# DK65 Tractors

## WORKSHOP MANUAL

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# 3. SPECIFICATIONS

| Model | | | DK65 |
|---|---|---|---|
| Maximum PTO power | | | 51.1 PS |
| Engine GROSS power | | | 64.5 PS |
| Engine | Model | | 903.27T |
| | Type | | Direct injection, vertical, water-cooled, 4-cycle diesel engine |
| | Number of cylinder | | 3 |
| | Bore and stroke | | 95 × 127 mm (3.7 × 5 in.) |
| | Total displacement | | 2,700 cc |
| | Rated revolution | | 2,250 rpm |
| | Injection timing | | 7° before T.D.C. |
| | Injection order | | 1-2-3 |
| | Compression ratio | | 17.5 |
| | Lubricating system | | Forced lubrication by trochoid pump |
| | Cooling system | | Pressurized radiator, Forced circulation with water pump |
| | Alternator | | 12 V, 50 AMPS |
| | Weight (Dry) | | 231 kg (509.3 lbs) |
| Capacities | Fuel tank | | 100 ℓ (26.4 U.S.gal.) |
| | Engine crankcase | | 8.0 ℓ (2.1 U.S.gal.) / On filter replacement: 8.8 ℓ (2.3 U.S.gal.) |
| | Engine coolant | | 24.8 ℓ (6.6 U.S.gal.) |
| | Transmission case | | 58 ℓ (15.3 U.S.gal.) |
| | Support of front axle | | 4.8 ℓ (1.28 U.S.gal.) |
| | Front axle case (LH, RH) | | Each 3.5 ℓ (0.93 U.S.gal.) |
| Dimensions (with Std.tires) | Overall length (without 3p) | | 3,452 mm (135.9 in.) |
| | Overall length (with 3p) | | 3,709 mm (106.7 in.) |
| | Overall width (minimum tread) | | 1,784 mm (70.2 in.) |
| | Overall height (Top of ROPS) | | CABIN: 2,615 mm (103 in.), ROPS: 2,680 mm (105.5 in.) |
| | Overall height (Top of steering wheel) | | 1,798 mm (70.8 in.) |
| | Wheel base | | 2,048 mm (80.6 in.) |
| | Min. ground clearance | | 423 mm (16.7 in.) |
| | Tread | Front | 1,470 mm (57.9 in.) |
| | | Rear | 1,406 ~ 1,902 mm (55.4 ~ 74.9 in.) |
| Traveling system | Tire size (Std. tires) | Front | 9.5 ~ 24 PR |
| | | Rear | 16.9 ~ 30 PR |
| | Clutch | | Dry type single plate-single stage |
| | Steering | | Hydraulic power steering |
| | Transmission | | Synchronized shuttle and transmission (12 forward and 12 reverse speeds) |
| | Brake | Traveling | Wet disc type |
| | | Parking | Hydraulic |
| | Differential | | Spiral bevel gear |

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### 5. Special Torque Tensions

The torque tensions below apply to components lubricated lightly with clean engine oil before they are Fitted.

| Description | Thread Size | Torque | | |
|---|---|---|---|---|
| | | N·m | kgf·m | lbf·ft |
| **Cylinder head assembly** | | | | |
| Setscrews, cylinder head | M12/M14 | See section 2-4 | | |
| Fasteners, rocker shaft brackets: | M10 | See section 2-4 | | |
| Cap nuts, rocker cover - metal cover | M10 | 30 | 3.0 | 22 |
| Cap nuts, rocker cover - plastic cover | M10 | 20 | 2.0 | 15 |
| Setscrews, inlet manifold to cylinder head | M8 | 22 | 2.2 | 16 |
| Nuts, exhaust manifold to cylinder head | M8 | 22 | 2.2 | 16 |
| Setscrews, engine lift bracket | M10 | 44 | 4.5 | 33 |
| Temperature switch | 5/8 UNF | 30 | 3.1 | 22 |
| Temperature switch | 3/8 PTF | 30 | 3.1 | 22 |
| **Piston and connecting rod assembly** | | | | |
| Nuts, connecting rods | 7/16 UNF | 77.5 | 7.9 | 57 |
| **Crankshaft assembly** | | | | |
| Setscrews, main bearings | 9/16 UNF | 152 | 15.6 | 112 |
| Setscrews, crankshaft pulley | 7/8 UNF | 325 | 33.2 | 240 |
| Setscrews, crankshaft pulley with washer | 7/8 UNF | 365 | 37.2 | 269 |
| Setscrews, rear oil seal housing | M8 | 22 | 2.2 | 16 |
| Setscrew, balance weight to crankshaft | 7/16 UNF | 73 | 7.4 | 54 |
| Capscrew, adapter to crankshaft pulley | 3/8 UNC | 37 | 3.8 | 27 |
| **Timing case and drive assembly** | | | | |
| Setscrews, timing case to cylinder block | M8 | 22 | 2.2 | 16 |
| Setscrews, bottom cover to timing case | M8 | 22 | 2.2 | 16 |
| Setscrews, front cover to timing case | M8 | 22 | 2.2 | 16 |
| Setscrews, front cover to timing case | M6 | 9 | 0.9 | 7 |
| Setscrews, front cover to bridge piece, bottom cover | M8 | 22 | 2.2 | 16 |
| Setscrew, camshaft gear | M8 | 27 | 2.8 | 20 |
| Setscrew, idler gear | 1/2 UNF | 65 | 6.6 | 48 |
| | M12 | 78 | 8.0 | 57 |
| **Cylinder block** | | | | |
| Setscrew oil pan clamping bracket | M12 | 78 | 8.0 | 58 |
| **Aspiration system** | | | | |
| Setscrews, inlet manifold to cylinder head | M8 | 22 | 2.2 | 16 |
| Nuts, exhaust manifold to cylinder head | M8 | 22 | 2.2 | 16 |
| Nuts, turbocharger to manifold | M8 | 44 | 4.5 | 33 |
| Elbow, turbocharger oil drain | 1/2 PTF | 24 | 2.4 | 18 |
| Induction heater | 7/8 UNF | 30 | 3.1 | 22 |
| Induction heater | M22 | 30 | 3.1 | 22 |

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## 4.2 ROCKER COVER

### A. TO REMOVE AND TO FIT

Early engines are supplied with an aluminum rocker cover. The latest engines have a plastic rocker cover. Both of these covers have a seal (B1) fitted in the flange.

