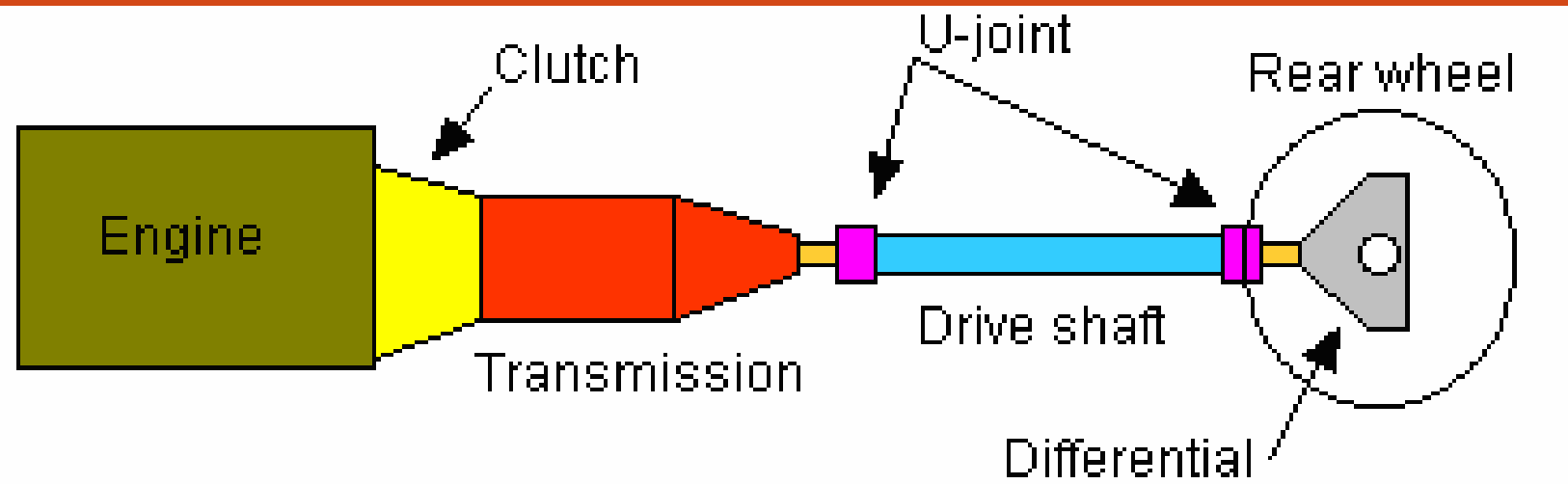




K.S.R. COLLEGE OF ENGINEERING
(AUTONOMOUS)
III – YEAR
DEPARTMENT OF AUTOMOBILE ENGINEERING
18AU511- Automotive Transmission

Automotive Transmission



Introduction

- Transmission system means the whole mechanism that transmits the power from the engine crankshaft to the wheels.
- The transmission system consists of a clutch, gear box, propeller shaft, rear axle and differential gear between the driving wheels.

REQUIREMENTS OF TRANSMISSION SYSTEM

- To disconnect the engine from the road wheels when decide.
- Connect the engine to the wheels without shock.
- To vary the leverage between engine and drive wheels.
- Reduce the engine speed permanently in a fixed ratio
- To turn the drive through a right angle.
- To make provision such that the driving wheels may rotate at different speeds while taking turns.
- To make provision for the turning of the road springs which causes a relative movement between the engine and driving wheels.

CLUTCH

- A clutch is a device which is used to engage or disengage the power from engine to gear box .
- The clutch is located between the engine and gear box
- When the clutch is engaged, the power flows from the engine to the rear wheels through the transmission system and the vehicle moves.
- When the clutch is disengaged, the power is not transmitted to the rear wheels and the vehicle stops while the engine is still running.
- The clutch is disengaged when
 - i) Starting the engine
 - ii) Shifting the gears
 - iii) Stopping the vehicle
 - iv) Idling the engine
- The clutch is engaged only when the vehicle is to move and is kept engaged when the vehicle is moving

