8354/8404 SERVICE MANUAL

MTD Products, LLC Product Training and Education Department

FORM NUMBER 769-00902

CONTENTS

CHAPTER 1

GENERAL INFORMATION

1. TRACTOR VIEW

615W101A

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			7T			9T		
	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 ~ 15.7 N·m	1.2 ~ 1.6 kgf·m	8.6 ~ 11.5 lbf·ft
M10	24.5 ~ 31.4 N·m	2.5 ~ 3.2 kgf·m	18.0 ~ 23.1 lbf·ft
M12	34.3 ~ 49.0 N·m	3.4 ~ 5.0 kgf·m	25.3 ~ 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. SPECIFICATIONS

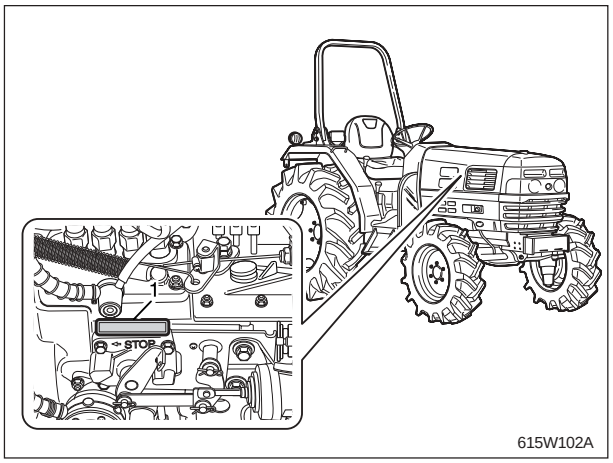
Model			8354	8404
Maximum PTO power			28.3 HP	33.4 HP
Engine GROSS power			33.5 HP	40.4 HP
Engine	Model		3A165D	4A200
	Type		Indirect injection, vertical, water-cooled, 4-cycle diesel	
	Number of cylinders		3	4
	Bore and stroke		87 × 92.4 mm (3.425 × 3.637 in.)	83 × 92.4 mm (3.268 × 3.637 in.)
	Total displacement		1,647	1,999
	Rated revolution		2,700 rpm	
	Injection timing		18° before T.D.C.	
	Injection order		1-2-3	1-3-4-2
	Compression ratio		22 : 1	
	Lubricating system		Forced lubrication by trochoidal pump	
	Cooling system		Pressurized radiator, Forced circulation with water pump	
	Alternator		12 V, 50 AMPS	
	Weight (Dry)		179 kg	205 kg
Capacities	Fuel tank		40 ℓ (10.6 U.S.gal.)	
	Engine crankcase		5.8 ℓ (1.5 U.S.gal.)	7.0 ℓ (1.9 U.S.gal.)
	Engine coolant		7.0 ℓ (1.9 U.S.gal.)	8.9 ℓ (2.4 U.S.gal.)
	Transmission case		44 ℓ (11.6 U.S.gal.)	←
	Front axle case		7.5 ℓ (2.0 U.S.gal.)	←
Dimensions (with std. Tires)	Overall length (without 3p)		3,357 mm (132.2 in.)	3,365 mm (132.5 in.)
	Overall length (with 3p)		3,468 mm (136.5 in.)	3,550 mm (139.8 in.)
	Overall width (minimum tread)		1,440 mm (56.7 in.)	1,505 mm (59.3 in.)
	Overall height (Top of ROPS)		2,445 mm (96.5 in.)	2,465 mm (97.0 in.)
	Overall height (Top of steering wheel)		1,530 mm (60.2 9n.)	1,545 mm (60.8 in.)
	Wheelbase		1,668 mm (65.7 in.)	1,780 mm (70 in.)
	Ground clearance		239 mm (9.4 in.)	257 mm (10.1 in.)
	Tread	Front	1,235mm (48.4 in.)	1,235 mm (48.4 in.)
		Rear	1,166 mm (45.9 in.)	1,158 mm (45.6 in.)
			1,077 ~ 1,387 mm (42.4 ~ 54.6 in.)	1,158 ~ 1,467 mm (45.6 ~ 57.8 in.)
Traveling system	Tire size (Std. tires)	Front	7-16	8-16
		Rear	12.4-24	13.6-24
	Clutch		Dry single stage	
	Steering		Hydrostatic steering system	

Model			8354	8404
Traveling system	Transmission		Synchronized shuttle and transmission 8 forward and 8 reverse speeds (CR: 16 forward and 16 reverse speeds)	
	Brake	Traveling	Wet disc type	
		Parking	Connected with the traveling brake	
	Differential		Bevel gear	
Hydraulic system	Hydraulic lift control system		Position, Draft and Mixed control	
	Pump capacity	Main pump	29.7 ℓ /min (7.8 U.S.gal.)	
		Power steering pump	17.8 ℓ /min (4.7 U.S.gal.)	
	Three point hitch		SAE Category I	
	Maximum lifting capacity (the end of lower ling)		1,650 kg (3,638 lb)	1,550 kg (3,417 lb)
PTO	No. of Remote control valve ports(Option)		2 or 4	2 or 4
	PTO shaft		SAE 1-3/8, 6 splines	
	Revolution (independent PTO)	MID PTO	2,000 (2,542 rpm)	2,000 (2,542 rpm)
		Rear PTO	540 (2,451 rpm)	540 (2,451 rpm)
Min. turning radius (without brake)			3,100 mm (112.7 in.)	3,125 mm (123 in.)
Traction system			Swing Draw-Bar	
Weight (with ROPS)			1,515 kg	1,665 kg
Traveling speed (at 2700 engine speed with Std. tires)	Forward (creeper)		1.6 (0.21) ~ 23.2 km/h 0.99 (0.13) ~ 14.41 mph	1.7 (0.21) ~ 23.4 km/h 1.06 (0.13) ~ 14.54 mph
	Reverse (creeper)		1.55 (0.20) ~ 21.4 km/h 0.96 (0.12) ~ 13.30 mph	1.56 (0.20) ~ 21.6 km/h 0.97 (0.12) ~ 13.42 mph

4. IDENTIFICATION

4.1 ENGINE NUMBER

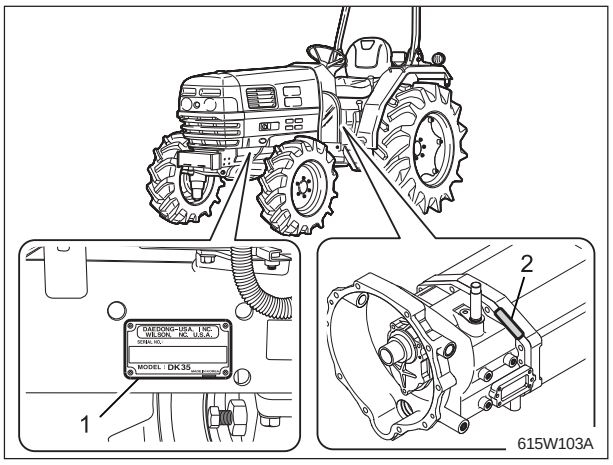
The engine serial number is stamped on the left side of the cylinder block as shown in the figure. Engine serial number provides important information.



(1) Engine Serial Number

4.2 CHASSIS NUMBER OF THE TRACTOR (CHASSIS NUMBER OF THE MACHINE)

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



(1) Manufacture Plate

(2) Transmission Serial Number

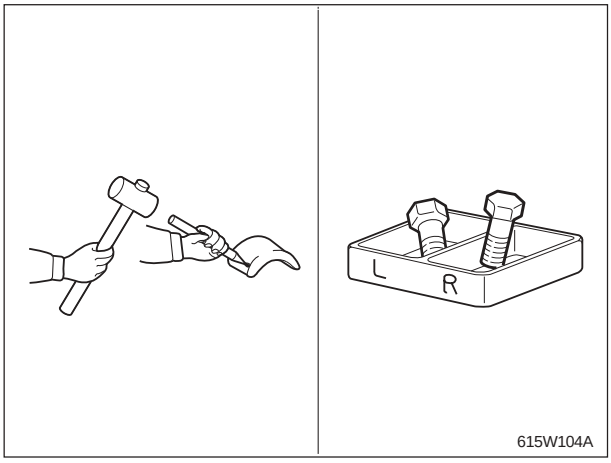
5. CAUTION BEFORE REPAIR

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.

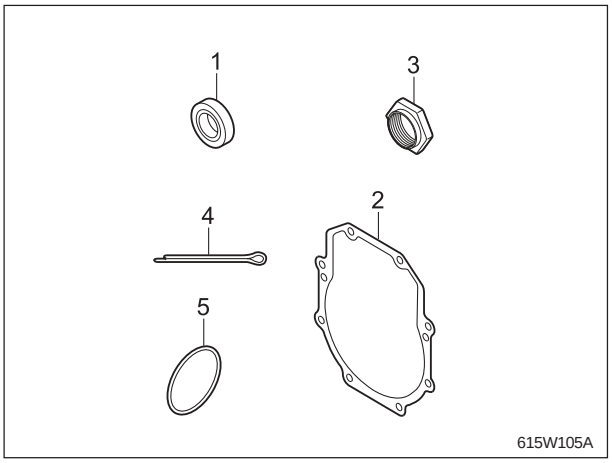
5.2 ASSEMBLY AND DISASSEMBLY

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.



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.

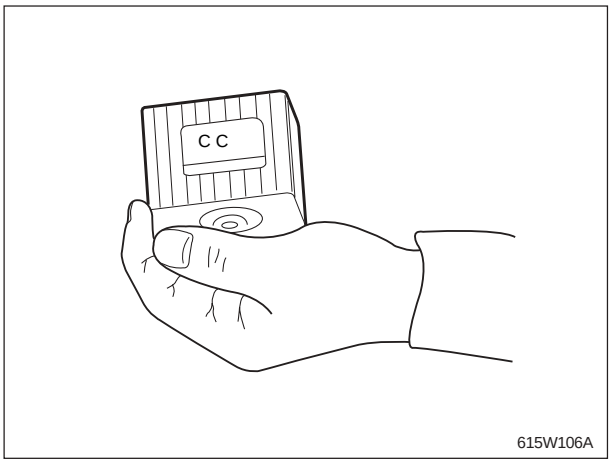
5.3 PARTS TO BE REPLACED



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



When replacing parts, use 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.

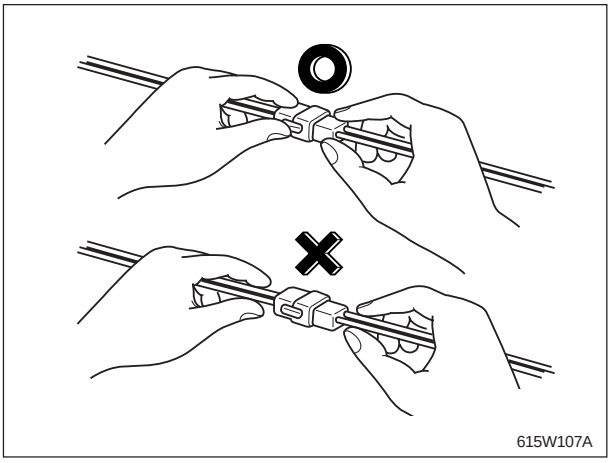
5.6 ELECTRICAL SYSTEM

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.

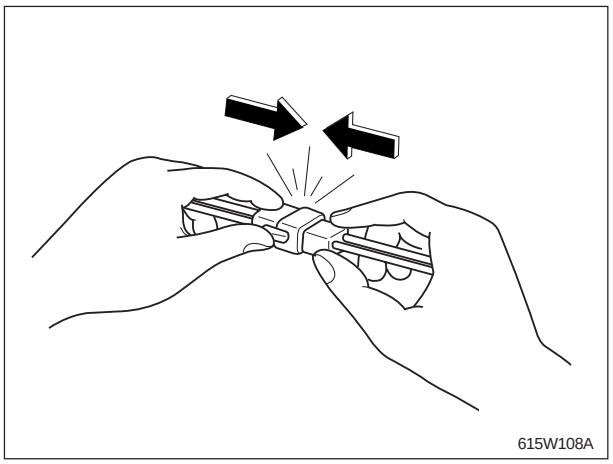
Disconnect battery negative terminal

CAUTION

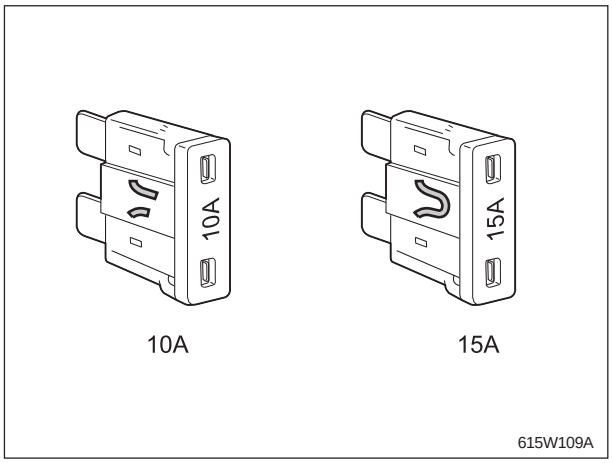
- *Be sure to turn the starting key OFF when connecting or disconnecting the cable.*



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

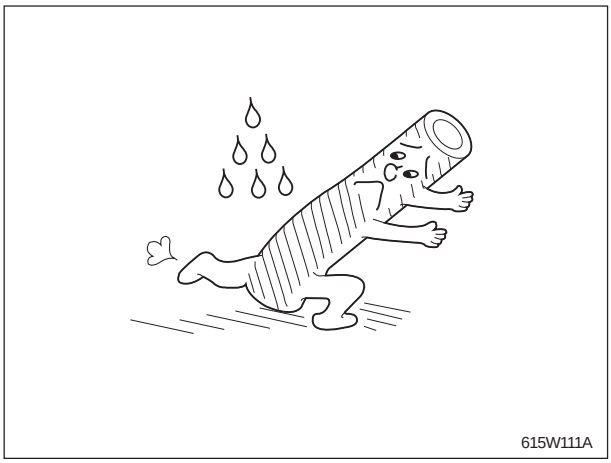


5. When connecting the connector, insert it until it snaps.



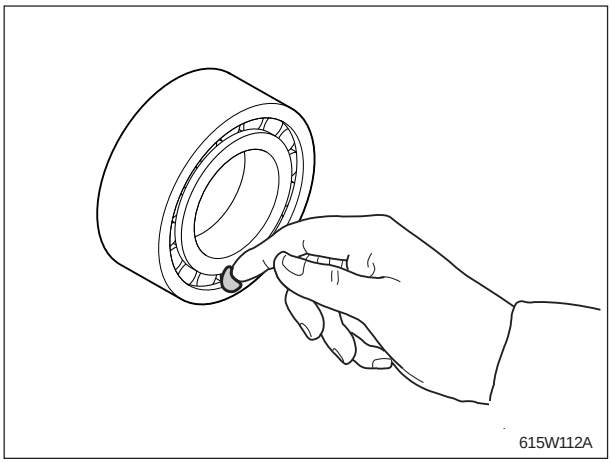
6. Be sure not to drop sensors and relays which are fragile.
7. When replacing a broken fuse with a new one, be sure to use the fuse of capacity as specified.

5.7 TUBES AND RUBBERS



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

5.8 LUBRICANT



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

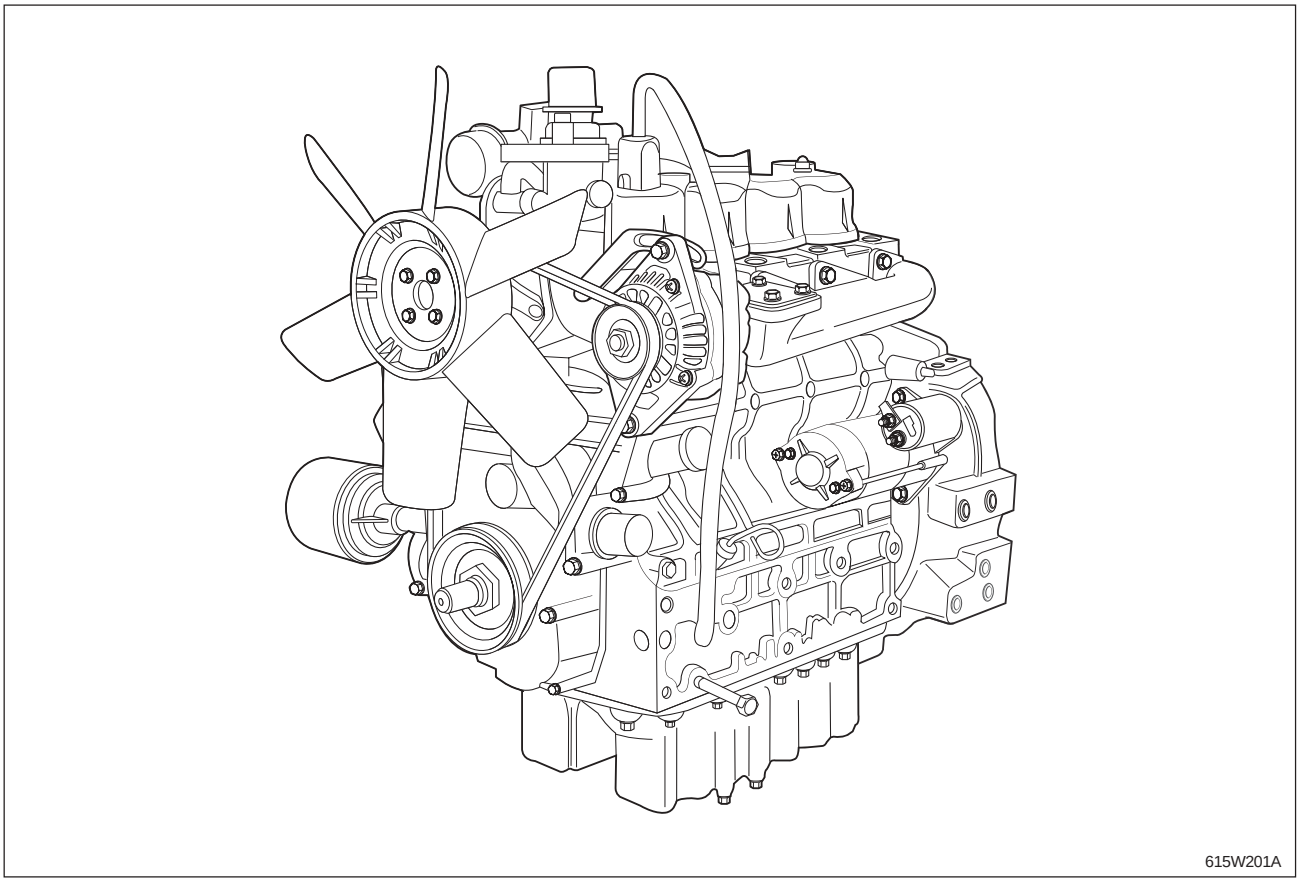
Supply Items		Capacity	Recommended Spec.
Fuel		40 ℓ (42.3 U.S.gal.)	No. 2 - D diesel fuel No. 1 - D diesel fuel if temperature is below - 10 °C (14 °F)
Coolant	3A165D	7.0 ℓ (1.85 U.S.gal.)	Fresh clean water with antifreeze
	4A200B	8.9 ℓ (2.35 U.S.gal.)	
Engine Oil	3A165D	5.5 ℓ (1.45 U.S.gal.)	SAE 15 W - 40
	4A200B	7.0 ℓ (1.85 U.S.gal.)	
Transmission Oil		44 ℓ (11.6 U.S.gal.)	Universal tractor/transmission
Front Axle Section		7.8 ℓ (2.0 U.S.gal.)	hydraulic oil
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 SYSTEM

1. GENERAL

1.1 APPEARANCE



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

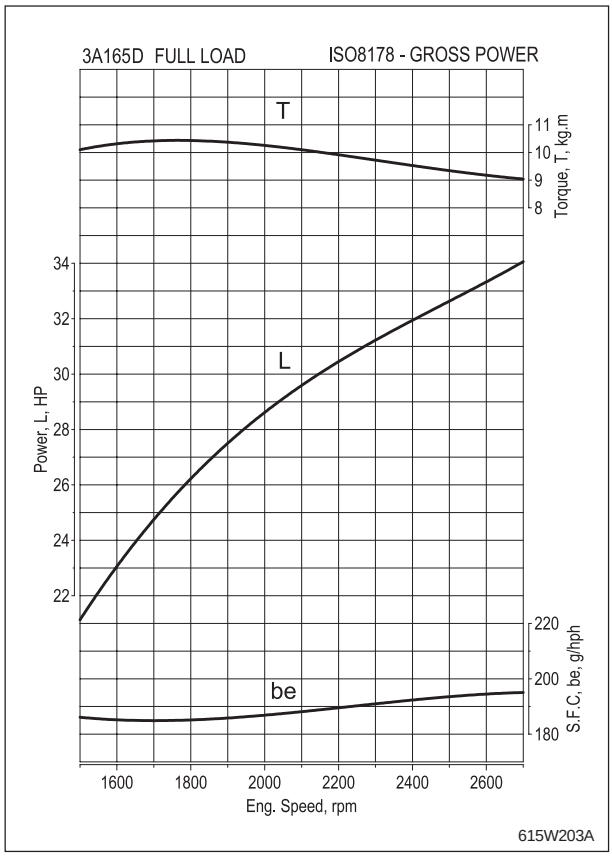
With swirl combustion chamber, bosch K type fuel injection pump, well-balanced designs, they feature greater power, low fuel consumption, less vibration and noise, and low emission.

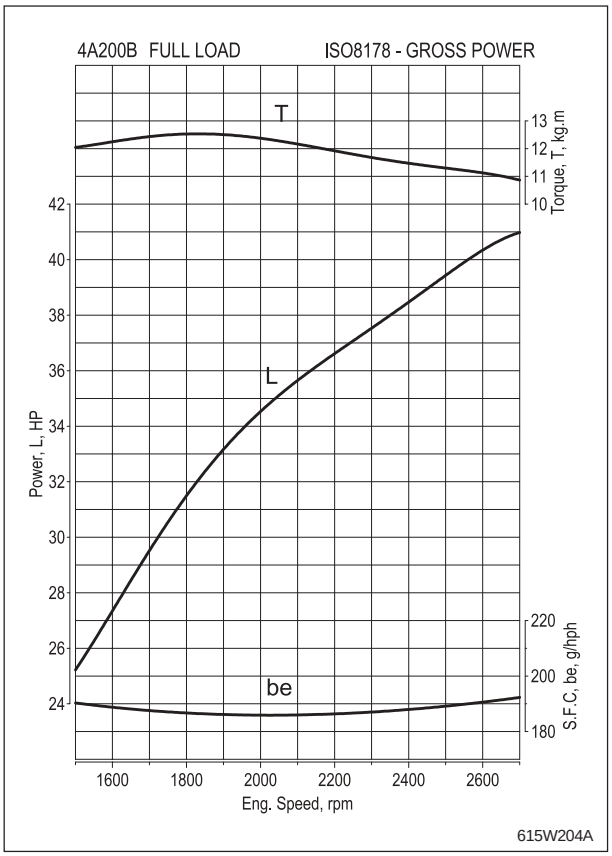
1.2 SPECIFICATIONS

Model	3A165D	4A200B
Type	Vertical, water-cooled, 4-cycle diesel engine	Vertical, water-cooled, 4-cycle diesel engine
Number of cylinder	3	4
Bore and stroke	87 x 92.4 mm 3.43 x 3.64 in.	83 x 92.4 mm 3.27 x 3.64 in.
Total Displacement	1,647 cc 100.5 in^3	1,999 cc 122.0 in^3
Combustion Chamber	Spherical type	Spherical type
Gross power	33.5/2,700 HP/rpm 30.0/2,700 kW/rpm	40.4/2,700 HP/rpm 36.2/2,700 kW/rpm
Maximum idling speed	2,900 rpm	2,900 rpm
Minimum idling speed	850 ~ 900 rpm	850 ~ 900 rpm
Order of firing	1 - 2 - 3	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 1,991 ~ 2,133 psi	140 ~ 150 kgf/cm^2 13.73 ~ 14.71 MPa 1,991 ~ 2,134 psi
Injection timing (Before T.D.C)	18 °	18 °
Compression Ratio	22 : 1	22 : 1
Fuel	Diesel fuel	Diesel fuel
Lubricant	Engine oil SAE 15W-40	Engine oil SAE 15W-40
Dimensions (length x width x height)	722.3 x 488.1 x 729.9 mm 28.4 x 19.2 x 28.7 in.	817.3 x 488.1 x 735.8 mm 32.2 x 19.2 x 29.0 in.
Dry weight	179 kg 395 lbs.	183 kg 403 lbs.

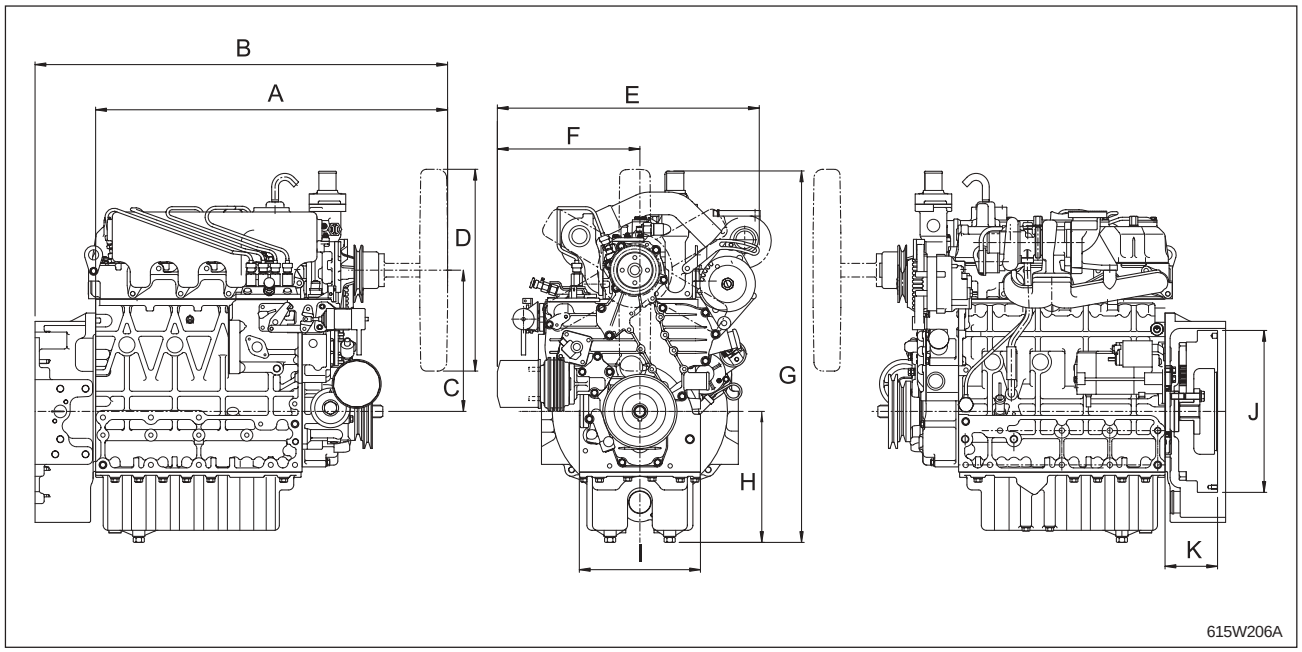
*** NOTE:** Change of parts are not subject to advance notice.

1.3 PERFORMANCE CURVE





1.4 DIMENSIONS



	A	B	C	D	E	F	G	H	I	J	K
3A165D (mm)	602.3	722.3	280.0	400.0	488.1	251.6	729.9	259.7	240.0	315.0	95.0
(in.)	23.71	28.44	11.02	15.75	19.22	9.91	28.74	10.00	9.45	12.40	3.74
4A200B (mm)	697.3	817.3	280.0	400.0	488.1	251.6	735.8	259.7	240.0	321.0	92.0
(in.)	27.45	32.18	11.02	15.75	19.22	9.91	28.97	10.22	9.45	12.64	3.62

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 servicing electrical parts or connecting instruments to electrical equipment, first disconnect the battery negative terminal.
- Replace gaskets or O-rings with new ones when reassembling, and apply grease on a O-ring and the oil seal when reassembling.
- When exchanging parts, use Cub Cadet 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 reinstalling 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.

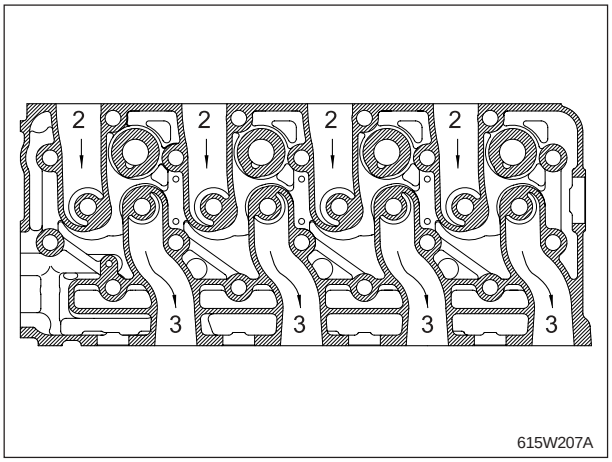
2. STRUCTURE AND FUNCTION

2.1 BODY

A. CYLINDER HEAD

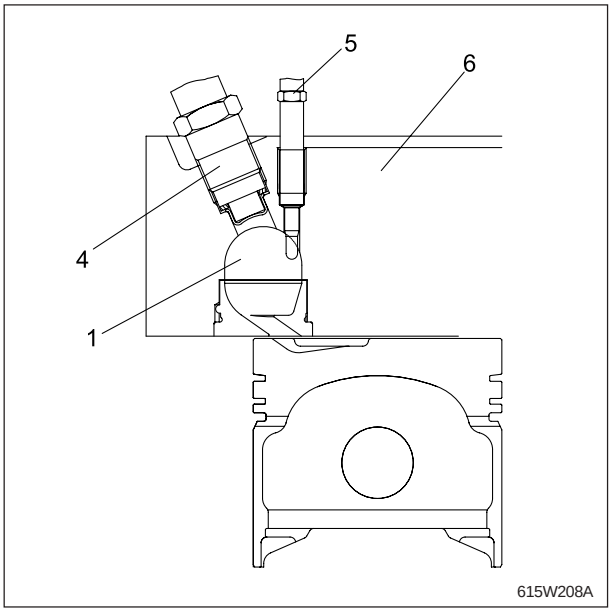
The cylinder head is made of special alloy cast iron which can resist high temperature and pressure caused by combustion. The inlet and exhaust ports are arranged cross-flow type to get high combustion efficiency by protecting the suction air from being heated and expanded by heated exhaust air.

The DAEDONG vortex type combustion chamber is designed for high combustion efficiency and reducing fuel consumption. The glow plug assures easier than ever engine starts even at -15 °C (5 °F).



615W207A

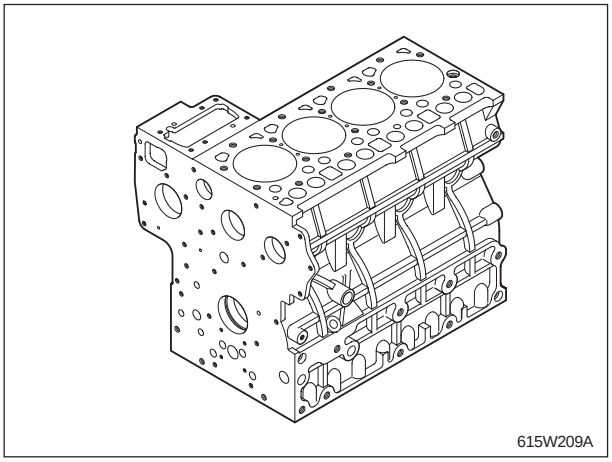
(1) Combustion Chamber
(2) Inlet Port
(3) Exhaust Port
(4) Injection Nozzle
(5) Glow Plug
(6) Cylinder Head



615W208A

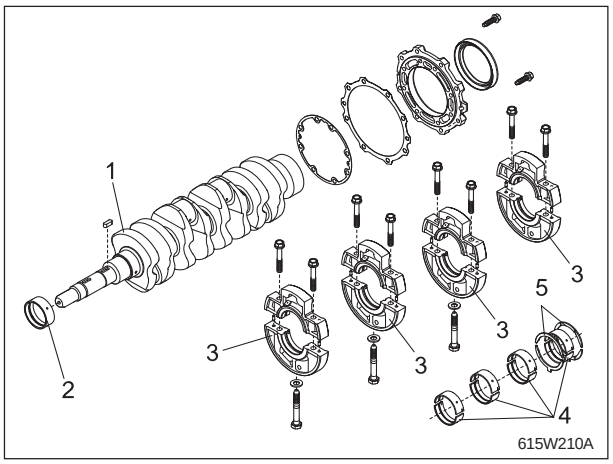
B. CYLINDER BLOCK

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 has its chamber.


615W209A

C. CRANKSHAFT

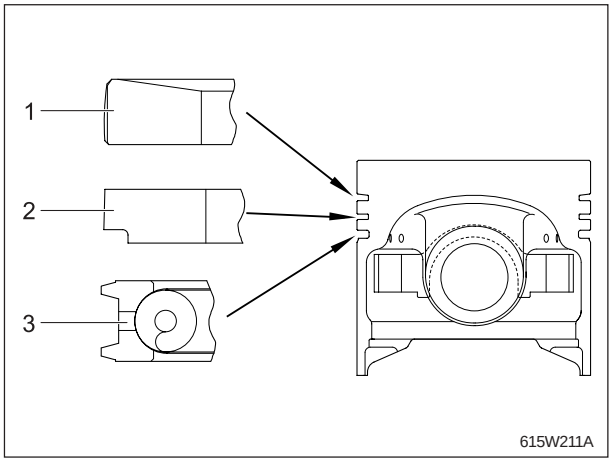
The crankshaft is made of forged steel and the journals, the crankpins and the bearing surface for the oil seal are induction-hardened to increase wear resistance. Each crankshaft journal is supported by the main bearing case (3) having a bearing inside. The front bearing-crankshaft bearing (2) is a solid type bushing and rear and intermediate bearings are a split type. The crankshaft, crankshaft bearings have oil holes for lubricant flow.



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

D. PISTON AND PISTON RINGS

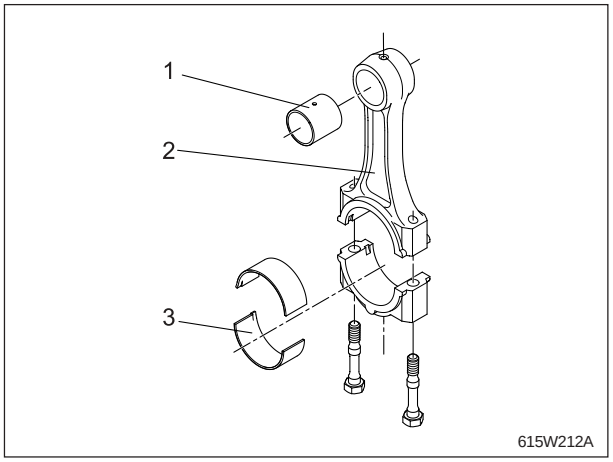
The piston is made of an aluminum alloy which is temperature and pressure resistant. Three rings are installed in the grooves of the piston. The top ring (1) is a keystone type, which can withstand heavy loads, and the barrel face on the ring fits well to the cylinder wall. The second ring (2) is an 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 made of a special steel).



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

E. CONNECTING ROD

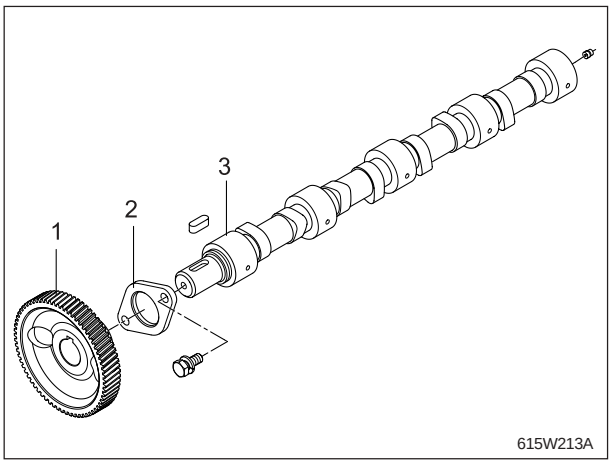
The connecting rod (2), which converts the reciprocating motion of the pistons caused by the fuel combustion into the rotating motion of the crankshaft, is made of hard forged steel. The connecting rod has bearings at both ends. The small end has a solid type bearing (small end bushing (2)) and the big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



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

F. CAMSHAFT

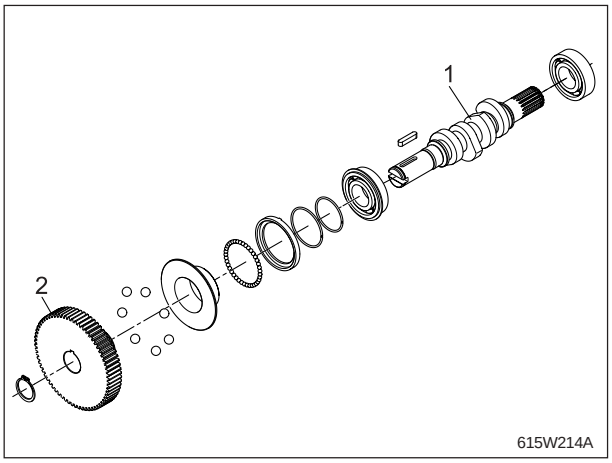
The camshaft (3) is made of forged steel and its journal and cams are hardened to increase wear resistance. The cams on the camshaft open and close the inlet and exhaust valves with the push rods and rocker arms. The journals and their bearings are force-lubricated.



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

G. FUEL CAMSHAFT

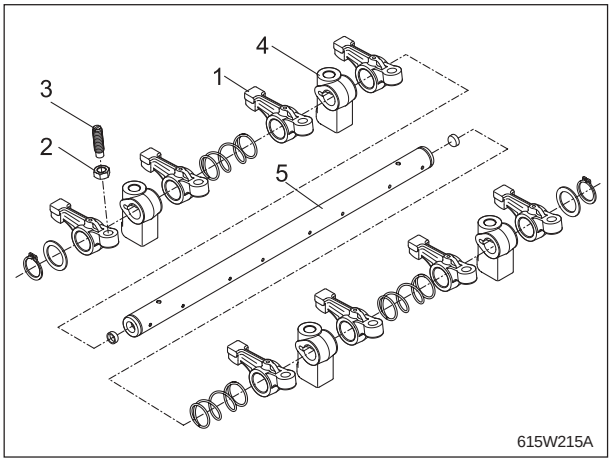
This fuel camshaft is made of forged steel and its cams are hardened and tempered to increase wear resistance. The cams on the fuel camshaft (1) drive the injection pump and the fuel transfer pump. The governor balls are installed on the fuel camshaft to control the engine speed.



(1) Fuel Camshaft
(2) Injection Pump Gear

H. ROCKER ARM ASSEMBLY

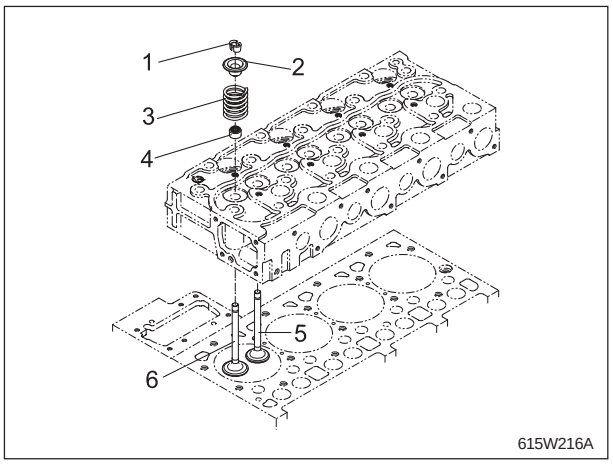
The rocker arm assembly includes the rocker arms (1) and an adjusting screw (3), which is at the end of rocker arm and rests on the push rod, rocker arm brackets (4) and rocker arm shaft (5). The rocker arms are activated by the reciprocating motion of the push rods and open or close the inlet and exhaust 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. INLET AND EXHAUST VALVES

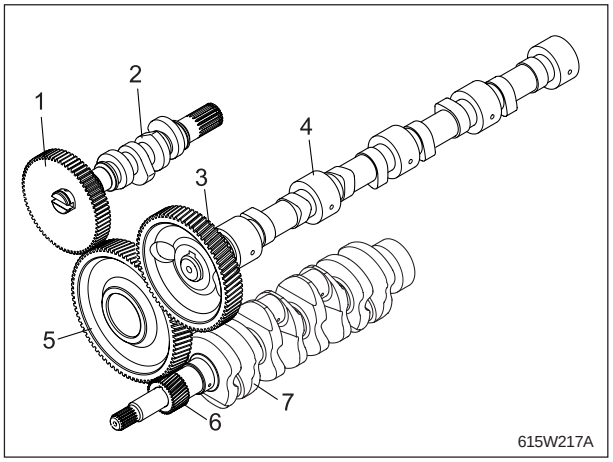
The valve and its guide of the inlet are different from those for the exhaust. Other parts, such as the spring, spring retainers, valve spring collets, valve stem seals are the same for both the inlet and the exhaust. All contact or sliding surfaces are hardened to increase wear resistance.



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

J. TIMING GEARS

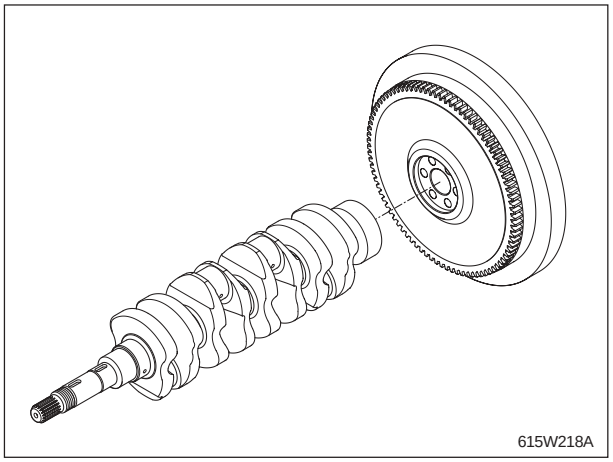
The crankshaft drives the oil pump and the idle gear engaged fuel camshaft and camshaft. The timings for opening and closing the valves is extremely important to achieve effective air inlet and sufficient gas exhaust. The appropriate timing can be obtained by aligning the mark on the crankshaft gear (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 flywheel 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 mesh with the drive pinion of the starter. The flywheel has also 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.

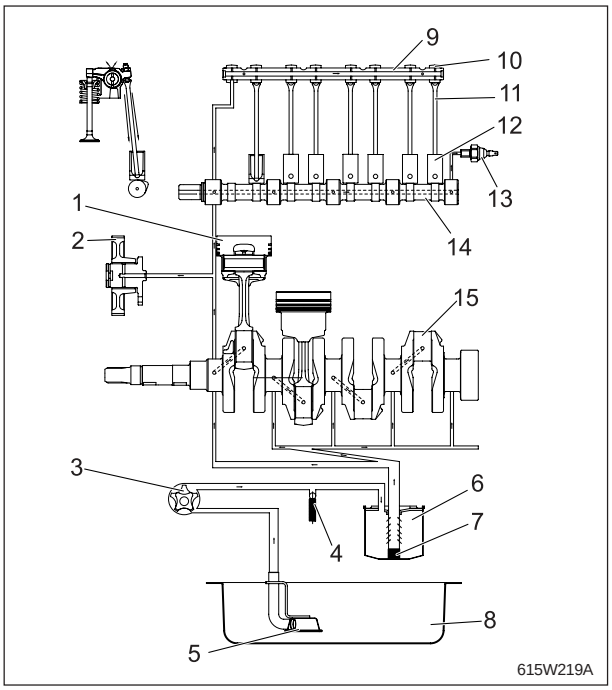


(1) Ring Gear
(2) Flywheel
(3) Crankshaft

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), camshaft (14), and crankshaft (15).



(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

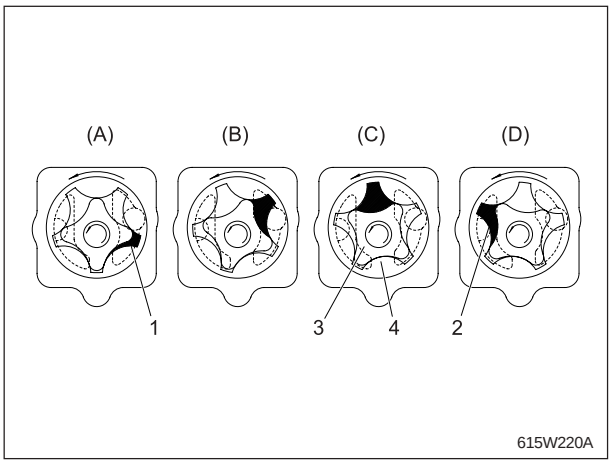
B. OIL PUMP

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 with 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.

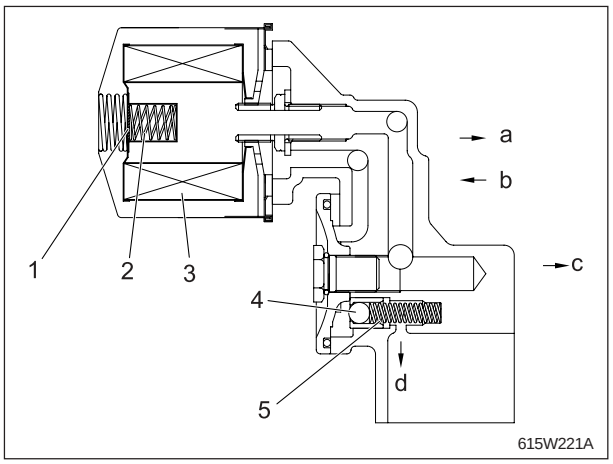
At (D), the space decreases and oil is discharged through the outlet port.



(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/cm², 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/cm², 64 psi).

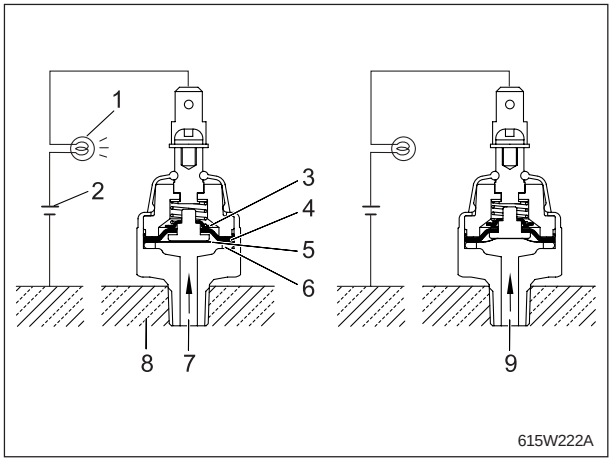


(1) Bypass Valve
(2) Bypass Adjusting Spring
(3) Filter Element
(4) Relief Valve Ball
(5) Relief Adjusting Spring

(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).



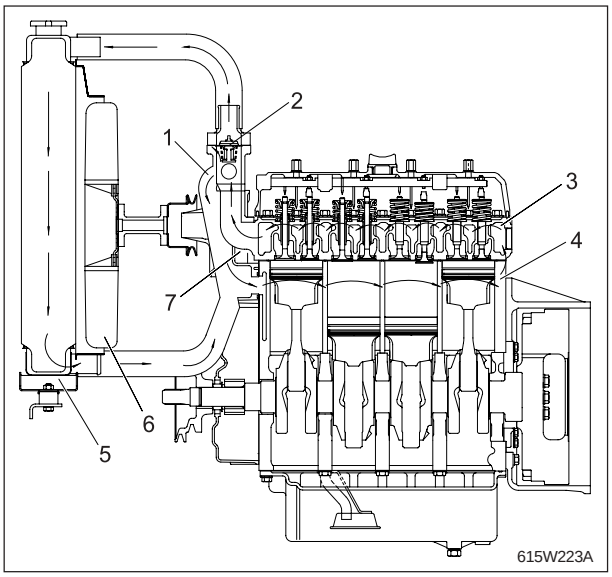
(A) At Lower Oil Pressure
(49 kPa (0.5 kgf/cm², 7 psi) or less)
(B) At Proper Oil Pressure

(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

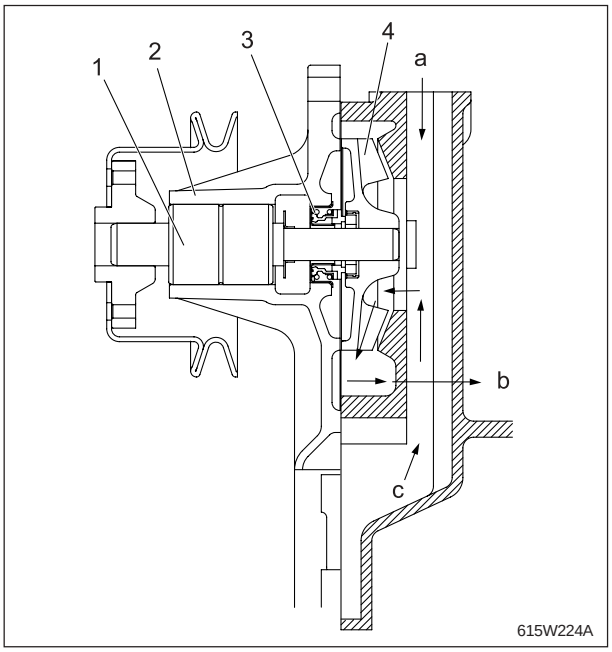
The cooling system consists of a radiator (5), a centrifugal water pump (7), a cooling fan (6) and a thermostat (2). The water is cooled as it flows through the radiator core, and the fan behind the radiator pulls the cooling air through the radiator core. The water pump receives water from the radiator 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. 71 °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.

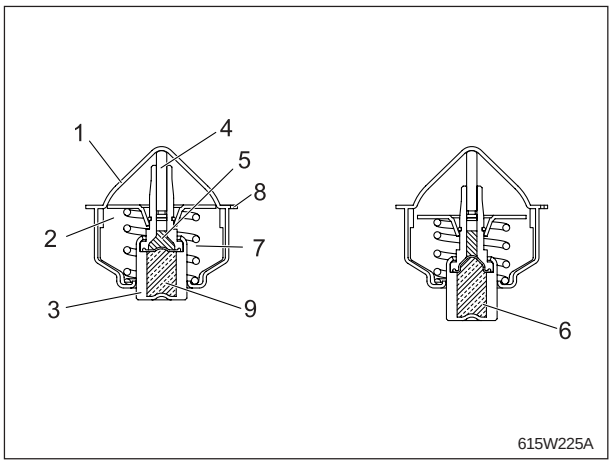
(A) At Low Temperature (Lower than 71 °C (160 °F)).

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.

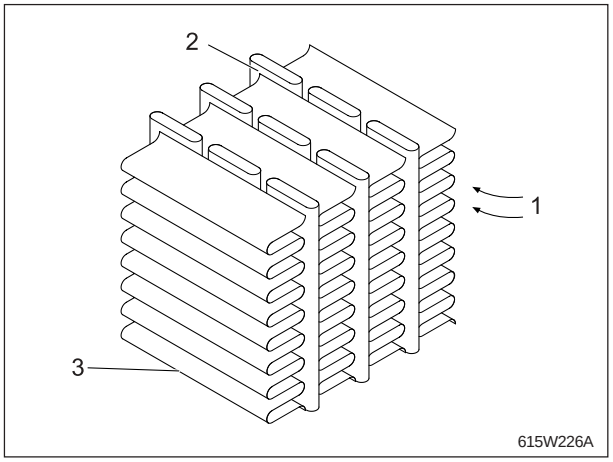
The pellet lowers and the valve (2) opens to send the cooling water to the radiator.



(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 Water
(2) Tube
(3) Fin

E. RADIATOR CAP

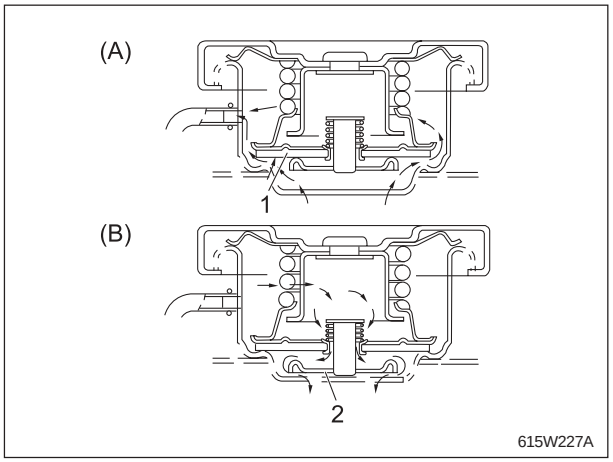
The pressure type cap is installed on the radiator, which prevents the pressure difference between the inside and the outside of the radiator from deforming the radiator.

(A) At High Pressure
(Higher than 88 kPa (0.9 kgf/cm², 13 psi)

When the water temperature rises and the pressure in the radiator increases above the specified pressure, the pressure valve (1) opens to reduce the internal pressure.

(B) At Low Pressure.

When the water temperature falls and a vacuum is formed in the radiator, the vacuum valve (2) opens to allow the water to enter the radiator.

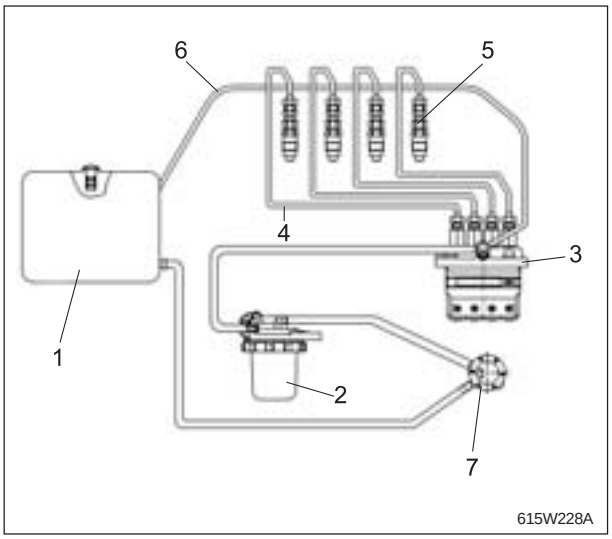


(1) Pressure Valve
(2) Vacuum Valve

2.4 FUEL SYSTEM

A. FLOW OF FUEL

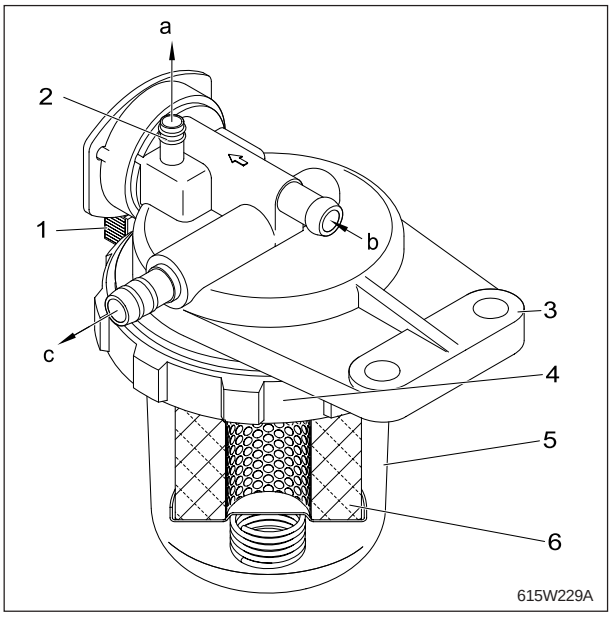
The fuel is fed from the fuel tank (1) through the fuel feed pump (7) to the injection pump (3) by the fuel filter (2). The injection pump force-feds the fuel through the injection nozzles (5), which inject the fuel into the cylinders for combustion. The excessive fuel from the injection pump to the injection nozzles (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/cm², 3 psi). The fuel from the fuel feed pump is filtered by the filter element (6), while flowing through the filter body (3) has an air vent (2) to return the air tin 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

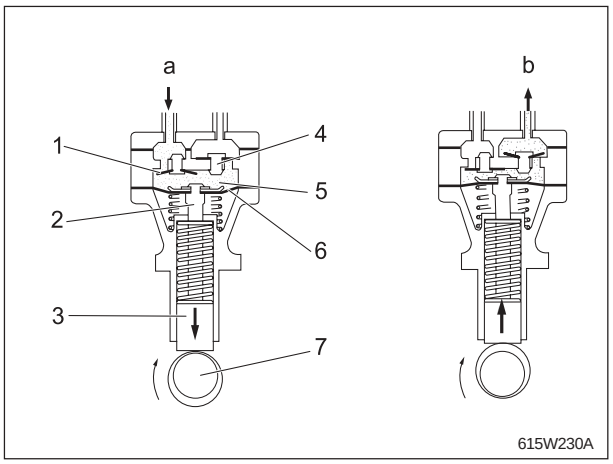
The diaphragm (6) is linked to the tappet (3) with the push rod (2). The tappet is reciprocated by the eccentric cam on the fuel camshaft (7).

(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 to force 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.

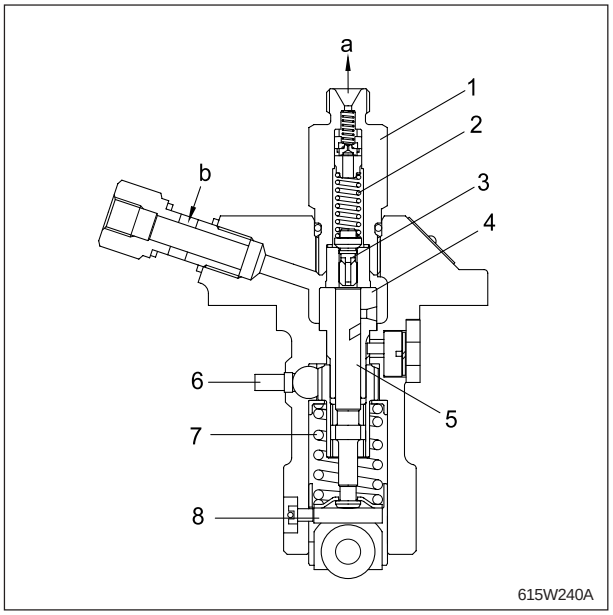


(a) From Fuel Tank
(b) To Fuel Filter

(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.

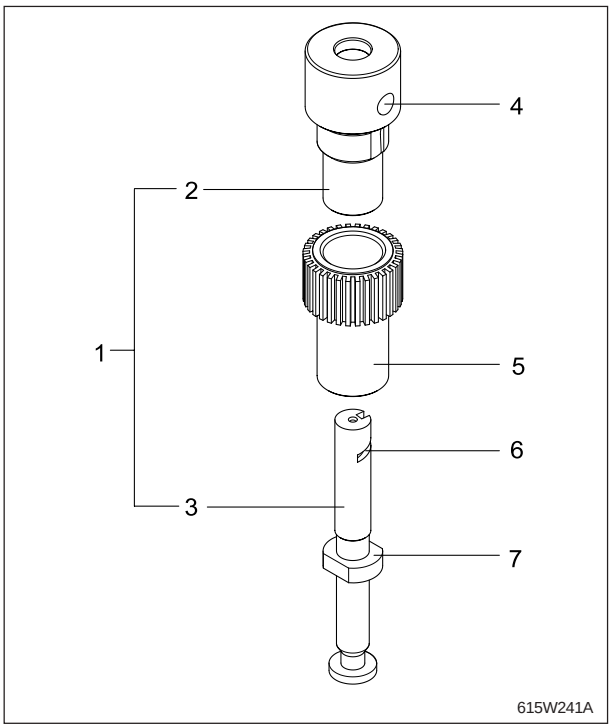


(a) To Injection Nozzle
(b) From Fuel Filter

(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

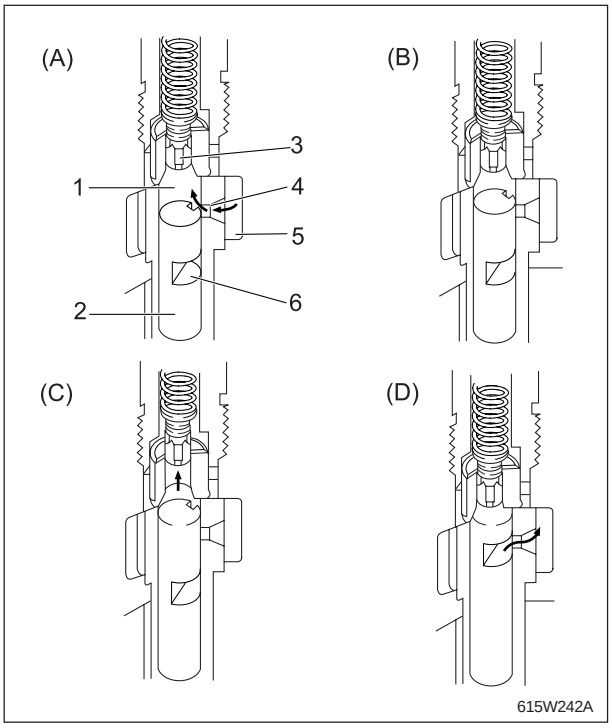
When the plunger is pushed up by the cam and the head of the plunger closes the feed hole (4), the pressure in the delivery chamber (1) rises to push the delivery valve (3) open.

(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

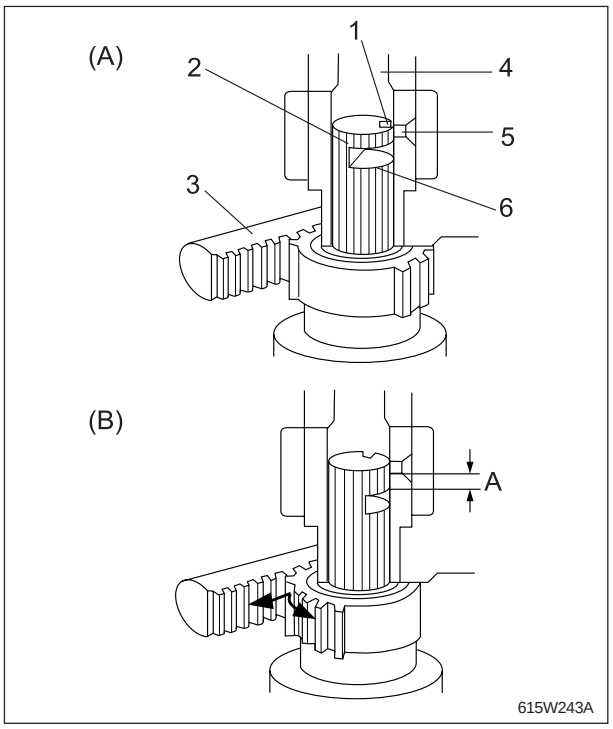
c. Amount of Fuel Delivery

(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

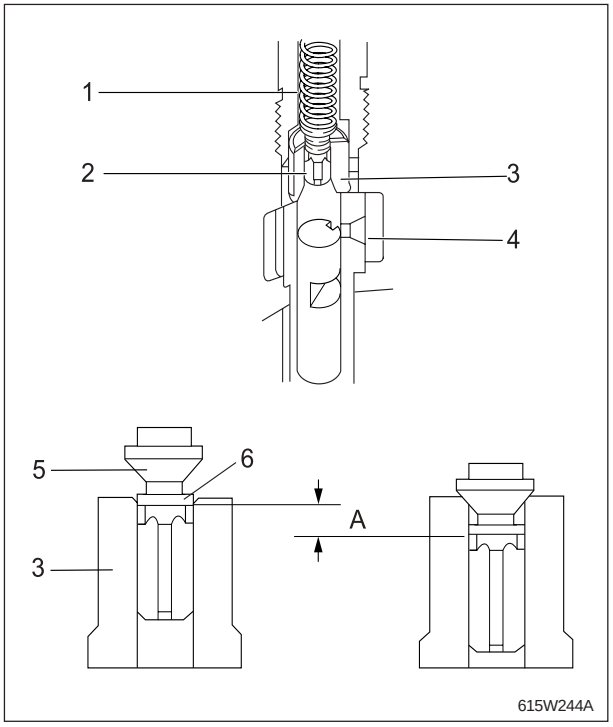
The plunger is rotated by the control rack and the feed hole is not aligned with the lengthwise slot. When the plunger is pushed up, the feed hole is closed by the plunger. The pressure in the delivery chamber builds up and forces the fuel to the injection nozzle until the control groove (6) meets the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

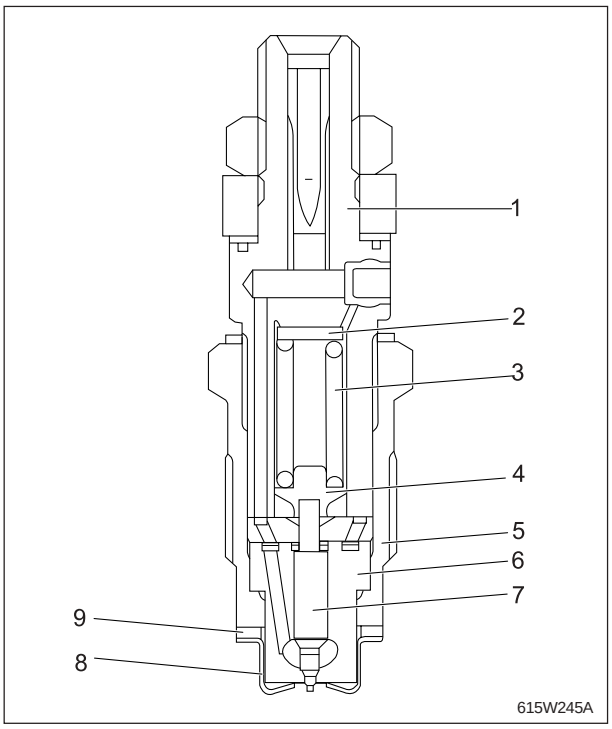
The delivery valve prevents the fuel in the injection pipe from flowing back into the delivery chamber and the fuel in the injection nozzle from dribbling after injection.



(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 one. 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/cm², 1991 to 2134 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 can adjust the opening pressure. A washer of 0.1 mm corresponds to 980 kPa (10 kgf/cm², 142 psi) change in opening pressure. The heat seal is employed to improve the durability and reliability of the nozzle.

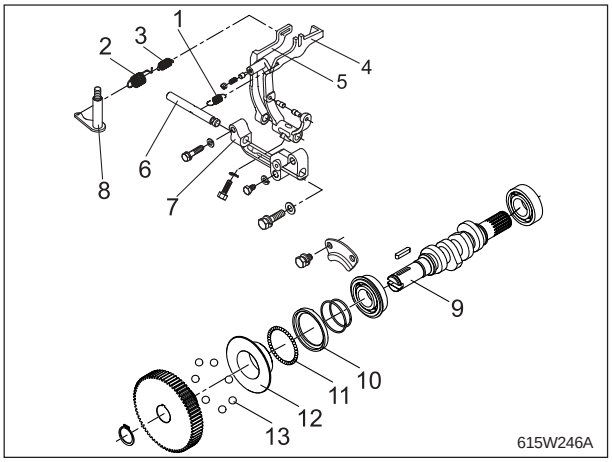


(1) Nozzle Holder Ass'y
(2) Adjusting Washer
(3) Nozzle Spring
(4) Push Rod
(5) Retaining Nut
(6) Nozzle Body
(7) Needle Valve
(8) Heat Seal
(9) Packing

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 controls centrifugal force of the steel ball (13) weight, produced by rotation of the fuel camshaft (9), and tension of the governor spring 1 (2) and 2 (3) are balanced.

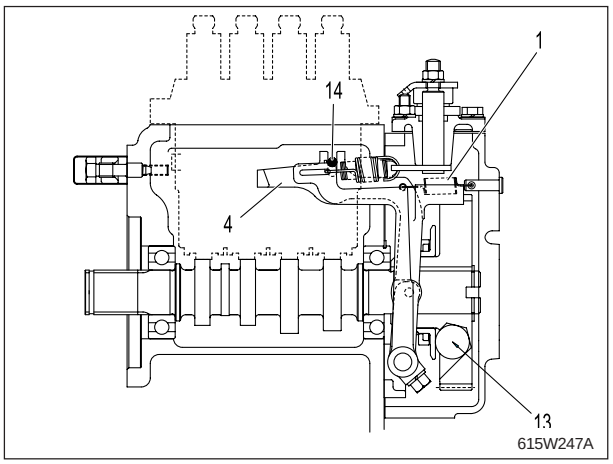


(1) Start Spring
(2) Governor Spring 1
(3) Governor Spring 2
(4) Fork Lever 1
(5) Fork Lever 2
(6) Fork Lever Shaft
(7) Fork Lever Holder
(8) Governor Lever
(9) Fuel Camshaft
(10) Governor Ball Case
(11) Steel Ball
(12) Governor Sleeve
(13) Steel Ball

b. Operation of Governor

1) At start

The steel ball (13) has 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.

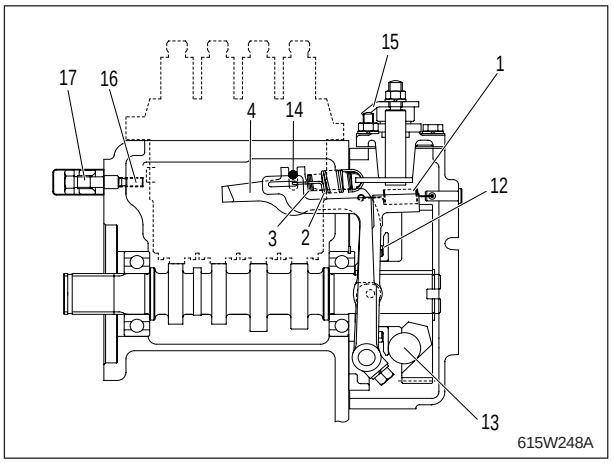


2) At idling

At the idling position of the speed control lever (15), the governor spring 1 (2) is free and the governor spring 2 (3) does only act 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 left 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 is kept at a position here a centrifugal force of steel ball (13) and forces start spring (1), governor spring 2 (3) and idling limit spring are balanced, providing stable idling.

IMPORTANT:

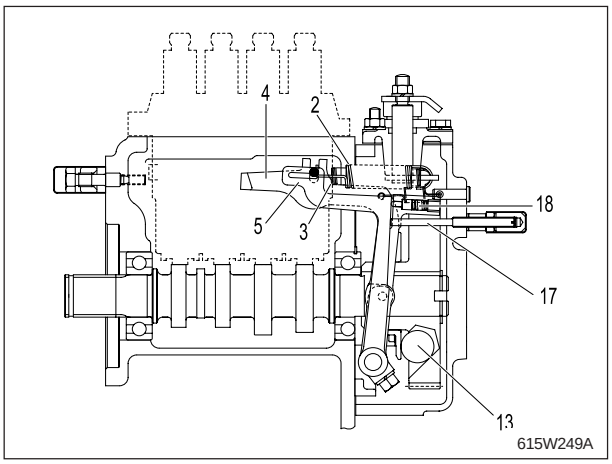
- *The idling speed has been factory-set. The idling adjusting screw (20) and spring (16) should not be disassembled and readjusted.*



(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
(17) Idle Adjusting Screw

3) At high speed running with overload

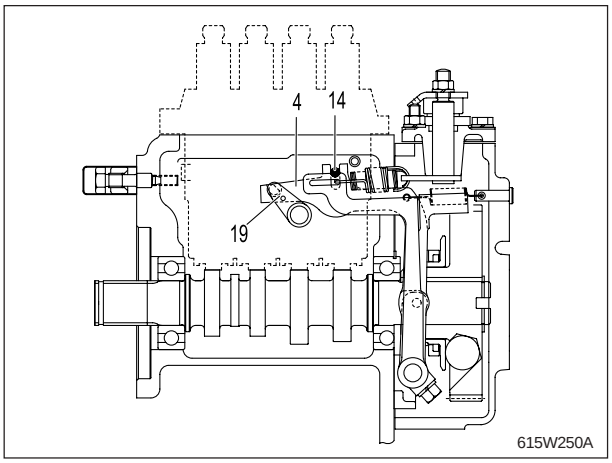
When an overload is applied to the engine running at a high speed, the centrifugal force of steel ball (13) becomes small as the engine speed is dropped, and fork lever 2 (5) is pulled to the right by the governor spring 1 (2) and 2 (3), increasing fuel injection. Though, fork lever 2 becomes ineffective in increasing 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 ball, fork lever 1 (4) moves rightward 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

4) To stop engine

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



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

A. FLOW OF INTAKE AIR AND EXHAUST GAS

(a) Intake Air

(b) Exhaust Gas

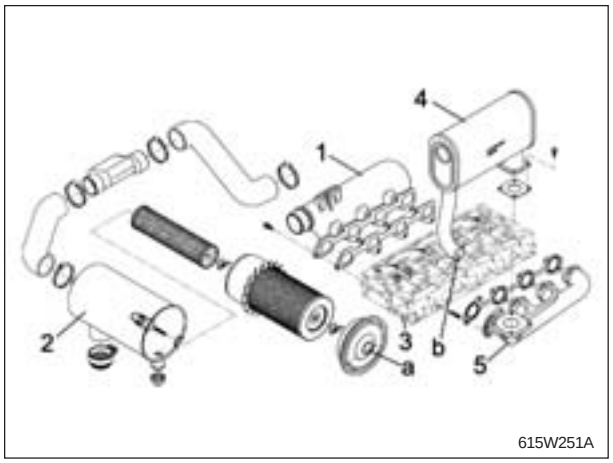
(1) Intake Manifold

(2) Air Cleaner

(3) Cylinder Head

(4) Muffler

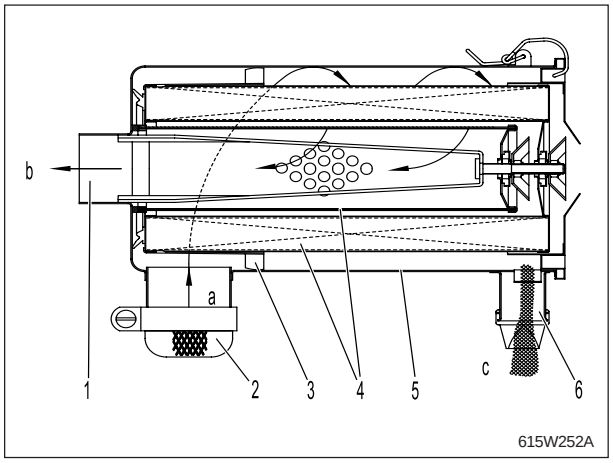
(5) Exhaust Manifold



615W251A

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).



615W252A

(a) Inlet Air

(b) To Intake Manifold

(c) Heavier Dust

(1) Outlet Port

(2) Inlet Port

(3) Fin

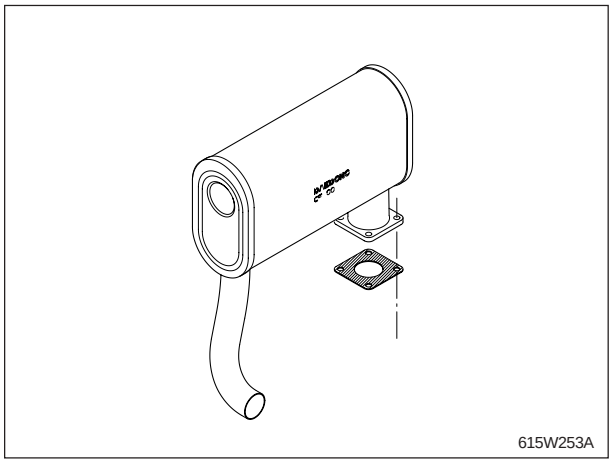
(4) Air Cleaner Element

(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.



615W253A

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	Reduce to the specified level
	• Piston ring and bore worn or piston ring stuck	Repair or replace
	• Incorrect injection timing	Adjust
	• Insufficient compression	Adjust top clearance
Either Black or Dark Gray Exhaust Gas is Observed	• Over heated	Lessen the load
	• Low grade fuel used	Use the specified fuel
	• Fuel filter clogged	Clean or replace
	• Air cleaner clogged	Clean or replace
Insufficient Output	• Incorrect injection timing	Adjust
	• Engine's moving parts seem to be seizing	Repair or replace
	• Uneven fuel injection	Repair or replace the injection pump
	• Insufficient nozzle injection	Repair or replace the nozzle
	• Compression leak	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	Shift ring gap direction
	• Oil ring worn or stuck	Replace
	• Piston ring groove worn	Replace the piston
	• Valve stem and guide worn	Replace
	• Crankshaft bearings, and crank pin bearings worn	Replace
Fuel Mixed into Lubricating Oil	• Injection pump plunger worn	Replace pump element or pump
	• Fuel transfer pump broken	Replace
Water Mixed Into Lubricating oil	• Head gasket defective	Replace
	• Cylinder block or cylinder head cracked	Replace
Low Oil Pressure	• Engine oil insufficient	Replenish
	• Oil strainer closed	Clean
	• Oil filter cartridge clogged	Replace
	• Relief valve stuck with dirt	Clean
	• Relief valve spring weak or broken	Replace
	• Excessive oil clearance of crankshaft bearings	Replace
	• Excessive oil clearance of crank pin bearings	Replace
	• Excessive oil clearance of rocker arm bushings	Replace
	• Oil passage closed	Clean
	• Improper type of oil	Use the specified type of oil
	• Oil pump defective	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
Valve Clearance (Cold)	IN. EX.	0.25 mm 0.0098 in. 0.30 mm 0.0118 in.	
Valve Seat Angle	IN. EX.	1.047 rad. 60° 0.785 rad. 45°	
Valve Face Angle	IN. EX.	1.047 rad. 60° 0.785 rad. 45°	
Valve Recessing		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.	0.10 mm 0.0039 in.
Valve Stem O.D		7.960 ~ 7.975 mm 0.31339 ~ 0.31398 in.	-
Valve Stem I.D		8.015 ~ 8.030 mm 0.31555 ~ 0.31614 in.	-

c. Valve Timing

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

d. Cylinder Bore

Item		Factory Specification	Allowable Limit
Cylinder bore inner diameter	3A165D	87.000 ~ 87.022 mm 3.4252 ~ 3.4261 in.	0.15 mm 0.0059 in.
	4A200B	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.	33.59 mm 1.3224 in.	33.54 mm 1.3205 in.
	EX.	33.69 mm 1.3264 in.	33.64 mm 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 crankshaft 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 crankshaft 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/cm^2, 20 psi
Radiator cap tightness	10 seconds or more for pressure falling from 88 ~ 59 kPa from 0.9 ~ 0.6 kgf/cm^2 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)	18°

b. Injection Nozzle

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

NOTE:

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

E. TIGHTENING TORQUES

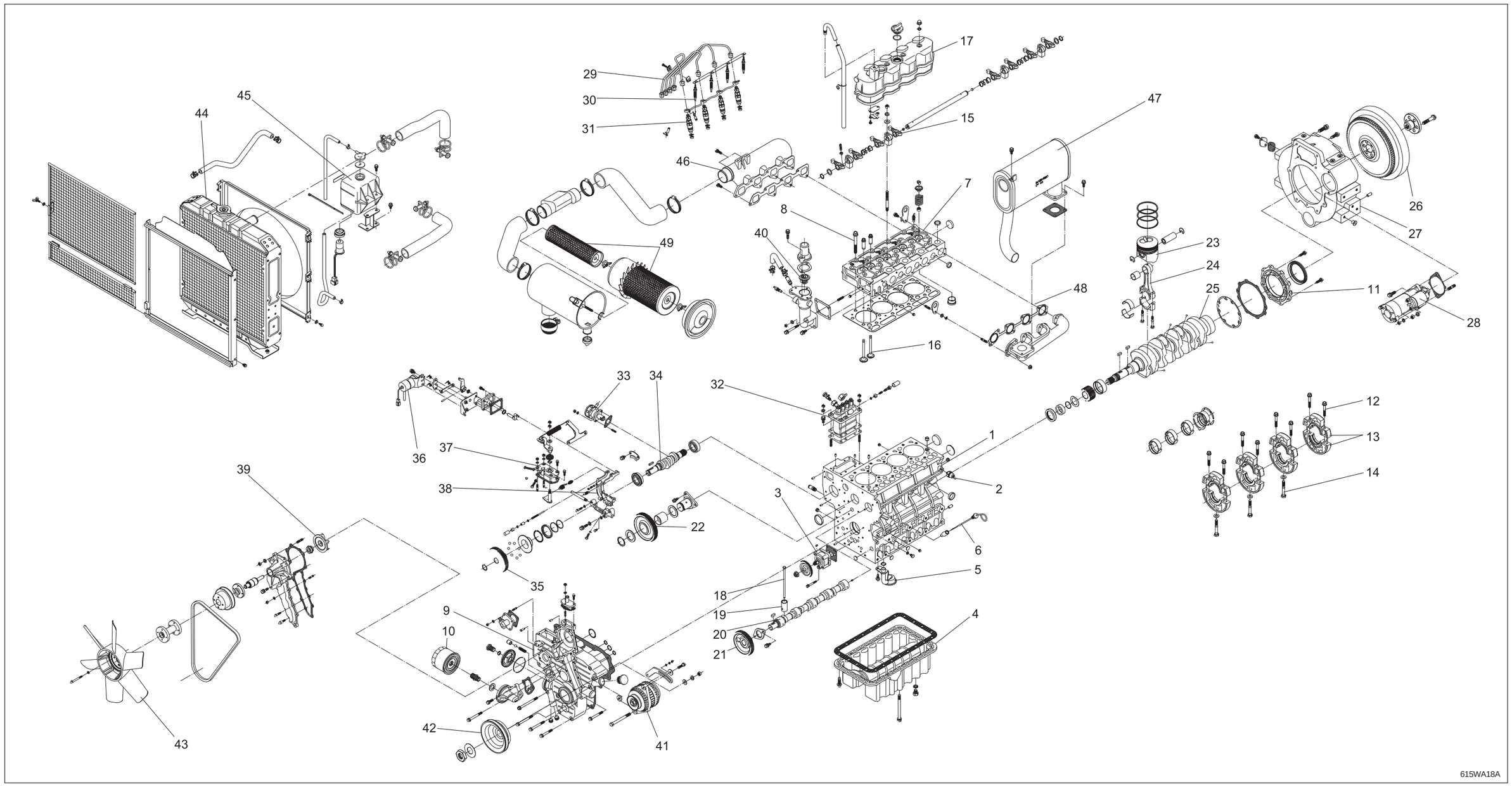
Item	Size x Pitch	N•m	kgf•m	lbf·ft
Cylinder head screws	M11 x 1.25	103.0 ~ 107.9	10.5 ~ 11.0	75.9 ~ 79.6
Head cover nuts	M10 x 1.25	8.8 ~ 10.8	0.9 ~ 1.1	6.5 ~ 8.0
* Bearing case screw 1	M9 x 1.25	46.1 ~ 51.0	4.7 ~ 5.2	34.0 ~ 37.6
* Bearing case screw 2	M10 x 1.25	68.6 ~ 73.6	7.0 ~ 7.5	50.6 ~ 54.2
* Flywheel 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

B. EXTERNAL COMPONENTS

a. Checking and Adjusting

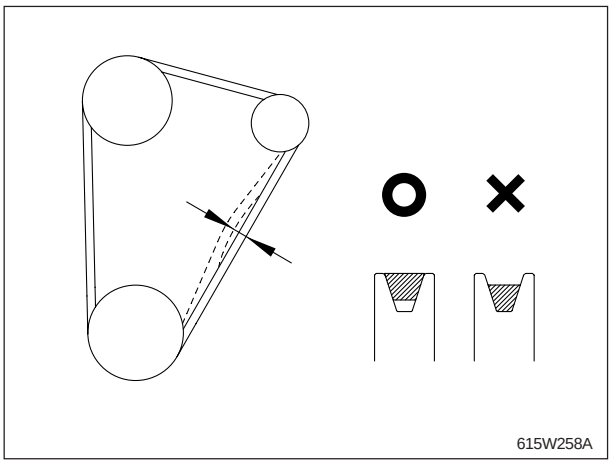
1) Fan belt

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.



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).

(When reassembling)

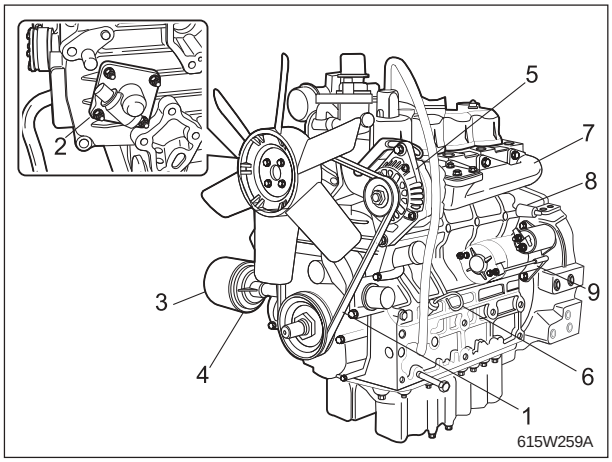
Apply liquid gasket (three bond 1,215 or equivalent) on the thread of the oil pressure switch (8).

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



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

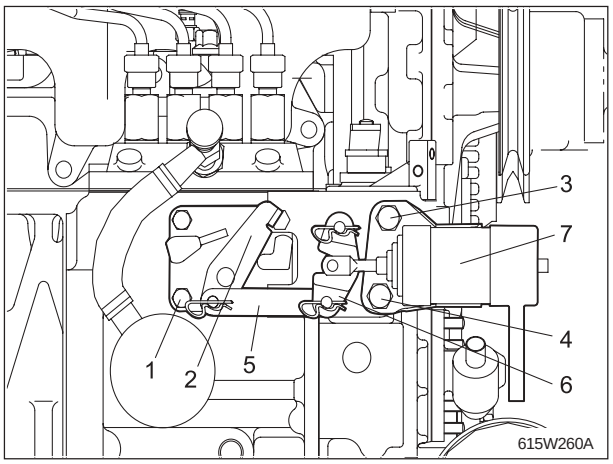
* This figure does not show Hour meter Unit (2) covered with the cooling fan.

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

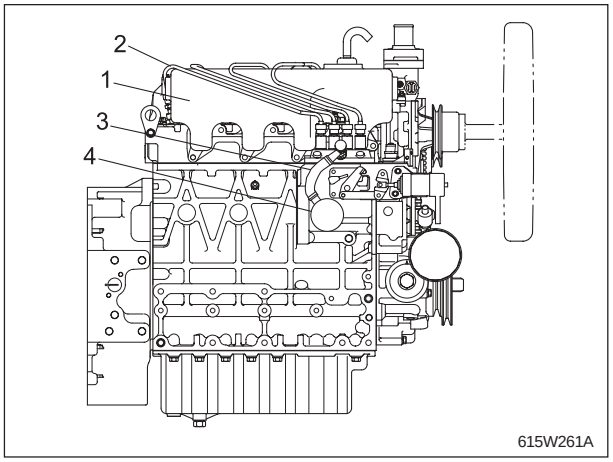
3) Intake manifold and fuel pipes

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



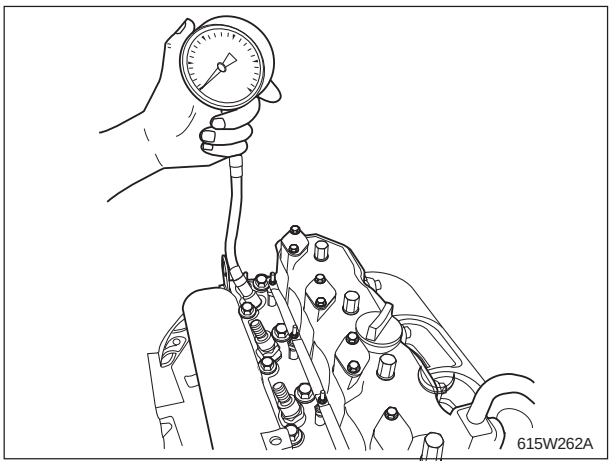
(1) Intake Manifold
(2) Injection Pipe
(3) Fuel Pipe
(4) Fuel Feed Pump

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.



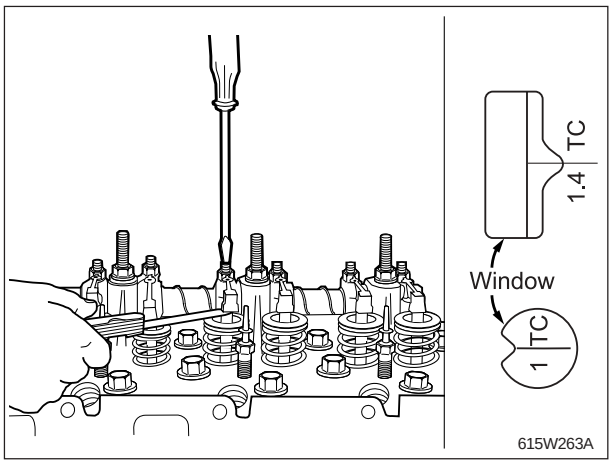
Compression pressure	Factory spec.	3.24 ~ 3.73 MPa 33 ~ 38 kgf/cm^2 469 ~ 540 psi
	Allowable limit	2.55 MPa 26 kgf/cm^2 370 psi
Difference between two cylinders	Allowable limit	10 %

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 cleara



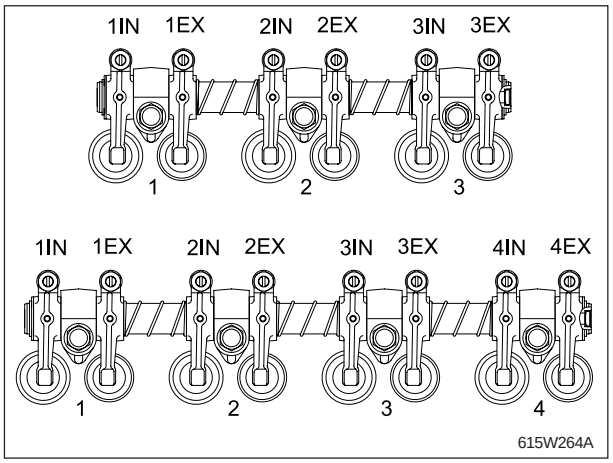
Valve clearance	Factory spec.	In. : 0.25 mm 0.0098 in.
		Ex. : 0.30 mm 0.0118 in.

(3A165D)

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

(4A200B)

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



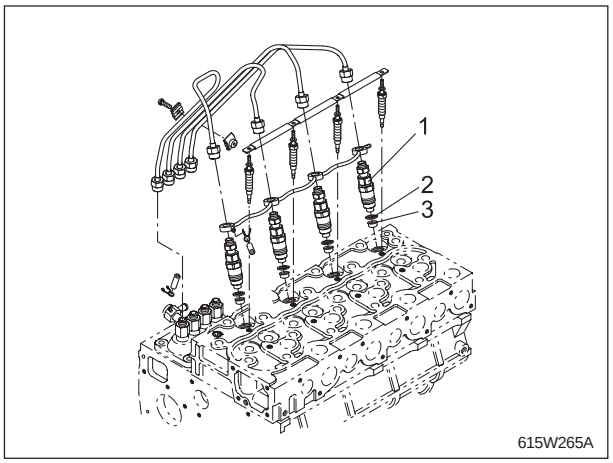
b. Disassembling and Assembling

(A) 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.



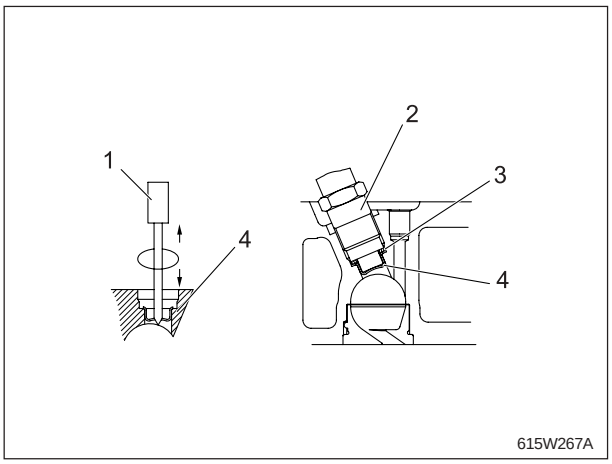
(1) Injection Nozzle (3) Heat Seal
(2) Gasket

(B) 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).*



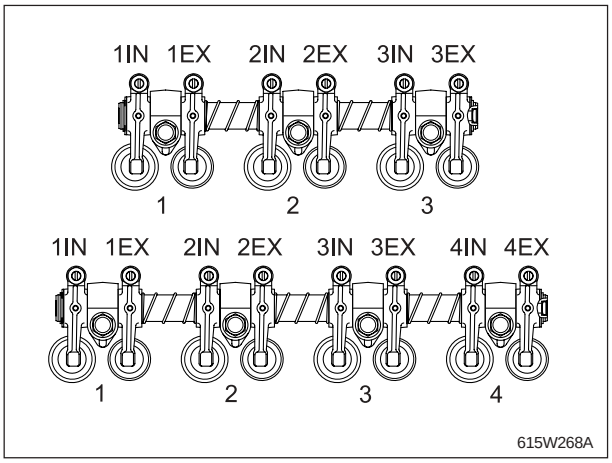
(1) Philips Screw Driver (2) Nozzle
(3) Injection Nozzle Gasket (4) Heat Seal

(C) 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)

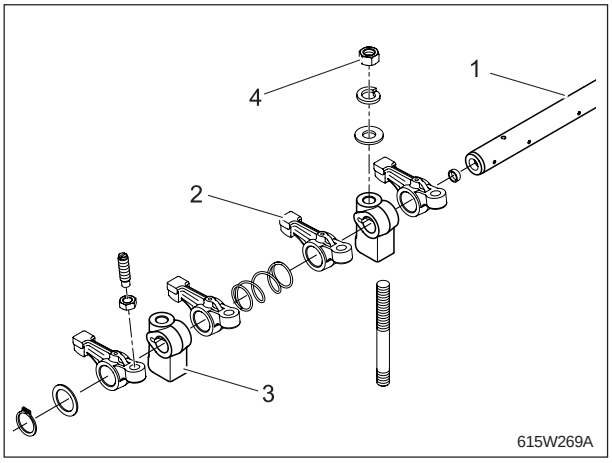
- Rest the end of push rod at the indent of tappet and install the rocker arm assembly.
- Tighten the nuts in several steps and in the specified sequence to the specified torque. As shown in the figure.
- Adjust the valve clearance after assembling the rocker arm assembly.