#### a. To Remove

1. Disconnect the breather pipe, if fitted.
2. Remove the two cap nuts (A1), Each cap nut has a steel washer (A2), a shim washer (A3) and a rubber seal (A4).

***NOTE:***

- *The shim washers are not used with the plastic rocker covers.*

3. Lift off the rocker cover.

#### b. To Fit

1. Check the condition of the rubber seals (A4), the steel washers (A2) and the shim washers (A3) for the cap nuts (A1). If necessary, the seals for the cap nuts can be replaced.

***NOTE:***

- *The shim washers are not used with the plastic rocker covers.*

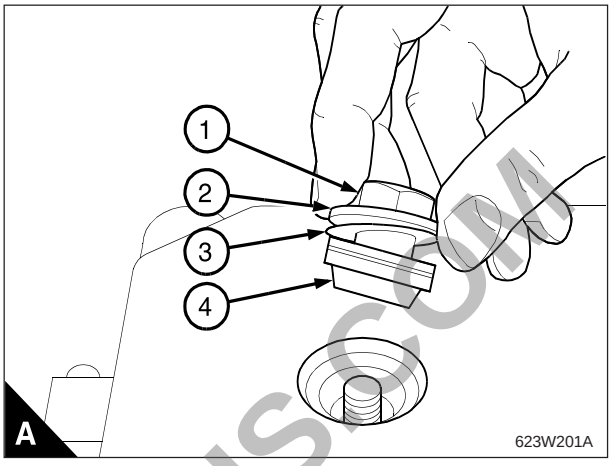
2. Check the condition of the rocker cover seal (B1).

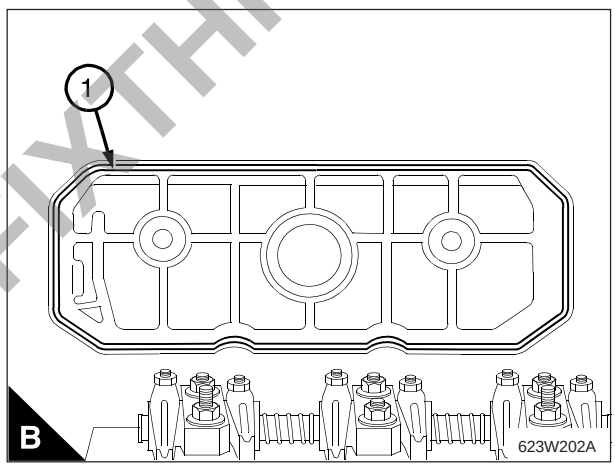
   If necessary, the seal can be replaced.
3. Clean the seal face of the cylinder head and fit the rocker cover.
4. Fit the steel washer, the shim and the seal to each cap nut and fit the cap nuts.

***NOTE:***

- *Damage to the seals can occur if the cap nuts are not tightened centrally through the sealing washer and the rocker cover. If the seals are damaged they must be replaced.*

5. Tighten the cap nuts to 30 N·m (22 lbf·ft) 3.1 kgf·m for the aluminum rocker cover, or 20 N·m (15 lbf·ft) 2.0 kgf·m for the plastic rocker cover.



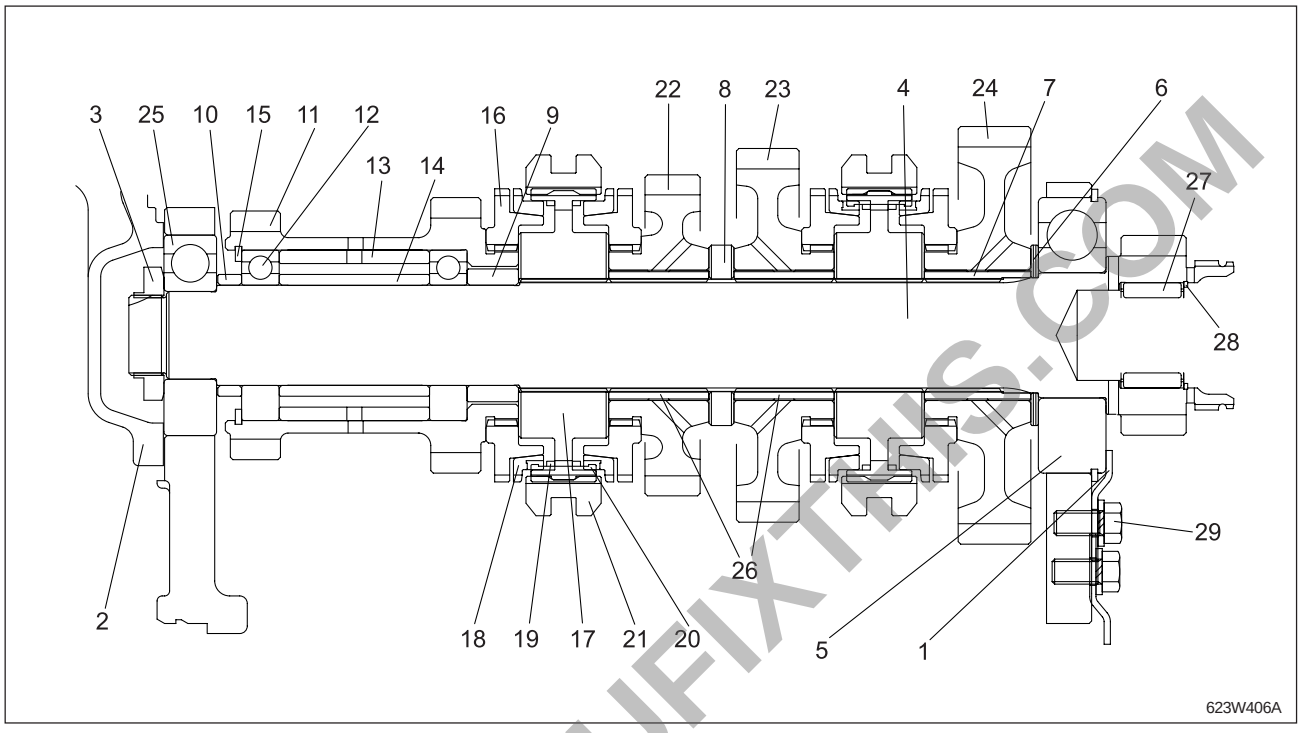

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## 2.3 20 GEAR SHAFT RELATION

