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## SAFETY ALERT SYMBOL

**Be Prepared - Get to Know All Operating and Safety Instructions**

**This is the Safety Alert Symbol. Wherever it appears - in this manual or on safety signs on the machine - you should be alert to potential for personal injury or accidents. Always observe safety precautions and follow recommended procedures.**

### **LEARN SIGNAL WORDS USED WITH SAFETY ALERT SYMBOL**

Words "**CAUTION**," "**WARNING**," and "**DANGER**" used throughout this manual and on labels on machine indicate hazards or unsafe practices. All three statements indicate that safety is involved. Observe precautions indicated whenever you see the Safety Alert "Triangle," no matter which signal word appears next to the "Exclamation Point" symbol.

## CAUTION!

**This word is used on safety messages and safety labels and indicates potential of a hazardous situation that, if not avoided, could result in minor or moderate injury. It may also be used to alert against a generally unsafe practice.**

## WARNING!

**This word is used on safety messages and safety labels and indicates potential of a hazardous situation that, if not avoided, could result in serious injury or death. It may also be used to alert against a highly unsafe practice.**

## DANGER!

**This word is used on safety messages and safety labels and indicates imminent hazard of a situation that, if not avoided, is very likely to cause death or extremely serious injury. It may also be used to alert against equipment that may explode or detonate if handled or treated carelessly.**

Safety precautions are described in SAFETY from page 6 on.

DISD cannot predict every circumstance that might involve a potential hazard in operation and maintenance. Therefore the safety messages in this manual and on the machine may not include all possible safety precautions. If any procedures or actions not specifically recommended or allowed in this manual are used, you must be sure that you and others can do such procedures and actions safely and without damaging the machine. If your unsure about the safety of some procedures, contact a DISD distributor.

## PRECAUTIONS WITH HIGH PRESSURE LINE, TUBES AND HOSES

When inspecting or replacing high-pressure piping or hoses, check that the pressure has been released from the circuit. Failure to release the pressure may lead to serious injury. Always do the following;

- Wear protective glasses and leather gloves.
- Fluid leaks from hydraulic hoses or pressurized components can be difficult to see but pressurized oil has enough force to pierce the skin and cause serious injury. Always use a piece of wood or cardboard to check for suspected hydraulic leaks. Never use your hands or expose your fingers.
- Do not bend high pressure lines. Do not strike high pressure lines. Do not install lines, tubes or hoses that are bent or damaged.
- Make sure that all clamps, guards and heat shields are installed correctly to prevent vibration, rubbing against other parts, and excessive heat during operation.
  - If any of the following conditions are found, replace the part.
  - Damage or leakage from hose end.
  - Wear, damage, cutting of covering, or exposure of strengthening wire layer.
  - Cover portion is swollen in places.
  - There is twisting or crushing at movable parts of hose.
  - Foreign material is embedded in the covering.
  - Hose end is deformed.

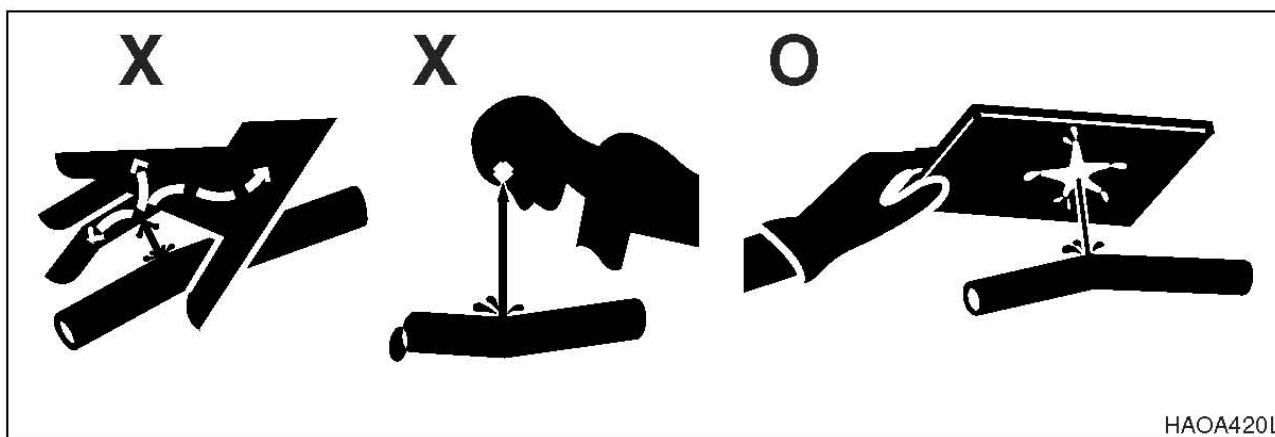


Figure 29

**OBTAIN IMMEDIATE MEDICAL ATTENTION IF PRESSURIZED OIL PIERCES SKIN.**

### **⚠ WARNING!**

**Failure to obtain prompt medical assistance could result in gangrene or other serious damage to tissue.**

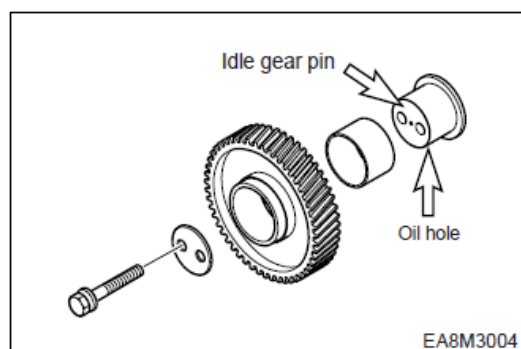
# TORQUE VALUES FOR STANDARD METRIC FASTENERS

