

DIESEL MECHANIC



MINING QUALIFICATIONS AUTHORITY

CODE: CLU

MAINTAIN CLUTCHES

INDEX

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OBJECTIVE

WHAT YOU MUST DO

1. Strip, inspect, assemble and adjust a friction plate clutch.
2. State the possible causes for:
 - (a) the clutch not releasing, and
 - (b) the clutch slipping.
 - (c) the clutch grabbing or shudder

WHAT YOU WILL BE GIVEN

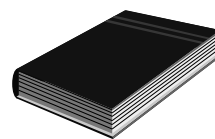
1. An engine fitted with a friction plate clutch.
2. All the necessary tools and equipment.


HOW WELL YOU MUST DO IT

1. The clutch pedal height must be within specification.
2. The pedal free play must be within specification.
3. The push rod play must be within specification
4. When the clutch pedal is depressed, the transmission shaft must be able to be turned freely by hand.
5. When the transmission shaft is turned with the clutch lever having been released, the clutch must not slip.
6. There must not be any damage to the parts, tools or equipment.
7. All the bolts and nuts must be torqued to specification.

ADDITIONAL RESOURCES

1. A demonstration by a competent person, e.g. your Instructor.
2. Audiovisual aids if available.



<p align="center"><u>HAZARD IDENTIFICATION AND CONTROL (HIAC) FORM</u></p> <div style="display: flex; justify-content: space-around; align-items: center;">  <div style="text-align: center;"> <p><u>CLU</u></p> <p><u>MAINTAIN A CLUTCH</u></p> </div> </div>		
STEPS IN OPERATION / PROCESS	POTENTIAL ACCIDENT / INCIDENT	CONTROLS (BY RESPONSIBLE PERSON)
<ul style="list-style-type: none"> • Use hand tools • Use special tools • Bleeding of hydraulic system 	<ul style="list-style-type: none"> • Using damaged tools or wrong tools for the job can cause injury and damage to equipment. • Be aware of High pressure when bleeding clutches 	<ul style="list-style-type: none"> • Always use the correct tool for the job. • Ensure tools are in good condition. • Use tools correctly. • Wear appropriate PPE where necessary. • Always take good care of tools. Maintain, clean and store it properly.

NOTE: Before doing the practical work contained in this module, the learner must study the content of the above HIAC Form again and then sign the statement below:

The above risks, which will be encountered in this module, are fully understood and will be controlled during the practical work.

Signature of Learner:.....

Signature of Training Officer:.....

Date:.....

MAINTAIN A CLUTCH

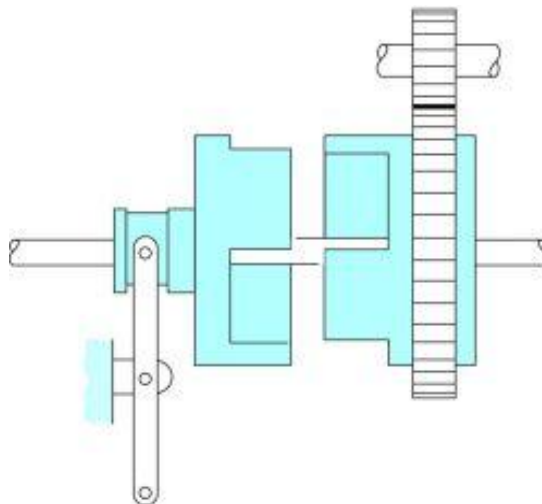
ITEM / TASK: Introduction

DESCRIPTION:

A clutch is a mechanism which couples two shafts together, thereby enabling them to revolve together. It may also uncouple the shafts so that they are free from one another. There are two basic types, namely the **positive clutch** and the **friction clutch**.

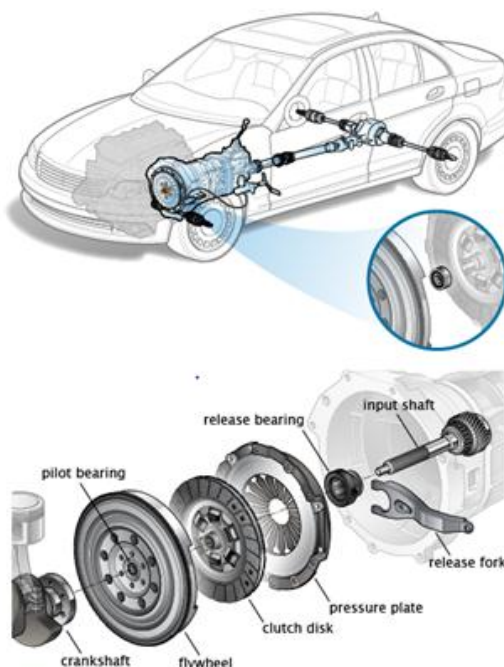
Square-jaw-type Positive clutch (Fig. 1).

Fig 1



Friction clutch (Fig. 2).

Fig 2



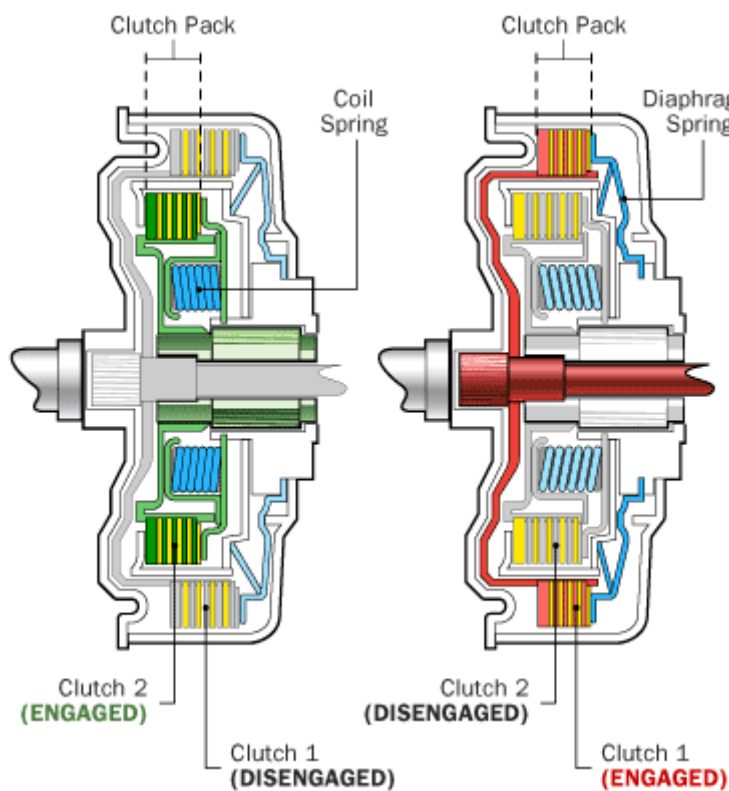
In a car with a manual gearbox, the first stage in the transmission system is the clutch. It transmits engine power to the gearbox and allows transmission to be interrupted either while a gear is being selected to move off from a stationary position or when gears are changed while the car is moving. Most cars use a friction clutch that is operated either by fluid (hydraulic) or by a cable.

When a car is moving under power, the clutch is engaged. A pressure plate bolted to the flywheel exerts constant force, by means of a diaphragm spring, on the driven (or friction) plate. Some cars have a series of coil springs, instead of a diaphragm spring, at the back of the pressure plate.

The driven plate runs on a splined input shaft, through which the power is transmitted to the gearbox. The plate has friction linings, similar to brake linings, on both its faces. These allow the drive to be taken up smoothly when the clutch is engaged.

Friction clutch (Fig.3).

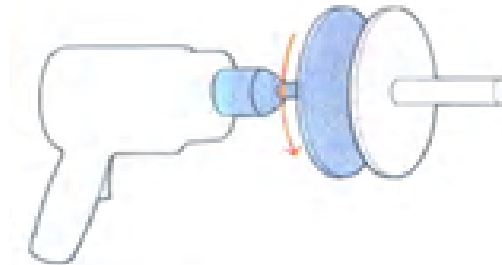
Fig 3



Operation principles of Friction clutches

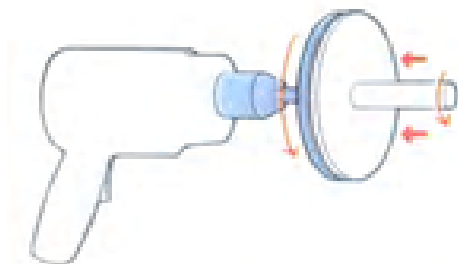
A sanding disc, driven by a power drill corresponds to the flywheel of a car, driven by the engine (Fig. 4).

Fig 4



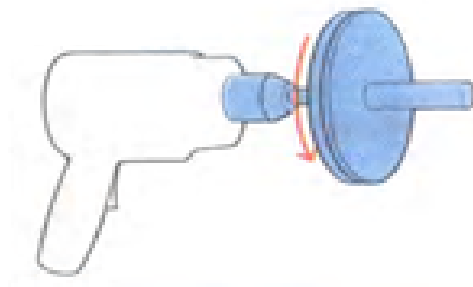
If a second sanding disc is brought into contact with the first, friction makes it revolve too but moves slowly (Fig. 5).

Fig 5



Under increased pressure the two sanding discs revolve as one. This is how a friction clutch works (Fig. 6 on the next page).

Fig 6



FRICION CLUTCHES

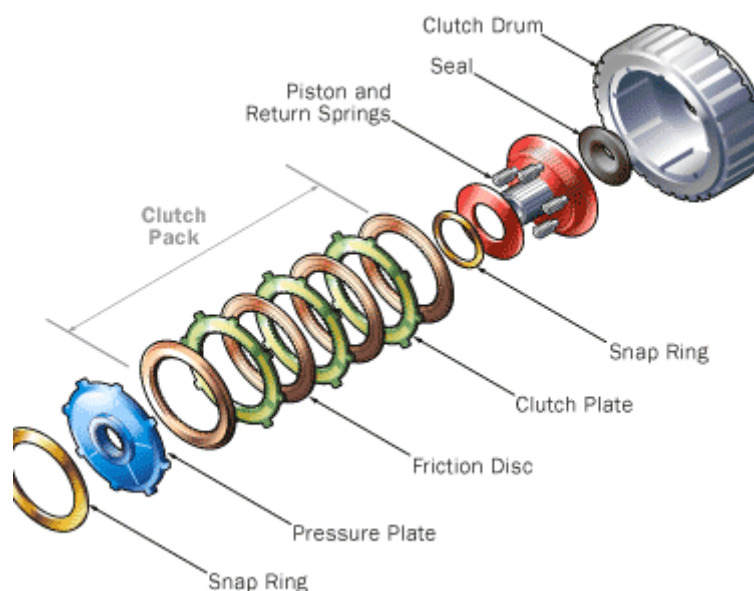
Two kinds of friction clutches are used in the mining industry:

- a) the multi-disc friction type
- b) the plate-friction type

Multi-Disc Friction Clutches

These clutches are occasionally used for transmitting high powers. They are also used on a driveshaft to protect the motor from becoming overloaded. (When the motor is loaded to its maximum the clutch will start to slip) (Fig.7).

Fig 7



This type of clutch may be regarded as a series of single plate clutches connected together in such a manner that all the friction plates are attached to the driving shaft by means of splines on the shaft.