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

(D) 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.*

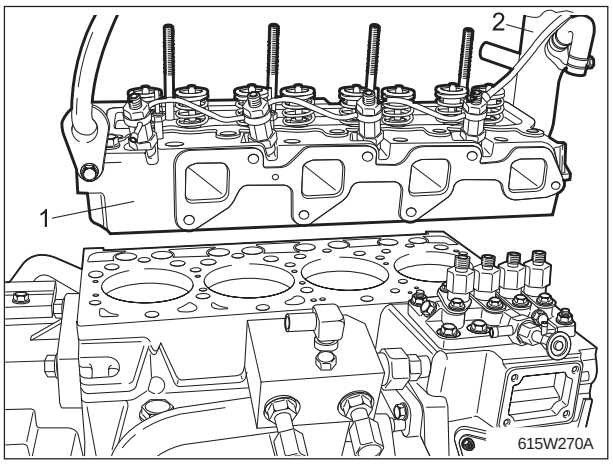
(When reassembling)

- 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.

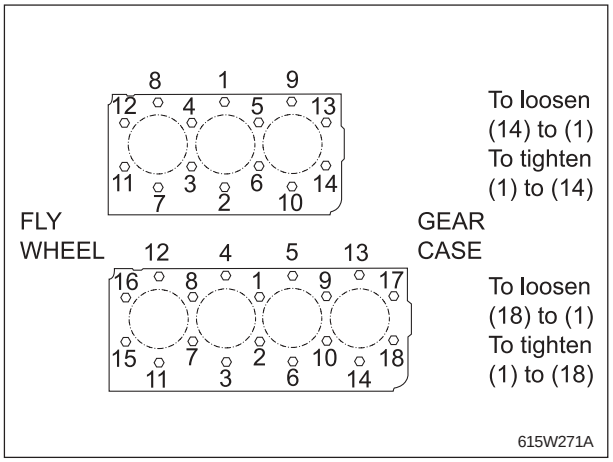
IMPORTANT:

- *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



(E) Valve

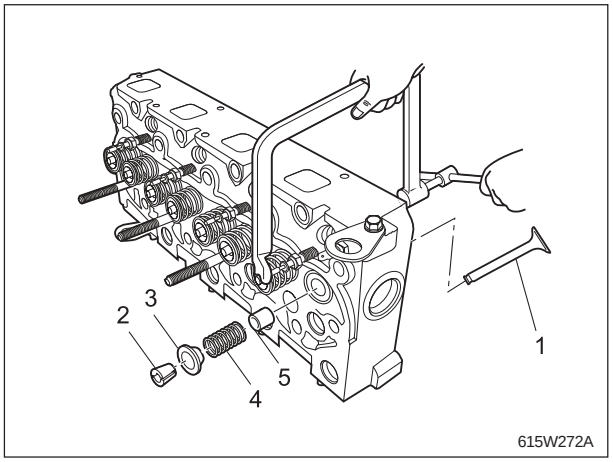
1. Compress the valve spring with a replaces and remove the collect (2).
2. Remove the retainer (3), valve spring (4), valve stem seal (5) and the valve (1).

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

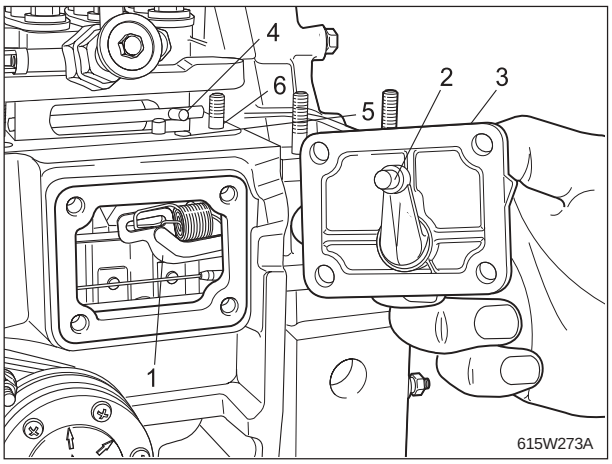
1) Timing Gears and Camshafts

(A) 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).



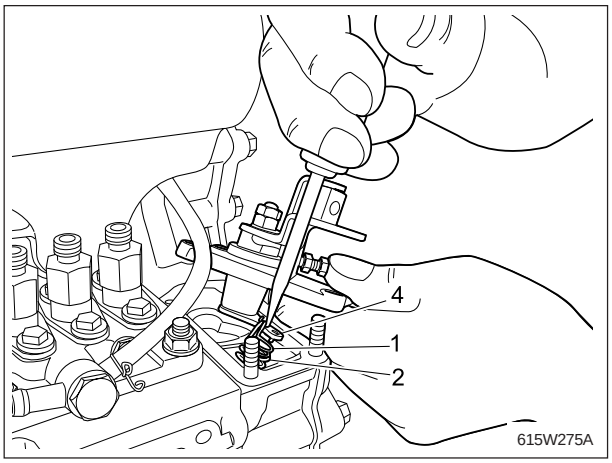
(1) Fork Lever 1
(2) Engine Stop Lever
(3) Injection Pump Cover
(4) Control Rack Pin
(5) Groove
(6) Shim

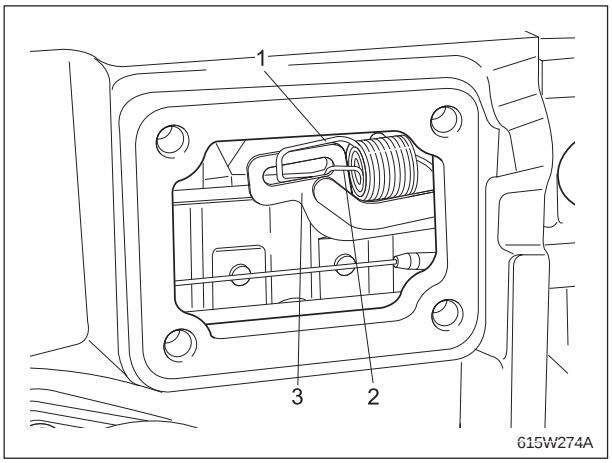
(B) Governor spring and Speed control plate

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.





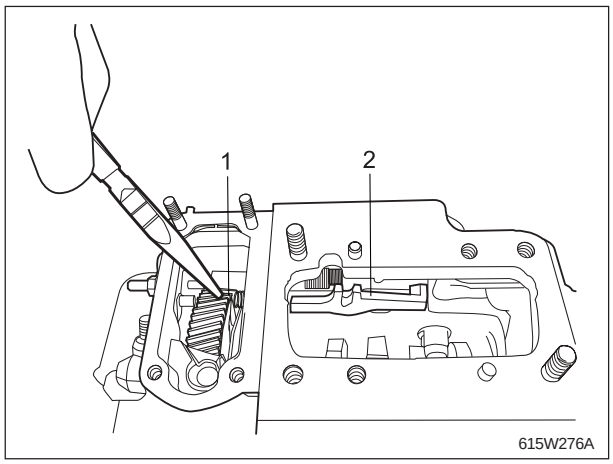
(1) Governor Spring 1
(2) Governor Spring 2
(3) Fork Lever 2
(4) Governor Lever

(C) 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.

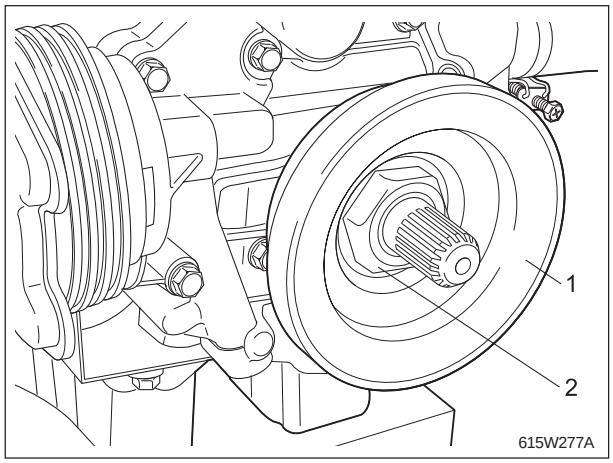


(1) Start Spring (2) Fork Lever 1

(D) 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



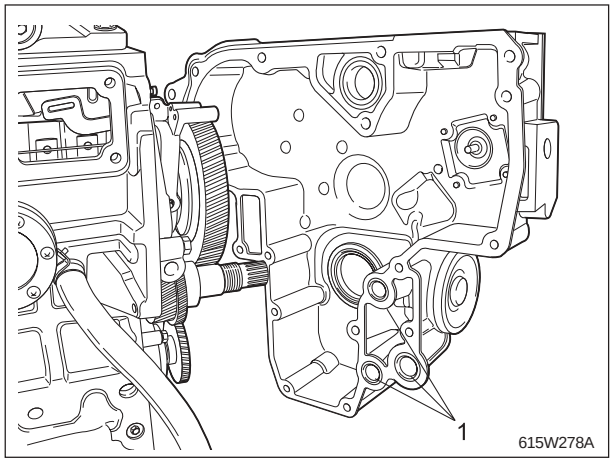
(1) Fan Drive Pulley (2) Crankshaft Nut

(E) 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

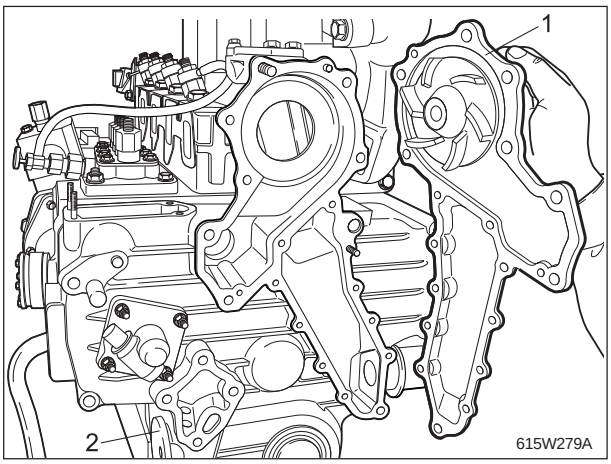
(F) Water pump and relief valve

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



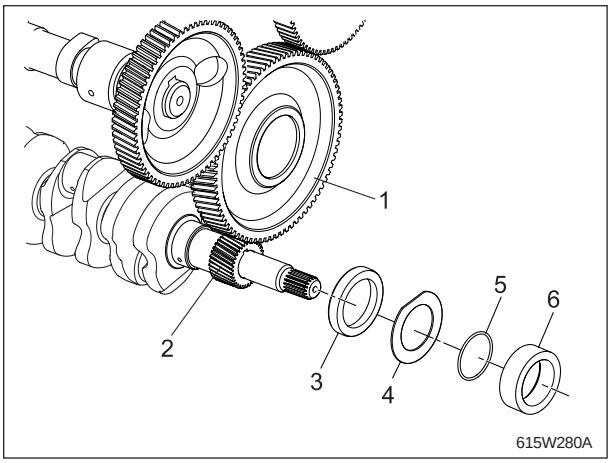
(1) Water Pump Body (2) Relief Valve Cover

(G) 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.

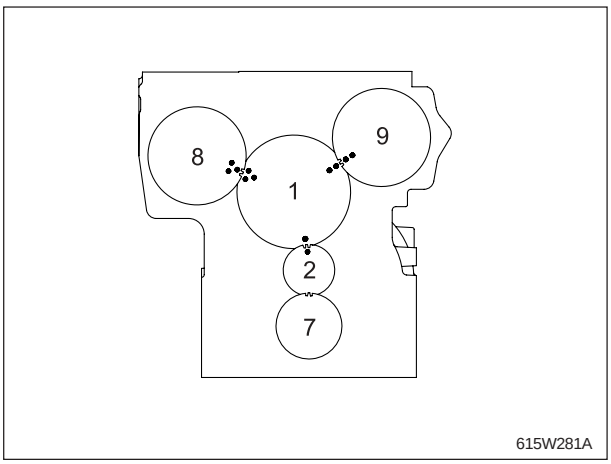
(When reassembling)

- 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.*



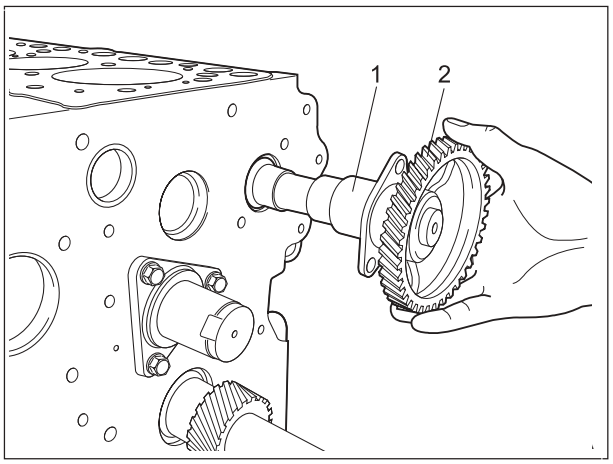
(1) Idle Gear
(2) Crankshaft Gear
(3) Crank Gear Collar
(4) Oil Slinger
(5) O-Ring
(6) Crankshaft Collar
(7) Oil Pump Gear
(8) Injection Pump Gear
(9) Cam Gear

(H)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).



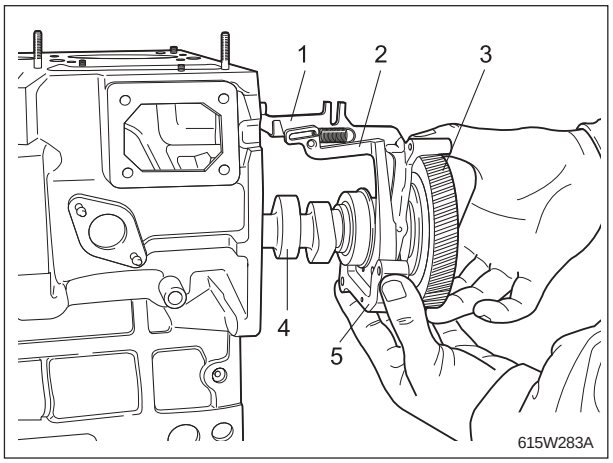
(1) Camshaft (2) Cam Gear

(I) 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

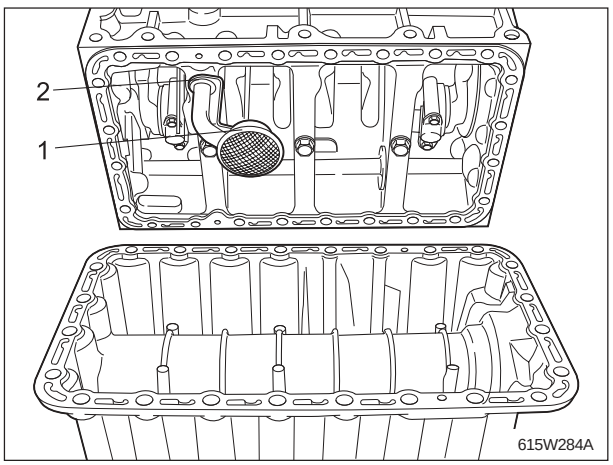
2) Connecting rod and piston

(A) Oil pan and oil filter

1. Remove 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

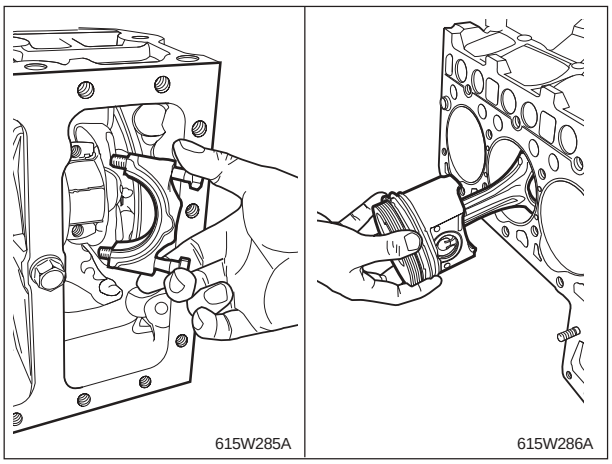
1. Remove the screws and the connecting rod cap.
2. Push out the rod and piston assembly.

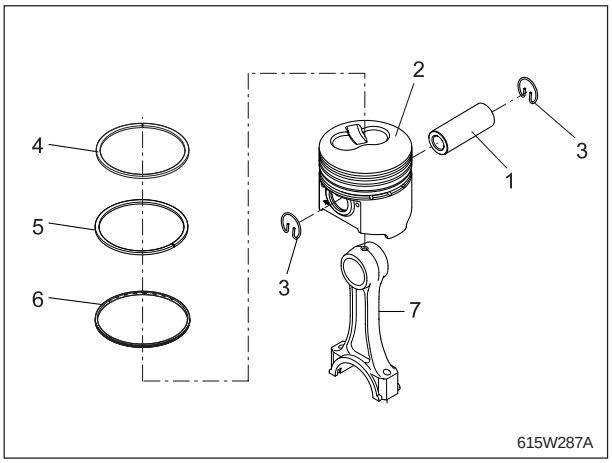
(When reassembling)

- Apply oil to the crankpin bearing, cylinder wall and connecting rod cap screw.
- Insert the connecting 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 the connecting rod cap screws can not be screwed to the end by hand, replace the screw.*





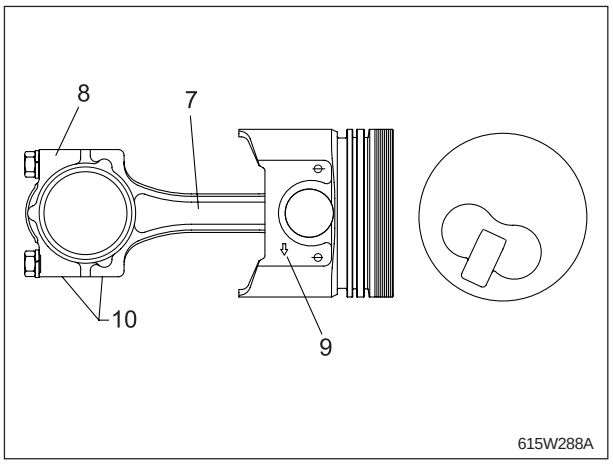
(1) Piston Pin
(2) Piston
(3) Piston Pin Snap Ring
(4) Top Ring
(5) Second Ring
(6) Oil ring
(7) Connecting Rod

(C) Piston ring and piston pin

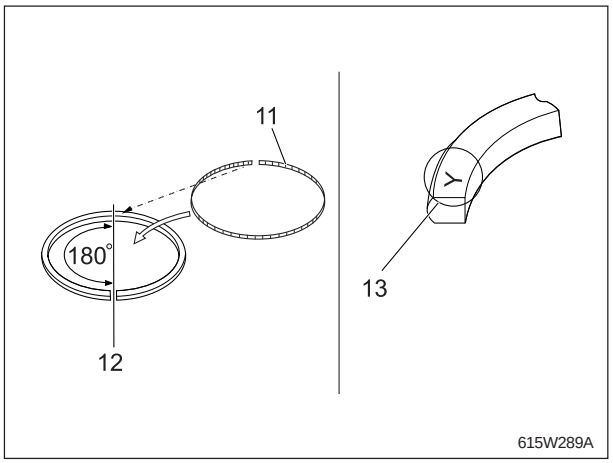
1. Remove the piston rings with a piston ring replacing tool.
2. Remove the piston pin.

(When reassembling)

- Clean all the parts before assembling.
- Heat the piston in approx. 80 °C (176 °F) of oil for 10 ~ 15 minutes, when inserting the piston pin into the piston.
- Install the piston and connecting rod with the mark FW on the piston to the flywheel and the mark on connecting rod to the injection pump.
- Install the piston rings with their manufacture's mark to the top of 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 °).



615W288A



615W289A

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

3) Crankshaft

(A) Flywheel

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

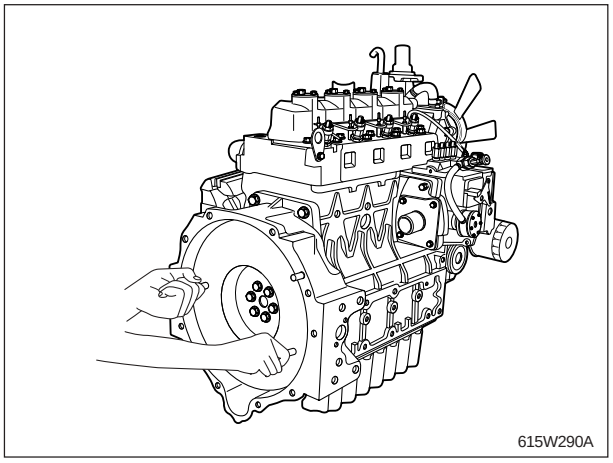
(When reassembling)

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

NOTE:

- *Screw longer screws to 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


615W290A

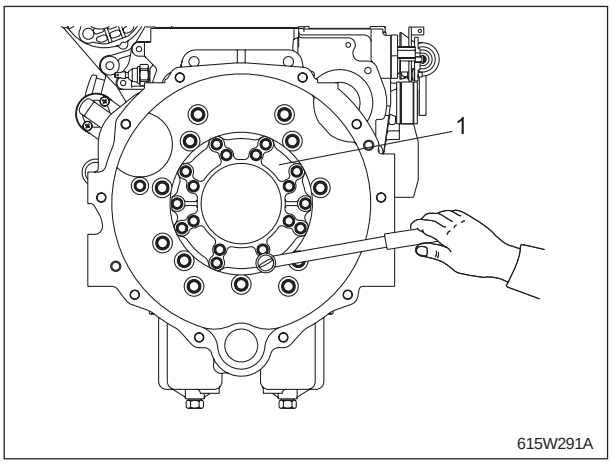
(B) Bearing case cover

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

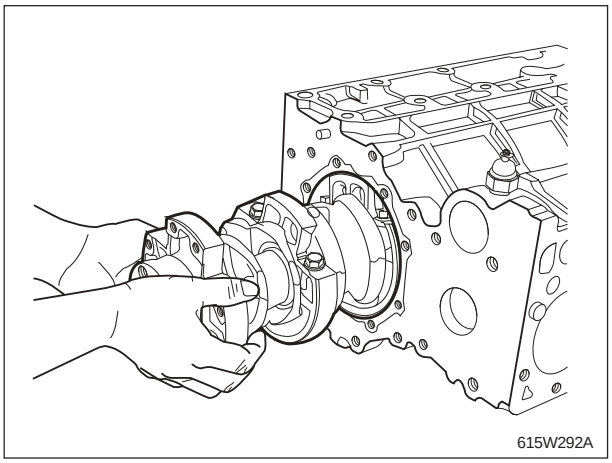
(C) Crankshaft

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

(When reassembling)

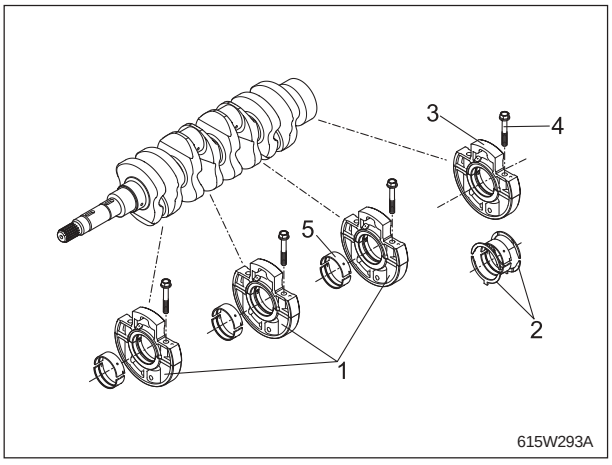
- Apply oil to the bearing case screw 2.
- Clean the oil passage of the crankshaft with compressed air.

Tightening torque	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 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

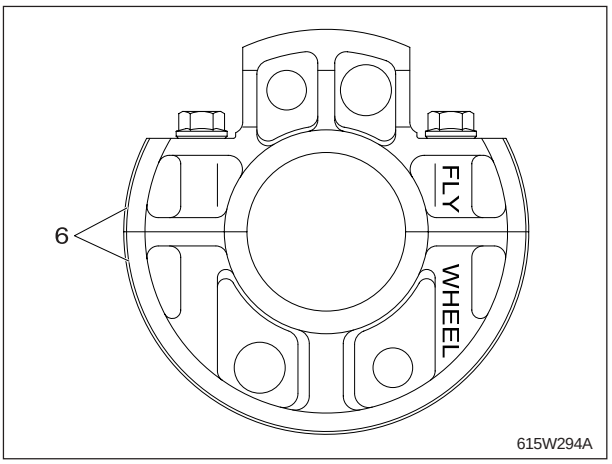
IMPORTANT:

- *Mark the location line 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

c. Servicing

1) Cylinder head and valve

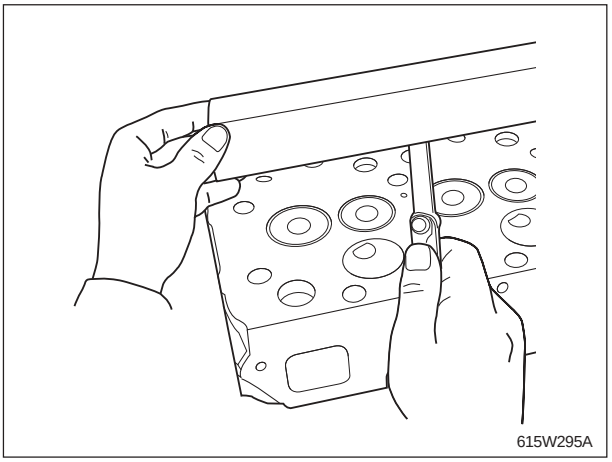
(A) Cylinder head surface flatness

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:

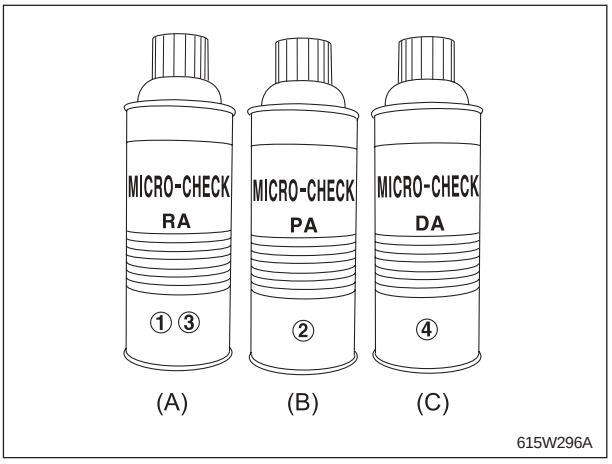
- *Do not place the straight edge on the combustion* chamber.

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

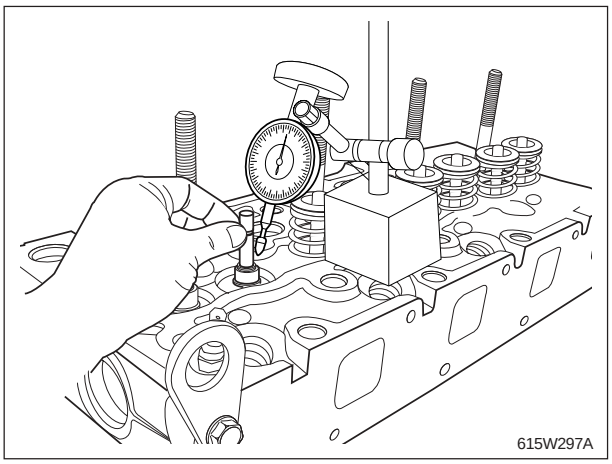
(B) Detergent

(C) White Developer

(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.

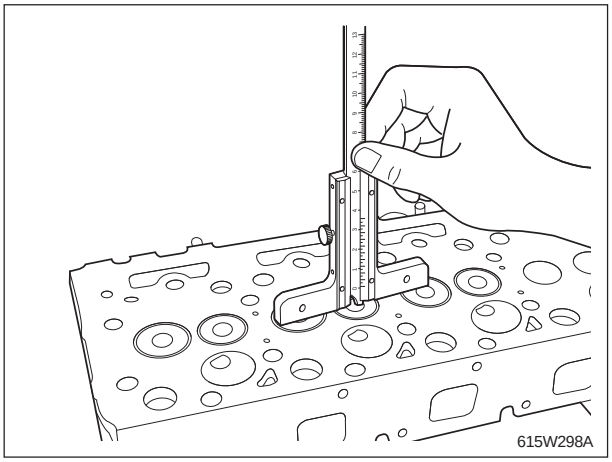
Valve stem clearance	Factory spec.	0.040 ~ 0.070 mm 0.00157 ~ 0.00276 in.
	Allowable limit	0.1 mm 0.004 in.
Valve guide bore I.D.	Factory spec.	8.015 ~ 8.030 mm 0.31555 ~ 0.31614 in.
Valve stem O.D.	Factory spec.	7.960 ~ 7.975 mm 0.31339 ~ 0.31398 in.


615W297A

(D) Valve recessing

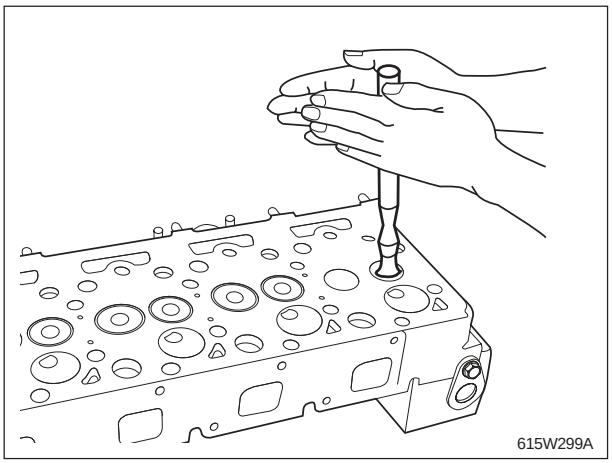
1. Clean the cylinder head, the valve face and the seat.
2. Insert the valve in the guide.
3. Measure the valve recessing with a depth gauge.
4. If the recessing exceeds the allowable limit, replace the valve and check the valve seating.

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


615W298A

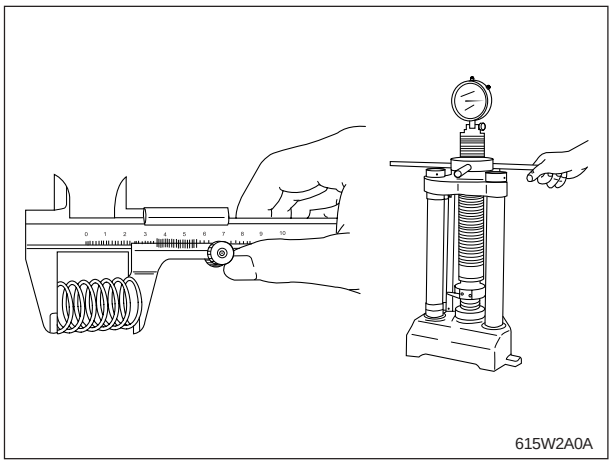
(E) Valve seat

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 lap 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.


615W299A

(F) Valve spring

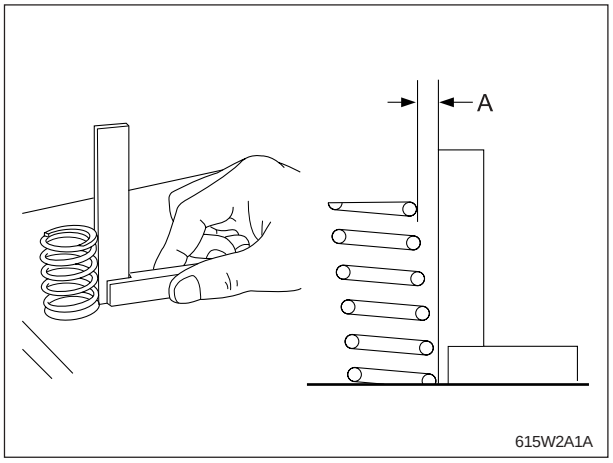
1. Measure the free length of the spring with venire calipers.
2. Place the spring on a spring compression tester and compress to the specified length, and get the tension.
3. If the measurement is less than the allowable limit, replace the valve spring.


615W2A0A

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.

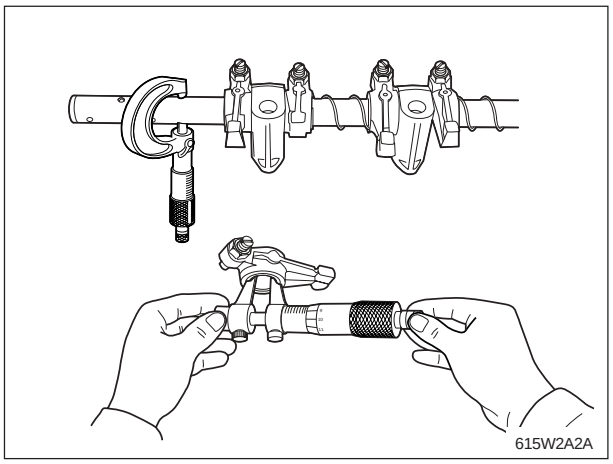


615W2A1A

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.


615W2A2A

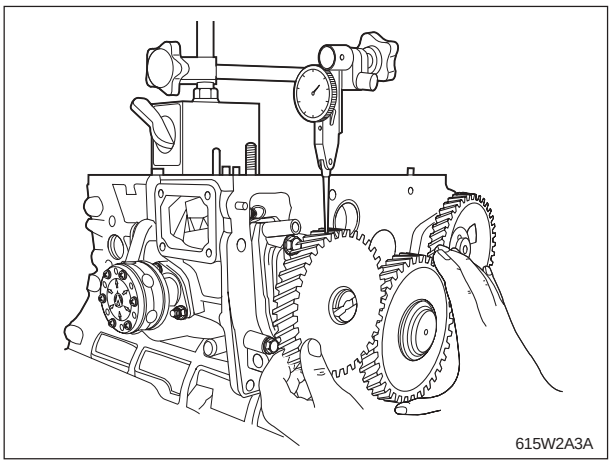
Clearance	Factory spec.	0.020 ~ 0.070 mm 0.00079 ~ 0.00276 in.
	Allowable limit	0.15 mm 0.0059 in.
Rocker arm shaft O.D.	Factory spec.	18.955 ~ 18.980 mm 0.74626 ~ 0.74724 in.
Rocker arm I.D.	Factory spec.	19.000 ~ 19.025 mm 0.74803 ~ 0.74902 in.

2) 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 improper, replace the gear.

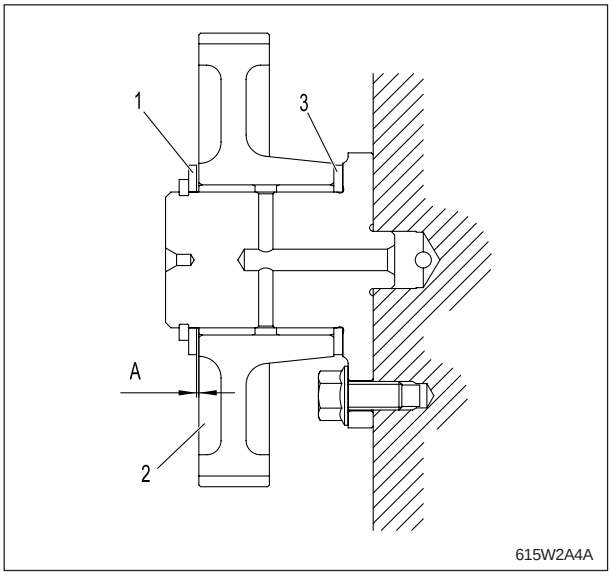
Clearance	Factory spec.	0.04 ~ 0.11 mm 0.0016 ~ 0.004 in.
	Allowable limit	0.15 mm 0.0059 in.


615W2A3A

(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 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 ~ 0.0201 in.
	Allowable limit	0.9 mm 0.035 in.



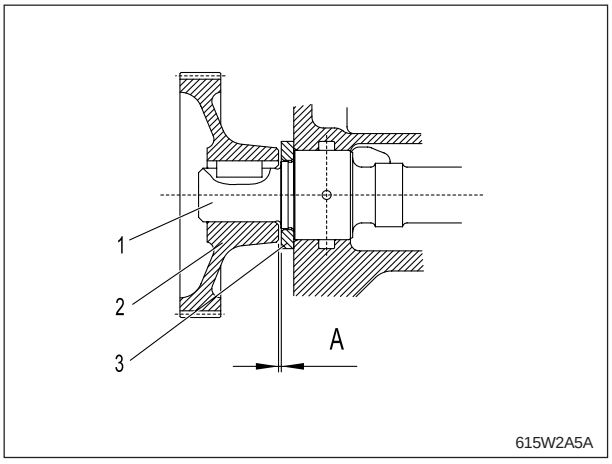
615W2A4A

(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.



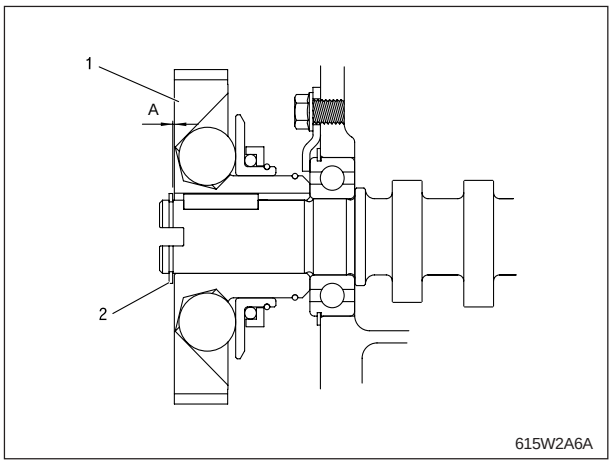
615W2A5A

(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.

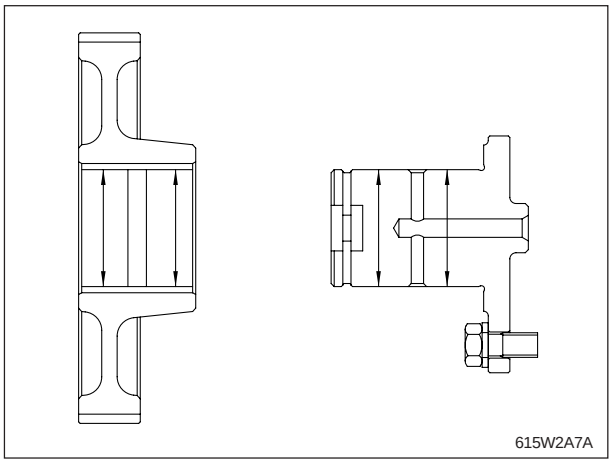


(1) Injection Pump Gear (2) Snap Ring

(E) Idle gear oil clearance

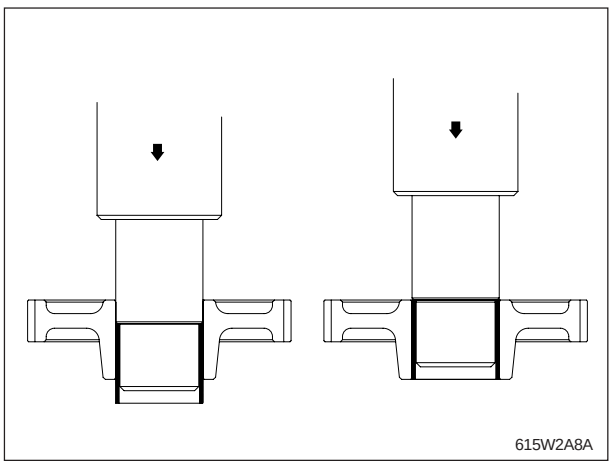
1. Measure the idle gear shaft O.D. with an outside micrometer.
2. Measure the idle gear bushings I.D. with an inside micrometer.
3. If the clearance exceeds the allowable limit, replace the bushing.

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

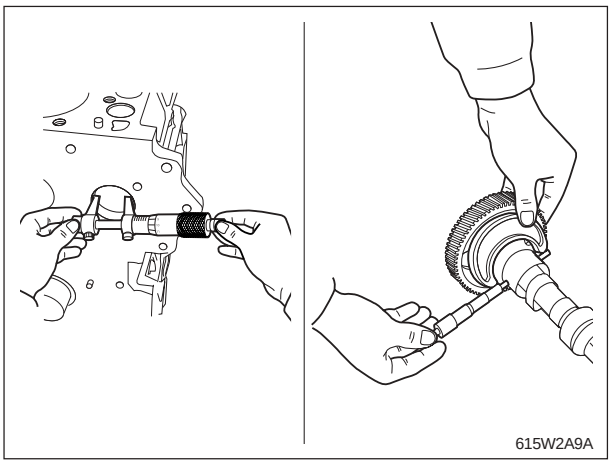
1. Press out the bushings using an idle gear bushing replacing tool.
2. Clean the bushings and the bore, and apply oil to them.
3. Press in the bushing using the replacing tool.



(G) Camshaft oil clearance

1. Measure the I.D. of the camshaft bore on the crankcase 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.

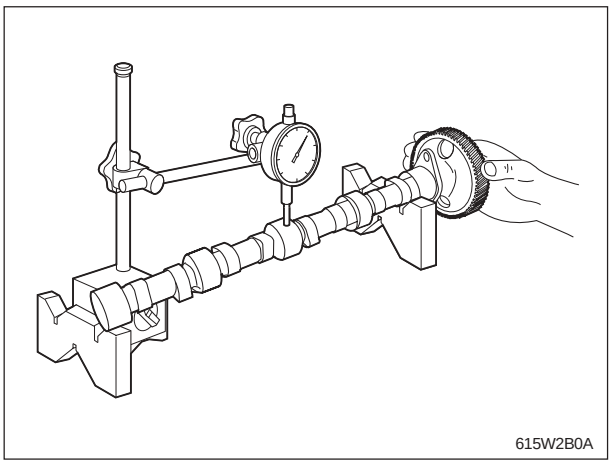
Oil clearance	Factory spec.	0.050 ~ 0.091mm 0.00197 ~ 0.00358 in.
	Allowable limit	0.15 mm 0.0059 in.
Journal O.D.	Factory spec.	39.934 ~ 39.950 mm 1.57221 ~ 1.57284 in.
Bore I.D.	Factory spec.	40.000 ~ 40.025 mm 1.57480 ~ 1.57579 in.


615W2A9A

(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 limit, replace the camshaft.

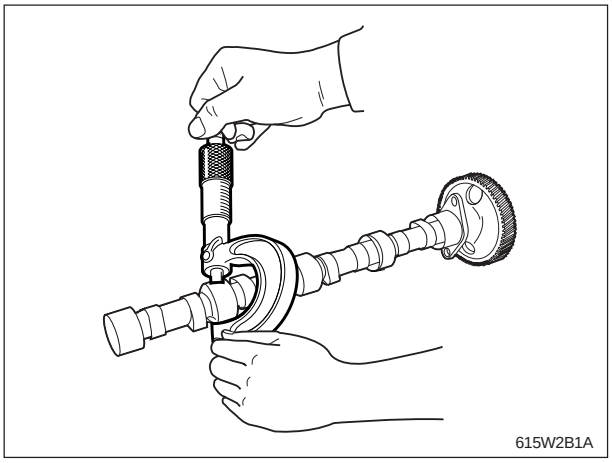
Eccentricity	Allowable limit	0.05 mm 0.002 in.


615W2B0A

(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	3A165 4A200	(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.

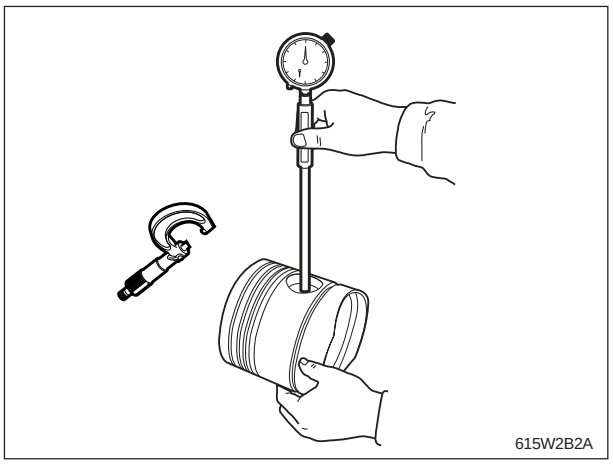

615W2B1A

3) Connecting rod and piston

(A) Piston pin bore

1. Measure the I.D. of 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.

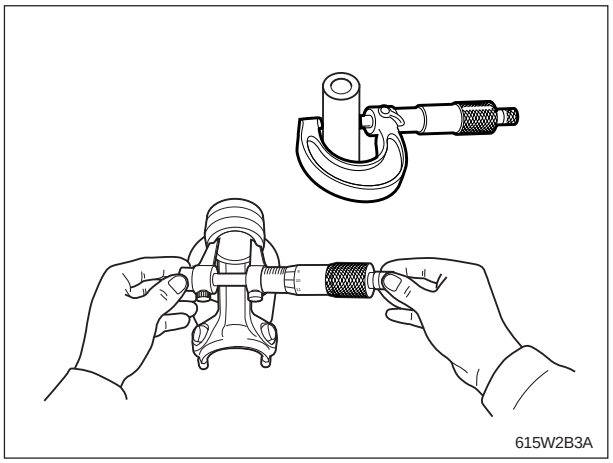
Piston Pin bore I.D.	Factory spec.	25.000 ~ 25.006 mm 0.9843 ~ 0.9845 in.
	Allowable limit	25.03 mm 0.9854 in.


615W2B2A

(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.

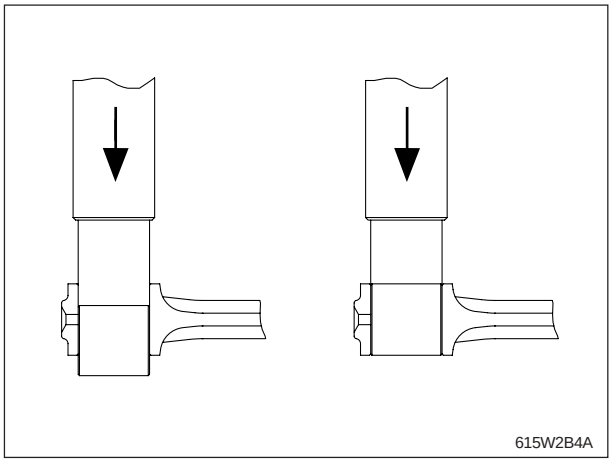

615W2B3A

(C) Replacing 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:

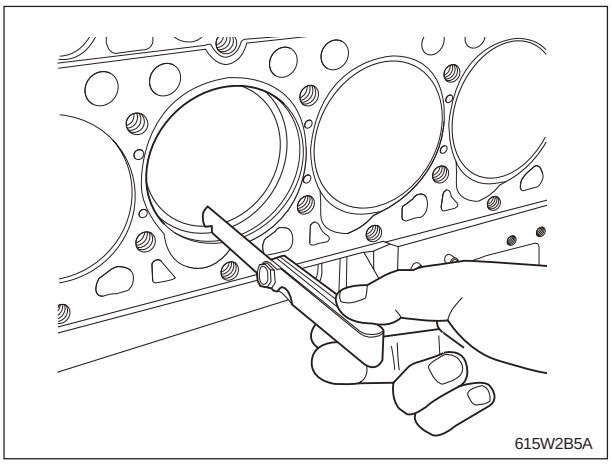
- *Align the oil holes of the connecting rod and the bushing.*


615W2B4A

(D)Piston ring end gap

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

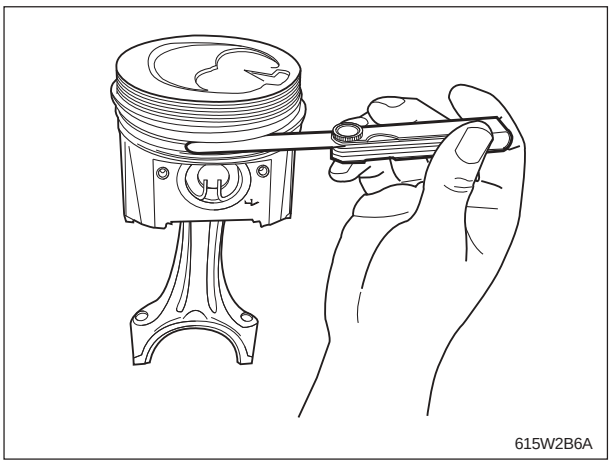
Piston ring end gap	2nd ring	Factory spec.	0.55 ~ 0.70 mm 0.0217 ~ 0.0276 in.
		Allowable limit	1.25 mm 0.0492 in.
	Top ring, oil ring	Factory spec.	0.25 ~ 0.40 mm 0.0098 ~ 0.0157 in.
		Allowable limit	1.25 mm 0.0492 in.


615W2B5A

(E) Piston ring clearance

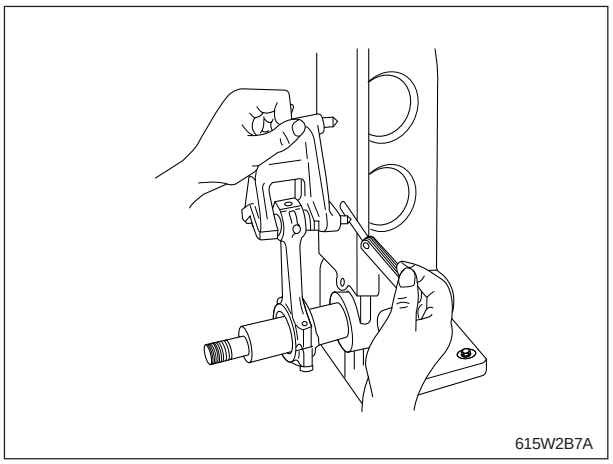
1. Clean the ring and the ring grooves, and install each ring in its groove.
2. Measure the clearance between the ring and the groove with a feeler gauge.
3. If the clearance exceeds the allowable limit, replace the piston ring.
4. If the clearance still exceeds the allowable limit with the new ring,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


615W2B6A

(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.

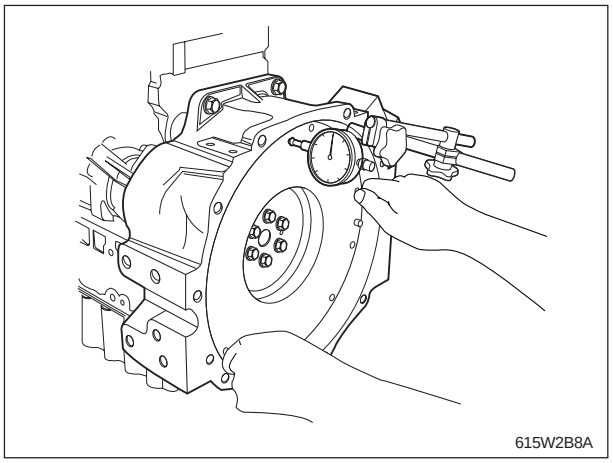

615W2B7A

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

4) 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, regrind 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.

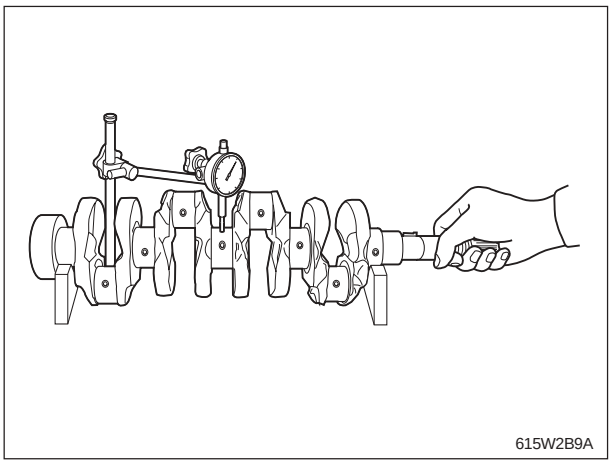

615W2B8A

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.

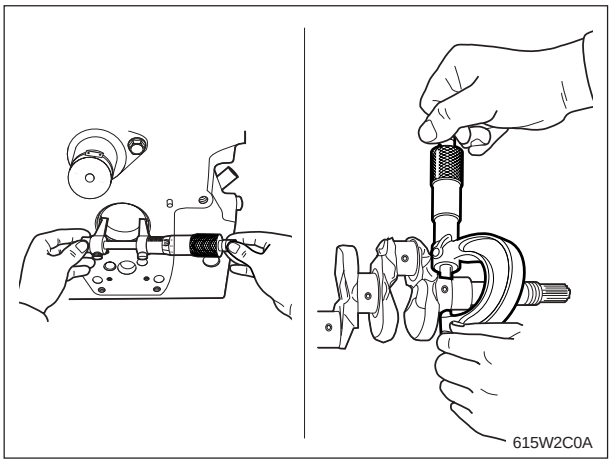
Misalignment	Allowable limit	0.08 mm 0.0031 in.


615W2B9A

(C) Crankshaft journal and bearing 1 oil clearance

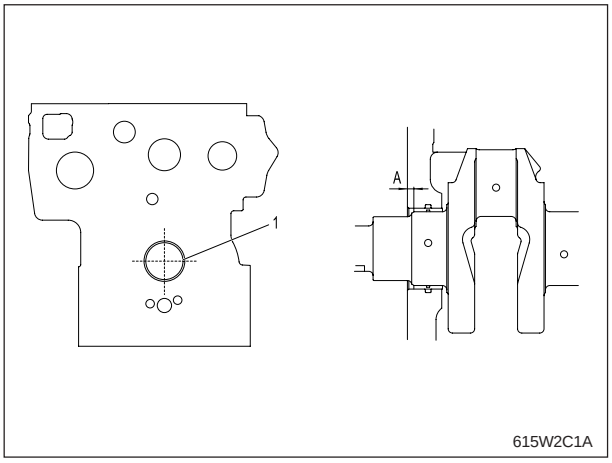
1. Measure the I.D. of the crankshaft bearing 1 with an inside micrometer.
2. Measure the O.D. of the crankshaft journal with an outside micrometer.
3. If the clearance exceeds the allowable limit, replace the bearing referring to Replacing Crankshaft Bearing 1.

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.


615W2C0A

(D) Replacing crankshaft bearing 1

1. Press out the crankshaft bearing 1 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.



615W2C1A

(1) Seam

(E) Crankshaft journal and bearing 2 oil clearance

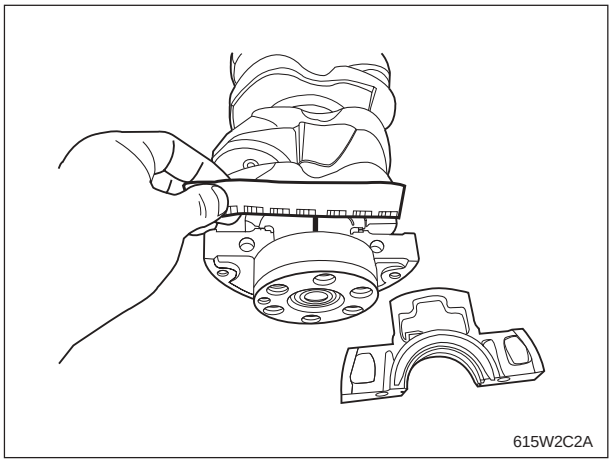
1. Put plastic gauge lengthwise in the center of the journal.
2. Install the bearing cap and tighten the screw to the specified torque once, and remove the cap again.
3. Measure the amount of the flattening with the scale and get the oil clearance.
4. If the clearance exceeds the allowable limit, replace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

1. Put a strip of Plastigage lengthwise in the center of the crank pin.
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.

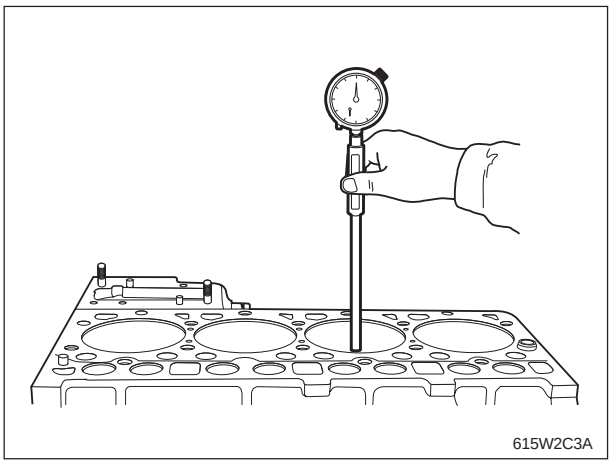


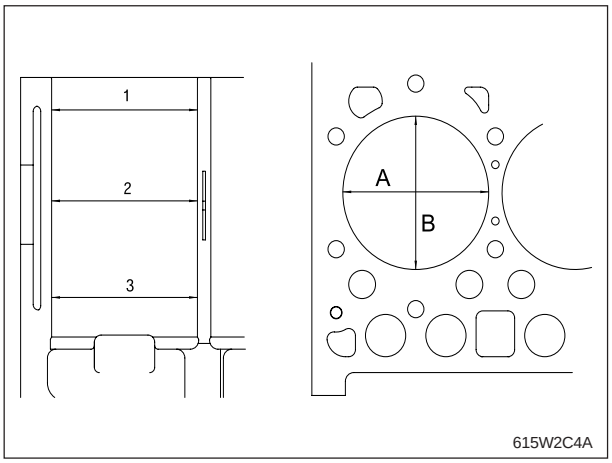
5) Cylinder bore

(A) Cylinder bore diameter

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

4A200B	83.000 ~ 83.022 mm 3.2677 ~ 3.269 in.
3A165D	87.000 ~ 87.022 mm 3.425 ~ 3.4261 in.


615W2C3A



615W2C4A

(A) Axial Direction

(B) Transverse Direction

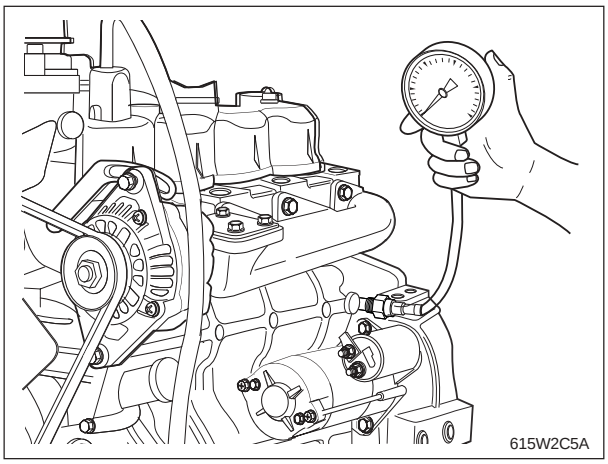
1,2,3 Measuring Points

D. 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.


615W2C5A

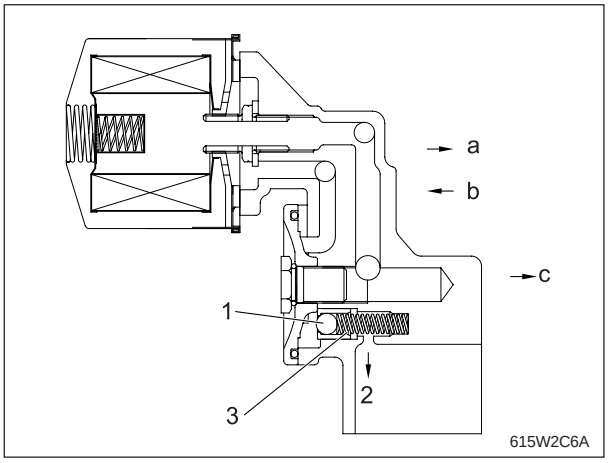
Engine oil pressure	At idle speed	Factory spec.	more than 49 kPa 0.5 kgf/cm² 7.11 psi
	At rated speed	Factory spec.	294 ~ 441 kPa 2.5 ~ 4.5 kgf/cm² 35.6 ~ 64.0 psi
		Allowable limit	245 kPa 2.5 kgf/cm² 35.6 psi

(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.



615W2C6A

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

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.*

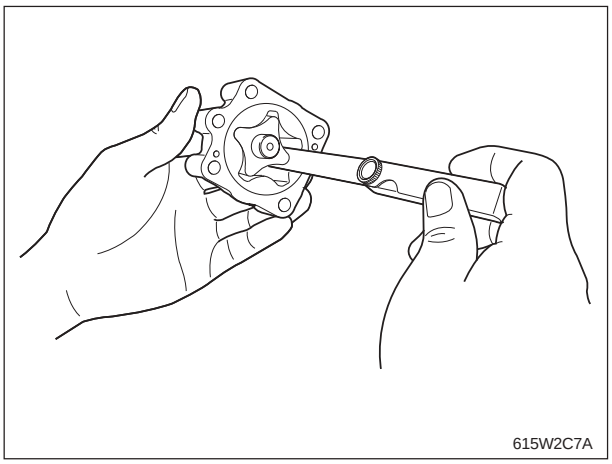
Tightening torque	Relief cover	32.4 ~ 36.3 N·m 3.3 ~ 3.7 kgf·m 23.9 ~ 36.8 lbf·ft

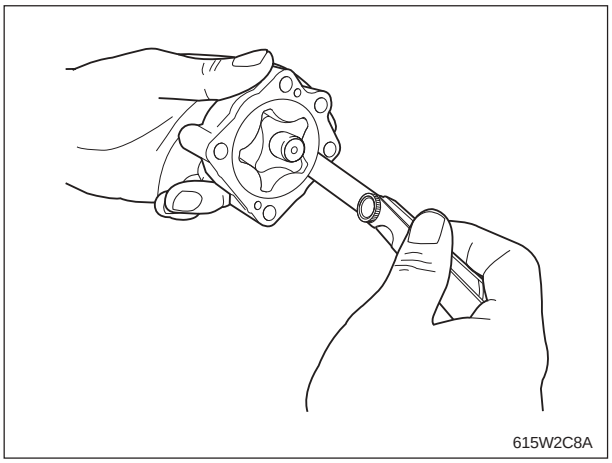
b. Servicing

(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.

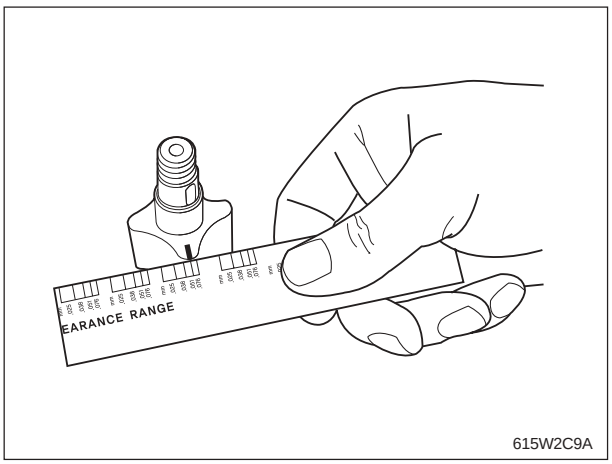

615W2C7A


615W2C8A

(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.



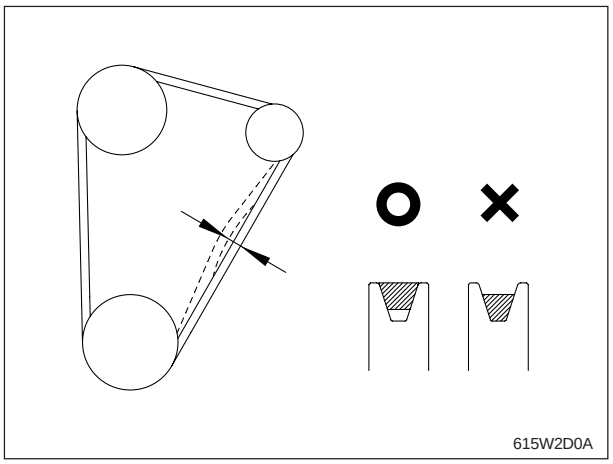
615W2C9A

E. COOLING SYSTEM

a. Checking Adjusting

(A) Fan belt

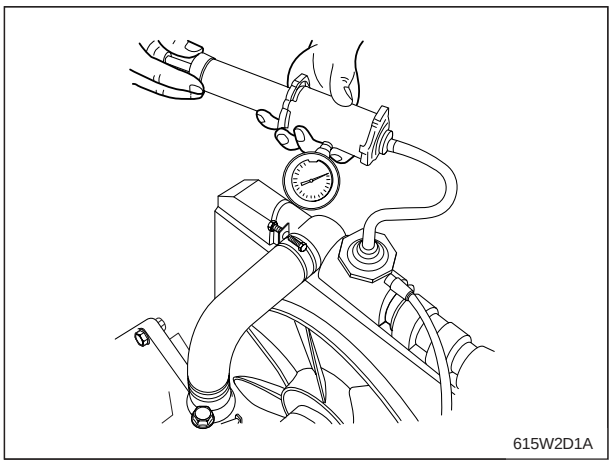
1. Measure the deflection, depressing the belt halfway between the fan drive pulley and the alternator pulley at 98 N (10 kgf, 22 lbs) of force.
2. If the deflection is not between the factory specifications, loosen the bolts and nuts, and relocate the alternator to adjust.
3. If the belt is damaged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



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

(B) Radiator water tightness

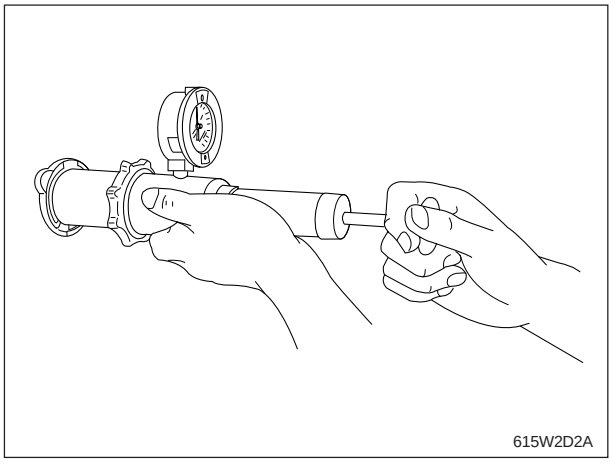
1. Fill radiator with water to the specified amount and warm up the engine.
2. Set a radiator tester and raise the water pressure to the specified pressure.
3. Check the radiator for water leaks.
4. For water leak from the pin hole, repair with a radiator cement, and for other leaks, replace the radiator.



Radiator water tightness	Factory spec	No leaks at 137 kPa (1.4 kgf/cm², 20 psi)

(C) Radiator cap tightness

1. Set a radiator tester on the radiator cap.
2. Apply 88 kPa (0.9 kgf/cm², 13 psi) of pressure and measure the pressure for 10 seconds.
3. If the pressure falls below 59 kPa (0.6 kgf/cm², 9 psi), replace the radiator cap.



Radiator cap tightness	Factory spec	More than 10 seconds for pressure fall from 88 ~ 59 kPa (0.9 ~ 0.6 kgf/cm², 13 ~ 9 psi)

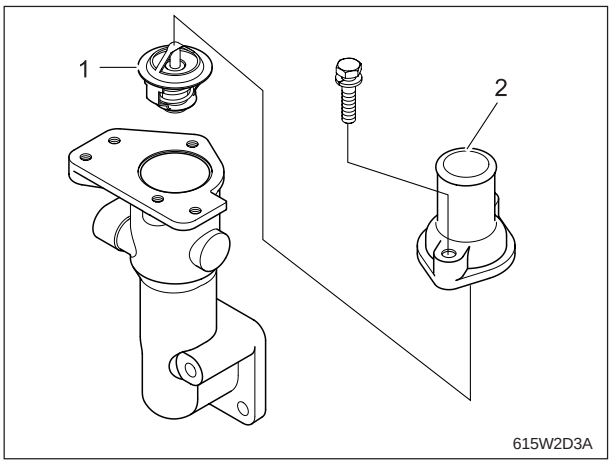
b. Disassembling and Assembling

(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.



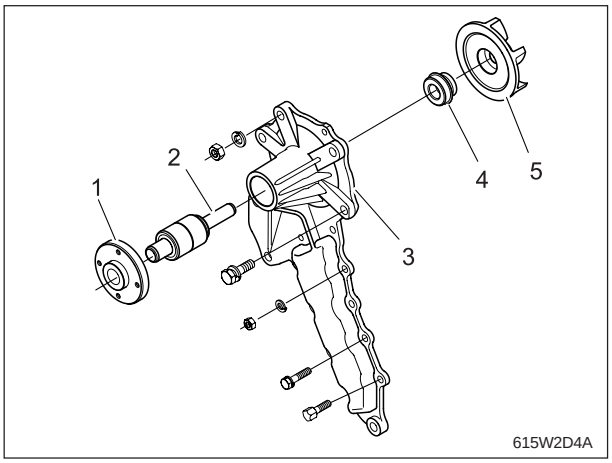
(1) Thermostat (2) Thermostat Cover

(B) Water pump

1. Remove the fan and fan pulley.
2. Remove the water pump body from the 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.



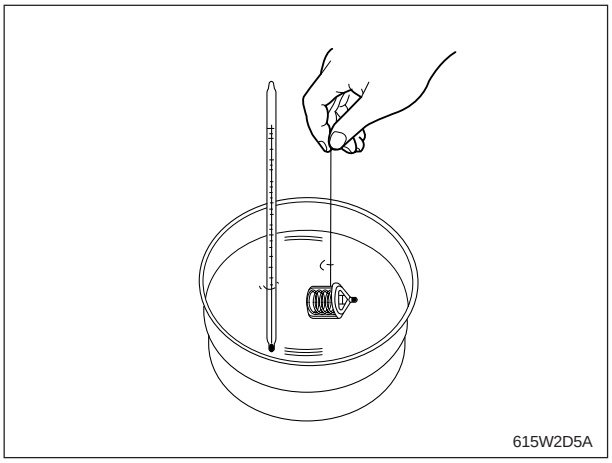
(1) Water Pump Flange (4) Water Pump Body
(2) Water Pump Bearing (5) Mechanical Seal
(3) Water Pump Shaft (6) Impeller

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 open and leave the string and when the valve opens 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



F. 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 flow through to the hole of the delivery valve holder (1).
4. Turn the flywheel further and stop turning when the fuel stop 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.

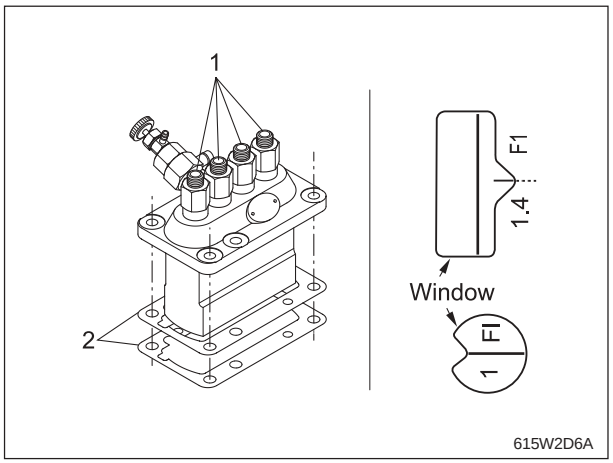
Injection timing	3A165D, 4A200B,	0.31 rad, 18 ° before T.D.C

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 the outer rim of the flywheel equals 0.26 rad (1.5 °) of crank angle.

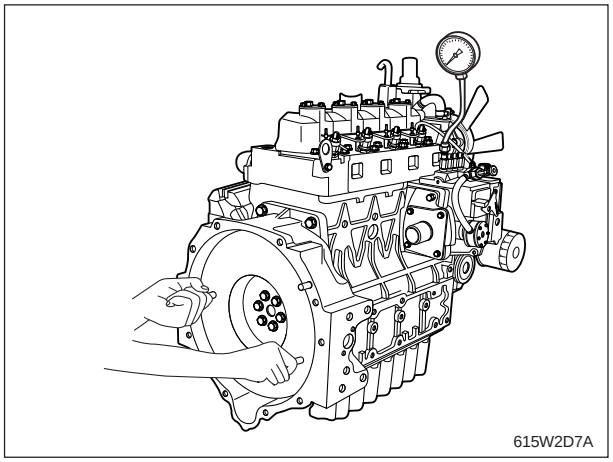


(1) Delivery Valve Holder (2) Shim

(B) Delivery valve fuel tightness

1. Remove the injection pipes, glow plugs and the inlet manifold, and install the 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 drop 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.

Fuel Injection pressure	Factory spec.	14.71 MPa 150 kgf/cm² 2134 psi
Pressure drop	Allowable limit	0.98 MPa 10 kgf/cm² 142 psi



b. Injection nozzle

CAUTION

- *Never contact with spraying diesel fuel under pressure, 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.

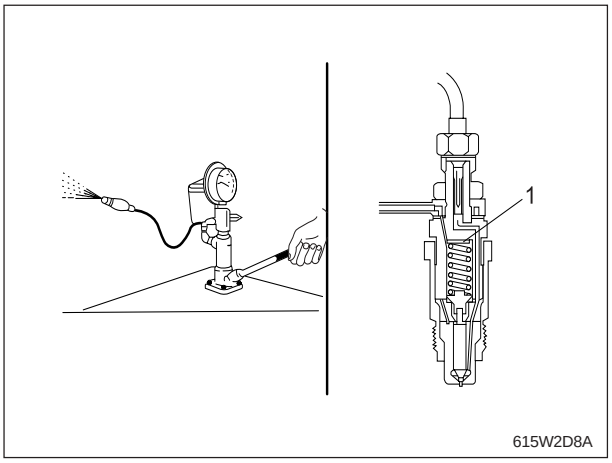
(Reference)

- Pressure variation with 0.1 mm (0.004 in.) difference of adjusting washer thickness is approx. 10 kgf/cm².

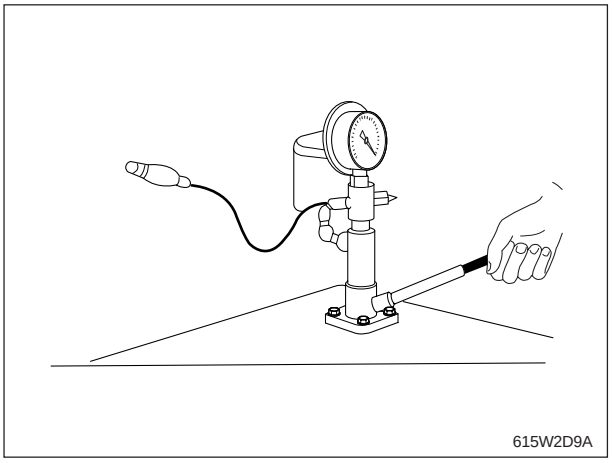
Fuel injection pressure	Factory spec.	13.73 ~ 14.71 MPa 140 ~ 150 kgf/cm² 1991 ~ 2134 psi

(B) Fuel tightness of needle valve seat tightness

1. Set the injection nozzle to the nozzle tester.
2. Apply a pressure 130 kgf/cm² (12.75 MPa, 1849 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.



(1) Adjustment Washer

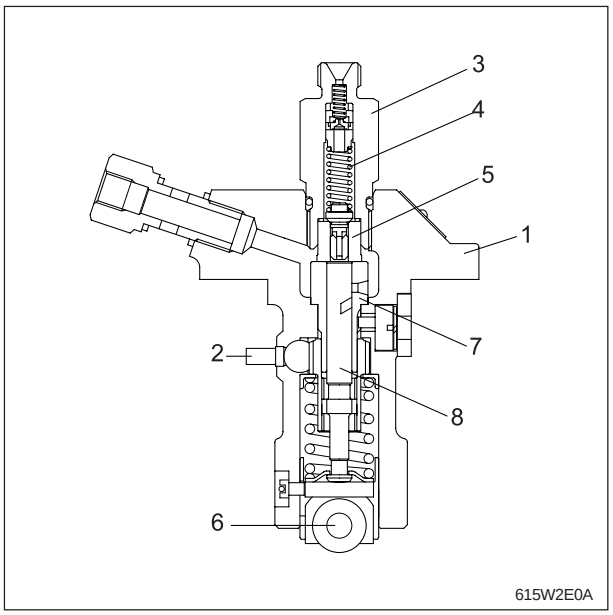


c. Disassembling and Assembling

1) Injection pump

IMPORTANT:

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



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

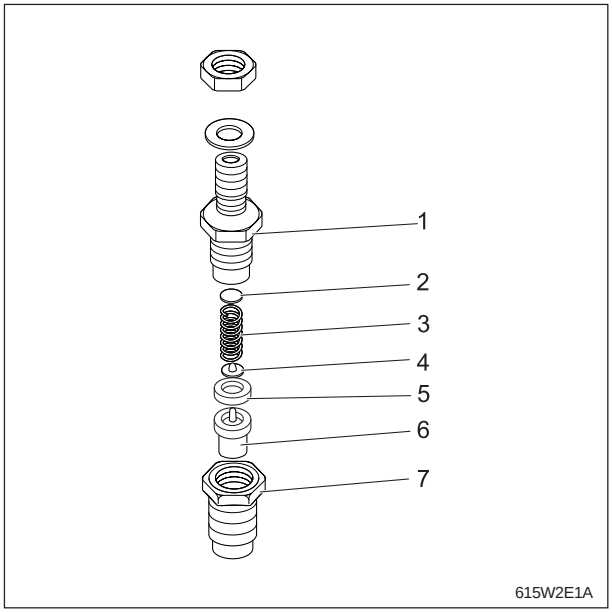
2) Injection nozzle

(A) Nozzle holder

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

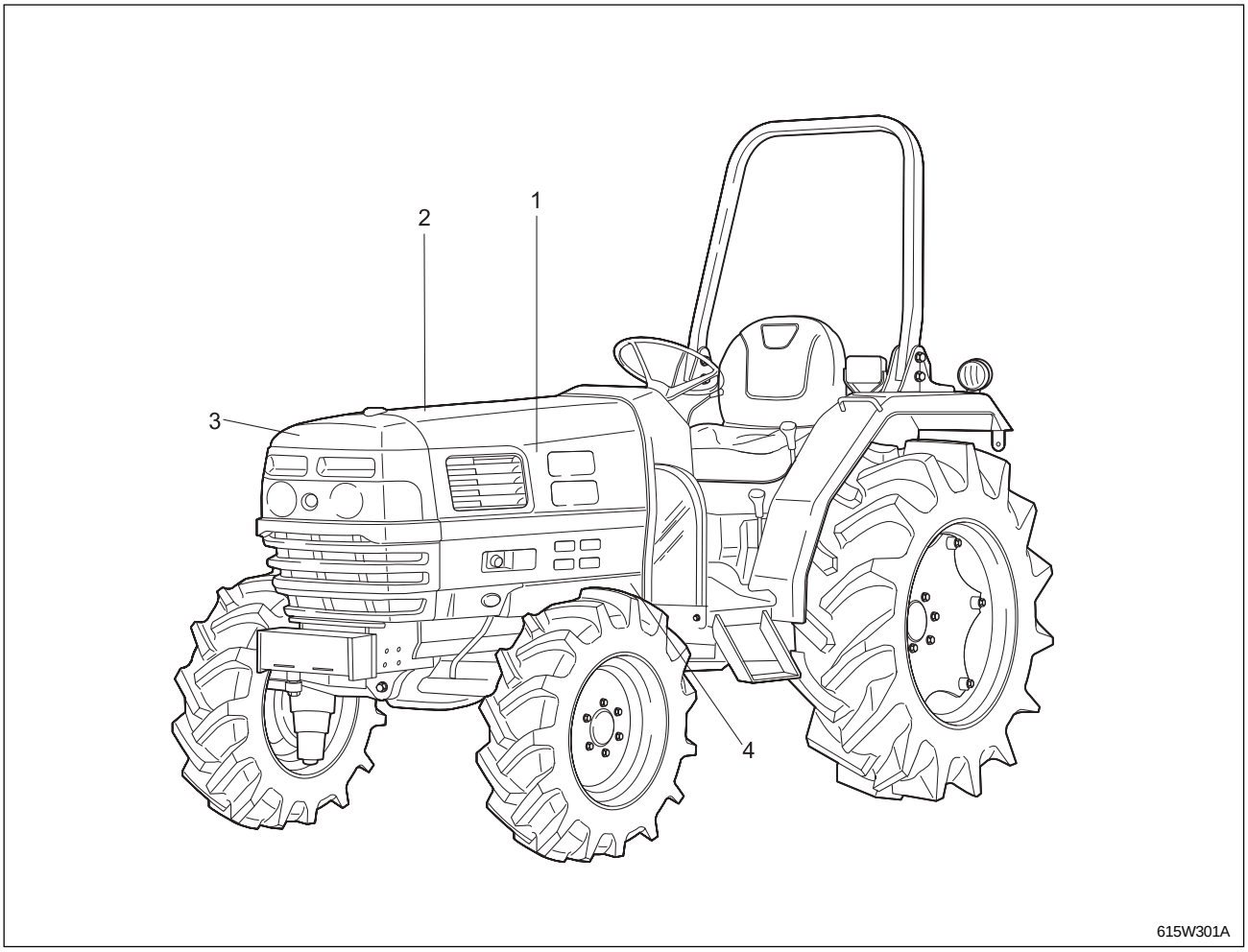
CHAPTER 3

CLUTCH

1. DISASSEMBLY AND ASSEMBLY

1.1 DISASSEMBLY OF PANEL FRAME

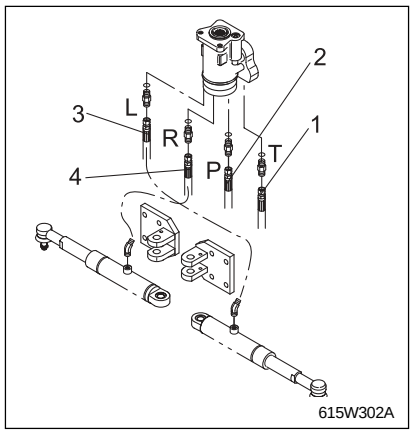
A. FIRST STAGE

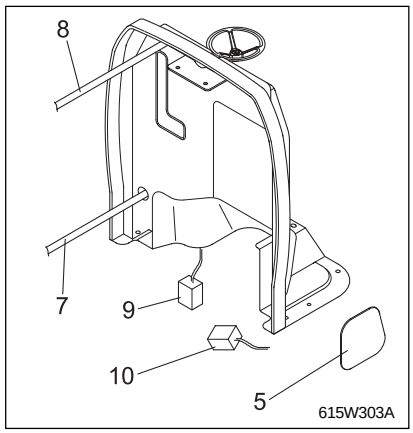


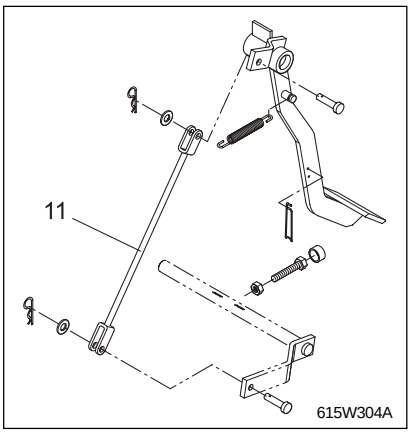
(1) Side Cover (Left, Right)
(2) Bonnet
(3) Front Grill Assembly
(4) Cover-Low (Left, Right)

1. Disassemble side cover (1), bonnet (2), front grill assembly (3) and cover-low (4).

B. SECOND STAGE

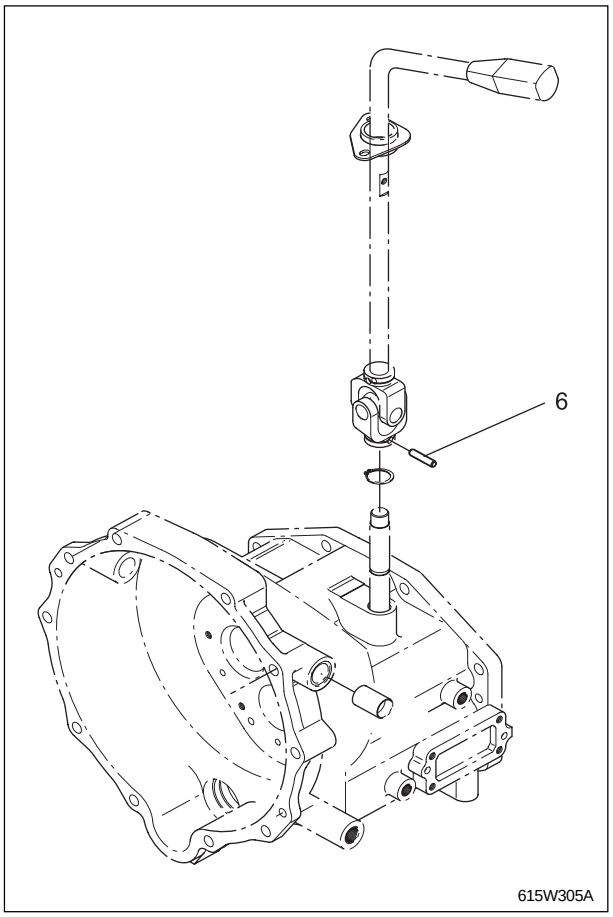






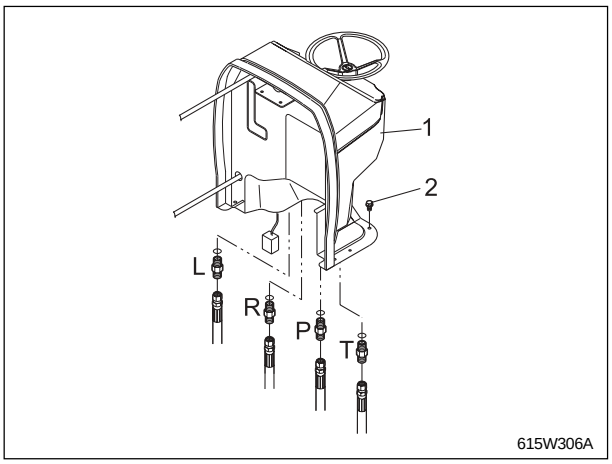
(1) Steering Hose Assembly T
(2) Steering Hose Assembly P
(3) Steering Hose Assembly L
(4) Steering Hose Assembly R
(5) Frame Cover
(6) Parallel Pin
(7) Accelerator Cable
(8) Indicator Cable
(9) Panel Wiring Harness Assembly
(10) Fender Wiring Harness Assembly
(11) Clutch Rod

1. Disassemble power steering unit connection hoses (1), (2), (3) and (4).
2. Remove frame cover (5) in left bottom of frame assembly and then parallel pin (6) for connecting shuttle lever.
3. Disconnect accelerator cable (7) and indicator cable (8).
4. Disconnect panel wiring harness assembly (9) and fender wiring harness assembly (10).
5. Disconnect clutch rod (11).



C. THIRD STAGE

1. Disengage attaching bolt (2) of frame assembly (1).
2. Disassembly frame assembly.



(1) Frame Assembly
(2) Bolt

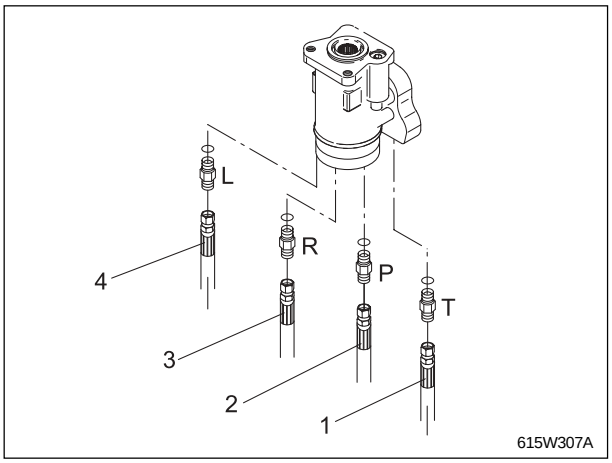
(When reassembling)

- When connecting with power steering unit hoses (1), (2), (3) and (4) make sure hose color and connecting port to be assembled properly.

Connecting Port	Hose Type
T	Steering hose assembly T (Green)
P	Steering hose assembly P (Red)
R	Steering hose assembly R (White)
L	Steering hose assembly L (Yellow)

- When connecting power steering unit hose, see the specified torque.

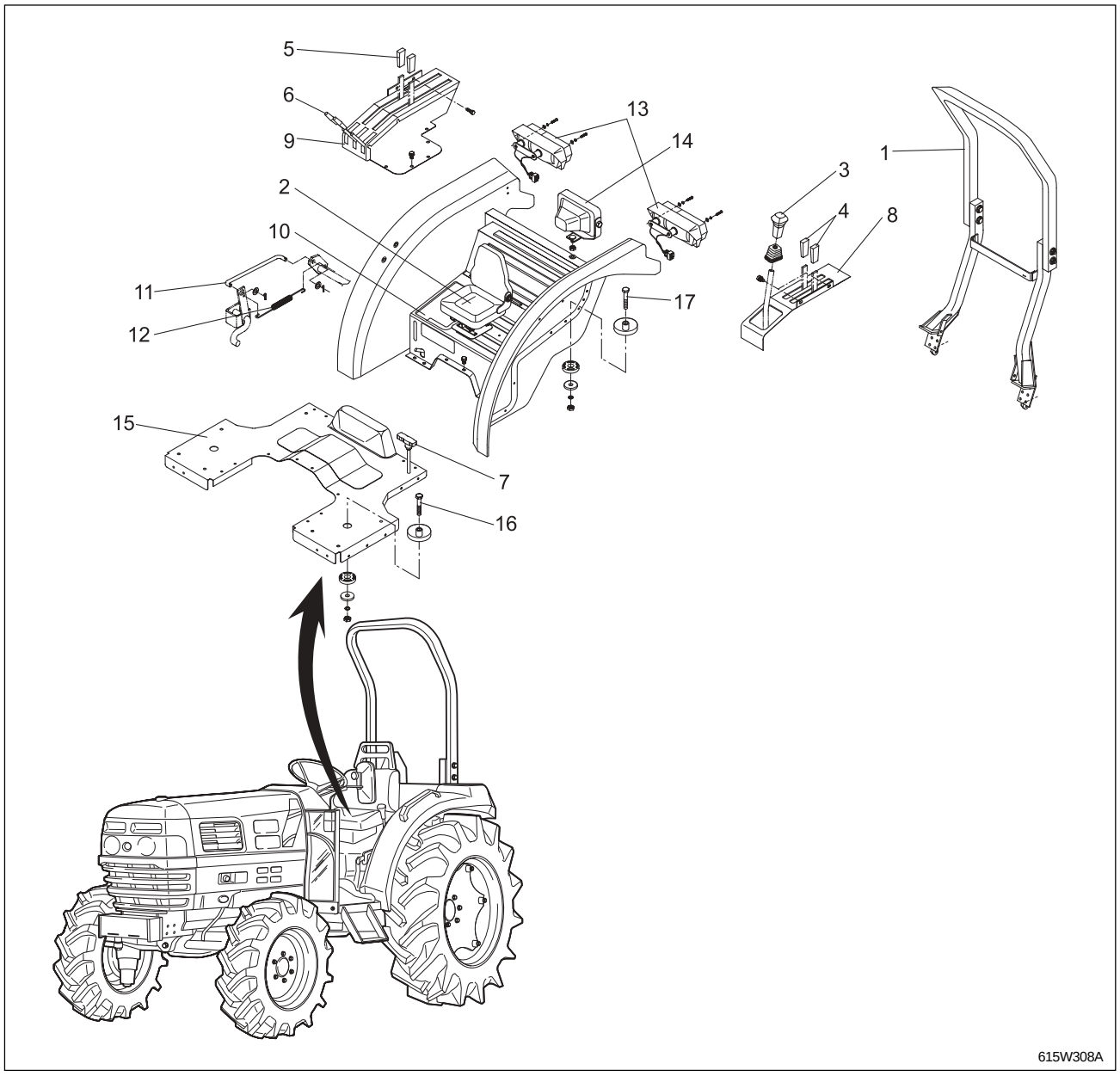
Hose connecting nut tightening torque	46.6 ~ 58.9 N·m 4.8 ~ 5.2 kgf·m 18.1 ~ 21.7 lbf·ft



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

1.2 DISASSEMBLY OF FENDER AND STEPLADDER ASSEMBLY

A. FIRST STAGE



(1) ROPS
(2) Seat Assembly
(3) Main Shift Knob
(4) Knob (Range Lever)
(5) Knob (Position Control Lever)
(6) Knob (External Hydraulic Lever)
(7) Knob (Front Wheel Lever)
(8) Transmission Shift Lever Guide
(9) Hydraulic Lever Guide
(10) Seat Lower Assembly
(11) Differential Clamping Rod
(12) Spring
(13) Rear Light
(14) Work Light
(15) Stepladder Assembly
(16) Bolt
(17) Bolt

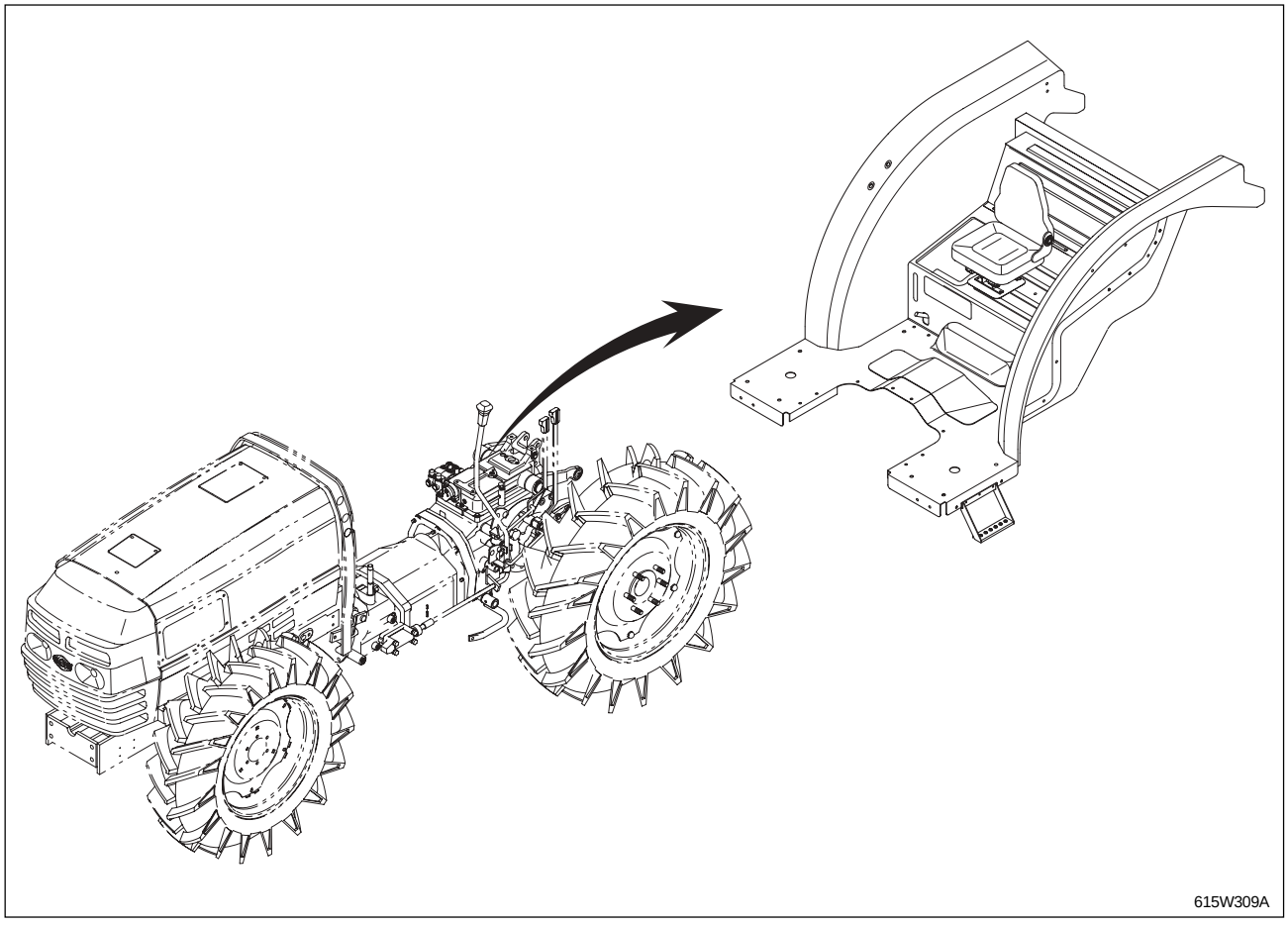
1. Disconnect ROPS (1).
2. Disconnect seat assembly (2).
3. Disconnect knobs (3), (4), (5), (6) and (7) of each transmission shift lever.
4. Disconnect transmission shift lever guide (8) and hydraulic lever guide (9).
5. Disconnect differential clamping rod (11) and the spring (12) from lower seat assembly (10).
6. Disconnect the wiring connector from rear fender light (13) and work light (14).
7. Loosen locking bolts (16) and (17) from the step-ladder assembly (15) and seat lower assembly (10).

