

# SERVICE MANUAL

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2B1 02467-up 3S1 00060-up  
2B2 00775-up 3S5 00098-up  
2B3 00295-up 3S6 00061-up  
2B5 00883-up  
2B6 01125-up  
2B7 00047-up

## MITSUBISHI TRACTOR BD2GII

## TRACTOR SHOVEL BS3GII

### POWER TRAIN

#### CONTENS

- SYSTEMS OPERATION
- TESTING AND ADJUSTING
- DISASSEMBLY AND REASSEMBLY



**MITSUBISHI**  
HEAVY INDUSTRIES, LTD.



## FOREWORD

This manual has instructions and procedures for the subject on the front cover. The information, specification, and illustrations in this publication are on the basis of information that was current at the time this issue was written.

Correct operation, maintenance, test and repair procedures will give this product a long service life.. Before starting a test, repair or rebuild job, the serviceman must read the respective sections of this manual, and know all the components he will work on.

Safety precautions, skills and knowledge are listed in the descriptions of operations where hazards exist. Warning labels have also put on the machine to provide instructions and identify specific hazards which, if not heeded, could cause bodily injury or death to you or other persons. These labels identify hazards which may not be apparent to a trained mechanic. There are many potential hazards during repair for an untrained mechanic and there is no way to label the machine against all such hazards. These warnings in this manual and on the machine are identified by this symbol:



This manual is divided in three parts, SYSTEMS OPERATION, TESTING AND ADJUSTING and DISASSEMBLY AND REASSEMBLY. In each part, however, a full explanation is not given; the explanation is for the servicemen who have had a basic training or those with wide experience.

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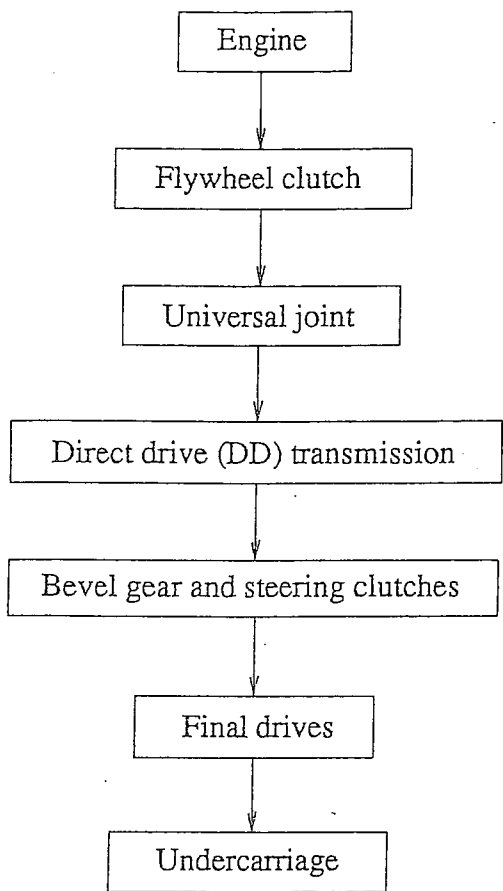


# SYSTEMS OPERATION

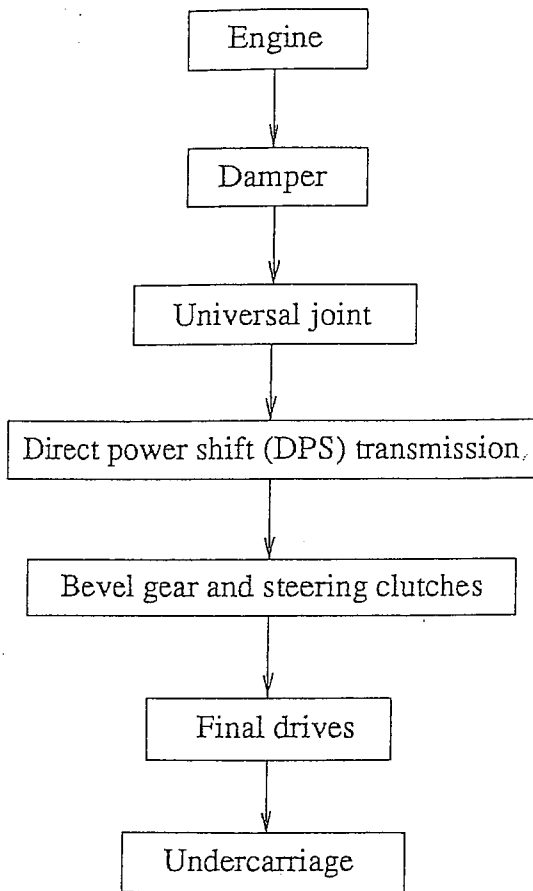
GENERAL INFORMATION

The BD2GII and BS3GII machines are either direct drive type or direct power shift type, the difference being based on the type of a transmission they use.

Direct Drive Type

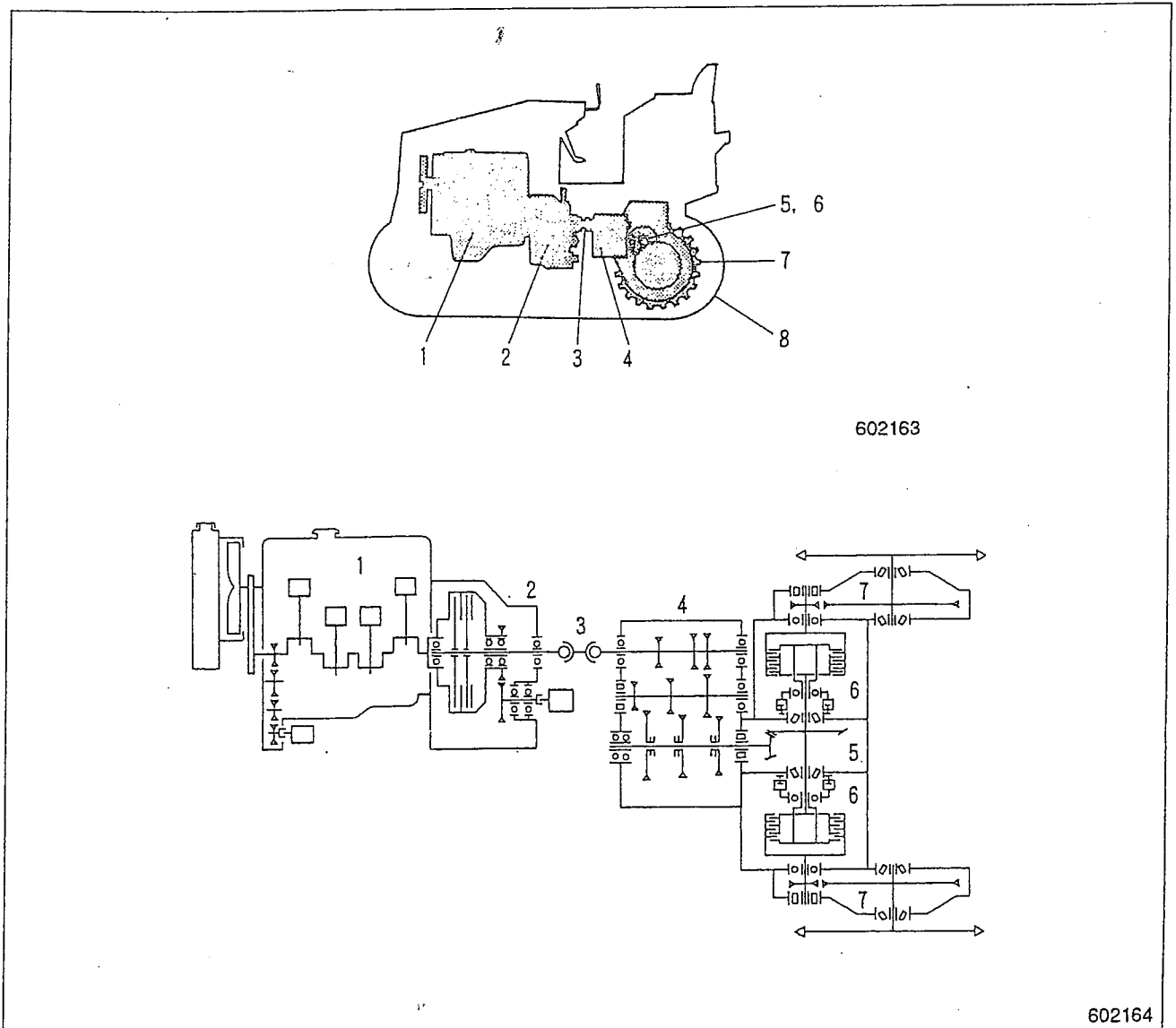


Direct Power Shift Type





Direct Drive (DD)



- |                   |                     |
|-------------------|---------------------|
| 1 Diesel engine   | 5 Bevel gear        |
| 2 Flywheel clutch | 6 Steering clutches |
| 3 Universal joint | 7 Final drives      |
| 4 Transmission    | 8 Undercarriage     |

Power from diesel engine 1 is sent to flywheel clutch 2. The flywheel clutch is engaged and disengaged manually. The output shaft of the flywheel clutch drives the upper (input) shaft in transmission 4 through a universal joint 3.

The transmission has three FORWARD and two REVERSE speeds. The selection of these speeds is done manually. The bevel pinion, at the rear of the transmission, sends the power to bevel gear 5.

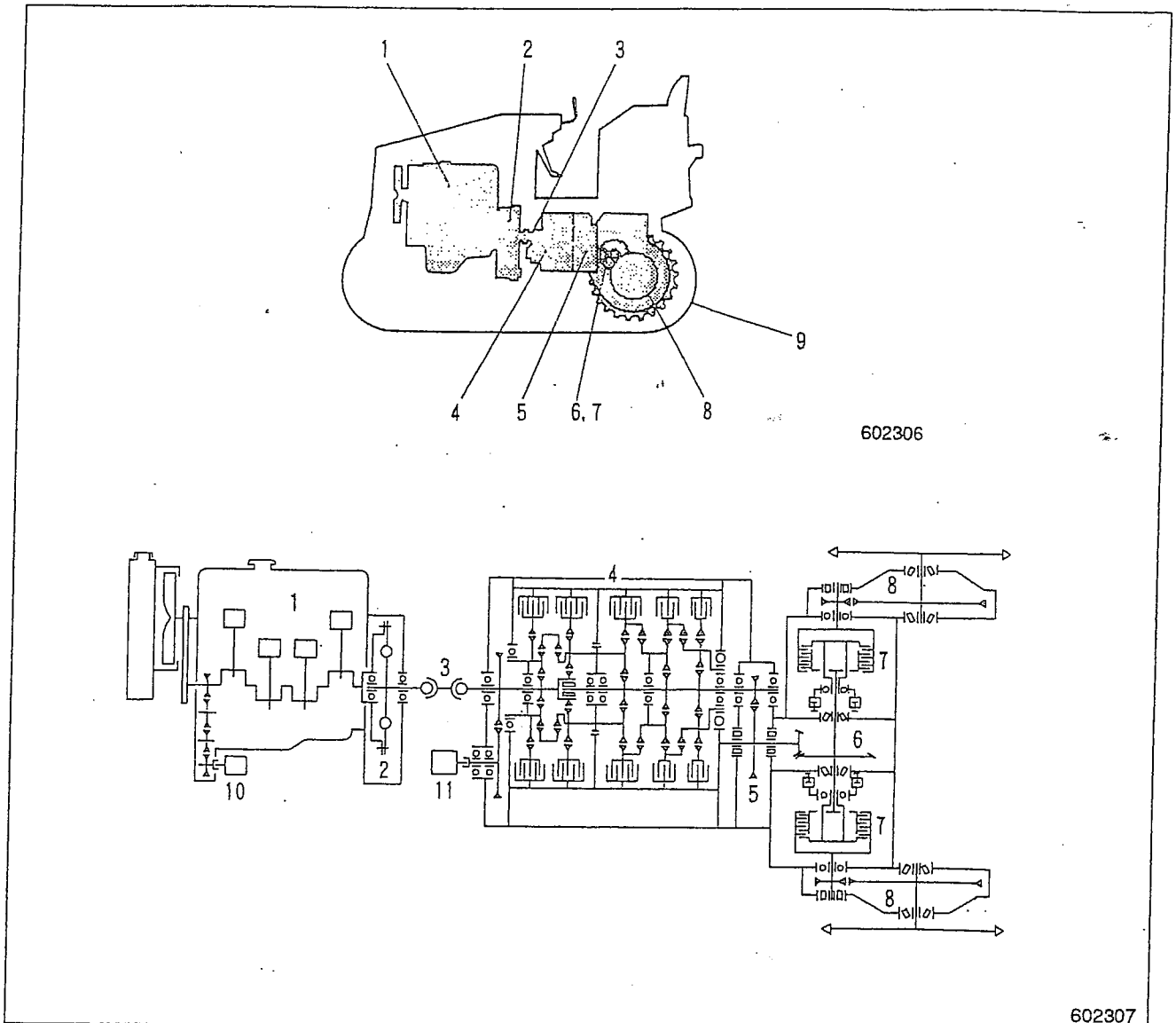
The power is then sent through steering clutches 6 into final drives 7, to the sprockets which drive the tracks.

The engine and flywheel clutch are integrally coupled and are mounted on the frame at four places with cylindrical rubber mounts.

The transmission is housed in its own case which is bolted to the front of the steering clutch cases.



Direct Power Shift (DPS)



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- |                   |                     |                           |
|-------------------|---------------------|---------------------------|
| 1 Diesel engine   | 5 Transfer          | 9 Undercarriage           |
| 2 Damper          | 6 Bevel gear        | 10 Hydraulic oil pump     |
| 3 Universal joint | 7 Steering clutches | 11 Transmission gear pump |
| 4 Planetary gears | 8 Final drives      |                           |

Power from diesel engine 1 is sent through damper 2 to universal joint 3. The universal joint drives the sun gears and planet gears in the transmission.

Five planetary gear trains 4, each with its own clutch, give the machine three speeds in either forward or reverse. The selection of the desired machine speed is done manually by the operator but hydraulic oil, directed by the transmission hydraulic control valve, engages the clutches in the transmission.

The output shaft of the transmission drives the

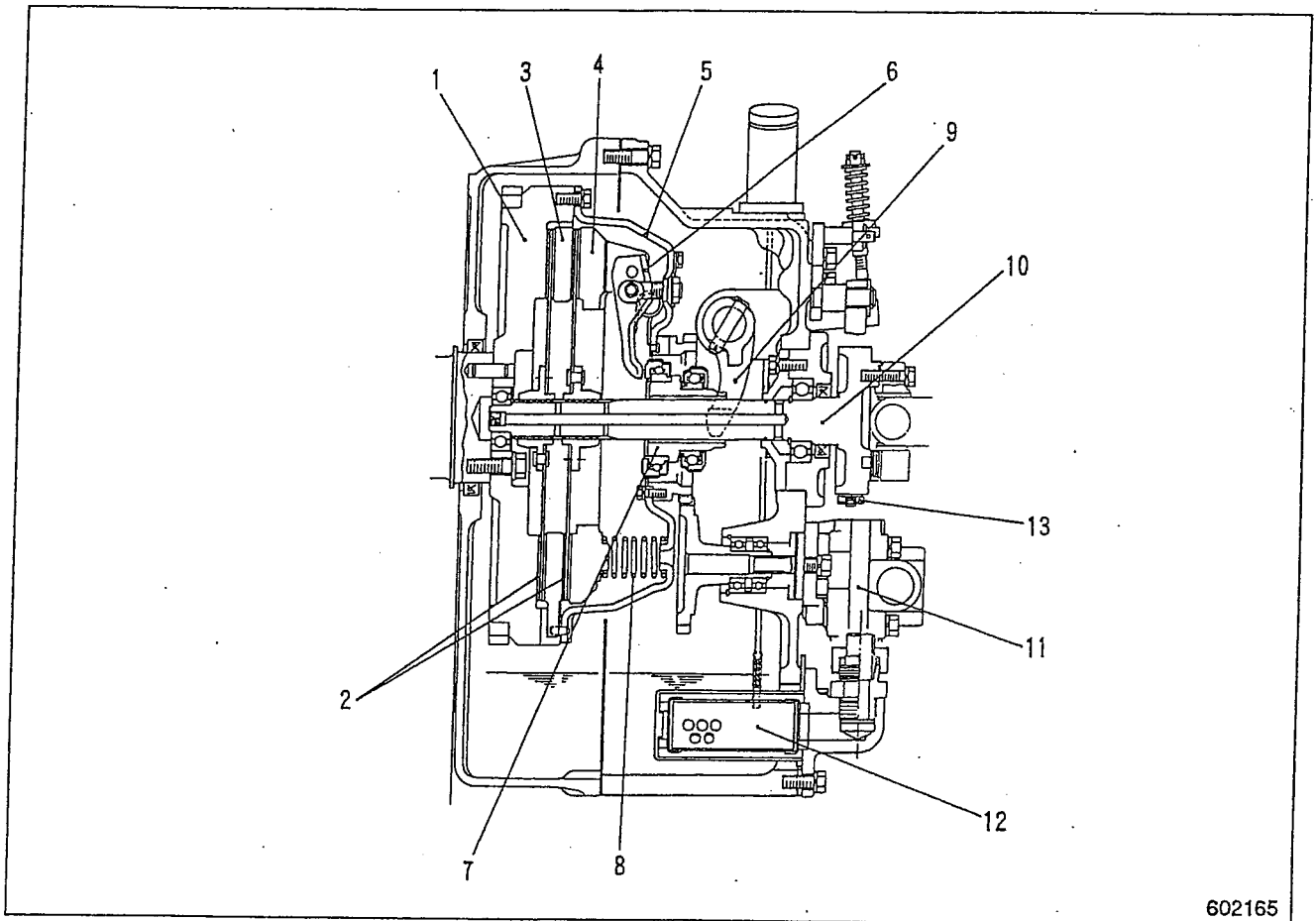
input shaft of transfer 5. The bevel pinion in the transfer sends power to bevel gear 6. The power is then sent through steering clutches 7 into final drives 8, to the sprockets which drive the tracks.

The engine and damper are integrally coupled and are mounted on the frame at four places with cylindrical rubber mounts.

The transmission planetary gears and transfer are housed in their own cases. The transfer case is bolted to the front of the steering clutch cases.



FLYWHEEL CLUTCH

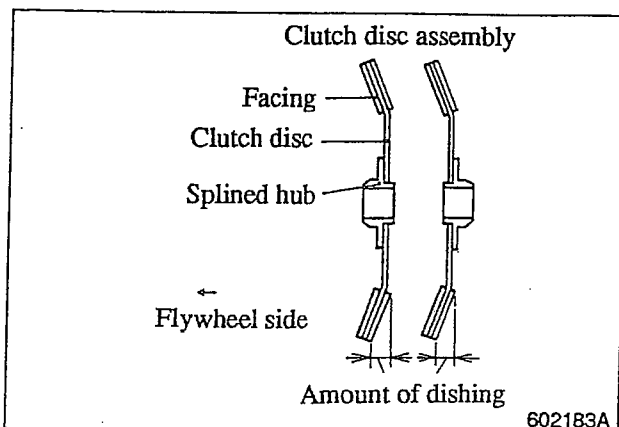


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- |                  |                   |                           |
|------------------|-------------------|---------------------------|
| 1 Flywheel       | 6 Release lever   | 11 Gear pump              |
| 2 Clutch discs   | 7 Release hub     | 12 Oil strainer           |
| 3 Mating plate   | 8 Pressure spring | 13 Clutch (inertia) brake |
| 4 Pressure plate | 9 Fork            |                           |
| 5 Clutch cover   | 10 Main shaft     |                           |

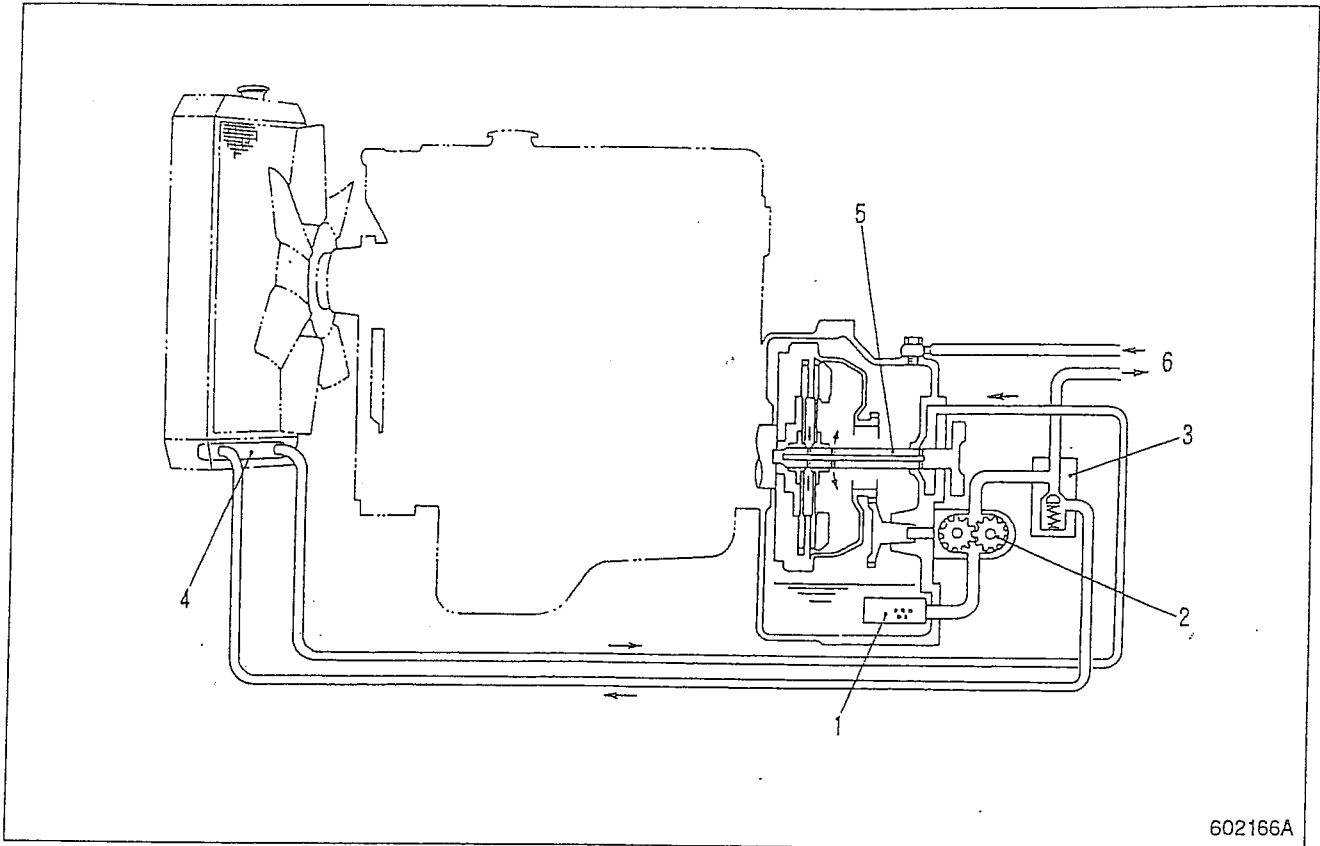
The flywheel clutch is a multiple-disc wet type clutch (running in sprayed oil). This clutch is operated manually and sends the torque from the engine through the universal joint to the transmission.

Clutch discs (driven plates) 2, whose facings have checkered oil grooves, are slightly "dished" to facilitate smooth clutch engagement. Dishing the clutch discs will permit a gradual engagement of the clutch facings with the flywheel and pressure plate. When in the engaged position, the dished clutch discs are pressed flat between the flywheel and pressure plate.



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## CLUTCH HYDRAULIC CONTROL



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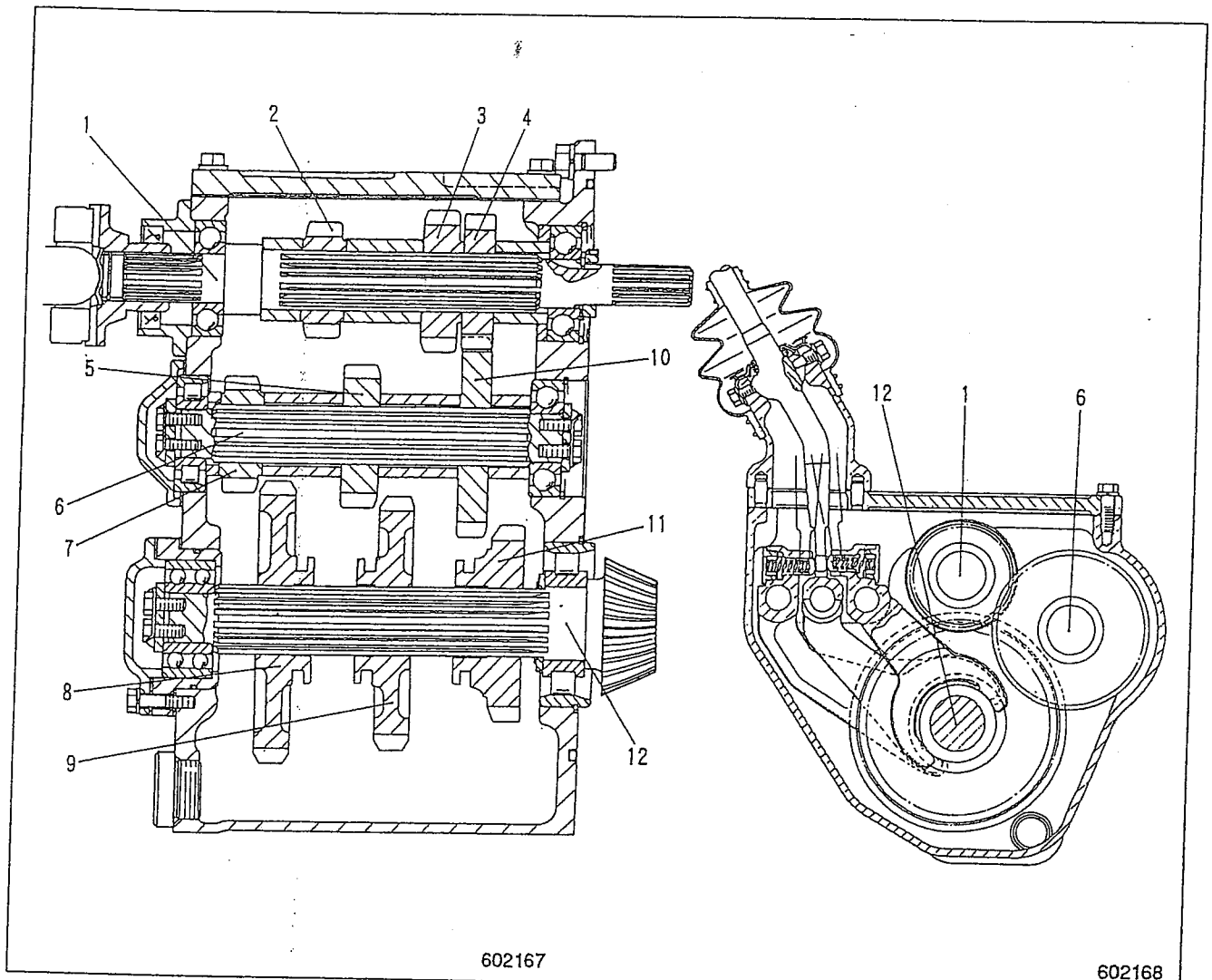
- |                                     |                             |
|-------------------------------------|-----------------------------|
| 1 Oil strainer                      | 4 Oil cooler                |
| 2 Gear pump (for steering clutches) | 5 Clutch main shaft         |
| 3 Relief valve                      | 6 To steering clutch valves |

In the DD machine, oil for the lubrication and cooling of the clutch disc friction surfaces is from the supply used for the operation of the steering clutches.

Oil is pulled from the reservoir through strainer 1 by gear pump 2 and goes to relief valve 3. After this relief valve, the oil flows to the steering clutch valves. The remainder of the oil flows through oil cooler 4 (built in the lower tank of the radiator) to clutch main shaft 5 from which it is sprayed on the clutch discs and pressure plate for lubrication and cooling.

The oil used for actuating the clutch valves is returned to the top of the clutch case for lubrication.

## DIRECT DRIVE (DD) TRANSMISSION



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- |                          |                          |                           |
|--------------------------|--------------------------|---------------------------|
| 1 Input shaft            | 5 2nd-speed drive gear   | 9 2nd-speed sliding gear  |
| 2 1st-speed reverse gear | 6 Countershaft           | 10 Countergear            |
| 3 2nd-speed reverse gear | 7 1st-speed drive gear   | 11 3rd-speed sliding gear |
| 4 Input gear             | 8 1st-speed sliding gear | 12 Bevel pinion shaft ..  |

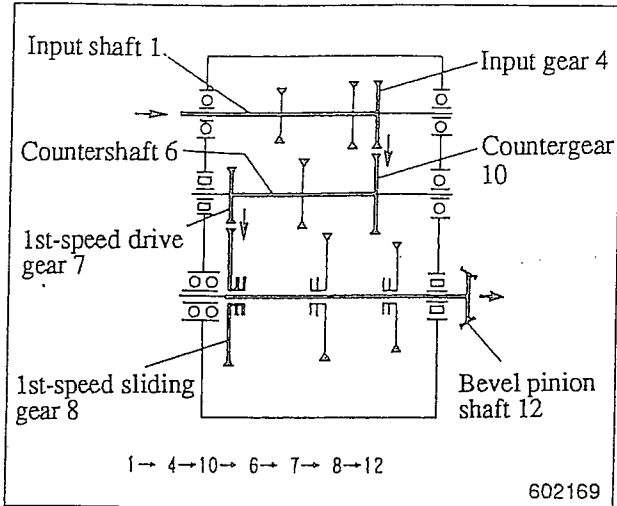
This transmission is a sliding gear type and has three forward and two reverse speeds. The selection of these speeds is done manually.

For the selection of forward speed, sliding gear on the bevel pinion shaft (3rd shaft) is slid into mesh with gear on the countershaft (2nd shaft). For the selection of reverse speed, sliding gear is slid into mesh with gear on the input shaft (1st shaft).

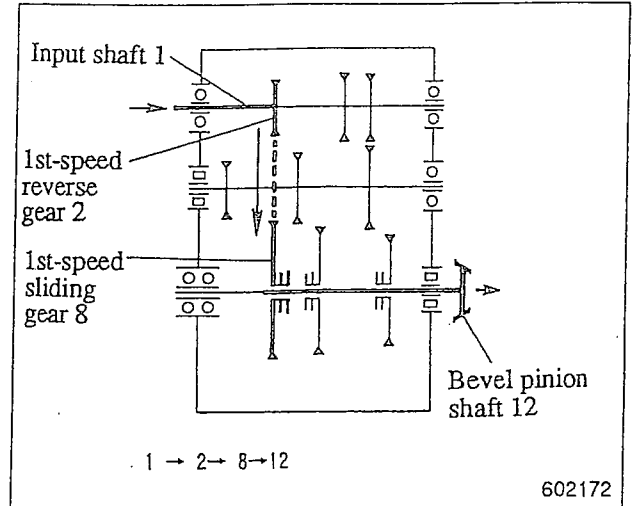
SYSTEMS OPERATION

Power Flow

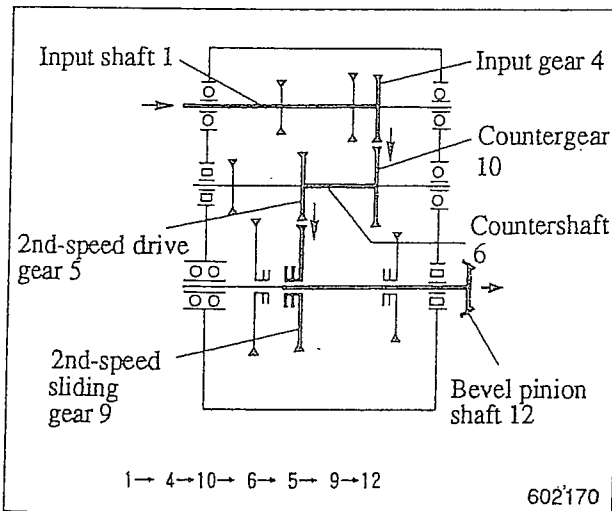
Forward 1st speed position



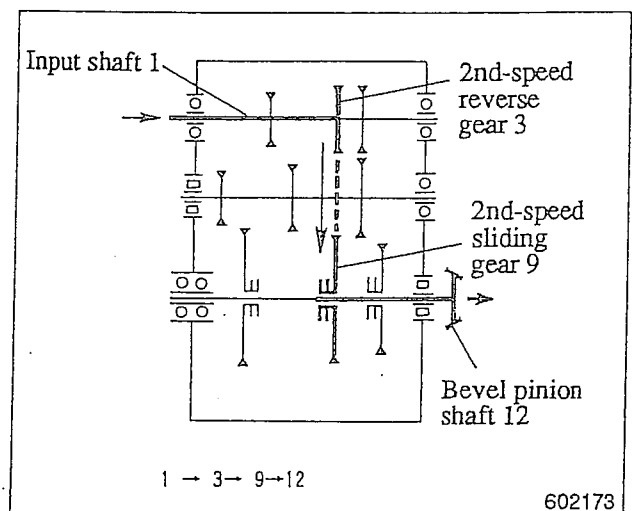
Reverse 1st speed position



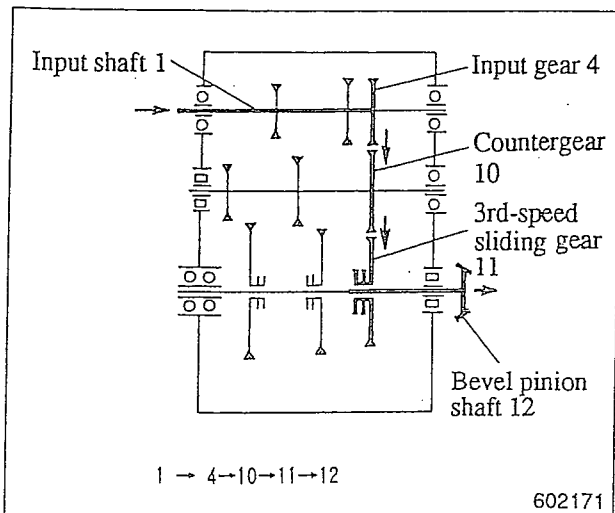
Forward 2nd speed position



Reverse 2nd speed position

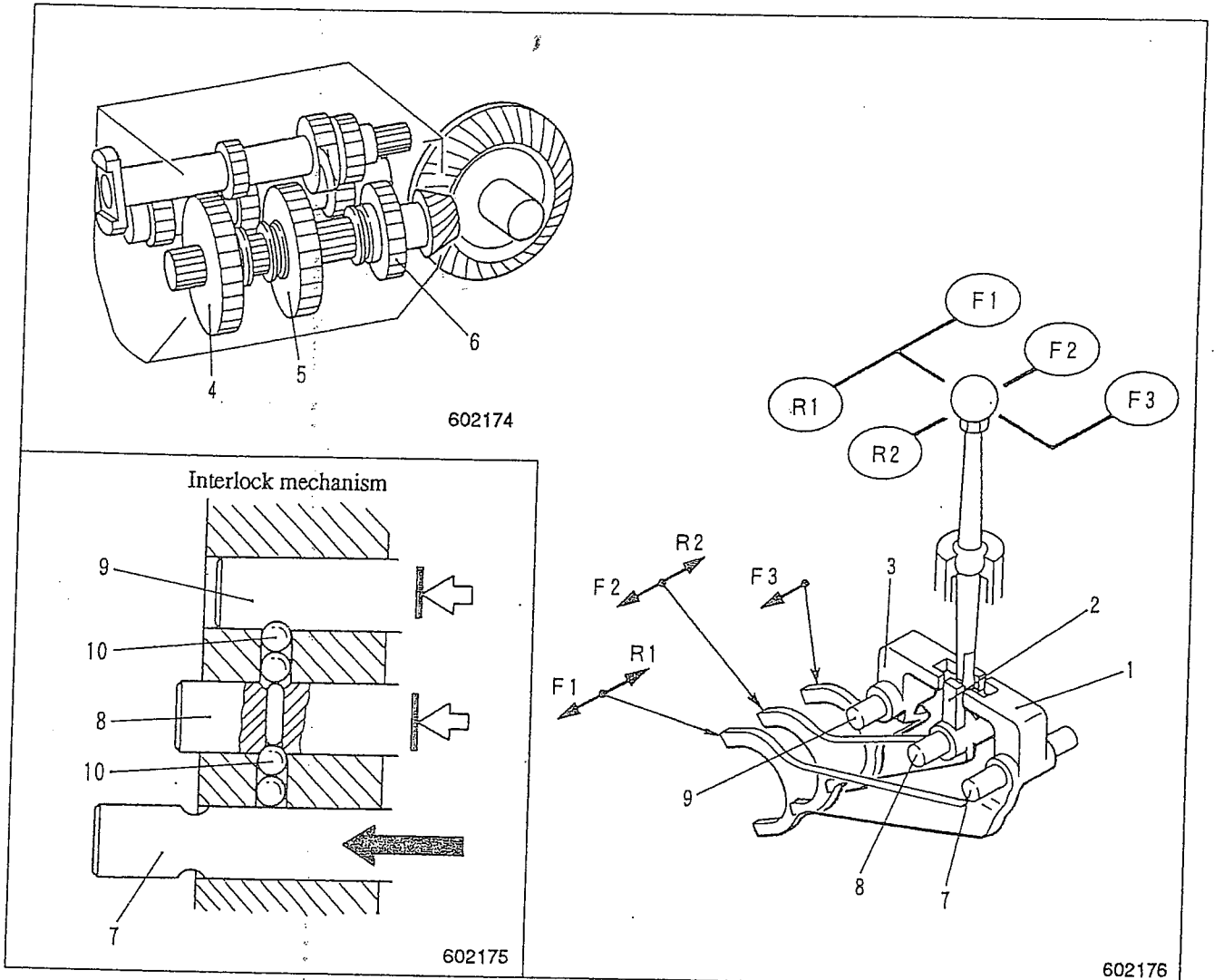


Forward 3rd speed position





TRANSMISSION CONTROL (DD)



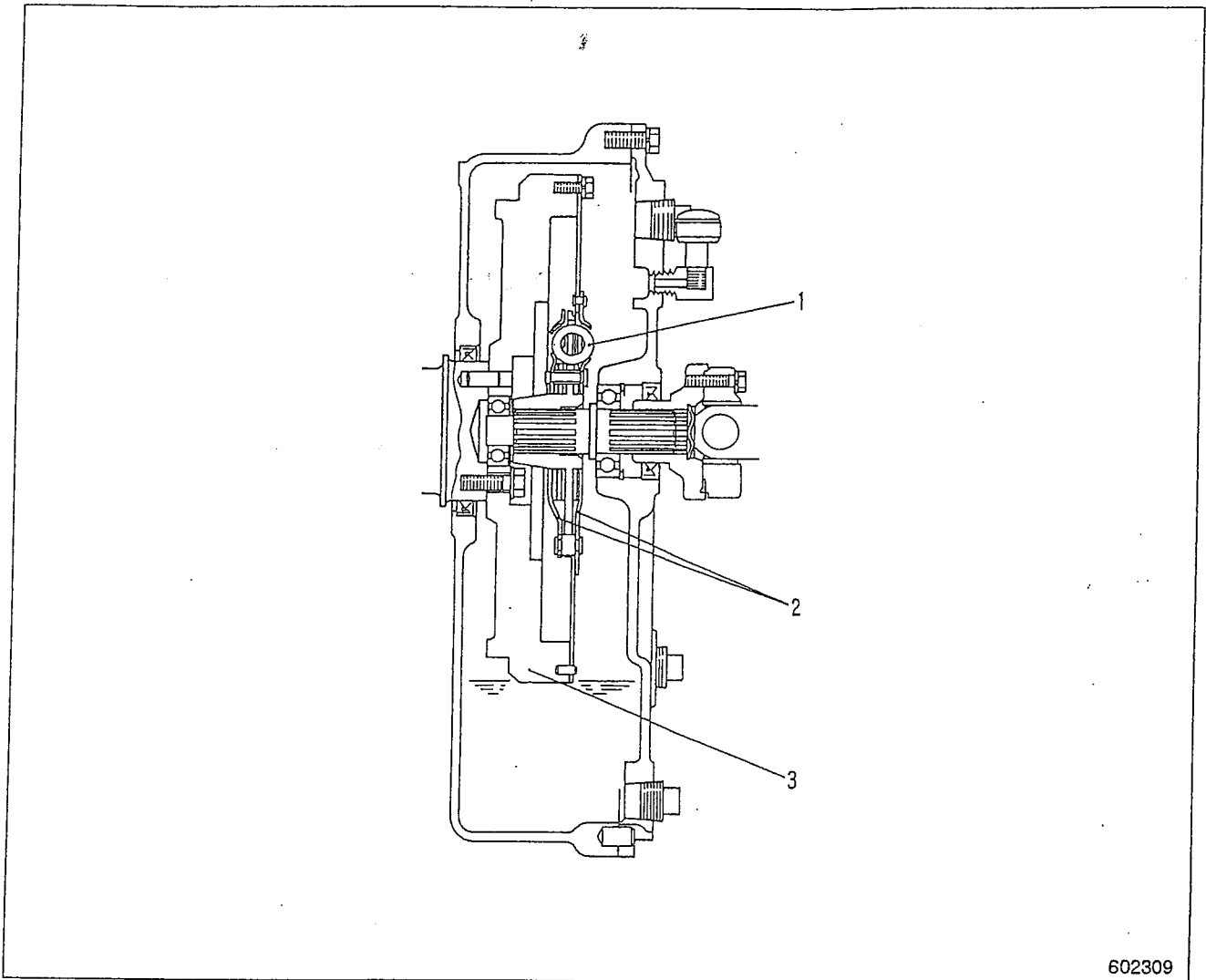
- |                          |                          |                  |
|--------------------------|--------------------------|------------------|
| 1 1st shift fork         | 5 2nd-speed sliding gear | 8 2nd shift rail |
| 2 2nd shift fork         | 6 3rd-speed sliding gear | 9 3rd shift rail |
| 3 3rd shift fork         | 7 1st shift rail         | 10 Steel balls   |
| 4 1st-speed sliding gear |                          |                  |

The transmission control (gearshift mechanism) consists of three shift rails, three shift forks, spring-loaded detent balls and a shift lever. This mechanism is designed so that it is only possible to engage one gear reduction at a time.

The interlock mechanism consists of a pin and steel balls which fit into notches on the shift rails.

If 1st shift rail 7 is moved for making a shift (the shift lever is moved to forward 1st-speed position), for example, 2nd shift rail 8 and 3rd shift rail 9 are locked by the steel balls. This holds the transmission gears so that they will not slide out of position.

DAMPER



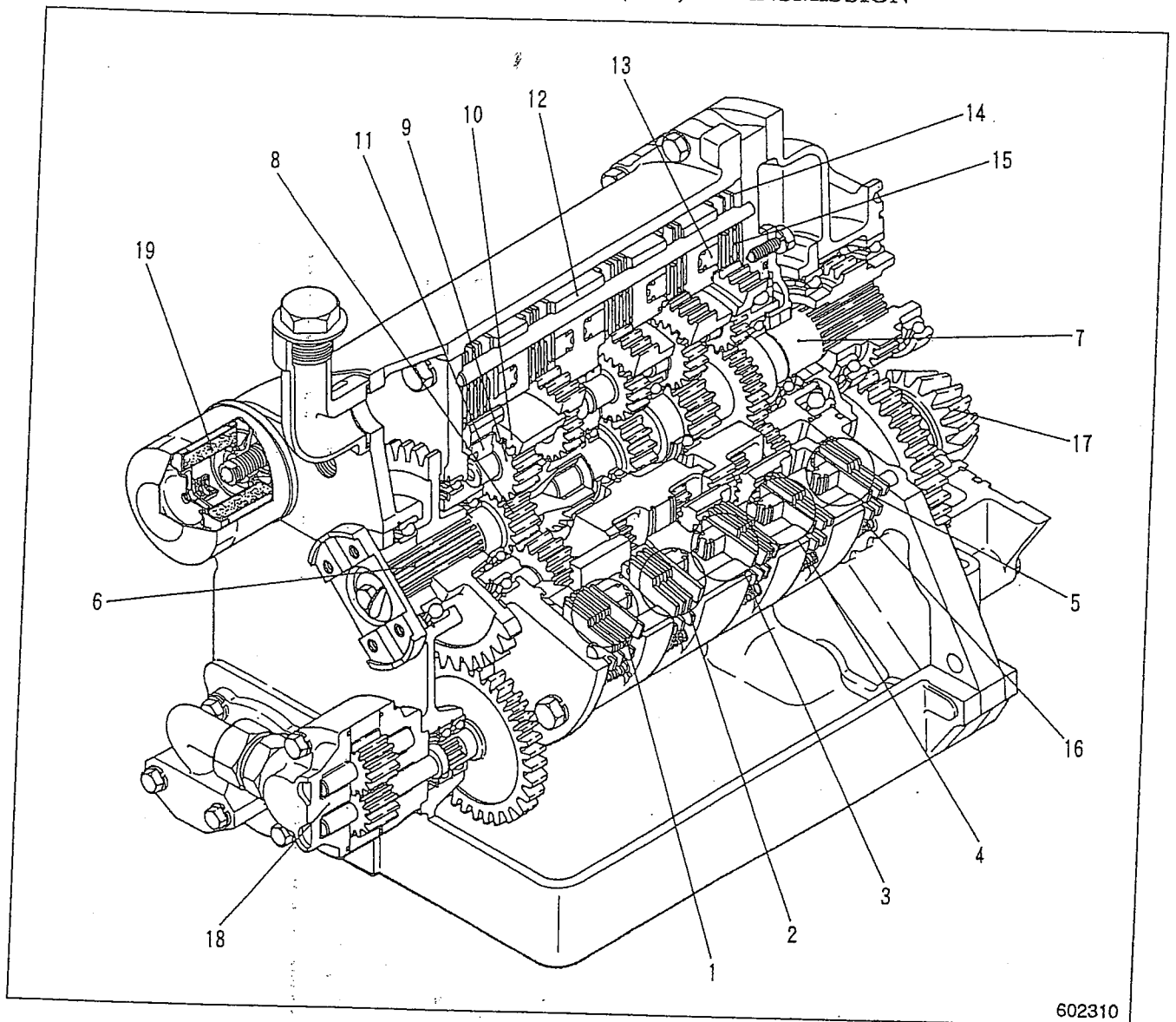
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- 1 Coil spring
- 2 Friction plates
- 3 Flywheel

The damper consists essentially of six coil springs 1 and two friction plates 2. Its hub is splined to the shaft and one of the friction plates is bolted to flywheel 3.

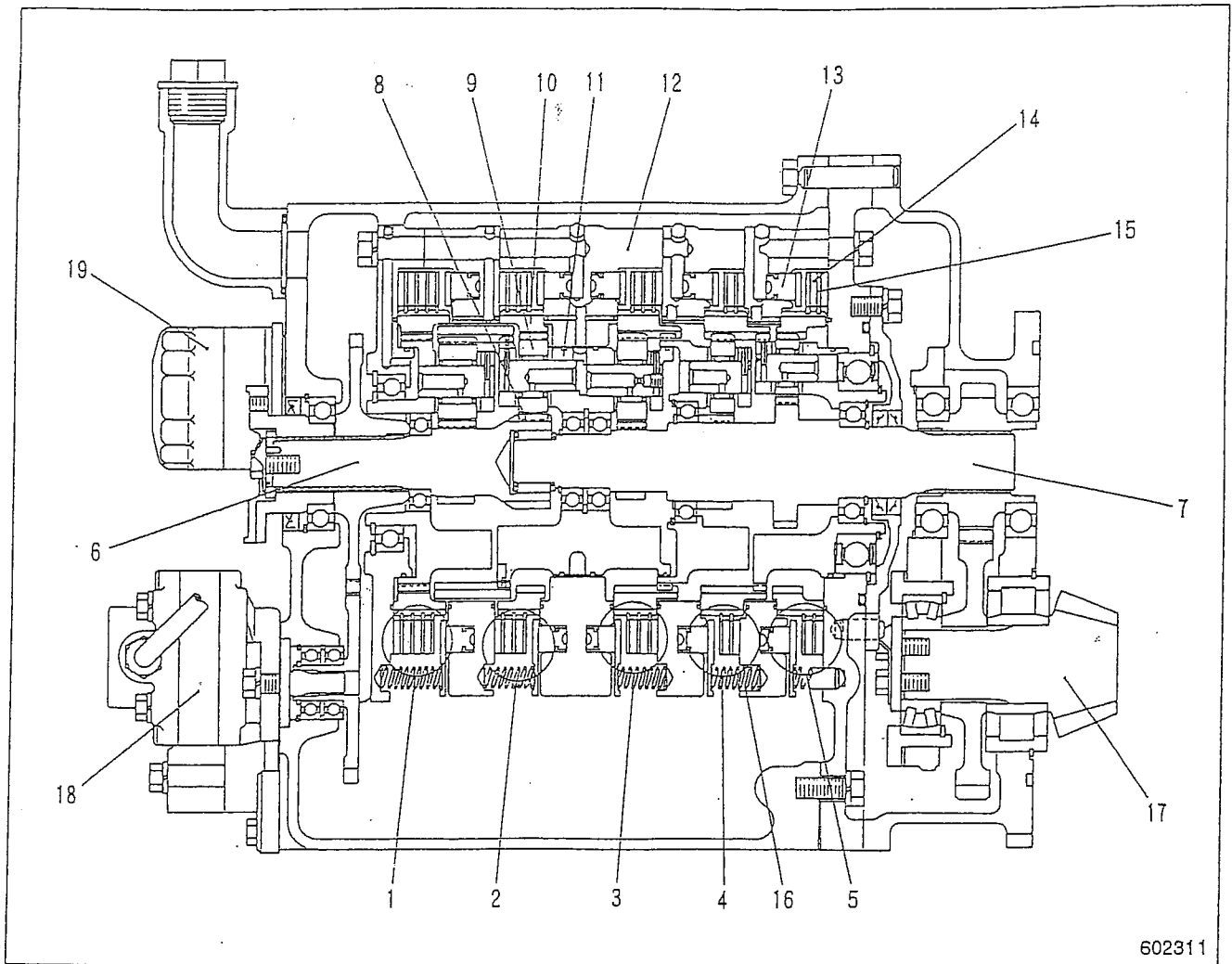
The combination of coil springs and friction plates absorbs power impulse from the engine which would otherwise be transmitted directly to the gears in the transmission as when the engine is quickly accelerated or decelerated and shocks from the ground through power train.

DIRECT POWER SHIFT (DPS) TRANSMISSION



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- |                    |                   |                   |
|--------------------|-------------------|-------------------|
| 1 Reverse clutch   | 8 Sun gear        | 15 Friction plate |
| 2 Forward clutch   | 9 Planet gear     | 16 Return spring  |
| 3 3rd-speed clutch | 10 Ring gear      | 17 Bevel pinion   |
| 4 2nd-speed clutch | 11 Carrier        | 18 Gear pump      |
| 5 1st-speed clutch | 12 Piston housing | 19 Oil filter     |
| 6 Input shaft      | 13 Piston         |                   |
| 7 Output shaft     | 14 Mating plate   |                   |



- |                    |                   |                   |
|--------------------|-------------------|-------------------|
| 1 Reverse clutch   | 8 Sun gear        | 15 Friction plate |
| 2 Forward clutch   | 9 Planet gear     | 16 Return spring  |
| 3 3rd-speed clutch | 10 Ring gear      | 17 Bevel pinion   |
| 4 2nd-speed clutch | 11 Carrier        | 18 Gear pump      |
| 5 1st-speed clutch | 12 Piston housing | 19 Oil filter     |
| 6 Input shaft      | 13 Piston         |                   |
| 7 Output shaft     | 14 Mating plate   |                   |

This transmission consists of five sets of planetary gear train, each having a hydraulically controlled clutch pack, control valve, oil pump, oil filter and their related parts.

The two planetary gear sets on the input side are for directional control — forward or reverse drive — and the remaining three sets on the output side are for speed selection — 1st-speed, 2nd-speed or 3rd-speed drive.

Each planetary gear set comprises sun gear 8, planet gears 9, carrier 11 and ring gear 10. The sun gear rotates; the carrier revolves; and the planet gears rotate on their own shafts or pins and revolve with the carrier, on which they are mounted.

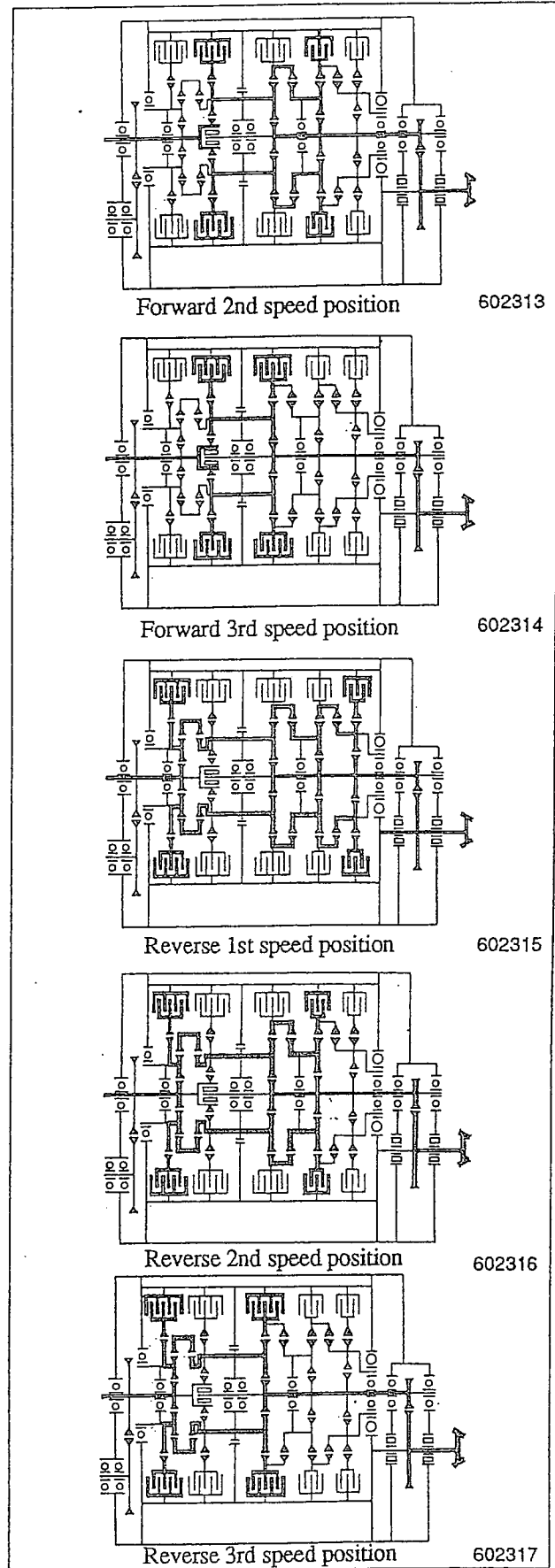
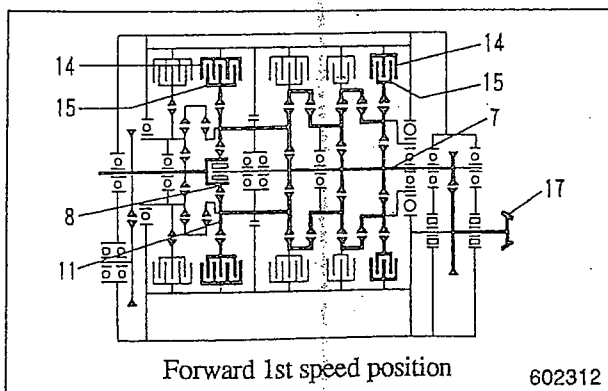
Let us see the paths of power flow in the transmission in forward 1st speed position and in reverse position.

Friction plates 15 are engaged with the external splines of ring gear 10 and mating plates 14 with the internal splines of housing 12. "To engage the clutch" is to admit the pressure oil from the control valve into the piston chamber of housing 12. By the admitted oil, piston 13 pushes the stack of the friction and mating plates to hold them together. "To disengage the clutch" is to relief this pressure. When the pressure is removed from the piston, return springs 16 push the piston back to loosen the stack of the plates.

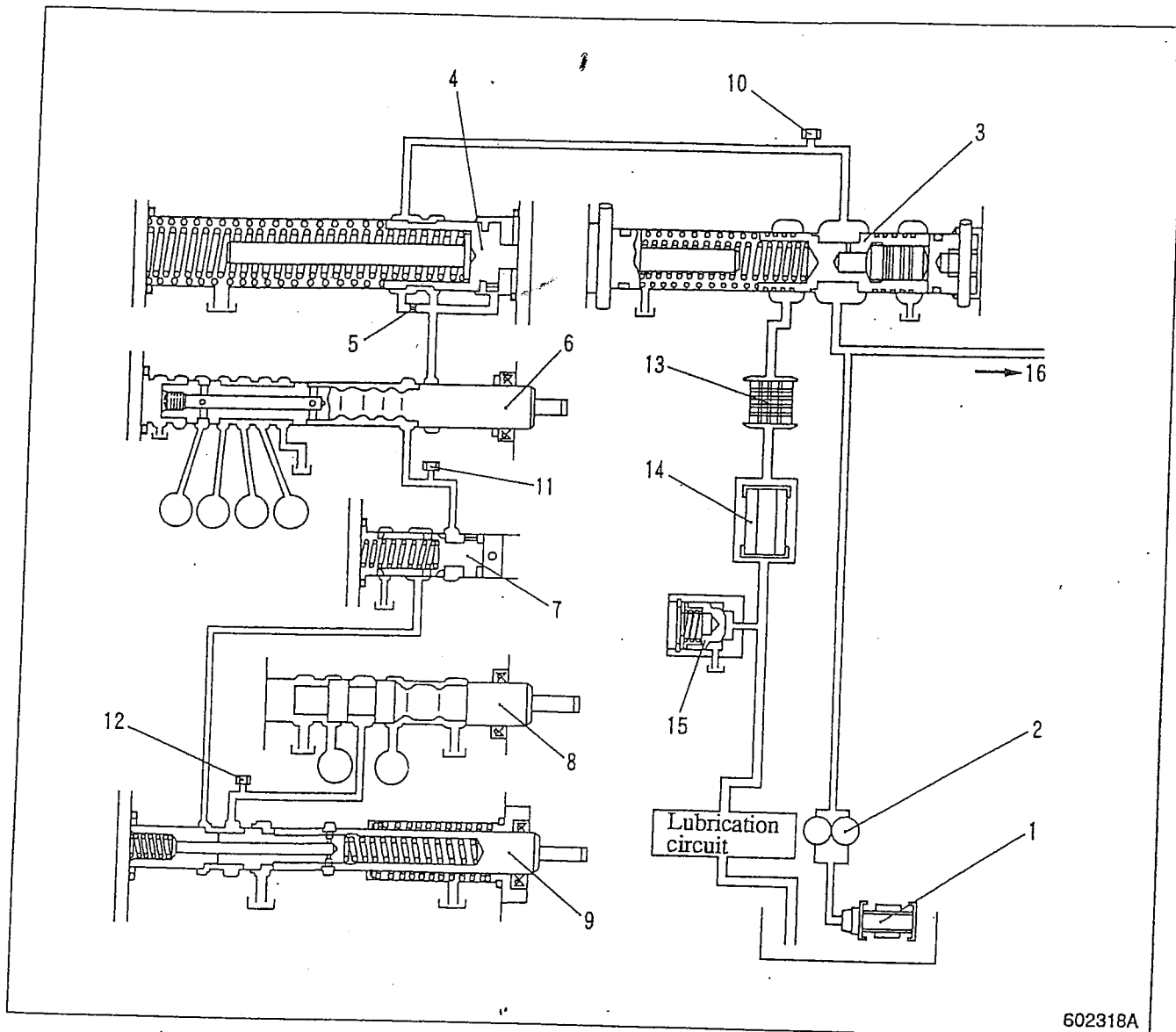
In forward 1st speed position, forward clutch 2 and 1st-speed clutch 5 are engaged. Because forward ring gear 10 is locked, power from input shaft 6 flows to carrier 11 through sun gear 8. From this carrier 11, the power flows to the sun gear of 1st-speed clutch through carrier and then to output shaft 7.

In reverse position, reverse clutch 1 is engaged. In this case, the reverse carrier is locked, and the reverse sun gear and ring gear rotate in reverse direction. The flow of power from this ring gear is similar to that in forward 1st speed drive.

From the output shaft, power flows through single-stage-reduction transfer gear to the bevel pinion.