### A. DISASSEMBLING




(1) Bearing Knob Plate
(2) Propeller Shaft Case
(3) 32 Nut
(4) 20 Gear Shaft
(5) Ball Bearing
(6) Thrust Collar
(7) Inner Ring
(8) Thrust Collar
(9) Collar
(10) Collar
(11) 26-28 Gear
(12) Ball Bearing
(13) Collar
(14) Collar
(15) Snap Ring
(16) Synchronizer Gear
(17) Synchronizer Hub
(18) Synchronizer Ring
(19) Spring
(20) Synchronizer Key
(21) Shift
(22) 33 Gear
(23) 40 Gear
(24) 45 Gear
(25) Ball Bearing
(26) Inner Ring
(27) Needle Bearing
(28) Snap Ring
(29) Bolt

1. After disassembling 12 points of bolts and 2 points of nut on the assembly surface of clutch housing and transmission case, remove clutch housing and transmission case.
2. Disassemble back bearing knob plate (1) of clutch housing. Disassemble front clutch lever of clutch housing and then propeller shaft case (2).
3. Remove the caulking part of 32 nut (3) and disassemble 32 nuts (3).
4. Tap lightly the end of 20 gear shaft (4) to backward clutch housing and disassemble 20 gear shaft (4).

**Tightening Torque**

| | |
|---|---|
| Bearing knob plate adjusting bolt (29) | 23.536 ~ 27.458 N·m |
| | 2.40 ~ 2.80 kgf·m |
| | 17.4 ~ 20.3 lbf·ft |
| 32 nut (3) | 77.472 ~ 90.221 N·m |
| | 7.90 ~ 9.20 kgf·m |
| | 57.2 ~ 66.6 lbf·ft |

**Part Specification**

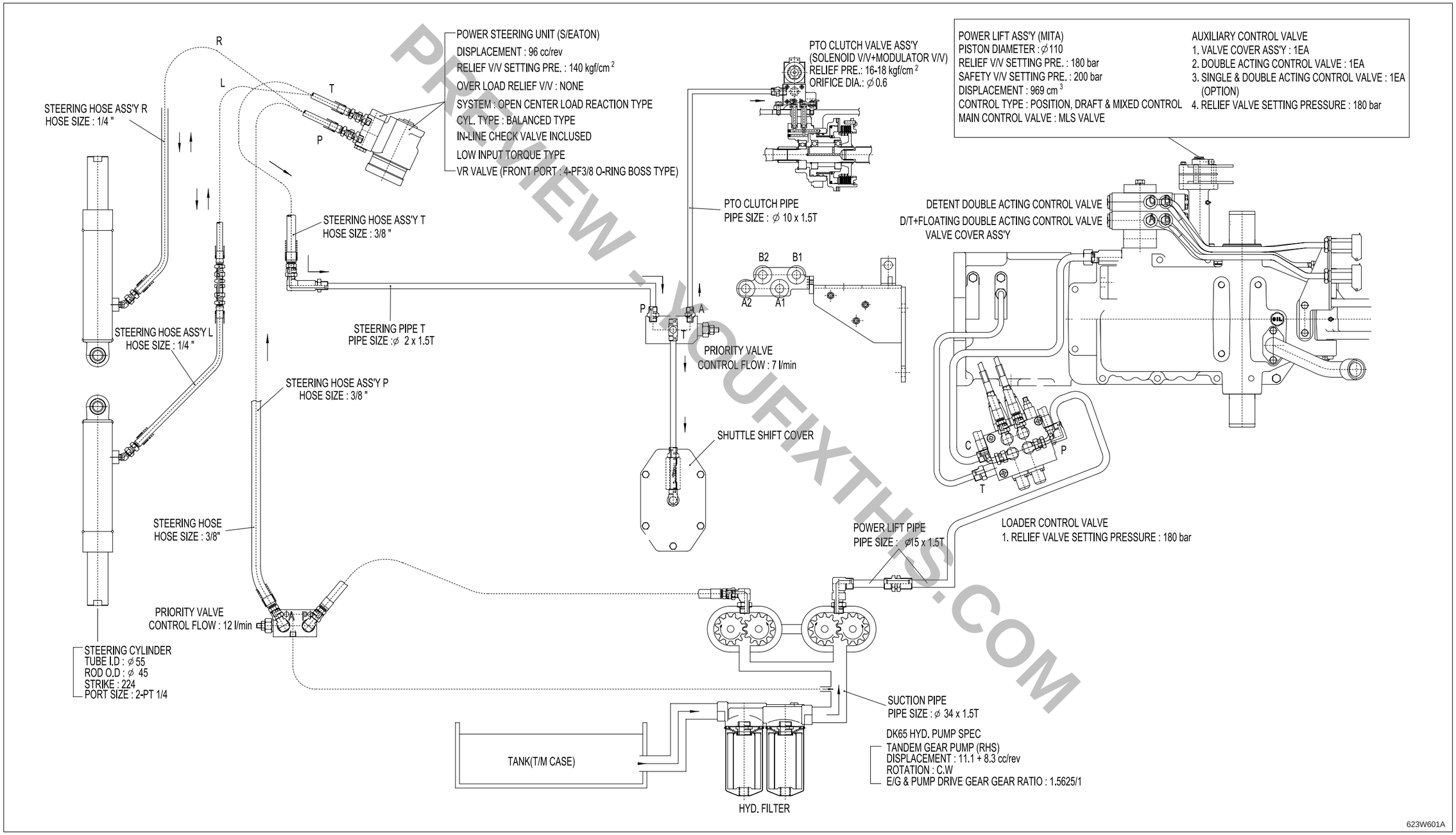
| | |
|---|---|
| Needle bearing (inside diameter x outside diameter x width) | 30 x 42 x 25 mm |
| | 1.18 x 1.65 x 0.98 in. |



