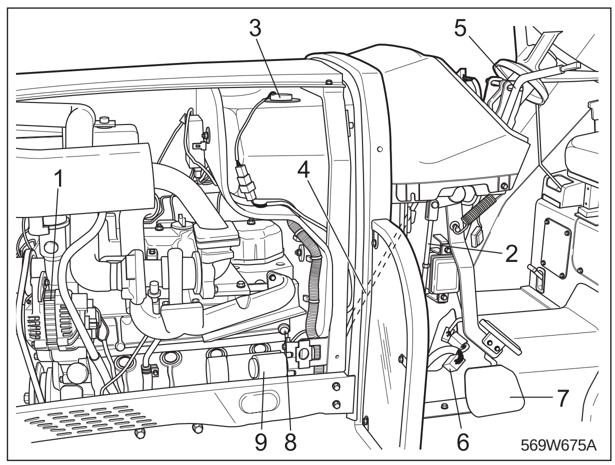
(3) Front Grille

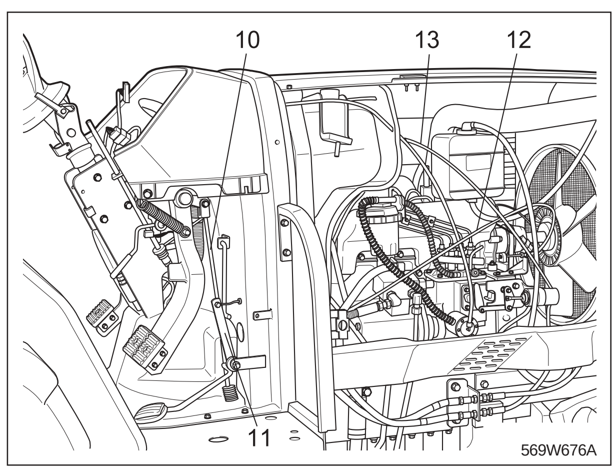
(4) Side Skirt (RH, LH)

(5) Battery Negative Code

Preparation 2

1. Disconnect the brake rods (4), (10).
2. Disconnect the clutch rod (2).
3. Remove the accelerator rod (12).
4. Disconnect the foot accelerator rod (11).
5. Remove the panel frame cover (7) and disconnect the connectors (6).
6. Remove the shuttle shaft lever (5) after disconnecting limit switch wire harness.
7. Disconnect the 2P connector of alternator (1), jumper for fuel level sensor (3) and starter (9).
8. Disconnect the meter cable (13) at the engine side.





(1) 2P Connector for Alternator

(2) Clutch Rod

(3) Jumper Lead For Fuel Level Sensor

(4) Brake Rod (LH)

(5) Shuttle Shift Lever

(6) Connectors

(7) Panel Frame Cover

(8) Jumper Lead For Oil Switch

(9) Jumper Lead For Starter

(10) Brake Rod (RH)

(11) Food Accelerator Rod

(12) Accelerator Rod

(13) Meter Cable

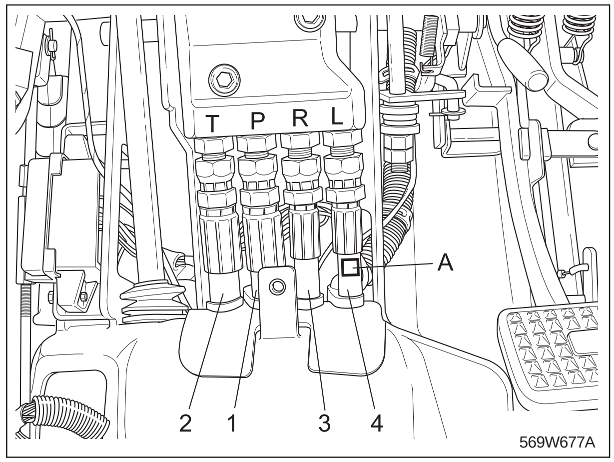
Hydraulic Pipes

1. Disconnect the main delivery hose (1), return hose (2), right turning delivery hose (3) and left turning delivery hose (4).

(When reassembling)

- In assembling the turning delivery hoses to the steering controller, connect the delivery hose with identification mark (tape) "A" to the L port of the steering controller.

Tightening torque	Main delivery hose retaining nut	46.6 ~ 50.9 N·m 4.8 ~ 5.2 kgf·m 34.4 ~ 37.6 lbf·ft
	Turning delivery hoses retaining nut	24.5 ~ 29.4 N·m 2.5 ~ 3.0 kgf·m 18.1 ~ 21.7 lbf·ft



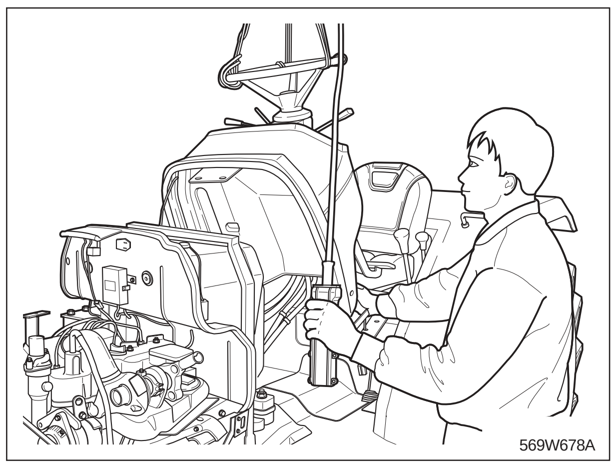
[A] Identification Mark (Tape)
(1) Main Delivery Hose
(2) Return Hose
(3) Right Turning Delivery Hose
(4) Left Turning Delivery Hose

Panel Frame and Steering Assembly

1. Remove the panel frame mounting crews (Two screws a upper part. Seven screws at lower part.).
2. Take out the panel frame and steering assembly as a unit.

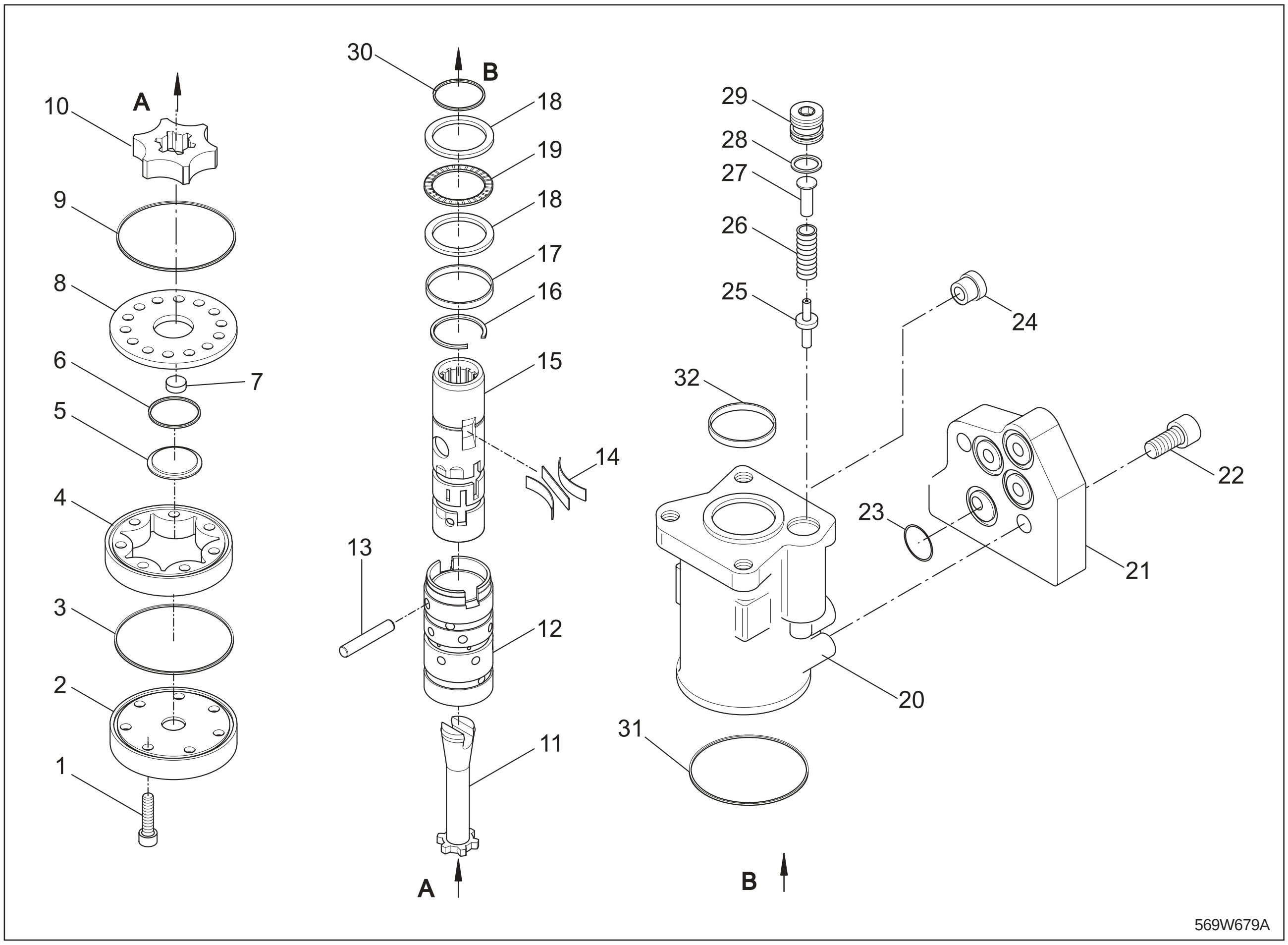
(When reassembling)

- Do not get in the wiring harness between panel frame and platform.



3.5 TO DISASSEMBLING AND TO ASSEMBLE

POWER STEERING UNIT



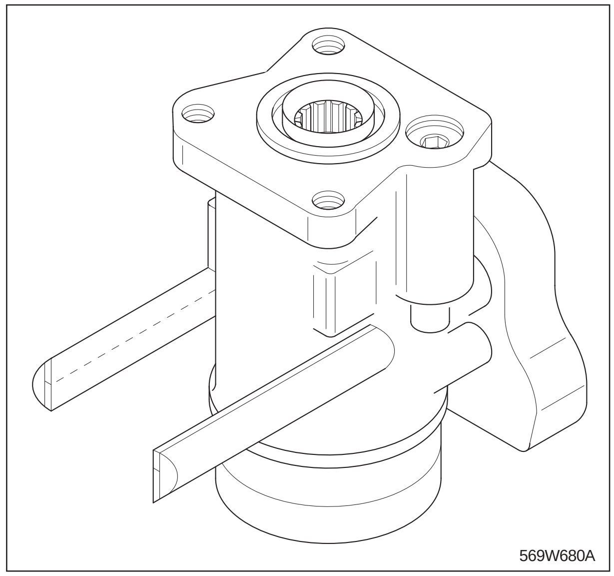
(1) Screw	(9) O-Ring	(17) Retainer Ring	(25) Poppet
(2) End Cap	(10) Rotor	(18) Bearingless	(26) Spring
(3) O-Ring	(11) Drive	(19) Needle Bearing	(27) Poppet
(4) Stator	(12) Sleeve	(20) Housing	(28) O-Ring
(5) Spacer	(13) Pin	(21) Housing	(29) Plug
(6) O-Ring	(14) Centering Spring	(22) Screw	(30) O-Ring
(7) Spacer	(15) Spool	(23) O-Ring	(31) O-Ring
(8) Spacer Plate	(16) stop Ring	(24) Inlet Check Valve Ass'y	(32) Dust Seal

a. To Disassemble the Gerotor Parts

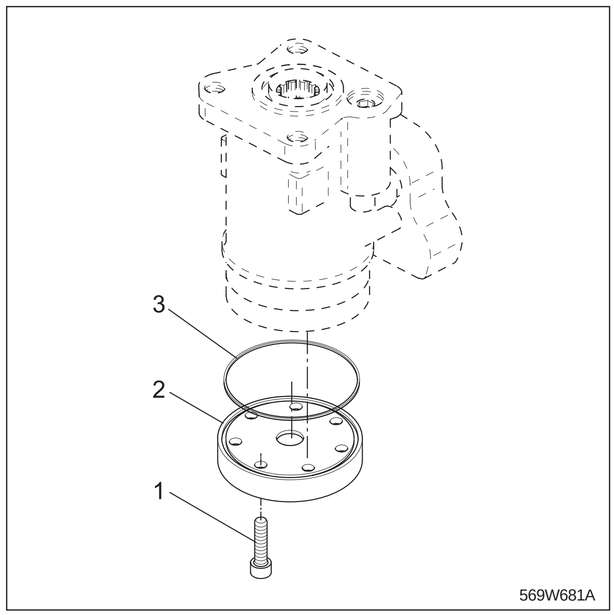
1. Let the port face of the tractor's body housing vised slightly with the end cap upward.
2. Loosen 2 screws to Disassembling housing (21).

CAUTION

- *Do not tighten the vise too firmly with a steel pate or the like applied to.*



3. Loosen 7 screws (1).
4. Remove end cap (2).
5. Remove O-ring (3) out of the end cap.



(1) Screw

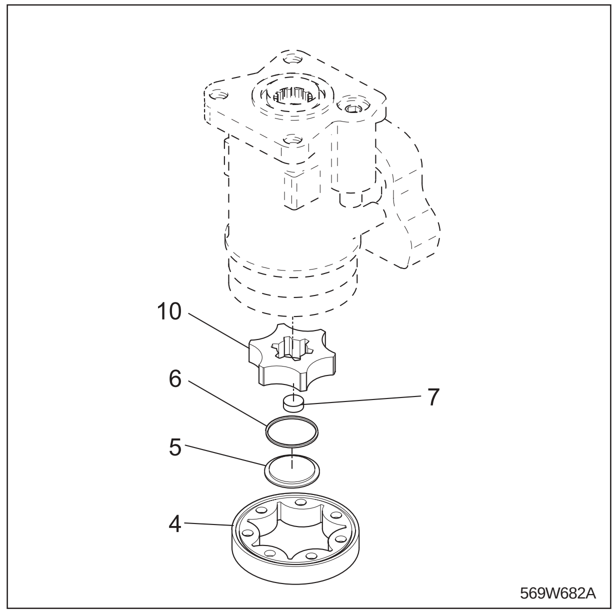
(2) End cap

(3) O-ring

6. Take out spacers (5), (7) and O-ring (6) located inside the inner spline of the rotor (10) in gerotor (4).

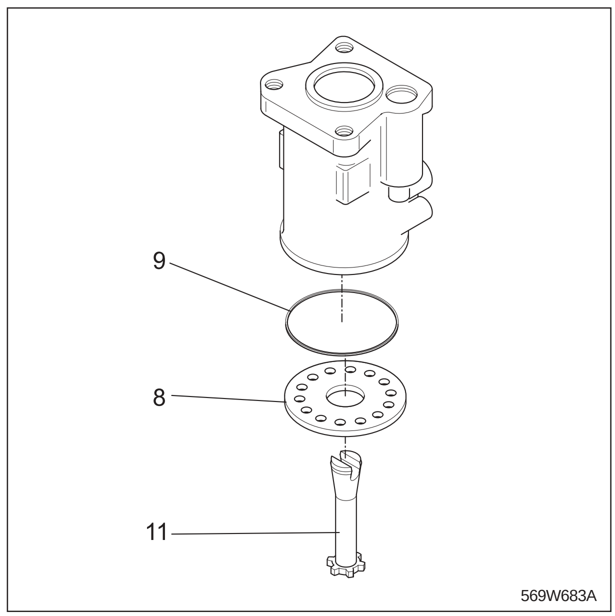
CAUTION

- *There is no spacer in the power steering units of outlet capacities of 31 cc/rev and 51 cc/rev.*



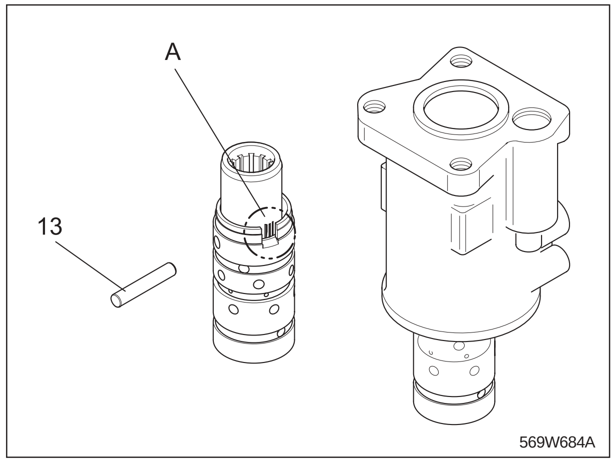
(4) Stator
(5) Spacer
(6) O-ring
(7) Spacer
(10) Rotor

7. Disassembling the gerotor. Be careful not to drop the rotor from the outer ring of the gerotor.
8. Take out spacer plate (8) and O-ring (9).
9. Take out drive (11).
10. Remove O-ring out of the housing.



(8) Spacer Plate
(9) O-ring
(11) Drive

11. Take out the spool and sleeve ass'y at the opposite side to the flange of the housing while pushing the inner spline of the spool with the thumb. Be careful not to allow the circumference of the sleeve to be stuck in the inner bore of the housing this time.



(A) Positioning Marks (13) Pin

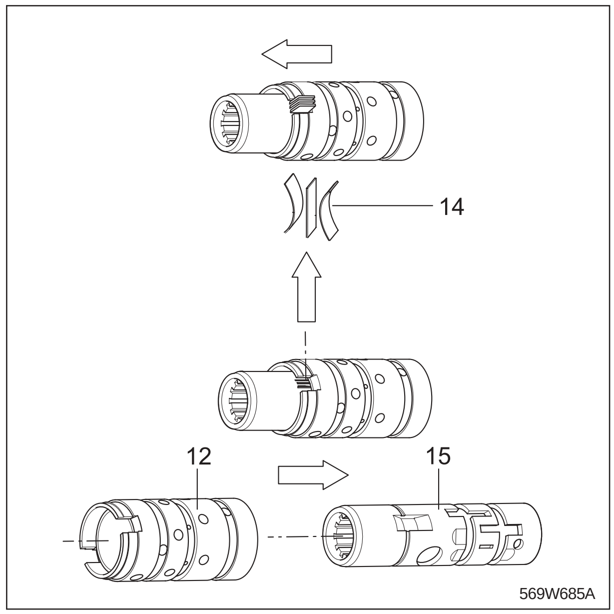
12. Take pin (13) out of the spool and sleeve ass'y.

CAUTION

- *Since the centering spring might fly out of the pool, surely wear goggles.*

13. Push forward the spool in the sleeve a little to remove the centering spring out of the spool with hand carefully.

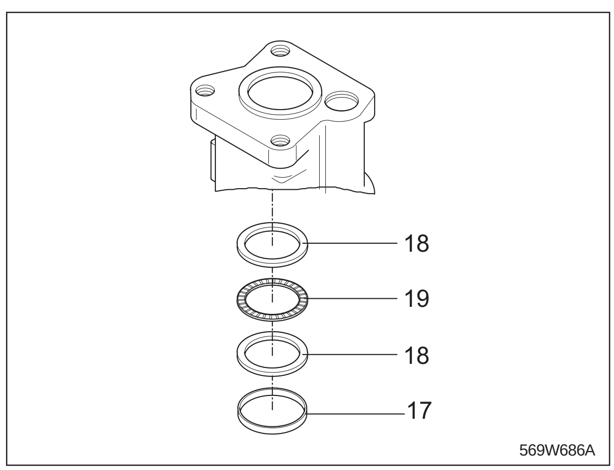
    While turning around the sleeve carefully, take it out of the spool.



(12) Sleeve (15) Spool
(14) Centering Spring

14. Take out two bearinglesses (18), needle bearing (19) and oil seal.

    Surely insert the needle bearing between the bearingless.



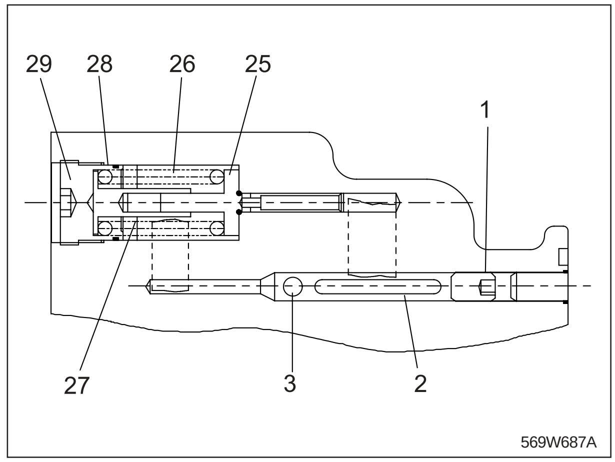
(17) Retainer Ring (19) Needle Bearing
(18) Bearingless

b . To Disassembling the Relief Valve

1. Loosen retainer screw (1) on plug (29) area of housing (20) and take out retainer pin (2) and ball (3).
2. Loosen relief adjusting plug (29) with the flange face of housing (20) upward and remove O-ring (28).
3. Remove damper collar (8) and spring (5) out.
4. Take poppet (4) out of housing (20) using a pin set.

CAUTION

- *Previously measure the depth from the flange faced and of the housing to the relief adjusting plug (7) with binary calipers to easily perform adjustment of the pressure when reassembling.*



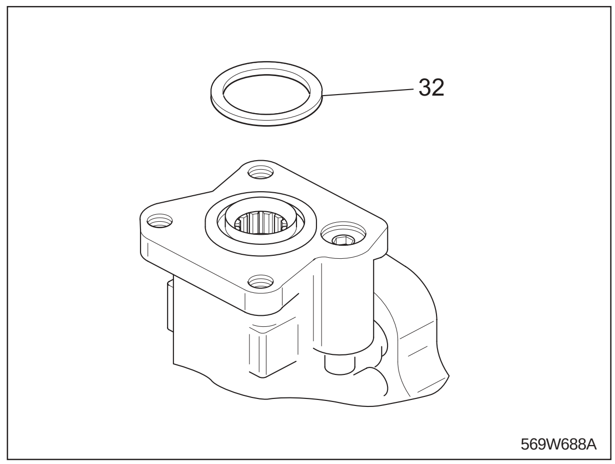
(1) Screw
(2) Retainer Pin
(3) Ball
(25) Poppet
(26) Spring
(27) Damper Collar
(28) O-Ring
(29) Adjusting Plug

c. To Assemble the Control

1. Insert the dust seal into the flange section of the housing.

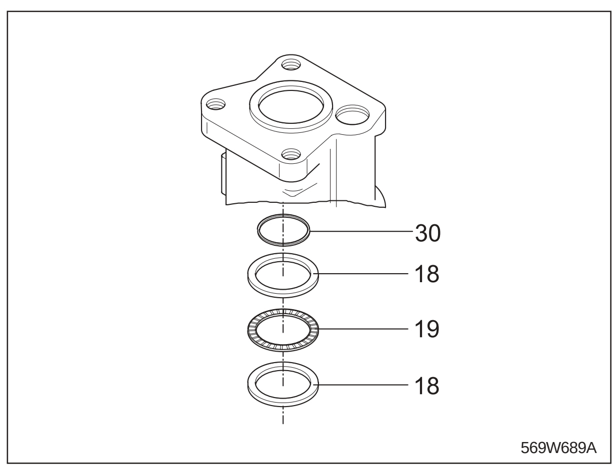
CAUTION

- *Install the flat surface of the dust room downward.*



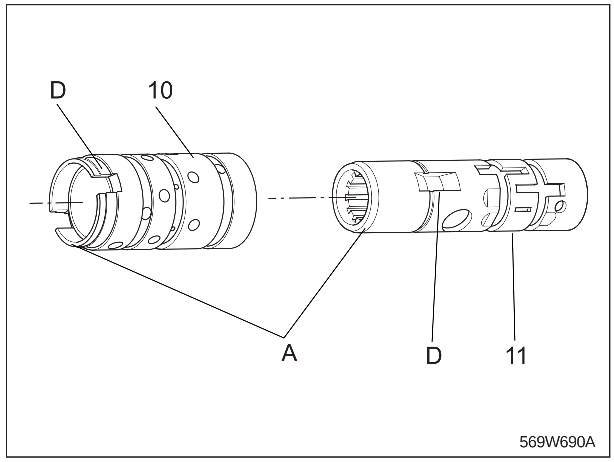
(32) Dust Seal

2. With the flange face of the housing downward, insert O-ring (30) onto the assembling groove to fix with one bearingless (18), thrust needle bearing (19) and the other bearingless (18).



(18) Bearingless
(19) Needle Bearing
(30) O-ring

3. While turning around spool (15), insert it slowly into sleeve (12), Take up the spline area to the spool to check if the spool turns lightly inside the sleeve.

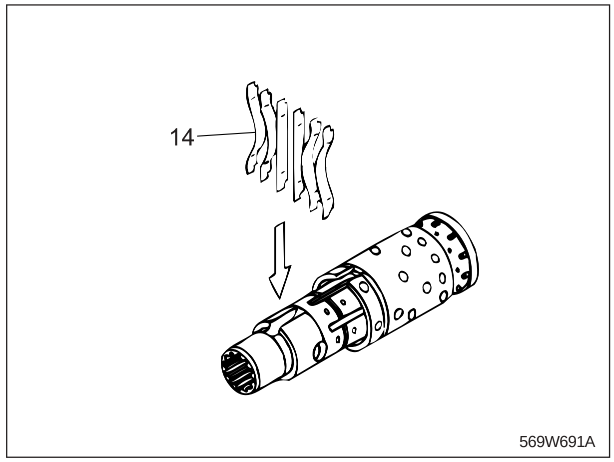


(10) Sleeve
(11) Spool
(A) Positioning Marks
(D) Spring Slot

4. Keep two spring groove at an angle of 180 respectively in the spool and the sleeve on a level plane as aligned. Place a spring insertion tool inside the spring groove and mount the centering spring on the insertion tool with its both sectional ends downward. At this time, lift the spool up off the sleeve a little to insert easily.

CAUTION

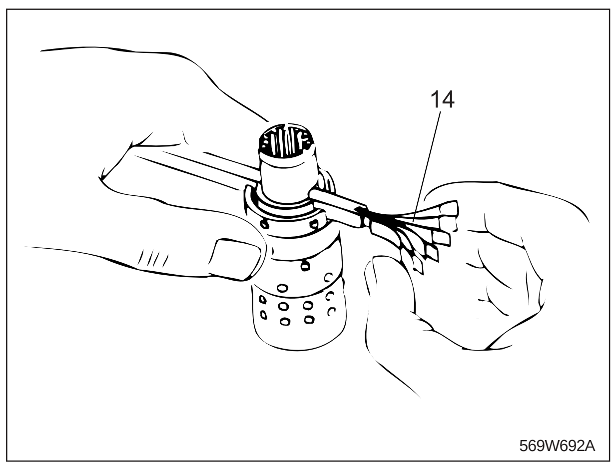
- *Check the number of centering springs prior to assembly, as it varies according to the input torque spec. for the product.*



5. Insert the spool while lifted a little off the sleeve with the opposite end of the centering spring compressed by hand into the groove of the spool and sleeve. At this time, slide the insertion tool at the same speed as the spring is inserted while compressed. After the insertion, align the spring end with the circumference of the sleeve.

CAUTION

- *When dismantling, align the position by confirming the position aligning mark.*
- *Since the centering spring might fly out of the spool, surely wear goggles.*



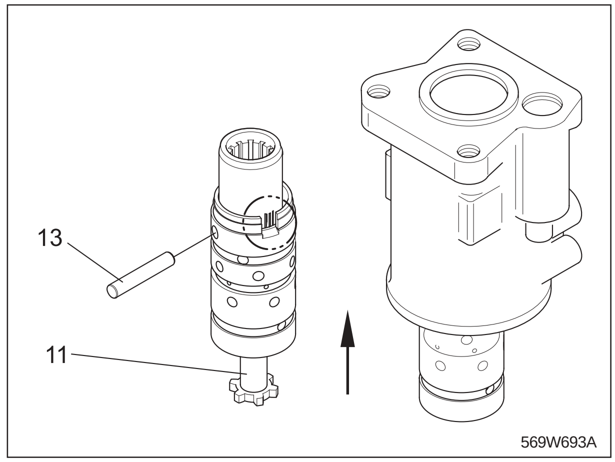
(14) Centering Spring

6. Insert pin (13) onto the sleeve groove and insert the spool and sleeve ass'y from the gerotor side of the housing.

CAUTION

- *Check if the spool and sleeve ass'y turns lightly inside the housing.*

7. Insert the drive (11). And align pin (13) with the york part of the drive this time.
8. Install O-ring on the Stator (4)Fd the gerotor star on the positioning groove.