Transmission Hydraulic Control



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- |  |   |
|--|---|
| <p>1 Suction strainer (with magnet)</p> <p>2 Gear pump</p> <div style="border: 1px solid black; padding: 2px; margin: 5px 0;"> <p>37.7 liters (10 U.S. gal)/min at 2300 engine rpm (40 PS model)<br/>             39.3 liters (10.4 U.S. gal)/min at 2400 engine rpm (50 PS model)</p> </div> <p>3 Main relief valve</p> <div style="border: 1px solid black; padding: 2px; margin: 5px 0;"> <p>19 to 22 kgf/cm<sup>2</sup> (270 to 313 psi) [1.9 to 2.2 MPa]</p> </div> <p>4 Accumulator valve</p> <div style="border: 1px solid black; padding: 2px; margin: 5px 0;"> <p>3 to 13 kgf/cm<sup>2</sup> (43 to 185 psi) [0.3 to 1.3 MPa]</p> </div> <p>5 Main orifice</p> <p>6 Speed selector valve</p> <p>7 Differential valve</p> <div style="border: 1px solid black; padding: 2px; margin: 5px 0;"> <p>Differential pressure: 2 kgf/cm<sup>2</sup> (28 psi) [0.2 MPa]</p> </div> <p>8 Directional selector valve</p> | <p>9 Inching valve</p> <div style="border: 1px solid black; padding: 2px; margin: 5px 0;"> <p>0 to 5 kgf/cm<sup>2</sup> (0 to 71 psi) [0 to 0.5 MPa]</p> </div> <p>10 Main relief pressure tap (M)</p> <p>11 Speed clutch pressure tap (S)</p> <p>12 Directional clutch pressure tap (D)</p> <p>13 Oil cooler (built in radiator lower tank)</p> <p>14 Oil filter</p> <div style="border: 1px solid black; padding: 2px; margin: 5px 0;"> <p>Bypass pressure: 1 kgf/cm<sup>2</sup> (14 psi) [0.1 MPa]</p> </div> <p>15 Lubrication relief valve</p> <div style="border: 1px solid black; padding: 2px; margin: 5px 0;"> <p>1 to 2 kgf/cm<sup>2</sup> (14 to 28 psi) [0.1 to 0.2 MPa]</p> </div> <p>16 To steering valve</p> |
|--|---|

The hydraulic control consists essentially of suction strainer 1, gear pump 2, main relief valve 3, oil cooler 13, oil filter 14, lubrication relief valve 15, control valve and steering clutch hydraulic control.

Suction strainer 1 is a 100-mesh stainless type element with a magnet and serves to protect gear pump 2.

Gear pump 2 is of external gear type and is driven by the gear to which drive is transmitted from the transmission input shaft.

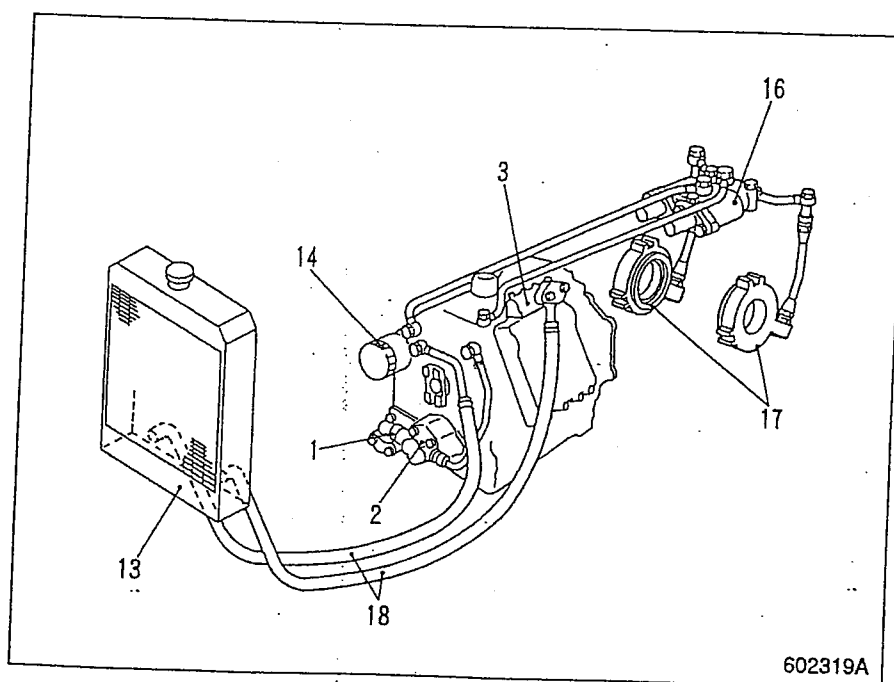
Oil cooler 13 is of multi-plate type and is built in the lower tank of the radiator.

Oil filter 14 is of cartridge type. It opens its bypass circuit when its element is clogged and the pressure difference across it exceeds 1.0 kgf/cm<sup>2</sup> (14 psi) [0.1 MPa] to maintain constant flow of oil to the lubrication circuit.

Lubrication relief valve 15 maintains the oil pressure in the lubrication circuit at 1 to 2 kgf/cm<sup>2</sup> (14 to 28 psi) [0.1 to 0.2 MPa] for protection.

The oil in the oil sump is lifted by gear pump 2 through suction strainer 1. Oil from the pump flows into two circuits, one leading to the steering valve for actuating the steering clutches and the other to main relief valve 3 for actuating the clutch pistons of planetary gears.

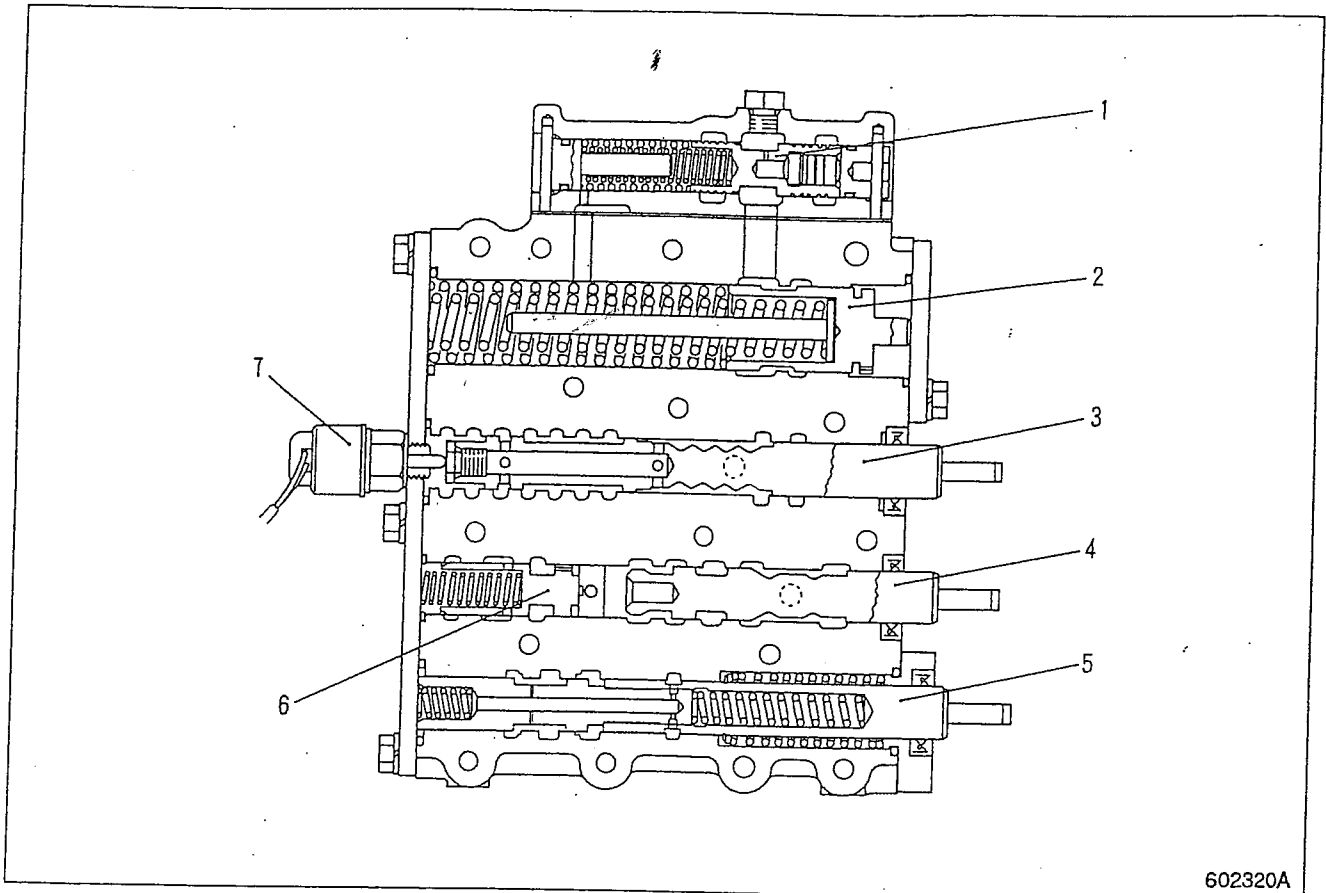
After delivering the main pressure, the excess oil is cooled by oil cooler 13, flows through oil filter 14, lubricates planetary gears and transmission parts, and gravity-returns to the oil sump for recirculation.



- 1 Suction strainer
- 2 Gear pump
- 3 Main relief valve
- 13 Oil cooler
- 14 Oil filter
- 16 Steering valve
- 17 Steering clutch cylinders
- 18 Oil cooler hoses

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Transmission Control Valve



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- |                        |                              |                      |
|------------------------|------------------------------|----------------------|
| 1 Main relief valve    | 4 Directional selector valve | 6 Differential valve |
| 2 Accumulator valve    | 5 Inching valve              | 7 Neutral switch     |
| 3 Speed selector valve |                              |                      |

This control valve comprises accumulator valve 2, inching valve 5, differential valve 6, directional selector valve 4 and speed selector valve 3.

- (1) Accumulator valve 2 gradually rises the oil pressure in the clutch piston chamber to insure smooth clutch engagement (smooth starting).
- (2) Differential valve 6 keeps the pressure applied to the directional clutches (forward and reverse clutches) lower than the pressure applied to the speed clutches (1st-speed, 2nd-speed and 3rd-speed clutches) by 2 kgf/cm<sup>2</sup> (28 psi) [0.2 MPa]. Consequently, the speed clutch is engaged earlier than the directional clutch and the directional clutch serves to transmit the power.
- (3) Directional selector valve 4 directs the oil to

either forward clutch piston chamber or reverse clutch piston chamber.

- (4) Speed selector valve 3 directs the oil to any of the 1st-speed, 2nd-speed and 3rd-speed clutch ports.
- (5) Inching valve 5, actuated by the inching pedal, reduces the pressure in the forward or reverse clutch piston chamber to control the clutch in transition from full engagement to full disengagement for moving the machine in an inching manner.
- (6) Main relief valve 1 maintains the pressure of oil discharged from the pump. Because of this valve, the pressure applied to the clutch piston chambers is always constant and full-flow oil is supplied to the lubrication circuit except when oil is supplied to clutch piston chambers.



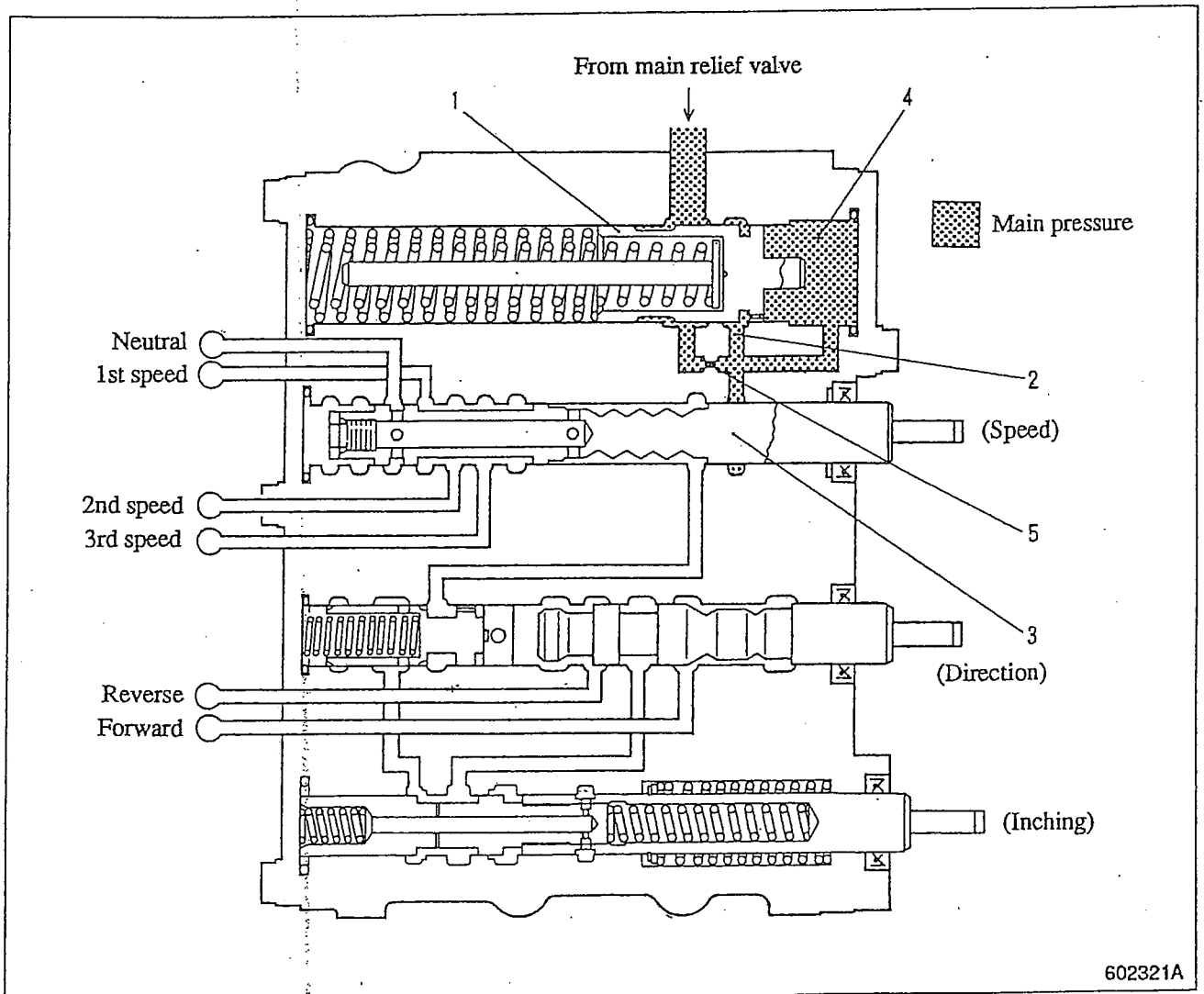
Operation

The control valve operation will be described on the assumption that the transmission control lever is moved from neutral to forward 1st speed position.

[NEUTRAL position]

As the engine starts, main pressure is applied through main port 2 to speed selector valve 3 and accumulator valve pressure chamber 4.

Speed selector valve 3 is in neutral position, covering the port leading to the 1st-speed clutch piston chamber. As the pressure rises in the chamber 4, accumulator valve 1 moves to the left to cover main port 2. Now, a circuit through main orifice 5 is formed to allow the oil from the pump to flow into pressure chamber 4 for pressure accumulation. This pressure accumulation continues until the accumulator valve comes to the left end of its stroke.



SYSTEMS OPERATION

[FORWARD 1ST SPEED position]

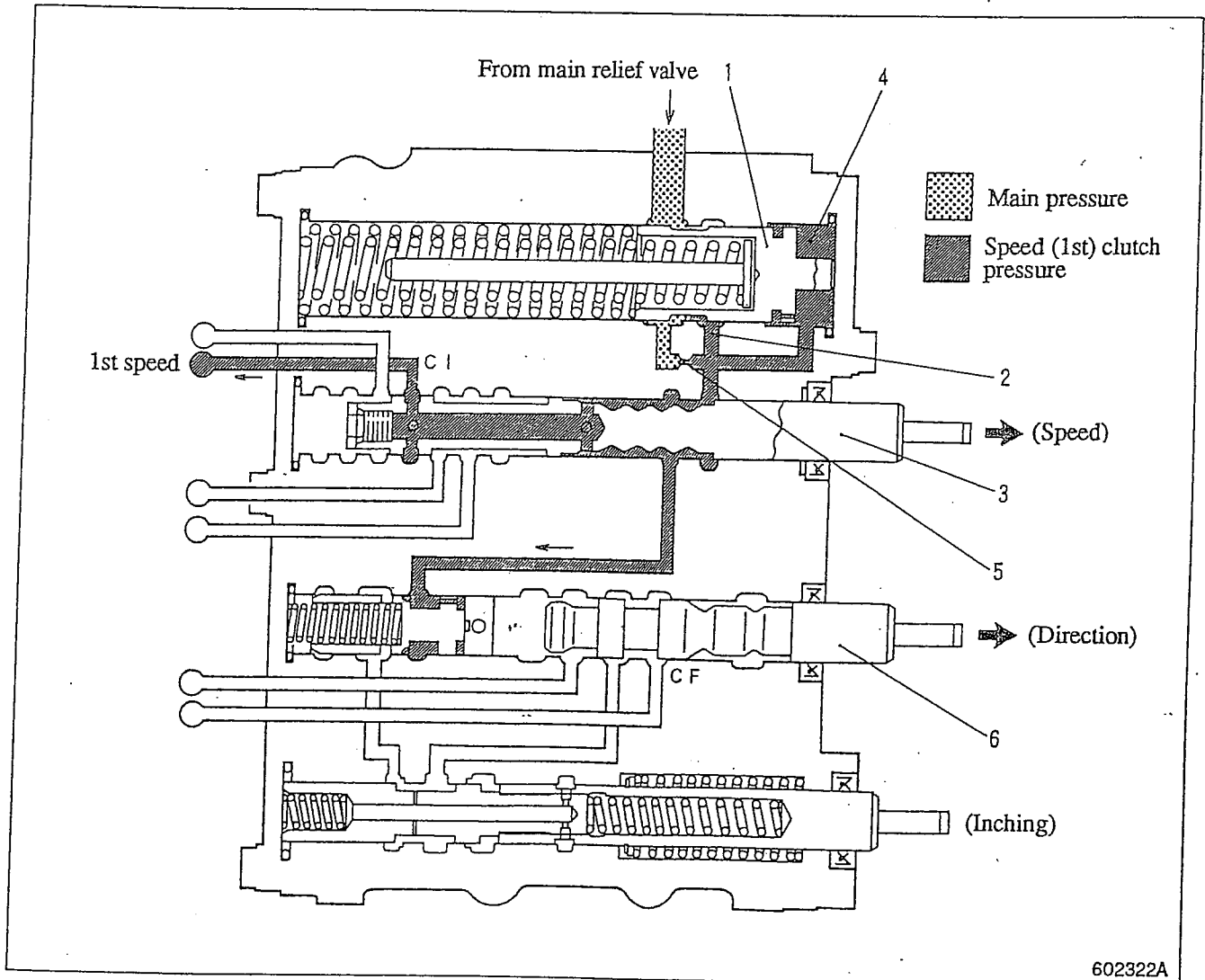
1. Prefilling of 1st-speed clutch piston chamber

When the transmission control lever is moved from neutral to forward 1st speed position, speed selector valve 3 moves to 1st speed position and directional selector valve 6 to forward position, uncovering 1st-speed clutch port (C1) and forward clutch port (CF) respectively.

Under this condition, the pressure is being applied to the 1st-speed clutch piston chamber but

it is not applied to the forward clutch chamber yet.

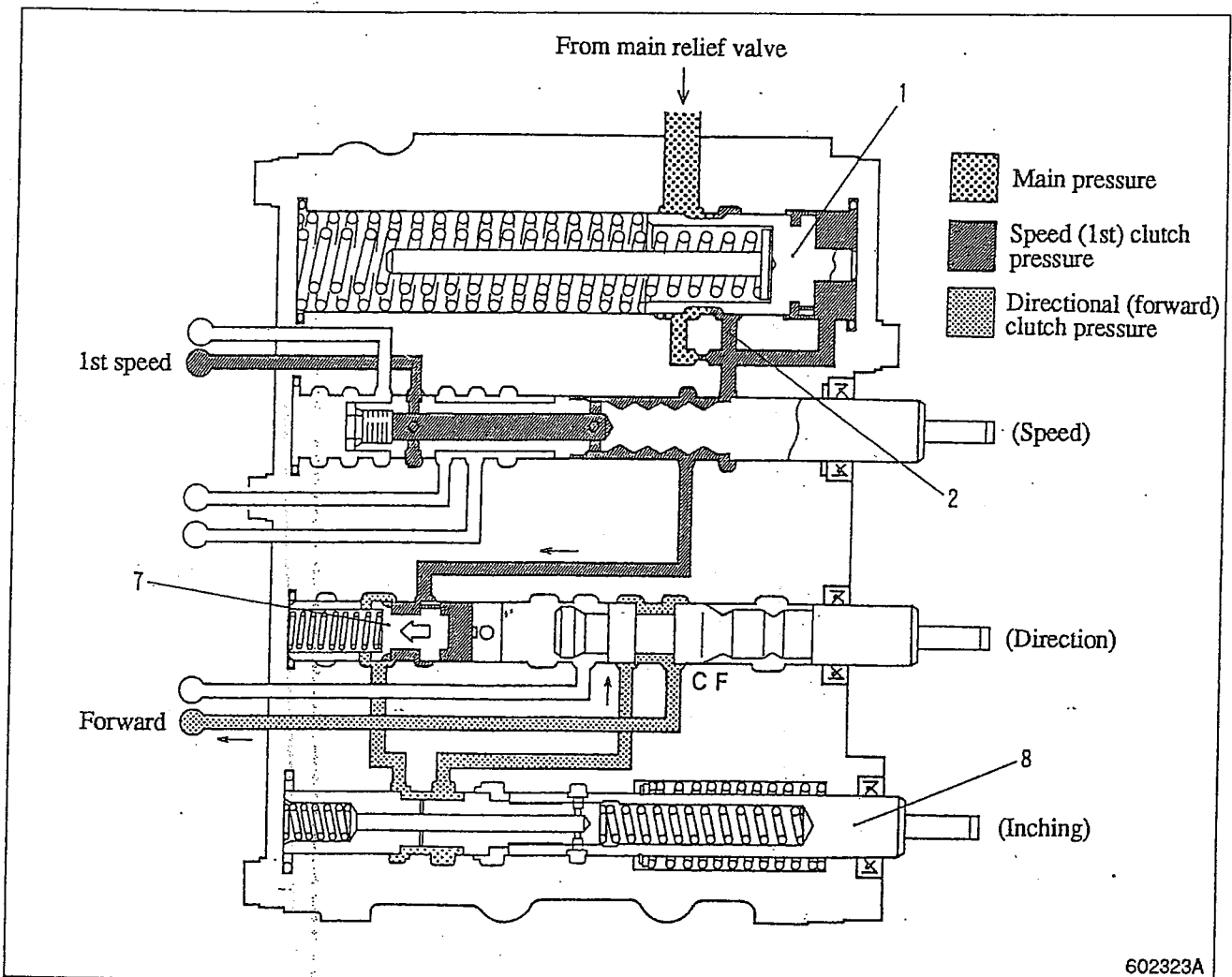
The moment the oil in accumulator valve pressure chamber 4 enters the 1st-speed clutch piston chamber for prefilling, accumulator valve 1 returns to the right end to uncover main port 2. Now, a circuit bypassing main orifice 5 is formed to assist in prefilling the 1st-speed clutch piston chamber.



2. Prefilling of forward clutch piston chamber

Upon completion of prefilling the 1st-speed clutch piston chamber, the speed clutch pressure rises beyond  $2 \text{ kgf/cm}^2$  (28 psi) [0.2 MPa]. This pressure moves differential valve 7 to the left end, allowing the speed clutch pressure oil to enter forward clutch pressure port (CF) through inching valve 8.

Since accumulator valve 1 does not move yet, keeping main port 2 uncovered, the oil from the pump flows into the forward clutch piston chamber without being metered.



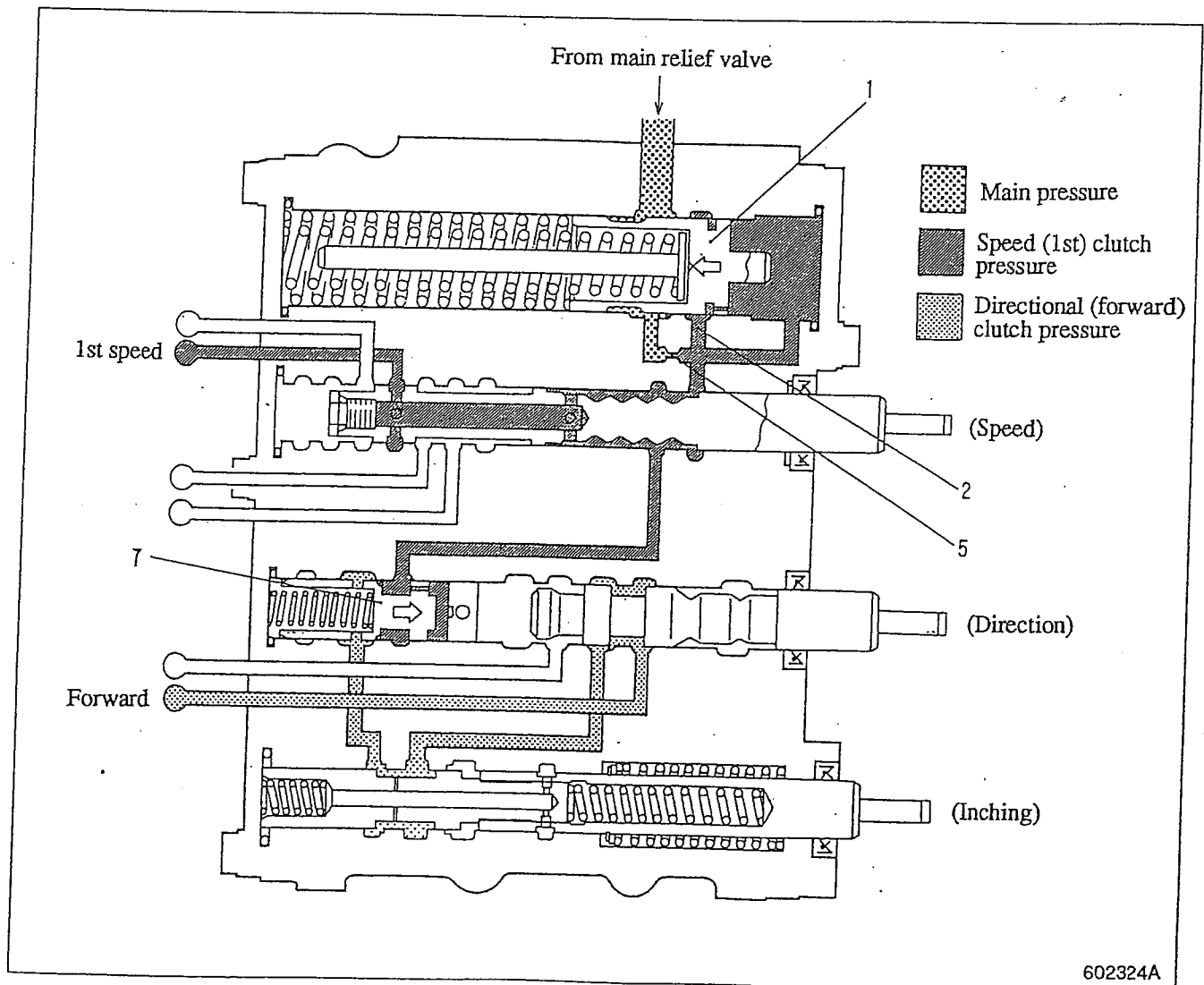
## SYSTEMS OPERATION

### 3. Modulation action

Upon prefilling the forward clutch piston chamber, differential valve 7 is returned to its pressure regulating position for maintaining the difference between the 1st-speed clutch pressure and forward clutch pressure at constant level (2 kgf/cm<sup>2</sup> (28 psi) [0.2 MPa]) and, at the same time, accumulator valve 1 starts moving to the left to cover main port 2.

Then, only the oil metered by main orifice 5 flows into the 1st-speed clutch circuit to move accumulator valve 1 slowly and to increase both forward and 1st-speed clutch pressures gradually. This is called "modulation action."

Since the speed clutch pressure is always higher than the directional clutch pressure, the 1st-speed clutch and forward clutch are engaged in that sequence. This means that shock produced during shifting is arrested by the forward clutch. Both forward and 1st-speed clutches are engaged during this modulation action to insure smooth shifting.



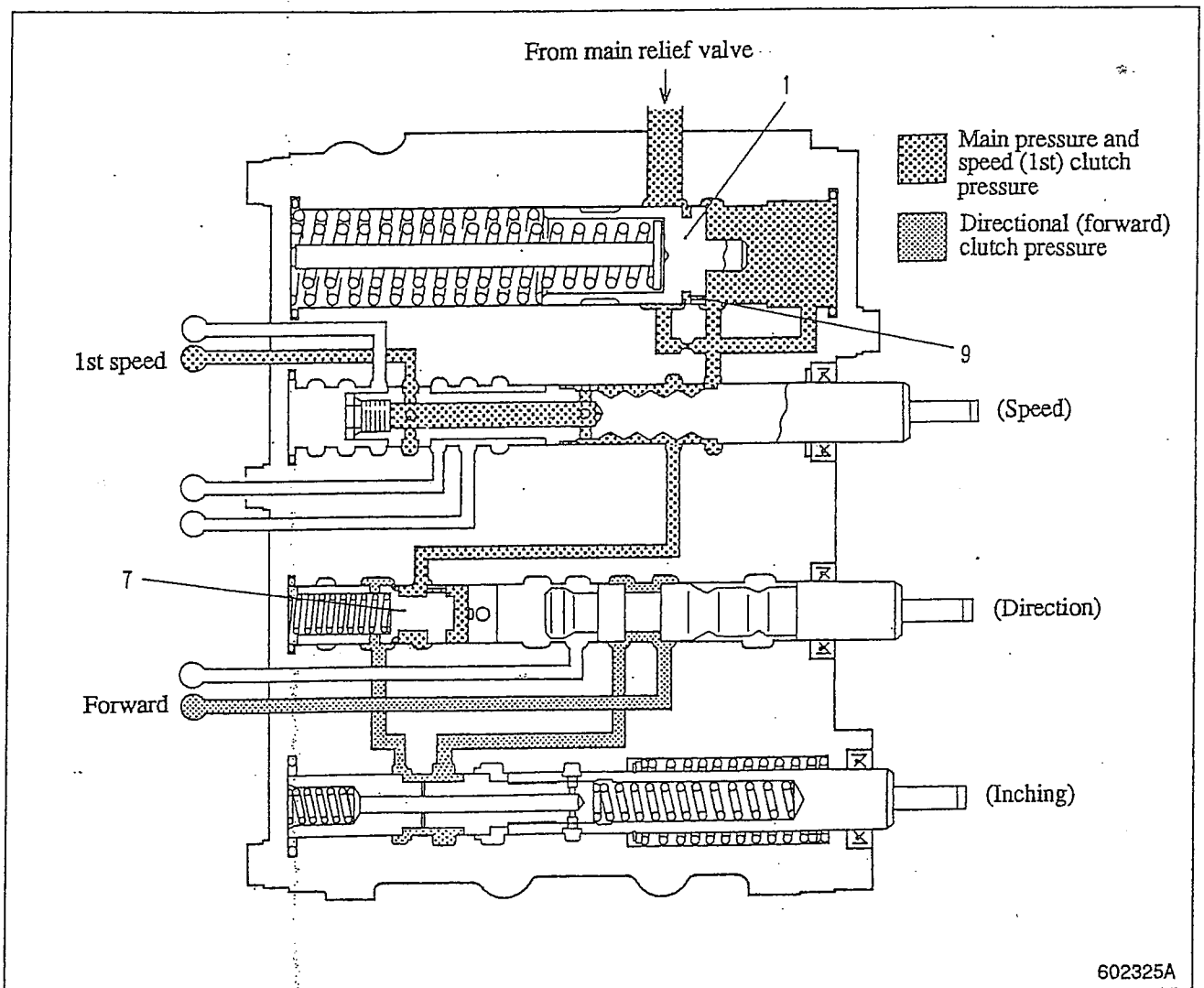
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4. Completion of shifting

When accumulator valve 1 comes to the left end of its stroke, bypass orifice 9 opens again and the 1st-speed clutch pressure rises rapidly to the level of main pressure. Thus, shifting into forward 1st speed is completed.

Differential valve 7 still remains in the pressure regulating position. This keeps the forward clutch pressure lower than the 1st-speed clutch pressure by 2 kgf/cm<sup>2</sup> (28 psi) [0.2 MPa].

In the operation for shifting into other speeds, too, differential valve 7 is returned to the right end of its stroke for draining the directional clutch pressure, because the speed clutch pressure decreases in advance. Subsequent actions are the same as those described for neutral to forward 1st speed shifting.



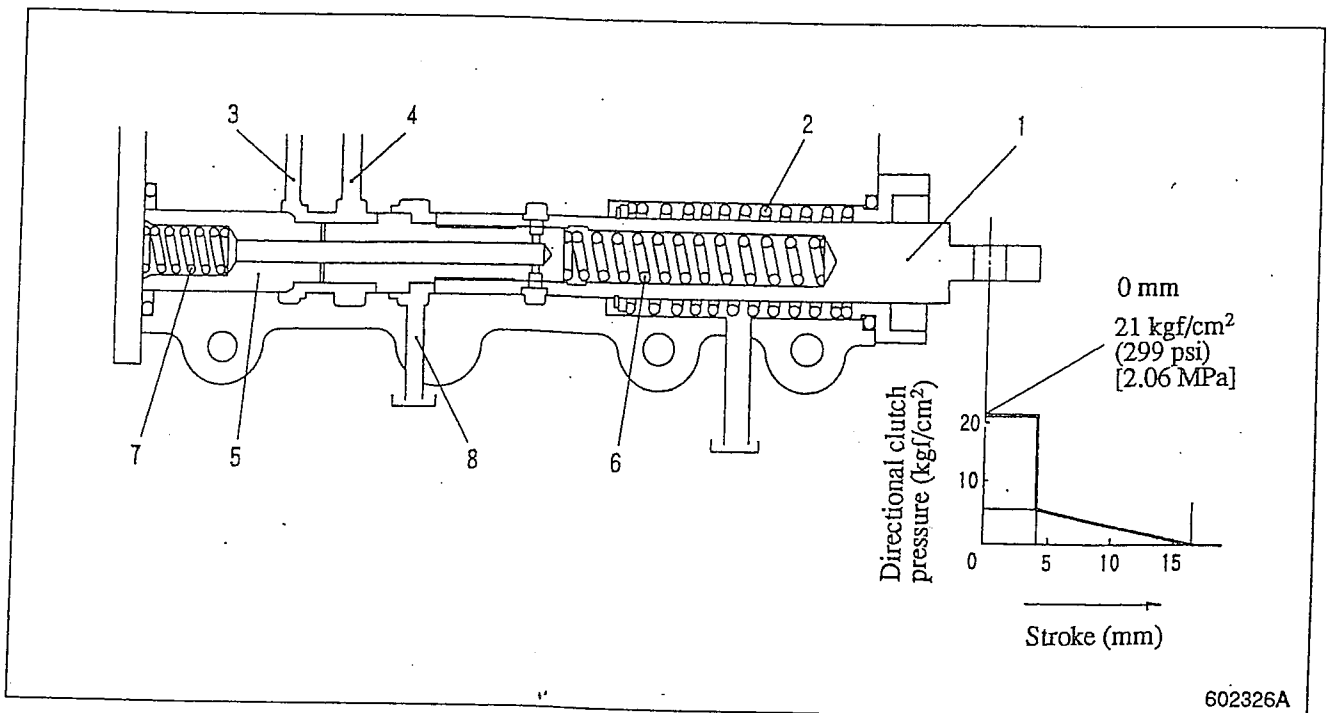
602325A

SYSTEMS OPERATION

5. Inching action .

The inching valve regulates the directional clutch pressure for driving the machine in an inching manner or extremely slowly. Inching valve plunger 1 is connected to the inching pedal (left pedal) through rod.

As long as the inching pedal is in released position, plunger 1 is kept pushed to the left end of its stroke by return spring 2. Under this condition, primary pressure in passage 3 is admitted into secondary pressure passage 4, thus maintaining 21 kgf/cm<sup>2</sup> (299 psi) [2 MPa] pressure there.

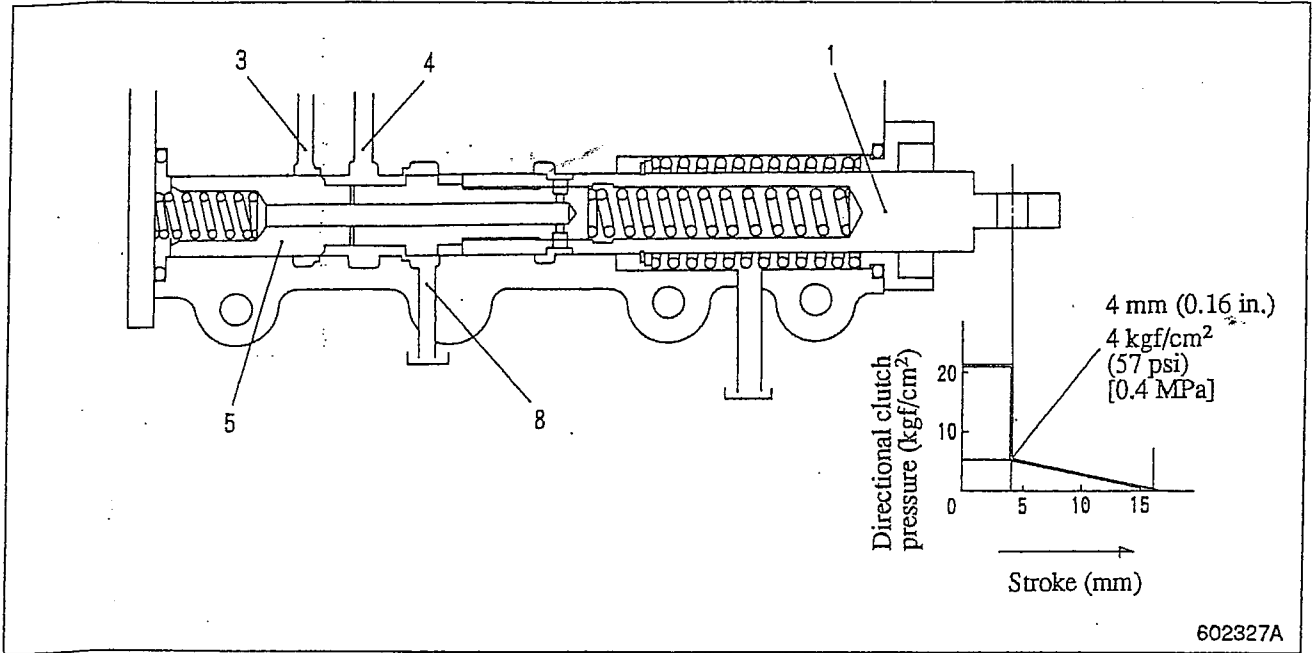


602326A

- |   |                  |
|---|------------------|
| 1 Plunger   | 5 Valve          |
| 2 Return spring   | 6 Inching spring |
| 3 Primary pressure passage<br>(from differential valve)         | 7 Return spring  |
| 4 Secondary pressure passage<br>(to directional selector valve) | 8 Oil passage    |

As the inching pedal is depressed, plunger 1 is moved to the right. When it is moved 4 mm (0.16 in.), valve 5 meters the oil flowing into passage 4 from passage 3 and, at the same time, starts

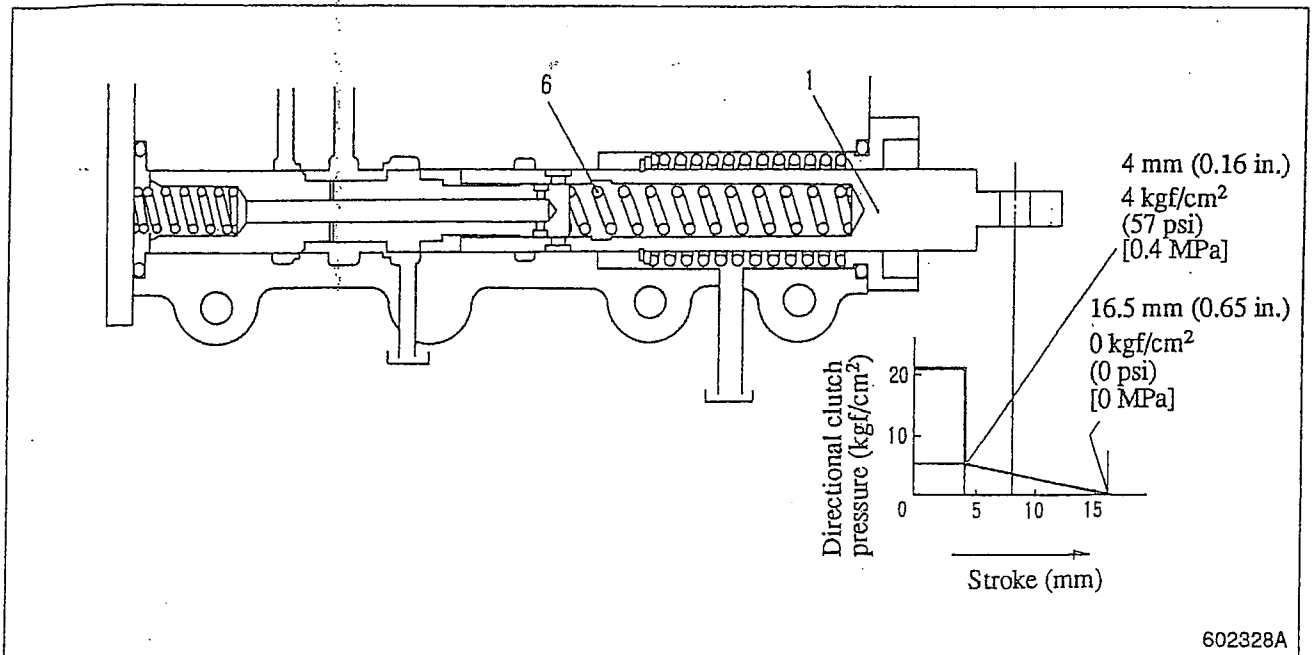
draining oil from passage 4 to the oil sump through passage 8 to reduce the directional clutch secondary pressure down to 4 kgf/cm<sup>2</sup> (57 psi) [0.4 MPa].



602327A

As the inching pedal is farther depressed, plunger 1 is moved to the position indicated. Now, inching spring 6 becomes expanded and pressure proportional to the load of this spring so expanded is built in the pressure chamber,

decreasing secondary pressure (PD2). Thus secondary pressure (PD2) varies from 4 to 0 kgf/cm<sup>2</sup> (57 to 0 psi) [0.4 to 0 MPa] within the range of 4 to 16.5 mm (0.16 to 0.65 in.) stroke of plunger 1.

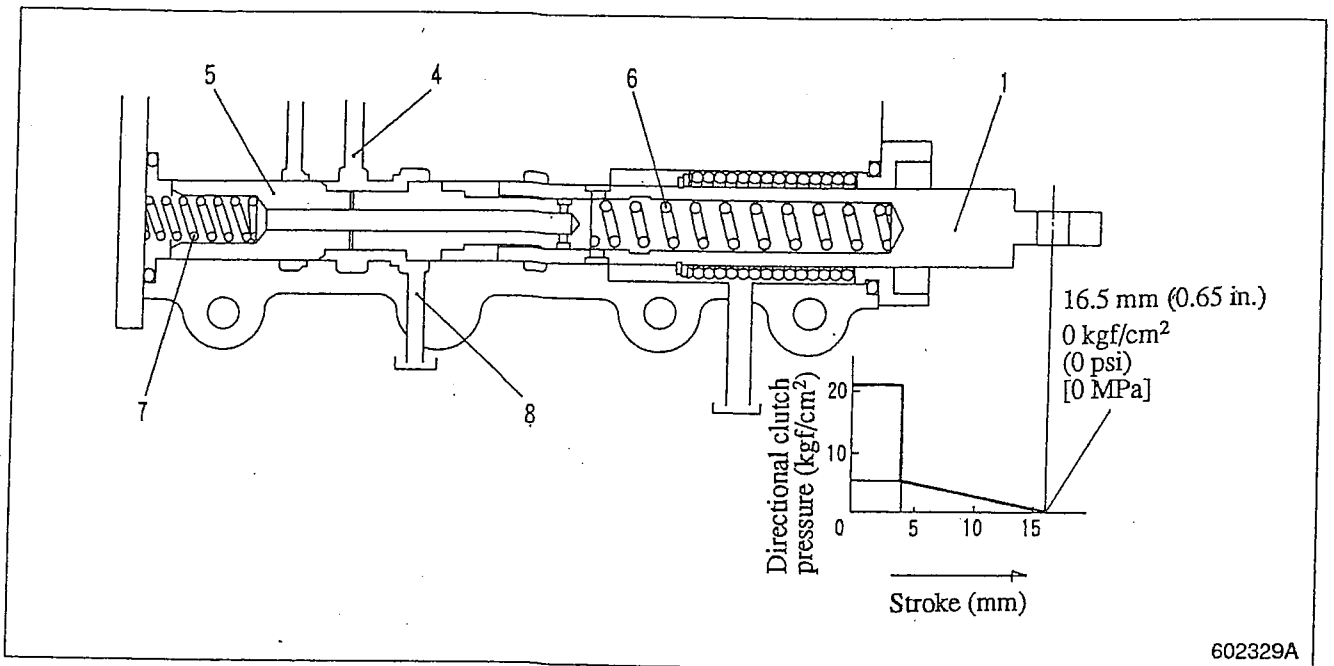


602328A

SYSTEMS OPERATION

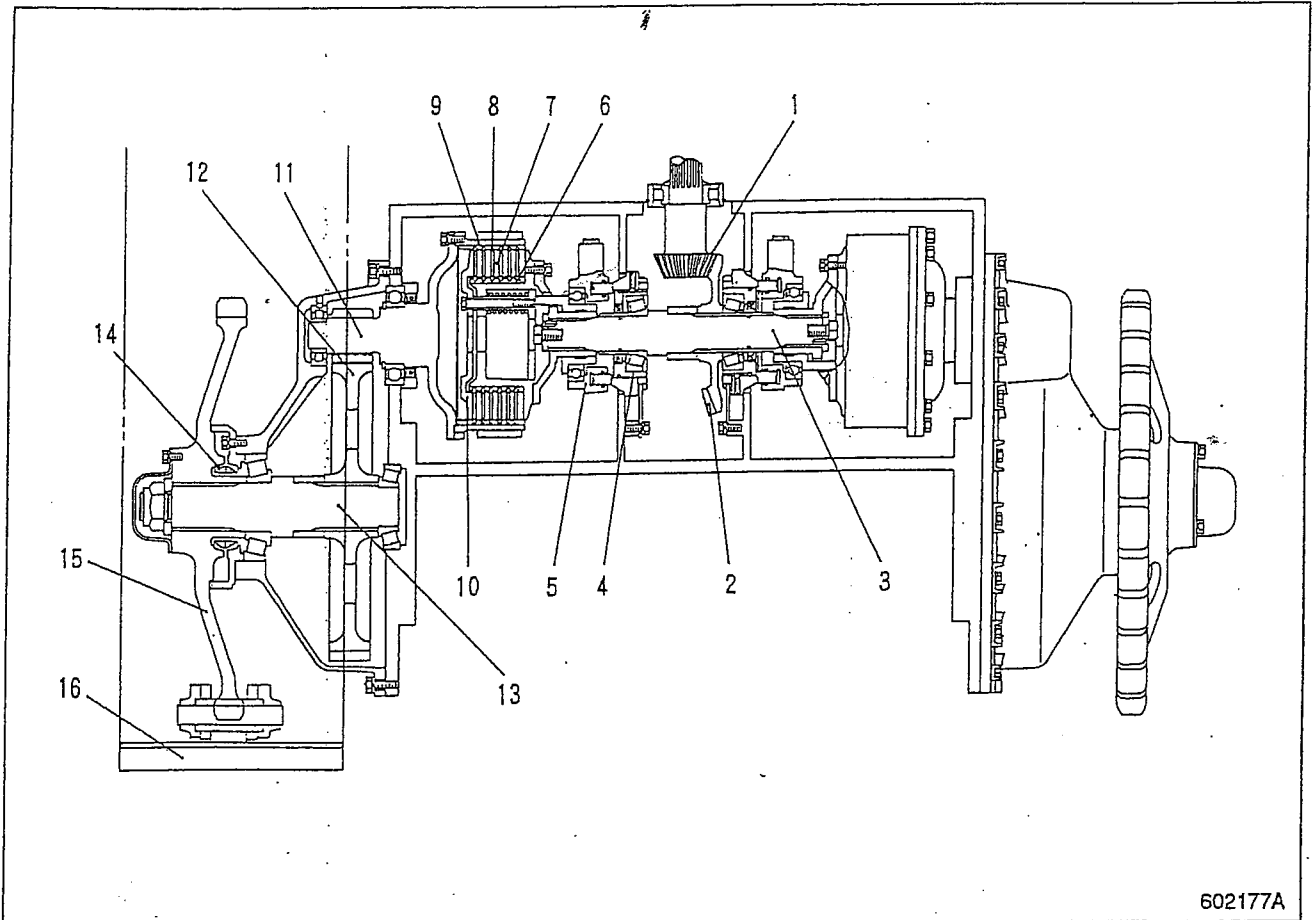
When the inching pedal is depressed all the way and plunger 1 is moved 16.5 mm (0.65 in.) of its stroke, inching spring 6 restores to free stage, causing return spring 7 to move valve 5 to the right. This will completely stop oil flow to passage 4, and passage 4 and passage 8 are communicated to each other without being metered. Consequently, secondary pressure falls to zero and the machine is brought into a complete stop as in neutral.

In summary, the inching pedal may be used like the clutch pedal of a direct-drive model. The machine can be started smoothly by depressing the inching pedal quickly all the way to the end of its stroke and then releasing it gradually to a position within the range of 4 to 16.5 mm (0.16 to 0.65 in.) of the stroke of plunger 1, depending on the load, to gradually increase the pressure acting on the directional clutch piston.





## STEERING CLUTCHES, BRAKES AND FINAL DRIVES



602177A

- |                            |                       |                  |
|----------------------------|-----------------------|------------------|
| 1 Bevel pinion             | 7 Disc plate          | 13 Shaft         |
| 2 Bevel gear               | 8 Friction plate      | 14 Floating seal |
| 3 Drive shaft              | 9 Outer drum          | 15 Sprocket      |
| 4 Bearing cage             | 10 Pressure plate     | 16 Track         |
| 5 Steering clutch cylinder | 11 Final drive pinion |                  |
| 6 Inner drum               | 12 Final driven gear  |                  |

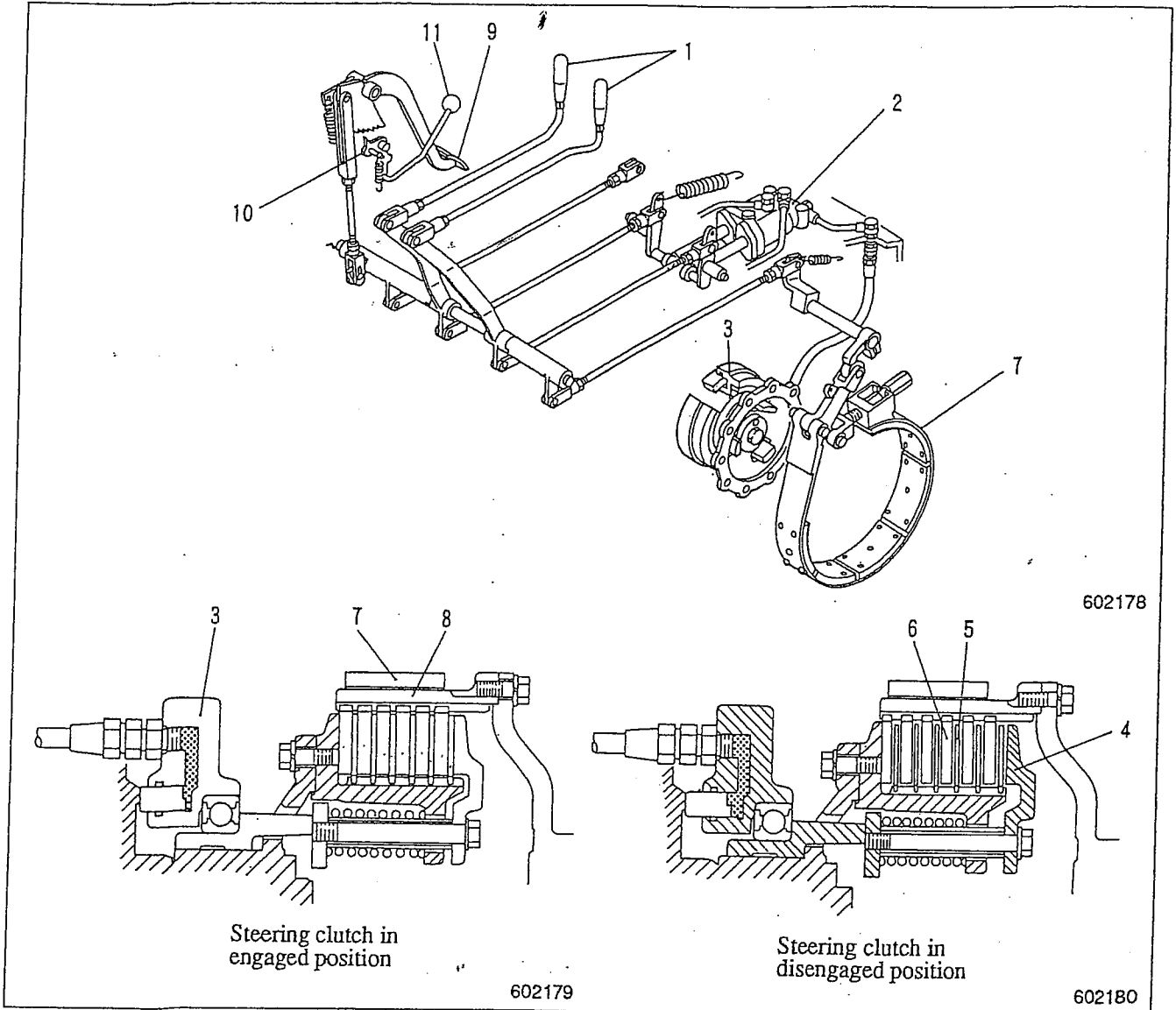
The steering clutch is of dry multi-disc type controlled from steering clutch lever.

Outer (driven) drum 9 is bolted to the flange of final drive pinion. Inner (driving) drum 6 to the flange of drive shaft 3. Friction plates 8 are engaged with the outer drum and disc plates 7 with the inner drum. The stack of these plates is normally kept compressed by spring-loaded

pressure plate 10 to transmit the power to the final drive involving pinion 11 and gear 12. When disengaged, the pressure plate is moved away from the stack.

The outer drum is surrounded by a brake band which is actuated (contracted) from the steering clutch lever to brake the drum.

STEERING CLUTCH AND BRAKE CONTROLS



- |                            |                  |                         |
|----------------------------|------------------|-------------------------|
| 1 Steering clutch lever    | 5 Disc plate     | 9 Brake pedal           |
| 2 Steering valve           | 6 Friction plate | 10 Ratchet (brake lock) |
| 3 Steering clutch cylinder | 7 Brake band     | 11 Lock/unlock lever    |
| 4 Pressure plate           | 8 Outer drum     |                         |

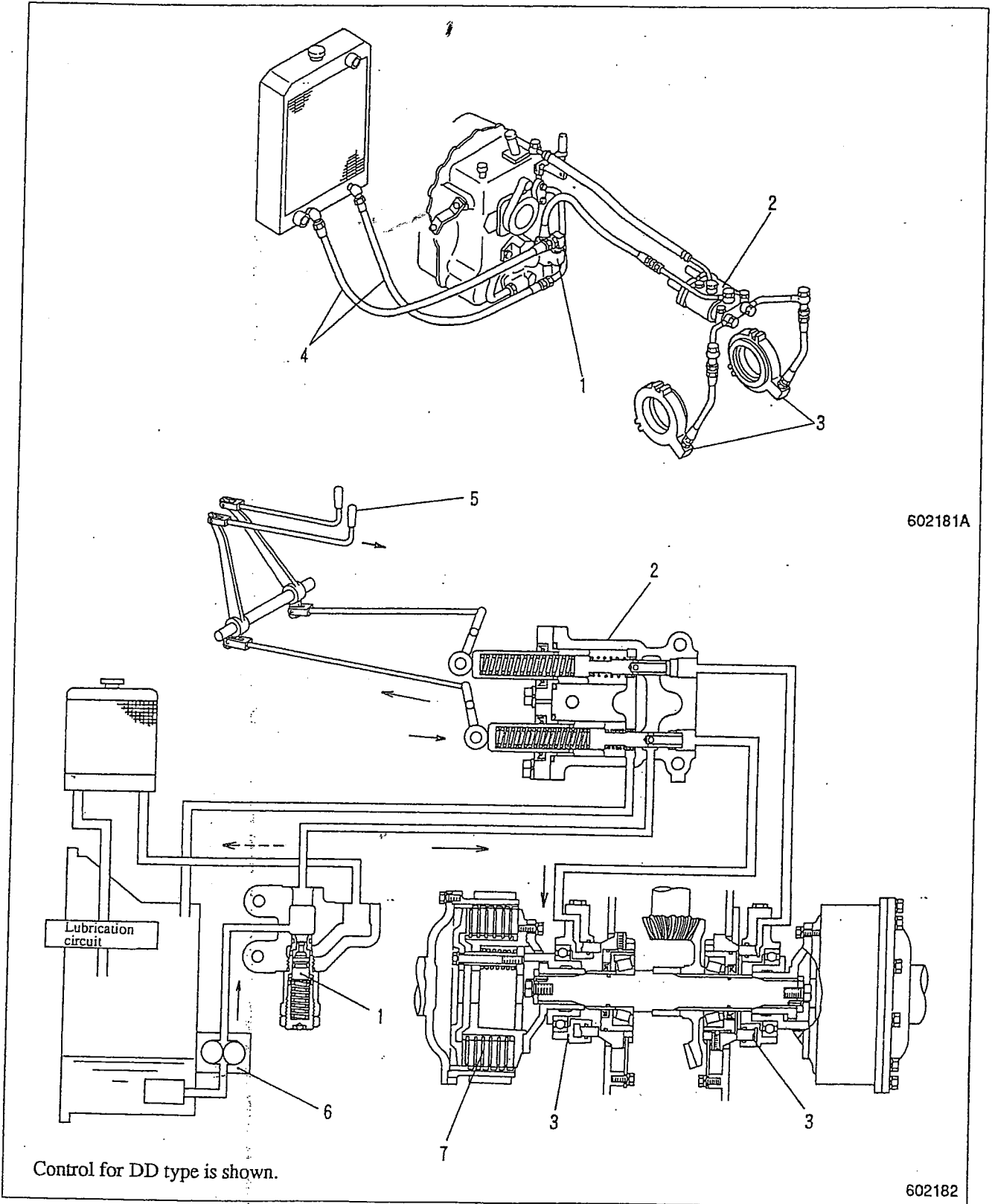
As steering clutch lever 1 is pulled, the piston of steering valve 2 is moved in such a direction as to apply hydraulic pressure to steering clutch cylinder 3. By this hydraulic pressure, pressure plate 4 is moved away from the stack of disc plates 5 and friction plates 6 to disengage the clutch.

When the lever is further pulled, brake band 7 is contracted to brake outer drum 8 to interrupt the flow of power to the final drive.

It is possible to disengage the steering clutch without braking for gradual turn or to disengage it with braking for sharp turn.

As brake pedal 9 is depressed, the brake bands of right-hand and left-hand clutches are simultaneously contracted for braking independently of the clutch control. This pedal can be used as a parking brake if locked in fully depressed position by means of ratchet 10.

STEERING CLUTCH HYDRAULIC CONTROL



Control for DD type is shown.

- |   |                          |   |                       |   |                 |
|---|--------------------------|---|-----------------------|---|-----------------|
| 1 | Relief valve             | 4 | Oil cooler hose       | 6 | Gear pump       |
| 2 | Steering valve           | 5 | Steering clutch lever | 7 | Steering clutch |
| 3 | Steering clutch cylinder |   |                       |   |                 |

602182



## TESTING AND ADJUSTING

### Inspection

A good program of diagnosing and testing has three basic steps.

#### 1. Asking the operator

You can get the full story from the operator; he will tell you how the system or the machine acted when it began to fail, what was abnormal about it. Ask about how the machine was used, when it was finally serviced. Remember, most failures are usually traced to poor servicing or abuse of the machine.

#### 2. Checking the machine

- (1) Check the oil level in the transmission.
- (2) Check the transmission case and oil lines for any sign of leaks.
- (3) Check the inching pedal and transmission control lever linkages for adjustment.