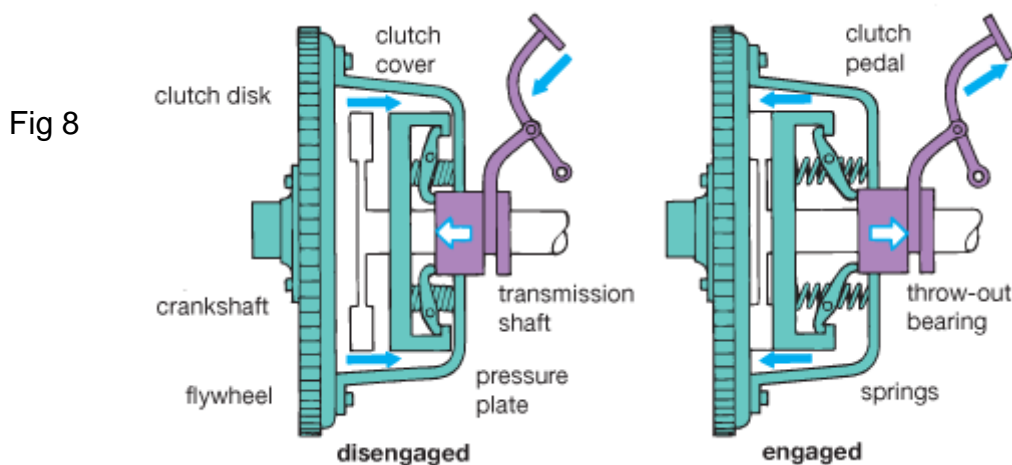
The metal contact plates are attached to the driven shaft by means of splines in the clutch housing. The friction and metal plates can also slide along the shaft and clutch housing.

Plate Friction Clutch

This type of clutch is going to be discussed in detail in this module because it is the type most commonly used in any vehicle.

Operation

When the clutch pedal is released (engaged) the pressure plate comes into contact with the clutch plate (disc) and presses it until it comes into contact with the flywheel. The pressure of the clutch spring keeps the three plates in firm contact with one another. (Fig.8).



When the clutch is disengaged (i.e. when the pedal is depressed), an arm pushes a release bearing (throw-out bearing) against the centre of the diaphragm spring, which releases the clamping pressure.

As a result, the outer part of the pressure plate, which has a large friction surface, no longer clamps the driven plate to the flywheel, so the transmission of power is interrupted and the gears can be changed.

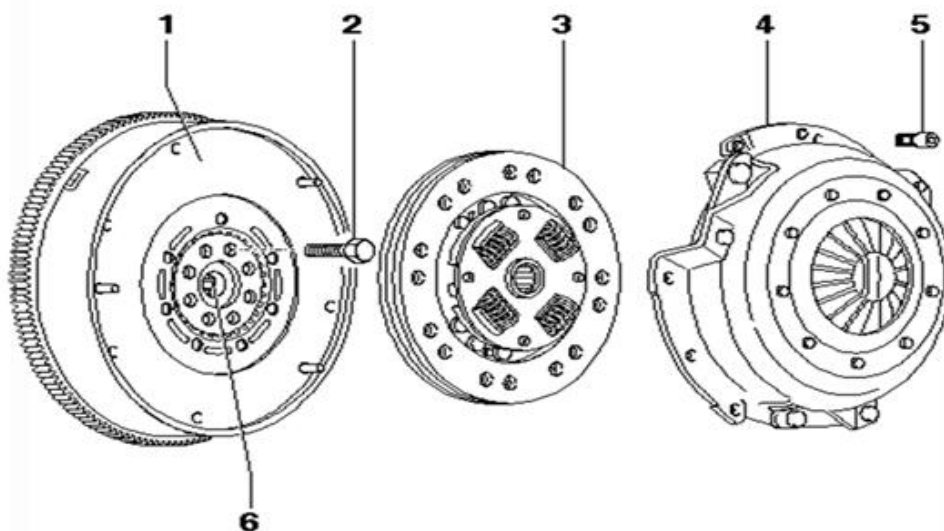
When the clutch pedal is released, the release bearing is withdrawn and the diaphragm-spring load once again clamps the driven plate to the flywheel so as to resume the transmission of power.

Dismantled clutch

1. flywheel
2. flywheel bolt(to crankshaft)
3. clutch friction plate
4. pressure plate
5. pressure plate bolts(to flywheel)
6. pilot bearing(for inputshaft of gearbox)

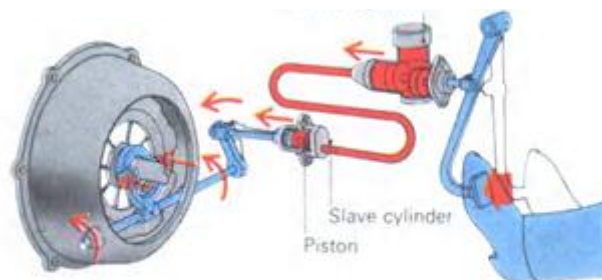
Exploded view of a Dismantled clutch (Fig 9).

Fig 9



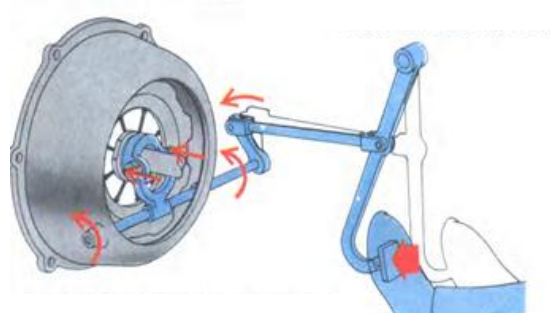
Some cars have a hydraulically operated clutch. Pressure on the clutch pedal inside the car activates a piston in a master cylinder, which transmits the pressure through a fluid-filled pipe to a slave cylinder (mounted on the gearbox). The slave-cylinder piston is connected to the clutch release arm. (Fig10).

Fig 10



Other cars have a cable operated or link operated clutches. Pressure on the clutch pedal inside the car activates cables or links, which is connected to the clutch release arm(fork) (Fig11).

Fig 11



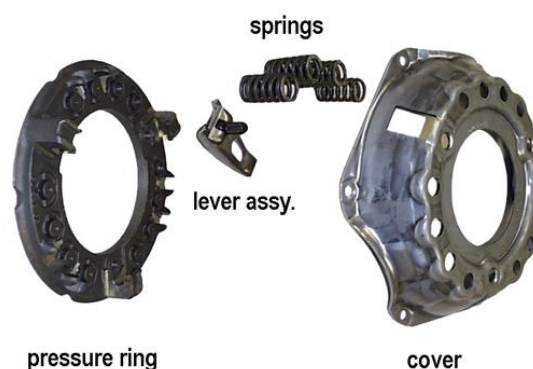
Pressure plate

The driving member is commonly called the pressure plate. It is bolted to the engine flywheel and its main purpose is to exert pressure against the clutch plate, holding the plate tight against the flywheel, and allowing the power to flow from the engine to the transmission. It must also be capable of interrupting the power flow by releasing the pressure on the clutch plate. This allows the clutch plate to stop rotating while the flywheel and pressure plate continues to rotate.

The pressure plate consists of a heavy metal plate, coil springs or a diaphragm spring, release levers (fingers), and a cover.

Coil spring pressure plate (Fig12).

Fig 12

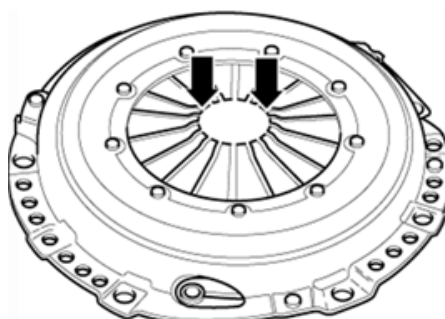


When coil springs are used, they are evenly spaced around the metal plate and located between the plate and the metal cover. This places an even pressure against the plate, which in turn presses the clutch plate tight against the flywheel. The cover is bolted tightly to the flywheel and the metal plate is movable, due to internal linkages. The coil springs are arranged to exert direct or indirect tension upon the metal plate, depending upon the manufacturers design.

Three release levers (fingers) are used on most pressure plates, evenly spaced around the cover, to release the holding pressure of the springs on the clutch plate, allowing it to disengage the power flow.

Diaphragm spring pressure plate (Fig 13).

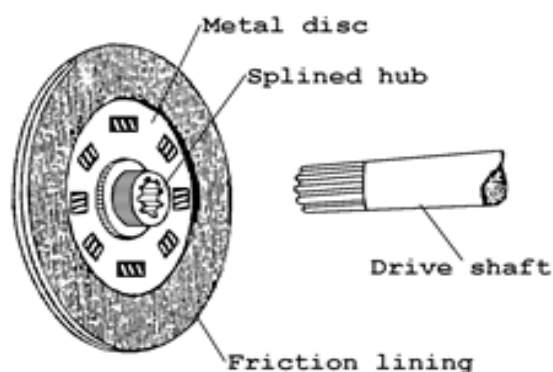
Fig 13



The Friction Plate (clutch plate)

The clutch plate or driven member consists of a round metal plate attached to a splined hub. The outer portion of the round plate is covered with a friction material of moulded or woven asbestos and is riveted or bonded to the plate. The thickness of the clutch plate and/or facings may be warped to give a softer clutch engagement. Coil springs are often installed in the hub to help provide a cushion against the twisting force of clutch engagement. The splined hub is mated to (and turns) a splined transmission shaft when the clutch is engaged. (Fig14).

Fig 14



This part of the clutch is sometimes known as the disc and is made in different ways. A typical construction consists of a thin metal disc which has a friction lining attached to it. A hub with splines, which fit into the grooves in the gearbox drive shaft, is centred in the middle of the disc (Fig 14). **Note that the internal splines of the hub and the grooves in the gearbox shaft provide a sliding connection.**

ITEM / TASK: Adjusting the cable-operated clutch

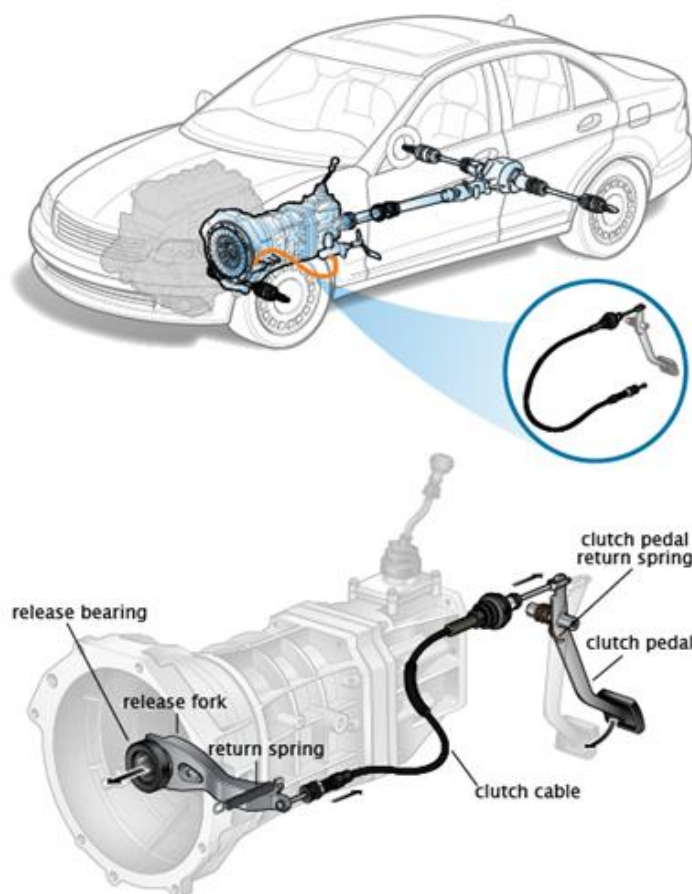
DESCRIPTION:

To work efficiently, the clutch needs the correct amount of free play (or clearance) in the linkage between the foot pedal and the clutch operating lever (also known as the release arm or fork).

Anything less than the correct amount of free play will result in clutch slip, because the pressure plate will be unable to exert its full pressure on the friction plate.