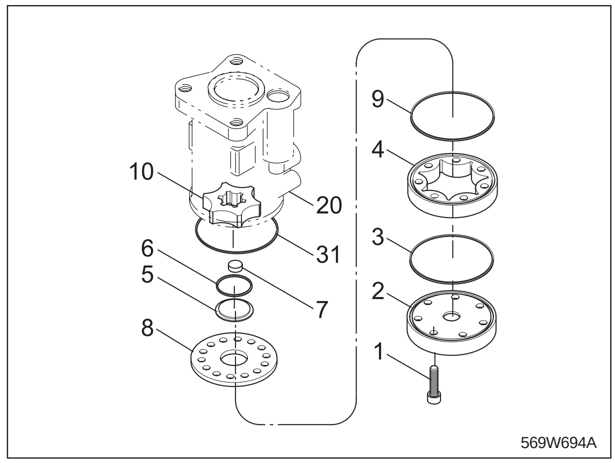


(11) Drive (13) Pin

9. Insert O-ring (6) and plate (7) installed on plate (5) into the inner spline part of the Stator star.
10. Let spacer plate (8) ride on to align the bolt hole of the housing with the oil hole.11. Apply oil on the threads of screw (1) to put end cap (2) on.

CAUTION

- *Previously tighten 7 screws (1) at a torque of approx 1.0 kgf·m (7.23 ft-lbs).*



(1) Screw	(7) Plate
(2) End cap	(8) Spacer Plate
(3) O-ring	(9) O-ring
(4) Stator	(10) Rotor
(5) Plate	(20) Housing
(6) O-ring	

d. To Assemble the Relief Valve

1. Pick up the spring guide part with a pin set to insert poppet (25) into the flange area of the housing.
2. Insert spring (26) and damper collar (27).
3. Insert O-ring into the relief adjusting plug (29) to tighten with the housing.

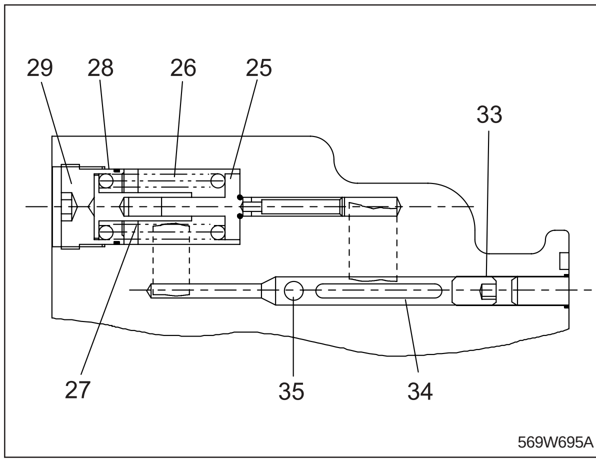
CAUTION

- *Adjust pressure of the steering relief valve when the assembly is completed.*

  Variable amount of pressure per revolution of the relief adjusting plug (29) is 15 kgf/cm^2 (213 psi).

e. Caution for Assembly of the Power Steering Unit

1. Be careful not to allow damages on the mechanically processed ends of the sleeve, spool and housing.
2. Perform disassembly and repair at a clean place, and remove any dust or foreign substance on joints around the main body of the product with a wire brush.
3. Be thoroughly careful not to cut of damage any parts by body drop or contact when handling.
4. Disassembly of the power steering unit shall be as specified in this manual, however not recommended to if possible.



(25) Poppet
(26) Spring
(27) Damper Collar
(28) O-Ring
(29) Adjusting Plug
(33) Screw
(34) Retainer Plate
(35) Ball

4. HYDRAULIC PUMP

4.1 TROUBLE SHOOTING

No.	Repair item	Factory spec.	Measure & sequence
1	Clearance between drive gear and main frame	• Allowable limit → 0.05 mm (0.00196 in.)	• Install bushing on the main frame. • Fix drive shaft and idle gear. • Measure with a clearance gauge.
2	Drive shaft parts worn out	• Allowable limit → 19.25 mm (0.75787 in.)	• Measure the shaft diameter with a micrometer.
3	Clearance between drive shaft and bushing	• Allowable limit → 0.177 mm (0.00696 in.)	• Measure the inner diameter of bushing with a micrometer. • Compare this with the measured diameter of drive shaft.
4	Bushing length	• Allowable limit → 25.75 mm (1.01378 in.)	• Measure the bushing length with a micrometer.
5	Pump frame length and bushing length	• 0.1 ~ 0.18 mm (0.00393 ~ 0.00708 in.) (bushing length is short)	• Measure the bushing length and pump frame length with a micrometer.

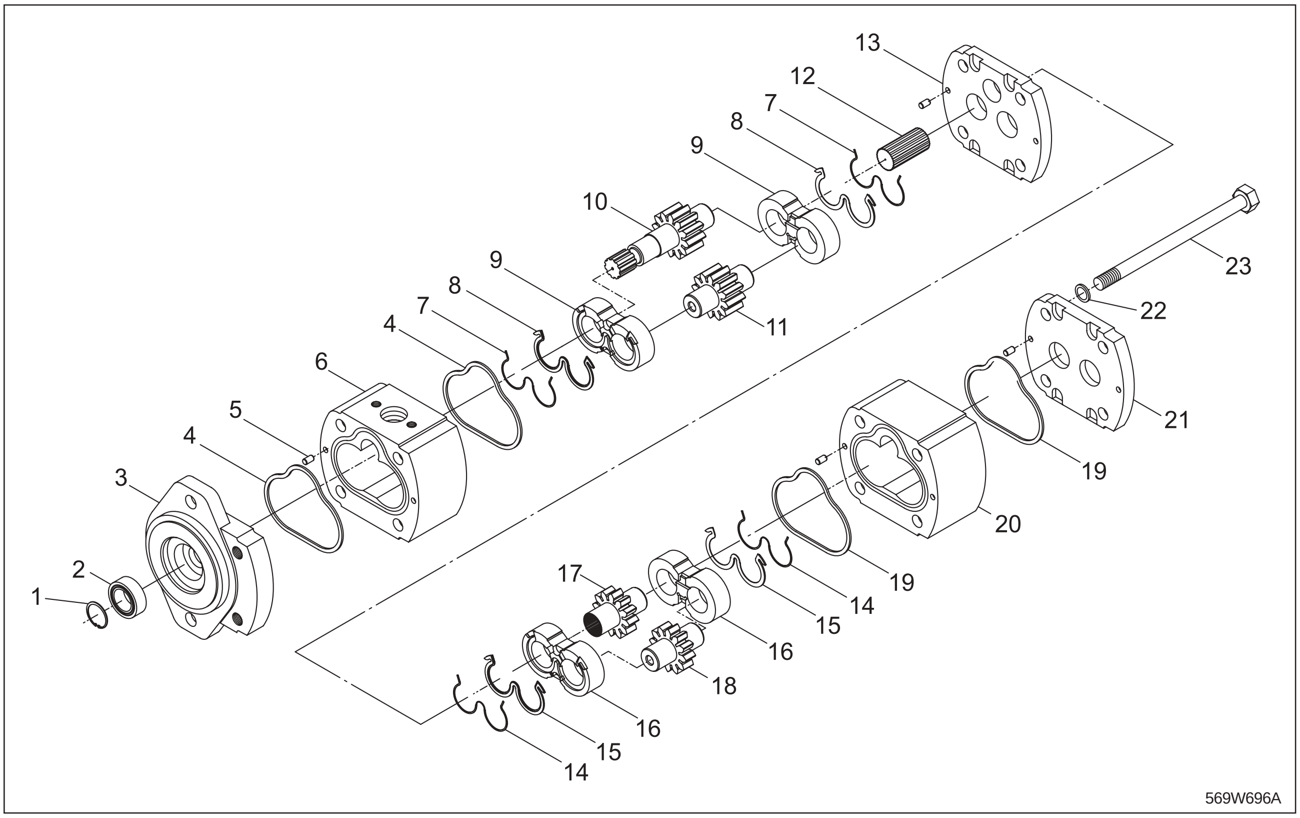
4.2 SPECIFICATIONS

Classification	8454
Type	Tandem
Capacity (cc/rev)	14.4 (First)
	6.3 (Second)
Gear ratio	1 : 1
Revolution direction	C.C.W
Attaching position	At the right side of the engine

• Reference: [First: for hydraulic lift, Second: for steering cylinder]

4.3 STRUCTURE AND OPERATION

A. STRUCTURE



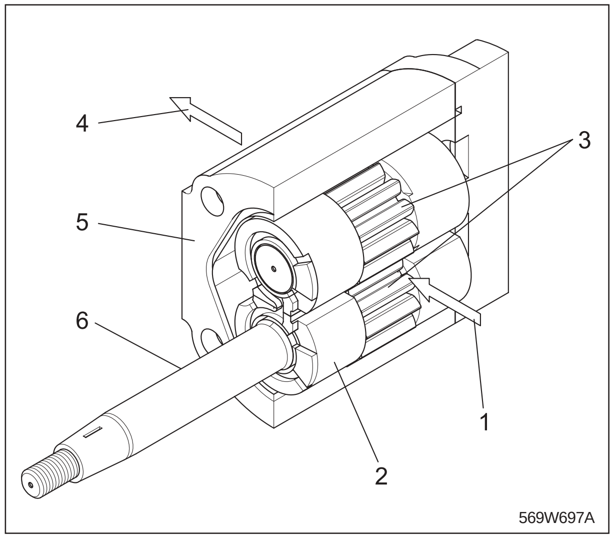
(1) Snap Ring
(2) Bearing
(3) Cover (Front)
(4) Sealing
(5) Pin
(6) First Pump
(7) Sealing
(8) Sealing
(9) Bushing
(10) Drive Gear Shaft (1)
(11) Passive Gear (1)
(12) Coupling
(13) Cover
(14) Sealing
(15) Sealing
(16) Bushing
(17) Drive Gear Shaft (2)
(18) Passive Gear
(19) Sealing
(20) Second Pump
(21) Cover (Rear)
(22) Spring Washer
(23) Bolt

B. OPERATION

a. Hydraulic pump delivers constant oil flow to operate the steering wheel and the hydraulic cylinder, and the hydraulic pump ass'y is composed of 2 pumps with different displacement respectively.

b. Two pump applicable in the same way are as designed as of the exterior gear to displace the fluid amount and to transmit the specified fluid amount for each revolution. Outlet flowing amount increases as the revolution speed of the pump increases.

c. Hydraulic pump is operated by the cam shaft drive gear of the engine, and the pump gear (C) turns to allow the transmission oil to continue flowing in and out. A vacuum is formed to let oil flow in the pump (A) when the gear is disconnected. Oil continuously flows together with the gear as it turns.

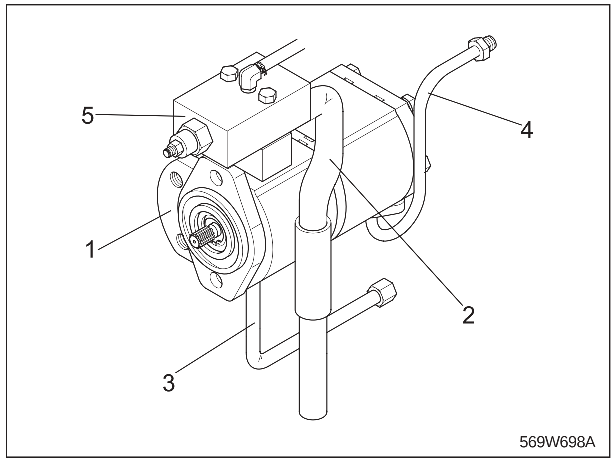


(1) Flow In the Pump
(2) Bushing
(3) Gear
(4) Flow Out of the Pump
(5) Pump Housing
(6) Drive Shaft

4.4 TO DISASSEMBLING AND TO ASSEMBLE

A. GEAR PUMP ASSEMBLY

1. Remove hydraulic pipes (3), (4) and inlet pipes (2) installed on gear pump (1).

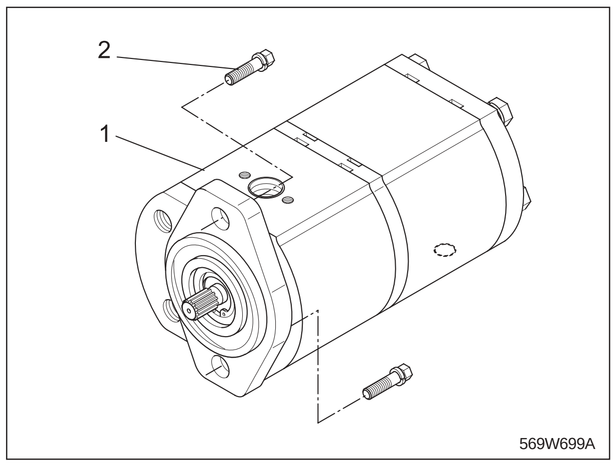


(1) Gear Pump
(2) Inlet Pipe
(3) Hydraulic Pipe 1
(4) Hydraulic Pipe 2
(5) Priority Valve

2. Loosen and remove bolt (2), gear pump (1) and gasket.

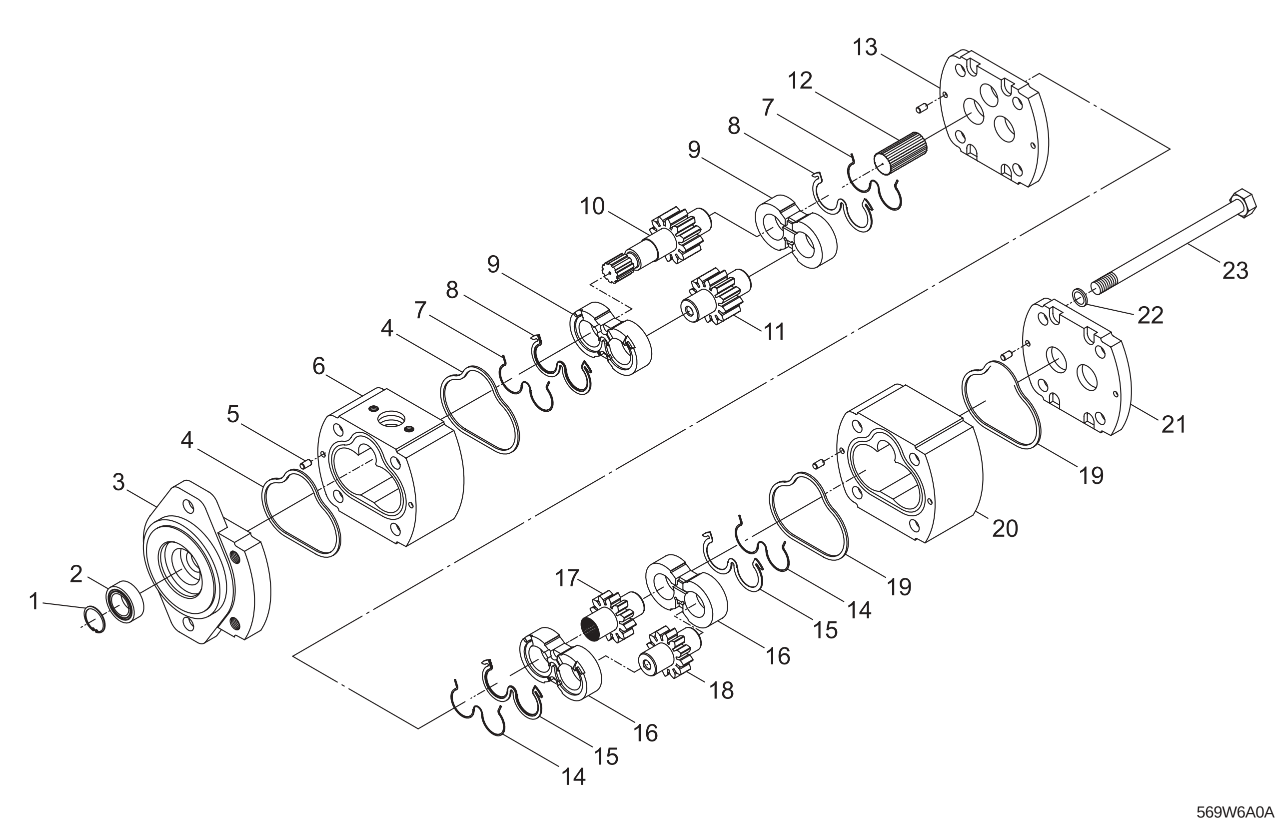
CAUTION

- *Be careful not to cause damages on the gasket. If damaged, replace it with a new one.*



(1) Gear Pump Assembly
(2) Bolt

B. GEAR PUMP



(1) Snap Ring	(7) Sealing	(13) Cover	(19) O-Ring
(2) Bearing	(8) Sealing	(14) Sealing	(20) Second Pump
(3) Front Cover	(9) Bushing	(15) Sealing	(21) Cover
(4) O-Ring	(10) Drive Gear Shaft 1	(16) Bushing	(22) Spring Washer
(5) Straight Pin	(11) Passive Gear	(17) Drive Gear Shaft 2	(23) Bolt
(6) First Pump	(12) Coupling	(18) Passive Gear	

1. Fix the gear pump ass'y with a vise.
2. Loosen 4 bolts (23) and remove rear cover (21).
3. Disassembling snap ring (1) and bearing (2) of the drive shaft.
4. Loosen second pump (20) and remove bushing (16), sealing (14), (15), O-ring (19), drive gear shaft 2 (17) and passive gear (18).
5. Loosen cover (13) and coupling (12).
6. Loosen first pump (6) and remove bushing (9), sealing (7), (8), O-ring (4), drive gear shaft 1 (10) and passive gear (11).
7. Remove the oil seal attached to cover (front) (3).

Tightening torque	Bolt (23)	48.0 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.4 ~ 41.2 lbf·ft

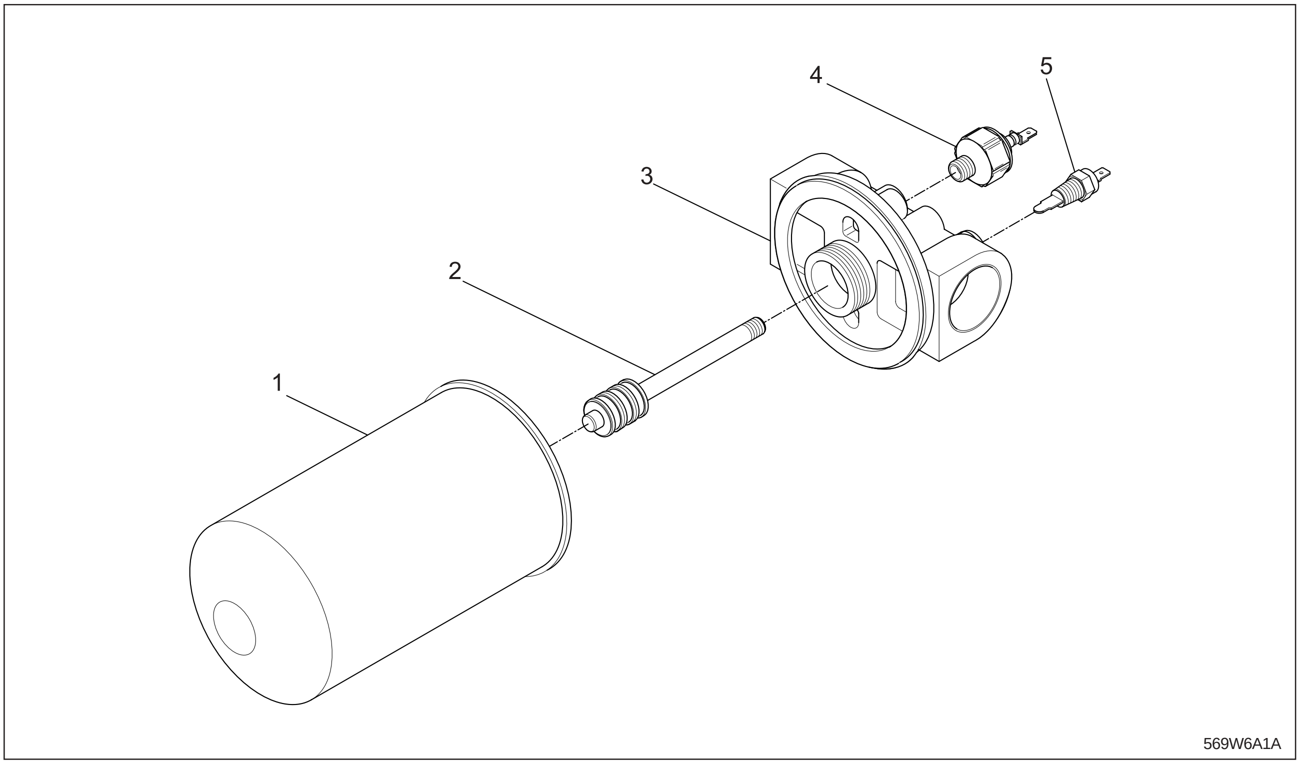
CAUTION

- *If the oil seal has been cracked or aged, replace it with a new one when assembling.*
- *Be careful not to cause damages on the sealing. If damaged, replace it with a new one.*
- *Pay attention to the assembling direction of the sealing when assembling.*

5. HYDRAULIC FILTER

5.1 STRUCTURE AND OPERATION

A. STRUCTURE



(1) Hydraulic Filter

(2) Magnetic Ass'y

(3) Filter Bracket

(4) Vacuum Sensor

(5) Thermostat Sensor

Hydraulic filter as of inlet filter on the inlet gear pump has permanent magnet installed on the center of the element, and the filter mounted on the hydraulic lift is structured with a vacuum sensor and a thermo sensor to detect blockage.

B. OPERATION

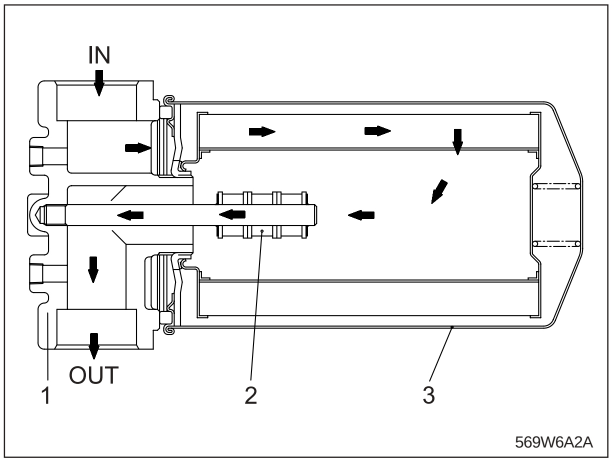
a. Function

It filters any particle or contaminated substance out of oil.

b. Operation Principle

The filtering system as of an inlet filter installed on the inlet gear pump is composed of filter bracket, magnet ass'y and element ass'y. The filter used 8000 series is by itself applicable to both hydraulic lift and direction control of the steering wheel.

The hydraulic oil flows into IN port if the filter bracket and the transmission oil delivered into the hydraulic element ass'y (3) and delivery out into the outlet port via the inner element flows into the hydraulic pump. All foreign substances are filtered at the element this time. In addition, a vacuum sensor and a thermo sensor are mounted thereon to detect blockage in the filter. The vacuum sensor and the thermo sensor are always turned OFF under the pressure load of 500 ± 30 mmHg and under 53°C respectively. Two switches by application of the transistor switch are turned ON over the flowing oil temperature of 53°C and over the pressure load of 500 ± 30 mmHg with the alarm lamp on the instrument panel turned on.



(1) Filter Bracket

(2) Magnetic Ass'y

(3) Hydraulic Filter

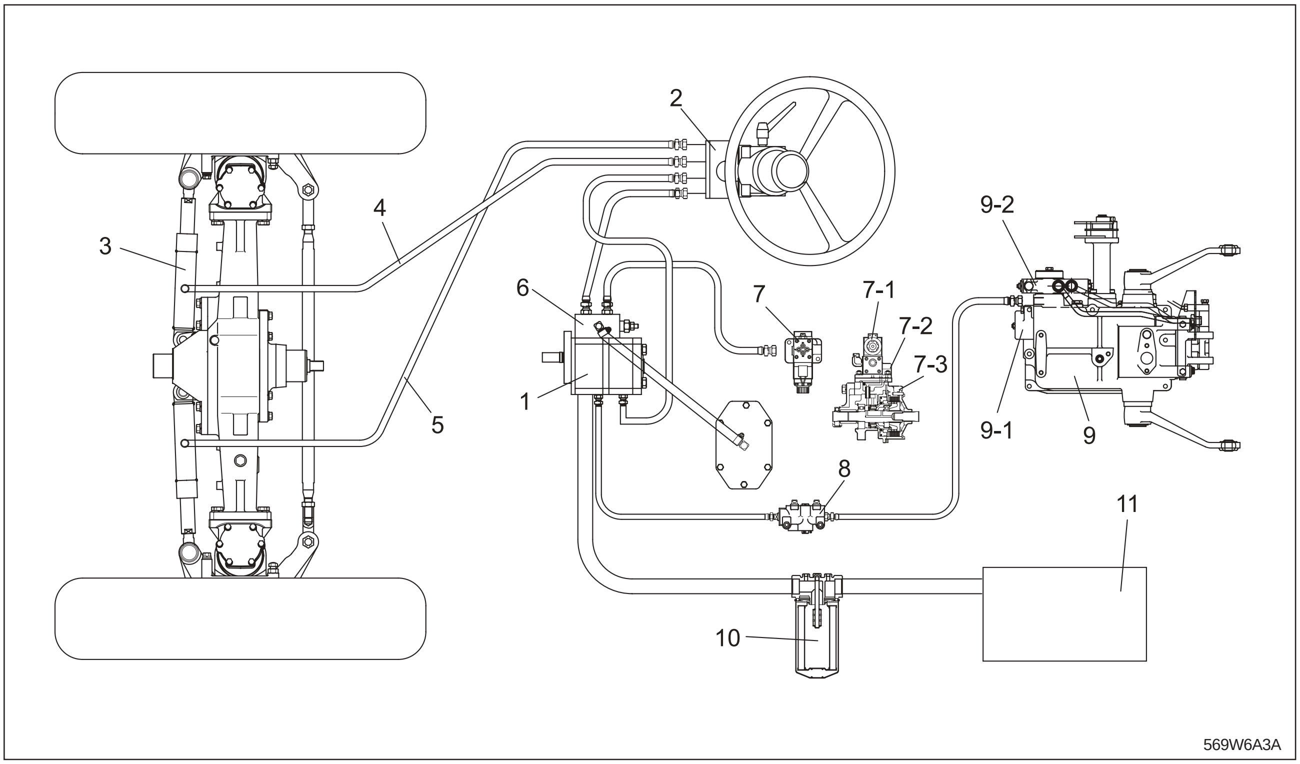
C. TO CHECK

As for the hydraulic filter, the oil filter shall be replaced if its alarm lamp on the instrument panel is turned on to avoid damages on the hydraulic system. And the hydraulic filter also shall be replaced every service term of 200 hours.