#### 3. Operating the machine

Get on the machine and operate it for testing. During the test, shift the transmission into all gears, forward and reverse, and operate the inching pedal. If the machine fails to start smoothly, or if inching or shifting is hard, see Troubleshooting, which follows.

#### Testing the clutches for slippage

- (1) Start the engine, depress and lock the brake pedal.
- (2) Run the engine at maximum speed, and move the transmission control lever into forward 2nd speed position.
- (3) If the engine stalls as soon as the transmission control lever is shifted, all clutches are not slipping. If it does not stall for more than 3 seconds, or if it does not stall at all, any of the clutch (forward 2nd-speed) is slipping.

Trouble diagnosis by oil pressure readings

1. If transmission shifts hard:

Complaint	Possible cause	Remedy
<p>No shift to some speeds.</p> <p>Pressure reading at tap M: Normal</p> <p>Pressure reading at taps D and S: Abnormally low — not higher than 10 kgf/cm<sup>2</sup> (142 psi) [1 MPa]</p>	<p>(1) Clutch piston sealing ruptured</p> <p>(2) Control valve gasket ruptured</p> <p>(3) Absence of O-ring or broken O-ring in pipe between transmission-case and clutch case</p> <p>(4) Oil hole blanking ball off</p>	<ul style="list-style-type: none"> <li>• Disassemble and replace.</li> <li>• Disassemble and replace.</li> <li>• Disassemble and install O-ring or replace broken one.</li> <li>• Fit ball by driving.</li> </ul>
<p>No shift to all speeds.</p> <p>Pressure reading at taps M, D and S: All low — not higher than 10 kgf/cm<sup>2</sup> (142 psi) [1 MPa]</p>	<p>(1) Defective gear pump</p> <p>(2) Clogged oil passage between strainer and pump, between pump and line filter or between filter and control valve; or leakage</p> <p>(3) Main relief valve sticking</p>	<ul style="list-style-type: none"> <li>• Replace.</li> <li>• Check and clean clogged part by flushing; or repair leaking point.</li> <li>• Disassemble and clean.</li> </ul>
<p>No shift to all gears.</p> <p>Pressure reading at tap M: Normal</p> <p>Pressure reading at taps D and S: 0 kgf/cm<sup>2</sup></p>	<p>Main orifice restricted</p>	<p>Disassemble and clean.</p>
<p>No shift to some speeds.</p> <p>Pressure reading at taps M, D and S: All normal.</p>	<p>Clutch plates burnt or friction-material surfaces lost due to peeling</p> <p>If forward clutch plates burnt and seized:</p> <p style="padding-left: 20px;">Machine starts on F1, F2 and F3 but engine stalls on R1, R2 and R3.</p> <p>If 1st-speed clutch plates burnt and seized:</p> <p style="padding-left: 20px;">Machine starts on F1 and R1 but engine stalls on F2, R2, F3 and R3.</p>	<p>Disassemble and replace.</p>

TESTING AND ADJUSTING

2. If shock is felt when shifted:

Complaint	Possible cause	Remedy
Indicating hand of pressure gauge jumps momentarily from 0 to 21 kgf/cm <sup>2</sup> (299 psi) [2 MPa] on shifting to any speed.	Accumulator valve sticking	Wash valve body, check bore for damage and, as necessary, replace valve and body, if valve does not move sliding smoothly.
Indicating hand of pressure gauge jumps momentarily from 0 to 21 kgf/cm <sup>2</sup> (299 psi) [2 MPa] on shifting to some speeds.	(1) Clutch piston sticking (2) Accumulator valve sticking	<ul style="list-style-type: none"> <li>• Disassemble and repair or replace.</li> <li>• Refer to above. (The same trouble occurs unless slug is inserted properly.)</li> </ul>

3. If time lag in shifting is excessive:  
(Normally machine starts within 0.9 second in standing start.)

Complaint	Possible cause	Remedy
Lag is large in shifting from N to 1 and from N to 2, but is normal in shifting from 1 to 2 and 2 to 1. Indicating hand takes 2 seconds or more in deflecting from 0 to 21 kgf/cm <sup>2</sup> (299 psi) [2 MPa].	(1) Accumulator valve sticking  (2) Accumulator valve spring weakened	<ul style="list-style-type: none"> <li>• Wash valve body, check bore for damage and, as necessary, replace valve and body, if valve does not move sliding smoothly.</li> <li>• Replace.</li> </ul>
Indicating hand takes longer time than normal to deflect from 0 to 21 kgf/cm <sup>2</sup> (299 psi) [2 MPa] upon shifting to any speed.	(1) Accumulator valve sticking (2) Accumulator valve spring weakened (3) Main orifice clogged (4) Insufficient pump output	<ul style="list-style-type: none"> <li>• Refer to above.</li> <li>• Replace.</li> <li>• Disassemble and clean.</li> <li>• Disassemble and clean clogged parts of lines.</li> </ul>
Indicating hand takes longer time than normal to deflect from 0 to 21 kgf/cm <sup>2</sup> (299 psi) [2 MPa] upon shifting to some speeds.	(1) Clutch piston sealing ruptured (2) Absence of O-ring or broken O-ring in pipe between transmission case and clutch case	<ul style="list-style-type: none"> <li>• Disassemble and replace.</li> <li>• Disassemble and install O-ring or replace broken one.</li> </ul>



4. If inching pedal malfunctions:

Complaint	Possible cause	Remedy
<p>Clutch grabs even if inching pedal is depressed.</p> <p>Pressure reading at taps M, S and D: Normal</p>	<p>Clutch plates in forward or reverse clutch seized</p>	<p>Disassemble and replace.</p>
<p>Clutch grabs even if inching pedal is depressed.</p> <p>Pressure reading at taps M and S: Normal</p> <p>Pressure reading at tap D: Does not drop to 0 kgf/cm<sup>2</sup></p>	<p>(1) Control linkage maladjusted (2) Clutch valve defective</p>	<ul style="list-style-type: none"> <li>◦ Check and adjust.</li> <li>◦ Disassemble, wash and repair or replace.</li> </ul>
<p>Releasing inching pedal after fully depressing causes machine to jerk in standing start.</p> <p>Pressure reading at taps M and S: Normal</p> <p>Pressure reading at tap D: Rises but not smoothly as pedal moves in releasing direction.</p>	<p>Clutch valve sticking</p>	<p>Disassemble and clean by washing. Replace 2-piece spool as necessary.</p>

TESTING AND ADJUSTING

5. If transmission overheats:

Complaint	Possible cause	Remedy
Pressure reading at taps M, D and S: Normal or slightly lower.	(1) Oil level too high (2) Oil level too low	<ul style="list-style-type: none"> <li>• Lower oil level.</li> <li>• Raise oil level.</li> </ul>
Pressure reading at taps M, D and S: Normal	(1) Clutch plates seized (2) Mechanical trouble inside transmission	<ul style="list-style-type: none"> <li>• Disassemble and replace.</li> <li>• Overhaul and replace defective parts.</li> </ul>

6. If output power is not enough:

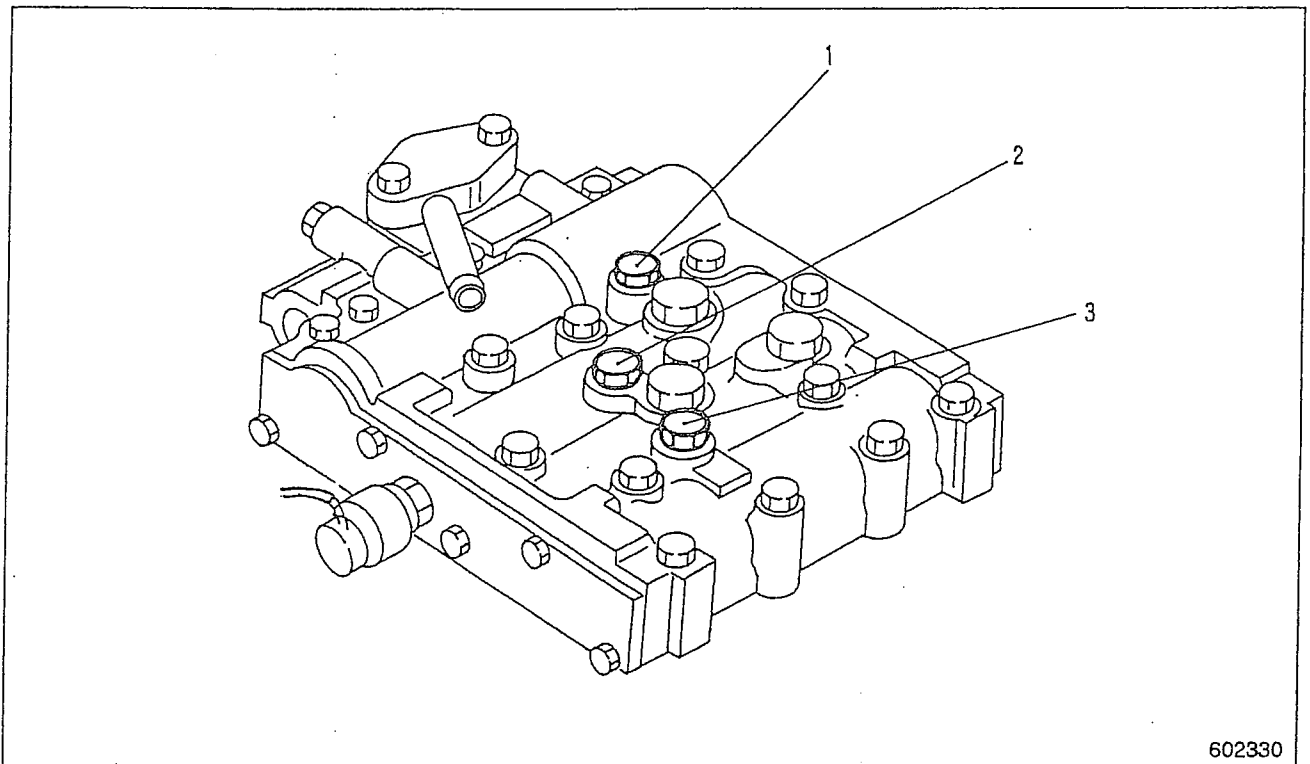
Complaint	Possible cause	Remedy
Pressure reading at taps M, D and S: Low	Oil level too low	Add oil.
Pressure reading at taps M, D and S: Normal	(1) Engine lacks power (2) Mechanical trouble inside transmission	<ul style="list-style-type: none"> <li>• Tune up engine.</li> <li>• Overhaul and replace defective parts.</li> </ul>

7. If oil pressures are high:

Complaint	Possible cause	Remedy
Pressure reading at taps M, D and S: Above 21 kgf/cm <sup>2</sup> (299 psi) [2 MPa]	(1) Main relief valve sticking (2) Main relief valve spring defective	<ul style="list-style-type: none"> <li>• Disassemble and wash.</li> <li>• Replace.</li> </ul>

### Testing the control valve

Connect an oil pressure gauge to each of taps M, S and D in testing the hydraulic pressures with the control valve mounted on the transmission. When running the transmission and control valve on the bench in order to break them in, be sure to form an oil cooler bypassing circuit by connecting two rubber hoses, one leading to the cooler inlet and the other from the cooler outlet.



602330

- 1 Main relief pressure: Tap M
- 2 Speed clutch (1st-speed, 2nd-speed and 3rd-speed) pressure: Tap S
- 3 Directional clutch (forward and reverse) pressure: Tap D

TESTING AND ADJUSTING

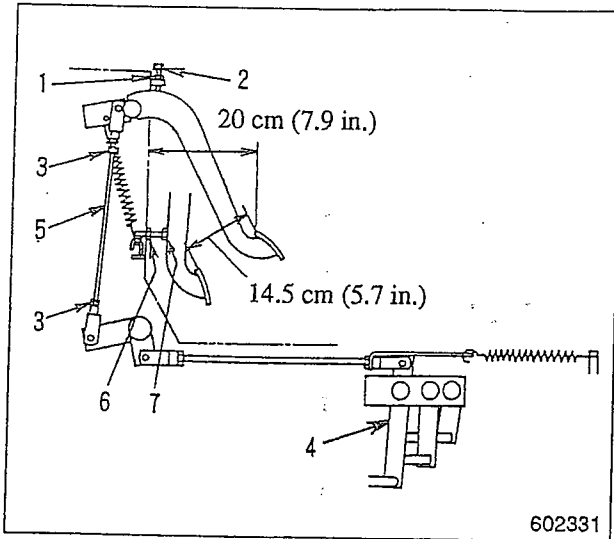
Pressure to be tested	Pressure tap	Pressure requirement								
Main relief pressure	M (G 1/8", with O-ring)	With engine running at high idle speed and control lever kept in neutral, this pressure is required to take the following value: 21 kgf/cm <sup>2</sup> (299 psi) [2 MPa] If not, replace main relief valve spring.								
1st-speed, 2nd-speed and 3rd-speed clutch pressure	S (G 1/8", with O-ring)	With engine running at high idle speed, this pressure is required to remain at a level equal to main relief pressure.								
Forward and reverse clutch pressure	D (G 1/8", with O-ring)	With engine running at high idle speed, this pressure is required to take the following value: 0 kgf/cm <sup>2</sup> for both clutches with control lever in neutral. Not lower than main relief pressure by 2 kgf/cm <sup>2</sup> (28 psi) [0.2 MPa], with control lever in 1st, 2nd or 3rd speed position.								
Shifting time	S (G 1/8", with O-ring)	Measure time required for pressure to change when control lever is shifted from neutral to any position, or from one position to another. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Shifting</th> <th>Time</th> </tr> </thead> <tbody> <tr> <td>N → 1</td> <td>1.0 ± 0.3 sec.</td> </tr> <tr> <td>1 ↔ 2</td> <td>0.7 ± 0.3 sec.</td> </tr> <tr> <td>2 ↔ 3</td> <td>0.7 ± 0.3 sec.</td> </tr> </tbody> </table>	Shifting	Time	N → 1	1.0 ± 0.3 sec.	1 ↔ 2	0.7 ± 0.3 sec.	2 ↔ 3	0.7 ± 0.3 sec.
Shifting	Time									
N → 1	1.0 ± 0.3 sec.									
1 ↔ 2	0.7 ± 0.3 sec.									
2 ↔ 3	0.7 ± 0.3 sec.									

G: Straight gas thread

Bench test criteria for transmission oil pump

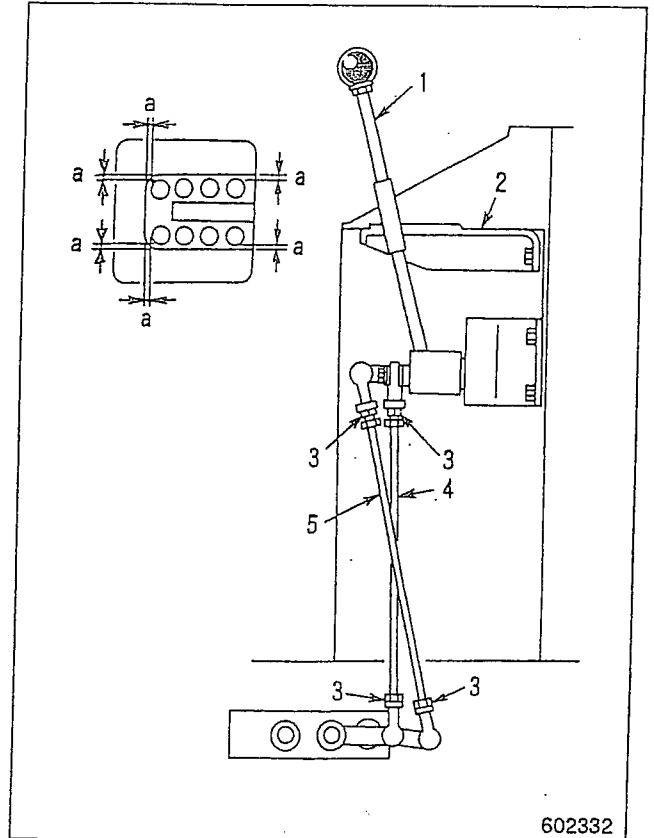
Direction of rotation	Clockwise (as seen from spline shaft side)
Hydraulic oil	Engine oil, SAE 10W
Oil temperature	50°C ± 5°C (122°F ± 9°F)
Discharge flow, liter (U.S. gal)	37.7 (10)/min at 2890 rpm, with engine running at 2300 rpm (rated speed) 39.3 (10.4)/min at 3020 rpm, with engine running at 2400 rpm (rated speed)

INCHING PEDAL



1. Loosen lock nut 1.
2. Reposition stopper bolt 2 so that the inching pedal is 20 cm (7.9 in.) from the dashboard wall.
3. Loosen lock nut 3.
4. Adjust the length of rod so that lever 4 starts moving when the inching pedal is depressed.
5. Loosen lock nut 6.
6. Reposition stopper bolt 7 so that the pedal stroke is 14.5 cm (5.7 in.).

TRANSMISSION CONTROL LEVER

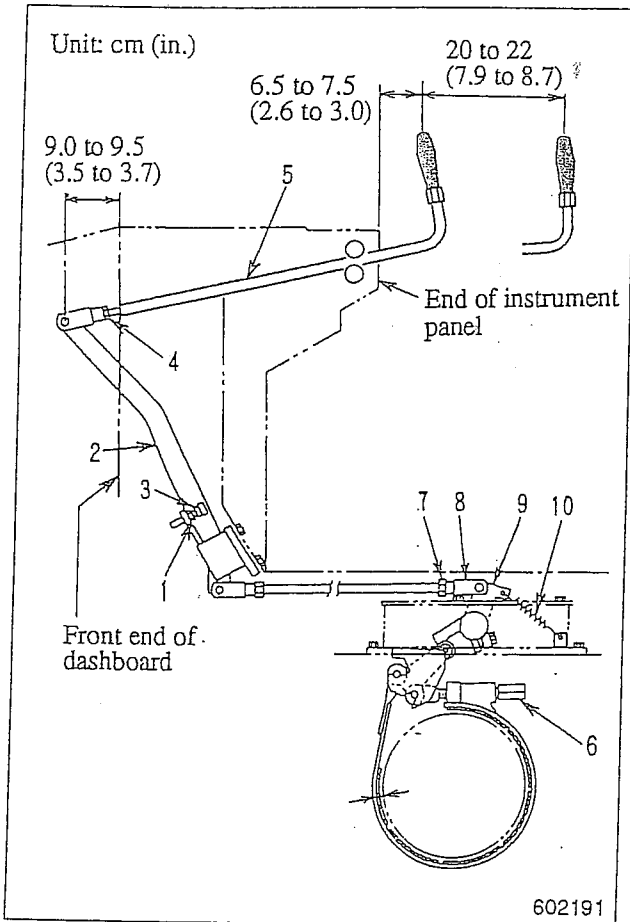


**NOTE**

Clearance a between guide 2 and lever 1 should be 0.5 to 2.0 mm (0.02 to 0.08 in.) in any lever position.

1. Loosen lock nut 3.
2. Turn rods 4 and 5 to adjust clearance a.

STEERING CLUTCHES



602191

**NOTE**

The steering clutches and brakes are interlocked with each other. This means that they must be adjusted at one time. Make adjustment (A) thru (D) in that order.

(A) Adjusting the released position of steering clutch levers

1. Loosen lock nut 1.
2. Set lever 2 by turning stopper bolt 3 so that it is 9.0 to 9.5 cm (3.5 to 3.7 in.) from the front end of dashboard. (Equalize the right-hand and left-hand lever positions.)
3. Loosen lock nut 4.
4. Set the knob of steering clutch lever 5 by turning the lever so that it is 6.5 to 7.5 cm (2.6 to 3.0 in.) from the end of instrument panel.

(B) Adjusting the clearance between brake band and outer drum

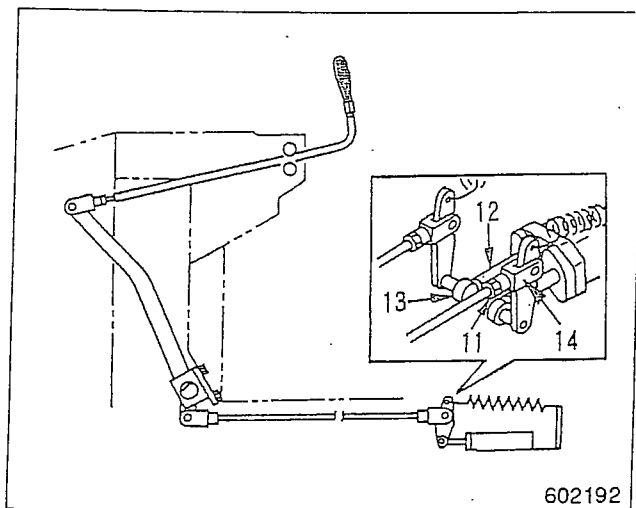
1. Screw adjusting nut 6 all the way.
2. Back off the nut 2-2/3 rotations.

(C) Adjusting the stroke of steering clutch levers

1. Loosen lock nut 7.
2. Set the stroke by means of clevis 8 so that is 20 to 22 cm (7.9 to 8.7 in.) from release position to fully pulled position.

**NOTE**

When making a connection to lever 9, lightly push lever 9 forward until it encounters a resistance, with return spring 10 unhitched.



602192

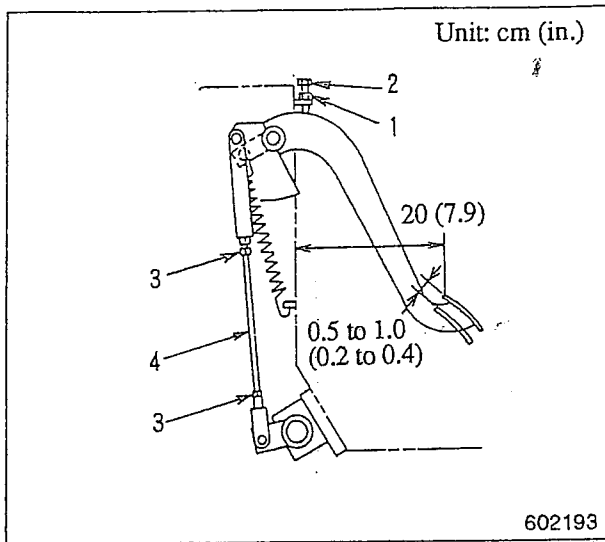
(D) Connecting steering lever to steering valve

1. Loosen lock nut 11.
2. Bring roller 13 into contact with the end of plunger (piston) 12 of the steering valve by means of clevis 14.

**NOTE**

Do not push in the plunger.

BRAKE PEDAL



**NOTE**

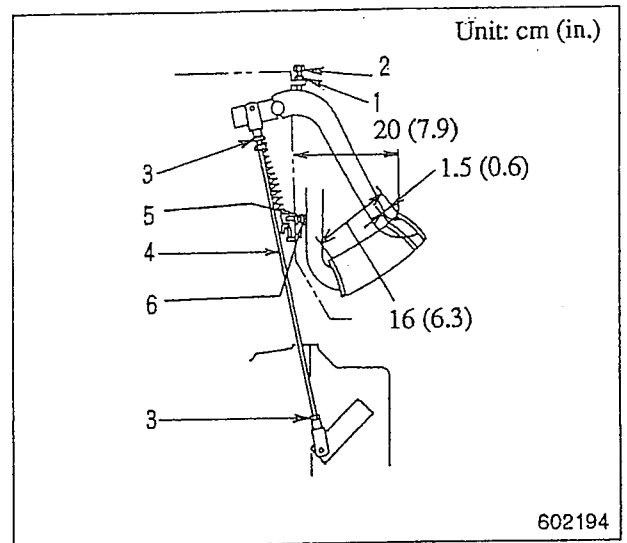
There is no need of adjusting the brake pedal stroke after the steering clutch has been adjusted properly. To be adjust on the pedal is its free play.

1. Loosen lock nut 1.
2. Set the released position of the pedal by turning stopper bolt 2 so that it is 20 cm (7.9 in.) from the dashboard wall.
3. Loosen lock nut 3.
4. Set the free play of the pedal by turning rod 4 so that it is 0.5 to 1.0 cm (0.2 to 0.4 in.).

**NOTE**

Make sure that the right and left brakes are applied simultaneously.

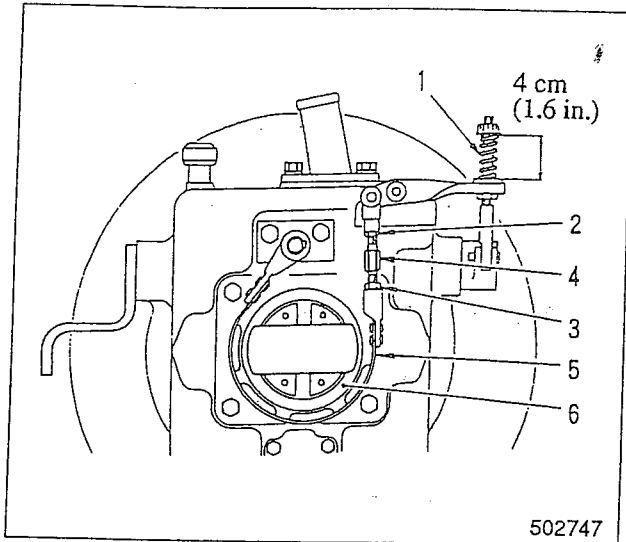
CLUTCH PEDAL



1. Loosen lock nut 1.
2. Set the released position of the pedal by turning stopper bolt 2 so that it is 20 cm (7.9 in.) from the dashboard wall.
3. Loosen lock nut 3.
4. Set the free play of the pedal by turning rod 4 so that it is 1.5 cm (0.6 in.).
5. Loosen lock nut 5.
6. Set the stroke of the pedal by turning stopper bolt 6 so that it is 16 cm (6.3 in.).

## TESTING AND ADJUSTING

### CLUTCH BRAKE



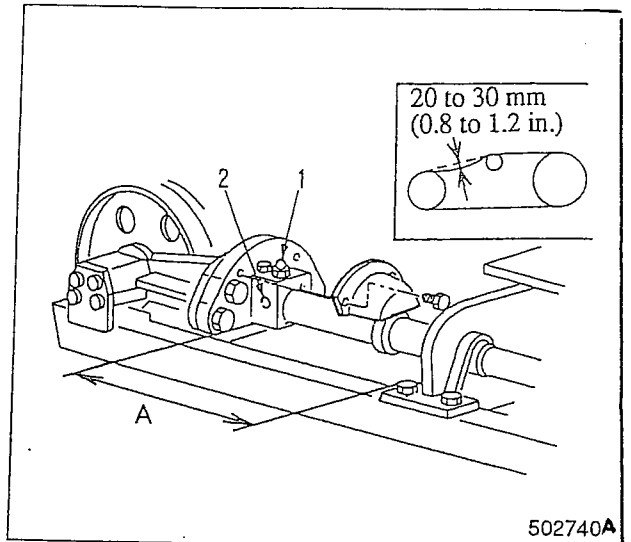
502747

#### NOTE

The clutch brake should be capable of stopping a rotating universal joint in about 2.5 seconds when the clutch pedal is depressed all the way with the engine running at maximum speed.

1. Adjust the length under test force of spring 1 to 4 cm (1.6 in.).
2. Loosen lock nuts 2 and 3.
3. Screw adjusting bolt 4 until brake band 5 comes in full-face contact with drum 6.
4. Back off adjusting bolt 4 2.5 to 3 rotations.

### TRACKS



502740A

#### To loosen:

1. Remove the cover, and gradually turn fill valve 1 counterclockwise to allow grease to escape from vent hole 2.
2. If grease does not appear at the vent hole loosen the fill valve until it touches the stopper.
3. If grease does not appear at the vent hole and the vent hole appears to be open and the track appears to have tension, start the engine, and move the machine back and forth slightly.
4. If the track still appears to have tension even after such a backward and forward movement of the machine, insert a wood block into between the sprocket and track, and move the machine backward slightly. This will strain the track to force grease out of the vent hole.

#### ! WARNING

Never look into the vent hole to see if the pressure in the track adjuster cylinder is released. Make sure of relief of the pressure by observing the backward movement of front idler.



**To adjust:**

1. Apply grease, with a grease gun, into the fill valve until the slack or sag in the track is 20 to 30 mm (0.8 to 1.2 in.).
2. Operate the machine backward and forward to equalize the adjustment.

**NOTE**

When applying grease into the fill valve, be careful not to increase the dimension A (between the cylinder shaft flange and rigid bar mounting bolt) more than is specified.

Dimension A	Unit: mm (in.)
Standard/swamp model	400 (15.7)
Super swamp model	530 (21)
Ultra-super swamp model	490 (19.3)

TROUBLESHOOTING

Flywheel clutch

Complaint	Possible cause	Remedy
Clutch slips.	(1) No pedal free play (2) Worn down clutch facings (3) Clutch facings burnt, resulting in reduced coefficient of friction (4) Dirty friction surfaces of clutch discs (5) Weakened or broken clutch springs	<ul style="list-style-type: none"> <li>◦ Adjust.</li> <li>◦ Replace.</li> <li>◦ Replace.</li> <li>◦ Clean by washing, or replace.</li> <li>◦ Replace.</li> </ul>
Clutch drags.	(1) Pedal free play too large (2) Not enough pedal stroke (3) Release levers not set for uniform lever height (4) Binding or sticky splines of clutch shaft (5) Dirty friction surfaces of clutch discs	<ul style="list-style-type: none"> <li>◦ Adjust.</li> <li>◦ Adjust.</li> <li>◦ Adjust.</li> <li>◦ Disassemble and repair, or replace.</li> <li>◦ Clean by washing.</li> </ul>
Clutch chatters when disengaged.	Release bearing seized, poorly lubricated or damaged	Disassemble and repair, lubricate or replace.
Incomplete disengagement, resulting in hard shifting.	Oil viscosity too high	Change with oil of proper viscosity.
Hard gear shifting.	Clutch brake maladjusted, or band linings worn	Adjust, or replace linings.

Clutch hydraulic control

Complaint	Possible cause	Remedy
Gear pump is not lifting oil, that is, not discharging oil.	(1) Suction strainer clogged (2) Oil viscosity too high (3) Loose joint in connector (4) Broken drive shaft of gear pump (5) Pump gears worn or seized	<ul style="list-style-type: none"> <li>◦ Clean.</li> <li>◦ Change with oil of proper viscosity.</li> <li>◦ Retighten.</li> <li>◦ Replace.</li> <li>◦ Replace.</li> </ul>

## DD transmission

Complaint	Possible cause	Remedy
Gears slip out of mesh.	(1) Incomplete meshing action due to improperly assembled shift control mechanism (2) Inner end of shift lever worn down or loose (3) Gear teeth unevenly worn (4) Backlash too large (5) Shaft splines badly worn, resulting in loose fit	<ul style="list-style-type: none"> <li>◦ Disassemble and repair or replace.</li> <li>◦ Repair or replace.</li> <li>◦ Replace.</li> <li>◦ Replace gears.</li> <li>◦ Replace.</li> </ul>
Hard shifting.	(1) Dragging clutch (2) Shift lever or forks loose or worn (3) Foreign matter lodged between gears (4) Oil viscosity too high (5) End faces of gear teeth damaged (6) Distorted or broken forks	<ul style="list-style-type: none"> <li>◦ Adjust clutch.</li> <li>◦ Repair or replace.</li> <li>◦ Clean by washing.</li> <li>◦ Change with oil of proper viscosity.</li> <li>◦ Repair or replace.</li> <li>◦ Repair or replace.</li> </ul>
Noisy.	(1) Not enough oil, or oil dirty (2) Backlash too large (3) Worn, damaged or rattling bearings (4) Excessively worn shaft splines (5) Damaged or worn gear teeth, or improper tooth contact (6) Bevel gear out of adjustment (7) Gears out of alignment, or teeth distorted	<ul style="list-style-type: none"> <li>◦ Add or change.</li> <li>◦ Change gears.</li> <li>◦ Adjust or replace.</li> <li>◦ Repair or replace.</li> <li>◦ Repair or replace.</li> <li>◦ Adjust.</li> <li>◦ Adjust, or replace.</li> </ul>

TESTING AND ADJUSTING

DPS transmission

Complaint	Possible cause	Remedy
Machine does not move in one or more speeds or all clutches slip.	<p>A. Low oil pressure</p> <ol style="list-style-type: none"> <li>(1) Not enough oil</li> <li>(2) Loose, broken or maladjusted control linkage</li> <li>(3) Gear pump or its drive defective</li> <li>(4) Air being sucked into pump</li> <li>(5) Internal oil leakage in control valve due to wear or failure of sealing members such as piston seals and O-rings</li> <li>(6) Main relief valve internally dirty with foreign matter stuck in sliding clearance, or out of adjustment</li> <li>(7) Oil viscosity too low</li> </ol> <p>B. Mechanical failure</p> <ol style="list-style-type: none"> <li>(1) Transmission shaft damaged</li> <li>(2) Seized or bound clutch piston, friction plates or mating plates, resulting in reduced clutch capacity</li> <li>(3) Friction plates or mating plates worn or damaged</li> <li>(4) Bevel gears or other gears defective</li> </ol> <p>C. Neutral safety valve malfunctions</p>	<ul style="list-style-type: none"> <li>◦ Refill.</li> <li>◦ Repair or readjust.</li> <li>◦ Overhaul or replace.</li> <li>◦ Check packed joint in pump suction and repair or replace.</li> <li>◦ Disassemble and repair or replace defective parts.</li> <li>◦ Overhaul. Correct its pressure setting.</li> <li>◦ Use Class CD oil (engine oil) of API classification, whose viscosity rating is SAE 10W.</li> <li>◦ Disassemble and replace.</li> <li>◦ Disassemble, repair or replace.</li> <li>◦ Disassemble and replace.</li> <li>◦ Disassemble and replace.</li> <li>Overhaul or replace.</li> </ul>
Machine jolts on shifting.	<ol style="list-style-type: none"> <li>(1) Accumulator valve not working properly</li> <li>(2) Oil viscosity too high</li> </ol>	<ul style="list-style-type: none"> <li>◦ Disassemble and repair or replace.</li> <li>◦ Change with oil of proper viscosity.</li> </ul>
Slow response of transmission to shifting.	<ol style="list-style-type: none"> <li>(1) Clogged orifice in control valve</li> <li>(2) Not enough oil</li> <li>(3) Control linkage maladjusted</li> <li>(4) Air being sucked into gear pump due to loose packed joint in suction line</li> <li>(5) Faulty seal ring on clutch piston</li> <li>(6) Damaged O-ring in path of oil to clutch piston</li> </ol>	<ul style="list-style-type: none"> <li>◦ Disassemble and clean.</li> <li>◦ Refill.</li> <li>◦ Readjust.</li> <li>◦ Retighten or replace packing.</li> <li>◦ Disassemble and replace.</li> <li>◦ Disassemble and replace.</li> </ul>

Complaint	Possible cause	Remedy
Not enough output.	<ol style="list-style-type: none"> <li>(1) Engine not delivering enough power</li> <li>(2) Not enough oil</li> <li>(3) Air being sucked into gear pump</li> <li>(4) Sticking or bound spool in main relief valve</li> <li>(5) Weakened spring in main relief valve.</li> <li>(6) Worn-down gear pump</li> <li>(7) Strainer or filter clogged</li> <li>(8) Badly worn clutch piston ring or O-ring</li> <li>(9) Water in oil</li> <li>(10) Control linkage maladjusted</li> <li>(11) Slipping clutches due to low main pressure</li> <li>(12) Damaged clutch piston</li> <li>(13) Dragging wheel brakes</li> </ol>	<ul style="list-style-type: none"> <li>◦ Re-tune engine.</li> <li>◦ Refill.</li> <li>◦ Check joint and replace packing as necessary.</li> <li>◦ Disassemble and repair or replace.</li> <li>◦ Disassemble and replace the spring.</li> <li>◦ Replace.</li> <li>◦ Clean or replace.</li> <li>◦ Disassemble and replace.</li> <li>◦ Change oil.</li> <li>◦ Readjust.</li> <li>◦ Readjust.</li> <li>◦ Disassemble and replace.</li> <li>◦ Readjust.</li> </ul>
Transmission does not shift into neutral even if control lever is moved into neutral or inching pedal is depressed.	<ol style="list-style-type: none"> <li>(1) Control linkage maladjusted</li> <li>(2) Burnt clutches</li> <li>(3) Clutch piston, friction plates or mating plates binding.</li> <li>(4) Clutch valve seized, resulting in no pressure drop</li> <li>(5) Oil level too high or too low</li> </ol>	<ul style="list-style-type: none"> <li>◦ Readjust.</li> <li>◦ Disassemble and replace burnt parts.</li> <li>◦ Disassemble, repair or replace.</li> <li>◦ Disassemble, repair or replace.</li> <li>◦ Adjust to the prescribed level.</li> </ul>
Abnormal oil temperature rise.	<ol style="list-style-type: none"> <li>(1) Air being drawn into oil circuit</li> <li>(2) Water in oil</li> <li>(3) Burnt or worn bearings</li> <li>(4) Instrument out of order</li> <li>(5) Dragging clutches</li> <li>(6) Clutch valve linkage maladjusted</li> <li>(7) Dragging brakes</li> <li>(8) Continuous overloading of machine</li> </ol>	<ul style="list-style-type: none"> <li>◦ Retighten joints and connections, replace gaskets, or check oil level and add oil, as necessary.</li> <li>◦ Change oil.</li> <li>◦ Disassemble and repair or replace.</li> <li>◦ Replace.</li> <li>◦ Replace friction and mating plates.</li> <li>◦ Readjust.</li> <li>◦ Readjust.</li> <li>◦ Avoid abusive use of machine.</li> </ul>

TESTING AND ADJUSTING

Complaint	Possible cause	Remedy
<p>Main relief pressure is too high. (This is not a symptom; it is a finding obtained by checking with pressure gauge.)</p>	<p>(1) Main relief valve maladjusted (2) Internal oil passage in main relief valve clogged (3) Wrong kind of hydraulic oil</p>	<ul style="list-style-type: none"> <li>◦ Overhaul and adjust.</li> <li>◦ Overhaul and clean.</li> <li>◦ Use oil meeting the specifications.</li> </ul>
<p>Transmission responds too slow to shifting, or clutches slip. (This is the symptom of main pressure being too low.)</p>	<p>(1) Clogged oil strainer or filter (2) Worn-down gear pump (3) Main relief valve maladjusted (4) Air being drawn into oil circuit  (5) Not enough oil (6) Oil leakage from loose joint or connection.</p>	<ul style="list-style-type: none"> <li>◦ Clean or replace.</li> <li>◦ Replace.</li> <li>◦ Readjust.</li> <li>◦ Retighten joints and connections, replace gaskets, or add oil to oil pan.</li> <li>◦ Add oil.</li> <li>◦ Inspect and repair, replacing O-rings and seals as necessary.</li> </ul>
<p>Clutch oil pressure is abnormally low when inching pedal is in released condition. (This is not a symptom; it shows up as slow response of transmission or as slipping clutch.)</p>	<p>(1) Main relief pressure too low (2) Clutch valve spool defective (3) Clutch piston seal ring defective (4) Inching pedal control linkage maladjusted</p>	<ul style="list-style-type: none"> <li>◦ Refer to the procedure immediately above. (Transmission responds too slow to shifting.)</li> <li>◦ Repair or replace.</li> <li>◦ Replace.</li> <li>◦ Readjust.</li> </ul>
<p>Machine jolts even when inching pedal is depressed gently.</p>	<p>(1) Inching pedal control linkage maladjusted (2) Clutch valve out of order</p>	<ul style="list-style-type: none"> <li>◦ Readjust.</li> <li>◦ Repair or replace.</li> </ul>
<p>Machine picks up speed too slowly even when inching pedal is released sharply.</p>	<p>(1) Clutch pedal control linkage maladjusted (2) Clutch valve out of order</p>	<ul style="list-style-type: none"> <li>◦ Readjust.</li> <li>◦ Repair or replace.</li> </ul>

Transfer

Complaint	Possible cause	Remedy	Remarks
Machine does not move in any speed.	Mechanical trouble inside transfer	Repair or replace.	
Machine does not move in one or more speeds, forward or backward.	One or more gears damaged	Replace.	
Noisy operation.	(1) Not enough oil (2) Backlash too large  (3) Bearings worn or damaged (4) Shaft splines worn (5) Gear tooth contact incorrect, or teeth worn or damaged	<ul style="list-style-type: none"> <li>◦ Add oil.</li> <li>◦ Readjust or replace parts.</li> <li>◦ Replace.</li> <li>◦ Replace.</li> <li>◦ Readjust or replace.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Check bearings, shaft and gears for wear — cause of excessive backlash.</li> </ul>
Oil leakage.	(1) Oil level too high (2) O-rings damaged (3) Oil seals damaged (4) Transfer case installation loose or packing defective	<ul style="list-style-type: none"> <li>◦ Lower oil level.</li> <li>◦ Replace.</li> <li>◦ Replace.</li> <li>◦ Retighten or replace packing.</li> </ul>	
Overheating.	(1) Oil level too low (2) Backlash too large or too small  (3) Bearings misaligned	<ul style="list-style-type: none"> <li>◦ Add oil.</li> <li>◦ Repair or replace.</li> <li>◦ Repair or replace.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Check bearings for spalled or cracked races.</li> </ul>
Abnormal wear.	(1) Oil insufficient or dirty  (2) Abuse	<ul style="list-style-type: none"> <li>◦ Add or change oil.</li> <li>◦ Avoid abuse of machine.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Check oil for presence of metal chips.</li> </ul>

TESTING AND ADJUSTING

Bevel gear

Complaint	Possible cause	Remedy	Remarks
Excessive gear noise.	(1) Gear oil insufficient or dirty (2) Backlash too large  (3) Bearings worn down, damaged or loose (4) Damaged or worn gear teeth or poor tooth contact (5) Bevel gear improperly installed	<ul style="list-style-type: none"> <li>◦ Add or change.</li> <li>◦ Adjust.</li>   <li>◦ Adjust or replace.</li>   <li>◦ Adjust or replace.</li>   <li>◦ Adjust.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Noise on turning to one side means some rattling condition due to worn splines, loose bearings or excessive backlash.</li>   <li>◦ Misalignment could be the cause.</li> </ul>
Overheating.	(1) Gear oil wanting or dirty, or of wrong kind (2) Backlash too large or too small (3) Bearings too tight, too loose, or damaged  (4) Bearings out of alignment	<ul style="list-style-type: none"> <li>◦ Add or change.</li> <li>◦ Adjust or replace.</li> <li>◦ Adjust or replace.</li>   <li>◦ Adjust.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Raceways could be in cracked, spalled or otherwise damaged condition.</li> </ul>
Oil leakage.	(1) Too much gear oil, or oil viscosity too low  (2) Defective oil seal (3) Portions of shaft in contact with oil seals worn  (4) Cracked case	<ul style="list-style-type: none"> <li>◦ Remove excess oil to hold oil level as prescribed, or change oil by one meeting viscosity specification.</li> <li>◦ Replace.</li> <li>◦ Repair or replace.</li>   <li>◦ Repair or replace.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Leakage of oil into steering clutch side incapacitates this device.</li>   <li>◦ Loose bearings cause shaft to wobble and thus promote oil leakage even if oil seals are in sound condition.</li> </ul>
Abnormal wear.	(1) Gear oil not enough, dirty or of wrong kind  (2) Bevel gear out of adjustment	<ul style="list-style-type: none"> <li>◦ Add or change.</li>   <li>◦ Adjust.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Change oil if metal particles are noted in oil. Such particles or gritty matter promotes wear.</li> </ul>



Steering clutches and brakes

Complaint	Possible cause	Remedy	Remarks
Clutch slips (overheats).	(1) Control linkage out of adjustment (2) Linings dirty  (3) Disc plates and friction plates not capable of smooth sliding movement  (4) Spalled, flaked or damaged linings of disc plates (5) Weakened or broken clutch springs  (6) Disc plates and friction plates warped  (7) Defective clutch cylinder	<ul style="list-style-type: none"> <li>◦ Adjust.</li> <li>◦ Wash with gasoline, or replace the disc plates.</li> <li>◦ Repair drums and plates, eliminating offsets or any irregularity interfering with smooth axial sliding movement.</li> <li>◦ Replace plates.</li> <li>◦ Replace.</li> <li>◦ Repair or replace.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Check lever free play.</li> <li>◦ Investigate to locate a point through which oil is entering clutch case. Wash case interior clean, as necessary.</li> <li>◦ Be sure that each disc plate moves smoothly in or on drum.</li> <li>◦ Habitual "half-clutch" operation tends to overheat clutch and thus weakens springs.</li> <li>◦ Warped plates are usually a result of overheating, for which habitual "half-clutch" operation is usually to blame.</li> <li>◦ See the topic, "Steering clutch cylinder."</li> </ul>
Clutch drags.	(1) Clutch out of adjustment (2) Excessive rattle in steering control linkage (3) Worn or damaged release bearing  (4) Dirty disc linings. (5) Disc plates and friction plates sticking or warped  (6) Defective clutch cylinder	<ul style="list-style-type: none"> <li>◦ Adjust.</li> <li>◦ Adjust.</li> <li>◦ Replace.</li> <li>◦ Clean by washing, or replace.</li> <li>◦ Repair or replace.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Grease bearing fully at the time of reassembly.</li> <li>◦ Warped disc plates are caused by overheating resulting from habitual "half-clutch" operation.</li> <li>◦ See the topic, "Steering clutch cylinder."</li> </ul>

TESTING AND ADJUSTING

Complaint	Possible cause	Remedy	Remarks
Not enough braking force.	(1) Brake out of adjustment (2) Brake lining dirty  (3) Lining worn down, with rivet heads in rubbing condition (4) Brake band warped, broken or otherwise damaged (5) Dragging clutch	<ul style="list-style-type: none"> <li>◦ Adjust.</li> <li>◦ Clean by washing.</li>   <li>◦ Replace.</li> <li>◦ Repair or replace.</li> <li>◦ Adjust or repair.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Be aware of possibil of oil leaking in fron final drive case and bevel gear case. Dra out oil and water, if any, now and then.</li>   <li>◦ Dragging clutch is often cause of appare poor braking.</li> </ul>
Brake drags.	(1) Maladjustment  (2) Return spring weakened (3) Brake band distorted	<ul style="list-style-type: none"> <li>◦ Adjust as prescribed.</li>   <li>◦ Readjust or replace.</li> <li>◦ Repair or replace.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Uneven or inadequate band-to-drum clearan is likely to result in overheating. Readjustment is necessary if pulling steering clutch lever just a little causes machine to turn.</li> </ul>

Steering valve

Complaint	Possible cause	Remedy	Remarks
Jerky movement	(1) Foreign particles lodged between valve (plunger) and bore (2) Weakened or broken return spring (3) Valve (plunger) and bore worn	<ul style="list-style-type: none"> <li>◦ Disassemble and clean. Change hydraulic oil if dirty.</li> <li>◦ Replace.</li> <li>◦ Replace.</li> </ul>	
Poor returning action of piston.	(1) Foreign particles lodged between piston and bore (2) Weakened or broken valve spring	<ul style="list-style-type: none"> <li>◦ Disassemble and clean.</li> <li>◦ Replace.</li> </ul>	

## Steering clutch cylinder

Complaint	Possible cause	Remedy	Remarks
Clutch drags or grabs.	(1) Oil leaks inside cylinder (2) Valve (plunger) and bore worn (3) Relief valve out of adjustment (4) Air leaks at pipe joints	<ul style="list-style-type: none"> <li>◦ Repair or replace.</li> <li>◦ Repair or replace.</li> <li>◦ Adjust.</li> <li>◦ Retighten.</li> </ul>	
Clutch slips, resulting in no power flow.	Steering control valve defective	Repair or replace.	

## Final drives

Complaint	Possible cause	Remedy	Remarks
Noisy.	(1) Not enough gear oil, or dirty gear oil  (2) Backlash too large  (3) Worn or damaged shaft or teeth	<ul style="list-style-type: none"> <li>◦ Add or change.</li> <li>◦ Repair or replace.</li> <li>◦ Repair or replace.</li> </ul>	<ul style="list-style-type: none"> <li>◦ After working machine on muddy or flooded ground, check oil for contamination by examining oil sampled out of drain point.</li> <li>◦ Loose bearings or worn shaft promotes tooth wear, resulting in excessive backlash.</li> </ul>
Overheating.	(1) Not enough gear oil, wrong kind of oil or dirty oil (2) Damaged bearings	<ul style="list-style-type: none"> <li>◦ Add or change.</li> <li>◦ Replace.</li> </ul>	<ul style="list-style-type: none"> <li>◦ "Damage" here means spalled or chipped balls, rollers or raceways or broken cages. Inspect bearings very carefully, for bearing trouble can result in costly major repair.</li> </ul>
Oil leakage.	(1) Too much gear oil, or oil viscosity too low  (2) Faulty oil seals (3) Bolts securing case or cover loose, or packings broken	<ul style="list-style-type: none"> <li>◦ Remove excess oil or use gear oil of proper viscosity.</li> <li>◦ Replace.</li> <li>◦ Retighten. Replace broken packings.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Oil leakage into steering clutch case results in slipping clutch.</li> </ul>

TESTING AND ADJUSTING

Complaint	Possible cause	Remedy	Remarks
Sprocket rattles.	(1) Worn or damaged bearings  (2) Worn splines in fit of sprocket to its shaft	<ul style="list-style-type: none"> <li>◦ Replace.</li>   <li>◦ Replace.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Damaged bearings escape notice because their effect usually show up when machine is running. If the sprocket is suspected to rattle, check its bearings immediately.</li> </ul>
Sprocket teeth wear abnormally.	(1) Track stretched (due to permanent elongation) (2) Master pin worn (3) Side faces of sprocket teeth worn	<ul style="list-style-type: none"> <li>◦ Replace pins and bushings.</li> <li>◦ Replace.</li> <li>◦ Repair by welding or replace.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Abnormal sprocket tooth wear is often due to misalignment of sprocket, track rollers and front idler or of the track frame. When checking these for alignment, check track frame, too, for misalignment particularly at its front end.</li> </ul>
Side faces of sprockets wear.	(1) Track frame misalignment relative to sprocket (2) Front idler mispositioned in place, or its wear strips excessively worn  (3) Track too loose tensioned (4) Track pin bushings badly worn  (5) Too much axial play of track rollers (6) Track frame distorted	<ul style="list-style-type: none"> <li>◦ Realign frame.</li>   <li>◦ Reposition and adjust idler, or replace wear strips.</li>   <li>◦ Adjust.</li> <li>◦ Repair by welding or replace.</li>   <li>◦ Repair or replace.</li>   <li>◦ Repair.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Front idler, track rollers and sprocket must be in perfect alignment in fore-aft direction or side faces of sprocket and links or track roller flanges will rapidly wear off.</li>   <li>◦ With pin bushings badly worn, track moves in wavy fashion to rub side faces of sprocket.</li> </ul>

Undercarriage

Complaint	Possible cause	Remedy	Remarks
<p>Front idlers, track rollers and carrier rollers wear abnormally.</p>	<p>(1) Improper installation or misalignment</p> <p>(2) Track frame misaligned relative to chassis</p> <p>(3) Distorted track frame</p> <p>(4) Worn link pins and bushings</p> <p>(5) Front idler and track rollers have too much axial play</p> <p>(6) Track links worn</p> <p>(7) Loose track</p>	<ul style="list-style-type: none"> <li>◦ Check position of each and set it correctly.</li> <li>◦ Adjust.</li> <li>◦ Repair.</li> <li>◦ Repair or replace.</li> <li>◦ Repair or replace.</li> <li>◦ Repair or replace. (Secure specified link height.)</li> <li>◦ Adjust.</li> </ul>	<ul style="list-style-type: none"> <li>◦ So that track will move straight, front idler and other rollers must be lined up straight. This is particularly important for front idler.</li> <li>◦ Track frame must be trued up with respect to sprocket, and two frames, right and left, must be perfectly parallel.</li> <li>◦ Refer to (4).</li> <li>◦ Track will move in wavy fashion to rub rollers and sprocket if pins and bushings are worn down.</li> <li>◦ Track will oscillate sidewise to promote wear of flange parts of rollers if idler and rollers have too much sidewise play.</li> <li>◦ This malcondition allows roller flanges to rub link bosses.</li> <li>◦ A loose track promotes flange wear.</li> </ul>
<p>Rollers tend to overheat, or will not roll.</p>	<p>(1) Inadequate lubrication</p> <p>(2) Rolling clearance between bushing and shaft too small, or roller has little or no axial play</p>	<ul style="list-style-type: none"> <li>◦ Disassemble and lubricate.</li> <li>◦ Repair or replace.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Loss of lubricant is often accompanied by presence of muddy water in rolling clearance. Such muddy water means that floating seal has failed.</li> </ul>

TESTING AND ADJUSTING

Complaint	Possible cause	Remedy	Remarks
	<p>(3) Interference between track roller and track frame, or foreign matter lodged between the two</p> <p>(4) Unevenly worn rollers</p> <p>(5) Track too tight</p> <p>(6) Bolts securing roller shaft bushings broken</p>	<ul style="list-style-type: none"> <li>◦ Adjust axial play of shaft, or remove foreign matter.</li> <li>◦ Repair.</li> <li>◦ Adjust.</li> <li>◦ Disassemble and repair.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Interference is likely to occur when bushing end faces are worn, resulting in excessive axial play of shaft.</li> <li>◦ "Uneven wear" means here localized wear due to abrasive contact between a stuck roller and track.</li> <li>◦ This condition is often due to recoil spring being fouled up with dirt, sand, etc.</li> </ul>
<p>Abnormal noise from undercarriage.</p>	<p>(1) Loose shoe bolts</p> <p>(2) Bolts securing roller shaft collar loose</p> <p>(3) Bolts securing roller shaft bushing broken or missing</p> <p>(4) Track pitch too large</p> <p>(5) Interference of track with roller flanges</p>	<ul style="list-style-type: none"> <li>◦ Retighten.</li> <li>◦ Retighten.</li> <li>◦ Disassemble and repair.</li> <li>◦ Replace link pins and bushings.</li> <li>◦ Repair.</li> </ul>	<ul style="list-style-type: none"> <li>◦ This retightening should be carried out as early as possible; otherwise the whole shoe assembly would fail beyond repair.</li> <li>◦ This condition not only gives rise to noise but also promotes wear of rollers.</li> <li>◦ This condition is evidenced by shiny metal surfaces on roller flanges and side faces of sprocket teeth and, if left unheeded, will result in the kinds of wear already mentioned.</li> </ul>

Complaint	Possible cause	Remedy	Remarks
Track tends to slip off.	(1) Track loose (2) Front idler mispositioned (3) Recoil spring insufficiently preloaded or broken (4) Roller flanges worn (5) Abusive steering by operator (6) Sprocket teeth worn	<ul style="list-style-type: none"> <li>▫ Adjust.</li> <li>▫ Relocate idler to correct position.</li> <li>▫ Adjust or replace.</li> <li>▫ Repair or replace.</li> <li>▫ Avoid backing and sharp turning on rough ground.</li> <li>▫ Repair by welding.</li> </ul>	<ul style="list-style-type: none"> <li>▫ Refer to Complaint "Front idlers, track rollers and carrier rollers wear abnormally."</li> </ul>





# DISASSEMBLY AND REASSEMBLY

## ENGINE REMOVAL AND INSTALLATION

### Removal

Start by:

- (a) drain the engine oil from the engine and flywheel clutch (DD) or from the engine and damper (DPS)

#### Capacities

Engine: 7 liters (1.8 U.S. gal)

Flywheel clutch: 5.5 liters (1.5 U.S. gal)

Damper: 3.5 liters (0.9 U.S. gal)

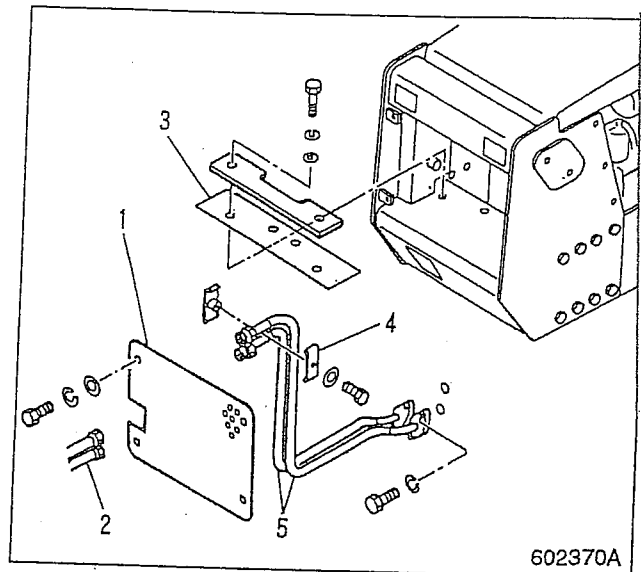
The oil may be drained with the engine and flywheel clutch or damper hoisted after they are removed from the machine.

- (b) drain the coolant [13 liters (3.4 U.S. gal), approx.]
- (c) raise the bucket fully and support the lift cylinders with the bracket (lower it to the ground rubber after removing the radiator guard and side covers (BS3GII))
- (d) disconnect the hoses and pipes from the blade tilt cylinder (BD2GII-PT)

- 1 Radiator grille
- 2 Rubber hoses (2 pcs)
- 3 Rubber plate
- 4 Clamp
- 5 Pipes (2 pcs)

#### NOTE

Disconnect pipes 5 after removing the engine room side cover.



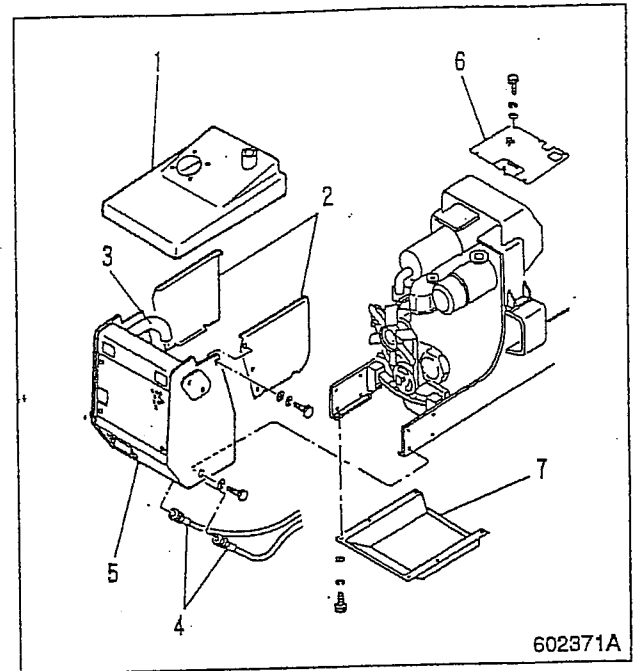
Removal sequence

1. Remove the following parts:

- 1 Engine hood
- 2 Side covers (both sides)
- 3 Overflow hose, upper hose, lower hose
- 4 Oil cooler hoses (2 pcs)
- 5 Radiator and radiator guard
- 6 Floor plate (platform)
- 7 Under guard

**NOTE**

To remove radiator guard 5 on BD2GII-PAT, raise or lower the C-frame for access to the bolts.

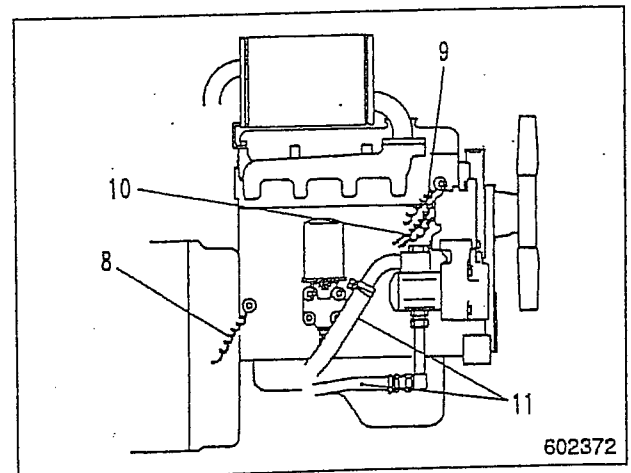


2. Remove the following electric wires and parts on and around the engine:

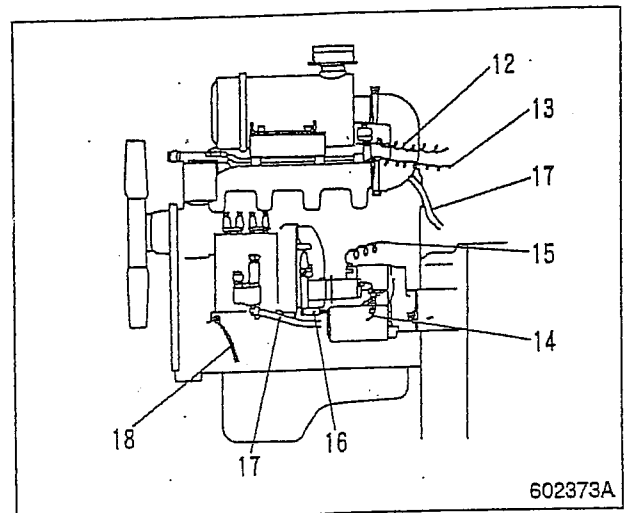
- 8 Oil pressure switch wire
- 9 Thermo switch wire
- 10 Alternator wire
- 11 Hydraulic rubber hoses (2 pcs)

**NOTE**

Before disconnecting the wires, mark them for the components to which they are to be reconnected at the time of installation.



