4.2 CLUTCH :

The clutch is a mechanism with the help of which the engine is connected or disconnected at will, whenever required, from the rest of the transmission.

4.2.1 Principle of Clutch :

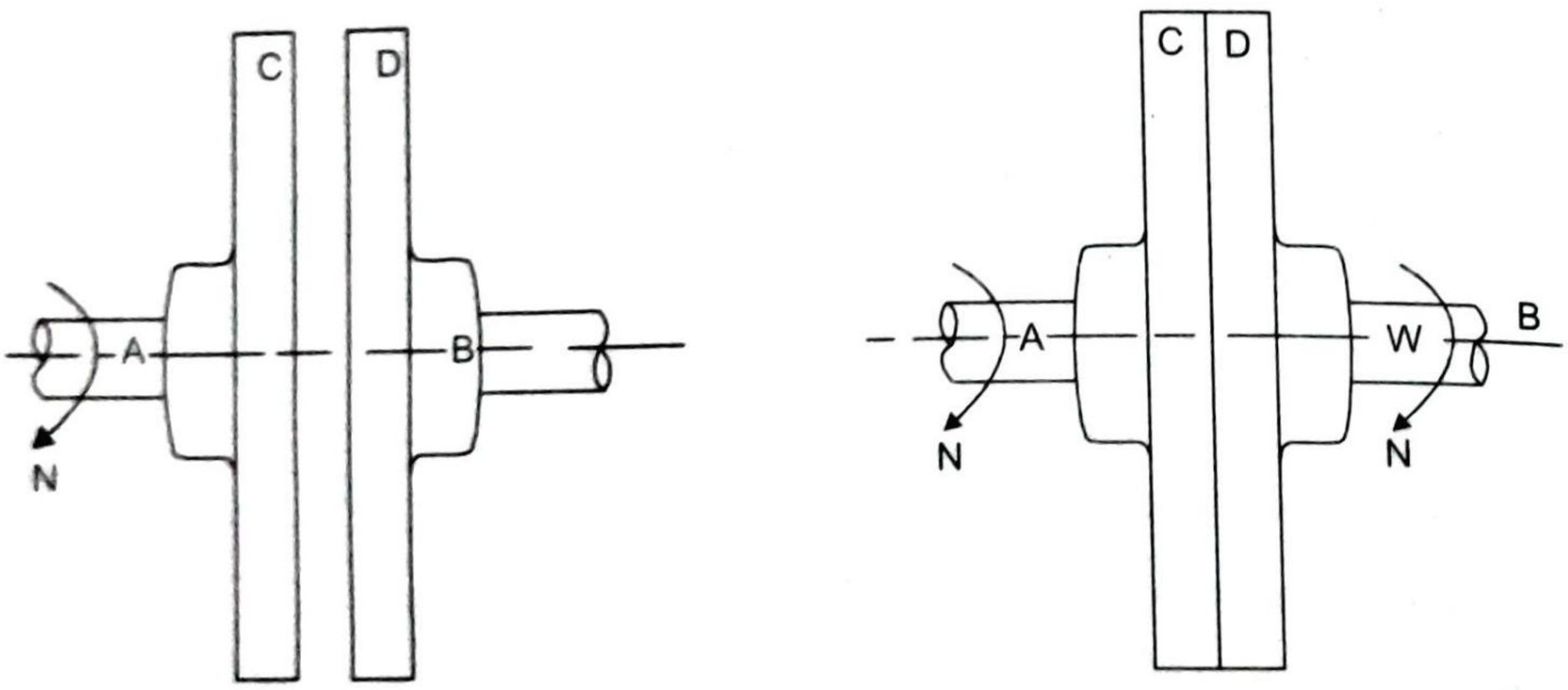

Fig. 4.2 Principle of friction clutch

The principle of Friction Clutch is easy to explain with the help of the figure shown in 'Fig. 4.2'. Let us assume that shafts A and C are revolving at N rpm: Initially, at this state shaft B and disc D should be held stationary. Thus the clutch is not engaged. When some force 'F' is applied to 'D' and when it is made to have contact with C, the friction between C and D will have

its effect. Consequently, D will also start rotating. The speed of D depends upon C and frictional force which is supplied by increasing the force F. Gradually the speed of D and E will become equal. Then the clutch is said to be completely engaged.

Therefore, Torque transmission $T = \mu FR$

Where μ = Co-efficient of friction; T = Torque, R = effective mean radius of friction surface.

4.3 NEED AND TYPES :

Clutches are normally classified as positive clutch and gradual engagement clutch:

1. Friction Clutch
   (i) Wet clutch (ii) Dry clutch (iii) Cone clutch (Either internal or external clutch).
2. Centrifugal clutch.
3. Semi centrifugal clutch.
4. Conical spring clutch or diaphragm clutch.
5. Positive clutch.
6. Hydraulic clutch.
7. Electro magnetic clutch
8. Vacuum clutch
9. Over running clutch or free wheel clutch.

4.3.1 Requirements of Clutch :

1. Gradual engagement.
2. Torque transmission.
3. Heat dissipation.
4. Vibration damping.
5. Dynamic balancing,
6. Free pedal play.
7. Ease of operation.

4.3.2 Functions of Clutch :

1. To engage or disengage the rest of the transmission as required.
2. To transmit the engine power to the rear wheels without shock.
3. To enable the gear to get engaged when the vehicle is in motion.