Failure to cure this fault will quickly lead to a burned-out friction plate and possibly a ruined pressure plate. If, on the other hand, there is too much clearance in the clutch linkage, the gears will grate on selection and the car may tend to creep forward when in gear with the clutch pedal fully depressed. This is known as clutch drag, which can cause difficulties in heavy traffic. It is generally better, however, to have too much play in the clutch linkage than too little. (Fig 15)

Fig 15



On most cars, mechanical clutch- linkage clearance is measured and adjusted underneath the car. On some older cars, checking and adjustment can be done at the bulkhead under the bonnet. Wherever adjustment is made, the same principles apply to all cable linkages: they are adjusted by either increasing or decreasing the lengths of the inner and outer cables in relation to each other. If there is insufficient clearance in the linkage, the inner cable has to be made longer. If there is too much, it has to be shortened.

As a rule of thumb, 1-2mm usually gives a good working clearance on the clutch thrust bearing, but more can be allowed for if the clutch disengages and allows smooth gear shifting whilst the pedal is more than 40-50 mm above floor level.

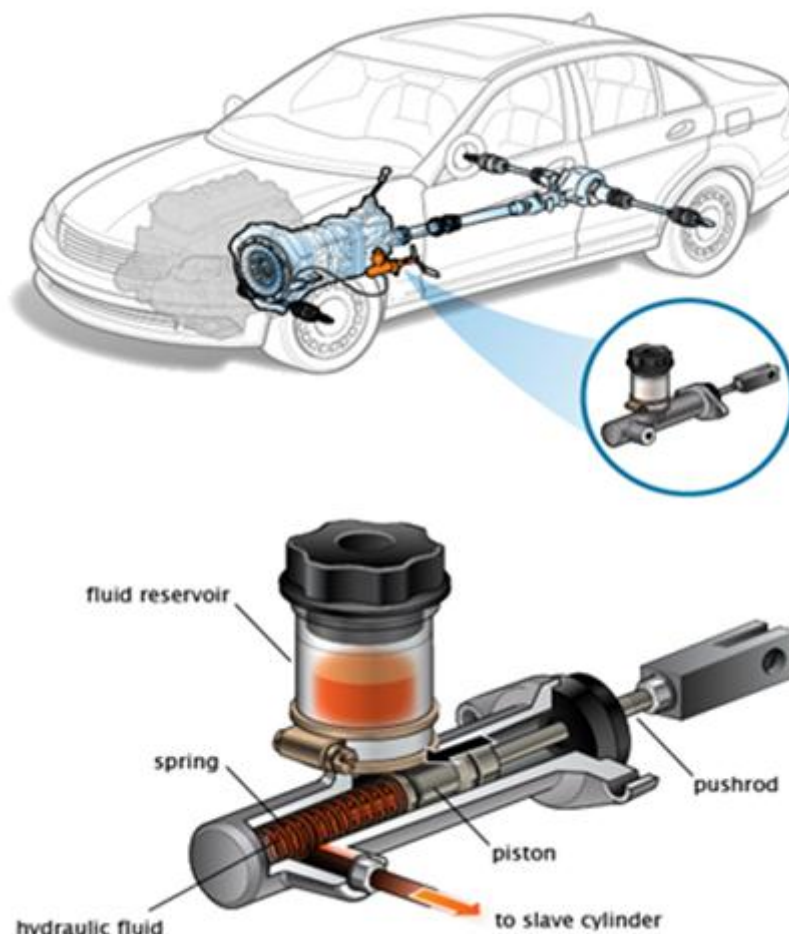
ITEM / TASK: Checking and adjusting a hydraulic clutch

DESCRIPTION:

Many hydraulic clutches are self- adjusting, but some designs allow adjustment to compensate for wear of the friction plate.

If your hydraulic clutch is adjustable, the pushrod at the slave cylinder will be threaded and fitted with a locknut. (Fig 16)

Fig 16



Check that the fluid in the clutch master-cylinder reservoir is at the correct level.

To do so, first raise the car securely on ramps or axle stands. Get underneath the car and locate the clutch slave cylinder and its adjustable pushrod to the clutch operating lever.

Use pliers to unhook the pull-off spring from the operating lever. Without attempting to force fluid back towards the main cylinder, push the lever towards the slave cylinder as far as it will go. Now move the lever in the opposite direction until its movement is stopped by the clutch thrust bearing contacting the pressure-plate fingers.

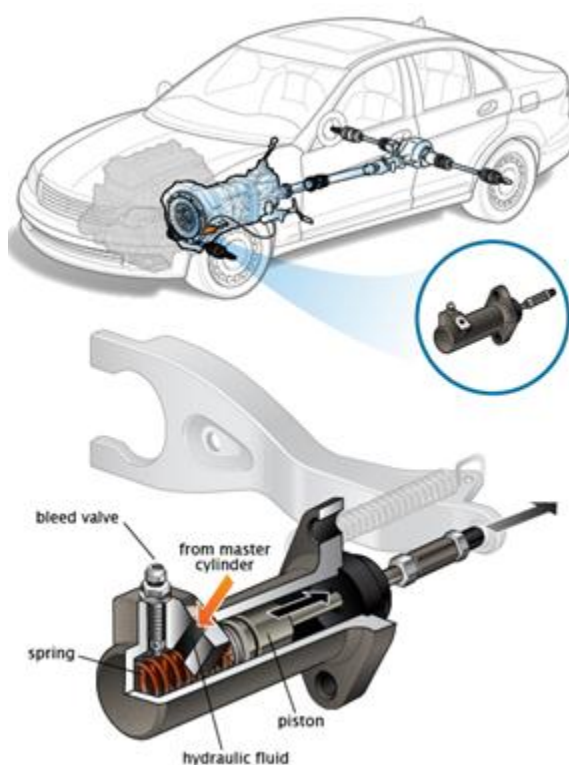
If specifications are available, measure the distance and correct to the recommended settings. If not, increase or reduce this distance until there is 15-25mm of free play at the clutch pedal when you push it lightly.

The locknut and the adjuster nut are on the threaded end of the pushrod. Loosen the locknut.

Screw the adjuster nut towards the slave cylinder to increase the amount of free play, or towards the operating arm to decrease it. When the measurement is correct, tighten the locknut.

Recheck the measurement and adjust it again if necessary. Depress the clutch pedal several times, then check it again, refit pull-off spring. (Fig 17)

Fig 17



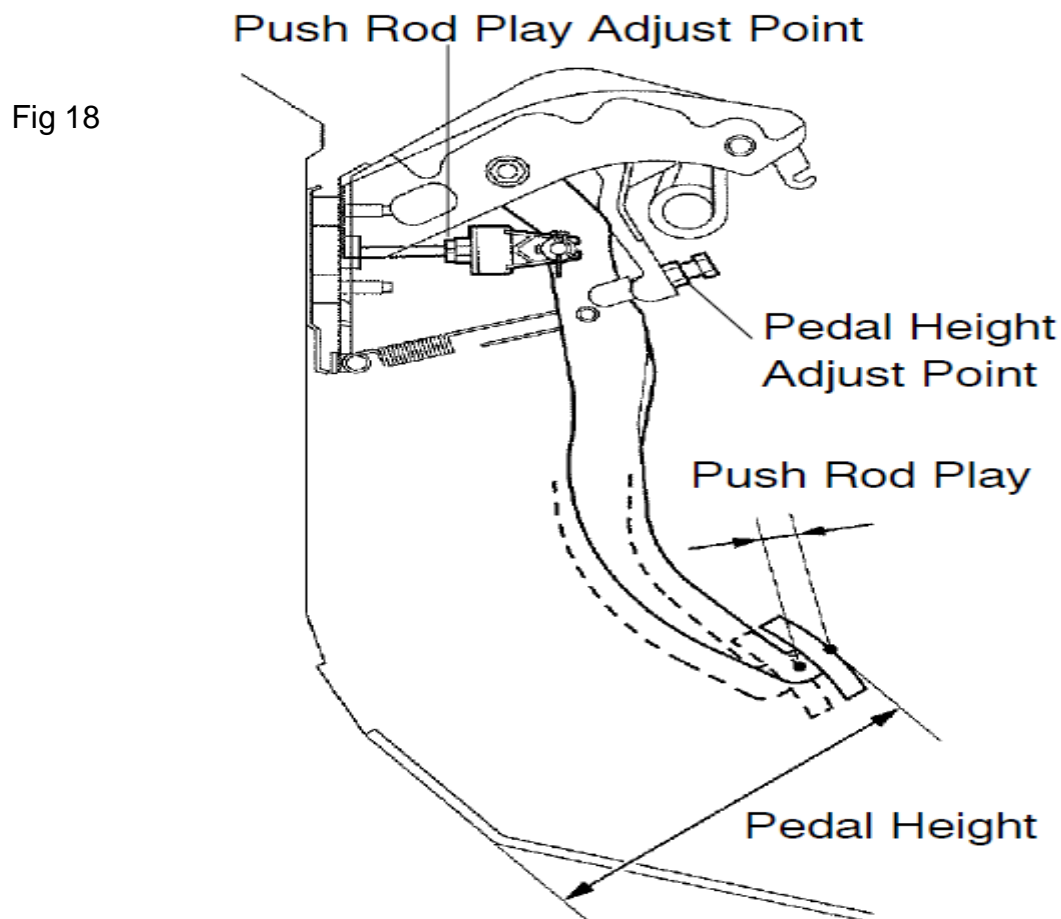
TEM / TASK: Servicing a Clutch

DESCRIPTION:

Servicing refers to general maintenance procedures to be performed by qualified service personnel.

Clutch pedal height.

Inspection: Measure to verify that the distance from the upper surface of the pedal to the firewall is within the standard value.



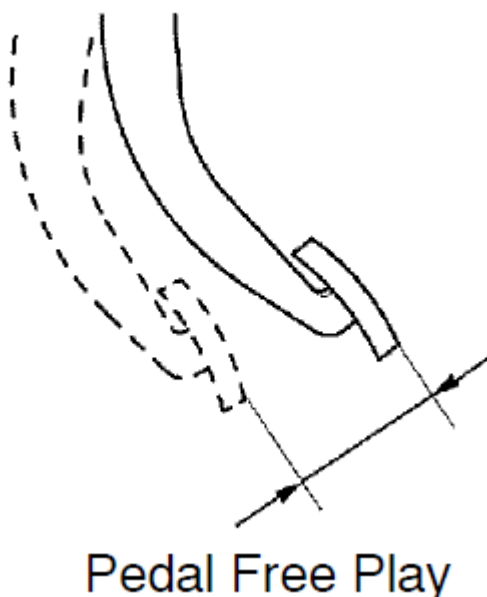
Adjustment (Fig 18)

- Check that the pedal height is correct according specifications.
- Loosen the lock nut and turn the stopper bolt until the pedal height is within the specified range.
- Tighten the lock nut. (Torque to specification)

Pedal Free play adjustment (Fig 19)

1. Depress the clutch pedal until resistance is felt.
2. Measure the distance between the pedal's released position and the position in (1).
3. Release the pedal. Using your finger, gently press the pedal until resistance increases slightly.
4. Measure the distance between the pedal's released position and the position in (3).

Fig 19

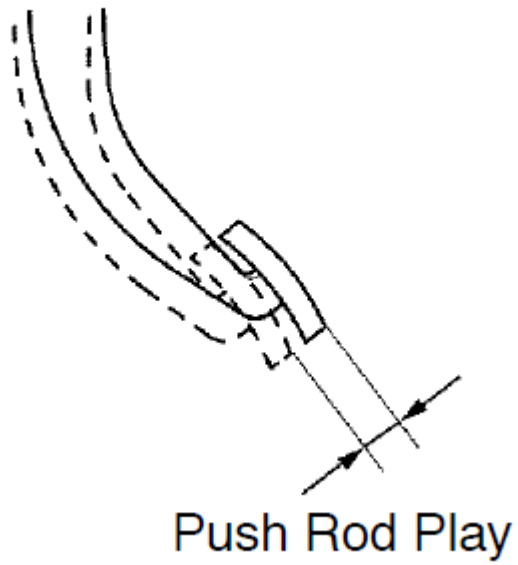


PUSH ROD PLAY (Fig 20 on next page)

Push rod play at pedal top must be according to manufacturer's specification.