**NOTE:** The units for the torque values are kg•m (ft lb).

| Dia. x<br>Pitch (mm) | Grade             |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |
|----------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--------------------|
|                      | 3.6<br>(4A)       | 4.6<br>(4D)       | 4.8<br>(4S)       | 5.6<br>(5D)       | 5.8<br>(5S)       | 6.6<br>(6D)       | 6.8<br>(6S)       | 6.9<br>(6G)       | 8.8<br>(8G)       | 10.9<br>(10K)     | 12.9<br>(12K)      |
| M5 x Std.            | 0.15<br>(1.08)    | 0.16<br>(1.15)    | 0.25<br>(1.80)    | 0.22<br>(1.59)    | 0.31<br>(2.24)    | 0.28<br>(2.02)    | 0.43<br>(3.11)    | 0.48<br>(3.47)    | 0.50<br>(3.61)    | 0.75<br>(5.42)    | 0.90<br>(6.50)     |
| M6 x Std.            | 0.28<br>(2.02)    | 0.30<br>(2.16)    | 0.55<br>(3.25)    | 0.40<br>(2.89)    | 0.55<br>(3.97)    | 0.47<br>(3.39)    | 0.77<br>(5.56)    | 0.85<br>(6.14)    | 0.90<br>(6.50)    | 1.25<br>(9.04)    | 1.50<br>(10.84)    |
| M7 x Std.            | 0.43<br>(3.11)    | 0.46<br>(3.32)    | 0.70<br>(5.06)    | 0.63<br>(4.55)    | 0.83<br>(6.00)    | 0.78<br>(5.64)    | 1.20<br>(8.67)    | 1.30<br>(9.40)    | 1.40<br>(10.12)   | 1.95<br>(14.10)   | 2.35<br>(17.99)    |
| M8 x Std.            | 0.70<br>(5.06)    | 0.75<br>(5.42)    | 1.10<br>(7.95)    | 1.00<br>(7.23)    | 1.40<br>(10.12)   | 1.25<br>(9.04)    | 1.90<br>(13.74)   | 2.10<br>(15.18)   | 2.20<br>(15.91)   | 3.10<br>(22.42)   | 3.80<br>(27.48)    |
| M8 x 1               | 0.73<br>(5.28)    | 0.80<br>(5.78)    | 1.20<br>(8.67)    | 1.00<br>(7.23)    | 1.50<br>(10.84)   | 1.35<br>(9.76)    | 2.10<br>(15.18)   | 2.30<br>(16.63)   | 2.40<br>(17.35)   | 3.35<br>(24.23)   | 4.10<br>(29.65)    |
| M10 x Std.           | 1.35<br>(9.76)    | 1.40<br>(10.12)   | 2.20<br>(15.91)   | 1.90<br>(13.74)   | 2.70<br>(19.52)   | 2.35<br>(19.99)   | 3.70<br>(26.76)   | 4.20<br>(30.37)   | 4.40<br>(31.18)   | 6.20<br>(44.84)   | 7.20<br>(52.07)    |
| M10 x 1              | 1.50<br>(10.84)   | 1.60<br>(11.57)   | 2.50<br>(18.08)   | 2.10<br>(15.18)   | 3.10<br>(22.42)   | 2.80<br>(20.25)   | 4.30<br>(31.10)   | 4.90<br>(35.44)   | 5.00<br>(36.16)   | 7.00<br>(50.63)   | 8.40<br>(60.75)    |
| M12 x Std.           | 2.40<br>(17.35)   | 2.50<br>(18.08)   | 3.70<br>(26.76)   | 3.30<br>(23.86)   | 4.70<br>(33.99)   | 4.20<br>(30.37)   | 6.30<br>(45.56)   | 7.20<br>(52.07)   | 7.50<br>(54.24)   | 10.50<br>(75.94)  | 12.50<br>(90.41)   |
| M12 x 1.5            | 2.55<br>(18.44)   | 2.70<br>(19.52)   | 4.00<br>(28.93)   | 3.50<br>(25.31)   | 5.00<br>(36.16)   | 4.50<br>(32.54)   | 6.80<br>(49.18)   | 7.70<br>(55.69)   | 8.00<br>(57.86)   | 11.20<br>(81.00)  | 13.40<br>(96.92)   |
| M14 x Std.           | 3.70<br>(26.76)   | 3.90<br>(28.20)   | 6.00<br>(43.23)   | 5.20<br>(37.61)   | 7.50<br>(54.24)   | 7.00<br>(50.63)   | 10.00<br>(72.33)  | 11.50<br>(83.17)  | 12.00<br>(86.79)  | 17.00<br>(122.96) | 20.00<br>(144.66)  |
| M14 x 1.5            | 4.10<br>(29.65)   | 4.30<br>(31.10)   | 6.60<br>(47.73)   | 5.70<br>(41.22)   | 8.30<br>(60.03)   | 7.50<br>(54.24)   | 11.10<br>(80.28)  | 12.50<br>(90.41)  | 13.00<br>(94.02)  | 18.50<br>(133.81) | 22.00<br>(158.12)  |
| M16 x Std.           | 5.60<br>(40.50)   | 6.00<br>(43.39)   | 9.00<br>(65.09)   | 8.00<br>(57.86)   | 11.50<br>(83.17)  | 10.50<br>(75.94)  | 15.50<br>(112.11) | 17.90<br>(129.47) | 18.50<br>(133.81) | 26.00<br>(188.05) | 31.00<br>(224.22)  |
| M16 x 1.5            | 6.20<br>(44.84)   | 6.50<br>(47.01)   | 9.70<br>(70.16)   | 8.60<br>(62.20)   | 12.50<br>(90.41)  | 11.30<br>(81.73)  | 17.00<br>(122.96) | 19.50<br>(141.04) | 20.00<br>(144.66) | 28.00<br>(202.52) | 35.50<br>(256.77)  |
| M18 x Std.           | 7.80<br>(56.41)   | 8.30<br>(60.03)   | 12.50<br>(90.41)  | 11.00<br>(79.56)  | 16.00<br>(115.72) | 14.50<br>(104.87) | 21.00<br>(151.89) | 27.50<br>(198.90) | 28.50<br>(206.14) | 41.00<br>(296.55) | 43.00<br>(311.01)  |
| M18 x 1.5            | 9.10<br>(65.82)   | 9.50<br>(68.71)   | 14.40<br>(104.15) | 12.50<br>(90.41)  | 18.50<br>(133.81) | 16.70<br>(120.79) | 24.50<br>(177.20) | 27.50<br>(198.90) | 28.50<br>(206.14) | 41.00<br>(296.55) | 49.00<br>(354.41)  |
| M20 x Std.           | 11.50<br>(83.17)  | 12.00<br>(86.79)  | 20.50<br>(148.27) | 18.00<br>(130.19) | 25.00<br>(180.82) | 22.50<br>(162.74) | 35.00<br>(253.15) | 39.50<br>(285.70) | 41.00<br>(296.55) | 58.00<br>(419.51) | 68.00<br>(491.84)  |
| M20 x 1.5            | 12.80<br>(92.58)  | 13.50<br>(97.64)  | 20.50<br>(148.27) | 18.00<br>(130.19) | 25.00<br>(180.82) | 22.50<br>(162.74) | 35.00<br>(253.15) | 39.50<br>(285.70) | 41.00<br>(296.55) | 58.00<br>(419.51) | 68.00<br>(491.84)  |
| M22 x Std.           | 15.50<br>(112.11) | 16.00<br>(115.72) | 24.50<br>(177.20) | 21.00<br>(151.89) | 30.00<br>(216.99) | 26.00<br>(188.05) | 42.00<br>(303.78) | 46.00<br>(332.71) | 49.00<br>(354.41) | 67.00<br>(484.61) | 75.00<br>(542.47)  |
| M22 x 1.5            | 17.00<br>(122.96) | 18.50<br>(133.81) | 28.00<br>(202.52) | 24.00<br>(173.59) | 34.00<br>(245.92) | 29.00<br>(209.75) | 47.00<br>(339.95) | 52.00<br>(44.76)  | 56.00<br>(405.04) | 75.00<br>(542.47) | 85.00<br>(614.80)  |
| M24 x Std.           | 20.50<br>(148.27) | 21.50<br>(155.50) | 33.00<br>(238.68) | 27.00<br>(195.29) | 40.00<br>(289.32) | 34.00<br>(245.92) | 55.00<br>(397.81) | 58.00<br>(419.51) | 63.00<br>(455.67) | 82.00<br>(593.10) | 92.00<br>(655.43)  |
| M24 x 1.5            | 23.00<br>(166.35) | 35.00<br>(253.15) | 37.00<br>(267.62) | 31.00<br>(224.22) | 45.00<br>(325.48) | 38.00<br>(202.52) | 61.00<br>(441.21) | 67.00<br>(484.61) | 74.00<br>(535.24) | 93.00<br>(672.66) | 103.00<br>(744.99) |