Whenever the load of the body is applied to the engine, the u will be carried. This will produce unnecessary damping and vibration may get damaged. Therefore, some device is essential to relieve the load on the engine and disconnect the transmission temporarily to adjust the engine to meet the demand. The transmission also must be disconnected, while the engine is idling or about to stop. For this purpose, the clutch is used in the transmission between the engine and the gearbox. The clutch is disengaged when shifting and changing gears, and during idling. The clutch is a device used to engage and disengage the engine with the rest of the transmission.

4.4 CONE CLUTCH :

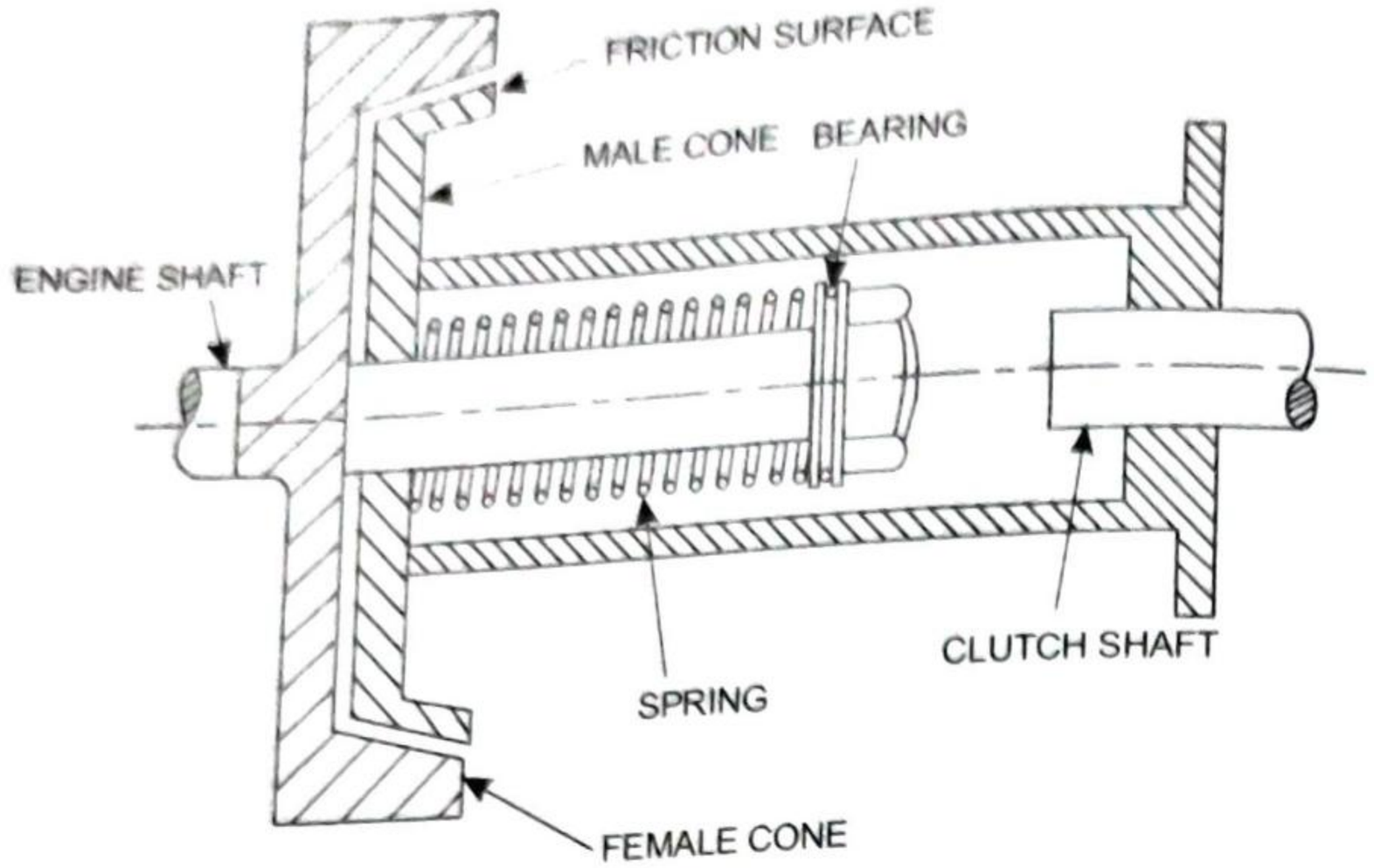

Fig. 4.3 Cone clutch

Cone clutch is a friction type clutch, which consists of conical friction surfaces. The female cone is an integral part with engine shaft. The male cone is mounted on the clutch shaft over splines, so that it can slide over. In this clutch the frictional surfaces are only on the conical portion. The arrangement is shown in fig. 4.3. When the clutch is engaged, the male cone come in contact with the frictional surfaces of the female by means of the spring force. By pressing the clutch pedal, the male cone slides against the spring force and the clutch is disengaged. In fully engaged condition, the male cone remains fully with in the female cone so that the friction surfaces remain in complete contact. In the engaged position the power is transmitted from the engine shaft to the female cone, hence from the male cone to the gearbox through the splined shaft. When the clutch system is disengaged, the male cone is drawn or pulled out, thereby the contact surfaces are made free. But now-a days this type of clutch is obsolete.

Advantages :

1. The normal force acting on the friction surface is greater than the axial force as compared with that in the single plate clutch.

Disadvantages :

1. If the angle is less than 20^0, the male cones have a tendency to bind in the female cone. In this case it becomes very difficult for disengagements.
2. Even a little amount of wear on the conical surfaces results in a considerable amount of movement of male cone in axial direction

4.5 SINGLE PLATE CLUTCH :

Single plate clutch is shown in figure 4.4.