- Adjust the pedal free play and push rod play.
- Loosen the lock nut and turn the push rod until the pedal free play and push rod play are within the specified ranges.
- Tighten the lock nut. (Torque to specification)
- After adjusting the pedal free play, check the pedal height.

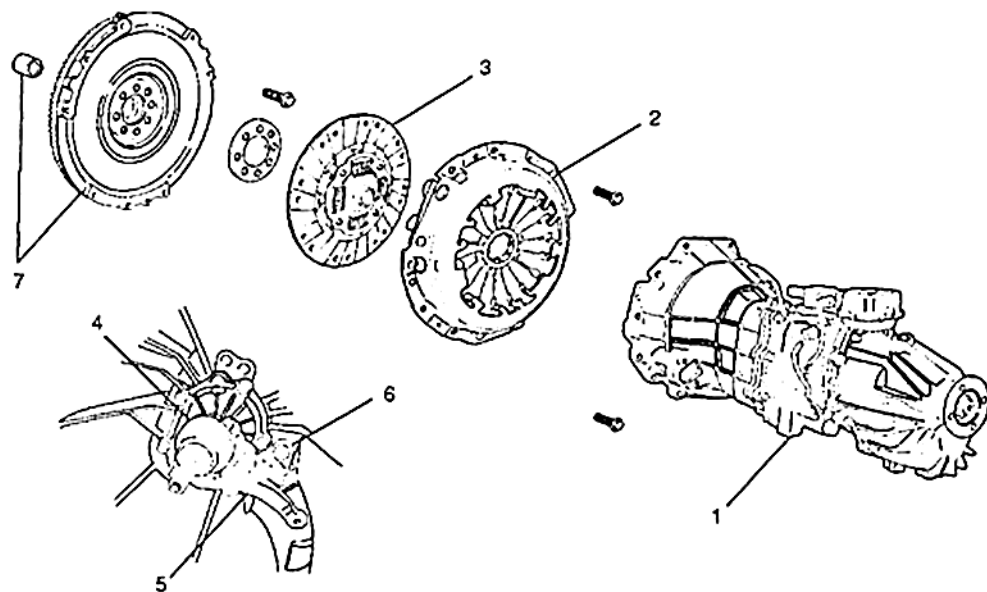
Fig 20



ITEM / TASK: Clutch removal and installation (Fig 21)

DESCRIPTION:

Fig 21



Legend

- (1) Transmission Assembly
- (2) Pressure Plate Assembly
- (3) Driven Plate Assembly

- (4) Release Bearing
- (5) Shift Fork
- (6) Fulcrum Bridge
- (7) Flywheel Assembly and Crankshaft Bearing

NB: For the correct removal of a clutch, follow the steps in the OEM document or workshop manual.

Removal Steps

1. Transmission assembly
2. Pressure plate assembly
3. Drive plate assembly
4. Release bearing
5. Shift fork
6. Fulcrum bridge

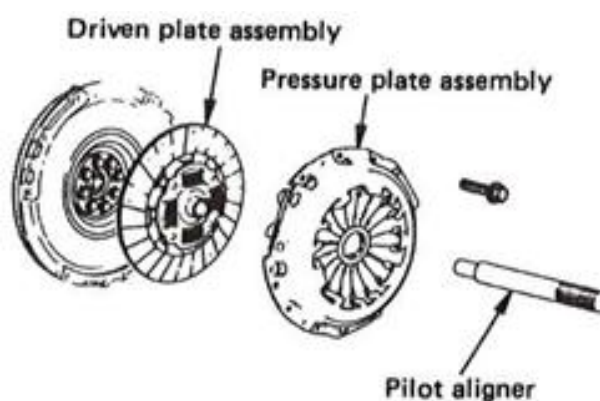
1. Transmission Assembly:

- Refer to the workshop manual for removal procedure for the engine and transmission in you training centre.

2. Pressure Plate Assembly: (Fig 22)

- Remove the bolts on the outer side of the pressure plate assembly in a circular rotation. If the bolts are remove one at a time the pressure plate assembly may be damaged due to the spring tension of the diaphragm spring.

Fig 22



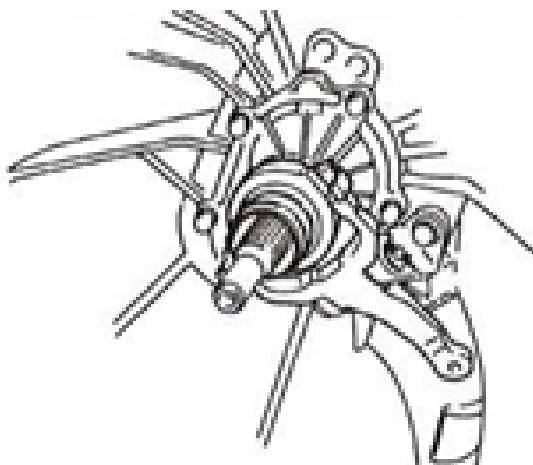
3. Drive Plate Assembly:

- Use the drive plate aligner to prevent the drive plate assembly from falling free (Fig.22).
- Mark the fly wheel, clutch cover and pressure plate lug for alignment when installing.

4. Release Bearing:

- Remove the release bearing from the transmission case (Fig 23).

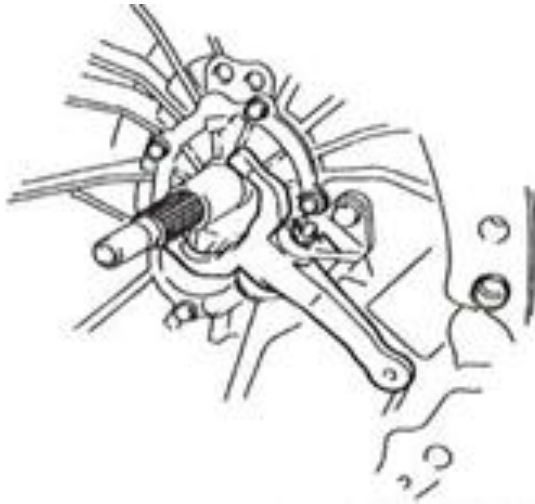
Fig 23



5. Shift Fork: (Fig 24).

- Remove the snap pin.
- Remove the shift fork pin and shift fork from the fulcrum bridge.

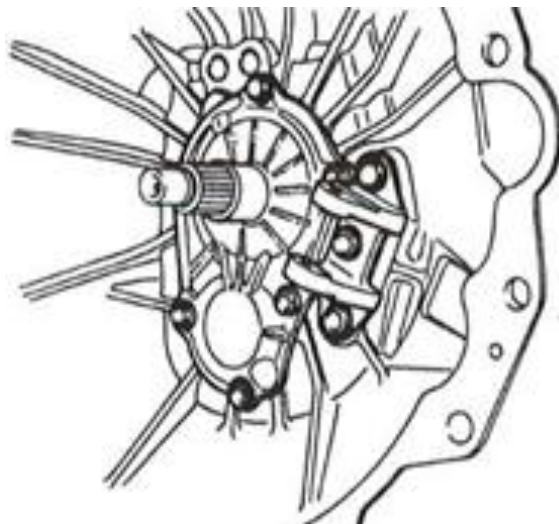
Fig 24



6. Fulcrum Bridge: (Fig 25).

- Remove the fulcrum bridge bolts
- Remove the fulcrum from the transmission case.

Fig 25

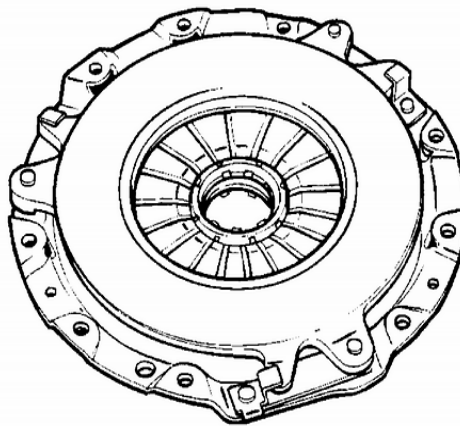


ITEM / TASK: Inspection and repair.

DESCRIPTION:

Make the necessary adjustments, repairs and part replacements if any excessive wear or damage is discovered during inspection (Fig 26).

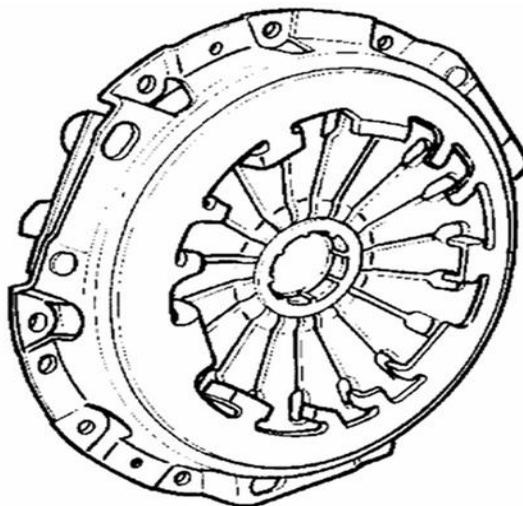
Fig 26



Pressure Plate Assembly (Fig 27).

Visually inspect the pressure plate friction surface for excessive wear and heat cracks. If excessive wear or deep heat cracks are present the pressure plate must be replaced.

Fig 27



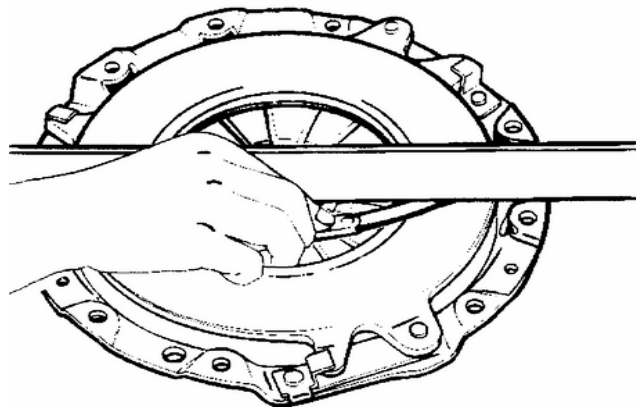
Pressure Plate Warpage (Fig 28).

- Use a straight edge and feeler gauge to measure the pressure plate friction surface flatness in four directions.

NB: If any of the values exceed the specific limit, the pressure plate must be replaced.

Pressure plate maximum war page limit= 0.3mm

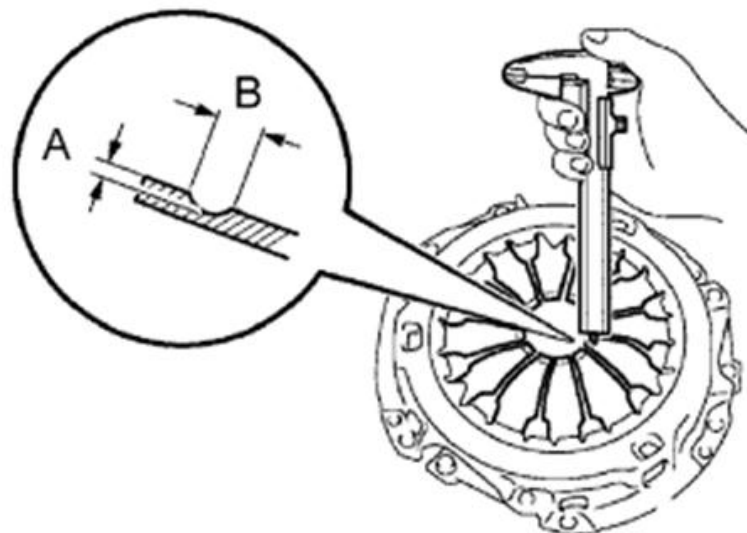
Fig 28



Inspect Diaphragm Spring for Wear (Fig 29).