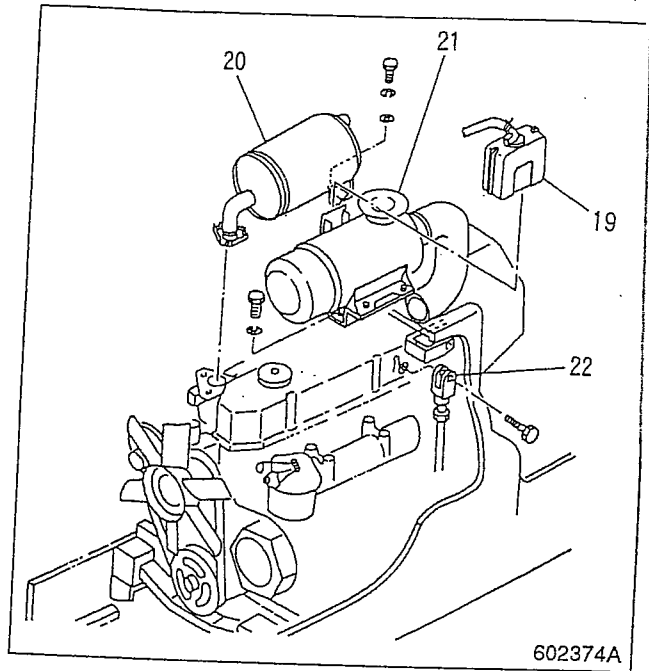
- 12 Air cleaner indicator wire
- 13 Glow plug wire
- 14 Stop solenoid wire
- 15 Starter wire
- 16 Engine control cable
- 17 Fuel hoses (2 pcs)
- 18 Ground wire



DISASSEMBLY AND REASSEMBLY

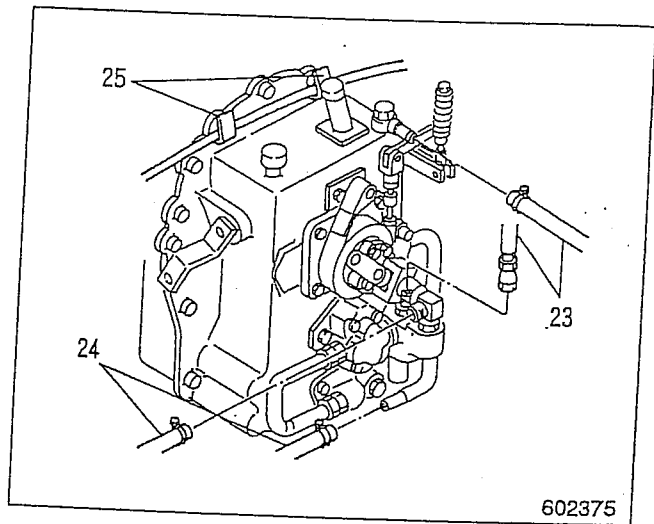
3. Remove the following parts:

- 19 Reserve tank
- 20 Muffler
- 21 Air cleaner
- 22 Clutch control rod

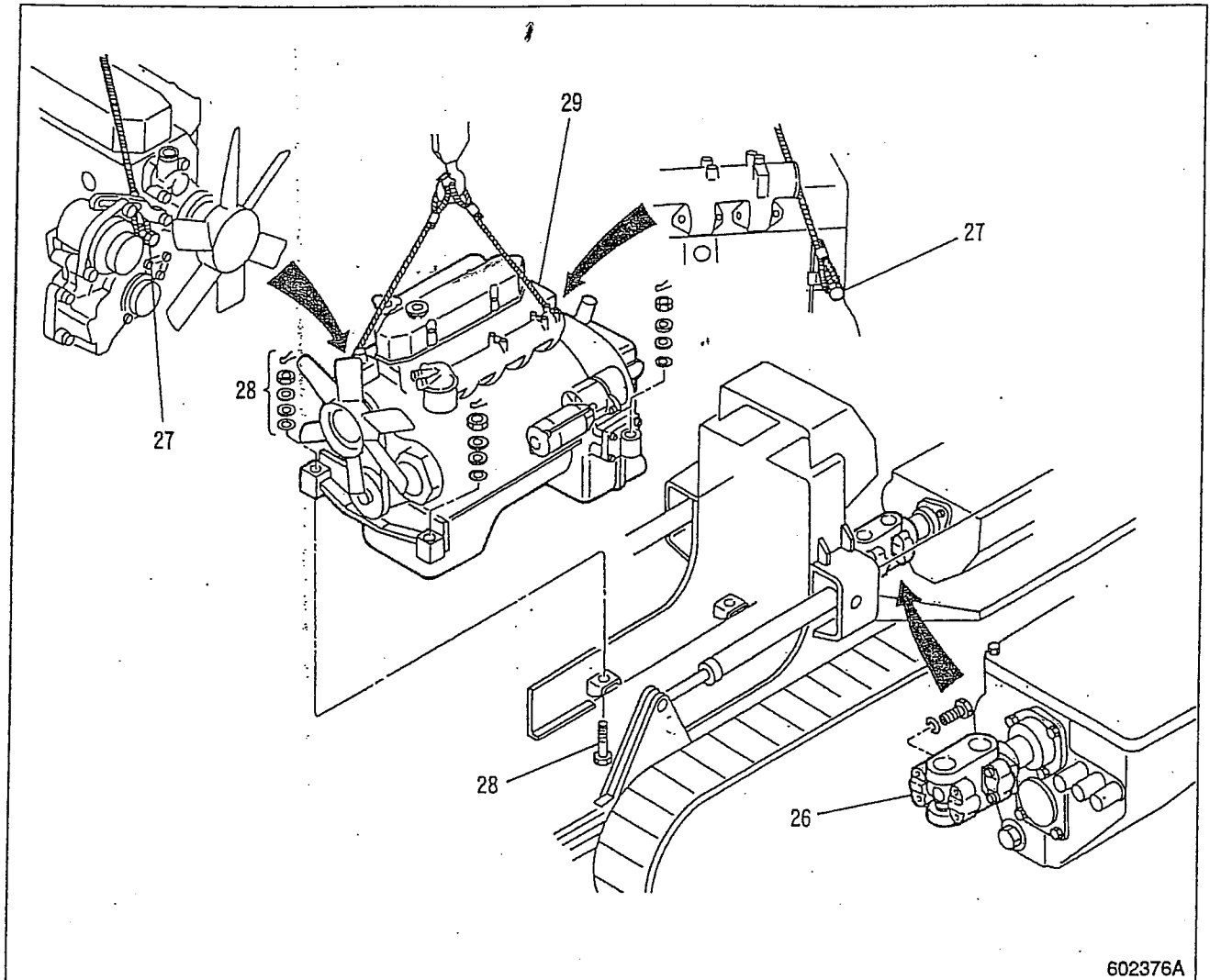


4. Remove the following parts:

- 23 Steering clutch oil rubber hoses (2 pcs)
- 24 Oil cooler rubber hoses (2 pcs)
- 25 Electric wire (by loosening clamps)



5. Remove the following parts:



- 26 Disconnect the universal joint.
- 27 Attach lifting slings to the engine hitching bolts.
- 28 Remove the castle nuts, washers and bolts (4 places)
- 29 Lift off the engine and flywheel clutch.

**NOTE**

The word "engine," when used in the current manuals, does not include the following components:

- a) Flywheel clutch
- b) Hydraulic pump

Weight of engine and flywheel clutch assembly

340 kg (750 lb), approx.

## DISASSEMBLY AND REASSEMBLY

### Installation

To install, follow the reverse of removal sequence.

### Suggestions

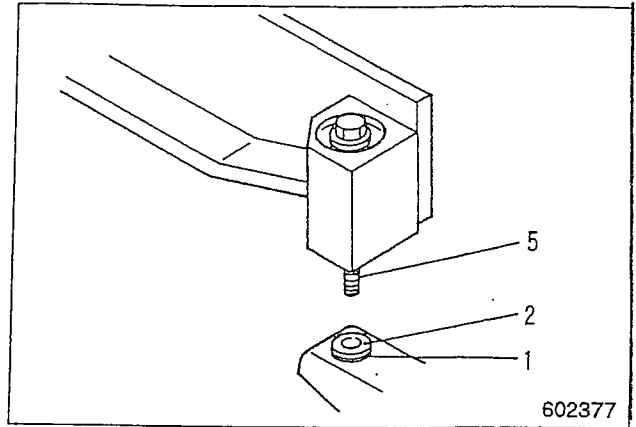
1. Insert bolt into each mount bracket from the upper side, and locate the bracket relative to the frame.
2. After the engine has been lowered onto the brackets, check top clearance B and bottom clearance A.
  - (1) Put shims 1 and washer 2 on bottom side and shims 3 and washer 4 on top side.
  - (2) Check to make sure that clearance A between the bottom end of mount bracket and washer 2 is 1.8 to 2.8 mm (0.07 to 0.11 in.). If this clearance is zero (0) at one or more brackets, replace all brackets.
  - (3) With mount bolt 5 in place, see if clearance B is 1.2 to 2.2 mm (0.05 to 0.09 in.); if not, decrease or increase the thickness of shims 3 to set the clearance within this range at each bracket.
  - (4) Tighten castle nut 6 to the specified torque.
  - (5) After tightening all mount bracket bolts, check to make sure the engine and clutch assembly is nearly horizontal.

#### NOTE

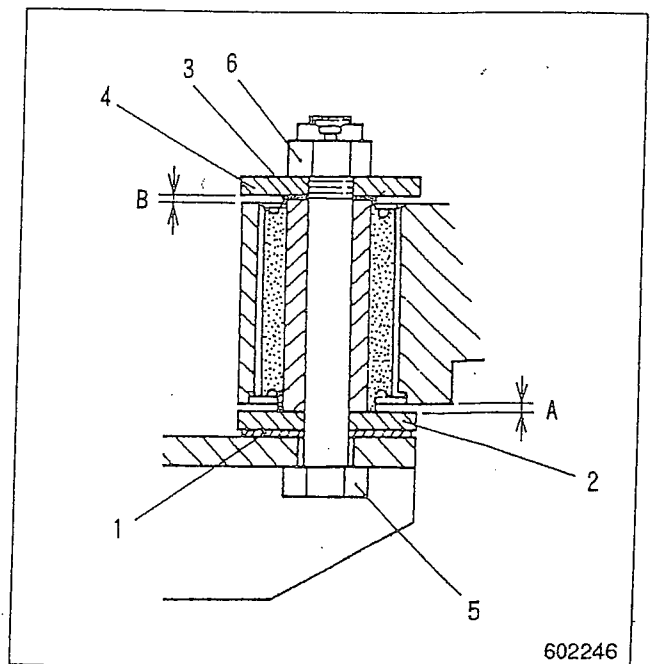
If the engine and clutch assembly is not horizontal, increase or decrease the thickness of shims 1.

#### Washers and shims

Washer	58611-11200	t = 4 mm (0.16 in.)
Washer	58611-02400	t = 6 mm (0.24 in.)
Shim set	58611-02500	
	64361-74611	t = 1 mm (0.04 in.)
	64361-74612	t = 0.5 mm (0.02 in.)
Shim	64361-17516	t = 0.5 mm (0.02 in.)



1 Shims 2 Washer 5 Bolt



602246

### Inspection after installation

- (1) Make sure the electric wires, pipes and hoses are properly routed and connected.
- (2) Adjust the clutch pedal. (Refer to TESTING AND ADJUSTING.)
- (3) Adjust the engine control.
- (4) Fill the engine and clutch with recommended oil and coolant.

## FLYWHEEL CLUTCH

There are two methods of removing the flywheel clutch from the engine, off-the-machine method and on-the-machine method. For the former, follow the steps under "ENGINE REMOVAL AND INSTALLATION."

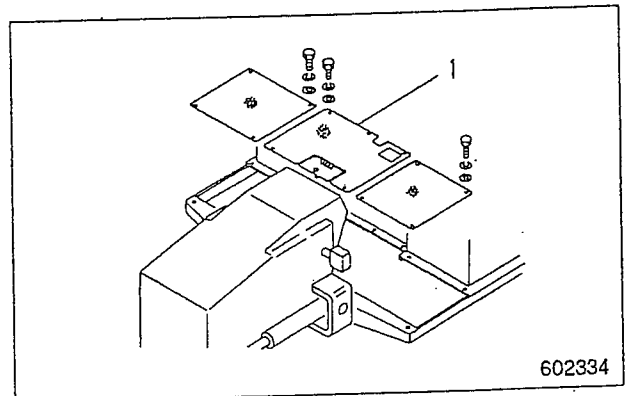
On-the-machine method

Start by:

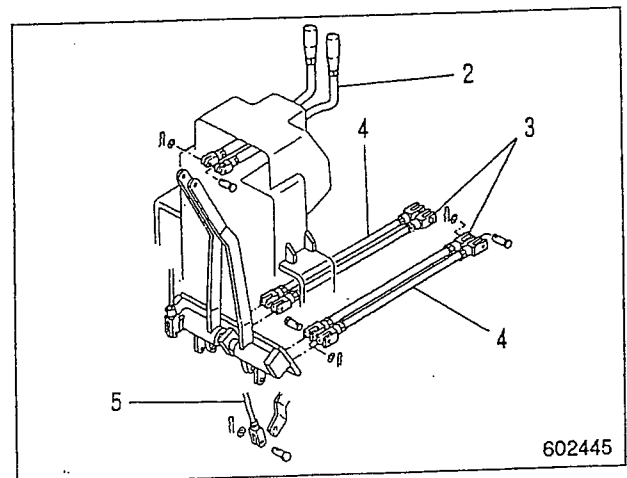
- (a) remove the under guard
- (b) drain the oil from the clutch case  
[5.5 liters (1.5 U.S. gal), approx.]

1. Remove the following parts:

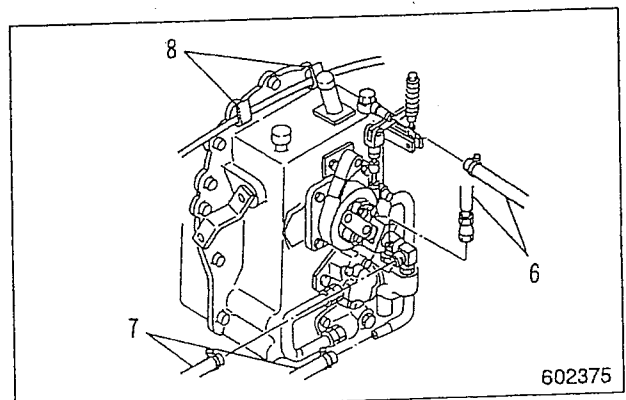
- 1 Floor plate (platform) (center, 1 pc)



- 2 Steering clutch levers (2 pcs)
- 3 Steering control rods (2 pcs)
- 4 Brake control rods (2 pcs)
- 5 Clutch control rod (1 pc)



- 6 Rubber hoses for steering clutches (2 pcs)
- 7 Rubber hoses for oil cooler (2 pcs)
- 8 Electric wire (by loosening clamps)



## DISASSEMBLY AND REASSEMBLY

2. After removing the universal joint, remove the following components from the flywheel clutch housing:

- (1) Gear pump
- (2) Relief valve
- (3) Oil strainer
- (4) Clutch brake

### NOTE

Remove the universal joint together with the flange attached to the front end of input shaft.

3. Remove the oil filler from the threaded hole (M10 – 1.25) at the top of clutch housing 9. Attach hook A in that threaded hole, and hoist the housing.

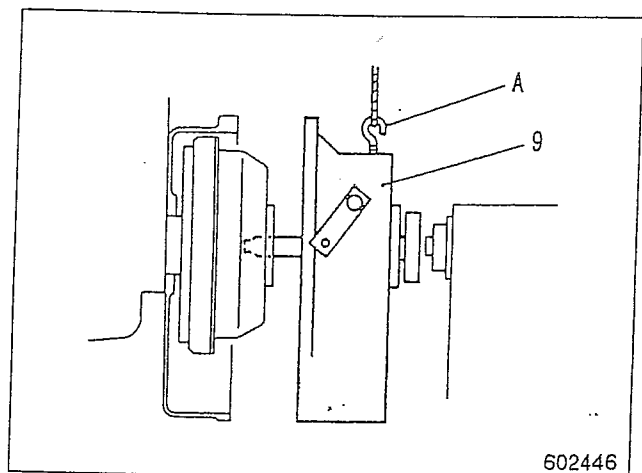
### NOTE

When hoisting the clutch housing, cover the dashboard for protection.

4. Unscrew the bolts securing the clutch housing, and move the housing backward until it is possible to pull the main drive shaft out of the clutch cover.

### NOTE

Have the sling off hook A and attach it to shackle B bolted to the housing through one of the mounting bolt holes.

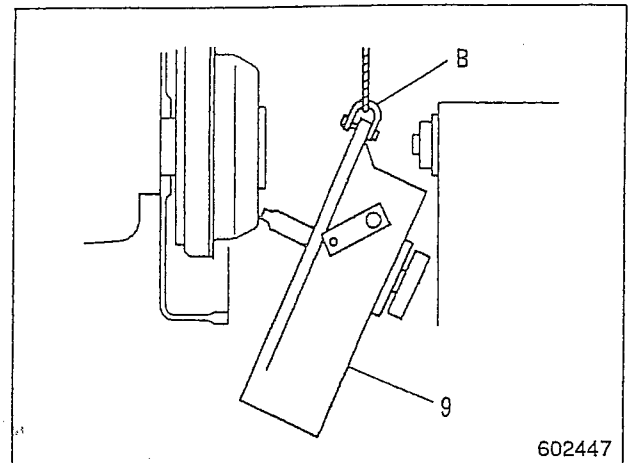




5. Tilt clutch housing 9 with its rear (transmission) side lower than its front side, as shown, and take the housing down.
6. For removal of the parts from the clutch housing and removal of the pressure plate assembly from the engine flywheel, follow the steps under "Disassembly."

**NOTE**

For disassembly and reassembly of the gear pump, refer to GEAR PUMP FOR TRANSMISSION AND STEERING CLUTCHES.



## Installation

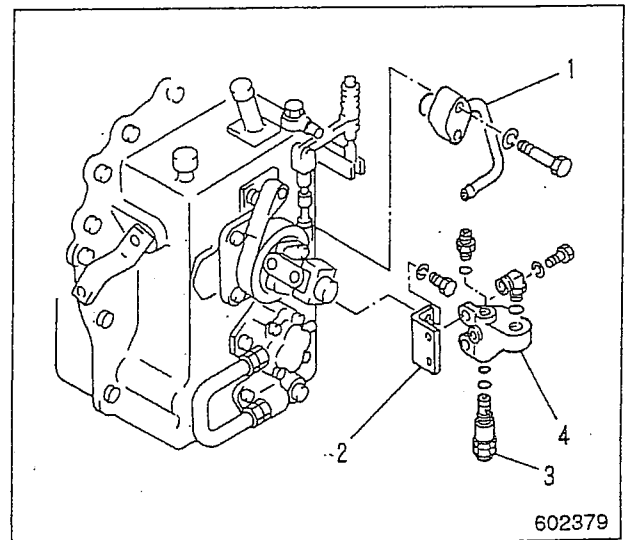
To install, follow the reverse of removal sequence.

## Off-the-machine method

## Relief valve removal and installation

1. Remove the following parts:

- 1 Pipe
- 2 Bracket
- 3 Relief valve
- 4 Block

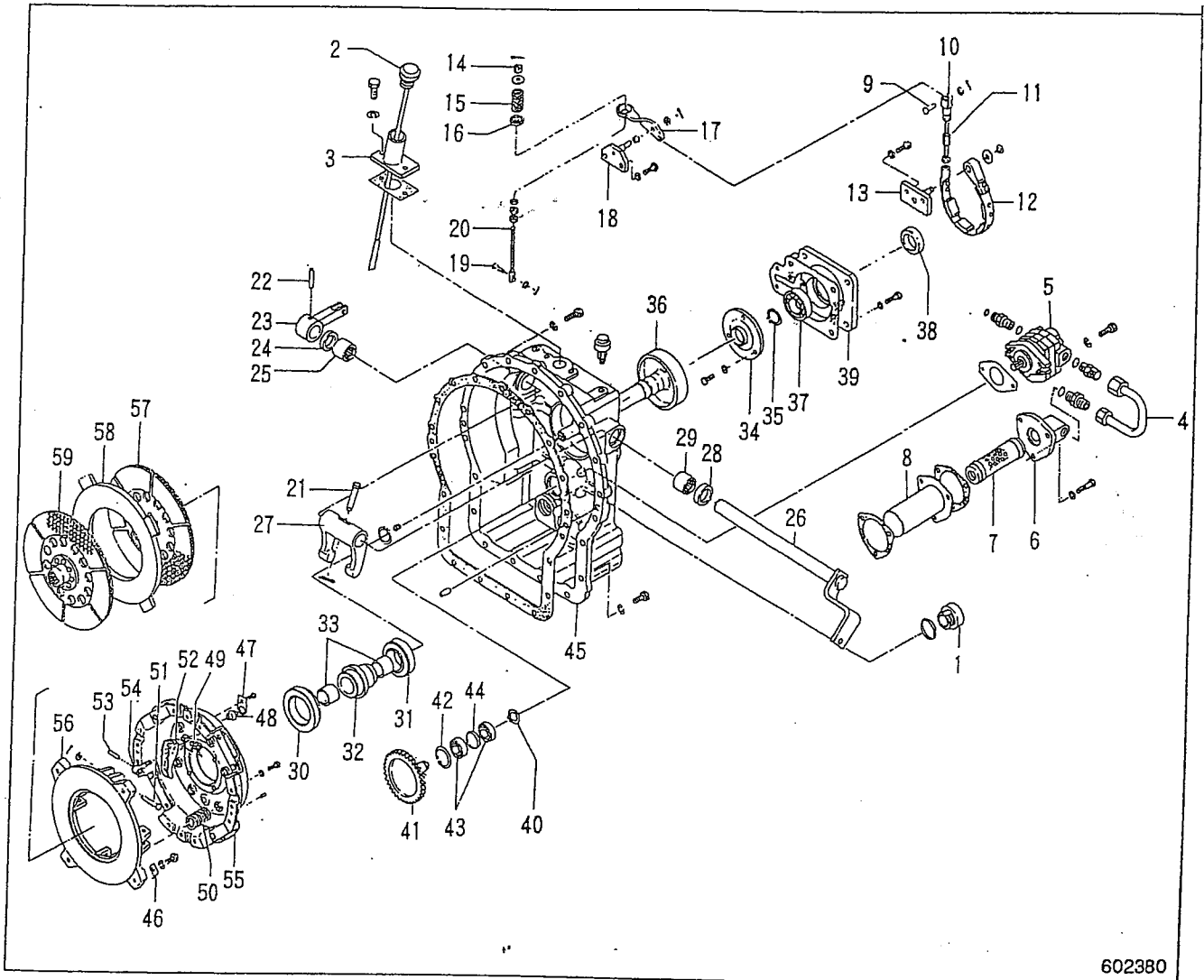


2. When installing the valve to the block, apply a coat of oil to the O-ring of the gear pump-side connector.

## DISASSEMBLY AND REASSEMBLY

### Disassembly

(The following disassembly sequence is for the off-the-machine method but it is valid also for the on-the-machine method.)



602380

### Disassembly sequence

- |                                     |                                     |                                     |
|-------------------------------------|-------------------------------------|-------------------------------------|
| 1 Drain plug                        | 20 Bolt                             | 40 Snap ring                        |
| 2 Oil level gauge                   | 21 Pin                              | 41 Gear                             |
| 3 Oil filler                        | 22 Pin                              | 42 Snap ring                        |
| (Remove 4 thru 45 as an assembly.)  | 23 Lever                            | 43 Bearings                         |
| 4 Suction pipe [connector]          | 24 Oil seal                         | 44 Spacer                           |
| 5 Gear pump [connectors]            | 25 Needle roller bearing            | 45 Clutch housing                   |
| 6 Filter cover                      | 26 Shaft                            | (Remove 46 thru 56 as an assembly.) |
| 7 Filter                            | 27 Release lever (fork)             | 46 Washer                           |
| 8 Filter case                       | 28 Oil seal                         | 47 Lock plate                       |
| 9 Pin                               | 29 Needle roller bearing            | 48 Nut                              |
| (Remove 10 thru 13 as an assembly.) | 30 Needle roller bearing            | 49 Return spring                    |
| 10 Clevis                           | 31 Bearing                          | 50 Pressure spring                  |
| 11 Adjusting bolt                   | 32 Release hub                      | 51 Pin                              |
| 12 Brake band                       | 33 Bushing                          | 52 Release lever                    |
| 13 Support                          | (Remove 34 thru 39 as an assembly.) | 53 Pin                              |
| 14 Castle nut                       | 34 Cover                            | 54 Lever support                    |
| 15 Spring                           | 35 Snap ring                        | 55 Clutch cover                     |
| 16 Spring seat                      | 36 Main drive shaft                 | 56 Pressure plate                   |
| 17 Lever                            | 37 Bearing                          | 57 Clutch disc                      |
| 18 Support                          | 38 Oil seal                         | 58 Mating plate                     |
| 19 Pin                              | 39 Cover                            | 59 Clutch disc                      |

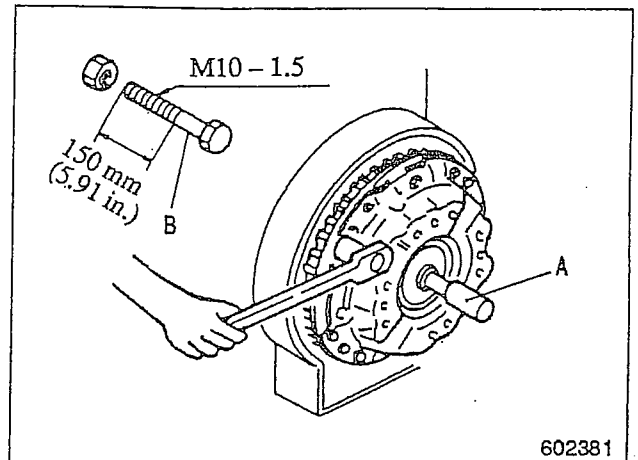
Suggestions

1. Clutch housing removal

Remove oil filler 3 from the threaded hole (M10 - 1.25) at the top of housing 45. Attach a hook in that threaded hole, and hoist the housing.

2. Pressure plate assembly removal

Before removing pressure plate assembly, mark pressure plate 56 and clutch cover 55. Install clutch disc arbor A (special tool) in the splined hole of clutch disc, and run guide bolt B into each clutch spring hole. Tighten the guide bolts to compress the clutch springs lightly, and remove the pressure plate assembly.



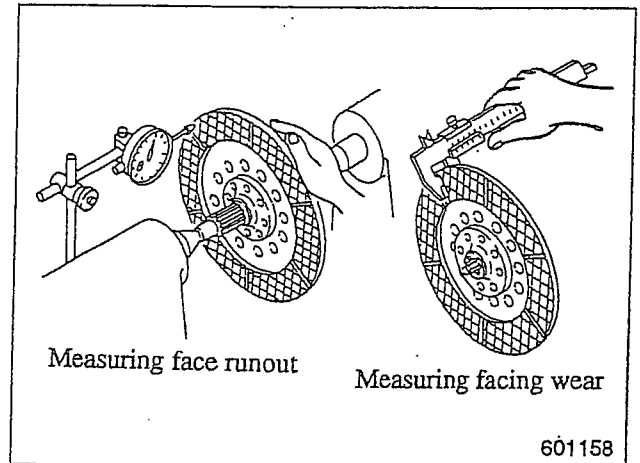
Inspection

1. Clutch discs

Measure the face runout, facing wear and looseness of mating splines. Replace the disc if any of these measurements exceeds the service limit.

Unit: mm (in.)

Item	Assembly standard	Service limit
Thickness of facing	5.7 to 6.3 (0.224 to 0.248)	-0.4 (-0.016) for one side -0.8 (-0.031) for both sides
Face runout	0.7 (0.028), maximum	0.7 (0.028)
Looseness of mating splines	0.05 to 0.15 (0.0020 to 0.0059)	0.30 (0.0118)



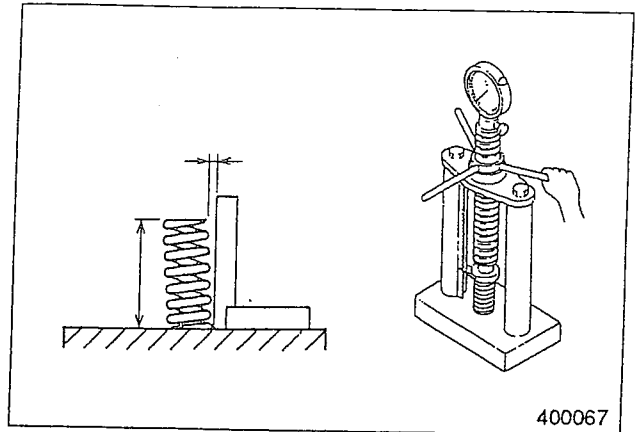
DISASSEMBLY AND REASSEMBLY

2. Pressure springs

Measure the free length, test force and squareness. Replace the spring if any of these measurements exceeds the service limit.

Unit: mm (in.)

Item	Assembly standard	Service limit
Free length	70.6 (2.780)	68.5 (2.697)
Test force, kgf (lbf) [N] (Initial working length: 48.2 (1.90))	43.5 ± 2.2 (96 ± 5) [427 ± 22]	39.2 (86) [384]
Squareness	2°, maximum	3°



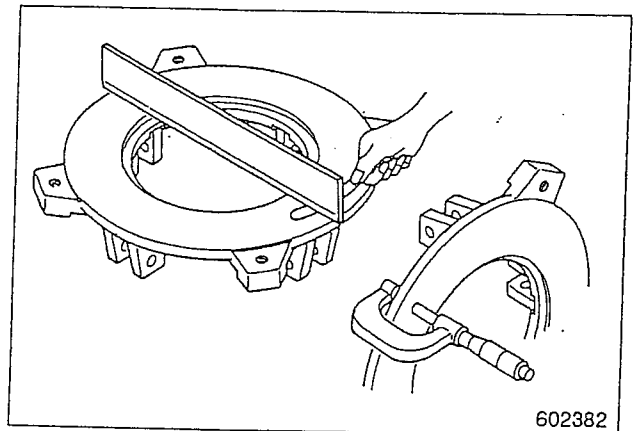
400067

3. Pressure plate

Measure the thickness and flatness of the friction surface. Replace the plate if any of these measurements exceeds the service limit.

Unit: mm (in.)

Item	Assembly standard	Service limit
Thickness of friction surface	20.2 (0.795)	19.7 (0.776)
Flatness	0.05 to 0.15 (0.0020 to 0.0059)	0.30 (0.0118)



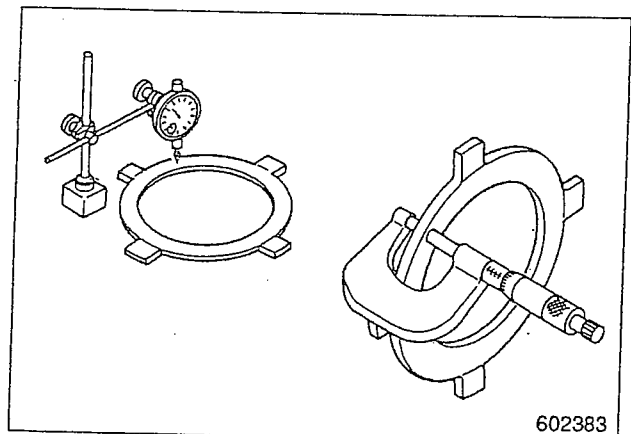
602382

4. Mating plates

Measure the thickness and flatness of the friction surface. Replace the plates if any of these measurements exceeds the service limit.

Unit: mm (in.)

Item	Assembly standard	Service limit
Thickness of friction surface	13.0 (0.512)	12.5 (0.492)
Flatness	0.05 to 0.10 (0.0020 to 0.0039)	0.20 (0.0079)



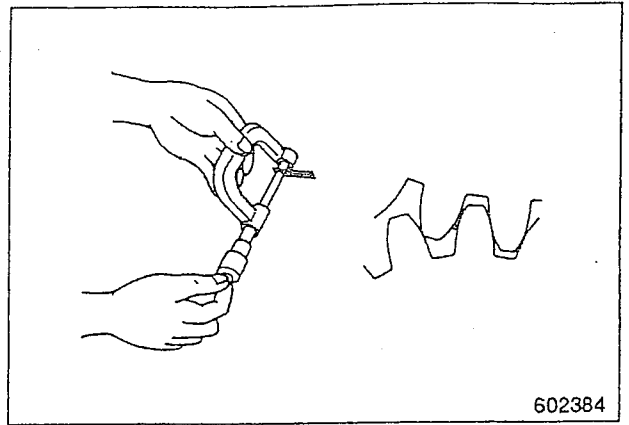
602383

### 5. Pump drive gear

Measure the pump drive gear backlash with mating gear. Replace the gear if the measurement exceeds the service limit.

Unit: mm (in.)

Item	Assembly standard	Service limit
Backlash	0.35 to 0.42 (0.0138 to 0.0165)	0.70 (0.0276)



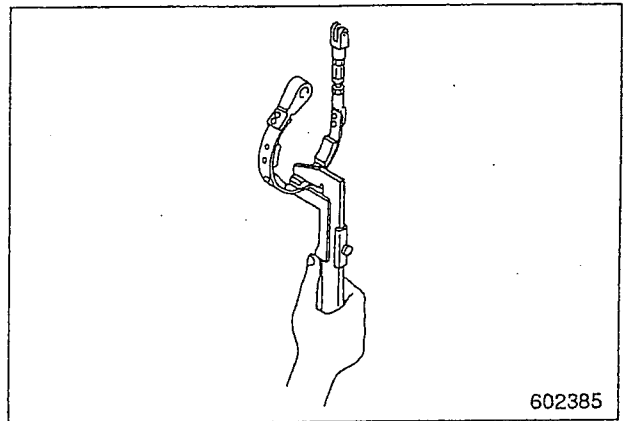
602384

### 6. Brake band

Measure the thickness of the facing. Replace the band if the measurement exceeds the service limit.

Unit: mm (in.)

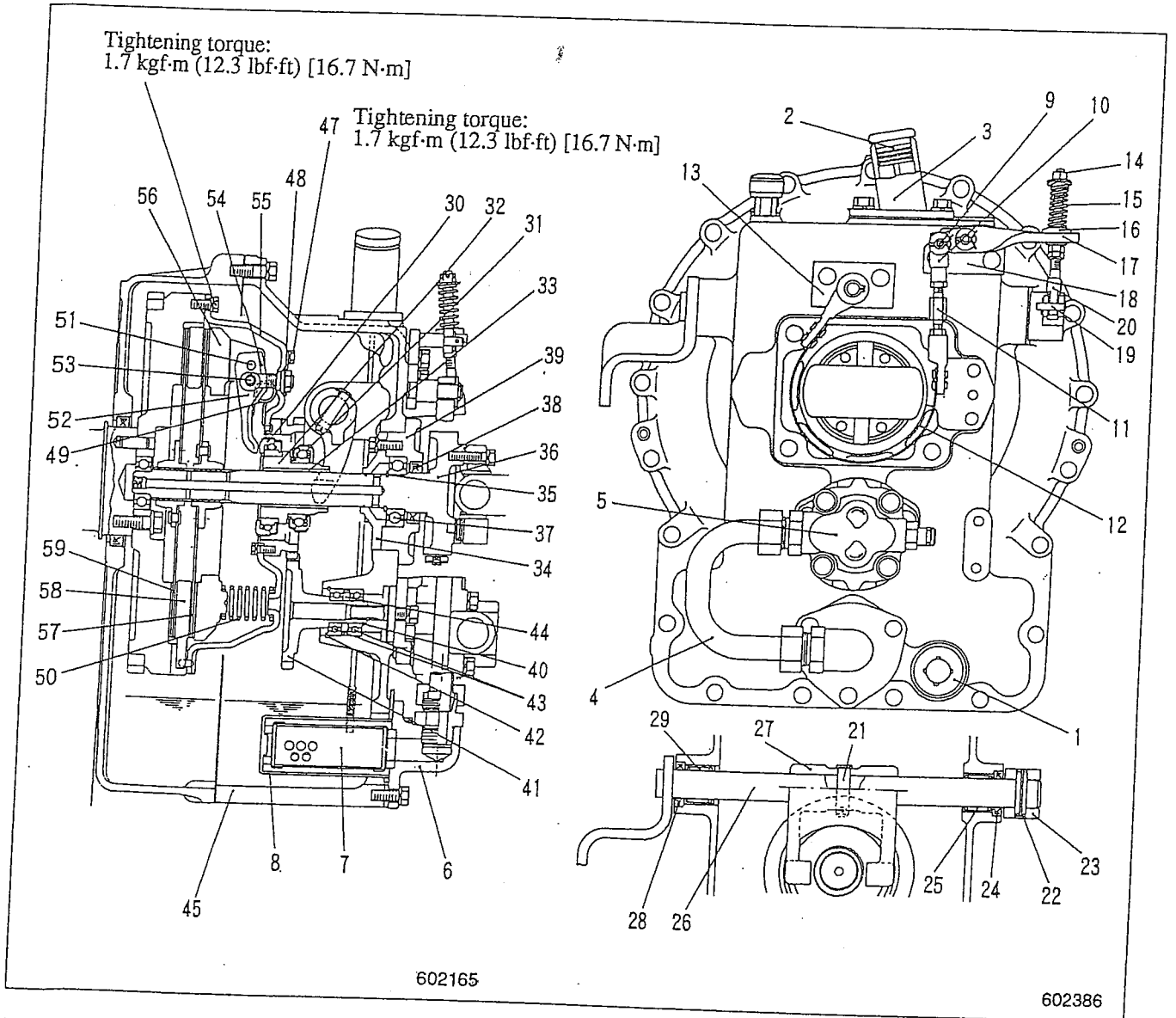
Item	Assembly standard	Service limit
Thickness of facing	5.0 (0.20)	3.0 (0.12)



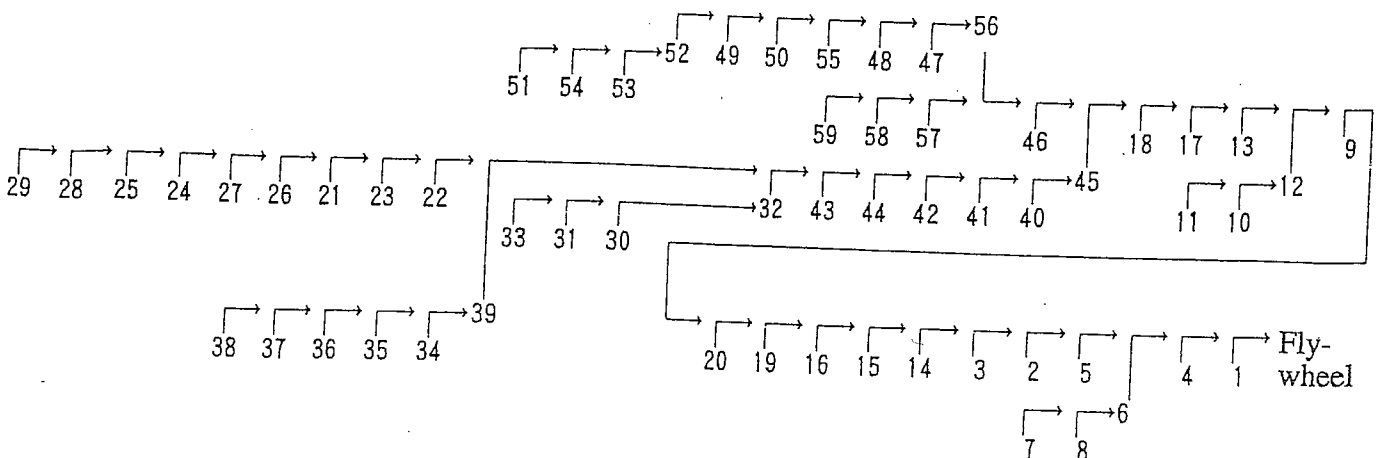
602385

# DISASSEMBLY AND REASSEMBLY

## Reassembly



## Reassembly sequence

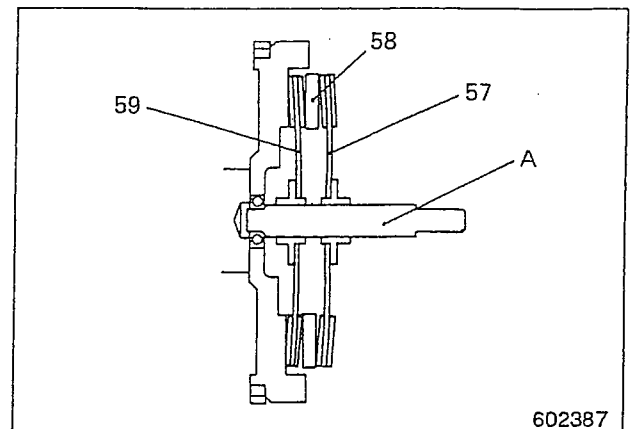


## Suggestions

## 1. Clutch disc installation

Use clutch disc arbor A (special tool) to install pressure plate assembly including parts 46 thru 56, mating plate 58 and clutch discs 57 and 59. When installing them, make sure that the clutch discs are "dished."

Tighten the mounting bolts to the specified torque in a criss-cross pattern.

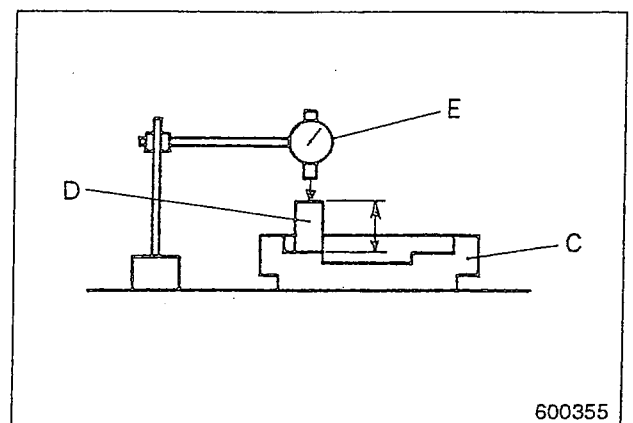


## 2. Release lever height adjustment

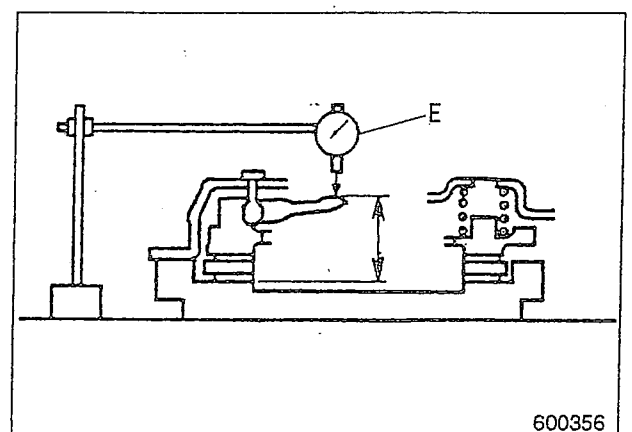
- (1) Place flywheel C (or a jig equivalent to the flywheel) on a surface plate, and set up dial indicator E as shown. Place 74-mm (2.91-in.) block gauge D on the friction surface of the flywheel, and set the dial indicator to read 0 mm for the 74-mm (2.91-in.) height.

**NOTE**

Support the dial indicator firmly to retain the original setting.



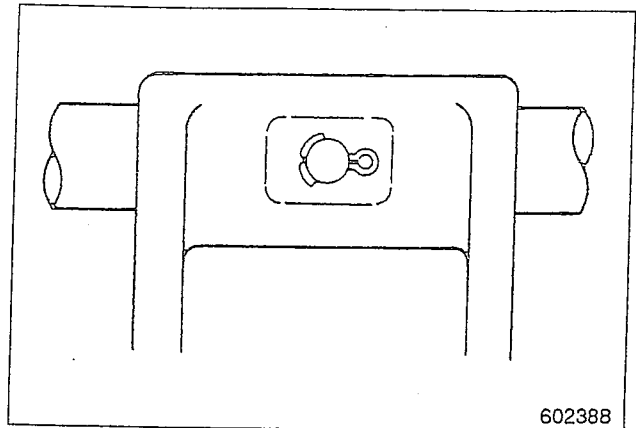
- (2) Put the clutch disc, mating plate, clutch disc and clutch cover assembly in that order on flywheel C (or the jig). Then, remove guide bolts B.
- (3) Set the dial indicator at the tip of the release lever. Take an indicator reading and tighten or loosen the lever nut until the reading is 0 mm. After following this step on the other three release levers, tap each release lever at least 50 times, giving it a stroke of 14 mm (0.6 in.) at each tapping. This is for setting the release levers in their adjusted condition. Check the lever height once again and, if necessary, adjust it, making sure that the difference between average height of any two release levers next to each other is below 0.7 mm (0.028 in.).
- (4) Install lock plate 47 to lever nut 48, holding the nut so it does not rotate, and secure the release lever to clutch cover 55 with bolt.



## DISASSEMBLY AND REASSEMBLY

### 3. Split pin installation

Insert the split pin into release lever 27 in parallel with the shaft and spread its ends properly to avoid interference with the pump drive gear.



### 4. Oil seal installation

Apply a coat of Three Bond 1104 to the periphery of oil seal 38 before installation.



## DIRECT DRIVE (DD) TRANSMISSION

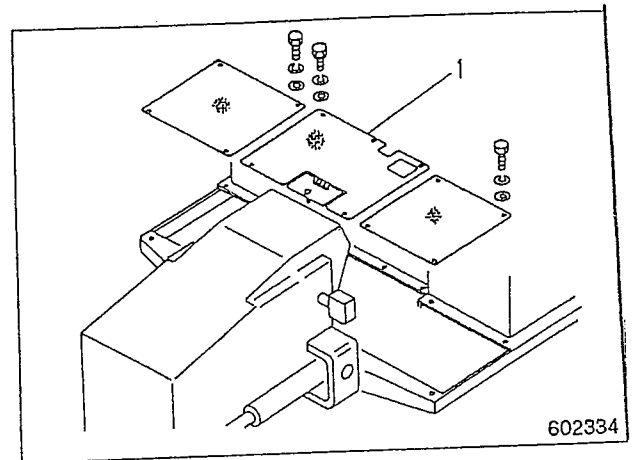
### Removal

Start by:

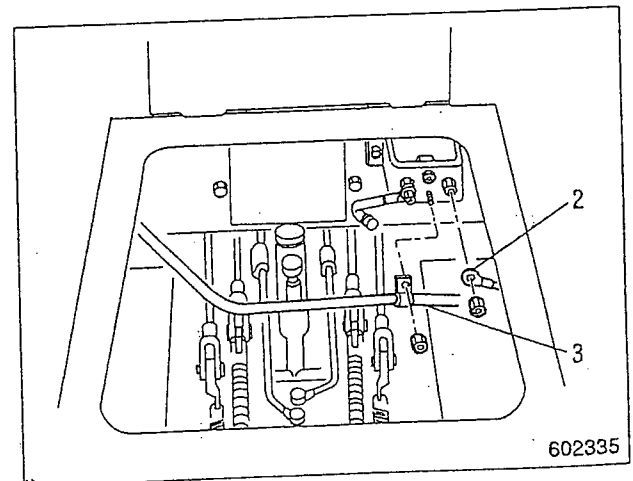
- (a) remove the under guard
- (b) drain the oil from the transmission case and bevel gear case [9.5 liters (2.5 U.S. gal), approx.]

1. Remove the following parts:

1 Floor plate (platform) (center, 1 pc)

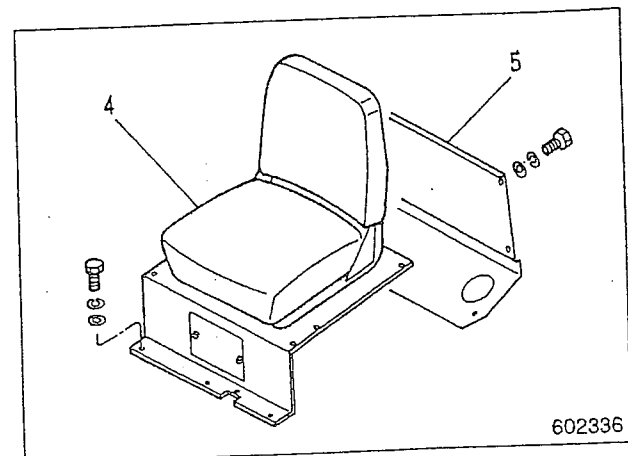


- 2 Electric wire between battery switch and battery
- 3 Clamp for electric wire between battery and starter



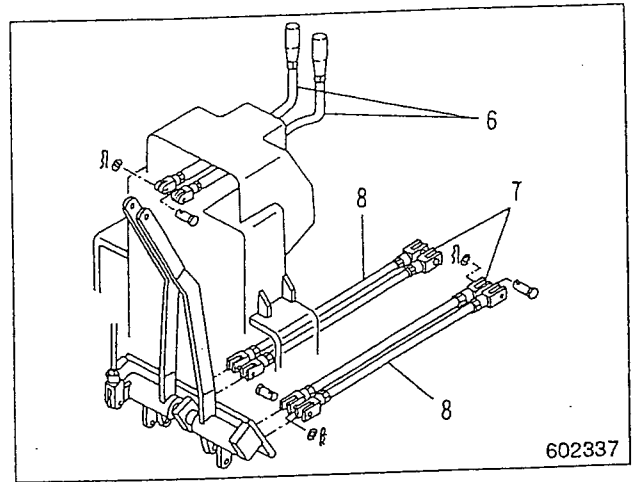
- 4 Operator's seat and seat plate
- 5 Rear cover

Weight of operator's seat and seat plate	31 kg (68 lb), approx.
--	------------------------



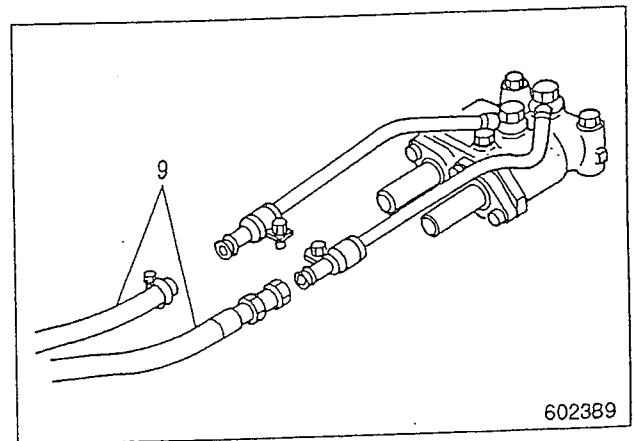
DISASSEMBLY AND REASSEMBLY

- 6 Steering clutch levers
- 7 Steering control rods
- 8 Brake control rods



2. Disconnect the following parts:

- 9 Steering clutch oil hoses (2 pcs)



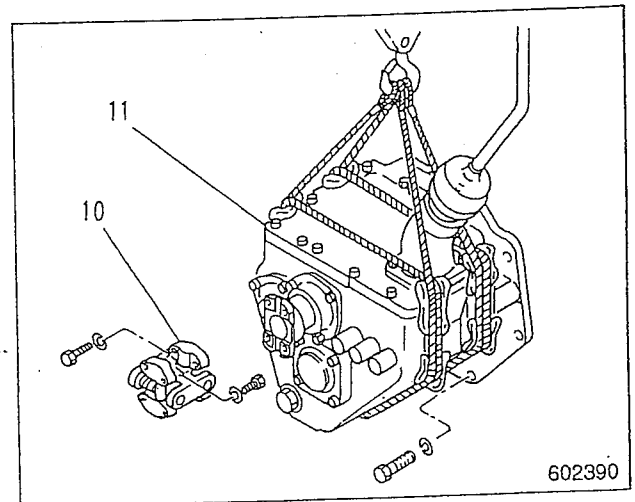
3. Remove the following parts:

- 10 Universal joint
- 11 Transmission

Weight of universal joint	2 kg (4 lb), approx.
Weight of transmission	73 kg (161 lb), approx.

**NOTE**

Before hoisting the transmission, shift it forward to pull the pinion back out of mesh with the bevel gear.



Installation

To install, follow the reverse of removal sequence.

Inspection after installation

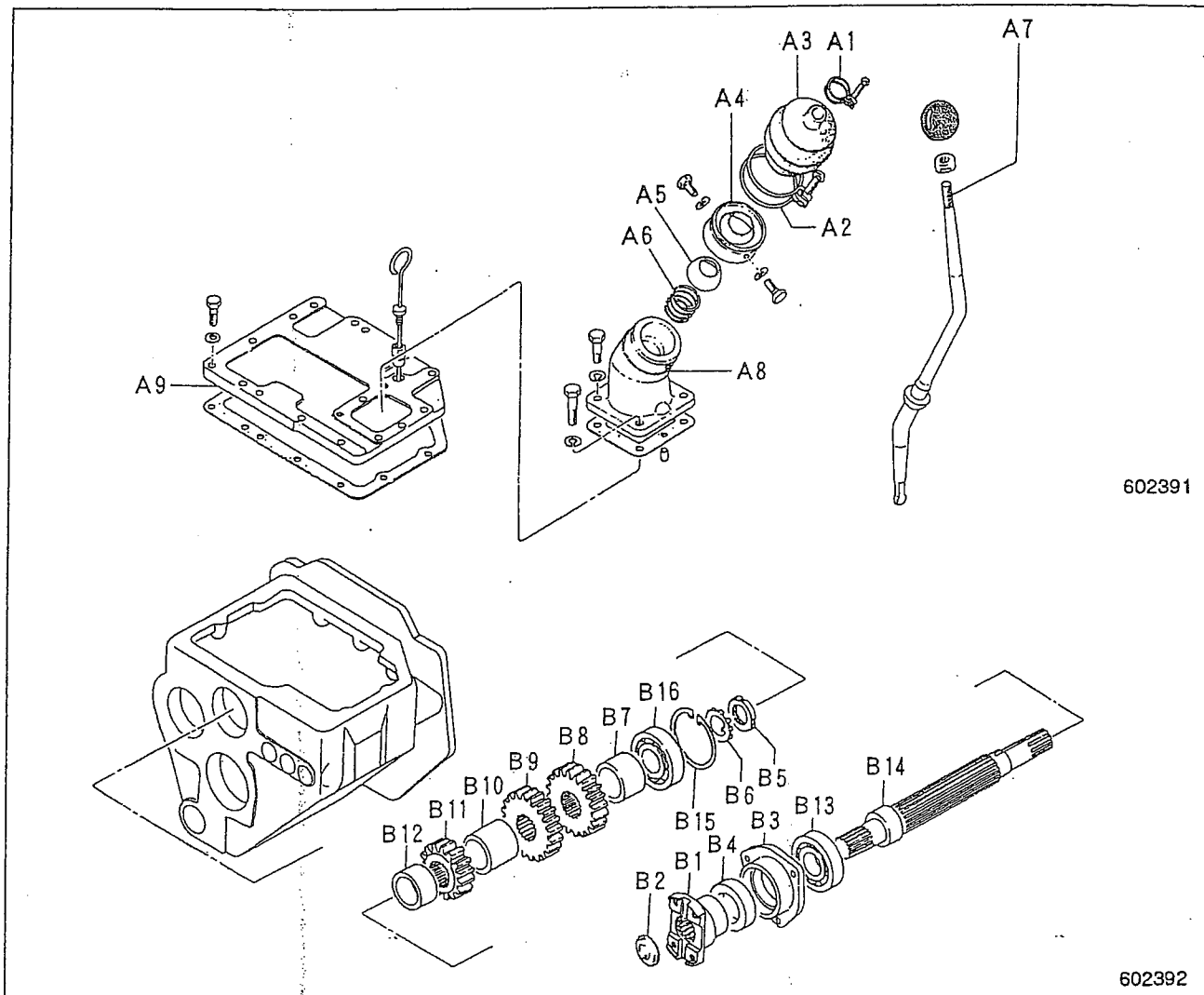
- (1) Make sure that the electric wires, pipes and hoses are connected properly.
- (2) Fill the transmission case and bevel gear case with recommended oil.

## Disassembly

Remove the following groups in the alphabetical order:

- |  |                          |
|--|--------------------------|
| A Transmission control lever group     | D Countershaft group     |
| B Main drive shaft (input shaft) group | E Bevel gear shaft group |
| C Shift fork group                     |                          |

A Transmission control lever group, B Main drive shaft (input shaft) group



## Disassembly sequence

(Loosen A1 and A2.)

A1, A2 Hose clamps

(Remove A1 thru A7 as an assembly.)

A3 Cover

A4 Cover

A5 Retainer

A6 Spring

A7 Control lever

A8 Lever case

A9 Transmission cover

(Remove B1 and B2 as an assembly.)

B1 Flange

B2 Plug

(Remove B3 and B4 as an assembly.)

B3 Cover

B4 Oil seal

B5 Lock nut

B6 Lock washer

(Remove B7 thru B14 as an assembly.)