It consists of the following main parts :

1. Driving Plate.
2. Driven Plate.
3. Pressure Plate.

4.5.1 Driving plate :

Engine fly wheel will be the driving member of the clutch. The fly wheel is fitted to the cover which encloses the pressure plate, pressure spring and releasing lever.

4.5.2 Driven plate :

This is in the form of a disc or plate and free to slide on the splines of the clutch shaft. At its outer facing, this plate contains a lining of heat resisting material with a high coefficent of friction. These linings are rivetted . When it is gripped, it provides frictional contact between the fly wheel and the pressure plate and rotates as a whole. Springs are provided so that when the torque is applied to the clutch plate, the spring compresses .Any shock present is safely absorbed. Thus, springs provide a cushioning effect.

4.5.3 Pressure plate :

The pressure plate is connected to the flywheel. This holds the clutch plate assembly consisting of pressure disc, spring operating fingers and holding down cover. The pressure plate will be Withdrawn from the fly wheel whenever the release levers are pressed by the operating mechanism. This consists of foot pedal, linkages, release or bearing. A fork is provided to hold, release and move the release bearing over the clutch shaft. The operation of the fork is by means of a foot-pedal.

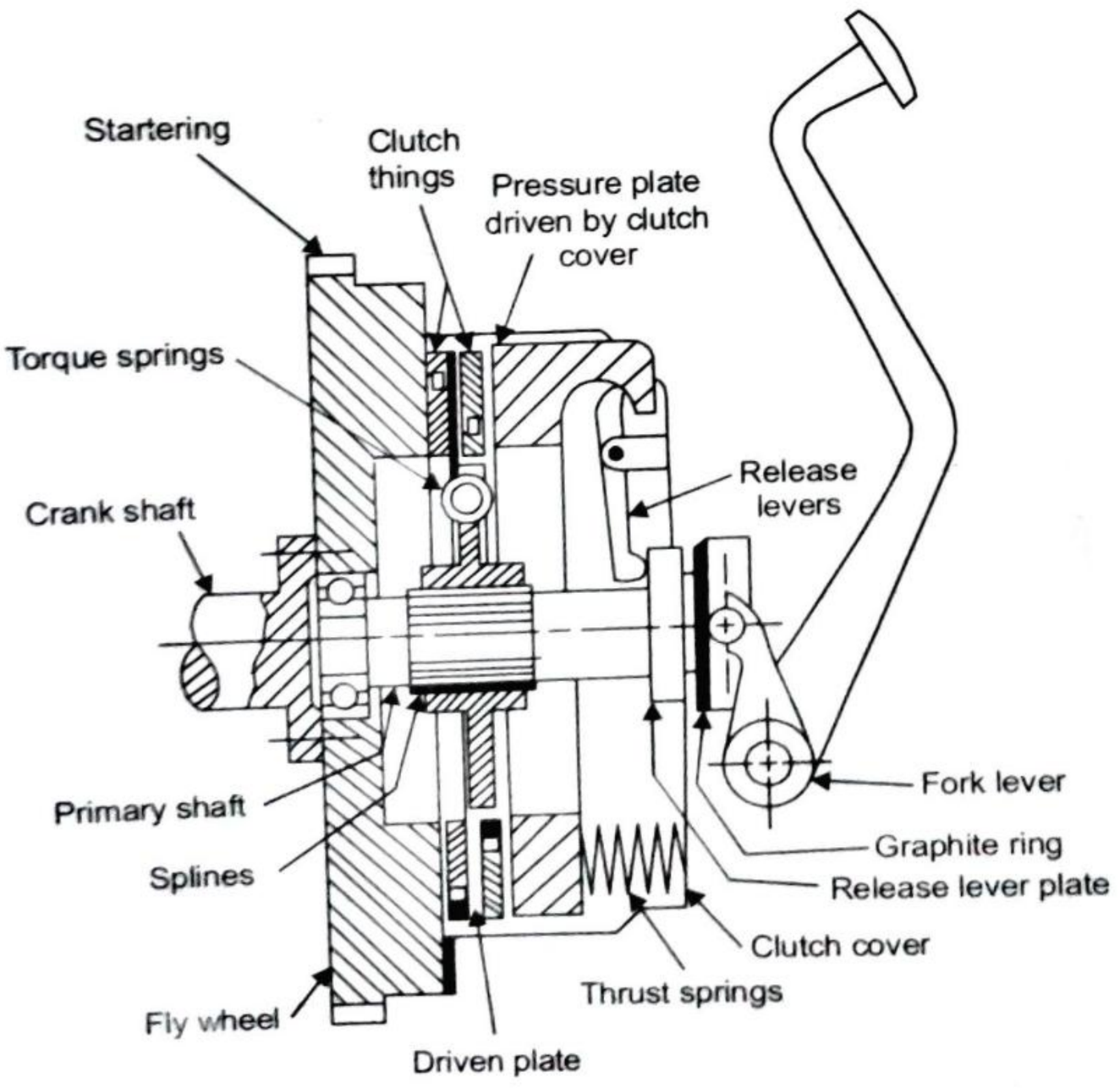

Fig. 3.4 Single Plate Clutch

4.5.4 Working :

When pressure is applied to the foot pedal, the pressure is transmitted through the release finger, fork and release bearing. Then, the springs are compressed and it moves back the pressure disc thus releasing the clutch plate. Now the clutch is said to be disengaged. At this stage, the pressure plate and fly wheel are free to rotate clutch plate stationary. Similarly, when the clutch pedal is released, spring pressure is fully applied on the clutch plate. The plate is held between the fly wheel and the pressure plate and rotates as a single unit. Thus the clutch is said to be engaged.