6. HYDRAULIC PRESSURE OPERATION PRINCIPLE AND TROUBLE SHOOTING

6.1 COMPOSITION OF HYDRAULIC DEVICE & FLOW DIAGRAM OF HYDRAULIC OIL

A. SCHEMATIC DIAGRAM OF HYDRAULIC DEVICE



(1) Gear Pump Assembly
(2) Orbitrol Unit
(3) Steering Cylinder Ass'y
(4) Hydraulic Hose Ass'y (RH)
(5) Hydraulic Hose Ass'y (LH)
(6) Prior Valve Assembly
(7) PTO Clutch Valve
(7-1) Solenoid Valve Ass'y
(7-2) Modulator Valve Ass'y
(7-3) PTO Clutch Assembly
(8) Hydraulic Block Ass'y
(9) Hydraulic Cylinder Ass'y
(9-1) MLS Valve Assembly
(9-2) Double-Acting Valve Assembly
(10) Hydraulic Filter

B. FLOW DIAGRAM OF TRANSMISSION OIL

a. STEERING DEVICE & PTO CLUTCH SYSTEM

Transmission Case (Hydraulic Tank) → Hydraulic filter → Hydraulic pump 2 (7.2 cc/rev) → Power steering unit (74 cc/rev)

→ Steering cylinder → Prior valve assembly (7 L/min) → Solenoid valve assembly →

Modulator valve assembly → PTO clutch assembly

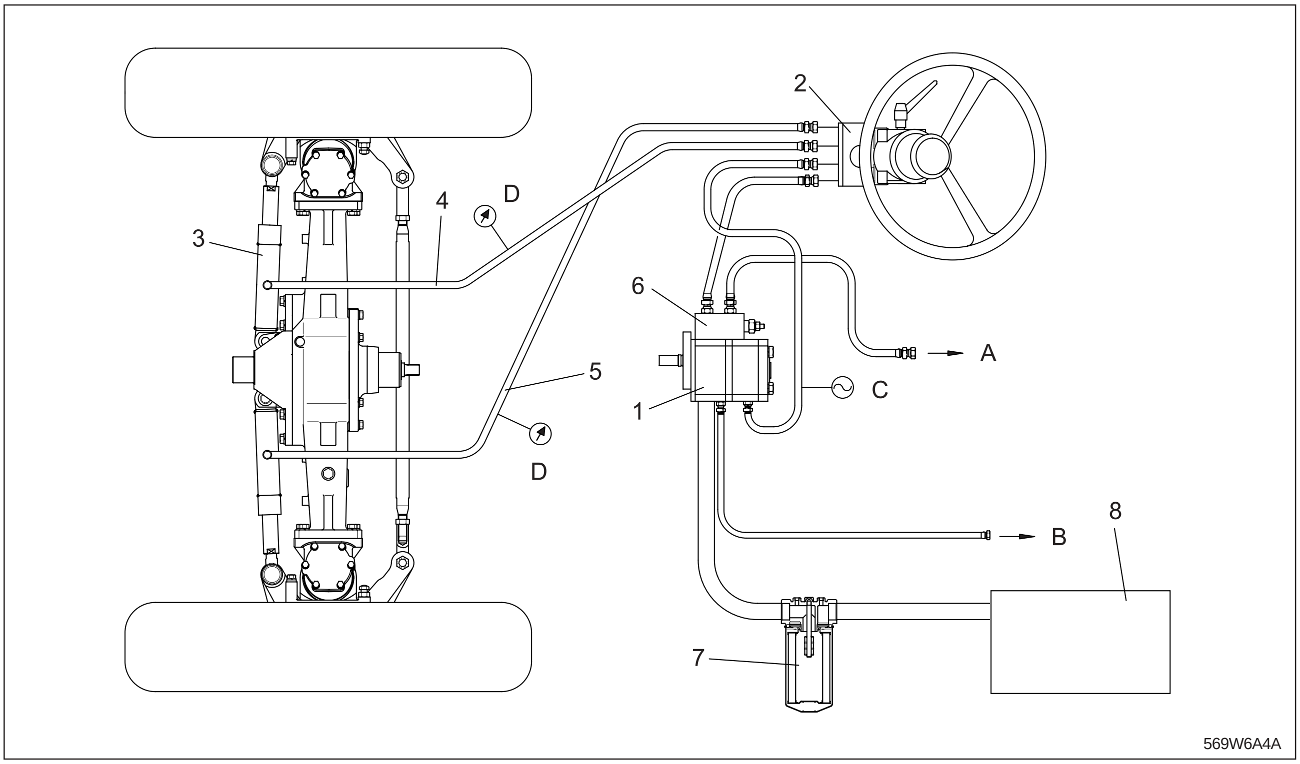
b. Hydraulic pressure Lift Device

Transmission case (hydraulic tank) → Hydraulic filter → Hydraulic pump 1 (12 cc/rev) → Hydraulic block (forward external output port)

→ Hydraulic cylinder assembly

6.2 STEERING DEVICE

A. SCHEMATIC DIAGRAM OF STEERING DEVICE



(1) Gear Pump Assembly
(2) Power Steering Unit
(3) Steering Cylinder Ass'y
(4) Hydraulic Hose Ass'y (RH)
(5) Hydraulic Hose Ass'y (LH)
(6) Prior Valve Assembly
(7) Hydraulic Filter
(8) Transmission Case

[A] PTO Clutch Valve
[B] Lift Line
[C] Flow Rate Gauge
[D] Pressure Gauge

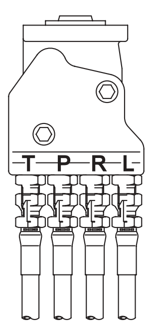
B. PRINCIPLES OF OPERATION

The steering device shall be operated by supplying the operating oil in the transmission case to hydraulic filter and orbitrol unit by hydraulic pump 2 and operating the steering cylinder to the direction that the operator turns the handle.

C. DESCRIPTION OF COMPONENTS

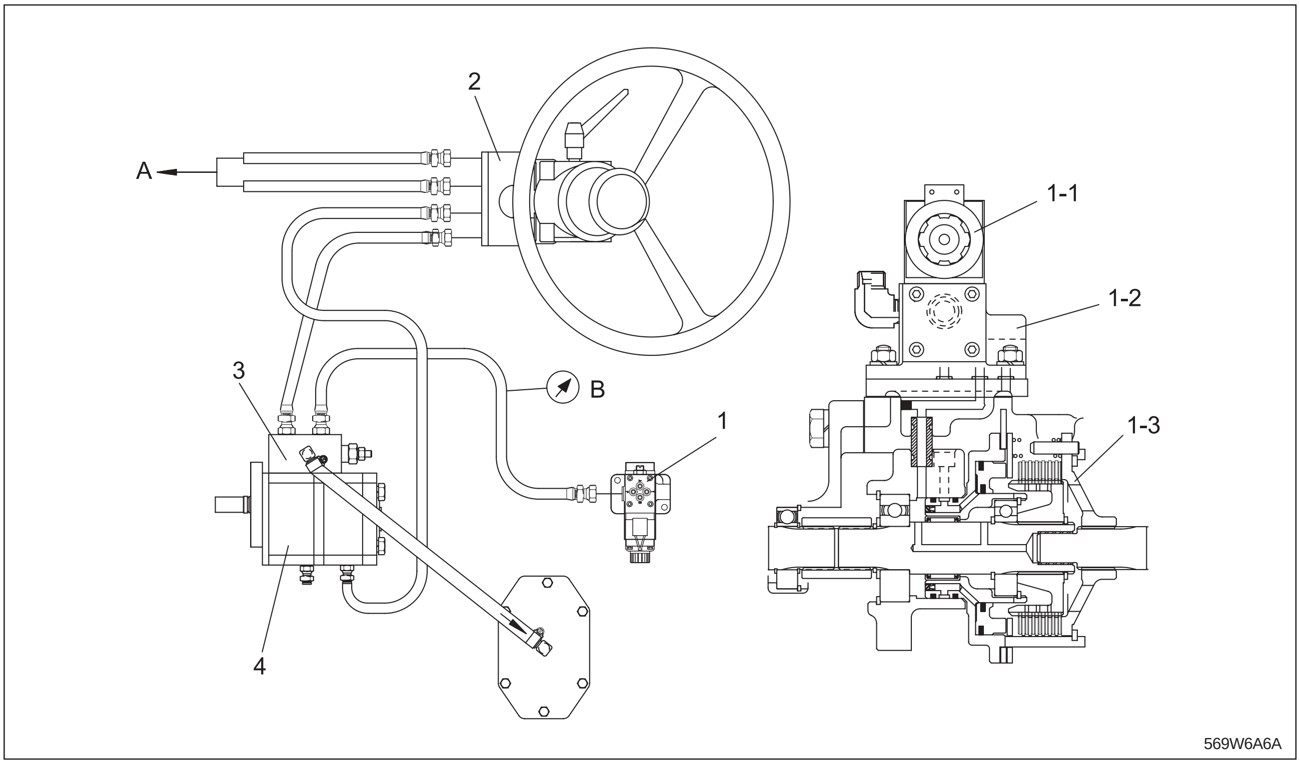
1) Hydraulic filter: filtering of contaminated materials.
2) Hydraulic pump: to supply the constant flow of hydraulic oil.
   - First Pump (hydraulic pressure rise & fall pump) : 12 cc/rev
   - Second Pump (steering operation pump) : 7.2 cc/rev
3) Steering cylinder: rotating of front wheel by the reaction of cylinder by orbitrol unit according to the steering direction.

D. TROUBLE SHOOTING

Components	Trouble Checking	Remark
Hydraulic pump	1. Install the flow rate gauge on the outlet of pump (refer to the schematic Diagram). 2. Check the discharged flow rate. First pump rated flow rate: normal if over 26.5 ℓ/min. (7.0 U.S.gal/min) Second pump rated flow rate: normal if over 15.9 ℓ/min (4.2 U.S.gal/min) (engine rotation: 2600, based on pump efficiency 85 %) ref.) Calculation formula of flow rate Q = (gear ratio x engine rotation x pump capacity) / 1000	
Hydraulic filter	Replacement - 200 hrs (replace after initial use of 50 hr) - When filter warning lamp is lit on the indicator panel.	
Orbital unit & steering cylinder	In case of the failure of orbitrol unit & steering cylinder, check the following: 1. Install the pressure gauge in the hydraulic hose assembly (rh, lh) (ref. To schematic diagram). 2. Rotate the handle till the noise of relief is generated. 3. Check the pressure from the pressure gauge. - Standard pressure: more than 120 kg/cm^2 (1,707 psi) In case that the rotation of handle is not available, check the following. 1. Check the leakage of oil from steering cylinder ass'y. 2. Check the connection of hydraulic hose. 3. Check the pressure is below standard pressure (120 kg/cm^2, 1,707 psi) - Check and replace hydraulic pump and orbitrol unit. * Assembly position of orbitrol unit hydraulic hose (ref. To schematic diagram).  569W6A5A Hydraulic hose ass'y P: assembled with hydraulic pump Hydraulic hose ass'y T: assembled with prior valve Hydraulic hose ass'y L: assembled with steering cylinder Hydraulic hose ass'y R: assembled with steering cylinder	

6.3 PTO SYSTEM

A. SCHEMATIC DIAGRAM OF PTO SYSTEM



(1) PTO Clutch Valve	(2) Orbitrol Unit	(A) Steering Cylinder
(1-1) Solenoid Valve Ass'y	(3) Prior Valve Ass'y	(B) Pressure Gauge
(1-2) Modulator Valve Ass'y	(4) Gear Pump Ass'y	
(1-3) PTO Clutch Ass'y		

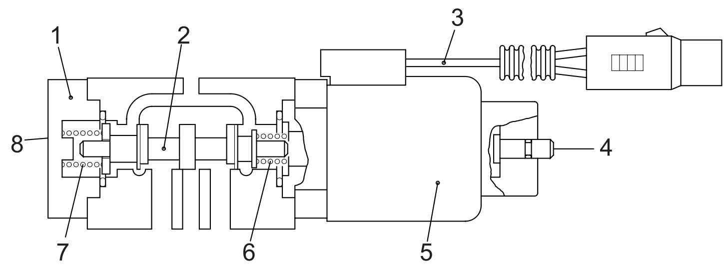
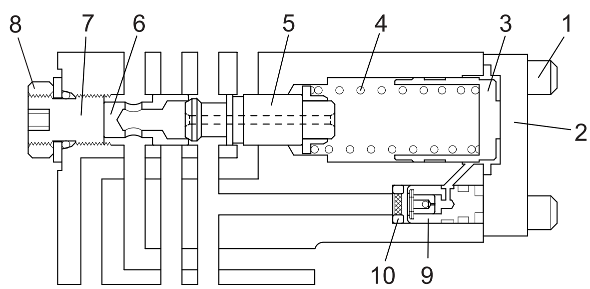
B. PRINCIPLES OF OPERATION

PTO operates the steering device and PTO clutch at the hydraulic pump 2 and the oil flows to the prior valve from hydraulic hose T line connected with orbitrol unit T port and the flow rate of 7 ℓ/min operates solenoid valve (1-1), modulator valve (1-2), PTO clutch (1-3). At this time, PTO clutch operation shall be controlled by electrical device of PTO ON-OFF switch.

C. DESCRIPTION OF COMPONENTS

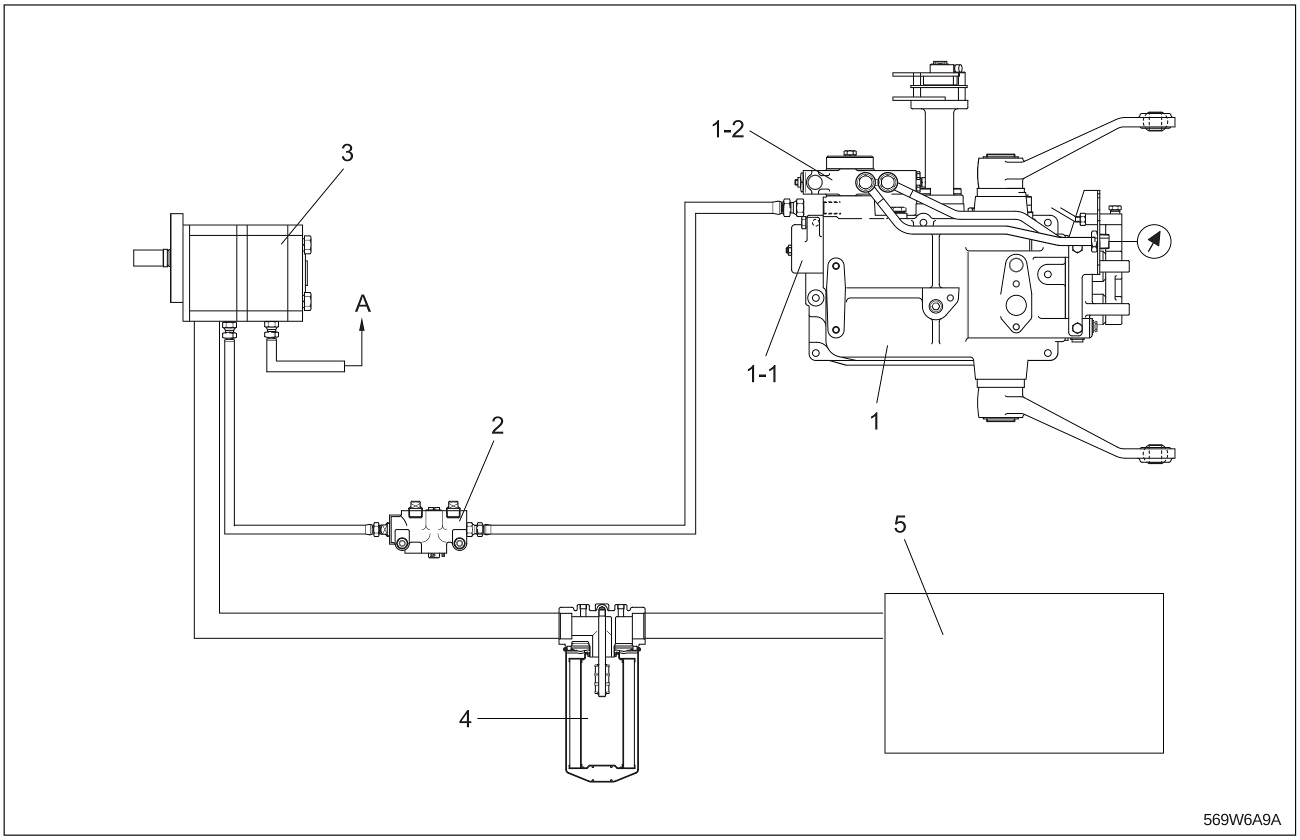
1) Solenoid valve assembly: to control the oil path by ON-OFF electrically.
2) Modulator valve assembly: to generate the regular pressure (16 kg/cm^2 ~ 18 kg/cm^2) to operate the PTO clutch.
3) Prior valve assembly: to deliver the regular flow rate 7 (ℓ/min) to operate PTO.
4) PTO clutch assembly: to transmit the power to the PTO axle by the operation of piston inside the clutch assembly.

D. TROUBLE SHOOTING

Components	Trouble Checking	Remark
PTO clutch does not work.	1. Press the push button of solenoid valve assembly to check the fitting of spool.  569W6A7A (Solenoid valve assembly) 2. After installing the pressure gauge on PTO hydraulic pipe, check the standard pressure value (installation position of pressure gauge: refer to schematic diagram). - Standard pressure value: 16 kg/cm^2 ~ 18 kg/cm^2, (228 ~ 256 psi) 3. How to adjust modulator valve when it does not reach standard pressure.  569W6A8A (modulator valve assembly) (1) Bolt (2) Cover (3) Piston (4) Spring (5) Spool (Poppet) (6) Valve Seat (7) Adjusting Kit (8) Lock Nut (9) Check Valve Ass'y (10) Filter - Adjust the adjusting screw of lock nut (7-1) to clockwise or counter clockwise to set the standard pressure of pressure gauge within 16 kg/cm^2 ~ 18 kg/cm^2.	

6.4 HYDRAULIC PRESSURE RISE & FALL DEVICE

A. SCHEMATIC DIAGRAM OF HYDRAULIC PRESSURE RISE & FALL DEVICE



(1) Hydraulic Cylinder Ass'y
(1-1) MLS Valve
(1-2) Double Acting Valve
(2) Hydraulic Block
(3) Hydraulic Pump
(4) Hydraulic Filter
(5) Transmission Case

(A) Orbital Unit (Steering Device)

B. PRINCIPLE OF OPERATION

The hydraulic pressure rise & fall device operates hydraulic block and hydraulic cylinder assembly by supplying the oil from hydraulic pump 1.

The MLS valve of hydraulic cylinder assembly is available to work regardless of the load of the machine by controlling the incoming and outgoing flow rate.

C. DESCRIPTION OF COMPONENTS

1) Hydraulic block: valve to exhaust the front exterior hydraulic pressure.
2) Double acting valve: valve to exhaust the rear exterior hydraulic pressure.
3) MLS valve: to control hydraulic cylinder assembly (control of rise and fall of the pressure).
4) Hydraulic cylinder assembly: to control external operating machine with 3 point link.

D. TROUBLE SHOOTING

<table>
<tr><th>Components</th><th>Trouble Checking</th><th>Remark</th></tr>
<tr><td>1. Hydraulic block</td><td>

Checking of hydraulic block

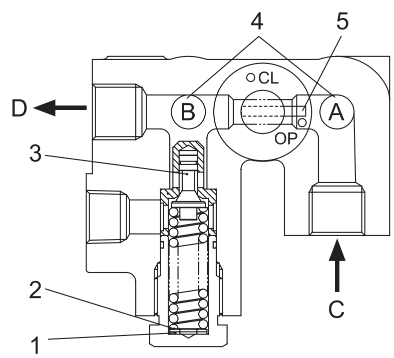
1. Install the pressure gauge on coupler socket assembly to check the pressure value.
   - Standard pressure value : 165 kg/cm² ~ 190 kg/cm² (2,347 ~ 2,700 psi) (engine rotation: 2,600 rpm).
   - Installation of pressure gauge: (ref. schematic diagram)
   - when pressure is below 50 kg/cm² (711 psi), replace or clean hydraulic block.

Ref.) Check the pressure by measuring the pressure gauge between port A and port B with external operating machine.

When using hydraulic block, please be noted that

- Use the external operating machine by turning the adjusting screw (5) to the CL direction.
- Use the 3 point link by turning the adjusting screw (5) to the OP direction.

(Hydraulic block)



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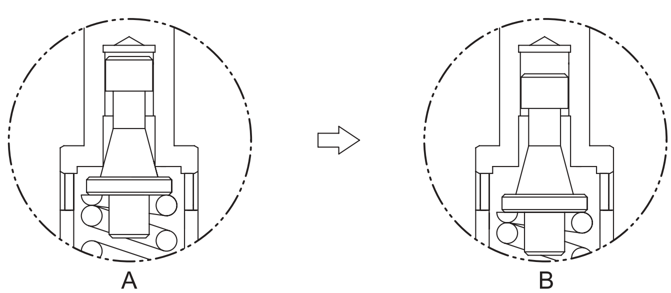
(1) Plain Washer (A) A Port
(2) Adjusting Seam (B) B Port
(3) Poppet (C) In (Pump)
(4) External Output Port (D) Out
(5) Adjusting Screw

How to adjust the pressure of hydraulic block

- When below standard pressure, add the adjusting seam (2) to adjust (check the pressure with pressure gauge).
- In excessive pressure (over 180kg/cm², 2,560 psi), poppet is open.



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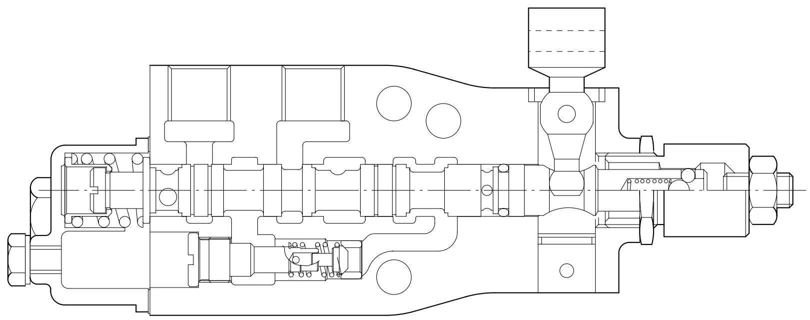
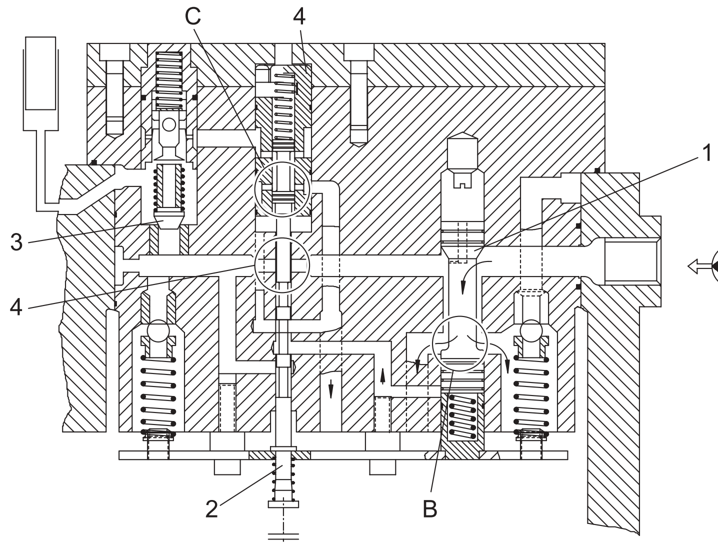
(poppet (3) closed) (poppet (3) open)

</td><td></td></tr>
</table>

Components	Trouble Checking	Remark
2. Double-acting valve assembly	**How to adjust the pressure of double-acting valve** 1. Install the pressure in the coupler socket to check the standard pressure of external hydraulic pressure (Refer to schematic diagram). 2. Standard pressure of rear external hydraulic pressure: 165 kg/cm^2 ~ 190 kg/cm^2 (engine rotation: 2,600 rpm). (Double-acting valve assembly)  569W6B3B • After removing a nut (1), turn the adjusting screw (2) to clockwise or counterclockwise using a hexagonal wrench to check the pressure gauge and then adjust it to standard pressure value.	

<table>
<tr><th>Components</th><th>Trouble Checking</th><th>Remark</th></tr>
<tr><td>3. MLS valve assembly (operation principle)</td><td>

(Neutral Stage)



569W6B4A

(1) Piston
(2) Spool
(3) Check Valve
(4) Falling Valve

Operation principle of MLS valve neutral stage

The supply oil is exhausted to the transmission case as Spool (2) closes the pipe line (A) and piston (1) falls down by oil pressure to open the pipe line (B), the falling valve (4) shall be neutral stage as the pipe line (C) is closed.

Operation of main components

(1) Piston: Spool (2) is operated by a link and operated up & down acc.to opening/closing of pipe line (A).

- When pipe line (A) is closed: piston falls down by oil pressure to open the pipe line (B) and oil is exhausted to the transmission case.

(neutral/supply stage).

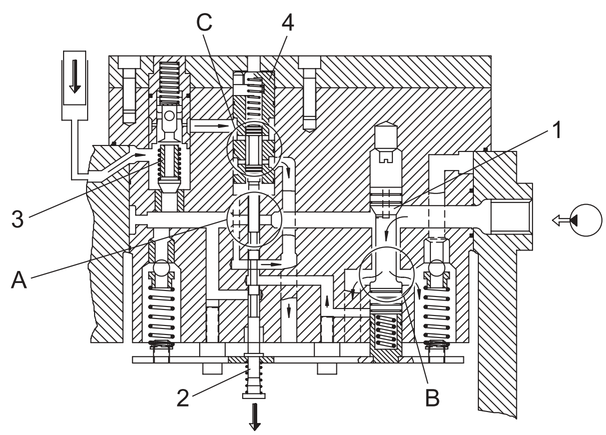
- When pipe line (A) is open: piston is lifted by a spring to close the pipe line (B) and oil is supplied to the cylinder (supply stage).

(2) Spool: spool is operated by a link device to control the open/close of pipe line (A) and determine the exhaust, supply and neutral stage.

(3) Check valve: check valve is operated acc.to operation of spool (2), i.e. opening/closing of pipe line (A).

- When pipe line (A) is closed: check valve does not work (exhaust, neutral stage).
- When pipe line (A) is open: check valve is operated upward by oil pressure (supply stage).

</td><td></td></tr>
</table>

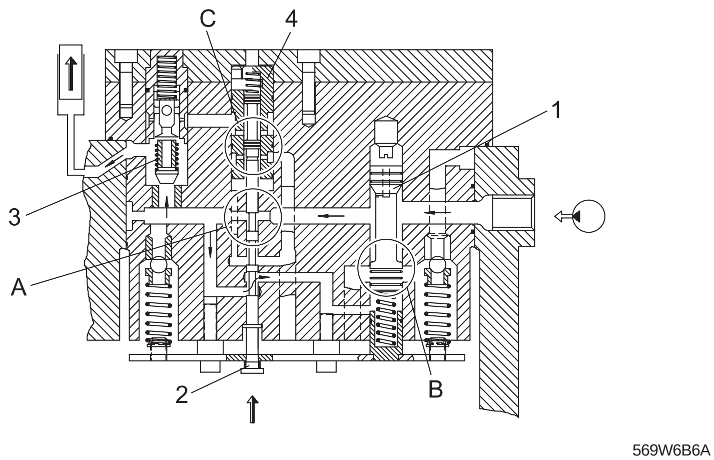
Components	Trouble Checking	Remark
2. Double-acting valve assembly	(4) Falling valve: as spool (1) is operated, the falling valve (4) falls down by a spring to open the pipe line (C) and the oil is exhausted from the cylinder. (refer to the figure of "exhaust stage") **Operation principle of MLS valve exhaust stage** The oil supplied from the pump is exhausted to the transmission case as spool (2) closes the pipe line (A) and piston (1) falls down by oil pressure to open the pipe line (B). And while spool (2) falls own, the falling valve (4) is operated by a spring to open the pipe line (C) and exhaust the oil of the cylinder which results in the fall of lift arm. (exhaust stage)  (1) Piston (3) Check Valve (2) Spool (4) Falling Valve **Operation of main components** (1) Piston: as spool (2) closes the pipe line (A), piston (1) falls down to open the pipe line (B). (2) Spool: spool (2) is pushed by a link device to the direction of arrow to close the pipe line (A). (3) Check valve: does not work. (4) Falling valve: as spool (2) falls down, the falling valve (4) falls down by a spring to open the pipe line (C).	

<table>
<tr><th>Components</th><th>Trouble Checking</th><th>Remark</th></tr>
<tr><td></td><td>

Operation principle of MLS valve supply stage

Spool (1) is operated by a link to open the pipe line (A) and the oil supplied from the pump flows into the cylinder through check valve (3) while falling valve (4) closes the pipe line (C) to prevent the exhaust of oil which results in the rise of the lift arm. When the rise of lift arm is completed, piston (1) falls down by oil pressure to open the pipe line (B) while check valve does not work.

(supply stage)



(1) Piston (3) Check Valve

(2) Spool (4) Falling Valve

Operation of main components

(1) Piston: as spool (2) opens the pipe line (A), piston (1) closes the pipe line (B).

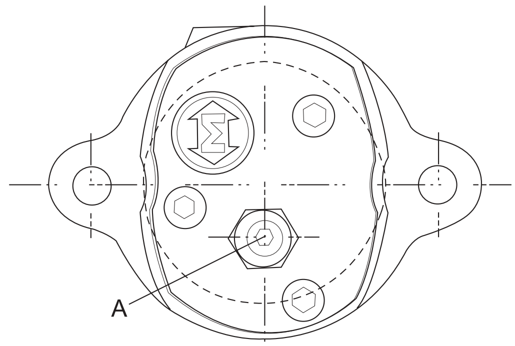
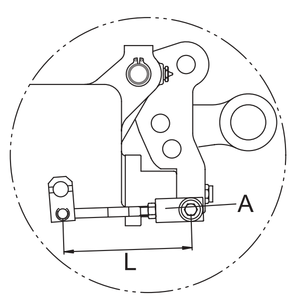
when the rise of lift arm is completed, piston (1) falls down by oil pressure to open the pipe line (B).

(2) Spool: spool (2) is pushed by a link device to the direction of arrows to open the pipe line (A).

(3) Check valve: opened by oil pressure. When the rise of lift arm is completed, the pipe line (B) is open while check valve does not work.

(4) Falling valve: to close the pipe line (C).