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# 1. HYDRAULIC SYSTEM

## HYDRAULIC OIL FLOW SCHEMATIC (MECHANICAL)

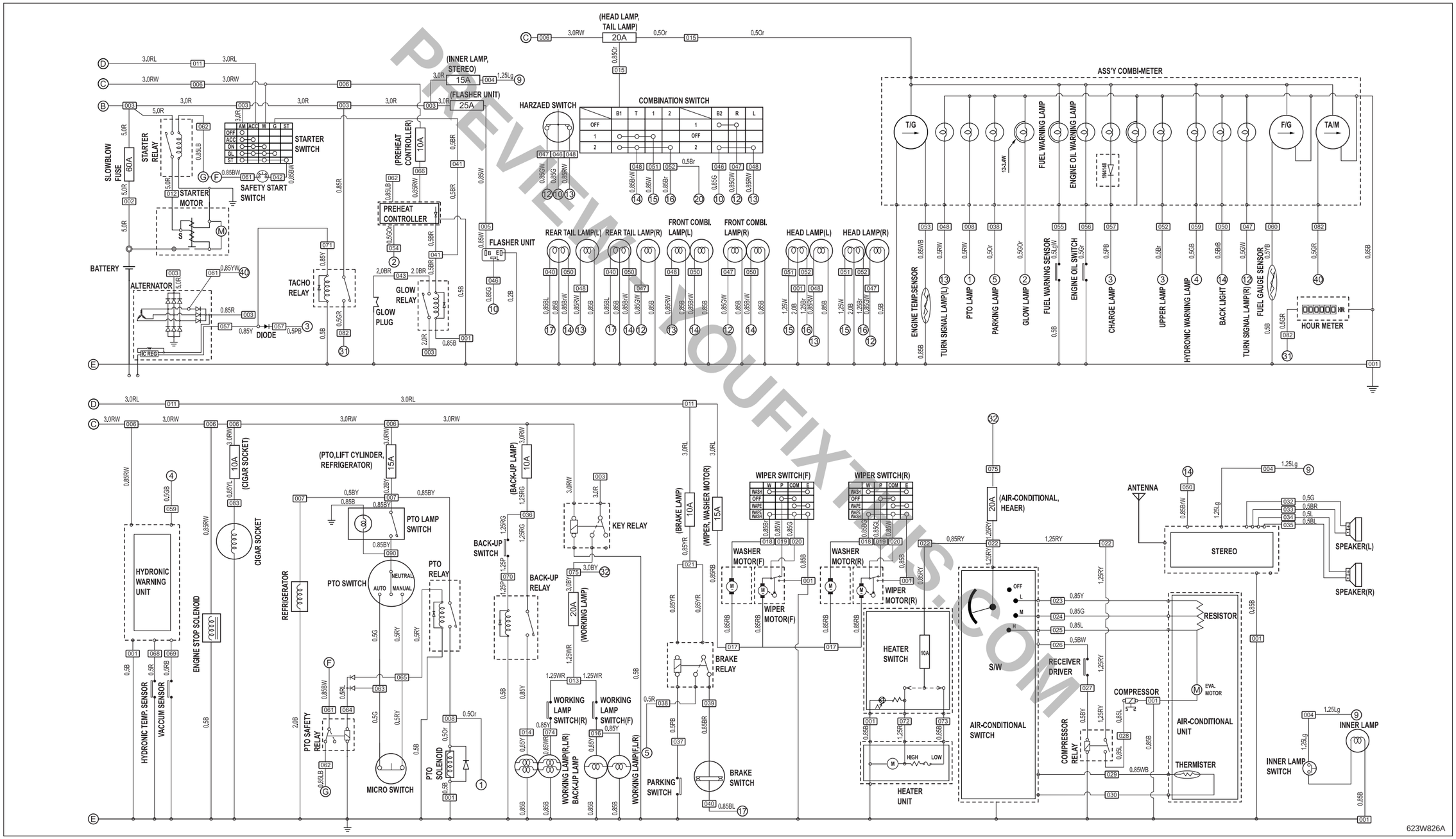



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## 6.2 FUSE DIAGRAM CIRCUIT

### (1) CABIN, OPEN CAB TYPE




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# 4. TROUBLE-SHOOTING

## 4.1 CLUTCH NOISE, CLUTCH OPERATION PROBLEMS

| Symptom | Probable Causes | Solution |
|---|---|---|
| Clutch does not work | 1. Improper adjustment of clutch pedal clearance | Adjustment (clearance 20 ~ 30 mm, 0.78 ~ 1.18 in.) |
| | 2. Clutch disc worn | Replace |
| Clutch noise | 1. Clutch disc floor plan transformed | Replace |
| | 2. The diaphragm spring height of clutch cover is not even. | Replace |
| | 3. Release bearing attached. | Replace |

## 4.2 SHUTTLE SHIFT TROUBLES

| Symptom | Probable Causes | Solution |
|---|---|---|
| Noise when shuttle shifting | 1. Excessive clearance of shuttle synchronizer assembly (spec.: 58.2 ± 0.2mm). | Replace |
| | 2. Cone assembly 2 worn. | Replace |
| | 3. Front gear (33 gear), reverse gear (30 gear) chamber ring section damaged. | Replace |
| | 4. Guide pin broken ($\phi$ 6: 4 points, $\phi$ 5: 6 points). | Replace |
| Gears slip when shifting | 1. Improper adjustment of external lever. | Adjust |
| | 2. Improper shift distance (stroke distance: 9 mm, 0.35 in.). | Reassemble after checking the cause |
| | 3. Excessive clearance of shuttle synchronizer assembly (spec.: 58.2 ± 0.2mm). | Replace |
| | 4. Instable position due to shuttle fork transformation. | Replace |
| | 5. Shortage of tension due to spring transformation to support 6 points of ball inside shuttle sleeve assembly. | Replace |
| Hard shifting | 1. Burr of spline section inside sleeve assembly is not removed. | Reuse |
| | 2. Fitting due to the damage of spline section inside diameter of sleeve assembly. | Replace |
| | 3. Fitting due to the small hole of guide pin mounted on sleeve assembly. | Replace |
| | 4. Cone assembly 2 worn. | Replace |
| | 5. The number of teeth is not good due to the damage of champering section of opposite gear (front gear: 33 gear) (reverse gear: 30 gear). | Replace |
| | 6. Tilting when shifting due to shuttle shift fork transformation. | Replace |