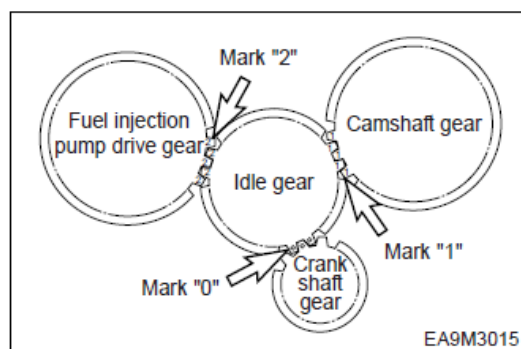
| Condition                            | Causes  | Remedies   |
|--------------------------------------|---|--|
| 5) Engine noisy                      | For noises arise compositely such as rotating parts, lapping parts etc., there is necessity to search the cause of noises accurately.   |  |
| (1) Crankshaft                       | <ul style="list-style-type: none"> <li>As the wear of bearing or crankshaft progress, the oil clearances increase.</li> <li>Lopsided wear of crankshaft</li> <li>Oil supply insufficient due to oil passage clogging</li> <li>Stuck bearing</li> </ul>  | Replace bearing & grind crankshaft<br>Grind or replace<br>Clean oil passage<br>Replace bearing & Grind   |
| (2) Con rod and Con rod bearing      | <ul style="list-style-type: none"> <li>Lopsided wear of con rod bearing</li> <li>Lopsided wear of crank pin</li> <li>Connecting rod distortion</li> <li>Stuck bearing</li> <li>Oil supply insufficiency as clogging at oil passage progresses</li> </ul>  | Replace bearing<br>Grind crankshaft<br>Repair or replace<br>Replace & grind crankshaft<br>Clean oil passage  |
| (3) Piston, piston pin & piston ring | <ul style="list-style-type: none"> <li>Piston clearance increase as the wear of piston and piston ring progresses</li> <li>Wear of piston or piston pin</li> <li>Piston stuck</li> <li>Piston insertion poor</li> <li>Piston ring damaged</li> </ul>  | Replace piston & piston ring<br>Replace<br>Replace piston<br>Replace piston<br>Replace piston  |
| (4) Others                           | <ul style="list-style-type: none"> <li>Wear of crankshaft, thrust bearing</li> <li>Camshaft end play increased</li> <li>Idle gear end play increased</li> <li>Timing gear backlash excessive</li> <li>Valve clearance excessive</li> <li>Abnormal wear of tappet, cam</li> <li>Turbocharger inner part damaged</li> </ul>   | Replace thrust bearing<br>Replace thrust plate<br>Replace thrust washer<br>Repair or replace<br>Adjust valve clearance<br>Replace tappet, cam<br>Repair or replace |
| 6) Fuel Consumption Excessive        | <ul style="list-style-type: none"> <li>Injection timing incorrect</li> <li>Fuel injection amount excessive</li> </ul>   | Adjust<br>Adjust injection pump  |
| 7) Oil Consumption Excessive         |   |  |
| (1) Oil level elevated               | <ul style="list-style-type: none"> <li>Clearance between cylinder liner &amp; piston</li> <li>Wear of piston ring, ring groove</li> <li>Piston ring's damage, stick, wear</li> <li>Piston ring opening's disposition improper</li> <li>Piston skirt part damaged or abnormal wear</li> <li>Oil ring's oil return hole clogged</li> <li>Oil ring's contact poor</li> </ul> | Replace<br>Replace piston, piston ring<br>Replace piston ring<br>Correct position<br>Replace piston<br>Replace piston ring<br>Replace piston ring                  |
| (2) Oil level lowered                | <ul style="list-style-type: none"> <li>Looseness of valve stem &amp; guide</li> <li>Wear of valve stem seal</li> <li>Cylinder head gasket's leak</li> </ul>   | Replace in set<br>Replace seal<br>Replace gasket   |
| (3) Oil leak                         | <ul style="list-style-type: none"> <li>Looseness of connection parts</li> <li>Various parts' packing poor</li> <li>Oil seal poor</li> </ul>   | Replace gasket, repair<br>Replace packing<br>Replace oil seal  |