</td><td></td></tr>
</table>

Components	Trouble Checking	Remark
4. Hydraulic cylinder assembly	**How to adjust the sensitivity**  569W6B7A (MLS valve assembly) 1. Apply the load of 500 kg to the lift arm and move the adjusting lever up to be placed on the middle of the whole adjustment range. 2. The sensitivity shall be adjusted by turning the loosening-prevention screw "A" to counter clockwise with a hexagonal wrench till the lift arm continues to move. 3. Turn the screw "A" to clockwise till the lift arm stops to move and check if it is sealed on that position. 4. After completion of the above adjustment, turn the screw "A" to maximum 1/4 clockwise to seal it completely. By doing this, the sensitivity of MLS valve shall be set to maximum. **How to adjust the hydraulic lift arm hunting** 1. Adjust the length of tie rod (A) in the state of attaching operating machine and if the hunting occurs after adjustment, return to the original length before adjustment. - Standard value: 135 ± 5 mm 2. If the same phenomenon occurs in adjusting the above clause 1, turn the adjusting bolt (A) of MLS sensitivity and tighten it with a nut if the hunting does not occur.  569W6B8A	

CHAPTER 7

BRAKE

1. TROUBLESHOOTING

Symptom	Provable Causes	Solution
Uneven braking force	- Brake pedal play unevenly adjusted	Adjust
	- Brake disc worn	Replace
	- Cam Plate warped	Replace
Brake drags	- Brake pedal play too small	Adjust
	- Cam plate return spring weaken or broken	Replace
	- Brake pedal return spring weaken or broken	Replace
	- Brake camshaft rusted	Repair
Poor braking force	- Brake pedal play excessive	Adjust
	- Brake disc worn	Replace
	- Cam plate warped	Replace
	- Brake camshaft or lever damaged	Replace
	- Brake camshaft or lever damaged	Change

2. SPECIFICATIONS

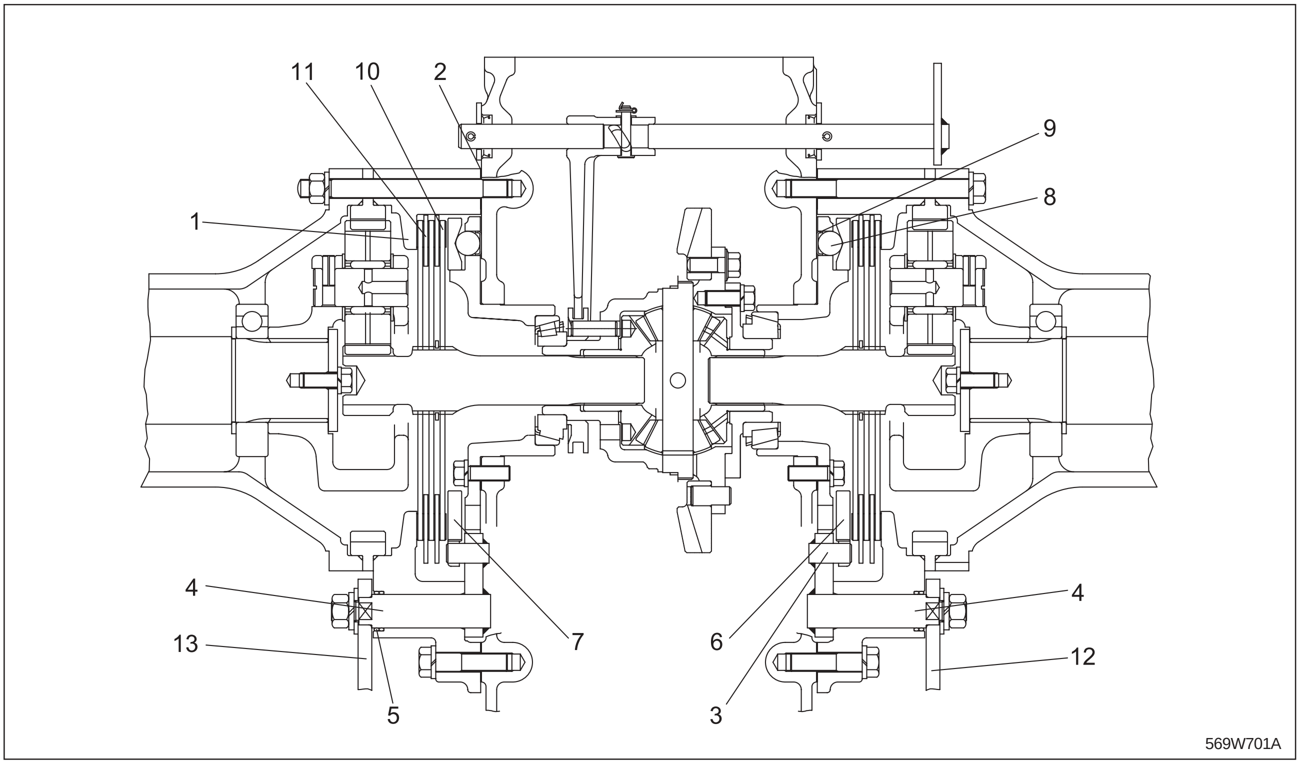
Item		Factory Specifications	Allowable Limit
Brake pedal	Free play	25 ~ 40 mm 0.984 ~ 1.574 in.	-
Right and left	Difference	Less than 5 mm 0.20 in.	-
Brake pedal shaft to bushing	Clearance	0.007 ~ 0.101 mm 0.00027 ~ 0.00397 in.	0.4 mm 0.0197 in.
Brake pedal shaft	O.D.	24.980 ~ 24.993 mm 0.9834 ~ 0.9839 in	-
Bushing (brake pedal)	I.D.	25.000 ~ 25.081 mm 0.9842 ~ 0.9874 in.	-
Cam plate 1	Flatness	-	0.3 mm 0.012 in.
Cam plate 1 and ball	Height	20.9 ~ 21.1 mm 0.8228 ~ 0.8307 in.	20.6 mm 0.8110 in.
Brake disc	Thickness	4.6 ~ 4.8 mm 0.181 ~ 0.189 in.	4.0 mm 0.1574 in.
Plate	Thickness	2.54 ~ 2.66 mm 0.100 ~ 0.1047 in.	2.0 mm 0.0787 in.

3. TIGHTENING TORQUE

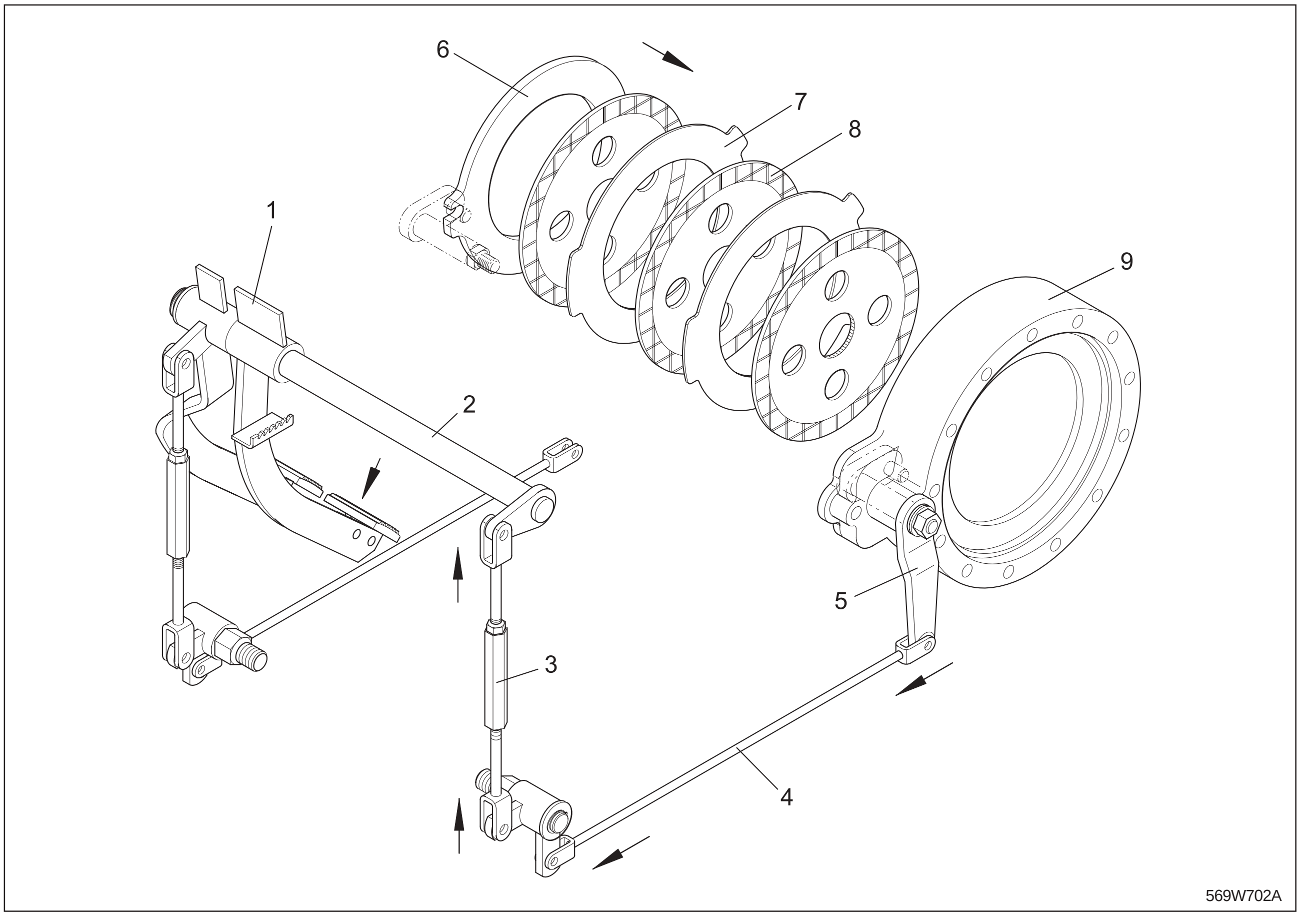
Tightening torque	Brake shaft	367.8 ~ 431.6 N·m 37.5 ~ 44.0 kgf·m 271.2 ~ 317.8 lbf·ft
	Mounting bolt of parking brake shaft	23.5 ~ 27.4 N·m 2.4 ~ 2.8 kgf·m 17.3 ~ 20.2 lbf·ft
	Mounting nut of brake cam lever	123.6 ~ 147.1 N·m 12.6 ~ 15.0 kgf·m 91.1 ~ 108.5 lbf·ft
	Mounting bolt of brake case	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.1 ~ 66.5 lbf·ft
	Mounting nut of brake case	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.1 ~ 66.5 lbf·ft
	Mounting nut of brake rod	48.0 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.4 ~ 41.2 lbf·ft

4. STRUCTURE AND OPERATION

4.1 STRUCTURE



(1) Brake Case
(2) Packing
(3) Guide Pin
(4) Brake Cam
(5) O-Ring
(6) Cam Plate (RH)
(7) Cam Plate (LH)
(8) Steel Ball
(9) Steel Ball Sheet
(10) Brake Disc
(11) Plate
(12) Brake Cam Lever (RH)
(13) Brake Cam Lever (LH)



(1) Pedal
(2) Shaft
(3) Brake Rod
(4) Brake Rod 3
(5) Brake Cam Lever
(6) Cam Plate
(7) Plate
(8) Brake Disk
(9) Brake Case

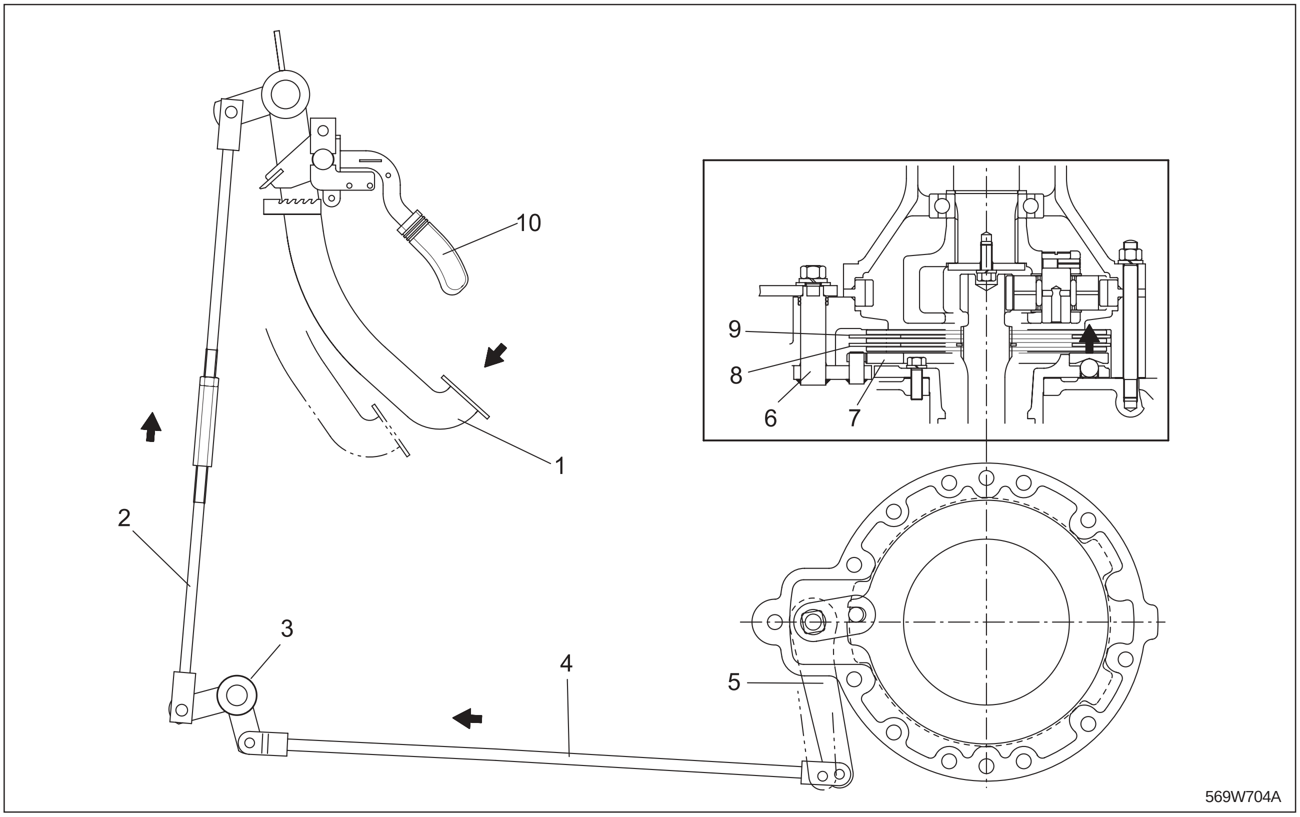
a. Brake

The brake is of mechanical wet-disc type with its two pedals left and right operated respectively. If the pedal (1) located at the front of the driver's seat is stepped down, brake rods 3 (4) and brake cam lever (5) linked with brake lever by the hinge point are activated forward while brake rod (3) is pulled upward. The cam plate gets rotated, as the brake cam connected to the brake cam lever turns to the direction as arrowed. When the cam plate turns, the cam plate while being pushed toward the steel ball between the cam plate and the brake case compresses the brake disc.

b. Parking Brake

The parking brake is operated mechanically.
If the hand lever located at the lower part of the instrument panel is pulled upward with brake pedal stepped powerfully, the parking brake lever holds the brake pedal as stepped down. The next application is as processed as the foot brake.

4.2 OPERATION



(1) Brake Pedal
(2) Connecting Rod
(3) Link
(4) Connecting Rod
(5) Brake Lever
(6) Brake Cam
(7) Cam Plate
(8) Brake Disc
(9) Brake Plate
(10) Parking Brake Lever

- If brake pedal (1) is stepped down, brake lever (5) is pulled to the direction as arrowed through connecting rods (2), (4) and link (3), and brake cam (6) is allowed to turn cam plate (7) to let it move as arrowed and apply braking with brake disc (8) as adhered closely to brake plate (9).
- For parking, step the brake pedal completely and pull the parking brake lever (10) to hold the pedal.

5. DISASSEMBLING AND ASSEMBLING

5.1 DRAINING THE TRANSMISSION FLUID

Draining the Transmission Fluid

1. Place oil pans underneath the transmission case.
2. Remove the drain plugs.
3. Drain the transmission fluid.
4. Reinstall the drain plugs

(When refilling)

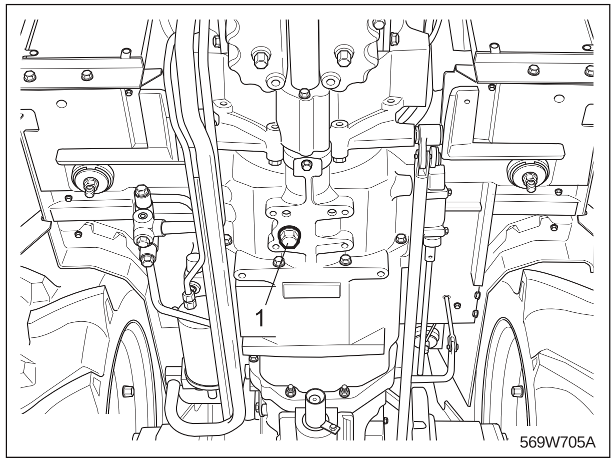
- Fill up from filling port after removing the filling plug (1) until reaching the gauge (2).
- After running the engine for few minutes, stop it and check the oil level again, add the fluid to prescribed level if it is not correct level.

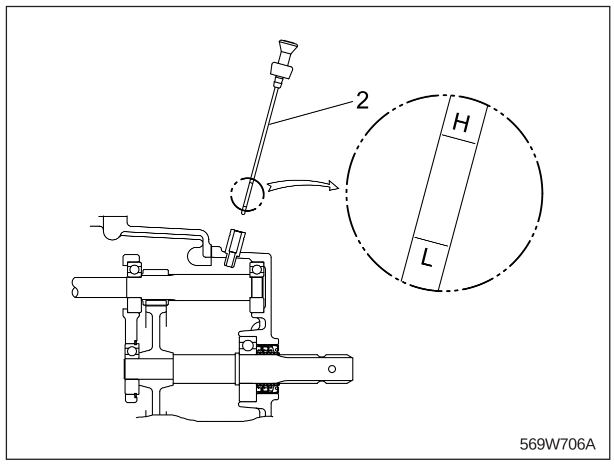
Capacity	Transmission fluid	34.0ℓ 9.0 U.S.gal.

IMPORTANT

- *Use only SAE 80, 90 gear oil. Use of other oils may damage the transmission or hydraulic system.*

  Refer to "LUBRICANTS, FUEL AND COOLING WATER" (See page 1-13).
- *Do not mix different brands fluid together.*



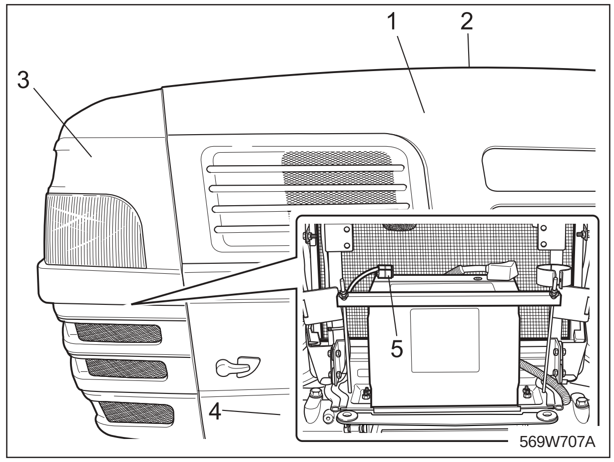


(1) Drain Plugs (2) Gauge

5.2 SEPARATING PANEL FRAME ASSEMBLY

Preparation 1

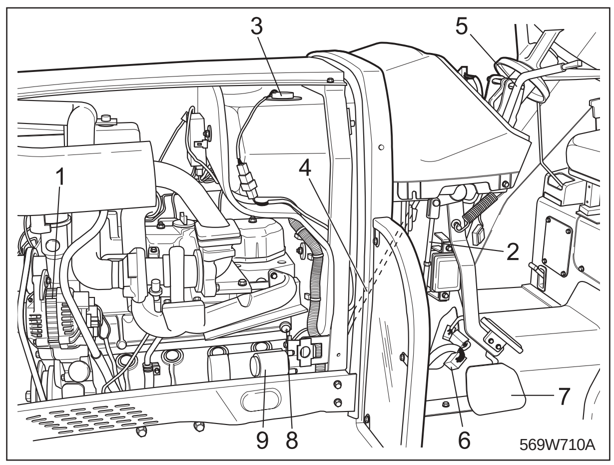
1. Removing the following parts.

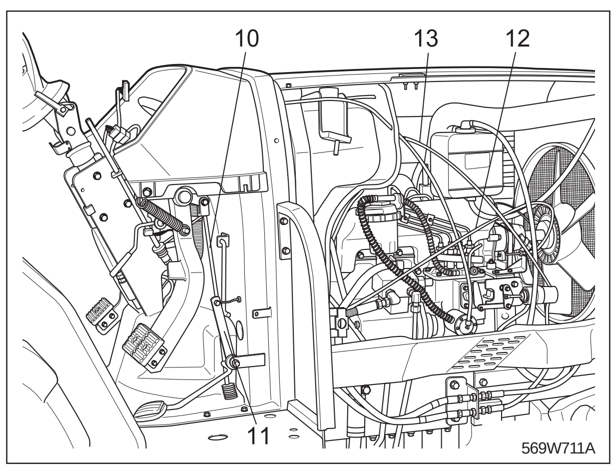


(1) Side Cover (RH, LH)
(2) Bonnet
(3) Front Grille
(4) Side Skirt (RH, LH)
(5) Battery Negative Code

Preparation 2

1. Disconnect the brake rods (4), (10).
2. Disconnect the clutch rod (2).
3. Remove the accelerator rod (12).
4. Disconnect the foot accelerator rod (11).
5. Remove the panel frame cover (7) and disconnect the connectors (6).
6. Remove the shuttle shaft lever (5) after disconnecting limit switch wire harness.
7. Disconnect the 2P connector of alternator (1), jumper for fuel level sensor (3) and starter (9).
8. Disconnect the meter cable (13) at the engine side.





(1) 2P Connector for Alternator
(2) Clutch Rod
(3) Jumper Lead for Fuel Level Sensor
(4) Brake Rod (LH)
(5) Shuttle Shift Lever
(6) Connectors
(7) Panel Frame Cover
(8) Jumper Lead for Oil Switch
(9) Jumper Lead for Starter
(10) Brake Rod (RH)
(11) Food Accelerator Rod
(12) Accelerator Rod
(13) Meter Cable

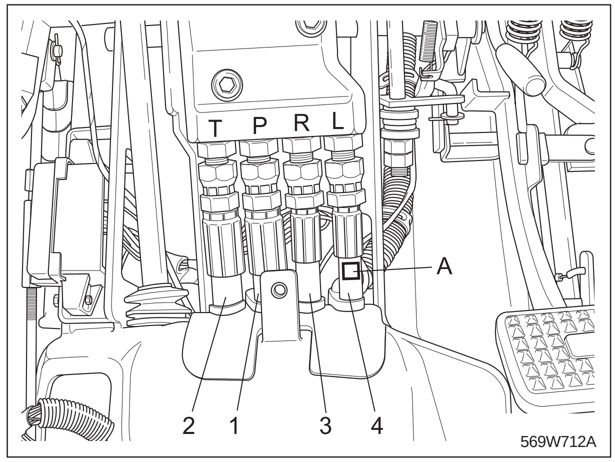
Hydraulic Pipes

1. Disconnect the main delivery hose (1), return hose (2), right turning delivery hose (3) and left turning delivery hose (4).

(When reassembling)

- In assembling the turning delivery hoses to the steering controller, connect the delivery hose with identification mark (tape) “A” to the L port of the steering controller.

Tightening torque	Main delivery hose retaining nut	46.6 ~ 50.9 N·m 4.8 ~ 5.2 kgf·m 34.4 ~ 37.6 lbf·ft
	Turning delivery hoses retaining nut	24.5 ~ 29.4 N·m 2.5 ~ 3.0 kgf·m 18.1 ~ 21.7 lbf·ft



[A] Identification Mark (Tape)

(1) Main Delivery Hose

(2) Return Hose

(3) Right Turning Delivery Hose

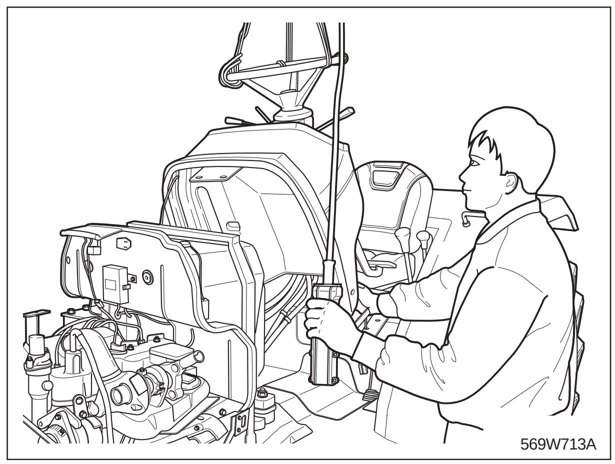
(4) Left Turning Delivery Hose

Panel Frame and Steering Assembly

1. Remove the panel frame mounting crews. (Two screws a upper part. Seven screws at lower part.)
2. Take out the panel frame and steering assembly as a unit.

(When reassembling)

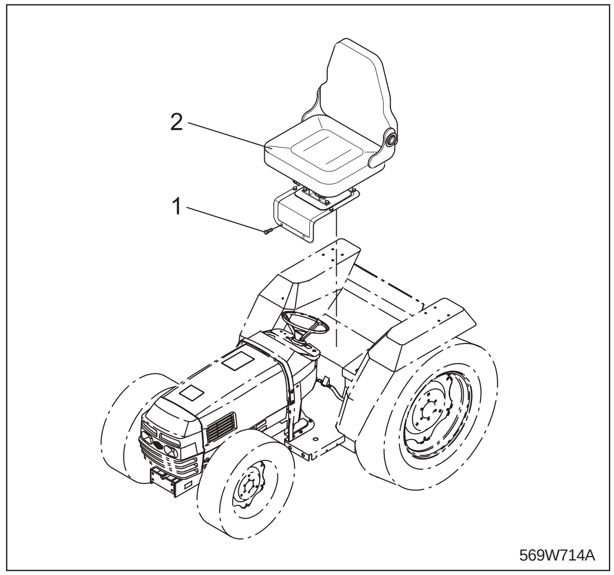
- Do not get in the wiring harness between panel frame and platform.



5.3 SEPARATING REAR FENDERS AND PLATFORM ASSEMBLY

Preparation

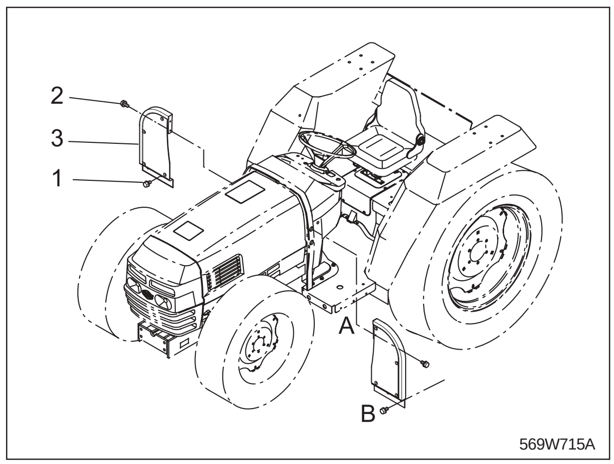
1. Remove the Rops.
2. Remove the Bolts (1) and take out the seat Assembly (2).



(1) Bolt (2) Seat Assembly

Cover

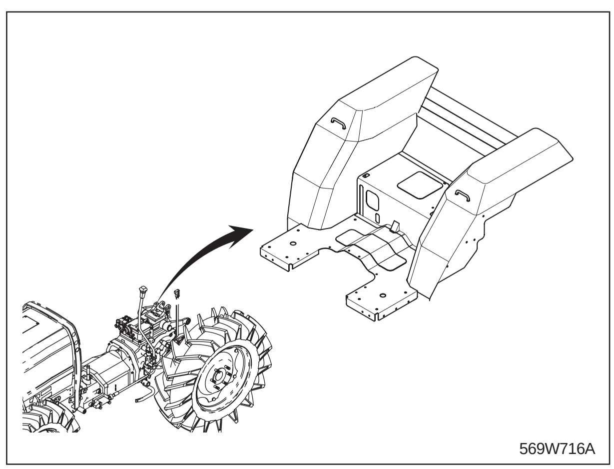
1. Remove the blots (1), (2) and the cover assembly (3).



(1) Bolt (3) Cover
(2) Bolt

Fender, Floor Seat and Platform Assembly

1. Remove the fender (1, 2), floor seat and platform as a unit.



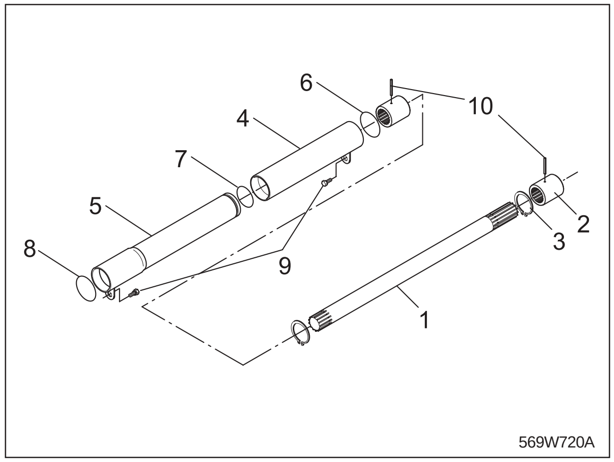
D. SEPARATING CLUTCH HOUSING

Propeller Shaft

1. Slide the propeller shaft cover, (4), (5), after removing the screws (9).
2. Tap out the spring pin (10) and then slide the coupling (2) to the front.

(When reassembling)

- Apply grease to the splines of the propeller shaft.