(When reassembling)

Sect.	Spec.	Tightening Torque
Stepladder assembly and seat lower assembly locking nut	M16	196 ~ 225 N·m 20.0 ~ 23.0 kgf·m 145 ~ 166 lbf·ft
ROPS locking bolt, nut	M14	166.7 ~ 196.1 N·m 17.0 ~ 20.0 kgf·m 123 ~ 144 lbf·ft
	M12	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.1 ~ 66.5 lbf·ft

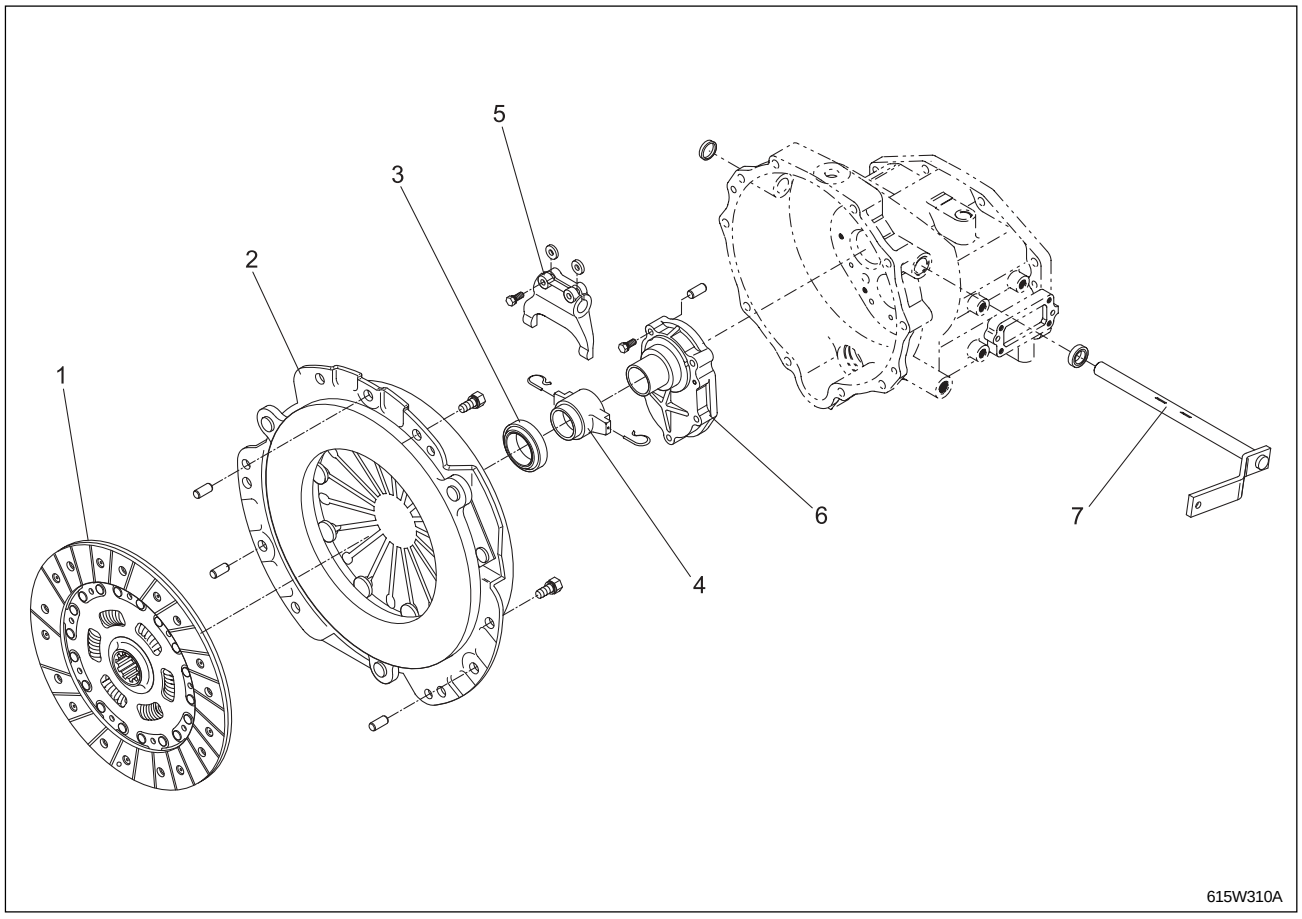
B. SECOND STAGE

1. Disassembly fender and stepladder assembly in a whole.



2. CLUTCH

2.1 CHARACTERISTICS

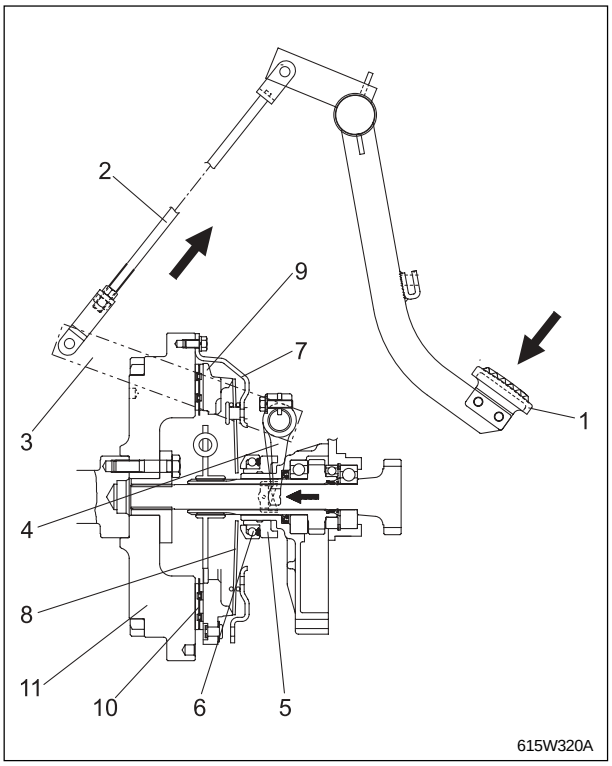


(1) Clutch Disc Assembly
(2) Clutch Cover Assembly
(3) Release Bearing
(4) Clutch Release Hub
(5) Clutch Release Fork
(6) Propulsion Shaft Case
(7) Main Clutch Lever

- Independent PTO method clutch are adapted enable to control the power of Running and the PTO system independently.
- Running Clutch: Is a dry single plate clutch. Depress clutch pedal to disconnect power of running system.
- PTO Clutch: Is a wet multi plate clutch. Control the PTO switch to connect and disconnect power of the PTO.

2.2 LINK STRUCTURE AND CONTROL

- If working clutch pedal, clutch rod (2) is pulled in the direction of arrow and release hub (5) moves to the direction of arrow through release fork (4).
- Release bearing (6) of release hub pushes diaphragm spring (8) of clutch cover assembly (7), releases clutch disc (10) between clutch pressure plate (9) and flywheel (11), and then disconnects power from engine.



(1) Clutch Pedal
(2) Clutch Rod
(3) Main Clutch Lever
(4) Clutch Release Fork
(5) Clutch Release Hub
(6) Release Bearing
(7) Clutch Cover Assembly
(8) Diaphragm Spring
(9) Pressure Plate
(10) Clutch Disc
(11) Flywheel

2.3 TROUBLESHOOTING

Trouble	Probable Cause	Remedy	Remark
Clutch trailed	• Clutch pedal play excessive	Adjust	
	• Clutch disk dirty due to clutch disc assembly	Clean	
	• Clutch fork broken	Replace	
	• Clutch disc or pressure plate distorted	Replace	
	• Diaphragm spring of Pressure Plate worn or broken	Replay pressure Plate assembly	
Clutch slip	• Clutch pedal play too small	Adjust	
	• Clutch disc worn excessively	Replace	
	• Grease or oil on clutch disc	Replace	
	• Clutch disc or pressure plate distorted	Replace	
	• Diaphragm spring weaken or broken	Replace pressure Plate assembly	
Bumping noise	• Grease or oil on clutch disc	Replace	
	• Clutch disc or pressure plate bent	Replace	
	• Clutch disc boss worn or dusty	Replace or clean	
	• Gear shaft bent	Replace	
	• Pressure plate or flywheel cracked or scratched	Replace	
	• Clutch disc spline boss or gear shaft spline worn	Replace	
	• Diaphragm spring not operating constantly or broken	Replace Replace	
Crashing noise	• Clutch disc spline boss worn	Replace	
	• Thrust ball bearing worn or sticking	Replace	
Crashing noise	• Thrust ball bearing sticking or dry	Replace or lubricate	
	• Clutch disc worn excessively	Replace	
Vibration	• Gear shaft bent	Replace	
	• Clutch disc rivet worn or broken	Replace	
	• Clutch parts broken	Replace	

2.4 SPECIFICATION

Item		Reference	Allowable Limit
Clutch pedal	Play	30 ~ 40 mm 1.18 ~ 1.57 in.	-
Stopper bolt setting length	Height	27 ~ 29 mm 1.06 ~ 1.14 in.	-
Clearance between safety switch and clutch pedal	Gap	3 ~ 4 mm 0.12 ~ 0.16 in.	-
Depth from disc to the top of rivet	Depth	-	0.3 mm 0.012 in.
Play of clutch disc O.D.	Displacement	-	2.0 mm 0.079 in.
Pressure plate	Flatness	-	0.2 mm 0.008 in.
Diaphragm spring	Difference	-	0.5 mm 0.020 in.

2.5 TIGHTENING TORQUE

Item		Reference	Allowable Limit
Clutch pedal	Play	30 ~ 40 mm 1.18 ~ 1.57 in.	-
Stopper bolt setting length	Height	27 ~ 29 mm 1.06 ~ 1.14 in.	-
Clearance between safety switch and clutch pedal	Gap	3 ~ 4 mm 0.12 ~ 0.16 in.	-
Depth from disc to the top of rivet	Depth	-	0.3 mm 0.012 in.
Play of clutch disc O.D.	Displacement	-	2.0 mm 0.079 in.
Pressure plate	Flatness	-	0.2 mm 0.008 in.
Diaphragm spring	Difference	-	0.5 mm 0.020 in.

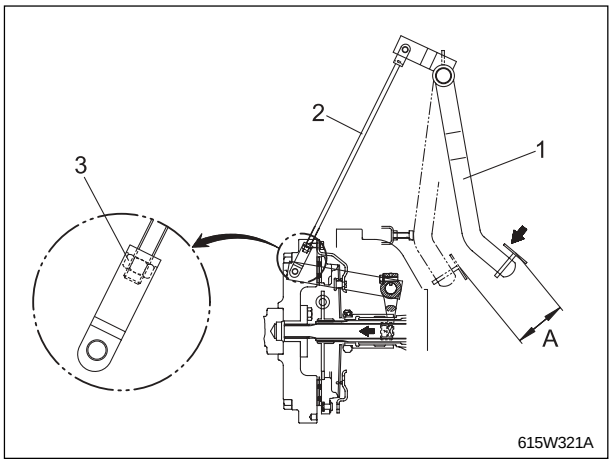
2.6 DISASSEMBLY, MAINTENANCE

A. CLUTCH PEDAL CHECK AND ADJUSTMENT

a. First Stage (Clutch Pedal Play Adjustment)

1. Press clutch pedal (1) by hand and measure play (A) at the end of pedal.
2. If measurement exceeds the specified, loosen lock nut (3) of clutch rod (2), re-adjust the length of clutch rod, set pedal play and then tighten with lock nut.

Sect	Specified
Play of clutch pedal (A)	30 ~ 40 mm 1.18 ~ 0.57 in.

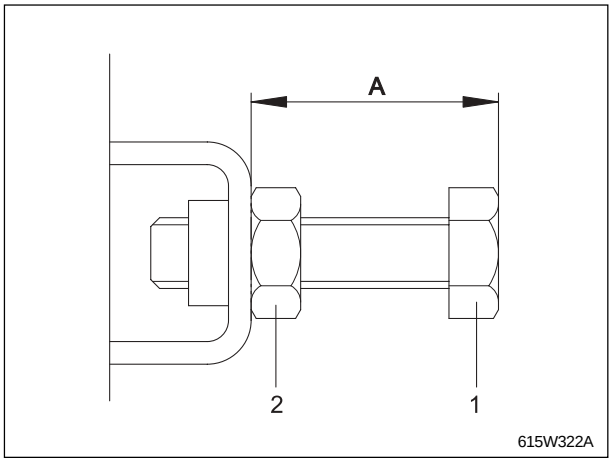


(1) Clutch Pedal (2) Clutch Rod
(3) Lock Nut

b. Second Stage (Adjustment of Clutch Pedal Stopper Bolt)

1. When working clutch pedal when clutch is disconnected, avoid bolt setting to prevent excessive force to clutch.
2. If setting (A) of stopper bolt exceeds the specified, loosen lock nut (2), readjust the length, and then set with lock nut.

Sect	Specified
Stopper bolt setting length (A)	27 ~ 29 mm 1.06 ~ 1.14 in.



(1) Stopper Bolt (2) Lock Nut

c. Third Stage (Adjustment of Safety Switch)

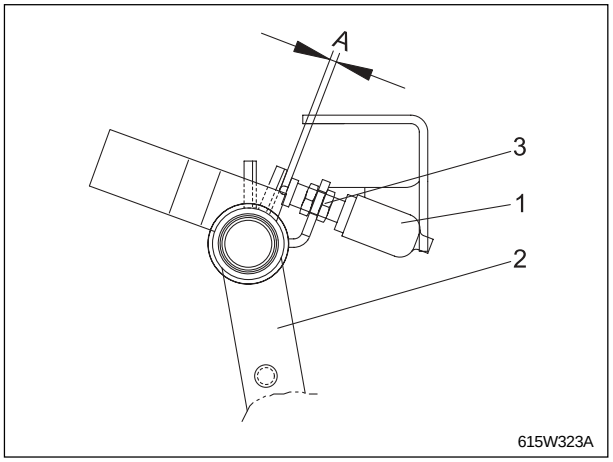
1. Measure clearance (A) of safety switch (1) and clutch pedal (2).
2. If the measured value exceeds the specified, loosen safety switch lock nut (3).

   Readjust and then lock not to be loosen.

Sect	Specified
Clearance of safety switch and clutch pedal (A)	3 ~ 4 mm 0.12 ~ 0.16 in.

CAUTION

- *Without working of clutch pedal, start motor should not be prerated.*



(1) Safety Switch (2) Clutch Pedal
(3) Lock Nut

B. DISASSEMBLY, ASSEMBLY

a. First Stage (Disconnection of Clutch Housing and Flywheel Housing)

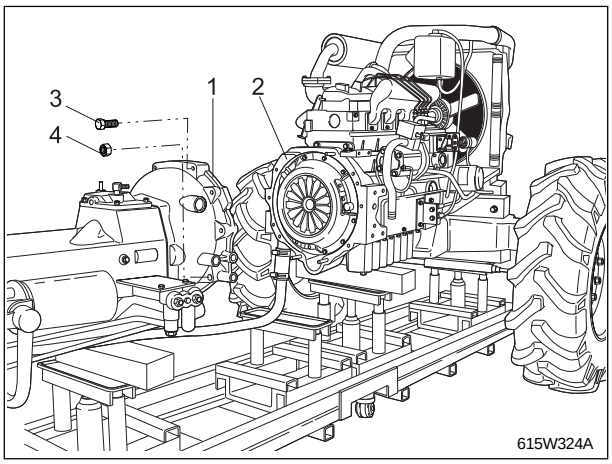
1. Support clutch housing (1) and engine with hydraulic jack.
2. Disengage clutch housing (1), flywheel housing (2), tightening bolt (3) nut (4).
3. Disconnect clutch housing and engine.

(When reassembling)

- Apply spline with grease.
- Apply the contacted surface between clutch housing and flywheel housing with sealing agent.

Sealing agent	Three bond 1208D or equivalent

Sect.	Specified	Tightening Torque
Tightening bolt, nut	M12	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.2 ~ 66.5 lbf·ft
Stud	M12	39.2 ~ 49.0 N·m 4.0 ~ 5.0 kgf·m 28.9 ~ 36.2 lbf·ft



(1) Clutch Housing (2) Flywheel Housing
(3) Bolt (4) Nut

b. Second Stage (Disconnection of Clutch Assembly)

1. Disengage clutch assembly (1), attaching bolt (2) and disconnect clutch from flywheel (3).

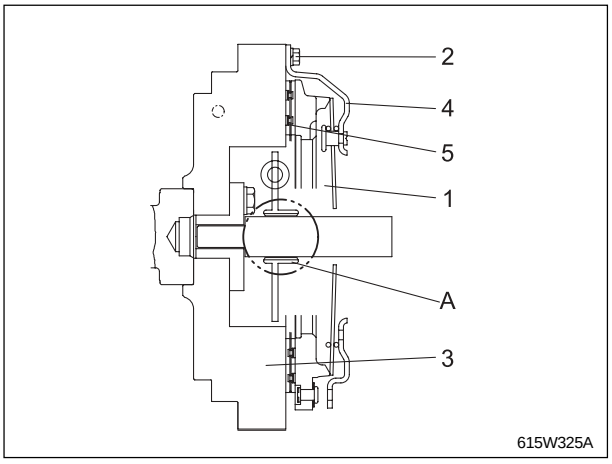
(When reassembling)

- Take notice that assembly direction and shorter spline boss (A) should be located toward flywheel when assembling clutch disc.
- Take care to treat clutch disc and clean each fiction surface of flywheel and clutch pressure plate.

IMPORTANT:

- *When attaching the clutch cover (4) and clutch disk (5) with the flywheel, you should set the clutch disk (5) in the right position. And then, tight bolt equally in the diagonal direction.*

Sect.	Specified	Tightening Torque
Tightening bolt	M8	23.5 ~ 27.5 N·m 2.4 ~ 2.8 kgf·m 17.4 ~ 20.3 lbf·ft



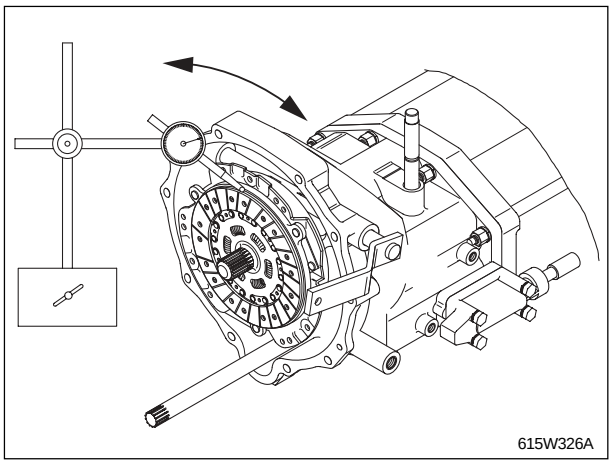
(1) Clutch Assembly (4) Clutch Cover
(2) Washer Holding Bolt (5) Clutch Disc
(3) Flywheel

C. MAINTENANCE

a. Check of Play Between Clutch Disc Spline Boss and Gear Shaft

1. Attach gear shaft with clutch disc.
2. With the gear shaft locked, rotate the disc slightly and measure the play at O.D. end of disc.
3. If the measured value exceeds the allowable limit, replace the disc.

Sect.	Allowable Limit
Play at O.D. end of disc (O.D.: Outside Diameter)	2.0 mm 0.079 in.

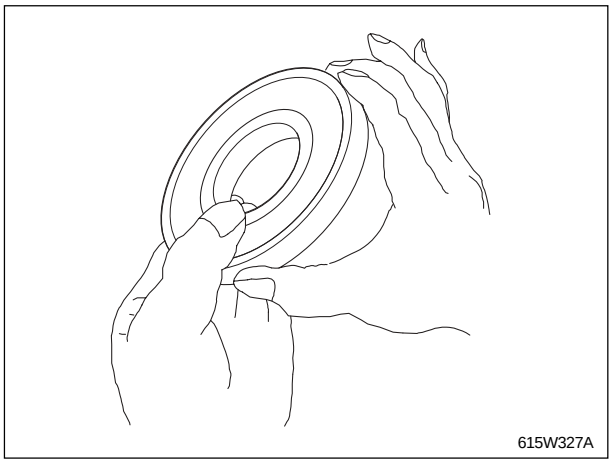


b. Check of Thrust Ball Bearing

1. Check to see if contacted is worn excessively.
2. With inner wheel seized and outer wheel loaded, check for abnormal noise or operation.
3. If faulty, replace it.

CAUTION

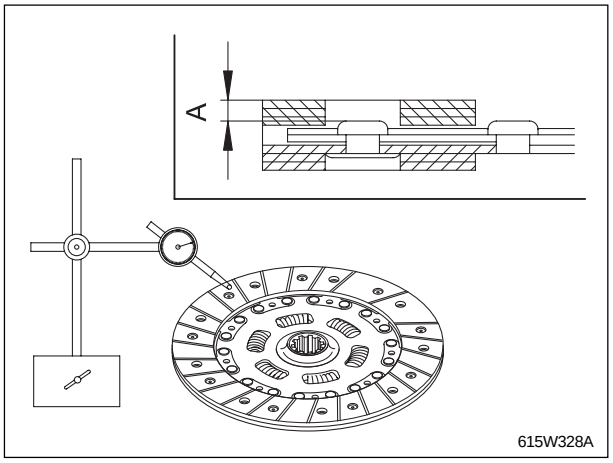
- *When assembling bearing, make sure the outer wheel is not shocked.*



c. Check of Worn Clutch Disc

1. Using a depth gauge, measure the depth from the disc to rivet.
2. If the measured value exceeds the allowable limit, replace it.

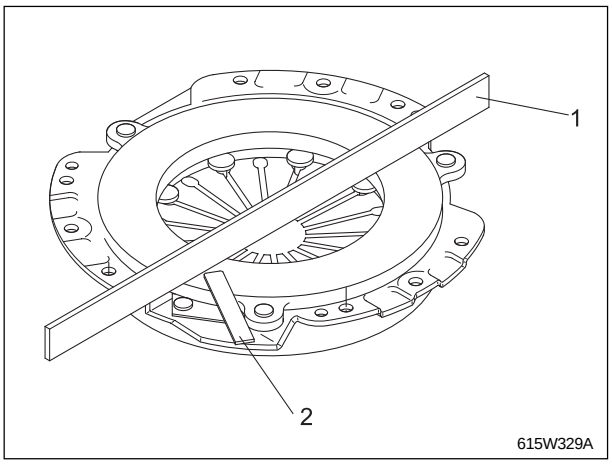
Sect.	Allowable Limit
Depth to upper rivet from disc (A)	0.3 mm 0.012 in.



d. Check of Flywheel and Clutch Pressure Plate

1. Check to see if the flywheel and clutch pressure plate are faulty or scored.
2. If a dent or score is found then replace it.
3. Put a straight rule on clutch pressure plate and check the flatness using a gab gauge, if it exceeds the allowable limit, replace it.

Sct.	Allowable Limit
Fatness of clutch pressure plate	0.2 mm 0.008 in.



(1) Straight Rule

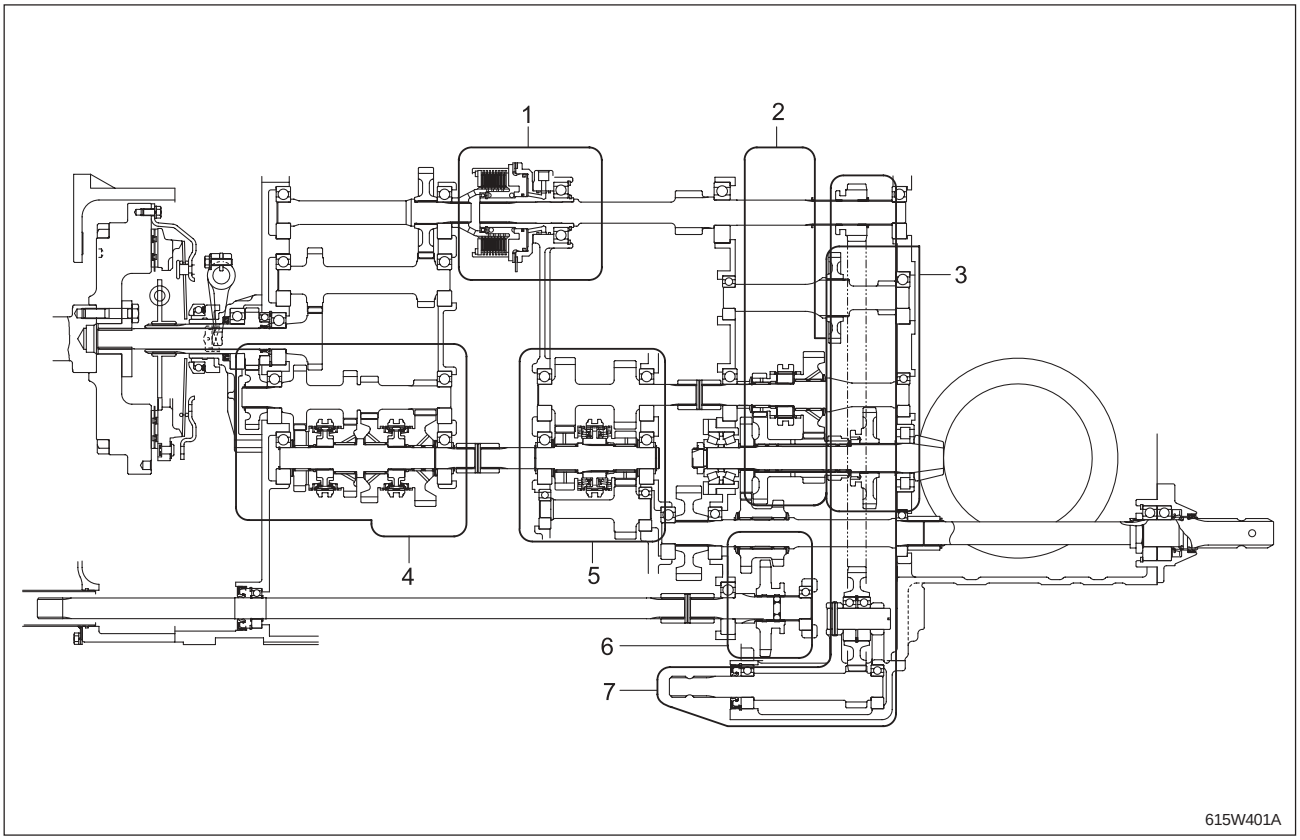
(2) Gab Gauge

CHAPTER 4

TRANSMISSION

1. STRUCTURE

Sect.	Main Shift	Shuttle	Hi-Lo Shift	Creep Speed (*)	PTO
Transmission method	Synchro mesh	Synchro mesh	Constant mesh	Constant mesh	Fixed
Transmission stage	4th Stage	Forward/ Reversing	2nd Stage (Low/High Speed)	2nd Stage (Low/High Speed)	1st Stage
Forward: 8th Stage, Reversing: 8th Stage (*:Option,Forward: 16th Stage, Reversing: 16th Stage)					



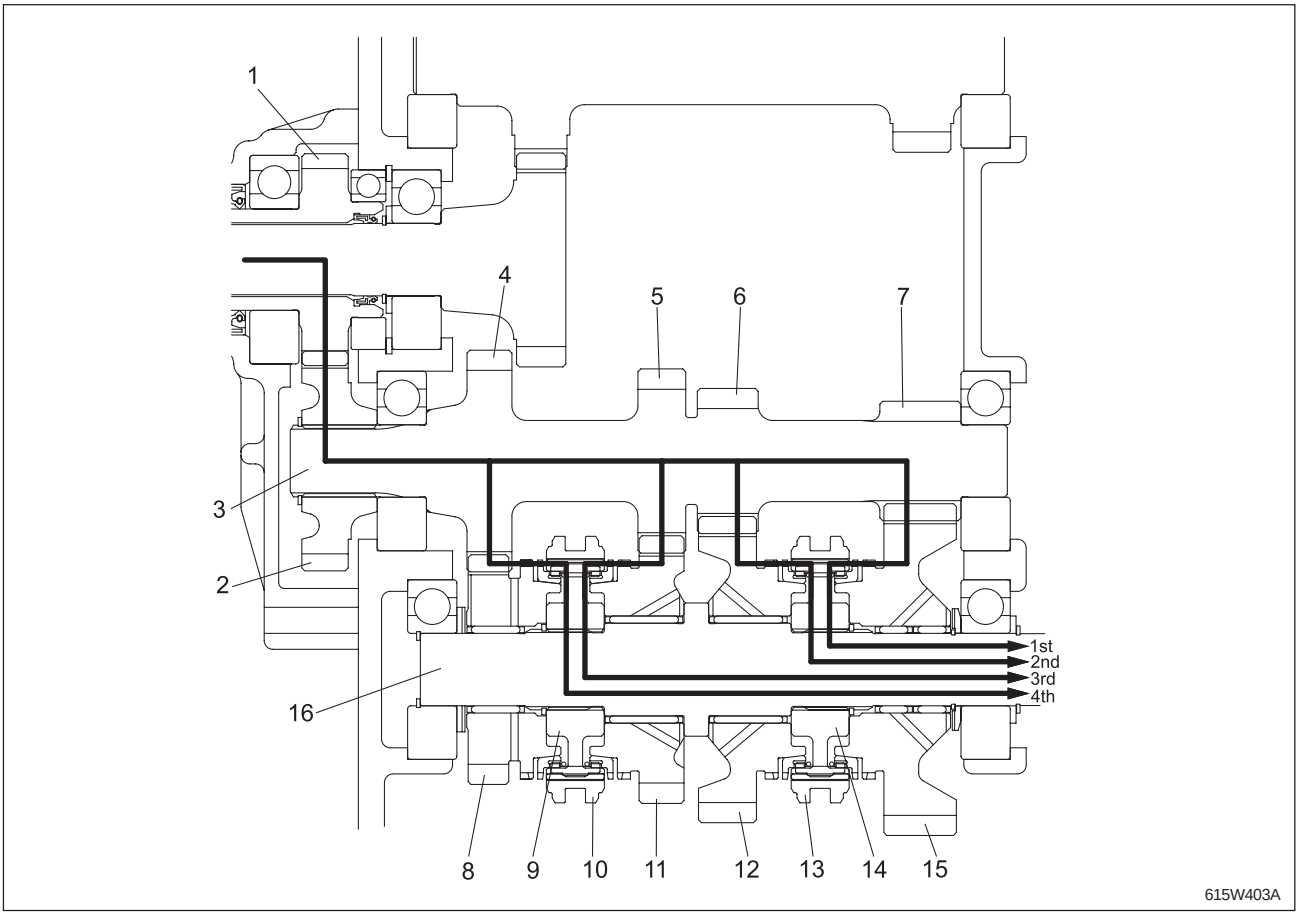
(1) Clutch Pack for PTO
(2) Hi-Low Shift Section
(3) Creep Shift Section(IF APPLICABLE)
(4) Main Gear Shift Section
(5) Shuttle Shift Section
(6) Front Wheel Drive Shift Section
(7) MID PTO Section

2. POWER TRANSMISSION

2.1 MAIN TRANSMISSION

- Consists of full synchro mesh and employs key type as synchro.

A. Power Transmission Flow



(1) 25 Gear Shaft
(2) 26 Gear
(3) Main Gear Shaft
(4) 23 Gear
(5) 29 Gear
(6) 14 Gear
(7) 11 Gear
(8) 24 Gear
(9) Synchro Hub
(10) Shift
(11) 29 Gear
(12) 33 Gear
(13) Shift
(14) Synchro Hub
(15) 36 Gear
(16) Counter Shaft

1st Stage

25 Gear shaft (1) → 26 Gear (2) → Main gear shaft (3) → 11 gear (7) → 36 gear (15) → Shift (13) Synchro hub (14) → Counter shaft (16)

2nd Stage

25 Gear shaft (1) →26 Gear (2) → Main gear shaft (3) → 14 Gear (6) → 33 Gear (12) → Shift (13) Synchro hub (14) → Counter shaft (16)

3rd Stage

25 Gear shaft (1) → 26 Gear (2) → Main gear shaft (3) →19 Gear (5) → 29 Gear (11) → Shift (10) Synchro hub (9)→ Counter shaft (16)

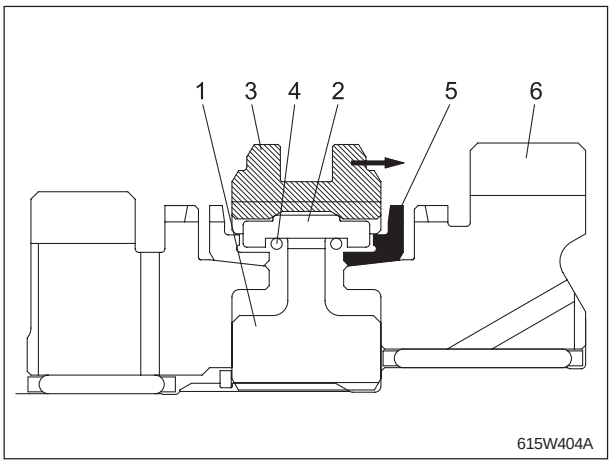
4th Stage

25 Gear shaft (1) → 26 Gear (2) → Main gear shaft (3) → 23 Gear (4) → 24 Gear (8) → Shift (10) Synchro hub (9) → Counter shaft (16)

B. Synchro Operation

1st Stage

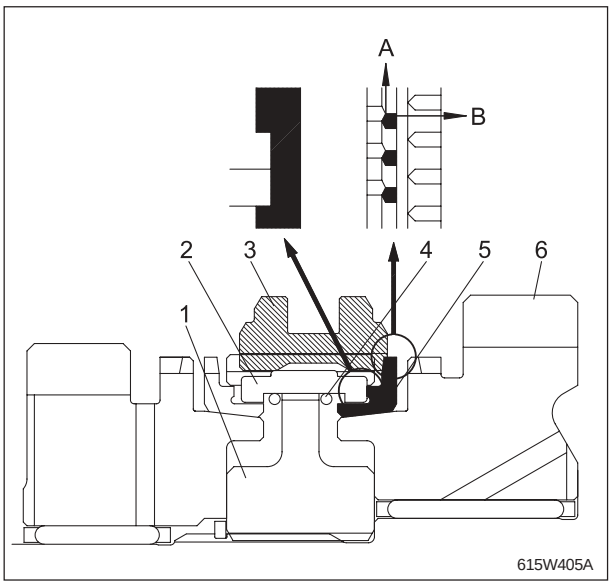
- By shifting the main transmission shift lever, shifter (3) and key (2) are moved and the end of the key contacts with cone of gear (6) with synchronizer ring (5) pushed.
- By friction power occurred in the cone of synchronizer key (2), and synchro hub (1) rotates in a body.



(1) Synchro Hub
(2) Synchronizer Key
(3) Shift
(4) Synchronizer Spring
(5) Synchronize Ring
(6) Gear

Intermediate Stage

- When synchronizer key (2) is not slipped any longer by synchronizer ring (5), it will fall from shift (3) and the key will enter the groove of the synchronizer ring.
- Synchronizer key, shift, and synchro hub (1) starts to rotate and the synchronizer ring and gear (6), rotates simultaneously by tightening the chamfering of the shift and synchronizer ring.

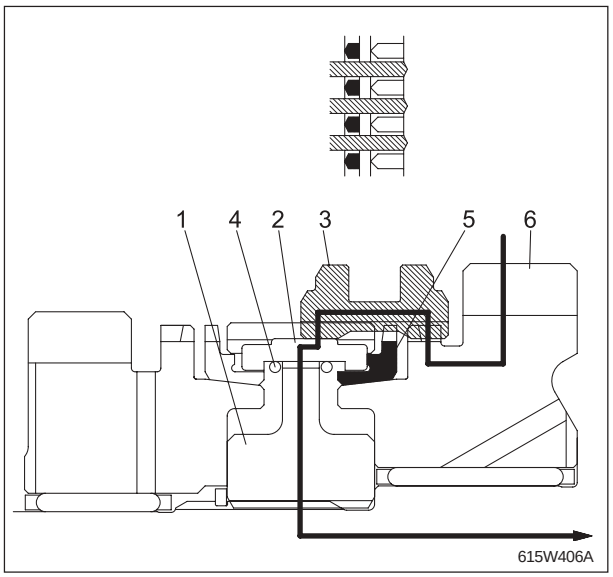


(1) Synchro Hub
(2) Synchronizer Key
(3) Shift
(4) Synchronizer Spring
(5) Synchronize Ring
(6) Gear

[A] Rotating Force
[B] Force to Shift

Final Stage

- When the rotation speed of shift (3) are equal with that of gear (6), the rotation force of synchronizer ring (4), will not affect on shift any longer. The Shift is rotated with the synchronizer ring and gear (6), engaged for perfect transmission.

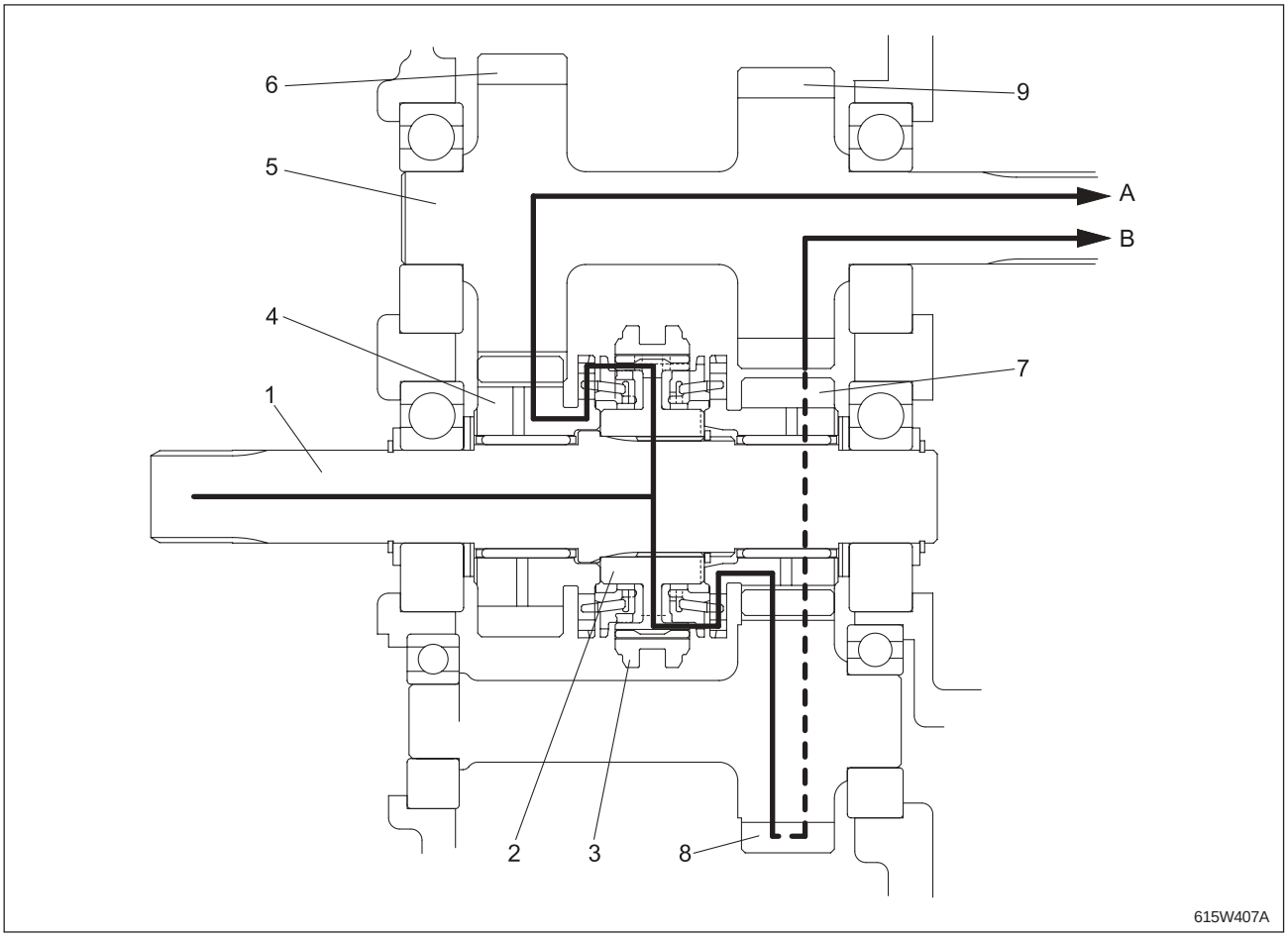


(1) Synchro Hub
(2) Synchronizer Key
(3) Shift
(4) Synchronizer Spring
(5) Synchronize Ring
(6) Gear

2.2 SHUTTLE

- Employs double synchro mesh type with 8th stage in forward or reverse and improves the transmission shift power and durability as the contacted amount of cone increased twice.

Power Transmission Flow Chart



(1) Shuttle Shaft
(2) Spline Hub
(3) Shift
(4) 19 Gear
(5) 23-21 Gear Shaft
(6) 23 Gear
(7) 16 Gear
(8) 18 Gear
(9) 21 Gear

[A] FORWARD
[B] REVERSE

Forward

Shuttle shaft (1) → Spline hub (2) → Shift (3) → 19 Gear (4) → 23 Gear (6) → 23-21 Gear shaft (5)

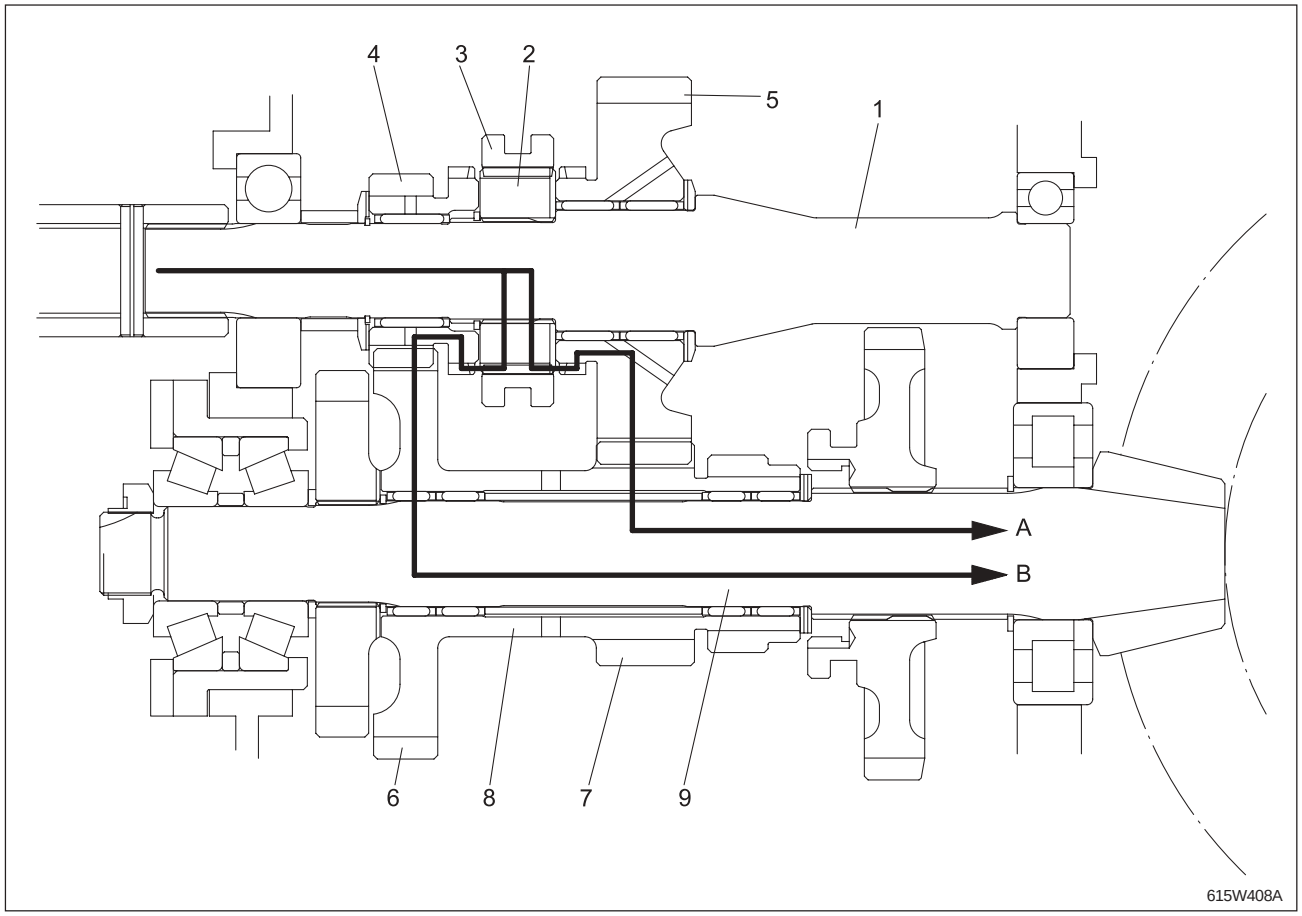
Reversing

Shuttle shaft (1) → Spline hub (2) → Shift (3) →18 Gear (8) → 21 Gear (9) → 23-21 Gear shaft (5)

2.3 HI-LO SHIFT

- With High/Low stage, employs selective engagement method and when setting the Hi-Lo shift lever to the transmission position, the power will be transmitted.

Power Transmission Flow



(1) Hi-Lo Shift Shaft
(2) Spline Boss
(3) Shift
(4) 18 Gear
(5) 32 Gear
(6) 42 Gear
(7) 17 Gear
(8) 42-17-18 Gear
(9) Spiral Bevel Pinion Gear

[A] HIGH SPEED
[B] LOW SPEED

Low Speed

Hi-Lo shift shaft (1) → Spline boss (2) → Shift (3) → 18 Gear (4) → 42 Gear (6) → Spiral bevel pinion gear (9)

High Speed

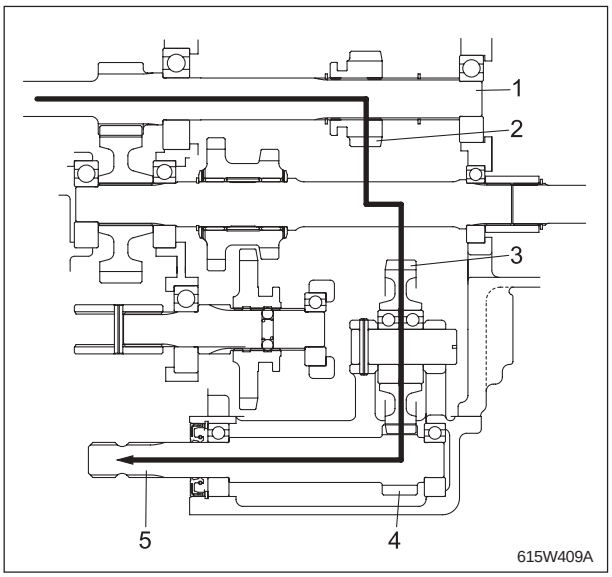
Hi-Lo shaft (1) → Spline boss (2) → Shift (3) → 32 Gear (5) → 17 Gear (7) → Spiral bevel pinion gear (9)

2.4 MID PTO

- Consists of an independent PTO, which uses a gear engagement shift method and performs gear transmission when PTO clutch is set to OFF.

Power Transmission Flow

- 12 gear shaft (1) → 20 spur gear (2) → 41 spur gear (3) → 14 gear (4) → Mid PTO shaft (5)



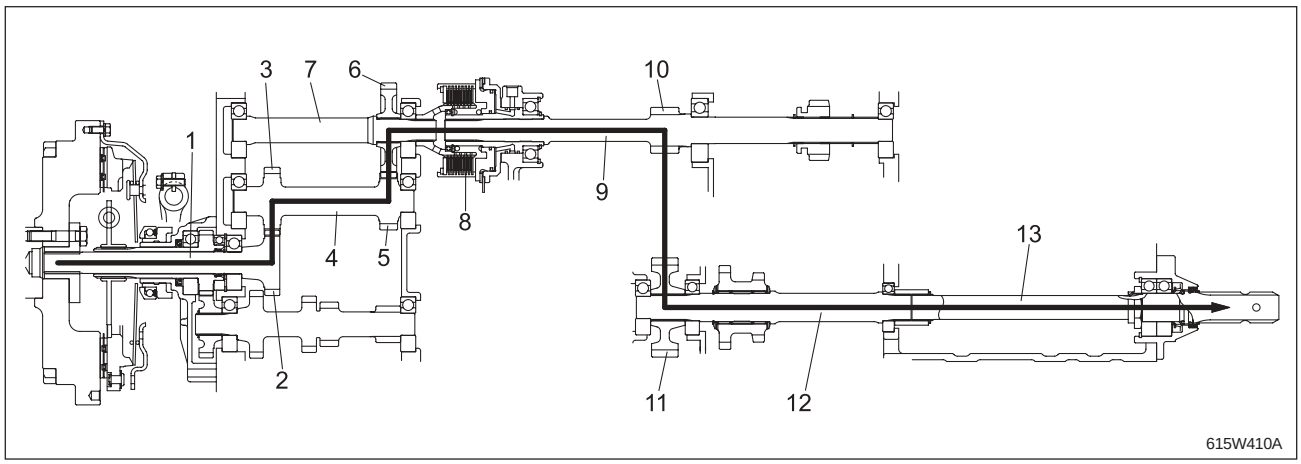
(1) 12 Gear Shaft
(2) 20 Spur Gear
(3) 41 Spur Gear
(4) 14 Gear
(5) Mid PTO Shaft

2.5 REAR PTO

- The independent PTO method in the 1st stage is the fixed type, and employs a hydraulic clutch.

Power Transmission Flow

Applicable Model	PTO type	PTO stage	PTO rpm/Engine rpm
8354/8404	Independent PTO	1st stage fixed type	540/2505



(1) 22 Gear Shaft (PTO)
(2) 22 Gear
(3) 23 Gear
(4) 23 - 19 Gear
(5) 19 Gear
(6) 33 Gear
(7) Counter Shaft (PTO)
(8) PTO Clutch Assembly
(9) 12 Gear Shaft
(10) 12 Gear
(11) 30 Gear
(12) PTO Drive Shaft
(13) PTO Shaft

- 22 Gear shaft (PTO) (1) → 22 Gear (2) → 23 Gear (3) → 23-19 Gear (4) → 19 Gear (5) → 33 Gear (6) → Counter shaft (PTO) (7) → PTO clutch assembly (8) → 12 Gear shaft (9) → 12 Gear (10) → 30 Gear (11) → PTO drive shaft (12) → PTO shaft (13)

2.6 CREEPER SPEED (IF APPLICABLE)

- The High/Low stage, employs a gear engagement method and when setting the Hi-Lo shift lever and creep speed lever to the transmission position, the power will then be transmitted.

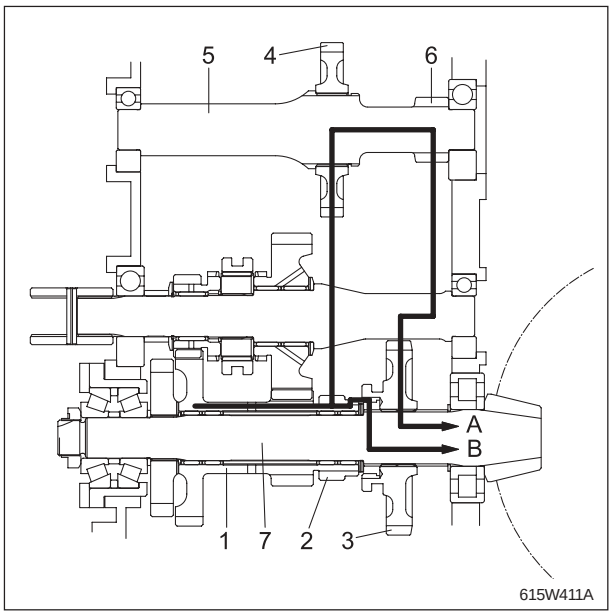
A. Power Transmission Flow

Low Speed

- 42-17-18 Gear (1) → 18 Gear (2) → 41 Gear (4) → 13 Gear shaft (5) → 13 Gear (6) → 46 Gear (3) → Spiral bevel pinion gear (7)

High Speed

- 42-17-18 Gear (1) → 18 Gear (2) → 46 Gear (3) → Spiral bevel pinion gear (7)



(1) 42-17-18 Gear
(2) 18 Gear
(3) 46 Gear
(4) 41 Gear
(5) 13 Gear Shaft
(6) 13 Gear
(7) Spiral Bevel Pinion Gear

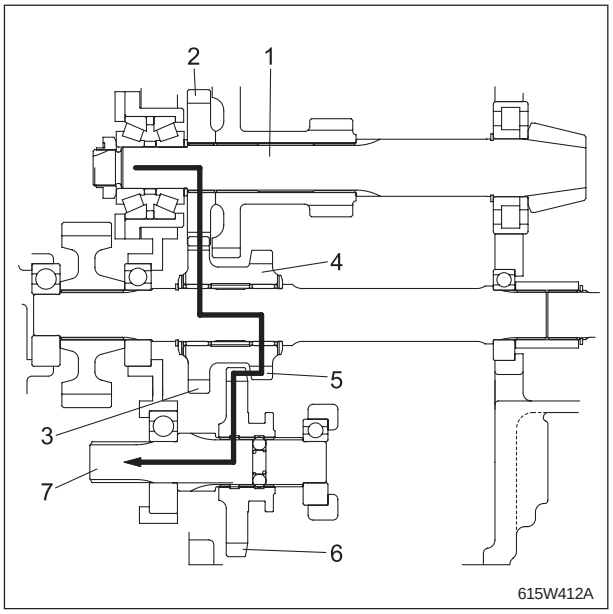
[A] Low
[B] High

2.7 FRONT WHEEL DRIVE

- Employs a gear engagement type and disengage/ engage in a simple style.

Power Transmission Flow

- Spiral bevel pinion (1) → 25 Gear (2) → 26 Gear (3) → 26-20 Gear (4) → 20 Gear (5) → 31 Gear (6) → Front wheel drive shaft (7)

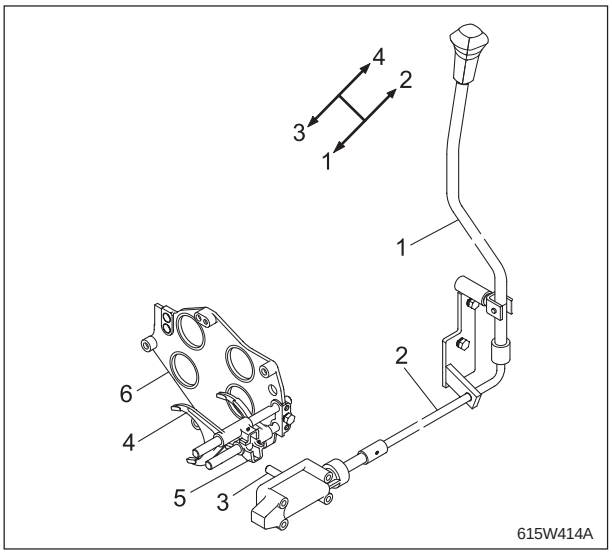


(1) Spiral Bevel Pinion
(2) 25 Gear
(3) 26 Gear
(4) 26-20 Gear
(5) 20 Gear
(6) 31 Gear
(7) Front Wheel Drive Shaft

3. TRANSMISSION SHIFT LINK STRUCTURE

3.1 MAIN SHIFT

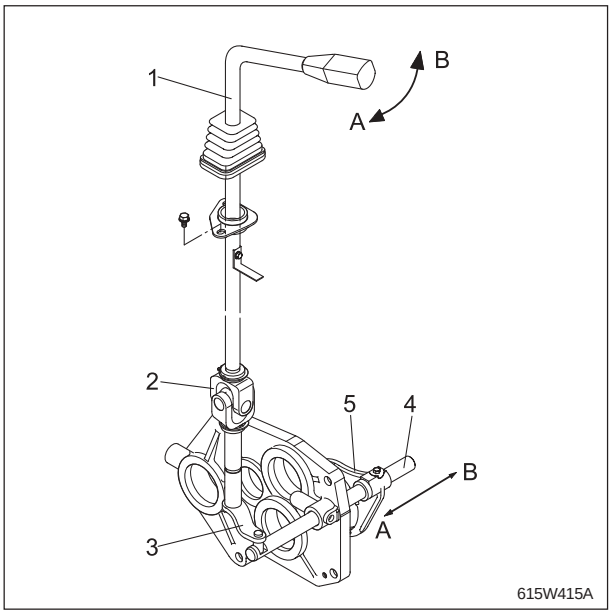
- The transmission shift lever (1) is located in left of the driver's seat and is connected to transmission arm (3), transmission fork (4), and (5).
- One transmission shift lever is enabled from the 1st to the 4th stage and is easy to operate.
- If the transmission shift lever moved to left, the transmission arm will be engaged with transmission fork (4) in 1st and 2nd stage. If the lever is moved to the front or rear, then the 1st and 2nd transmission shift will be enabled.
- If the transmission shift lever is moved to the right, the transmission arm will be engaged with transmission fork (5) in 3rd and 4th stage. If the lever is moved to the front or rear, 3rd and 4th transmission shift will be engage.



(1) Transmission Shift Lever
(2) Main Transmission Shift Rod
(3) Transmission Arm
(4) Transmission Fork (1st, 2nd)
(5) Transmission Fork (3rd, 4th)
(6) Bearing Case

3.2 SHUTTLE SHIFT

- Shuttle lever (1) is located to the left of the steering wheel and connected to universal joint (2), transmission arm (3), fork rod (4), and transmission fork (5).
- If pushing shuttle lever (1), [Forward] transmission will be done and if pulling it, [Reversing] done.

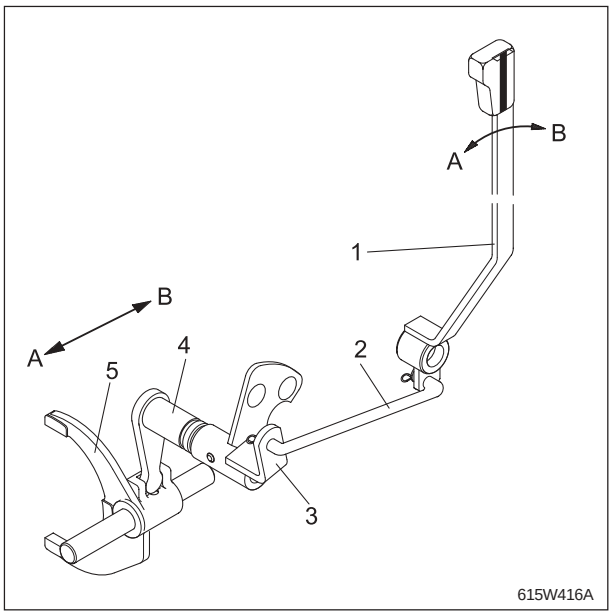


(1) Shuttle Lever
(2) Universal Joint
(3) Transmission Arm
(4) Fork Rod (Shuttle)
(5) Transmission Fork (Shuttle)

[A] FORWARD [B] REVERSE

3.3 HI-LO SHIFT

- Aux. transmission shift lever (1) is located towards the left of the driver's seat and is connected to Hi-Lo shift rod (2), Hi-Lo shift lever 1 (3), Transmission arm (4), and the Transmission fork (5).
- If pushing Hi-Lo shift lever forward, [Low Speed] transmission shift will be done and if pulling backward, [High Speed] transmission shift done.



(1) Aux. Transmission Shift Lever
(2) Aux. Transmission Rod
(3) Aux. Transmission Shift Lever 1
(4) Transmission Arm (Aux. Transmission)
(5) Transmission Fork (Aux. Transmission)

[A] Low
[B] High

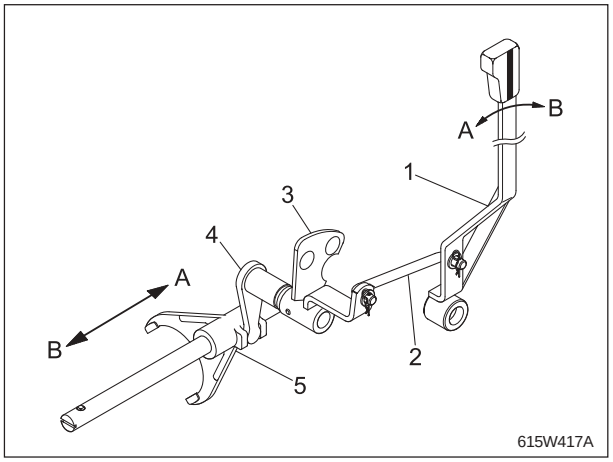
3.4 SHIFT

- 8354 and 8404 models employs 1st stage fixed type and enables manual or auto operation by means of a switch.

3.5 CREEPER SPEED

Model:(IF APPLICABLE)

- Creep speed lever (1) is located at left of driver's seat and is connected to the creep speed rod (2), creep speed lever 1 (3), transmission arm (4), and transmission fork (5).
- If pushing creep speed lever forward, [Low Speed] transmission shift will be done and if pulling backward, [High Speed] transmission shift done.

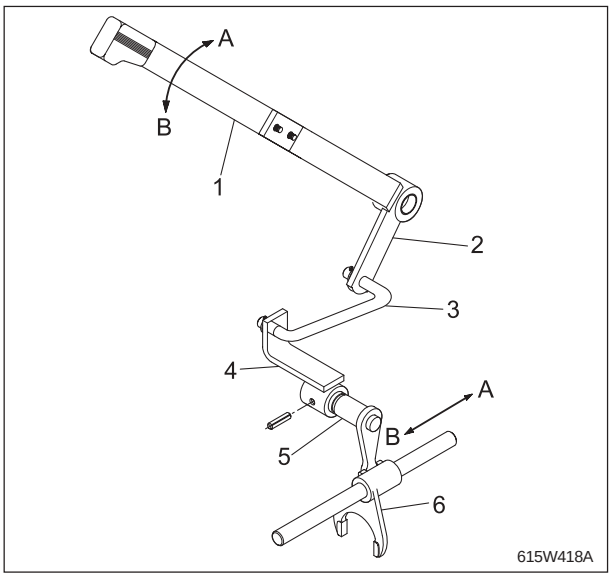


(1) Creep Speed Lever
(2) Creep Speed Rod
(3) Creep Speed Lever 1
(4) Transmission Arm
(5) Transmission Fork

[A] Low
[B] High

3.6 MID PTO SHIFT

- Mid PTO lever (1) is located to the right of the driver's seat and connected to the mid PTO lever assembly (2), rod (3), mid PTO lever 1 (4), transmission arm (5), and the transmission fork (6).
- Set the PTO switch at Neutral and convert switch into Manual or Auto after a completion of transmission shift.
- If pushing mid PTO lever forward, it will be set to [Disengagement] and if pulling backward, set to [Engagement].

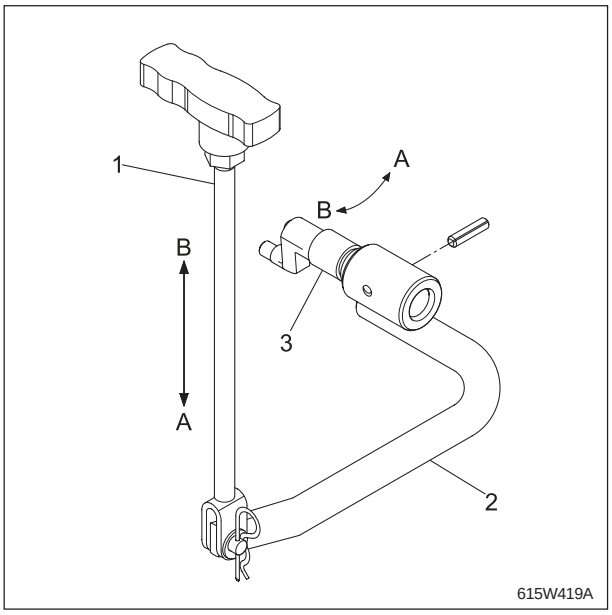


(1) Mid PTO Lever
(2) Mid PTO Lever Assembly
(3) Rod (Mid PTO)
(4) Mid PTO Lever 1
(5) Transmission Arm
(6) Transmission Fork (Mid)

[A] ENGAGED
[B] DISENGAGED

3.7 FRONT WHEEL DRIVE SHIFT

- Front wheel drive lever 2 (1) is located at left lower of driver's seat and connected to front wheel drive lever (2) and transmission arm (3) in the method of gear engagement.
- If pulling front wheel drive lever 2 (1) upward, it will be set to [Disengagement] and if pushing downward, set to [Engagement].



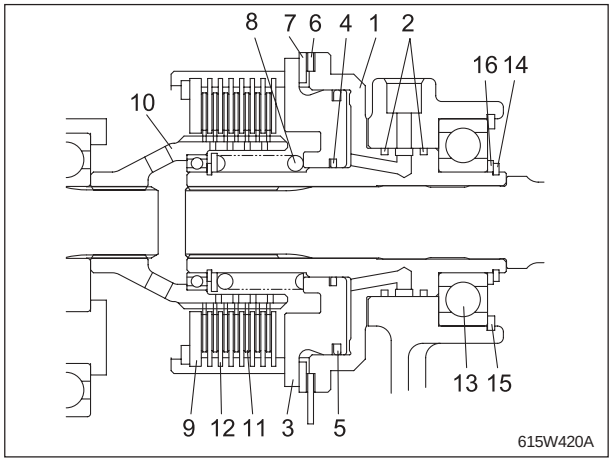
(1) Front Wheel Drive Lever 2
(2) Front Wheel Drive Lever
(3) Transmission Arm (Front Wheel Drive)

[A] ENGAGED
[B] DISENGAGED

4. PTO CLUTCH

4.1 CHARACTERISTICS

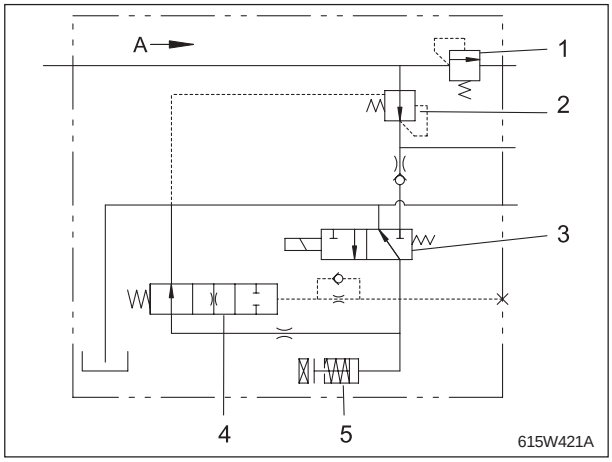
- PTO clutch body is a wet multiplate hydraulic clutch and the clutch valve is set to [ON] or [OFF] to supply the PTO, using PTO switch.
- When PTO clutch is set to [ON], it can be selected automatically or manually. If PTO switch is selected to [AUTO] and hydraulic elevating arm located to Increase, PTO power will be disconnected automatically. If PTO switch selected to [MANUAL], PTO power will be transmitted regardless of position of hydraulic elevating arm.
- The PTO clutch valve has a built-in Modulator valve, which increases the pressure of the clutch slowly and takes a role of semi clutch. The PTO clutch body is installed with a brake system to prevent the clutch body from rotating due to inertia force in [OFF] and to stop the PTO shaft accurately.



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

4.2 HYDRAULIC CIRCUIT

- Reducing valve of the modulator valve assembly controls the pressure of the oil and flows oil into the PTO clutch or drain tank in accordance with the solenoid valve control.



(1) Sequence Valve
(2) Reducing Valve
(3) Solenoid Valve
(4) Pressure Control Valve
(5) PTO Clutch Body

[A] INPUT

4.3 OIL FLOW

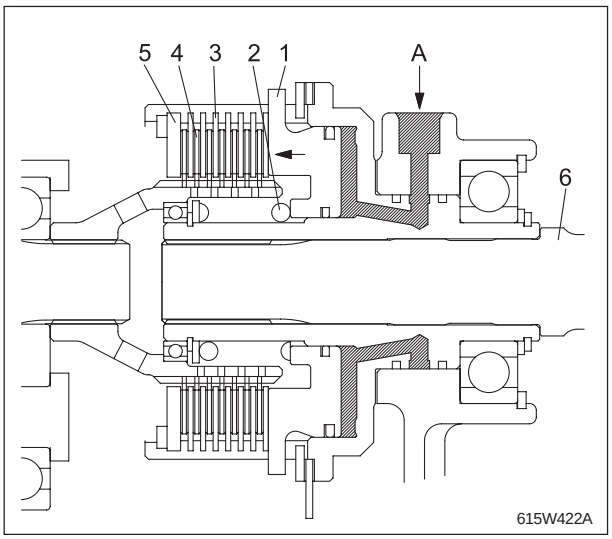
A. With PTO Clutch ON

a. If PTO conversion switch is set to [ON], the PTO clutch valve will be operated to flow oil from the hydraulic pump to PTO clutch “A” port.

b. This oil flows to the piston, where it pushes the piston in the direction of arrow with spring compression.

c. Tighten clutch plate and clutch disc with pressure plate to drive PTO shaft by friction force.

d. The pressure in the PTO clutch circuit is slowly increased to the reducing valve control pressure (between 19 and 21 kgf/cm^2) by the modulator valve.

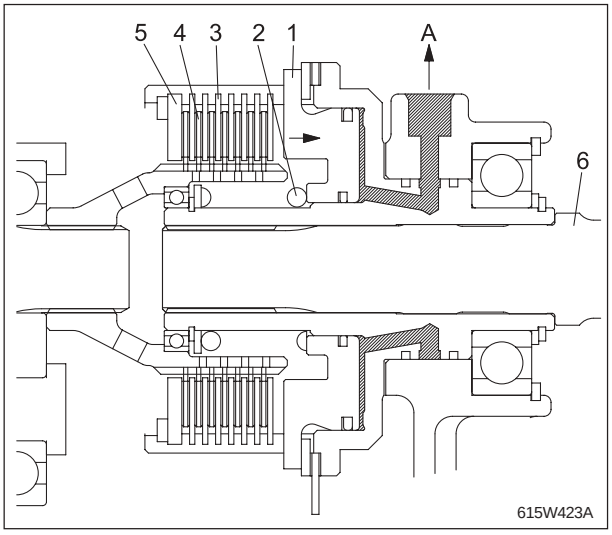


(1) Piston
(2) Spring
(3) Clutch Plate
(4) Clutch Disc
(5) Pressure Plate
(6) PTO Shaft

B. With PTO Clutch OFF

a. If PTO conversion switch is set to [OFF], the PTO clutch valve will operate to close the path of “A” port by solenoid valve.

b. The piston will be retracted by spring reaction force in the direction of arrow and the clutch disc will not be locked tightly. Consequently, Power transmission will be stopped toward the PTO shaft.

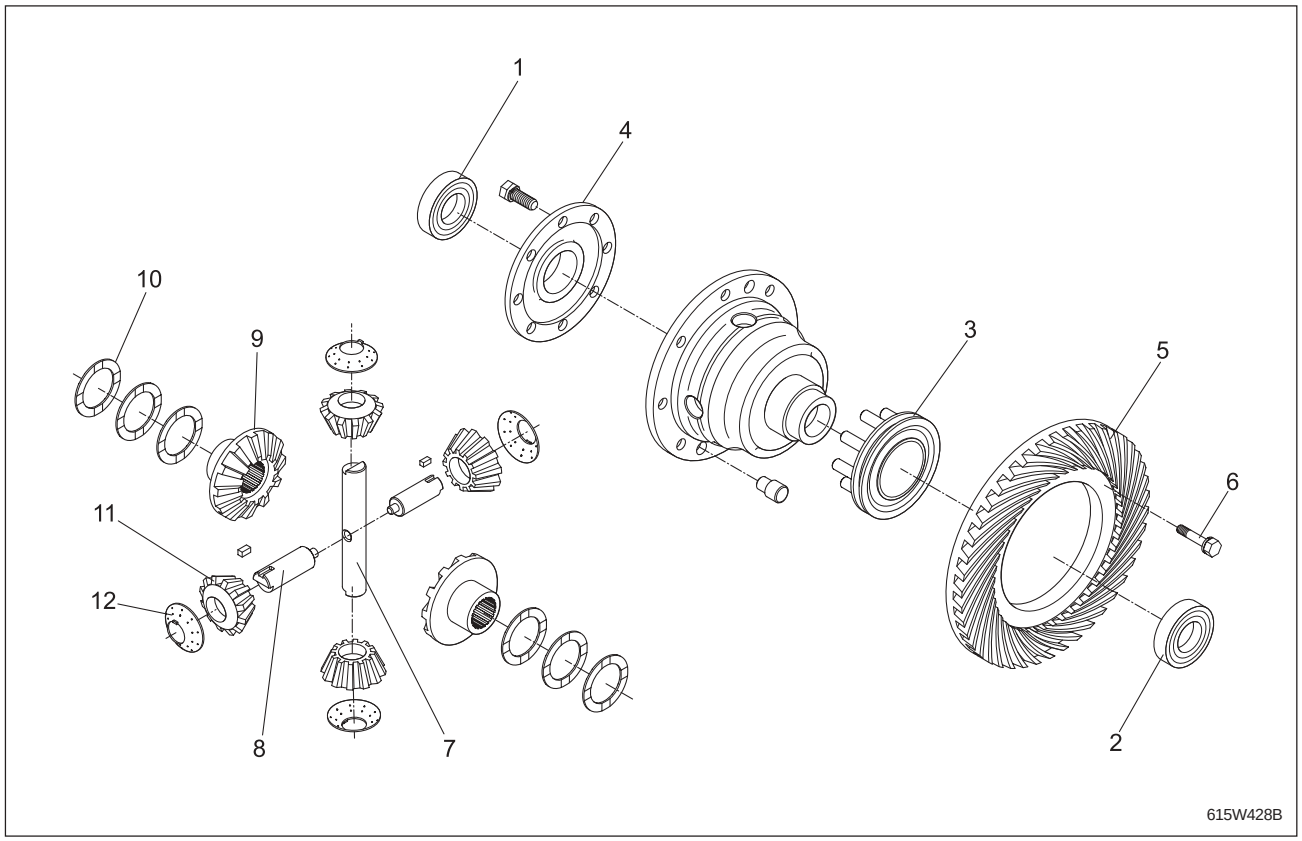


(1) Piston
(2) Spring
(3) Clutch Plate
(4) Clutch Disc
(5) Pressure Plate
(6) PTO Shaft

5. DIFFERENTIAL GEAR

5.1 STRUCTURE

- Differential gear is a 4 pin type, distributes and provides suitable rpm's automatically to the left and right wheel for tractor's turning and efficient running on off road or curve.
- It is equipped with a pin type differential locking device to stop differential operation when slipping, and stopping only one wheel according to road or pavement conditions.

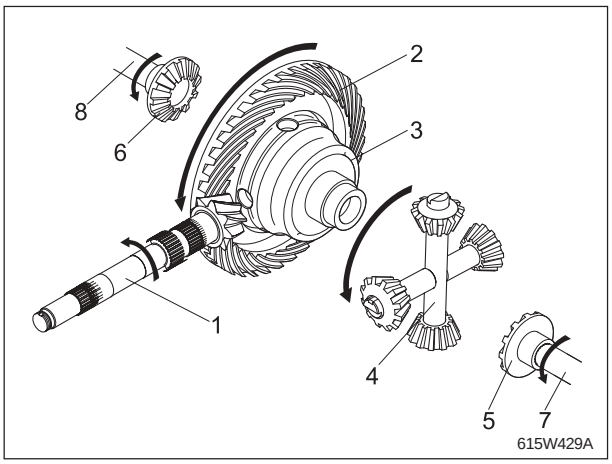


(1) Differential Gear Case
(2) Cap
(3) Parallel Pin
(4) Bolt
(5) Differential Pinion Shaft 1
(6) Differential Pinion Shaft 2
(7) Key
(8) Differential Pinion
(9) Differential Pinion Washer
(10) Differential Side Gear (Right)
(11) Differential Side Gear (Left)
(12) Differential Washer
(13) Bolt
(14) Spiral bevel Gear
(15) Differential Locking Shift

5.2 OPERATION

A. Traveling Straight Ahead

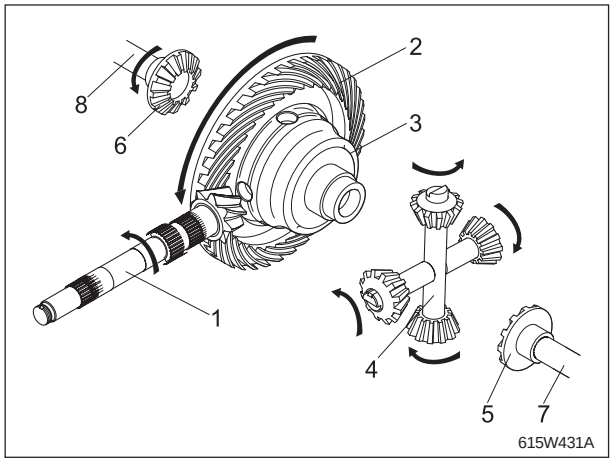
- Rotation of spiral bevel pinion (1) will be transmitted to spiral bevel gear (2) and if road resistance is transmitted to both wheels equally, the differential pinion (4) and differential side gear (5), (6) will be rotated with differential case (3) in a body and differential gear shaft (7). (8) Will run at the same speed, transmitting equal rotation to both wheels.



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

B. Turning a Corner

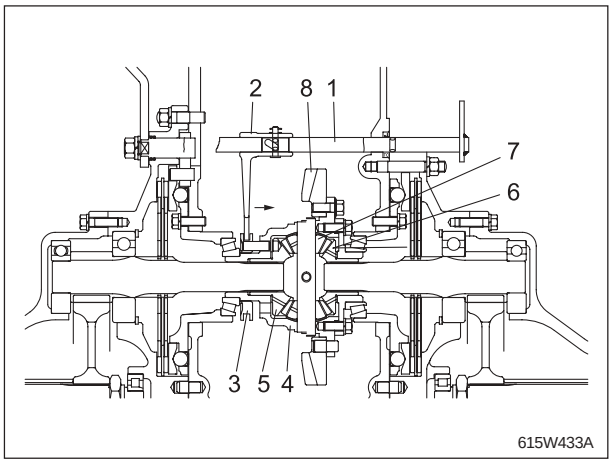
- Rotation of spiral bevel pinion (1) will be transmitted to spiral bevel gear (2). When turning, the outer wheel should rotate faster than the inner wheel. Therefore, While differential pinion (4) rotated with the differential case (3), one differential gear shaft should be rotating on differential pinion faster than the other.



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

C. Differential Lock

- When the resistance of the right and left tires varies from the ground or work conditions, it could cause the wheels to slip and one wheel will be rotating faster than the other. Therefore, towing power will be decreased. To compensate for this, the differential locking device restricts differential function and provides equal rpm's to both wheels.
- If working the differential locking pedal, differential locking fork shaft (1) will rotate and the differential locking fork (2) will moved to differential side gear (5) with differential locking shift (3), pin of shift entered groove of side gear to lock side gear. Rotation of spiral bevel gear (8) will be transmitted to both wheels to move tractors forward.
- If stopping differential locking pedal, differential locking shift (3) will be removed from side gear by the return spring of the differential locking pedal to release locking and to return differential function.



(1) Differential Locking Fork Shaft
(2) Differential Locking Fork
(3) Differential Locking Shift
(4) Differential Gear Case
(5) Differential Side Gear (Left)
(6) Differential Side Gear (Right)
(7) Differential Pinion
(8) Spiral Bevel Gear

6. TROUBLESHOOTING

Trouble	Probable Cause	Remedy	Remark
Transmission noise excessive	• Lack in transmission oil or unsuitable oil used.	Re-supply	
	• Gear worn or backlash improper	Replace	
	• Bearing worn or broken	Replace	
	• Transmission fork worn	Replace	
	• Spline worn	Replace	
	• Snap ring missing	Replace and reassembly	
	• Spiral bevel pinion lock nut tightening poor	Tighten	
	• Improper backlash between spiral bevel pinion and spiral bevel gear	Adjust	
	• Improper backlash between differential pinion and differential gear	Adjust	
Transmission tightened	• Shift or transmission fork worn or broken	Replace	
	• Transmission fork distorted	Replace	
	• Transmission arm shaft corroded	Maintenance	
	• Synchronizer broken	Replace	
Gear bumped against in transmission shift	• Clutch restoration poor	Adjust and maintenance	
	• Gear worn or broken	Replace	
	• Synchronizer broken	Replace	
Differential gear will not operate	• Differential gear transmission fork broken	Replace	
	• Differential gear transmission fork head pin broken	Replace	
	• Differential gear transmission shift pin bent or broken	Replace	
	• Differential gear fork shaft bent or broken	Replace	
Differential gear will not be disengaged	• Differential gear pedal return spring weaken or broken	Replace	
	• Differential gear transmission shift pin bent or broken	Replace	
	• Differential gear fork shaft bent	Replace	
Abnormal noise in rotation	• Differential pinion or differential gear worn or broken	Replace	
	• Differential gear not disengaged	Replace	
	• Bearing worn	Replace	

7. MAINTENANCE SPECIFICATION

Item		Reference Value	Allowable Limit
Transmission shift and shift groove	Clearance	0.10 ~ 0.3 mm 0.004 ~ 0.012 in.	0.8 mm 0.031 in.
Between synchro and spline	Clearance	1.35 ~ 1.65 mm 0.053 ~ 0.065 in.	0.5 mm 0.02 in.
Synchronizer ring and gear taper	Contacted rate	80 %	80 %
Clutch disc	Thickness	2.10 ~ 2.30 mm 0.089 ~ 0.091 in.	2.05 mm 0.081 in.
Clutch plate	Thickness	1.45 ~ 1.55 mm 0.057 ~ 0.061 in.	2.05 mm 0.081 in.
Brake plate thickness	Flatness	1.45 ~ 1.5 mm 0.057 ~ 0.061 in.	1.40 mm 0.005 in.
Piston	Flatness	0.05 mm 0.002 in.	0.15 mm 0.006 in.
Pressure plate	Flatness	0.1 mm 0.004 in.	0.3 mm 0.012 in.
Return plate	Flatness	0.1 mm 0.004 in.	0.25 mm 0.010 in.
Spring	Free tension	46.5 mm 1.83 in.	42.0 mm 1.65 in.
Seal ring	Thickness	2.35 ~ 2.40 mm 0.093 ~ 0.094 in.	2.0 mm 0.079 in.
Transmission shift and shift groove	Clearance	0.1 ~ 0.3 mm 0.004 ~ 0.012 in.	0.8 mm 0.031 in.
Spiral bevel gear and bevel pinion shaft	Backlash	0.15 ~ 0.30 mm 0.006 ~ 0.012 in.	-
Differential case, differential case cap and differential side gear	Clearance	0.050 ~ 0.151 mm 0.00197 ~ 0.00594 in.	0.035 mm 0.0138 in.
Differential case and differential case cap	I.D	40.500 ~ 40.562 mm 1.59449 ~ 1.59693 in.	-
Differential side gear	O.D	40.411 ~ 40.450 mm 1.59098 ~ 1.59252 in.	-
Differential pinion and differential pinion shaft	Backlash	0.020 ~ 0.062 mm 0.00079 ~ 0.00244 in.	0.25 mm 0.0098 in.
Differential pinion	I.D (Inside Diameter)	20.000 ~ 20.021 mm 0.78740 ~ 1.78661 in.	-
Differential pinion	O.D (Outside Diameter)	19.959 ~ 19.980 mm 0.78579 ~ 0.78661 in.	-
Differential pinion and differential side gear	Backlash	0.13 ~ 0.25 mm 0.005 ~ 0.010 in.	0.4 mm 0.016 in.

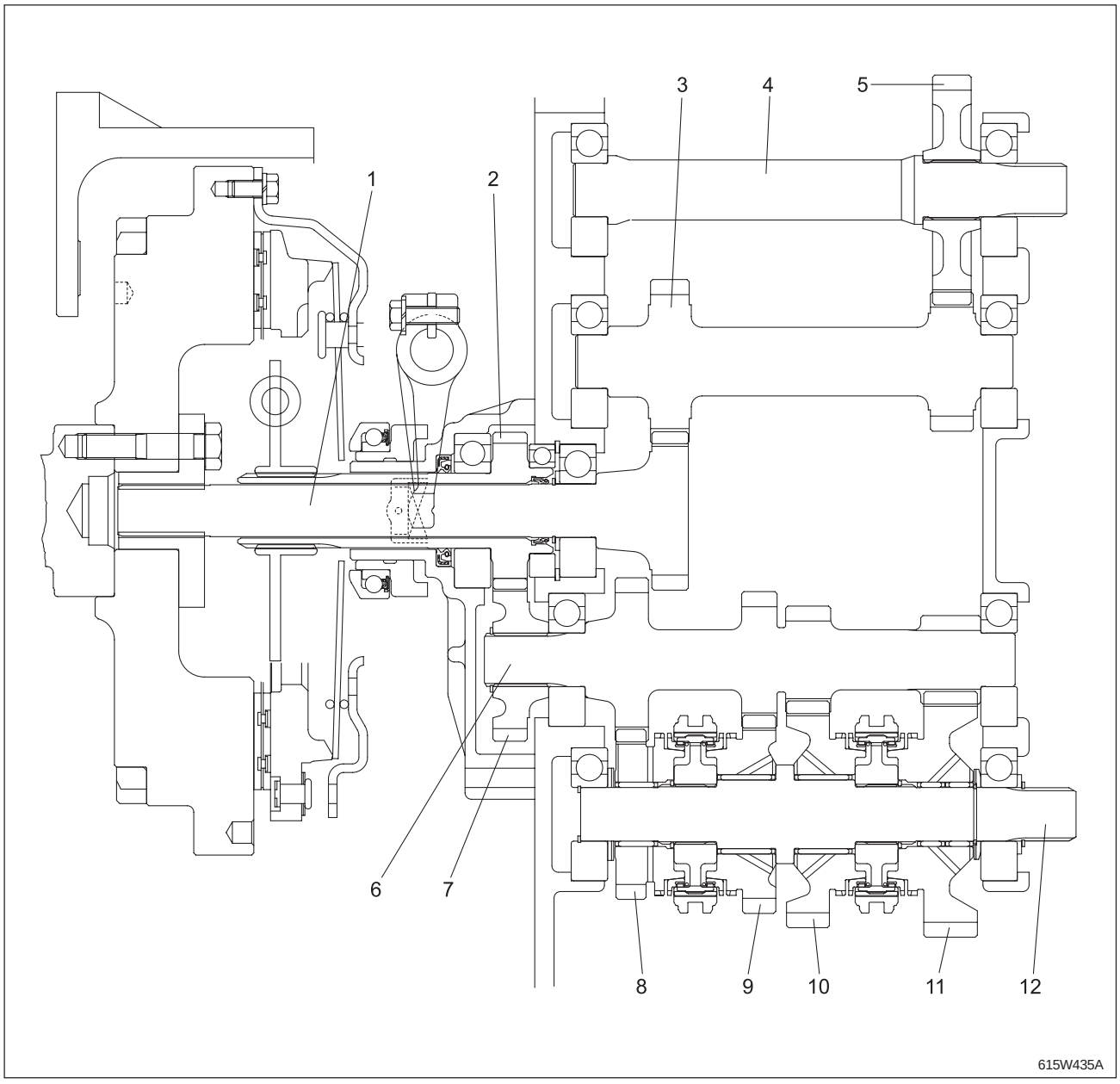
8. TIGHTENING TORQUE

The following nut and bolt tightening torque was specified specially.

Item	Spec	N·m	Kgf·m	lbf·ft
Hydraulic hose and joint bolt of front hydraulic block	M18	49.0 ~ 58.8	5.0 ~ 6.0	36.2 ~ 43.4
Hydraulic block support tightening bolt	M8	23.6 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2
Hydraulic block support tightening bolt	M10	48.1 ~ 55.8	4.9 ~ 5.7	35.5 ~ 41.2
Clutch housing and flywheel housing tightening bolt	M12	77.5 ~ 90.2	7.9 ~ 9.0	57.2 ~ 66.5
Clutch housing and flywheel housing tightening nut	M12	77.5 ~ 90.2	7.9 ~ 9.0	57.2 ~ 66.5
Clutch housing and flywheel housing tightening planting bolt	M12	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Clutch housing and intermediate case tightening bolt	M12	77.5 ~ 90.2	7.9 ~ 9.2	57.2 ~ 66.5
Clutch housing and intermediate case tightening nut	M12	77.5 ~ 90.2	7.9 ~ 9.2	57.2 ~ 66.5
Clutch housing and intermediate case tightening planting bolt	M12	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Main transmission cover tightening bolt	M6	9.8 ~ 11.3	1.0 ~ 1.15	7.2 ~ 8.3
Main transmission cover tightening bolt	M8	23.5 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2
Clutch housing and propulsion shaft case tightening bolt	M8	23.5 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2
PTO transmission arm locking pin bolt	M8	23.5 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2
Clutch housing sub bearing cover attaching bolt	M10	48.1 ~ 55.9	4.9 ~ 5.7	35.1 ~ 41.2
Bearing cover locking bolt	M10	48.1 ~ 55.8	4.9 ~ 5.7	35.5 ~ 41.2
Intermediate case and mission case tightening bolt	M12	77.5 ~ 90.2	7.9 ~ 9.2	57.2 ~ 66.2
Intermediate case and mission case tightening nut	M12	77.5 ~ 90.2	7.9 ~ 9.2	57.2 ~ 66.2
Intermediate case and mission case tightening planting bolt	M12	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Intermediate case modulate valve assembly tightening bolt	M8	23.5 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2
Intermediate case bearing cover tightening bolt	M10	48.1 ~ 55.9	4.9 ~ 5.7	35.4 ~ 41.2
Intermediate case bearing cover transmission fork locking bolt	M6	9.8 ~ 11.3	1.0 ~ 1.15	7.2 ~ 8.3
Hydraulic pipe joint bolt	M8	49.0 ~ 58.8	5.0 ~ 6.0	36.2 ~ 43.4
Hydraulic block support and intake pipe tightening bolt	M8	23.5 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2
Hydraulic block support and intake pipe tightening bolt	M10	48.1 ~ 55.9	4.9 ~ 5.7	35.5 ~ 41.2
Hydraulic cylinder assembly tightening bolt	M10	48.1 ~ 55.9	4.9 ~ 5.7	35.4 ~ 41.2
Main transmission bracket tightening bolt	M8	23.5 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2
Rear axle case tightening bolt	M10	48.1 ~ 55.9	4.9 ~ 5.7	35.4 ~ 41.2
Brake case tightening bolt, nut	M12	77.5 ~ 90.2	7.9 ~ 9.2	57.1 ~ 66.5
Brake case planting bolt	M12	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Brake case lever shaft	M12	77.5 ~ 90.2	7.9 ~ 9.2	57.1 ~ 66.5
PTO shaft locking bolt	M32	147 ~ 196	15 ~ 20	108 ~ 145
Intermediate case bearing cover tightening bolt	M10	48.0 ~ 55.9	4.9 ~ 5.7	35.5 ~ 41.2
Spiral bevel pinion shaft locking nut	M22	147 ~ 196	15 ~ 20	108 ~ 145
Spiral bevel pinion shaft tightening bolt	M10	48.0 ~ 55.9	4.9 ~ 5.7	35.5 ~ 41.2
Differential gear assembly bearing case tightening bolt	M10	48.0 ~ 55.9	4.9 ~ 5.7	35.5 ~ 41.2
Differential gear cap tightening bolt	M10	48.0 ~ 55.9	4.9 ~ 5.7	35.5 ~ 41.2
Spiral bevel gear tightening bolt	M10 (UBS)	68.6 ~ 88.2	7.0 ~ 9.0	50.6 ~ 65.1

9. CLUTCH HOUSING

DISASSEMBLY, MAINTENANCE



(1) 22 Gear Shaft (PTO)
(2) 25 Gear Shaft
(3) 23-19 Gear Shaft (PTO)
(4) Counter Shaft (PTO)
(5) 33 Gear (PTO)
(6) 26 Gear
(7) Main Shaft Gear
(8) 24 Gear
(9) 29 Gear
(10) 33 Gear
(11) 36 Gear
(12) Counter Shaft

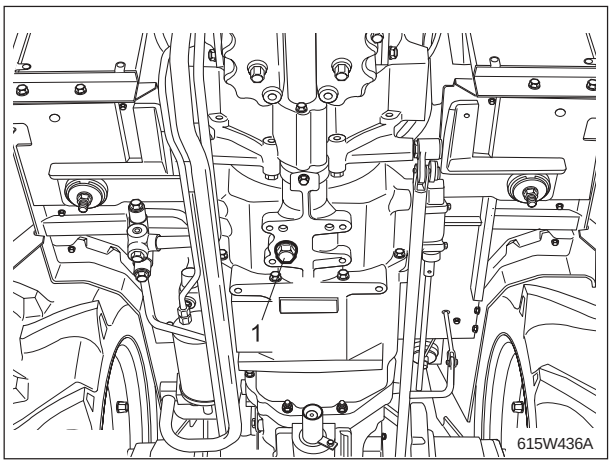
9.1 TRANSMISSION OIL DRAINING

1. Loosen oil drain plug in the lower of clutch housing and transmission case.
2. Drain transmission oil.
3. Reconnect oil drain plug.