- With the oil port on the idle gear pin facing the cylinder block, install the idle gear pin.
- Idler gear pin with oil hole is assembled toward cylinder block.



- Install the idle gear by coinciding the marks impressed on the crank gear, cam gear, fuel injection pump drive gear, and idle gear.
- Install a thrust washer on the idle gear and tighten to specified torque.

|               |                 |
|---------------|-----------------|
| <b>Torque</b> | <b>3.1 kg•m</b> |
|---------------|-----------------|

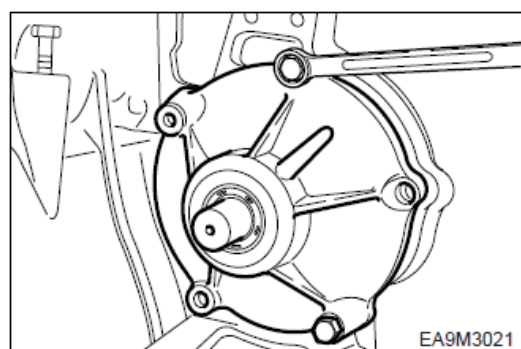


- Check and adjust the amount of backlash between gears using a feeler gauge.

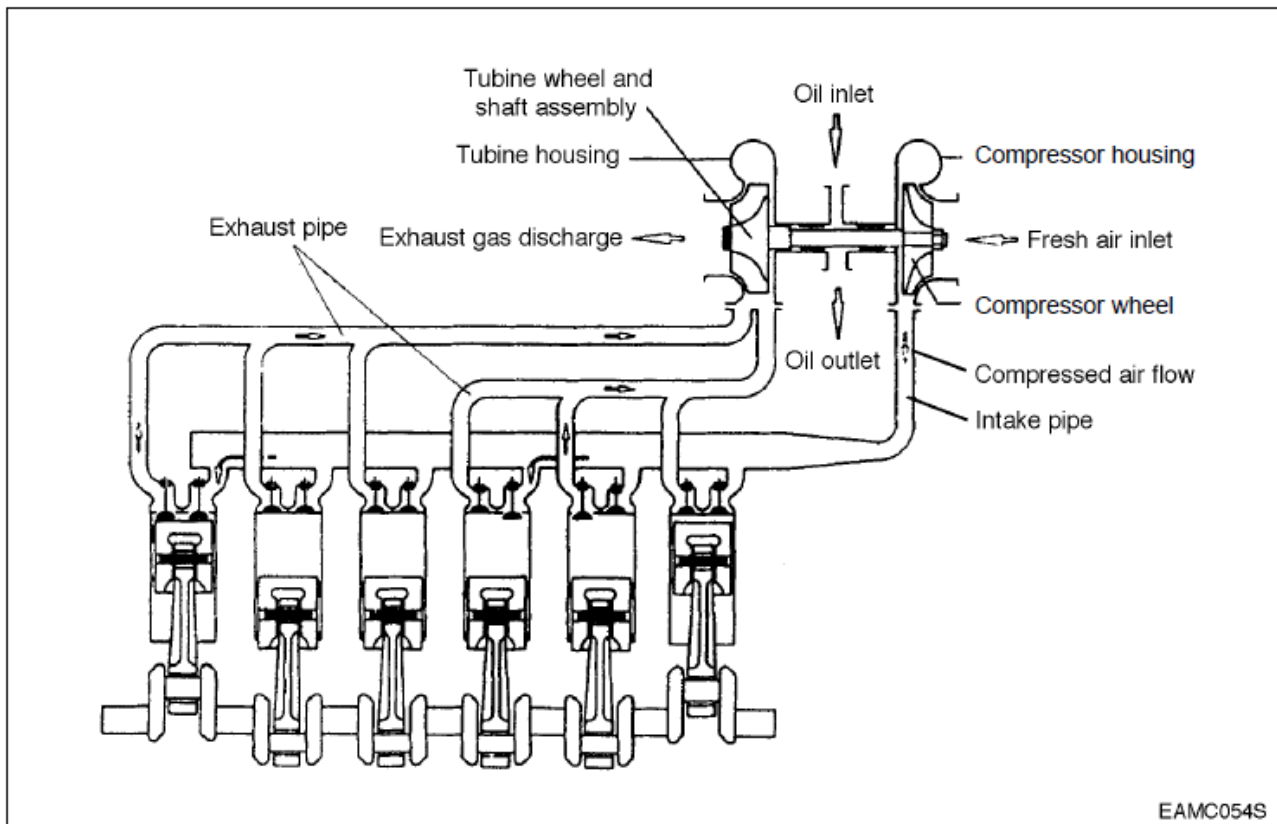
| Measuring position<br>(between) | Backlash       | Limit   |
|---------------------------------|----------------|---------|
| cam gear & idle gear            | 0.16 ~ 0.28 mm | 0.35 mm |
| crank gear & idle gear          | 0.16 ~ 0.28 mm | 0.35 mm |
| injection pump & idle gear      | 0.16 ~ 0.28 mm | 0.35 mm |