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**WARNING**

- *The laminated gasket has sharp edges which can cut your hands.*

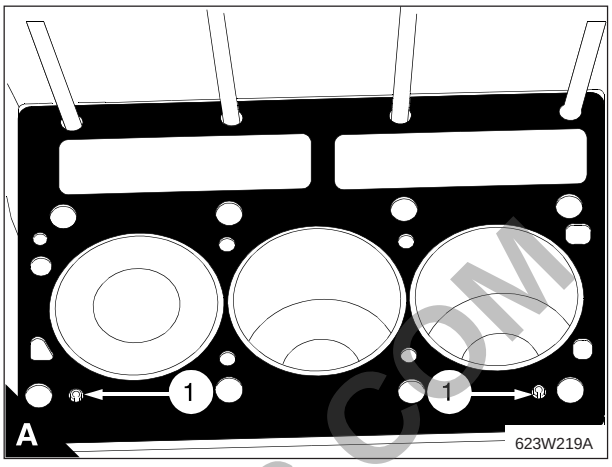
  *Protect your hands with gloves.*

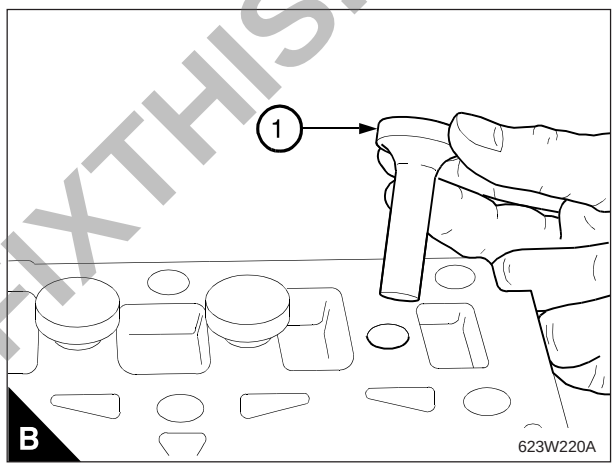
**CAUTION**

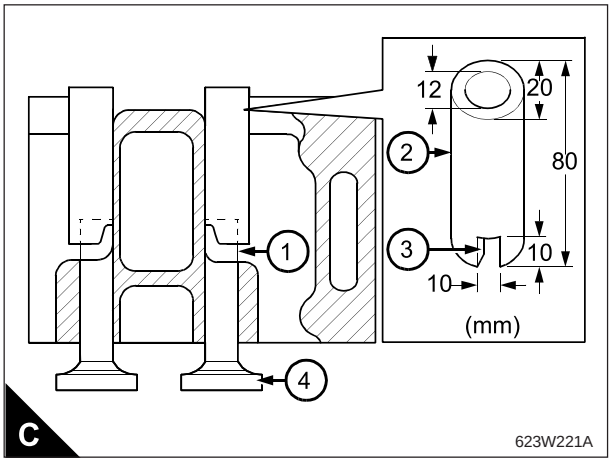
- *To ensure that the laminated gasket remains clean, do not remove it from its container until it is to be fitted.*

4. Check that the top face of the cylinder block is still clean.
5. Remove the cylinder head gasket from its container and put it in position on the two pins (A1) in the cylinder block. The part number, stamped on the gasket, must be to the top when the gasket is fitted.
6. Clean and dry the tappets and their parent bores in the cylinder head. Fit the tappets (B1) into their parent bores. If the surface of the cylinder head gasket is damaged, the gasket must be replaced. Therefore, it is important to ensure that the tappets do not fall onto the gasket when the cylinder head is put in position.

   To do this, use six pieces of rubber hose (C2) to retain each tappet (C4). Cut a piece out of one end of each hose (C3). Push this end onto the end of the tappet (C1). The gap in the hose is necessary because there is very little clearance between the cylinder head and the tappet.
7. Check that the bottom face of the cylinder head is still clean. Carefully fit the cylinder head. Ensure that the cylinder head is fully onto the two location pins, but do not damage the gasket.
8. Remove the pieces of hose which retained the tappets. Lubricate thoroughly the tappets with clean engine lubricating oil. Check that the tappets are free to move in their parent bores.
9. Lightly lubricate the threads of the ten cylinder head setscrews and the thrust faces of the setscrew heads. Lightly lubricate the threads of the studs and the thrust faces of the two nuts. Fit the setscrews and the nuts and tighten them finger tight.




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## 6.6 CRANKSHAFT

### A. TO REMOVE AND TO FIT



***WARNING***

- *Use lift equipment or obtain assistance to lift heavy engine components such as the flywheel, the flywheel housing and the crankshaft.*

***NOTE:***

- *Perkins recommends, for safety reasons, that this operation is done with the engine upside down.*

  *This will ensure that the crankshaft can be lifted out. Also the pistons will be retained in the cylinder bores.*

**a. To Remove**

1. Before the engine is removed from the vehicle or from the machine, drain the lubricating oil and the coolant.
2. Remove the fan and the drive belt.
3. Remove the crankshaft pulley, operation (2-6.2A).
4. Remove the timing case cover, operation (2-7.2A).
5. Remove the idler gear, operation (2-7.4A).
6. Remove the front bridge piece, operation (2-7.8A).
7. Remove the starter motor, see section (2-14). Remove the flywheel and the flywheel housing, see section (2-14).
8. Remove the rear oil seal housing, operation (2-6.3A).
9. Remove the lubricating oil pan, operation (2-11.4A).
10. Remove the lubricating oil suction pipe, the delivery pipe, and the lubricating oil pump see section (2-11).
11. Release and remove the bolts and nuts of the connecting rods. Remove the big end bearing caps. Keep the bearings and with the relevant caps, see operation (2-5.5A).
12. Ensure that the tops of the main bearing caps are stamped with their relevant position number. Release and remove the setscrews for the main bearing caps. Remove the main bearing caps, the lower half of the shell bearings and the upper and lower thrust washers. Keep the bearings with the relevant caps.
13. Lift out the crankshaft. Remove the upper half of the bearings and keep each bearing with its relevant lower half and cap.