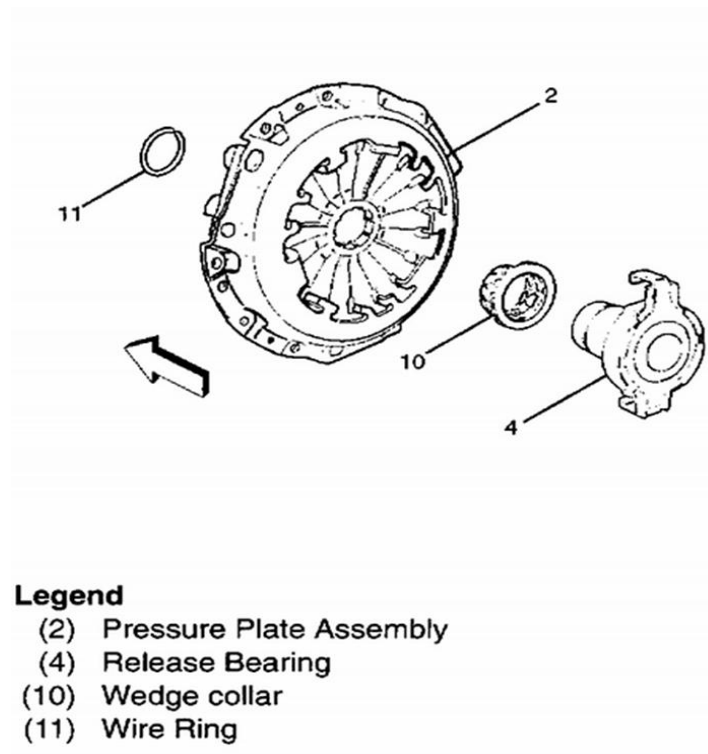
- Using callipers, measure the diaphragm spring for depth and with wear. See workshop manual for above specifications.

Fig 29



Pressure plate and release bearing assembly (Fig 30).

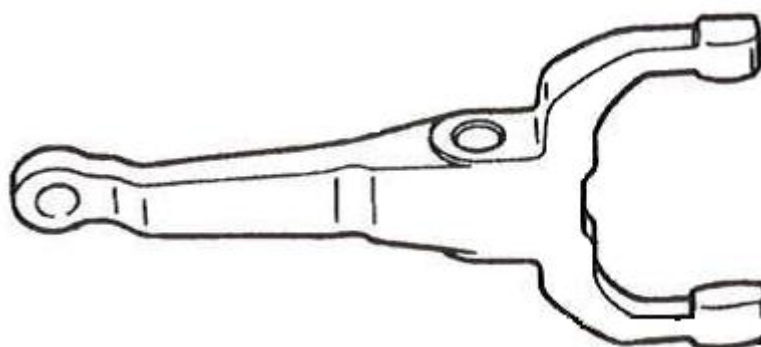
Fig 30



Shift Fork (Fig 31)

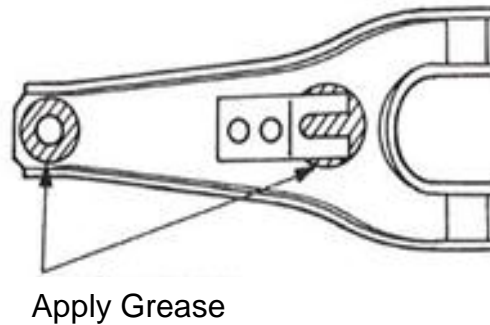
- Visually check the surfaces of the shifting fork, making contact with the release bearing for excessive wear and damage.
- Remove any minor stepping or abrasion from the shift fork with an oil stone or file.
- Replace any exhibiting excessive wear or damage.

Fig 31



- Apply multi-purpose grease as shown in (Fig 32)

Fig 32

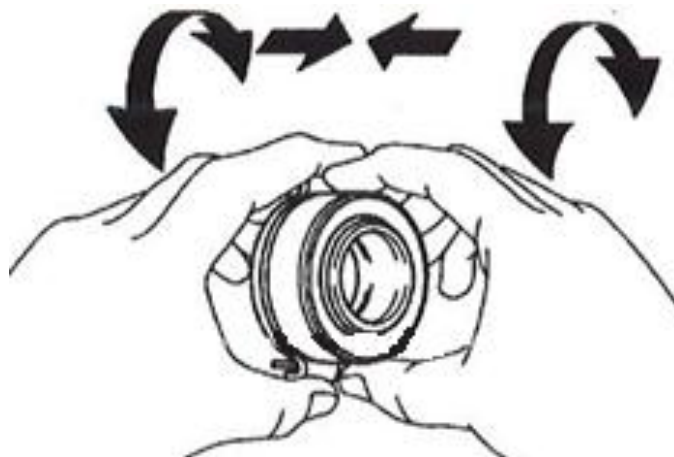


Release Bearing

- Visually inspect the release bearing for excessive play, noise and breakage.

NB: If any of these conditions are discovered, the bearing must be replaced. (Fig 33)
Irrespective of condition of release and pilot bearing always replace them when overhauling clutches.

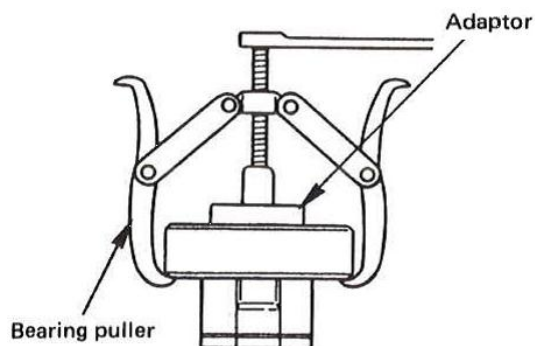
Fig 33



Release bearing replacement (Fig 34)

- Use a bearing puller and adaptor to remove the release bearing.

Fig 34



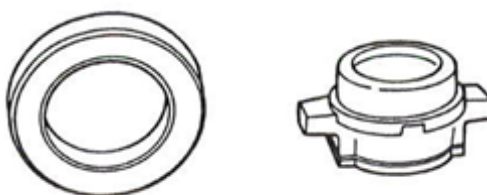
Release bearing installation (Fig 35)

- Set the release bearing to the shift block bearing fitting surface.

NB: The release bearing must be perfectly horizontal.

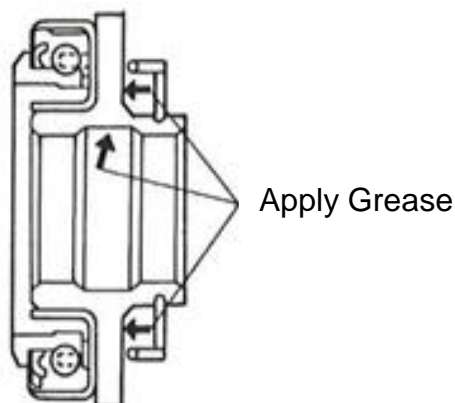
- Use a bench press to fit the release bearing to the shift block.

Fig 35



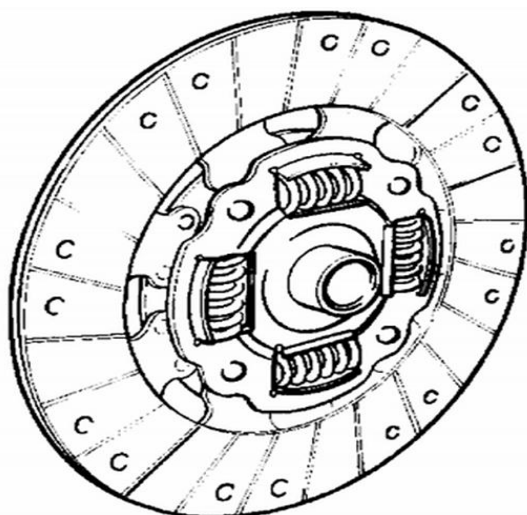
- Install the parts as illustrated after applying wheel bearing grease or multi-purpose grease as shown in (Fig 36).

Fig 36



Drive plate assembly (Fig 37).

Fig 37



- Visually inspect the torsion springs for looseness, breakage and weakening.
- Visually inspect the facing surfaces for cracking and excessive scorching.
- Using a Vernier calliper, measure the rivet head depth. Minimum of 0.3mm
- Visually inspect the surfaces for the presence of oil or grease.

NB: If any of these conditions are present the drive plate need to be replaced.

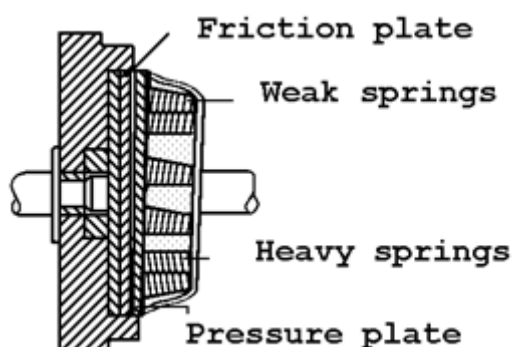
Examination

- Inspect the surface of the flywheel and the pressure plate for grooving, cracking, distortion or signs of overheating (discolouring).
- Inspect the friction disc to make sure that the linings are not loose, cracked, worn or oil soaked. Also check that the rivets are secure. Check that the heads of the rivets are below the surface of the friction material. If they are not the rivet head will score the pressure plate or the flywheel surfaces.
- Measure the lengths of all the springs with Vernier callipers. Compare their lengths to a new spring. A tolerance of + 0, 5 mm is allowed.

NOTE: Remember that the ability of the clutch to transmit all the power from the engine to the transmission is dependent on the clutch spring pressure.

NB: If the spring pressure is not sufficient to hold the clutch plate against the flywheel, the power of the engine will cause the plate to slip (Fig.38)

Fig 38



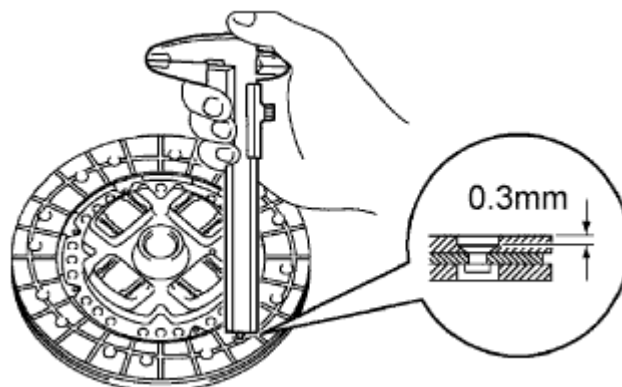
- Check that the drive plate moves smoothly on the transmission input shaft

INSPECT CLUTCH DISC ASSEMBLY (Fig 39)

- Measure the flatness of pressure plate with a square. If it exceeds 0.5mm, replace it.
- Check the pressure plate surface for wear, cracks and colour change.
- Measure the thickness of friction plate (Fig 39).

NB: Always refer to manufacturer's specifications when measuring.