(1) Propeller Shaft
(2) Coupling
(3) Cir-Clip
(4) Propeller Shaft Cover
(5) Propeller Shaft Cover
(6) O-Ring
(7) O-Ring
(8) O-Ring
(9) Bolt
(10) Spring Pin

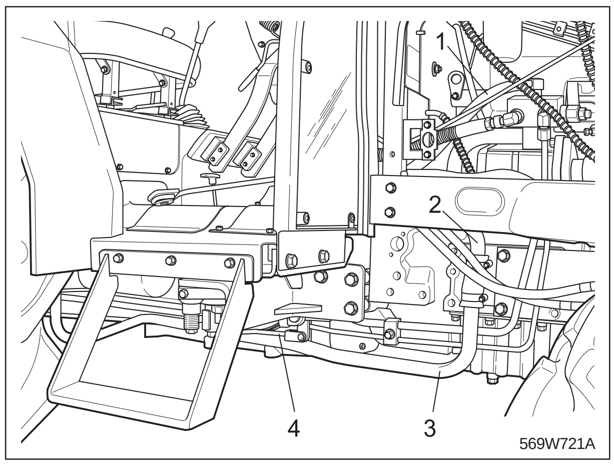
Hydraulic Pipes

1. Remove the brake rod (4) and suction pipe (3).
2. Remove the rubber hoss (2).
3. Slide the return hose (1).

(When reassembling)

- Reinstall the pipe clamps securely.

Tightening torque	Join bolt for delivery pipe (3) and front hydraulic block	49.0 ~ 58.8 N·m 5.0 ~ 6.0 kgf·m 36.2 ~ 43.4 lbf·ft
	Join bolt for delivery pipe (2) and front hydraulic block	34.3 ~ 39.2 N·m 3.5 ~ 4.0 kgf·m 25.3 ~ 28.9 lbf·ft



(1) Return hose
(2) Rubber Hose
(3) Suction Pipe
(4) Brake Rod

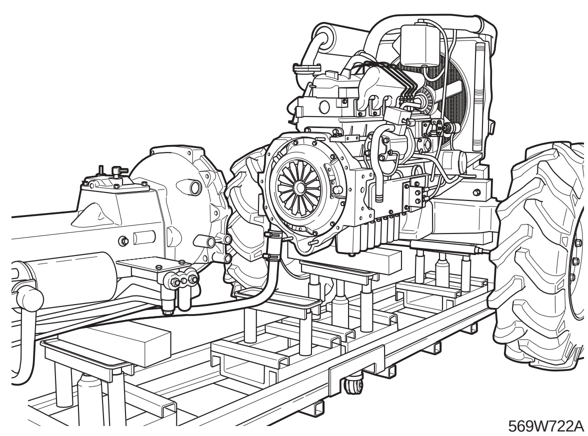
Separating the Engine from Clutch Housing

1. Place the jack under the clutch housing case.
2. Hoist the engine by the nylon lift strap at the tank support.
3. Remove the engine mounting screws, and then pull the engine to the front.

(When reassembling)

- Apply grease to the splines.
- Apply liquid gasket (There Bond 1208D or equivalent) to joint face of the engine and clutch housing.

Tightening torque	Engine and clutch Housing mounting Screws, nuts	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.1 ~ 66.5 lbf·ft
	Engine and clutch Housing mounting Stud bolts	39.2 ~ 49.0 N·m 4.0 ~ 5.0 kgf·m 28.9 ~ 36.2 lbf·ft



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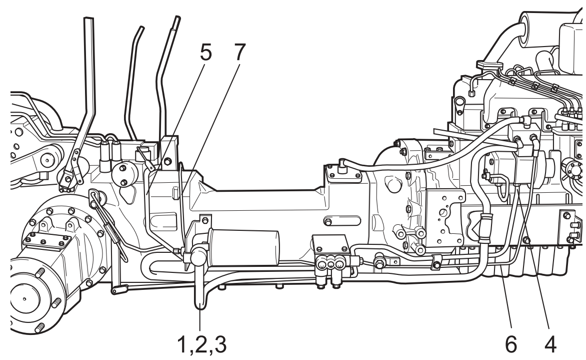
Hydraulic Pipes

1. Loosen the screws (1), bolt (2) and remove the suction pipe (3).
2. Remove the pipe (4), (5), (6), (7).



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(1) Screw
(2) Bolt
(3) Suction Pipe
(4) PTO Pipe 1
(5) Pipe 1
(6) Pipe 2
(7) PTO Pipe 2

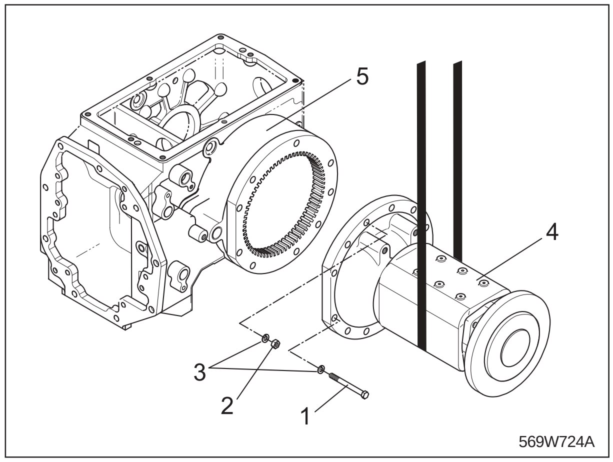
5.4 DISASSEMBLING REAR AXLE CASE

Rear Axle Case

1. Support the transmission case with nylon lift strap and hoist.
2. Loosen and remove the rear axle case mounting screws (1), spring washer (3) and nuts (2).
3. Support the rear axle case (4) with nylon lift strap and hoist.
4. Carefully move the axle assembly out and away from the tractor.

(When reassembling)

Tightening torque	Rear axle case mounting screws	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.1 ~ 66.5 lbf·ft
	Rear axle case mounting nuts	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.1 ~ 66.5 lbf·ft
	Brake shaft (LH, RH)	367.8 ~ 431.8 N·m 37.5 ~ 44.0 kgf·m 271.2 ~ 318.2 lbf·ft
	Parking brake shaft mounting bolt	23.5 ~ 27.4 N·m 2.4 ~ 2.8 kgf·m 17.3 ~ 20.2 lbf·ft
	Brake rod mounting nut	48.0 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.4 ~ 41.2 lbf·ft



(1) Bolt
(2) Nut
(3) Spring Washer
(4) Rear Axle Case
(5) Brake Case

5.5 DISASSEMBLING BRAKE CASE

Brake Case

1. Loosen and remove the nut (1), spring washer (2), plain washer (3), brake can lever (4), bolt (5) and spring washer (6).
2. Separate the brake case (7), tapping the brake case lightly.

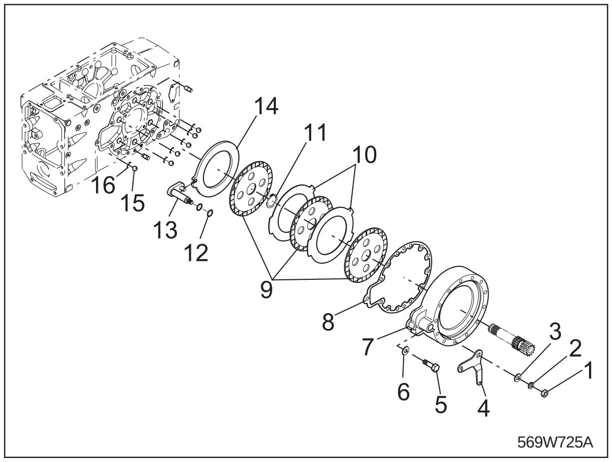
(When reassembling)

- Apply grease to the brake ball seats (16).

(Do not grease excessively.)

- Before installing the brake case (7) to the transmission case, install the cam plate (14) to the transmission case.

Tightening torque	Brake case mounting bolt, nut	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.1 ~ 66.5 lbf·ft
	Brake cam lever mounting nut	123.6 ~ 147.1 N·m 12.6 ~ 15.0 kgf·m 91.1 ~ 108.5 lbf·ft

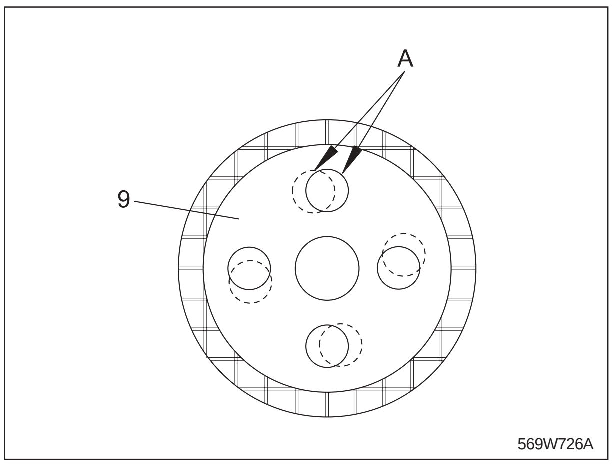


(1) Nut
(2) Spring Washer
(3) Plain Washer
(4) Brake Cam Lever
(5) Bolt
(6) Spring Washer
(7) Brake Case
(8) Gasket
(9) Disc
(10) Plate
(11) Snap Ring
(12) O-Ring
(13) Brake Cam
(14) Cam Plate
(15) Ball
(16) Ball Seat

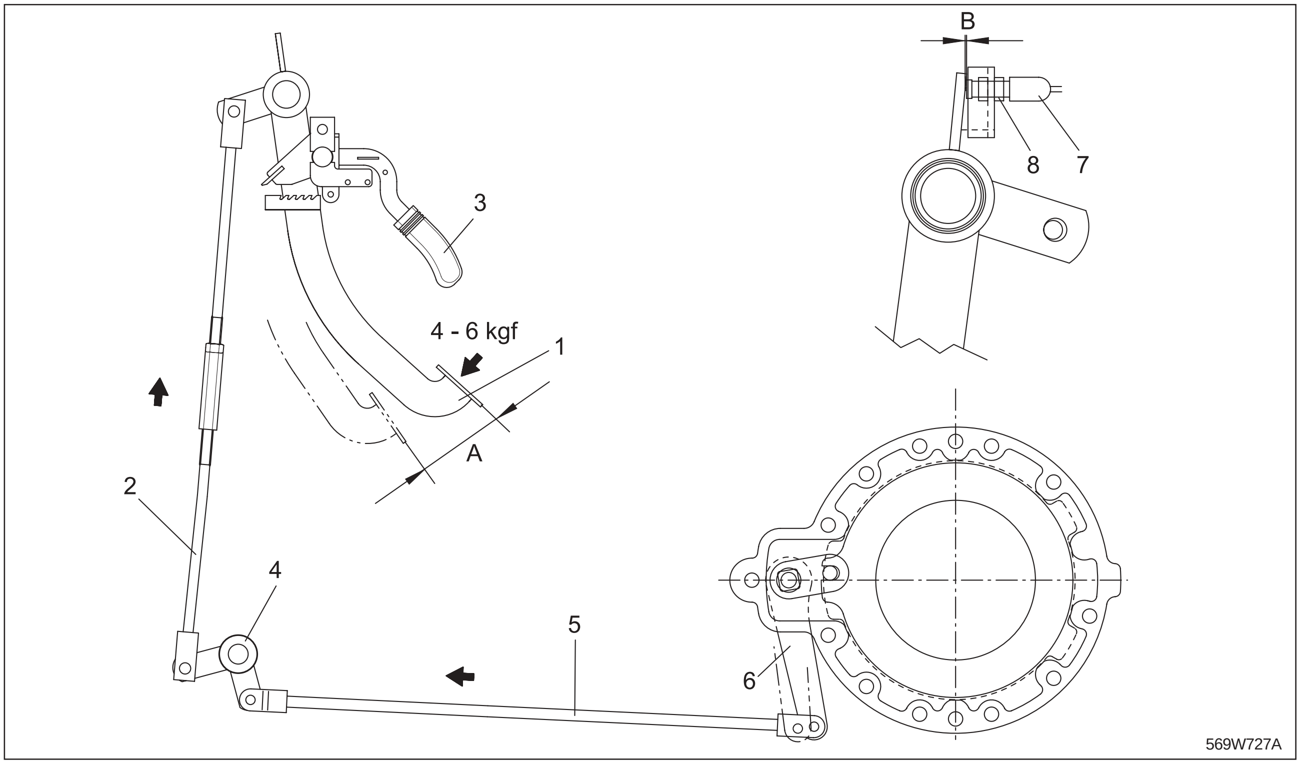
It is Possible to Disassemble as Shown in the Figure Above.

(When reassembling)

- Place the brake discs (9) so that the hole "A" of the second disc should be overlapped 70% or more.
- Apply grease to the O-ring (12) and take care not to damage them.



6. ADJUSTMENT OF THE BRAKE



(1) Brake Pedal
(2) Brake Rod
(3) Parking Brake Lever
(4) Brake Lever
(5) Brake Rod
(6) Brake Cam Lever
(7) Stop Switch
(8) Nut

Brake Pedal Free Play

1. Press the center of the pedal with a force of approx. 39.2 ~ 58.8 N (4 ~ 6 kgf, 8.8 ~ 13.2 lbs), and measure the free play of the brake pedal edge.
2. If the measurement is not within the factory specifications, turn the turnbuckle of brake rod to adjust.
3. After adjustment, tighten the turnbuckle lock nut firmly.

Brake pedal free play (A)	Factory spec.	25 ~ 40 mm 0.984 ~ 1.574 in.

CAUTION

- *The difference between the right and left pedal plays must be less than 5 mm (0.20 in.).*

NOTE:

- *After checking brake pedal free play, be sure to engage the parking brake lever fully and check to see that the brake pedals are securely locked.*

Adjustment of the Brake Stop Switch

1. Install the stop switch on the bracket.
2. Adjust the position of the switch (7) installed, to allow the clearance between the stop switch and the brake pedal to be 0 to 1 mm.

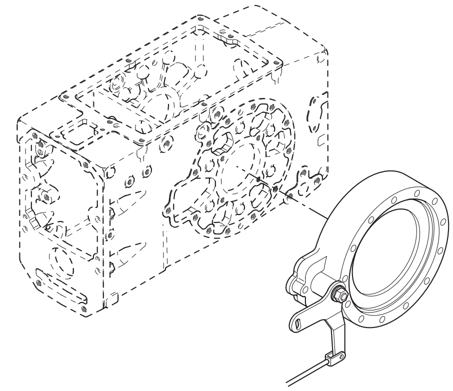
Clearance between the stop switch and the brake pedal (B)	Factory spec.	0 ~ 1.0 mm 0 ~ 0.0393 in.

3. After the adjustment of the clearance, surely tighten the stop switch with its mounting nut (8).

7. SERVICING

Brake Can Lever Movement

1. Move the brake cam lever by hand to check the movement.
2. If the movement is heavy, refine the brake cam with sandpaper.



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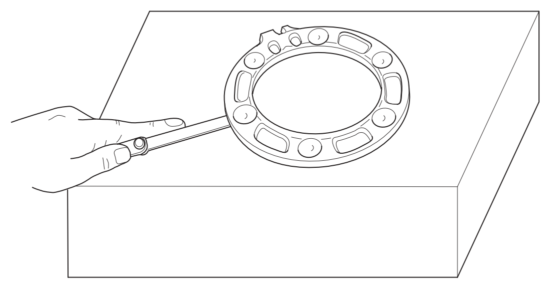
Cam Plate Flatness

1. Place the cam plate on the surface plate.
2. Use a feeler gauge of 0.3 mm (0.012 in.) thick for judgment of the cam plate flatness.
3. If the measurement is above the allowable limit, replace it.

Cam plate flatness	Allowable limit	0.3 mm 0.012 in.



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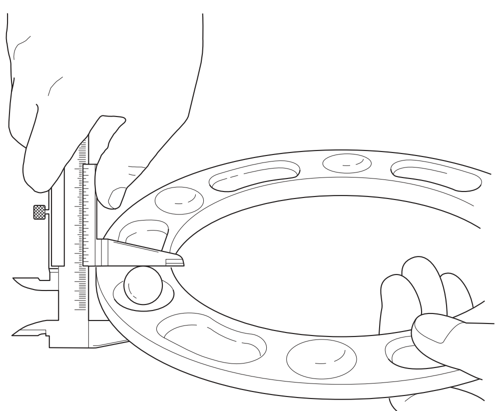
Height of Cam Plate and Ball

1. Measure the dimensions of the cam plate with the ball installed.
2. If the measurement is less than the allowable limit, replace the cam plate and balls.
3. Inspect the ball holes of cam plate for uneven wear. If the uneven wear is found, replace it.

Height of cam plate and ball	Factory spec.	20.9 ~ 21.1 mm 0.8228 ~ 0.8307 in.
	Allowable limit.	20.6 mm 0.8110 in.



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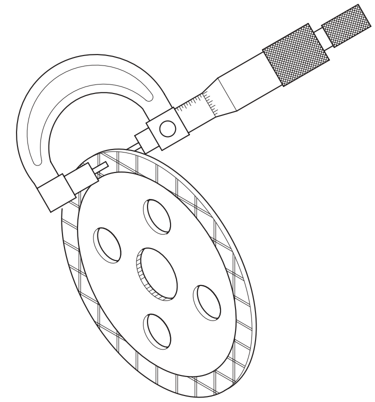
Brake Disc Wear

1. Measure the brake disc thickness with venire calipers.
2. If the thickness is less than the allowable limit, replace it.

Brake disc thickness	Factory spec.	4.6 ~ 4.8 mm 0.181 ~ 0.189 in.
	Allowable limit.	4.0 mm 0.1574 in.



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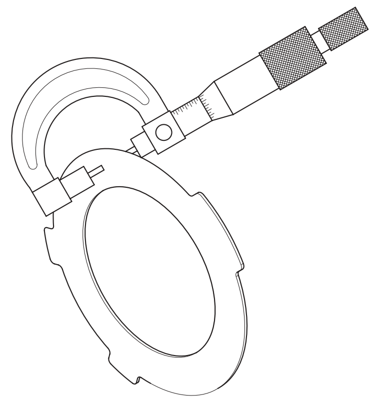
Brake Dise Wear

1. Measure the plate thickness with venire calipers.
2. If the thickness is less than the allowable limit, replace it.

Plate thickness	Factory spec.	2.54 ~ 2.66 mm 0.1000 ~ 0.1047 in.
	Allowable limit.	2.0 mm 0.0787 in.



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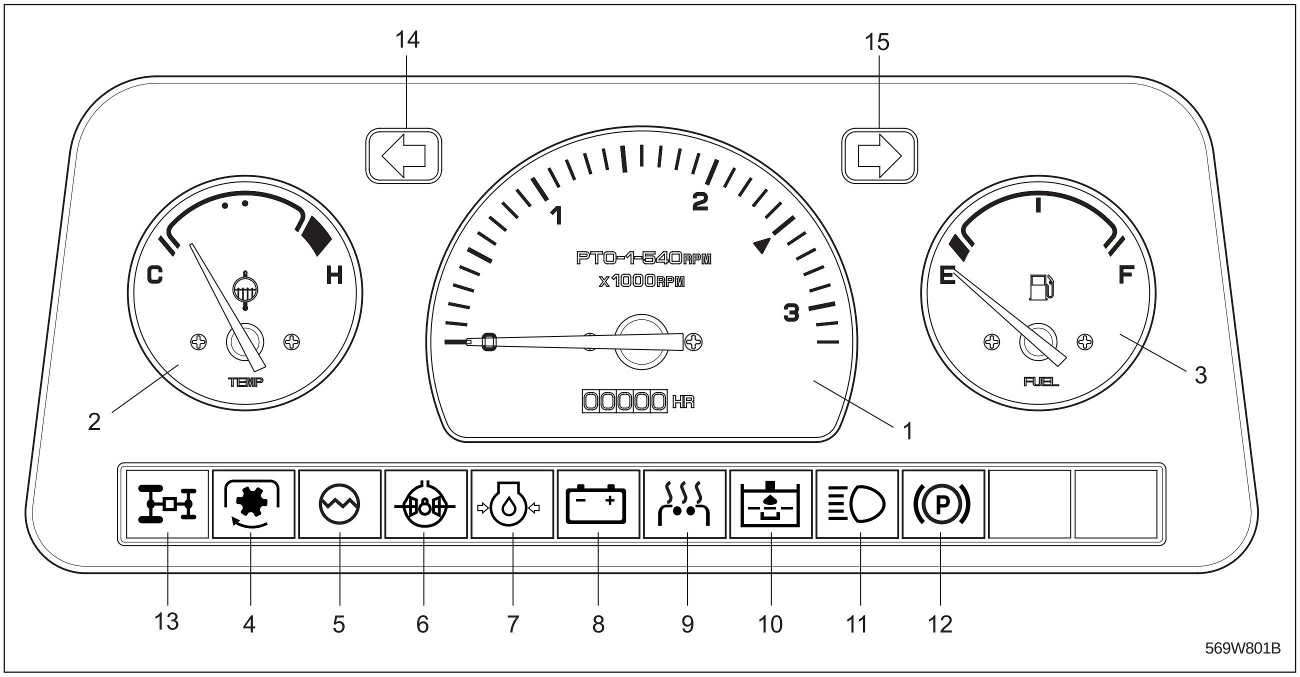
CHAPTER 8

ELECTRIC SYSTEM

1. ELECTRONIC INSTRUMENTATION



(1) Tachometer
(2) Temperature Gauge
(3) Fuel Gauge
(4) PTO On Indicator
(5) Engine Coolant Low Level Warning lamp
(6) Differential Lock Operation lamp
(7) Engine Oil Pressure Warning Lamp
(8) Battery Charge Warning Lamp
(9) Grow Plug Indicator
(10) Hydraulic Filter Warning Lamp
(11) Upward Indicator
(12) Parking Brake Indicator
(13) 4WD Lamp
(14, 15) Turning Signal Indicator

1.1 INSTRUMENT GAUGE

1. TACHOMETER (1)

Registers engine RPM (Revolutions per minute.) The gauge is marked in increments of 1000 and returns to zero when the engine is not running. The tachometer is driven mechanically by the cable type drive shaft, which is engaged in hour meter unit of engine.

2. HOUR METER (1)

Records the hours and portions of hours that tractor has been operated. Use the hour meter as a guide to determine hourly service and maintenance intervals. If the engine is operated in approx. 2000RPM of engine speed for an hour, 1 hour of hour meter will be accumulated. The lowest numbers on white ground indicate one tenth of an hour.

3. TEMPERATURE GAUGE (2)

Indicates coolant temperature. It is activated when the key switch is turned to the “ON” position. If the needle registers in the green range of the gauge, this indicates a normal operating temperature. If the needle moves to the red portion of the gauge, this indicates an over heated condition. In this case, stop the tractor engine immediately and investigate the cause.

4. FUEL GAUGE (3)

Indicates the amount of diesel fuel remaining in the tank. The gauge is activated when the key switch is in the “ON” position.

1.2 INDICATORS AND WARNING LIGHTS

A. POWER-TAKE-OFF OPERATION LAMP (4)

Light will illuminate when the PTO selection switch is located at Auto or Manual mode.

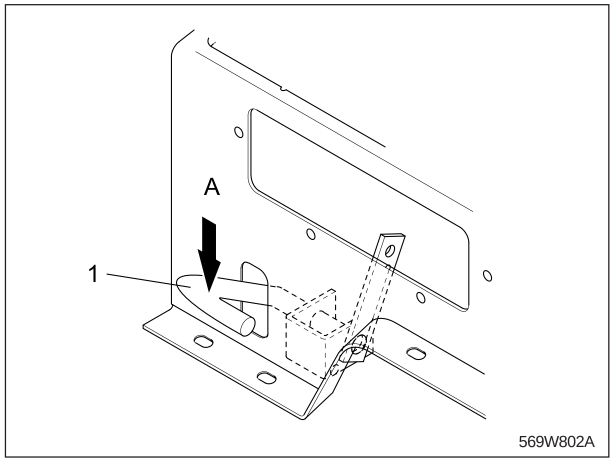
Before you start the engine, be sure that the PTO selection switch is located at the Neutral position.

B. ENGINE COOLANT LOW LEVEL WARNING LAMP (5)

Light will illuminate when the engine coolant is not enough to operate the tractor. As soon as the light illuminate, stop the engine and investigate the cause. (If the coolant is low level, put the coolant into the surge tank.)

C. DIFFERENTIAL LOCK OPERATION LAMP (6)

The light will illuminate when the differential lock pedal is engaged.



(1) Differential Lock Operation Pedal

(A) Push

D. ENGINE OIL PRESSURE LAMP (7)

The light will illuminate when the engine oil pressure is below than set value.

As soon as the light illuminate, stop the engine and investigate the cause. (And must visit the nearest maintenance facilities.)

E. BATTERY CHARGING LIGHT LAMP (8)

Illuminates when the key switch is in the “ON” position and goes out when the Engine is started. If this bulb becomes lit during operation, it indicates that the charging system is not operating normally. The battery can be fully discharged under this condition.

Must check the cause as soon as possible.

F. PRE-HEAT CONTROL OPERATION LAMP (9)

When the key switch is in the “ON” position, light will illuminate.

When the whether is cold, remain the key switch in the “ON” position before starting for a while or until the lamp goes out.

During this period, glow plug and combustion chambers are heated up and the engine becomes easier to start.

G. HYDRAULIC FILTER WARNING LAMP (10)

If the hydraulic filter is restricted or the vacuum pressure of filter is increased over specified level, this lamp turns on.

Stop the engine and check the hydraulic line.

H. HEADLAMP HIGH-BEAM INDICATOR (11)

The light will be illuminated when the headlamp switch is located at high beam position.

I. PARKING BRAKE WARNING LAMP (12)

The light will be illuminate when the parking lever is pulled up.

J. 4WD LAMP (13)

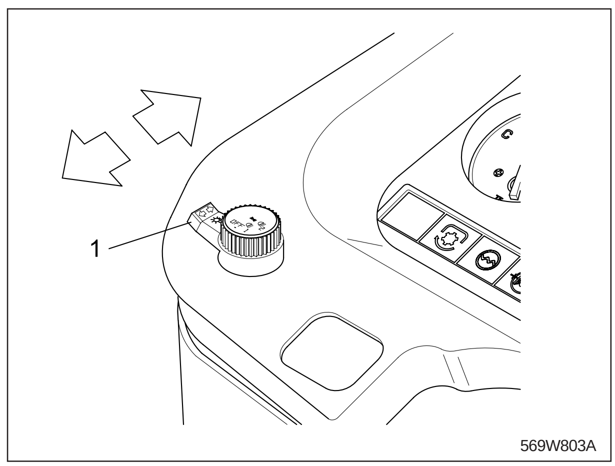
The light will be illuminate when the front wheel drive lever is pushed down.

K. TURN SIGNAL LAMP INDICATOR (14 AND 15)

Light will be flash when operating the turn signal switch to the left or right.