(When reassembling)

- Disconnect plug from filler neck and then fill oil to the scale of oil gauge.
- After running the engine properly, recheck the scale of oil gauge and add fluid if necessary.

Mission oil specified amount	44 ℓ (11.6 US.gal)



(1) Oil Drain Plug

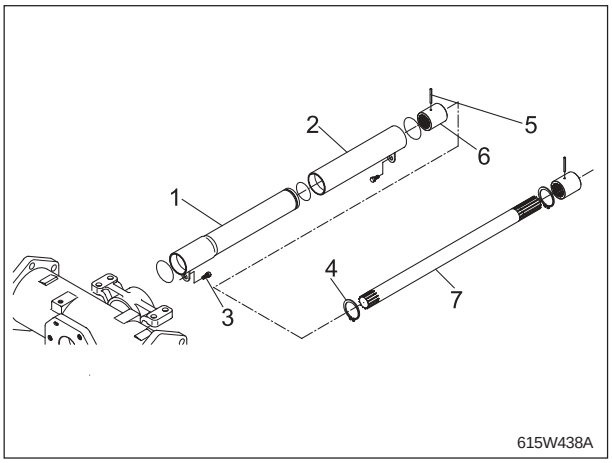
9.2 CLUTCH HOUSING GROUP DISASSEMBLY

A. First Stage (Propulsion Shaft Cover Disassembly)

1. Disengage propulsion shaft covers (1), (2) and bolt (3) from the lower of machine.
2. After propulsion shaft cover is tighten inward, pull out snap ring (4) and spring pin (5).
3. With coupling (6) tightened to propulsion shaft 2 (7), disconnect propulsion shaft 2 combined with propulsion shaft cover.

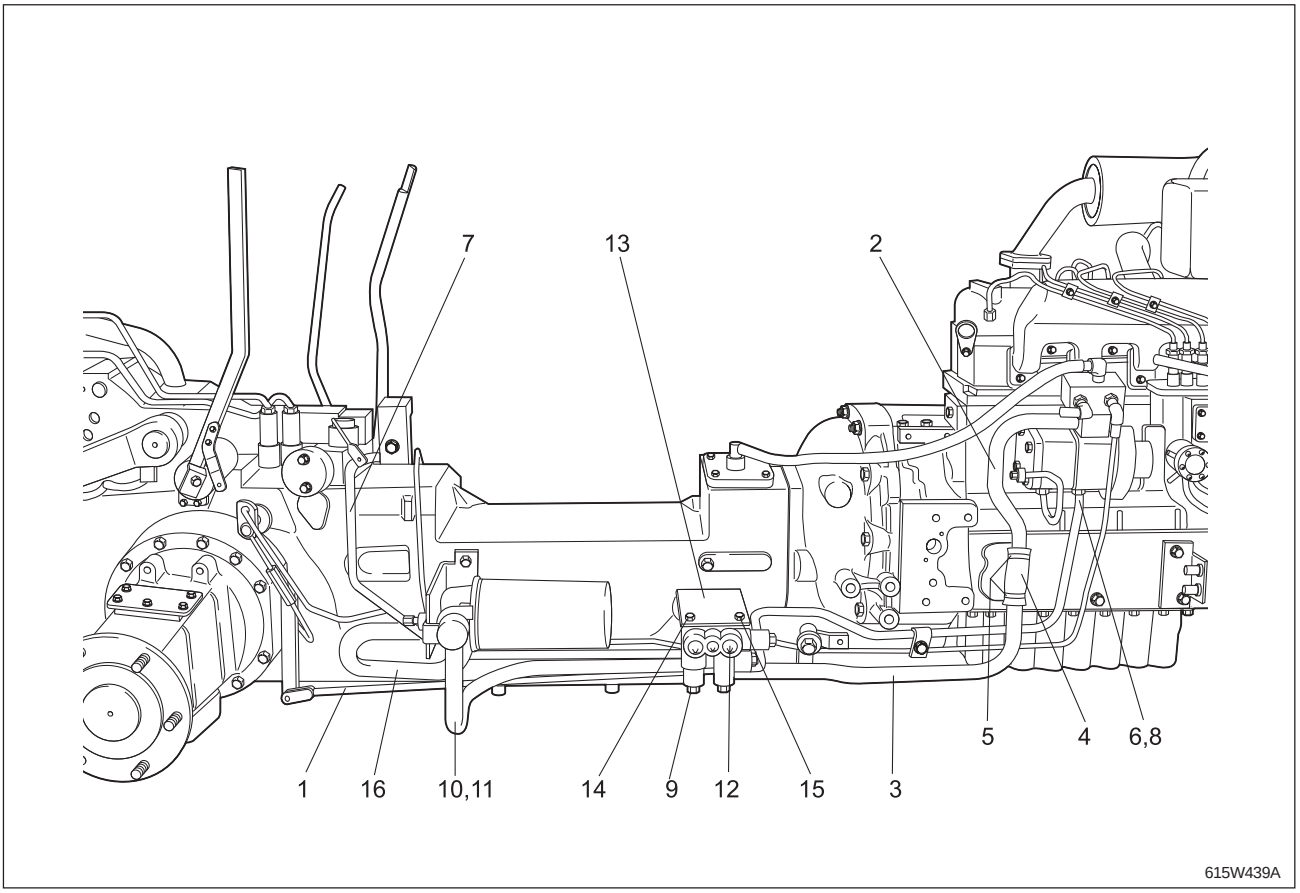
(When reassembling)

- Apply spline part of propulsion shaft 2 and O-ring contacts at the end of propulsion shaft cover 1 and 2 with grease.



(1) Propulsion Shaft Cover 1
(2) Propulsion Shaft Cover 2
(3) Bolt
(4) Snap Ring
(5) Spring Pin
(6) Coupling
(7) Propulsion Shaft 2

B. Second Stage (Hydraulic Pipe Disconnection)



(1) Brake Rod
(2) Intake Pipe 3
(3) Intake Pipe 2
(4) Rubber Pipe
(5) Clamp
(6) Hydraulic Pipe 1
(7) Hydraulic Pipe 2
(8) Bolt
(9) Joint Bolt
(10) PTO Hydraulic Pipe
(11) Bolt
(12) Hydraulic Block
(13) Hydraulic Block Support
(14) Washer Holding Bolt
(15) Washer Holding Bolt
(16) Intake Pipe 1

1. Disconnect brake rod (1) from the left and right of tractor body.
2. Loosen intake pipe 3 (2) and intake pipe 2 (3), connecting rubber pipe (4), and clamp (5), Push and lower the rubber pipe into intake pipe 2 and then disconnect the connecting part.
3. Loosen bolts (14), (15) and joint bolt (9) of hydraulic pipe 1 (6) and hydraulic pipe 2 (7) and disconnect the hydraulic pipe.
4. Disengage bolt (11) of PTO hydraulic pipe (10).
5. Disengage bolts (14), (15) of hydraulic block (12) and hydraulic block support (13) and disconnect from clutch housing.

(When reassembling)

- Make sure to clamp connecting rubber pipe of intake pipe to prevent air from entered.
- Apply hydraulic pipe connecting O-ring with grease and take precautions not to do any damage.

Sect.	Spec.	Tightening Torque
Joint bolt	M18	49.0 ~ 58.8 N·m 5.0 ~ 6.0 kgf·m 36.1 ~ 43.4 lbf·ft
Tightening bolt	M8	23.6 ~ 27.4 N·m 2.4 ~ 2.8 kgf·m 17.3 ~ 20.2 lbf·ft
	M10	23.6 ~ 27.4 N·m 2.4 ~ 2.8 kgf·m 17.3 ~ 20.2 lbf·ft

C. Third Stage (Disconnection of Clutch Housing and Flywheel Housing)

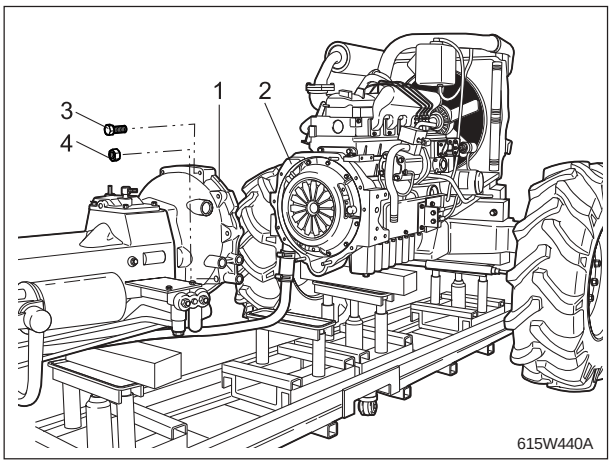
1. Support the lower of clutch housing (1) and engine with a hydraulic jack.
2. Loosen tightening bolt (3) and nut (4) of clutch housing and flywheel housing (2).
3. Disconnect the clutch housing and engine.

(When reassembling)

- Apply grease on the spline part.
- Apply a sealing agent on the contacted surface of clutch housing and flywheel housing.

Sect.	Spec.	Tightening Torque
Tightening bolt, nut	M12	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.2 ~ 66.5 lbf·ft
Stud	M12	39.2 ~ 49.0 N·m 4.0 ~ 5.0 kgf·m 28.9 ~ 36.2 lbf·ft

Sealing agent	Three bond 1208D or equivalent



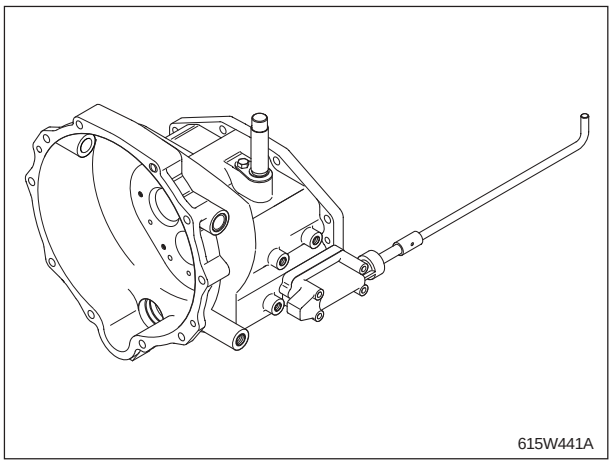
(1) Clutch Housing
(2) Flywheel Housing
(3) Bolt
(4) Nut

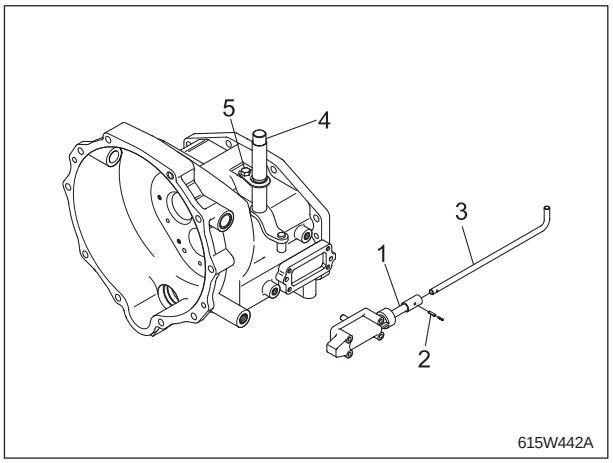
D. Fourth Stage (Transmission Rod Disconnection)

1. Pull out spring pin (2) of transmission shift rod (1) and disconnect the main transmission shift rod 2 (3).
2. Disengage the shuttle transmission arm (4) locking bolt (5) and raise the transmission arm.

(When reassembling)

- When using spring pin type in transmission rod, the forked area should be toward the direction of shaft.
- When assembling shuttle transmission arm, the portion of transmission arm should be seated in the groove (A) of shuttle fork rod.


615W441A



615W442A

(1) Transmission Shift Rod
(2) Spring Pin
(3) Main Transmission Shift Rod 2
(4) Shuttle Transmission Shift Arm
(5) Flange Bolt

E. Fifth Stage (Disconnection of Intermediate Case and Clutch Housing)

1. Disengage the shuttle transmission arm (1) locking bolt (2) and pull up transmission arm.
2. Disengage tightening bolt (5) and nut (6) of clutch housing (3) and intermediate case (4).
3. Disconnect clutch housing (3) from intermediate case (4).

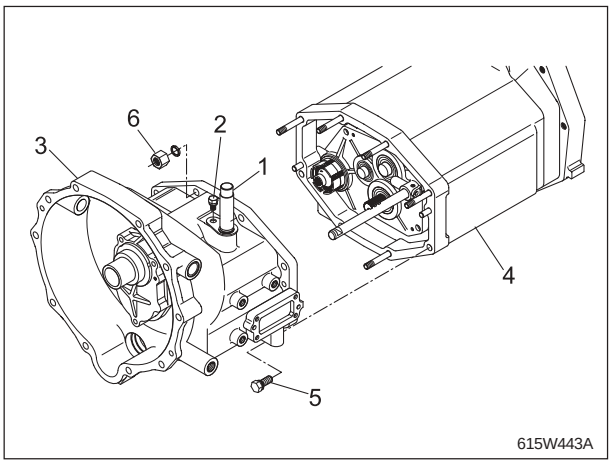
(When reassembling)

- Remove foreign matters or oil from the contacted surface of the clutch housing (3) and intermediate case (4) and apply a sealing agent.

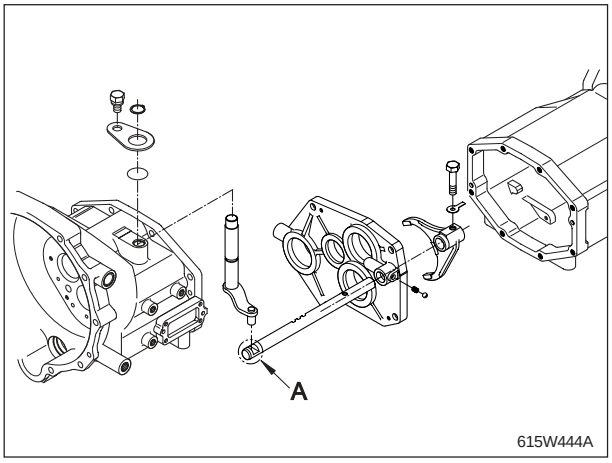
Sealing agent	Three bond 1208D or equivalent

- Perform docking clutch housing (3) and intermediate case (4) and then make transmission arm (1) of shuttle transmission arm to be seated in the groove (A) of shuttle fork rod.

Sect.	Spec.	Tightening Torque
Tightening bolt, nut	M12	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.2 ~ 66.5 lbf·ft
Stud	M12	39.2 ~ 49.0 N·m 4.0 ~ 5.0 kgf·m 28.9 ~ 36.1 lbf·ft



(1) Shuttle Transmission Arm
(2) Flange Bolt
(3) Clutch Housing
(4) Intermediate Case
(5) Bolt
(6) Nut



10. CLUTCH HOUSING DISASSEMBLY

10.1 FIRST STAGE (DISCONNECTION OF MAIN TRANSMISSION COVER)

1. Disengage main transmission cover (1) attaching bolt (2) and disconnect transmission cover.

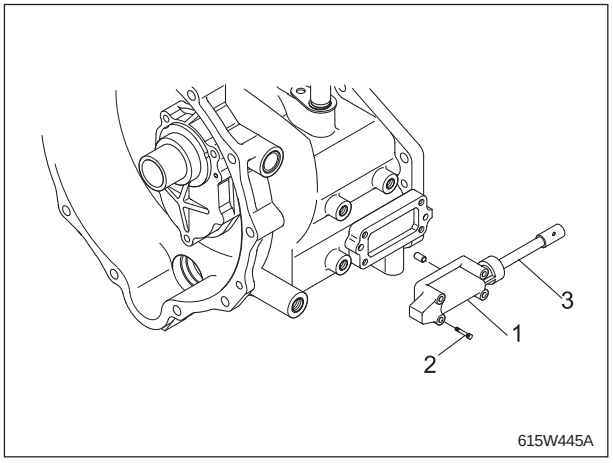
(When reassembling)

- Engage transmission rod (3) with transmission arm (4) locking bolt (5) and perform locking both ends of jawed washer firmly to prevent loosening.
- Wipe out foreign matters or oil from the contacted surface of clutch housing and main transmission cover and apply a sealing agent.

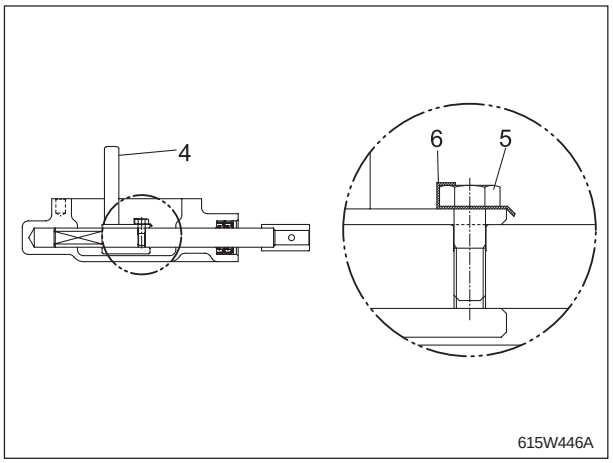
Sealing agent	Three bond 1208D or equivalent

With main transmission fork set to Neutral, set transmission arm (4) at the groove of main transmission fork.

Sect.	Spec.	Tightening Torque
Tightening bolt, nut	M6	9.8 ~ 11.3 N·m 1.0 ~ 1.15 kgf·m 7.2 ~ 8.3 lbf·ft
	M8	23.5 ~ 27.4 N·m 2.4 ~ 2.8 kgf·m 17.3 ~ 20.2 lbf·ft



615W445A



615W446A

(1) Main Transmission Cover
(2) Bolt
(3) Transmission Rod
(4) Transmission Arm
(5) Locking Bolt
(6) Jawed Washer

10.2 SECOND STAGE (DISCONNECTION OF PROPULSION SHAFT CASE)

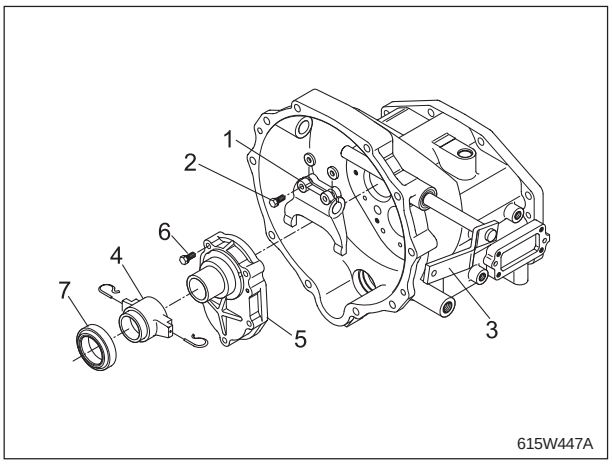
1. Loosen clutch release fork (1) locking bolt (2) and pull out main clutch lever (3).
2. Disconnect clutch release hub (4) and release bearing (7).
3. Loosen propulsion shaft case (5) attaching bolt (6) and using M6 service bolt (two), disconnect propulsion case.

(When reassembling)

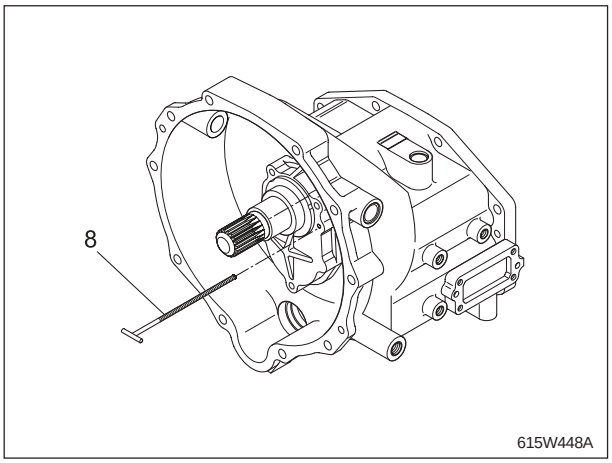
- Apply the slip of propulsion case and release hub with grease.
- Wipe out foreign matters or oil from the contacted surface of clutch housing and propulsion shaft case and apply with sealing agent.

Sealing agent	Three bond 1208D or equivalent

Sect.	Spec.	Tightening Torque
Tightening bolt, nut	M8	23.5 ~ 27.4 N·m 2.4 ~ 2.8 kgf·m 17.3 ~ 20.2 lbf·ft



615W447A

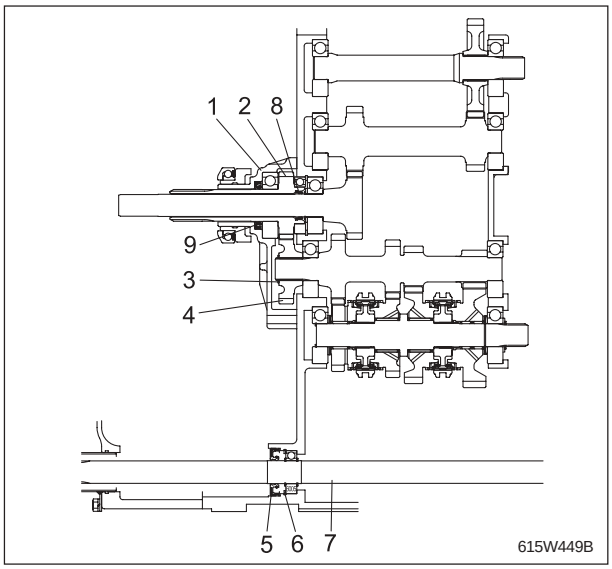


615W448A

(1) Clutch Release Fork
(2) Bolt With Washer
(3) Main Clutch Lever
(4) Clutch Release Hub
(5) Propulsion Shaft Case
(6) Bolt With Washer
(7) Release Bearing
(8) Service Bolt

10.3 THIRD STAGE (DISASSEMBLY OF 25 GEAR SHAFT AND PROPULSION SHAFT 1)

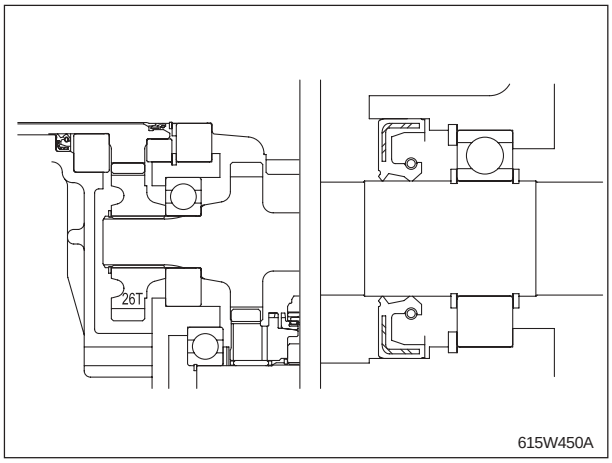
1. Pull out 25 gear shaft (2) from propulsion shaft cover (1).
2. Loosen snap ring (3) for shaft and pull out 26 gear (4).
3. Pull out oil seal (5) from clutch housing and loosen snap ring (6) for hole.
4. Pull out propulsion shaft 1 (7) with bearing.



(1) Propulsion Shaft Cover
(2) 25 Gear Shaft
(3) Snap Ring
(4) 26 Gear
(5) Oil Seal
(6) Snap Ring
(7) Propulsion Shaft 1
(8) Oil Seal
(9) Oil Seal

(When reassembling)

- Renew oil seal (5), (8), and (9) and apply grease to the contacted portion of assembly. Make sure direction of assembly is correct.



10.4 FOURTH STAGE (DISASSEMBLY OF BEARING COVER ASSEMBLY)

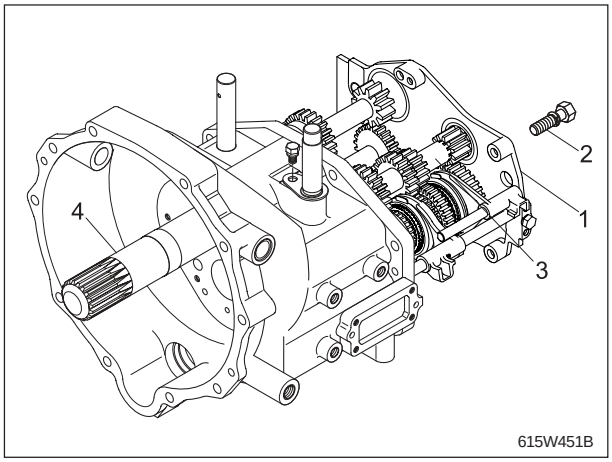
1. Loosen bearing cover (1) attaching bolt (2) and disconnect bearing cover with gears in a body.

CAUTION

- *When difficult to disconnect bearing cover assembly, make sure 23 gear tooth of main shaft gear (3) engaged with 22 gear shaft (4) tooth, and disconnect with gear tooth engaged each other*

(When reassembling)

- 26 gear should be assembled with the protruded gear toward the bearing.



(1) Bearing Cover
(2) Bolt
(3) Main Shaft Gear
(4) 22 Gear Shaft

10.5 FIFTH STAGE (DISCONNECTION OF TRANSMISSION FORK)

(When reassembling)

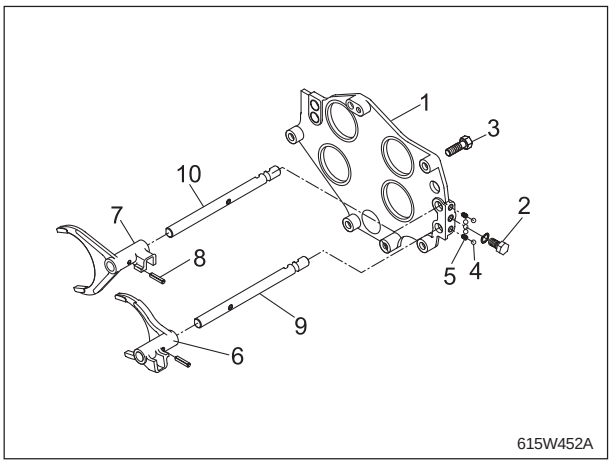
1. Loosen locking bolt (2), (3) from bearing cover (1) and pull out ball (4) and spring (5).
2. Pull out spring pin (8) from transmission fork (6), (7) and disconnect transmission fork and fork rod (9), (10).
3. Disconnect gear shaft assembly (11), (12), (13), (14) from bearing cover.

- With transmission fork set to Neutral, insert ball and spring and tighten locking bolt.
- When tightening the locking bolt, ensure the assembly position and the number of spring and bass are correct and then apply with grease.

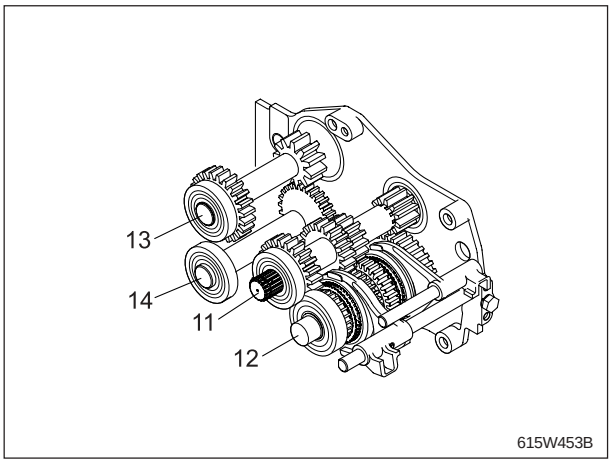
Sect.	Spec.	Tightening Torque
Locking bolt	M10	48.1 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.4 ~ 41.2 lbf·ft

CAUTION

- *Take great care of assembly direction of transmission fork and type direction of spring pin.*



615W452A



615W453B

(1) Bearing Cover
(2) Locking Bolt
(3) Bolt
(4) Ball
(5) Spring
(6) Main Transmission Fork (1st, 2nd)
(7) Main Transmission Fork (3rd, 4th)
(8) Spring Pin
(9) Fork Rod (1st, 2nd)
(10) Fork Rod (3rd, 4th)
(11) Main Shift Gear Shaft
(12) Counter Shaft
(13) Counter Shaft (PTO)
(14) 23-19 Gear Shaft

10.6 SIXTH STAGE (DISASSEMBLY OF 22 GEAR SHAFT)

1. Disengage snap ring (2) for 22 gear shaft (1) and pull out 22 gear shaft from the clutch housing.
2. Loosen snap ring (3) for hole of clutch housing and pull out bearing (4).

CAUTION

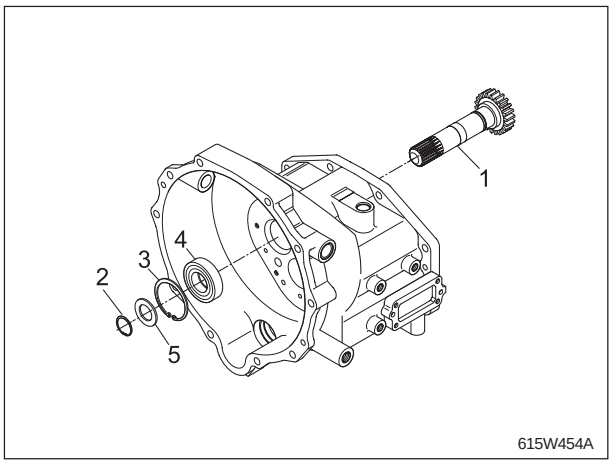
- *When disassembling 25 gear shaft (1), tap lightly the end of shaft using plastic hammer not to be damage.*

(When reassembling)

- Insert 22 gear shaft into gearing, seat bearing in housing with snap ring for hole, and tap lightly gear shaft.
- Snap ring should be assembled with rounding toward bearing.

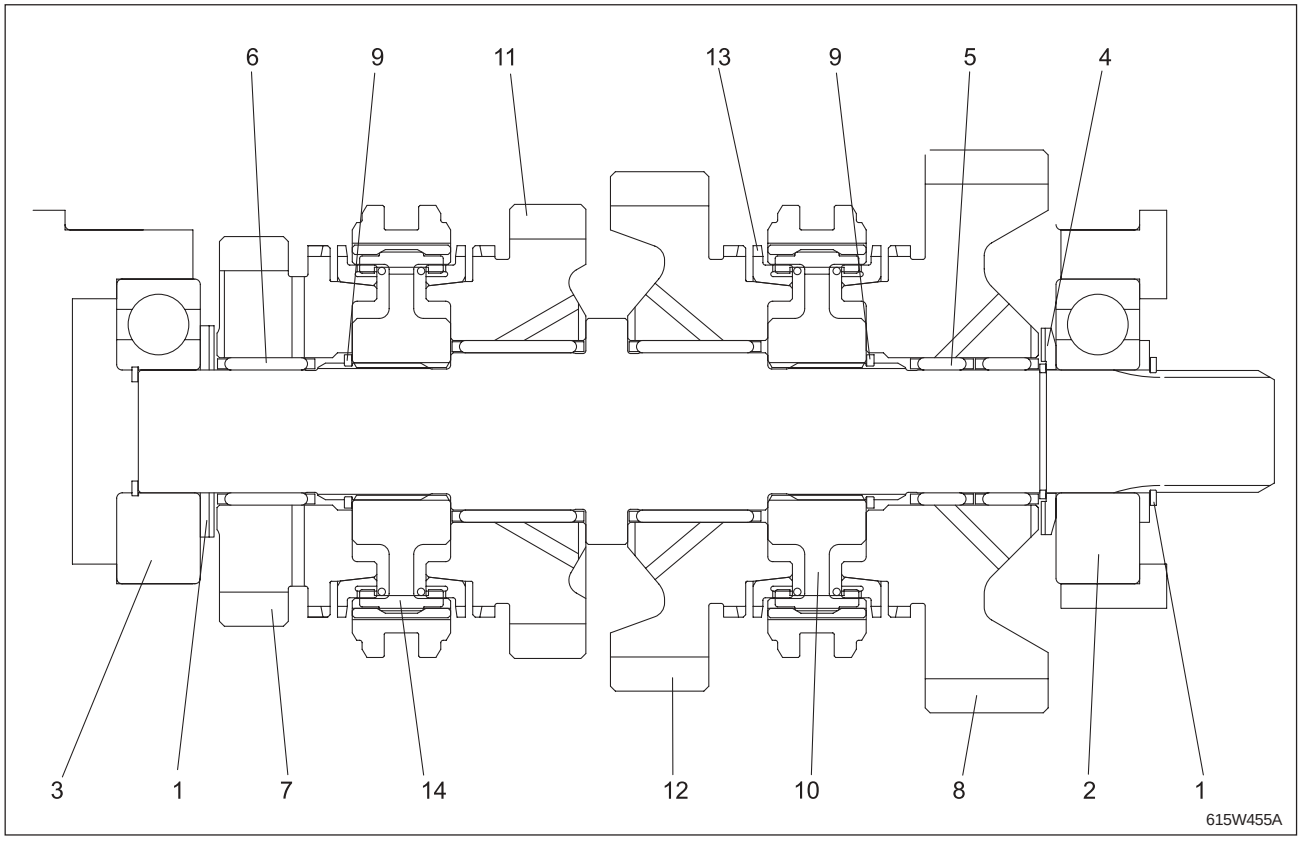
CAUTION

- *When disassembling locking bolt from bearing cover, take care of ball not to be bounded.*



(1) 25 Gear Shaft
(2) Snap Ring
(3) Snap Ring
(4) Ball Bearing
(5) Collar

10.7 SEVENTH STAGE (DISASSEMBLY OF MAIN TRANSMISSION COUNTER SHAFT)

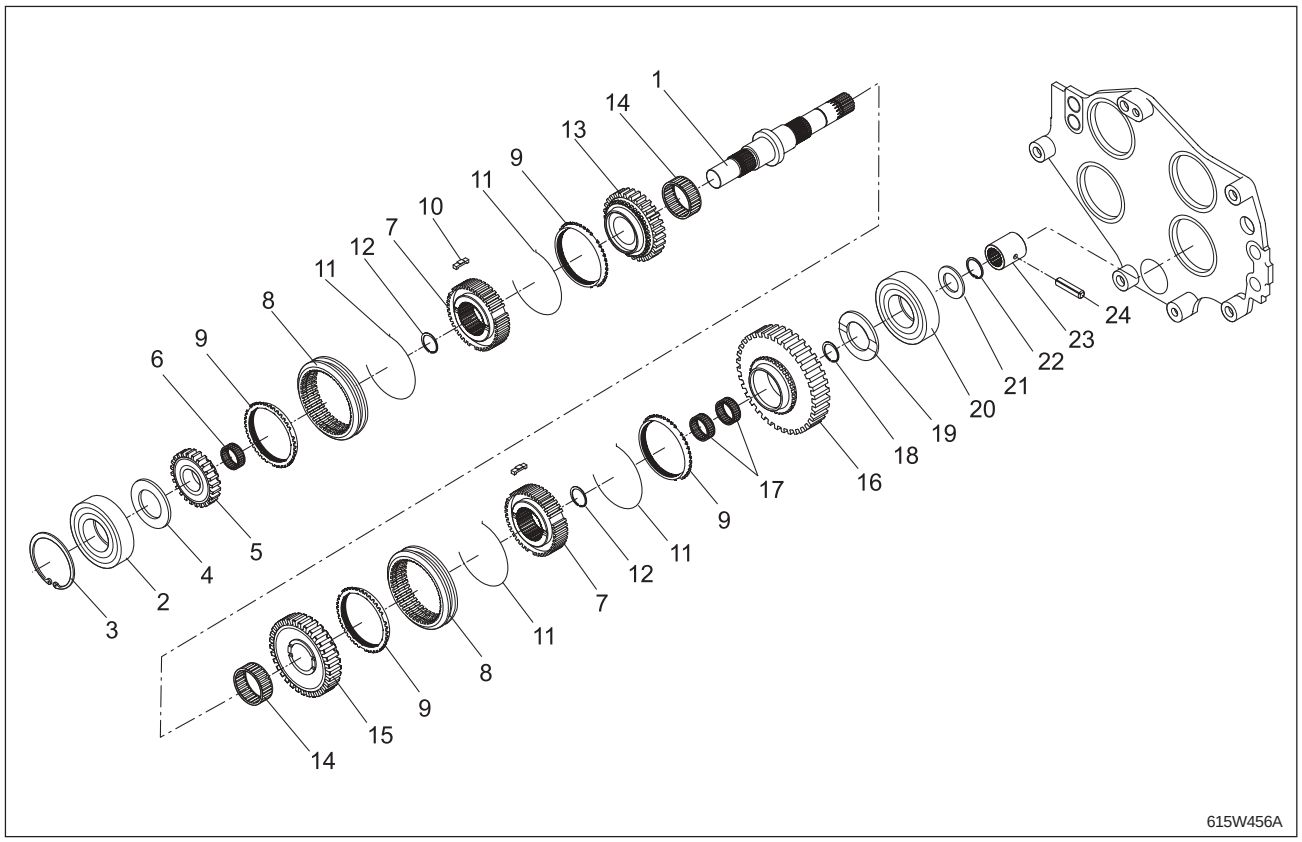


(1) Snap Ring
(2) Ball Bearing
(3) Ball Bearing
(4) Thrust Collar
(5) Needle Bearing
(6) Needle Bearing
(7) 24 Gear
(8) 36 Gear
(9) Snap Ring
(10) Synchro Hub Assembly
(11) 29 Gear
(12) 33 Gear
(13) Synchronizer Ring
(14) Synchronizer Key

1. Loosen snap ring (1) for shaft.
2. Pull out bearing (2), (3) using bearing puller.
3. Disassemble thrust collar (4), needle bearing (5), (6), and gear (7), (8).
4. Loosen snap ring (9) and disassemble synchro hub assembly (10), gear (11), (12) and needle bearing.

(When reassembling)

- Take case of assembly position of needle bearing by specification.
- 24 Gear side: 25*30*20
- 33 Gear side: 32*37*27
- 29 Gear side: 32*37*27
- 36 Gear side: 25*30*13
- When assembling synchronizer ring (13), ensure the groove position of synchronizer key (14) is correct.
- Ensure oil groove of thrust collar towards gear.

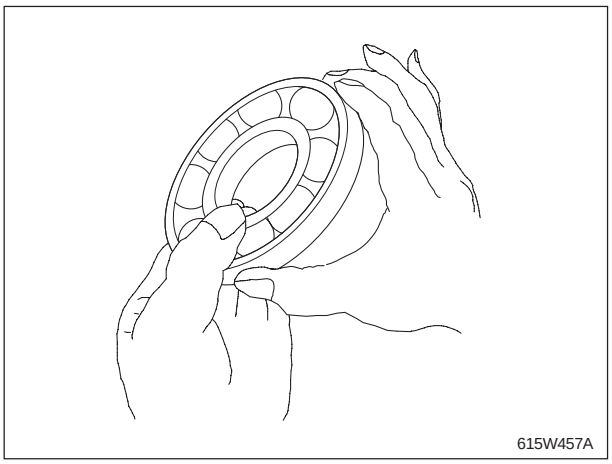


(1) Shaft, Counter
(2) Bearing, Ball
(3) Cir-clip
(4) Collar, Thrust
(5) Gear, 24
(6) Bearing, Needle
(7) Hub, Synchro
(8) Shifter
(9) Ring, Synchronize
(10) Key, Synchronize
(11) Spring
(12) Cir-clip
(13) Gear, 29
(14) Bearing, Needle
(15) Gear, 33
(16) Gear, 36
(17) Bearing, Needle
(18) Cir-clip
(19) Collar, Thrust
(20) Bearing, Ball
(21) Spacer
(22) Cir-clip
(23) Coupling
(24) Pin, Spring

10.8 MAINTENANCE

A. Bearing Checking

1. With bearing inner wheel seized, pull in and out outer wheel left and right and check for wear and clearance.
2. Apply bearing ball with transmission oil and with bearing inner wheel seized and outer wheel rotated, check for abnormal noise and operation.
3. If damage and failure found, replace it.



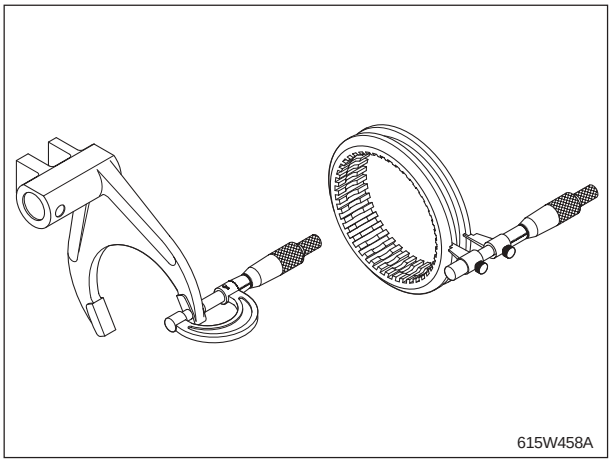
B. Gear Checking

1. Ensure slip or tooth surface is worn and replace it if necessary.

C. Checking for Groove Clearance Between Transmission Fork and Shift Groove.

1. Measure groove depth of transmission shift using I.D. micrometer.
2. Measure the depth of transmission fork hook using O.D. micrometer.
3. Check the clearance with measured value of shift and fork and replace it if exceeded the limit.

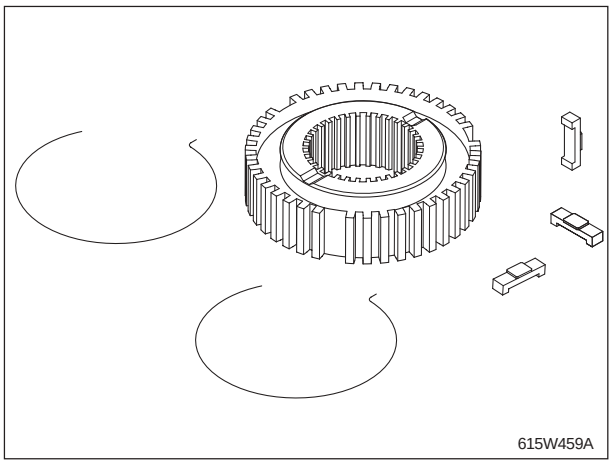
Sect.	Specified	Allowable Limit
Clearance of groove between transmission fork and shift	0.1 ~ 0.3 mm 0.004 ~ 0.012 in.	0.8 mm 0.03 in.



D. Synchro Assembly Check

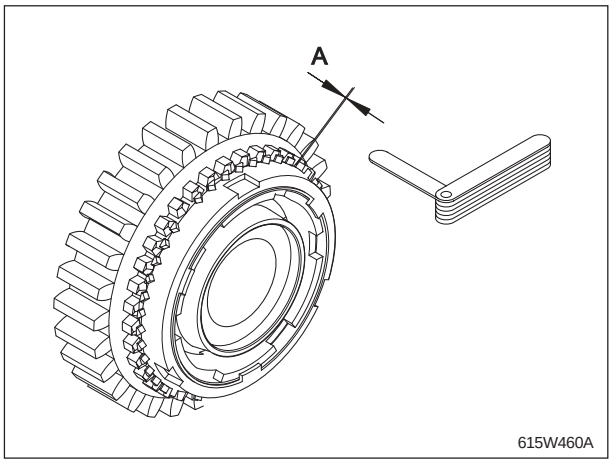
1. Check synchronizer key and spring for damage and replace it if necessary.
2. With synchronizer ring contacted with taper cone of the opposite gear, measure the clearance between synchro spline and opposite gear spline using clearance gauge.

Sect.	Specified	Allowable Limit
Clearance of between synchro and gear spline(A)	1.35 ~ 1.65 mm 0.053 ~ 0.065 in.	0.5 mm 0.02 in.


615W459A

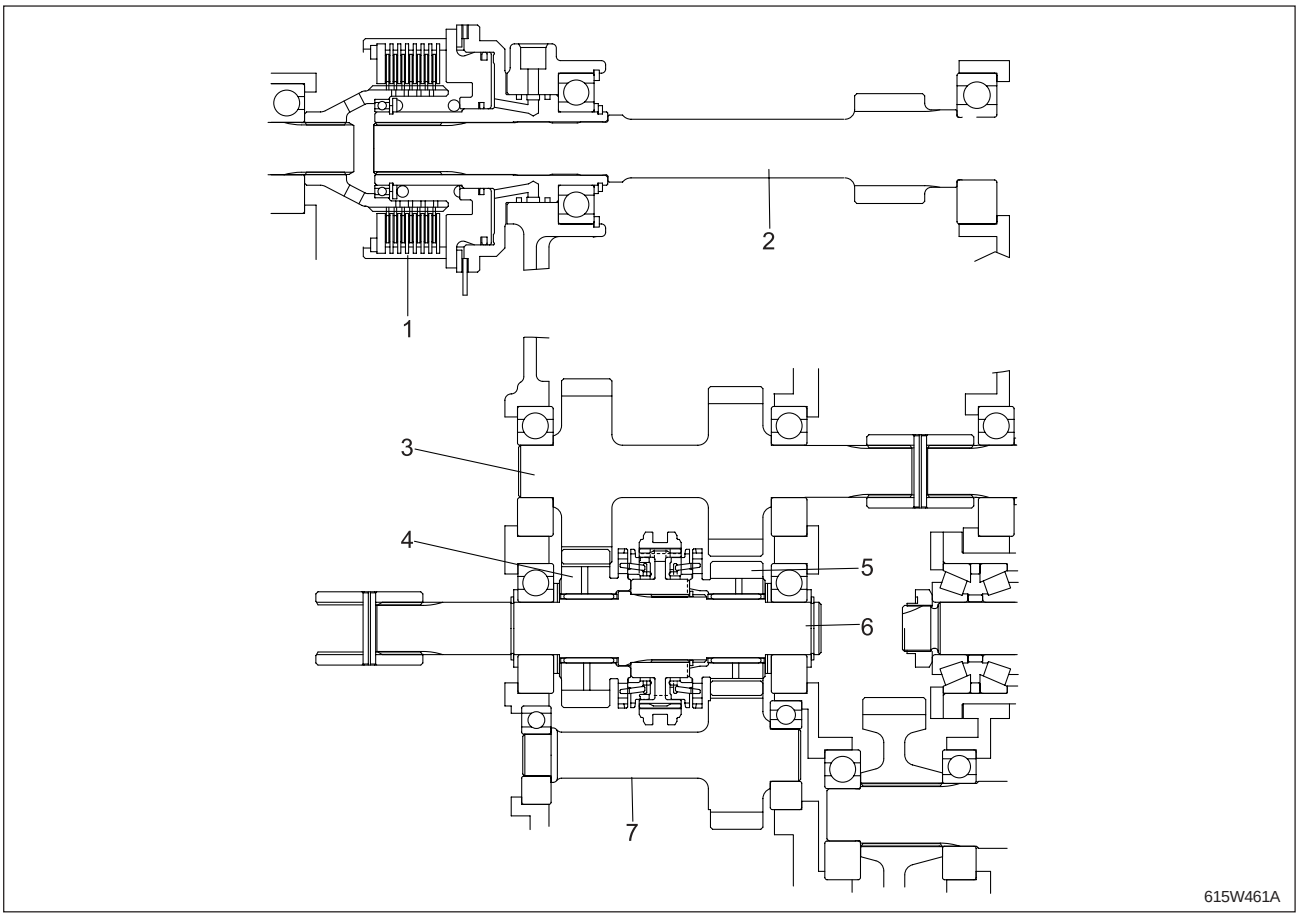
3. Apply O.D. of taper cone in gear with thin film of red lead, tighten synchronizer ring firmly, and check for contacted state.

Sect.	Specified	Allowable Limit
Clearance of between synchronizer ring and gear taper.	More than 80%	More than 80%



615W460A

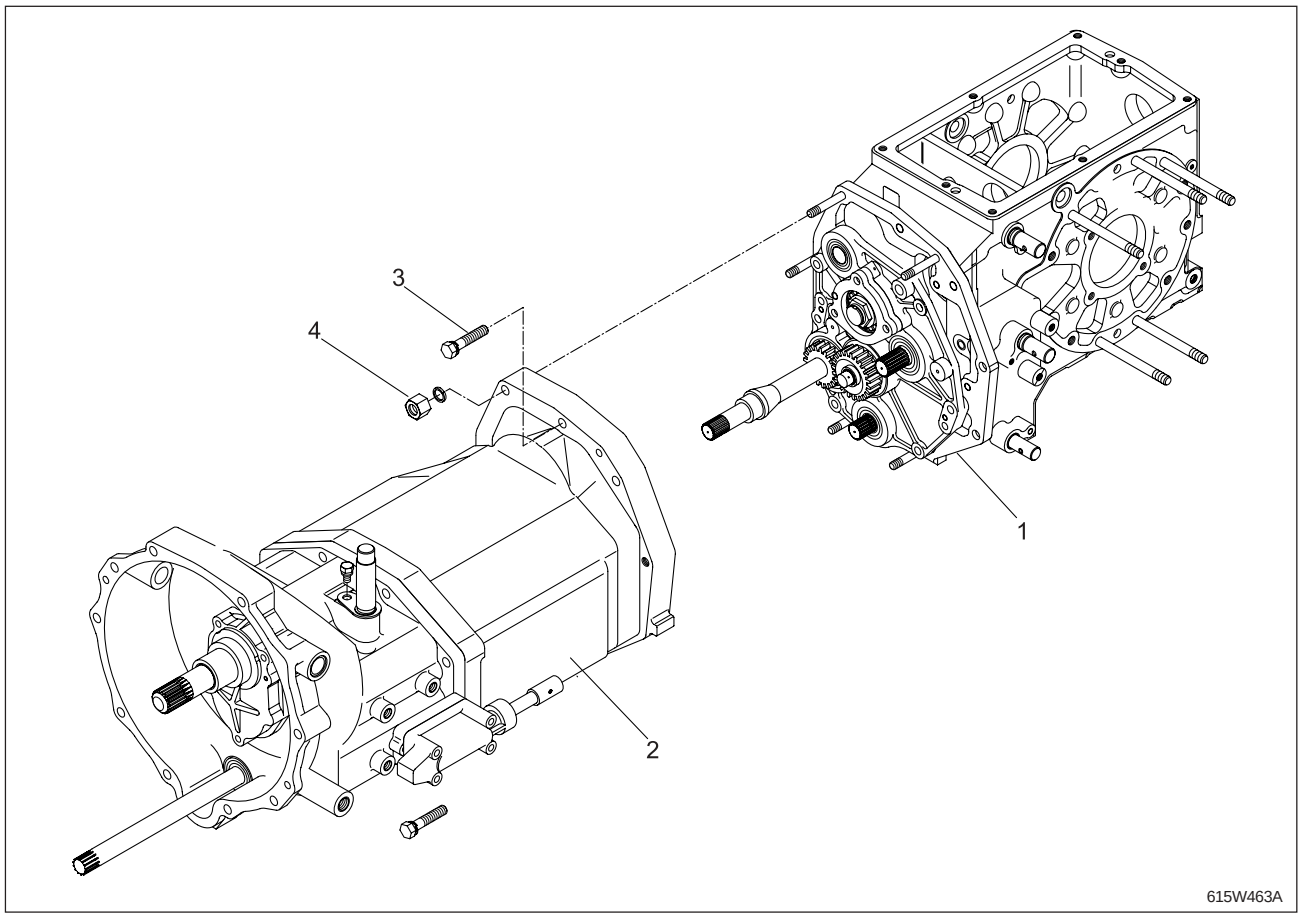
11. INTERMEDIATE CASE



(1) PTO Clutch Assembly
(2) 12 Gear Shaft
(3) 23-21 Gear
(4) 19 Gear
(5) 16 Gear
(6) Shuttle Shaft
(7) 18 Gear

11.1 DISASSEMBLY, ASSEMBLY

A. Disconnection of Intermediate Case Group



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

a. First Stage (Disconnection of Intermediate Case and Transmission Case)

1. Support the lower of transmission case (1) with a hydraulic jack.
2. Disengage tightening bolt (3) and nut (4) from intermediate case (2) and transmission case.
3. Disconnect intermediate case (2) and transmission case (1).

(When reassembling)

- Make sure PTO clutch assembly and spline hub is seated properly. Apply the contacted surface of intermediate case and transmission case with sealing agent.

Sealing agent	Three bond 1208D or equivalent

Sect.	Spec.	Tightening Torque
Tightening bolt, nut	M12	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.2 ~ 66.5 lbf·ft
Stud	M12	39.2 ~ 49.0 N·m 4.0 ~ 5.0 kgf·m 28.9 ~ 36.2 lbf·ft

B. Disassembly of Intermediate Case

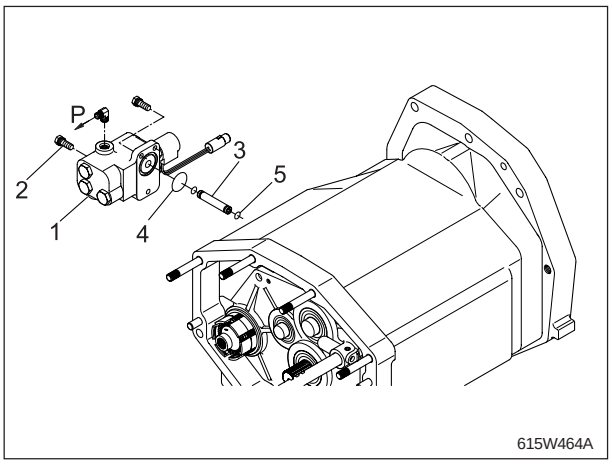
a. First Stage (Disconnection of Modulator Valve Assembly)

1. Disengage modulator valve assembly (1) attaching bolt (2) and disconnect valve assembly.

(When reassembling)

- Check valve assembly, connecting pipe (3), and O-ring (4), (5) and apply the contacted surface with grease.
- Take great care to prevent foreign matters from being entered inside of valve assembly and connecting pipe.

Sect.	Spec.	Tightening Torque
Tightening bolt, nut	M8	23.5 ~ 27.4 N·m 2.4 ~ 2.8 kgf·m 17.4 ~ 20.2 lbf·ft



(1) Modulator Valve Assembly
(2) Bolt
(3) Connecting Pipe
(4) O-ring
(5) O-ring

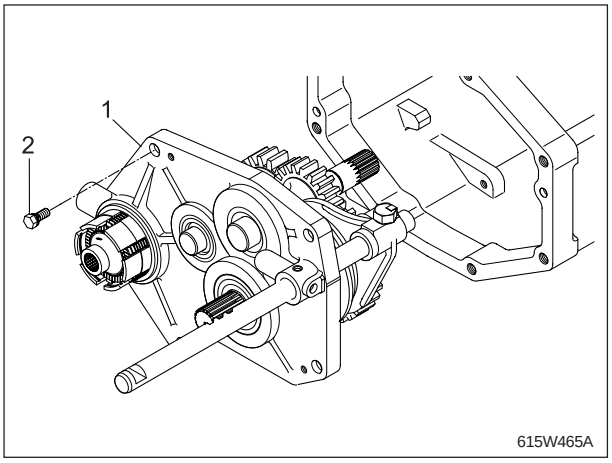
b. Second Stage (Disconnection of bearing over assembly)

1. Disengage bearing cover (1) attaching bolt (2) and disconnect bearing cover assembly from intermediate case.

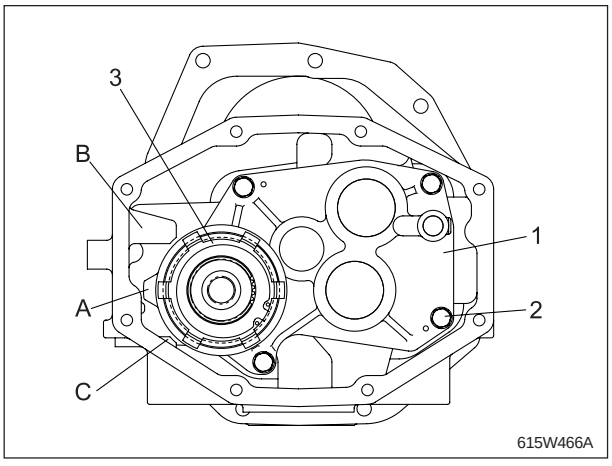
(When reassembling)

- Take care of assembly position when attaching to intermediate case with PTO clutch assembly (3) assembled in bearing cover.
- Ensure that protrusion (A) of clutch assembly is located between protrusion (B) and (c) of intermediate case (See the figure below).

Sect.	Spec.	Tightening Torque
Tightening bolt, nut	M10	48.1 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.4 ~ 41.2 lbf·ft



(1) Bearing Cover
(2) Bolt



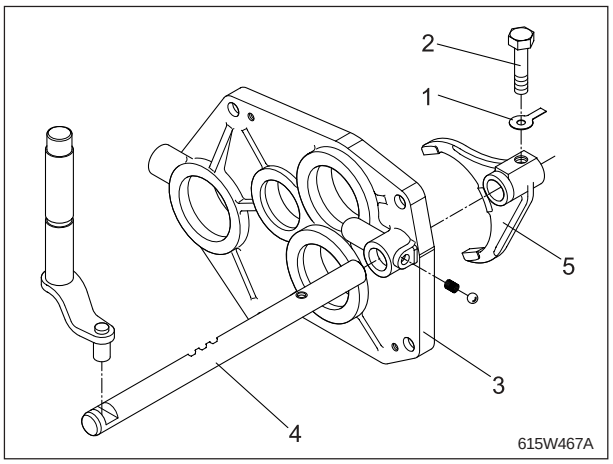
(1) Bearing Cover
(2) Bolt
(3) PTO Clutch Assembly

c. Third Stage (Disassembly of Shuttle Fork)

1. Straighten cocking of lock washer (1) and loosen lock bolt (2).
2. Pull out fork rod (4) from bearing cover (3) and disassemble transmission fork (5).

CAUTION

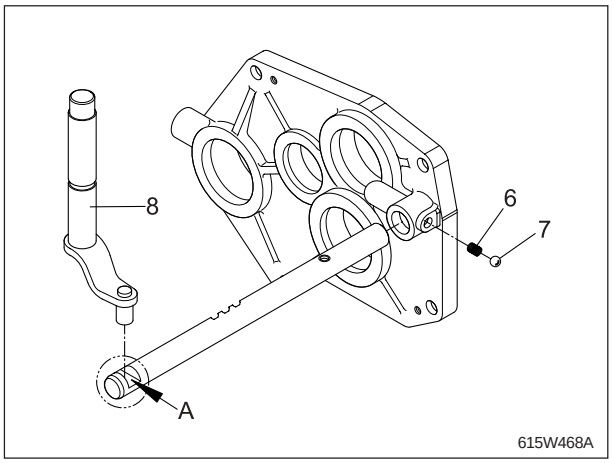
- *When disassembling fork rod from bearing cover, take care of Spring (6) and Ball (7) not to be bounded.*



(When reassembling)

- Insert spring and Ball into bearing cover and assemble with groove (A) of fork rod upward.
- Perform cocking of lock washer firmly not to be loosen after tightened with transmission fork lock bolt.

Sect.	Spec.	Tightening Torque
Tightening bolt	M6	9.8 ~ 11.3 N·m 1.0 ~ 1.15 kgf·m 7.2 ~ 8.3 lbf·ft



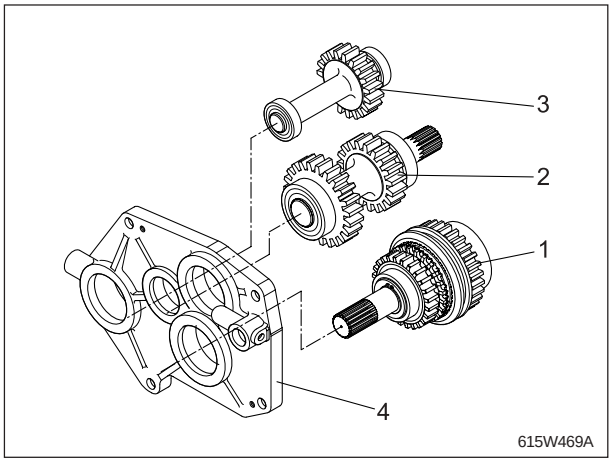
(1) Lock Washer
(2) Lock Bolt
(3) Bearing Cover
(4) Fork Rod
(5) Transmission Fork
(6) Spring
(7) Ball
(8) Shuttle Transmission Arm

d. Fourth Stage (Disconnection of Gear Shaft Assembly)

1. Disconnect shuttle shaft assembly (1), 23-21 gear shaft assembly (2) and 18 gear shaft assembly (3) from bearing cover (4).

(When reassembling)

- Make sure the assembly position is correct when assembling gear shaft assembly into bearing cover.



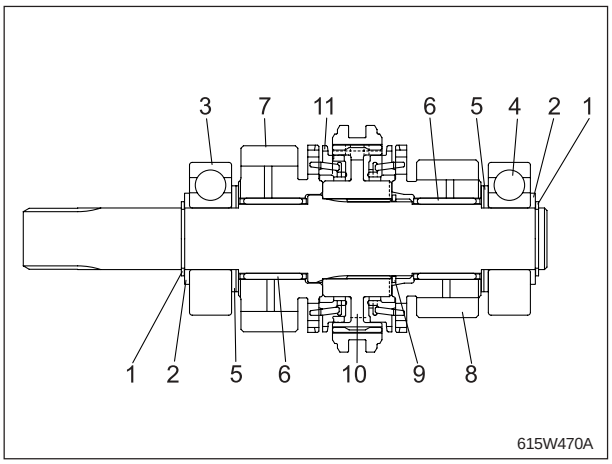
(1) Shuttle Shaft Assembly
(2) 23-21 Gear Shaft Assembly
(3) 18 Gear Shaft Assembly
(4) Bearing Cover

e. Fifth Stage (Disassembly of Shuttle Shaft)

1. Loosen snap ring (1) and disassemble spacer (2).
2. Remove bearing (3), (4) using bearing puller.
3. Disassemble thrust collar (5), needle bearing (6), 19 gear (7) and 16 gear (8).
4. Loosen snap ring (9) and disassemble spline hub (10).

(When reassembling)

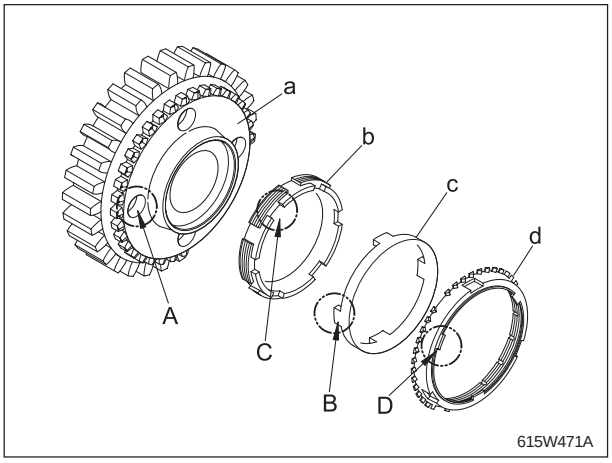
- Thrust collar oil groove should be toward gear. Assembly direction of snap ring (1) should be with rounding toward spacer.
- When assembling synchronizer ring, align with groove position of synchronizer key (11).



(1) Snap Ring
(2) Spacer
(3) Ball Bearing
(4) Ball Bearing
(5) Thrust Collar
(6) Needle Bearing
(7) 19 Gear
(8) 16 Gear
(9) Snap Ring
(10) Spline Hub
(11) Synchronizer Key

f. How to Assemble Synchro Assembly

- Put gear side (a) on inner cone (b). With center cone (c) contacted with inner cone, insert protrusion (B) of center cone into hole (A) of gear. Align protrusion (D) of synchronizer ring (d) with the groove (C) of inner cone and tighten together with center cone.



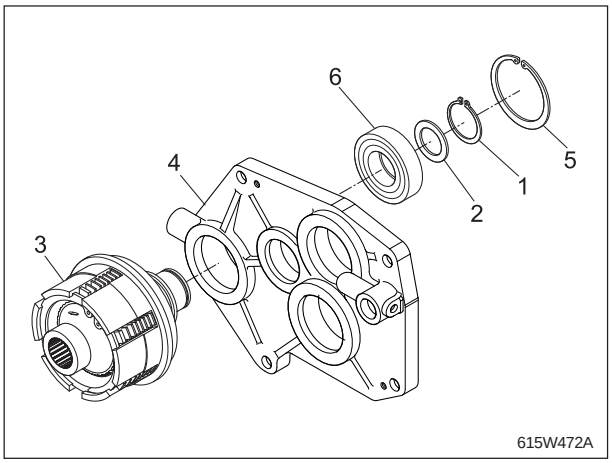
C. Disassembly of PTO Clutch Assembly

a. First Stage (Disconnection of PTO Clutch Assembly)

1. Loosen snap ring (1) and pull out spacer (2).
2. Tap lightly PTO clutch body (3) using plastic hammer and pull out from bearing cover (4).
3. Loosen snap ring (5) for hole and pull out bearing (6).

(When reassembling)

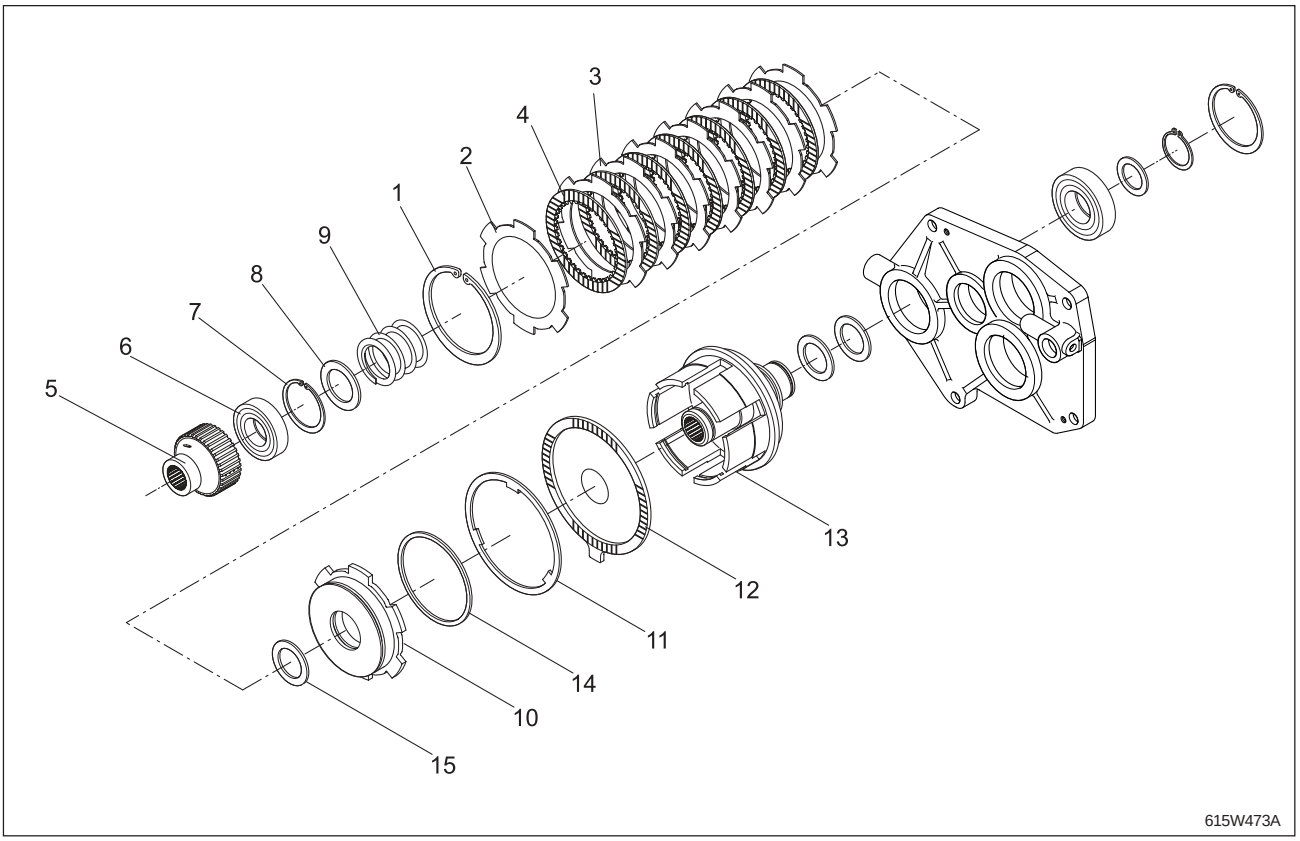
- Taking care of foreign matters not to be entered bearing cover oil groove, clean thoroughly if necessary.
- When assembling clutch assembly, apply sealing contacted surface lightly with grease and take care of not to be damage.
- Assembly direction of snap ring (1) should be with rounding toward spacer.
- After installing clutch assembly on bearing cover, blow oil groove with air and check for operation.



(1) Snap Ring
(2) Spacer
(3) Clutch Body
(4) Bearing Cover
(5) Snap Ring
(6) Bearing

b. Second Stage (Disconnection of PTO Clutch)

1. Disengage snap ring (1) for hole and pull out pressure plate (2), clutch plate (3), clutch disc (4), spline hub (5) and bearing (6).
2. Disengage snap ring (7) for shaft and pull out spacer (8), spring (9), piston (10), return plate (11), and brake plate (12).



(1) Snap Ring
(2) Pressure Plate
(3) Clutch Plate
(4) Clutch Disc
(5) Spline Hub
(6) Ball Bearing
(7) Snap Ring
(8) Spacer
(9) Spring
(10) Piston
(11) Return Plate
(12) Brake Plate
(13) Clutch Body
(14) Piston Ring
(15) Piston Ring

(When reassembling)

- Taking care of foreign matters not to be entered clutch body oil groove, clean thoroughly if necessary.
- Check piston ring (14), (15) for status and apply the contacted surface with grease.

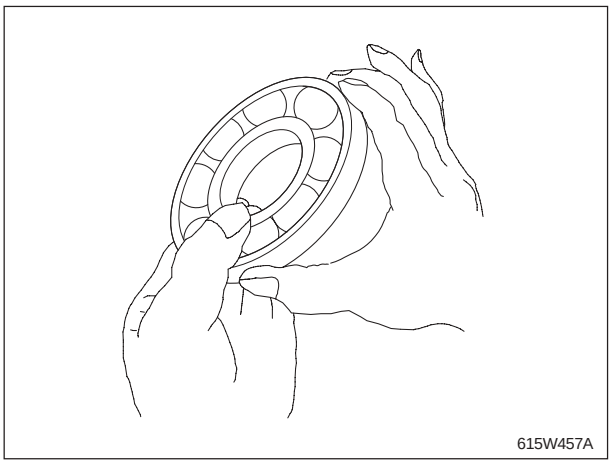
CAUTION

- *Locate the rounding portion of snap ring (1) toward pressure plate and forked portion at boss of clutch body as shown in the left figure.*

11.2 MAINTENANCE

A. Bearing Check

1. With bearing inner wheel seized, pull in and out outer wheel left and right and check for wear and clearance.
2. Apply bearing ball with transmission oil and check for abnormal noise or operation, while taking bearing inner wheel and rotating outer wheel by hand.
3. If damage of failure found, replace it.



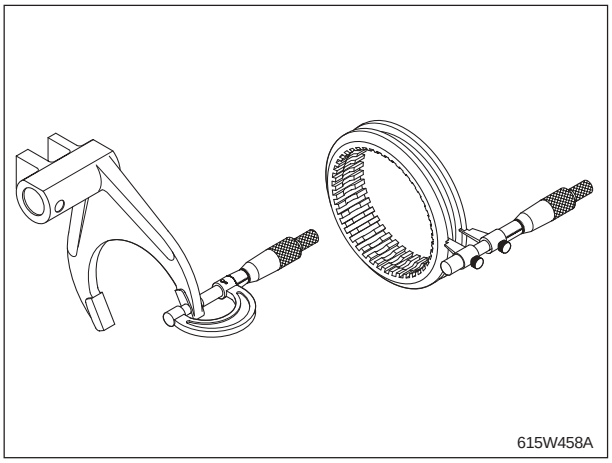
B. Gear Check

1. Ensure slip or tooth surface is worn and replace it if vecessary.

C. Checking for clearance between Transmission Fork and Shift groove.

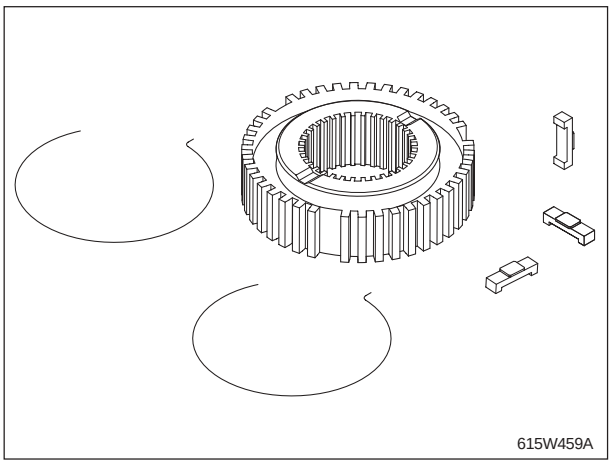
1. Measure groove depth of transmission shift using I.D. micrometer.
2. Measure the depth of transmission fork hook using O.D. micrometer.
3. Check the clearance with measured value of shift and fork and replace it if exceeded the limit.

Sect.	Specified	Limit
Clearance between transmission fork and shift grove	0.1 ~ 0.3 mm 0.004 ~ 0.012 in.	0.8 mm 0.031 in.



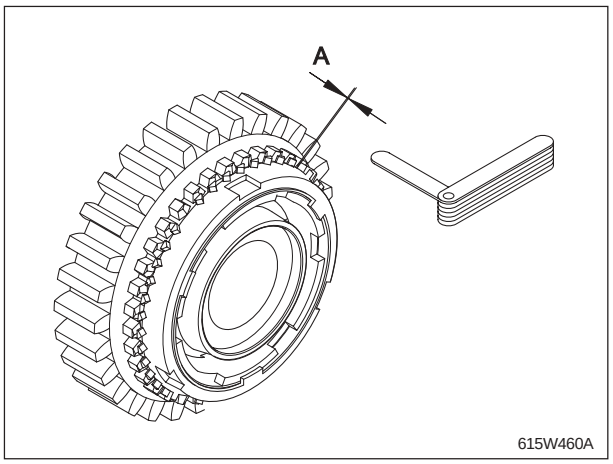
D. Synchro Assembly Check

1. Check synchronizer key and spring for damage and replace it if necessary.



2. With synchronizer ring contacted with taper cone of the opposite gear, measure the clearance between synchro spline and opposite gear spline using clearance gage.

Sect.	Specified	Limit
Clearance between synchro and gear spline (A)	1.35 ~ 1.65 mm 0.053 ~ 0.065 in.	0.5 mm 0.02 in.



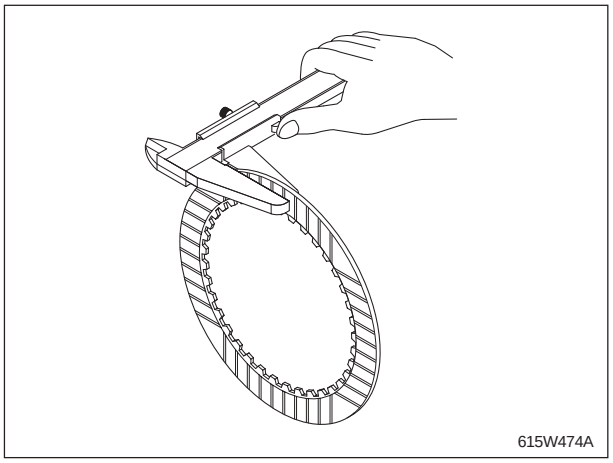
3. Apply O.D. of taper cone in gear with thin red lead, tighten synchronizer ring firmly, and check for contacted state.

Sect.	Specified	Limit
Contact rate between synchronizer ring and gear taper	More than 80%	More than 80%

E. Checking Clutch disc, Clutch plate, brake disc for wear state

1. Using venire calipers, measure the thickness of clutch disc, clutch plate and brake plate.
2. If exceeds allowable tolerance, replace it.

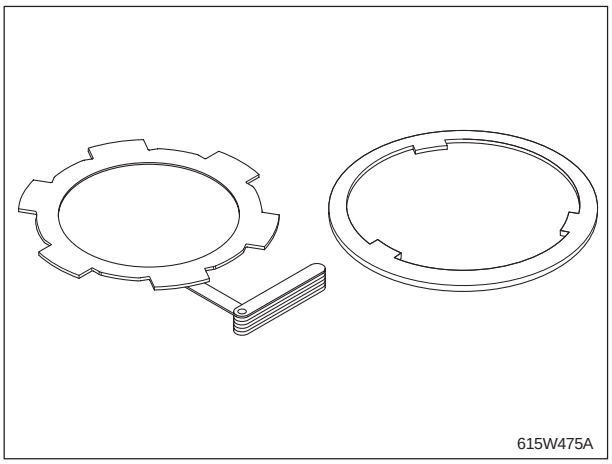
Sect.	Specified	Allowable Limit
Thickness of clutch disc	2.10 ~ 2.30 mm 0.083 ~ 0.091 in.	2.05 mm 0.081 in.
Thickness of clutch plate	1.45 ~ 1.55 mm 0.057 ~ 0.061 in.	1.40 mm 0.055 in.
Thickness of brake plate	2.90 ~ 3.10 mm 0.114 ~ 0.122 in.	2.60 mm 0.102 in.



F. Checking piston, pressure plate and return plate for flatness

1. Using feeler gage, measure the flatness of piston, pressure plate, and return plate.
2. If exceeds allowable tolerance, replace it.

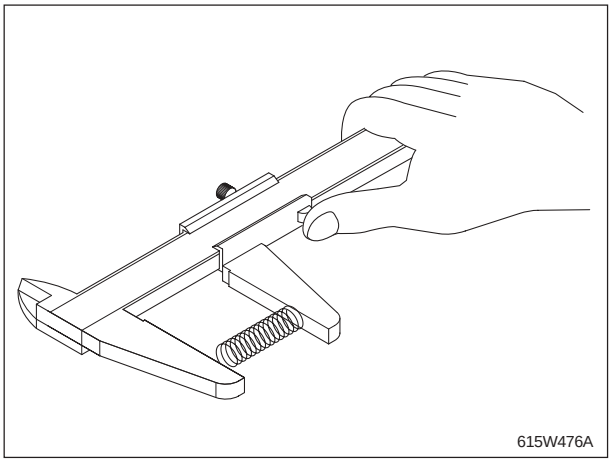
Sect.	Specified	Allowable Limit
Flatness of piston	0.05 mm 0.002 in.	1.5 mm 0.006 in.
Flatness of pressure plate	0.1 mm 0.004 in.	0.3 mm 0.012 in.
Flatness of return plate	0.1 mm 0.004 in.	0.25 mm 0.010 in.


615W475A

G. Checking Length of free tension in piston return spring

1. Using venire calipers, measure the length of free tension in spring.
2. If exceeds allowable tolerance, replace it.

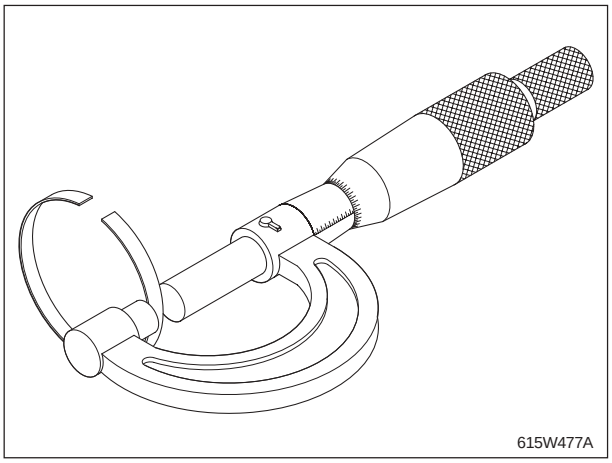
Sect.	Specified	Allowable Limit
Length of spring free tension	46.5 mm 1.83 in.	42.0 mm 1.65 in.


615W476A

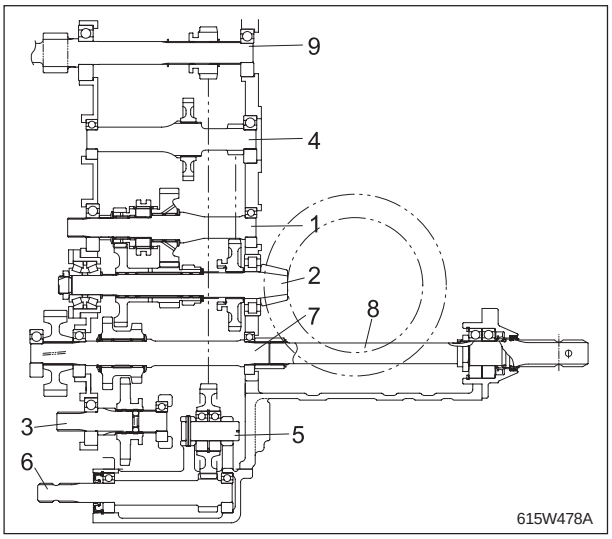
H. Checking seal ring for worn

1. Measure the thickness of seal ring using micrometer.
2. If exceeds allowable tolerance, replace it.

Sect.	Specified	Allowable Limit
Thickness of seal ring	2.35 ~ 2.40 mm 0.093 ~ 0.094 in.	2.0 mm 0.079 in.


615W477A

12. TRANSMISSION CASE



(1) Aux. Shift Shaft
(2) Spiral Bevel Pinion
(3) Front Drive Shaft
(4) 13 Gear Shaft (CR option)
(5) Idle Shaft
(6) Mid PTO Shaft
(7) PTO Drive Shaft
(8) PTO Shaft
(9) PTO Drive Shaft

12.1 DISASSEMBLY, ASSEMBLY

A. Disconnection of Transmission Group

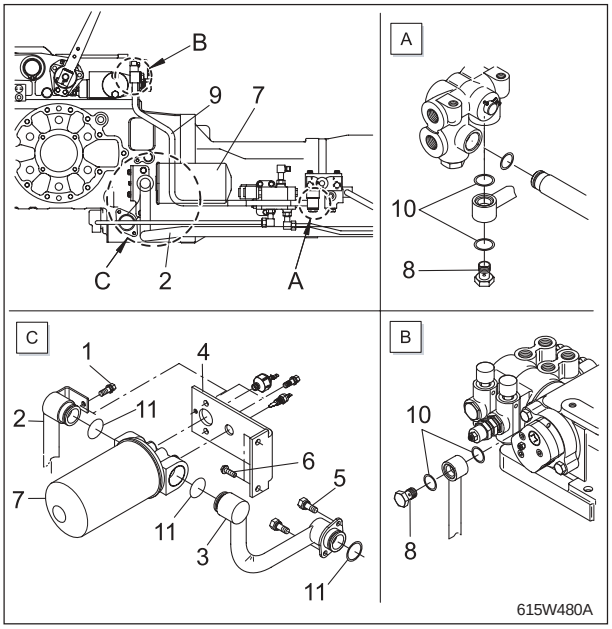
a. First Stage (Disconnection of Hydraulic Pipe)

1. Loosen bolt (1) and disconnect intake pipe2 (2).
2. Loosen intake pipe 1 (3), filter support (4) and attaching bolt (5), (6) and disconnect intake pipe 1, filter support and hydraulic filter assembly (7) in assembly.
3. Loosen joint bolt (8) and disconnect hydraulic pipe 2 (9).

(When reassembling)

- Apply Hydraulic pipe connection O-ring (10), (11) with grease and take care of not damaged.

Sect.	Spec.	Tightening Torque
Joint bolt	M18	49.0 ~ 58.8 N·m 5.0 ~ 6.0 kgf·m 36.2 ~ 43.4 lbf·ft
Tightening bolt	M8	23.5 ~ 27.4 N·m 2.4 ~ 2.8 kgf·m 17.4 ~ 20.2 lbf·ft
	M0	48.1 ~ 55.8 N·m 4.9 ~ 5.7 kgf·m 35.5 ~ 41.2 lbf·ft



(1) Bolt
(2) Intake Pipe 2
(3) Intake Pipe 1
(4) Filter Support
(5) Bolt
(6) Bolt
(7) Hydraulic Filter Assembly
(8) Joint Bolt
(9) Hydraulic Pipe2
(10) O-ring
(11) O-ring

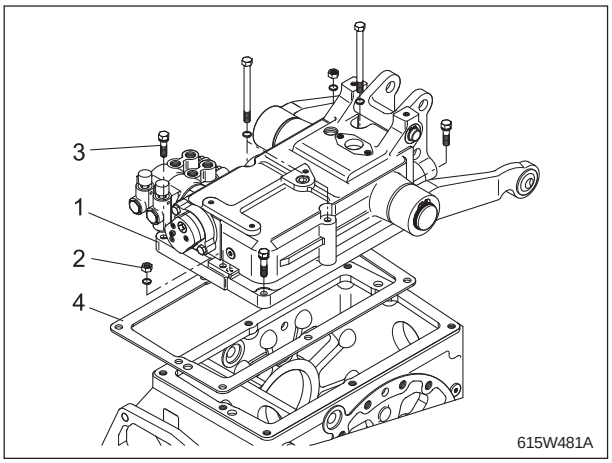
b. Second Stage (Disconnection of Hydraulic Cylinder Assembly)

1. Disengage hydraulic cylinder assembly (1) attaching bolt (3) and nut (2) and disconnect hydraulic cylinder assembly (1).

(When reassembling)

- Replace packing.

Sect.	Spec.	Tightening Torque
Tightening bolt	M10	48.1 ~ 55.8 N·m 4.9 ~ 5.7 kgf·m 35.5 ~ 41.2 lbf·ft



(1) Hydraulic Cylinder Assembly
(2) Nut
(3) Bolt
(4) Packing

c. Third Stage (Disconnection of Transmission Lever)

1. Remove the main transmission bracket (1) attaching bolt (2) and disconnect bracket and main transmission lever (3) in assembly.
2. Pull out snap pin (4) and disconnect aux. transmission rod (5), creep rod (6).
3. Remove spring pin (7) and disconnect aux. transmission lever (8), creep speed lever (9), aux. transmission lever 1 (10), creep speed lever 1 (11) and front wheel driving lever (12).

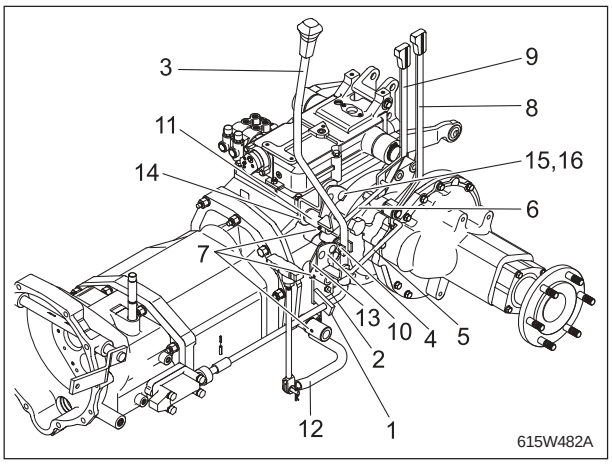
(When reassembling)

Sect.	Specified Value
Clearance between Aux. transmission lever 1, creep speed lever and safety switch	00 mm 00 in.

Sect.	Spec.	Tightening Torque
Tightening bolt, nut	M8	23.5 ~ 27.4 N·m 2.4 ~ 2.8 kgf·m 17.4 ~ 20.2 lbf·ft

IMPORTANT:

- After assembling aux. transmission lever (8) and creep speed lever (9), check the safety switch (15) (quick speed ON/OFF switch) operation.
- When it does not operate properly, check the safety switch (15) or adjust shim (16).



(1) Main Transmission Bracket
(2) Bolt
(3) Main Transmission Lever
(4) Snap Pin
(5) Aux. Transmission Rod
(6) Creep Speed Rod
(7) Spring Pin
(8) Aux. Transmission Lever
(9) Creep Speed Lever
(10) Aux. Transmission Lever 1
(11) Creep Speed Lever 1
(12) Front Wheel Driving Lever
(13) Stopper
(14) Stopper
(15) Safety Switch
(16) Shim

d. Fourth Stage (Disconnection of Rear Axle Case)

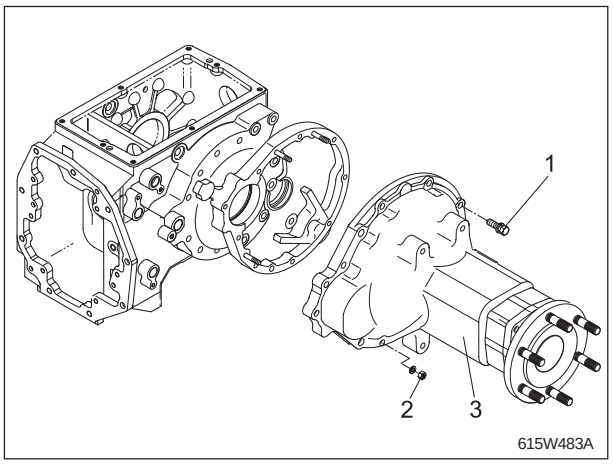
1. Loosen bolt (1) and nut (2) and disconnect rear axle case (3) in assembly.

(When reassembling)

- Remove foreign matters or oil from contacted surface between brake case and rear axle case and apply it with sealing agent.

Sealing agent	Three bond 1208D or equivalent

Sect.	Spec.	Tightening Torque
Tightening bolt, nut	M10	48.1 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.4 ~ 41.2 lbf·ft



(1) Bolt With Washer
(2) Nut
(3) Rear Axle Case

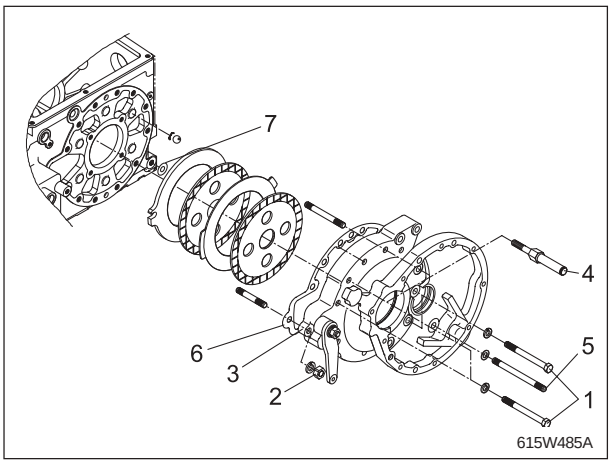
e. Fifth Stage (Disconnection of Brake Case)

1. Loosen bolt (1) and nut (2) and disconnect brake case (3) in assembly.

(When reassembling)

- Make sure assembly position of lever shaft (4), bolt (1), and stud (5) is correct.
  - Assembly position: See Maintenance of Brake Case.
- Replace packing (6), (7).

Sect.	Spec.	Tightening Torque
Tightening bolt	M12	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.1 ~ 66.5 lbf·ft
Stud	M12	39.2 ~ 49.0 N·m 4.0 ~ 5.0 kgf·m 28.9 ~ 36.0 lbf·ft
Tightening bolt	M12	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.1 ~ 66.5 lbf·ft



(1) Bolt
(2) Nut
(3) Brake Case
(4) Lever Shaft
(5) Stud
(6) Packing
(7) Packing

B. Disconnection of Transmission Case

a. First Stage (Disconnection of PTO Shaft)

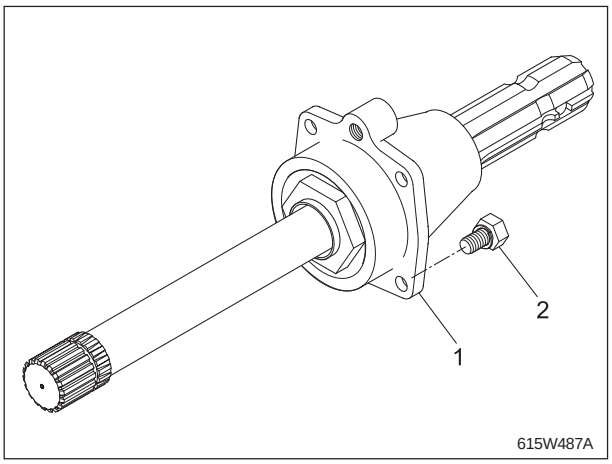
1. Loosen bearing case (1) attaching bolt (2) and disconnect PTO shaft (3) and bearing case in assembly.
2. Loosen snap ring (4) and pull out PTO shaft with bearing (5).

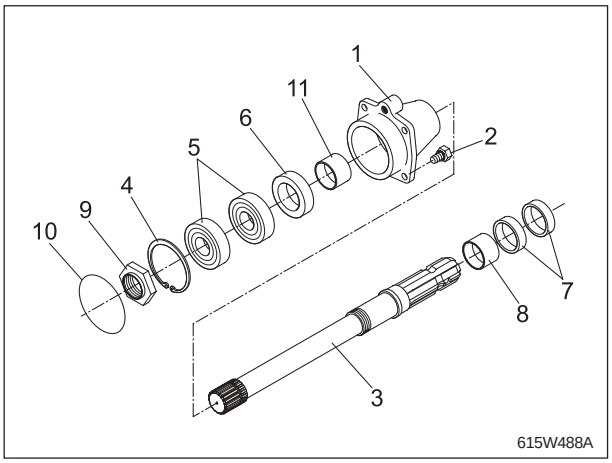
(When reassembling)

- Make sure assembly direction of oil seal (6), (7) are correct and apply the contacted with grease.
- When assembling sleeve (8) into PTO shaft, apply the inside with bonding agent and then push fit.
- Engage PTO shaft locking nut (9) and then perform cocking firmly to prevent loosen.