4.5.5 Clutch plate :

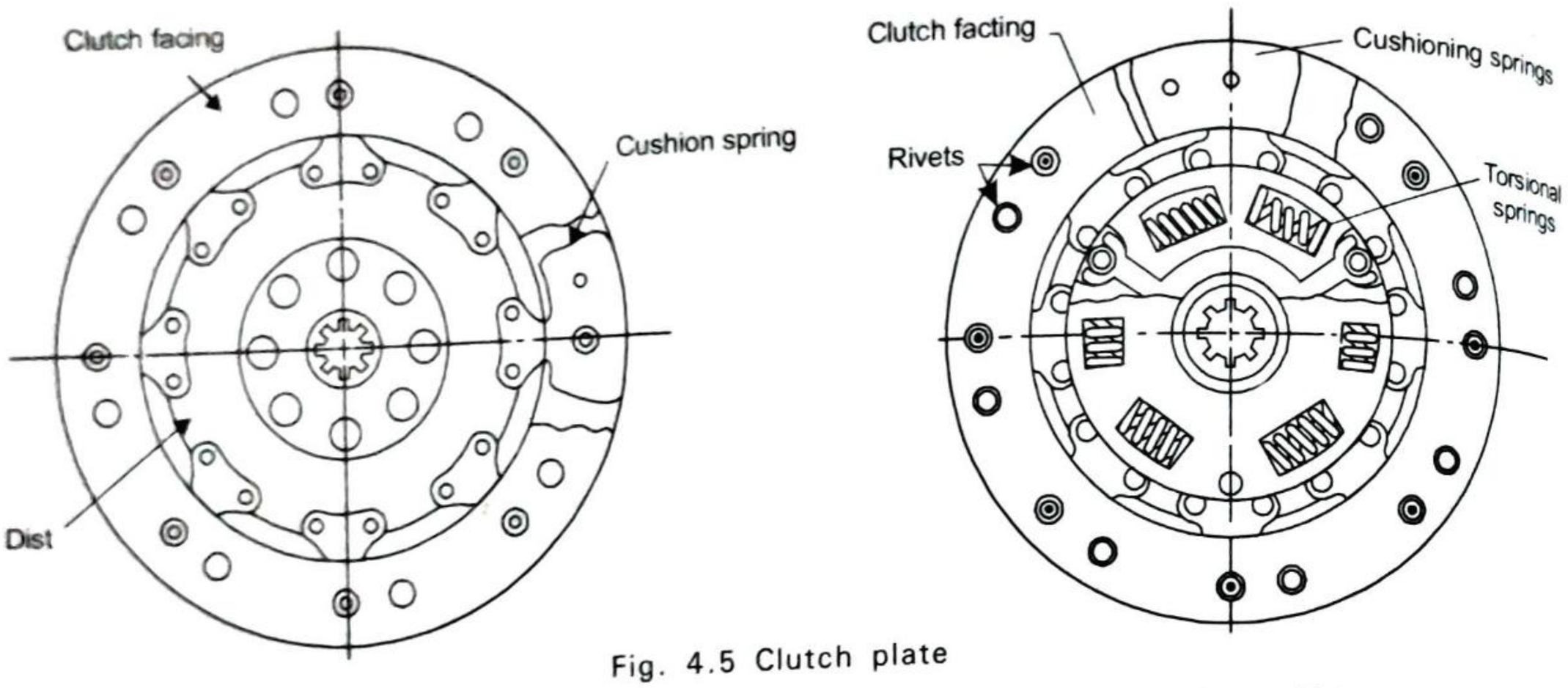

Fig. 4.5 Clutch plate

The clutch plate is made of steel. In the hub, it is splined to enable it to slide over the shaft. The friction linings are rivetted over the facing. Apart from rivetting ,special resins are used to bind the friction facings. There are a number of curved cushion spring segments rigidly attached over the central plate as shown in figure linings are rivetted only to these springs.

The clutch plate is made of two parts :

1. Central hub made of two parts.
2. Outer face ring assembly.

These two parts are torsionally flexible with respect to each other .The central plate assembly consists of radial slots.

There are two plates, one on either side of the hub flange. These plates are provided with similar slots as shown in fig.4.5. Compression springs are fitted in-these slots; coil springs provide flexible torsion between the central hub flanged and the side plates. These side plates are rivetted to the main clutch plate by barrel rivets

Advantages :

1. The construction is very simple.
2. Only a little effect of the driver is needed for operation.
3. Clutch plate is durable.
4. Friction lining can be replaced as and when required.

MULTIPLATE CLUTCH :

This is almost similar to a single plate clutch but consists of a number of clutch plates When more number of clutches are provided, the capacity of the clutch for transmission is increased for the same size. Instead of a single plate clutch a number of plates are alternately connected to the engine shaft and the gear box shaft as shown in figure 4.6.

One set of plates slide in grooves of the fly wheel and the other slides on the splines of the pressure plate hub. The plates are firmly pressed by a coil enclosed in a drum. The working of the multiple plate clutch is similar to that of a single plate clutch. This type of clutch is used for heavy transport vehicles, racing cars and motorcycles. This arrangement may be dry or wet, depending on the fact whether it is operating in oil bath or not.