CAUTION

- *If the turn signal lamp is flashing faster than normal condition, check the lamps. One of the lamps must be malfunctioned.*



(1) Turn Signal Switch

2. TROUBLE SHOOTING

Symptom	Provable Causes	Solution
All electrical equipment does not operate	• Battery discharged or defective	Recharge or replace
	• Battery positive or negative cable disconnected or improperly connected	Repair or replace
	• Fusible link blown	Repair or replace
Fuse blown frequently	• Short-circuited	Repair or replace
Battery discharges too fast	• Battery defective	Recharge or replace
	• Alternator defective	Repair or replace
	• Regulator relay defective	Replace
	• Wiring harness disconnected or improperly connected	Repair or replace
	• Cooling fan belt slipping	Adjust tension
Starter motor does not operate	• Battery discharged or defective	Recharge or replace
	• Fusible link blown	Replace
	• Safety switch improperly adjusted of defective	Repair or replace
	• Wiring harness disconnected or improperly connected	Repair or replace
	• Starter motor defective	Repair or replace
	• Main switch defective	Replace
Glow plug indicator does not glow	• Battery discharged or defective	Recharge or replace
	• Fusible link blown	Replace
	• Wiring harness disconnected or improperly connected	Repair or replace
	• Main switch defective	Replace
	• Glow plug indicator defective	Replace
Engine does not start when cool	• Timer relay defective	Replace
Charging lamp does not light when main switch is turned on	• Fuse blown	Replace
	• Regulator relay defective	Repair or replace
	• Wiring harness disconnected or improperly connected	Repair or replace
Charging lamp does not go off when engine is running	• Wiring harness disconnected or improperly connected	Repair or replace
	• Alternator defective	Repair or replace
	• Regulator relay defective	Replace
Headlight does not light	• Fuse blown	Replace
	• Bulb blown	Replace
	• Wiring harness disconnected or improperly connected	Repair or replace
Illumination light does not light	• Fuse blown	Replace
	• Bulb blown	Replace
	• Wiring harness disconnected or improperly connected	Repair or replace
Turning signal light does not light	• Fuse blown	Replace
	• Bulb blown	Replace
	• Wiring harness disconnected or improperly connected	Repair or replace
	• Flasher unit defective	Replace

Symptom	Provable Causes	Solution
Brake light does not light	• Fuse blown • Bulb blown • Wiring harness disconnected or improperly connected	Replace Replace Repair or replace
Coolant level lamp does not light when cooling water is insufficient	• Brake switch defective • Bulb blown • Water level switch defective • Fuse blown • Circuit in instrument panel defective	Replace Replace Replace Replace Replace
Coolant level lamp does not turn off when cooling water is sufficient	• Water level switch defective • Circuit in instrument panel defective	Replace Repair or replace
Oil pressure lamp lights up when engine is running	• Engine oil pressure too low • Engine oil insufficient • Oil pressure switch defective • Short circuit between oil pressure switch lead and chassis	Repair engine Replenish Replace Repair
Oil pressure lamp does not light when main switch is turned on and engine is not running	• Bulb blown • Oil pressure switch defective • Wiring harness disconnected or improperly connected • Circuit in instrument panel defective	Replace Replace Repair or replace Replace
Temperature or fuel gauge does not function	• Fuse blown • Coolant temperature gauge or fuel gauge (fuel sender) defective • Wiring harness disconnected or improperly connected • Circuit in instrument panel defective	Replace Replace Repair or replace Replace
Engine tachometer does not function when engine is running	• Tachometer cable defective or improperly con-nected • Hour meter assembly defective • Gear in instrument panel defective	Repair or replace Replace Replace

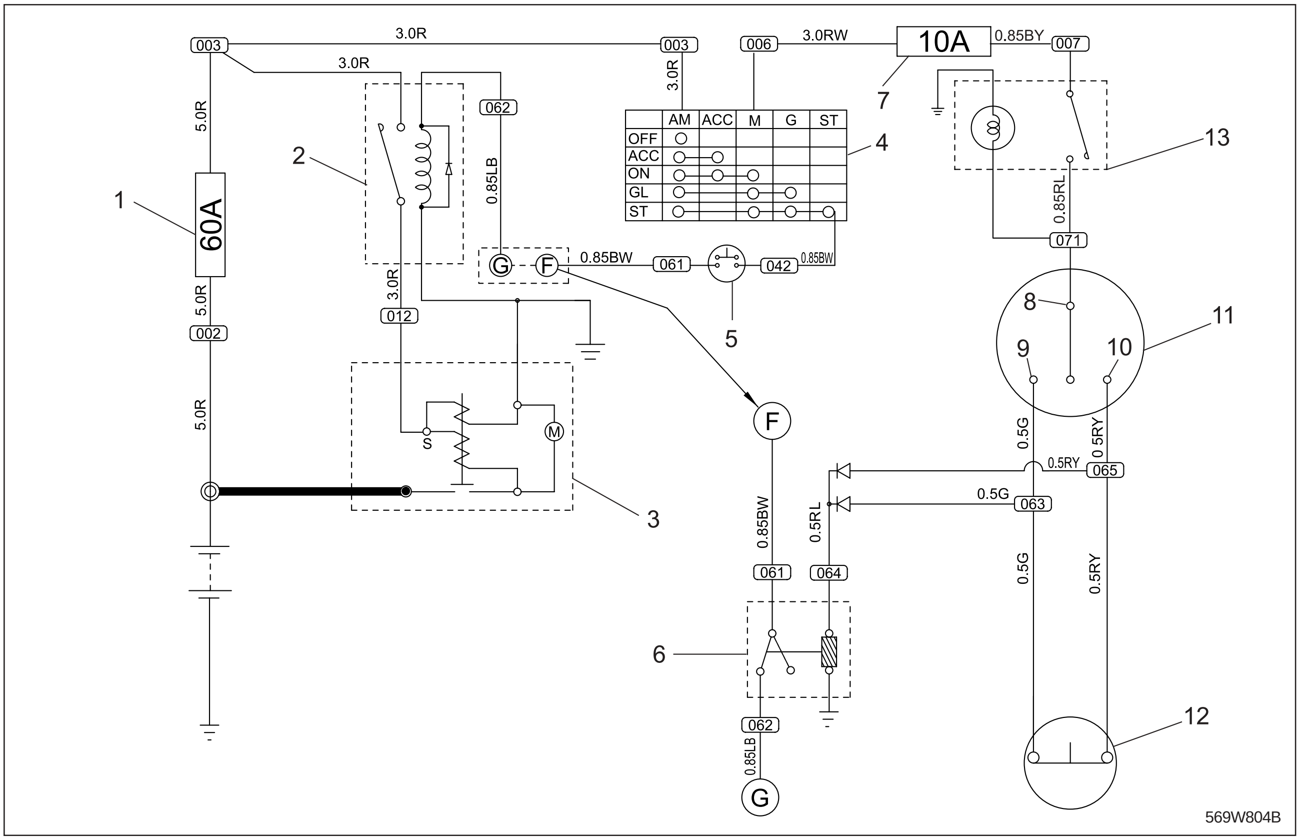
3. SERVICING SPECIFICATIONS

Item	Capacity (factory spec.)		Feature
Battery	Rated voltage capacity	12V 80AH	
Start motor	Rated voltage Rated power	12V 2.0kw	
Alternator	Rated voltage Rated current	12V 50A	Regulator built - in type
Indicator bulb	Rated voltage Rated power	14V 3.4W	

4. MECHANISM

4.1 STARTING SYSTEM

A. CIRCUIT DIAGRAM FOR STARTING SYSTEM



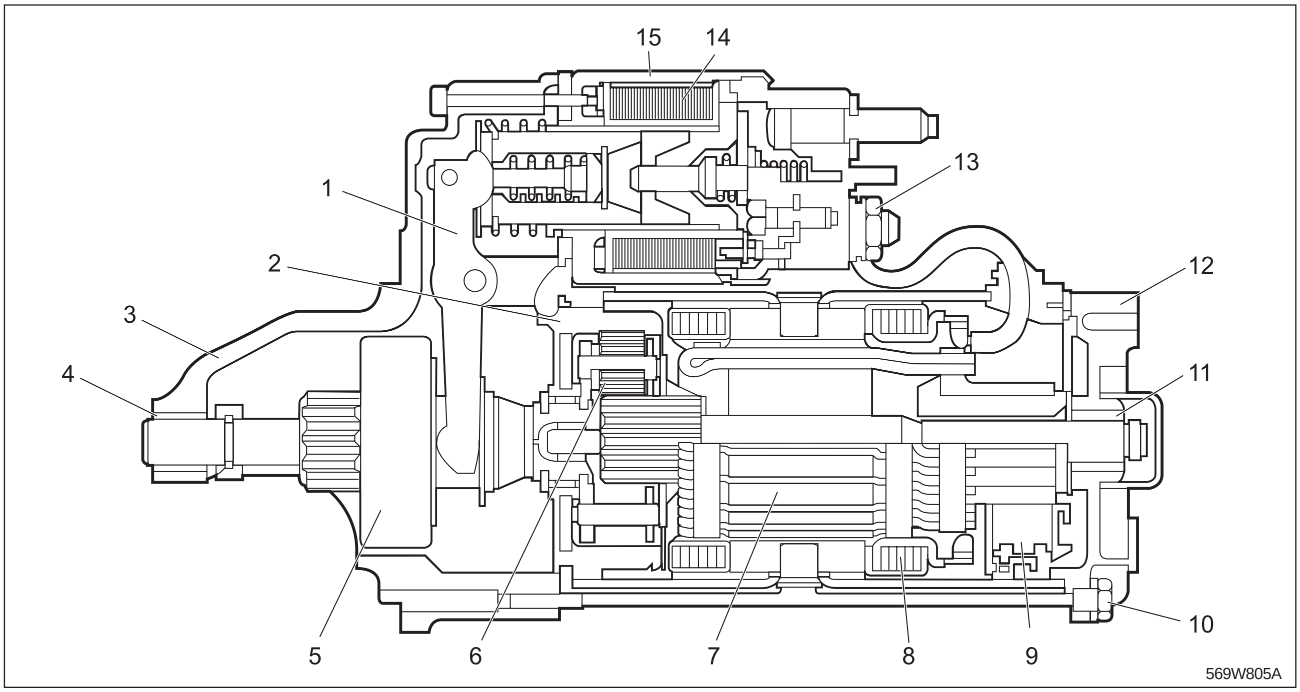
(1) Main fuse
(2) Start Relay
(3) Start motor
(4) Key s/w
(5) Safety s/w
(6) PTO safety relay
(7) PTO fuse
(8) Neutral
(9) Auto
(10) Manual
(11) PTO control s/w
(12) Micro s/w
(13) PTO Lamp Switch

B. OPERATION OF START MOTOR

a. Starter

The magnet-switch type starter is composed of two main sections. The first section converts battery current into mechanical rotation to turn the engine crankshaft. It is composed of the field coil, armature, brush, commutator, pinion, overrunning clutch, etc. The second section allows the pinion and flywheel to engage together and current to flow through the motor section. It is composed of the pull-in coil, holding plunger, drive lever, contact plate, etc.

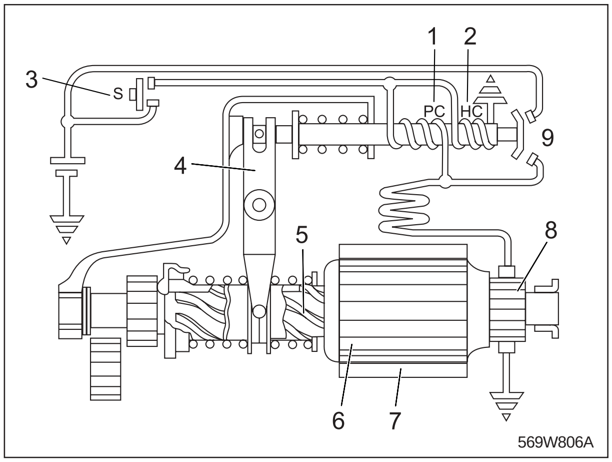
(A) Construction



(1) lever
(2) Internal Gear Ass'y
(3) Front Bracket Ass'y
(4) Needle Bearing
(5) 6 Roller ORC Ass'y
(6) Planet Gear Ass'y
(7) Armature Ass'y
(8) Field Coil
(9) Aual Brush
(10) Through Bolt
(11) Needle Bearing
(12) Rear Bracket Ass'y
(13) Nut
(14) Holding Coil
(15) Magnet Switch Ass'y

(B) Starter circuit

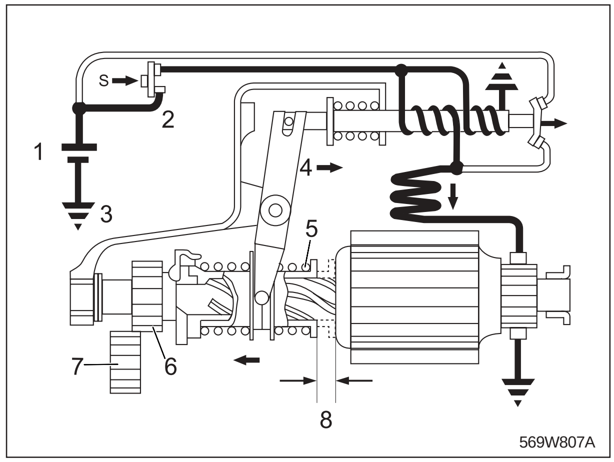
(1) PC : Pull-in coil
(2) HC : Holding coil
(3) S : Switch
(4) Drive lever clutch
(5) Screw spline
(6) Armature
(7) Pole cor
(8) Commutator
(9) Contact plate



(C) When key switch is on:

When the key switch is turned on, a current flows from the battery through the pull-in coil in the magnet switch section to the holding coil, energizing the plunger to pull it in.

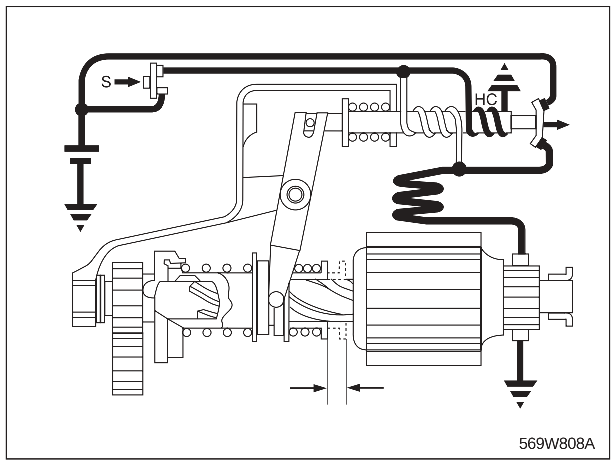
At this time, the pinion moves by the lever to engage with the ring gear.



(1) Battery
(2) Starter switch
(3) Ground
(4) Return spring
(5) Spline tube
(6) Pinion
(7) Ring gear
(8) Operated by lever

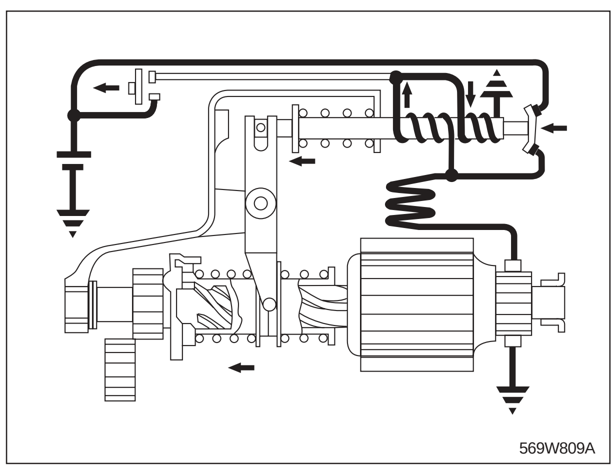
(D) When contact plate is closed:

When the contact plate is closed, a large current flows through the motor section to generate a large mechanical power which turns the engine crankshaft. At this time, the pinion is moved forward by the screw spline for more contact. Since the pull-in coil ends are short-circuited by the contact plate, the plunger is held only by force of the holding coil.



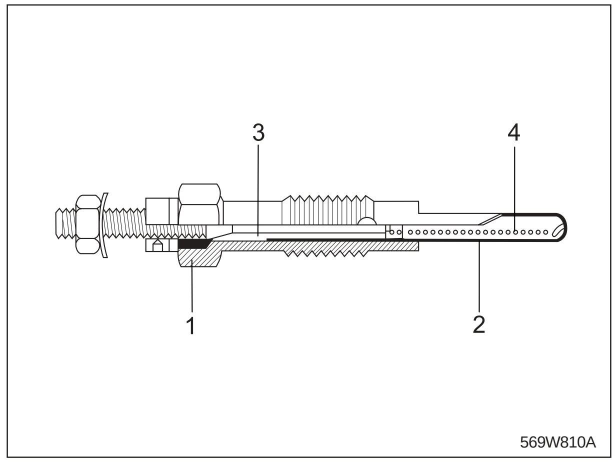
(E) When key switch is release:

When the key switch is release, a current flows instantaneously through the pull-in coil in the opposite direction as shown in flg. Therefore, the forces of the holding coil and pull- in coil are balanced. As a result, the plunger is returned by the return spring. Simultaneously, the pinion is disengaged from the ring gear, the contact plate is disconnected, and the starter is promptly stopped by the armature brake.



b. Glow plugs

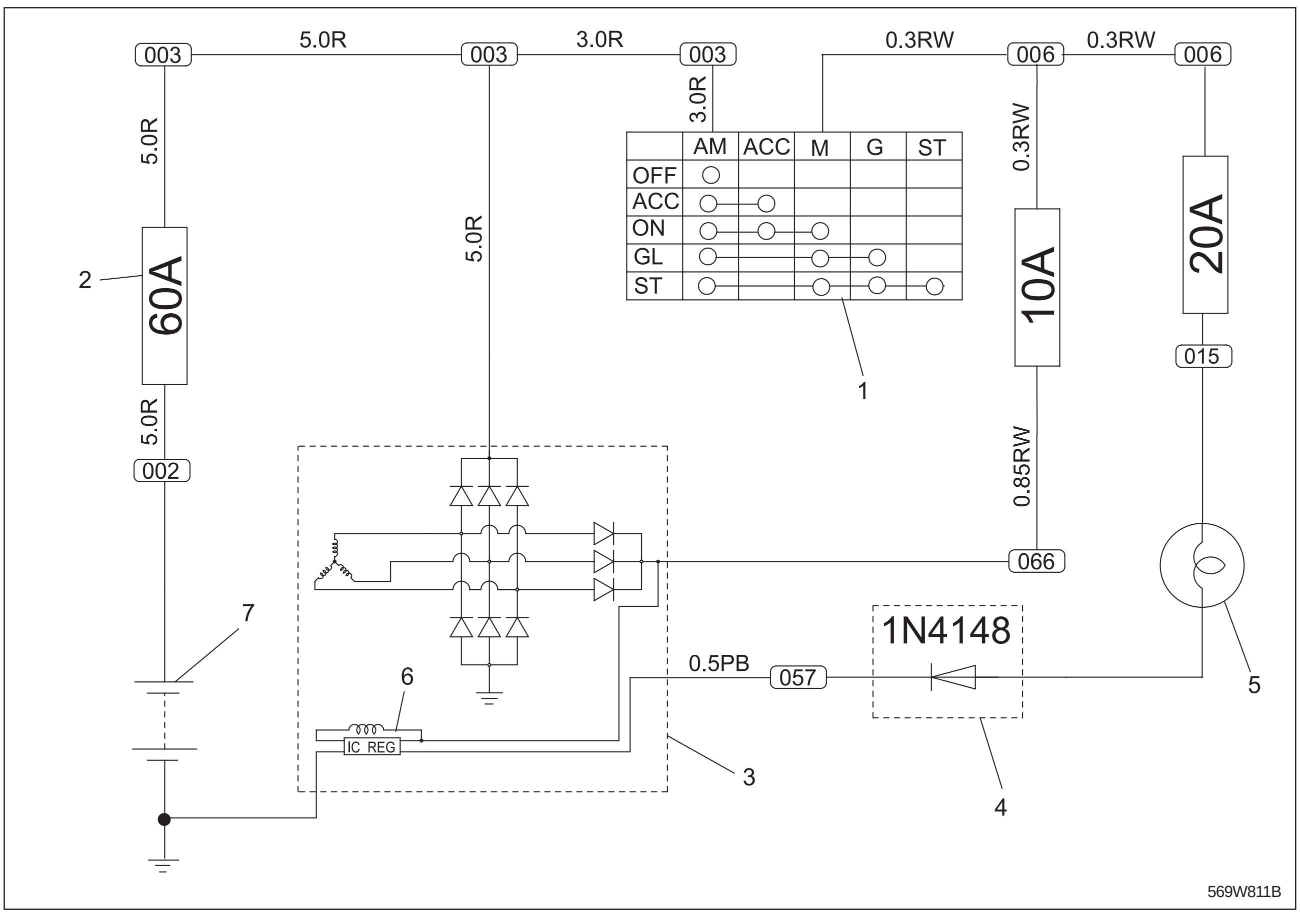
Glow plugs are used for each pre-combustion chamber of the cylinder head to make starting easier. The glow plugs are quick-heating type, which make starting easier with short pre-heating time.



(1) Housing
(2) Metal tube
(3) Insulating powder
(4) Heat coil

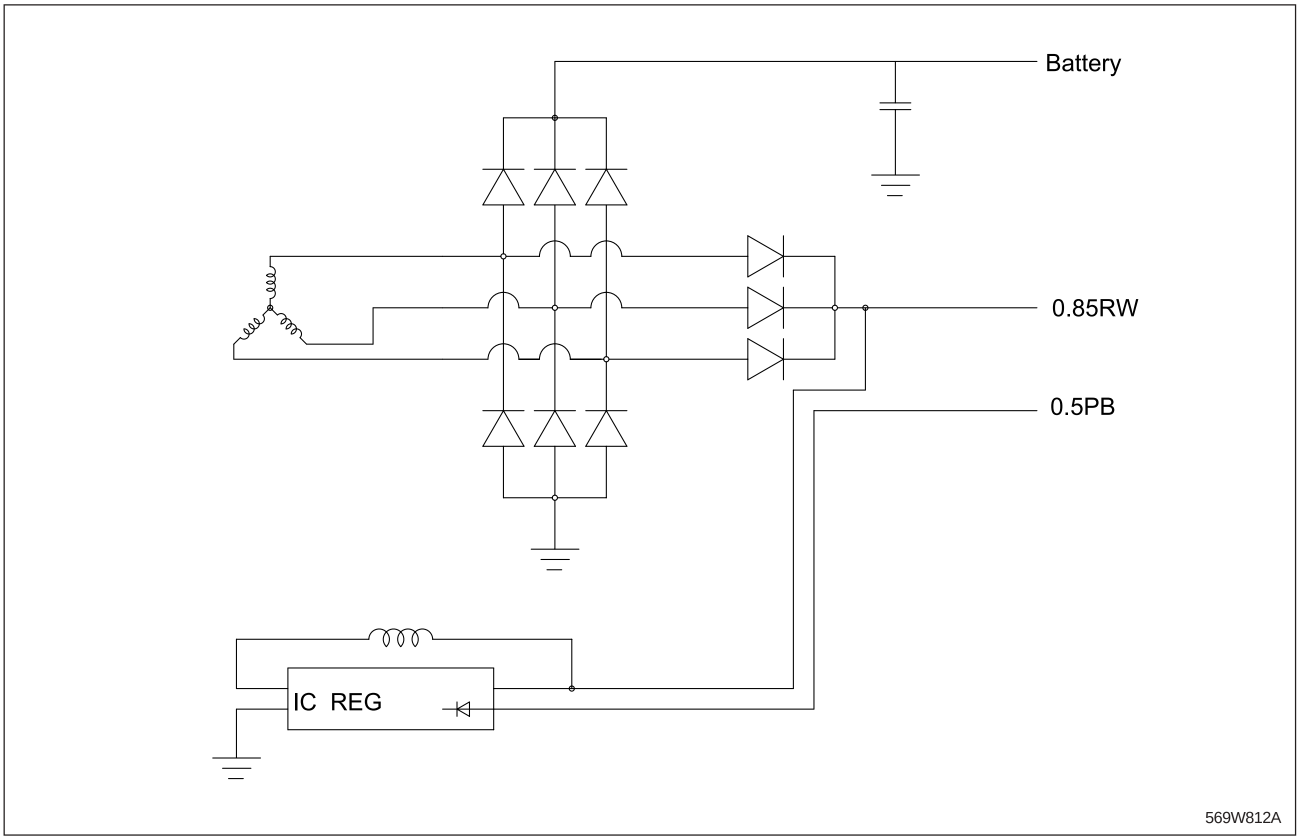
4.2 CHARGING SYSTEM

A. CIRCUIT DIAGRAM FOR CHARGING SYSTEM



(1) Key s/w
(2) Main Fuse
(3) Alternator
(4) Diode
(5) Battery charge warning lamp
(6) Regulator
(7) Battery

B. CIRCUIT DIAGRAM FOR ALTERNATOR UNIT



C. OPERATION OF CHARGING SYSTEM

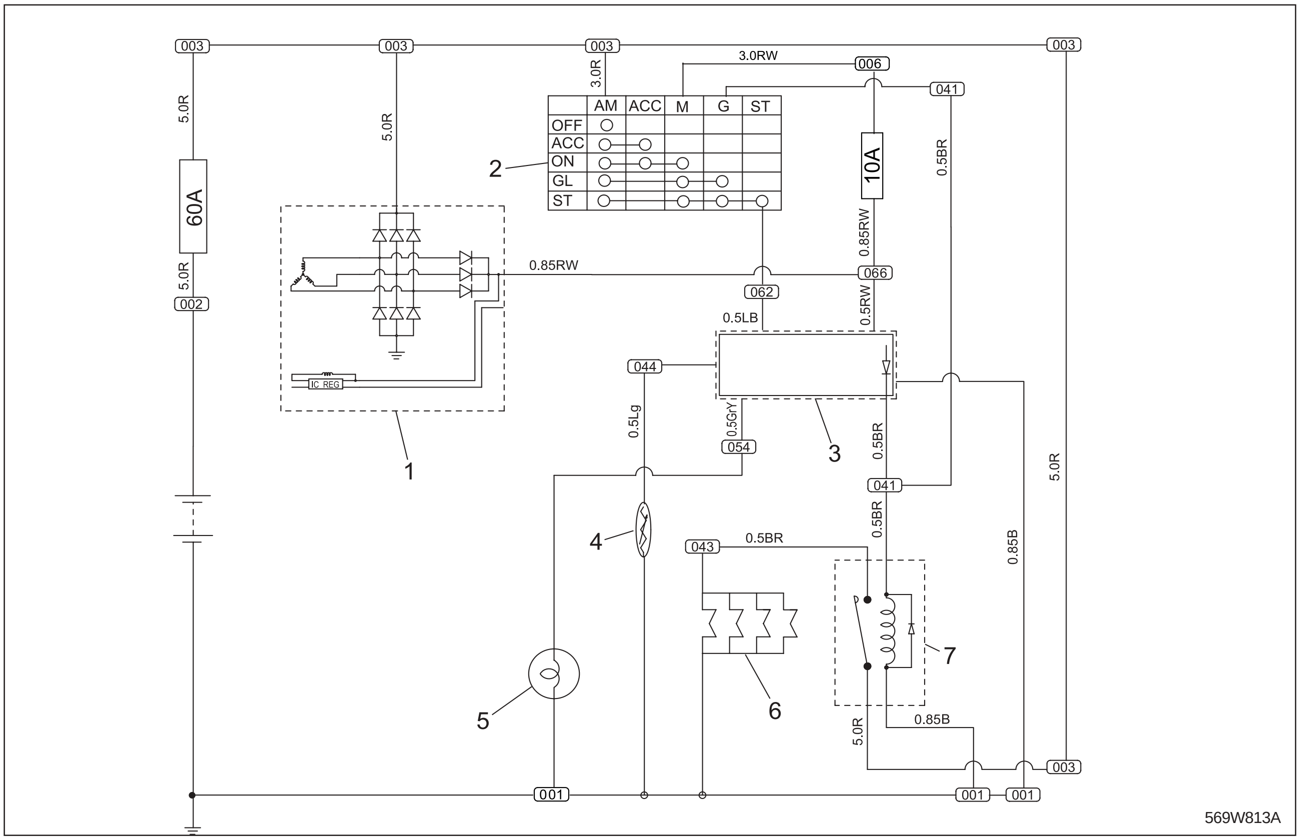
· The charging system supplies electric power for various electrical devices and also charges the battery while the engine runs.

· The alternator generates AC (alternating current) and the regulator converts AC into DC (direct current).
It also controls the output voltage for charging current to the battery.

· The regulator is built in inside of alternator.

4.3 PREHEATING SYSTEM

A. CIRCUIT DIAGRAM FOR PREHEATING SYSTEM



(1) Alternator
(2) Key s/w
(3) Preheating Controller
(4) Coolant temp. sensor
(5) Glow plug indicator
(6) Glow plug
(7) Glow Relay

PARTS SPECIFICATION

(1) Capacity of the preheating relay : DC12V 70A

(2) Capacity of the preheating controller : DC12V

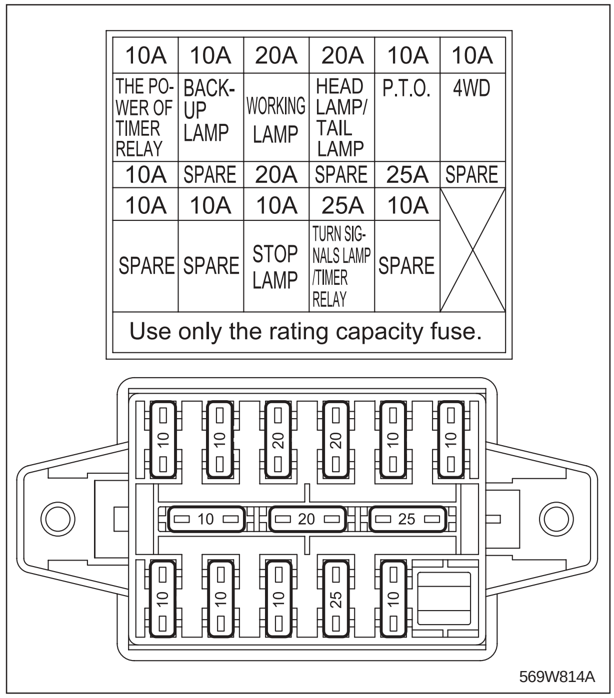
B. OPERATION FOR PREHEATING SYSTEM

If the key switch is in¡°ON¡±position, preheating system is operated automatically according to the coolant temperature. If the coolant temperature is bellow 60¡É the glow plug is heated up for 15 seconds. Due to this, combustion chambers are also heated up so that the engine becomes easier to start. If the coolant temperature is above 60¡É it doesn't work.

4.4 FUSE

A. FUSE BOX DIAGRAM

Classification	Cable standard	Connection terminal	Applicable fuse	Remark
3	AVS3.OR	5		
5	AVS2.OW	3	25A	
11	AVS3.ORL	21		
13	AVS2.OWR	6	20A	
21	AVS0.85YR	11	10A	
6	AVS3.ORW	7,13,15, 36,66,77		6WAY TERMINAL
7	AVS0.85BY	6	10A	
15	AVS2.OOR	6	20A	
36	AVS0.85RG	6	10A	
66	AVS0.85RW	6	10A	
77	AVS0.85YW	6	10A	



B. CAUTION FOR FUSE REPLACEMENT

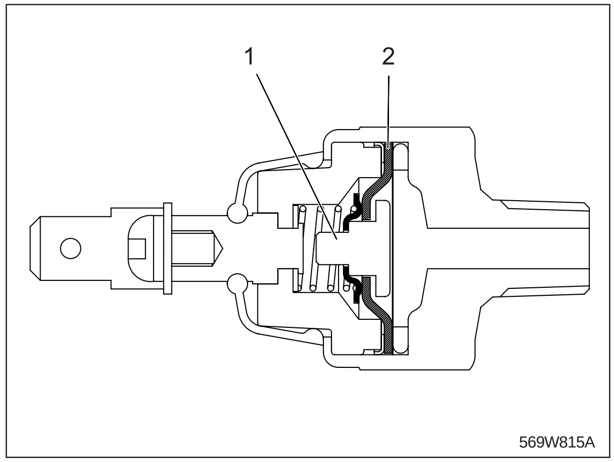
There are two kinds of fuse in this tractor. The one is main fuse which connected to the main wring near the start motor, the other is sub fuse which fixed in fuse box. Fuse box is located by clutch pedal. If the main fuse is failed, it makes impossible to operate any electrical devices of tractor. Replace it with new one. If this fuse failure continued, investigate the whole wirings whether there are any short circuit to the ground or not.