***NOTE:***

- *If the main bearings are to be used again, they must be fitted in the same positions from which they were removed.*

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# 11. LUBRICATION SYSTEM

## 11.1 GENERAL DESCRIPTION

Pressure lubrication is supplied by a rotor type pump which is driven through an idler gear from the crankshaft gear. The pump has an inner rotor and an outer rotor which are off-centre to each other.

The inner rotor has three lobes which mesh with the four lobes of the outer rotor. When the pump rotates, the space between the lobes of the outer rotor which are in mesh increases to cause a suction or decreases to cause a pressure increase.

Lubricating oil (A1) from the oil pan passes through a strainer and pipe to the suction side of the pump.

The lubricating oil, at increased pressure (A2), passes from the outlet of the pump to the relief valve, which is fitted into the oil pump body. As engine speed increases the output of the oil pump increases, and more oil flows into the system. The increase in flow causes an increase in pressure in the system. When the oil pressure on the plunger of the relief valve is greater than the spring pressure, the valve will open. When the valve opens, surplus oil is returned to the oil pan. This action will reduce the oil pressure and the valve will close.

Lubricating oil (A2) from the relief valve, passes through a pipe to the full flow oil filter. The oil filter is fitted to the left side of the engine.

Engines fitted with a turbocharger have an external lubrication circuit (A5). Lubricating oil passes from a channel drilled between the oil filter outlet and the pressure rail, through an external oil supply pipe to the inlet of the turbocharger. The oil lubricates the shaft and bearings and is gravity drained from the turbocharger through an external oil drain pipe back to the oil pan.

The lubricating Oil Passes from the filter to the pressure rail which is drilled the complete length of the left side of the cylinder block.

Lubricating oil passes from the pressure rail, through passages in the main journals of the crankshaft, to the main bearings. Lubricating oil also passes through passages in the crankshaft to the big end bearings. The small end bearings, the pistons and the cylinder bores are lubricated by splash and oil mist (A3).

Lubricating oil passes from the pressure rail through a hole drilled across the front of the cylinder block, which connects with a vertical passage to the front of the cylinder head. The hub of the idler gear is lubricated by oil from the pressure rail and the timing gears are splash lubricated.

Oil passes through a passage from the front of the cylinder head to a restriction in the first pedestal of the rocker shaft. The restriction reduces the oil pressure to lubricate the rocker assembly. The oil passes (A4), through the rocker shaft to the bore of each of the rocker levers and leaves the bores through holes in the top of the rocker levers. Oil passes along channels in the top of the rocker levers to the valve stems, the valve springs and the tappets which are lubricated by splash and oil mist.

Lubricating oil from the rocker shaft drains from the cylinder head into an oil reservoir below the camshaft. The camshaft and its journals is lubricated by splash. Excess oil which passes from the reservoir into the timing case lubricates the gears. Lubricating oil from the timing case returns to the oil pan.

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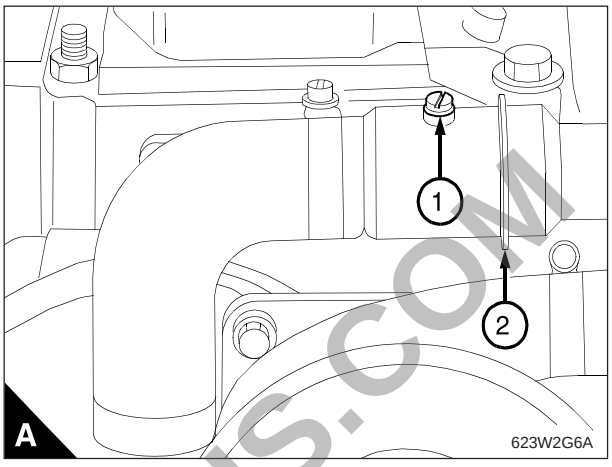
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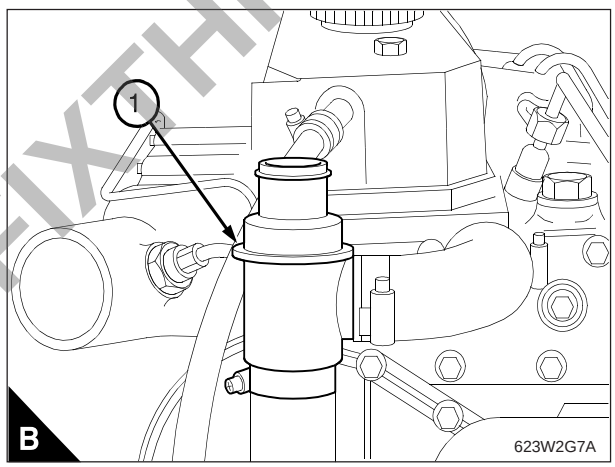
## 13.2 THERMOSTAT

The thermostat is held in a sealed brass housing which is held in position by three hoses: the top radiator inlet hose, the by-pass hose to the coolant pump and the outlet hose from the cylinder head.

The thermostat housing can be fitted in the horizontal position (A) or the vertical position (B) in accordance with the engine application.

If the thermostat does not operate correctly the complete assembly must be replaced.




### A. TO REMOVE, TO FIT AND TO TEST

#### a. To Remove

1. Drain the cooling system, until the coolant level is below the thermostat position.
2. Release the clips of the three thermostat hose connections. Remove the thermostat unit from the hoses.

#### b. To Fit

1. Ensure that the hose connections are clean and that the jiggle pin fitted inside the thermostat valve is free to move.

**CAUTION**

- *The flange (A2) or (B1) must be toward the radiator connection when the thermostat is fitted. If the assembly is fitted incorrectly, the engine will overheat as the flow of coolant will not pass through the radiator.*

2. Put the new thermostat into position on the three hoses, if the thermostat is fitted horizontally (A), ensure that the vent screw (A1) is at the top. If the thermostat is fitted in the vertical position (B), ensure that the flange on the thermostat body is at the top (B1) and is connected to the radiator hose.