Sealing agent	Three bond 1208D or equivalent

Sect.	Spec.	Tightening Torque
Locking nut	M32	147 ~ 196 N·m 15 ~ 20 kgf·m 108 ~ 145 lbf·ft





(1) Bearing Case
(2) Bolt
(3) PTO Shaft
(4) Snap Ring
(5) Ball Bearing
(6) Oil Seal
(7) Oil Seal
(8) Sleeve
(9) Nut
(10) O-Ring
(11) Oil Seal Collar

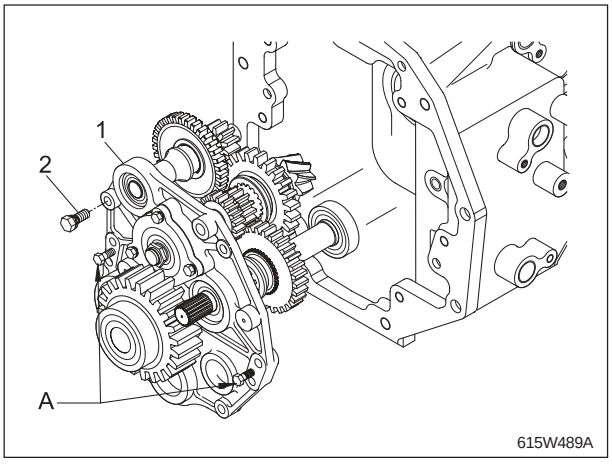
b. Second Stage (Disconnection of bearing cover assembly)

1. Pull out transmission arm (Aux. Transmission, Front wheel drive, MID PTO) outward and tighten to the wall of transmission case.
2. Loosen bearing cover (1) attaching bolt (2) and using service bolt (M8*1.25), tighten to bearing cover and disassemble bearing cover with gear in assembly.

(When reassembling)

- When assembling transmission arm (Hi-Lo shift, Front wheel drive, MID PTO), apply O-ring with grease and seat into the groove of transmission fork.

Sect.	Spec.	Tightening Torque
Tightening bolt	M10	48.1 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.4 ~ 41.2 lbf·ft



(1) Bearing Cover
(2) Bolt

[A] Service Bolt

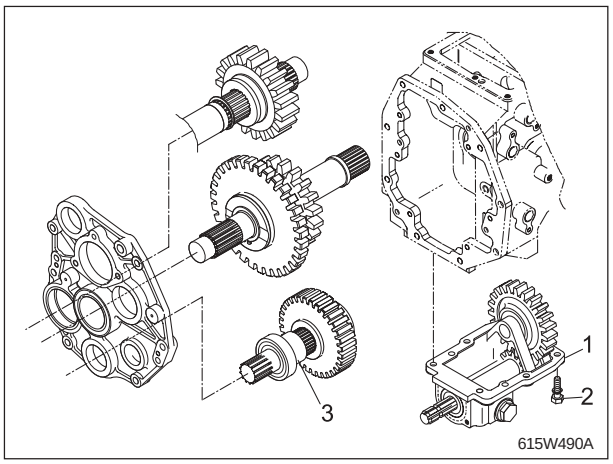
c. Third Stage (Disassembly of Front wheel drive gear assembly/MID PTO Case assembly)

1. Loosen MID PTO case (1) attaching bolt (2) and disconnect case and gear in assembly.
2. Disconnect front wheel drive shaft assembly (3) from transmission case.

(When reassembling)

- Wipe out oil or foreign matters from contacted surface between MID PTO case (1) and transmission case and apply with sealing agent.

Sealing agent	Three bond 1208D or equivalent



(1) MID PTO Case
(2) Bolt with Washer
(3) Front Wheel Drive Shaft Assembly

d. Fourth Stage (Disassembly of Spiral Bevel Pinion Shaft)

1. Pull out MID PTO transmission fork (3) and fork rod (2) from bearing cover (1).
2. Pull out Hi-Lo shift fork (4) and fork rod (5).
3. Disassemble fork rod from each transmission fork.

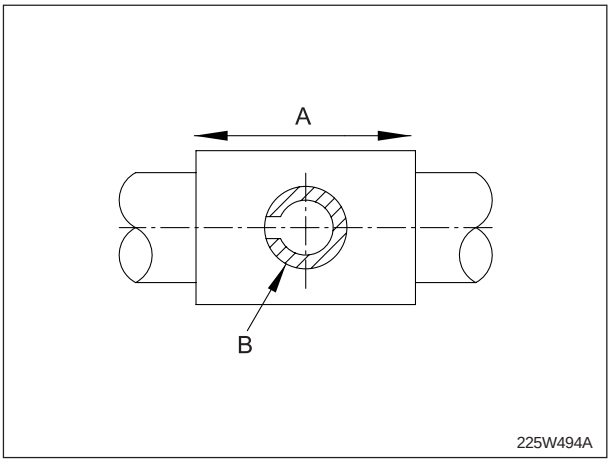
CAUTION

- *When disassembling locking bolt from bearing cover, take care of Ball not to be bounded.*

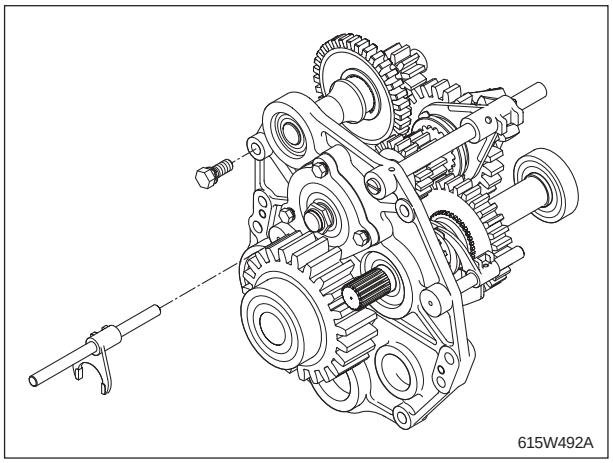
(When reassembling)

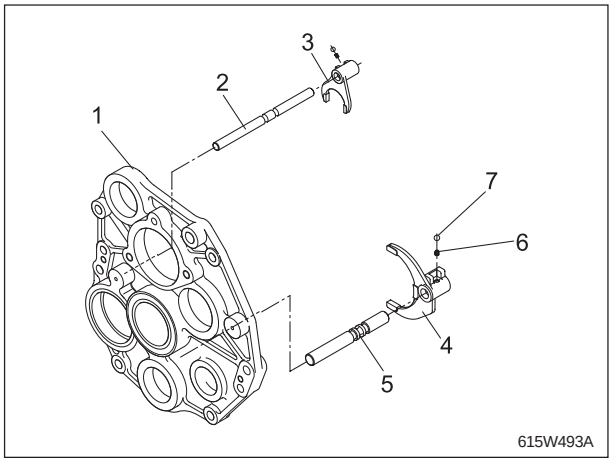
- Make sure foreign matters is not entered Ball of transmission fork and spring assembly hole.
- Forked portion of spring pin should be toward shaft.

Sect.	Spec.	Tightening Torque
Tightening bolt	M10	48.0 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.5 ~ 41.2 lbf·ft



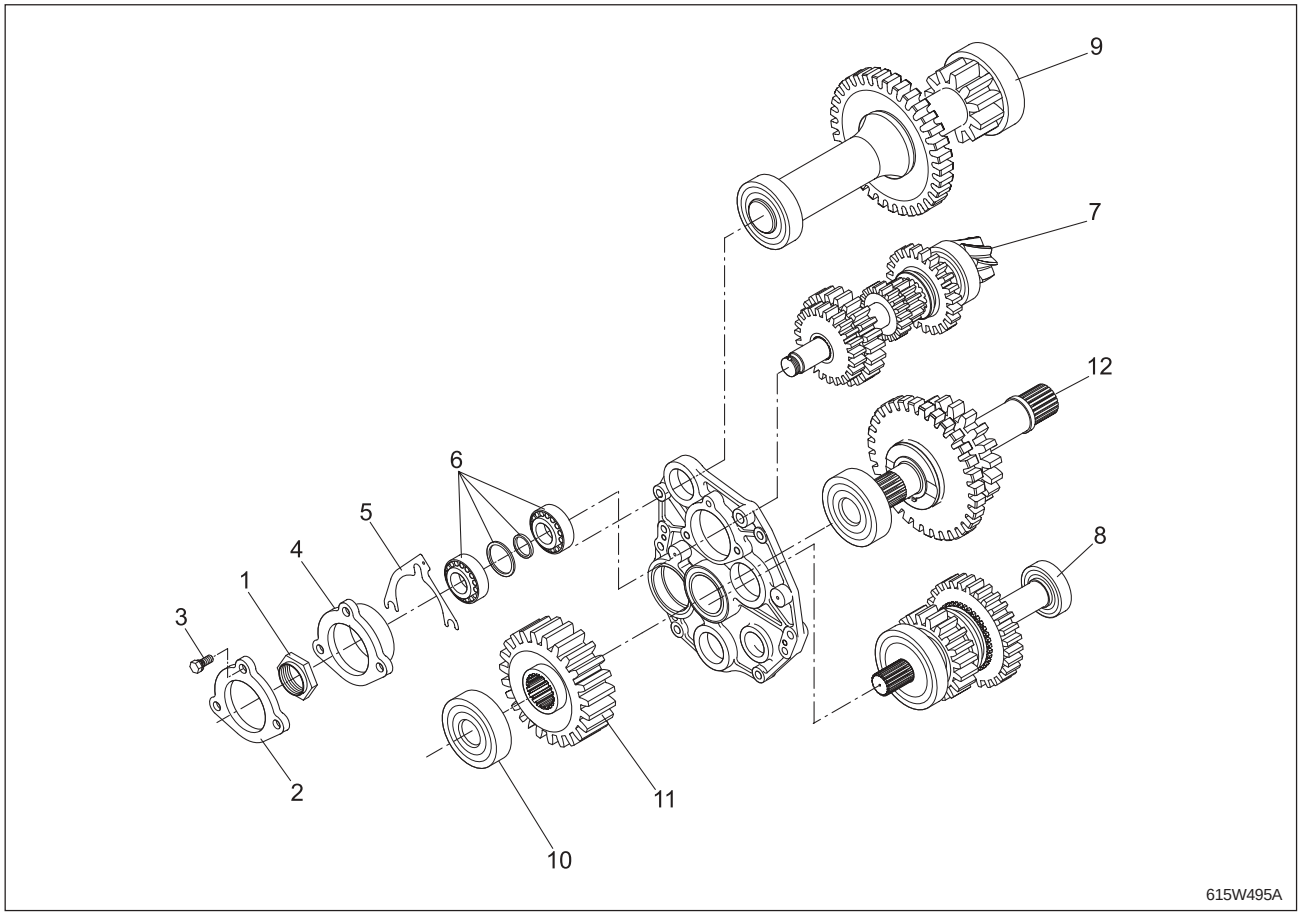
(A) Operating Direction (B) Spring Pin





(1) Bearing Cover
(2) Fork Rod (MID PTO)
(3) Transmission Fork (MID PTO)
(4) Transmission Fork (Hi-Lo Shift)
(5) Fork Rod (Hi-Lo Shift)
(6) Spring
(7) Ball

e. Fifth Stage (Disassembly of Gear Shaft Assembly)



(1) Nut
(2) Bearing Cover
(3) Bolt
(4) Bearing Case
(5) Shim
(6) Taper Roller Bearing Assembly
(7) Pinion Shaft Assembly
(8) Hi-Lo Shift Shaft Assembly
(9) 13 Gear Shaft (Optional)
(10) Ball Bearing
(11) 27 (30) Gear
(12) PTO Drive Shaft Assembly

1. Straighten cocking of lock nut (1) and loosen nut (1).
2. Loosen bearing cover (2) attaching bolt (3) and pull out bearing case (4), adjusting shim (5), and taper roller bearing assembly (6).
3. Disconnect pinion shaft assembly (7), Hi-Lo shift shaft assembly (8).
4. Using bearing puller, pull out PTO drive shaft bearing (10) with 27 (30) gear (11).
5. Disconnect PTO drive shaft assembly (2).

(When reassembling)

- When assembling gear shaft assembly into bearing cover, take a note of assembly position.
- When assembling bearing case, check depth.
- Replace lock nut, tighten and then perform cocking firmly to the specified torque.
- Take care of assembly direction of 27 (30) gear.
  - Longer protrusion of spline boss should be toward bearing cover.

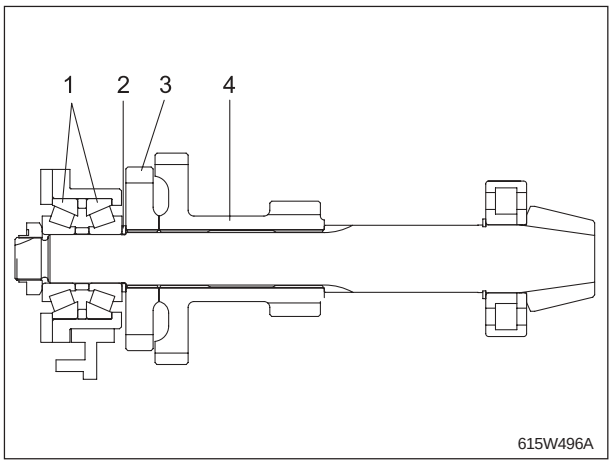
Sect.	Spec.	Tightening Torque
Lock nut	M22	147 ~ 196 N·m 15 ~ 20 kgf·m 108 ~ 145 lbf·ft
Tightening bolt	M10	48.0 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.5 ~ 41.2 lbf·ft

f. Sixth Stage (Disassembly of Spiral bevel pinion shaft)

1. Pull out taper roller bearing (1) using bearing puller and disassemble spacer (2), 25 spur gear (3), and 42-17 gear (4).

(When reassembling)

- Take care of assembly direction of 25 spur gear. Side oil groove should be toward needle bearing.



(1) Taper Roller Bearing
(2) Spacer
(3) 25 Spur Gear
(4) 42-17 Gear

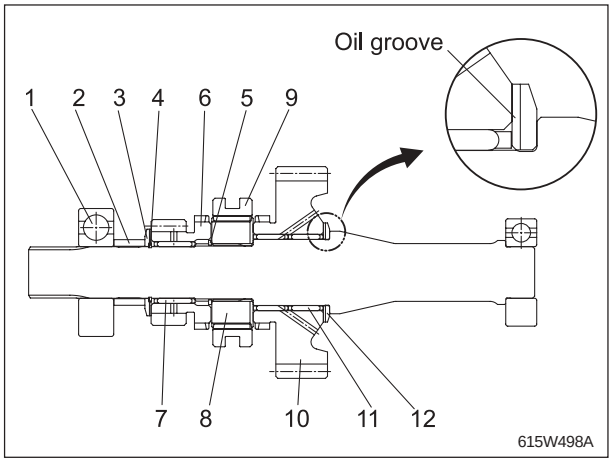
g. Seventh Stage (Disassembly of Aux. Transmission Shaft)

1. Using bearing puller, pull out bearing (1) and disassemble spacer (2) and thrust collar (3).
2. Loosen snap ring (4), (5) for shaft and disassemble 18 spur gear (6) and needle bearing (7), spline boss (8) and shift (9), 32 spur gear (10) and needle bearing (11) and thrust collar (12).

(When reassembling)

- Oil groove of thrust collar should be toward gear.

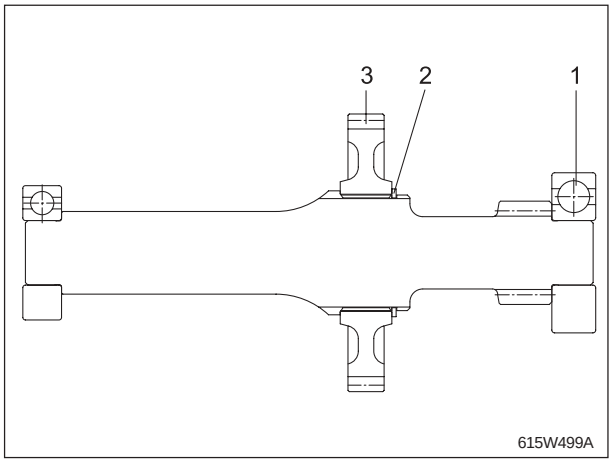
Sect.	Spec.	Tightening Torque
Lock nut	M22	147 ~ 196 N·m 15 ~ 20 kgf·m 108 ~ 145 lbf·ft
Tightening bolt	M10	48.0 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.5 ~ 41.2 lbf·ft



(1) Ball Bearing
(2) Spacer
(3) Thrust Collar
(4) Snap Ring
(5) Snap Ring
(6) 18 Spur Gear
(7) Needle Bearing
(8) Spline Boss
(9) Shift
(10) 32 spur Gear
(11) Needle Bearing
(12) Thrust Collar

h. Eighth Stage (Disconnection of Creep Speed Shaft)

1. Remove the bearing (1) using bearing puller.
2. Remove the snap ring (2) and disconnect the 41 spur gear (3).



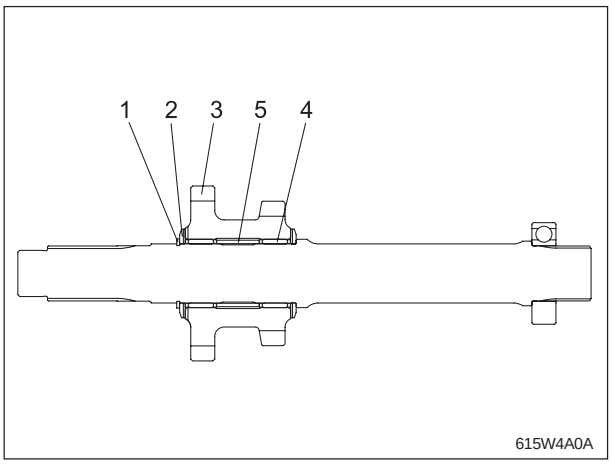
(1) Ball Bearing
(2) Snap Ring
(3) 41 Spur gear

i. Ninth Stage (Disassembly of Creep Speed Shaft)

1. Loosen snap ring (1) and disassemble thrust collar (2), 26-20 gear (3), needle bearing (4), and spacer (5).

(When reassembling)

- Oil groove of thrust collar should be toward gear.
- When assembling, rounding part of Snap ring should be toward gear.



(1) Snap Ring
(2) Thrust Collar
(3) 26-20 Gear
(4) Needle Bearing
(5) Spacer

j. (Disassembly of Front Wheel Drive/Mid PTO)

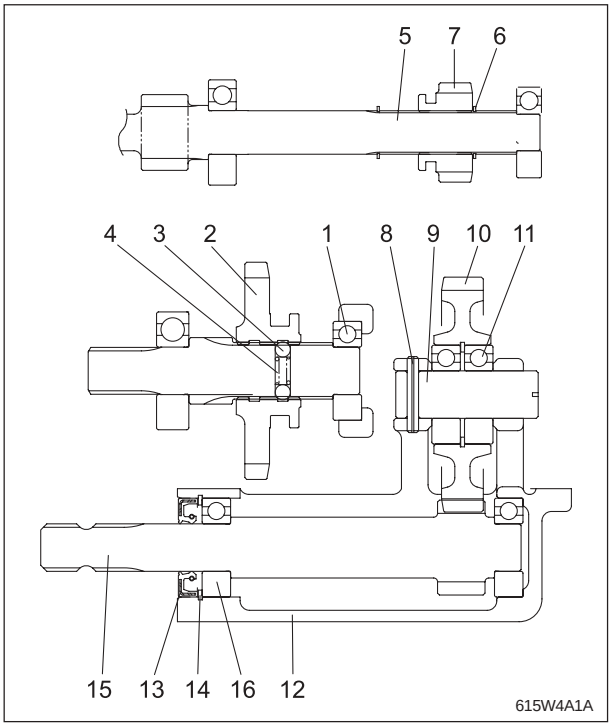
1. Using bearing puller, pull out bearing (1) and disassemble 31 spur gear (2).
2. Using bearing puller, pull out 12 gear shaft (5), loosen snap ring (6) for shaft and disassemble 20 spur gear (7).
3. Pull out spring pin (8), disassemble counter shaft (9) and 41 spur gear (10) with ball bearing (11).
4. Pull out oil seal (13) from MID PTO case (12) and disassemble snap ring (14) for hole.
5. Pull out 14 gear shaft (15) with ball bearing (16) from MID PTO case.

CAUTION

- *When disassembling 31 spur gear, take care of spring (4) and Ball (3) not to be bounded.*

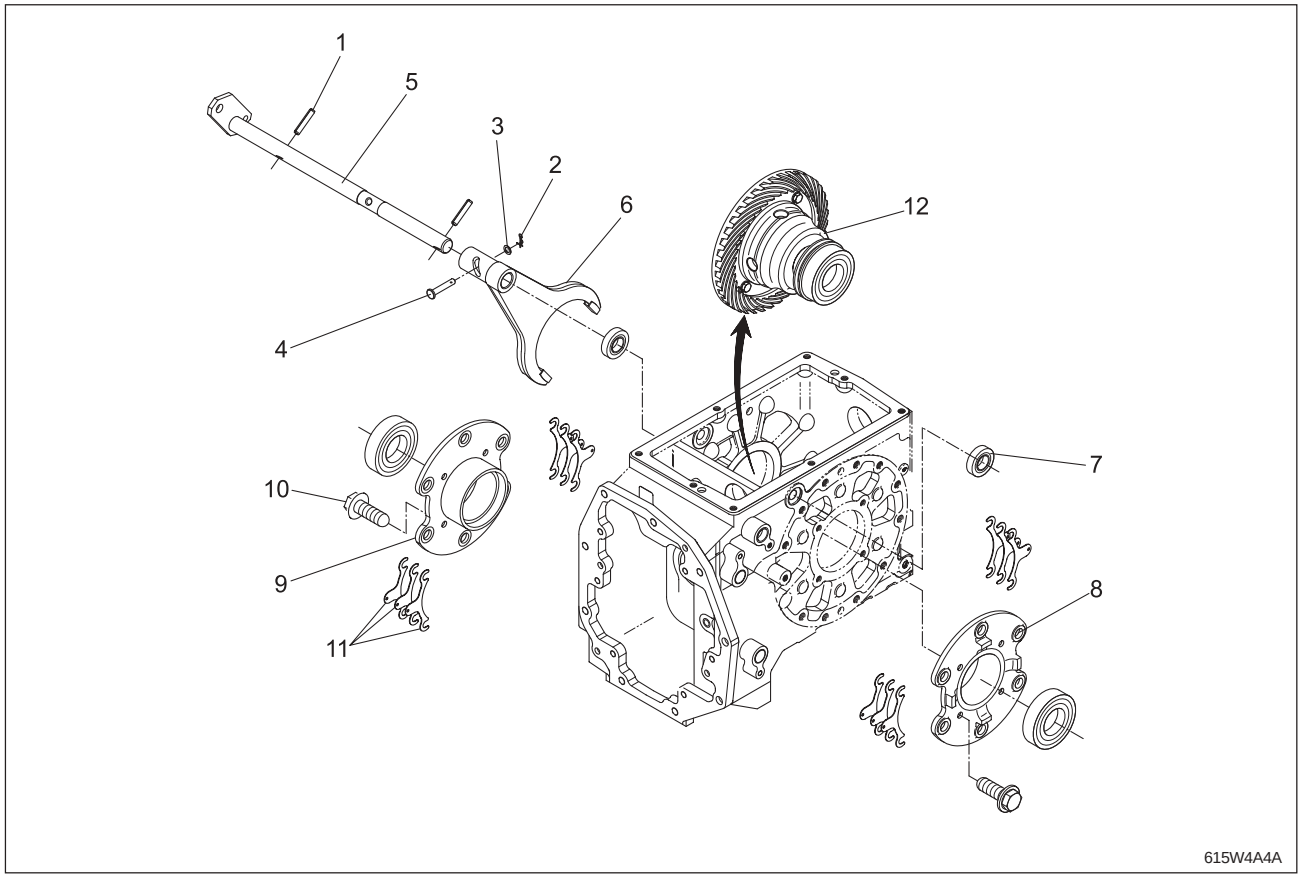
(When reassembling)

- Taking care of 31 spur gear assembly direction - 31 spur gear chamfering should be backward (See the above figure).
- Taking care of 41 spur gear assembly direction - 41 spur gear chamfering should be forward. (See the above figure).
- Rounding of snap ring should be toward bearing.· Apply oil seal contacted surface with grease and take care of not to be damaged.
- Spring pin should be assembled with forked portion toward vertical direction of shaft. (See the following figure).



(1) Ball Bearing
(2) 31 Spur Gear
(3) Ball
(4) Spring
(5) 12 Gear Shaft
(6) Snap ring
(7) 20 Spur Gear
(8) Spring Pin
(9) Counter Shaft
(10) 41 Spur Gear
(11) Ball Bearing
(12) MID PTO Case
(13) Oil Seal
(14) Snap Ring
(15) 14 Gear Shaft
(16) Ball Bearing

k. Tenth Stage (Disconnection of Differential Gear Assembly)



(1) Spring Pin
(2) Snap Pin
(3) Flat Washer
(4) Pin
(5) Differential Locking Fork Shaft
(6) Differential Locking Fork
(7) Oil Seal
(8) Bearing Case (Left)
(9) Bearing Case (Right)
(10) Bolt
(11) Shim
(12) Differential Gear Assembly

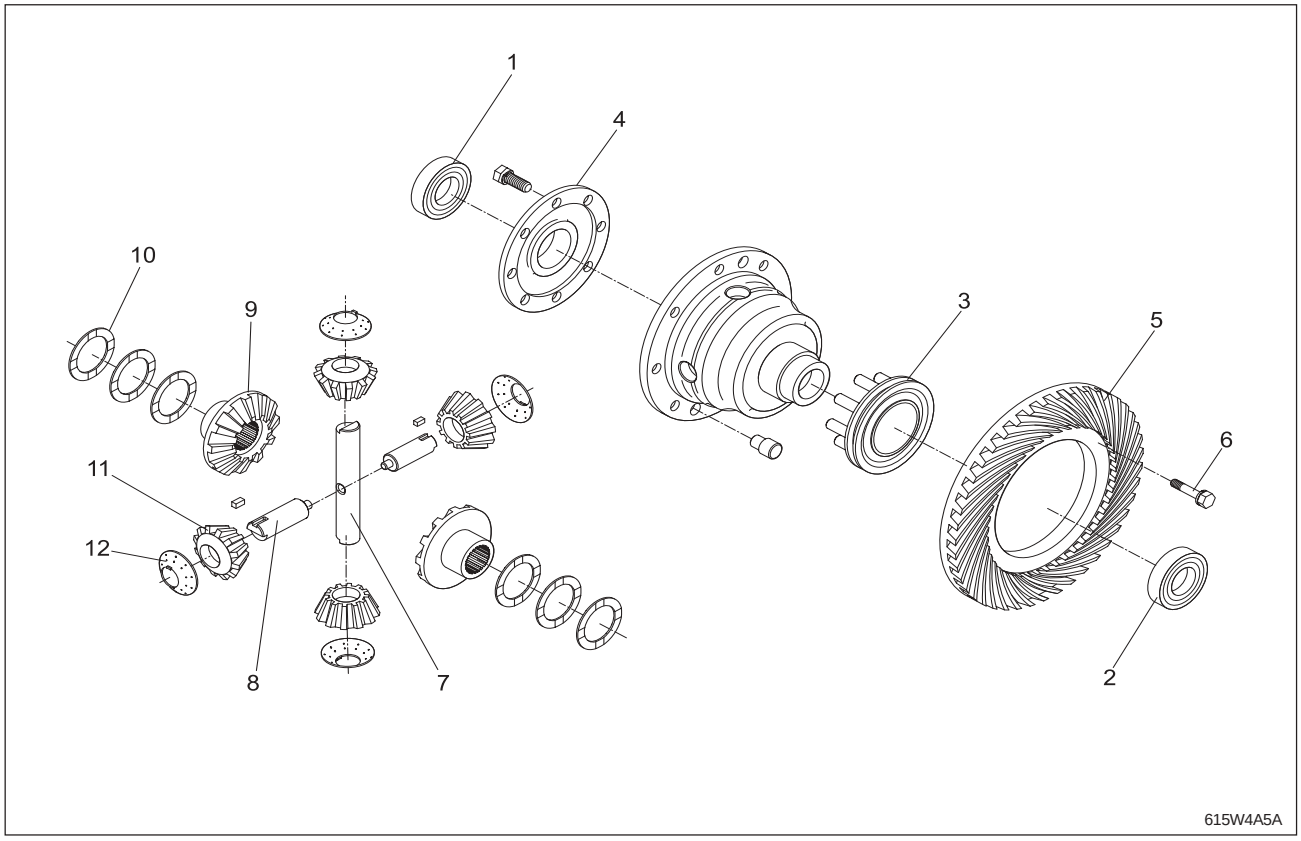
1. Pull out spring pin (1).
2. Pull out snap pin (2) and disassemble flat washer (3) and pin (4).
3. Pull out differential locking fork shaft (5) and disassemble differential locking fork (6).
4. Loosen left and right bearing case (8), (9) attaching bolt (10) and disassemble bearing case and adjusting shim (11).
5. Disconnect differential gear assembly (12) from transmission case.

(When reassembling)

- Make sure spiral bevel gear is worn and change with bevel pinion in a set if necessary.
- Make sure of assembly direction of differential gear assembly.
- From rear view, spiral bevel gear (ring gear) is from right.
- When assembling bearing cover, take care of the number of adjusting shim (11).
- Apply left and right oil seal (7) contacted surface of transmission case with grease and take care of not to be damaged.
- Taking care of spring pin type direction.- Forked portion should be outward (opposite of oil seal).

Sect.	Spec.	Tightening torque
Tightening bolt	M10	48.0 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.5 ~ 41.2 lbf·ft

l. Eleventh Stage (Disassembly of Differential gear)



(1) Taper Roller Bearing
(2) Taper Roller Bearing
(3) Differential Locking Shift
(4) Cap
(5) Spiral Bevel Gear
(6) Bolt
(7) Differential Pinion Shaft 1
(8) Differential Pinion Shaft 2
(9) Differential Side Gear
(10) Differential Washer
(11) Differential Pinion
(12) Differential Pinion Washer

1. Disassemble taper roller bearing (1), (2) using special tool.
2. Pull out differential locking shift (3).
3. Loosen differential gear cap (4) and spiral bevel gear (5) attaching bolt (6) and disassemble cap and spiral bevel gear (5).
4. Pull out differential pinion shaft 1 (7), differential pinion shaft 2 (8) and disassemble differential side gear (9), differential washer (10), differential pinion (11), and differential pinion washer (12).

(When reassembling)

- If there is the evidence of worn or damaged in differential gear, differential pinion, differential side gear, differential pinion shaft, replace parts simultaneously.
- Apply each operating part of differential gear with molybdenum. -Three Bond 1901 or equivalent.
- Apply differential case cap and spiral bevel gear tightening bolt with bonding agent and tighten diagonally.

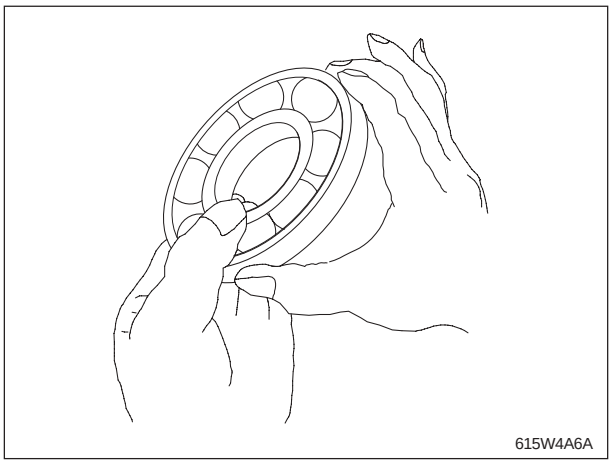
Bonding agent	Three Bond 1372 or equivalent

Sect.	Spec.	Tightening Torque
Cap tightening bolt	M10	48.0 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.5 ~ 41.2 lbf·ft
Spiral bevel gear tightening bolt	M10 (UBS)	68.6 ~ 88.2 N·m 7.0 ~ 9.0 kgf·m 50.6 ~ 65.1 lbf·ft

12.2 MAINTENANCE

A. Bearing Check

1. With bearing inner wheel seized, pull in and out outer wheel left and right and check for wear and looseness.
2. Apply bearing ball with transmission oil and with bearing inner wheel seized and outer wheel rotated, check for abnormal noise and operation.
3. If damage and failure found, replace it.

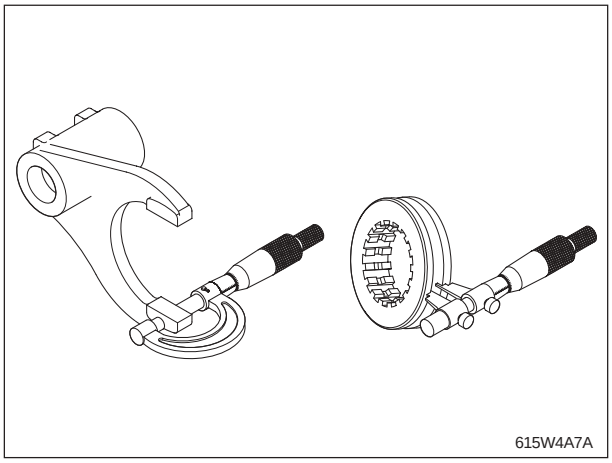

615W4A6A

B. Gear Check

1. Ensure slip or tooth surface is worn and replace it if necessary.

C. Checking for Clearance Between Transmission Fork and Shift Groove.

1. Measure groove depth of transmission shift using I.D. micrometer.
2. Measure the depth of transmission fork hook using O.D. micrometer.
3. Check the clearance with measured value of shift and fork and replace it if exceeded the limit.


615W4A7A

Sect.	Specified	Limit
Clearance of between Transmission fork and Shift groove	0.1 ~ 0.3 mm 0.004 ~ 0.012 in.	0.8 mm 0.031 in.

D. Bevel Pinion Shaft and Spiral Bevel Gear Setting

1. When assembling differential gear assembly into transmission case, adjust pre-load of taper roller bearing (1), (2).

a. Adjustment Method

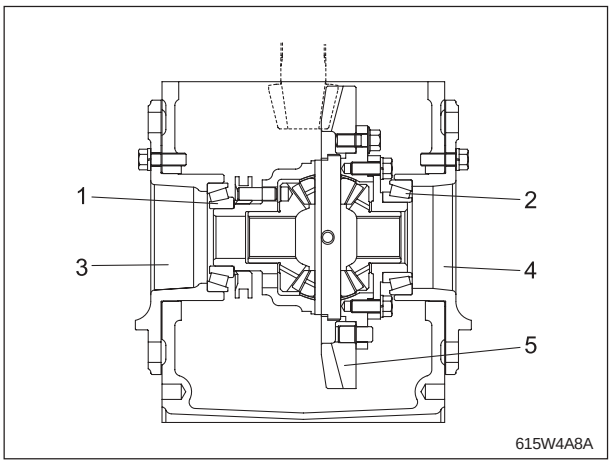
- Insert datum shim (0.75 mm) in left and right bearing case (3), (4) and check bearing pre-load with rotation torque of spiral bevel gear (5). If rotation torque exceeds the specified, increase the amount of shim and if less than the specified, decrease it.

b. Type of Adjustment Shim

0.1 mm (0.004 in.)

0.2 mm (0.008 in.)

0.5 mm (0.020 in.)



(1) Taper Roller Bearing
(2) Taper Roller Bearing
(3) Bearing Case (Left)
(4) Bearing Case (Right)
(5) Spiral Bevel Gear

2. Make sure backlash and tooth contacted between spiral bevel gear (1) and bevel pinion shaft (2).

Sect.	Specified
Rotation torque of spiral bevel gear	3.92 ~ 6.37 N·m 0.4 ~ 0.65 kgf·m 2.89 ~ 4.70 lbf·ft

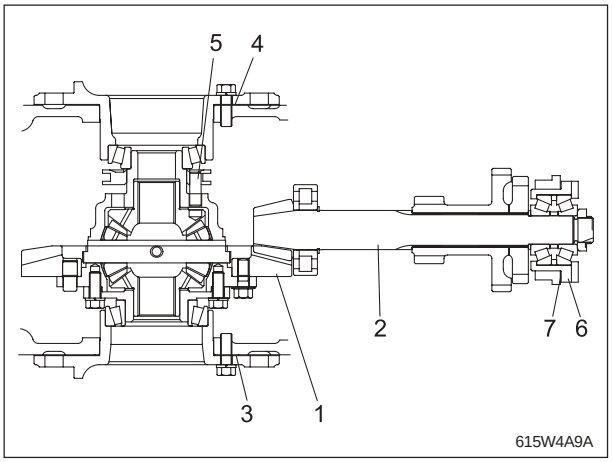
e. Backlash Adjustment Method

- Determine entire amount of shim (3), (4) with pre-load of left and right taper roller bearing in differential gear assembly. Divide left and right properly by determined entire amount of shim. If backlash less than the specified, move shim of spiral bevel gear to differential locking shift (5). If backlash exceeds the specified, move shim of differential locking shift to bevel gear properly.

CAUTION

- *When adjusting backlash, entire amount of shim should be kept.*

Sect.	Specified
Backlash between spiral bevel gear and bevel pinion shaft	0.15 ~ 0.30 mm 0.006 ~ 0.012 in.



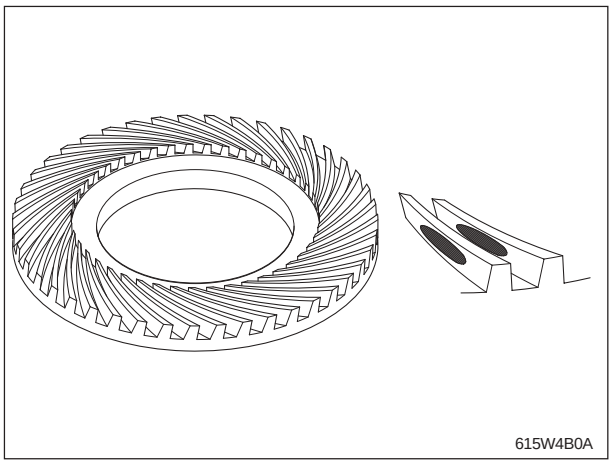
(1) Spiral Bevel Gear
(2) Bevel Pinion Shaft
(3) Shim
(4) Shim
(5) Differential Locking Shift
(6) Bearing Case
(7) Shim

f. Tooth Contact Checking Method

- Apply a few tooth surface with thin film of red lead at 3 positions where divided into 3 circumference, apply bevel gear properly with load, rotate bevel pinion shaft, and then ensure tooth contacted.

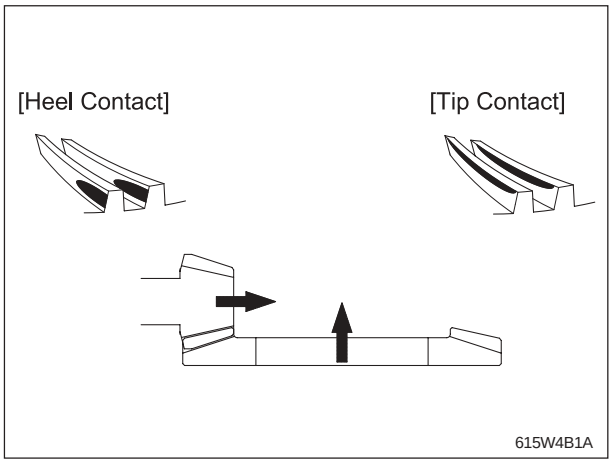
<Good Tooth Contact>

- More than 35% tooth contacted. The center is located between one third and one half from small.



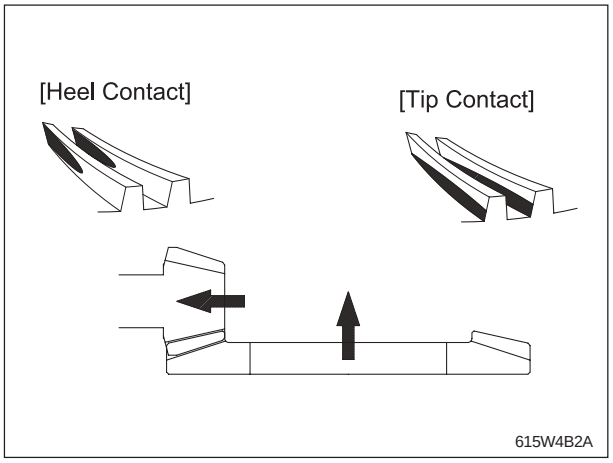
- Decrease shim (7) of bearing case (6) and move bevel pinion shaft (2) in the direction of arrow. Move some shim (4) of differential locking shift (5) to spiral bevel gear (1) and move spiral bevel gear in the direction of arrow.

* Repeat until good tooth contact and backlash obtained.



- Increase shim (7) of bearing case (6) and move bevel pinion shaft (2) in the direction of arrow. Move some shim (3) gear (1) to differential locking shift (5) of spiral bevel and move spiral bevel gear in the direction of arrow.

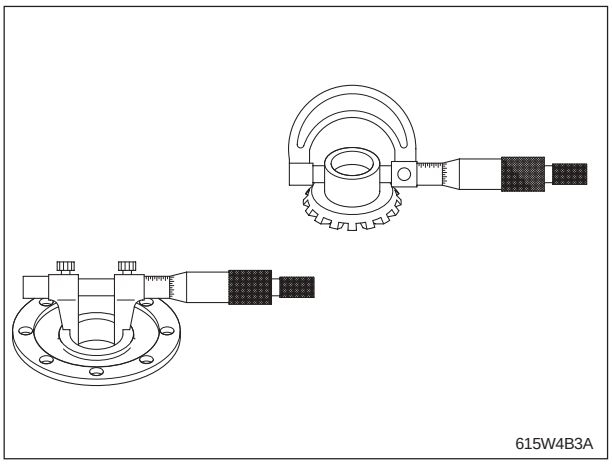
* Repeat until good tooth contact and backlash obtained.



E. Check Differential Gear for Worn

a. Clearance Check of Differential Case, Cap, and Differential Side Gear

Sect.	Specified	Limit
Clearance of differential case, differential case cap, and differential side gear	0.050 ~ 0.15 mm 0.00197 ~ 0.00594 in.	0.35mm 0. 0138in.
I.D. of differential case and differential case cap	40.500 ~ 40.561 mm 1.59449 ~ 1.59693 in.	-
O.D. of differential side gear	40.411 ~ 40.450 mm 1.59098 ~ 1.59252 in.	-

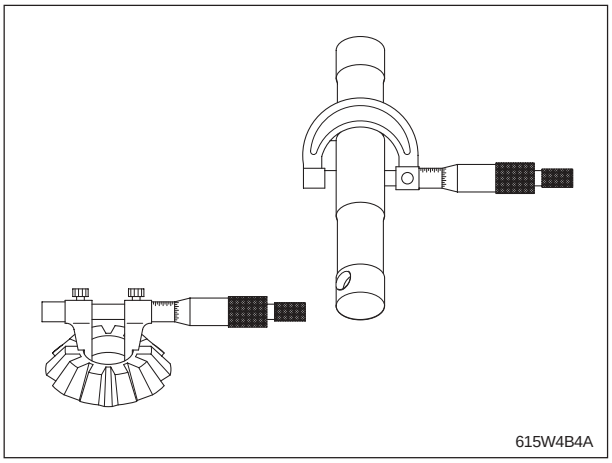

615W4B3A

1. Measure I.D. of differential case and cap.
2. Measure O.D. of differential side gear.
3. Check clearance using the measured and if exceeds limits, replace it.

b. Clearance Check of Differential Pinion Shaft and Pinoin

1. Measure I.D. of differential pinoin.
2. Measure O.D. of differential pinion.
3. Check clearance using the measured and if exceeds limits, replace it.

Sect.	Specified	Limit
Clearance of differential pinion and differential pinion shaft	0.020 ~ 0.062 mm 0.00079 ~ 0.00244 in.	0. 025mm 0.
I.D. of differential pinion shaft	20.000 ~ 20.021 mm 0.78740 ~ 0.78823 in.	0098in.
O.D. of differential pinion shaft	19.959 ~ 19.980 mm 0.78579 ~ 0.78661 in.	-


615W4B4A

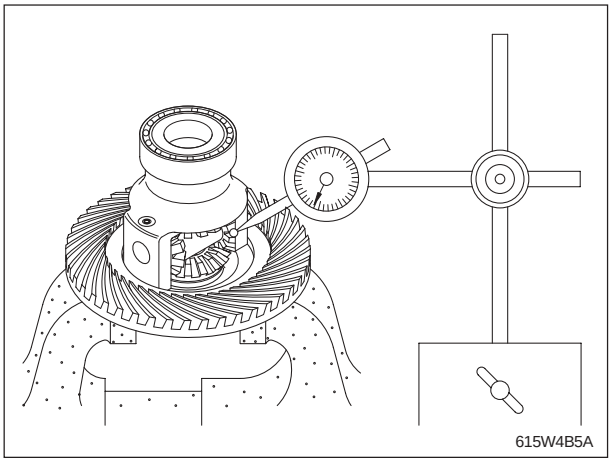
c. Type of Adjustment Shim

0.1 mm (0.004 in.) 0.2 mm (0.008 in.) 0.5 mm (0.020 in.)

e. Backlash Check of Differential Pinion and Differential Side Gear

1. Set dial gauge at tooth surface of differential pinion vertically.
2. With differential side gear seized, move pinion and measure backlash.
3. If the measured exceeds allowable limits, adjust backlash with differential washer of differential side gear.

Sect.	Specified	Limit
Backlash of differential pinion and differential side gear	0.13 ~ 0.25 mm 0.005 ~ 0.010 in.	0.4 mm 0.016 in.


615W4B5A

f. Types of Adjustment Shim

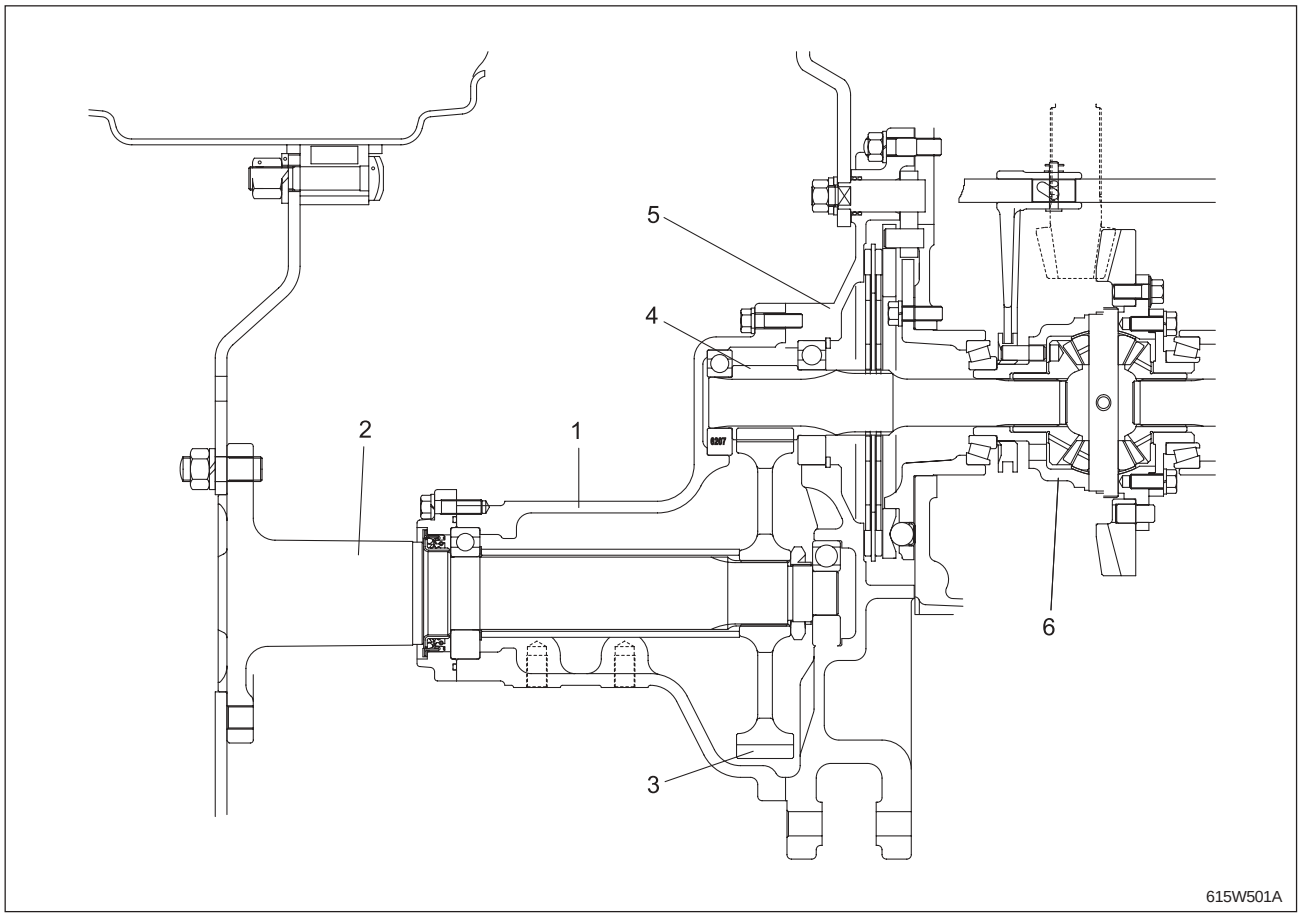
0.1 mm (0.004 in.) 0.2 mm (0.008 in.) 0.5 mm (0.020 in.)

CHAPTER 5

REAR AXLE

1. STRUCTURE

MODEL: 8354 / 8404



(1) Rear Axle Case
(2) Rear Axle
(3) 55 Gear (8354) / 60 Gear (8404)
(4) 10 Gear Shaft(8354)/11 Gear Shaft(8404)
(5) Brake Case
(6) Differential Gear Assembly

2. TIGHTENING TORQUE

Item	Spec.	N·m	Kgf·m	lbs·ft
Rear wheel tightening bolt	M16	260.8 ~ 303.8	26.6 ~ 31.0	192 ~ 224
Brake case and rear wheel case	M10	48.0 ~ 55.9	4.9 ~ 5.7	35.4 ~ 41.2
Tightening bolt, nut	M39, M45	48.0 ~ 55.9	4.9 ~ 5.7	35.4 ~ 41.2
Lock nut	M10	196 ~ 245	20 ~ 25	145 ~ 181
Rear axle case cover tightening bolt	M10	48.0 ~ 55.9	4.9 ~ 5.7	35.4 ~ 41.2
Planetary gear support attaching bolt	M10	48.0 ~ 55.9	4.9 ~ 5.7	35.4 ~ 41.2
Lock nut	M60	196 ~ 245	20 ~ 25	145 ~ 181

3. SERVICE SPECIFICATION

Application		Specified	Limit
Internal gear and planetary gear support	Backlash	0.1 ~ 0.2 mm 0.0039 ~ 0.0079 in.	0.5 mm 0.197 in.
Planetary gear and planetary gear shaft	Clearance	0.009 ~ 0.050 mm 0.00035 ~ 0.00197 in.	0.3 mm 0.086 in.
Planetary gear	I.D.	35.009 ~ 35.025 mm 1.37831 ~ 1.37894 in.	-
Planetary gear	O.D.	27.987 ~ 28.000 mm 1.10185 ~ 1.10236 in.	-
Needle bearing	Pin diameter	3.494 ~ 3.500 mm 0.1376 ~ 0.1378 in.	-
Thrust collar	Thickness	1.55 ~ 1.65 mm 0.0610 ~ 0.0650 in.	1.0 mm (Oil groove depth: Min. 0.3 mm) 0.0394 in. (Oil groove depth: Min. 0.0118 in.)

4. DISASSEMBLY, ASSEMBLY

4.1 DISCONNECTION OF REAR AXLE GROUP

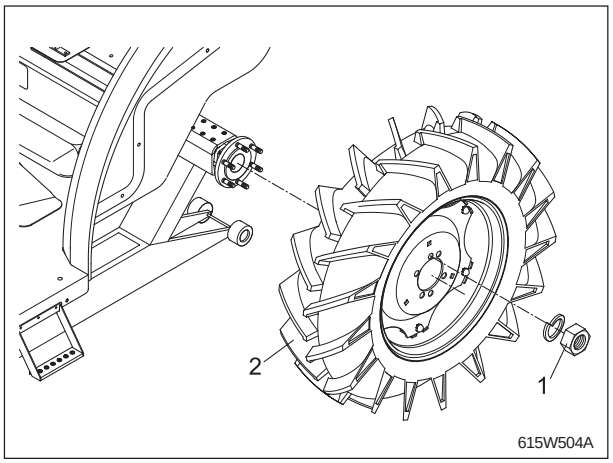
A. First Stage (Disconnection of Rear Wheel)

1. Support the transmission case with a hydraulic jack to raise tire the tires from the ground.
2. Loosen the wheel lug nuts and disconnect the tires from axle.

(When reassembling)

Sect.	Spec.	Tightening torque
Rear wheel tightening nut	M16	260.8 ~ 303.8 N·m 26.6 ~ 31.0 kgf·m 192.3 ~ 224.2 lbf·ft

- Tighten the wheel lug nuts firmly in a diagonal sequence.



(1) Nut (2) Wheel

B. Second Stage (Disconnection of Rear Axle Case)

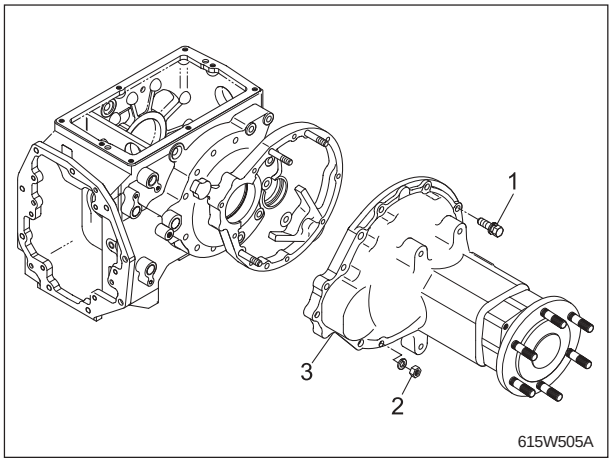
1. Loosen bolt (1) and nut (2) and disconnect rear axle case (3) in assembly.

(When reassembling)

- Wipe out oil or foreign matters from the contacted surface between brake case and rear axle case and apply with sealing agent.

Sealing agent	Three bond 1208D or equivalent

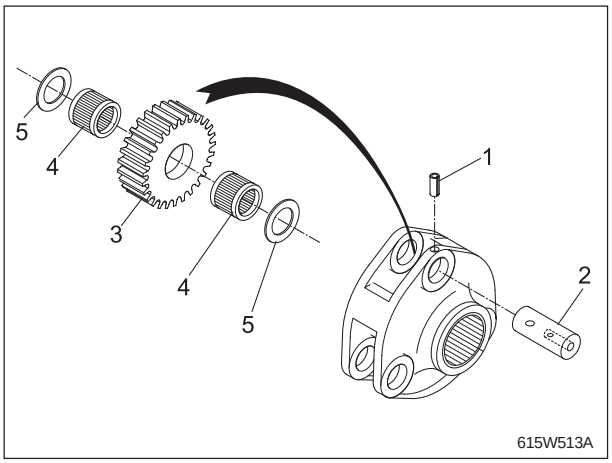
Sect.	Spec.	Tightening torque
Tightening bolt, nut	M10	48.1 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.4 ~ 41.2 lbf·ft



(1) Bolt (3) Rear Axle Case
(2) Nut

C. Third Stage (Disassembly of Planetary Gear)

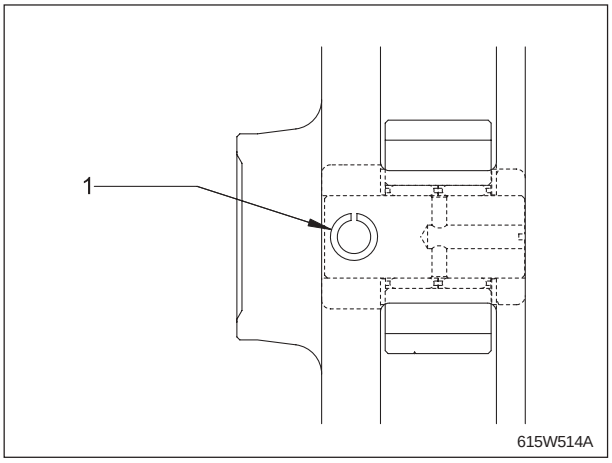
1. Insert spring pin (1) into planetary gear shaft (2).
2. When pulling out the planetary gear shaft (2), remove the planetary gear (3), needle bearing (4) and thrust collar (5).
3. Pull out the spring pin (1) from the planetary gear shaft (2).



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

(When reassembling)

- The spring pin should be assembled with forked portion toward vertical direction of shaft.



(1) Spring Pin

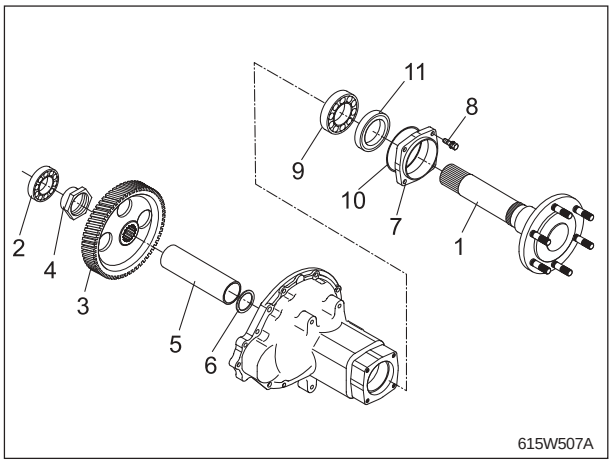
4.2 DISASSEMBLY OF REAR AXLE

1. Using bearing puller, pull out ball (roller) bearing (2) from the rear axle (1).
2. Straighten cocking of 55 (60) gear (3) locking nut (4).
3. Disassemble 55 (60) gear, spacer barrel (5), and spacer plate (6).
4. Loosen attaching bolt (8) of rear axle case cover (7) and pull out axle and cover from axle case in a body.
5. Using bearing puller, pull out rear axle case cover (7) and bearing (9) from axle.

Sect.	Spec.	Tightening torque
Lock bolt	M10	48.0 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.4 ~ 41.2 lbf·ft

(Reassembling)

- Apply grease to the O-ring (10) and oil seal (11) contacted surface.
- Take care of assembly direction and method for oil seal.



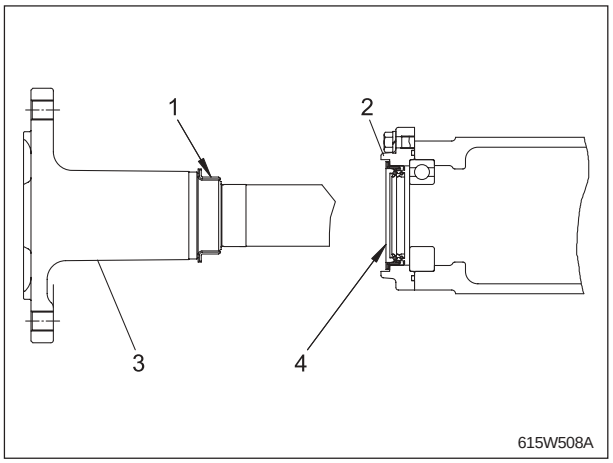
(1) Rear Axle
(2) Ball (Roller) Bearing
(3) 55 (60) Gear
(4) Nut
(5) Spacer Barrel
(6) Spacer Plate
(7) Rear Axle Case Cover
(8) Bolt
(9) Ball Bearing
(10) O-Ring
(11) Oil Seal

A. Oil Seal Assembly Method

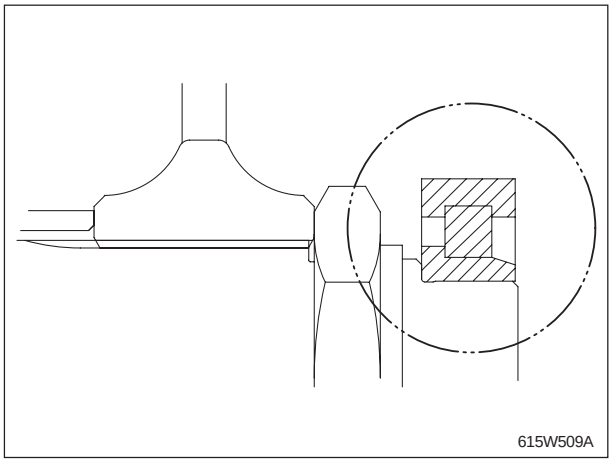
- Disconnect inner and outer wheels and assemble inner wheel into axle and outer wheel into cover to prevent damage using fixture.
- Replace lock nut, tighten and perform locking firmly.

Sect.	Spec.	Tightening torque
Lock nut	M39 M45	196 ~ 245 N·m 20 ~ 25 kgf·m 144.6 ~ 180.8 lbf·ft

- Make sure assembly direction of roller bearing (NE207E) is correct.
  - See the following figure (Applicable model: 8404)



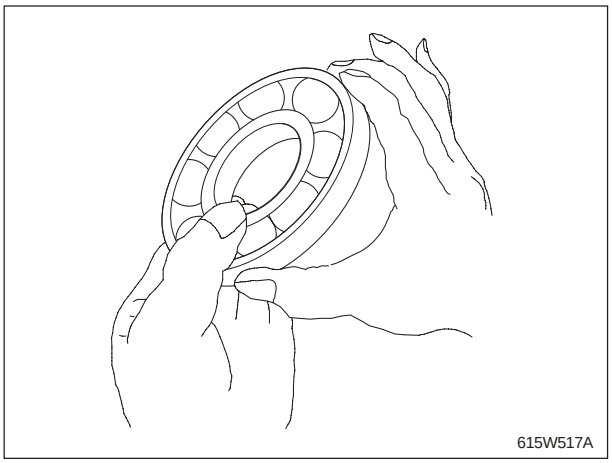
(1) Inner Wheel
(2) Rear Axle Case Cover
(3) Rear Axle
(4) Outer Wheel



5. MAINTENANCE

5.1 BEARING CHECK

1. With bearing inner wheel seized, pull in and out outside of bearing left and right and check for wear and clearance.
2. Apply the bearing ball with transmission oil and rotate the inside bearing while holding the outside of bearing still, checking for abnormal noise and operation.
3. If damage and failure found, replace it.


615W517A

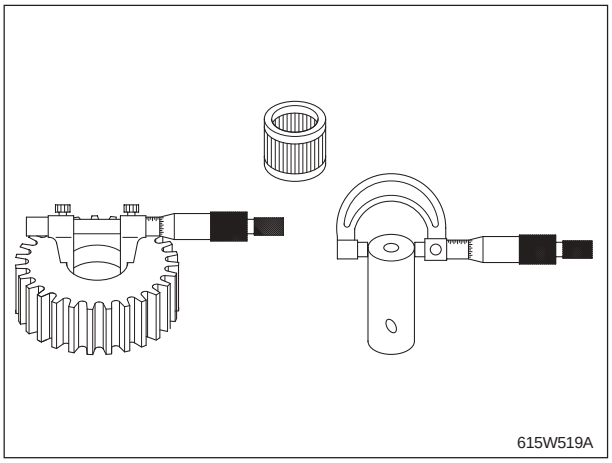
5.2 GEAR CHECK

1. Ensure slip or tooth surface is worn or scratched and replace it if necessary.

5.3 CLEARANCE CHECK OF PLANETARY GEAR AND PLANETARY GEAR SHAFT

1. Measure the planetary gear I.D. and O.D. of planetary gear shaft and needle bearing pin.
2. Measure the clearance of the planetary gear I.D. with planetary gear shaft O.D. and needle bearing pin removed.
3. If it exceeds specified limits, replace it with new one.

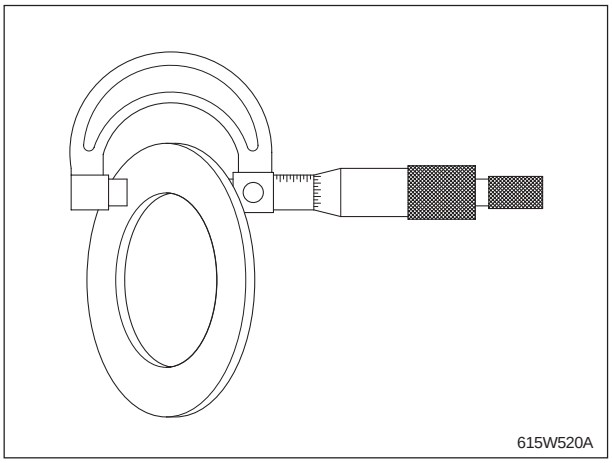
Sect.	Specified	Limit
Clearance between planetary gear and planetary gear shaft.	0.009 ~ 0.050 mm 0.00035 ~ 0.00197 in.	0.3 mm 0.0086 in.
I.D. of planetary gear	35.009 ~ 35.025 mm 1.37831 ~ 1.37894 in.	-
O.D. of planetary gear shaft	27.987 ~ 28.000 mm 1.10185 ~ 1.10236 in.	-
Pin diameter of needle bearing	3.494 ~ 3.500 mm 0.1376 ~ 0.1378 in.	-


615W519A

5.4 CHECK THRUST COLLAR FOR WORN

1. Measure the thickness of thrust collar.
2. If it exceeds specified limits, replace it with new one.

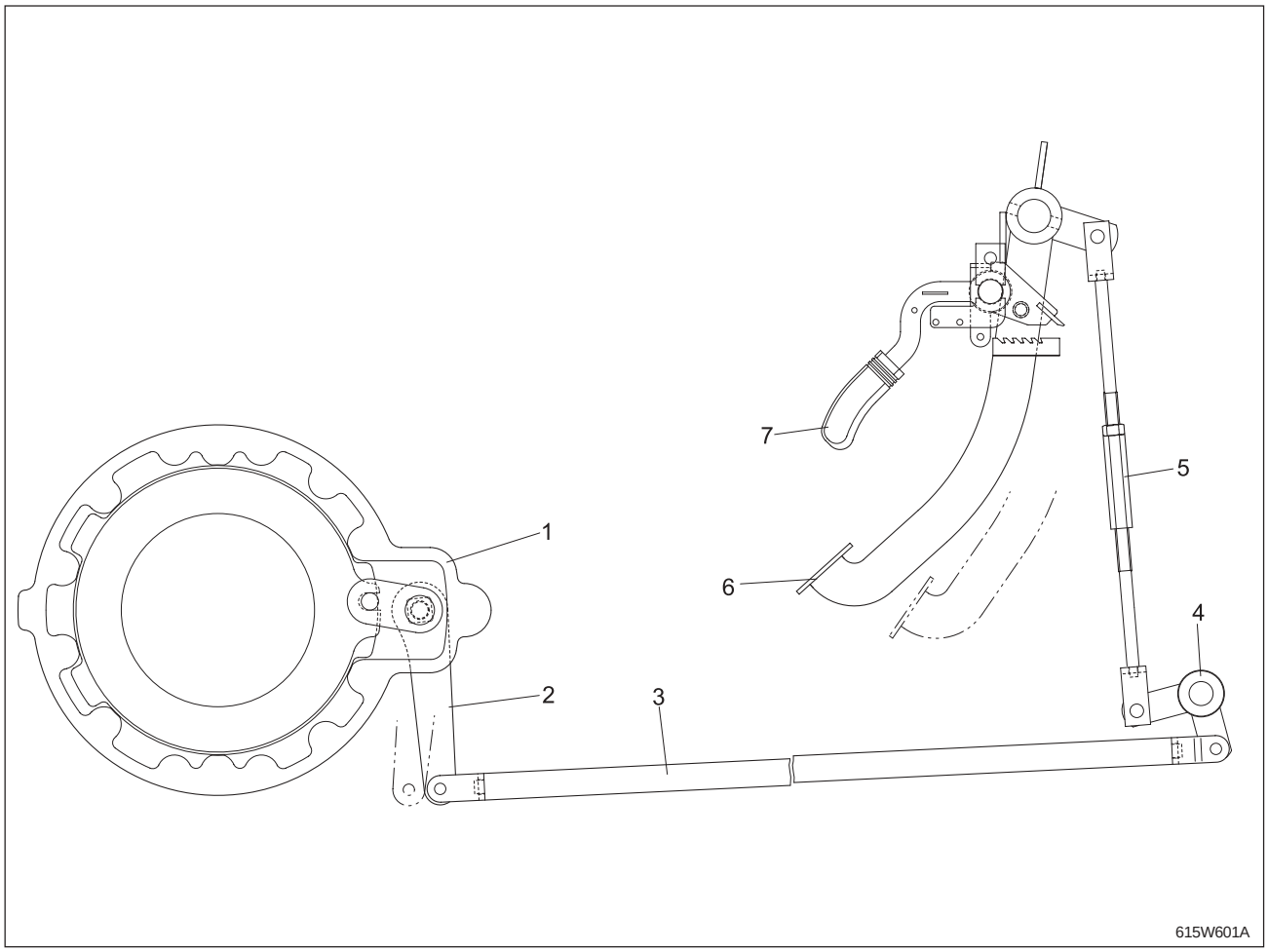
Sect.	Specified	Limit
Thickness of thrust collar	1.55 ~ 1.65 mm 0.0610 ~ 0.0650 in.	1.0 mm (Oil groove depth: Min. 0.3 mm) 0.0394 in (Oil groove depth: Min. 0.0118 in)


615W520A

CHAPTER 6

BRAKE

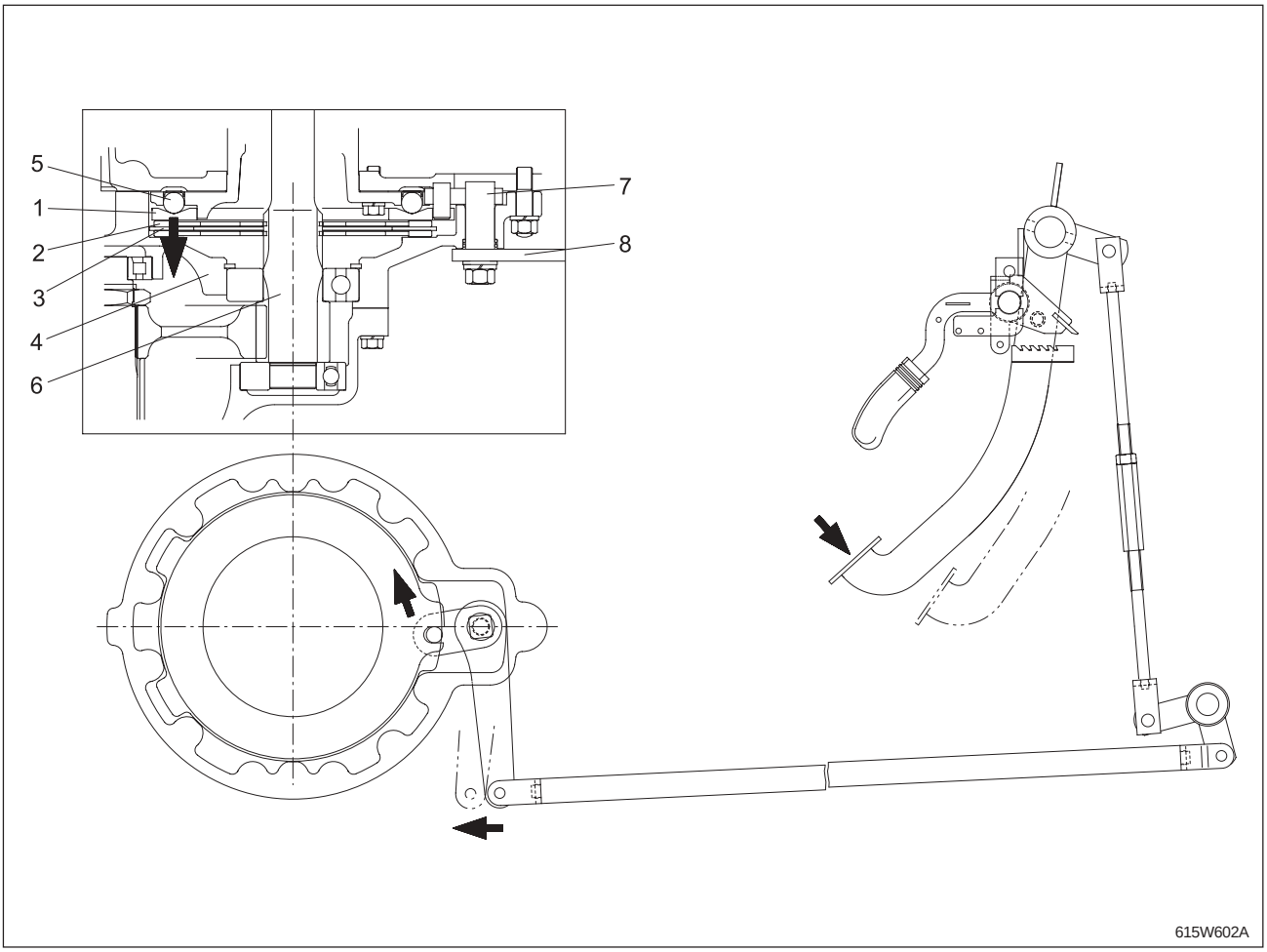
1. STRUCTURE



(1) Brake Case
(2) Brake Cam Lever
(3) Brake Rod
(4) Brake Lever
(5) Turn Buckle
(6) Brake Pedal
(7) Parking Brake Lever

- For the left and right running brake, an independent mechanical wet disc brake is used and operated through brake pedal by mechanical linkage.
- It enables the parking brake when parking. If brake pedal is locked with the parking brake lever pulled up, it keeps the brakes locked.
- Brake disc of wet disc type soaked in oil has more durability and braking force than an inside expandable dry brake type.

2. OPERATION



(1) Cam Plate
(2) Brake Disc
(3) Brake Plate
(4) Brake Case
(5) Ball
(6) Gear Shaft
(7) Brake Cam
(8) Brake Cam Lever

Operational Principle

If depressing brake pedal, brake cam lever (8) will be moved in the arrow direction by linkage as shown in the above figure. The cam plate (1) is rotated in the direction of the arrow and raised above ball (5) and brake disc (2) when it is applied with pressure. As brake disc is pressurized by the cam plate it grips the gear shaft (6) by friction force of the disc, then the brakes will be applied.

3. TROUBLESHOOTING

Trouble	Probable Cause	Remedy	Remark
Brake power is not constant	• Brake pedal clearance is not constant • Brake disc is worn • Cam clutch is bent	Adjust Replace Replace	-
Brake is trailed	• Brake pedal clearance is too small • Cam plate ball is worn unequally • Brake pedal return spring is worn or broken • Brake cam is corroded (rust)	Adjust Replace Replace Replace	-
Brake power is weaken	• Brake pedal clearance is excessive • Brake disc is worn • Cam plate is bent • Brake cam or lever is worn • Transmission oil is improper	Adjust Replace Replace Replace Change	-

4. MAINTENANCE SPECIFICATION

Item		Reference Value	Allowable Limit
Brake pedal	Clearance	25 ~ 35 mm (0.98 ~ 1.38 in.)	-
Difference between left and right when not depressing brake pedal	Deviation	5 mm (0.197 in.)	-
Brake pedal and stop switch	Clearance	0 ~ 1 mm (1 ~ 0.039 in.)	-
Between brake lever bush and brake shaft	Clearance	0.085 ~ 0.327 mm (0.00335 ~ 0.01287 in.)	0.3 mm (0.012 in.)
Brake lever bush	I.D	20.060 ~ 20.281 mm (0.78976 ~ 0.79846 in.)	
Brake shaft	O.D	19.957 ~ 19.975 mm (0.78559 ~ 0.78642 in.)	
Cam plate	Flatness	0.3 mm (0.012 in.)	0.3 mm (0.012 in.)
Cam plate and ball	Height	20.9 ~ 21.1 mm (0.8228 ~ 0.8307 in.)	20.5 mm (0.8071 in.)
Brake disc	Thickness	4.6 ~ 4.8 mm (0.181 ~ 0.189 in.)	4.2 mm (0.165 in.)
Plate	Thickness	2.54 ~ 2.66 mm (0.1000 ~ 0.1047 in.)	2.10 mm (0.0433 in.)

5. TIGHTENING TORQUE

Item	Spec	N·m	Kgf·m	lbf·ft
Stud.	M18	49.0 ~ 58.8	5.0 ~ 6.0	36.2 ~ 43.4
Lever shaft, bolt	M8	23.6 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2

6. BRAKE PEDAL

6.1 DISASSEMBLY, MAINTENANCE

[CHECK AND ADJUSTMENT]

A. First Stage (Clearance Adjustment of Brake Pedal)

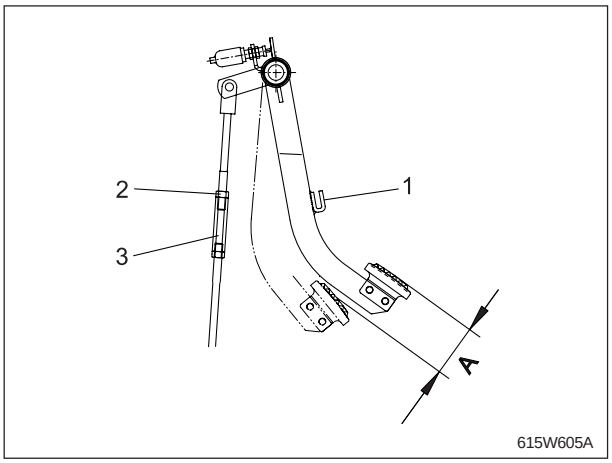
1. Disengage the brake pedal connection hook (1) and measure the clearance of left and right pedals.
2. If the clearance of left and right pedals exceeds the specified limit, loosen lock nut (2) and adjust clearance using a turn buckle (3).
3. If setting clearance of pedal, tighten firmly with lock nut.

IMPORTANT:

- *Clearance of pedal should be equal in left and right.*

Sect.	Specified
Clearance of brake pedal (A)	25 ~ 35 mm 0.98 ~ 1.38 in.

Sect.	Specified
Gap between left and right when depressing brake pedal	Within 5 mm Within 0.197 in.

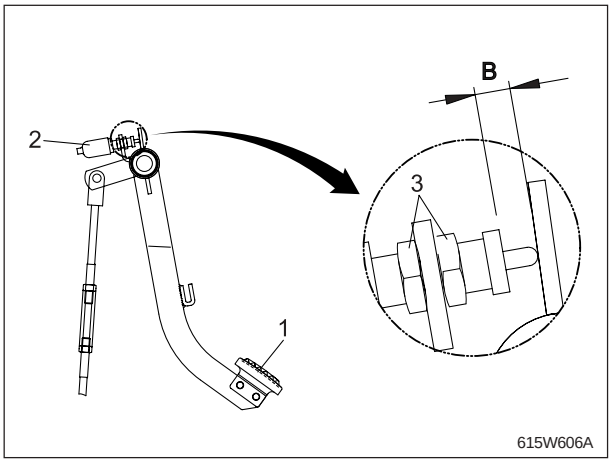


(1) Connection Hook (3) Turn Buckle
(2) Lock Nut

B. Second Stage (Gap Adjustment of Stop Switch)

1. Check the clearance between brake pedal (1) and stop switch (2) and if it exceeds the specified limit, loosen the lock nut (3) and readjust.

Sect.	Specified
Clearance between brake pedal and stop switch (B)	0 ~ 1 mm 0 ~ 0.039 in.



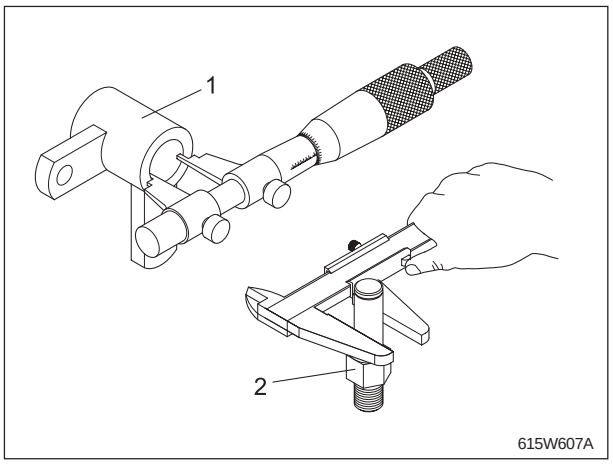
(1) Brake Pedal (3) Lock Nut
(2) Stop Switch

6.2 MAINTENANCE

Check the clearance between brake lever bush and brake shaft

1. Measure I.D. of brake lever bush.
2. Measure O.D. of brake shaft.
3. Calculate the clearance with the measured value. If exceeding the allowable limit, replace bush.

Sect.	Specified	Allowable Limit
Clearance between brake lever bush and brake shaft	0.085 ~ 0.327 mm (0.00335 ~ 0.01287 in.)	-
I.D. of brake lever bush	20.060 ~ 20.281 mm (0.78976 ~ 0.79846 in.)	-
O.D. of brake shaft	19.954 ~ 19.975 mm (0.78559 ~ 0.78642 in.)	-



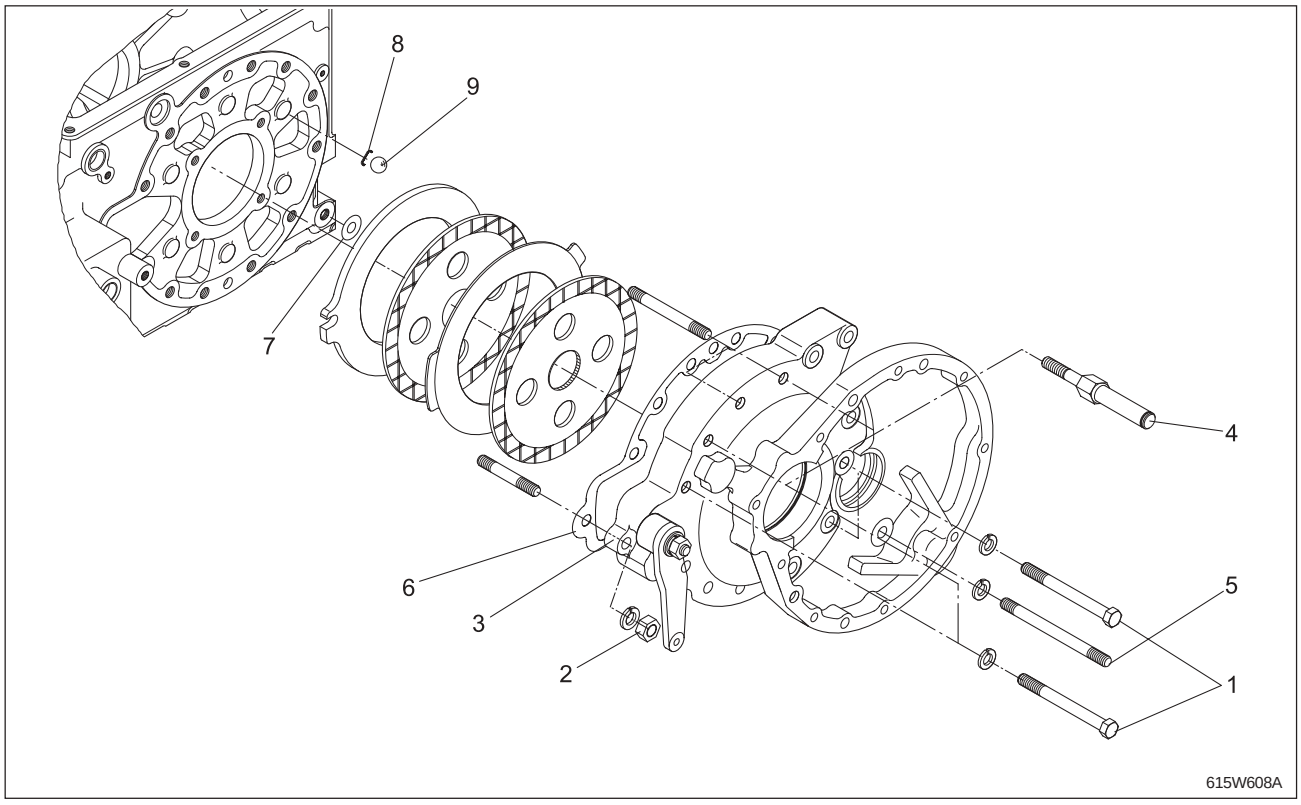
(1) Brake Lever Bush (2) Brake Shaft

7. BRAKE CASE

7.1 DISASSEMBLY AND ASSEMBLY

A. Disconnection of Brake Case Group

a. First Stage (Disconnection of Brake Case)



(1) Bolt
(2) Nut
(3) Brake Case
(4) Lever Shaft
(5) Stud
(6) Packing
(7) Packing
(8) Ball Seat
(9) Ball

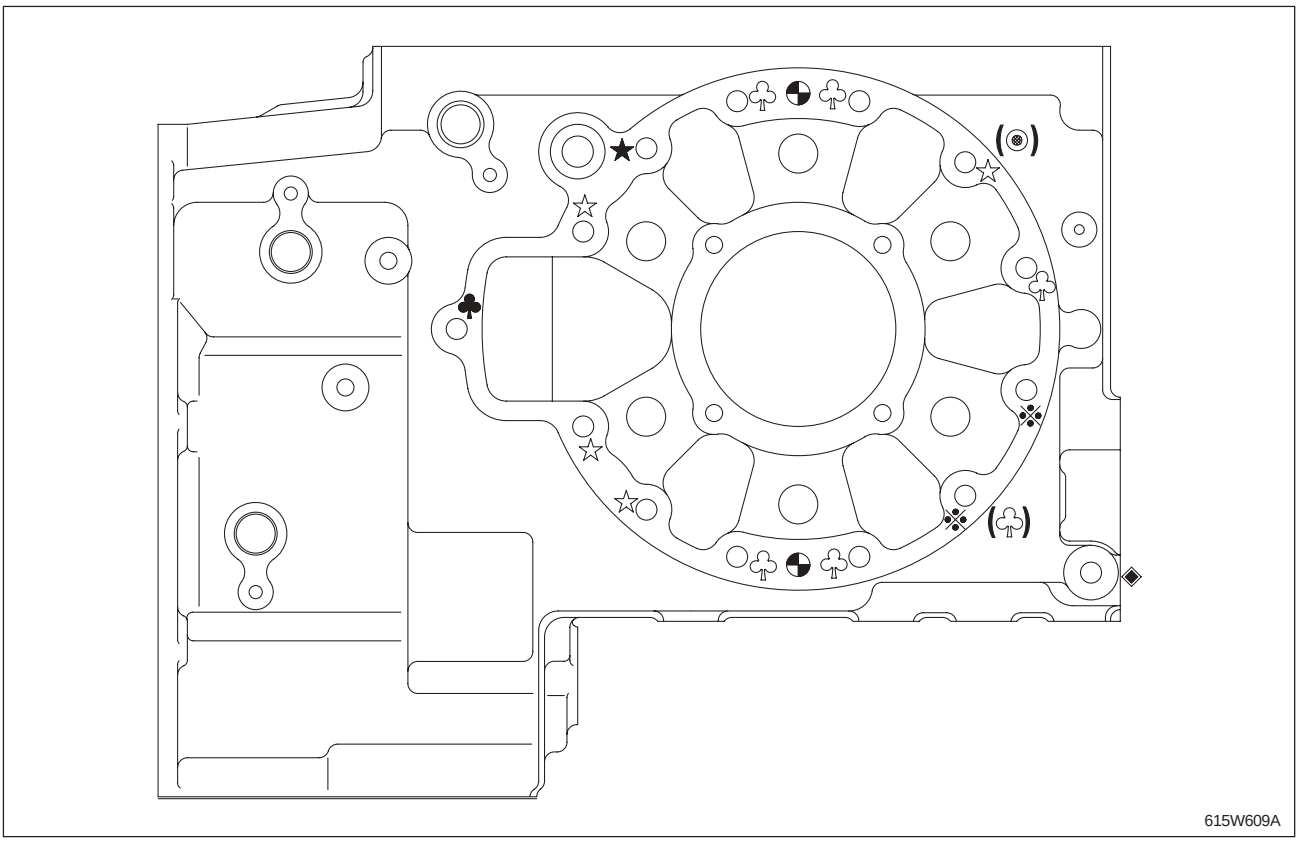
1. Disengage bolt (1) and nut (2) and disconnect brake case (3) in assembly.

(When reassembling)

- Make sure assembly position of lever shaft (4), bolt (1), and stud (5) is correct. Assembly position: see figure and following table.
- Replace packing (6) and (7).
- Apply stud (5) with bonding agent.

Bonding agent	Three bond 1372 or equivalent

- Apply ball seat (8) with grease sufficiently and make sure ball (9) not escaped.



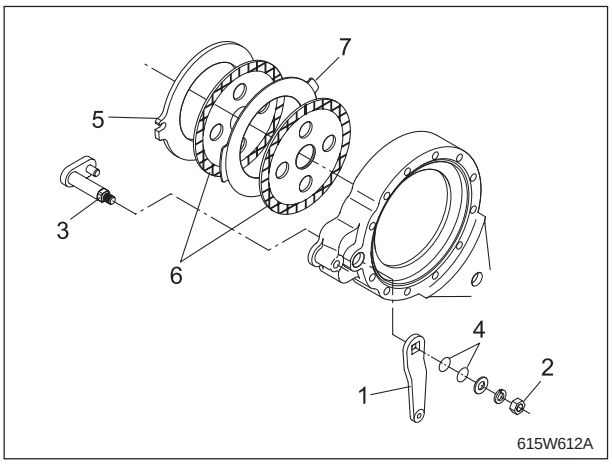
Bolt, Nut Assembly Position and Tightening Torque

Applicable Model: 8354					
Assembly position (mark)	Drawing No.	Part name	Qty. (Bolt)	Spec.	Tightening torque
♣	01754 - 51235	Stud.	2	M12	39.2 ~ 49.0 N·m
♧	37150 - 2735-2	Stud.	10		4.0 ~ 5.0 kgf·m
◈	01754 - 51285	Stud.	2		28.9 ~ 36.2 lbf·ft
★	T2610 - 60561	Lever shaft	Left: 1		77.5 ~ 90.2 N·m
	T2615 - 24432	Lever shaft (MID)	Right: 1		7.9 ~ 9.2kg f·m
☆	01173 - 51260	Bolt	8		57.1 ~ 66.5 lbf·ft
※	01176 - 51260	Bolt	4		
Applicable Model: 8404					
Assembly position (mark)	Drawing No.	Part name	Qty. (Bolt)	Spec.	Tightening torque
♣	01754 - 51235	Stud.	2	M12	39.2 ~ 49.0 N·m
♧	37150 - 2735-2	Stud.	12		4.0 ~ 5.0 kgf·m
◈	01754 - 51285	Stud.	2		28.9 ~ 36.2 lbf·ft
⊛	32435 - 2736-2	Stud.	2		
★	T2610 - 60561	Lever shaft	Left: 1		77.5 ~ 90.2 N·m
	T2615 - 24432	Lever shaft (MID)	Right: 1		7.9 ~ 9.2 kgf·m
☆	01173 - 51260	Bolt	6		57.1 ~ 66.5 lbf·ft
※	01176 - 51260	Bolt	2		

B. Brake Case Disassembly

a. First Stage (Disconnection of Brake Case)

1. Loosen cam lever (1) attaching nut (2) and disconnect brake cam (3), O-ring (4) and brake cam lever.
2. Disconnect Cam plate (5), brake disc (6) and plate (7).



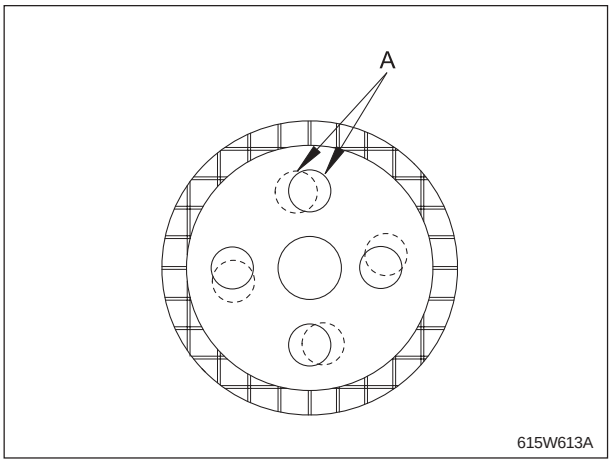
(1) Brake Cam Lever
(2) Nut
(3) Brake Cam
(4) O-Ring
(5) Cam Plate
(6) Brake Disc
(7) Plate

- Align with oil passage “A” of brake disc. It should be passed more than 70 %.
- Apply O-ring with grease, taking care not to damage it.
- Seat the brake disc into assembly position and when pressing plate by hand, it should not move.

CAUTION

- *Make sure assembly position of left and right cam plates is correct*

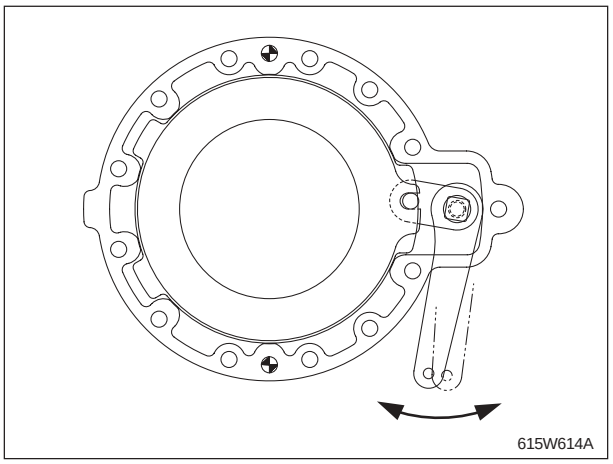
Model	Part name	Assembly position
8354 8404	Cam plate (left)	Left of transmission case
	Cam plate (right)	Right of transmission case



7.2 OPERATION CHECK OF BRAKE CAM LEVER

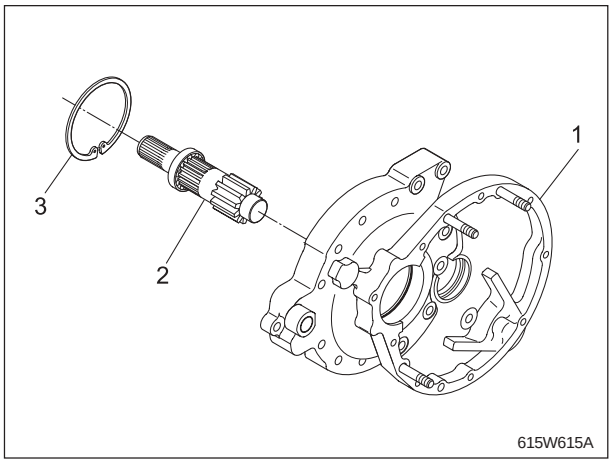
A. Operation Check of Brake Cam Lever

1. Move brake cam lever front to rear and check for proper operation.
2. If not operated smoothly, check the parts for dimension.



a. Second Stage (Disassembly of Gear Shaft)

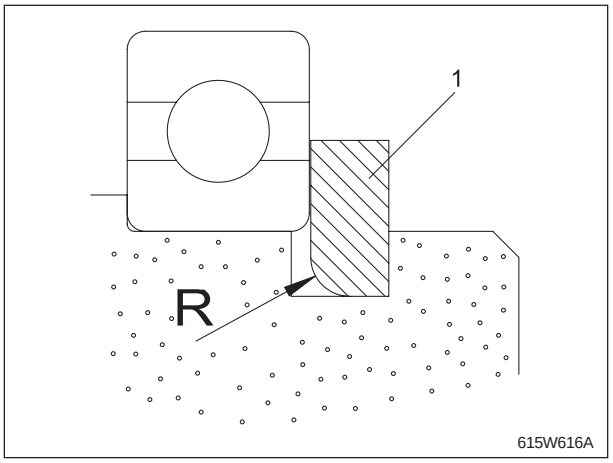
1. Pull out snap ring (3) from brake case (1).
2. Pull out gear shaft (2) with bearing.