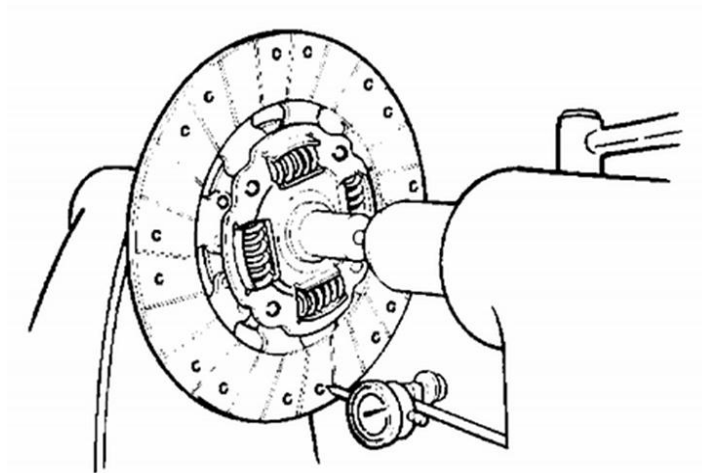
Fig 39



- Use Dial Indicator/Magnetic Base or equivalent to check clutch disc run out. (Fig 40)

NB: Replace the clutch disc if not within specifications.

Fig 40

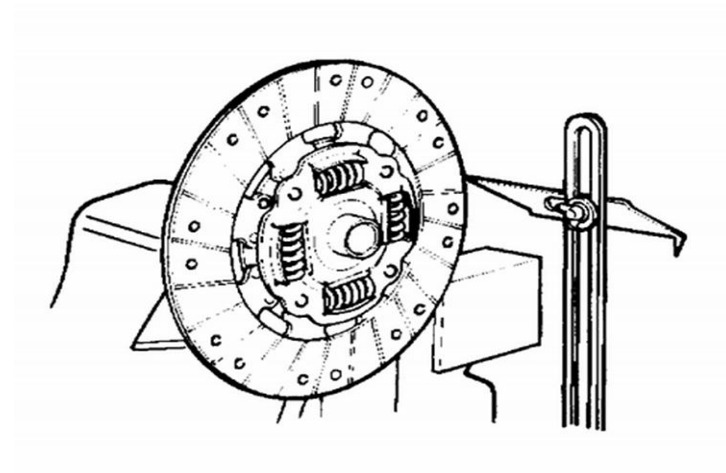


Measure clutch disc run out and backlash. (Fig 41)

- Slowly turn the driven plate counter clockwise. Measure the spline rotation play as you turn the driven plate.

NB: If either measurement exceeds the specification, replace clutch disc or clutch disc and clutch cover as a set.

Fig 41



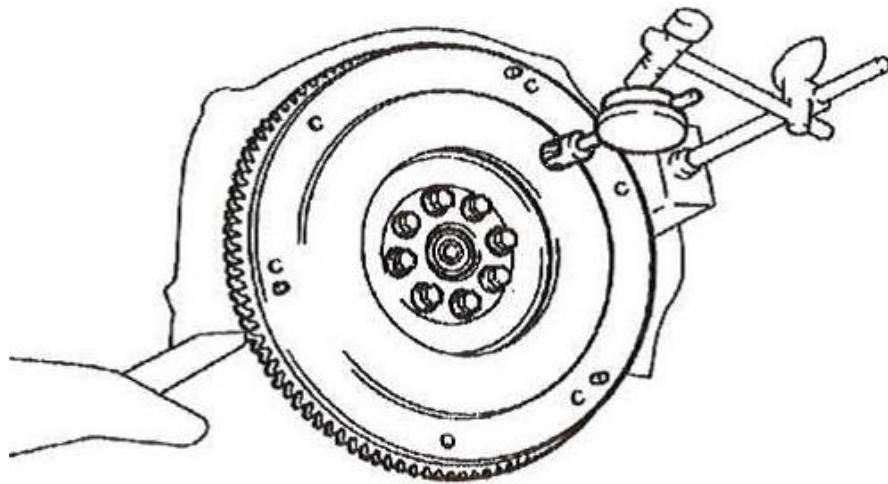
Flywheel Inspection (Fig 42 on the next page)

- Remove the ring gear holder.
- Inspect the ring gear teeth for wear and damage.

- Inspect the clutch disc mating surface on the flywheel for wear, cracks, and burning.
- Measure the flywheel run out using a dial indicator, through at least two full turns while pushing against the flywheel to take up the crankshaft thrust washer clearance.

NB: If the measurement is not within the standard, replace the flywheel, and recheck the run out.

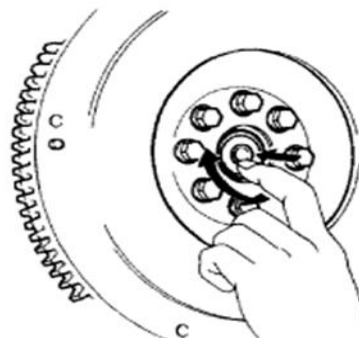
Fig 42



Crankshaft Pilot Bearing (Fig 43)

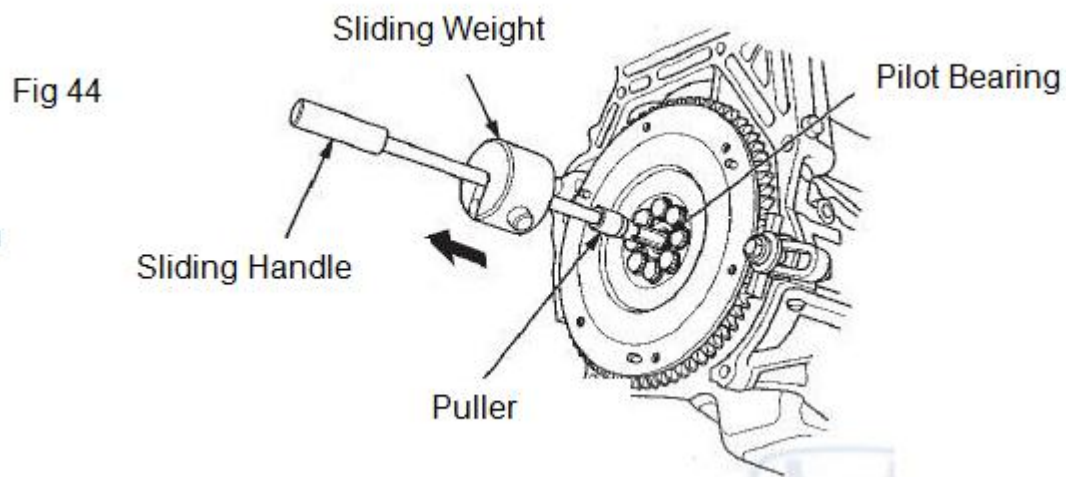
- Inspect the crankshaft pilot bearing for wear and damage.
- Inspect the inside surface of the crankshaft pilot bearing with your finger. If the crankshaft pilot bearing is not turning smoothly, replace it.

Fig 43

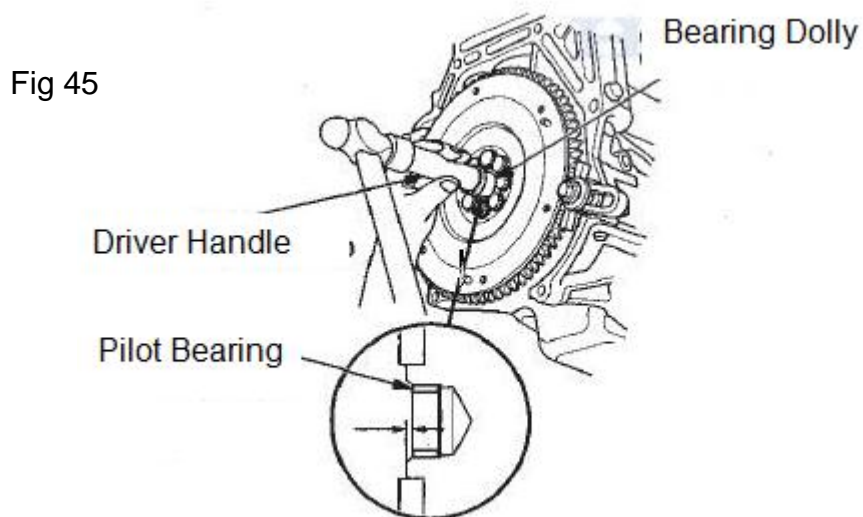


Crankshaft Pilot Bearing Replacement (Fig 44)

- Remove the crankshaft pilot bearing using the bearing remover shaft set.



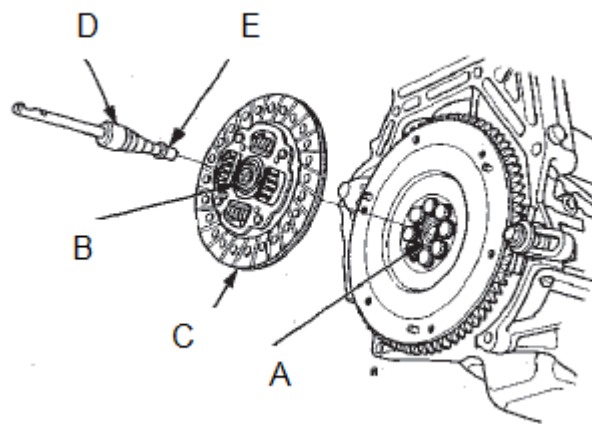
- Install a new crankshaft pilot bearing into the crankshaft to the specified depth using the driver handle and the bearing dolly (Fig 45).



Clutch Disc and Pressure Plate Installation (Fig 46).

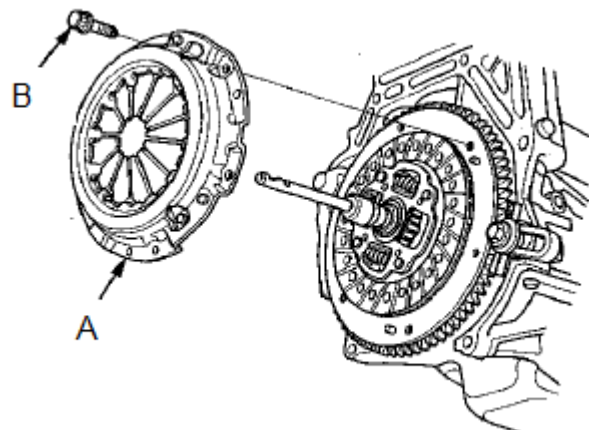
- Temporarily install the clutch disc onto the splines of the transmission main shaft. Make sure the clutch disc slides freely on the main shaft.
- Apply a light coat of super high temperature grease to the crankshaft pilot bushing (A).

Fig 46



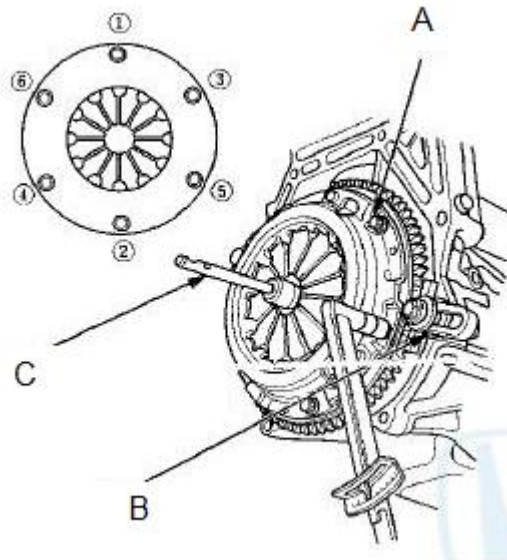
- Apply super high temperature grease to the splines (B) of the clutch disc (C), then install the clutch disc using the clutch alignment tool set (D), and the clutch alignment tool (E).
- Install the pressure plate (A) and the mounting bolts (B) finger-tight. (Fig 47).