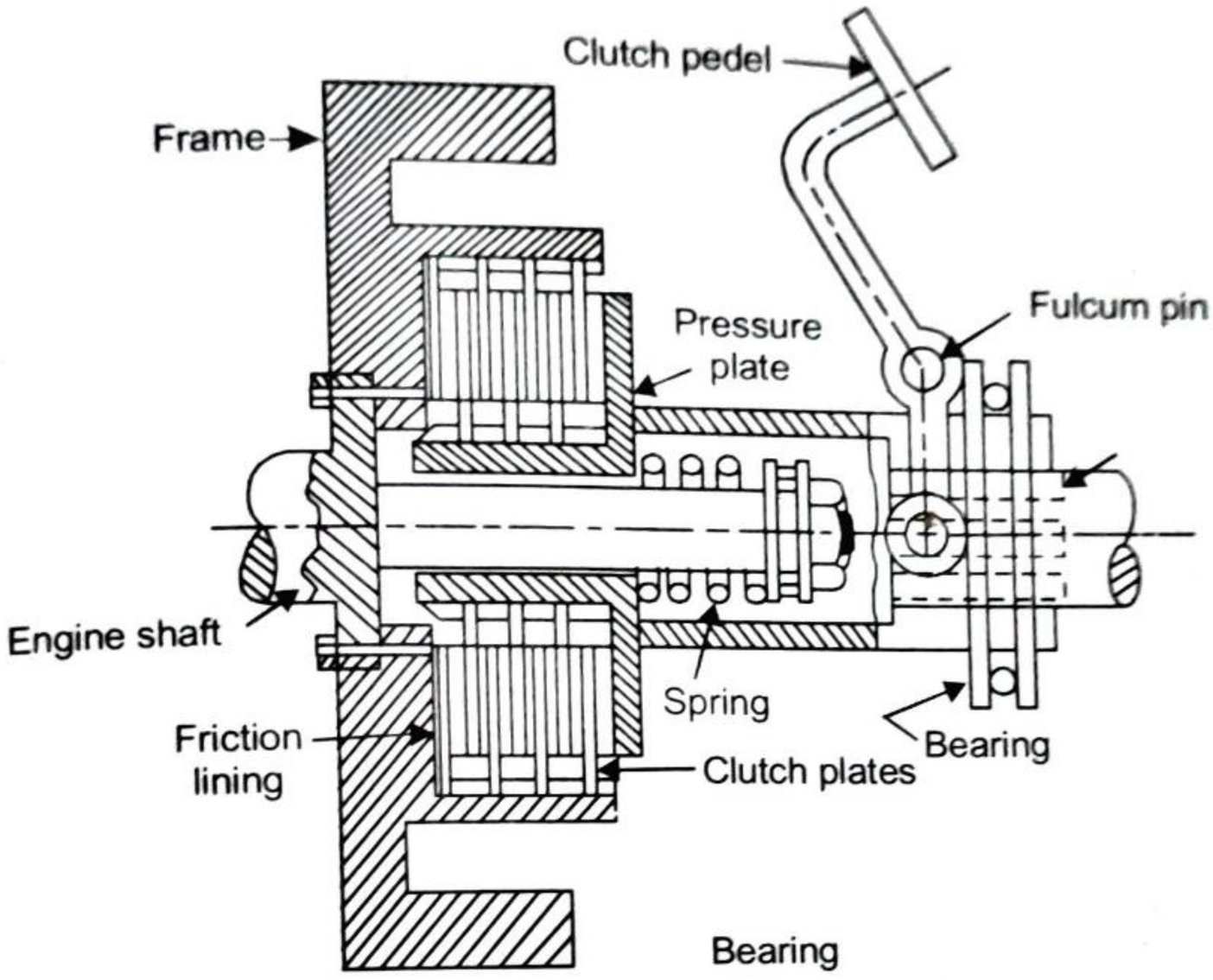

Fig. 4.6 Multiple plate clutch

4.6.1 Operation of the Clutch :

Basically, it is similar to a single plate clutch. The pressure plate presses against the friction plate and rotates along with the fly wheel. When the driver presses the pedal, the friction plates are released, the fly wheel continues to rotate; but the clutch shaft stops to rotate.

4.7 MAGNETIC CLUTCH :

In magnetic clutch the clutching medium is mixture of magantizable metal and dry lubricant. A magnetic clutch shown in figure 4.7. As magnetization takes place, the dry powder particles are drawn together, so as to form a solid drive unit. Apart from the usual clutch components, magnetic clutch consist of a coil fully enclosed by a magnetic circuit