B7 Spacer

B8 Input gear

B9 2nd-speed reverse gear

B10 Spacer

B11 1st-speed reverse gear

B12 Spacer

B13 Ball bearing

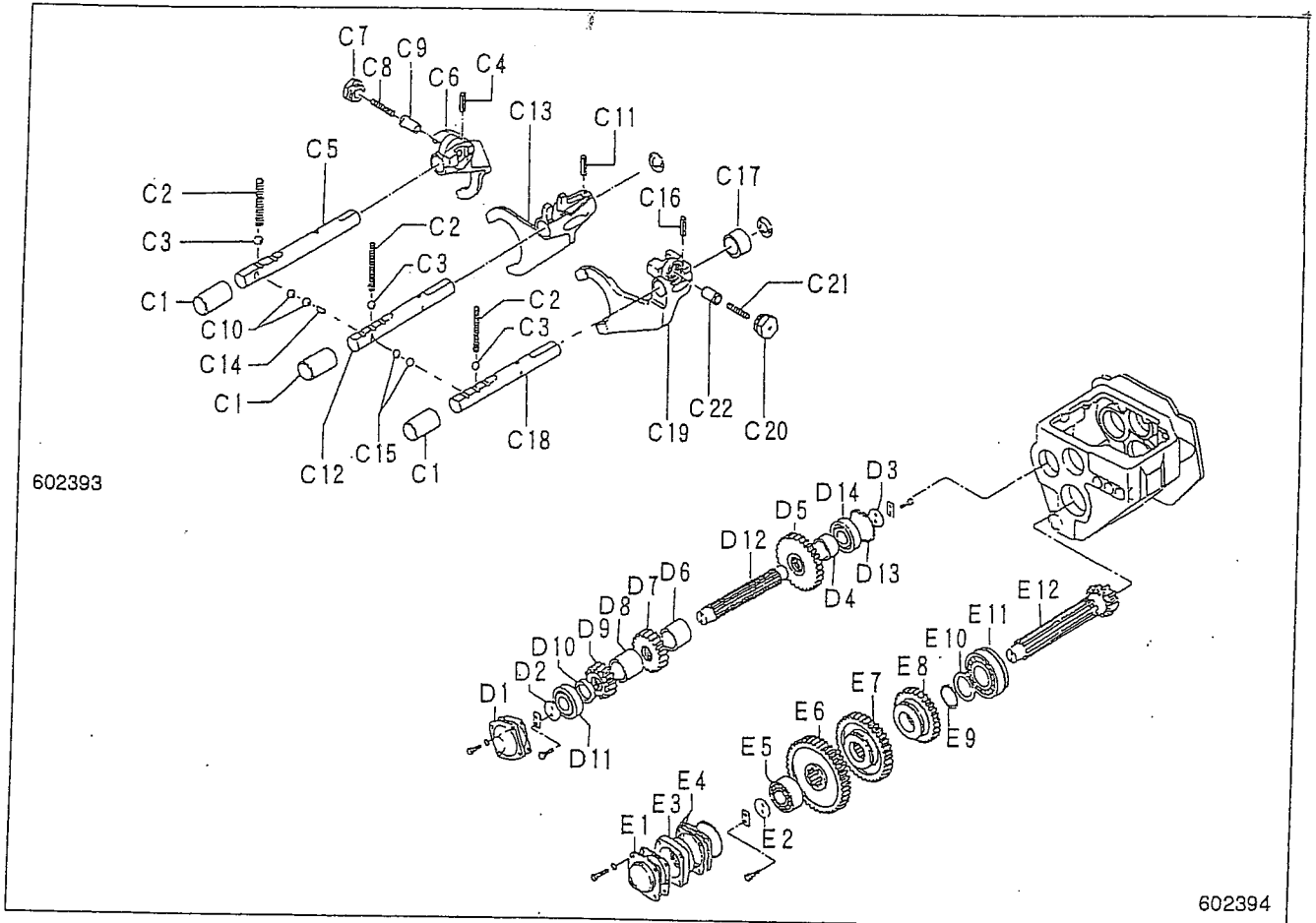
B14 Input shaft

B15 Snap ring

B16 Ball bearing

DISASSEMBLY AND REASSEMBLY

C Shift fork group, D Countershaft group, E Bevel gear shaft group



Disassembly sequence

- |                                     |                                       |                                      |
|-------------------------------------|---------------------------------------|--------------------------------------|
| C1 Expansion plug                   | (Remove C19 thru C22 as an assembly.) | E1 cover                             |
| C2 Spring                           | C19 1st-speed shift fork              | E2 Washer                            |
| C3 Steel (detent) ball              | C20 Spring retainer                   | (Remove E3 thru E5 as an assembly.)  |
| C4 Spring pin                       | C21 Spring                            | E3 Bearing cage                      |
| C5 3rd-speed shift rail             | C22 Plunger                           | E4 Shims                             |
| (Remove C6 thru C9 as an assembly.) | D1 Cover                              | E5 Ball bearing                      |
| C6 3rd-speed shift fork             | D2 Washer                             | (Remove E6 thru E12 as an assembly.) |
| C7 Spring retainer                  | D3 Washer                             | E6 1st-speed sliding gear            |
| C8 Spring                           | (Remove D4 thru D12 as an assembly.)  | E7 2nd-speed sliding gear            |
| C9 Plunger                          | D4 Spacer                             | E8 3rd-speed sliding gear            |
| C10 Steel (detent) balls (2 pcs)    | D5 Countergear                        | E9 Snap ring                         |
| C11 spring pin                      | D6 Spacer                             | E10 Spacer                           |
| C12 2nd-speed shift rail            | D7 2nd-speed drive gear               | E11 Roller bearing                   |
| C13 2nd-speed shift fork            | D8 Spacer                             | E12 Bevel pinion shaft               |
| C14 Interlock pin                   | D9 1st-speed drive gear               |                                      |
| C15 Steel (detent) ball (2 pcs)     | D10 Spacer                            |                                      |
| C16 Spring pin                      | D11 Roller bearing                    |                                      |
| C17 Collar                          | D12 Countershaft                      |                                      |
| C18 1st-speed shift rail            | D13 Snap ring                         |                                      |
|                                     | D14 Ball bearing                      |                                      |

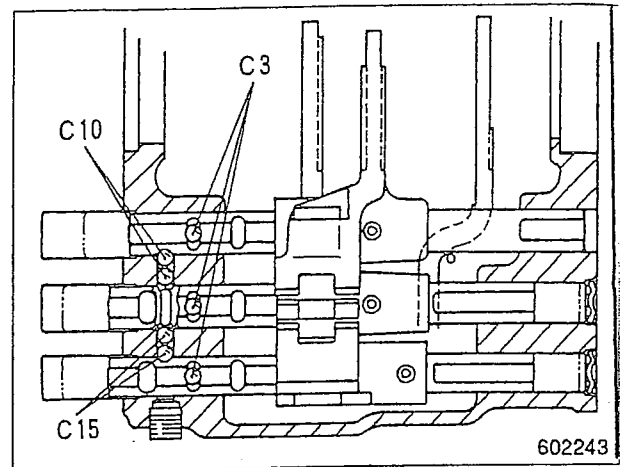
### Suggestions

#### 1. Detent group (interlock mechanism) removal

To remove the detent group, place the transmission control lever in NEUTRAL.

**NOTE**

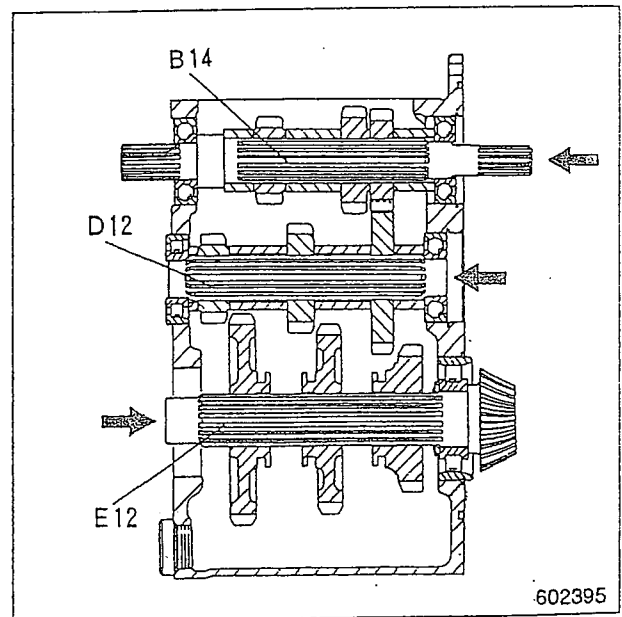
Carefully handle steel (detent) balls C3, C10 and C15 to prevent them from getting lost.



#### 2. Shaft removal

Drive the transmission shafts out of the case in the following directions:

- (1) Drive out input shaft (main drive shaft) B14 toward the steering clutch case side.
- (2) Drive out countershaft D12 toward the steering clutch case side.
- (3) Drive out bevel pinion shaft E12 toward the universal joint side.

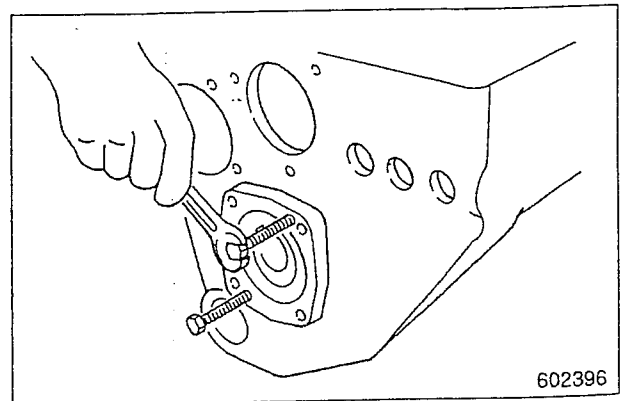


#### 3. Bevel pinion shaft bearing cage removal

Using jacking bolts, remove bearing cage E3 together with bearing E5 and shims E4.

#### 4. Bevel pinion shaft bearing removal

Remove the inner race and rollers of bearing E11. Remove the outer race if necessary.



## DISASSEMBLY AND REASSEMBLY

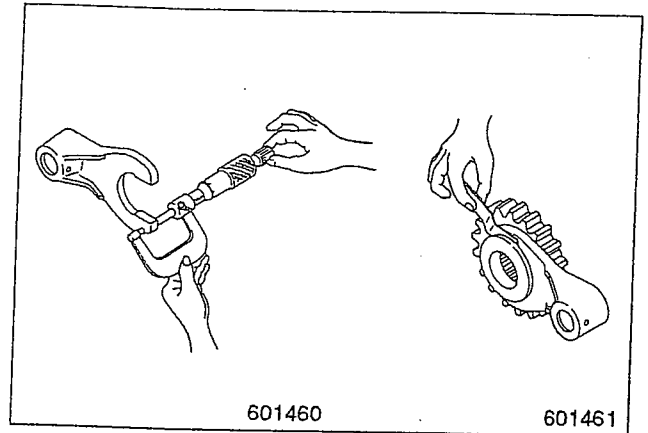
### Inspection

#### 1. Shift forks

Measure the clearance of each shift fork in its groove in the sliding gear. Replace the fork if the measurement exceeds the service limit.

Unit: mm (in.)

Item	Assembly standard	Service limit
Clearance of shaft fork in groove	0.1 to 0.3 (0.004 to 0.012)	0.5 (0.020)

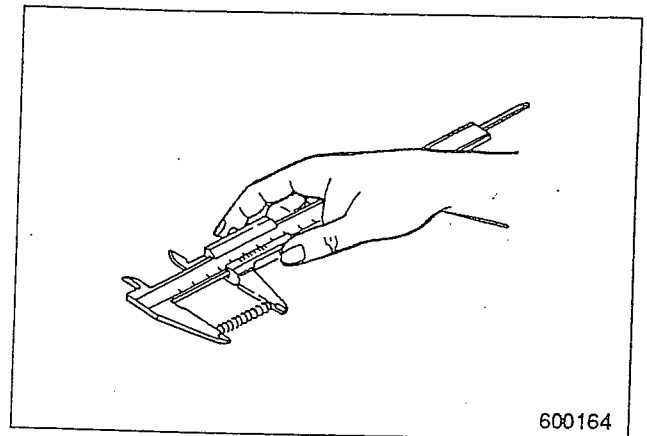


#### 2. Detent springs

Measure the free length and test force of each spring. Replace the spring if any of these measurements exceeds the service limit.

Unit: mm (in.)

Item	Assembly standard	Service limit
Test force, kgf (lbf) [N] (Initial working length: 55 (2.17))	9.80 ± 0.49 (22 ± 1) [96 ± 5]	7.5 (17) [74]

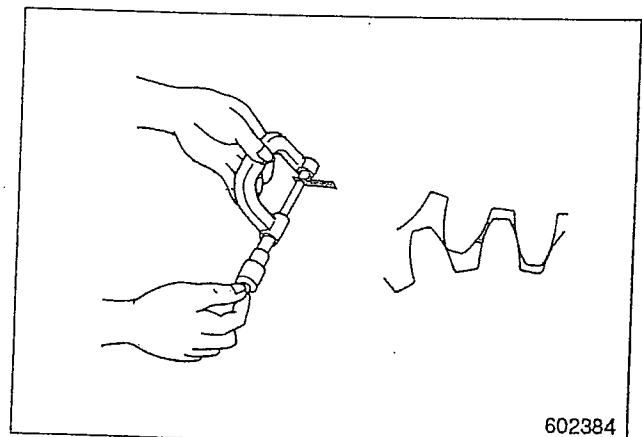


#### 3. Gear backlash

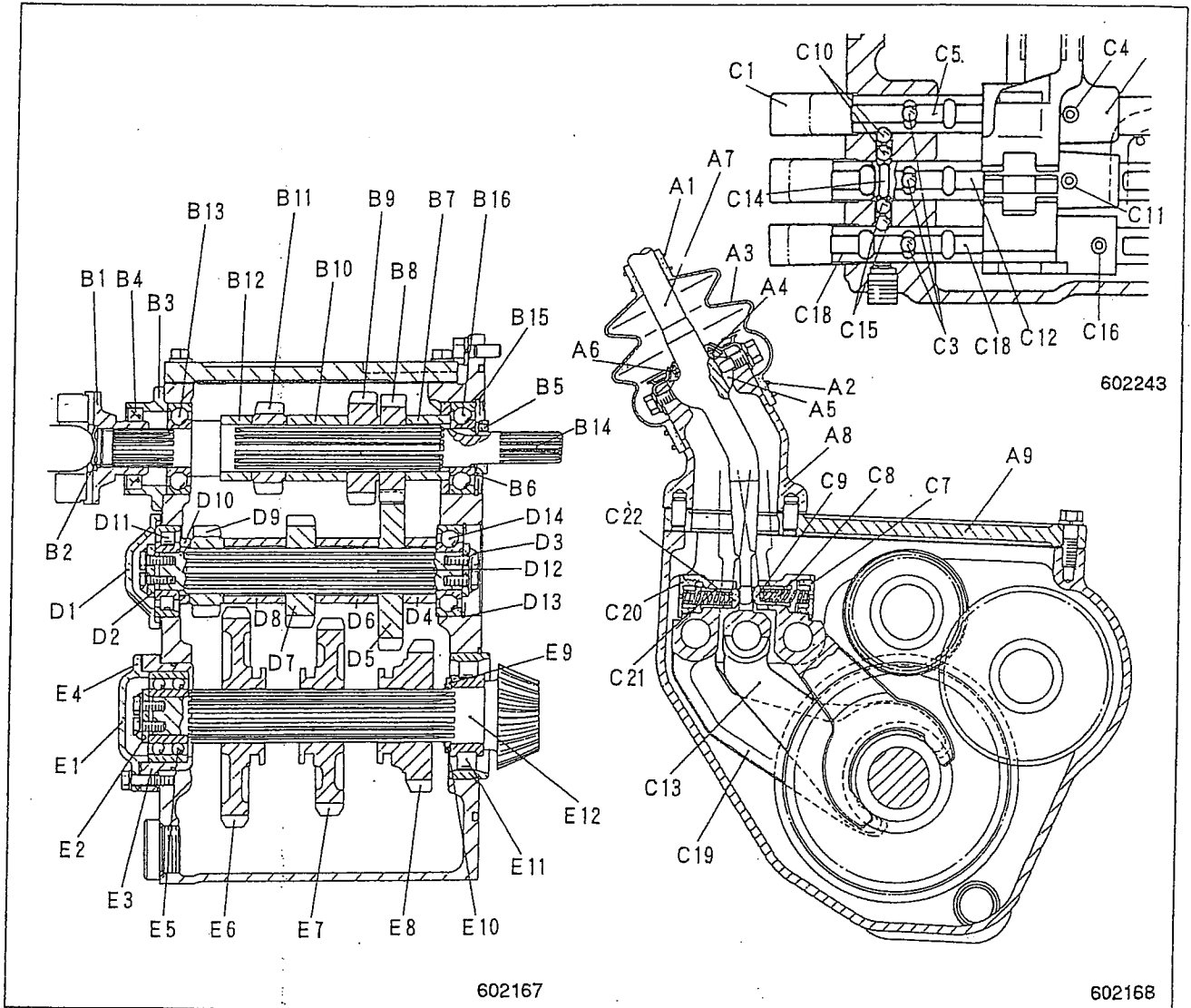
Measure the backlash of the gears. Replace the gears if the measurement exceeds the service limit.

Unit: mm (in.)

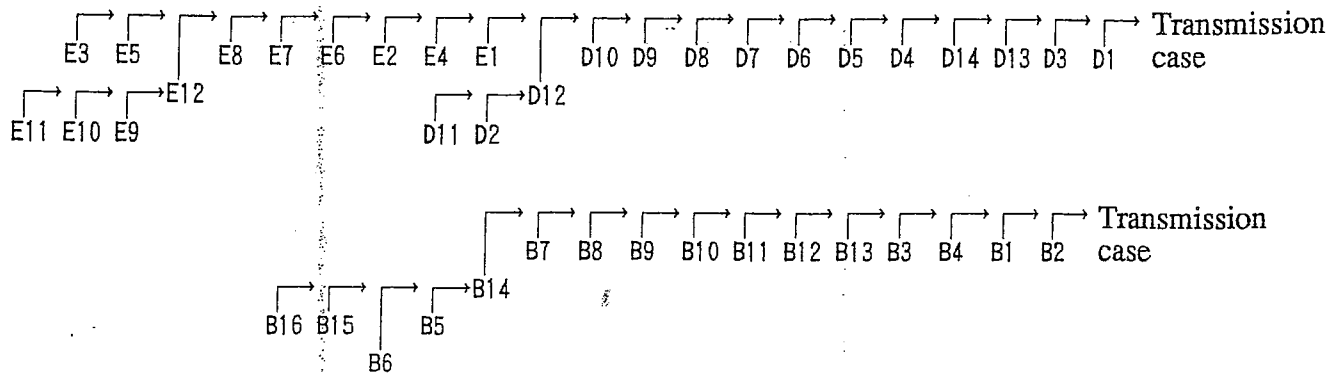
Item	Assembly standard	Service limit
Gear backlash	0.12 to 0.28 (0.0047 to 0.0110)	0.6 (0.024)



Reassembly



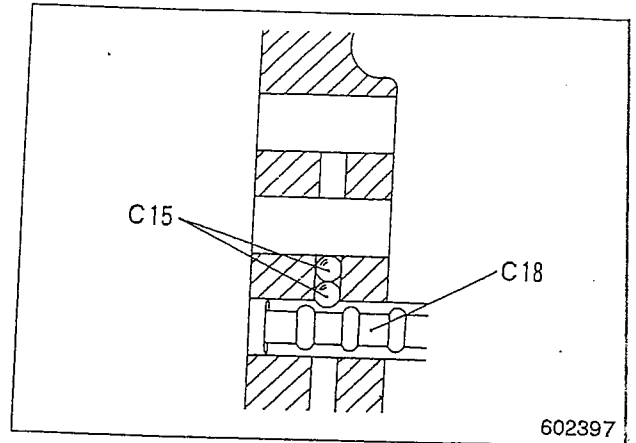
Reassembly sequence



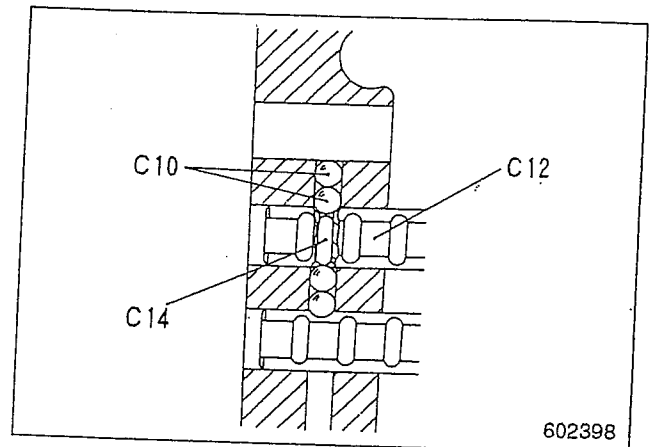
## DISASSEMBLY AND REASSEMBLY

### Suggestions

1. Detent group (interlock mechanism) installation
  - (1) Install 1st-speed shift rail C18 and steel balls C15 in that order.



- (2) Insert interlock pin C14 into the hole of 2nd-speed shift rail C12, and put steel balls C10 and 3rd-speed shift rail C5 in that order.



### NOTE

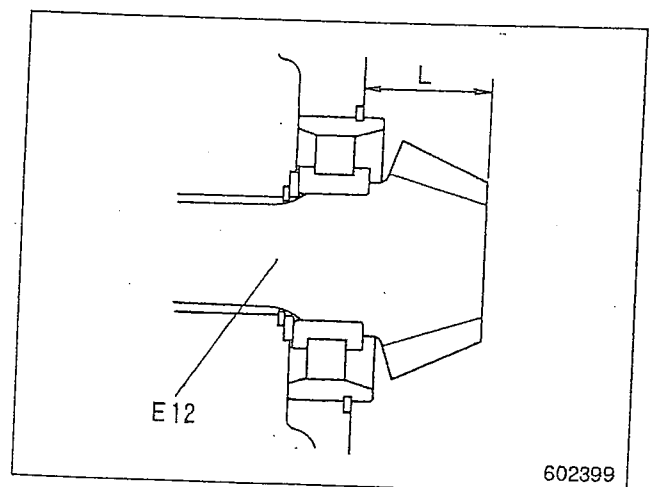
Install the detent parts with each shift rail held in NEUTRAL.

### 2: Bevel pinion shaft installation

- (1) Measure dimension L from the end face of pinion to that of transmission case, making sure that it is as specified below:

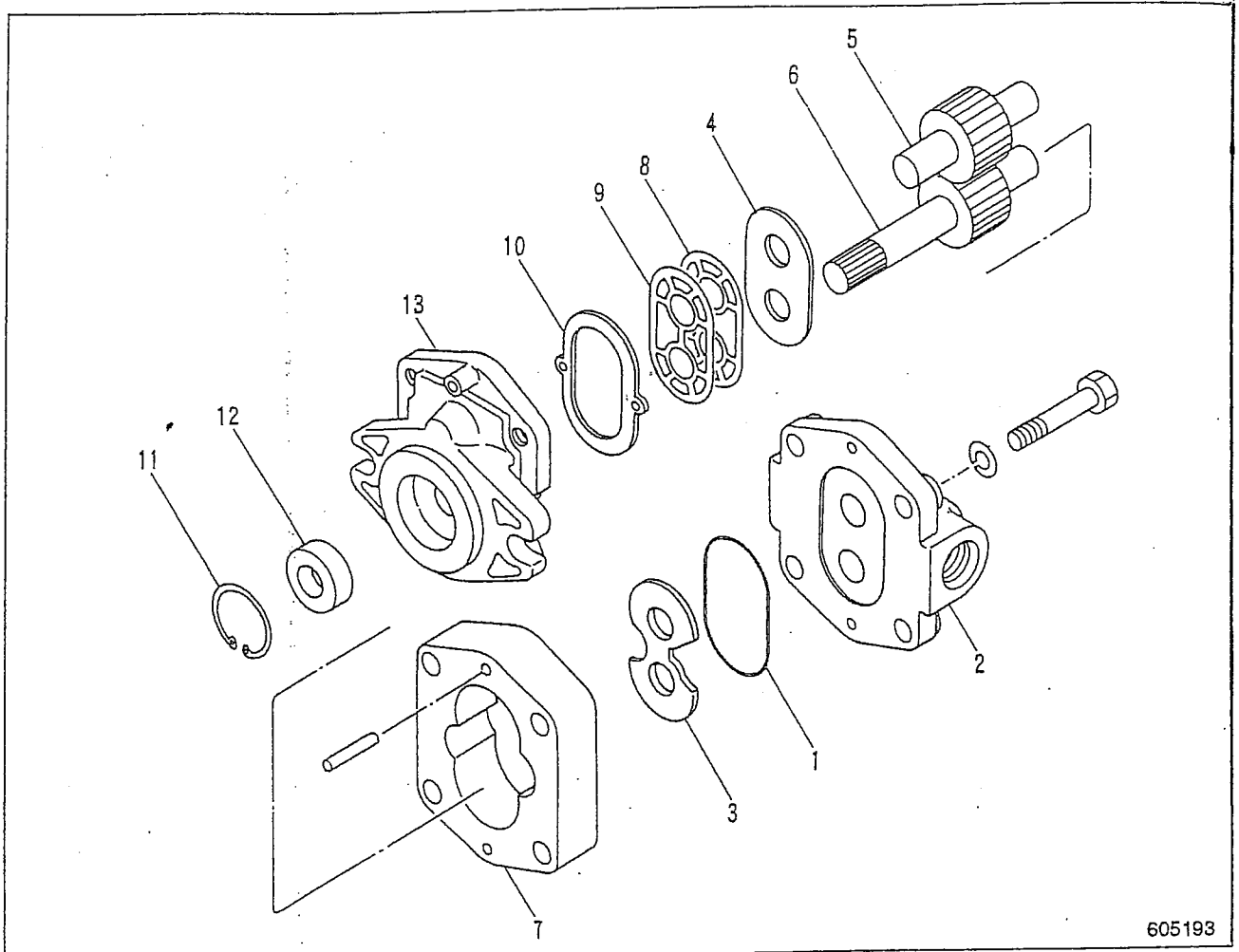
$$L = 46.2 \pm 0.1 \text{ mm } (1.819 \pm 0.004 \text{ in.})$$

- (2) The standard value of this dimension is indicated on the end face of pinion. Referring to that value, increase or decrease the thickness of shims E4 to be fitted to pinion shaft E12 on the opposite side of the pinion if the dimension is greater or smaller than the specification.





## GEAR PUMP FOR TRANSMISSION AND STEERING CLUTCHES



605193

## Disassembly sequence

(Remove 1 and 2 as an assembly.)

1 O-ring

2 Cover

3 Side plate B

(Remove 4 thru 7 as an assembly.)

4 Side plate A

5 Driven gear

6 Drive gear

7 Gear plate

8 Gasket A

9 Gasket B

10 Balance seal

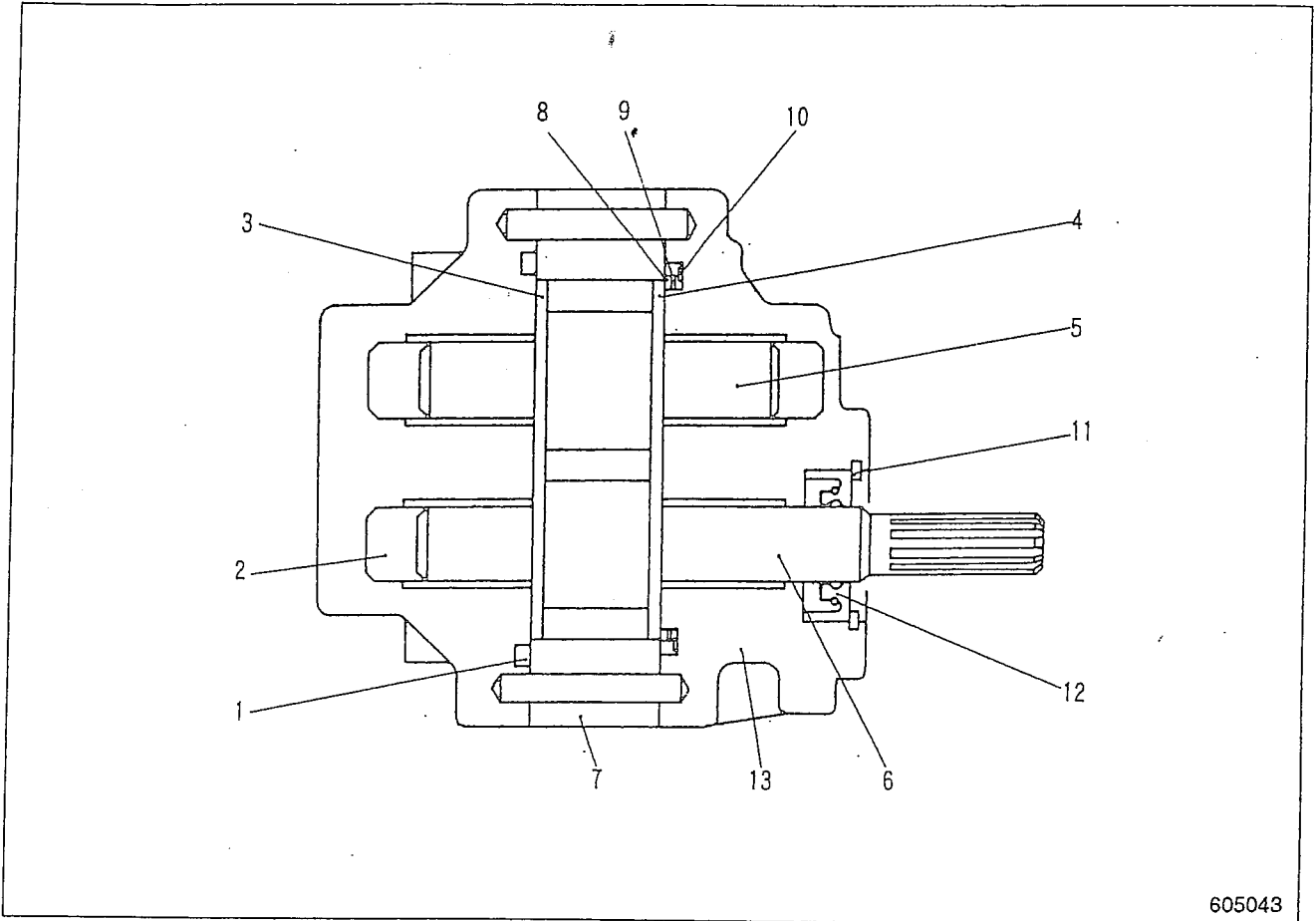
11 Snap ring

12 Oil seal

13 Mounting flange

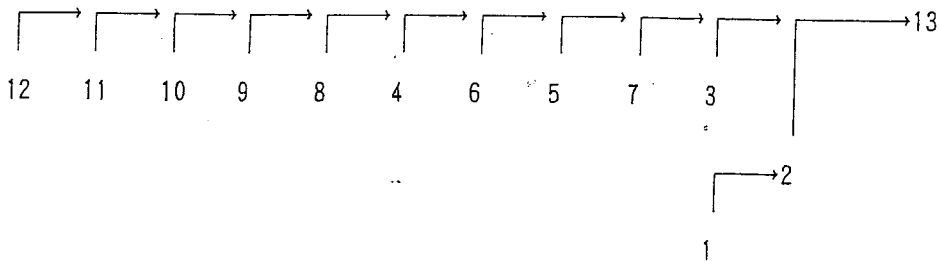
# DISASSEMBLY AND REASSEMBLY

## Reassembly



605043

## Reassembly sequence



### NOTE

Be sure to replace gasket A8, gasket B9, balance seal 10 and oil seal 12 when reassembling the pump.

## DPS TRANSMISSION

## Removal and Installation

## Removal

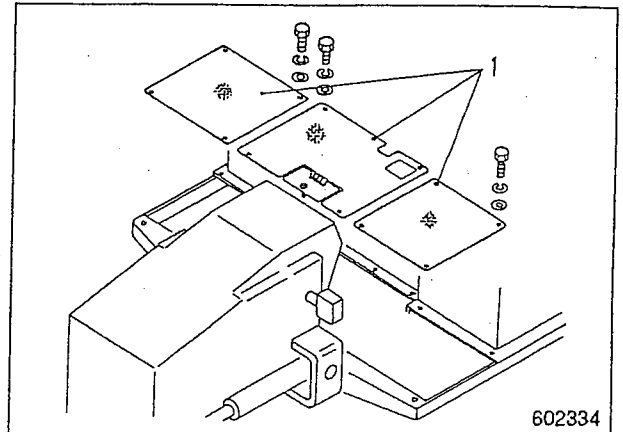
Start by:

- (a) remove the under guard
- (b) drain the oil from the transmission [11 liters (2.9 U.S. gal), approx.]
- (c) drain the oil from the transfer and bevel gear cases [7 liters (1.8 U.S. gal), approx.]

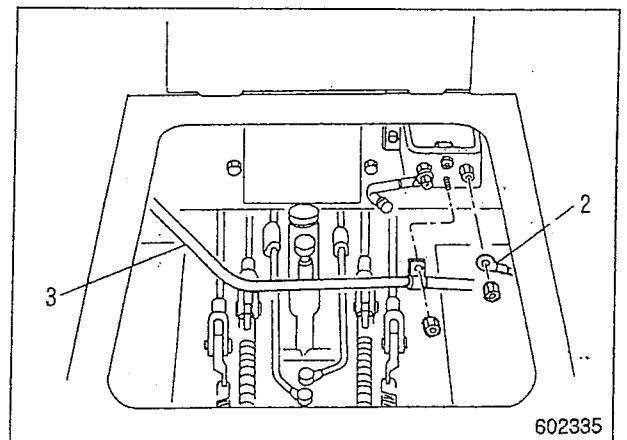
## Sequence

## 1. Remove the following parts:

- 1 Floor plates (platform) (3 pcs)

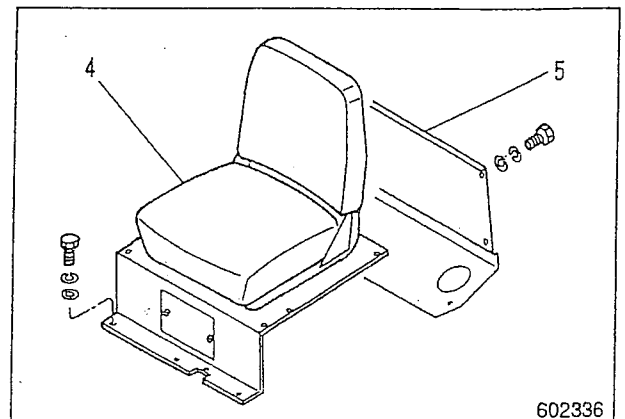


- 2 Electric wire between battery switch and battery
- 3 Clamp for electric wire between battery and starter



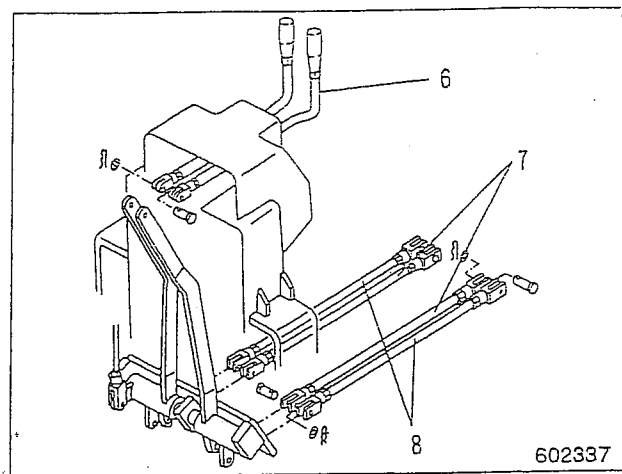
- 4 Operator's seat and seat plate
- 5 Rear cover

Weight of operator's seat and seat plate	31 kg (68 lb), approx.
--	------------------------

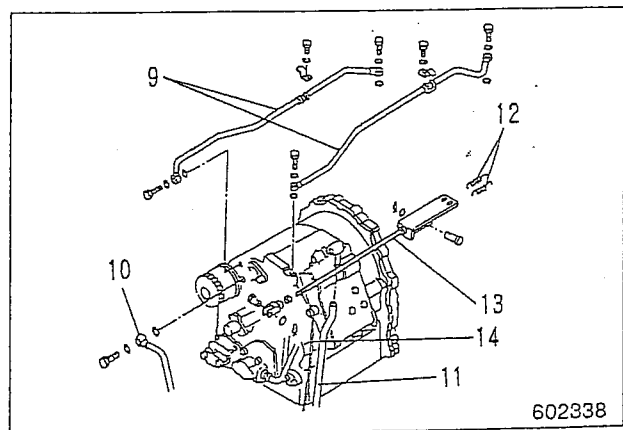


## DISASSEMBLY AND REASSEMBLY

- 6 Steering clutch levers
- 7 Steering control rods
- 8 Brake control rods

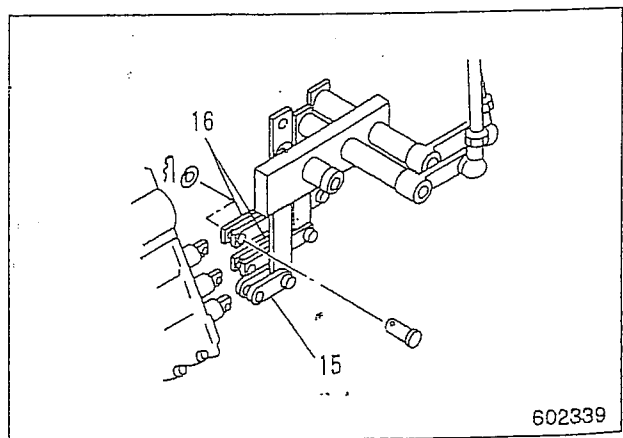


- 9 Steering clutch oil pipes (2 pcs)
- 10 Oil cooler pipe
- 11 Oil cooler hose
- 12 Springs (2 pcs)
- 13 Inching control rod
- 14 Neutral switch wire



### 2. Disconnect the following parts:

- 15 Inching valve link
- 16 Speed selector valve and directional selector valve links



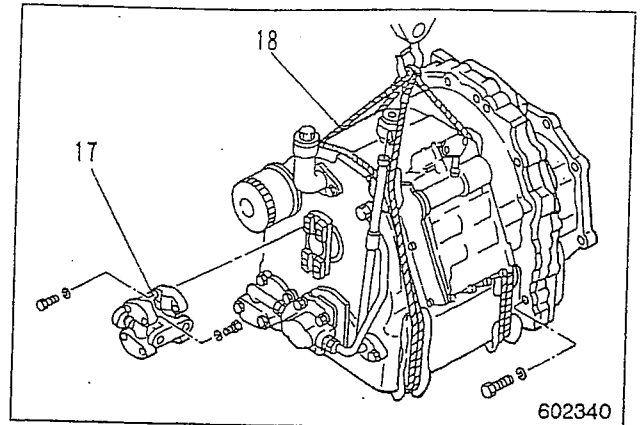
## 3. Remove the following parts:

- 17 Universal joint
- 18 Transmission

Weight of transmission	182 kg (400 lb), approx.
------------------------	-----------------------------

**NOTE**

Before hoisting the transmission, shift it forward to pull the pinion back out of mesh with the bevel gear.



## Installation

To install, follow the reverse of removal sequence.

## Inspection after installation

- (1) Make sure that the electric wires, pipes and hoses are connected properly.
- (2) Adjust the inching pedal. (Refer to TESTING AND ADJUSTING.)
- (3) Fill the transmission and transfer cases with recommended oil.

## DISASSEMBLY AND REASSEMBLY

### Disassembly and Reassembly

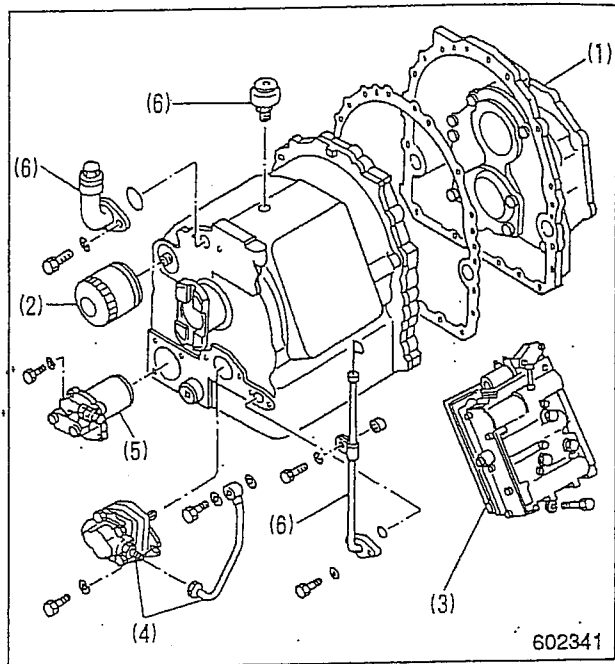
#### Disassembly

Start by:

- (a) remove the transfer assembly
- (b) remove the oil filter
- (c) remove the transmission control valve and main relief valve
- (d) remove the gear pump and oil pipe
- (e) remove the suction strainer
- (f) remove the air breather, oil filler and oil level gauge

#### NOTE

For disassembly and reassembly of the gear pump, refer to GEAR PUMP FOR TRANSMISSION AND STEERING CLUTCHES.

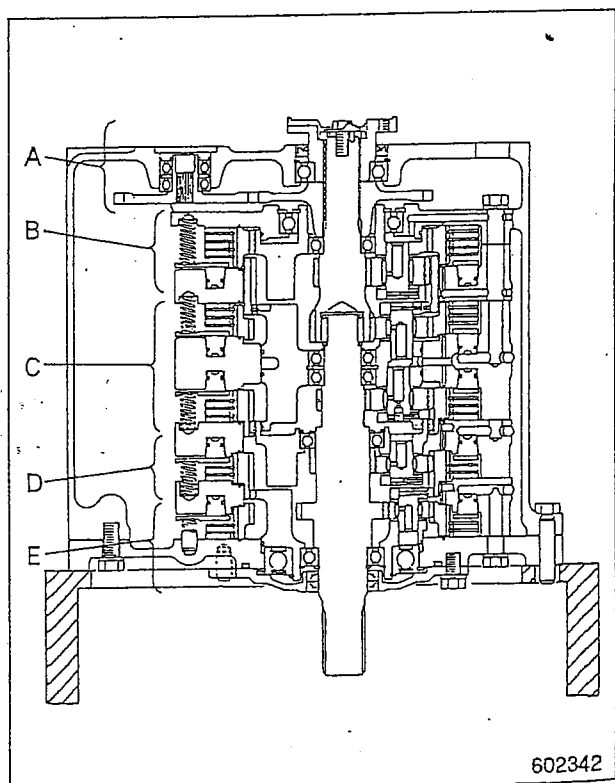


#### Disassembly sequence

Remove the following groups in the alphabetical order:

- A Transmission case and flange group
- B Reverse clutch group
- C Forward clutch group and 3rd-speed clutch group
- D 2nd-speed clutch group
- E 1st-speed clutch group and cover group

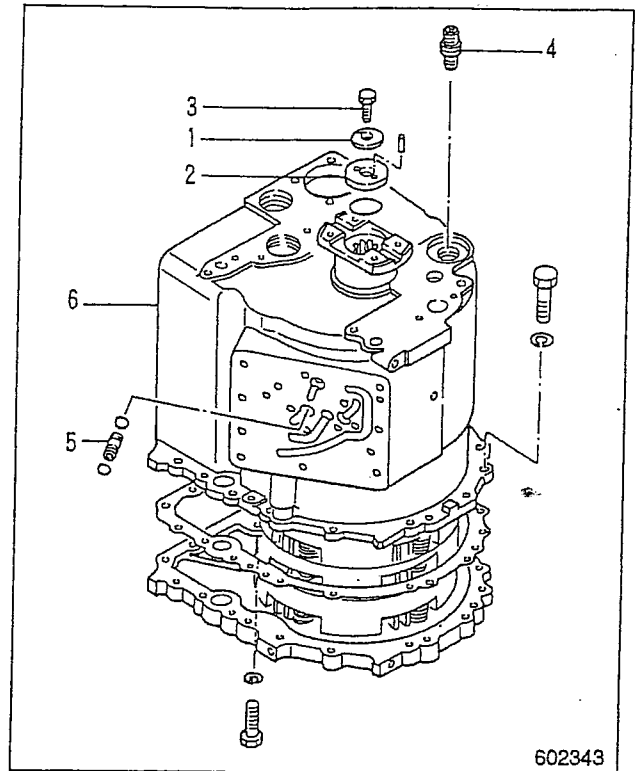
When disassembling the transmission, place it on a workbench having a hole for admitting the output shaft and cover mounting bolts, with the front (engine) side up.



A Transmission case and flange group

1. Remove the following parts:

- 1 Lock washer  
(to be straightened for removal)
- 2 Washer
- 3 Bolt (1 pc)
- 4 Oil filter screw
- 5 Oil pipe (4 pcs)
- 6 Transmission case

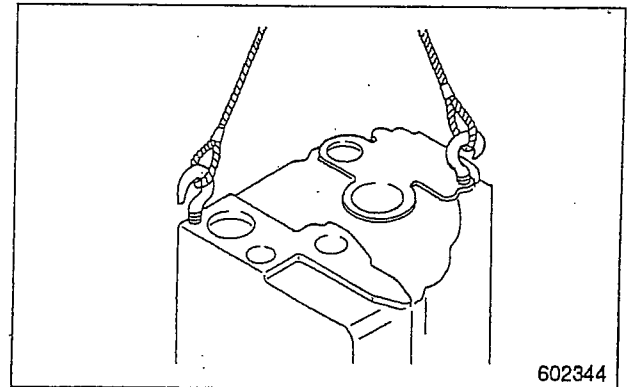


**NOTE**

To remove transmission case 6, attach the hangers to its front face, and hoist the case with that face up.

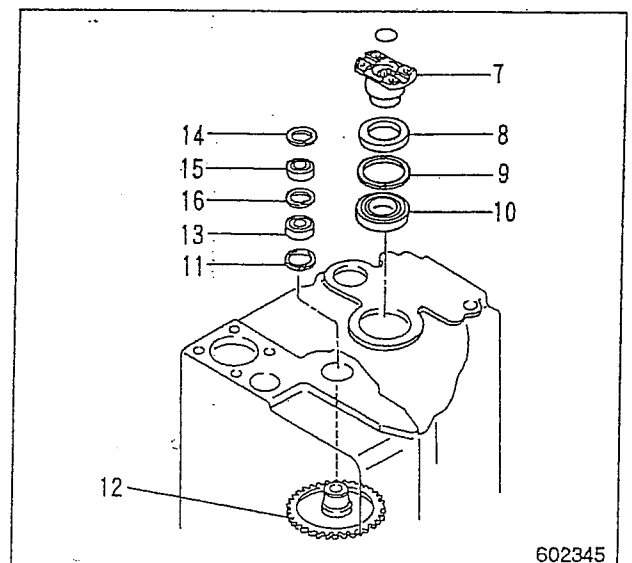
Thread size of hangers

M10 - 1.25



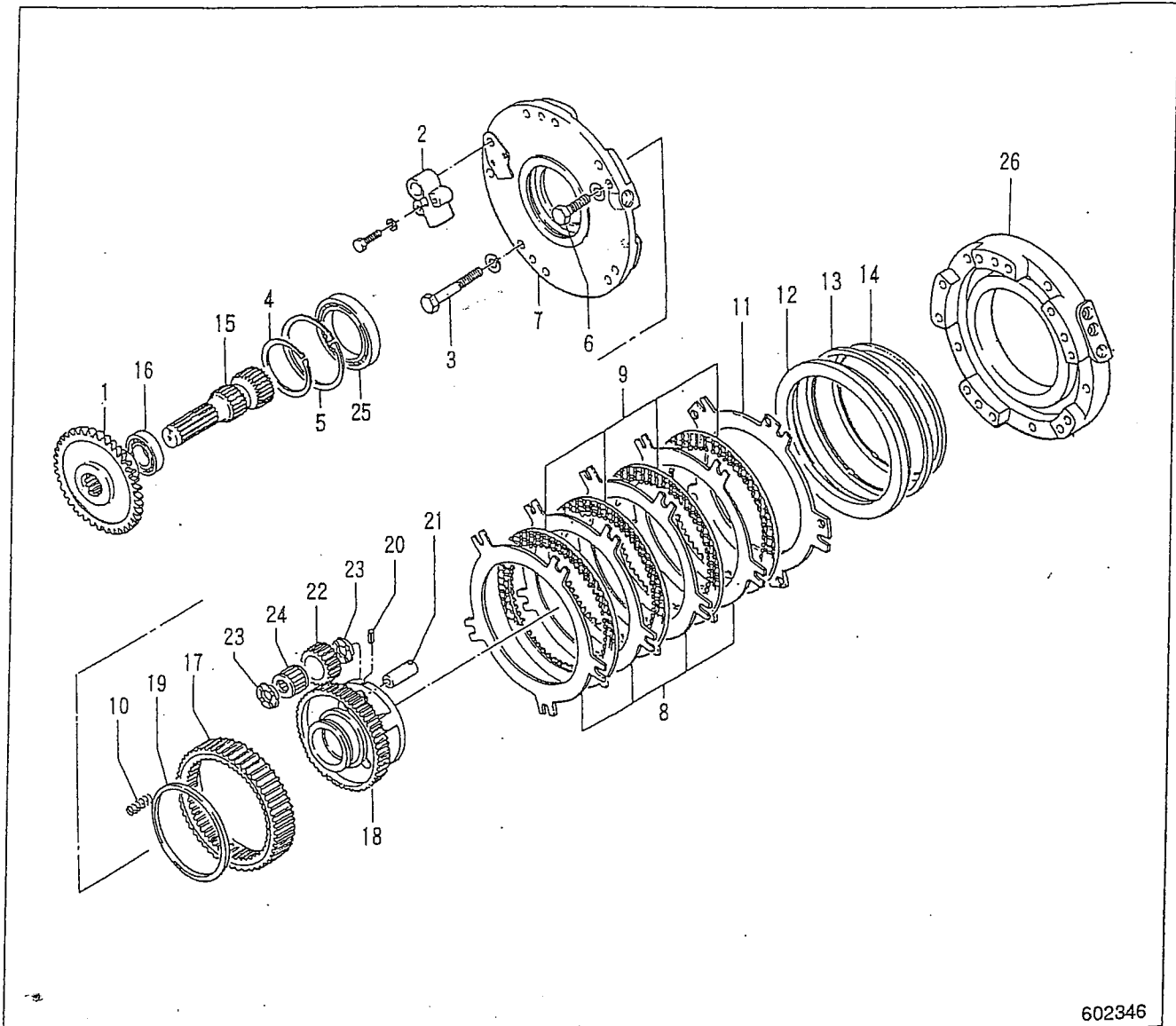
2. Remove the following parts from case 6:

- 7 Flange
- 8 Oil seal
- 9 Retaining ring
- 10 Ball bearing
- 11 Snap ring
- 12 Gear pump driven gear
- 13 Ball bearing
- 14 Retaining ring
- 15 Ball bearing
- 16 Retaining ring



DISASSEMBLY AND REASSEMBLY

B Reverse clutch group

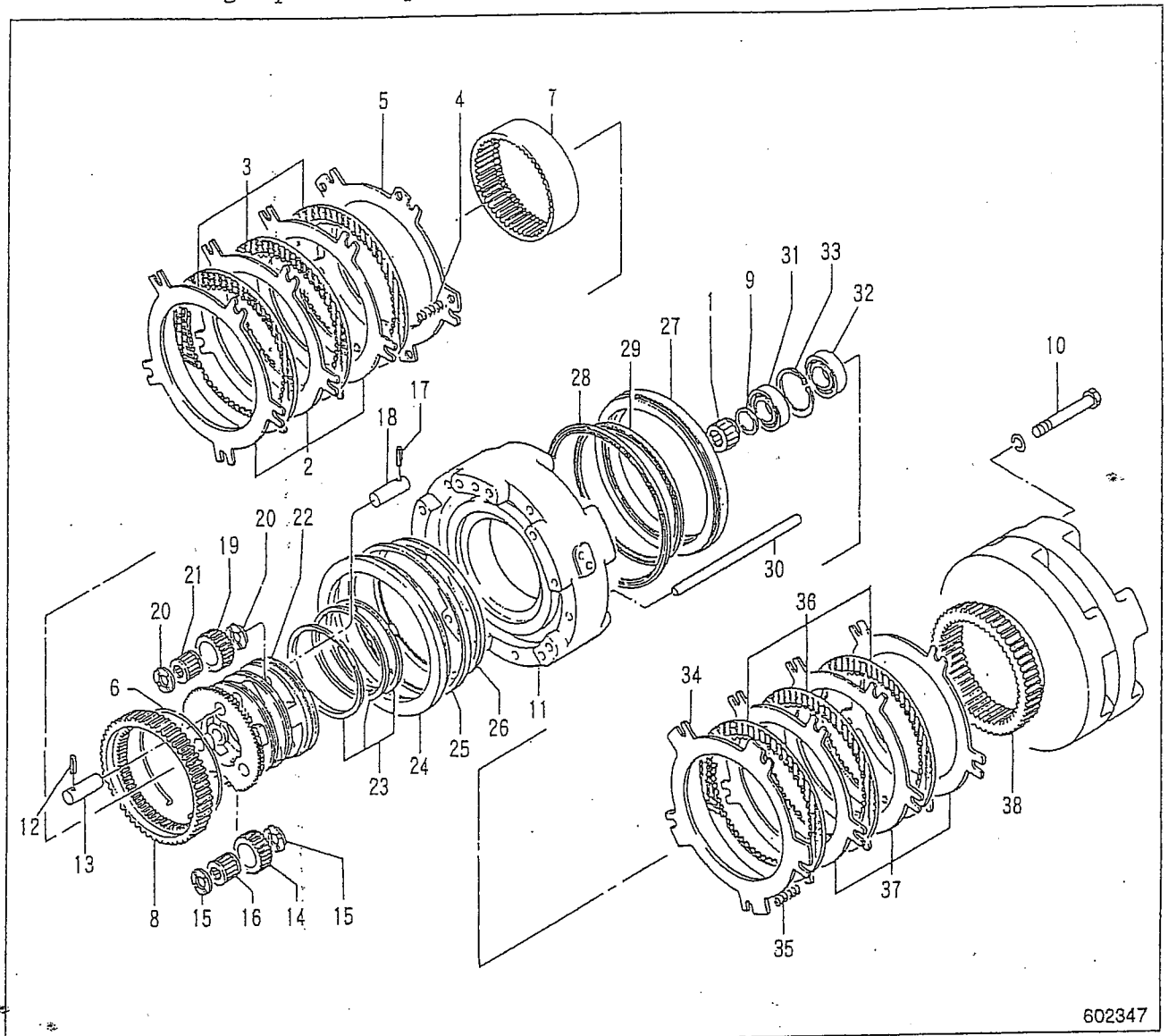


Disassembly sequence

- |                            |                                     |                                  |
|----------------------------|-------------------------------------|----------------------------------|
| 1 Pump drive gear          | 11 Pressure plate                   | 20 Spring pin (3 pcs)            |
| 2 Lubrication relief valve | 12 Piston                           | 21 Pin (3 pcs)                   |
| 3 Bolt (8 pcs)             | 13 Piston seal                      | 22 Planet gear (3 pcs)           |
| 4 Snap ring                | 14 Piston seal                      | 23 Thrust plates (6 pcs)         |
| 5 Snap ring                | 15 Input shaft                      | 24 Needle roller bearing (3 pcs) |
| 6 Bolt                     | 16 Ball bearing                     | 25 Ball bearing                  |
| 7 End housing              | 17 Ring gear                        | 26 Reverse clutch piston housing |
| 8 Mating plates (4 pcs)    | (Remove 18 thru 24 as an assembly.) |                                  |
| 9 Friction plates (4 pcs)  | 18 Reverse planet carrier           |                                  |
| 10 Return spring (5 pcs)   | 19 Seal ring                        |                                  |



## C Forward clutch group and 3rd-speed clutch group



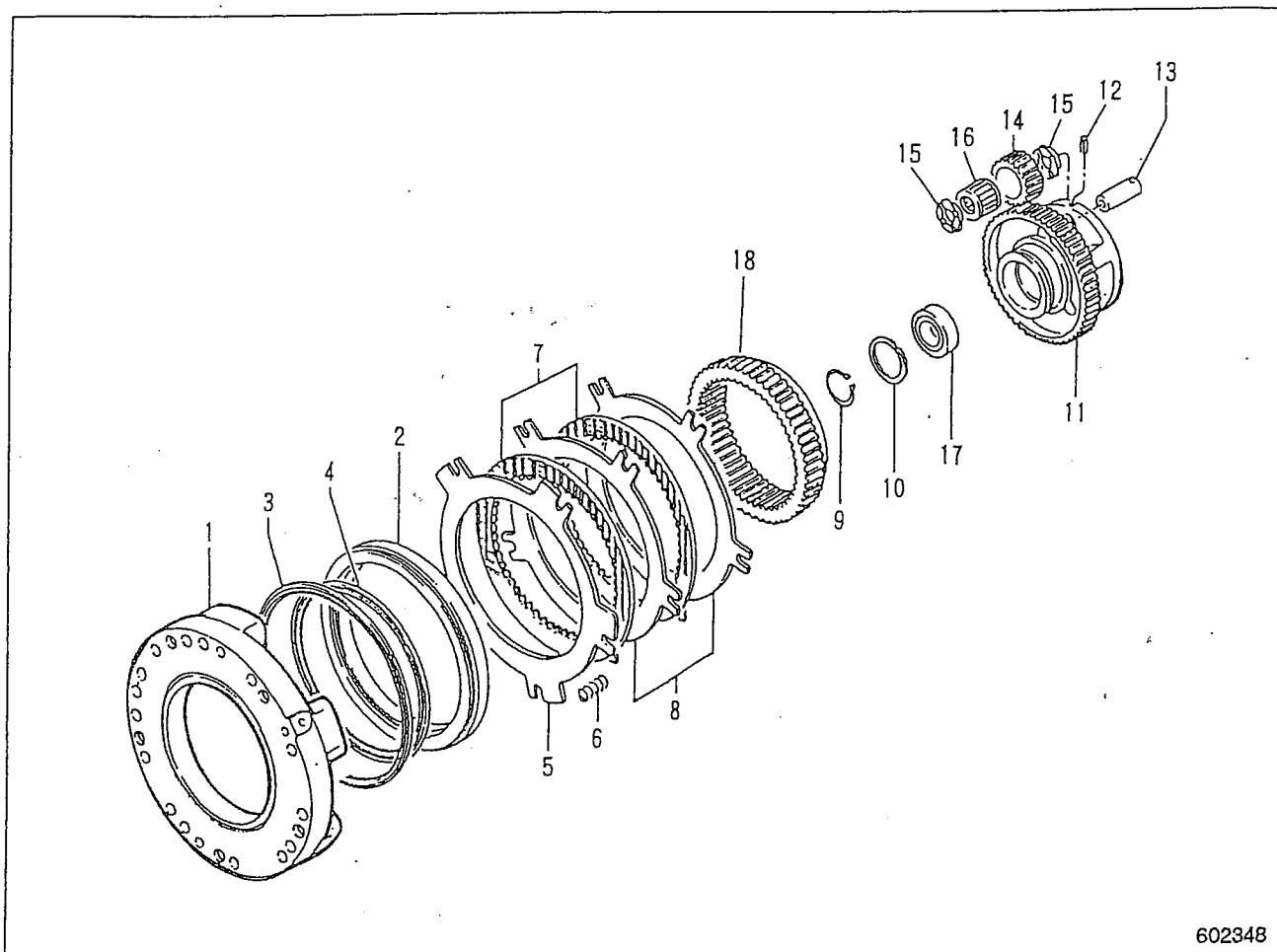
602347

## Disassembly sequence

- |  |                                       |                            |
|--|---------------------------------------|----------------------------|
| 1 Needle roller bearing                      | 13 Pin (3 pcs)                        | 27 Piston                  |
| 2 Mating plates (3 pcs)                      | 14 Planet gear (3 pcs)                | 28 Piston seal             |
| 3 Friction plates (3 pcs)                    | 15 Thrust plate (6 pcs)               | 29 Piston seal             |
| 4 Return spring (5 pcs)                      | 16 Needle roller bearing (3 pcs)      | 30 Pin (5 pcs)             |
| 5 Pressure plate                             | 17 Spring pin (3 pcs)                 | 31 Ball bearing            |
| 6 Snap ring                                  | 18 Pin (3 pcs)                        | 32 Ball bearing            |
| 7 Ring gear                                  | 19 Planet gear (3 pcs)                | 33 Snap ring               |
| 8 Ring gear                                  | 20 Thrust plates (6 pcs)              | 34 Pressure plate          |
| 9 Snap ring                                  | 21 Needle roller bearing (3 pcs)      | 35 Return spring (5 pcs)   |
| 10 Bolt (9 pcs)                              | 22 Forward & 3rd-speed planet carrier | 36 Friction plates (3 pcs) |
| (Remove 11 thru 30 as an assembly.)          | 23 Seal rings (3 pcs)                 | 37 Mating plates (3 pcs)   |
| 11 Forward & 3rd-speed clutch piston housing | 24 Piston                             | 38 Ring gear               |
| (Remove 12 thru 23 as an assembly.)          | 25 Piston seal                        |                            |
| 12 Spring pin (3 pcs)                        | 26 Piston seal                        |                            |

## DISASSEMBLY AND REASSEMBLY

### D 2nd-speed clutch group



602348

#### Disassembly sequence

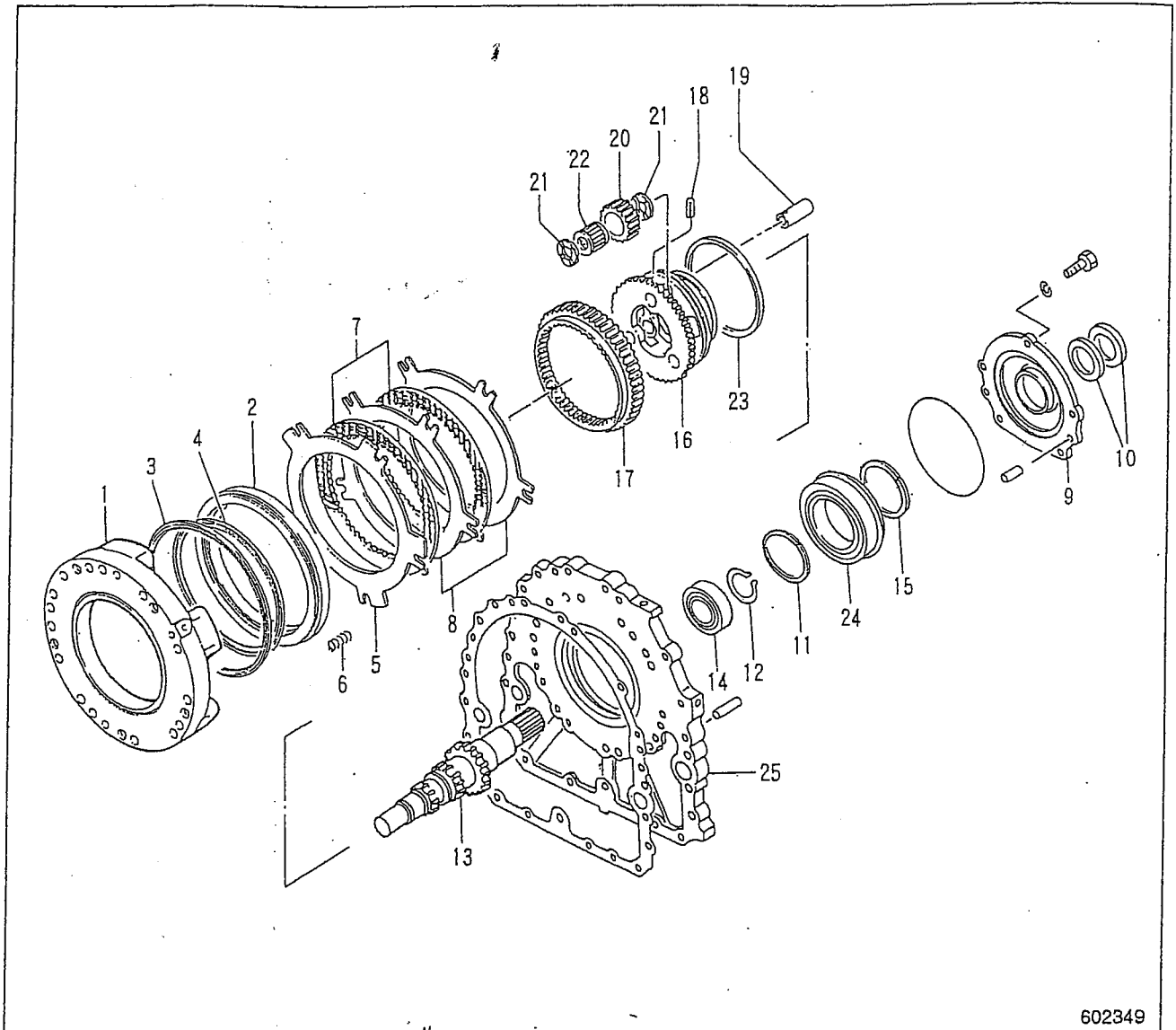
(Remove 1 thru 4 as an assembly.)