In the case of sub fuse failure in fuse box, replace it with new one. If the fuse failure continued, test the related devices and wirings and replace if necessary.

4.5 GAUGE AND SENSORS

A. OIL PRESSURE SWITCH

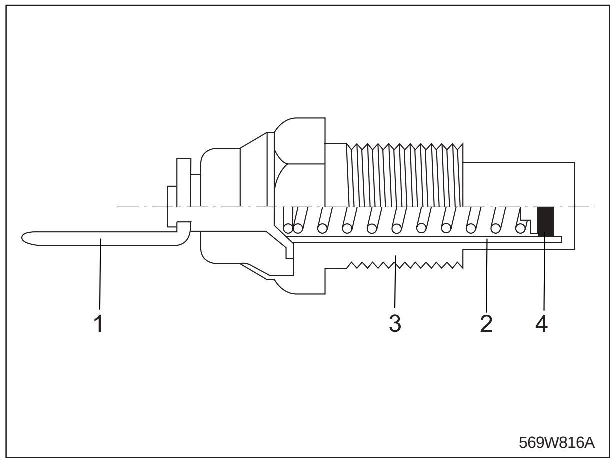
The oil pressure switch is installed on the cylinder block and leads to the oil passage of the lubricating oil. When the oil pressure falls below the specified value, the contacts of the oil pressure switch closes to turn on the warning lamp.



(1) Terminal contact (2) Diaphragm

B. COOLANT TEMPERATURE SENSOR

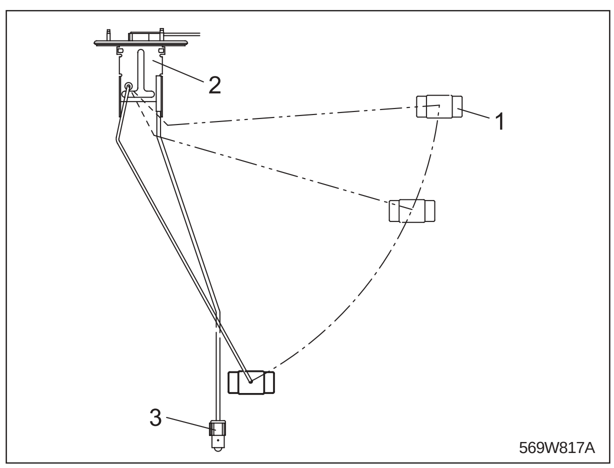
The coolant temperature sensor consists of terminal, thermostat, insulator. It is installed to the cylinder head of engine, and its tip is in touch with the coolant Electrical resistance of thermostat decreases as the temperature increase. Current varies with changes in the coolant temperature, and the increase of decreases in the current move the point of gauge.



(1) Terminal (3) Body
(2) Insulator (4) Thermostat

C. FUEL SENDER (FUEL LEVEL GAUGE)

The fuel sender consists of float, variable resister, thermostat which are installed in the fuel tank. As the float lowers, the resistance of variable resister varies. Resistance of the thermostat increases in the fuel and decreases in the air. When the fuel tank is empty, fuel indicator of instrument panel lights up by current increase.



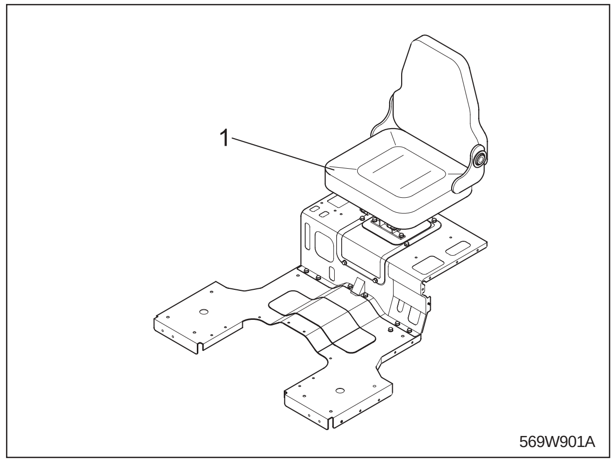
(1) Float (3) Thermostat
(2) Variable Resister

CHAPTER 9

CABIN SYSTEM

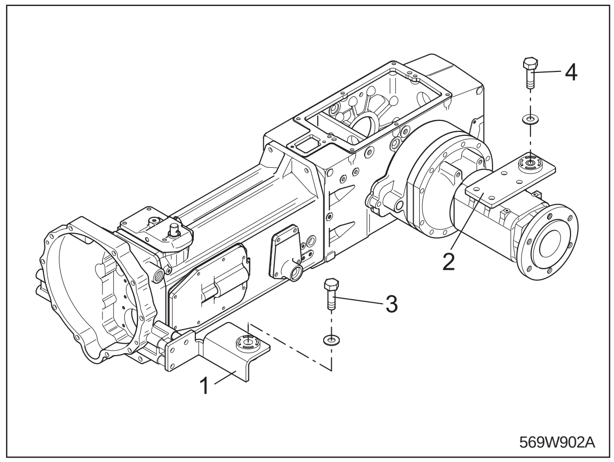
1. DISASSEMBLY AND ASSEMBLY

1. Loosen 6 setting bolts for chair assembly support and disconnect seat assembly in a body.



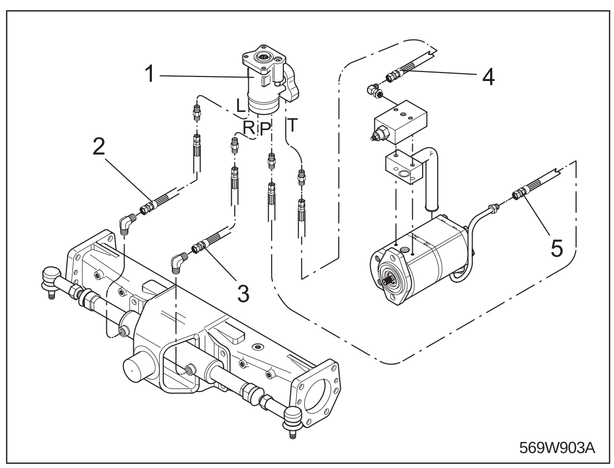
(1) Seat Assembly

2. Disengage 4 setting bolts for cabin assembly.



(1) Cabin Support (Front)
(2) Cabin Support (Rear)
(3) Bolt
(4) Bolt

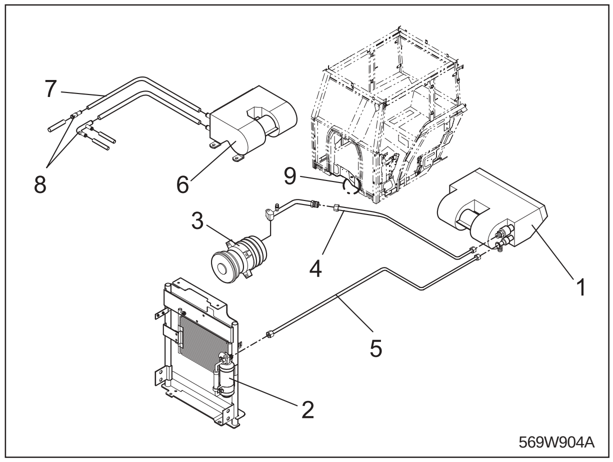
3. Remove steering hose L.R (steering cylinder assembly) and steering hose P.T (gear pump assembly).



(1) Steering Unit
(2) Steering Hose L
(3) Steering Hose R
(4) Steering Hose T
(5) Steering Hose P

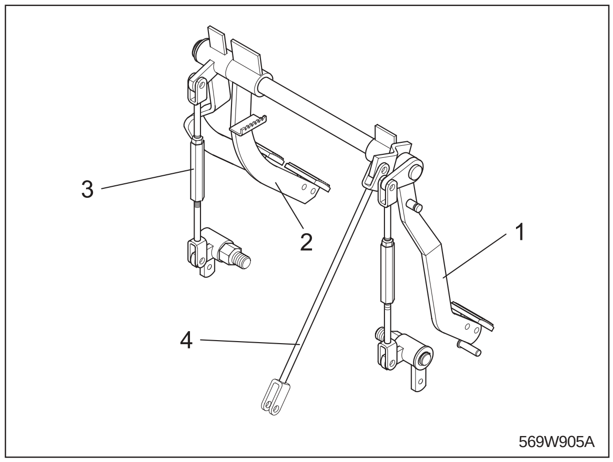
4. Open drain cock located in right of front axle frame, drain coolant, remove heat hose 2 pieces (7) connected to connecting pipe, and then remove air conditioner hose (4, 5).

   Remove wiring jack connected to the bottom of cabin.



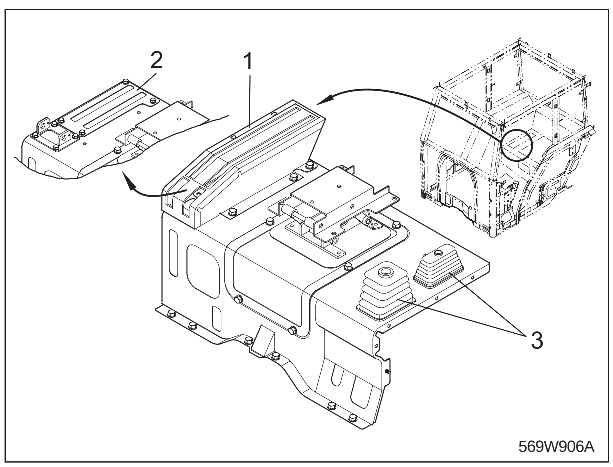
(1) Aircon. Unit
(2) R/D
(3) Compressor
(4) Aircon. Hose 1
(5) Aircon. Hose 2
(6) Heater Ass'y
(7) Heater Hose
(8) Pipe
(9) Wiring Jack

5. Remove clutch rod (4) connected to clutch lever and then brake rod (3) connected to brake lever (left, right). Remove accelerator cable and instrument panel cable.



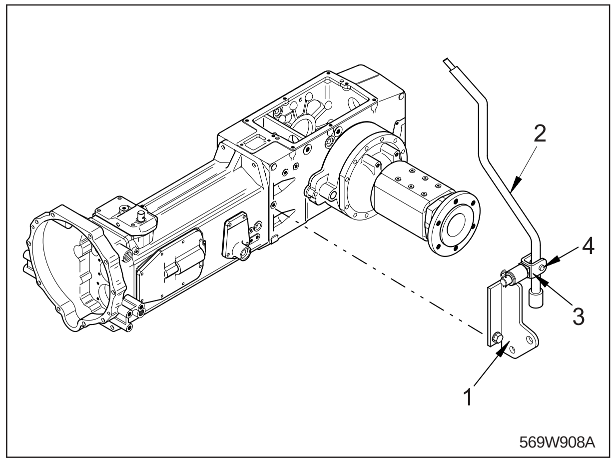
(1) Clutch Pedal
(2) Break Pedal
(3) Break Rod
(4) Clutch Rod

6. Remove all knobs in cabin and then right hydraulic lever guide and plate. Remove main transmission and PTO device from left of cabin.



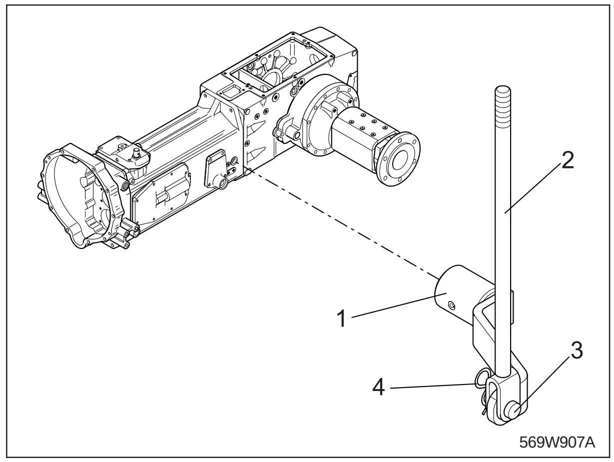
(1) Guide, Hyd. Lever
(2) Plate
(3) Boot

7. Loosen head pin and snap pin connected to main transmission lever at left bottom of cabin and remove main transmission lever.



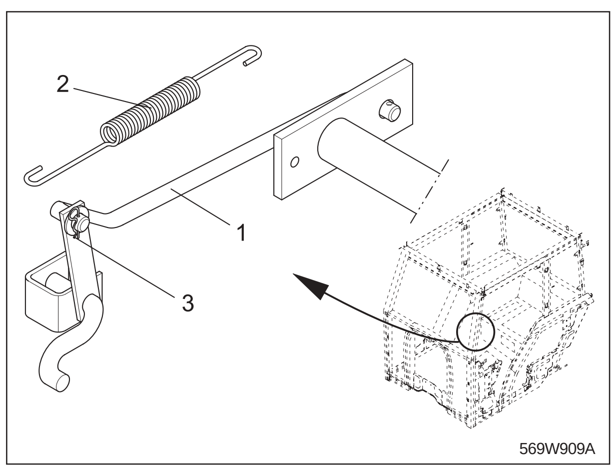
(1) Lever 1, Front Drive
(2) Lever 2, Front Drive
(3) Pin, Joint
(4) Snap Pin

8. Remove joint pin and snap pin connected to front wheel driving lever 1 in left lower of cabin and then remove front wheel driving lever 2.



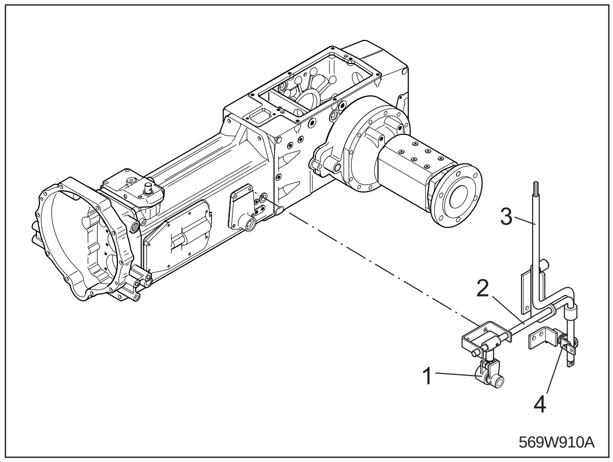
(1) Bracket, Main Shift Lever
(2) Lever, Main Shift Lever
(3) Pin, Main Shift Lever
(4) Pin, Joint

9. Remove differential rod and differential spring from right lower of cabin.



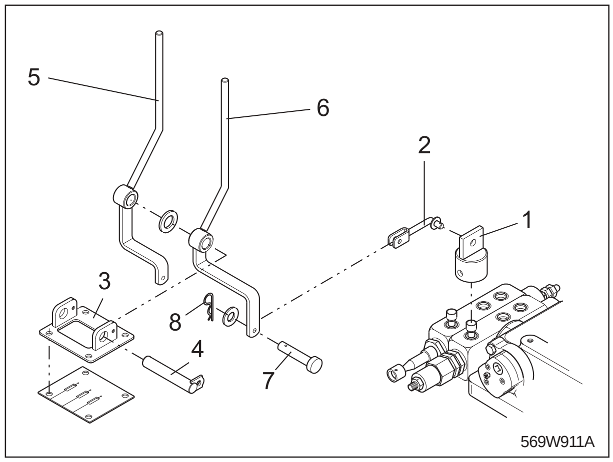
(1) Rod, Differential
(2) Spring
(3) Pin, Snap

10. Remove head pin and snap pin from Hi-Low shift lever connector and remove Hi-Low shift lever.



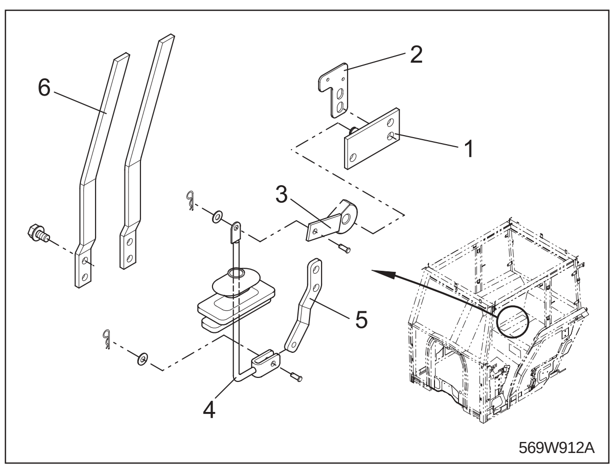
(1) Lever 2, Hi-Low	(3) Lever, Hi-low
(2) Rod, Hi-Low	(4) Shaft, Lever

11. Remove head pin and snap pin and then remove hydraulic control rod. Remove and disconnect head pin and snap pin connected between double acting lever and rod (double acting).



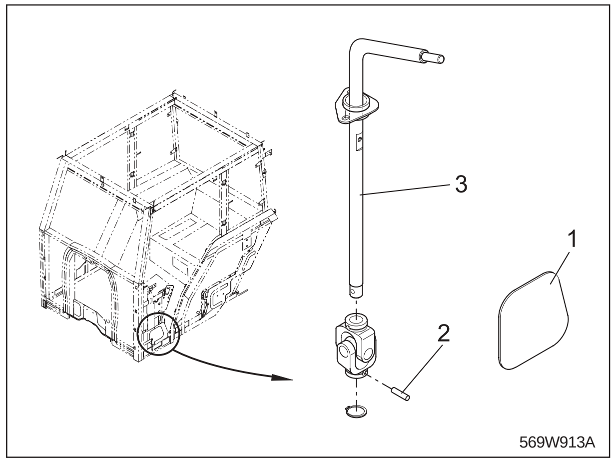
(1) Lever 1, Double Acting	(5) Lever 1
(2) Rod	(6) Lever 2
(3) Bracket	(7) Joint Pin
(4) Shaft	(8) Snap Pin

12. Remove head pin and snap pin connected to lever 1, 2 (switch) of rod (switch) and then remove rod (switch).



(1) Plate (Switch)	(4) Rod (Switch)
(2) Bracket (Switch)	(5) Lever 1 (Switch)
(3) Lever 2	(6) Lever

13. Remove frame cover (1) in left of frame assembly and parallel pin connected with shuttle lever arm (3) and then disconnect shuttle lever from shuttle lever arm.



(1) Cover, Frame
(2) Pin, Straight
(3) Lever, Shuttle

14. Remove cabin.

CAUTION

- *Disassemble cabin carefully, ensuring that it would not interfere with other parts or there would be parts not disassembled.*

2. HEATER

2.1 STRUCTURE

Item		8454
Heater	Type	Hot water type
	Radiating (kcal/h)	HI: 2170 kcal/h
		Low:1900 kcal/h
	Air flow	Hi: 230 m^3/h
		Low:130 m^3/h
	Power consumption	Less than 65 W (DC12 V)
	Coolant Capacity	8.9 ℓ , 2.4 U.S.gal
Air conditioner	Used refrigerator	HFC-134 A
	Level of refrigerator	0.95 ~ 1.0 kg, 2.1 ~ 2.2 lbs
	Compressor oil (compressor)	VCON488
	Level of oil (compressor)	150 CC

2.2 DISASSEMBLY AND ASSEMBLY

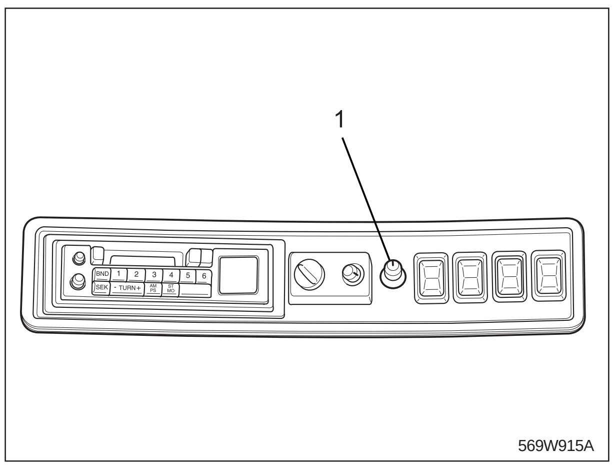
1. Open drain cock in right of front axle frame and drain coolant.
2. Remove heater hose connected to connecting plate 1, 2 and heater assembly using clamp.
3. Disconnect duct hose and wiring connected to heater assembly. Disengage 4 M8 nuts and remove heater assembly.

Precautions When Assembling

1. Be careful not to be distorted when connecting with hose.
2. Tighten firmly with clamp to prevent water leakage when connecting with hose.

2.3 HEATER OPERATION DEVICE

Heater switch is operated in two stages of High and Low. Heater operation makes the temperature in cabin controllable through increasing and decreasing the level of coolant circulated in engine. Ventilating hole moves in right, left, front and rear and can control the direction of air into cabin freely.

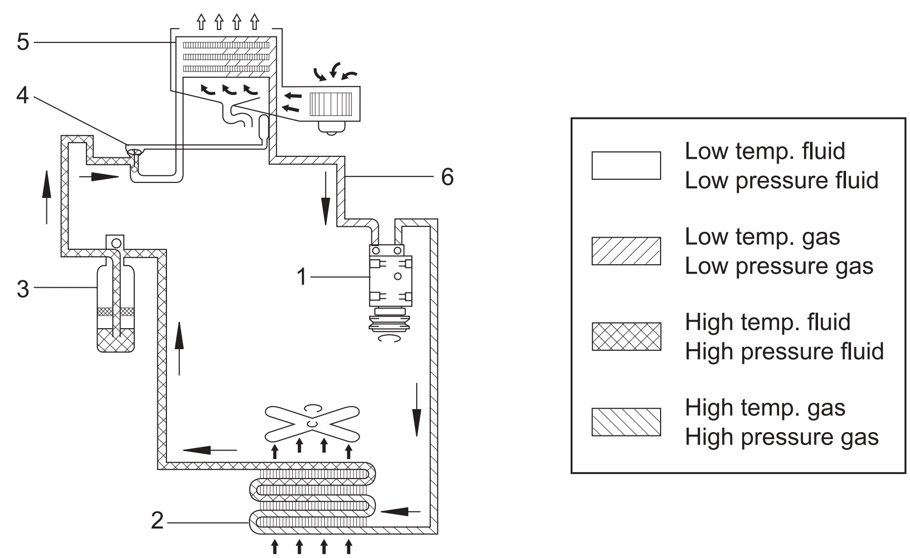


(1) Heater Switch

3. AIRCONDITIONER

3.1 AIR CONDITIONER

A. STRUCTURE



(1) Compressor
(2) Condenser
(3) Receiver Drier
(4) Expansion Valve
(5) Vaporizer
(6) Refrigerant

B. PRINCIPLE OF AIRCONDITIONING

The function of air-conditioning system is to cool the air inside the cabin and lower the humidity to promote the convenience of operator.

The temperature shall be controlled by absorbing the heat inside the cabin with a refrigerant and moving the heat absorbed by a refrigerant to the air outside.

In order to enable the heat movement, the following principle of heat generation and movement shall be applied in the inside air-conditioning system.

a. When the heat is with a solid of different temperature, the heat moves from one to another. In the air-conditioning system, the vaporizer absorbs the heat from the air inside the cabin and moves it to maintain the low temperature of a refrigerant.

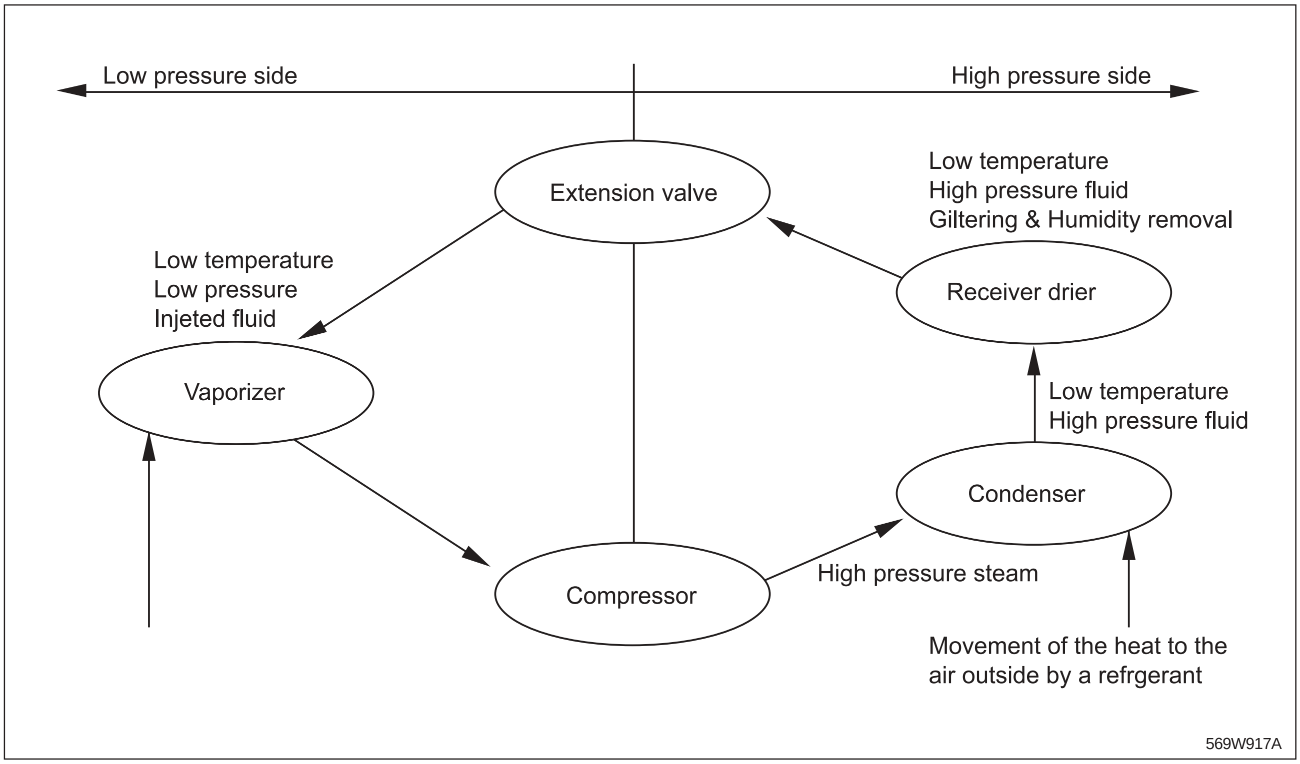
b. When the gas is pressed, the temperature of the gas increases. For the increase of pressure in the air-conditioning system, the compressor shall be used.

c. When the gas is cooled, this shall be concentrated to the fluid. In the air-conditioning system, the condenser shall be used to cool the gas and store the consequent fluid in the receiver drier.

d. When the fluid is injected through the hole, the consequent temperature of the steam shall fall down. Thus, the low temperature of the injected fluid shall absorb the heat around this. In the air-conditioning system, the refrigerant shall be injected with the extension valve.

   The main components of air-conditioning system is as follows:

   - Refrigerant
   - Vaporizer
   - Compressor
   - Condenser
   - Receiver drier
   - Extension valve



The above figure shows the circulation diagram of a refrigerant which passes through the 5 main components of the air-conditioning system.

The refrigerant shall be flowed into the compressor as the compressed cold low-pressure steam and then ejected as the hot high-pressure steam and get into the condenser.

When the hot high-pressure steam passes through the condenser core, this discharges the heat to the colder air outside and passes the pin by engine cooling fan and to be drawn.

By discharging the heat to the air outside, the steam shall be compressed as a fluid and moved to the receiver drier where this is stored until the vaporizer shall be discharged by the temperature extension valve as a state of high pressure.

When the fluid refrigerant passes through the measurement hole of extension valve, the refrigerant is changed from high pressure fluid to the low temperature and low pressure injection fluid.

Such low pressure, low temperature and injected fluid enters into the coil of the vaporizer to absorb the heat from the hot air of the cabin and blow it to the coil and the pin by blower motor. The refrigerant is changed from the cold low pressure injected fluid to the hot low pressure steam and moved from the exit of the vaporizer to the absorption side (low pressure) and then repeats the circulation.

When the heat loss occurs, the moisture (humidity) of the air in the cabin shall be compressed at the outside of vaporizer and flowed out as a water through the drainage hose attached to the drainage fan of vaporizer, which result in decreasing the humidity of the cabin.

C. OPERATION PRINCIPLES OF SYSTEM COMPONENTS

a. Refrigerant

In order to accomplish the intrinsic function of air-conditioning system, it is needed to use the suitable refrigerant - which features relatively low temperature boiling point and the desirable safety and stability. The refrigerant to be used in the air-conditioning system is HFC-134A.