(1) Brake Case (3) Snap Ring
(2) Gear Shaft

(When reassembling)

- Rounding of snap ring should be toward bearing.

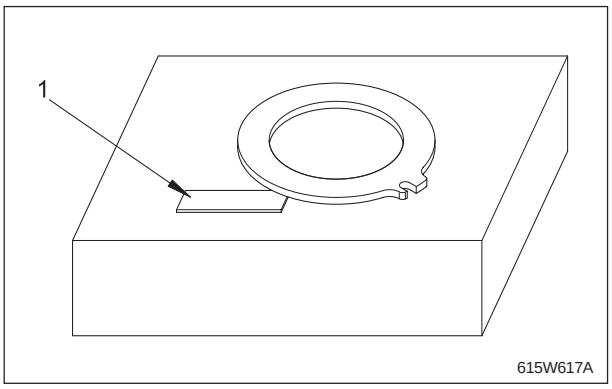


(1) Snap Ring

B. Wear Check of Cam Plate

1. Check brake disc contacted surface of cam plate for wear, and measure the flatness using a clearance gauge.
2. If it exceeding the allowable limit, replace it.

Sect.	Specified	Allowable limit
Flatness of cam plate	0.3 mm 0.012 in.	0.3 mm 0.012 in.

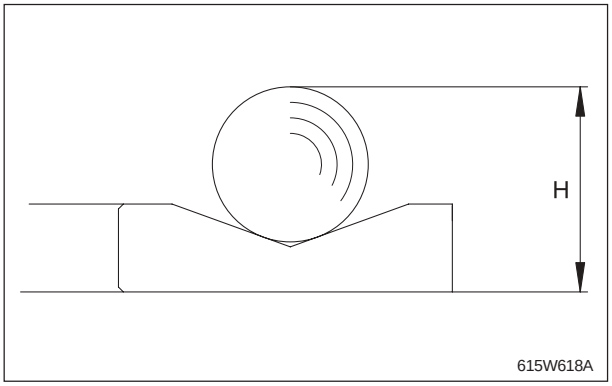


(1) Clearance Gauge

C. Height Check of Cam Plate and Ball

1. Seat ball into cam plate and measure the height of the ball in the bottom of cam plate.
2. If the measured value exceeds the allowable limit, replace the cam plate and ball.

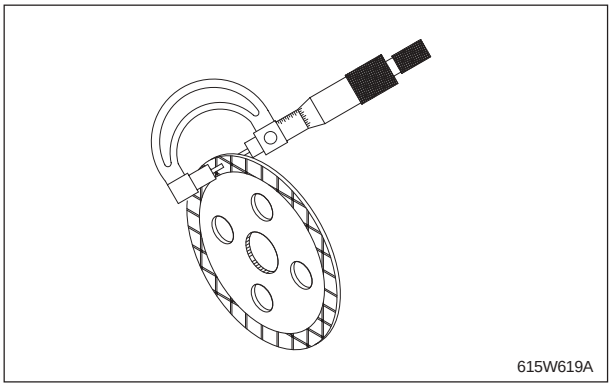
Sect.	Specified	Allowable limit
Height of ball from bottom of cam plate (H)	20.9 ~ 21.1 mm 0.8228 ~ 0.8307 in.	20.5 mm 0.8071 in.



D. Wear Check of Brake Disc

1. Measure the thickness of brake disc.
2. If the measured value exceeds the allowable limit, replace it.

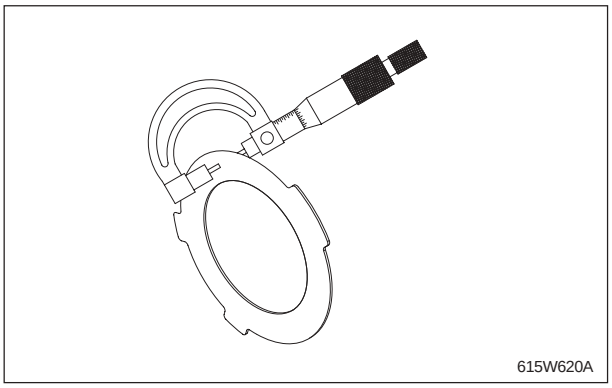
Sect.	Specified	Allowable limit
Thickness of brake disc	4.60 ~ 4.80 mm 0.181 ~ 0.189 in.	4.2 mm 0.165 in.



E. Wear Check of Brake Plate

1. Measure the thickness of brake plate.
2. If the measured value exceeds the allowable limit, replace it.

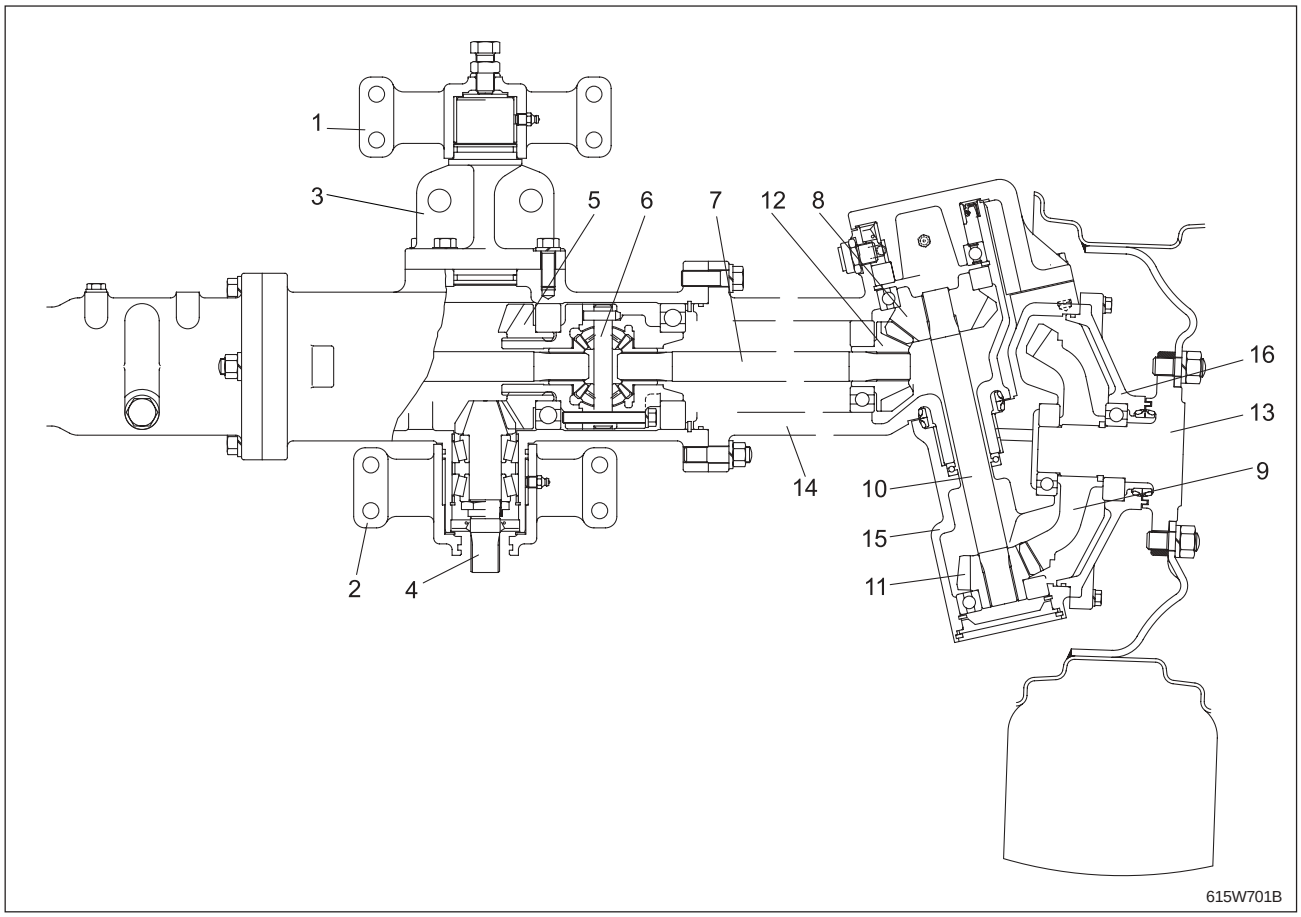
Sect.	Specified	Allowable limit
Thickness of brake disc	2.54 ~ 2.66 mm 0.1000 ~ 0.1047 in.	2.10 mm 0.0827 in.



CHAPTER 7

FRONT AXLE

1. STRUCTURE



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

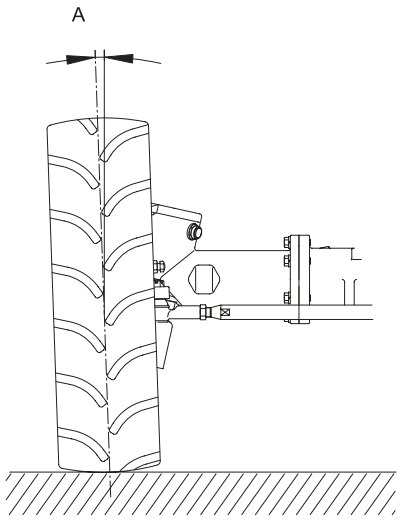
- The front axle is applied with a bevel gear type to improve work ability and extend the applicable range. The floating seal improves the sealing effect while working in the field with water as well as to maximize rotation ability.
- Front wheel steering angle (Inner Wheel): 56 ~ 58°.

2. WHEEL ALIGNMENT

To improve control and safety running, front wheel is applied with adequate inclination in the direction of left, right and forward.

Camber Angle

Camber angle (A) = 2°

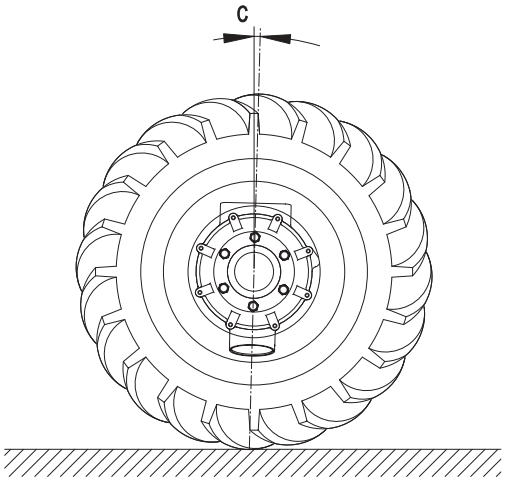


Camber not only decreases bending and warping against vertical load and running resistance but also keeps safety.

615W702A

Caster Angle

Caster angle (C) = 1.5°

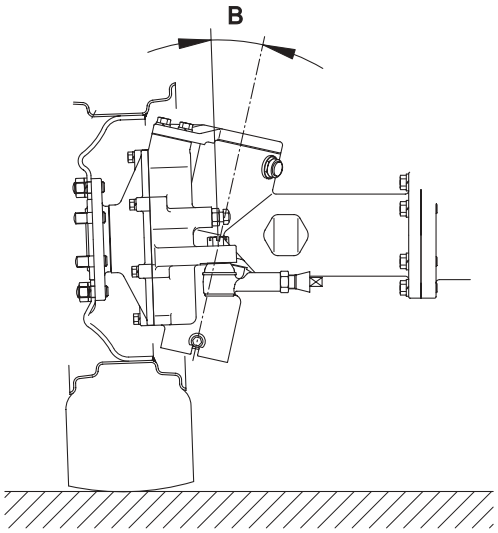


Caster angle improves steering ability.

615W703A

King Pin Angle

King pin angle (B) = 12.5°

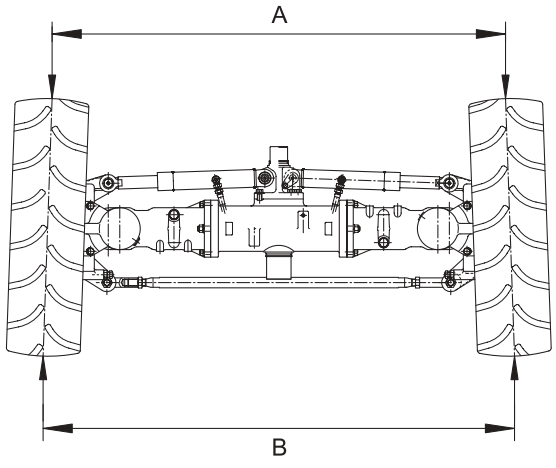


King pin angle decreases rolling resistance of wheel and improves vibration-preventative and steering ability.

615W704A

Tow-in

Tow in (rear-full width) = 2 ~ 8 mm



Tow-in prevents one tire excessively worn though parallel running with tow-in.

615W705A

(A) Front Width (B) Rear Width

3. TROUBLESHOOTING

Trouble	Probable Cause	Remedy	Reference
Left and right inclination of front wheel.	• Improper pressure of tire	Adjust	-
	• Inadequate tow-in adjustment	Adjust	
	• Excessive clearance between front axle cast boss and front axle front and rear brackets	Replace	
	• Front axle locking force is small	Adjust	
	• Excessive rolling of front wheel	Replace	
	• Tie rod end loosen	Tighten	
	• Power steering unit intake air	Air bleeding	
Front Wheel drive is disabled.	• Propulsion shaft broken	Replace	-
	• Front axle front wheel drive gear of transmission broken	Replace	
	• Front differential gear broken	Replace	
	• Transmission fork broken	Replace	
	• Coupling missing	Reassembly	
Front axle noise.	• Improper gear backlash	Adjust or replace	-
	• Lack in oil	Refill	
	• Bearing damage or broken	Replace	
	• Gear damage or broken	Replace	
	• Improper rotation torque of spiral bevel pinion shaft	Adjust	

4. MAINTENANCE SPECIFICATION

Item		Reference Value	Allowable Limit
Front wheel adjustment	Tow in (rear width front width)	2 ~ 8 mm 0.08 ~ 0.32 in.	-
Tire air pressure	7 - 16 8 - 16	1.8 kgf/cm² 25.6 psi 1.6 kgf/cm² 22.8 psi	-
Rocking force		49.0 ~ 117.6 N 5.0 ~ 12.0 kgf 11.0 ~ 26.5 lbs	-
Front axle oil spec.		7.8 ℓ	-
Bi-speed turn operation angle		Left: 35° ± 1° Right: 33° ± 1°	-
Bevel gear backlash in front axle case		0.15 ~ 0.35 mm 0.059 ~ 0.01377 in.	-
Bevel gear tooth contacted in bevel gear case		More than 35 %, center 1/3 ~ 1/2 from small end	-
Bevel gear backlash in bevel gear case		0.15 ~ 0.35 mm 0.059 ~ 0.01377 in.	-
Bevel gear tooth contacted in bevel gear case		More than 35 %, center 1/3 ~ 1/2 from small end	-
Backlash of bevel pinion shaft and spiral bevel gear		0.10 ~ 0.30 mm 0.059 ~ 0.01358 in.	-
Tooth contacted between bevel pinion and differential pinion shaft		More than 35 %, center 1/3 ~ 1/2 from small end	-
Clearance between differential pinion and differential pinion shaft		0.16 ~ 0.052 mm 0.00063 ~ 0.00205 in.	0.25 mm 0.098 in.
Differential pinion I.D.		16.000 ~ 16.018 mm 0.62992 ~ 0.63063 in.	-
Differential pinion O.D.		5.966 ~ 15.984 mm 0.62858 ~ 0.62929 in.	-
Clearance between front differential case, differential case cover and differential side gear		0.050 ~ 0.091 mm 0.00197 ~ 0.00358 in.	0.20 mm 0.0079 in.
Front differential case I.D.		32.025 ~ 32.050 mm 1.26083 ~ 1.26181 in.	-
Differential case cover I.D.		32.025 ~ 32.050 mm 1.26083 ~ 1.26181 in.	-
Differential side gear O.D.		31.959 ~ 31.975 mm 1.25823 ~ 1.25886 in.	-
Backlash and tooth contacted check of differential pinion and differential side gear		0.10 ~ 0.30 mm 0.039 ~ 0.0118 in.	-
Tooth contacted check of differential pinion and differential side gear		More than 35 %	-

NOTE:

- *Tire air pressure : Maintain the maximum pressure in front tires, if using afront loader or when equipped with a full load of front weights.*

5. TIGHTENING TORQUE

Item	Spec	N·m	Kgf·m	lbf·ft
Tie rod locking nut	M20	368 ~ 431	37.5 ~ 44.0	272 ~ 318
Front wheel steering angle setting lock bolt, nut	M14	123 ~ 147	12.6 ~ 15.0	91.2 ~ 108
Steering hose assembly connection tightening torque		46.6 ~ 50.9	4.8 ~ 5.2	34.4 ~ 37.6
Front bracket and rear bracket attaching bolt	M14	123 ~ 147	12.6 ~ 15.0	91.2 ~ 108
Front wheel attaching nut	M16	166.6 ~ 186.2	17.0 ~ 19.0	123.0 ~ 137.5
Axle case attaching bolt	M12	77.4 ~ 90.2	7.9 ~ 9.2	57.2 ~ 66.5
Front axle cover tightening bolt	M8	23.5 ~ 27.5	2.4 ~ 2.8	17.4 ~ 20.3
Bevel gear case attaching bolt, nut	M14	123.5 ~ 147	12.6 ~ 15.0	91.2 ~ 108.4
Center pin attaching bolt	M12	77.5 ~ 90.2	7.9 ~ 9.2	57.2 ~ 66.5
Differential case cover tightening bolt	M10	48.0 ~ 55.9	4.9 ~ 5.7	35.4 ~ 41.2

6. DISASSEMBLY, MAINTENANCE

6.1 CHECK AND ADJUSTMENT

A. First Stage (Tow-In)

1. Set tire to the specified air pressure.
2. Align front wheel tire in straight driving, measure front width and rear width of front wheel and calculate its difference (tow-in).
3. If it exceeds the specification, loosen lock nut, adjust the length of tie rod, and then firmly set with lock nut.

Sect.	Spec.	Specified value
Tire air pressure	7 - 16	1.8 (2.2) kgf/cm²
		25.6 (31.3) psi
	8 - 16	1.6 (2.0) kgf/cm²
		22.8 (28.4) psi

* ( ) : When using a front loader.

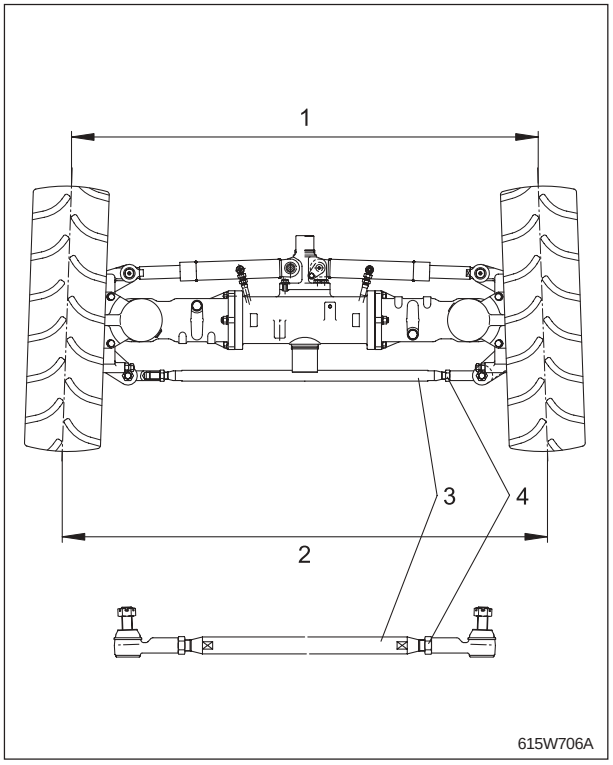
Sect.	Specified value
Tow-in (Rear width-front width)	2 ~ 8 mm
	0.08 ~ 0.31 in.

Sect.	Spec.	Tightening torque
Tie rod locking nut	M20	368 ~ 431 N·m
		37.5 ~ 44.0 kgf·m
		272 ~ 318 lbf·ft

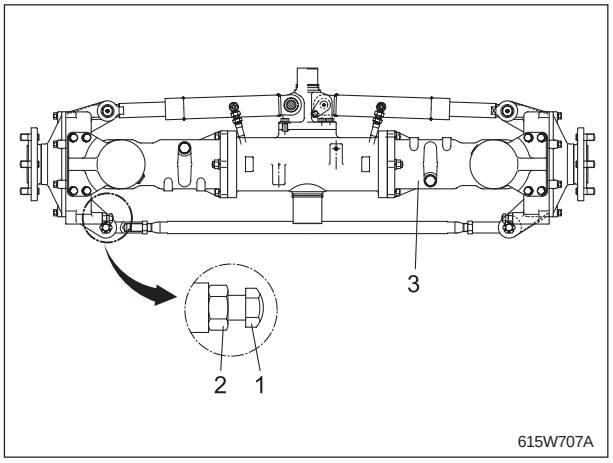
B. Second Stage (The Setting of Front Wheel Steering Angle)

1. Turn steering wheel to the maximum in left and right, rotate it about a quarter counterclockwise near relief valve, and set lock bolt contacted with the side of bevel gear case and then tighten with nut.

Sect.	Spec.	Tightening torque
Lock bolt lock nut	M14	123 ~ 147 N·m
		12.6 ~ 15.0 kgf·m
		91.2 ~ 108 lbf·ft



(1) Front Width
(2) Rear Width
(3) Tie Rod
(4) Lock Nut

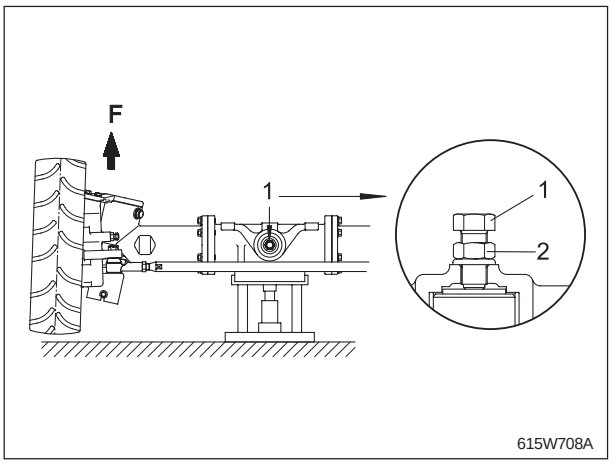


(1) Stopper Bolt
(2) Nut
(3) Bevel Gear Case

C. Third Stage (Adjustment of Front Axle Rocking Force)

1. Raise the front axle and make sure both tires are off the ground.
2. Using the front bracket adjusting bolt, check for rocking force and then tighten with nut.

Sect.	Specified value
Rocking force (F)	49.0 ~ 117.6 N·m 5.0 ~ 12.0 kgf·m 36.2 ~ 86.8 lbf·ft



(1) Adjusting Bolt (2) Nut

7. DISCONNECTION OF FRONT AXLE GROUP

7.1 DISASSEMBLY, ASSEMBLY

A. First Stage (Front Axle Case Oil Draining)

1. Loosen oil draining plug (1) of front axle support and front axle case lower section, oil filling plug (3) and drain oil.
2. Drain oil and retighten plug.

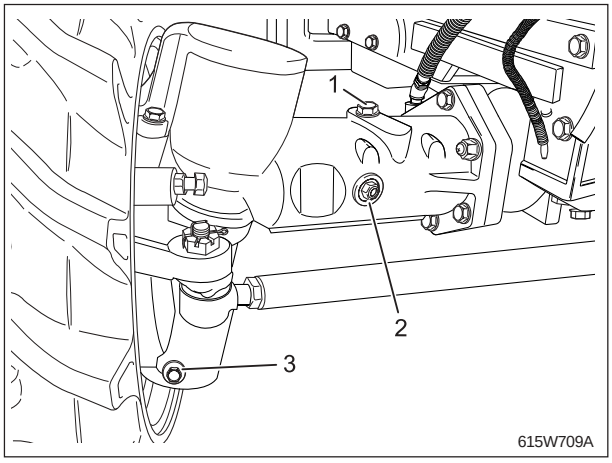
(When supplying with oil)

- Loosen oil filling plug and fill up to the position of oil level plug.
- Rotate front axle several times and then fill up to the specified level.

Front axle oil spec.	7.8 ℓ

IMPORTANT:

- *Always use Cub Cadet Industry approved front axle oil.*



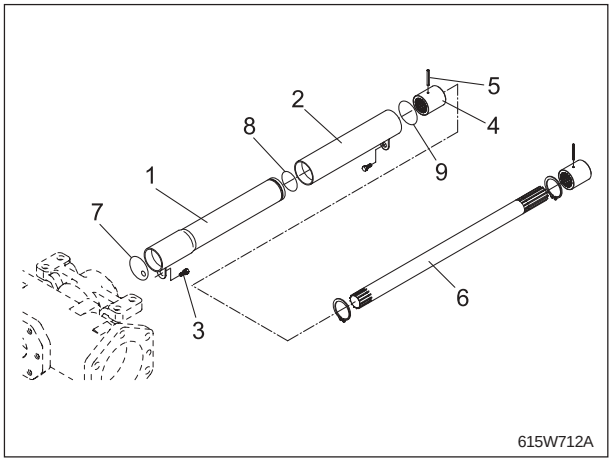
(1) Feeding Plug
(2) Oil Level Plug
(3) Draining

B. Second Stage (Disconnection of Propulsion Shaft)

1. Loosen propulsion shaft cover 1 (1), propulsion shaft cover 2 (2) and attaching bolt (3) and tighten propulsion shaft cover 1 and 2 into inside.
2. Pull out spring pin (5) of coupling (4) and disconnect propulsion shaft 2 (6), coupling and propulsion cover simultaneously.

(When reassembling)

- Apply propulsion shaft spline and O-ring (7), (8), and (9) with grease.



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

C. Third Stage (Disconnection of Steering Cylinder Hydraulic Hose)

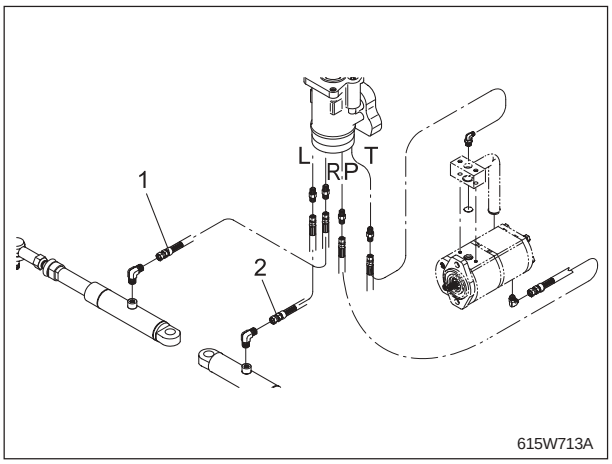
1. Loosen steering hydraulic hose (1) and (2).

Hose	Connection position
Steering hose assembly R	Right of steering cylinder
Steering hose assembly L	Left of steering cylinder

Sect.	Tightening torque
Steering hose assembly Connection torque	46.6 ~ 50.9 N·m 4.8 ~ 5.2 kgf·m 34.4 ~ 37.6 lbf·ft

(When reassembling)

- When connecting hydraulic hose, assemble it properly ensuring its color and connection position.



(1) Steering Hose Assembly R

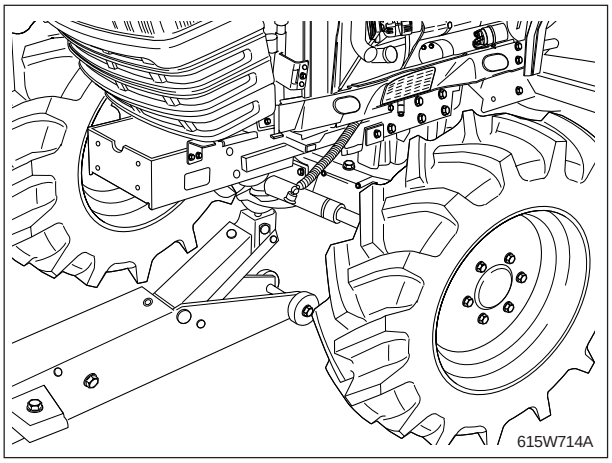
(2) Steering Hose Assembly L

D. Fourth Stage (Disconnection of Front Axle Assembly)

1. Support the lower of engine with a hydraulic jack.
2. Disengage the front bracket and rear bracket attaching bolt.
3. Disconnect front axle assembly together with front wheel.

(When reassembling)

Sect.	Spec.	Tightening torque
Front bracket and rear bracket attaching bolt	M22 (M14)	123 ~ 147 N·m 12.6 ~ 15.0 kgf·m 91.2 ~ 108 lbf·ft
Front wheel attaching nut	M10 (M16)	166.6 ~ 186.2 N·m 17.0 ~ 19.0 kgf·m 123.0 ~ 137.5 lbf·ft



8. DISASSEMBLY OF FRONT AXLE

8.1 FIRST STAGE (DISCONNECTION OF FRONT AXLE CASE AND BEVEL GEAR CASE)

1. Disengage axle case support (1) attaching bolt (2).
2. Disconnect front axle case (3) from bevel gear case (4), taking care not to drop it.

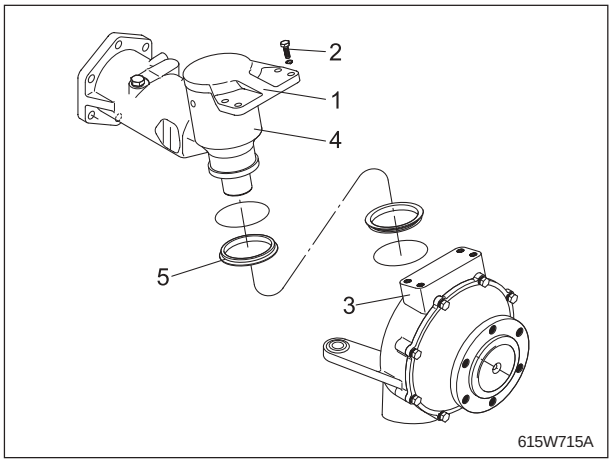
(When reassembling)

CAUTION

- *Make sure floating seal (5) is not damaged and the O-ring has not deteriorated with grease, oil, or other foreign matters.*

  FLOATING SEAL Assembling Method Divide each O-ring and seal ring into 1 suit and assemble in bevel gear case and front axle case, making sure O-ring is not damaged using assembly fixture.

Sect.	Spec.	Tightening torque
Axle case attaching bolt	M12	77.4 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.2 ~ 66.5 lbf·ft



(1) Axle Case Support
(2) Bolt
(3) Front Axle Case
(4) Bevel Gear Case
(5) Floating Seal

8.2 SECOND STAGE (DISASSEMBLY OF FRONT AXLE)

1. Loosen the attaching bolt of front axle cover (1) and disconnect the front axle (2) and cover from front axle case.
2. Pull out bevel gear (3) and bearing (4) simultaneously using a bearing puller.
3. Pull out snap ring (5) and remove front axle (2) from cover (1).

(When reassembling)

- Apply front axle cover O-ring (6) with grease.
- Check snap ring (5) for mounting.

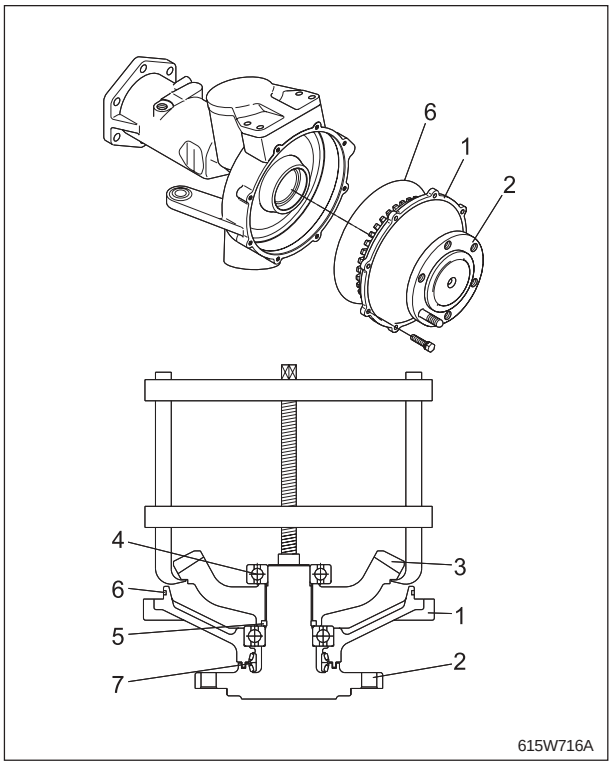
CAUTION

- *Make sure the floating seal (7) is not damaged and O-ring (6) is not deteriorated with grease, oil, or other foreign matters.*

A. Floating Seal Assembling Method

Divide each O-ring and seal ring into 1 suit and assemble in bevel gear case and front axle case with pushing O-ring not to be damaged using assembly fixture.

Sect.	Spec.	Tightening torque
Tightening bolt	M8	23.5 ~ 27.5 N·m 2.4 ~ 2.8 kgf·m 17.4 ~ 20.3 lbf·ft



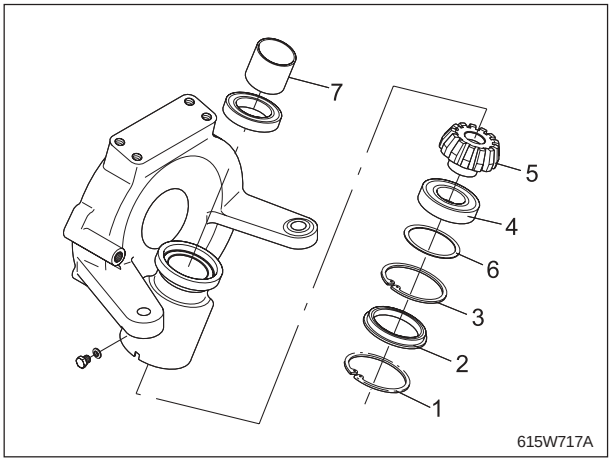
(1) Front Axle Cover
(2) Front Axle
(3) Bevel Gear
(4) Ball Bearing
(5) Snap Ring
(6) O-Ring
(7) Floating Seal

8.3 THIRD STAGE (DISASSEMBLY OF FRONT AXLE CASE)

1. Pull out snap ring (1) and disassemble plug (2).
2. Pull out snap ring (3) and disassemble bevel gear (5) and shim (6).

(When reassembling)

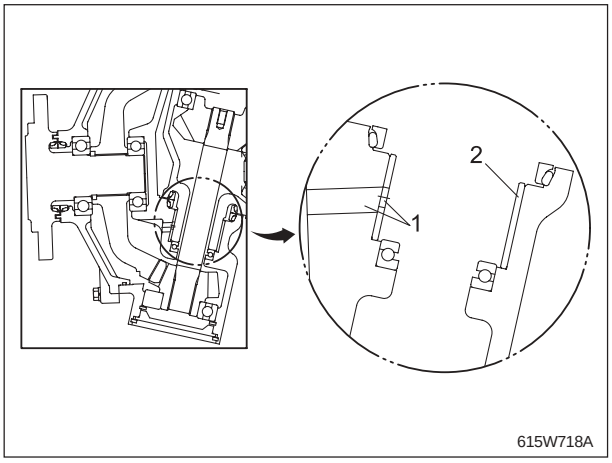
- Make sure the type and number of shim is correct.
- Apply DX bush (7) contacted surface with grease, taking care of assembly direction.



(1) Snap Ring
(2) Plug
(3) Snap Ring
(4) Ball Bearing
(5) Bevel Gear
(6) Shim
(7) DX Bush

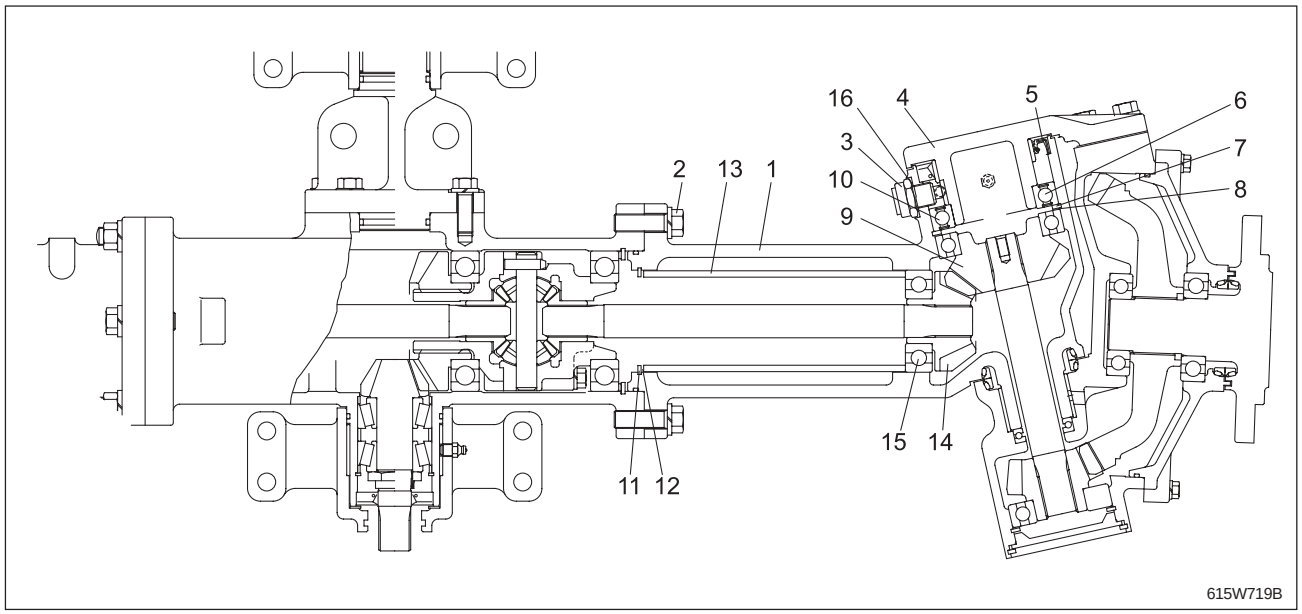
A. DX Bush Assembling Method

Align bush hole with oil passage hole of front axle case and always use assembly fixture.



(1) Oil Passage
(2) DX Bush

8.4 FOURTH STAGE (DISASSEMBLY OF FRONT AXLE SUPPORT)



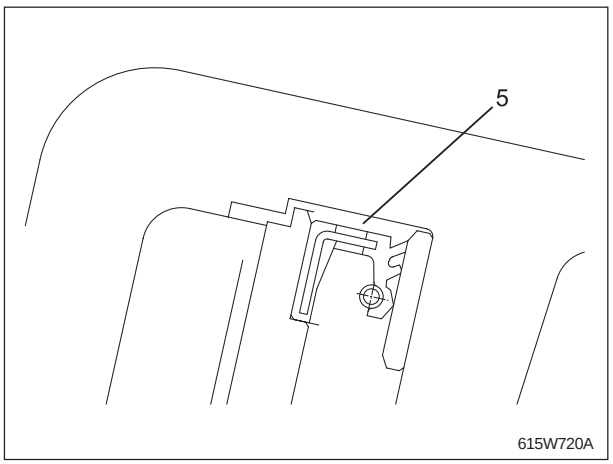
(1) Bevel Gear Case
(2) Bolt
(3) Plug
(4) Axle Case Support
(5) Oil Seal
(6) Ball Bearing
(7) Snap Ring
(8) Shim
(9) Bevel Gear
(10) Ball Bearing
(11) Snap Ring
(12) Shim
(13) Spacer Barrel
(14) Bevel Gear
(15) Ball Bearing

1. Disengage the attaching bolt (2) of bevel gear case (1) and disconnect bevel gear case assembly from front axle support.
2. Loosen plug (3).
3. Disassemble axle case support (4).
4. Pull out oil seal (5) and bearing (6).
5. Pull out snap ring (7) and disassemble shim (8) and bevel gear (9) with bearing (10).
6. Pull out snap ring (11) and disassemble shim (12), spacer barrel (13) and bevel gear (14) with bearing (15).

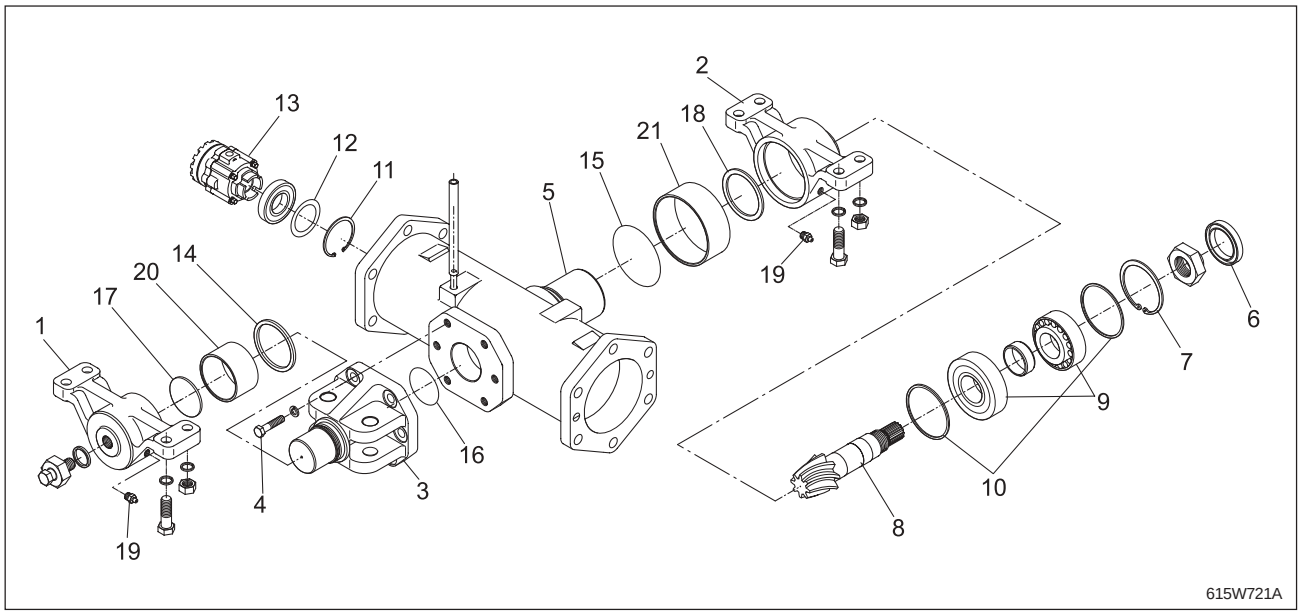
(When reassembling)

- Make sure the type and number of shim is correct.
- Apply oil seal and O-ring with grease and make sure oil seal is assembled in the right direction (Part No. 5 shown in the above figure).

Sect.	Spec.	Tightening torque
Tightening bolt, nut	M14	123.5 ~ 147 N·m 12.6 ~ 15.0 kgf·m 91.2 ~ 108.4 lbf·ft



8.5 FIFTH STAGE (DISASSEMBLY OF FRONT AXLE SUPPORT)

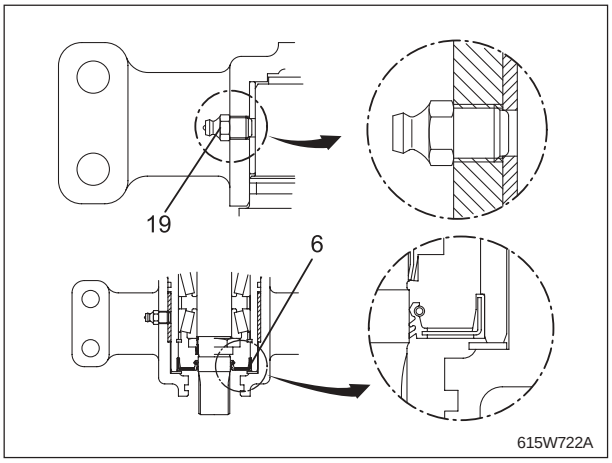


(1) Front Bracket
(2) Rear Bracket
(3) Center Pin
(4) Bolt
(5) Front axle Support
(6) Oil Seal
(7) Snap Ring
(8) Bevel Pinion Shaft
(9) Taper Rolling Bearing
(10) Adjusting Collar
(11) Snap Ring
(12) Shim
(13) Front Differential Gear Assembly
(14) O-Ring
(15) O-Ring
(16) O-Ring
(17) Spacer Plate
(18) Thrust Collar
(19) Grease Nipple
(20) DX Bush
(21) Dx Bush

1. Disconnect the front bracket (1) and rear bracket (2).
2. Disengage center pin (3) attaching bolt (4) and disconnect center pin (3) from front axle support (5).
3. Pull out oil seal (6) and snap ring (7) and disconnect bevel pinion shaft (8) with taper roller bearing (9) in a body.
4. Pull out snap ring (11) and disconnect the shim (12) of front differential gear assembly (13).

(When reassembling)

- Apply O-ring (14), (15), (16) and oil seal contacted surface with grease.
- Make rounding of snap ring toward bearing.
- Make sure the type and number of shim and adjusting collar (10) is correct.
- Check for spacer plate (17), thrust collar (18) of front and rear brackets.



CAUTION

- *When assembling DX bush (20), (21) into front and rear brackets, align hole of DX bush with assembly hole of grease nipple (19) (See the following figure).*
- *Make sure the oil seal assembly direction of bevel Pinion shaft is correct (See the following figure).*

Sect.	Spec.	Tightening torque
The attaching bolt of center pin	M12	77.5 ~ 90.2 N·m 7.9 ~ 9.2 kgf·m 57.2 ~ 66.5 lbf·ft

8.6 SIXTH STAGE (DISASSEMBLY OF BEVEL PINION SHAFT)

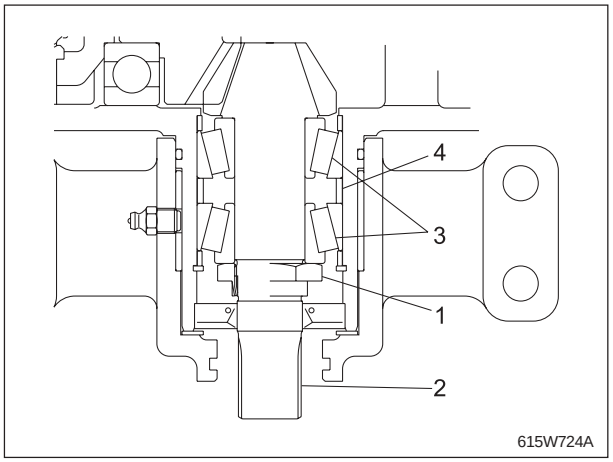
1. Straighten cocking and loosen lock nut (1).
2. Remove taper roller bearing (3) from bevel pinion shaft (2).

(When reassembling)

- Make sure taper roller bearing assembly direction is correct.

IMPORTANT:

- *When tightening lock nut, always check for bearing backpressure.*

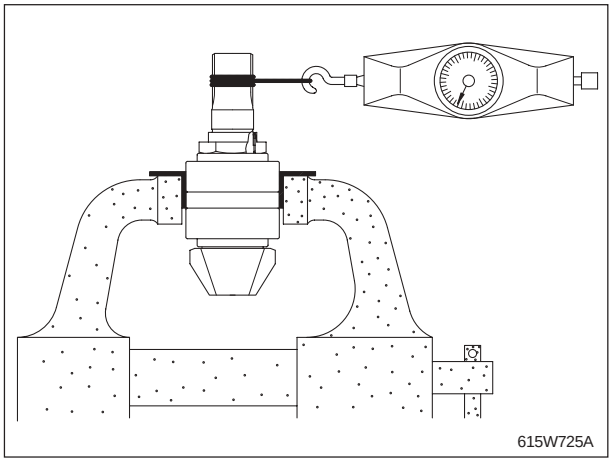


(1) Lock Nut
(2) Bevel Pinion Shaft
(3) Taper Roller Bearing
(4) Spacer Barrel

A. How to Check Bearing Backpressure

- Insert taper roller bearing and spacer barrel (4) into pinion shaft and tighten lock nut by hand.
- With bevel pinion shaft into assembly, lock the outer of bearing into vice.
- Wrap pinion shaft spline several times using rope, pull out rope using push-pull gage and check for rotation torque of pinion shaft.
- If rotation torque exceeding the spec., loosen lock nut and if less than the spec., tighten lock nut and perform cocking so that the nut will not loosen.

Sect.	Specified value
Bevel pinion shaft rotation torque	0.98 ~ 1.18 N·m 0.1 ~ 0.12 kgf·m 0.72 ~ 0.87 lbf·ft



8.7 SEVENTH STAGE (DISASSEMBLY OF DIFFERENTIAL GEAR)

1. Using bearing puller, pull out spiral bevel gear (2) and bearing (1) simultaneously.
2. Loosen bolt (3) and disconnect differential case cover (4).
3. Pull out parallel pin (11) and then disconnect differential pinion shaft (8).
4. Disconnect differential pinion (7), differential side gear (6), differential pinion washer (10), and shim (9) from case (5).

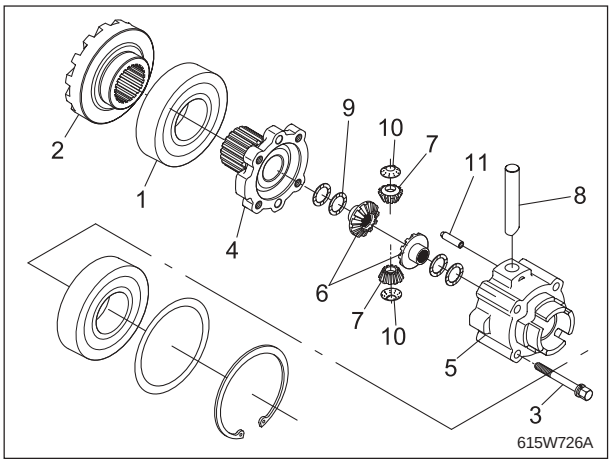
CAUTION

- *Mark disassembled part with its original position in order to assemble again into original position.*

(When reassembling)

- Assemble each part into the original position marked prior to disassembly.
- Apply differential gear operating part with molybdenum (Three bond 1901 or equivalent).

Sect.	Spec.	Tightening torque
Differential case cover tightening bolt	M10	48.0 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.4 ~ 41.2 lbf·ft

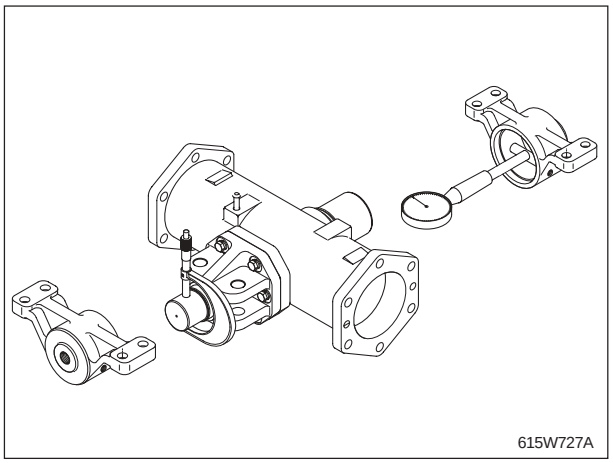


(1) Ball Bearing
(2) Spiral Bevel Gear
(3) Bolt
(4) Differential Case Cover
(5) Front Differential Case
(6) Differential Side Gear
(7) Differential Pinion
(8) Differential Pinion Shaft
(9) Shim
(10) Differential Pinion Washer
(11) Parallel Pin

9. MAINTENANCE

9.1 CLEARANCE CHECK BETWEEN CENTER PIN, FRONT AXLE SUPPORT BOSS AND FRONT AND REAL BRACKETS

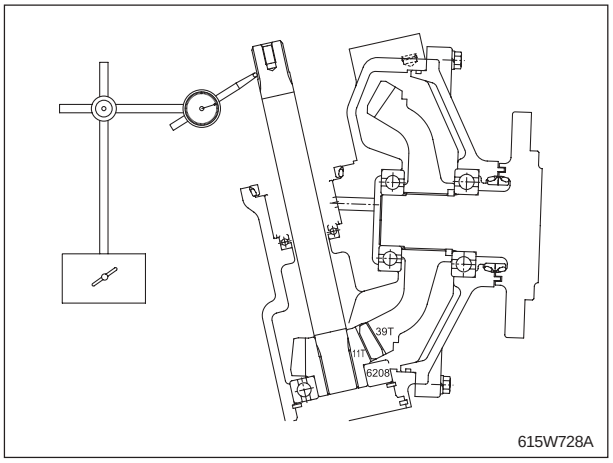
1. Check to see if DX bush of the front and rear brackets are worn.
2. If shaft contacted part is worn and bare metal surface, renew it.



9.2 CHECK FOR BACKLASH AND TOOTH CONTACTED IN FRONT AXLE CASE

A. Backlash Measurement

1. Set dial gage in bevel gear shaft spline.
2. Lock the front axle, move bevel gear shaft by hand and measure the backlash.
3. If exceeding the spec., adjust with shim.



B. Types of Adjusting Shim

0.2 mm (0.008 in.) 0.4 mm (0.016 in.)

0.8 mm (0.031 in.) 1.0 mm (0.039 in.)

1.2 mm (0.047 in.)

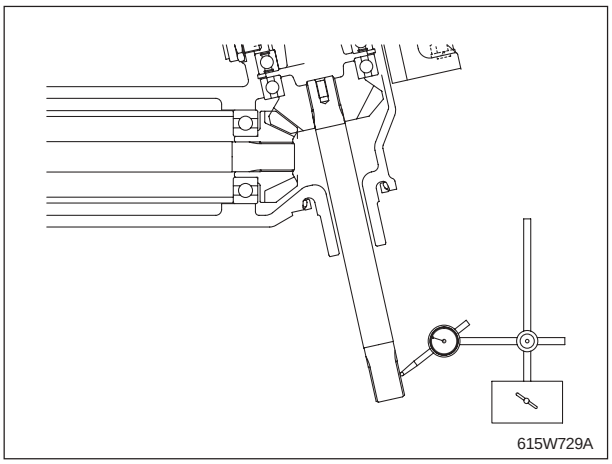
Sect.	Allowable limit
Bevel gear backlash	0.15 ~ 0.35 mm 0.059 ~ 0.0138 in.

C. Tooth Contacted Check

At any bevel gear, apply a few contacted surface from three positions divided by circumference with of red lead and then apply any one gear with load, rotate the other gear several times, and then check for tooth contacted amount.

Sect.	Allowable limit
Bevel gear tooth contacted	More than 35 % center 1/3 ~ 1/2 from small end.

9.3 CHECK FOR BEVEL GEAR BACKLASH AND TOOTH CONTACTED IN BEVEL GEAR CASE


615W729A

A. Backlash Measurement

1. Set the dial gage in bevel gear shaft spline.
2. Lock a gear into the differential gear shaft, move bevel gear shaft by hand and measure the backlash.
3. If exceeding the spec., adjust with a shim.

B. Types of Adjusting Shim

0.4 mm (0.016 in.) 0.8 mm (0.031 in.)

1.0 mm (0.039 in.) 1.2 mm (0.047 in.)

Sect.	Allowable limit
Bevel gear backlash	0.15 ~ 0.35 mm 0.059 ~ 0.0138 in.

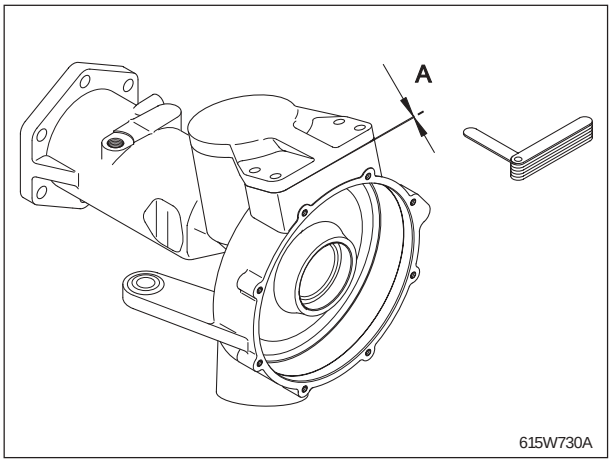
C. Tooth Contacted Check

At any bevel gear, apply a few contacted surface from three positions divided by circumference with thin film of red lead and then apply and one gear with load, rotate the other gear several times, and then check for tooth contacted amount.

Sect.	Allowable limit
Bevel gear tooth contacted	More than 35 % center 1/3 ~ 1/2 from small end.

9.4 CHECK FOR SHIM BETWEEN AXLE CASE SUPPORT AND FRONT AXLE CASE

1. With front axle case and bevel gear case compressed, measure the clearance (A) between axle case support and front axle case.



615W730A

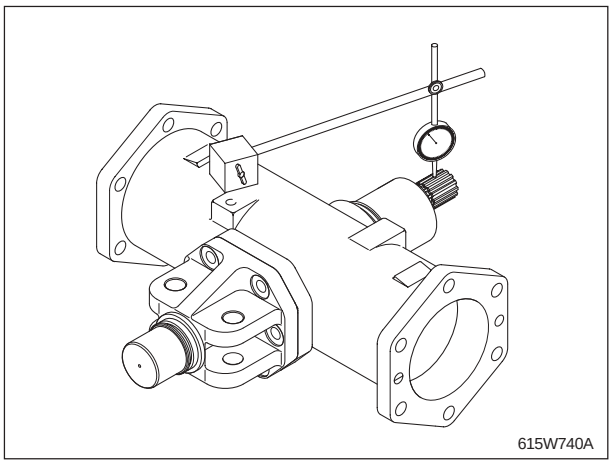
A. Shim Thickness

Clearance (A) + (0.2 ~ 0.5) = Shim thickness to be assembled.

B. Types of adjusting shim

0.5 mm (0.020 in.) 0.8 mm (0.031 in.)

9.5 CHECK FOR BACKLASH AND TOOTH CONTACTED BETWEEN BEVEL PINION SHAFT AND SPIRAL BEVEL GEAR


615W740A

A. Backlash Measurement

1. Set dial gage in bevel gear shaft spline.
2. Lock spiral bevel gear, move bevel gear shaft by hand and measure the backlash.
3. If exceeding the spec., adjust with shim and adjusting collar.

B. Types of Adjusting Shim

0.8 mm (0.031 in.) 1.0 mm (0.039 in.)

1.2 mm (0.047 in.) 2.0 mm (0.079 in.)

2.3 mm (0.091 in.)

C. Types of Adjusting Collar

5.8 mm (0.228 in.) 5.9 mm (0.232 in.)

6.0 mm (0.236 in.) 6.1 mm (0.240 in.)

6.2 mm (0.244 in.)

D. Tooth Contacted Check

At spiral bevel gear, apply a few contacted surface from three positions divided by circumference with thin film of red lead and then apply bevel gear with load, rotate bevel pinion shaft several times, and then check for tooth contacted amount.

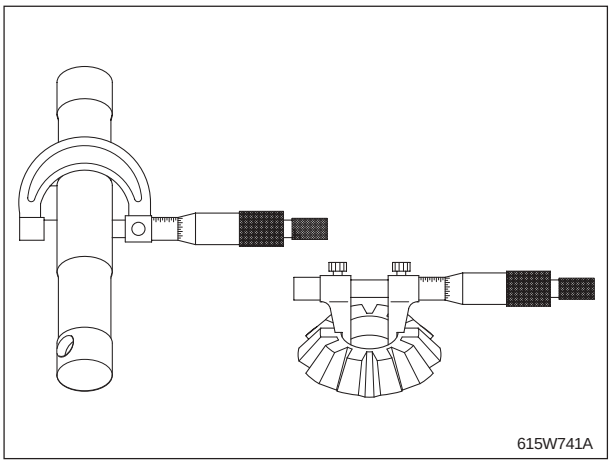
Sect.	Allowable limit
Bevel gear backlash	0.10 ~ 0.30 mm 0.0039 ~ 0.0118 in.

Sect.	Allowable limit
Bevel gear tooth contacted	More than 35 % center 1/3 ~ 1/2 from small end.

9.6 CLEARANCE CHECK BETWEEN DIFFERENTIAL PINION SHAFT AND DIFFERENTIAL PINION

1. Measure O.D. of differential pinion shaft.
2. Measure I.D. of differential pinion shaft.
3. Check clearance as the measured value and if exceeding allowable limit, renew it.

Sect.	Specified	Allowable limit
Clearance between differential pinion and differential pinion shaft	0.016 ~ 0.052 mm (0.00063 ~ 000205 in.)	0.25 mm (0.098 in.)
Differential pinion I.D.	16.000 ~ 16.018 mm (0.62992 ~ 0.63063 in.)	-
Differential pinion O.D.	15.966 ~ 15.984 mm (0.62858 ~ 0.62929 in.)	-

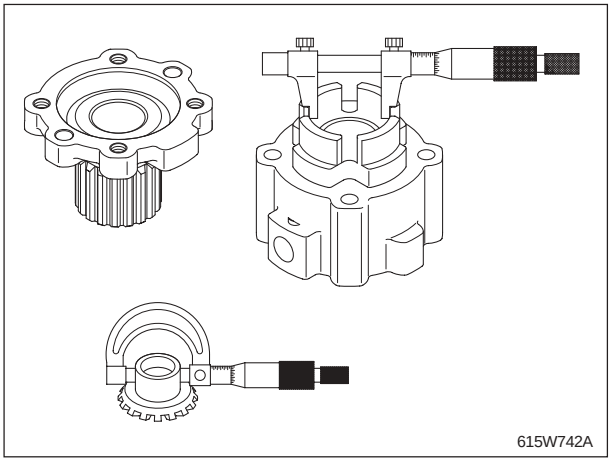


1.0 mm (0.039 in.) 1.2 mm (0.047 in.)

9.7 CLEARANCE CHECK BETWEEN FRONT DIFFERENTIAL CASE, DIFFERENTIAL CASE COVER AND DIFFERENTIAL SIDE GEAR.

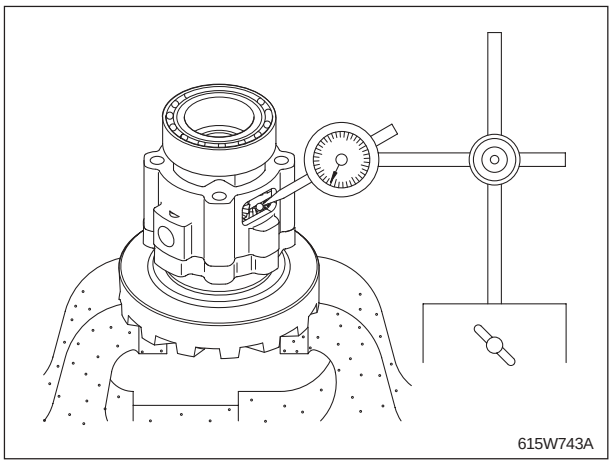
1. Measure O.D of differential side gear.
2. Measure I.D of differential side gear.
3. Measure I.D. of differential case cover.
4. Check the clearance as the measured value and if it exceeds the allowable limit, replace it.

Sect.	Specified	Allowable limit
Clearance between front differential case, differential case cover and differential side gear	0.016 ~ 0.052 mm (0.00063 ~ 000205 in.)	0.25 mm (0.098 in.)
Front differential case I.D.	32.050 ~ 32.050 mm (1.26083 ~ 1.26181 in.)	-
Differential case cover I.D.	32.025 ~ 32.050 mm (1.26083 ~ 1.26181 in.)	-
Differential side gear O.D.	31.959 ~ 31.975 mm (1.225823 ~ 1.25886 in.)	-



9.8 CHECK FOR BACKLASH AND TOOTH CONTACTED BETWEEN DIFFERENTIAL PINION AND DIFFERENTIAL SIDE GEAR

1. Set a dial gauge on the differential pinion gear tooth surface in vertical.
2. Fix differential side gear, move pinion gear by hand and measure backlash.
3. If exceeding allowable limit, replace differential pinion washer and differential side gear shim.



A. Types of Adjusting Shim

0.8mm (0.031 in.) 1.0mm (0.039 in.)

1.2mm (0.047 in.)

Sect.	Allowable limit
Bevel gear backlash	0.10 ~ 0.30 mm 0.0039 ~ 0.0118 in.

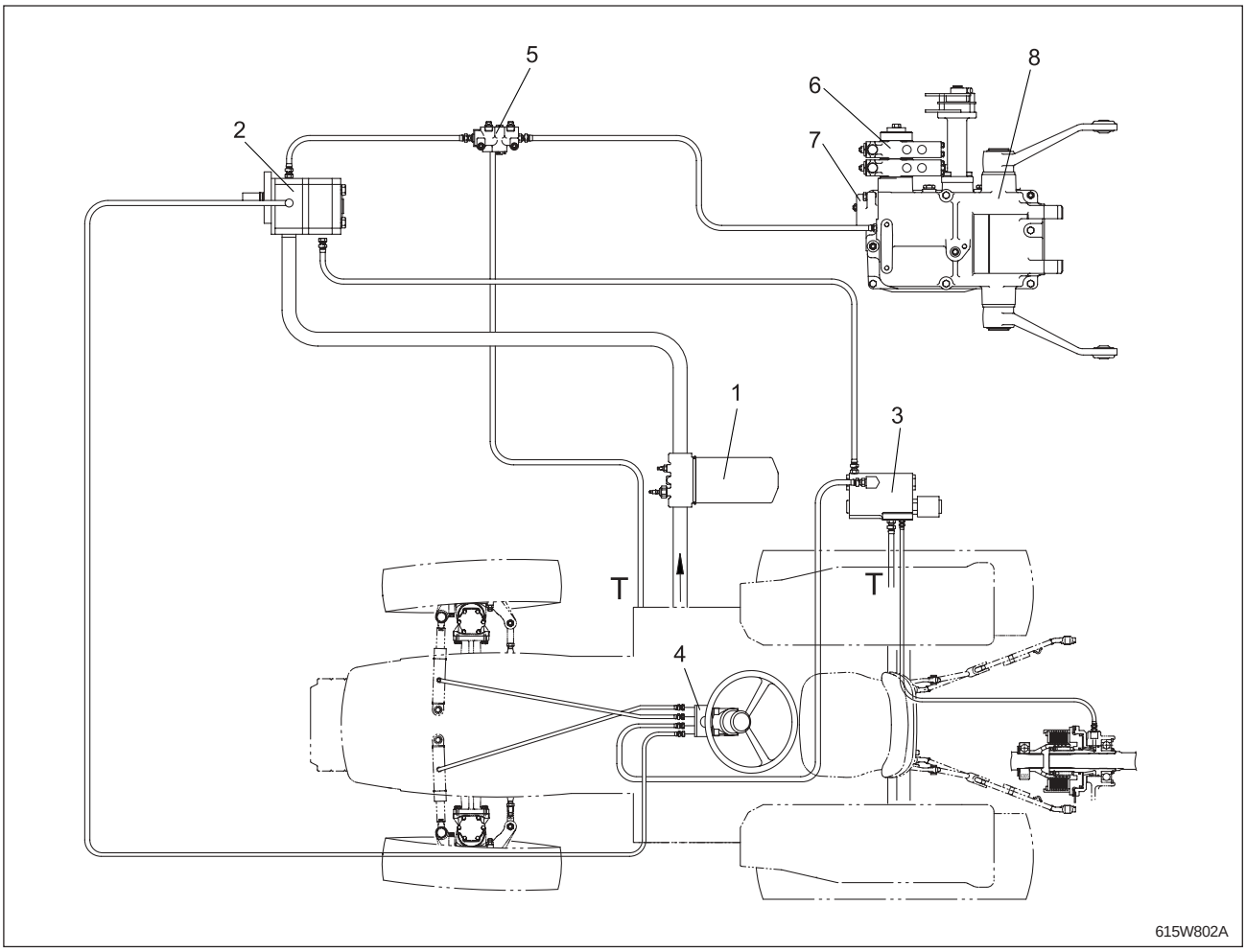
B. Tooth Contacted Check

At spiral bevel gear, apply a few contacted surface from three positions divided by circumference with the film of red lead and then apply bevel gear with load, rotate bevel pinion shaft several times, and then check for tooth contacted amount.

CHAPTER 8

STEERING SYSTEM

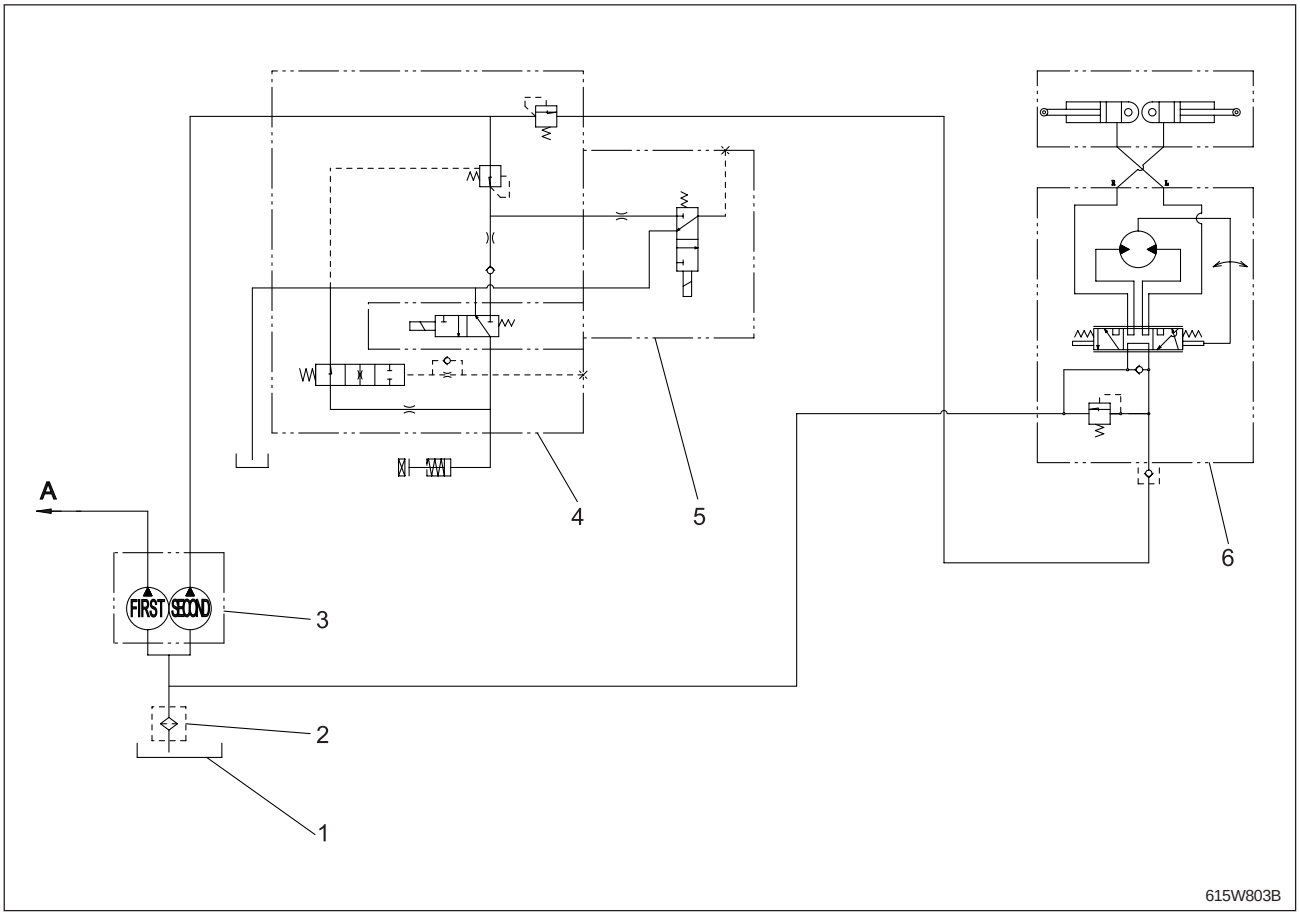
1. CHARACTERISTICS



(1) Hydraulic Filter
(2) Hydraulic Pump
(3) Modulating Valve
(4) Power Steering Unit
(5) Hydraulic Block
(6) Aux. Control Valve
(7) MLS(Control) Valve
(8) Power Lift Assembly

- Steering system is applied with full hydraulic power steering and installed with two single rod cylinders.
- The power steering unit is connected directly with hydraulic hoses and steering cylinders without additional linkage and has a superior steering power as transmission efficiency is increased.
- It is applied with a load reaction type and when releasing the steering wheel in steering, the wheel keeps in an almost straight direction.

2. HYDRAULIC CIRCUIT OF POWER STEERING SYSTEM



(1) Oil Tank
(2) Oil Filter
(3) Gear Pump
(4) Hydraulic Cylinder
(5) Hydraulic Block
(6) Steering Unit

HYDRAULIC OIL FLOW

- When the engine is started, the hydraulic pump will be driven to pass oil in transmission case through a modulator valve to the power steering unit.
- By means of steering wheel control, oil is passed through GEROTOR to steering cylinder, where steering of front wheel will be done by the motion of cylinder rod.
- Oil returned from steering cylinder returns to oil tank (transmission case) via power steering unit.

3. GEAR PUMP

3.1 PUMP CHARACTERISTICS

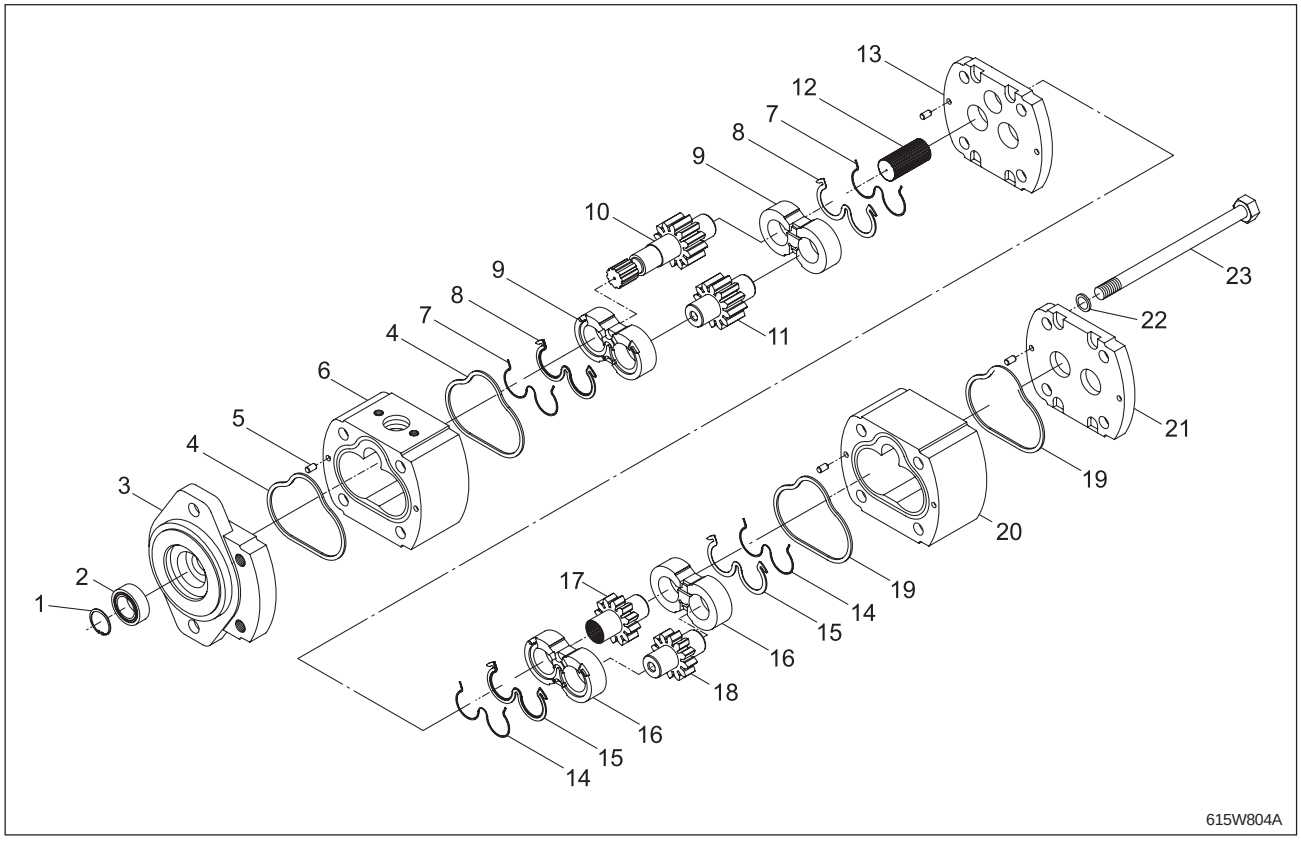
The power steering hydraulic pumps use the pump having superior volume efficiency and mechanical efficiency to extract power from engines right cam shaft gear.

3.2 MAJOR SPECIFICATION

Type	Volume (cc/rev)		Gear ratio	Rotation direction	RPM range	Discharge flow rate in engine rated rotation (l/min, gal/min)			Attached position
Tandem	12 First	7.2 Second	1 : 0.9	C.C.W	~ 3515	Q1: 29.7 7.86	Q2: 17.8 4.71	Qt: 47.5 12.57	Right of engine

- Ref.) Q1: For hydraulic elevation (First)
  Q2: Steering cylinder (Second)
  Qt: Total discharge flow rate
  C.C.W: Count clock wise.

3.3 STRUCTURE OF GEAR PUMP



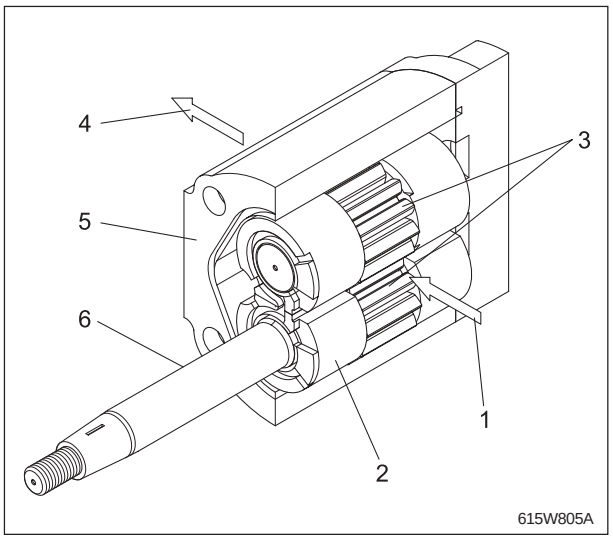
(1) Snap Ring
(2) Bearing
(3) Cover (Front)
(4) Seal Ring
(5) Pin
(6) First Pump
(7) Seal Ring
(8) Seal Ring
(9) Bushing
(10) Drive Gear Shaft 1
(11) Passive Gear 1
(12) Coupling
(13) Cover
(14) Seal Ring
(15) Seal Ring
(16) Bushing
(17) Drive Gear Shaft 2
(18) Passive Gear
(19) Seal Ring
(20) Second Pump
(21) Cover
(22) Spring Washer
(23) Bolt

3.4 OPERATION

a. Hydraulic pump provides constant oil flow to operate the steering wheel, and hydraulic cylinder. The hydraulic pump assembly consists of two pumps having different displacement.

b. Two pumps operate equally and use outside gear design to move the amount of fluid determined at each rotation and positive displacement.

c. Oil inflow and outflow continues while driving hydraulic pump from engine cam shaft, drive gear, and rotating pump gear (3). When gear is disconnected, a vacuum will be made to enable oil inflow (1) to pump. As gear is rotated, oil continues to flow.



(1) Inflow to Pump
(2) Bushing
(3) Gear
(4) Outflow From Pump
(5) Pump Housing
(6) Drive Shaft

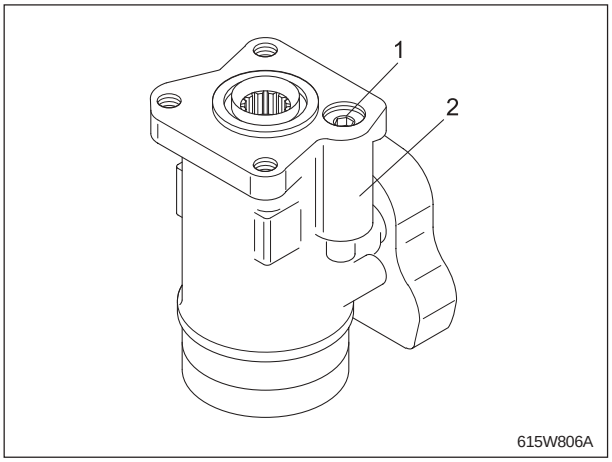
4. POWER STEERING UNIT

4.1 MAJOR SPEC.

Power Steering Unit Volume	51 cc/rev
Relief pressure	120 kgf/cm² 8.4 psi

4.2 STRUCTURE AND OPERATION

- Power steering controller consists of steering valve and relief valve.
- Steering valve is divided into control valve and metering device.

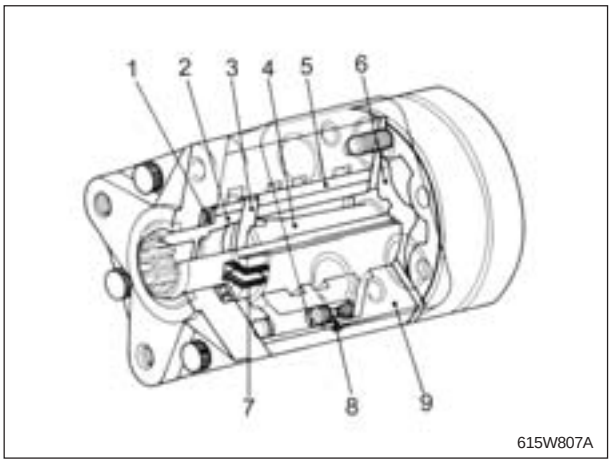


(1) Relief Valve (2) Steering Valve

A. Control Valve

The control valve consists of control valve housing (9), spool (2), and sleeve (5). The control valve is a rotary type and keeps in neutral by centering spring without valve control. If controlling the steering wheel, it takes a role of converting oil inflow direction to steering cylinder with Gerotor.

(1) Needle Bearing
(2) Spool
(3) Pin
(4) Drive
(5) Sleeve
(6) Rotor
(7) Centering Spring
(8) Ball
(9) Housing



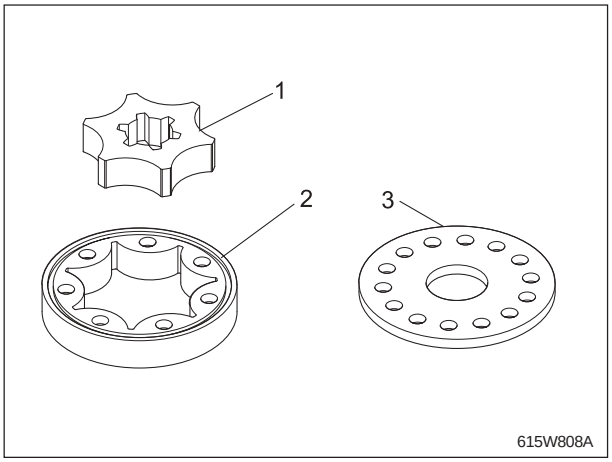
B. Metering Device

The metering device consists of a trochoid pump called a Gerotor (6). Oil passes metering device from hydraulic pump via the steering cylinder.

This metering device consists of a trochoid pump and if driving rotor, oil will be discharged from three chambers as volume changes between the rotor and stator.

It will passed to the rotor directly via steering shaft. Therefore, the stator takes a role in passing oil to the cylinder as it rotates. Then, steering wheel can be steered as steering wheel is rotated.

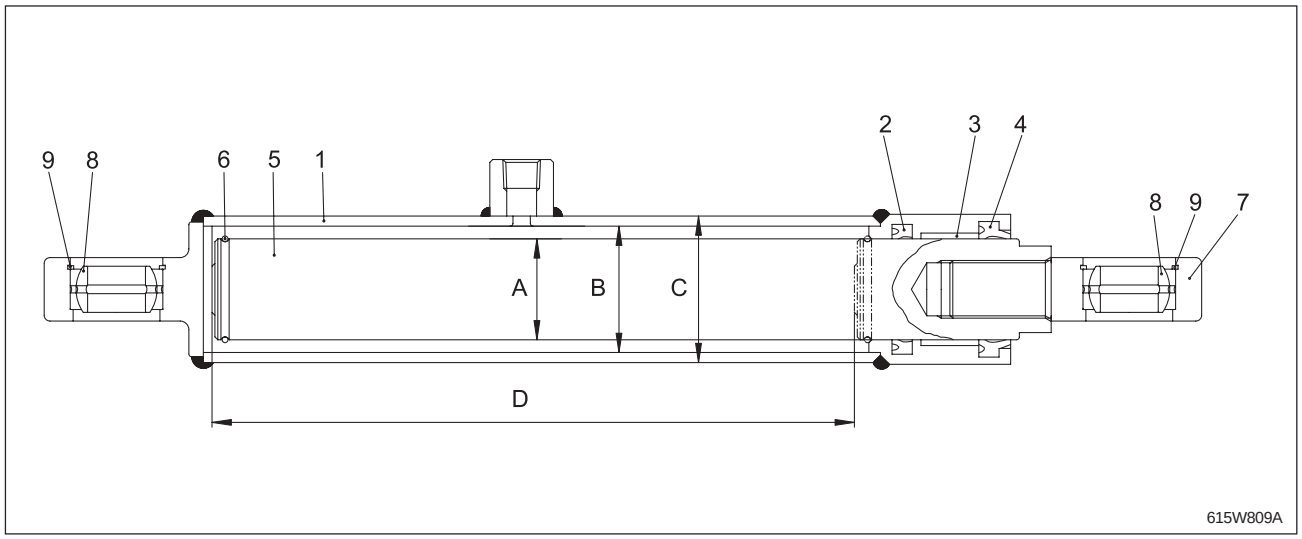
If engine stops or hydraulic is pump faulty, stator enables manual operation as a little engaged trochoid pump.



(1) Rotor
(2) Stator
(3) Plate

5. STEERING CYLINDER

5.1 STRUCTURE



(1) Tube
(2) Packing
(3) Bush
(4) Dust Seal
(5) Rod
(6) Ring
(7) Housing
(8) Bearing
(9) Snap Ring

[A] Rod O.D
[B] Tube I.D
[C] Tube O.D
[D] Stroke

5.2 MAJOR SPECIFICATION

Tube O.D. (C)	Tube I.D. (B)	Rod O.D (A)	Stroke (D)
ϕ 60 (2.36 in.)	ϕ 50 (1.97 in.)	ϕ 32 (1.26 in.)	243 mm (9.57 in.)

6. OIL FLOW

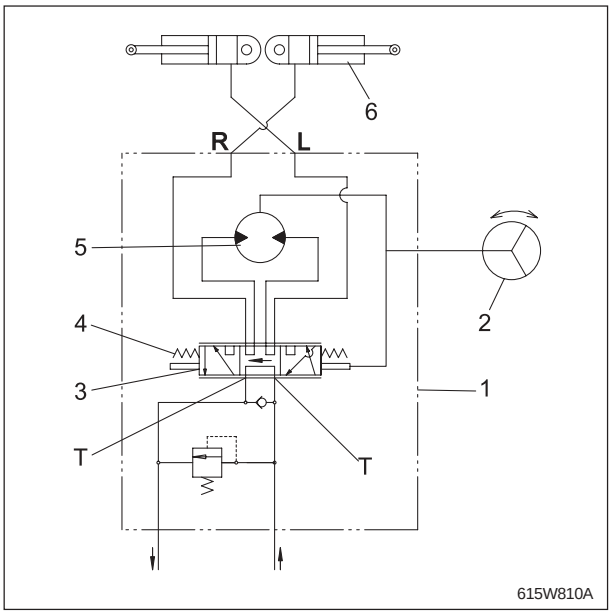
6.1 IN NEUTRAL

If the steering wheel is not rotated, valve plate (3) keeps in neutral by using a centering spring (4).

This time oil flow will be formed between port P (from pump) of control valve and port t of transmission case and all oil supplied from the gear pump will be drained to the port.

Besides, flow from cylinder port R and L will be shut off at control valve.

The steering cylinder will not move and it keeps the front wheels straight or at given angle without motion.



(1) Steering Controller
(2) Steering Wheel
(3) Valve Plate
(4) Centering Spring
(5) GEROTOR
(6) Steering Cylinder

6.2 TURNING TO THE RIGHT

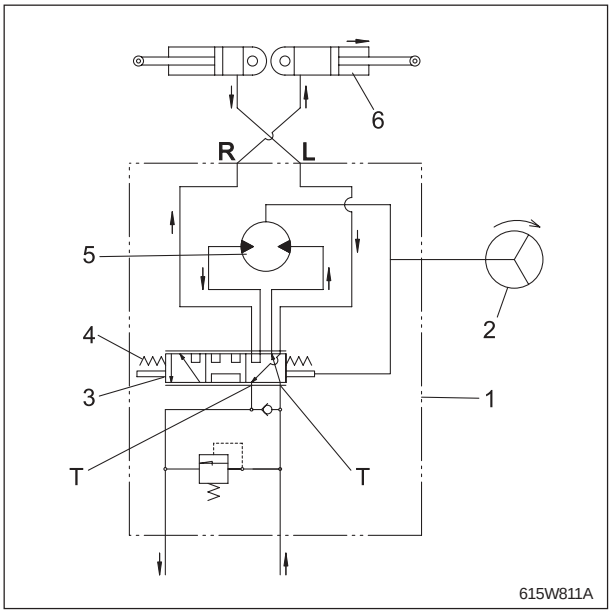
If the steering wheel is rotated to the right, the movement will be passed to control valve through the drive plate, GEROTOR and drive link.

Valve plate (3) rotates to the right on the manifold and is located in the opposite direction of the valve plate (3). Port P flow of control valve is connected to GEROTOR (5).

STATOR of GEROTOR (5) rotates as the steering wheel (2) is rotated, and performs metering function and passes oil as steering wheel (2) is rotated.

Oil that passed through GEROTOR (5) will flow to the rear of control valve, connected to cylinder port R and moves the steering cylinder (6).

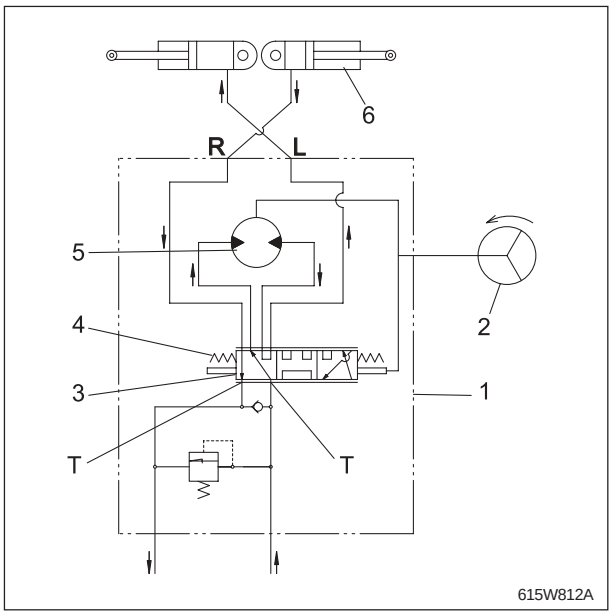
Front wheel moves as corresponding angle as oil passed. If steering cylinder (6) operated, returned oil will be flown to cylinder port L, connected to port T from control valve and returned to transmission case.



(1) Steering Controller
(2) Steering Wheel
(3) Valve Plate
(4) Centering Spring
(5) GEROTOR
(6) Steering Cylinder

6.3 TURNING TO THE LEFT

The steering system operates in the same direction as in rotating to the left, except for flow in and flow out directions to steering cylinder in the opposite when turning to the right.



(1) Steering Controller
(2) Steering Wheel
(3) Valve Plate
(4) Centering Spring
(5) GEROTOR
(6) Steering Cylinder

6.4 MANUAL STEERING

In case of manual steering due to engine stop or hydraulic pump failure, the GEROTOR operates as a manual trochoid pump. If controlling steering wheel, rotor inside of GEROTOR will be driven. Oil will be flown through check valve 2 installed in housing from oil tank to port P, where it operates cylinder in the same passage as power steering control.