- 1 2nd-speed clutch piston housing
- 2 Piston
- 3 Piston seal
- 4 Piston seal
- 5 Pressure plate
- 6 Return spring (5 pcs)
- 7 Friction plates (2 pcs)
- 8 Mating plates (2 pcs)
- 9 Snap ring
- 10 Snap ring

(Remove 11 thru 17 as an assembly.)

- 11 2nd-speed planet carrier
- 12 Spring pin (3 pcs)
- 13 Pin (3 pcs)
- 14 Planet gear (3 pcs)
- 15 Thrust plate (6 pcs)
- 16 Needle roller bearing (6 pcs)
- 17 Ball bearing
- 18 Ring gear

## E 1st-speed clutch group and cover group



602349

## Disassembly sequence

(Remove 1 thru 4 as an assembly.)

- 1 1st-speed clutch piston housing
- 2 Piston
- 3 Piston seal
- 4 Piston seal
- 5 Pressure plate
- 6 Return spring (5 pcs)
- 7 Friction plates (2 pcs)
- 8 Mating plates (2 pcs)
- 9 Oil seal retainer
- 10 Oil seals (2 pcs)
- 11 Retaining ring
- 12 Snap ring
- 13 Output shaft

14 Ball bearing

15 Retaining ring

(Remove 16 thru 23 as an assembly.)

- 16 1st-speed planet carrier
- 17 Ring gear
- 18 Spring pin (3 pcs)
- 19 Pin (3 pcs)
- 20 Planet gear (3 pcs)
- 21 Thrust plates (6 pcs)
- 22 Needle roller bearing (3 pcs)
- 23 Seal ring
- 24 Ball bearing
- 25 Cover

## DISASSEMBLY AND REASSEMBLY

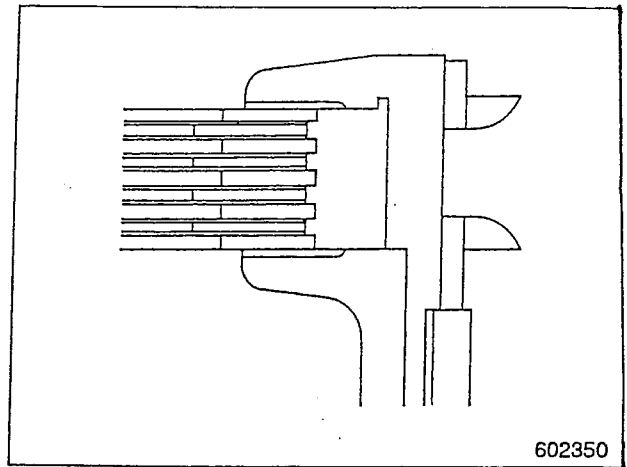
### Inspection

#### 1. Clutch plates

Measure the assembled (total) thickness of the plates. Replace the plates if the measurement exceeds the service limit.

Unit: mm (in.)

Item	Assembly standard	Service limit
Reverse clutch Thickness of new plates Friction plates: 4 pcs Mating plates: 4 pcs Pressure plate: 1 pc	$27.70 \pm 0.80$ ( $1.0905 \pm 0.0315$ )	26.10 (1.0276)
Forward/ 3rd- speed clutches Thickness of new plates Friction plates: 3 pcs Mating plates: 3 pcs Pressure plate: 1 pc	$21.57 \pm 0.62$ ( $0.8492 \pm 0.0244$ )	20.40 (0.8031)
2nd- speed/ 1st- speed clutches Thickness of new plates Friction plates: 2 pcs Mating plates: 2 pcs Pressure plate: 1 pc	$15.44 \pm 0.44$ ( $0.6079 \pm 0.0173$ )	14.60 (0.5748)
Thickness of one new friction plate	$2.95 \pm 0.10$ ( $0.1161 \pm 0.0039$ )	2.45 (0.0965)

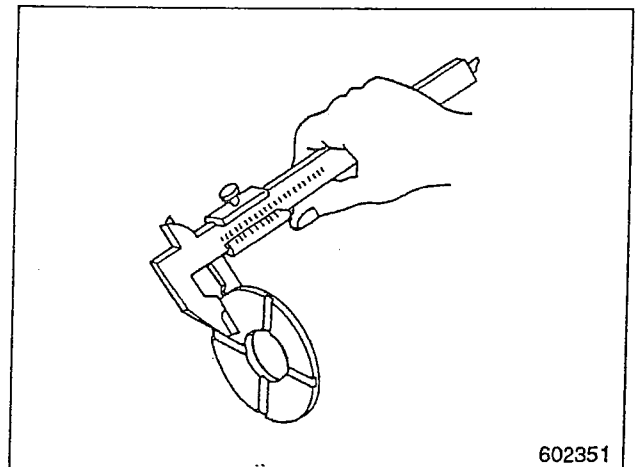


#### 2. Thrust plates

Measure the thickness of each thrust plate. Replace the plate if the measurement exceeds the service limit.

Unit: mm (in.)

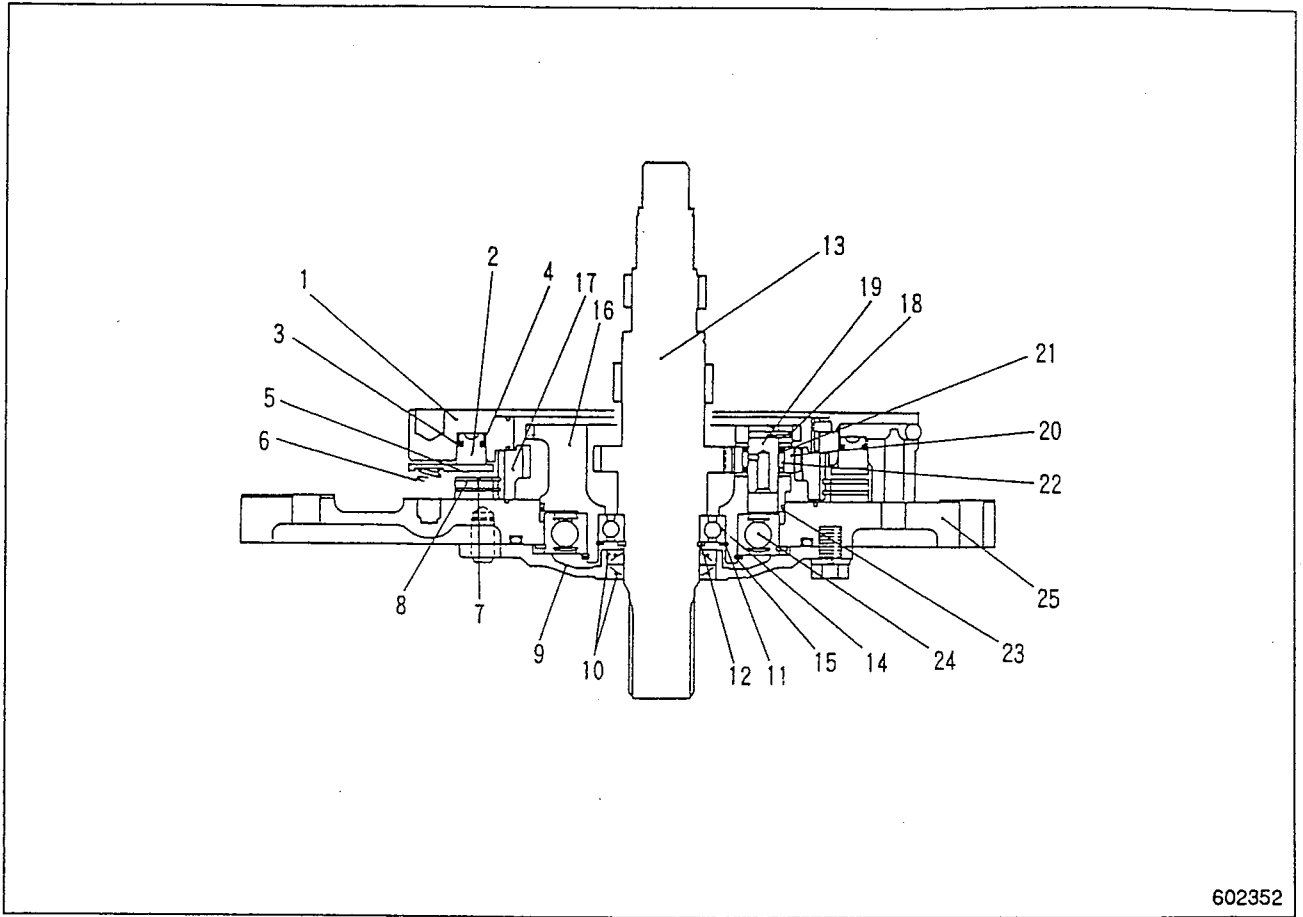
Item	Assembly standard	Service limit
Thickness of thrust plate	$2.00 \pm 0.05$ ( $0.0787 \pm 0.0020$ )	1.80 (0.0709)



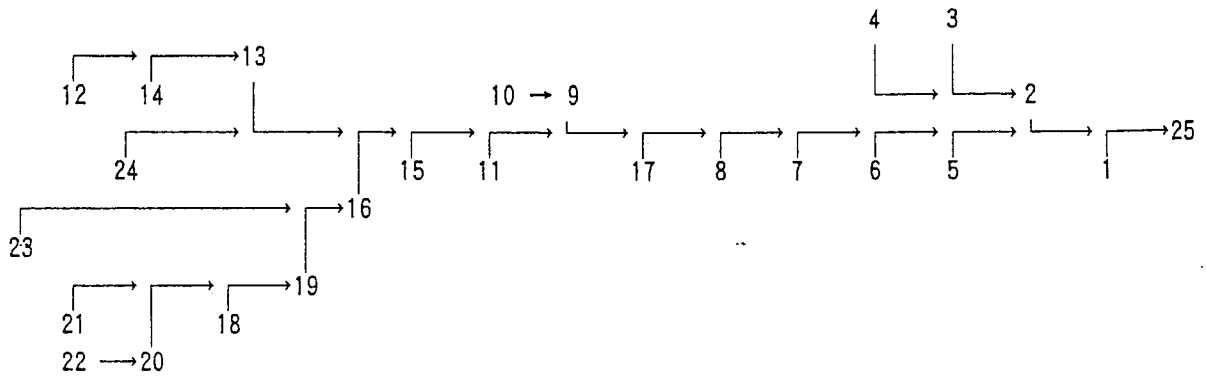
Reassembly

To reassemble, install the groups in the reverse sequence (E thru A).

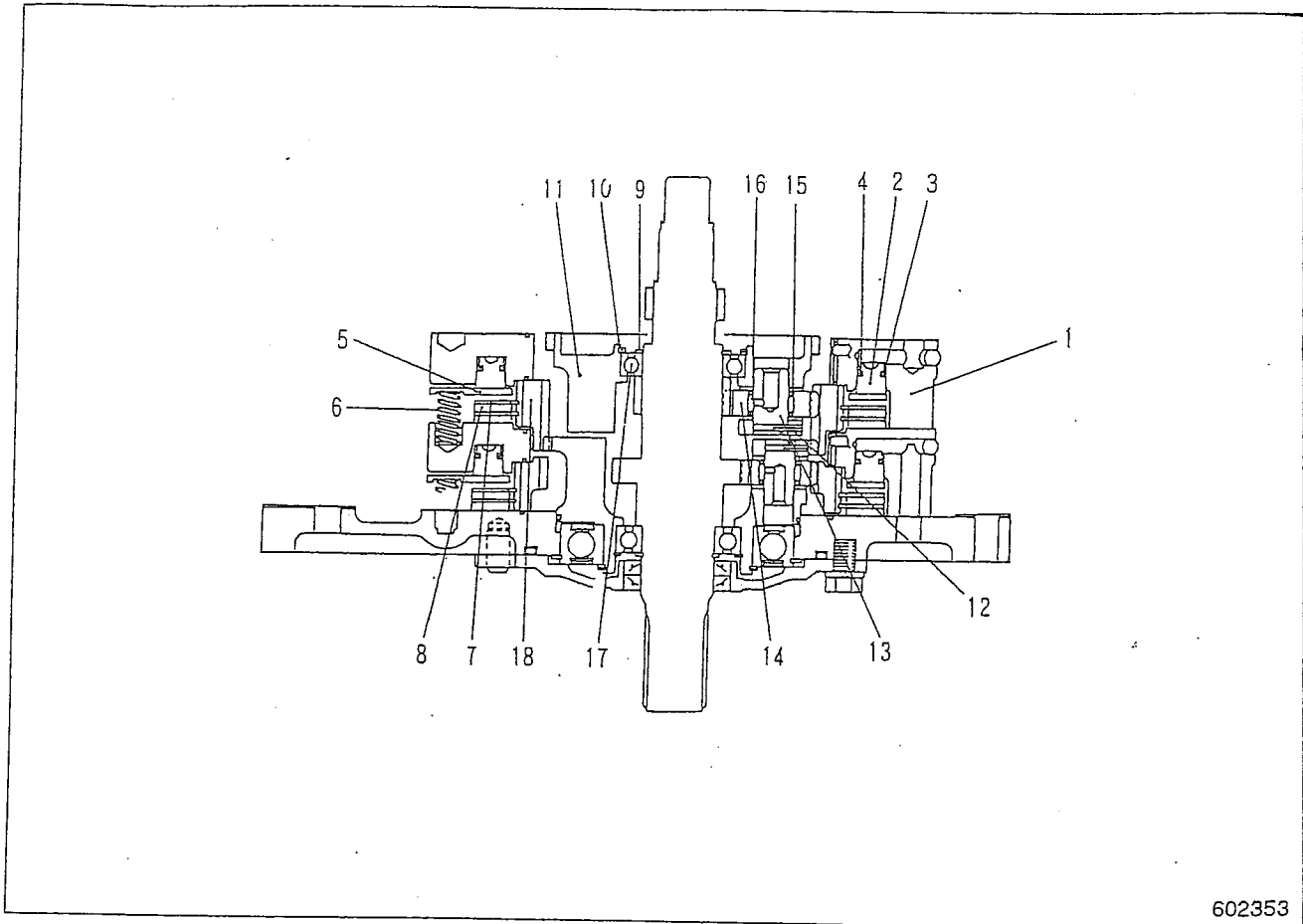
E 1st-speed clutch group and cover group



Reassembly sequence



D 2nd-speed clutch group

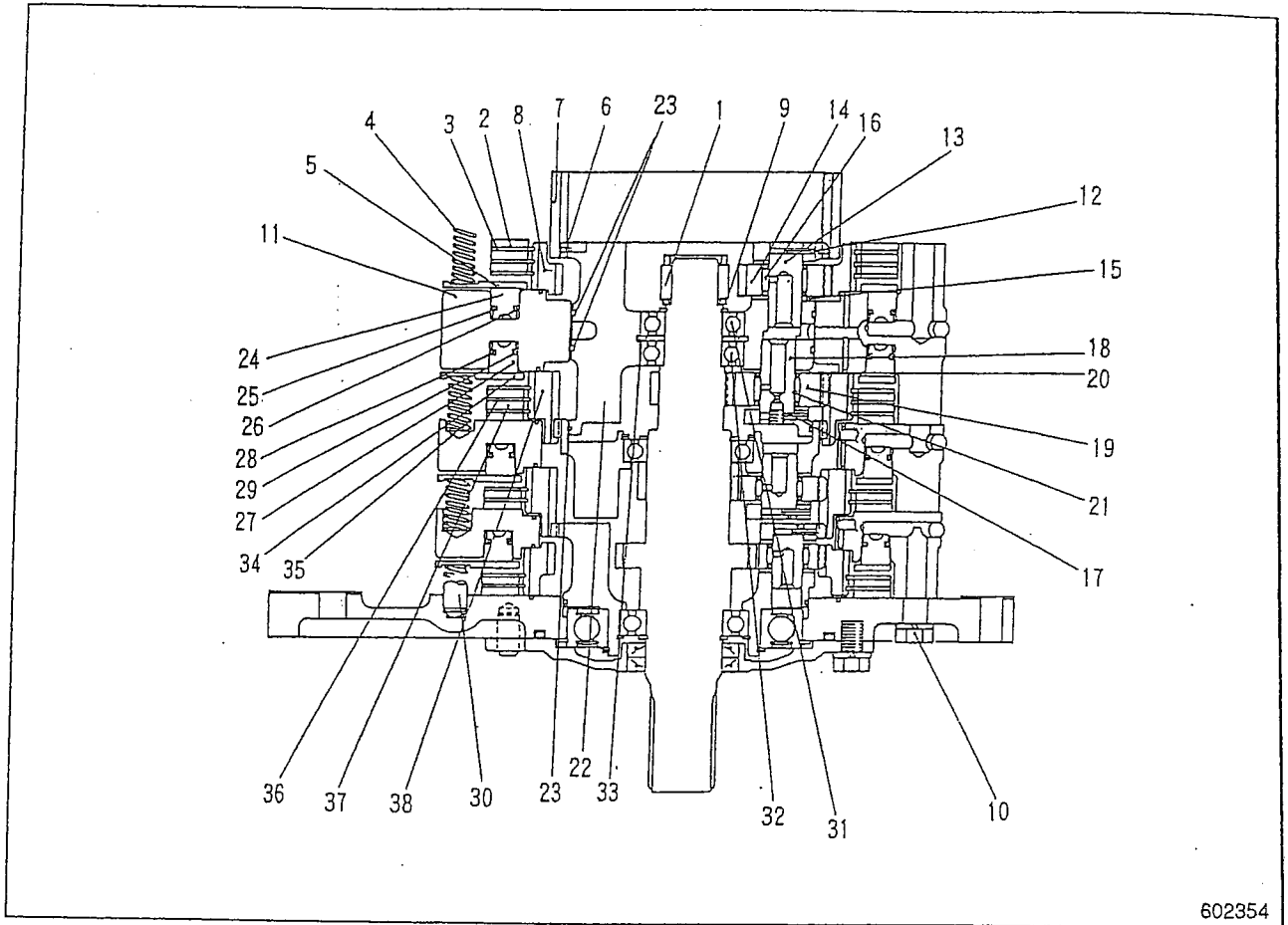


602353

Reassembly sequence

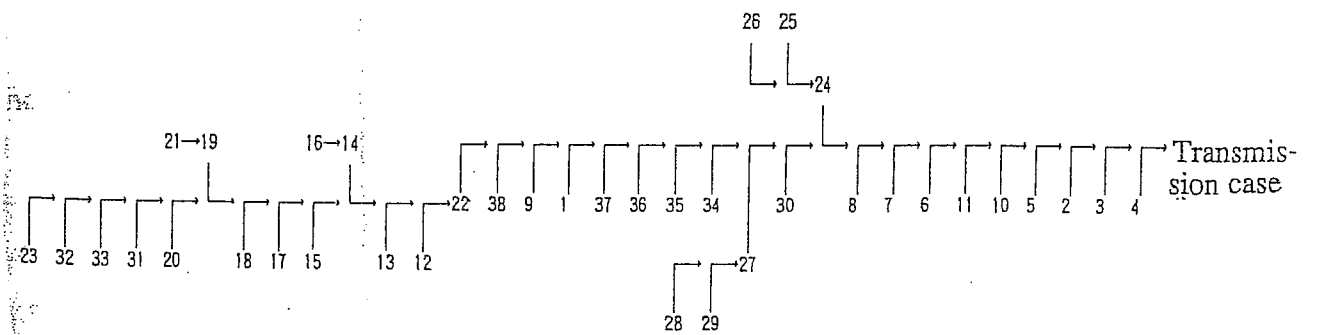


C Forward clutch group and 3rd-speed clutch group



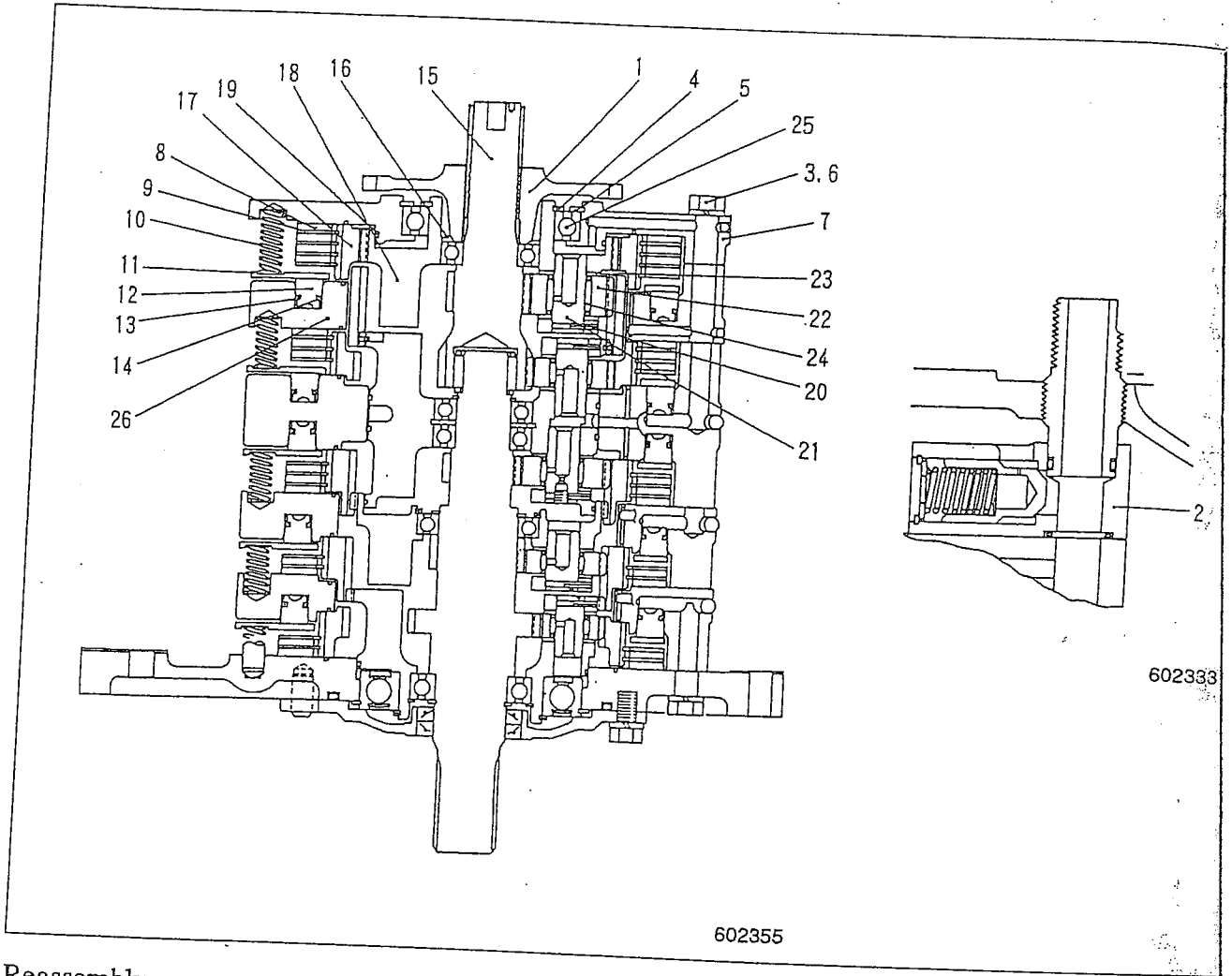
602354

Reassembly sequence

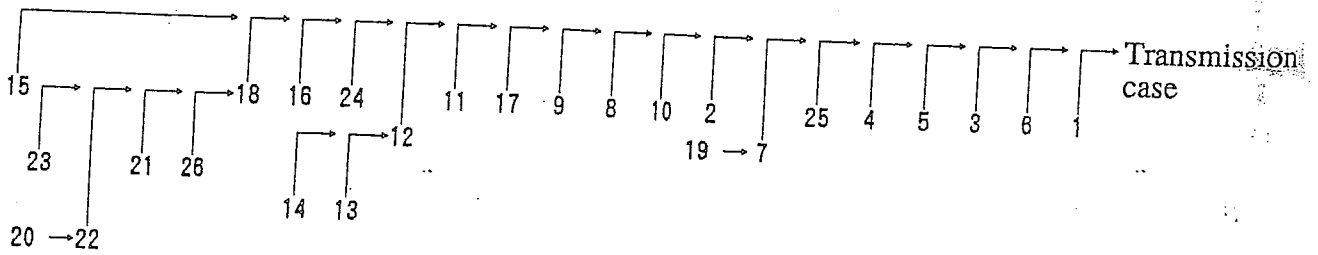


DISASSEMBLY AND REASSEMBLY

B Reverse clutch group

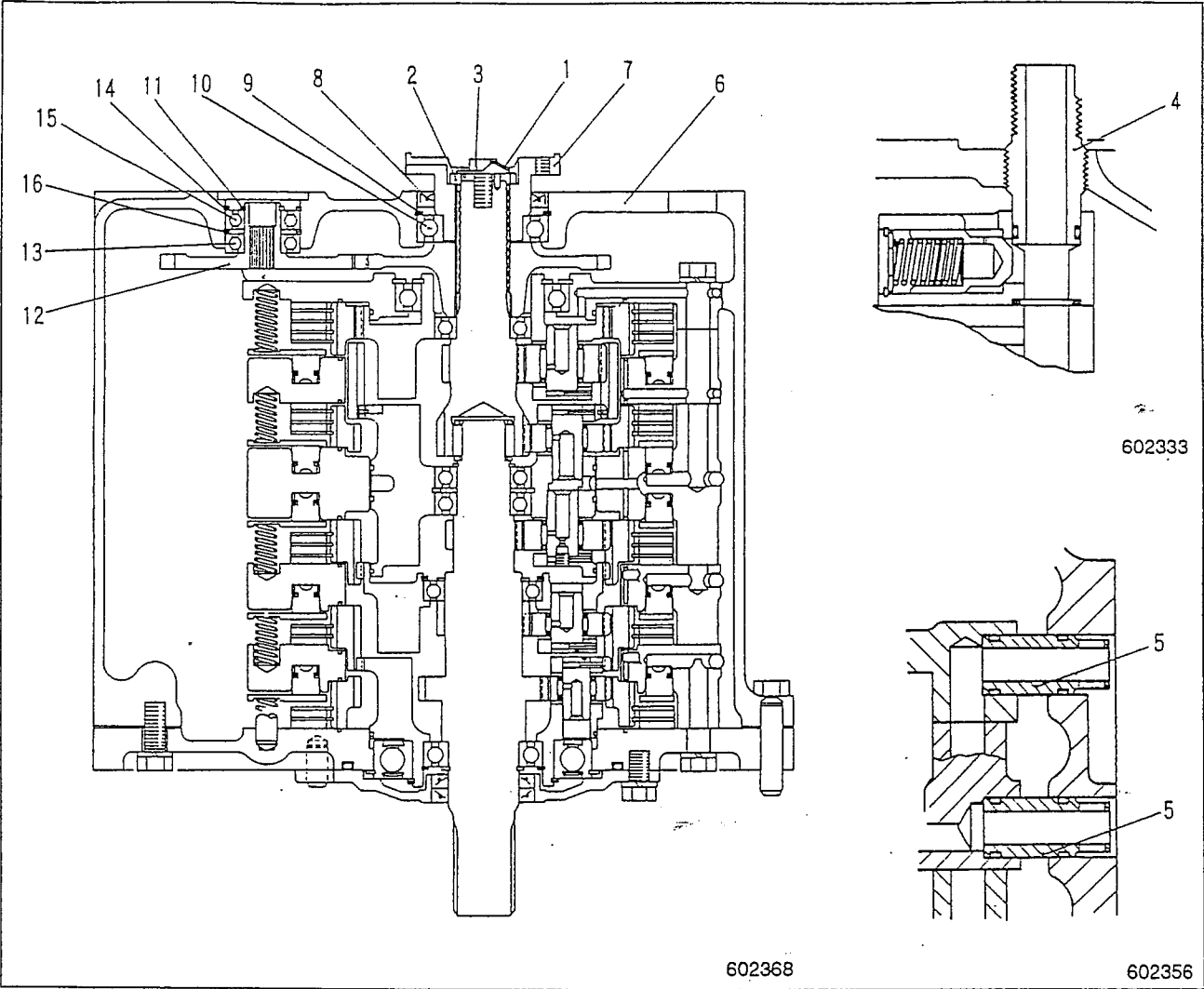


Reassembly sequence





A Transmission case and flange group



Reassembly sequence



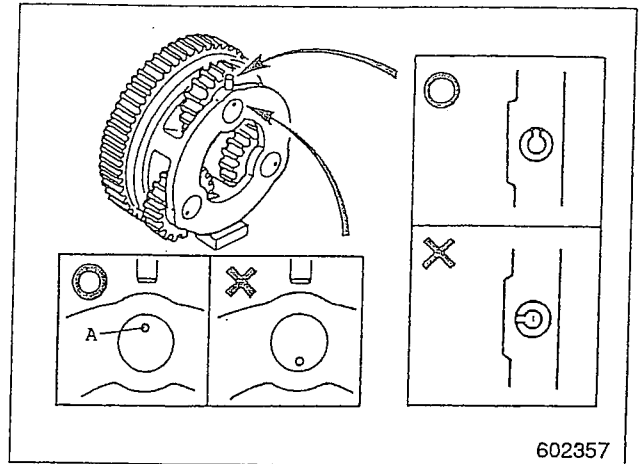
Suggestions

1. Apply a coat of engine oil to the O-ring of oil filter screw.
2. Bend each lock washer properly — against the flat of bolt.

DISASSEMBLY AND REASSEMBLY

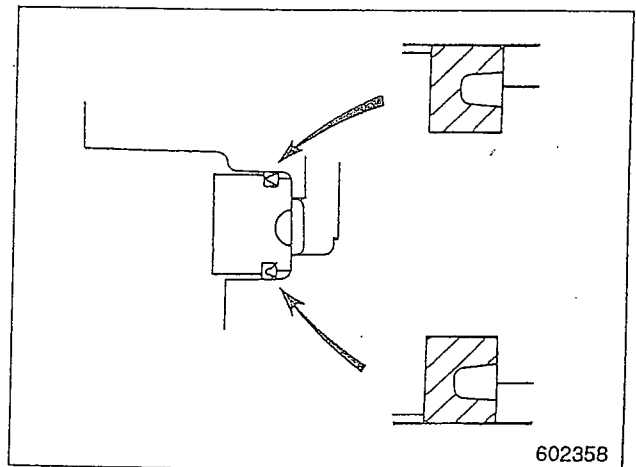
3. Planet carrier spring pin installation

Drive in the spring pin with its gap positioned in the direction of carrier rotation. Drive in the planet pin with its mark A outside.



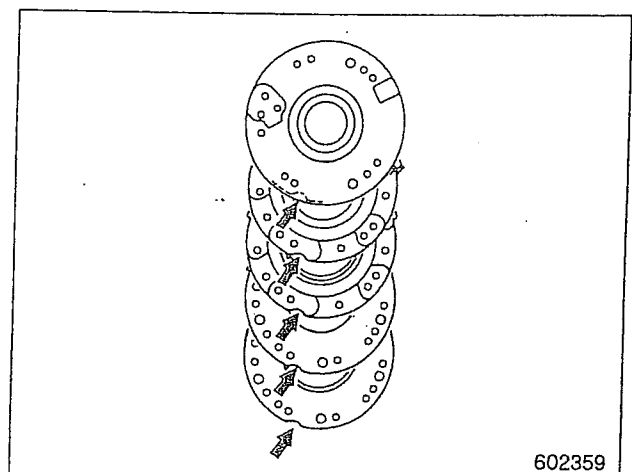
4. Clutch piston installation

Apply a coat of hydraulic oil (SAE 10W) to the sliding surface of each piston seal, and install the seal to the clutch piston as shown.



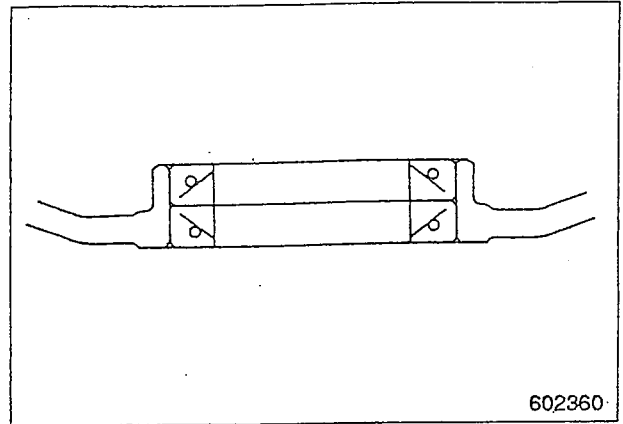
5. Piston housing installation

Install the piston housings (5 pcs) with their recessed portions aligned as shown. This illustration shows the piston housings seen from the engine end.



## 6. Oil seal installation to retainer

Install the oil seal to the retainer as shown.

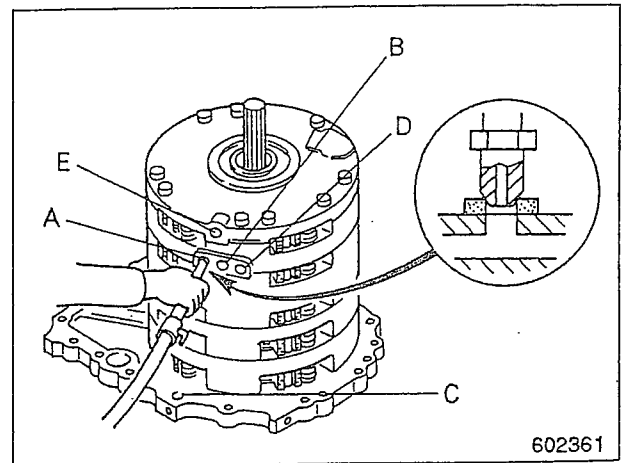


602360

## Testing after reassembly

Apply dirt-free pressure air to the oil holes in the transmission case to make sure that the clutch pistons move smoothly in the housing.

- A Oil hole for reverse clutch
- B Oil hole for forward clutch
- C Oil hole for 1st-speed clutch
- D Oil hole for 2nd-speed clutch
- E Oil hole for 3rd-speed clutch



602361

Air pressure	2 to 3 kgf/cm <sup>2</sup> (28 to 43 psi) [196 to 294 kPa]
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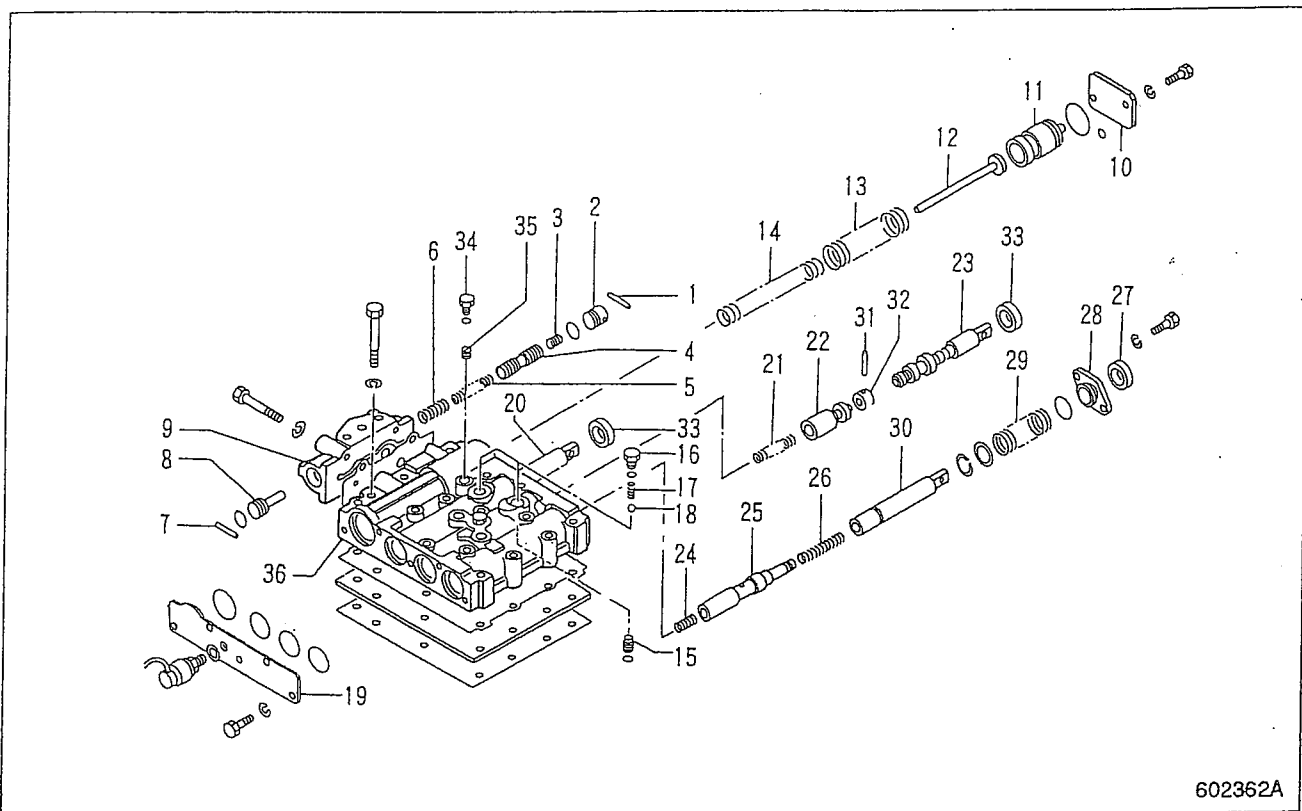
DISASSEMBLY AND REASSEMBLY

TRANSMISSION CONTROL VALVE

Removal and installation

1. Remove the transmission assembly including the control valve from the machine, and remove the valve from the transmission. (Refer to Removal, DPS TRANSMISSION.)
2. To install, follow the reverse of removal sequence.

Disassembly



Disassembly sequence

(Remove 1 thru 9 as an assembly.)

- 1 Roller pin
- 2 Plug [O-ring]

(Remove 3 and 4 as an assembly.)

- 3 Slug
- 4 Valve
- 5 Inner spring
- 6 Outer spring
- 7 Roller pin
- 8 Plug [O-ring]
- 9 Valve body

- 10 Cover [O-ring]
- 11 Accumulator piston
- 12 Seat

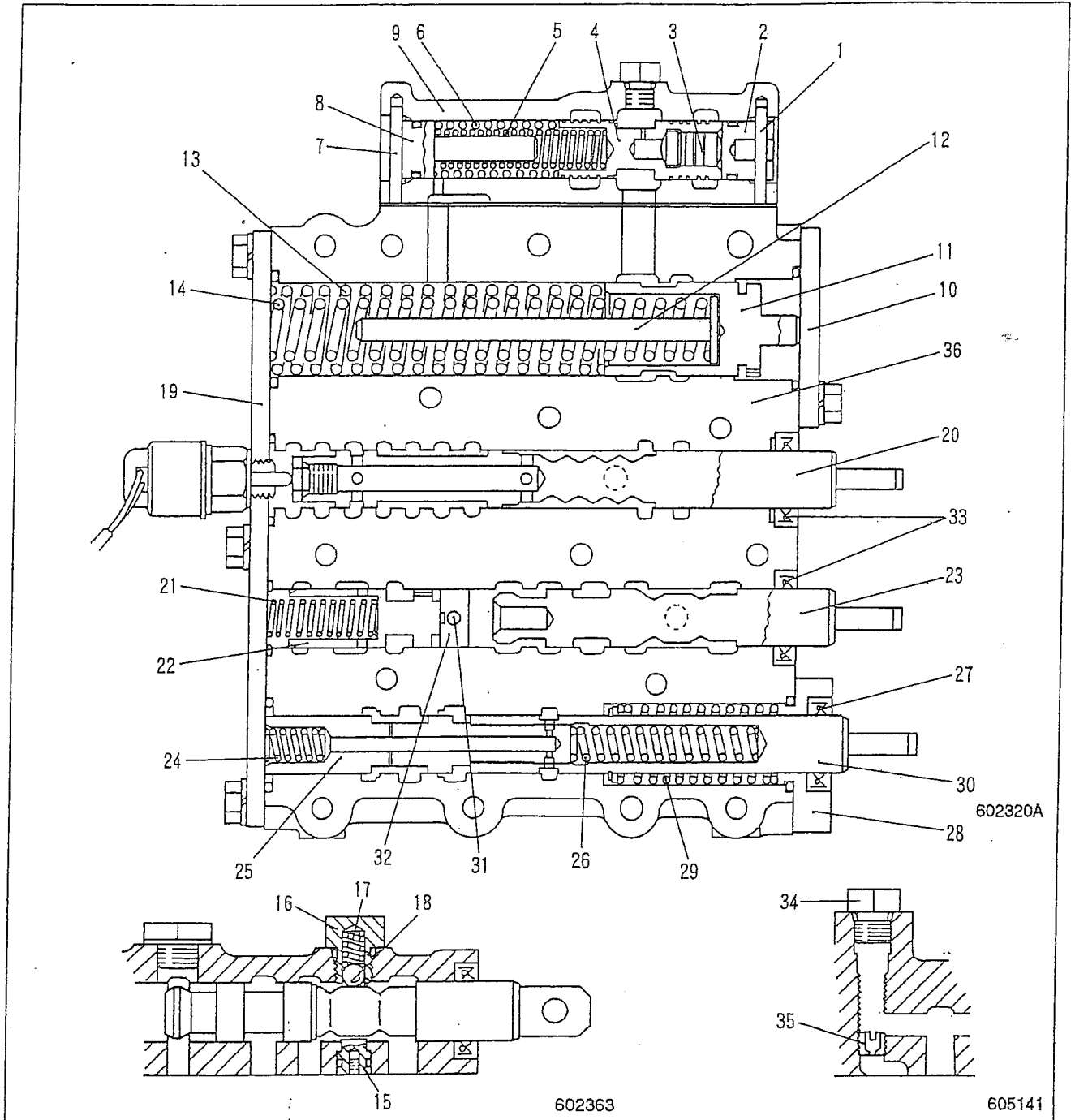
- 13 Outer spring
- 14 Inner spring
- 15 Pin (3 pcs)
- 16 Plug (2 pcs) [O-ring]
- 17 Spring (2 pcs)
- 18 Detent ball (2 pcs)
- 19 Cover [switch, O-ring]
- 20 Speed selector plunger
- 21 Spring
- 22 Differential valve
- 23 Directional plunger
- 24 Return spring
- 25 Inching valve
- 26 Inching spring

(Remove 27 and 28 as an assembly.)

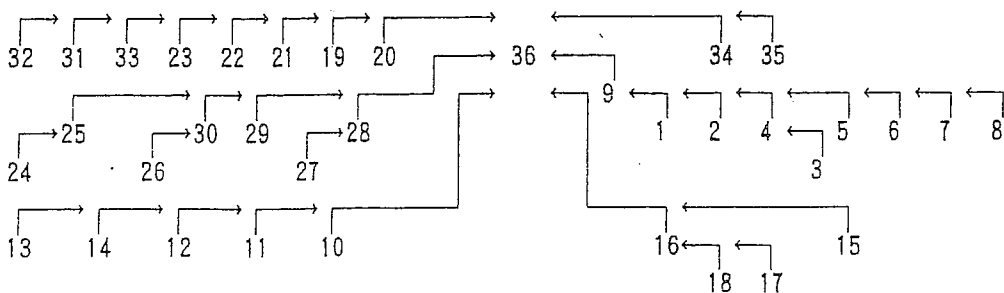
- 27 Oil seal
- 28 Cover
- 29 Spring [washer]
- 30 Inching valve plunger [snap ring]
- 31 Roller pin
- 32 Plug
- 33 Oil seal (2 pcs)
- 34 Plug [O-ring]
- 35 Screw
- 36 Valve housing

Reassembly

(Clean all control valve parts except for seals by alkali washing before installing them for reassembly.)



Reassembly sequence



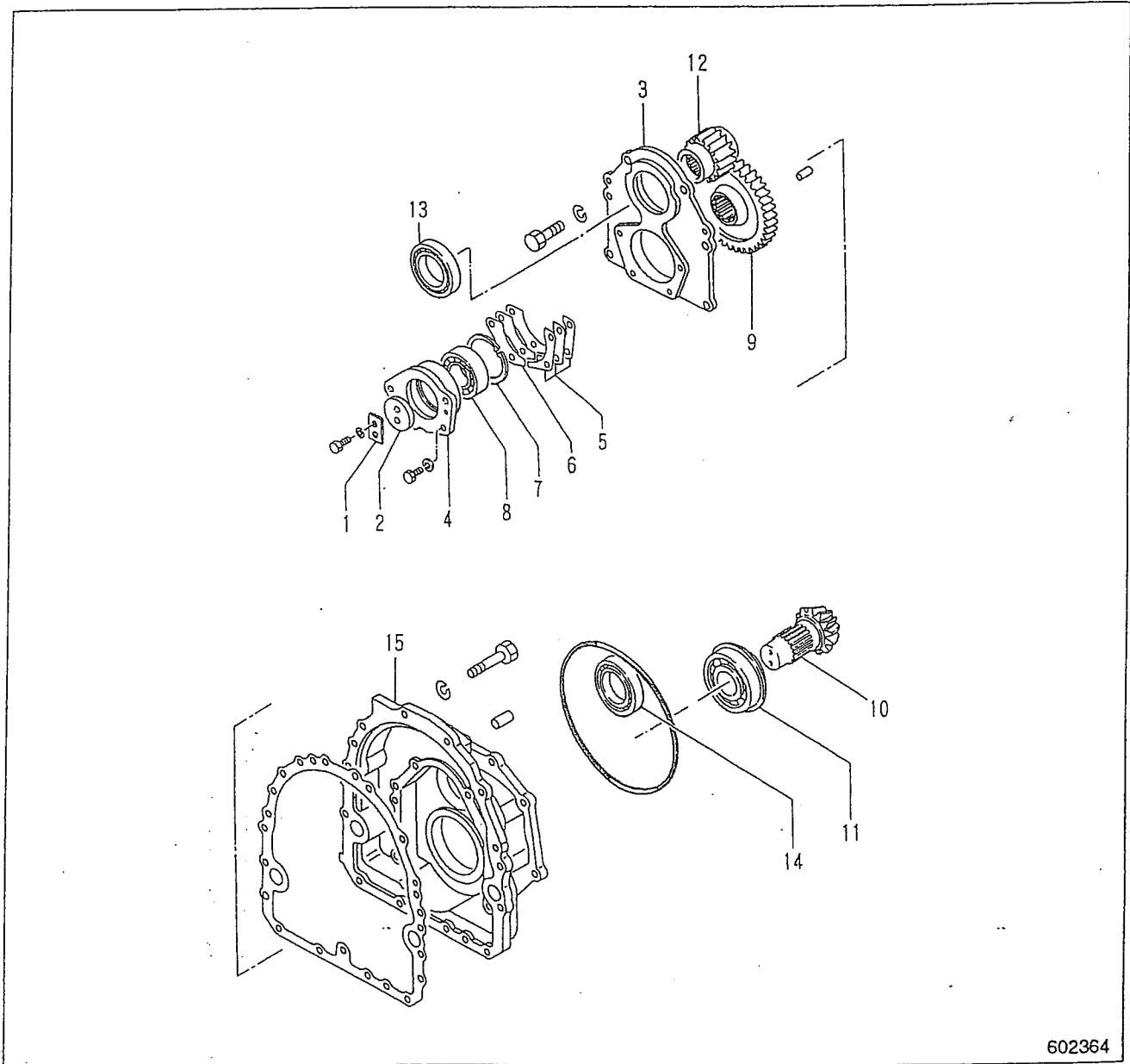
DISASSEMBLY AND REASSEMBLY

TRANSFER

Removal and installation

Refer to TRANSMISSION.

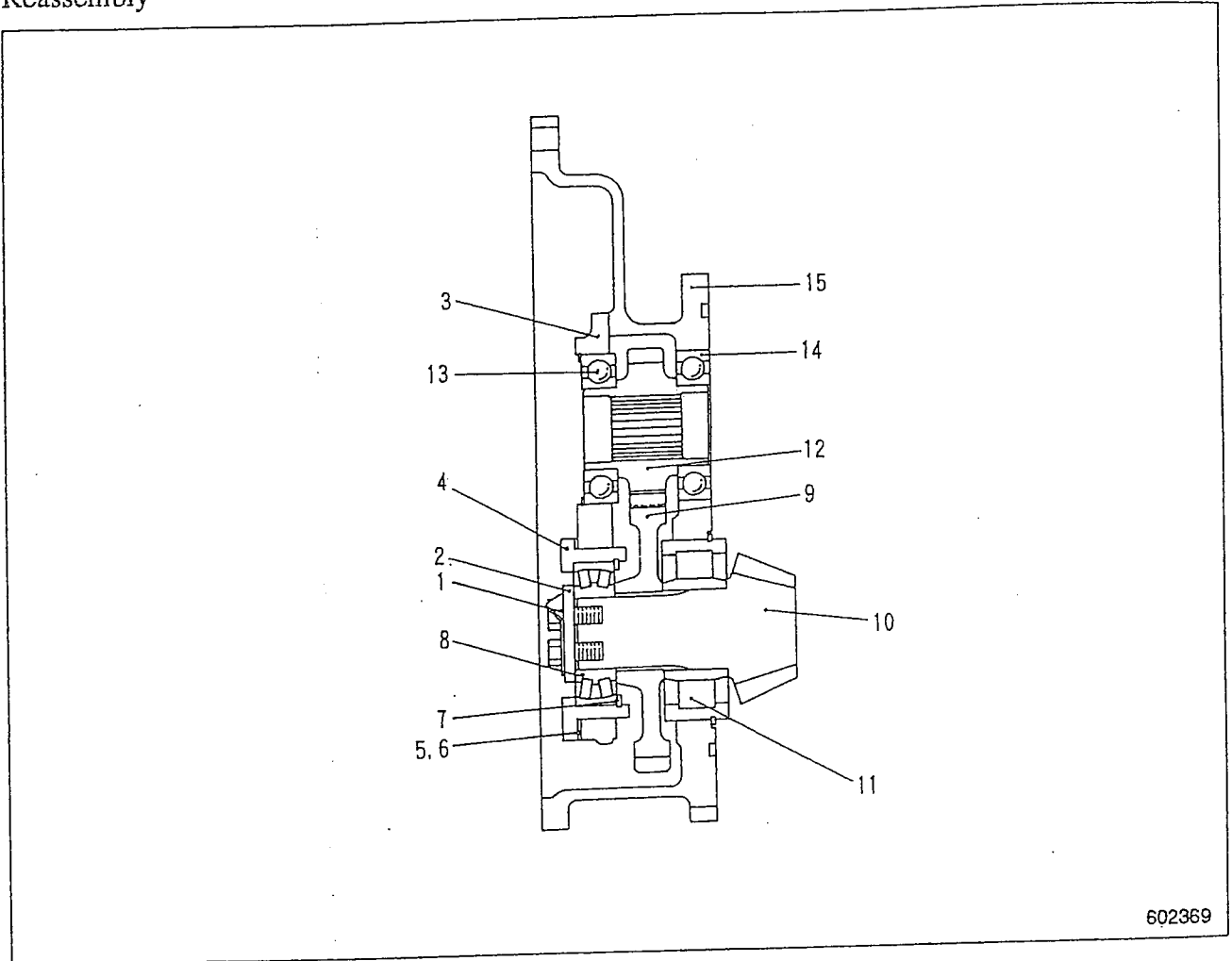
Disassembly



602364

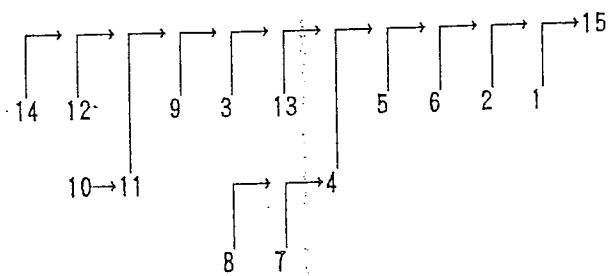
- |                  |                  |                   |
|------------------|------------------|-------------------|
| 1 Lock washer    | 6 Shims (1 set)  | 11 Roller bearing |
| 2 Washer         | 7 Snap ring      | 12 Drive gear     |
| 3 Transfer cover | 8 Roller bearing | 13 Ball bearing   |
| 4 Bearing cage   | 9 Driven gear    | 14 Ball bearing   |
| 5 Shims (1 set)  | 10 Bevel pinion  | 15 Transfer case  |

Reassembly



602369

Reassembly sequence



DISASSEMBLY AND REASSEMBLY

Suggestions

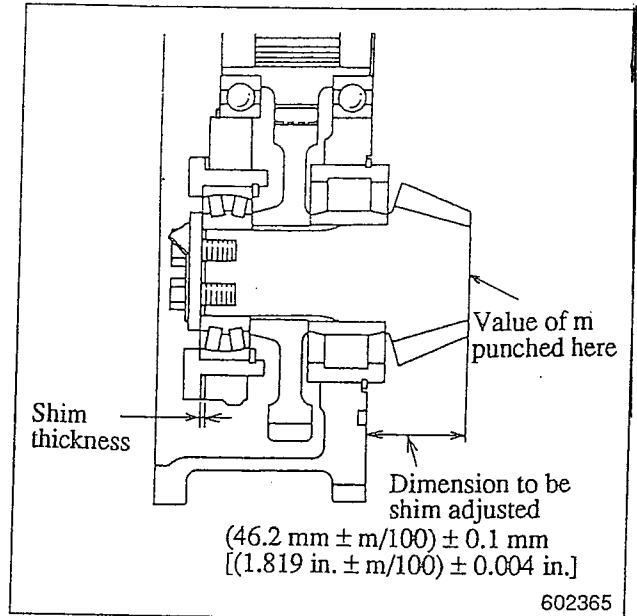
Pinion adjustment

The dimension from the end face of the pinion to the outer face of the transfer case is punched as  $m$  (plus or minus value) on the end face of the pinion. Shim adjust this dimension to  $[46.2 \text{ mm (1.819 in.)} - m/100] \pm 0.1 \text{ mm (0.004 in.)}$  if the  $m$  value is plus or  $[46.2 \text{ mm (1.819 in.)} + m/100] \pm 0.1 \text{ mm (0.004 in.)}$  if the  $m$  value is minus.

The shims for adjusting the pinion are available in these thickness:

Unit: mm (in.)

Part number	Shim thicknesses
58827-10900	0.1 (0.004), 0.4 (0.016), 1.0 (0.039)
58827-11000	0.1 (0.004), 0.4 (0.016), 1.0 (0.039)

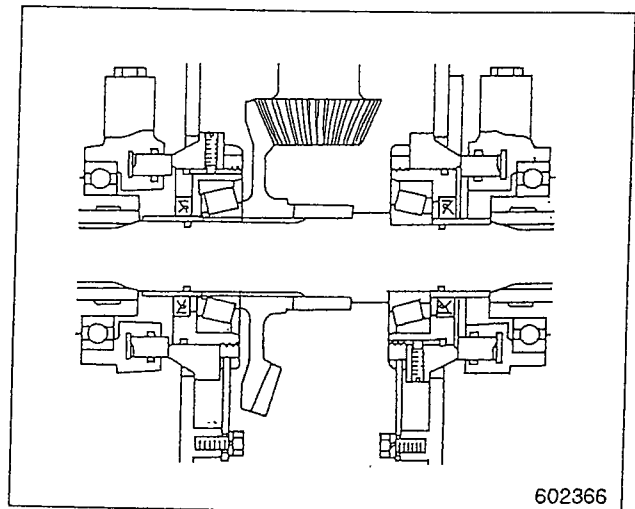


BEVEL GEAR

Installation

**NOTE**

Install the bevel gear on the left side in case of the DPS transmission; install it on the right side in case of the DD transmission.





## DAMPER

## Removal

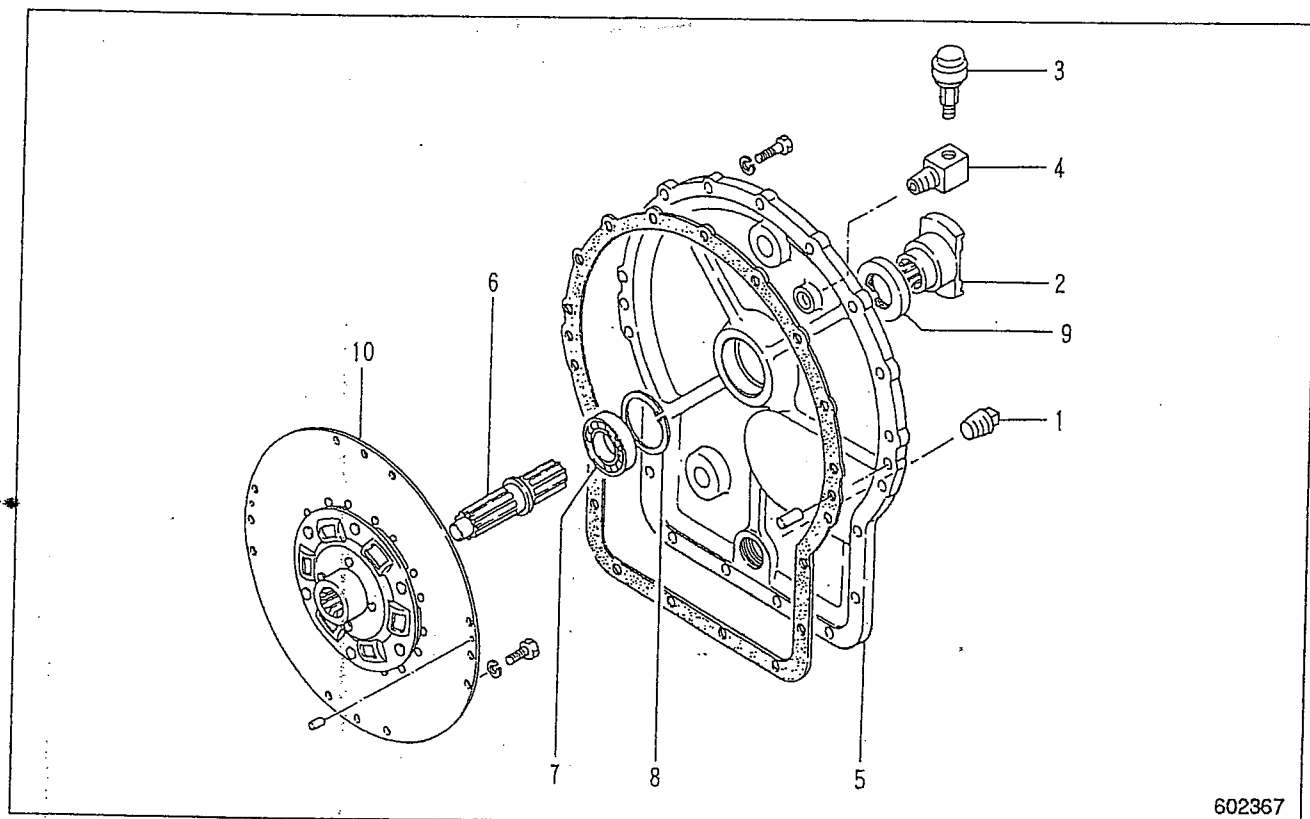
The damper resembles the flywheel clutch (DD) and is to be removed together with the engine. For removal of the damper, refer to FLYWHEEL CLUTCH except for the following items:

- (1) Clutch control rod
- (2) Rubber hose for steering clutch oil
- (3) Rubber hose for oil cooler (flywheel clutch group)

## Installation

To install, follow the reverse of removal sequence.