Fig 47



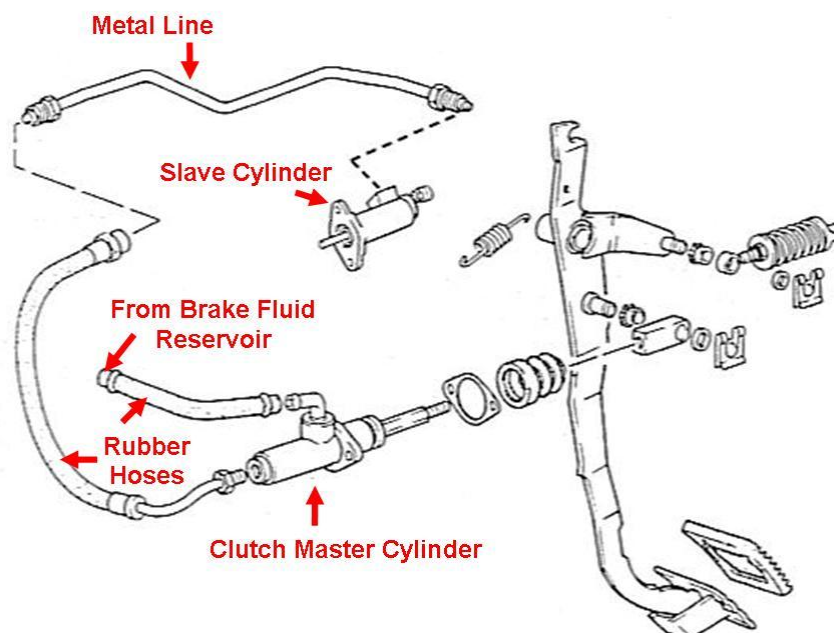
- Torque the mounting bolts (A) in a crisscross pattern (Fig 48) to prevent warping the diaphragm spring.
- Remove the ring gear holder (B), the clutch alignment tool set (C), and the clutch alignment tool.
- Make sure the diaphragm spring fingers are all the same height.

Fig 48



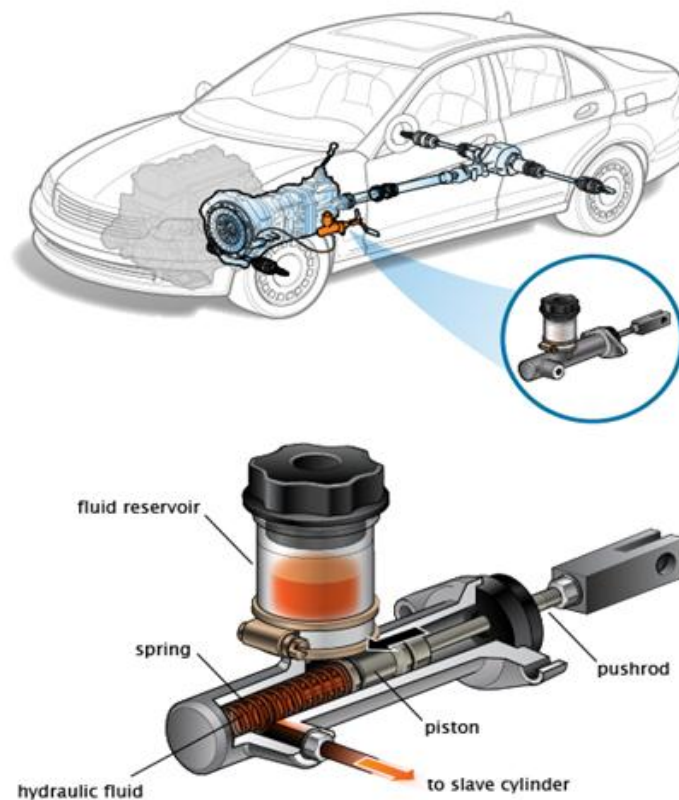
BASIC HYDRAULIC CLUTCH SYSTEM (Fig 49)

Fig 49



CLUTCH MASTER CYLINDER (Fig 50)

Fig 50



CLUTCH MASTER CYLINDER COMPONENTS (Fig 51)

Fig 51

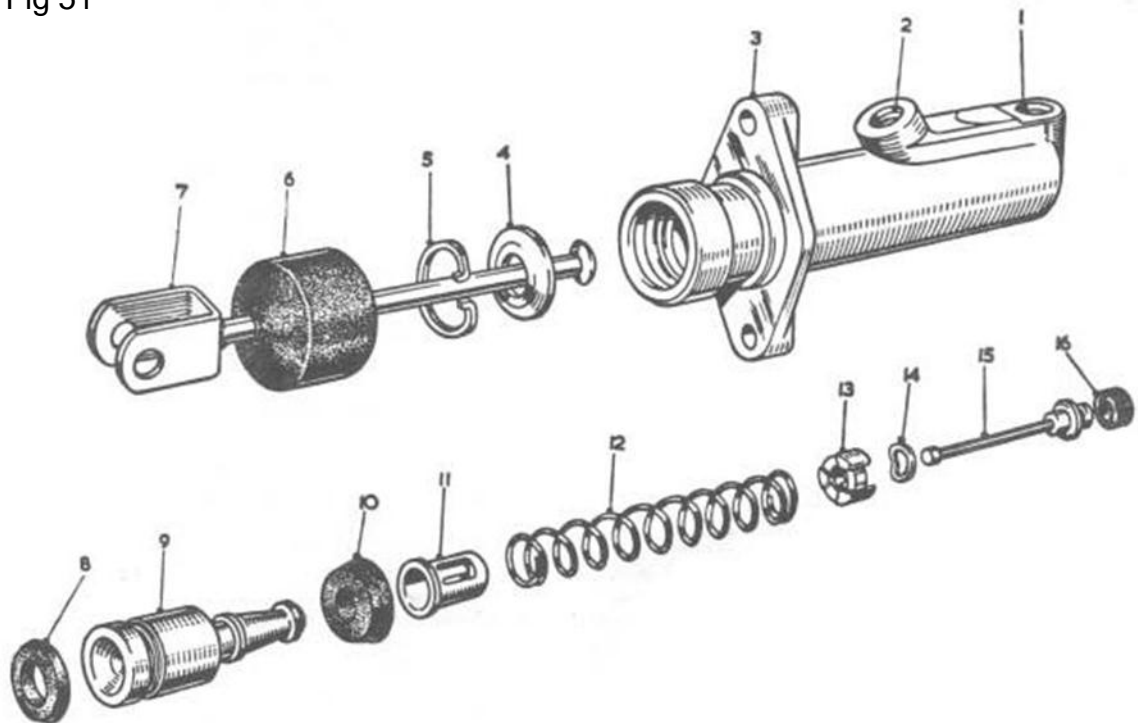
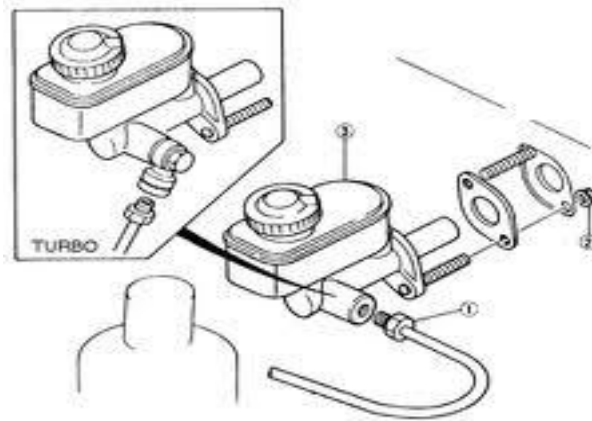


Fig 9.7 BRAKE MASTER CYLINDER COMPONENTS (SERVO ASSISTED)

- | | | | |
|-------------------|--------------|------------------|------------------|
| 1 Fluid inlet | 5 Circlip | 9 Plunger | 13 Valve spacer |
| 2 Fluid outlet | 6 Dust cover | 10 Plunger seal | 14 Spring washer |
| 3 Master cylinder | 7 Pushrod | 11 Thimble | 15 Valve stem |
| 4 Dished washer | 8 End seal | 12 Return spring | 16 Valve seal |

Remove master cylinder from vehicle (Fig 52)

Fig 52



Disassemble and inspect clutch master cylinder

- Remove the piston stop ring.
- Remove the push rod and piston assembly.
- Remove the reservoir band, reservoir cap and reservoir.
- Check the inside of cylinder body for rust, pitting or scoring.
- Check the piston cup for wear or distortion.
- Check the piston for rust, pitting or scoring.
- Check the clutch tube line for clogged.

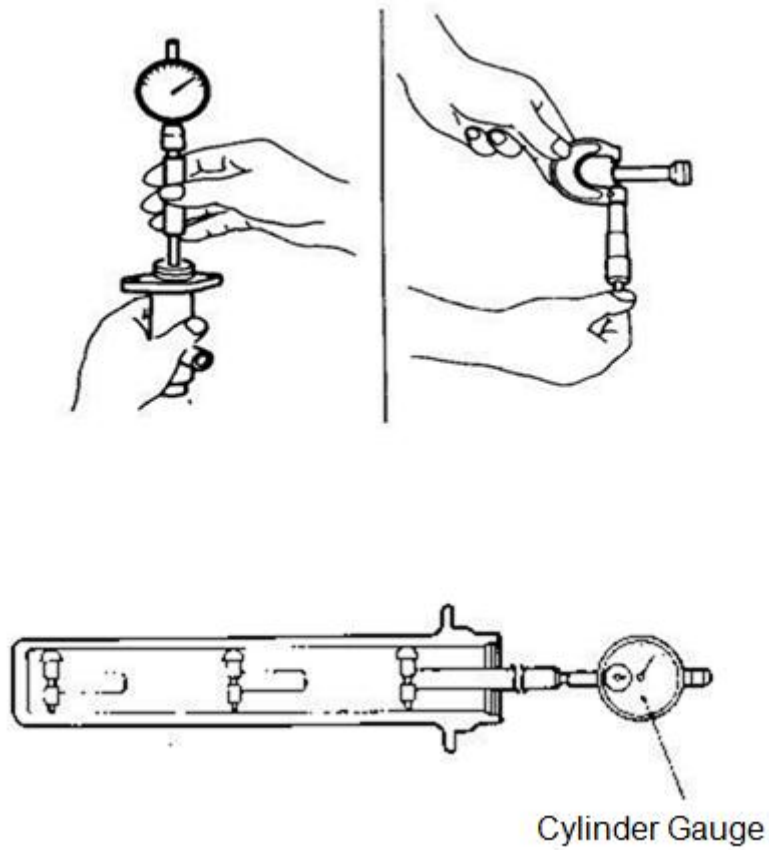
Measure the master cylinder

- Measure the master cylinder inside diameter with a cylinder gauge and the piston outside diameter with a micro meter (Fig 53) on the next page.

NOTE: Use care not to damage the master cylinder body and piston assembly.

- Do not disassemble the piston assembly.

Fig 53



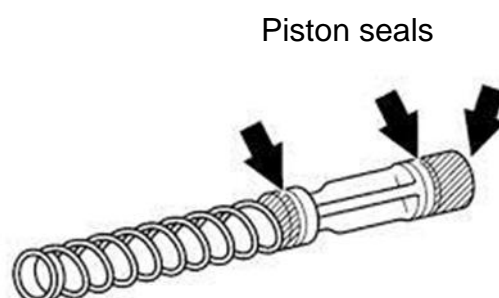
- Measure the inside diameter of the master cylinder at three places (bottom, middle, and top), in perpendicular directions.

NB: If the master cylinder-to-piston clearance exceeds the limit, replace the master cylinder assembly.

Assemble master cylinder

- Apply the specified fluid to the inner surface of the master cylinder body and to the entire periphery of the piston assembly (Fig 54).