### 3.3.15 Injection pump flange

- After assembling the fuel injection pump gear to the idle gear, tighten the assembling bolts of the injection pump flange.
- Mount gasket by aligning the bolt holes with the pin holes on the bearing housing.
- Turning the flywheel, adjust the pointer to the position of the engraved scale.
- After adjusting the injection timing of fuel injection pump drive gear, tighten the fixing bolts in the direction of fuel injection pump.



### 3) Operating principle



The turbocharger is a system designed to make use of the engine exhaust gas energy to charge high-density air into the cylinders, thereby to increase the engine output.

#### 4.4.2 General descriptions

The engine output is determined by the fuel delivery volume and engine efficiency.

To burn the supplied fuel completely to change into effective power for the engine, the volume of air enough to burn the fuel completely should be supplied into the cylinders.

Therefore, the engine output is determined substantially by the cylinder capacity, and a greater volume of compressed air is charged into cylinders of given capacity, the greater engine output can be obtained as a greater volume of air charged into the cylinders burns so much more fuel.

As explained, the compressing of air to supply into the cylinders is called "Supercharging" and the making use of the energy of exhaust gas discharged from the combustion chamber to charge the compressed air into the cylinders is called "Turbocharging".

**Note:**

In the following Disassembly and Reassembly Instructions are three different gearbox control Variants treated.

## 1.1 Cast-iron gearbox control

## 1.2 Aluminium sand-casting gearbox control

## 1.3 Aluminium die-cast gearbox control with WK-Valve

## 1.2 Aluminium sand-casting gearbox control

With the help of the following Figures, the coordination of the single gearbox control variants can be visually identified because of the different casting contours!

## 1.1 Cast-iron gearbox control

Measuring points for pressure oil:

65 = Central measuring point for system pressure  
(control pressure)

53 = Clutch KV

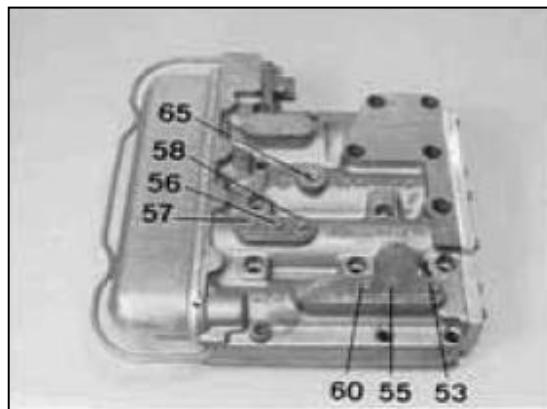
55 = Clutch KR

56 = Clutch K1

57 = Clutch K2

58 = Clutch K3

60 = Clutch K4



## 1.2 Aluminium sand-casting gearbox control

(e.g. 4 magnets)

Measuring points for pressure oil:

65 = Central measuring point for system pressure  
(control pressure)

53 = Clutch KV

55 = Clutch KR

(55) = Clutch KR (in case of 5-magnet Version)

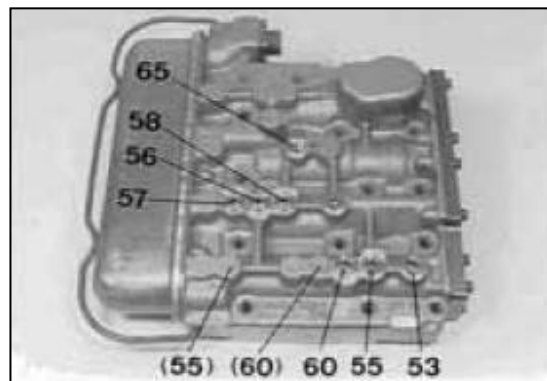
56 = Clutch K1

57 = Clutch K2

58 = Clutch K3

60 = Clutch K4

(60) = Clutch K4 (in case of 5-magnet Version)