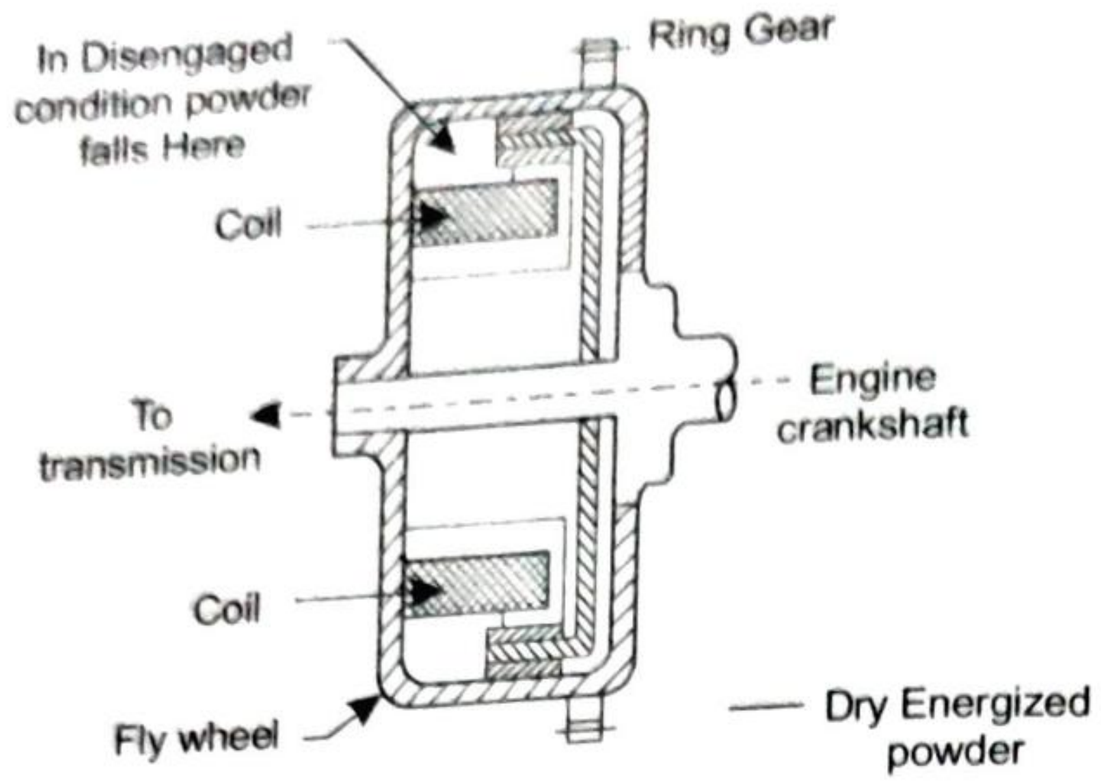

Fig. 4.7 Magnetic clutch

The fine metal used in the mixture generally consists of steel, nickel and carbon .The fine metal and lubricant particles form a strong bond for low- transmission. The mixture frozen in engaged position and unfrozen in disengaged position. This freezing and unfreezing is in direct proportion to the amount of current applied on the coil. Therefore the driver can make the extent of slippage or solid drive as per the need.

4.8 ELECTROMAGNETIC CLUTCH :

The principle of electromagnetism is applied in the operation of electromagnetic clutch. There is no need of linkages for its engagement or disengagement. This is not suitable for remote operation. This has been employed in Renault Cars.

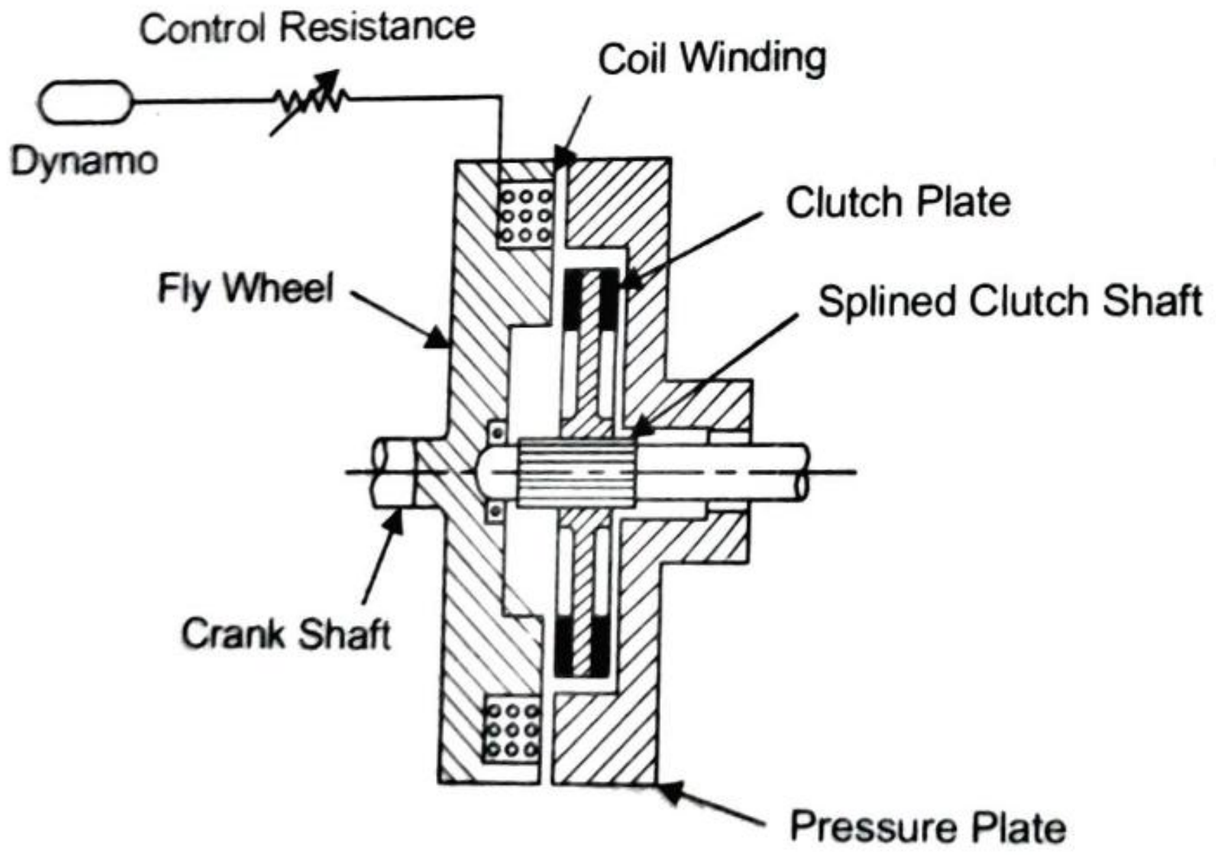

Fig. 4.8 Electromagnetic clutch

Figure. 4.8 shows a typical construction of an electromagnetic clutch. Like the conventional clutch, this also consists of flywheel, pressure plate, clutch plate, and splined shaft. This incorporates a coil winding which is housed in the flywheel. The dynamo supplies the electric power to the winding. The winding when energized, to engage the clutch and disengage when the supply is cut-off, attracts the pressure plate. To regulate the electromagnetic force, a control