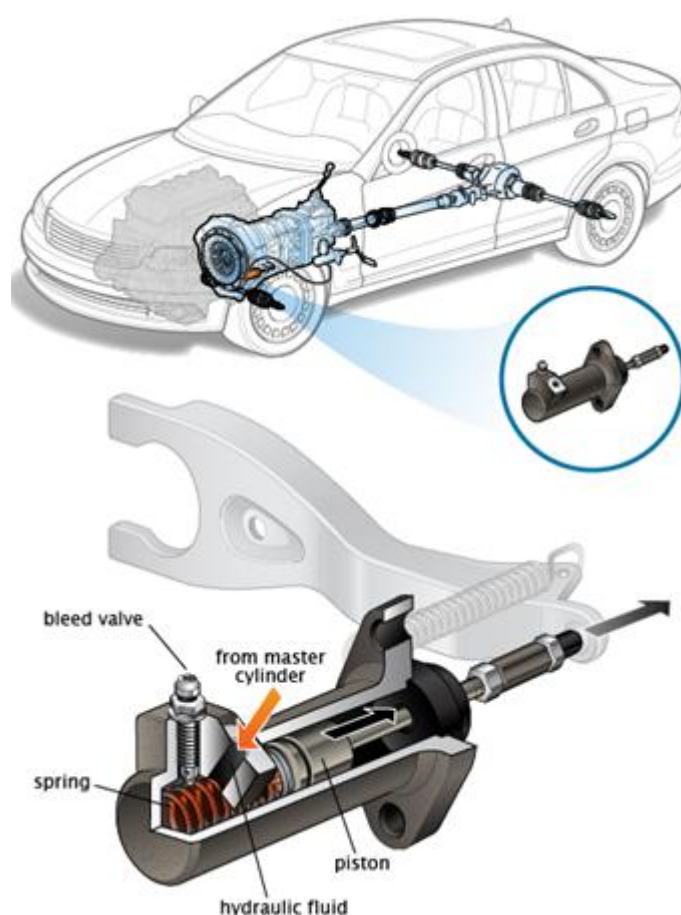
Fig 54



- Install the piston assembly.
- Install the push rod.
- Install the reservoir to the master cylinder body.

Slave Cylinder (Fig 55).

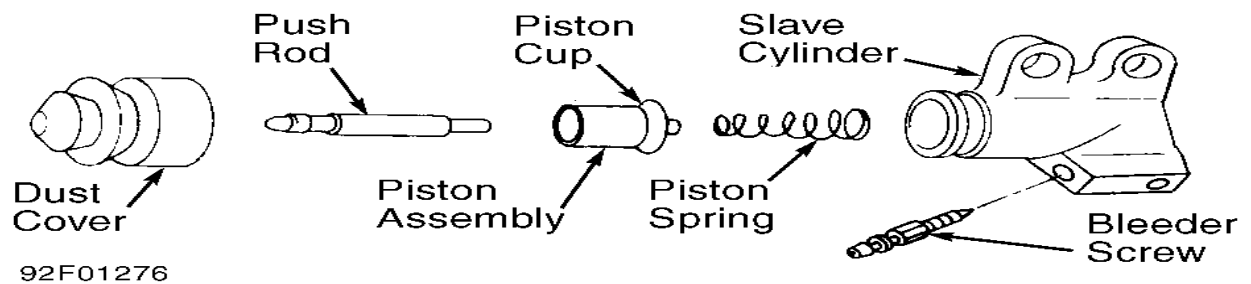
Fig 55



- Raise the vehicle and safely support with jack stands.
- Unscrew the hydraulic line from the release cylinder.
- Unhook the release fork return spring from the cylinder.
- Unfasten the nuts which secure the release cylinder to the transmission/transaxle.
- Installation is performed in the reverse order of removal. Bleed the hydraulic system as detailed below, and adjust the release fork free-play as previously described.

CLUTCH SLAVE CYLINDER COMPONENTS (Fig 56)

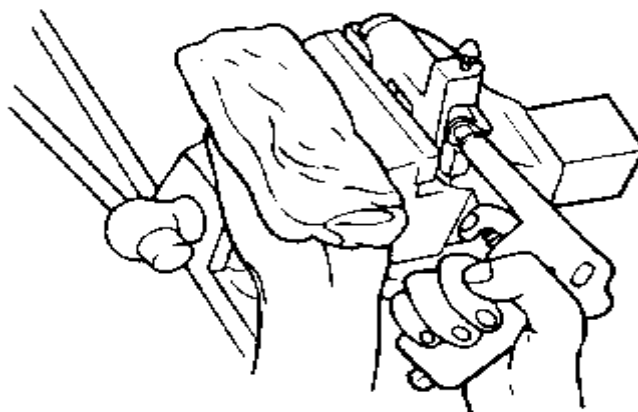
Fig 56



DISASSEMBLE THE CLUTCH SLAVE CYLINDER (Fig 57)

- Remove the clutch hose, valve plate, spring, push rod and boot.
- Remove any dirt from the piston bore opening of the release cylinder.
- Remove the piston from the release cylinder using compressed air. (Fig 57)

Fig 57



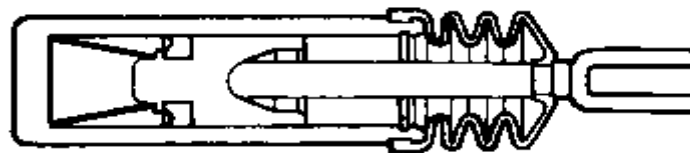
NB

- Cover with rags to prevent the piston from popping out and causing injury.
- Apply compressed air slowly to prevent the fluid from splashing in your eyes or on your skin.
- Check the clutch release cylinder for fluid leakage.
- Check the clutch release cylinder boots for damage.
- Check the release cylinder bore for rust and damage.
- Measure the release cylinder bore at three locations (bottom, middle and top) with a cylinder gauge and replace the release cylinder assembly if the bore-to-piston clearance exceeds the limit.

REASSEMBLY (Fig 58)

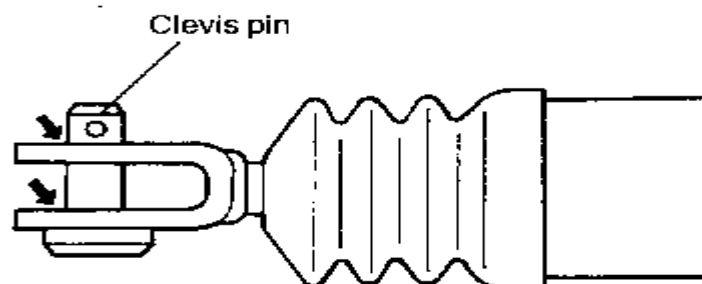
- Apply specified brake fluid to the release cylinder bore and the outer surface of the piston and piston cup, and push the piston cup assembly into the cylinder.
- Install the clutch hose, valve plate, spring, push rod and boot.

Fig 58



- Coat the clevis pin with the specified grease. Align the hole in the end of the release cylinder push rod with that of the clutch release fork shaft and insert the clevis pin into the holes. (Fig 59)

Fig 59



Bleeding the Clutch System

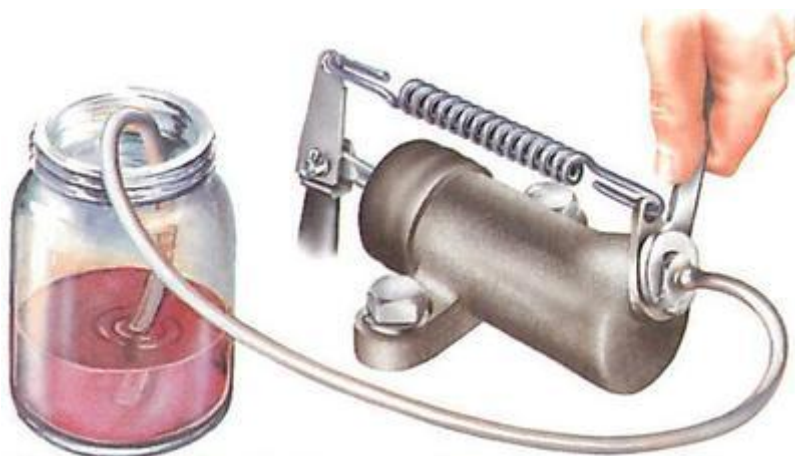
CAUTION: Brake/clutch fluid damages painted surfaces. Immediately clean any spilled fluid. During the bleeding procedure, the reservoir must be kept at least 3/4 full.

- Fill the master cylinder reservoir with clean brake fluid.
- Check the fluid level often during bleeding procedure; do not let the reservoir fall below half full.

Bleeding sequence

- Pour about an inch of new hydraulic fluid into a clean jar, and stand it on the ground under the slave cylinder.

Fig 60



- Put the free end of the bleed tube into the jar, below the surface of the fluid. Air and fluid from the system will be pumped into the jar. (Fig 60)
- Remove the bleed-nipple dust cover on the slave cylinder and fit the bleed tube as described. The nipple is easily damaged, so use a spanner of the right size to unscrew it about three-quarters of a turn.
- Get an assistant to press the clutch pedal smartly all the way down, then release it quickly. If bubbles flow from the end of the pipe in the jar, pump the pedal until no more appear. Keep the end of the tube immersed in the fluid all the time.
- If after six pedal strokes the bubbles have not cleared, top up the reservoir before you continue pumping. Otherwise, more air will be drawn into the system and it will have to be bled again.

- When the system is free of air, get the helper to hold the pedal down while you tighten the nipple.
- Before you remove the bleed tube and jar, depress the clutch pedal to ensure that the pressure required is normal.
- Top up the fluid reservoir and screw the cap on firmly. Get your helper to work the pedal vigorously several times while you inspect all the joints and piping of the system for leaks.
- Unless the end of the bleed tube is covered with fluid, air will be sucked into the system during pumping.

NB: When find difficult to get rid of all the air, firstly bleed air out at clutch master cylinder by applying pedal three times. Keep the pedal all the way down and now open bleeding nipple / hose at slave cylinder slowly to let air escape. Repeat steps until the fluid is free of air bubbles. Then bleed complete system as described.

FAULT FINDING

You must be able to give the reasons for a clutch not releasing and slipping. Table 1 gives these reasons and how to correct the faults.

TABLE 1		
SYMPTOM	CAUSE	REMEDY
Clutch will not release	Oil or grease on friction plate	Install new friction plate
	Improper pedal adjustment	Adjust clutch pedal free travel and linkage
	Damaged pressure plate or clutch cover	Replace defective part
	Friction plate hub binding on splined drive pinion	Clean up splines and smear with small quantity of grease
	Distorted friction plate. Broken facings on friction plate	Install new friction plate
	Dirt or foreign matter in the clutch	Remove clutch from flywheel and clean with dry rags. See that all working parts are free.
Clutch slip	Oil or grease on friction plate	Install new friction plate
	Weak or soft pressure springs	Install new set of pressure springs
	Binding of clutch pedal mechanism preventing its full return to stop	Free bearings
	Improper pedal adjustment preventing full engagement	Correct pedal adjustment
	Clutch facing worn	Install new friction plate
Clutch Grabs or Shudder	1. Engine mounting loose or damaged 2. Clutch disc run out is excessive 3. Clutch disc glazed, oily or worm out	Tighten or install new mounting Replace Clutch disc Replace Clutch disc

DO THE SELF-TEST ON THE NEXT PAGE BEFORE CONTINUING WITH THE REST OF THE MODULE



SELF-TEST

What causes a clutch not to release?

What causes a clutch to slip and to grab or shudder?

Give possible causes and the remedies in each case.

TABLE 1		
SYMPTOM	CAUSE	REMEDY

Compare your answers with the notes.

If your answers were not all correct, read the notes over and repeat the test.

PRACTICE

- Overhaul a complete clutch system and all relevant components.



Ask your Training Officer to check your work and to sign you off when it is correct.

LEARNER	TRAINING OFFICER
Date:	Date:
Signed:	Signed:



EMEMBER ALWAYS WORK SAFE

Once you have passed the self-test and practice, you are now at liberty to request a Formative Assessment from your Assessor.