## 1.3 Aluminium die-cast gearbox control

Measuring points for pressure oil:

65 = Central measuring point for system pressure  
(control pressure)

53 = Clutch KV

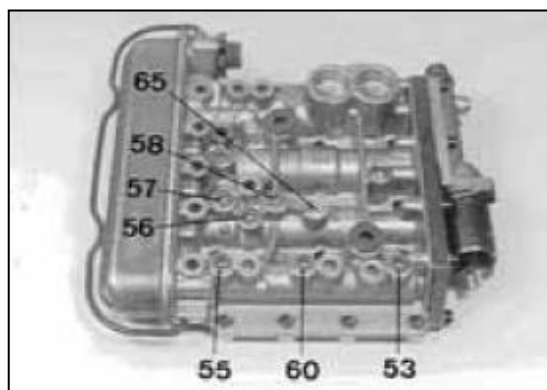
55 = Clutch KR

56 = Clutch K1

57 = Clutch K2

58 = Clutch K3

60 = Clutch K4



Furthermore, the single gearbox control units can include WK-Valve, 2-stage pressure control valve as well as 4, resp. 5 magnets (only for gearbox control 1.2).

Different steps resulting from this, can be carried out without great difficulty by qualified personnel, consulting the Perspective illustrations in the corresponding Spare Parts List!

SPC000007

Transmission and Torque Converter

Remove components, see Figure on the right !

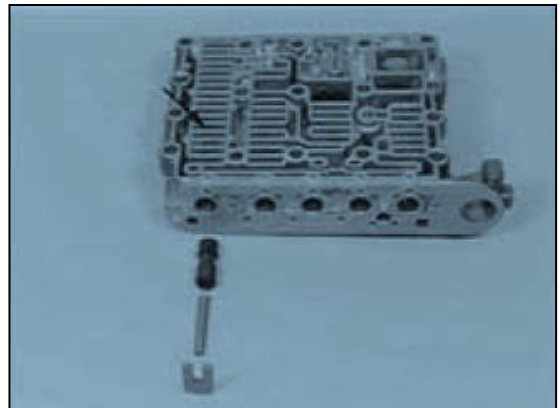


**Figure 107**

Remove stop plate and demount spring as well as spool.

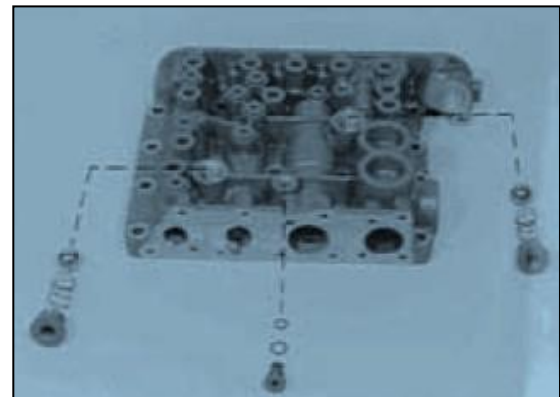
**NOTE :**

Installation position of the stop plate, see Arrow!



**Figure 108**

Remove diaphragm and check valves.



**Figure 109**

Loosen hex. head screws.



**Figure 5**

Tap loose and remove bearing cap.

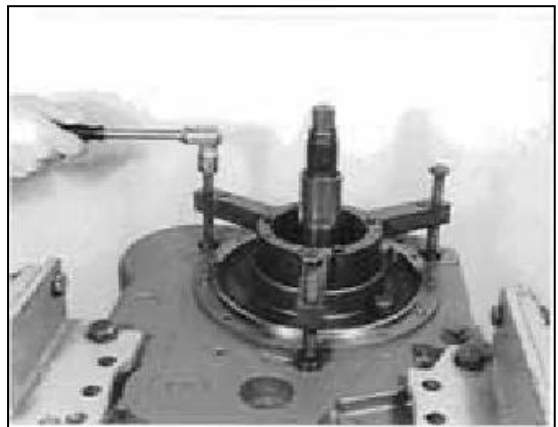


**Figure 6**

Fasten puller device at the oil supply flange by means of hex. head screws.

Pull converter charge pump and control pressure pump (complete) out of the housing bore.

(S) Back-off device 5870 000 062



**Figure 7**

Loosen hex. head screws and separate pump from oil supply flange.



**Figure 8**

Transmission and Torque Converter

SPC000007

### 3.2.6 Clutch KV/K1

#### NOTE :

The pre-assembly of the plate carrier KV/K1 has to be carried out accordingly like that of the plate carrier K4/K3, see Page 116 and 117.

#### ATTENTION ;

Pay attention to the different plate carriers, see Figure 148 and 169 !

#### 3.2.6.1 Plate pack KV

Install plate pack and check clearance.

#### NOTE :

Plate arrangement, see

Plate installation. Page 118 ... 122 !

#### 3.2.6.2 Pre-assembly and install spur gear KV

#### NOTE ;

According to the Transmission Version, resp. operating conditions, different spur gear bearings are possible, see corresponding Spare Parts List as well as Figures 184 and 185 !

Spur gear bearing KV, Version "A" (Fig. 184)

1 = Thrust plate

2 = Thrust washer

3 = Roller bearing

4 = Spur gear

5 = Plate

6 = Hex. head screws (M6/8.8 = 9,5 Nm)

7 = Shim (optional)

#### NOTE :

Secure hex. head screws (5) with Loctite (Type-No. 270) ! Pay attention to the installation position of the bearing inner races (oil grooves), see Arrows !