7. TROUBLESHOOTING

Trouble	Probable Cause	Remedy
Steering wheel is heavy	1. Power steering unit	
	(1) Column and center mismatched.	* Modify (Loosen tightening bolt with power steering unit can cause center mismatch
	(2) Spool and sleeve dirty	* Change
	(3) Excessive tightening torque of end cover bolt (7)	* Tighten equally into the specified torque
	2. Pump	
	(1) Not drive.	* Repair
	(2) Worn, faulty	* Change
	(3) Rated poor	* Reset pressure and flow rate
	3. Relief valve	
	(1) Faulty (Poor operation)	* Change
	(2) Pressure setting low	* Reset
When releasing steering wheel, it will not return to neutral. Or returns arbitrarily.	1. Power steering unit	
	(1) Spool and sleeve dirty.	* Change
	(2) Column and center misaligned	* Modify
Cylinder operation more degraded against steering wheel oration. Or it will not operate.	1. Power steering unit	
	Attached, mounted, GEROTOR taken dirty mixed air due to long-term unused.	* Air bleeding
	2. Cylinder	
	(1) Air mixture	* Air bleeding
	(1) Piston seal broken	* Change
Steering wheel rotates in reverse direction.	1. Power steering unit	
	(1) Valve timing assembly wrong (in disassembly and assembly)	* Modify
	2. Pipe	
	(1) 4-port pipe wrong	* Modify
Oil leakage		
1. Shaft	1. Oil seal worn	* Change fluid oil
(Outer of spline in spool)	Fluid oil dirty	
2. Assembly surface (between housing and spacer plate, between GEROTOR and end cover)	2. O-ring damage	* Change
	In disassembly and reassembly	

8. DISASSEMBLY, MAINTENANCE

8.1 GEAR PUMP

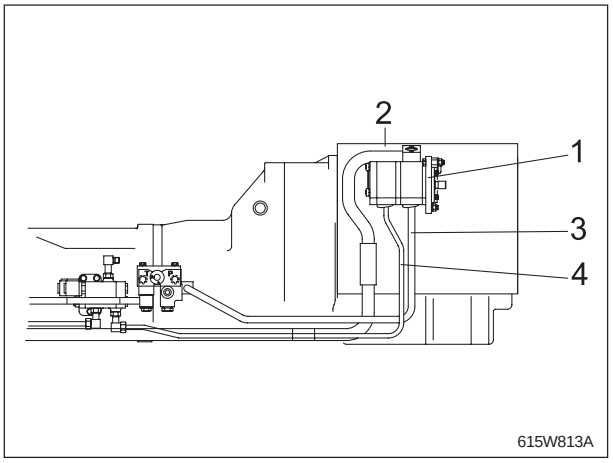
A. Tightening Torques

No.	Item	Reference Value	Description	Number
1	Clearance between drive gear and body	Allowable limit: 0.05 mm (0.002 in.)	- Assemble bushing into body. - Assemble drive shaft with idle gear. - Measure using clearance gage.	-
2	Drive shaft worn	Allowable limit: 19.25 mm (0.758 in.)	- Measure shaft diameter using micrometer.	-
3	Clearance between drive shaft and bushing	Allowable limit: 0.177 mm (0.007 in.)	- Measure bushing I.D. using micrometer. - Compare th difference from measured drive shaft diameter.	-
4	Length of bushing	Allowable limit: 25.75 mm (1.014 in.)	- Measure the length of bushing using micrometer	-
5	Length between pump body and mm bushing	0.10 ~ 0.18 (0.004 ~ 0.007) (bushing short)	- Measure bushing and pump body using micrometer.	-

B. Disassembly and Assembly

a. Disconnection of Gear Pump

Disassembly hydraulic pipe (3), PTO hydraulic pipe (4), and intake pipe 3 (2) from gear pump assembly (1).

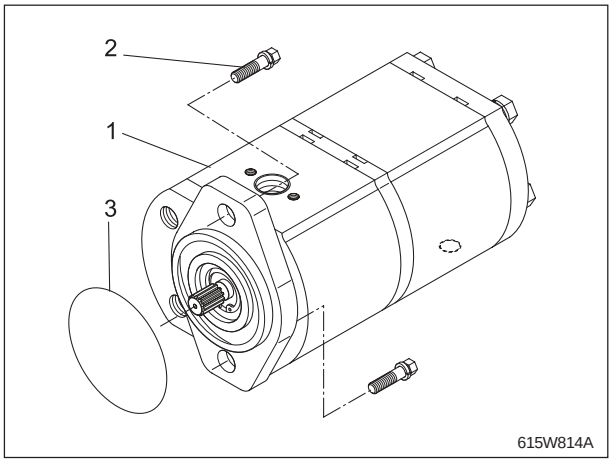


(1) Gear Pump Assembly (3) Hydraulic Pipe 1
(2) Intake Pipe 3 (4) PTO Hydraulic Pipe

1. Disassemble bolt (2).
2. Detach gear pump (1).
3. Detach O-ring (3)
   - See assembly bolt spec (M10*P1.25).

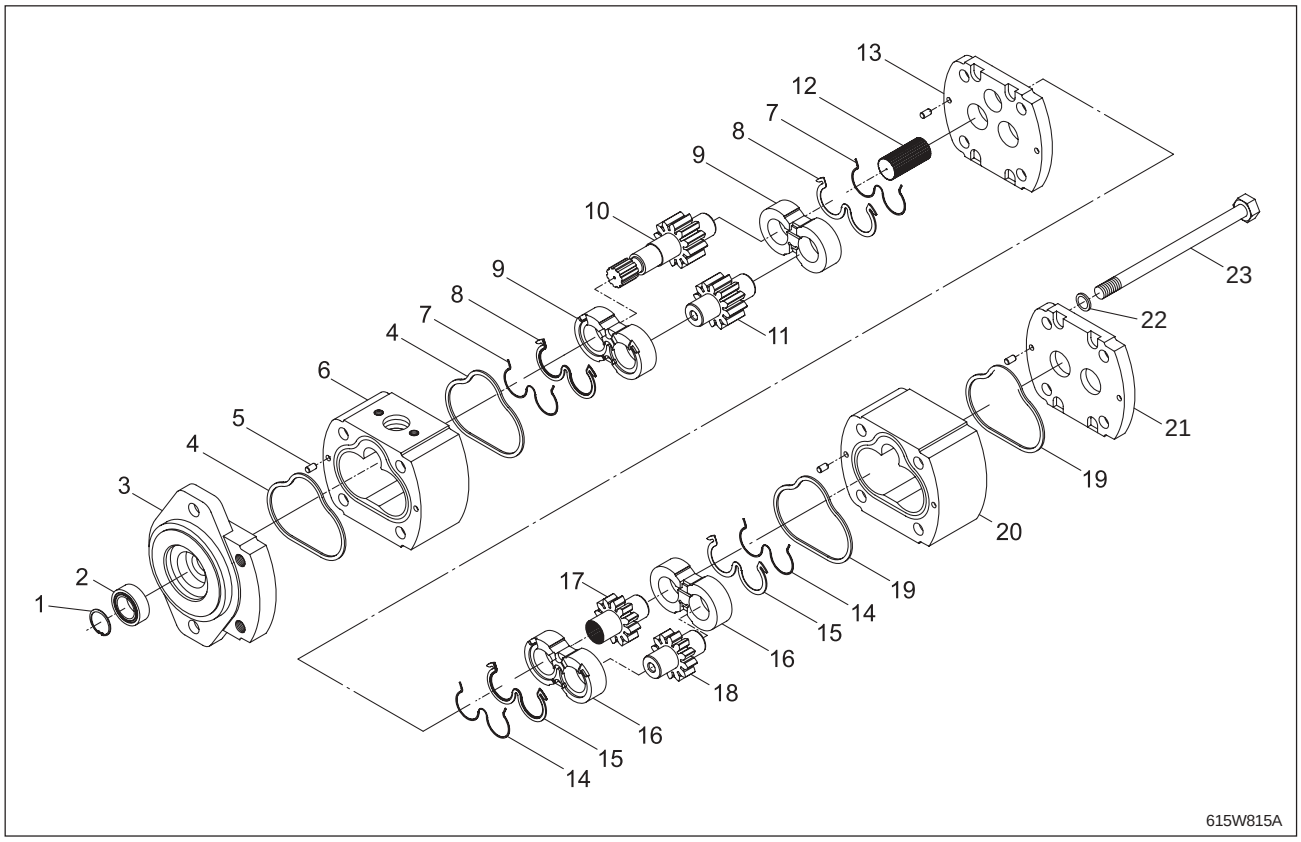
CAUTION

- *Make sure O-ring not damaged and if broken, replace it.*



(1) Gear Pump Assembly (3) O-Ring
(2) Bolt

b. Disassembly of Gear Pump



(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
(11) Passive Drive Gear
(12) Coupling
(13) Cover
(14) Sealing
(15) Sealing
(16) Bushing
(17) Drive Gear Shaft2
(18) Passive Gear
(19) Sealing
(20) Second Pump
(21) Cover
(22) Spring Washer
(23) Bolt

1. Fix gear pump assembly in vice.
2. Disengage 4 bolts (23) and disassemble rear cover (21).
3. Disassemble snap ring (1) and bearing (2) from drive shaft.
4. Disassemble SECOND pump (20), bushing (16), seal ring (14, 15), O-ring (19), drive gear shaft 2 (17), and passive gear (18).
5. Disassemble cover (13) and coupling (12).
6. Disassemble FIRST pump (6), bushing (9), seal ring (7, 8), O-ring (4), drive gear shaft 1 (10), passive gear (11).
7. Disassemble oil seal attached at cover (front) (3).

Tightening bolt, nut	Bolt (23)	48.1 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.4 ~ 41.2 lbf·ft

CAUTION

1. *If oil seal is cracked or damaged, replace it with new part.*
2. *Make sure seal ring is not damaged and if broken, replace it.*
3. *Make sure assembly direction of seal ring is correct.*

8.2 POWER STEERING UNIT

A. Disassembly, Assembly

a. Disconnection of Power Steering Unit Assembly

First Stage (Disconnection of Steering Hose)

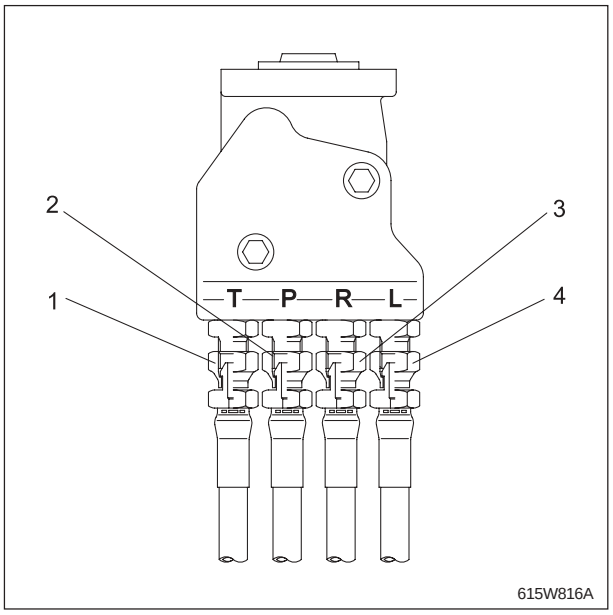
- Disengage steering hose (1), (2), (3), (4) connecting nut and disconnect hose from power steering unit (5).

(When reassembling)

- When connecting with power steering unit hose, make sure color and connecting port of hose are correct.

Connecting port	Hose type
T	Steering hose assembly T (Green color)
P	Steering hose assembly P (Red color)
R	Steering hose assembly R (White color)
L	Steering hose assembly L (Yellow color)

Sect.	Spec.	Tightening torque
Steering hose tightening nut	PF 1/4	46.6 ~ 50.9 N·m 4.8 ~ 5.2 kgf·m 34.4 ~ 37.6 lbf·ft



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

Second Stage (Disconnection of Steering Unit)

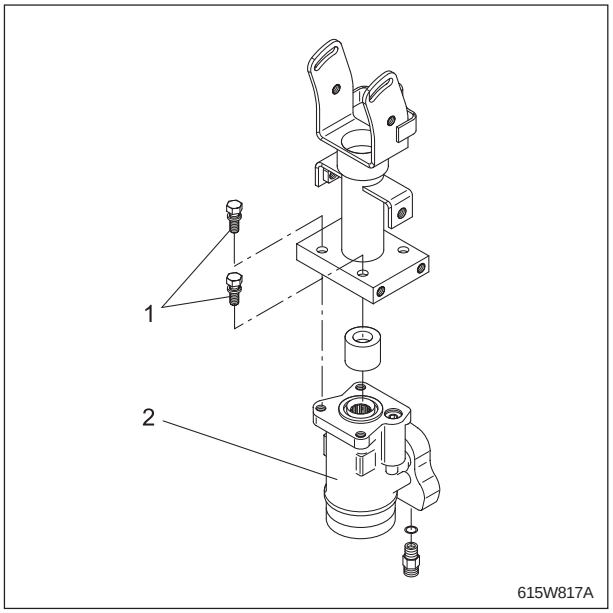
- Loosen bolt (1) and disconnect power steering unit (2).

(When reassembling)

- When attaching with power steering unit, apply bolt with bonding agent and tighten to the specified torque.

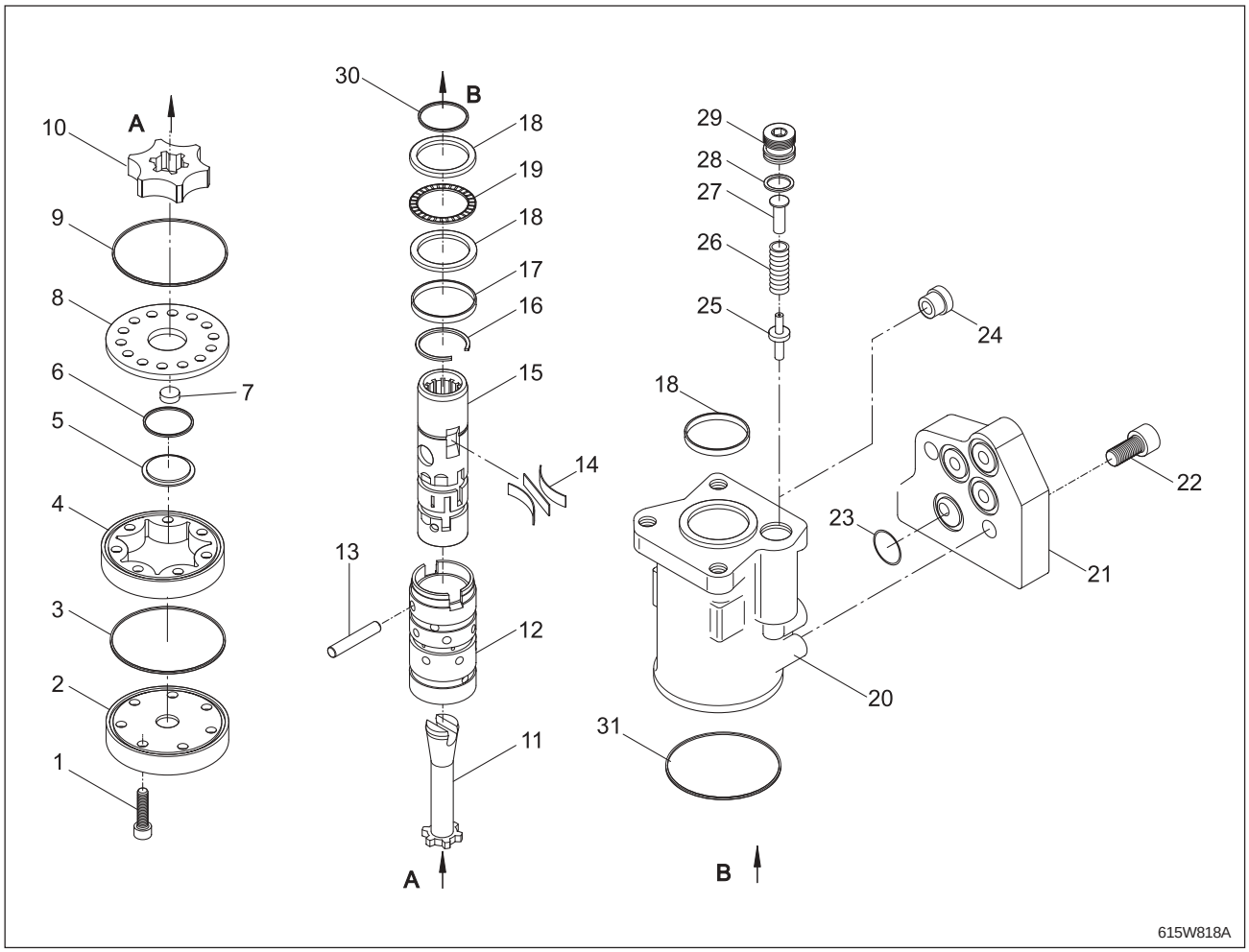
Bonding agent	Loctite #242 or equivalent

Sect.	Spec.	Tightening torque
Power steering unit tightening bolt	M10	48.0 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.5 ~ 41.2 lbf·ft



(1) Bolt (2) Steering Unit

B. Disassembly, Assembly of Power Steering Unit



(1) Screw
(2) End cap
(3) O-Ring
(4) Stator
(5) Spacer
(6) O-Ring
(7) Spacer
(8) Spacer Plate
(9) O-Ring
(10) Rotor
(11) Drive
(12) Sleeve
(13) Pin
(14) Centering Spring
(15) Spool
(16) Stop Ring
(17) Retainer Ring
(18) Bearing Less
(19) Needing Bearing
(20) Housing
(21) Housing
(22) Screw
(23) O-Ring
(24) Inlet Check Valve Assembly
(25) Poppet
(26) Spring
(27) Damper Collar
(28) O-Ring
(29) Plug
(30) O-Ring
(31) O-Ring

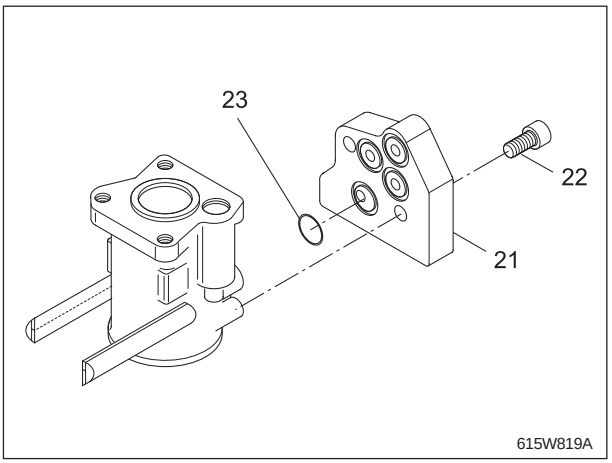
C. Disassembly of Power Steering Unit

a. Disassembly of GEROTOR

1. With end cap upward, lock port of body housing lightly into vice.
2. Loosen two screws (22) and disassemble housing (21).

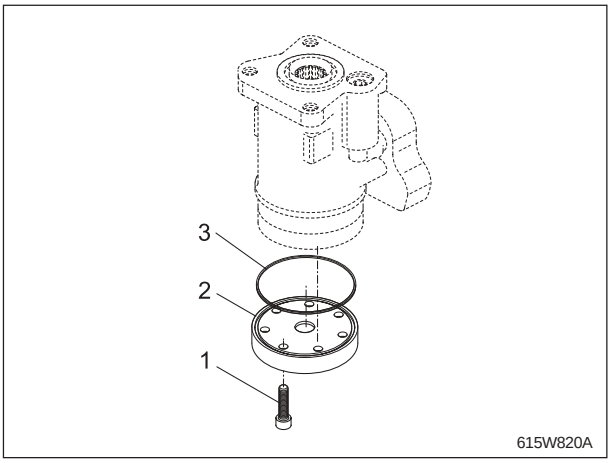
CAUTION

- *Never tighten firmly into vice with rigid plate and etc.*



(21) Housing
(22) Screw
(23) O-ring

3. Loosen seven screws (1).
4. Disassemble end cap (2).
5. Disassemble O-ring (3) from end cap.

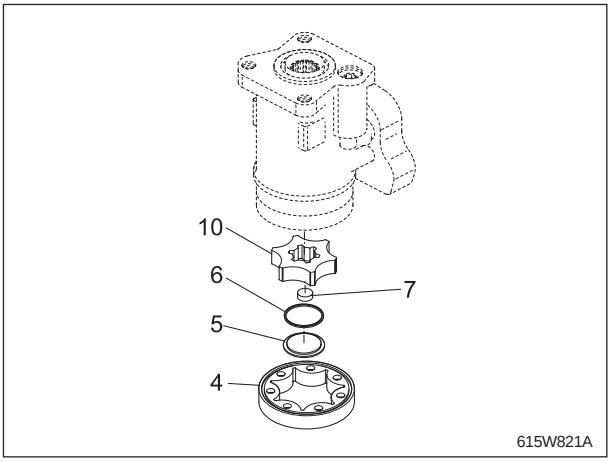


(1) Screw
(2) End Cap
(3) O-Ring

6. Detach spacer (5), (7) and O-ring (6) from inside spline of between rotor (10) and GEROTOR (4).

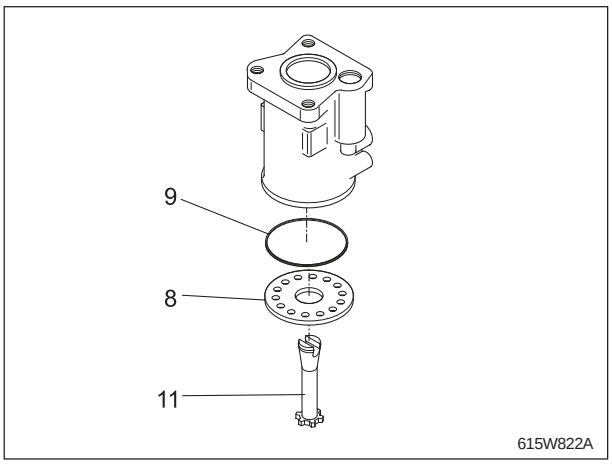
CAUTION

- *Power steering units with discharge capacity of 31 cc/rev and 51 cc/rev don't contain spacer.*



(4) Stator
(5) Spacer
(6) O-Ring
(7) Spacer
(10) Rotor

7. Disassemble GEROTOR. Make sure rotor not dropped from outer ring of GEROTOR.
8. Pull out spacer plate (8) and O-ring (9).
9. Pull out driver (11).
10. Pull out O-ring from housing.

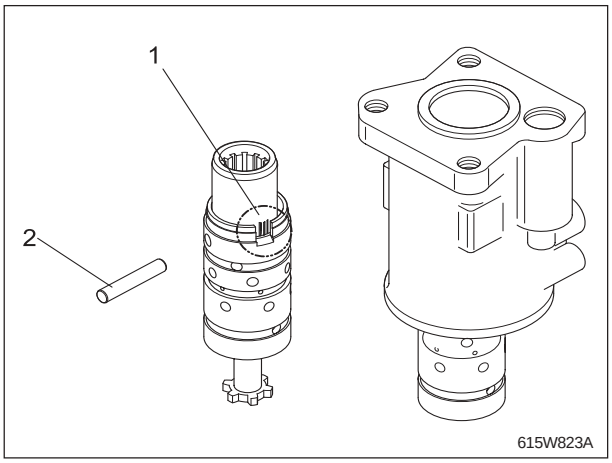


(8) Plate
(9) O-Ring
(11) Driver

11. Push inside spline of spool by the thumb and pull out spool and sleeve assembly from the opposite side of the housing flange. This time, make sure sleeve O.D. is not seized with into housing I.D.
12. Pull out pin (13) from spool and sleeve assembly.

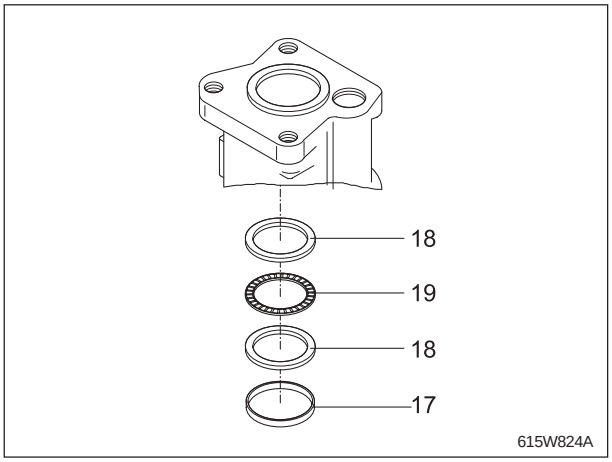
CAUTION

- *Centering spring can be protrude from spool, so always wear safety goggle.*



(1) Position Alignment Mark
(2) Pin

13. Push spool of sleeve forward and disassemble center spring from spool by hand. Pull out sleeve from spool. Rotate and pull out sleeve carefully.
14. Pull out two bearing less (18), needle bearing (19) and retainer ring (17). Always insert needle bearing between bearing less.



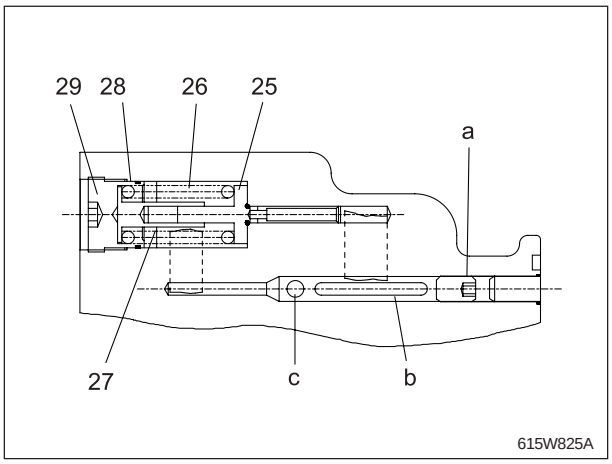
(17) Retainer Ring
(18) Bearing Less
(19) Needle Bearing

b. Disassembly of Relief Valve

1. Disassemble retainer screw (1) from plug (29) of housing (20) and pull out retainer pin (2) and ball (3).
2. With flanged surface of housing (20) upward, disassemble relief-adjusting plug (29) and pull out O-ring (28).
3. Pull out damper collar (27) and spring (26).
4. Pull out poppet (25) from housing (20) using pincette.

CAUTION

- *To easy pressure adjustment when reassembling, measure the depth from flanged surface of housing to relief adjusting plug (29) in advance using vernier calipers.*



(a) Screw
(b) Retainer Plate
(c) Ball
(25) Poppet
(26) Spring
(27) Damper Collar
(28) O-ring
(29) Adjusting Plug

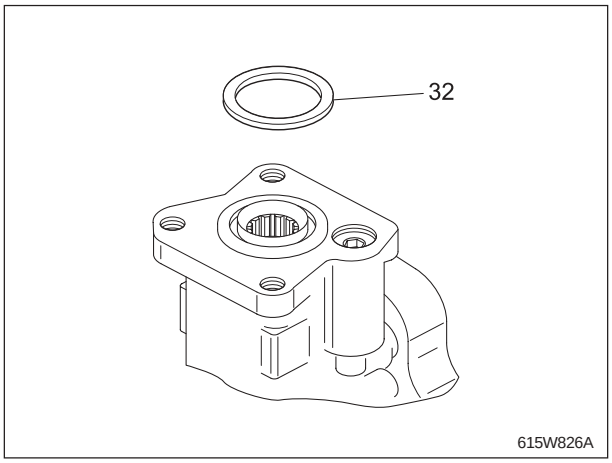
D. Assembly of Power Steering Unit

a. Assembly of Control

1. Insert dust seal (32) from flange section into housing.

CAUTION

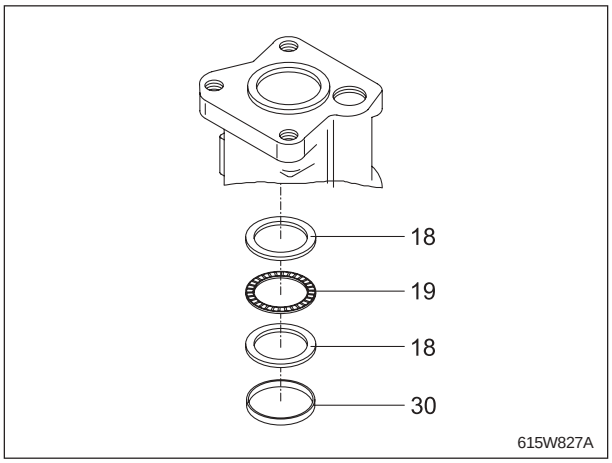
- *Assemble with the flat surface of dust seal downward.*



(32) Dust Seal

2. With housing flange downward, insert O-ring (30) into assembled groove and assemble with one bearing less (18), thrust needle bearing (19) and bearing less (18).

3. Rotate spool (15) and insert slowly into sleeve (12). Take spline of spool and make sure spool lightly rotated in sleeve.
4. Align two spring grooves between spool and sleeve at 180 and keep parallel. Insert spring insert tool into spring groove and install centering spring in insert tool with tooth ends downward. This time if raised spool from sleeve, it is convenient for insert.



(18) Bearing Less
(19) Thrust Needle Bearing
(30) O-Ring

CAUTION

- *Make sure the number of centering spring is correct, as it is different as input torque spec. of the product.*

5. While raising spool and from sleeve and compressing the opposite end of centering spring by hand, push spool into the groove of sleeve. This time, slide insert tool at the same speed of spring compression. After inserting, align the end of spring with outer circumference of sleeve.

CAUTION

- *Align with position alignment mark when disassembling.*
- *Centering spring can be protruded from spool, so always wear safety goggle.*

6. Insert pin (13) into hole of sleeve and spool and sleeve assembly into GEROTOR of housing.

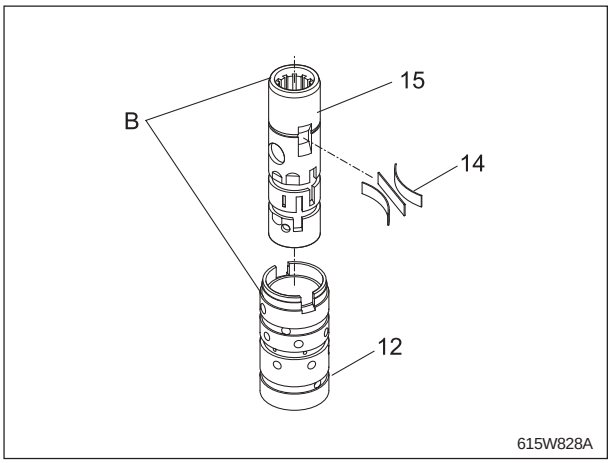
CAUTION

- *Make sure that spool and sleeve assembly are rotated slightly in housing.*

7. Insert driver (11). This time, align with pin (13) and yoke of driver.
8. Assemble O-ring (31) on gerotor and assemble GEROTOR rotor into groove.
9. Insert plate (5), O-ring (6) and plate (7) into inside spline of GEROTOR rotor.
10. Align bolt hole of housing with oil hole using spacer plate (8).
11. Apply screw (1) with oil and insert into end cap (2).

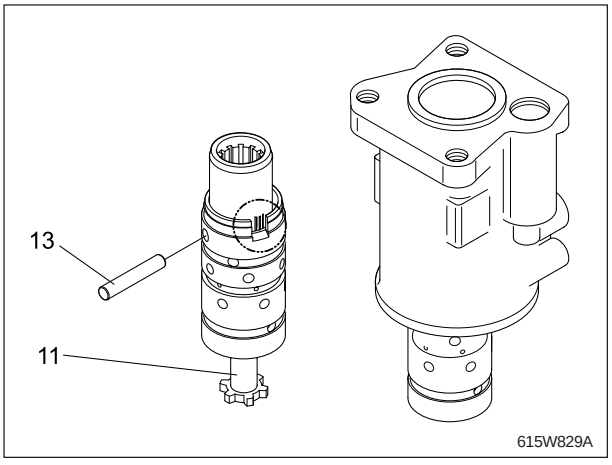
CAUTION

- *Tighten seven screws (1) into about 1. 0 Kgf·m (9.8 N·m, 7.2 lbf·ft) torque in advance.*



(12) Sleeve (15) Spool
(14) Spring

[B] Position Alignment Mark



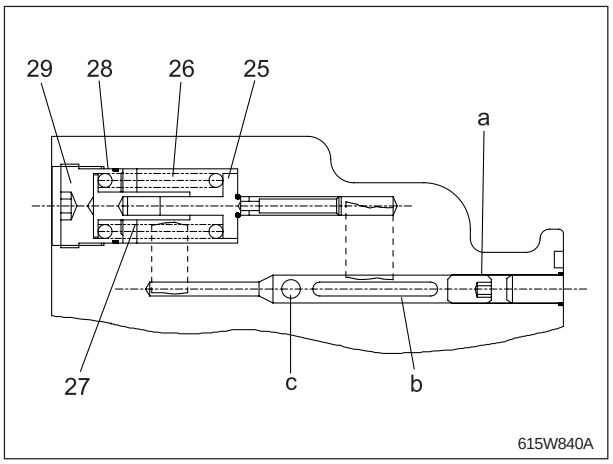
(11) Driver (13) Pin

b. Assembly of Relief Valve

1. Insert poppet (25) into flange of housing with spring guide seized using pincette.
2. Insert spring (26) and damper collar (27).
3. Insert O-ring into relief adjusting plug (29) and tighten to housing.

CAUTION

- *When completing the assembly, adjust the pressure of relief valve.· Pressure variance of relief adjusting plug (29) is 15 kgf/cm² Per one rotation.*



(a) Screw
(b) Retainer Plate
(c) Ball
(25) Poppet
(26) Spring
(27) Damper Collar
(28) O-ring
(29) Adjusting Plug

Precautions When Assembling Power Steering Unit

1. Make sure that the machined ends of sleeve, spool and housing are not damaged.
2. Perform disassembly and repair in a clean place and wipe out dust and dirt of body connectors with wire brush.
3. Make sure parts not dropped, chopped or damaged when handling.
4. When disassembling power steering unit, follow this instruction and never disassemble if possible.

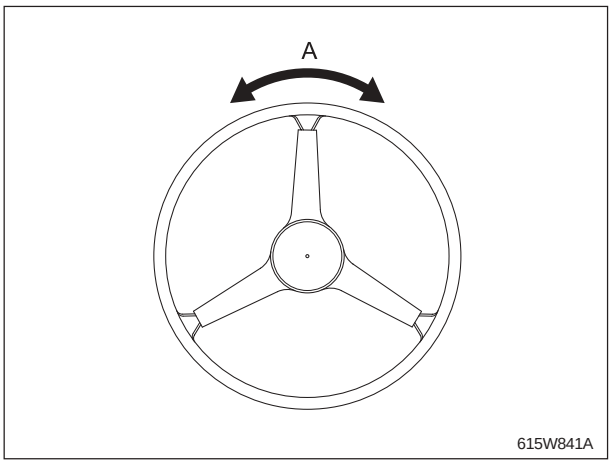
8.3 STEERING CYLINDER

A. Check

a. Steering Wheel Clearance

- After starting engine, wait for the engine to idle.
- Rotate the steering wheel by hand and measure clearance.
- If clearance exceeding the spec., check steering connection device for link.

Sect.	Specified
Steering wheel clearance	20 ~ 40 mm 0.79 ~ 1.97 in.

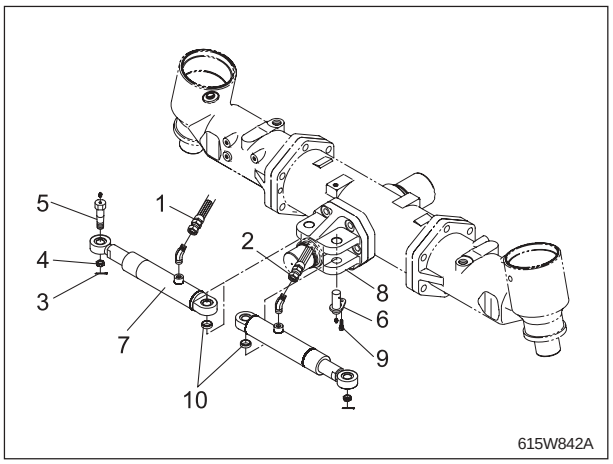


[A] Clearance

B. Disassembly, Assembly

a. Disconnection of Steering Cylinder Assembly

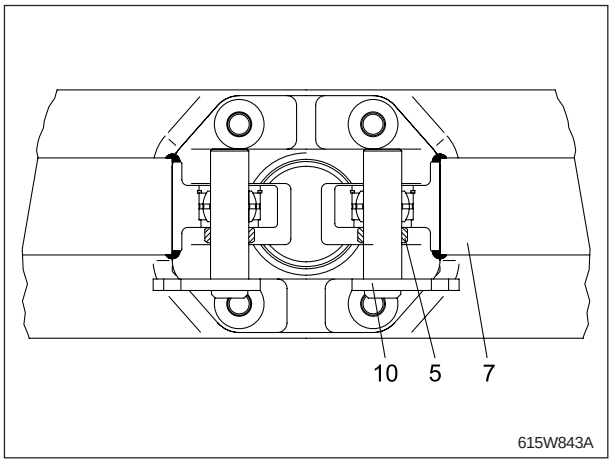
- Disconnect steering hose assembly (1) and (2).
- Pull out split pin (3) and disengage nut (4).
- With tapping the end of support pin (5) using plastic hammer, pull out support pin from front axle case.
- Disengage pin (6) locking bolt (9) and pull out pin from center pin (8).
- Disconnect steering cylinder assembly (7).



(1) Steering Hose Assembly R
(2) Steering Hose Assembly L
(3) Split Pin
(4) Nut
(5) Support Pin
(6) Support Pin
(7) Steering Cylinder Assembly
(8) Center Pin
(9) Bolt
(10) Nut

(When reassembling)

- When attaching steering cylinder with center pin, make sure assembly position of spacer barrel (10) is correct (See the following figure).



(5) Steering Cylinder Assembly
(7) Support Pin
(10) Spacer Barrel

- After assembling split pin, make sure the end is not fallen.
- Apply support pin and grease nipple with sufficient grease.

Sect.	Spec.	Tightening torque
Nut	M18	48.0 ~ 55.9 N·m 4.9 ~ 5.7 kgf·m 35.5 ~ 41.2 lbf·ft

- When assembly steering cylinder connector, apply screw with sealing agent.
- When connecting with steering cylinder hose, make sure the color and connecting port is correct.
- After assembly steering hose, perform air bleeding.

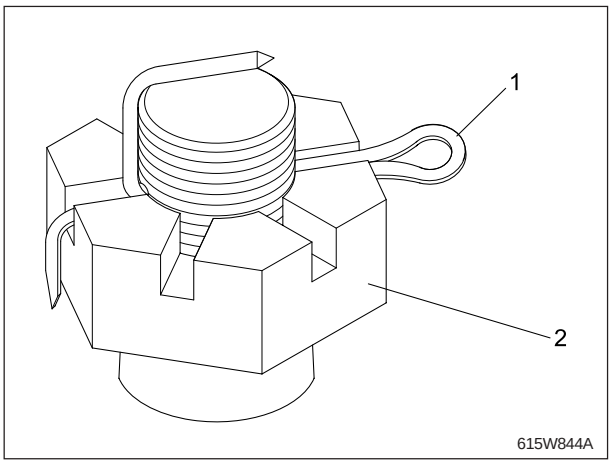
Sealing agent	Loctite #572 or equivalent

Connecting port and hose color	Assembly position
Steering hose assembly R (White)	Right steering cylinder
Steering hose assembly (yellow)	Left steering cylinder

b. Air Bleeding in Steering Hose

- After the engine has stopped, run engine at 2000 ~ 2200 rpm, turn steering wheel to the maximum in left and right and perform relief valve operation five or six times.
- Turn steering wheel to the maximum in left and right with 1200 ~ 1500 rpm, while relief valve beep occurred, disengage (about 1/4 rotation) hose tightening nut to allow air bleeding and then retighten nut.

Sect.	Spec.	Tightening torque
Steering cylinder hose tightening torque	PT 1/4	46.6 ~ 50.0 N·m 4.8 ~ 5.21 kgf·m 34.4 ~ 37.6 lbf·ft

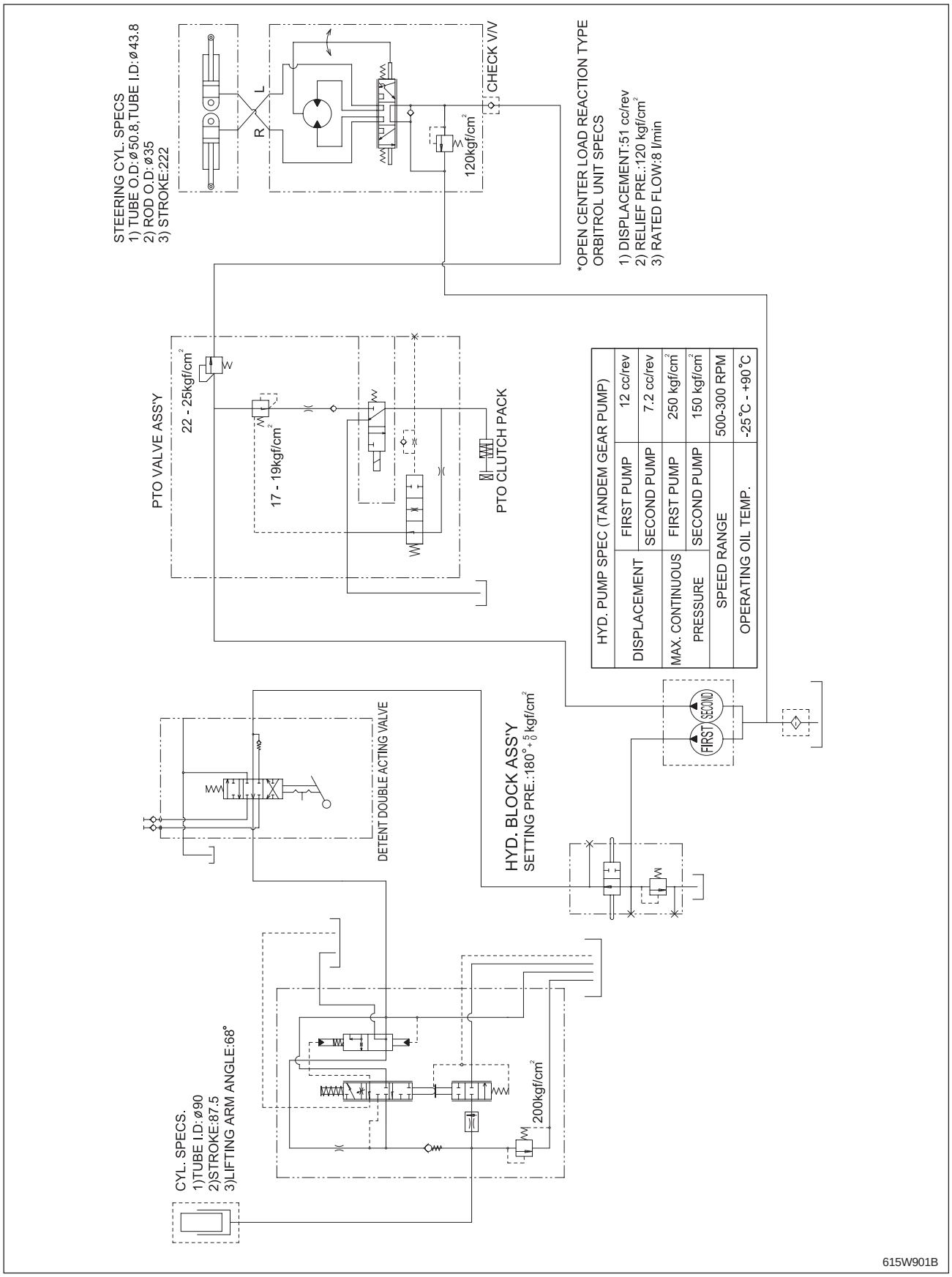


(1) Split Pin (2) Slotted Nut

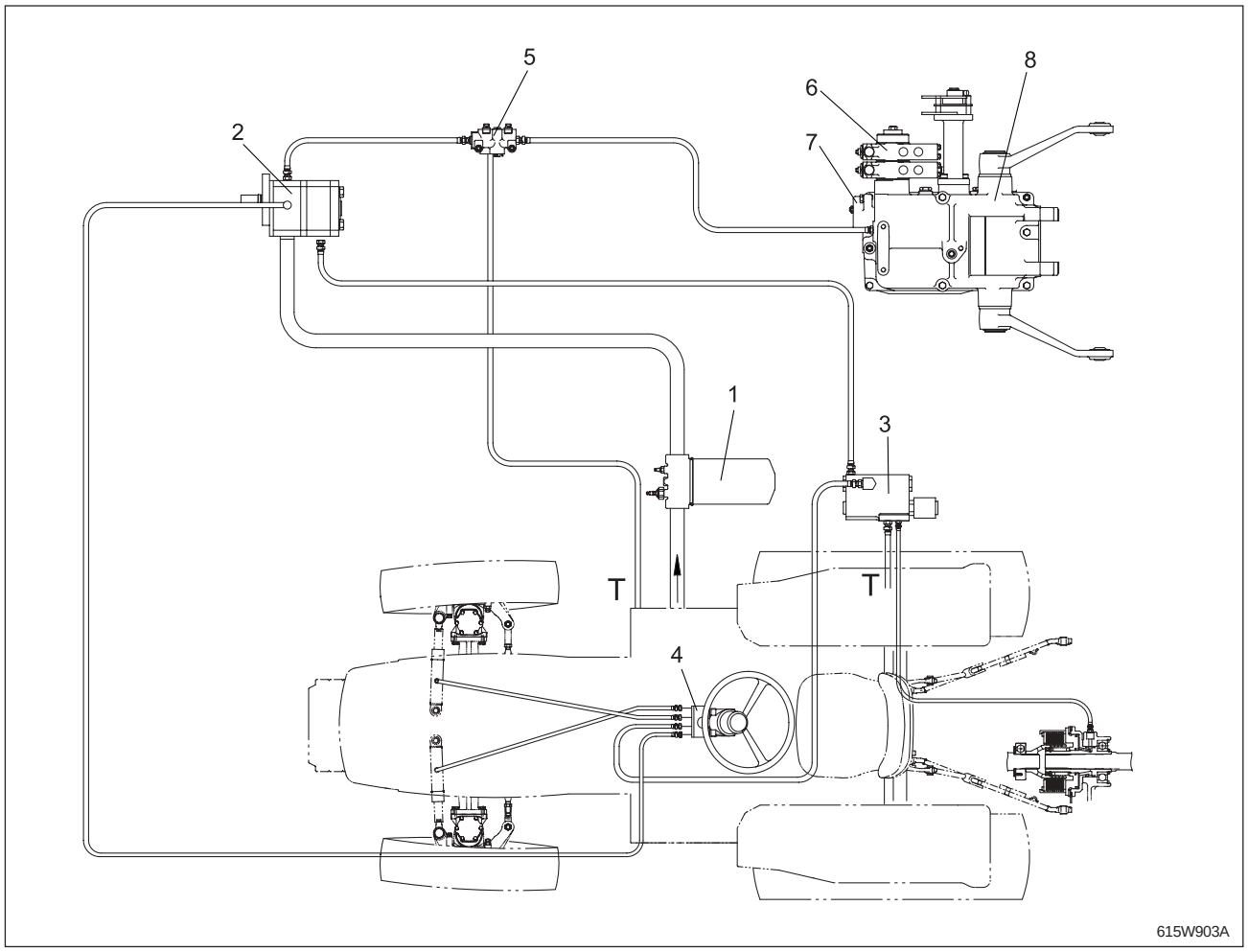
CHAPTER 9

HYDRAULIC SYSTEM

1. HYDRAULIC CIRCUIT DIAGRAM



2. STRUCTURE

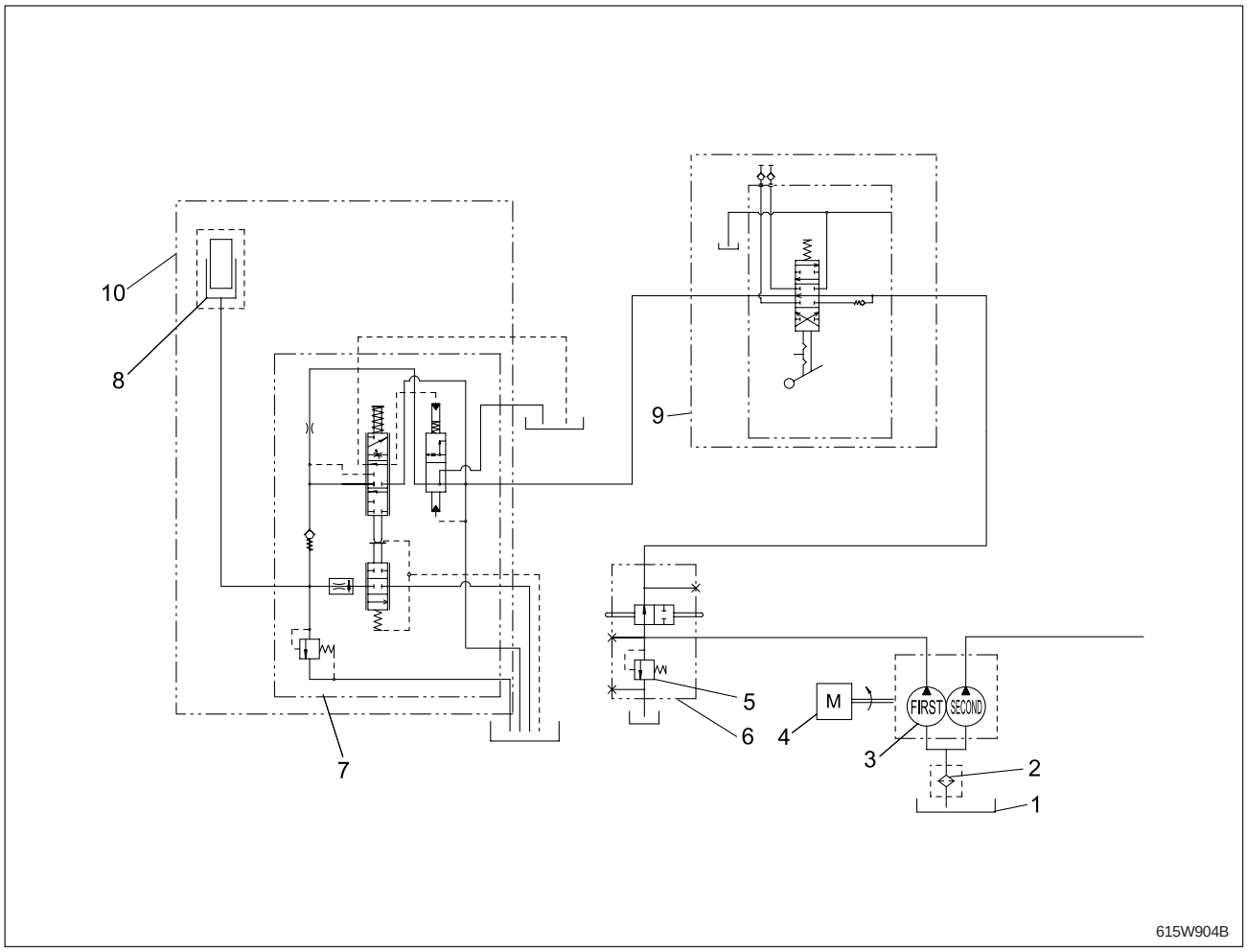


(1) Hydraulic Filter
(2) Hydraulic Pump
(3) Modulating Valve
(4) Power Steering Unit
(5) Hydraulic Block
(6) Aux. Control Valve
(7) MLS(Control) Valve
(8) Power Lift Assembly

The hydraulic system consists of major components as shown in the above figure. This system has the following three functions.

1. For elevating, and descending operation of working machine connected with 3-point hitch, three applicable controls (position control, Draft control and Mixed control) are provided by control valve and linkage installed at body of the hydraulic cylinder.
2. Hydraulic extraction of the hydraulic block for operation of hydraulic system in working machine.
3. For hydraulic working machine, hydraulic extraction through quick speed coupler installed with aux. control valve assembly.

3. HYDRAULIC CIRCUIT DIAGRAM OF 3-POINT HYDRAULIC SYSTEM



(1) Oil Tank (Transmission Case)
(2) Oil Filter
(3) Hydraulic Pump
(4) Engine
(5) Relief Valve
(6) Front Hydraulic Block
(7) Position Control Valve
(8) Hydraulic Cylinder
(9) Aux. Control Valve
(10) Hydraulic Cylinder Block

HYDRAULIC OIL FLOW

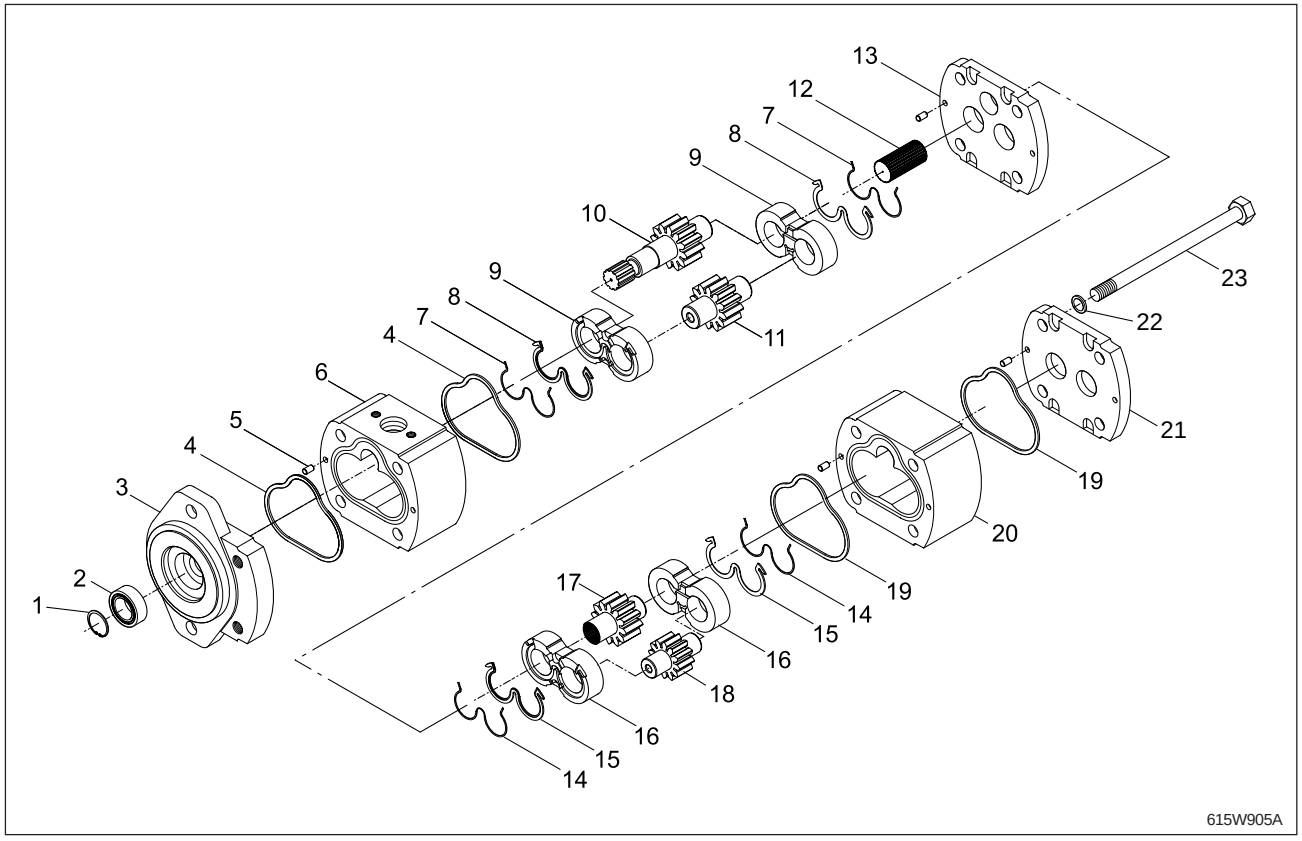
1. If the engine (4) is started and the hydraulic pump (3) is rotated, hydraulic pump intakes oil from transmission case (1) through intake pipe. Hydraulic pump is supplied with oil and oil sludge is removed by oil filter.
2. Oil passes through filter by hydraulic pump to hydraulic cylinder. If tractor installed with a front loader, oil pressure is extracted into front loader from hydraulic block, re-flown in hydraulic block, and then connected with hydraulic circuit.
3. Oil enters into position control valve through the distribution pipe.
4. The position control valve selects oil flow and oil enters the hydraulic cylinder or exhausts into oil tank (transmission case) to operate 3-point hydraulic system.

* Hydraulic system contains a relief valve to limit the max. pressure of the hydraulic circuit.

* To use hydraulic working machine, operate working machine cylinder using the double acting valve when extracting hydraulic pressure.

4. HYDRAULIC PUMP

4.1 STRUCTURE OF HYDRAULIC PUMP



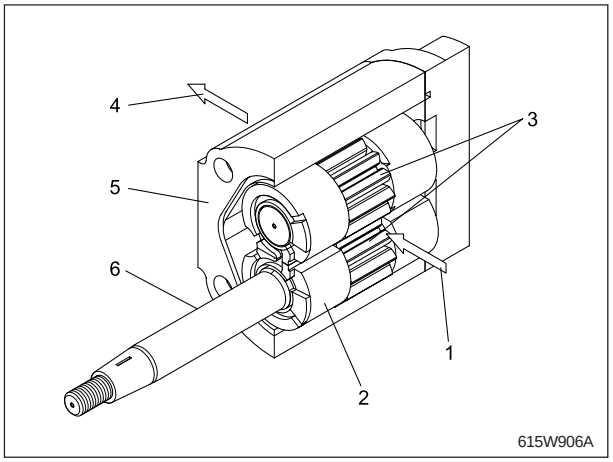
(1) Snap Ring
(2) Bearing
(3) Cover (Front)
(4) Seal Ring
(5) Pin
(6) 1st Pump
(7) Seal Ring
(8) Seal Ring
(9) Bushing
(10) Drive Gear Shaft 1
(11) Passive Gear 1
(12) Coupling
(13) Cover
(14) Seal Ring
(15) Seal Ring
(16) Bushing
(17) Drive Gear Shaft 2
(18) Passive Gear
(19) Seal Ring
(20) 2nd Pump
(21) Cover
(22) Spring Washer
(23) Bolt

4.2 OPERATION

A. The hydraulic pump provides constant oil flow to operate the steering wheel and hydraulic cylinder. The hydraulic assembly consists of two pumps having different displacements.

B. Two pumps operate equally and use a outside gear design to move the amount of fluid determined at each rotation and positive displacement.

C. Oil inflow and outflow continues while driving hydraulic pump from engine cam shaft, drive gear and rotating pump gear (3). When gear is disconnected, the vacuum will be made to enable oil inflow (1) to pump. As gear rotated, oil continues to flow.



(1) Inflow to Pump
(2) Bushing
(3) Gear
(4) Outflow From Pump
(5) Pump Housing
(6) Drive Shaft

5. OIL FILTER

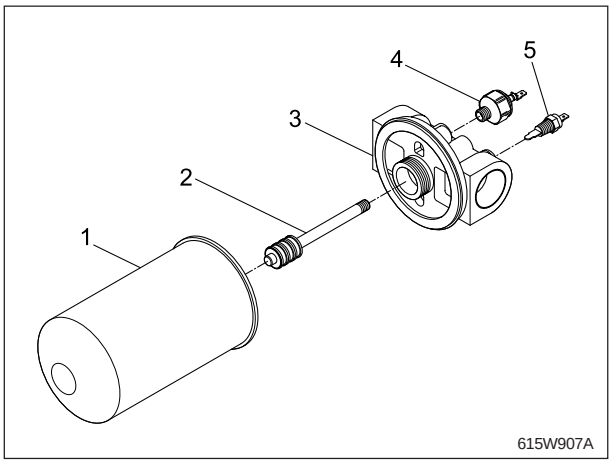
5.1 STRUCTURE OF OIL FILTER

A. Function

- Filters particle or sludge from oil.

B. Operation

- Oil filter consists of filter bracket, magnet assembly and element assembly as intake filter installed at intake side of gear pump.
- Filter used in M24 series is a hydraulic elevating and steering filter.
- Hydraulic filter, installed at the intake side of gear pump, is installed with a permanent magnet in the middle of elements, and attached with a vacuum sensor and temperature sensor to sense blockage.



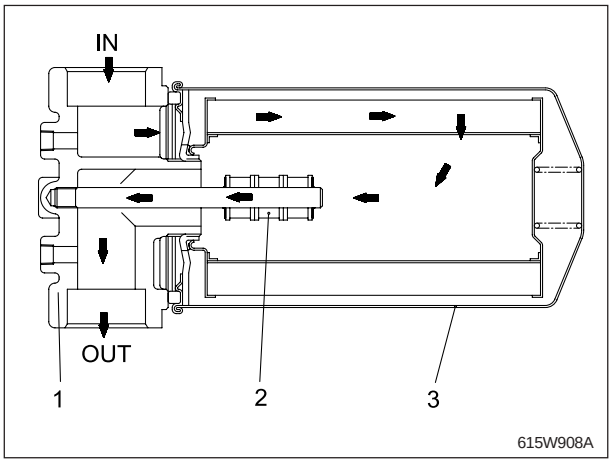
(1) Hydraulic Filter
(2) Magnet Assembly
(3) Filter Bracket
(4) Vacuum Sensor
(5) Temperature Sensor

5.2 FUNCTION AND OPERATION

- Hydraulic oil enters the IN port of filter bracket, where transmission oil entering the hydraulic element assembly (3) and flowing out to exhaust port through the element, and flows to hydraulic pump. This time, sludge is filtered at element. To sense filter clogged, it is attached with vacuum sensor and temperature sensor.
- Vacuum sensor is always set to OFF at less than 500 30 Hg and temperature sensor at less than 53. To operate transistor switch, two switches turned ON and oil filter warning light illuminated if temperature exceeding 53 and pressure exceeding 500 ± 30 Hg.

CHECK:

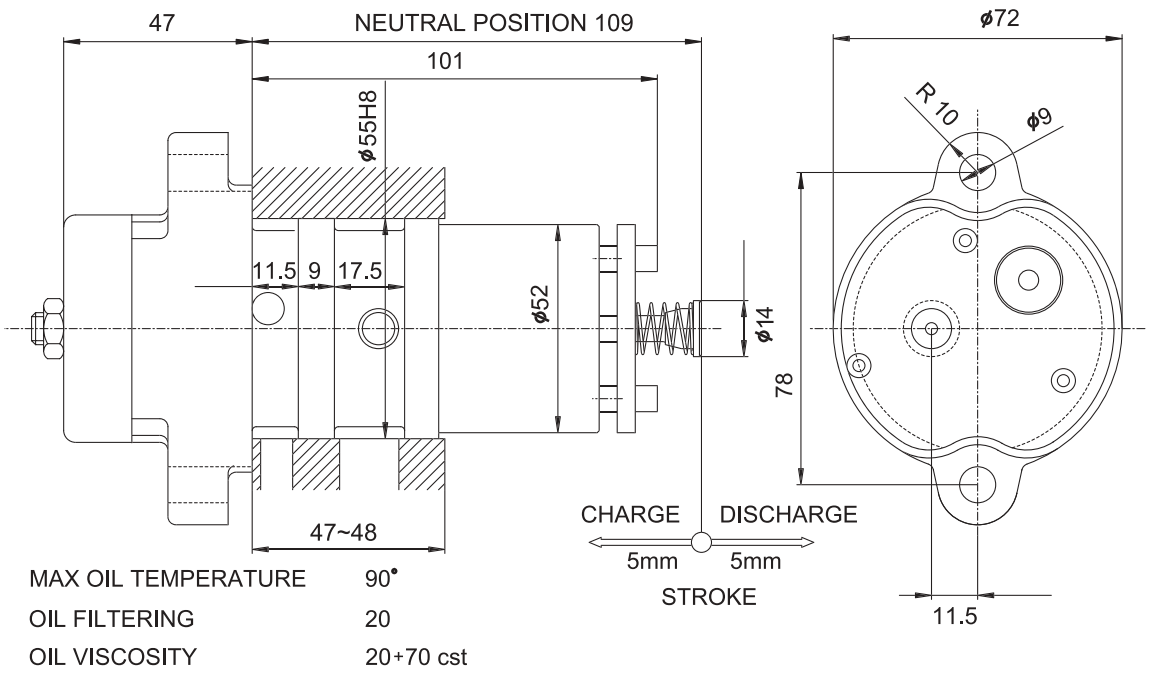
- *To prevent hydraulic filter damaged due to hydraulic system, always replace oil filter if filter warning light illuminated or whenever 200 hours used.*



(1) Filter Bracket
(2) Magnet Assembly
(3) Oil Filter

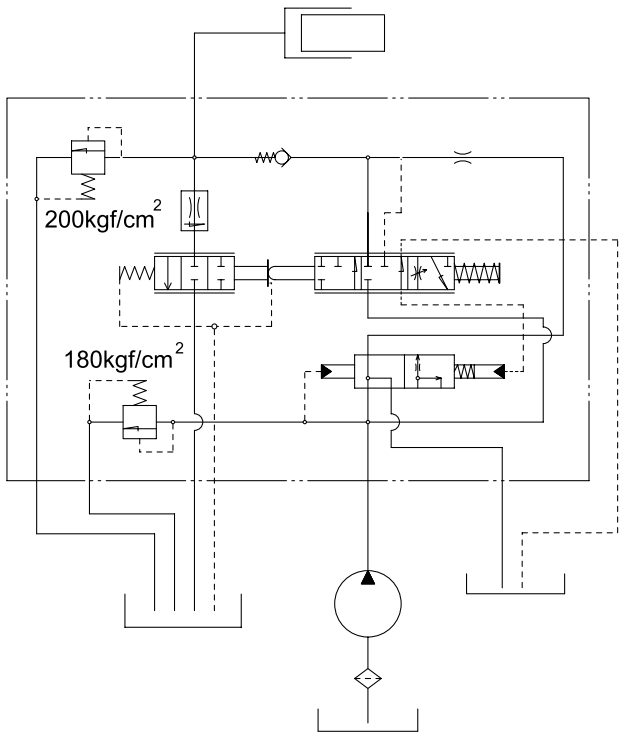
6. CONTROL VALVE (MLS VALVE)

6.1 STRUCTURE



615W909A

6.2 CIRCUIT DIAGRAM

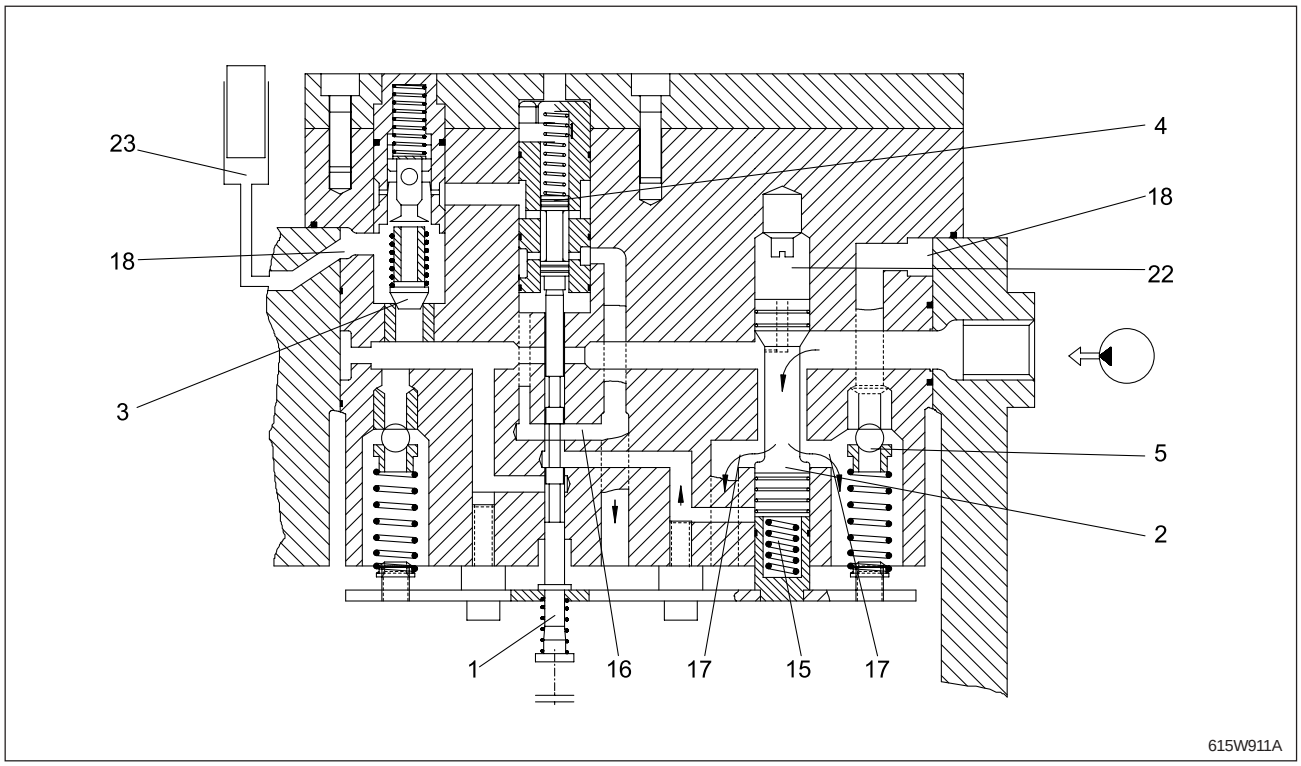


615W910A

6.3 OPERATION PRINCIPLE

- Since the control valve of the hydraulic cylinder is available to control oil flowing in and out of the hydraulic cylinder. It also controls the implement up and down at a constant speed regardless of the implement load. A high work performance can be achieved without impact, along with the operation principle classified into 3 phases of neutral, delivery and discharge.

A. Neutral Phase



(1) Control Spool
(2) Regulator Piston
(3) Check Valve
(4) Exhaust Valve
(5) Relief Valve
(15) Chamber
(16) Hole
(17) Hole
(18) Annular Duct
(22) Chamber
(23) Cylinder Chamber

In this phases the control valve keeps on pressure the oil contained in the cylinder thus allowing the oil coming from the pump to flow freely to the tank.

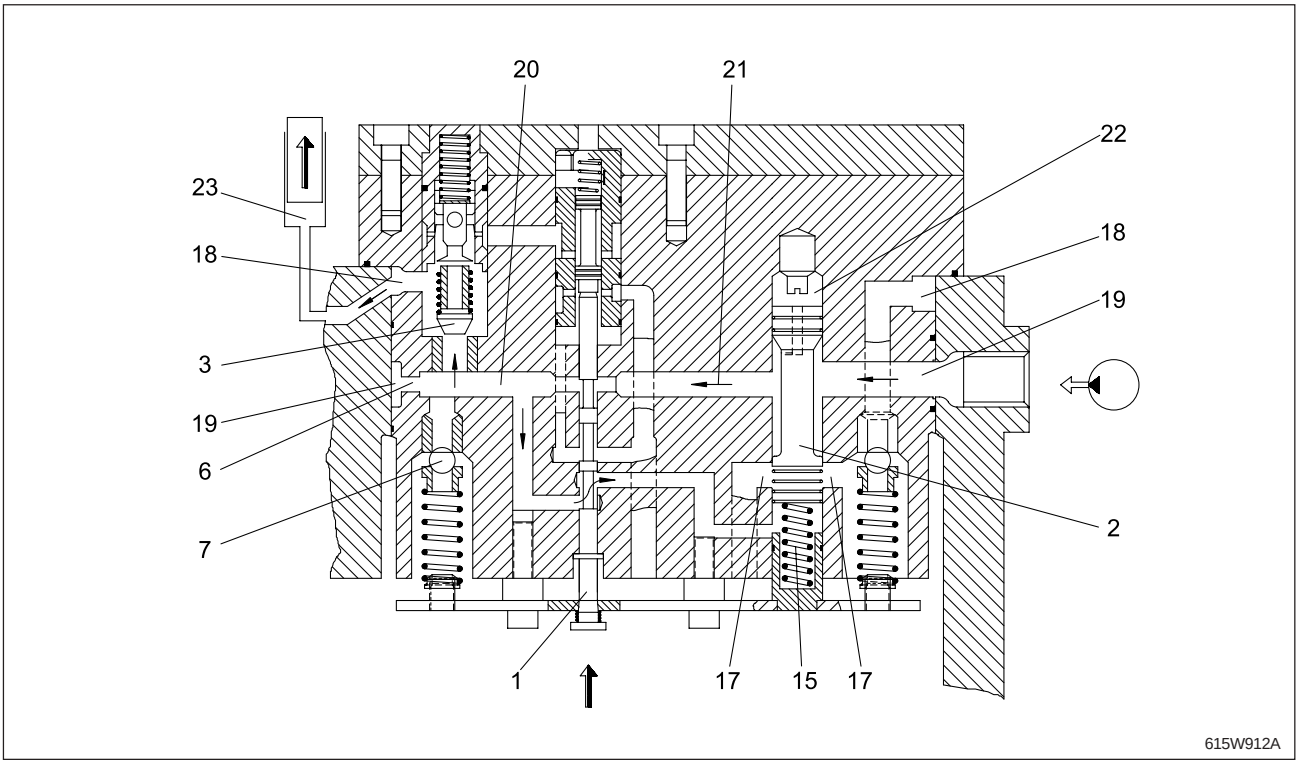
In this phase the control spool (1) is in such a position to connect the chamber (15) directly to the discharge through the hole (16).

The oil coming from the pump will thus be able to move downward through 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.

B. Delivery Phase



(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

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 the 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) closes discharge holes (17) due to the upward push of return spring.

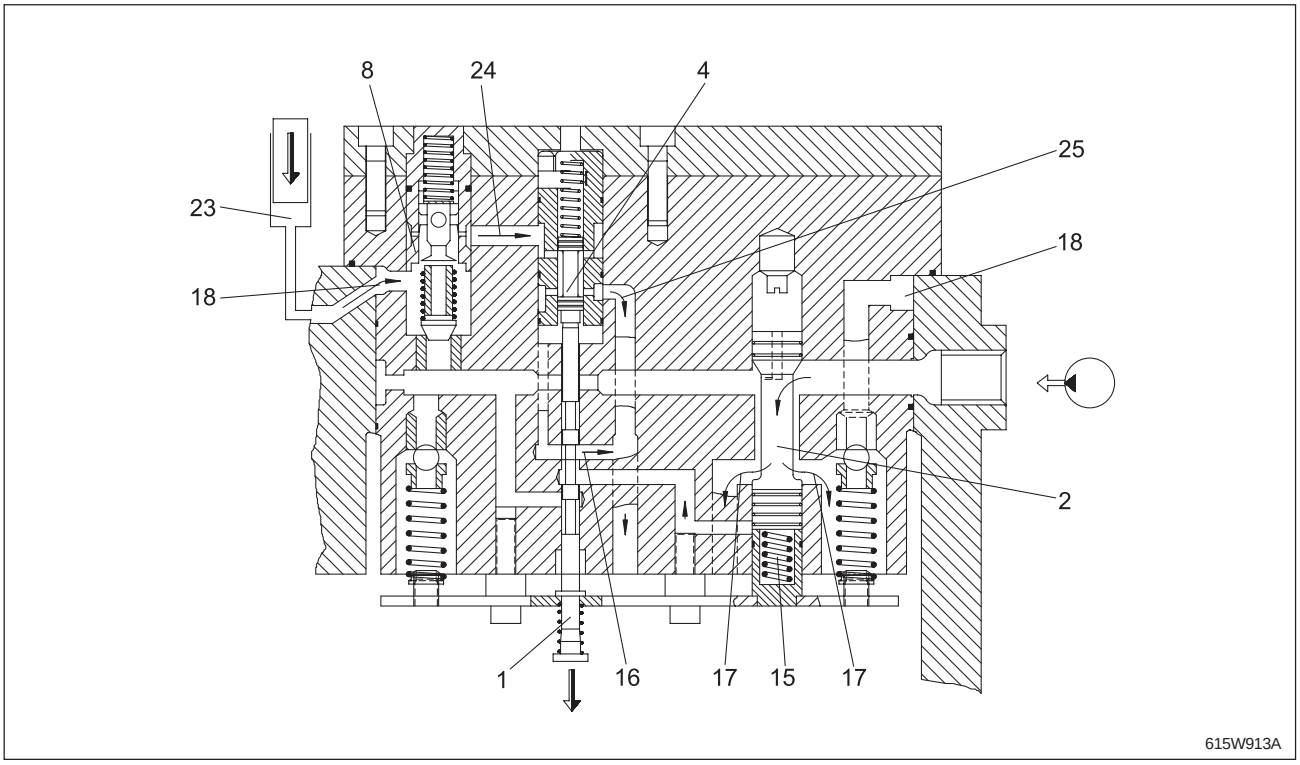
The oil on pressure flows to the cylinder through the annular duct (19), it enters the hole (20) through the fixed throat (6) and the variable throat made by the control spool (1) with the hole (21), it opens the check valve (3), it enters in annular duct (18) and flows into the cylinder chamber (23).

The small regulator piston (2) adjusts the oil flow to the cylinders 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 the 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).

C. Discharge Phase



(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

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).

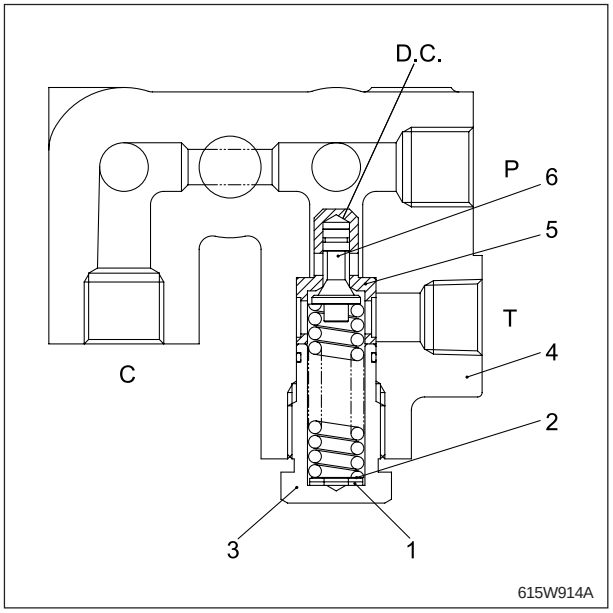
The oil coming from the pump, as in the neutral phase, is able to move downward the small regulator piston (2) and to flow to the discharge through holes (17).

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 phase 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.

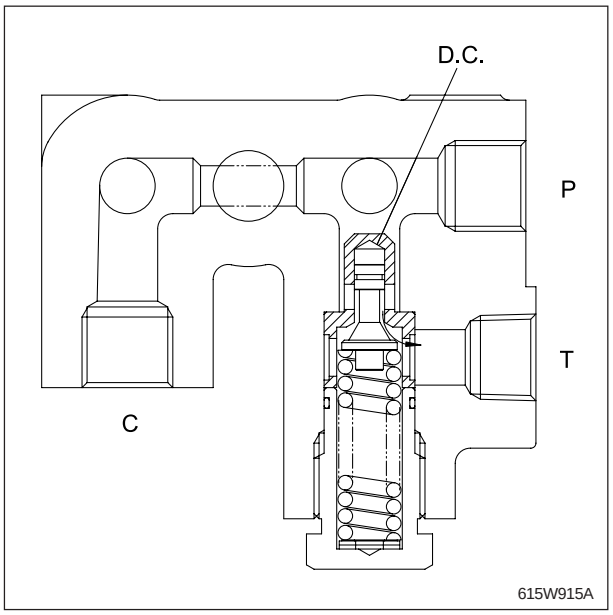
7. RELIEF VALVE (HYDRAULIC BLOCK)

- 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.

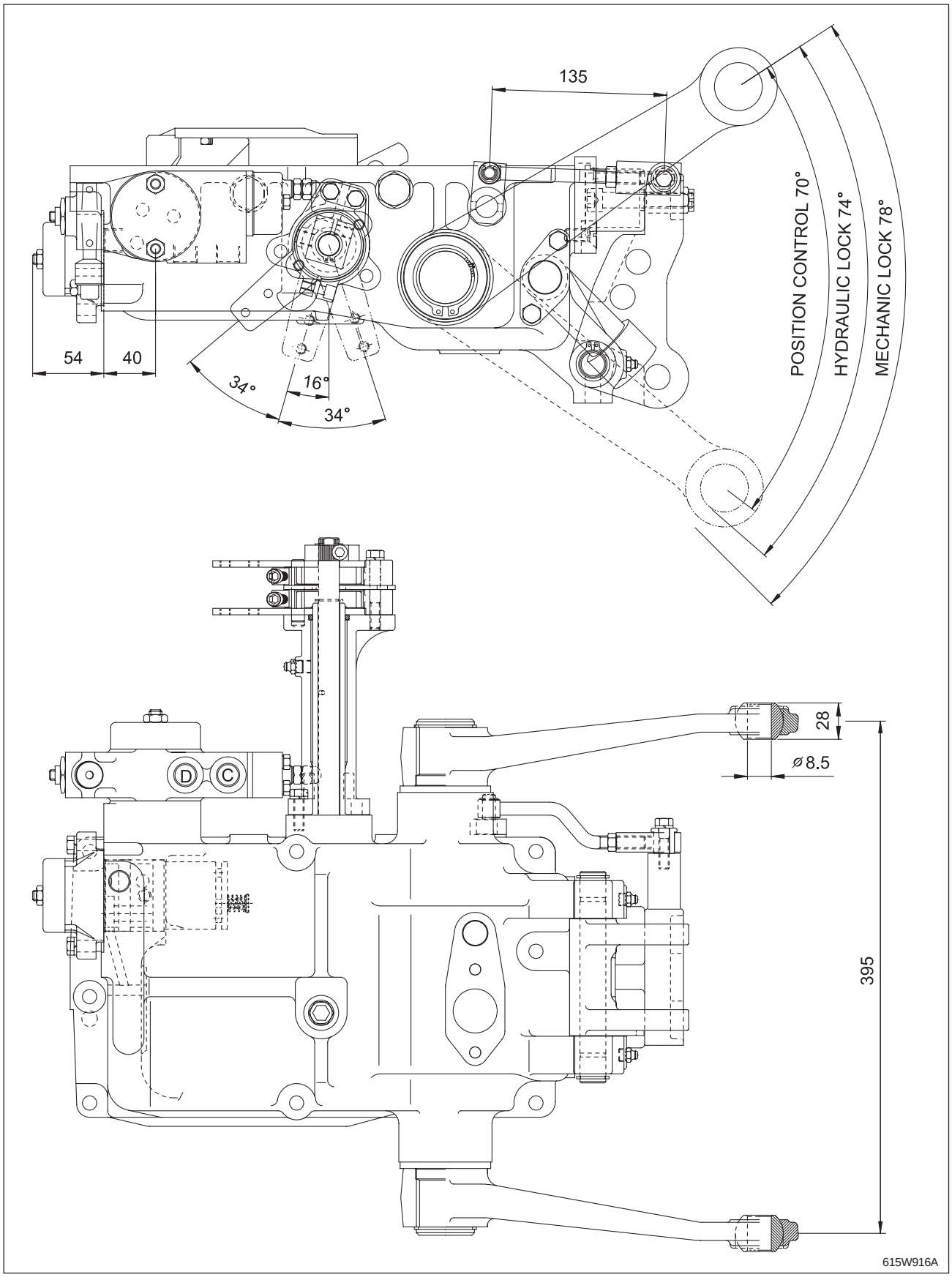


(1) Adjusting Shim
(2) Adjusting Shim
(3) Plug
(4) Hydraulic Block Body
(5) Seal
(6) Poppet

Relief valve setting pressure	16.2 ~ 17.2 Mpa 16.5 ~ 17.5 kgf/cm² 2.347 ~ 2.489 psi
Engine speed	Max.
Oil temperature	40 ~ 60 °C 104 ~ 140 °F

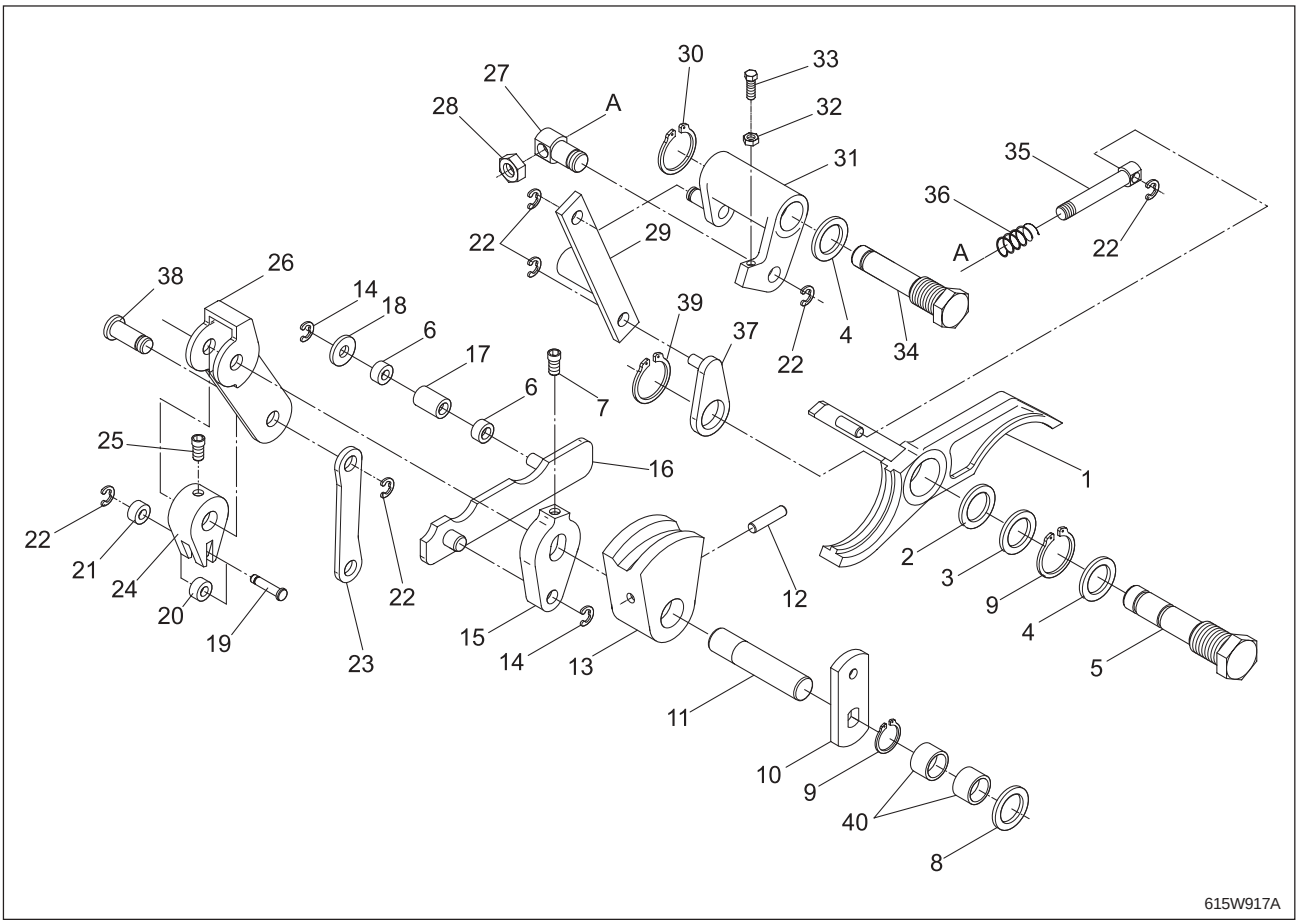


8. HYDRAULIC CYLINDER



9. STRUCTURE AND OPERATION

9.1 STRUCTURE

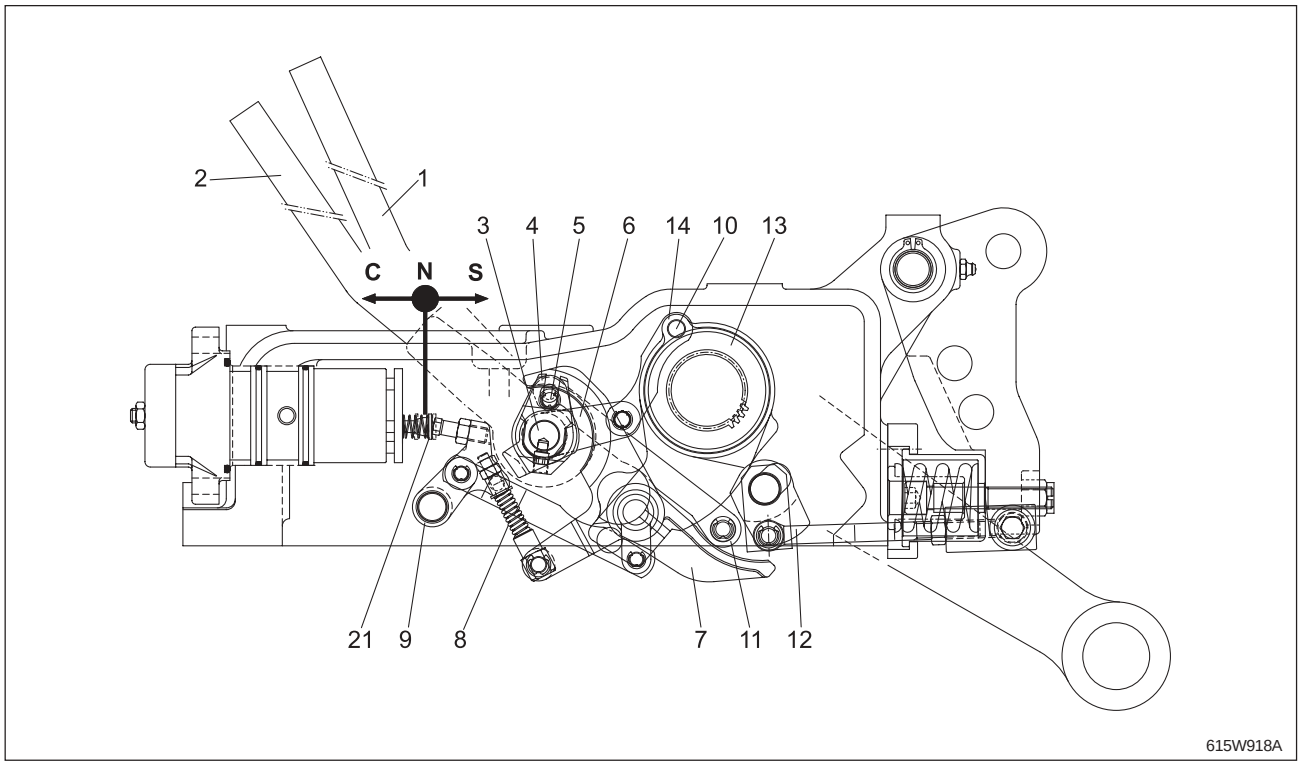


(1) Lever
(2) Needle Bearing
(3) Washer
(4) Packing
(5) Pin
(6) Roller 3
(7) Lock Screw
(8) Oil Seal
(9) Snap Ring
(10) Link 4
(11) Shaft
(12) Spring Pin
(13) Cam
(14) Snap Ring
(15) Link 1
(16) Link 2
(17) Roller 4
(18) Plain Washer
(19) Pin
(20) Roller 1
(21) Roller 2
(22) Snap Ring
(23) Link 3
(24) Arm
(25) Lock Screw
(26) Cam 1
(27) Pin
(28) Nut
(29) Link
(30) Snap Ring
(31) Arm
(32) Nut
(33) Bolt
(34) Pin
(35) Pin
(36) Spring
(37) Link
(38) Pin
(39) Snap Ring
(40) Bush

9.2 OPERATION

Operation is Divided Into Position Control, Draft Control and Mixed Operation.

A. Position Control



(1) Position Control Lever
(2) Draft Control Lever
(3) Shaft
(4) Arm
(5) Roller 1
(6) Cam 1
(7) Lever
(8) Friction Shock Absorber
(9) Arm
(10) Pin
(11) Roller 4
(12) Cam
(13) Crank
(14) Link 3
(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.

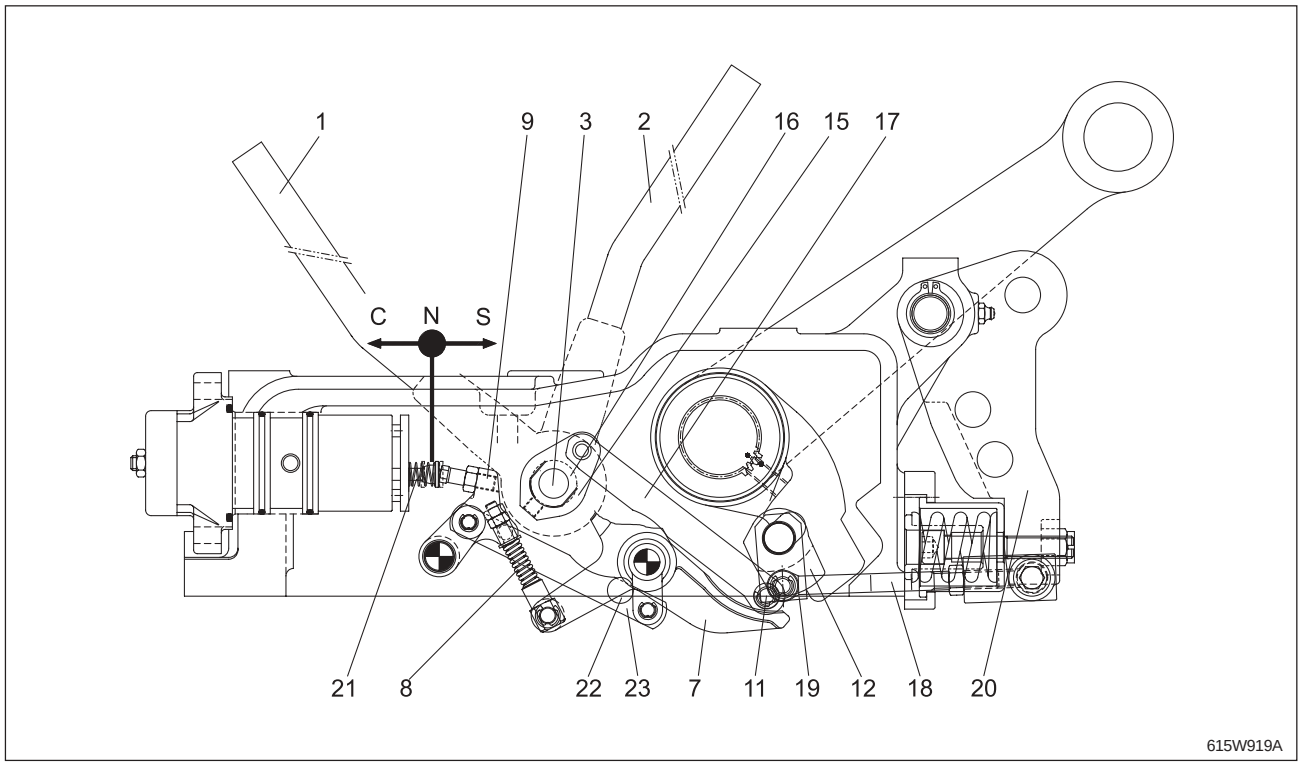
The arm (4) being an integral part of shaft (3) turns in a clockwise direction and causes the roller 1 (5) to slide on the positioning cam 1 (6), in turn causing the clockwise rotation of lever (7); the lever will transmit a counter-clockwise rotation, by means of friction shock absorber (8), to the 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. 225W918A,225W919A)



(1) Position Control Lever
(2) Draft Control Lever
(3) Shaft
(7) Lever
(8) Friction Shock Absorber
(9) Arm
(11) Roller 4
(12) Cam
(15) Crank
(16) Shaft
(17) Rod
(18) Tension Rod
(19) Fly Wheel
(20) Hitch Point
(21) Shaft
(22) Pin
(23) 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. 615W918A,615W919A)

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.