**CAUTION**

- *If the thermostat is fitted horizontally, it is important to eliminate air from the cooling system when it is filled. Ensure that the vent screw (A1) is released until it tightens. When coolant, free from air flow from the vent point, tighten the vent screw 3 ~ 4 N·m (2 ~ 3 lbf·ft).*

3. Tighten the three hose clips. Fill the cooling system.

#### c. To Test

**CAUTION**

- *If the thermostat does not operate correctly, it must be replaceed. Do not try to adjust the settings.*

1. Hang the thermostat unit in a suitable container filled with coolant.
2. Heat the coolant gradually. Use a thermometer to check the temperature at which the valve starts to open and at which it is fully open. The correct temperature is given in the data and dimensions.



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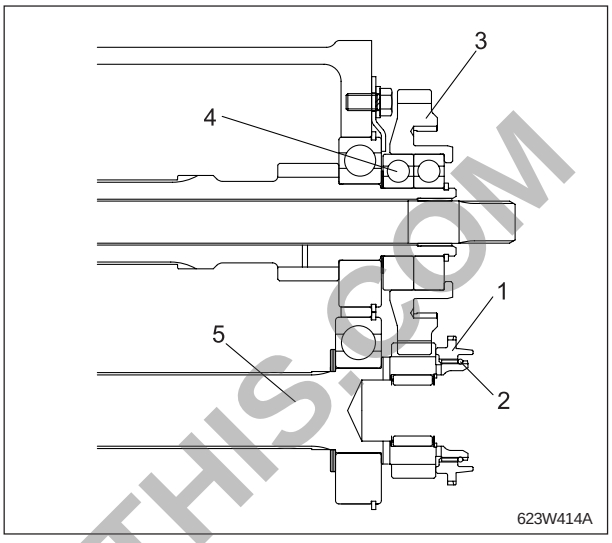
## 2.9 42 GEAR, AUXILIARY SHIFT SYNCHRONIZER RELATION

### A. DISASSEMBLING

1. Disassemble tightening ring (2) in the auxiliary shift synchronizer gear and then disassemble auxiliary shift synchronizer gear (1) and 42 gear (3).

### B. ASSEMBLING

1. Assemble 42 gear (3) to the rim of 6208 NR bearing (4).
2. After assembling the auxiliary shift synchronizer gear (1) to 20 gear shaft (5) spline section by tapping it lightly, fix it with a holding ring (2).




(1) Auxiliary Shift Synchronizer Gear
(2) Holding Ring
(3) 42 Gear
(4) Bearing
(5) 20 Gear Shaft

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## 4.8 REAR DIFFERENTIAL GEAR OPERATION TROUBLES

| Symptom | Probable Causes | Solution |
|---|---|---|
| Rear differential pedal is loose. | 1. Non-assembling of adjusting spring. | Assemble |
| | 2. Non-assembling of clevis pin to be mounted on the differential adjusting fork. | Assemble |
| Differential pedal does not return. | 1. Non-assembling of differential spring. | Assemble |
| | 2. Non-assembling of fixing spring. | Assemble |
| | 3. Fitting of differential fixing fork. | Replace |
| | 4. Fitting to differential fork rod and transmission case. | Replace |
| Rear differential section noise/ differential pedal lock gear does not work. | 1. Dog clutch of differential case section broken. | Replace |
| | 2. Improper adjustment of backlash of spiral bevel gear and pinion gear. | Adjust |
| | 3. Spiral bevel gear and pinion gear tooth surface broken. | Replace |
| | 4. Differential pinion shaft broken, differential bevel gear broken. | Replace |

## 4.9 REAR AXLE OPERATION TROUBLES

| Symptom | Probable Causes | Solution |
|---|---|---|
| Rear axle noise | 1. 13 gear shaft, 56 internal gear, 21 planetary gear broken. | Replace |
| | 2. Oil gear support plate clearance due to 13 gear shaft non-assembling of fixing plate. | Assemble |
| Rear axle leakage | 1. Brake case and rear axle case assembly section O-ring broken. | Replace |
| | 2. Rear axle bearing cover section O-ring broken. | Replace |
| | 3. Rear axle bearing cover oil seal broken. | Replace |

## 4.10 PARKING BRAKE OPERATION TROUBLES

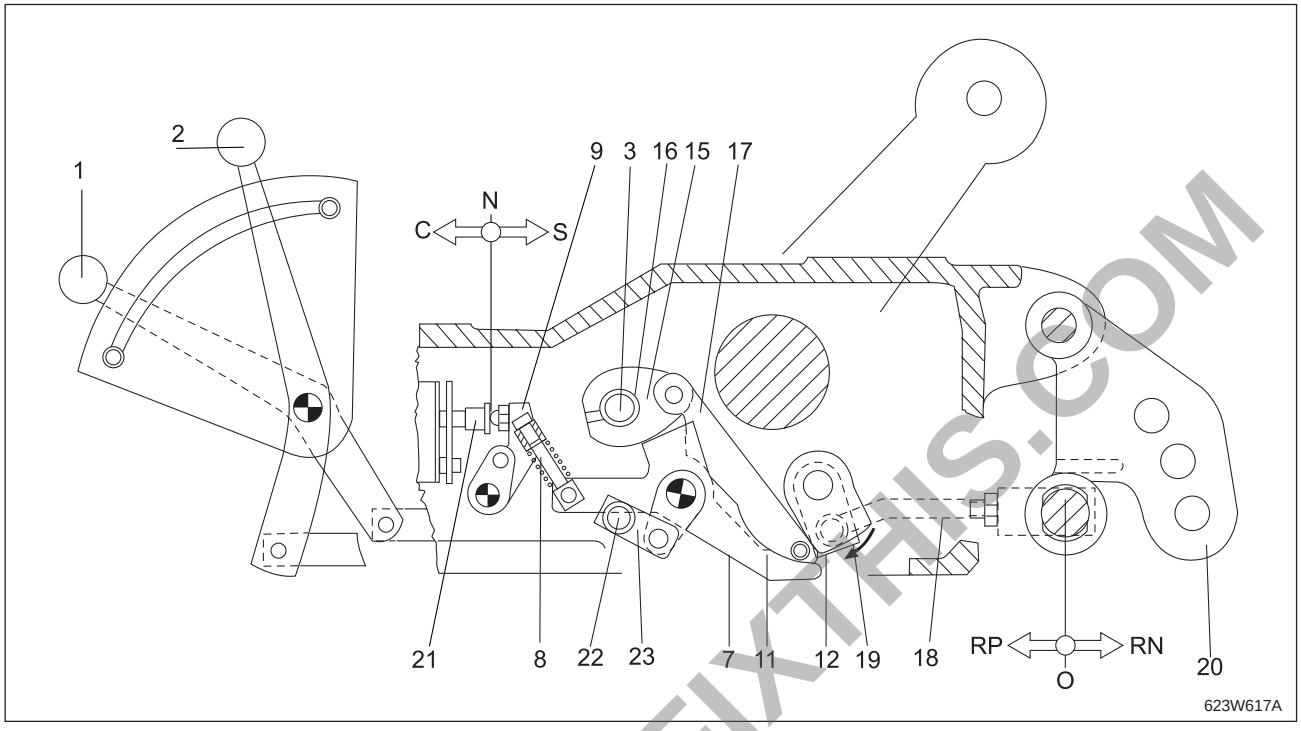
| Symptom | Probable Causes | Solution |
|---|---|---|
| Parking brake clearance (more/less) | 1. Improper adjustment of parking brake wire. | Readjust |
| Parking brake does not work | 1. Improper assembling position of parking brake disc. | Reassemble |
| | 2. Non-assembly of parking brake cam. | Assemble |
| Parking brake lever section leakage | 1. O-ring damaged. | Replace |