Spur gear bearing KV, Version "B" (Fig. 185)

1 = Thrust plate

2 = Disk

3 = Thrust washer

4 = Cylindrical rollers(short) (M6/8.8= 9,5 Nm)

5 = Disk

6 = Cylindrical rollers

7 = Thrust washer

8 = Spur gear

9 = Plate

10 = Hex.head screws

11 = Thrust washer

12 = Forked washer

#### NOTE :

Secure hex. head screws (10) with Loctite (Type-No. 270) !

Install long cylindrical rollers (according to the Version) on the converter side !



Figure 183

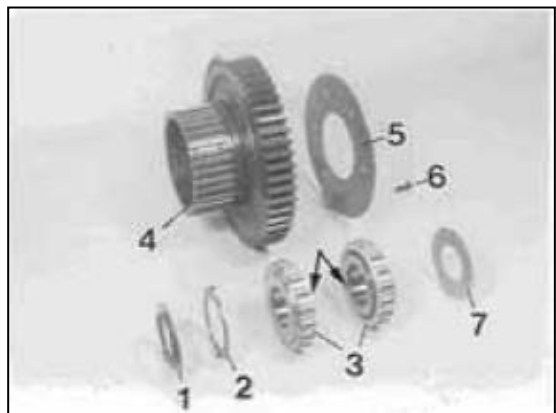


Figure 184

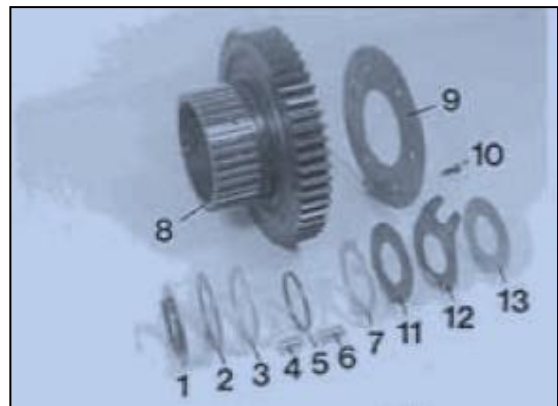


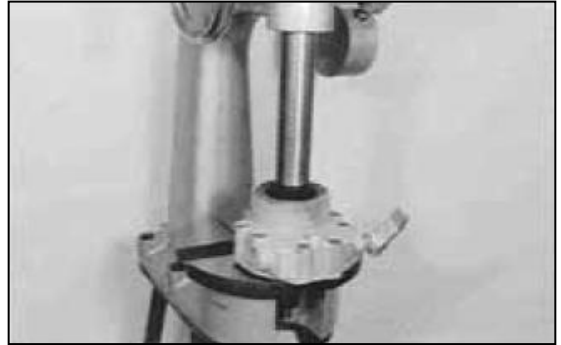
Figure 185

Pull sleeve from the output shaft.



**Figure 5**

Press output shaft out of the housing.

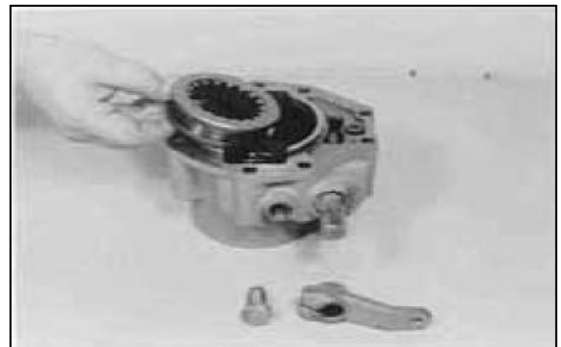


**Figure 6**

Demount locking screw and shift lever, and remove sliding collar.

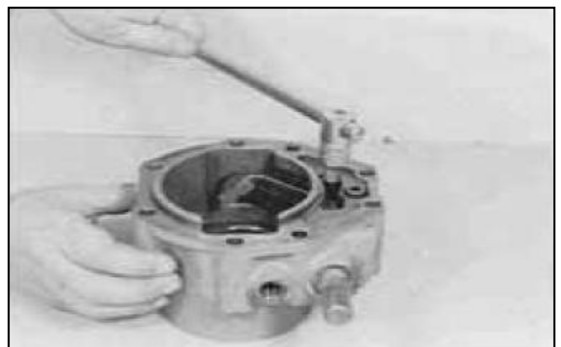
**NOTE :**

Mark the radial installation position of the shift lever !



**Figure 7**

Loosen the two set screws.