resistance is mounted between the dynamo and the winding as shown in figure . The operation of the accelerator pedal varies the resistance. During normal running, the clutch is disengaged by pressing the accelerator pedal thereby gradually cutting -off the electrical resistance. For momentary disengagement of the clutch, during change of gears, a clutch release switch mounted on gear lever is operated. During this change, it cuts off the current to the winding. Care must be taken to see that the heating effect of the current may not cause breakdown of the coil insulation.

4.9 CENTRIFUGAL CLUTCH :

In this arrangement, the centrifugal action of fly-weights is made use of for engaging and disengaging the pressure plate. A simple arrangement is shown in figure 4.9 in which the clutch pedal and the springs are eliminated. The functioning of the clutch is automatic and depends upon the engine speed. In this arrangement, there is no need for specific operation to disengage the clutch. The vehicle can also be stopped with the gear load, without stalling the engine. The vehicle is controlled by the accelerator pressure and gear transmission at the starting only. This arrangement makes the driving operation very easy and convenient

As the speed increases, the fly-weights move outwards due to centrifugal force. This movement operates a bell crank lever and presses the floating plate. As shown in the figure, there are helical springs between the floating plate and pressure plate. The force is transmitted to the pressure plate through the springs. The pressure plate containing the friction lining presses the clutch. There is one more set of springs on the back side of the pressure plate as shown in the figure to keep the clutch in disengaged position at low speed. A projection or a strip called stop is also provided to limit the movement of the fly-weights and the amount of the centrifugal force. Even if the speed is in beyond this limit, the pressure on the plates will remain constant.