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**Mechanism of Drawbar Pull Control**




(1) Position Control Lever
(2) Drawbar Pull Control Lever
(4) Crank
(7) Flywheel
(8) Shock Absorber
(9) Relaying Lever
(11) Roller
(12) Car
(15) Crank
(16) Drawbar Pull Control Shaft
(17) Tension Rod
(21) Shaft
(22) Pin
(23) Tension Rod

- When the position control lever (1) is shifted to the bottom along the lever guide, the crank (4) reaches the highest point CCW. The position roller (5) is lowered completely from the incline of position control cap (6). This causes the CCW rotation of flywheel (7) and CW rotation of relaying lever (9). Relaying lever (9) locates at exhaust position, “S”, pushed by the spring of spool lever shaft (21). This way, the position control lever is not interfered by the functioning of drawbar pull control.

- When drawbar pull control lever (2) is shifted to the utmost upper position, drawbar pull control shaft (16) rotates CW. Crank (15) linked with the shaft (16), reaches the far end by CW rotation. Tension rod (17) rotates the roller (11), and acts on the drawbar pull cam (12). This action rotates the flywheel (7) CW, and relaying lever (9) rotates CCW by shock absorber (8).

  Therefore, lift arm ascends when valve spool shaft (21) is located at supply position “C”.

- Lift arm stops immediately when the piston contacts limiter stop pin (22). Limiter stop rotates lever (9) CW through the tension rod (23). Therefore spring of shock absorber (8) is compressed and shaft (21) is withdrawn outward and moves to neutral position, “N”.

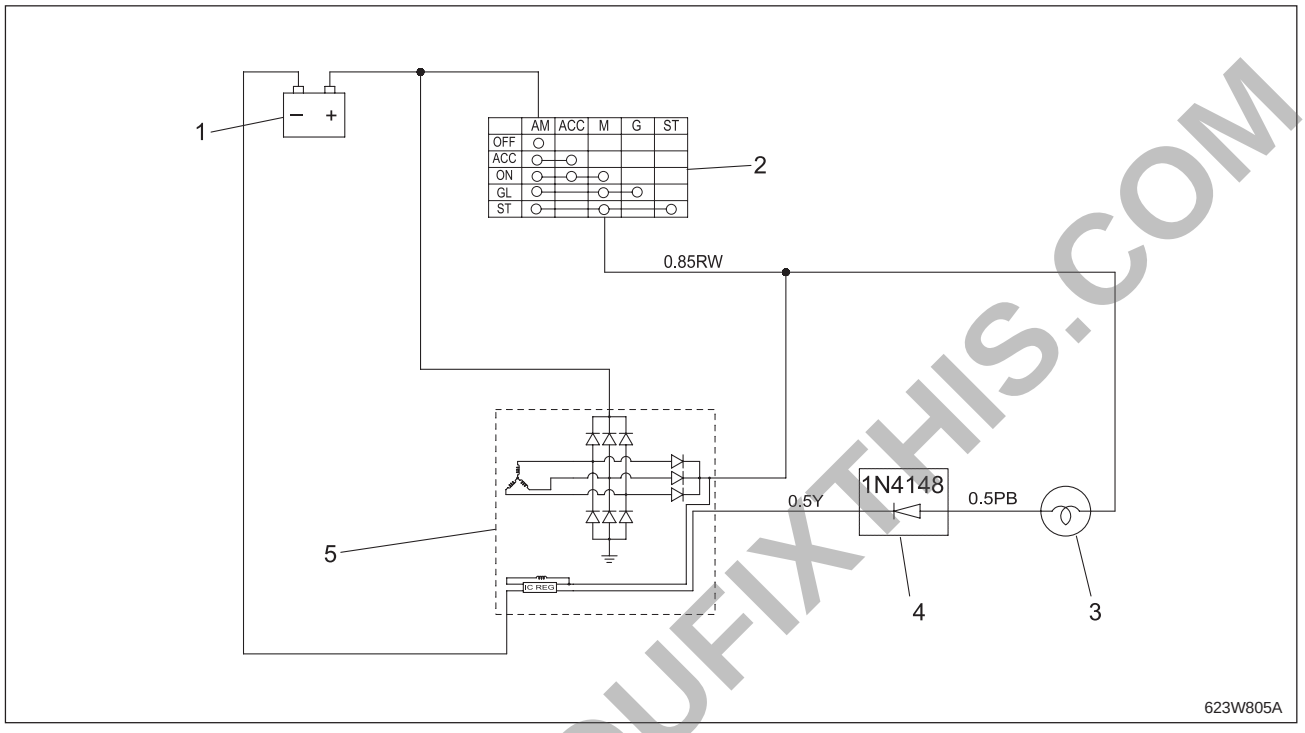
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# 3. CHARGING SYSTEM

## 3.1 CIRCUIT




(1) Battery
(2) Starting Switch
(3) Charging Lamp
(4) Diode
(5) Alternator

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