**Figure 8**

## Main drive assembly

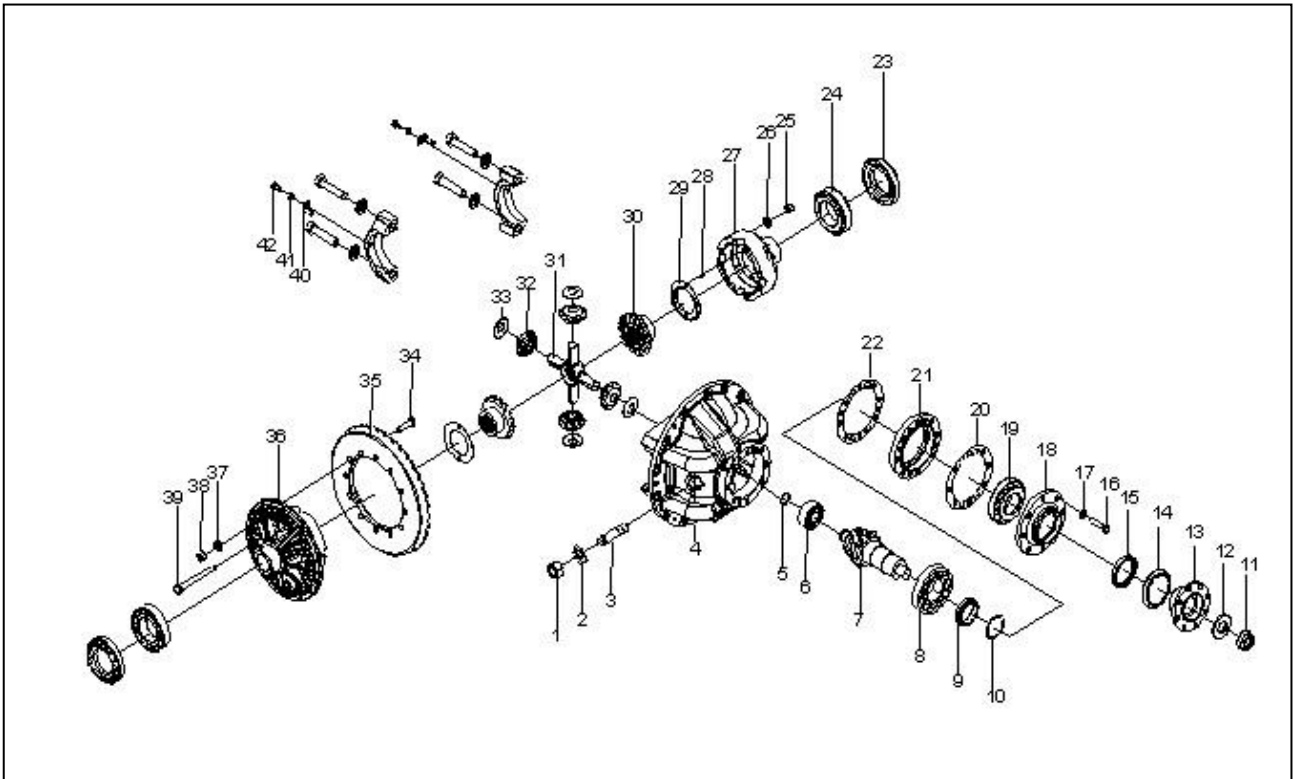


Figure 5

## Main drive assembly

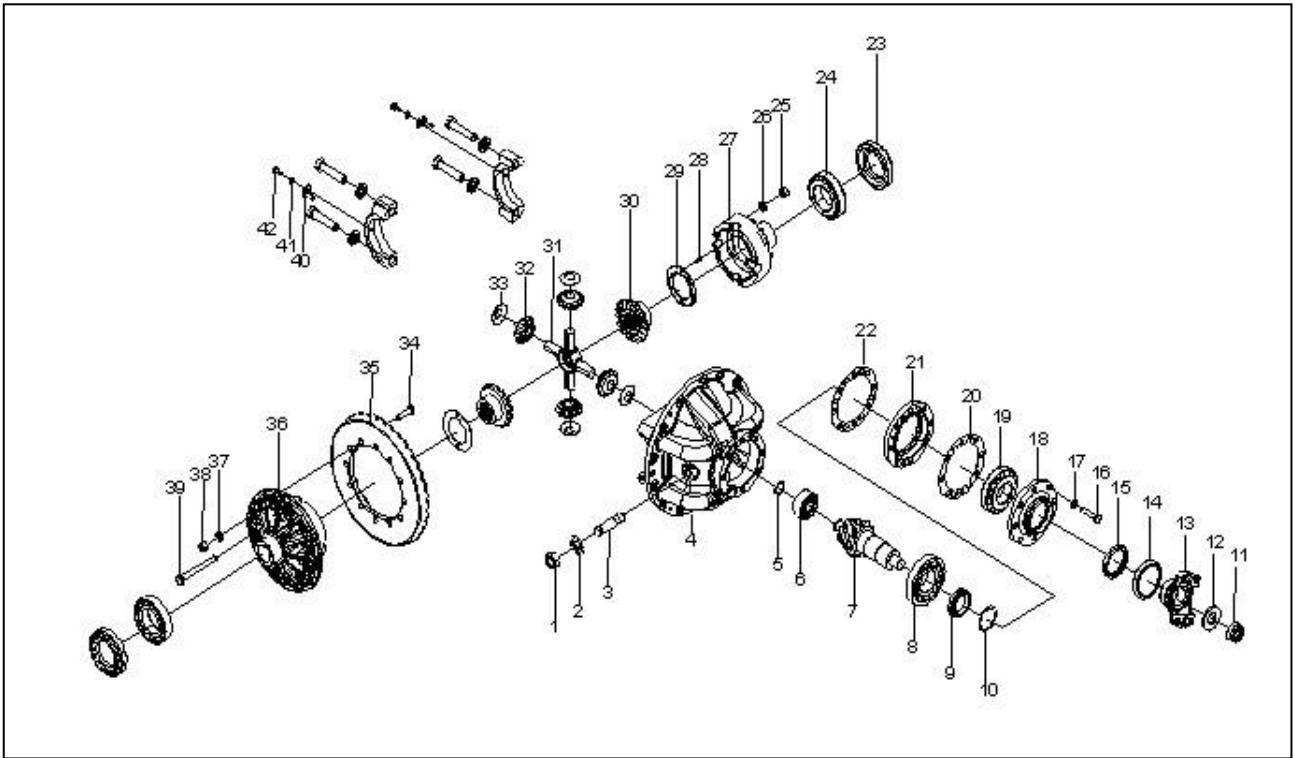


Figure 5