Ref.) In order to observe the environment regulations, the air emission of the refrigerant including HFC-134A is prohibited.

NOTE:

The refrigerant HFC-134A is not available to be compatible with CFC-12. It is not available to replace the HFC-134A refrigerant with CFC-12 refrigerant or test the system by using the gauge or equipment that is used for CFC-12 before as it may affect the damage to the system. The HFC-134A refrigerant is stable at all operation temperature and available to absorb lots of heat. The boiling point of HFC-134A is -22°C (-15°C).

b. Compressor

The compressor that is a major component of air-conditioning system, shall be installed on the upper part of the left side of engine.

The compressor is divided into the low-pressure side and high pressure side and originally is one pump which has two functions.

(1) The function to increase the refrigerant temperature higher than the ambient temperature.

(2) The function to circulate the necessary capacity of refrigerant through the system.

c. Condenser & Receiver Drier

The condenser is located in front of tractor and consists of continuous revolution of coil mounted on the series of fine cooling pin, and offers maximum heat movement in the minimum space.

The condenser receives a hot and high-pressure steam of refrigerant from the compressor. The hot steam passes the condenser coil and the air outside passes the condenser by the cooling fan of engine.

The heat moves from the hot steam of refrigerant to the cold air outside and flows to the coil and pin of the condenser.

When the steam of refrigerant reaches the pressure, the temperature causes the change of state and a large amount of heat moves to the air outside and the refrigerant is changed to the hot and high-pressure fluid.

The hot fluid of refrigerant continues the receiver drier which is filtered and dried and removes all humidity before passing the outlet line and automatic temperature control extension valve.

As the drier contains a drying agent, it absorbs all humidity in the system and the filter prohibits the external particles to enter in.

Ref.) The humidity of air-conditioning system is absolutely harmful. The humidity that is not absorbed by a drying agent shall be circulated with a refrigerant and able to cool down the hole of automatic temperature control extension valve. Such action prevent the flow of refrigerant and stop the operation of cooling. The humidity may generate the corrosive acid caused by a reaction of HFC-134A refrigerant and lubricant.

A drying agent is available to absorb the limited amount of humidity before reaching to the point of saturation. Thus, it is needed to change the receiver drier after replacing or repairing the system components.

d. Extension Valve

The extension valve is located near the pressure line which is connected to the receiver drier, and its functions are as follows:

- To change the fluid refrigerant from high-pressure and low temperature fluid to the injected fluid with low pressure and low temperature.
- The valve that is controlled by automatic temperature control in the extension valve shall adjust the capacity of fluid refrigerant that passes through the hole and make the refrigerant be evaporated completely in the evaporator.
- The valve reacts according to the change of cooling condition but if the cooling increase is needed, the valve will be open to increase the flow of refrigerant and on the contrary, if the cooling reduction is needed, the valve will be closed to reduce the flow of refrigerant.

e. Vaporizer

The vaporizer is located on the upper part of the cabin and consists of continuous revolution of coil mounted on the series of fine cooling pin and offers maximum heat movement in the minimum space.

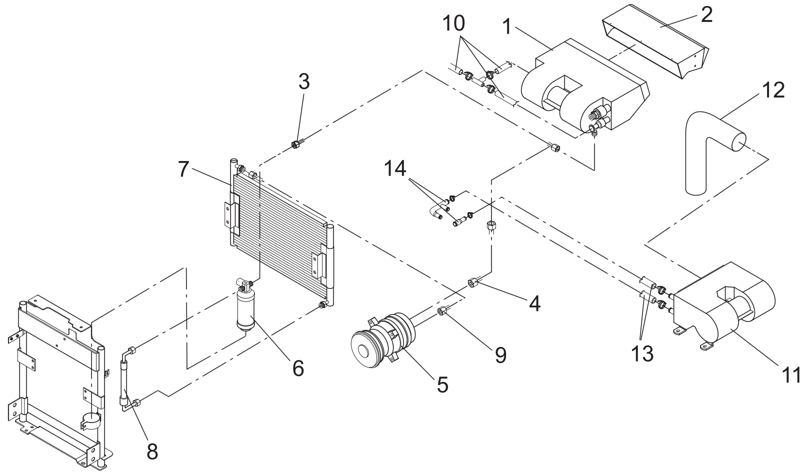
The low-temperature refrigerant of vaporizer absorbs the heat from hot air that exists in the space of operator and accordingly cools down the air.

f. Blower Fan

The blower fan draws out the air through ventilation filter hole from outside the cabin and makes the hot air cross the vaporizer before flowing into the cabin through the radiation hole.

The blower motor is adjusted by 3 stages. The switch changes the speed of fan by using various resistors. The high speed blower offers the maximum volume of the circulated air while the low speed blower makes the air to contact the cooling pin and the coil of vaporizer for a long time which results in the failure to make the hotter air and the colder refrigerant. Therefore, the coldest air temperature will be acquired when the blower fan operates at the lowest temperature.

D. AIR-CONDITIONING COMPONENTS



(1) Aircon. Unit	(5) Compressor	(9) Hose 1, Aircon	(12) Duct, Heater
(2) Duct, Aircon.	(6) R/D	(10) Hose, Drain	(13) Hose 1, Heater
(3) Hose 3, Aircon	(7) Condenser	(11) Heater	(14) Pipe 1, 2
(4) Hose 4, Aircon.	(8) Hose 2, Aircon.		

E. SAFETY PREVENTION MEASURES

WARNING

- *Before disassembling and inspecting the air-conditioning system, please read and obey the following safety prevention measures. If a repair or replacement is needed, it is required to hire the authorized air-conditioning engineer and use the approved equipment for repairing. It is prohibited to try to disassemble the air-conditioning system because the refrigerant may be emitted to cause severe frostbite and injury.*

IMPORTANT:

- *Do not emit the refrigerant outside the air.*
- *Care shall be taken to handle the refrigerant to avoid the failure.*
- *The skin and eyes may be frozen by direct contact with fluid refrigerant.*
- *The refrigerant case and air-conditioning system shall be maintained apart from the fire or heat, and if the pressure increases, the explosion of the case and the system can be happened.*
- *Direct contact with the fire or the hot metal surface may cause the resolution of refrigerant and the generation of poisonous or acid products.*
- *In order to avoid the danger and injury, you are requested to follow the requirements and simple prevention measures as follow:*

- *Never emit the refrigerant to the air. When checking the air-conditioning equipment, the authorized engineer should operate the authorized refrigerant recovery device.*
- *When discharging the refrigerant to the system, you should check whether the ventilation status is good on the assumption that the air circulation is good and the system is located apart from the fire.*
- *In case of charging or discharging the system, it is required to wear the protection glasses and obey the proper measures to protect the face and especially the eyes from the accidental leakage of cooling fluid.*
- *Oil and refrigerant mixture are pressed inside the air-conditioning system. Consequently, as far as the system is not discharged correctly, it is not allowed to loosen the components or change the line.*
- *Before disconnecting, it is required to protect the relevant device with a cloth and wear the gloves and protection glasses to protect the skin and eyes from the contact of a refrigerant.*
- *In case of accident, conduct as follow:*

  If the refrigerant touches the eye, wash the eye with a large amount of sterilized water immediately and go to the hospital to take medical measurements.

  If the refrigerant touches the skin, wash the skin with cold water and go to the hospital to take medical measurements.

F. OIL

- Checking of compressor oil

  The oil used to lubricate the compressor shall be supplemented when the components in the system need to be replaced or a large amount of gas leaks as the compressor is circulated into the system during operation.

  The amount of compressor oil: 265 cc

- How to handle the oil
  - The humidity, dust, metal pieces are not allowed to enter into the oil.
  - The mixing with oil is not allowed.
  - After using the oil, you should cover the vessel as the moisture shall be absorbed to the oil if the oil is left in the air for a long time after using.

G. CHECKING OF REFRIGERANT LEAKAGE

When you doubt the leakage of refrigerant or disassemble the connection assembly, it is required to carry out the leakage test with a leakage detector.

- Check the torque of connection assembly and tighten the loosened part and then check the leakage of gas with a leakage detector.
- If the leakage continues after tightening the connection assembly, it is required to emit the refrigerate and remove the connection assembly to check the damage of contact surface and if found a damage, change it with the new one.

H. DISASSEMBLING AND ASSEMBLING

a. Disconnect air conditioner hose 3 and 4 connected between air conditioner assembly, compressor, and receiver drier.

b. Disconnect two-drain hose wiring connected to air conditioner assembly.

   Disengage two M6 nuts and remove air conditioner assembly and air conductor in a body. Disengage 6 damping screws and remove air conductor.

c. Disconnect air conditioner hose 1 between compressor and capacitor and hose 2 between capacitor and receiver drier.

d. Loosen M8 bolt and nut to remove receiver drier. Loosen 4 M10 washer-holding bolts to remove capacitor.

e. Remove two setting nut for air conditioner and wiring and then disconnect air conditioner assembly in a body.

f. Disconnect duct and ventilation hole from air conditioner assembly.

g. Remove setting bolt and disconnect compressor.

h. Disconnect hose cover in cabin and disconnect air conditioner hose 3 and 4.

I. AIR CONDITIONER CONTROL

Air conditioner switch consists of air flow and temperature control switches. Airflow control switch is operated in three stages of LOW, MIDDLE and HIGH. Turning temperature control switch clockwise enables to select the highest temperature.

Air conditioner ventilating grill can be controlled freely in left, right, front and rear.

Air conditioner can be operated only with start switch ON.

J. CHECKING OF THE AIR-CONDITIONING SYSTEM

If air conditioner operated, make sure it operates effectively and properly.

a. Compressor: Check it for setting state, belt tension, and oil level.

b. Capacitor: Check if set and if foreign matters stuck to capacitor pin. If having foreign matters, clean capacitor pin.

3.2 TROUBLE SHOOTING

You can find the troubles simply during the daily checking and season-in checking by the naked eyes and audio, and the early finding of troubles and proper repair enable to extend the life time of each machine.

A. TROUBLE SHOOTING BY AUDIO/VISUAL

a. The noise caused by the loosened V-belt

   In case the V belt is loosened or worn out, the sliding sound is generated. In this time, adjust the tension of V belt. In case of wearing, change with new one.

b. Abnormal noise near the compressor

   Check whether the compressor or mounting bracket bolt is loosened and if loosened, tighten it more.

c. Abnormal noise from the compressor

   The abnormal noise inside the compressor results from the broken suction valve. Disassembling, repair or replacement is needed.

d. Mud and dust adhered to the condenser

   As the mud or dust reduce the radiation effect remarkably which affects the cooling capacity, it is required to wash the mud or dust etc. with water. In this case, care shall be taken not to occur the damage or distortion of the condenser fan.

e. Pollution of piping connection section or compressed section by oil

   The place contaminated by oil means that the refrigerant is leaked with the compressor oil from the inside cycle by a certain cause. If found the contaminated place, check the leakage of gas with a leakage detector and tighten it strong or change the components. Check the gasket and O-ring of the compressor, and sealed part of shaft carefully.

f. Abnormal noise from the blower motor

In case of the generation of abnormal noise from the blower motor and the poor revolution, change the blower motor with the new one.

In case of generation of the abnormal noise caused by the foreign material in the blower or by the poor tightening, pay attention to work.

B. EARLY FINDING OF TROUBLE SHOOTING

a. Poor Air-Conditioning

1) Fan motor does not revolve.

Causes	Checking Methods	Action
1. Fuse cutting	Check the fuse of air-conditioner.	Replacement
2. Wiring cutting or poor connection	Check the earth of fan motor and the missing of key boss.	Repair the cutting section or connect correctly.
3. Failure of fan motor	When checking 2 leads coming from the motor in the circuit tester, the current does not transmit.	Replacement
4. Wire cutting of resister	When checking whether or not the resister transmits the current by circuit tester, the current does not transmit.	Replacement
5. Failure of fan switch	Check the revolution of fan by operating the fan switch in order.	Replacement

2) Fan motor is normal but the capacity of wind is small.

Causes	Checking Methods	Action
1. Obstacles in the inlet of suction of vaporizer	Contamination of vaporizer	Removal of obstacles, cleaning
2. Air leakage	Check the assembly status of cooling unit case.	Modification or adjustment
3. Poor thermo-switch	Check whether the vaporizer is frozen with a circuit tester.	Replacement

3) The extract airflow and revolution of compressor is normal but poor air-conditioning.

Causes	Checking Methods	Action
1. Excess/lack of refrigerant	After 5 ~ 10 min. operation of air-conditioner, touch the high/low pressure pipe by hand. Observe the flow of refrigerant of sight glass and check the amount of refrigerant.	
2. Lack of refrigerant	Rarely the difference of temperature between high pressure side and low pressure side. The flow of bubble is seen in the sight glass or the flow of foggy state is a little seen.	Repair the leaked part and supplement by the proper amount.
3. Over supplement of refrigerant	The pressure of high-pressure side is high and the bubble of sight glass is not seen when we try to cool the compressor with water.	Exhaust the refrigerant little by little till you can see the bubble in the sight glass.

Causes	Checking Methods	Action
4. The pressure of inlet of the compressor	Normal pressure High pressure: 14 ~ 15 kg/cm²G (199 ~ 213 psi) Low pressure: 1.5 ~ 2.0 kg/cm²G (21 ~ 28 psi) Ambient temperature: 30 ~ 35 °C, Engine : about 1,500 rpm	Replacement
4-1. The pressure of low pressure is high.		
1) Poor thermo switch	Magnetic clutch is off before the extract air temperature falls down enough.	Adjustment, Replacement
2) Poor gasket or valve of the compressor	When magnetic clutch is off, the pressure of high/low pressure gauge is balanced promptly.	Replacement/repair of compressor
3) Poor contact of wound box of extension valve	Frost generation in the connection section of compressor and the temperature is colder than the pipe of outlet of vaporizer.	Adhere the wound box to the low pressure pipe.
4) Txtension valve is too much open	DITTO. No change of pressure regardless of attaching or detaching the wound box from the pipe.	Replacement
4-2. The pressure of low pressure is low.		
1) Lack of the amount of refrigerant	Refer to “the lack of the amount of refrigerant”.	Supplement of refrigerant
2) The receiver drier is clogged.	The difference of temperature of tank exit. Frost in the tank.	Replacement of the receiver drier
3) Extension valve is clogged.	The inlet side of extension valve is cold and frosty.	Replacement of extension valve
4) Gas leakage of wound box of extension valve	The outlet side of extension valve is not cold and low pressure gauge is vacuum.	Replacement of extension valve
5) Clogging or distortion of pipe	The clogging of pipe means the low pressure is low or negative pressure.	Cleaning of pipe or replacement
6) Poor thermo. switch	Freezing of vaporizer.	Adjustment/ replacement
4-3. The pressure of high pressure is high.		
1) Poor cooling of the compressor	Contamination/clogging of compressor, poor revolution of cooling fan, cutting of fuse, wire cutting of harness and poor contact.	Cleaning, repair or replacement of fan
2) Overcharging of refrigerant	Refer to “overcharging of refrigerant”.	Adjustment of refrigerant
3) Air mixing in the cycle		Vacuum works, recharging of refrigerant
4-4. The pressure of high pressure is low.		
1) Lack of refrigerant	Refer to “lack of refrigerant”.	Supplement of refrigerant

4) The compressor does not revolve or hard to revolve.

Causes	Checking Methods	Action
1. Loosening of belt	The vibration of belt is large.	Tension adjustment
2. Internal failure of compressor	The belt is sliding.	Repair/replacement
3. Relation of magnetic clutch		
3-1. Drop of battery voltage	Sliding when revolving	Battery charging
3-2. Layer shot of coil	Sliding when revolving	Replacement of magnetic clutch
3-3. Oil invasion to the surface of clutch	Sliding caused by the contamination around the magnetic clutch	Replacement or cleaning the surface of clutch.

C. TROUBLE SHOOTING BY GAUGE PRESSURE

CONNECTION OF MANIFOLD GAUGE

: Exhaust the air by loosening the nut.

1. Connect the manifold gauge to the high/low pressure connection section of the compressor.
2. Exhaust the air in the charging hose from the contacting side of manifold gauge.

* **Condition**

Ambient temperature: 30 ~ 35°C (86 ~ 95°F)

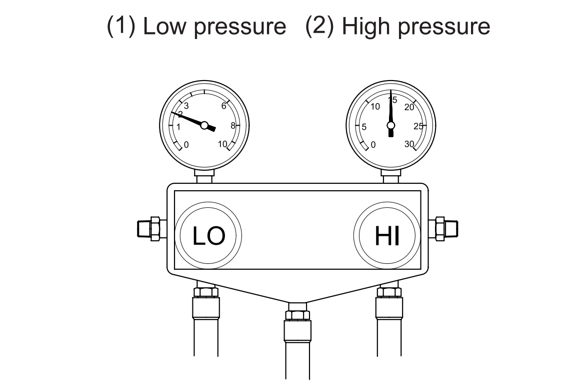
Revolution of engine: 150 rpm

Blower: HI (Maximum revolution)

Thermo. switch: Colder

* **Reference**

Low pressure side	1.5 ~ 2.0 kgf/cm^2	21.3 ~ 28.4 psi
High pressure side	1.5 ~ 2.0 kgf/cm^2	21.3 ~ 28.4 psi



a. Not Cool

1. Lack of refrigerant charging

Status: Not cool

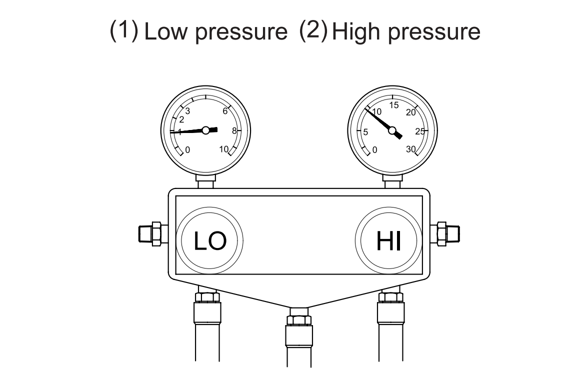
Phenomena:

- The pressure of high /low pressure side is low.
- The bubble in sight glass is seen.
- Discharging temperature does not fall down.

Cause: Refrigerant leakage

Action: Check with gas leakage detector and repair the leaked part and supplement the proper amount.

Low lack of refrigerant charging	1 kgf/cm^2	14.2 psi
High lack of refrigerant charging	8 ~ 9 kgf/cm^2	113.8 ~ 128.0 psi



2. Excess of refrigerant charging

   Status: Not cool

   Phenomena:

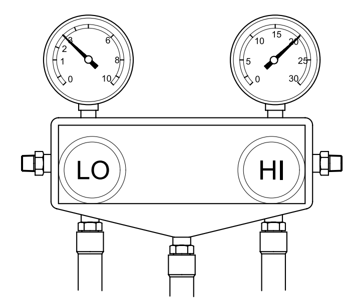
   - Pressure rising by overcharging of refrigerant
   - Lack of cooling of the compressor

   Cause:

   - Pressure rising by overcharging of refrigerant
   - Lack of cooling of the compressor

   Action:

   - Clean the compressor
   - Check and adjust fan belt or compressor motor
   - Check the amount of refrigerant



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CAUTION

- *When exhausting the refrigerant, exhaust it to the low pressure side slowly and check the pressure graduation and sight glass to check the amount of refrigerant.*
- *Pay attention to the contamination of radiator.*

Low excess of refrigerant charging	2.5 ~ 3.5 kgf/cm^2
	35.6 ~ 49.8 psi
High excess of refrigerant charging	20 kgf/cm^2
	284.5 psi

3. Air mixing (lack of vacuum working)

   Status: Not cool

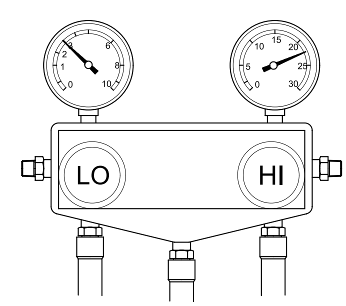
   Phenomena:

   - The pressure of high /low pressure side is high.
   - The pipe of low pressure side is not cold.

   Cause: Air mixing in the refrigerating cycle. In case of no vacuum working, the graduation is shown on the left figure.

   Action: When charging the refrigerant by making a vacuum, check the guide.

   In case of operating for a long time in the state of air mixing, replace the receiver drier.



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Low air mixing in the refrigerating cycle	2.5 ~ 3.5 kgf/cm^2
	35.6 ~ 49.8 psi
High air mixing in the refrigerating cycle	23 ~ 24 kgf/cm^2
	327.1 ~ 341.3 psi

4. Poor extension valve

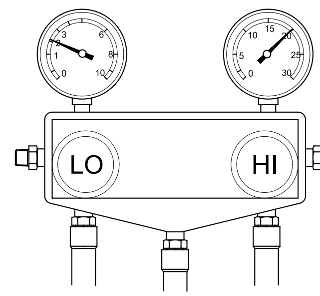
   Status: Not cool

   Phenomena:

   - The pressure of high /low pressure side is high.

   Cause: Poor extension valve, poor control of refrigerant flow rate by poor assembling of the wound box.

   Action: Check the assembly status, location and insulation status of the wound box. With no failure, replace the extension valve.



Low poor extension valve	2.3 kgf/cm^2
	32.7 psi
High poor extension valve	19 ~ 20 kgf/cm^2
	270.2 ~ 284.5 psi

b. Not Cool (some times cool)

1. Poor compression of the compressor

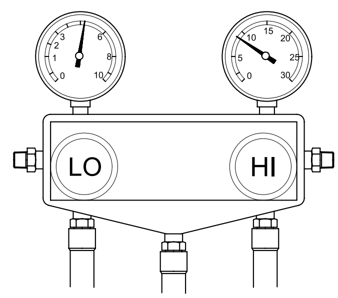
   Status: Not cool

   Phenomena:

   - The pressure of low pressure side is high and the pressure of high pressure side is very low.
   - When stopping the operation, the pressure of high/low pressure shall be the same immediately.

   Cause: Poor gasket of compressor, poor compressor caused by the broken suction valve.

   Action: Disassemble and repair the compressor.



Low poor compression of the compressor	4 ~ 6 kgf/cm^2
	56.9 ~ 85.3 psi
High poor compression of the compressor	7 ~ 10 kgf/cm^2
	99.6 ~ 142.2 psi

2. Moisture mixing

   Status: Sometimes cold, sometimes not cold

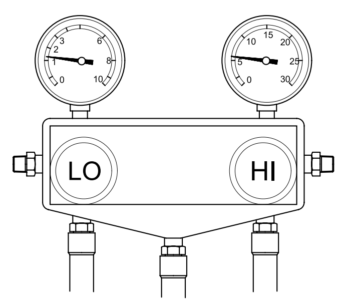
   Phenomena:

   - The pressure of low pressure side is sometimes negative or sometimes returning normal.

   Cause: The moisture inside refrigerating cycle is frozen which makes the cycle closed in the extension valve and return to the normal by melting of ice.

   Action: Replace the receiver drier.

   Repeat the vacuum working 2 ~ 3 times. Charge the proper amount of refrigerant.



Low moisture mixing in the refrigerating cycle	- ~ 1.5 kgf/cm^2
	- ~ 21.3 psi
High moisture mixing in the refrigerating cycle	6 ~ 16 kgf/cm^2
	85.3 ~ 227.6 psi

3. The refrigerant does not circulate.

   Status: not cool (sometimes cool)

   Phenomena:

   - The pressure of low pressure side is negative and the pressure of high pressure side shows the pressure 5 ~ 6 kg/cm^2.
   - Frost or dew forming in the receiver drier or the front/rear pipe connection section of extension valve.

   Cause:

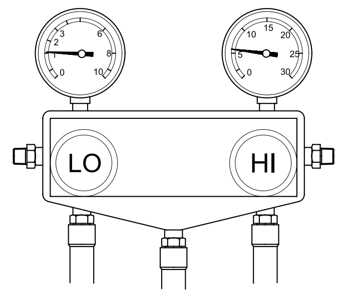
   - The cycle is closed by moisture freezing or dust in the refrigerating cycle.
   - The cycle is blocked due to the poor wound box of extension valve.

   Action: Stop the operation once to check the clogging by moisture or dust. If found the moisture, do the vacuum working.

   - Detach the extension valve and remove the dust by air.
   - Replace the receiver drier.
   - Charge the proper amount of refrigerant.

Low poor circulation of refrigerant	1.0332 kgf/cm^2
	14.696 psi
High poor circulation of refrigerant	5 ~ 6 kgf/cm^2
	71.1 ~ 85.3 psi

(1) Low pressure (2) High pressure



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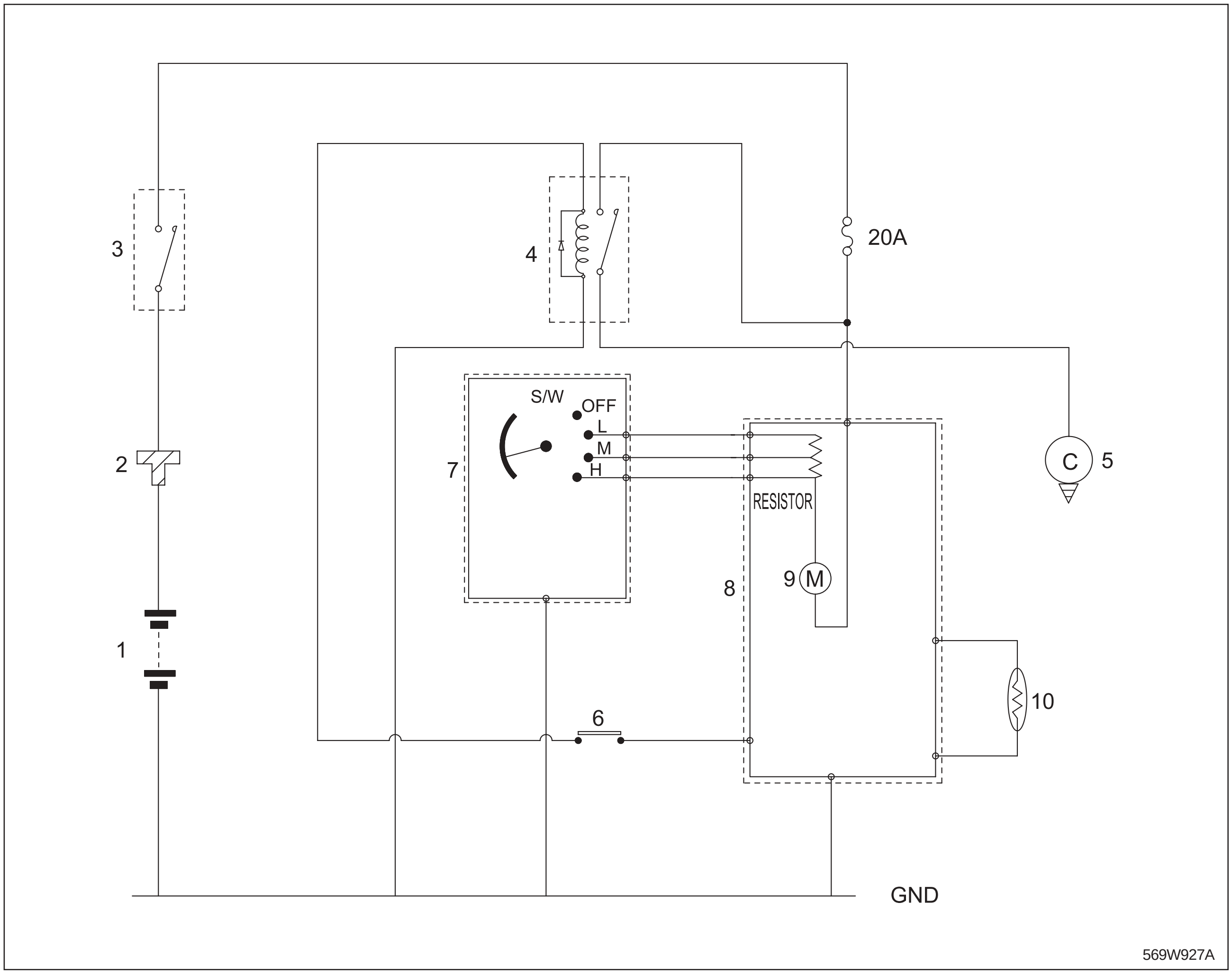
D. ELECTRICAL CIRCUIT

a. Air Conditioner System



(1) Battery
(2) Slow Blow Fuse
(3) Main Switch
(4) Compressor Relay
(5) Compressor
(6) Pressure Switch
(7) A/C Blower Switch
(8) Ass'y Air-Conditional
(9) Blower Motor
(10) Thermostat

The above figure shows the circuit composing the air conditioning system.

The magnetic clutch of the compressor is operated by the following order.

Main Switch (3) ON → A/C Blower Switch (7) ON (Low, Medium, High) → Blower Motor (9) ON → Thermostat (10) ON (if the temperature of thermostat is less than 4 °C (39.2 °F), Pressure Switch (6) OFF to cut the magnetic clutch of the compressor) → Pressure Switch (6) ON → A/C relay (4) ON → Compressor (5) ON (Magnetic Clutch ON in the compressor).