10. OUTSIDE HYDRAULIC EXTRACTION

10.1 HYDRAULIC BLOCK

A: To implement control valve “IN” port

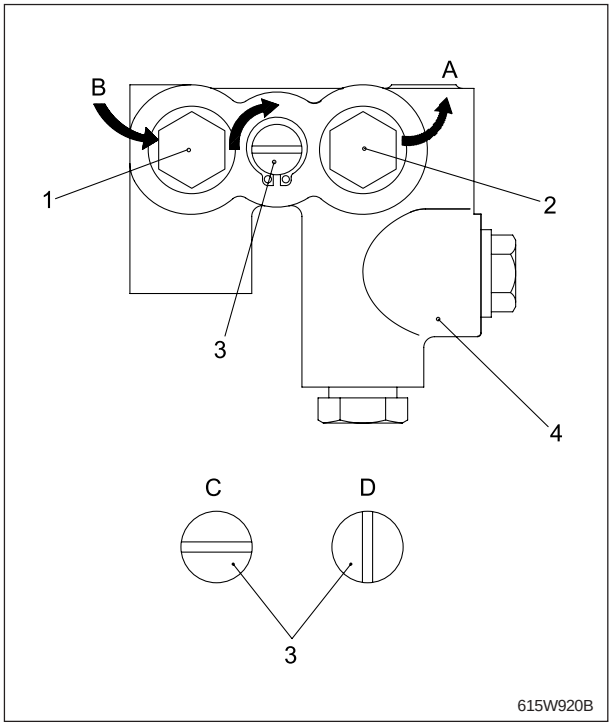
B: From implement control valve “TANK” port

C: Without attaching implement

D: With attaching implement

NOTE:

- *When an implement is not attached, turn the slit on the spool end to the horizontal position fully.*



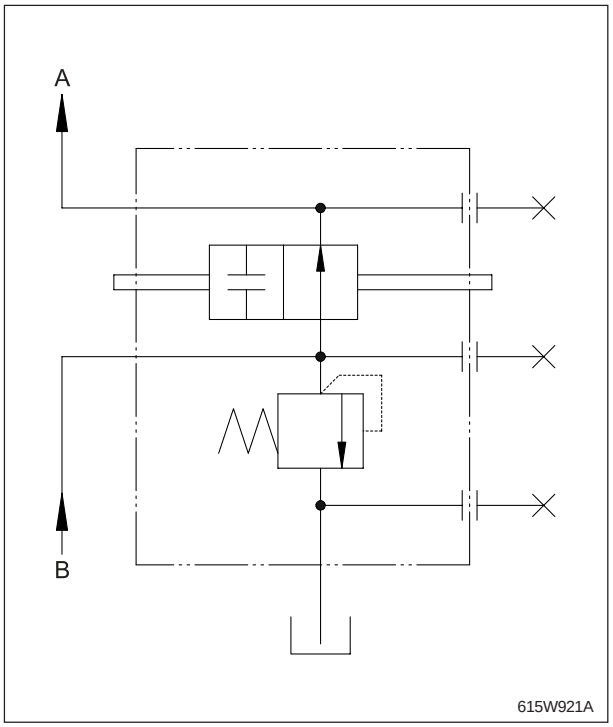
(1) Inflow Port

(2) Outflow Port

(3) Spool

(4) Hydraulic Block Body

- Remove the plugs from the OUT port (2) and IN port (1) of the front hydraulic block (4).
- Install the hydraulic take off adaptors (screw size PT 3/8″) to OUT port and IN port.
- Connect the hydraulic hose to the adaptor (OUT port side) and to the implement control valve IN port.
- Connect the other hydraulic hose to the adaptor (IN port side) an to the implement control valve TANK (RETURN) port.
- Turn the slit on the spool (3) end to the arrow side fully as shown in the figure.



[A] To the Remote Valves

[B] From the Pump

10.2 ACTING VALVE

A. Operation principle

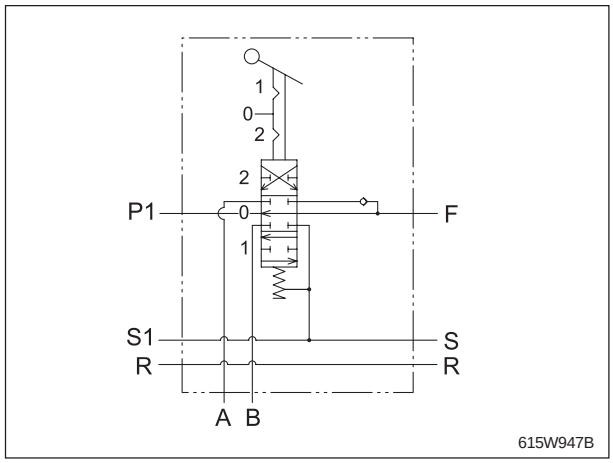
A double acting detent type auxiliary control valve is used, and the construction is shown in the figure right.

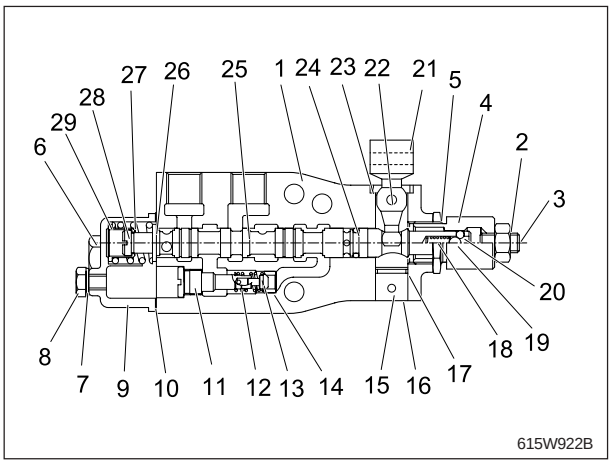
When the auxiliary control valve operating lever is moved to the implement cylinder actuating position, the spool is moved and the oil from the pump port flows into A to B, causing the implement cylinder to operate.

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.

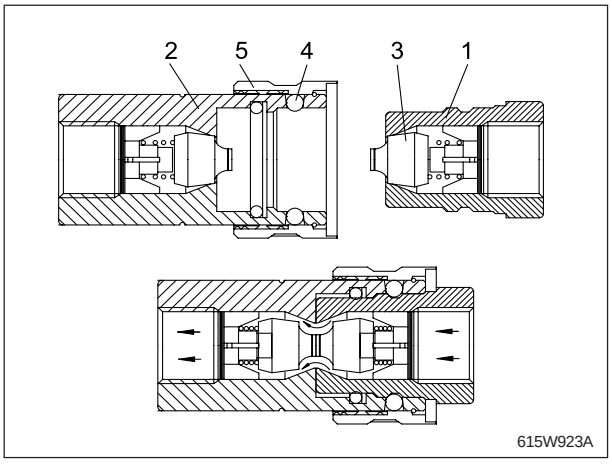
B. Circuit diagram





(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

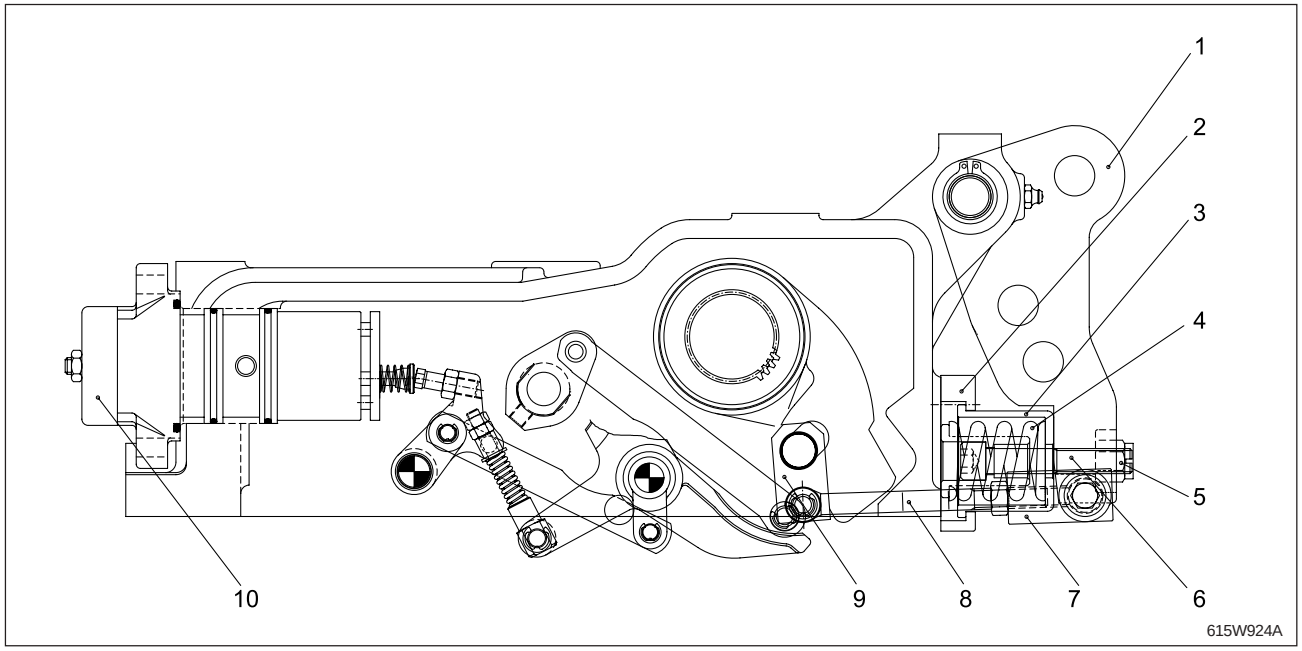
10.3 QUICK COUPLER



(1) Coupler Socket (Male)
(2) Coupler Socket (Female)
(3) Pocket
(4) Ball
(5) Sleeve

11. TOP LINK BRACKET DEVICE

11.1 STRUCTURE



(1) Top Link Holder
(2) Flange
(3) Cover
(4) Spring
(5) Nut
(6) Hex. Bolt
(7) Plate
(8) Crank
(9) Tie Rod
(10) MLS (Control) Valve

11.2 OPERATION

If shock is applied to the implement, it will be absorbed by cover (3), spring (4), and top link and connected to linkage by plate (7) and tie rod (9) to elevate the implement.

This time, the oil flow passage will be changed by linkage in the MLS valve.

12. TROUBLESHOOTING

Trouble	Probable Cause	Remedy
Hydraulic cylinder rises irregularly	* Lack in tank (mission case) oil * Intake filter clogged * Intake line mixed with air	Fill in oil to adequate level. Clean or replace filter. Check intake pipe, O-ring, and bolt for looseness.
Hydraulic cylinder doesn't	* Sticking of control position	Disassemble MLS valve
Elevating arm is positioned at STOP and there is periodic vibration with motor ON: load not decreased with motor OFF.	* Limit switch control of position lever faulty	Adjust control position and limit the operation range of upper part.
When working in the adjusted draft stage, working machine responds too sensitively.	* MLS valve sensitivity control faulty	Adjust sensitivity.
Adjusted draft doesn't operate and hydraulic cylinder moves up and down as the operation of position lever.	* Draft control lever faulty	Adjust draft control.
Adjusted position doesn't operate and hydraulic cylinder moves up and down	* Position lever control faultily * Inside connection control faulty	Adjust position lever. Disassemble hydraulic cylinder.
Hydraulic cylinder starts to rise but stops as soon as load applied (Relief valve not obstructed).	* Power transmission tie rod (7) faulty	Adjust draft control.
Hydraulic cylinder not fallen in entire range.	* Position lever control faulty * Sensitivity control faulty	Adjust position lever. Adjust sensitivity.
Hydraulic cylinder not fallen.	* Sticking of OUTLET valve	Disassemble MLS valve and clean OUTLET valve.
Rising capacity not conform with specification	* Poor sealing of MLS valve * Relief valve and safety valve control faulty * Bad pump efficiency * Bad efficiency of MLS valve	Disassemble MLS valve and clean OUTLET value. Disassemble MLS valve and replace inside seal ring.
Hydraulic cylinder supports the load, but there is vibration periodically: load decreased with motor OFF.	* Piston gasket worn * Valve sensitivity faulty * Relief valve faulty * Down preventative valve faulty valve.	Replace gasket. Adjust sensitivity or replace valve. Disassemble and replace MLS valve.

13. MAINTENANCE SPECIFICATION

13.1 3-POINT SYSTEM HYDRAULIC PUMP

Condition and Point	Applicable Model and Item	Reference Dimension	Allowable Limit
Hydraulic pump condition * Engine speed (2700 rpm) * Pressure 16.0 ~ 17.2 Mpa 165 ~ 175 kgf·m/cm² 2347 ~ 2489 psi * Oil temp. 40 ~ 60°C 104 ~ 140°F	8354 8404	 29.7 l/m 7.85 U.S.gal/min	
Housing	Depth of scratch		0.09 mm 0.035 in.
Relationship between gear shaft and bush	Clearance	0.11 mm 0.0043 in.	0.12 mm 0.0047 in.
Bush	Length	25.0 mm 0.984 in.	25.75 mm 1.014 in.

13.2 RELIEF VALVE

Item	Reference Dimension	Allowable Limit
Relief valve condition Engine speed: Max Oil temp. 40 ~ 60 °C (104 ~ 140 °F)	Setting pressure	16.2 ~ 17.2 Mpa 165 ~ 175 kgf/cm² 2347 ~ 2379 Psi

13.3 LINK CONTROL

Item	Reference Dimension	Allowable Limit
Lift arm	Free clearance (Max. Rising Position)	2 ~ 10 mm 0.0787 ~ 0.3937 in.

13.4 HYDRAULIC CYLINDER

Item		Reference Dimension	Allowable Limit
Cylinder bore I.D.		90.000 ~ 90.100 mm 3.5433 ~ 3.5472 in.	90.150 mm 3.5492 in.
Relationship between hydraulic are Shaft and bush Clearance	Right	0.125 ~ 1.230 mm 0.00492 ~ 0.00906 in.	0.50 mm 0.0197 in.
	Left	0.125 ~ 0.220 mm 0.00492 ~ 0.00866 in.	0.50 mm 0.0197 in.
Hydraulic arm shaft O.D.	Right	49.970 ~ 49.940 mm 1.96732 ~ 1.96614 in.	
	Left	44.975 ~ 44.950 mm 1.77066 ~ 1.76968 in.	
Bush I.D.	Right	50.075 ~ 50.115 mm 1.97145 ~ 1.97303 in.	
	Left	45.075 ~ 45.115 mm 1.77460 ~ 1.77618 in.	

14. TIGHTENING TORQUE

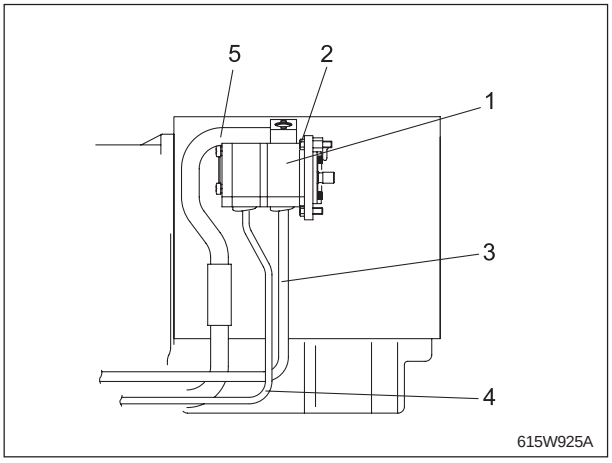
Item	N·m	Kgf·m	lbf·ft
Hydraulic pipe joint bolt	49.0 ~ 58.8	5.0 ~ 6.0	36.2 ~ 43.4
Hydraulic pipe attaching bolt (M10)	48.1 ~ 55.8	4.9 ~ 5.7	35.5 ~ 41.2
Hydraulic block support attaching bolt (M8)	23.6 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2
Hydraulic pipe attaching bolt (M8)	23.6 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2
Intake pipe 3 attaching bolt (M8)	23.6 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2
Filter support attaching bolt (M10)	48.1 ~ 55.8	4.9 ~ 5.7	35.5 ~ 41.2
Hydraulic pump assembly attaching bolt	48.1 ~ 55.8	4.9 ~ 5.7	35.5 ~ 41.2
Rear axle attaching stud	98.1 ~ 112.7	10.0 ~ 11.5	72.3 ~ 83.1
Rear axle attaching bolt, nut	197 ~ 226	20 ~ 23	145 ~ 166
ROPS attaching bolt			
M12	77.5 ~ 90.2	7.9 ~ 9.2	57.1 ~ 66.5
M14	166.7 ~ 196.1	17.0 ~ 20.0	123 ~ 144
M16	260.9 ~ 304.0	26.6 ~ 31.0	192 ~ 224
M20	490 ~ 568	50.0 ~ 58	362 ~ 420
Hydraulic cylinder assembly attaching stud (M10)	48.1 ~ 55.8	4.9 ~ 5.7	35.5 ~ 41.2
Hydraulic cylinder attaching bolt, nut (M10)	48.1 ~ 55.8	4.9 ~ 5.7	35.5 ~ 41.2
MLS (Control) valve attaching bolt (M10)	48.1 ~ 55.8	4.9 ~ 5.7	35.5 ~ 41.2

15. DISASSEMBLY, ASSEMBLY

15.1 GEAR PUMP

A. Disconnection of Gear Pump Assembly

1. Disassemble hydraulic pipe (3, 4) and intake pipe (5) assembled into gear pump (1).
2. Disassemble bolt (2).
3. Detach gear pump (1).

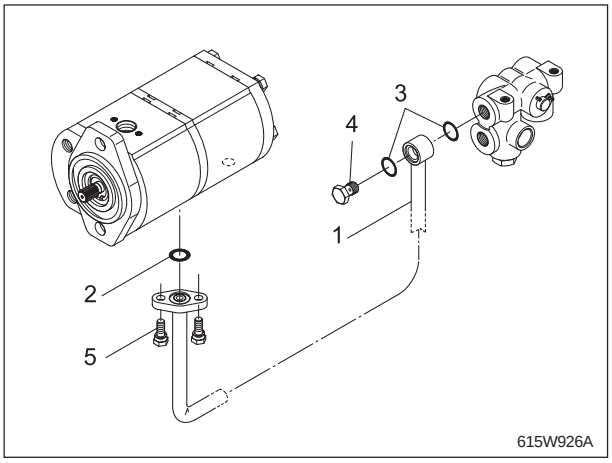


(1) Gear Pump
(2) Bolt
(3) Hydraulic Pipe
(4) Hydraulic Pipe
(5) Suction Pipe

(When reassembling)

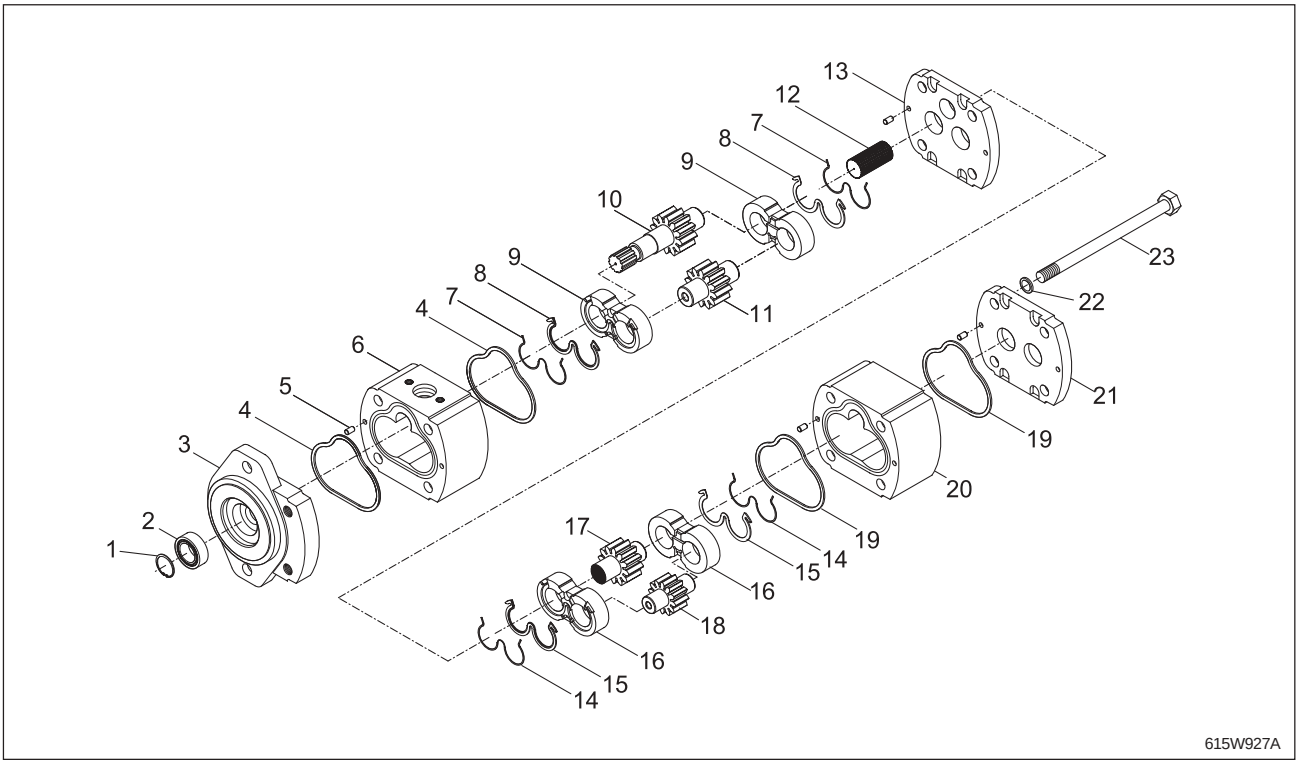
* Apply O-ring with grease to prevent damage.

Tightening torque	Hydraulic pipe 1 attaching bolt (M8*1.25)	23.6 ~ 27.4 N·m 2.4 ~ 2.8 kgf/m 17.4 ~ 20.2 lbf·ft
	Hydraulic pipe 1 attaching bolt joint bolt (18*1.25)	49.0 ~ 58.8 N·m 5.0 ~ 6.0 kgf·m 36.2 ~ 43.4 lbf·ft



(1) Hydraulic Pipe 1
(2) O-Ring
(3) O-Ring
(4) Joint Bolt
(5) Bolt

B. Disassembly and Assembly of Gear Pump



(1) Snap Ring
(2) Bearing
(3) Cover (Front)
(4) Seal Ring
(5) Pin
(6) 1st Pump
(7) Seal Ring
(8) Seal Ring
(9) Bushing
(10) Drive Gear Shaft 1
(11) Passive Gear 1
(12) Coupling
(13) Cover
(14) Seal Ring
(15) Seal Ring
(16) Bushing
(17) Drive Gear Shaft 2
(18) Passive Gear
(19) Seal Ring
(20) 2nd Pump
(21) Cover
(22) Spring Washer
(23) Bolt

1. Place the gear pump assembly into a vice.
2. Loosen blot (23) 4-point and disassemble rear cover (21).
3. Disassemble snap ring (1) and bearing (2) from the drive shaft.
4. Disassemble Second pump (2) and then bushing (16), sealing (14, 15), O-ring (10), drive gear shaft 2 (17) and driven motion gear (18).
5. Disassemble cover (13) and coupling (12).
6. Disassemble First pump (6) and then bushing (9), sealing (7, 8), O-ring (4), drive gear shaft 1 (10) and driven motion gear (11).
7. Disassemble oil seal attached to cover (front) (3).

CAUTION

- *If oil seal is cracked or aged, replace it with a new part.*
- *If the seal ring is damaged, replace it with a new one.*
- *Make sure the assembly direction of seal ring is correct.*

(When reassembling)

- Assemble the drive gear as in the original direction.
- When assembling bush (9, 16), reassemble each in the original position.
- Make sure seal ring and O-ring are not damaged.
- After reassembling hydraulic pump assembly, install long arm of about 100 mm (3.39 in.) to verify soft rotation.

Hydraulic Pump Trial Operation

After assembly, perform a trial operation as follows and check the pump for normal operation. If pump temperature is raised excessively, perform an inspection again.

1. Assemble the hydraulic pump into tractor and tighten the intake pipe and hydraulic pipe.
2. Set the engine speed to between 1300 and 1500 rpm and run hydraulic pump for 10 minutes without load.
3. Set the engine speed to between 2000 and 2200 rpm and run the hydraulic pump for about 15 minutes under the pressure between 30 and 50 kgf/cm^2.
4. Set engine to max. speed and then run relief valve five times for 25 seconds (once per 5 seconds).

15.2 MAINTENANCE

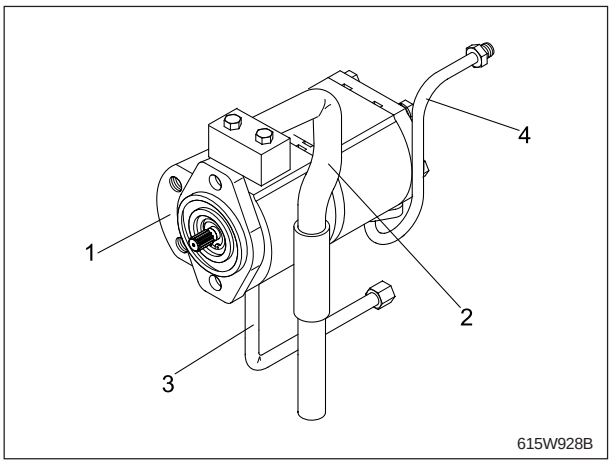
Housing Bore (Depth of Scratch)

1. Check if scratch occurred by gear in the surface of housing.
2. If scratched more than half of inside housing surface, the replace pump assembly.
3. Measure housing I.D. of inside surface without scratch and measure housing I.D. with scratch.
4. If the value obtained from both measurements exceeds the allowable limit, replace the hydraulic pump.

(Ref.)

Use cylinder gauge to measure housing I.D.

Depth of Scratch	Allowable Limit	0.09 mm 0.0035 in.



(1) Gear Pump
(2) Suction Pipe
(3) Hydraulic pipe
(4) hydraulic pipe

15.3 RELIEF VALVE

A. DISASSEMBLY, ASSEMBLY

a. Relief Valve Disassembly

1. Disengage plug (1) and pull out spring (5) and poppet (6).
2. Pull out valve seat (7).

(When reassembling)

Make sure the O-ring is not damaged.

Tightening torque	Relief valve	49.0 ~ 68.6 N·m 5.0 ~ 7.0 kgf·m 36.2 ~ 5.06 lbf·ft

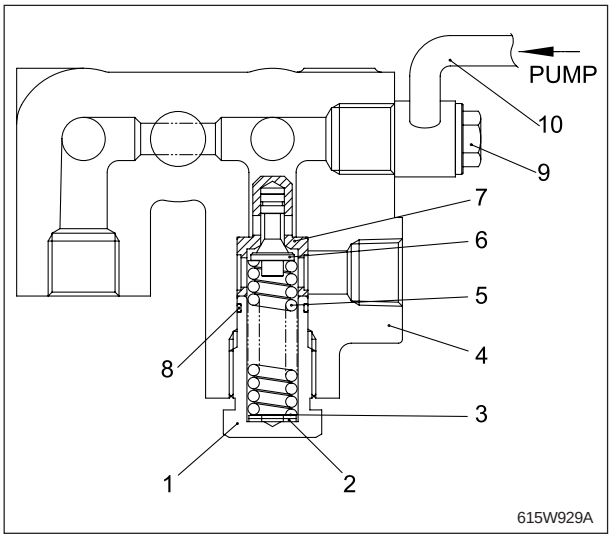
IMPORTANT:

- *After disassembling or assembling the relief valve, always adjust the setting pressure of the relief valve.*

1. Disengage joint bolt (9) and install the pressure gauge.
2. Start the engine and set it to max. speed.
3. Until relief valve is operated, move position lever and read gage.
4. If the pressure is out of reference, disengage the plug of hydraulic block (7) and adjust the adjusting shim.

[See figure]

Relief valve setting pressure	Reference pressure	16.2 ~ 17.2 Mpa 165 ~ 176 kgf cm^2 2347 ~ 2489 psi

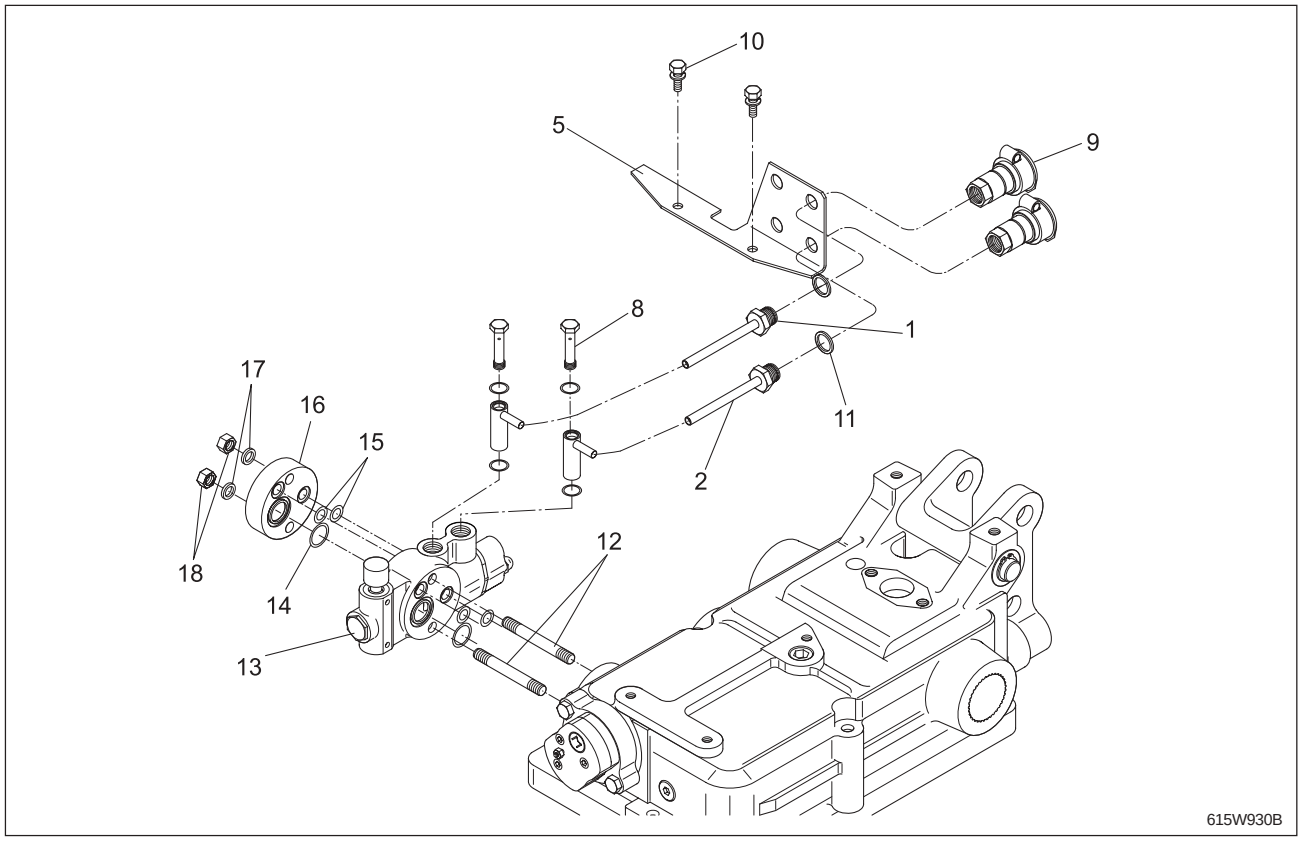


(1) Plug
(2) Adjusting Shim
(3) Adjusting Shim
(4) Hydraulic Block Body
(5) Spring
(6) Poppet
(7) Valve Seat
(8) O-Ring
(9) Joint Bolt
(10) Hydraulic Pipe

15.4 HYDRAULIC CYLINDER

A. DISASSEMBLY, ASSEMBLY

a. Pipe, Aux. Control Valve (If Attached)



(1) Pipe A
(2) Pipe B
(5) Bracket
(6) O-Ring
(8) Joint Bolt 2
(9) Quick Coupler
(10) Bolt
(11) Seal Washer
(12) Stud
(13) Double-Acting Valve
(14) O-Ring
(15) O-Ring
(16) Flange
(17) Washer
(18) Nut

1. Disengage joint bolt 2 (8) and detach the hydraulic pipe (1), (2) bracket (5), and quick coupler entirely.
2. Disengage nut (18) and washer (17) from aux. control valve and then detach aux. control valve from the power lift body.

(When reassembling)

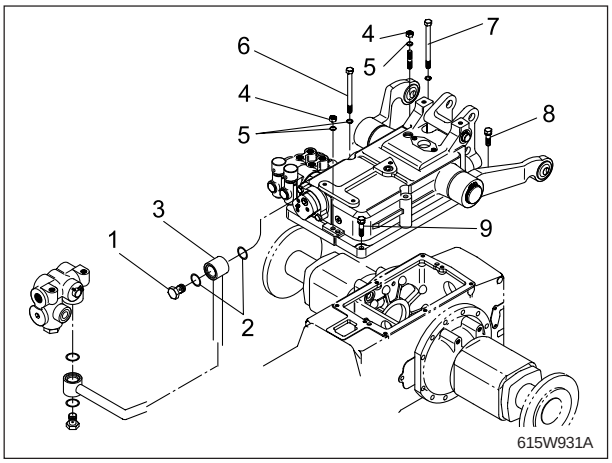
- Make sure the O-ring is not damage.

b. Hydraulic Cylinder Assembly

1. Disengage joint bolt (1).
2. Disengage the hydraulic cylinder assembly mounting bolts [(6), (7), (8), (9)], spring washer (5) and nut (4).
3. Raise and then detach the hydraulic cylinder assembly with a nylon rope supported.

(When reassembling)

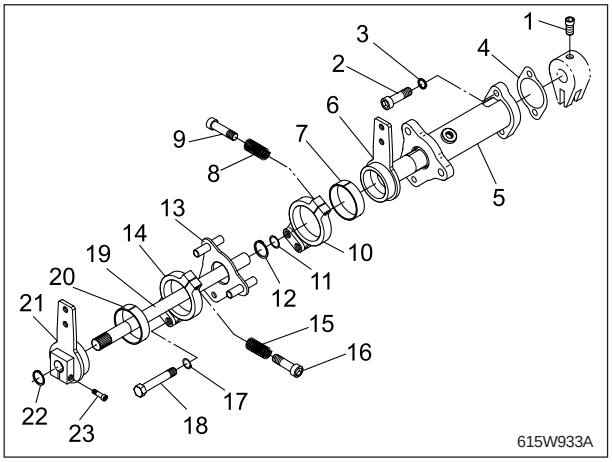
Tightening torque	Hydraulic cylinder attaching bolt, nut	48.1 ~ 55.8 N·m 4.9 ~ 5.7 kgf·m 35.5 ~ 41.2 lbf·ft



(1) Joint Bolt
(2) O-Ring
(3) Hydraulic Pipe 2
(4) Nut
(5) Spring Washer
(6) Bolt
(7) Bolt
(8) Bolt
(9) Bolt

c. Hydraulic Control Lever

1. Disengage screw (1) assembled into cylinder assembly inside link.
2. Disengage bolt (2) and remove relevant parts entirely.



(1) Screw
(2) Bolt
(3) Lock Washer
(4) Gasket
(5) Support
(6) Pitman Arm
(7) Clutch
(8) Spring
(9) Bolt
(10) Clutch Hub
(11) O-Ring
(12) Snap Ring
(13) Flange
(14) Clutch Hub
(15) Spring
(16) Bolt
(17) Lock Washer
(18) Bolt
(19) Shaft
(20) Clutch
(21) Control Lever
(22) Snap Ring
(23) Screw

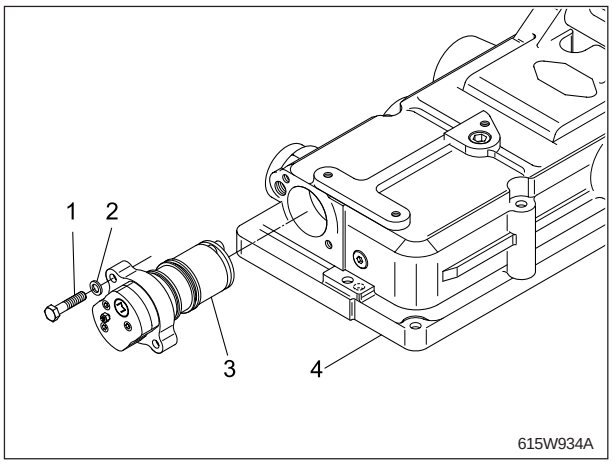
d. Control Valve

1. Disengage the control valve attaching bolt (1).
2. Detach control valve (3) carefully.

(When reassembling)

Make sure O-ring not damage.

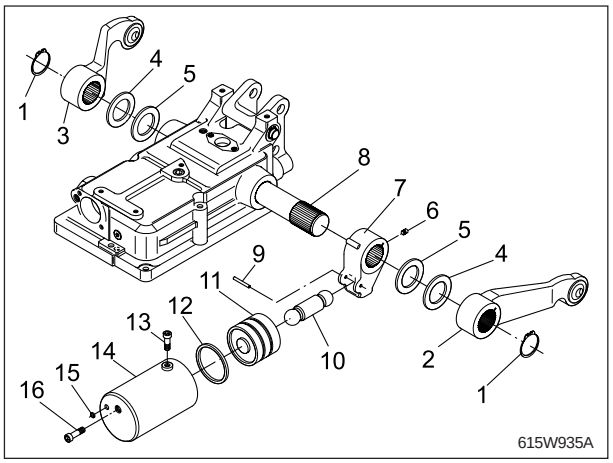
Tightening torque	Attaching bolt	23.6 ~ 27.4 N·m 2.4 ~ 2.8 kgf·m 17.4 ~ 20.2 lbf·ft



(1) Bolt
(2) Lock Washer
(3) Control Valve Assembly
(4) Power Lift Body (Hydraulic Cylinder Block)

e. Lift Arm, Hydraulic Cylinder Arm, Hydraulic Arm Shaft

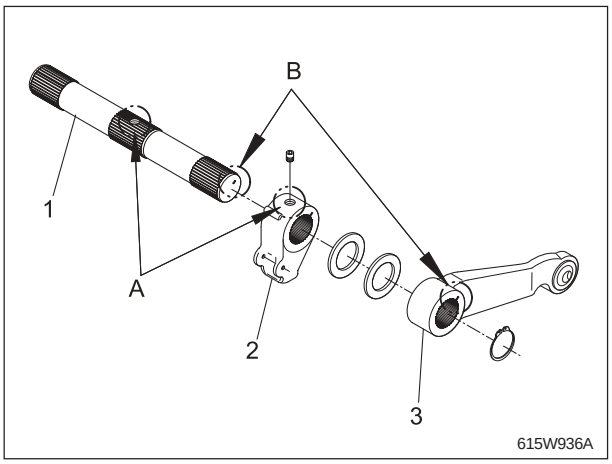
1. Loosen the cylinder attaching screw (13, 16) and crank attaching screw (6).
2. Disengage snap ring (1) and detach the hydraulic arm shaft and elevating arm, tapping on it using a urethane hammer.
3. Remove hydraulic cylinder (14), piston (11), connecting rod (10) and crank (7).



(1) Snap Ring
(2) Lift Arm (Left)
(3) Lift Arm (Right)
(4) Washer
(5) Seal
(6) Screw
(7) Crank
(8) Shaft
(9) Pin
(10) Connecting Rod
(11) Piston
(12) Seal
(13) Screw
(14) Cylinder
(15) O-Ring
(16) Screw

(When Reassembling)

- Taking care of seal (12), insert into piston (11).
- Apply the cylinder with transmission oil and insert the piston.
- Apply the bottom of the piston that contacts with the connecting rod with grease.
- Align with holes of shaft (8) and crank (7).
- Apply the left and right bushes of the power lift body with grease.



(1) Shaft
(2) Crank
(3) Elevating Arm

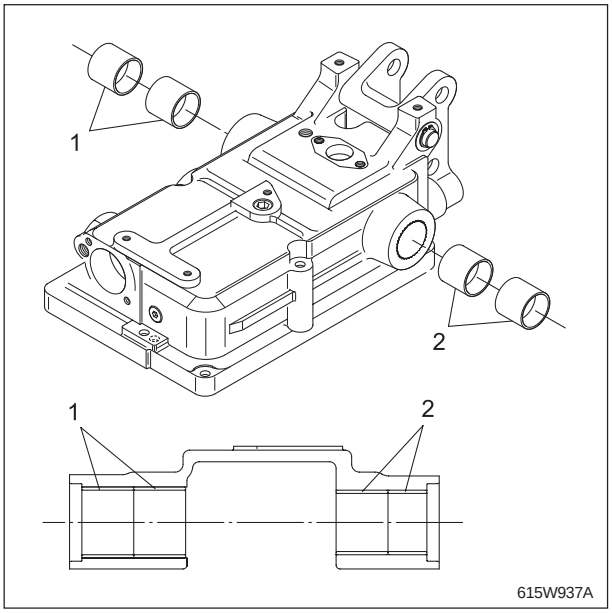
[A] Hole
[B] Mark

f. Bush

1. Remove bush (1), (2)

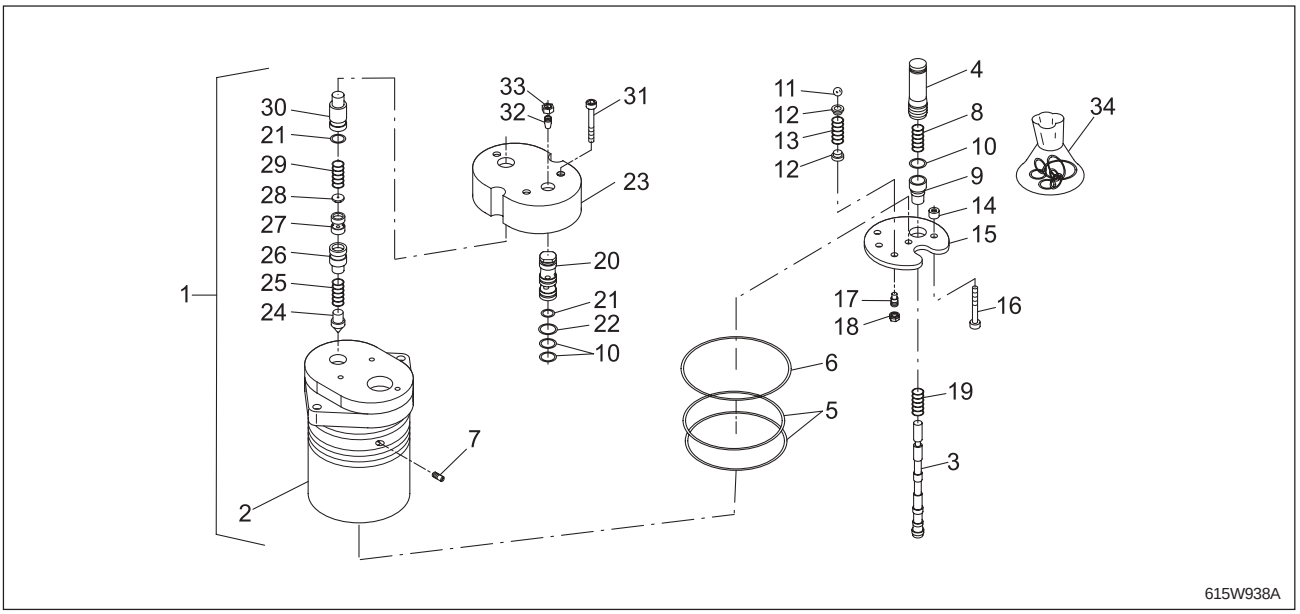
(When reassembling)

- When assembling new bush, apply the boss and bush of the hydraulic cylinder with transmission oil.



(1) Bush
(2) Bush

g. Disassembly, Assembly of MLS Valve



(1) Adjusting Valve
(2) Valve Body
(3) Spool
(4) Valve
(5) O-Ring
(6) O-Ring
(7) Adjusting Screw
(8) Spring
(9) Plug
(10) O-Ring
(11) Ball
(12) Spacer
(13) Spring
(14) Spacer
(15) Disc
(16) Adjusting Screw
(17) Adjusting Screw
(18) Nut
(19) Spring
(20) Valve
(21) O-Ring
(22) O-Ring
(23) Cover
(24) Valve
(25) Spring
(26) Valve Set
(27) Valve
(28) Pin
(29) Spring
(30) Plug
(31) Adjusting Screw
(32) Bolt
(33) Nut

a) To Disassembling

1. Loosen 3 adjusting screws (16) with a 5mm wrench.
2. Remove disc (15), spool (3) and spring (19) at a time.
3. Remove spacer (12), spring (13) and ball (11).
4. Loosen plug (9) without causing damage on the O-ring and remove spring (8) and adjusting screw (4).
5. Turn adjusting valve body (2) of the power lift upside down and loosen three adjusting screws (31) to remove the cover.
6. Loosen bolt (30) and spring (29) at a time without causing damage on the O-ring.
7. Remove pin (28), valve (27), spring (25) and valve (24) in due order.
8. Remove valve (20).

b) To Assemble

1. Apply grease sufficiently on bolt (32) inside cover (23).
2. Let all the parts applied with oil sufficiently when assembling.

CAUTION

- *Since disc (15) might fly away due to the spring tension, be careful not to lose spacer (14).*
- *Do not remove valve (4) concerning any damage expected.*
- *Pay attention to cover (23) which might fly up due to the spring tension.*
- *Be careful not to drop the spool inside when dismantling.*

h. Top Link Bracket

a) Disassembly

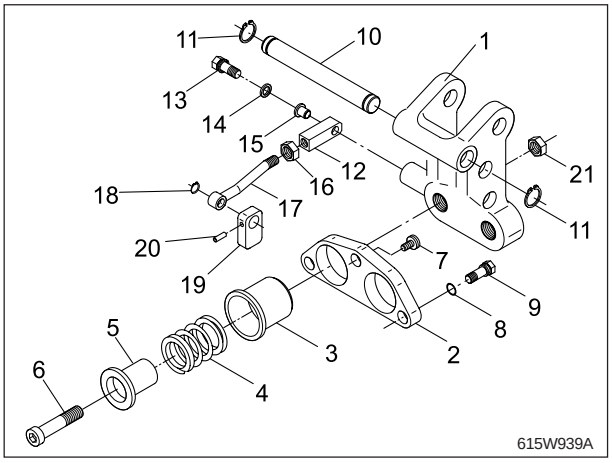
1. Before disassembling the top link holder assembly, disassemble the socket support and coupler socket assembly.
2. Disassemble bolt (13), lock washer (14), roller (15), and plate (12).
3. Disassemble nut (21).
4. Remove snap ring (11) and then disassemble pin (10).
5. Disassemble top link bracket (1).
6. Pull out bolt (7), (9), and then disassemble flange (2).
7. Disassemble cover (3), spring (4), roller (5), and bolt (6) in the assembly.

b) Assembly

1. Apply bolt (6), and spring (4) with grease sufficiently when assembling.

CAUTION

- *Don't change the assembled position of plate when disassembling flange (2).*
- *Make sure top link holder (1) does not fall to ground when disassembling pin (10).*
- *When assembling bolt (7), check draft for operation and then repeat assembly several times.*

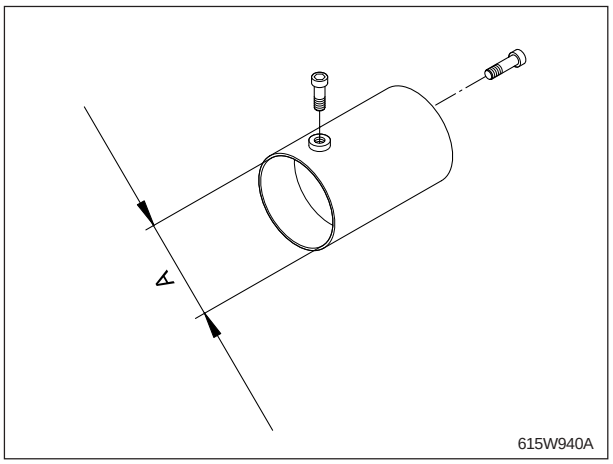


(1) Top Link Holder
(2) Flange
(3) Cover
(4) Spring
(5) Roller
(6) Bolt
(7) Bolt
(8) Lock Washer
(9) Bolt
(10) Pin
(11) Snap Ring
(12) Plate
(13) Bolt
(14) Lock Washer
(15) Roller
(16) Nut
(17) Tie Rod
(18) Snap Ring
(19) Crank
(20) Pin
(21) Nut

15.5 CHECK AND ADJUSTMENT

A. Hydraulic Cylinder Bore

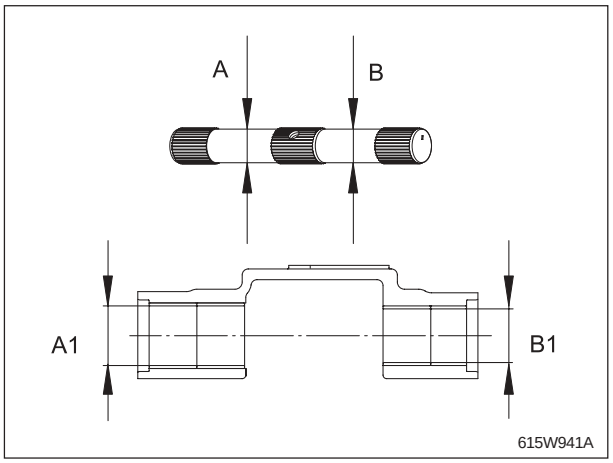
1. Check the cylinder inside surface for scratches or damage.
2. Using a cylinder gauge, measure cylinder I.D.
3. If the measured exceeds the allowable limits, replace the hydraulic cylinder block.



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.



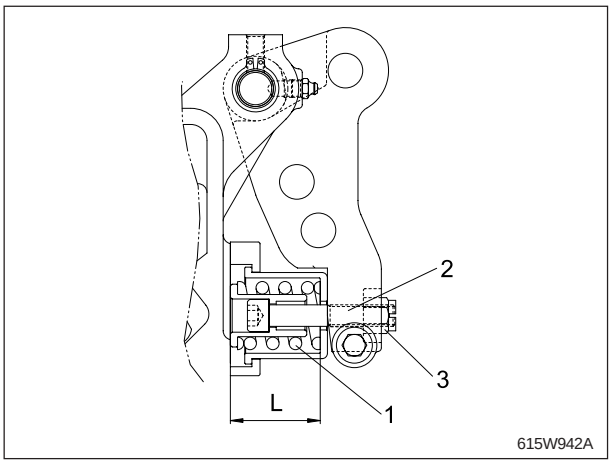
Clearance between hydraulic arm shaft and limit bush	Right	Reference allowable	0.125 ~ 0.230 mm 0.00492 ~ 0.00906 in.
		Allowable limit	0.50 mm 0.0197 in.
	Left	Reference dimension	0.125 ~ 0.220 mm 0.00492 ~ 0.00866 in.
		Allowable limit	0.50 mm 0.0197 in.

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 (B)	50.075 ~ 50.115 mm 1.97145 ~ 1.97303 in.
	Left (A)	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.



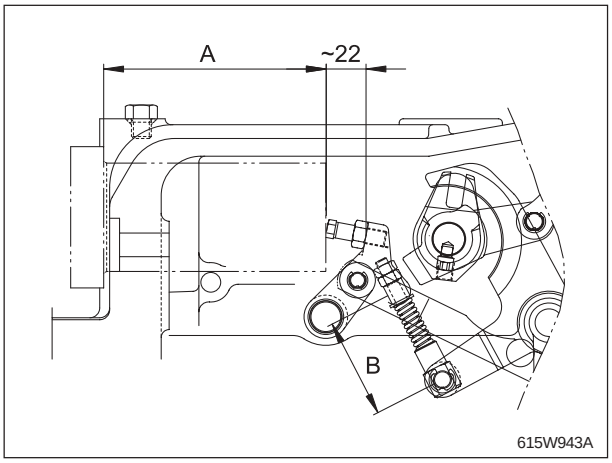
(1) Spring
(2) Hex. Bolt
(3) Nut

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.

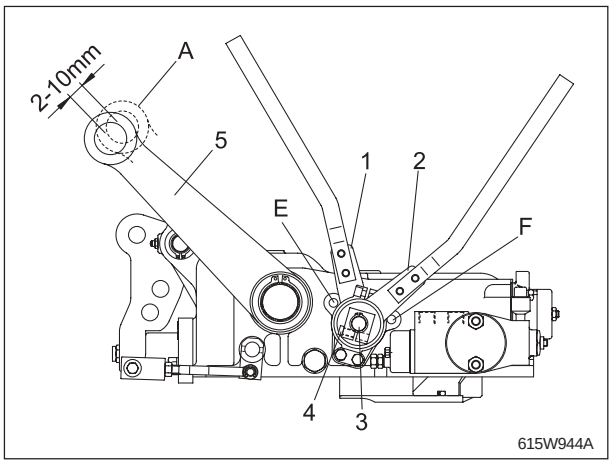


E. Lever Position Setting

a. 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

b. Draft Control Lever

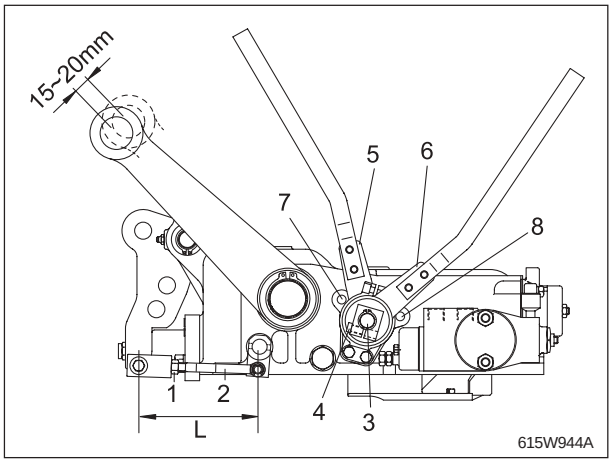
1. Lower elevating arm, loosen lock nut (1) and push backward.
2. Disengage lock bolt (2).
3. Adjust the length of the feedback rod.

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.)

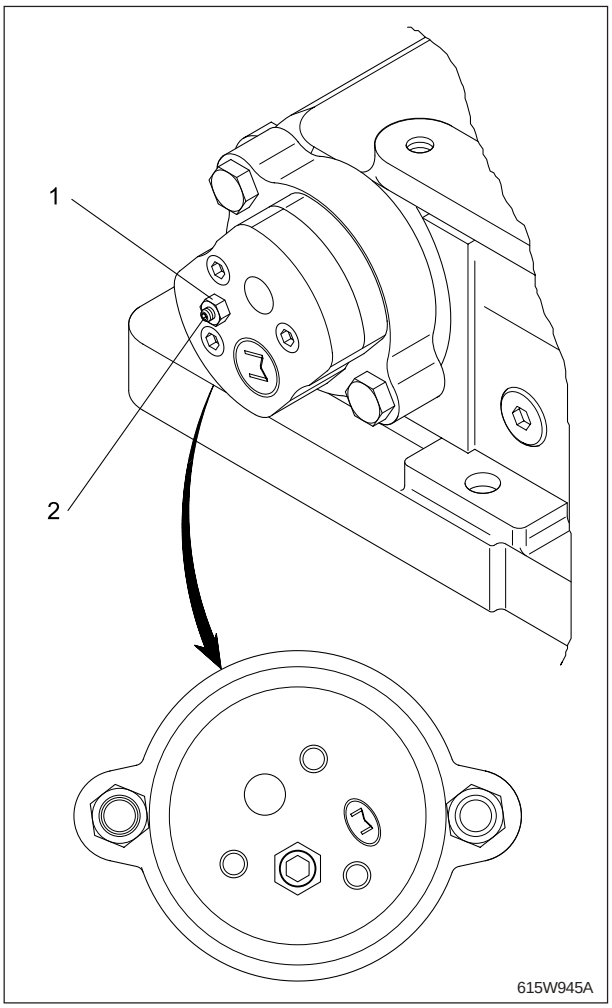
When raised to max. using the Draft control lever, height (H) will be higher between 15 and 20 mm (0.59 ~ 0.79 in.) than the max, using the position control lever.



(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.



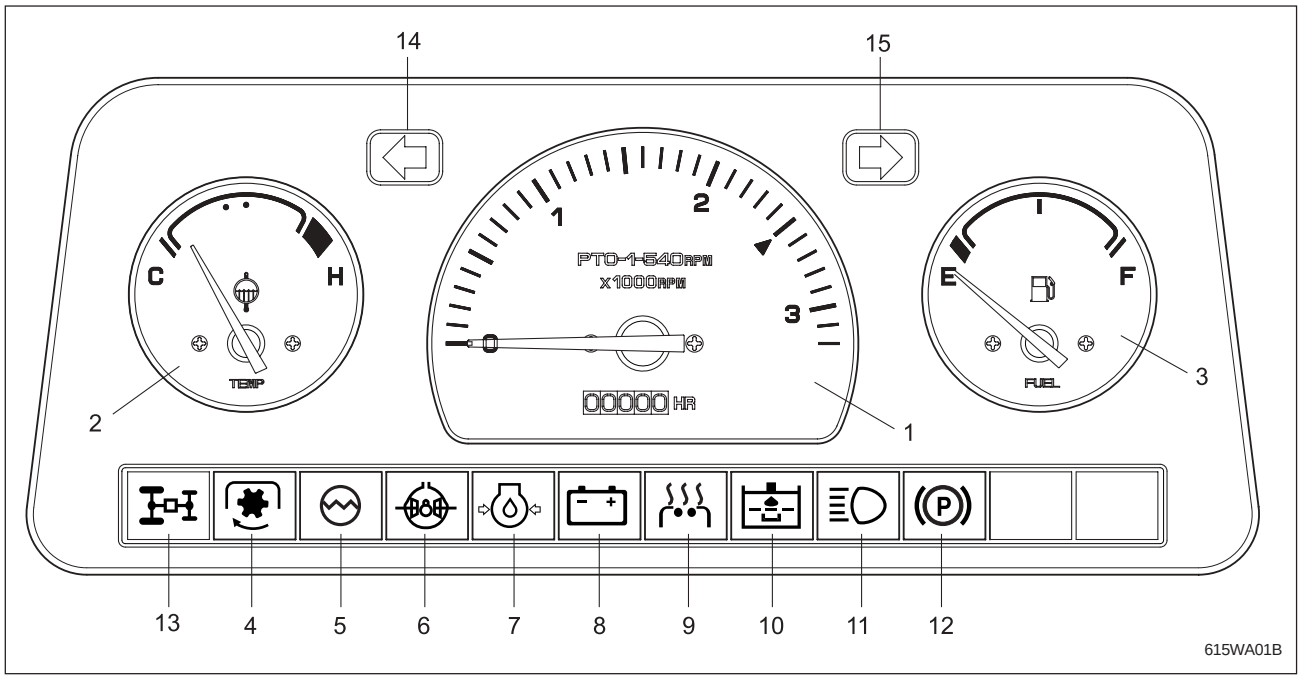
(1) Lock Nut

(2) Looseness Preventative Screw

CHAPTER 10

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

A. 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.

B. HOUR METER (1)

Records the hours and portions of hours that tractor has been operated. Use the hourmeter 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.

C. 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.

D. 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.

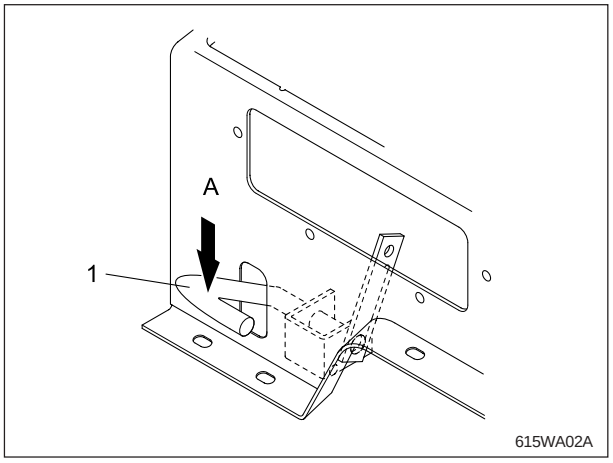
Before you start the engine, be sure that the PTO selection switch is located at the Neutral position.

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)

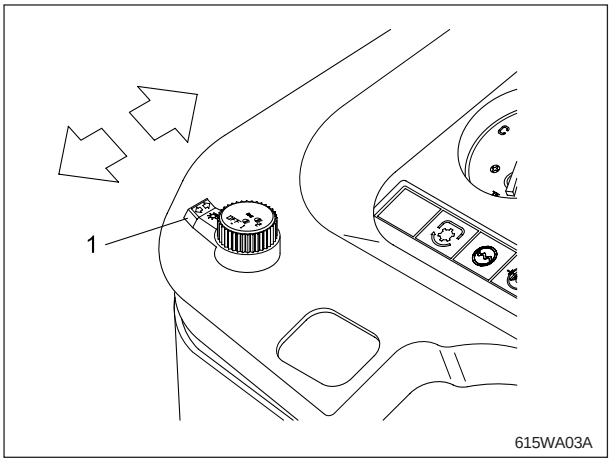
The light will be illuminate when the front wheel drive lever is pushed down.

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	Replace
	• Bulb blown	Replace
	• Wiring harness disconnected or improperly connected	Repair or replace
Coolant level lamp does not light when cooling water is insufficient	• Brake switch defective	Replace
	• Bulb blown	Replace
	• Water level switch defective	Replace
	• Fuse blown	Replace
	• Circuit in instrument panel defective	Replace
Coolant level lamp does not turn off when cooling water is sufficient	• Water level switch defective	Replace
	• Circuit in instrument panel defective	Repair or replace
Oil pressure lamp lights up when engine is running	• Engine oil pressure too low	Repair engine
	• Engine oil insufficient	Replenish
	• Oil pressure switch defective	Replace
	• Short circuit between oil pressure switch lead and chassis	Repair
Oil pressure lamp does not light when main switch is turned on and engine is not running	• Bulb blown	Replace
	• Oil pressure switch defective	Replace
	• Wiring harness disconnected or improperly connected	Repair or replace
	• Circuit in instrument panel defective	Replace
Temperature or fuel gauge does not function	• Fuse blown	Replace
	• Coolant temperature gauge or fuel gauge (fuel sender) defective	Replace
	• Wiring harness disconnected or improperly connected	Repair or replace
	• Circuit in instrument panel defective	Replace
Engine tachometer does not function when engine is running	• Tachometer cable defective or improperly connected	Repair or replace
	• Hour meter assembly defective	Replace
	• Gear in instrument panel defective	Replace

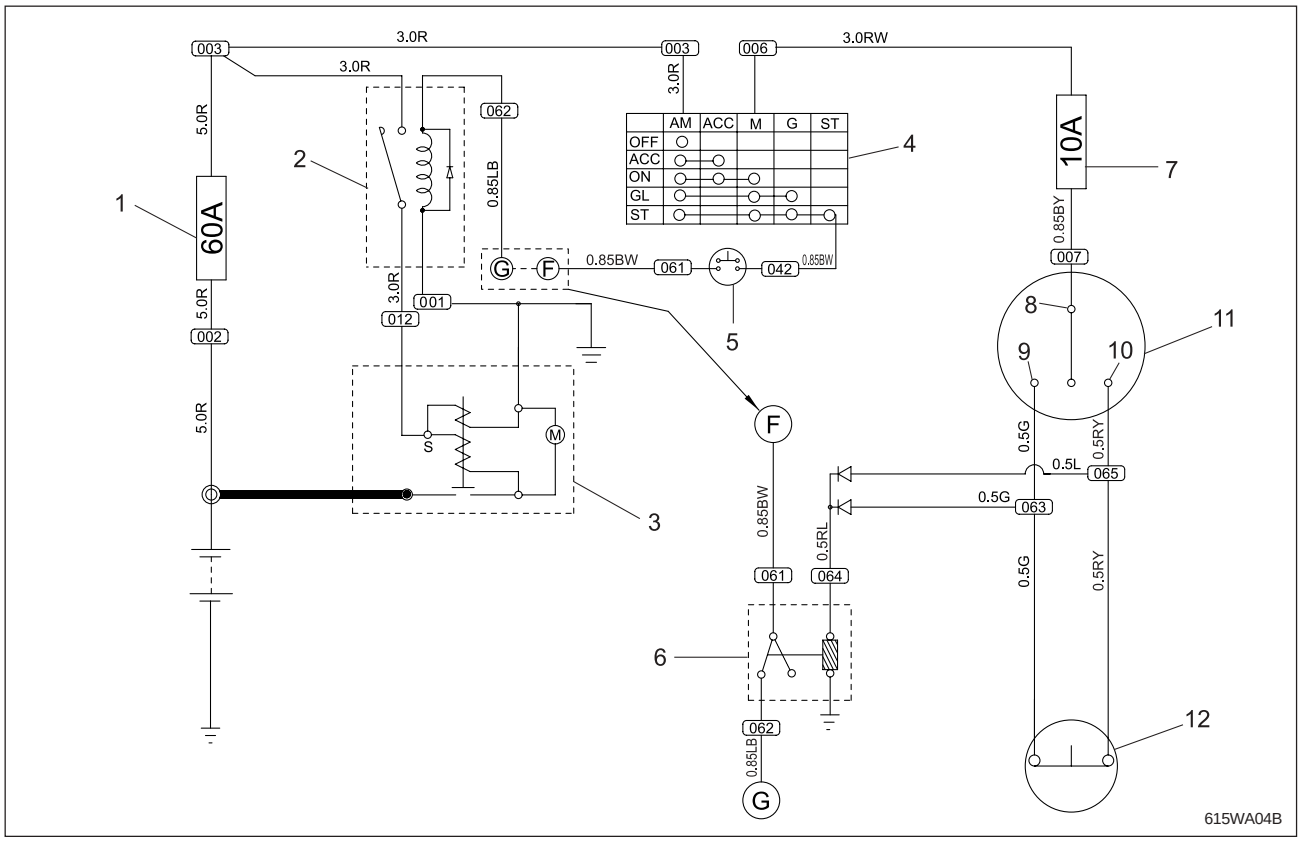
3. SERVICING SPECIFICATIONS

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



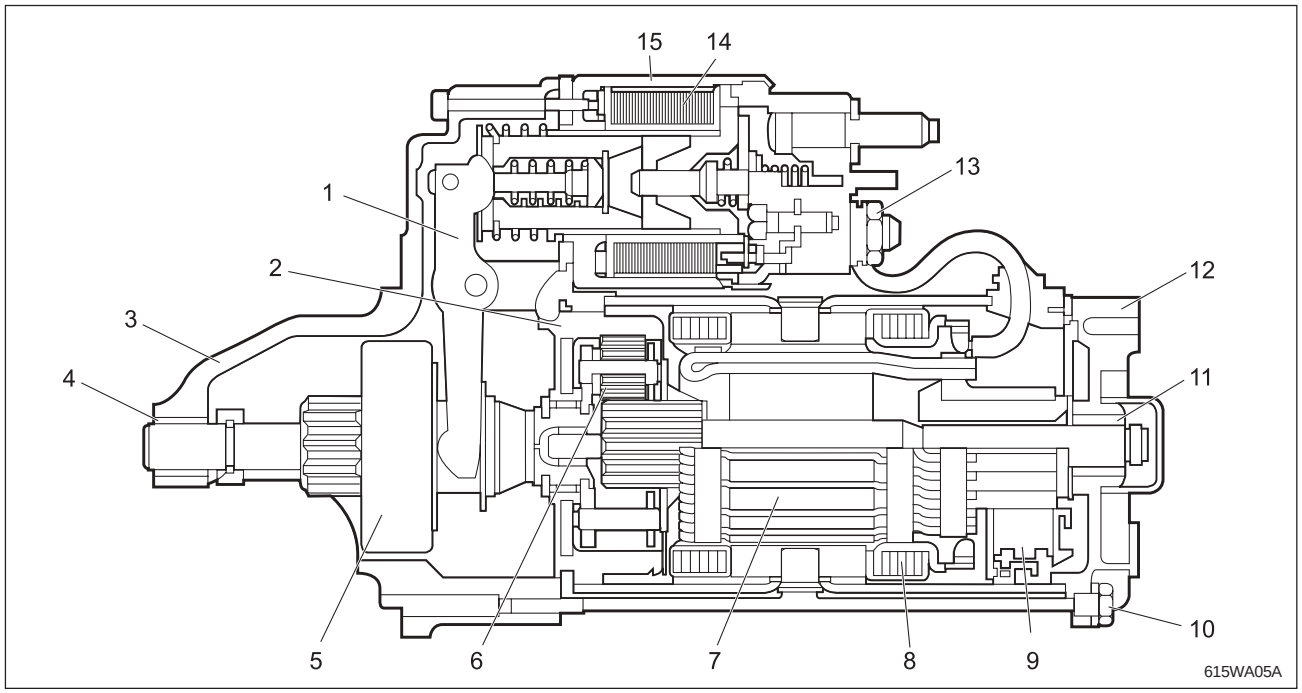
(1) Main fuse
(2) Start Relay
(3) Start motor
(4) Key s/w
(5) Safety s/w
(6) PTO safety relay
(7) PTO fuse
(8) Neutral
(9) Auto
(10) Manual
(11) PTO control s/w
(12) Micro s/w

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.

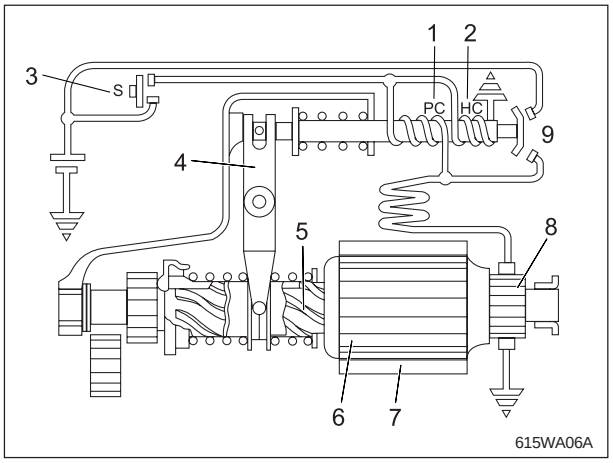
(A) Construction



(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

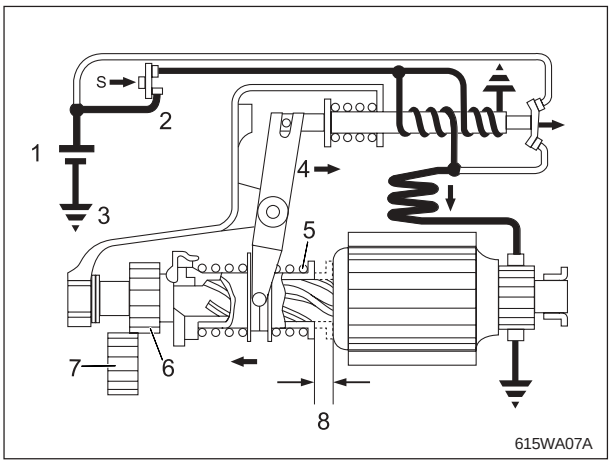
(1) PC : Pull-in coil
(2) HC : Holding coil
(3) S : Switch
(4) Drive lever clutch
(5) Screw spline
(6) Armature
(7) Pole cor
(8) Commutator
(9) Contact plate



(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.

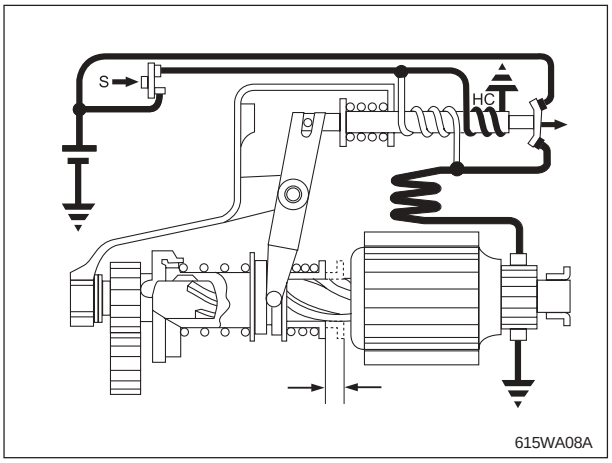
At this time, the pinion moves by the lever to engage with the ring gear.



(1) Battery
(2) Starter switch
(3) Ground
(4) Return spring
(5) Spline tube
(6) Pinion
(7) Ring gear
(8) Operated by lever

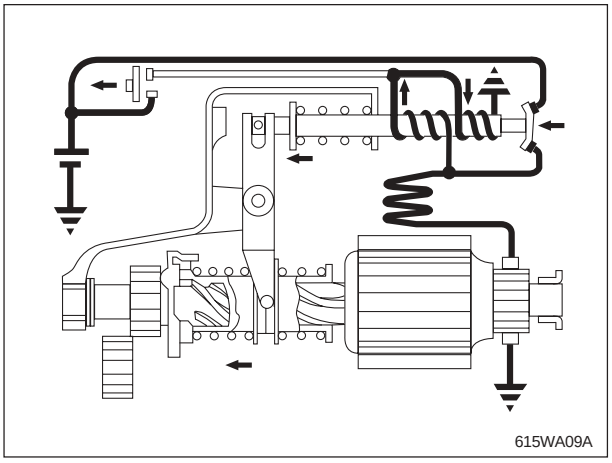
(D) When contact plate is closed:

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.



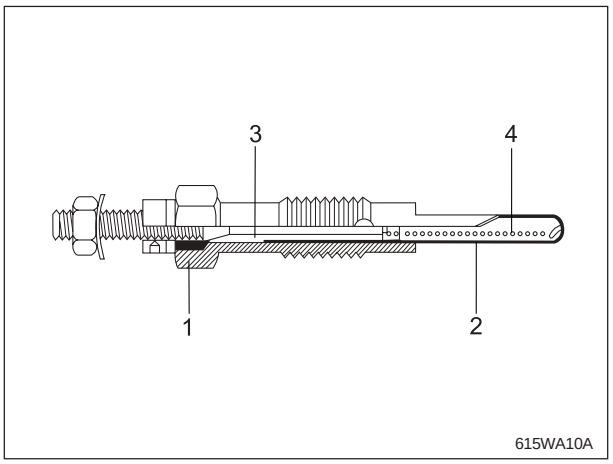
(E) When key switch is release:

When the key switch is release, a current flows instantaneously through the pull-in coil in the opposite direction as shown in fig. 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 plus

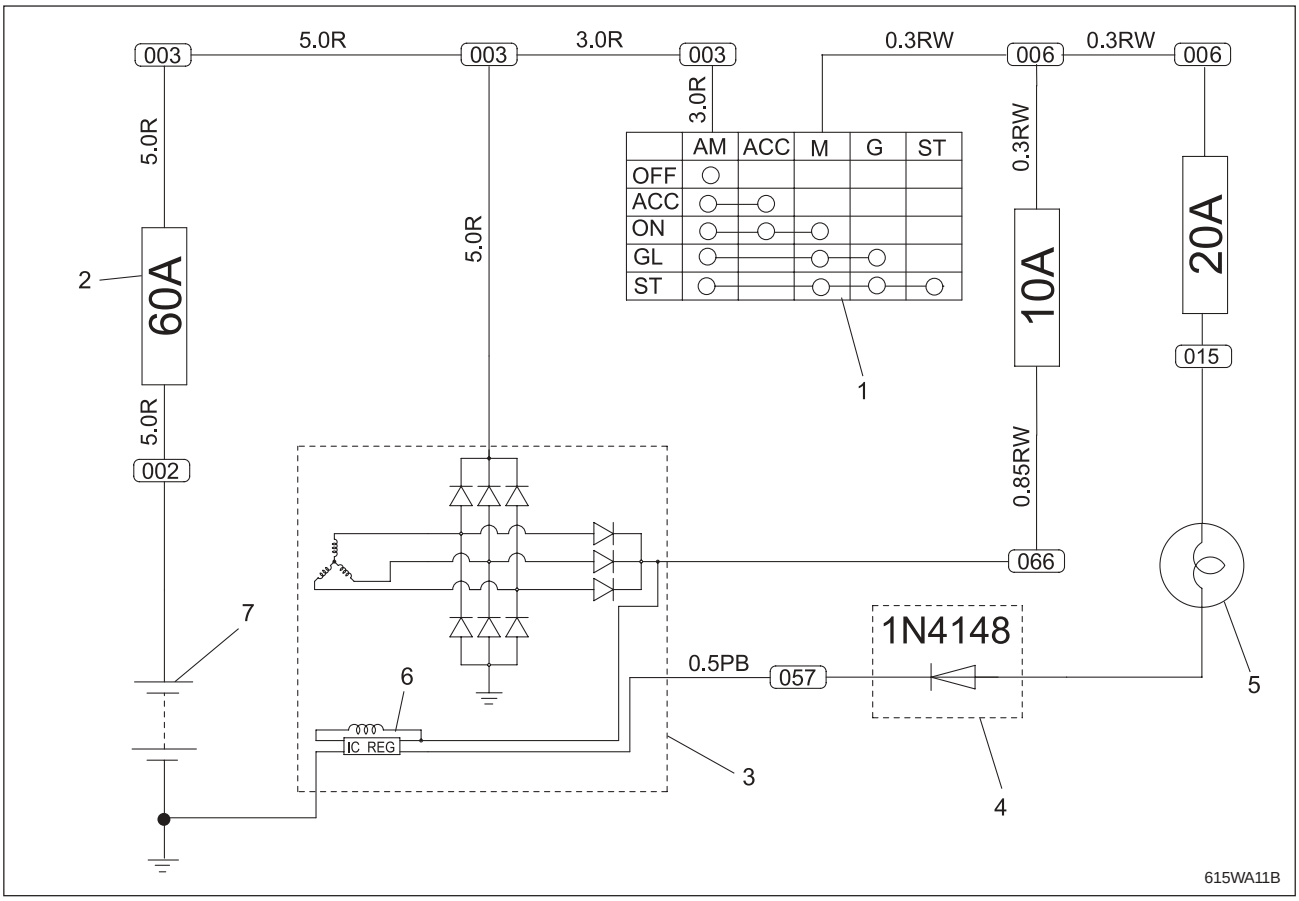
Glow plugs are used for each pre-combustion chamber of the cylinder head to make starting easier. The glow plugs are quick-heating type, which make starting easier with short pre-heating time.



(1) Housing
(2) Metal tube
(3) Insulating powder
(4) Heat coil

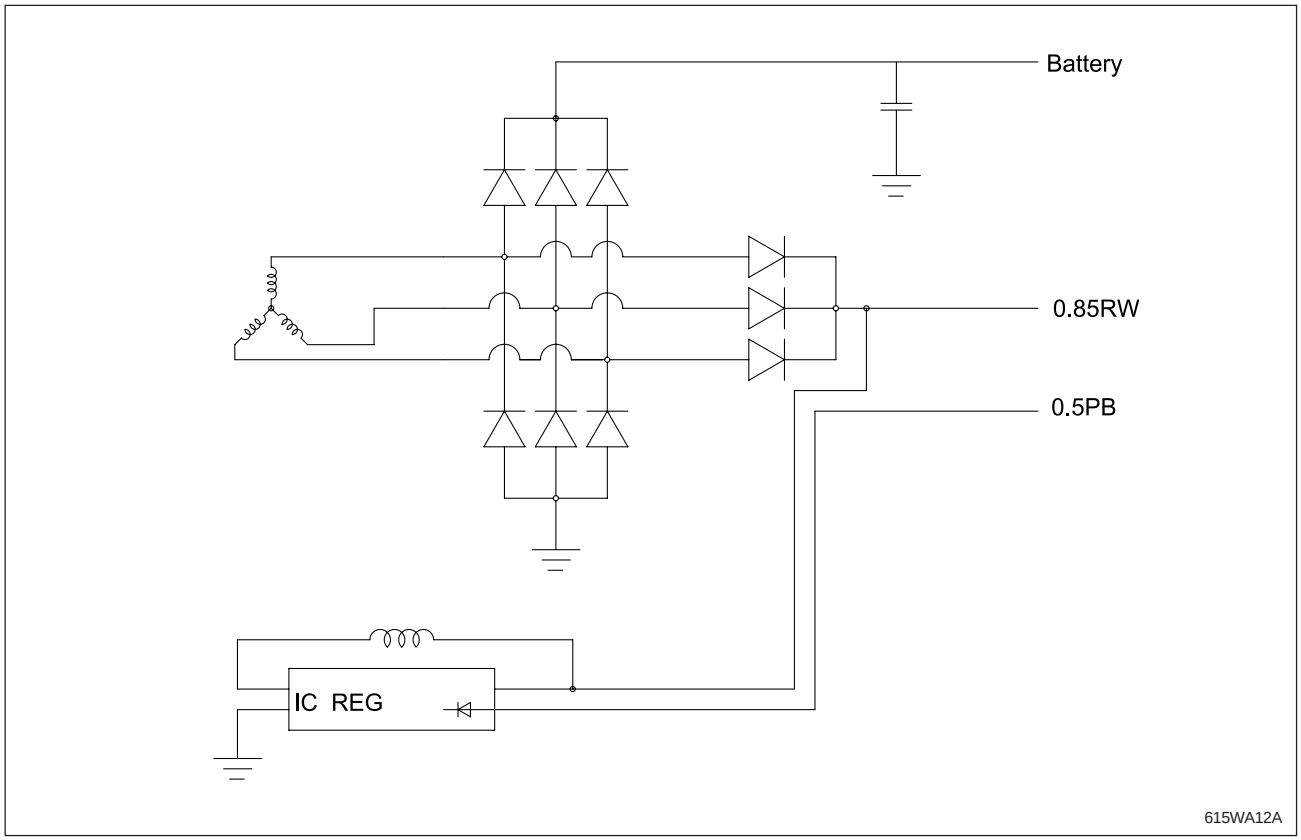
4.2 CHARGING SYSTEM

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

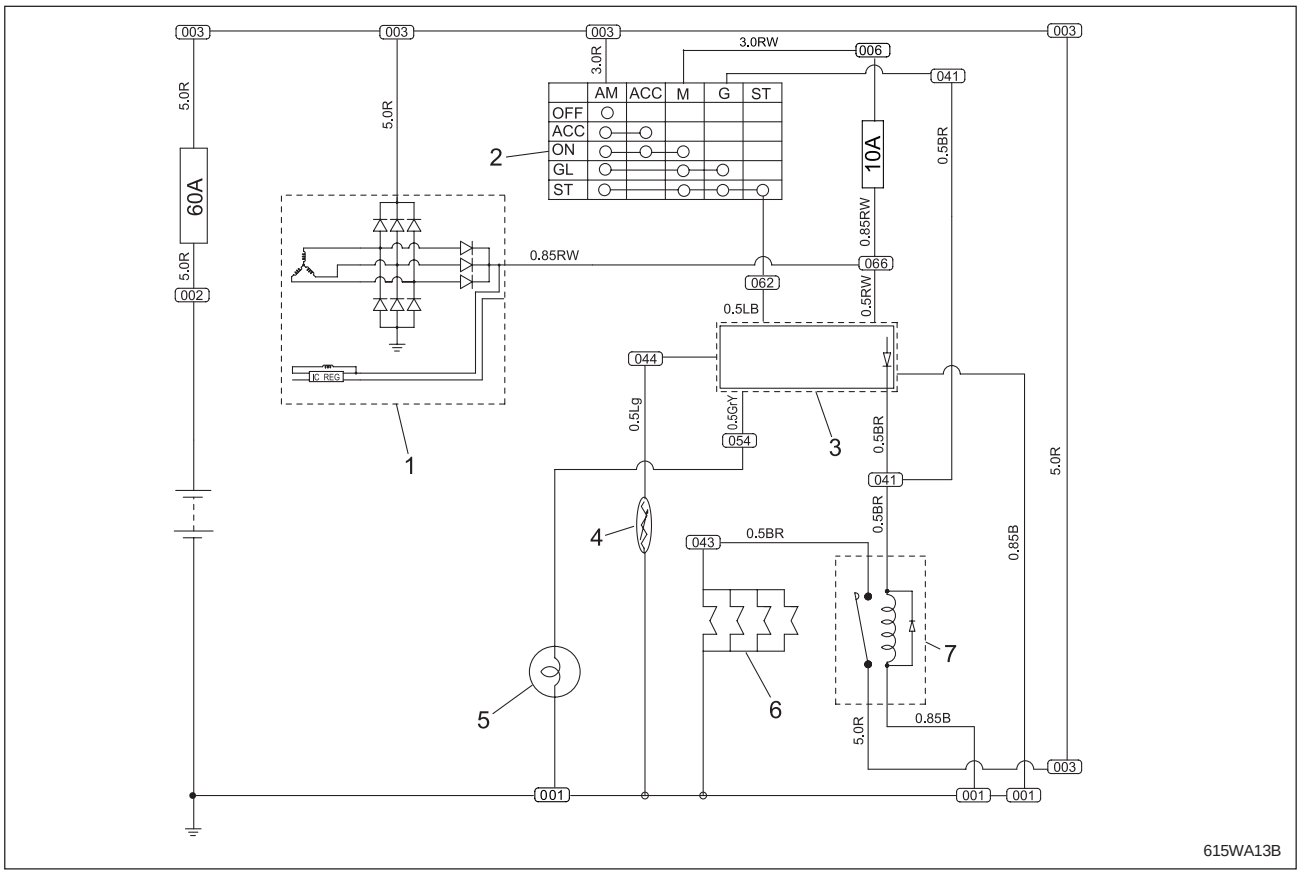
· The charging system supplies electric power for various electrical devices and also charges the battery while the engine runs.

· 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

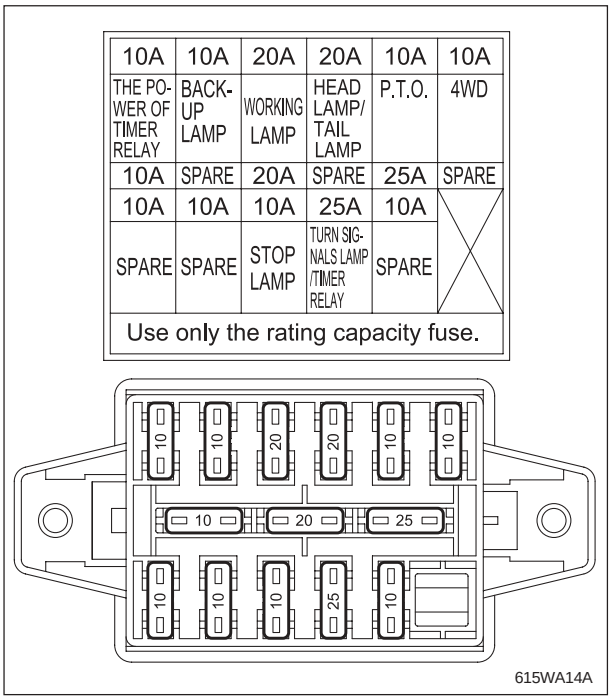
B. OPERATION FOR PREHEATING SYSTEM

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¡ÉC 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¡ÉC 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,		6WAY
		36,66,77		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

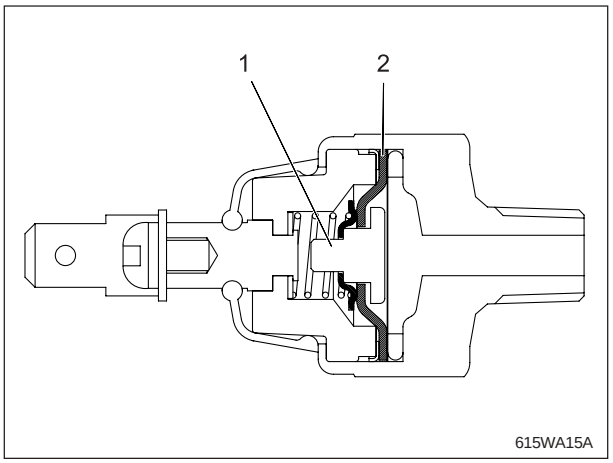
There are two kinds of fuse in this tractor. The one is main fuse which connected to the main wring near the start motor, the other is sub fuse which fixed in fuse box. Fuse box is located by clutch pedal. If the main fuse is failed, it makes impossible to operate any electrical devices of tractor. Replace 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

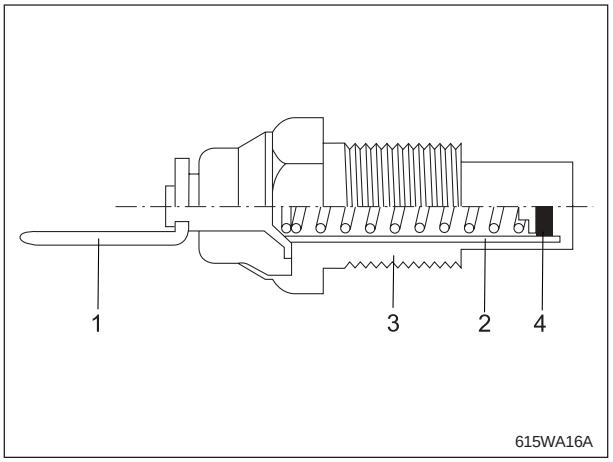
The oil pressure switch is installed on the cylinder block and leads to the oil passage of the lubricating oil. When the oil pressure falls below the specified value, the contacts of the oil pressure switch closes to turn on the warning lamp.



(1) Terminal contact (2) Diaphragm

B. COOLANT TEMPERATURE SENSOR

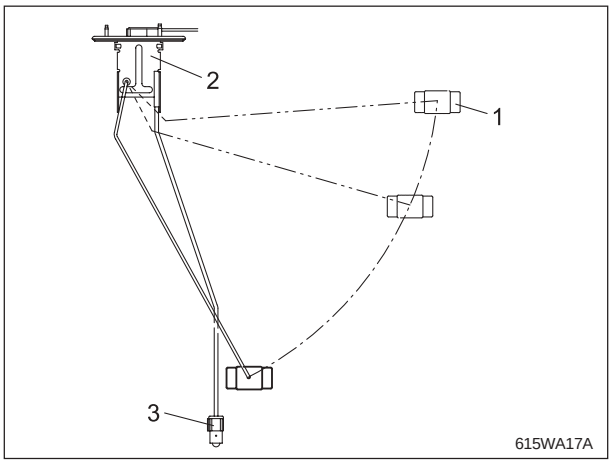
The coolant temperature sensor consists of terminal, thermister, insulator. It is installed to the cylinder head of engine, and its tip is in touch with the coolant Electrical resistance of thermister decreases as the temperature increase. Current varies with changes in the coolant temperature, and the increase of decreases in the current move the point of gauge.



(1) Terminal (3) Body
(2) Insulator (4) Thermister

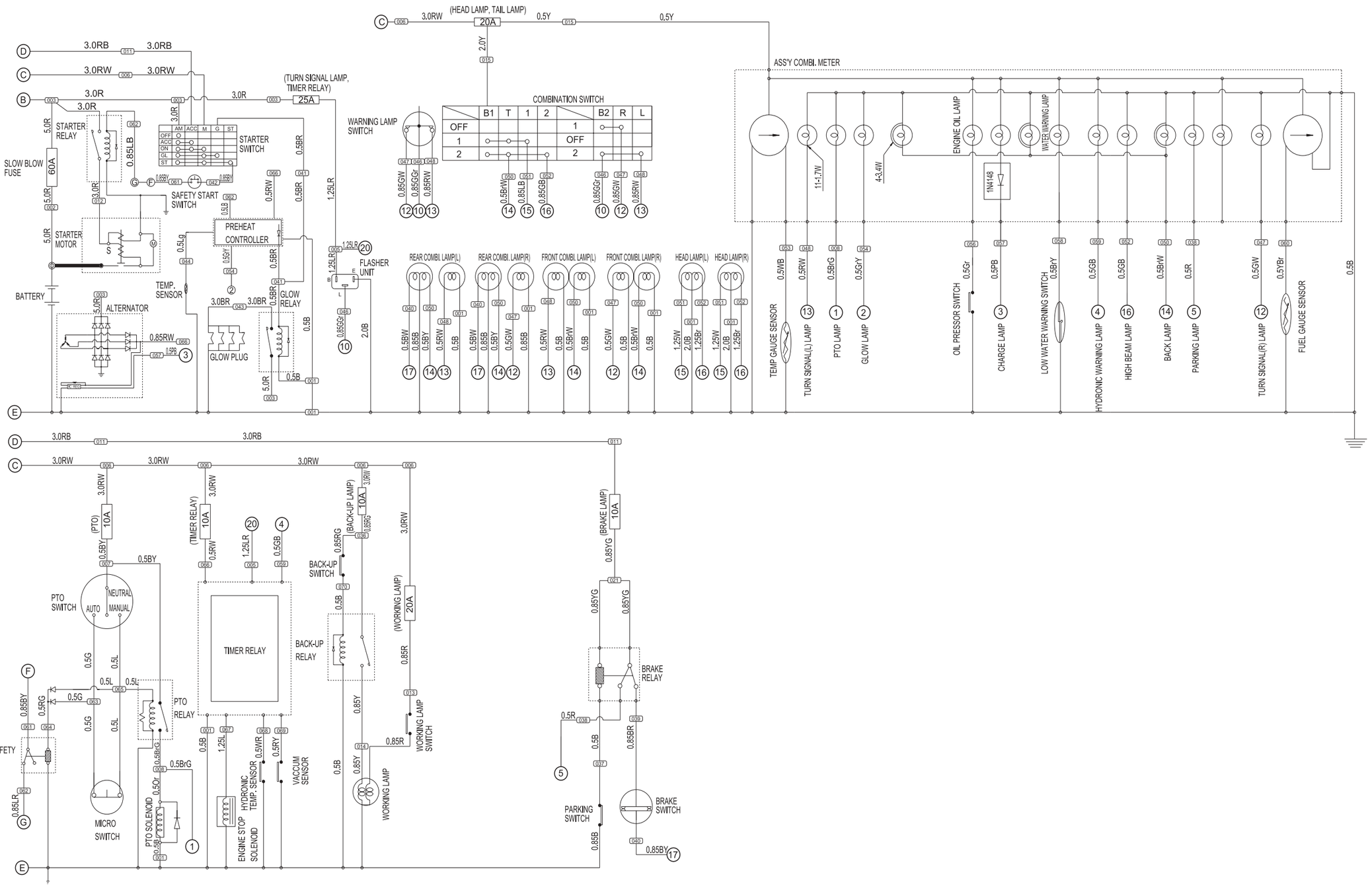
C. FUEL SENDER (FUEL LEVEL GAUGE)

The fuel sender consists of float, variable resister, thermister which are installed in the fuel tank. As the float lowers, the resistance of variable resister varies.Resistance of the thermister 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) Thermister
(2) Variable Resister

5. MAIN CIRCUIT DIAGRAM



615WA18A