## Disassembly



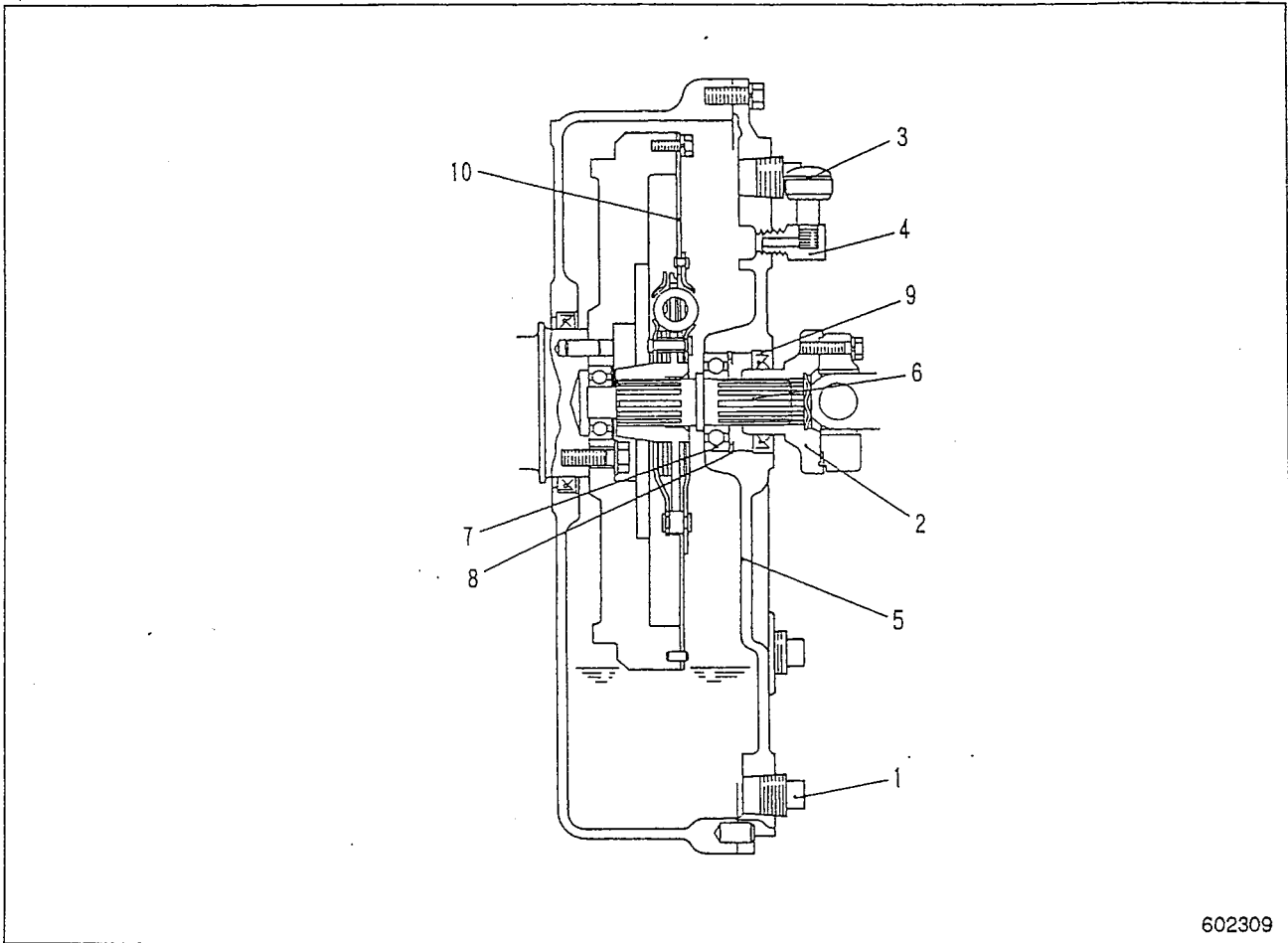
602367

## Disassembly sequence

- |                |                |
|----------------|----------------|
| 1 Drain plug   | 6 Shaft        |
| 2 Flange       | 7 Ball bearing |
| 3 Air breather | 8 Snap ring    |
| 4 Connector    | 9 Oil seal     |
| 5 Damper cover | 10 Damper      |

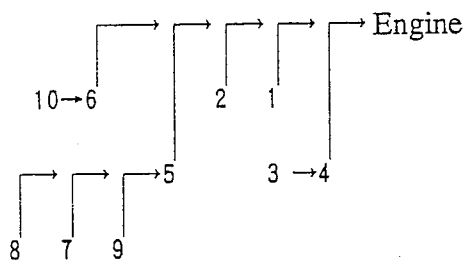
# DISASSEMBLY AND REASSEMBLY

## Reassembly



602309

## Reassembly sequence



## STEERING CLUTCHES AND BRAKES

## Removal

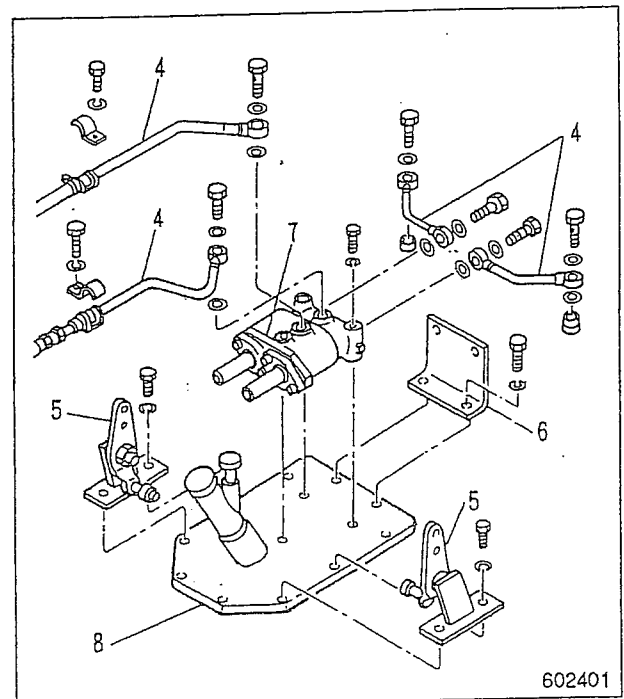
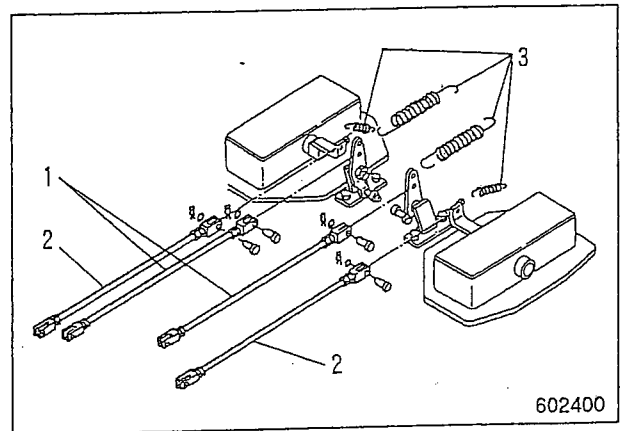
## Start by:

- (a) drain the oil from the bevel gear case and transmission case [9.5 liters (2.5 U.S. gal), approx.]
- (b) remove the tracks (on both sides)

It is not necessary to remove the tracks unless they engage the sprockets. (Refer to Removal, TRACKS.)

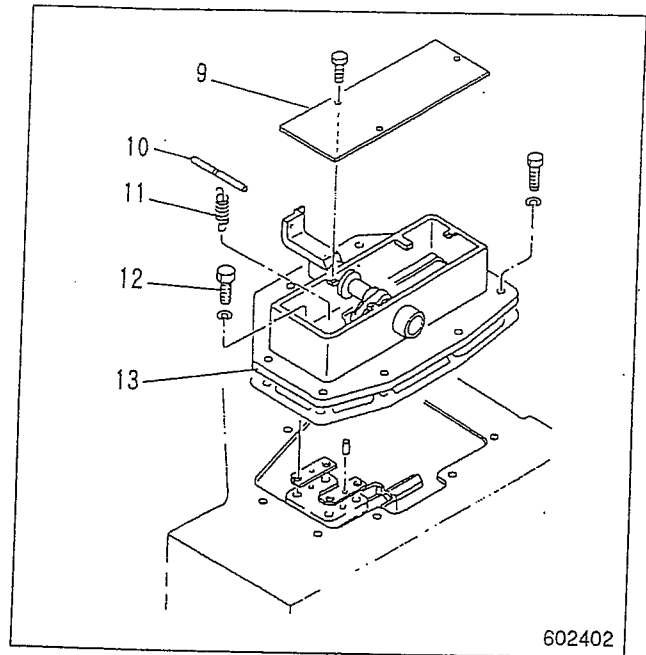
## Removal sequence

1. Disconnect the following electric wires:
  - (1) Wire between battery switch and battery
  - (2) Clamp for wire between battery and starter
2. Remove the following parts:
  - (1) Floor plate
  - (2) Operator's seat and seat plate
  - (3) Rear cover
3. Remove the following parts:
  - 1 Steering control rods (2 pcs)
  - 2 Brake control rods (2 pcs)
  - 3 Springs (4 pcs)
  - 4 Steering clutch oil pipes (4 pcs)
  - 5 Levers (2 pcs)
  - 6 Bracket
  - 7 Steering valve
  - 8 Cover

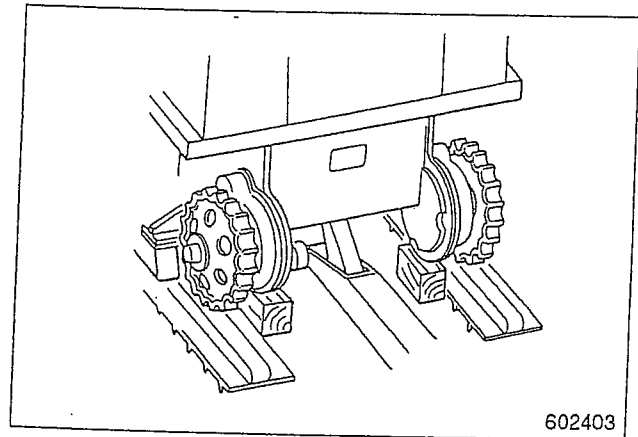


DISASSEMBLY AND REASSEMBLY

- 9 Cover
- 10 Shaft
- 11 Spring
- 12 Steering brake mounting bolts (4 pcs)
- 13 Bracket

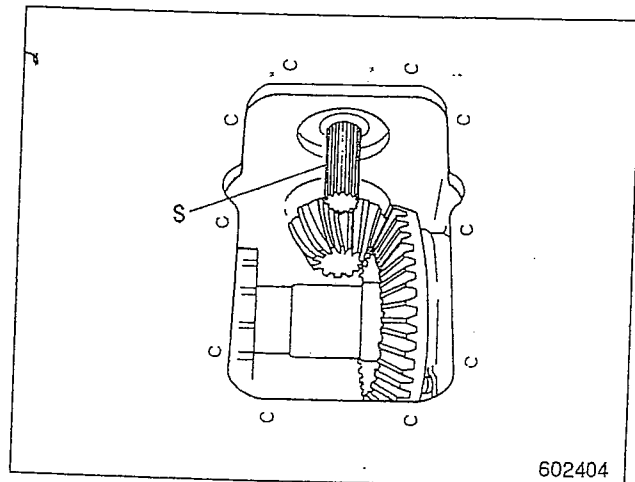


4. Raise the rear end of the machine by positioning a jack under the steering clutch case so that the sprockets can be freely rotated, and block the final drive cases, using wood blocks, as shown.



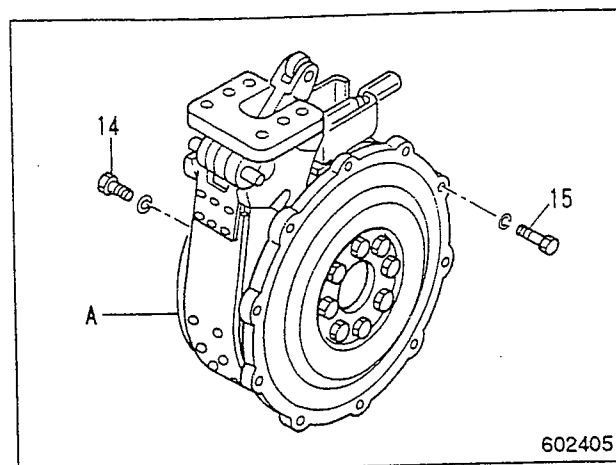
5. Hold the clutch pedal in depressed position, and place the transmission control lever in forward 1st position.

6. Unscrew bolts 14 and 15 securing the steering clutch & brake assembly. To do this, turn the splined portion of transmission input shaft S to rotate that assembly to remove the bolts one by one.

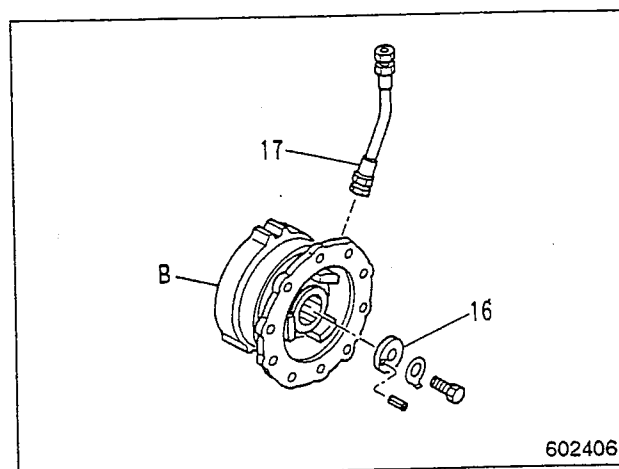


## 7. Remove the following parts:

- 14 Mounting bolts
- 15 Mounting bolts
- A Steering clutch & brake assembly



- 16 Washer
- 17 Hose
- B Steering clutch cylinder assembly

**Installation**

To install, follow the reverse of removal sequence.

Suggestions for steering clutch & brake assembly and cylinder assembly removal

These assemblies can be removed from the steering clutch case by removing bracket 13, with the operator's seat tilted forward. It is not necessary to remove the seat plate.

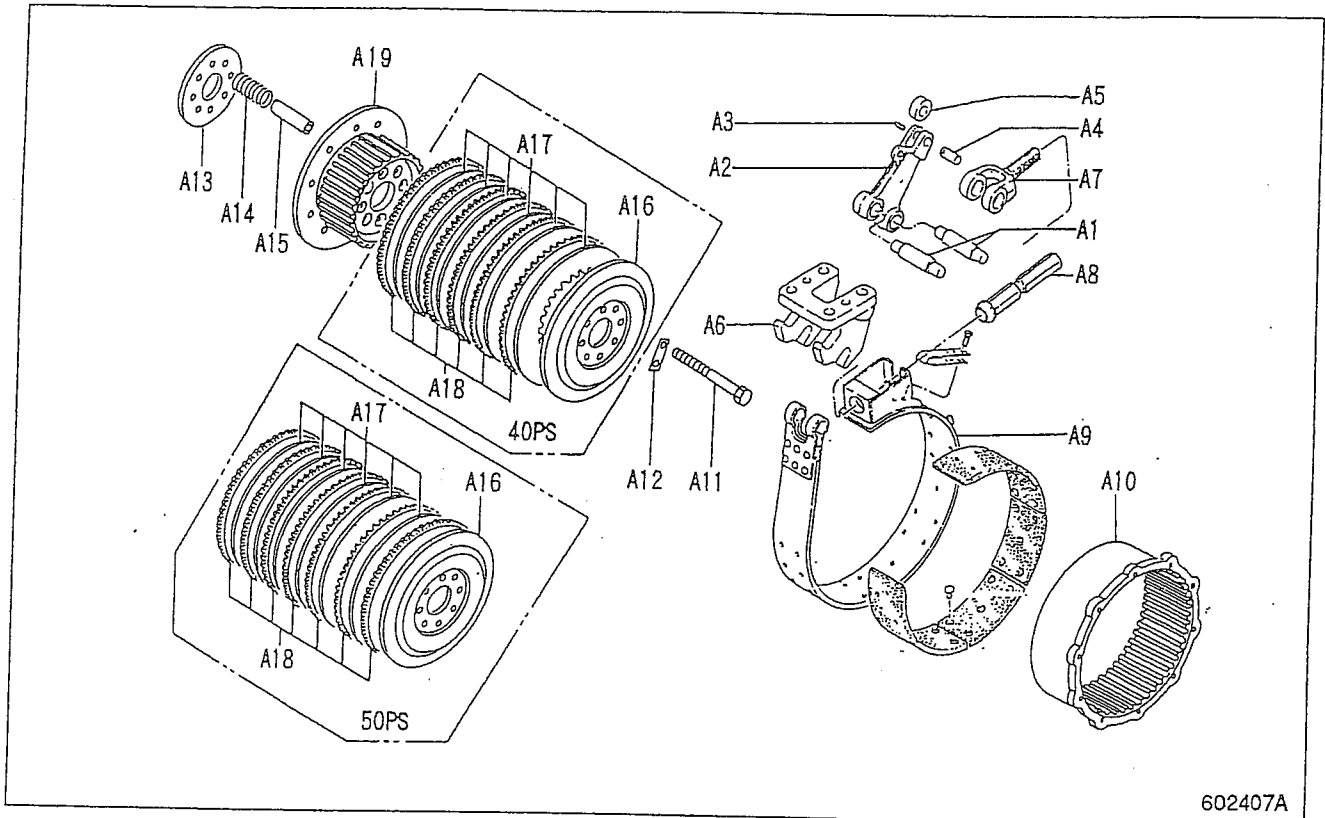
**Inspection after installation**

- (1) Make sure that the oil pipes are connected properly.
- (2) Fill the steering clutch with recommended oil.

DISASSEMBLY AND REASSEMBLY

Disassembly

A Steering clutch & brake assembly



602407A

Disassembly sequence

(Remove A1 thru A9 as an assembly.)

A1 Pin

(Remove A2 thru A5 as an assembly.)

A2 Lever

A3 Spring pin

A4 Pin

A5 Roller

A6 Anchor

A7 Clevis

A8 Adjusting nut

A9 Brake band assembly

A10 Outer drum

A11 bolt

A12 Plate

A13 Plate

A14 Spring

A15 Spacer

A16 Pressure plate

A17 Disc plate

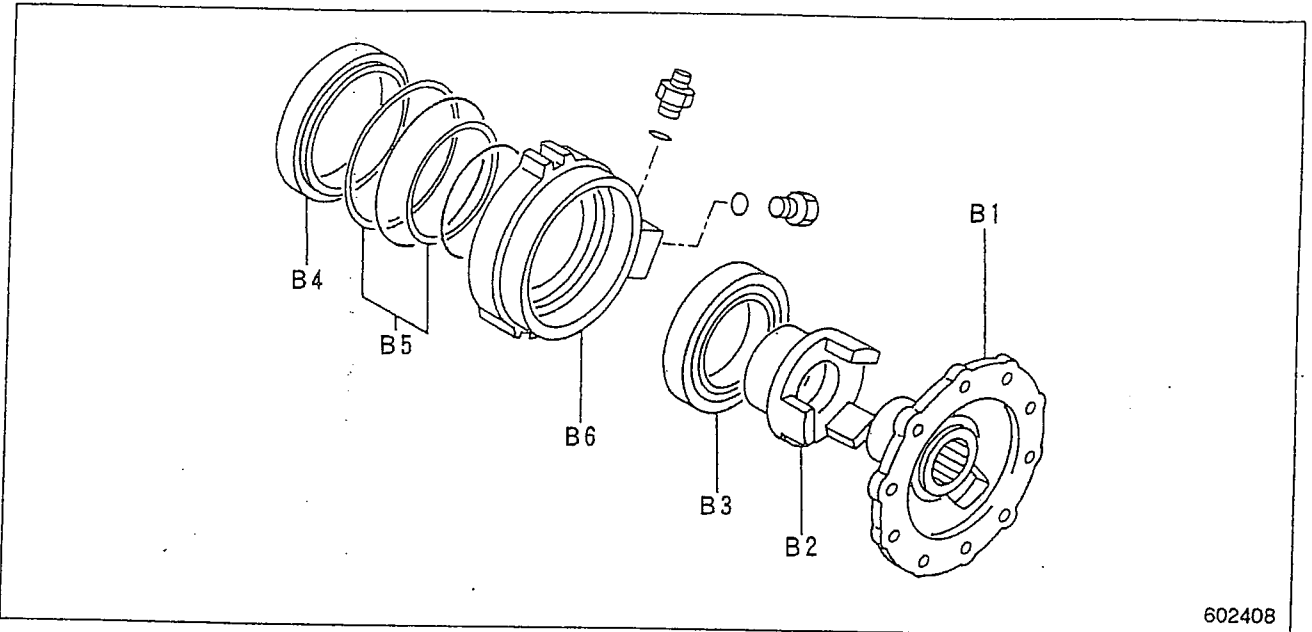
A18 Friction plate

A19 Inner drum

Number of friction plates A18

Machine model	No. of friction plates A18
40PS (standard/swamp models)	6, each side
50PS (super/ultra-super swamp models)	7, each side

B Steering clutch cylinder assembly

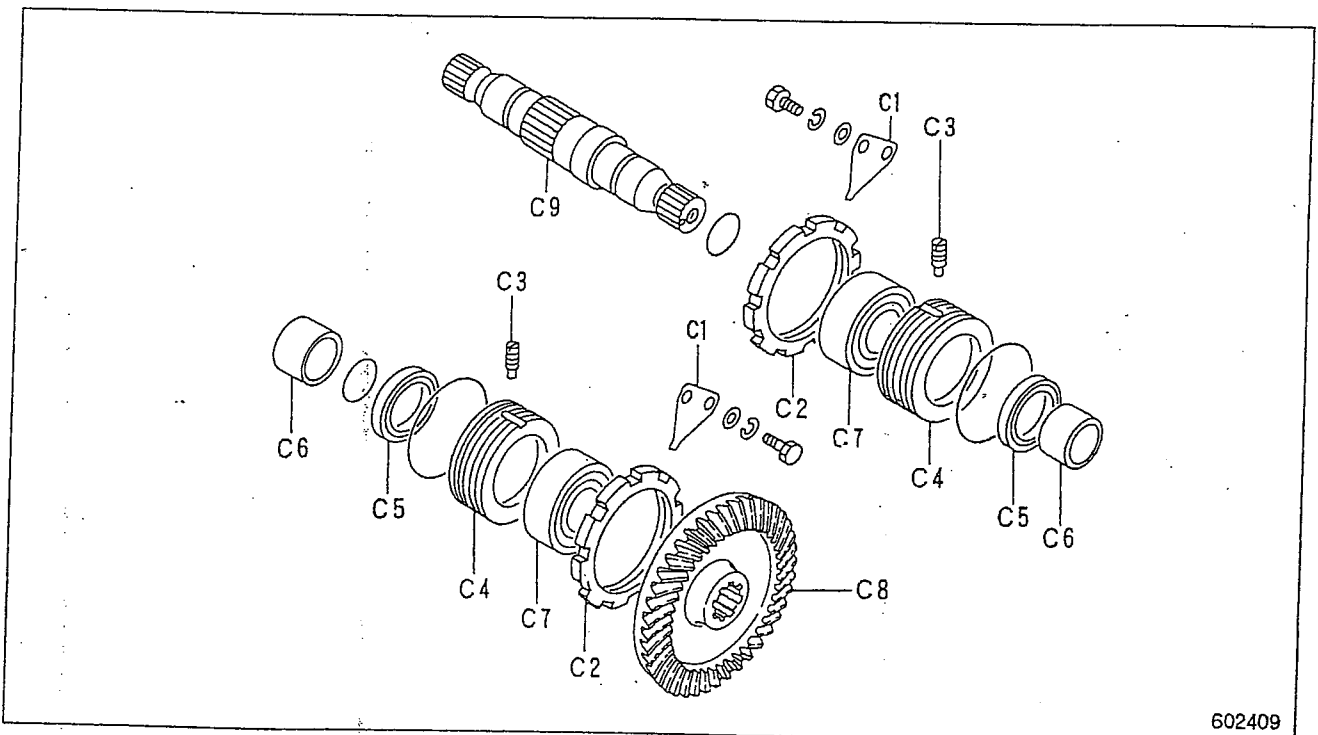


602408

Disassembly sequence

- |            |            |                |
|------------|------------|----------------|
| B1 Flange  | B3 Bearing | B5 Backup ring |
| B2 Shifter | B4 Piston  | B6 Cylinder    |

C Bevel gear assembly



602409

Disassembly sequence

- |                               |  |                   |
|-------------------------------|--|-------------------|
| C1 Locking plate              | (Remove C4, C5 and outer race of C7 as an assembly.) | C7 Roller bearing |
| C2 Nut                        | C4 Bearing cage                                      | C8 Bevel gear     |
| C3 Set screw (to be loosened) | C5 Oil seal  | C9 Drive shaft    |
|                               | C6 Collar  |                   |

DISASSEMBLY AND REASSEMBLY

Inspection

1. Thickness of disc plates and friction plates

Measure the thickness of the disc plates and friction plates. If the thickness is less than the service limit, do the steps 2 and 3 below.

Unit: mm (in.)

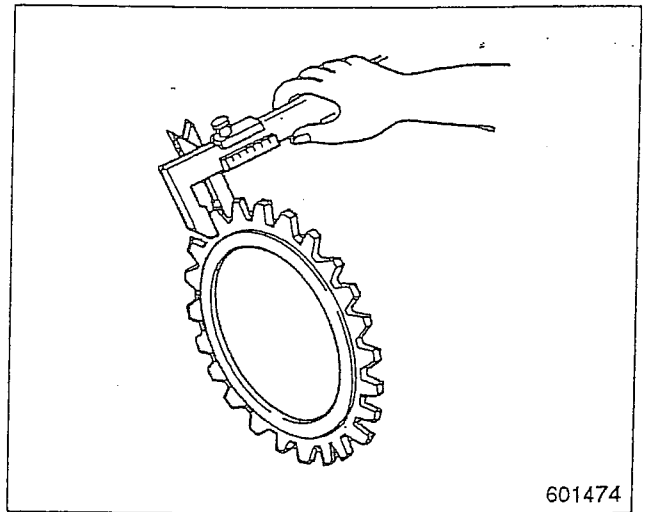
Item	Assembly standard	Service limit
Thickness of disc plates (6 pcs) and friction plates (6 pcs) (40PS model)	69 (2.72)	66 (2.60)
Thickness of disc plates (6 pcs) and friction plates (7 pcs) (50PS model)	69.3 (2.728)	66 (2.60)

2. Friction plates

Measure the thickness of each friction plate and its backlash with the outer drum splines. Replace the plate if any of these measurements exceeds the service limit.

Unit: mm (in.)

Item		Assembly standard	Service limit
Thickness	50PS model	8.7 (0.343)	6.0 (0.236)
	40PS model	7.5 (0.295)	
Backlash with outer drum splines		0.16 to 0.52 (0.0063 to 0.0205)	0.80 (0.0315)

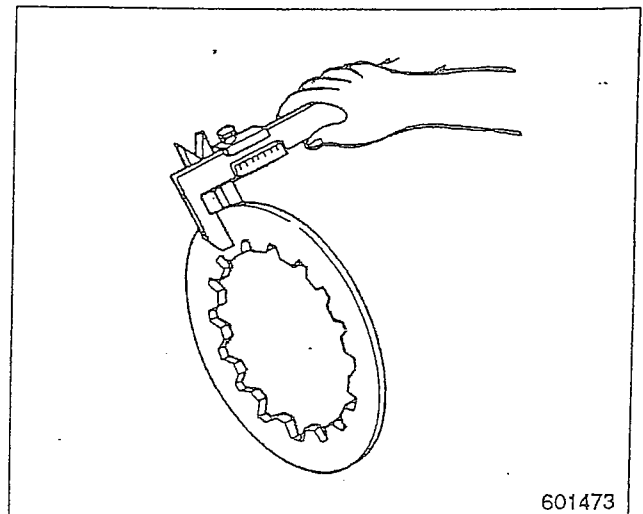


3. Disc plates

Measure the thickness of each disc plate and its backlash with the inner drum splines. Replace the disc plate if any of these measurements exceeds the service limit.

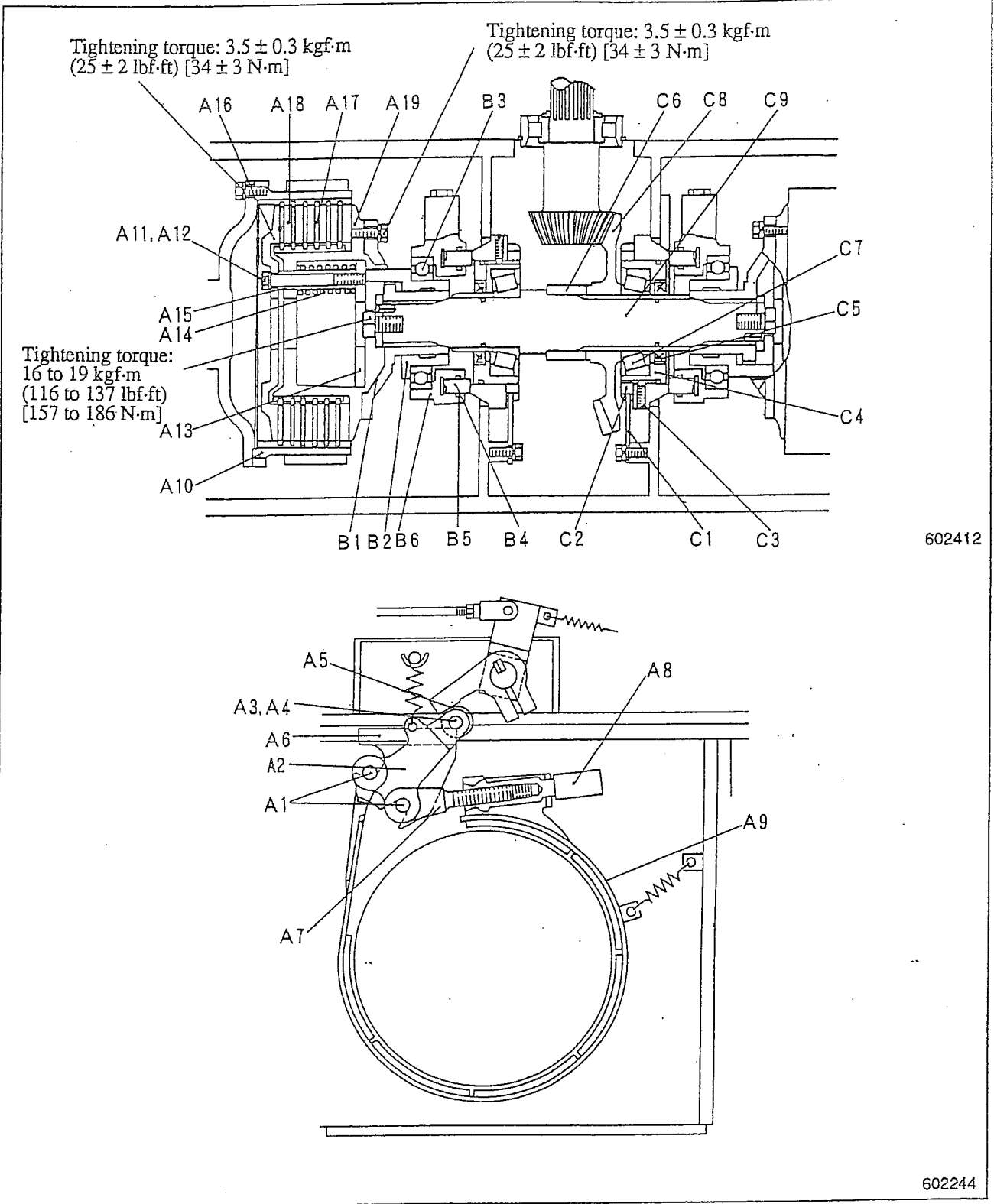
Unit: mm (in.)

Item	Assembly standard	Service limit
Thickness	2.8 (0.110)	2.3 (0.091)
Backlash with inner drum splines	0.14 to 0.30 (0.0055 to 0.0118)	0.60 (0.0236)





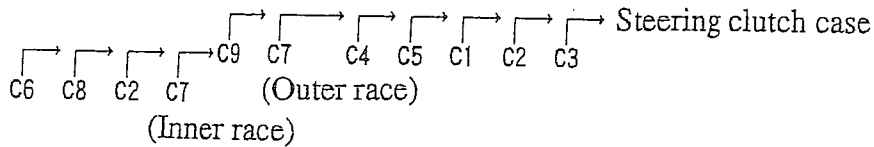
Reassembly



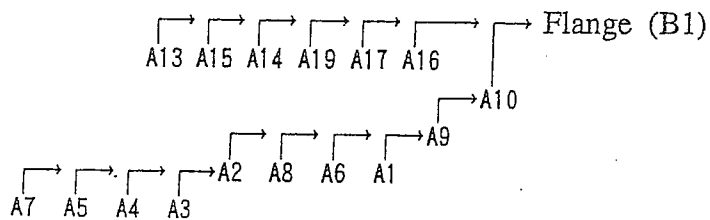
## DISASSEMBLY AND REASSEMBLY

### Reassembly sequence

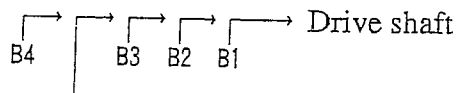
#### C Bevel gear assembly



#### A Steering clutch & brake assembly



#### B Steering clutch cylinder assembly



B5 → B6.

### Suggestions

#### 1. Drive shaft installation

- (1) Before installing drive shaft C9, fit the inner race of left-hand roller bearing C7 and collar C6 to the shaft.
- (2) After installing shaft C9 and bevel gear C8 in the steering clutch case, fit the inner race of right-hand roller bearing C7 to the shaft.

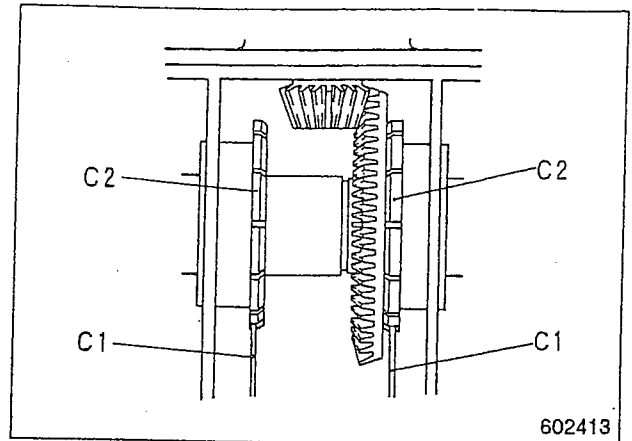
#### 2. Friction plate and disc plate installation

- (1) The 50 PS model has seven friction plates while the 40 PS model has six friction plates.
- (2) In the 50 PS model, put the friction plate next to the pressure plate.

### 3. Tapered roller bearing preload adjustment

- (1) Tighten adjusting nuts C2, right and left, to settle them in place. Lock one of the nuts with its lock plate C1, and tighten or loosen the other nut to adjust the preload. (Tightening the nut increases the preload.)
- (2) Hook a spring balancer to the tooth of bevel gear in mesh with the pinion with a wire, pull the balancer in the tangential direction, and read the balancer indication.

Item	Assembly standard
Preload	0.72 to 0.88 kgf·m (5.2 to 6.4 lbf·ft) [7.1 to 8.6 N·m]
Spring balancer reading	6.55 to 8.00 kgf (14.4 to 17.6 lbf) [64.2 to 78.5 N]



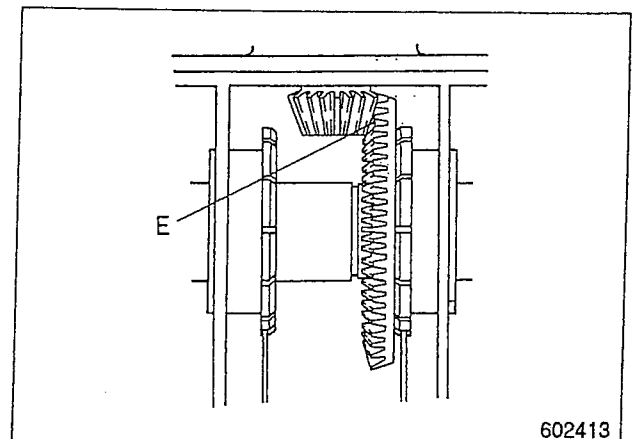
602413

### 4. Bevel gear and pinion backlash adjustment

- (1) Put a fuse stock into between the bevel gear and pinion at the place indicated as E, roll it and measure the amount of flattening.
- (2) Measure the backlash at a total of four places by turning the bevel gear 90° at a time, and take the smallest measurement for comparison with the assembly standard.
- (3) To adjust the backlash, tighten or loosen the adjusting nuts, right and left.

Unit: mm (in.)

Item	Assembly standard
Backlash	0.15 to 0.20 (0.0059 to 0.0079)



602413

#### NOTE

If one nut is loosened, for instance, the other nut must be tightened by the same amount to keep the preload unchanged.

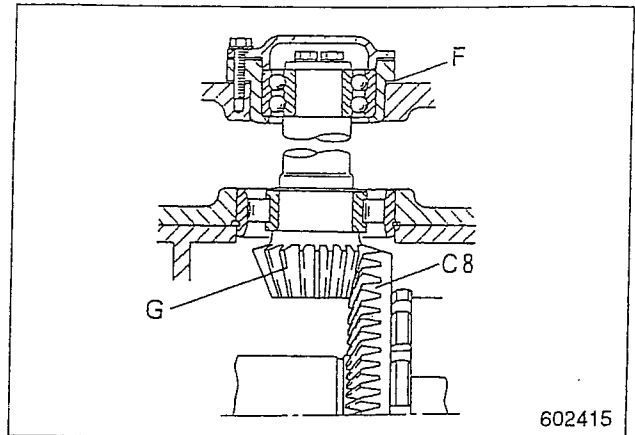
## DISASSEMBLY AND REASSEMBLY

### 5. Tooth contact adjustment

- (1) To move the bevel pinion G toward or away from the bevel gear C8 for tooth contact adjustment, decrease or increase shims F between the bearing cage and transmission case.
- (2) To determine the tooth contact pattern, brush red lead sparingly on the bevel gear teeth, and rotate the pinion backward and forward until a contact pattern is noted on both concave and convex faces of the gear teeth.

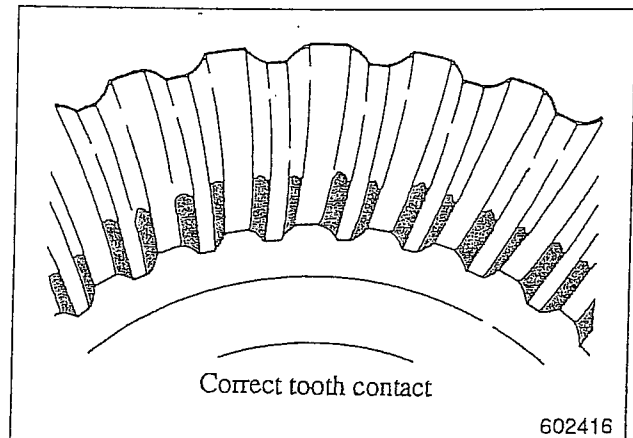
#### NOTE

To make the tooth contact pattern more visible, lightly press the gear when rotating the pinion.



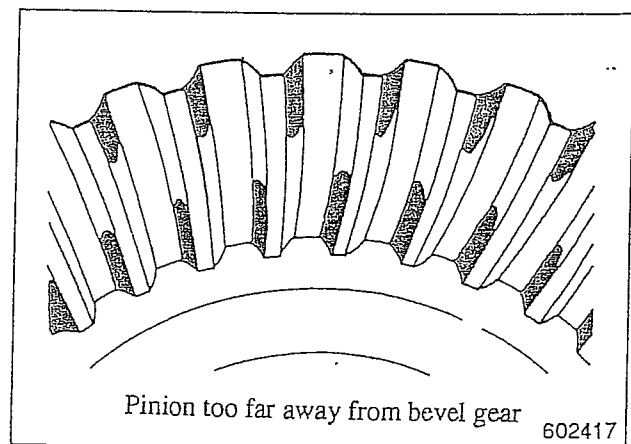
#### Correct tooth contact

Contact (indicated by the dark areas on the tooth faces) is heaviest toward the toe end and extends about 30% of the tooth length on both convex and concave faces.



#### Incorrect tooth contact

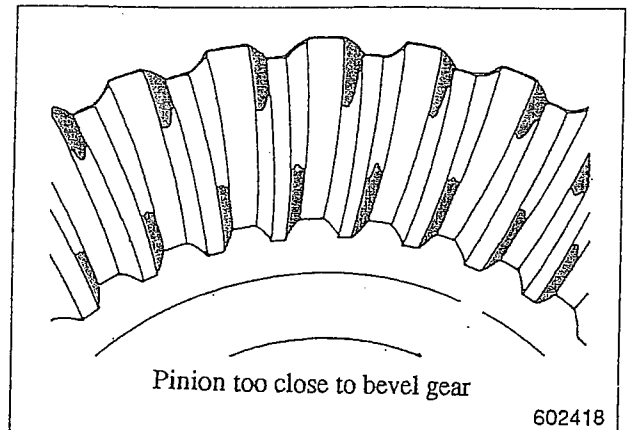
- Pinion too far away from bevel gear
- (1) Contact extends toward the toe end of concave faces and toward the heel end of convex faces.
  - (2) To correct this contact, decrease the thickness of shims F, and turn adjusting nuts C2 to move pinion G away from gear C8. Again brush red lead on the gear teeth, and check the contact pattern.



- Pinion too close to bevel gear
- (1) Contact extends toward the heel end of concave faces and toward the toe end of convex faces.
  - (2) To correct this contact, increase the thickness of shims F, and turn adjusting nuts C2 to move gear C8 toward pinion G. Recheck the contact pattern by brushing red lead.

**NOTE**

The foregoing tooth contact adjustments are meaningless unless the bevel gear and pinion backlash has been adjusted properly.



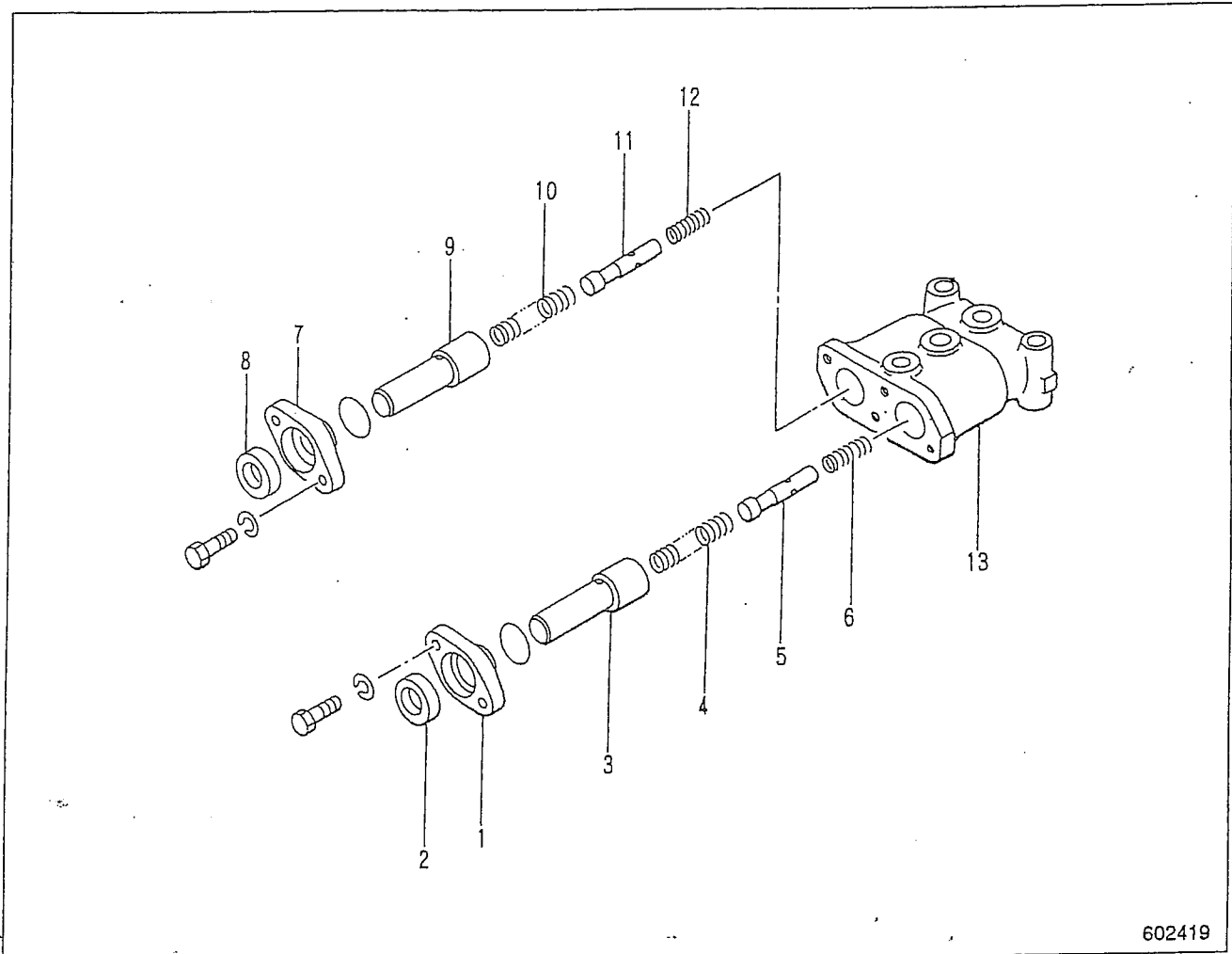
DISASSEMBLY AND REASSEMBLY

STEERING VALVE

Removal and installation

For removal and installation of the steering valve, refer to Removal, STEERING CLUTCHES AND BRAKES.

Disassembly

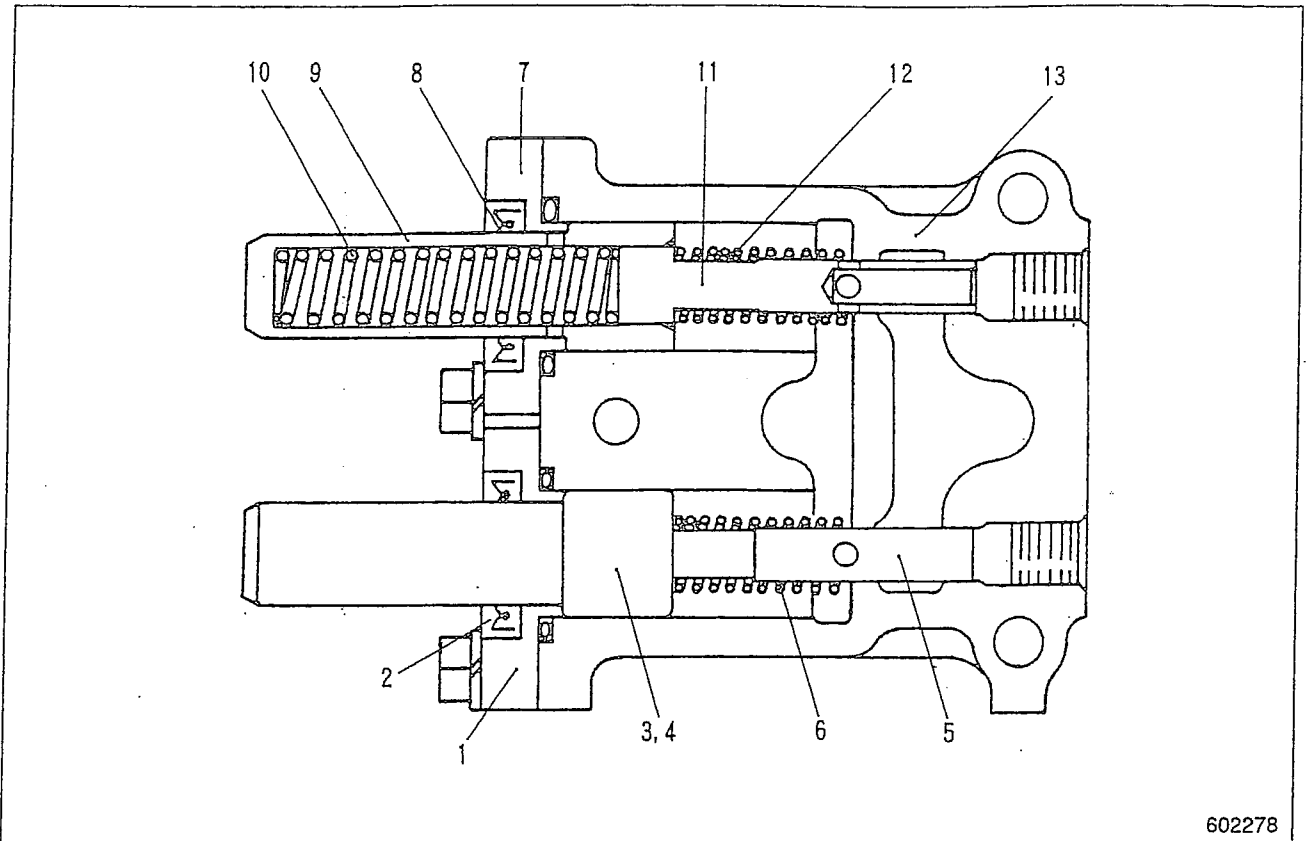


602419

Disassembly sequence

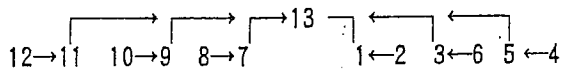
- |                 |                 |                  |
|-----------------|-----------------|------------------|
| 1 Cover         | 6 Return spring | 11 Plunger valve |
| 2 Oil seal      | 7 Cover         | 12 Return spring |
| 3 Piston        | 8 Oil seal      | 13 Valve housing |
| 4 Valve spring  | 9 Piston        |                  |
| 5 Plunger valve | 10 Valve spring |                  |

Reassembly



602278

Reassembly sequence

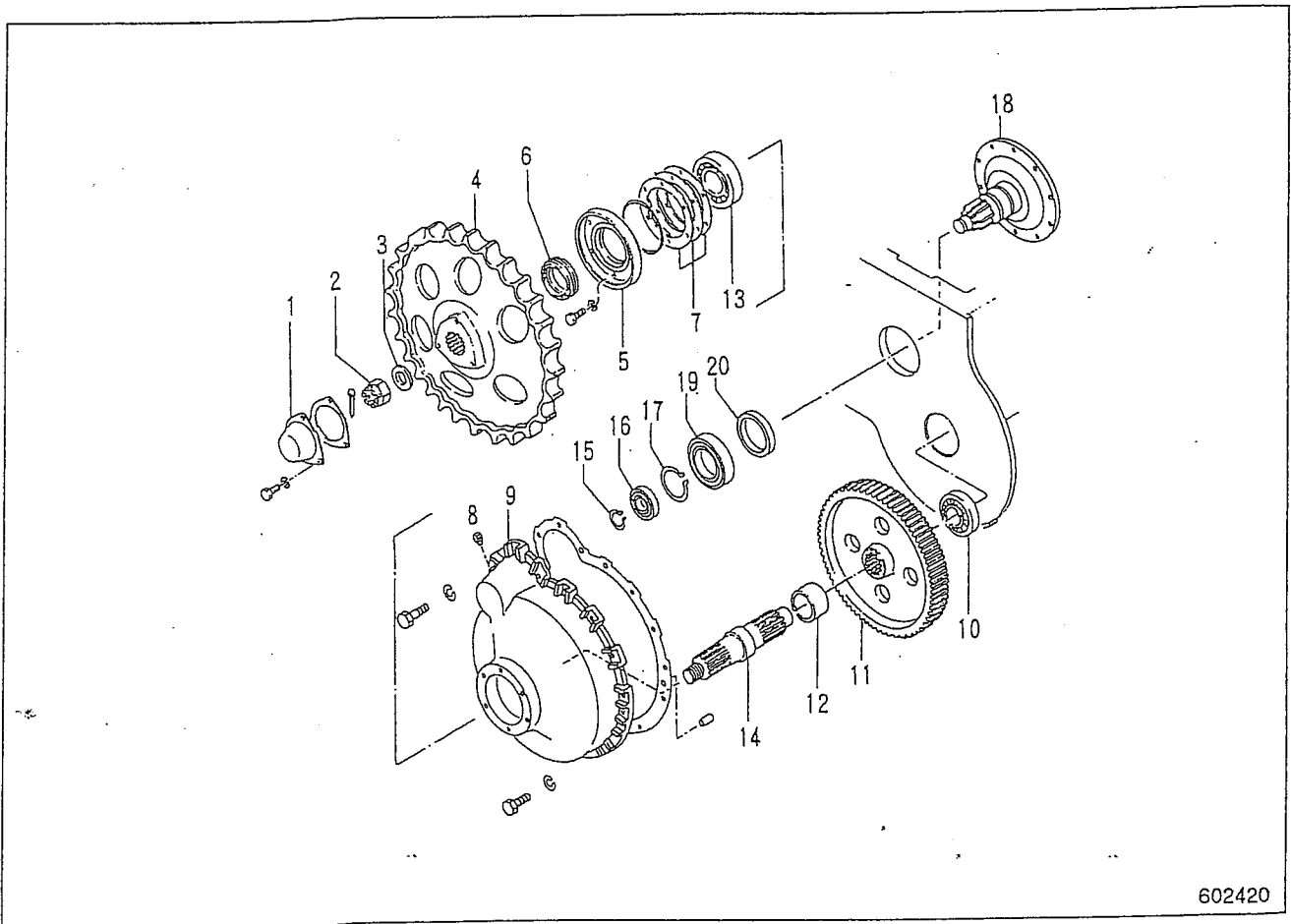


FINAL DRIVES

Removal (disassembly)

Start by:

- (a) separate the tracks (Refer to Removal, TRACKS.)
- (b) drain the oil from the final drive gear cases
- (c) when it is necessary to remove pinion 18, remove the steering clutch & brake assembly (Refer to Removal.)



602420

Disassembly sequence

- |                 |                                     |                   |
|-----------------|-------------------------------------|-------------------|
| 1 Cover         | (Remove 9 thru 14 as an assembly.)  | 15 Snap ring      |
| 2 Castle nut    | 9 Gear case                         | 16 Roller bearing |
| 3 Washer        | (Remove 10 thru 14 as an assembly.) | 17 Snap ring      |
| 4 Sprocket      | 10 Tapered roller bearing           | 18 Pinion         |
| 5 Seal case     | 11 Gear                             | 19 Ball bearing   |
| 6 Floating seal | 12 Spacer                           | 20 Oil seal       |
| 7 Shims         | 13 Tapered roller bearing           |                   |
| 8 Screw         | 14 Shaft                            |                   |



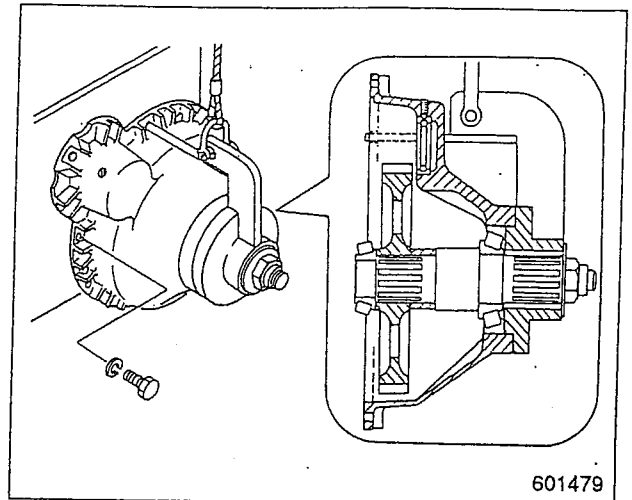
Suggestions

1. Gear case removal

Using a jig, remove gear case 9 together with shaft subassembly comprising parts 10 thru 14.

Unit: kg (lb)

Weight of gear case and shaft sub-assembly	Standard/swamp models	60 (132), approx.
	Super swamp model	70 (154), approx.
	Ultra-super swmap model	90 (198), approx.



**! WARNING**

The final drive shaft and its gear are supported by the gear case on one side and by the frame on the other. Thus, pulling the gear case alone from the frame is not only dangerous but also harmful to the shaft subassembly. Be sure to remove the case to which the shaft subassembly is installed.

2. Tapered roller bearing removal

- (1) Remove the inner race and rollers of tapered roller bearing 10 as the components of the shaft subassembly. Remove the outer race of this bearing from the steering clutch case when required.
- (2) Similarly remove tapered roller bearing 13. Remove its outer race from the gear case 9.
- (3) The outer race of roller bearing 16 comes off together with gear case 9 when removed. Remove it from the gear case by loosening the screw when required.

Inspection

1. Pinion and gear backlash

Measure the backlash, and replace the pinion and gear if the measurement exceeds the service limit.

Unit: mm (in.)

Item	Assembly standard	Service limit
Backlash	0.17 to 0.37 (0.0067 to 0.0146)	1.00 (0.0394)

DISASSEMBLY AND REASSEMBLY

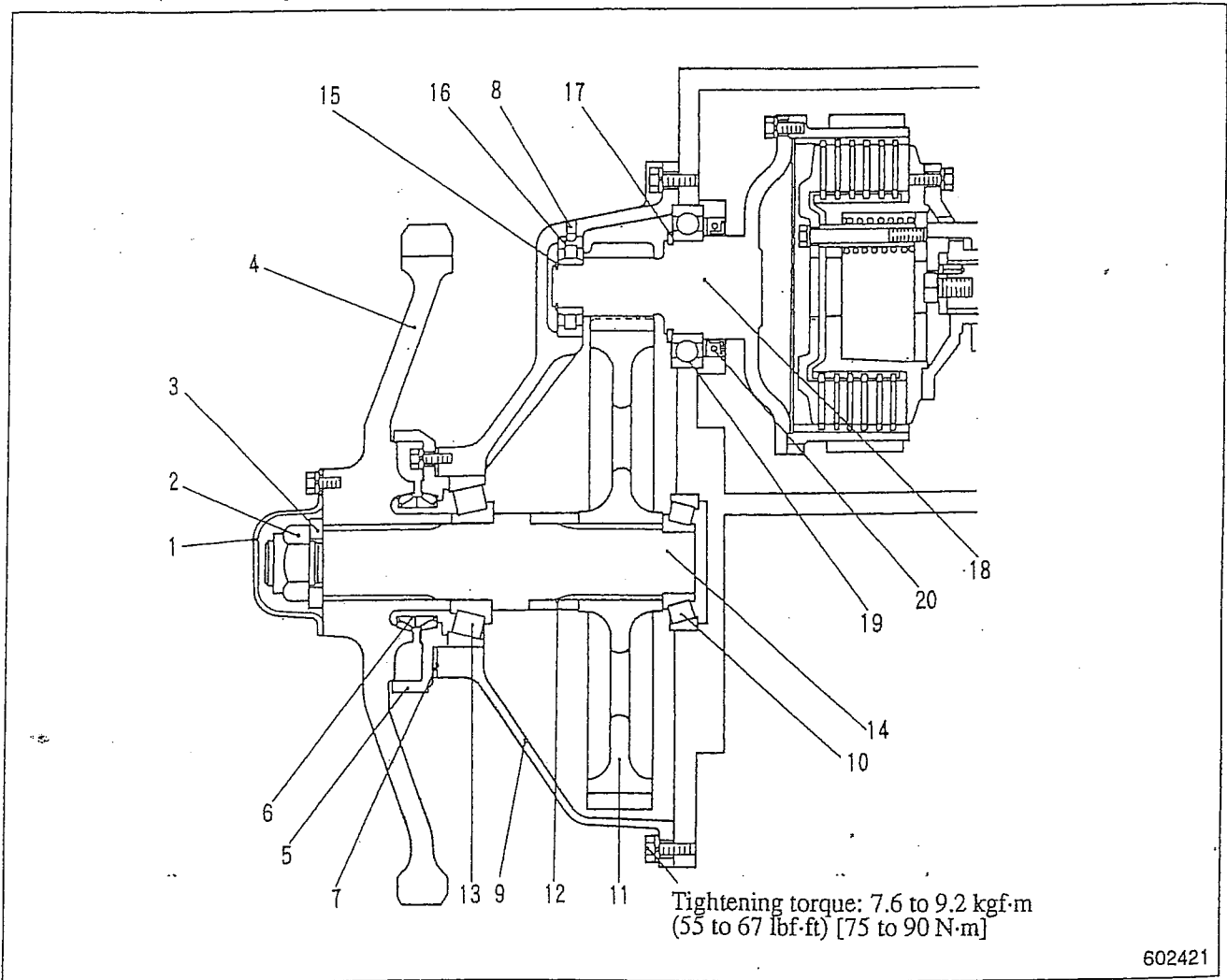
2. Sprockets

Measure the tooth width, and replace the sprocket if the measurement exceeds the service limit.