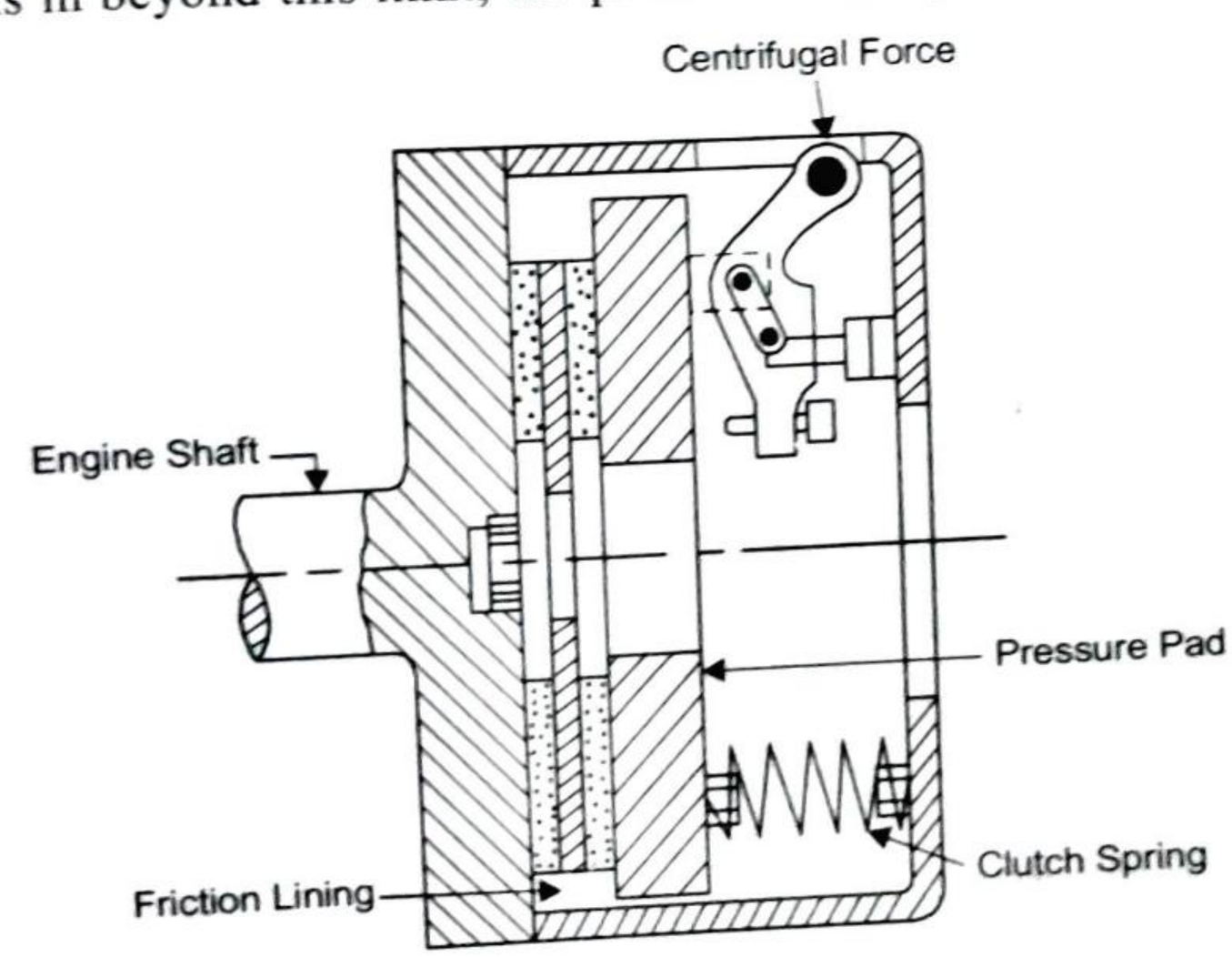

Fig. 4.9 Centrifugal Clutch

4.9.1 Semi-Centrifugal Clutch :

In this arrangement the motion is transmitted partly by the springs and partly by the centrifugal force. The spring action is effective at normal speeds like the conventional clutch.

For higher speeds the centrifugal action of fly weights is made use of .The constructional details are simplified in the figure. in this arrangement, three hinged levers three clutch springs are arranged alternatively at equal intervals.

The lever is provided with a fulcrum at the bottom, hinged to the pressure plate at the top as shown in figure 4.10. The fly weights are placed at the upper end of the lever with an adjusting screw provided at the bottom end of the lever. Centrifugal force on the pressure plate can be slightly varied by adjusting this screw. As stated earlier, the pressure of the springs is enough for torque transmission at normal speeds. When the speed increases, the fly weights move out due to the centrifugal force and operate the fulcrum to press the pressure plates.

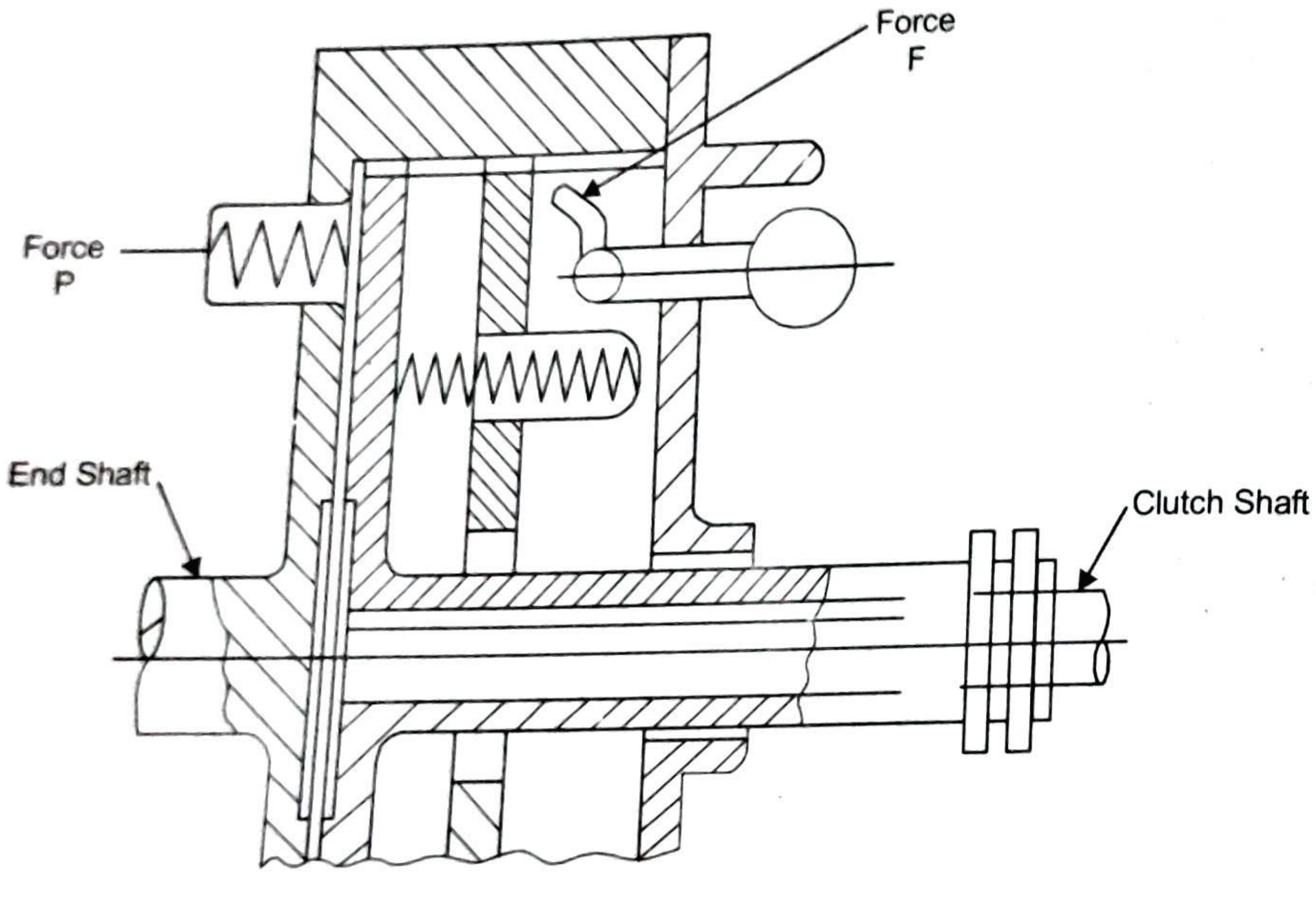

Fig. 4.10 Semi-Centrifugal Clutch