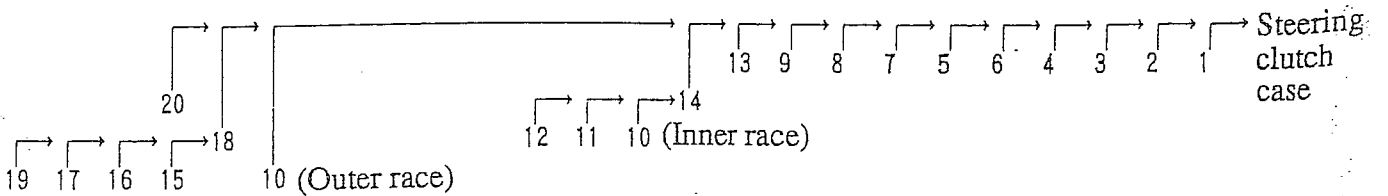
Unit: mm (in.)

Item	Assembly standard	Service limit
Width of teeth	40 (1.57)	36 (1.42)

Installation (reassembly)



Reassembly sequence



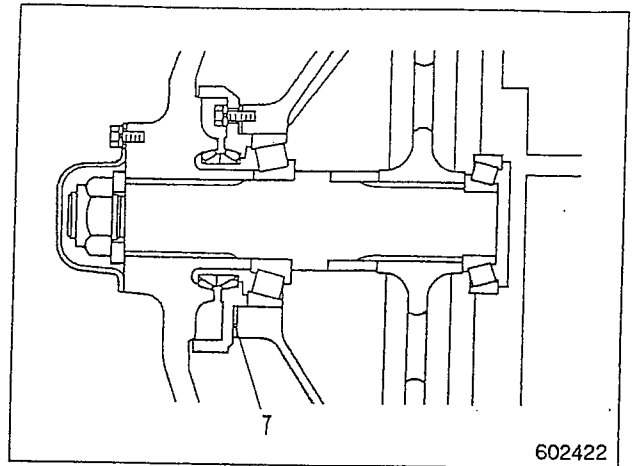
Suggestions

Tapered roller bearing preload adjustment

- (1) To adjust the preload of tapered roller bearing, decrease or increase the thickness of shims 7 between the gear case and oil seal cover.
- (2) Decreasing the thickness of the shims increases the preload of the bearing.

Unit: kgf·m (lbf·ft) [N·m]

Item	Assembly standard
Tapered roller bearing (pinion) preload	0.29 to 0.37 (2 to 3) [3 to 4]



Starting torque T of pinion:  
= F kgf (lbf) [N] x L m (in.) (distance from center of pinion)

[Example]

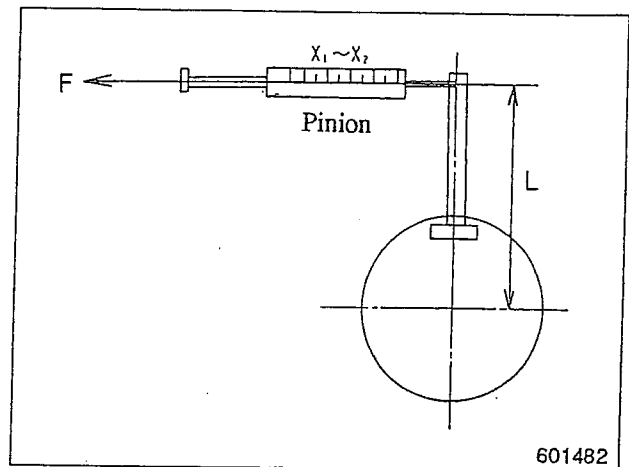
If L is 25 cm (9.8 in.), the balancer reading should be 1.16 kgf (2.6 lbf) [11.4 N] to 1.48 kgf (3.3 lbf) [14.5 N] as calculated below:

$$0.29 \text{ kgf}\cdot\text{m} (2 \text{ lbf}\cdot\text{ft}) [3 \text{ N}\cdot\text{m}] = 0.25 \text{ m} (9.8 \text{ in.}) \times X_1$$

$$X_1 = 1.16 \text{ kgf} (2.6 \text{ lbf}) [11.4 \text{ N}]$$

$$0.37 \text{ kgf}\cdot\text{m} (3 \text{ lbf}\cdot\text{ft}) [4 \text{ N}\cdot\text{m}] = 0.25 \text{ m} (9.8 \text{ in.}) \times X_2$$

$$X_2 = 1.48 \text{ kgf} (3.3 \text{ lbf}) [14.5 \text{ N}]$$



## DISASSEMBLY AND REASSEMBLY

### UNDERCARRIAGE

#### Removal

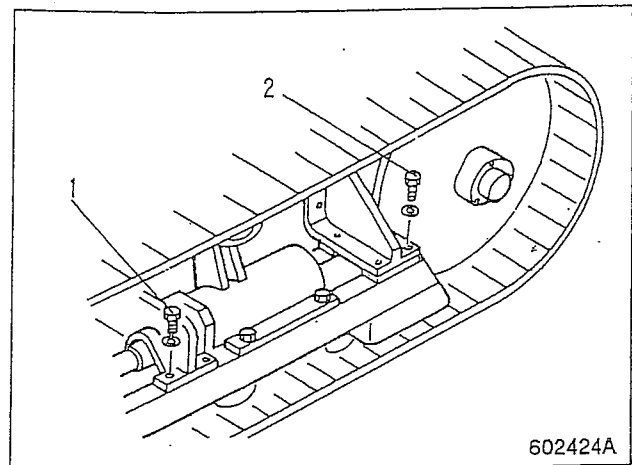
Start by:

- (a) separate the tracks (Refer to Removal, TRACKS.)
- (b) on the PT model, disconnect the hydraulic hoses from the tilt cylinder, and remove the blade and blade arms

#### Removal sequence

1. Remove the following parts:

- 1 Bolts securing rigid bar (4 pcs)
- 2 Bolts securing rear support (4 pcs)



2. Hoist or jack up the machine just a little, and securely block the rigid bars and steering clutch cases, using wood blocks.
3. Remove the undercarriage.

#### Installation

To install, follow the reverse of removal sequence.

## FRONT IDLERS

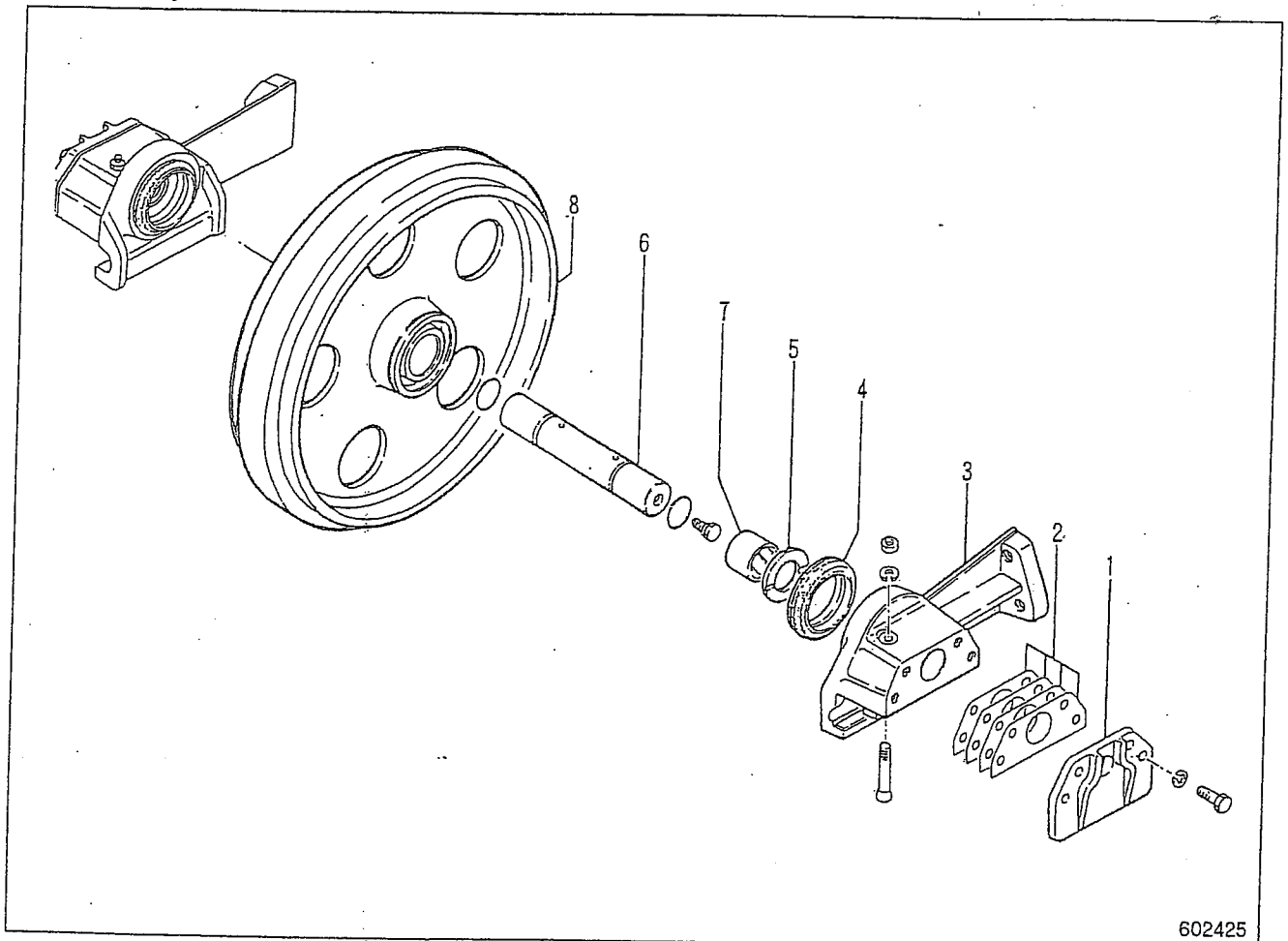
## Removal and installation

Start by:

- (a) separate the tracks (Refer to Removal, TRACKS.)
- (b) drain the oil from the idler

Unscrews the bolts (4 pcs). Fasten a hoist to the idler, and pull the idler assembly off the track frame.

## Disassembly



602425

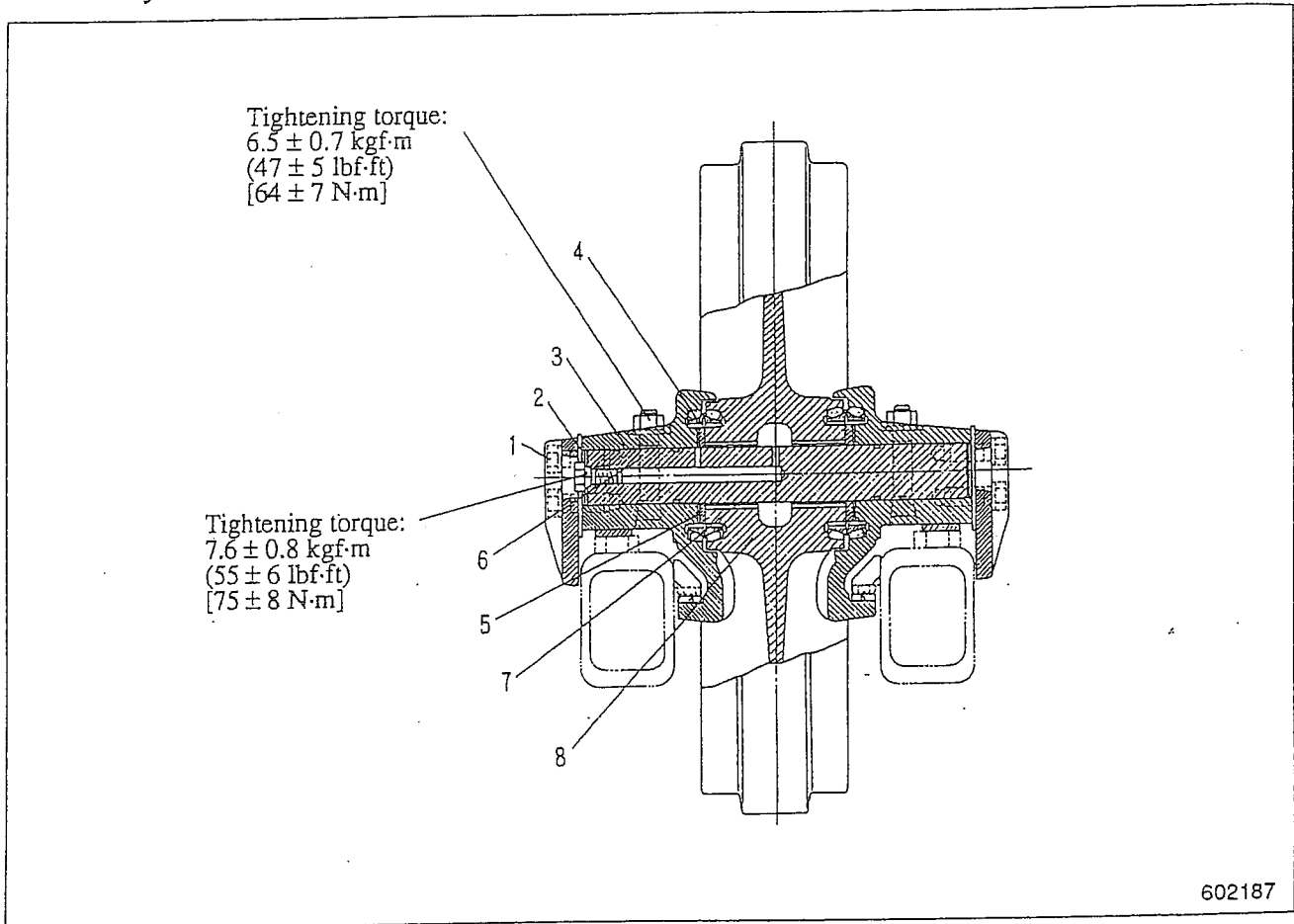
## Disassembly sequence

- |                 |                                   |
|-----------------|-----------------------------------|
| 1 Guide         | (Remove 6 thru 8 as an assembly.) |
| 2 Shim          | 6 Shaft                           |
| 3 Bearing       | 7 Bushing                         |
| 4 Floating seal | 8 Idler                           |
| 5 Thrust washer |                                   |

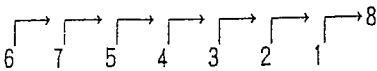
Weight of front idler	38 kg (84 lb), approx.
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## DISASSEMBLY AND REASSEMBLY

### Reassembly



### Reassembly sequence



### Suggestions

#### Lubrication

- (1) Fill the idler with recommended oil through the plug hole in the shaft.
- (2) Use an adaptor and volume pump for this filling.

Capacity, approx.	60 cc (3.7 cu in.) (SAE90 gear oil)
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Part name	Part number
Adaptor	58809-15100
Volume pump	58309-03100

## RECOIL CYLINDERS AND RECOIL SPRINGS

## Removal and installation

Start by:

remove the cover, and gradually turn the fill valve counterclockwise to allow grease to escape from the vent hole.

**! WARNING**

Keep your face away from the fill valve when adjusting or loosening the track. The cylinder pressure is released when the front idler stops moving backward.

## Removal sequence

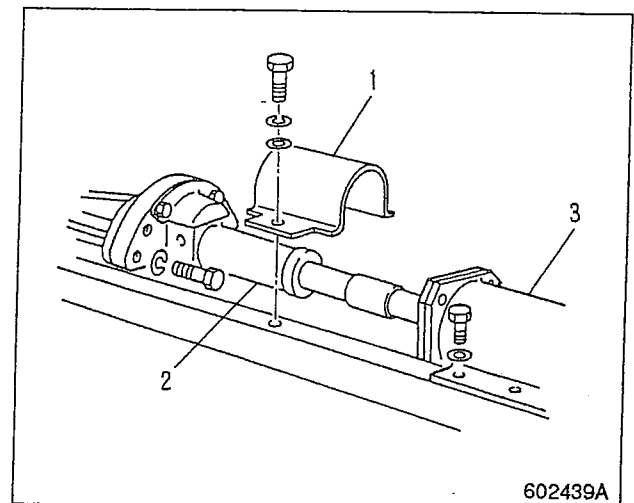
1. Remove recoil cylinder guard 1.
2. Remove recoil cylinder assembly 2 by unscrewing mounting bolts (4 pcs).

Weight of hydraulic adjuster cylinder assembly	15 kg (33 lb), approx.
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3. Remove carrier roller bracket assembly (recoil spring assembly) 3.

Weight of carrier roller bracket assembly (with carrier roller)	42 kg (93 lb), approx.
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4. Remove the track carrier roller assembly. (Refer to Removal, TRACK CARRIER ROLLERS.)



## Installation

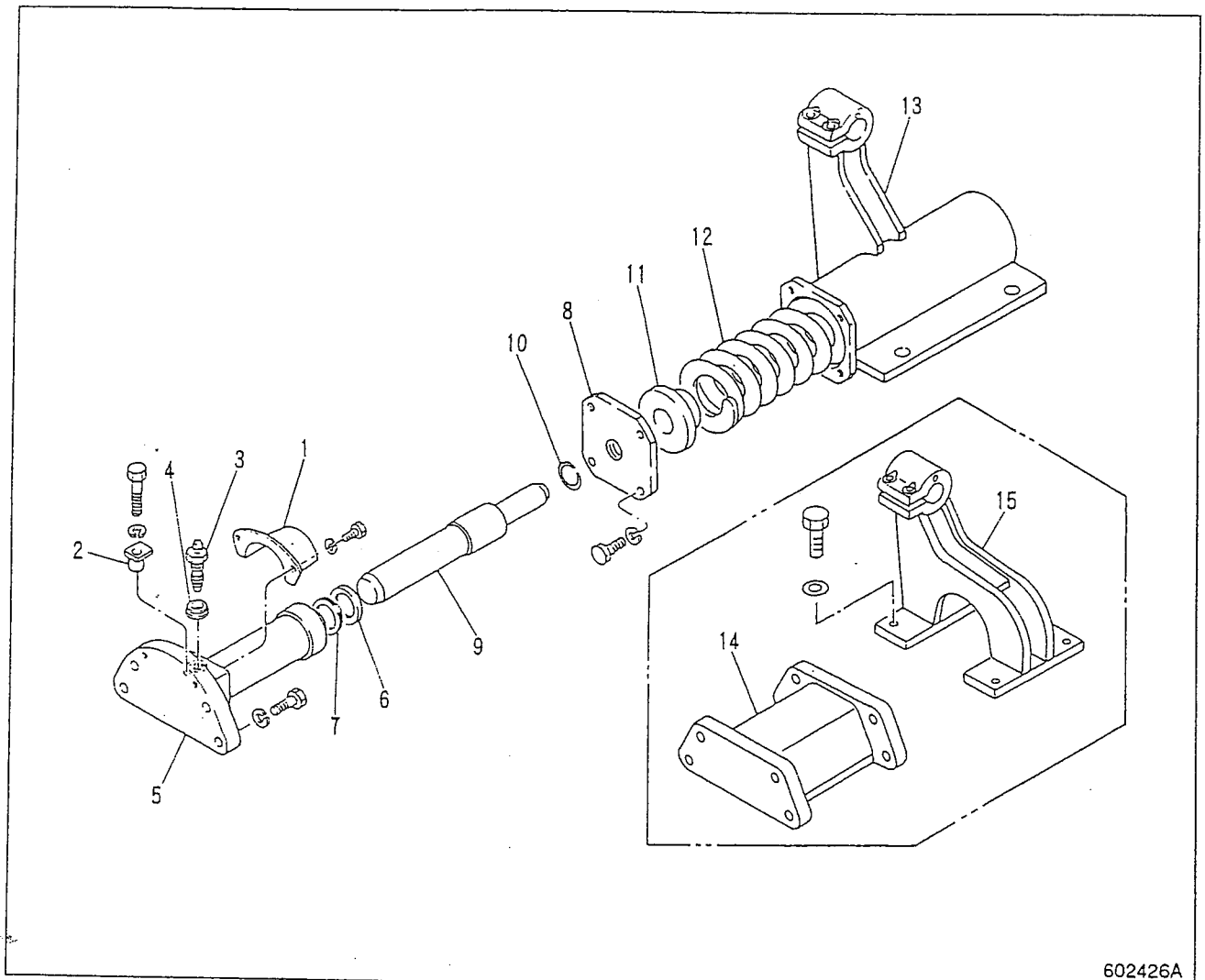
To install, follow the reverse of removal sequence.

## Adjustment after installation

Adjust the tracks.

# DISASSEMBLY AND REASSEMBLY

## Disassembly



602426A

### Disassembly sequence

- |                                   |                    |                               |
|-----------------------------------|--------------------|-------------------------------|
| 1 Cover                           | 6 Dust seal        | 12 Spring                     |
| 2 Stopper                         | 7 Rod packing      | 13 Carrier roller bracket     |
| 3 Fill valve                      | 8 Plate            | 14 Bracket                    |
| 4 Washer                          | 9 Shaft            | (for ultra-super swamp model) |
| (Remove 5 thru 7 as an assembly.) | 10 Ring            | 15 Carrier roller bracket     |
| 5 Cylinder                        | 11 Spring retainer | (for ultra-super swamp model) |

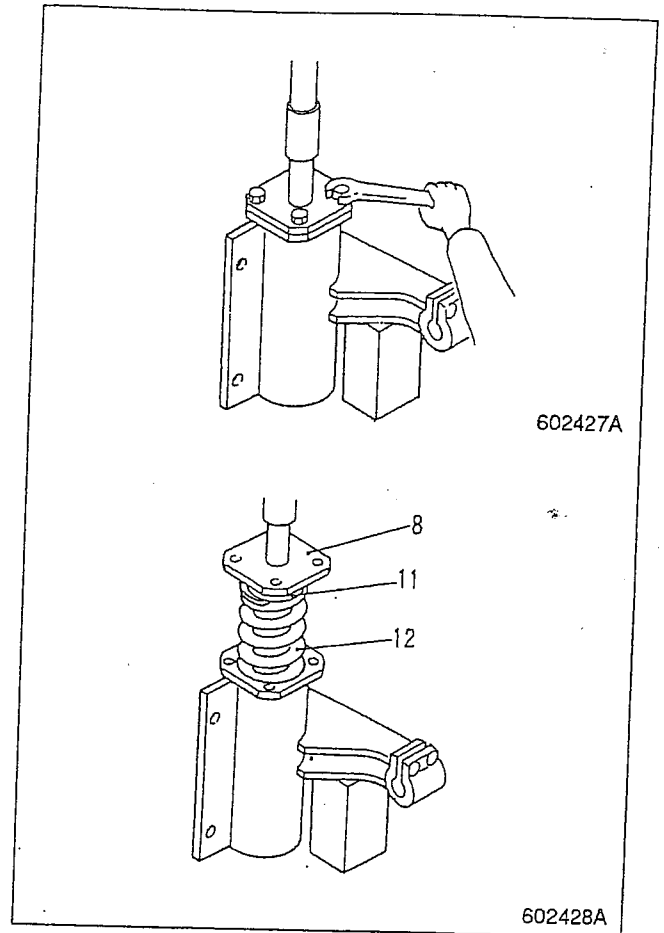


### Suggestions

To remove recoil spring 12, hold plate 8 with the arbor of a press having a capacity of at least 3 tons (7000 lb) as shown, unscrew four bolts, and gradually back off the press arbor to let the spring expand. Take out the plate, spring retainer 11 and spring.

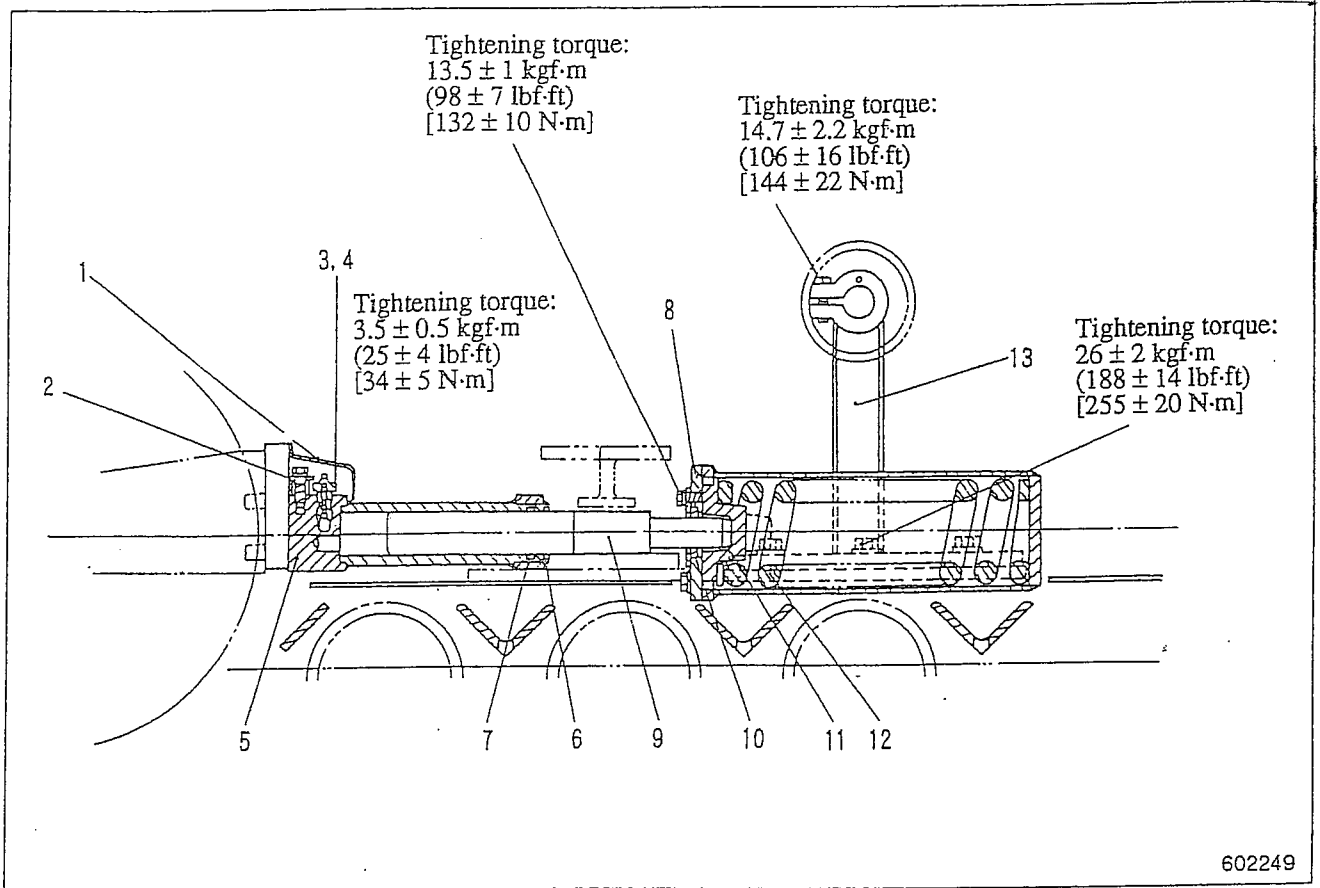
**! WARNING**

Never attempt to remove the recoil springs without using a press, or the cover, retainer and spring will fly out, resulting in a serious personal injury.

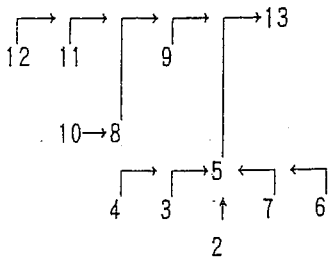


DISASSEMBLY AND REASSEMBLY

Reassembly



Reassembly sequence



Suggestion

Recoil spring installation

Compress spring 12 as in case of disassembly,  
 and install plate 8 to the spring.

## TRACK ROLLERS

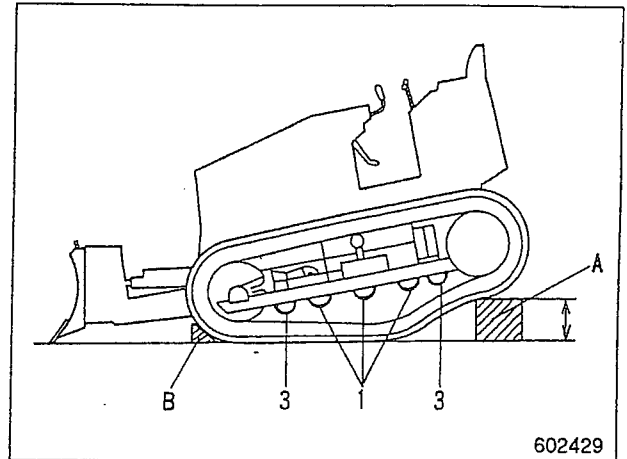
## Removal

Start by:

- (a) loosen the tracks (Refer to TRACKS, TESTING AND ADJUSTING.)
- (b) drain the oil from the track rollers

## Removal sequence

1. Place two wood blocks A of 300-mm (12-in.) square section behind the sprockets in a chocking manner, and move the machine to ride onto these blocks until the track rollers 1 and 3 float up and away from the track.
2. Chock the tracks at front end with blocks B.

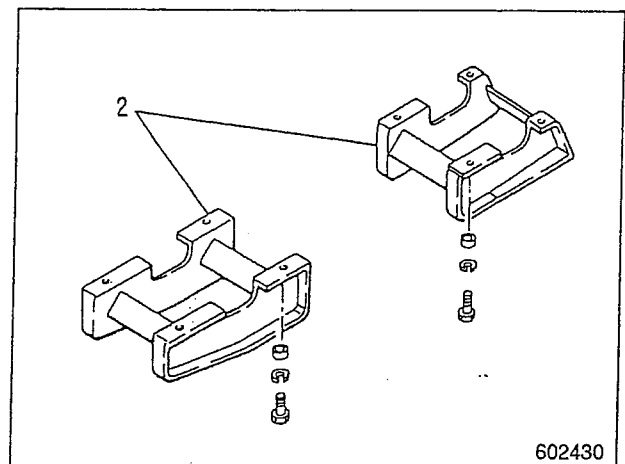


602429

## 3. Remove the following parts:

- 1 Track rollers (3 pcs, center)
- 2 Track roller guards (front and rear)
- 3 Track rollers (front and rear)

Weight of track roller (1 pc)	15 kg (33 lb), approx.
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602430

## Installation

To install, follow the reverse of removal sequence.

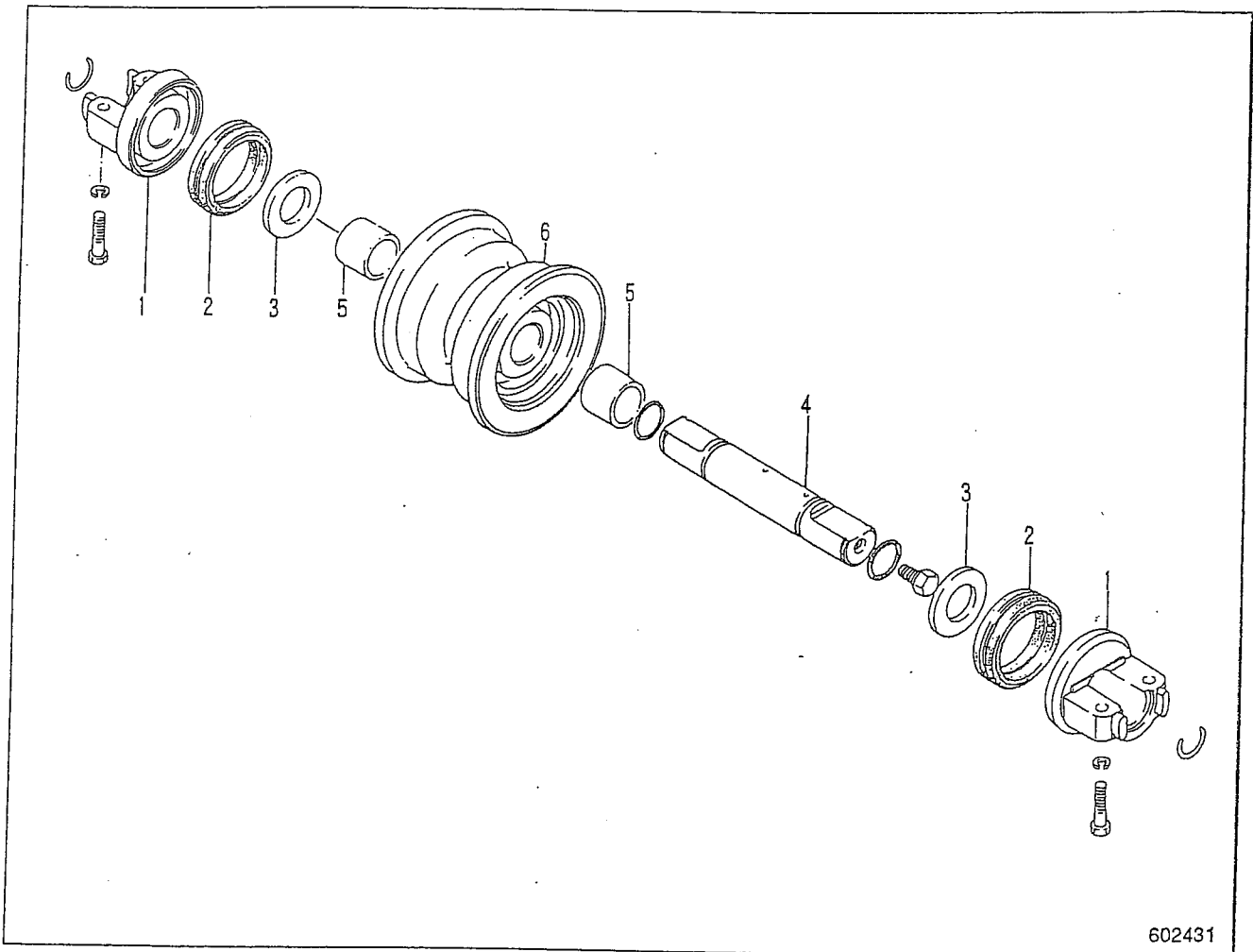
Tightening torque for track roller bolts	$6.0 \pm 0.5$ kgf·m ( $43 \pm 4$ lbf·ft) ( $58 \pm 5$ N·m)
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## Adjustment after installation

Remove the blocks and adjust the tracks.

# DISASSEMBLY AND REASSEMBLY

## Disassembly



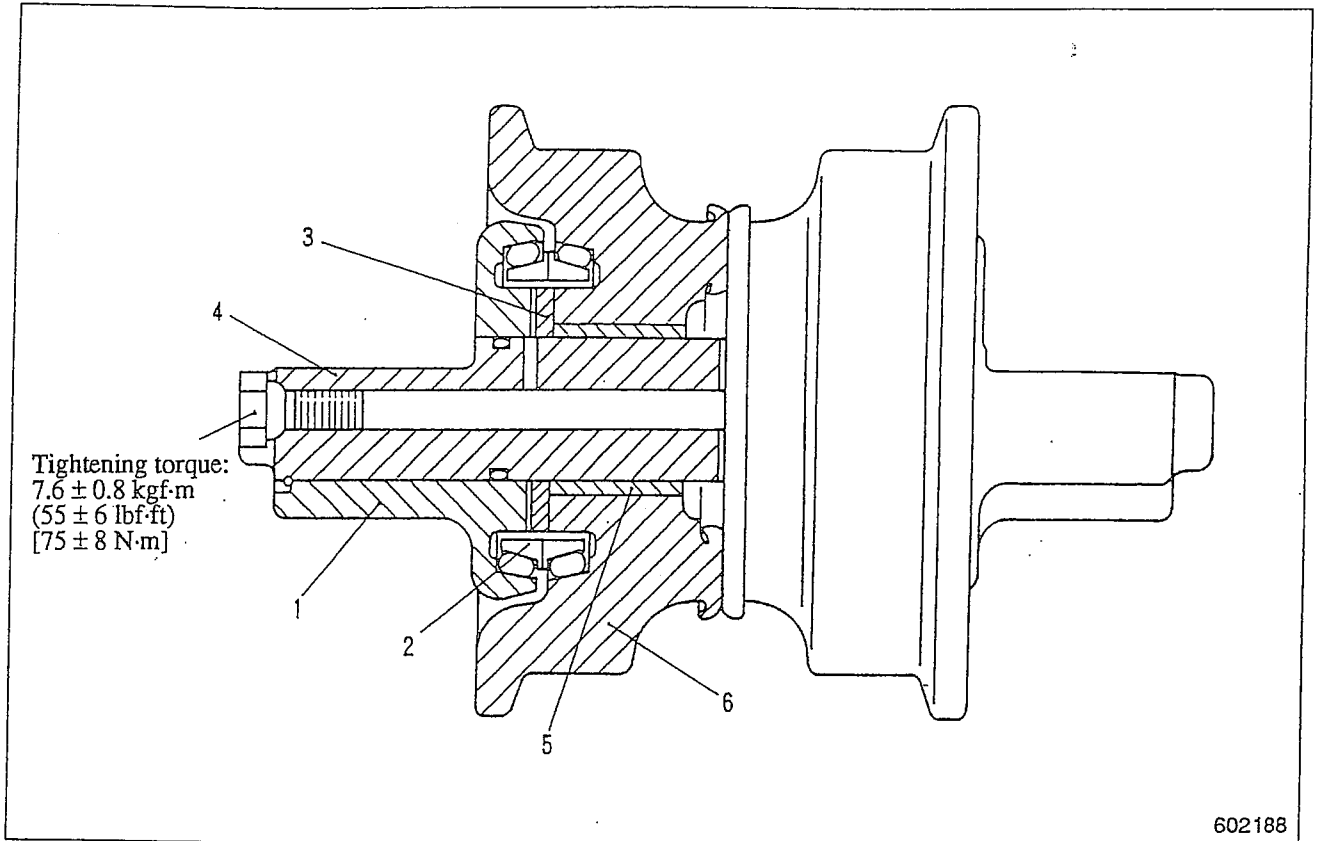
### Disassembly sequence

- 1 Collar
- 2 Floating seal

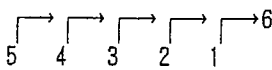
- 3 Thrust washer
- 4 Shaft

- 5 Bushing
- 6 Flanged roller

Reassembly



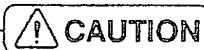
Reassembly sequence



Suggestions

1. Floating seal installation

- (1) When fitting the floating seals, use a properly sized round bar or the special tool to prevent damage to the seals and O-rings.



Never use a screwdriver or a sharp-edged tool to fit the floating seals.

- (2) Using a lint-free cloth or a brush and washing fluid, clean the surfaces of metal rings of floating seals, making sure that these rings are free of any grime.

2. Lubrication

- (1) After reassembling the roller, fill it with recommended oil through plug hole in the shaft.
- (2) Use an adaptor and volume pump for this filling.

Capacity, approx.	75 cc (4.6 cu in.) (SAE90 gear oil)
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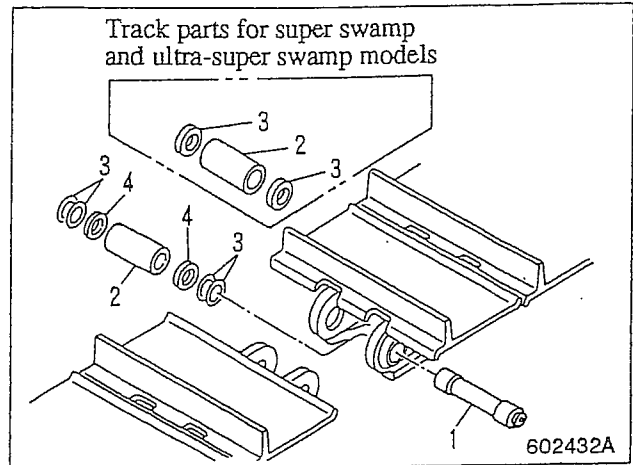
Part name	Part number
Adaptor	58809-15100
Volume pump	58309-03100

TRACKS

Removal

Removal sequence

1. Move the machine until the master pin comes to the upper part of sprocket.
2. Loosen the tracks. (Refer to TRACKS, TESTING AND ADJUSTING.)
3. Drive out master pin 1.
4. Remove bushing 2, seal washers 3 and spacers 4 (standard and swamp models). Remove bushing 2 and rubber seals 3 (super swamp and ultra-super swamp models).
5. Insert a bar into the link and, while holding the bar, move the machine slowly forward to lay out the track on the ground.
6. Raise the side of the machine, and remove the track.
7. After raising the side of the machine, place wood blocks under the rigid bar and steering clutch case.



Track weight

Unit: kg (lb)

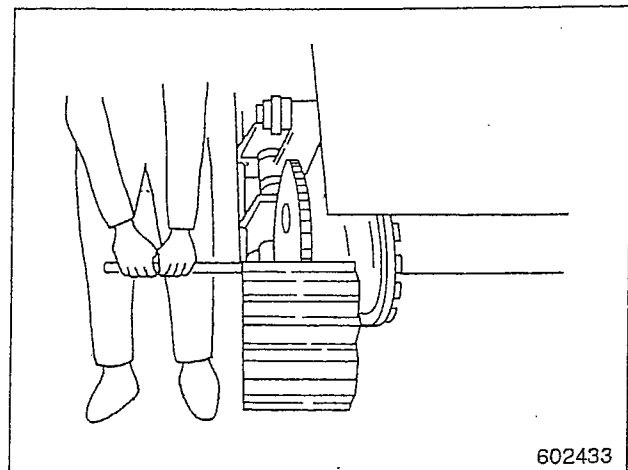
Standard model	BD2GII (P)	280 (620), approx.
	BS3GII (F)	310 (680), approx.
Swamp model (S)		420 (930), approx.
Super swamp model (SS)		470 (1040), approx.
Ultra-super swamp model (SSS)		600 (1320), approx.

Installation

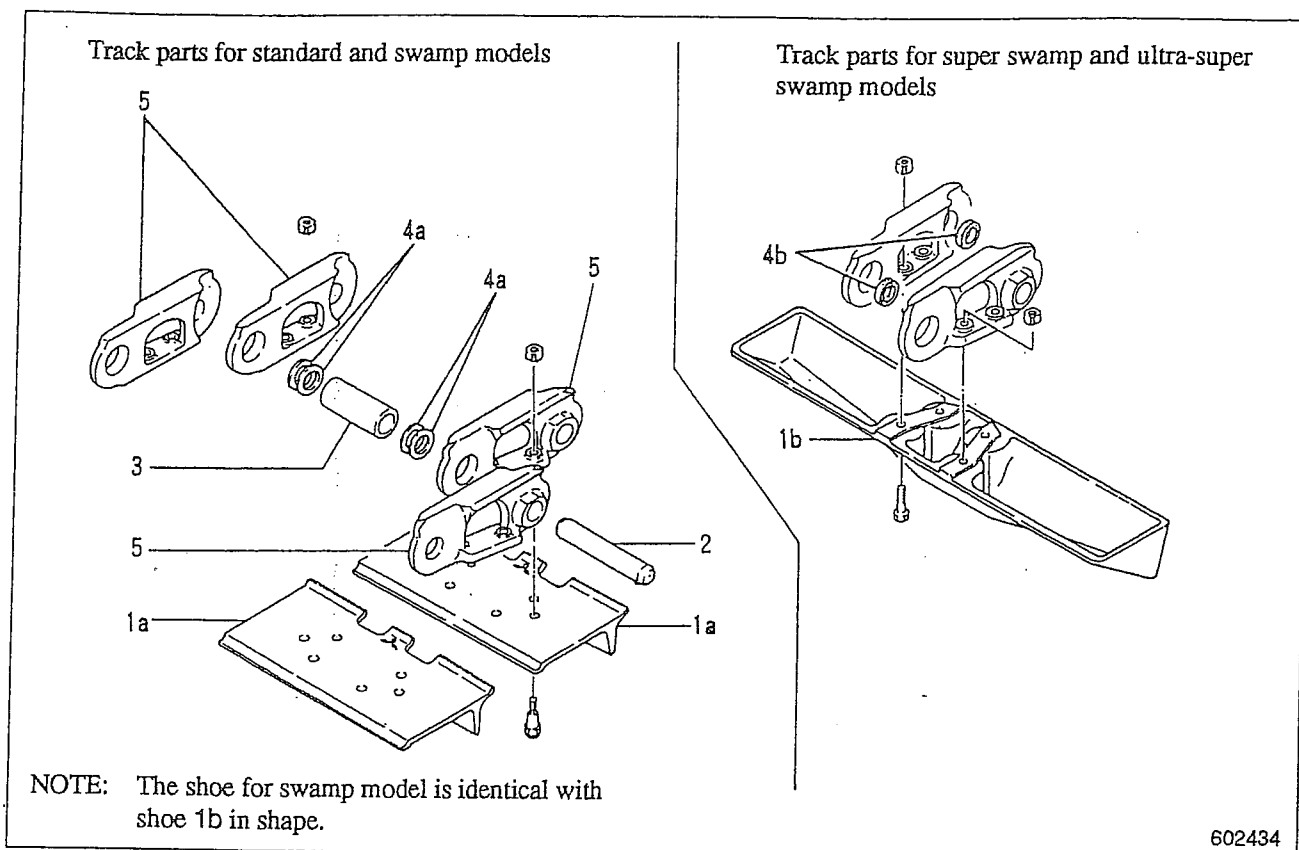
To install, follow the reverse of removal sequence.

Suggestions

1. Insert a bar into the link, and aid the track to climb over the sprocket, carrier roller and front idler, as the machine is moved slowly forward.
2. Install the seal washers properly. Drive in the master pin with its center hole outside. (For detail of seal washer installation, refer to Reassembly.)
3. To drive in the master pin, insert the guide bar, bushing, seal washers, etc. into the link, and drive in the pin in a manner of driving out the guide bar.



Disassembly



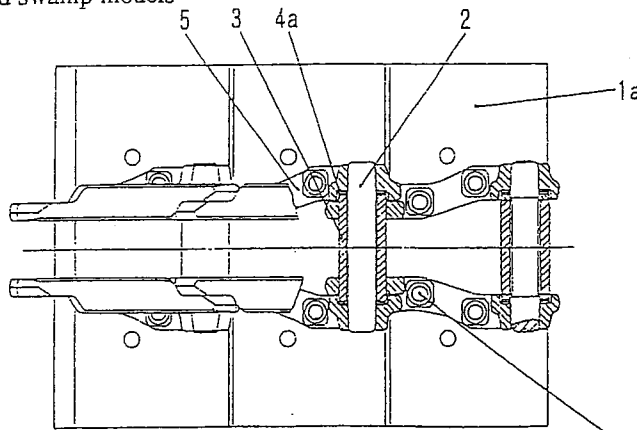
Disassembly sequence

- |   |   |
|---|---|
| 1a Standard shoe  | 4a Seal washer (for standard and swamp models)                |
| 1b Swamp/super swamp/ultra-super swamp shoe (curved apex shoe). | 4b Rubber seal (for super swamp and ultra-super swamp models) |
| 2 Pin   | 5 Link  |
| 3 Bushing   |   |

DISASSEMBLY AND REASSEMBLY

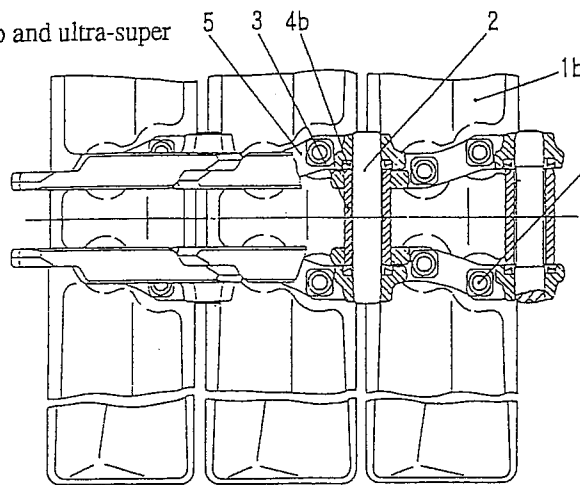
Reassembly

Track parts for standard and swamp models



602184

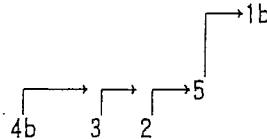
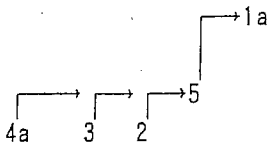
Track parts for super swamp and ultra-super swamp models



Tightening torque:  
17 to 20 kgf·m  
(123 to 145 lbf·ft)  
[167 to 196 N·m]

602185

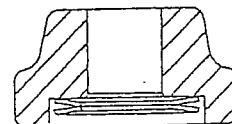
Reassembly sequence



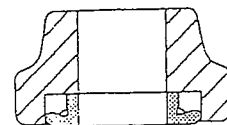
Suggestions

Install the seal washers and rubber seals as shown.

Seal washer  
(standard and  
swamp models)



Rubber seal  
(super swamp and  
ultra-super swamp  
models)



602435A



## TRACK CARRIER ROLLERS

## Removal

## Start by:

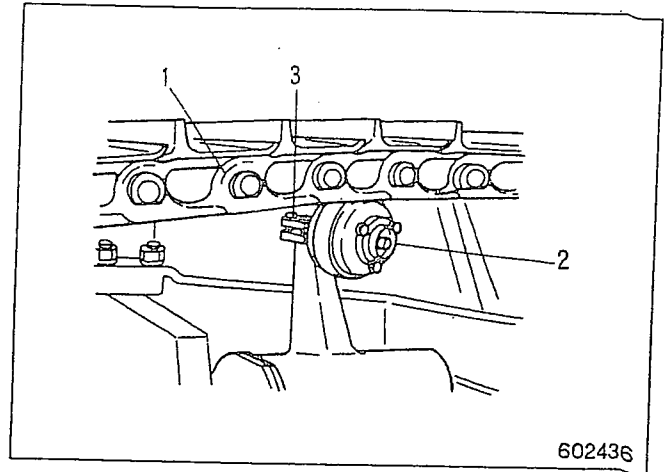
- (a) loosen the tracks (Refer to TRACKS, TESTING AND ADJUSTING.)
- (b) drain the oil from the track carrier rollers.

## Removal sequence

Push up the track above the carrier roller to produce some clearance between track 1 and carrier roller 2, and remove the following parts:

- 1 Bolts (2 pcs)
- 2 Track carrier roller

Weight of track carrier roller	11 kg (24 lb), approx.
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602436

## Installation

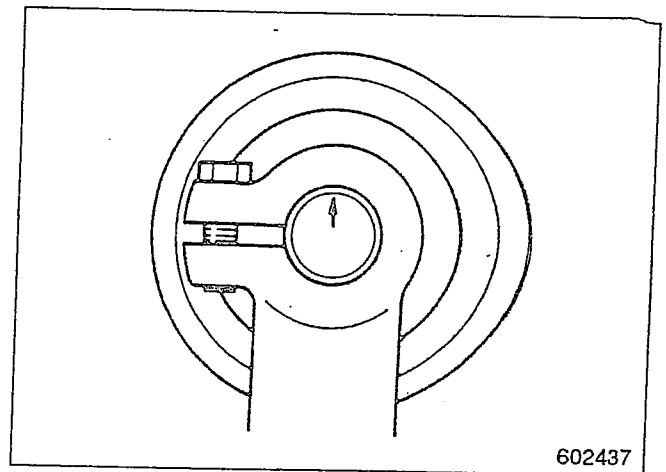
To install, follow the reverse of removal sequence.

## Suggestions

Insert the shaft into the bracket so that the arrow mark on one end points upward and the spring pin hole on the other comes to the top side.

## Adjusting after installation

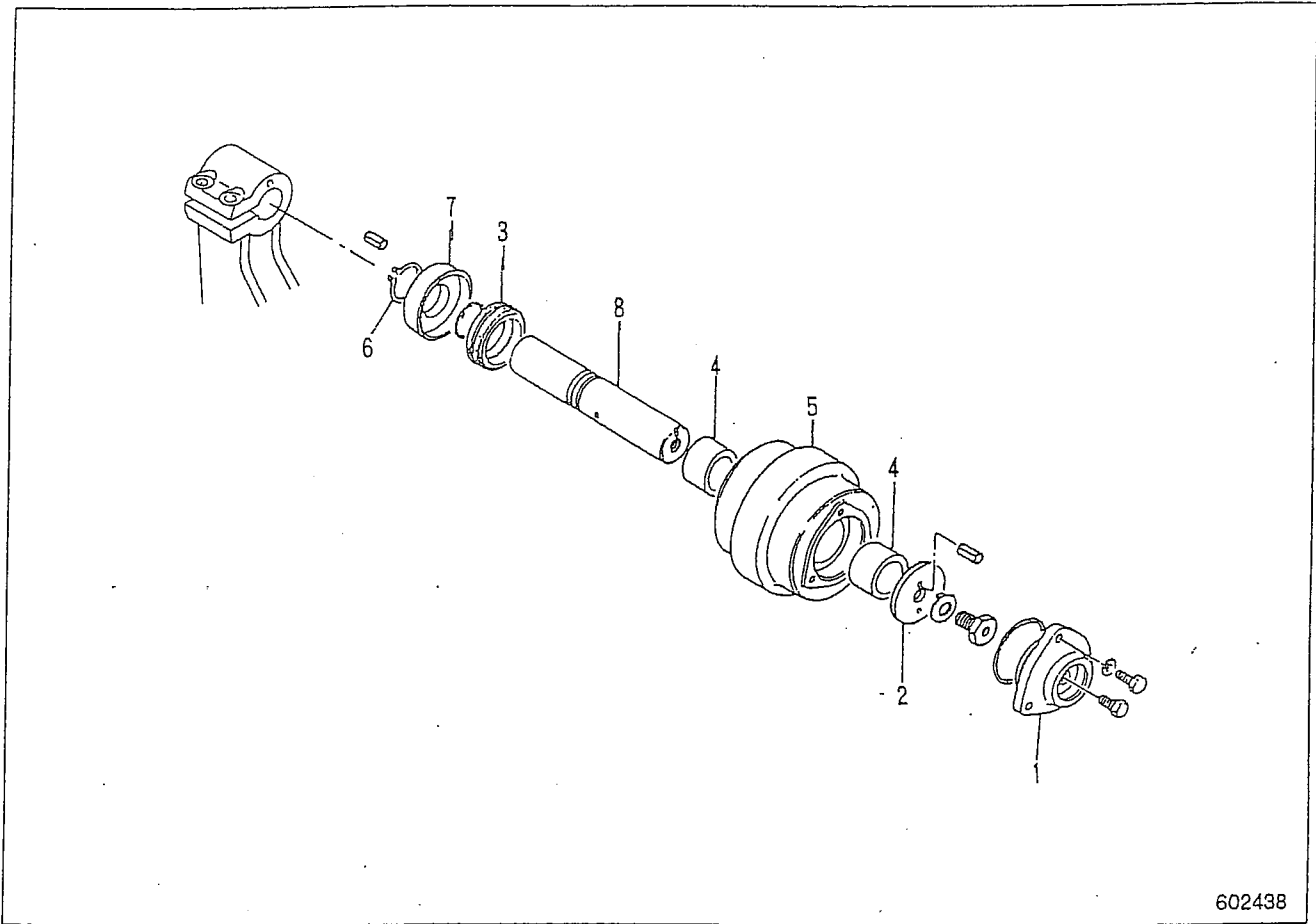
Adjust the tracks. (Refer to TRACKS, TESTING AND ADJUSTING.)



602437

# DISASSEMBLY AND REASSEMBLY

## Disassembly

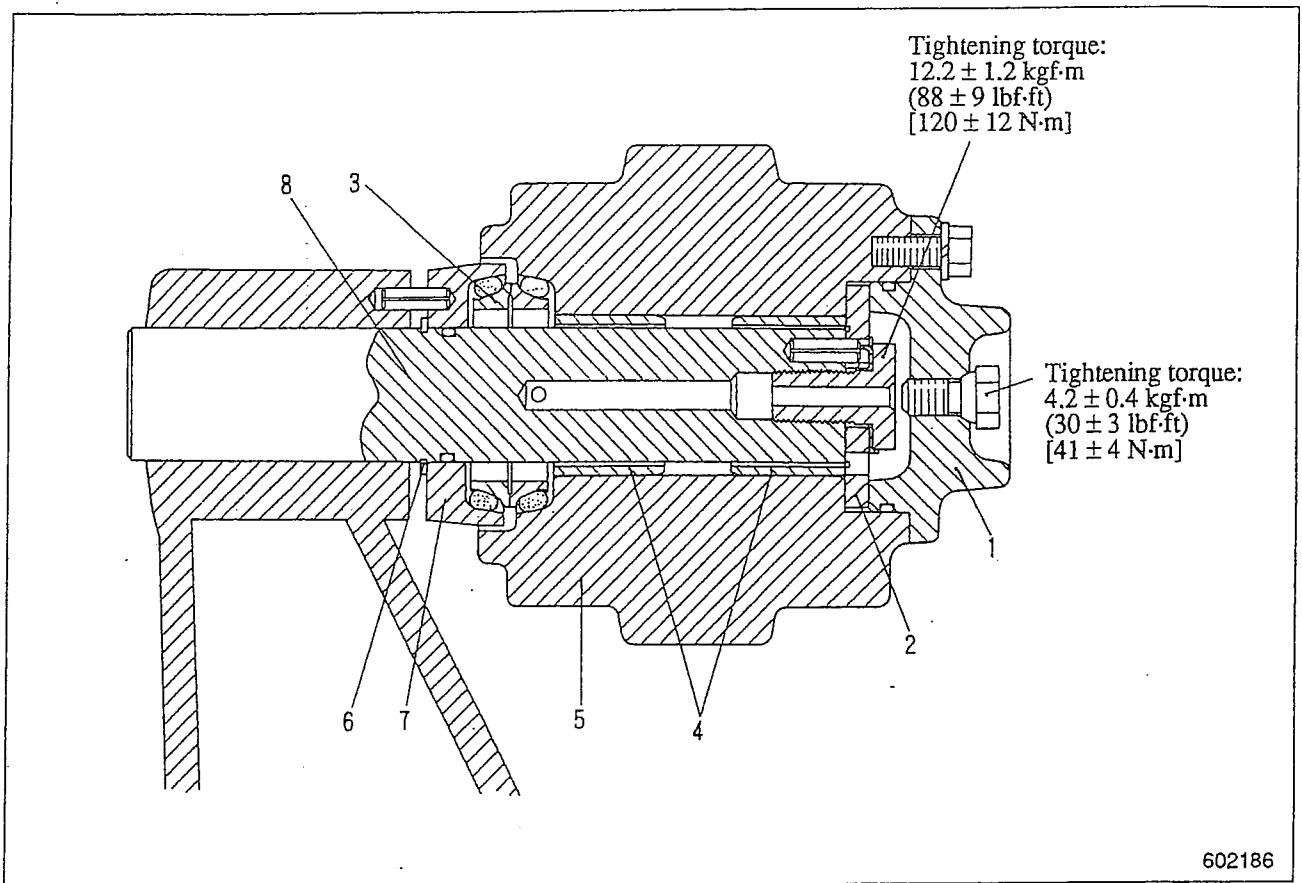


602438

## Disassembly sequence

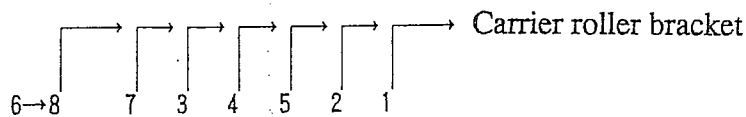
- |                                   |               |   |              |
|-----------------------------------|---------------|---|--------------|
| 1                                 | Cover         | 5 | Roller       |
| 2                                 | Washer        | 6 | Snap ring    |
| (Remove 3 thru 5 as an assembly.) |               |   |              |
| 3                                 | Floating seal | 7 | Seal support |
| 4                                 | Bushing       | 8 | Shaft        |

Reassembly



602186

Reassembly sequence



Suggestions

Lubrication

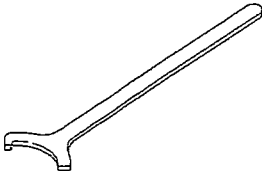
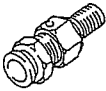
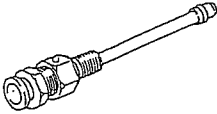
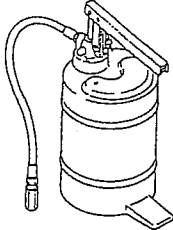
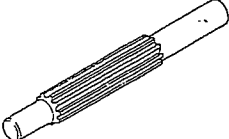
- (1) After reassembling the roller, fill it with recommended oil through plug hole in the cover.
- (2) Use an adaptor and volume pump for this filling.

Capacity, approx.	35 cc (2 cu in.) (SAE90 gear oil)
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Part name	Part number
Adaptor	58609-00300
Volume pump	58309-03100

DISASSEMBLY AND REASSEMBLY

SPECIAL TOOLS

Part number	Part name	Shape	Use
58809-10200	Wrench	 <p style="text-align: right;">602440</p>	Bevel gear adjustment
58609-00300	Adaptor	 <p style="text-align: right;">602441</p>	Carrier roller lubrication
58809-15100	Adaptor	 <p style="text-align: right;">602442</p>	Front idler and track roller lubrication
58309-03100	Volume pump	 <p style="text-align: right;">602443</p>	Carrier roller, front idler and track roller lubrication
58809-15600	Clutch disc arbor	 <p style="text-align: right;">602444</p>	Flywheel clutch installation [DD] (clutch disc assembly aligning)