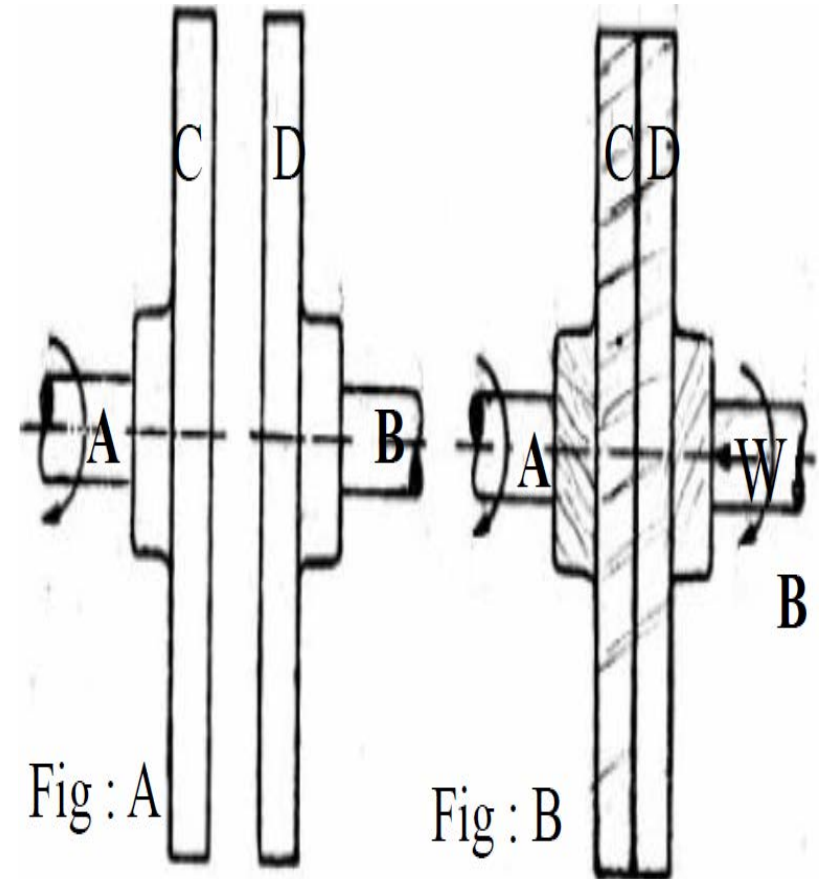
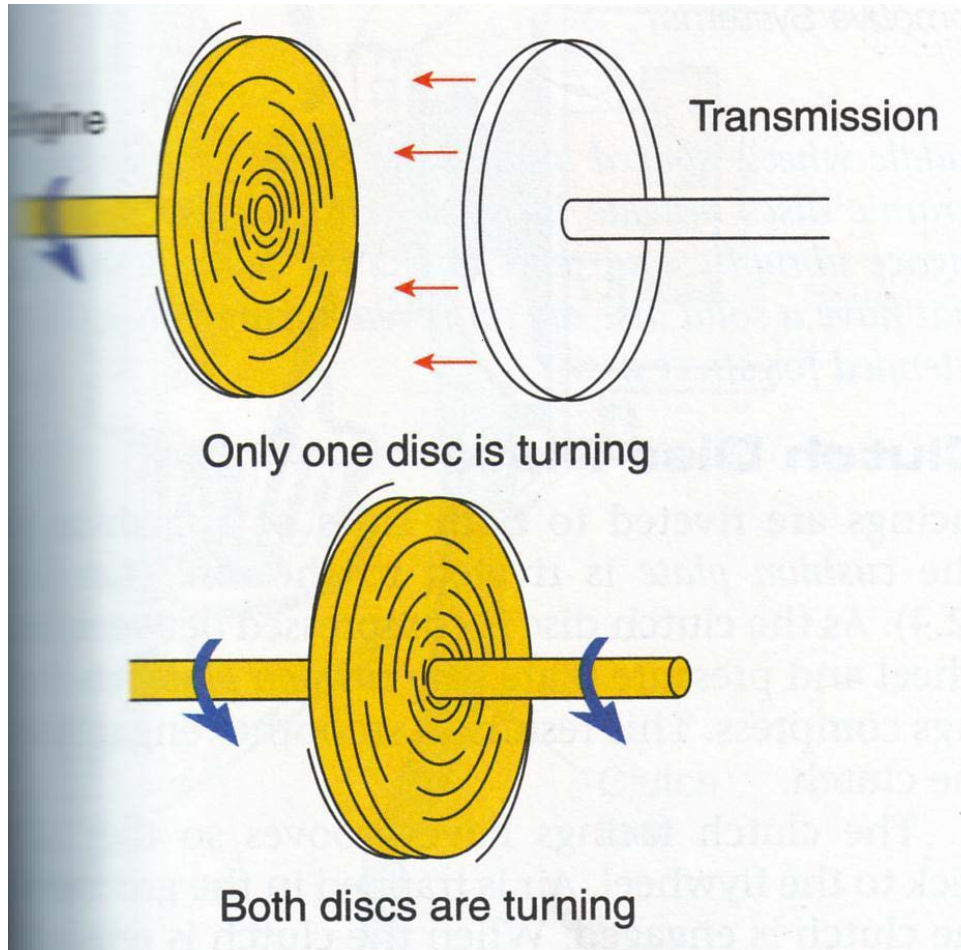
Function of a clutch

- To permit engagement or disengagement of a gear when the vehicle is stationary and the engine is running.
- To transmit the engine power to the road wheels smoothly without shock to through the transmission system while the wheel in motion.
- To permit the engaging of gears when the vehicle is in motion without damaging the gear wheels.

Types of clutch

- Friction clutch
 - Single plate clutch
 - Coil spring clutch
 - Diaphragm clutch
 - Multiplate clutch
 - Wet
 - Dry
 - Cone clutch
- Centrifugal Clutch
- Semi-centrifugal clutch
- Electromagnetic clutch
- Overrunning clutch or freewheel unit

Basic Principle of friction clutch



Here , One surface is considered as driving member and the other as driven member

Principle of friction clutch explanation

- Let shaft “A” and disc “C” be revolved at same speed, say N r.p.m
- Shaft “B” and the disc “D” keyed to it are stationary, initially when the clutch is not engaged.
- Now apply some axial force “W” to the disc “D” so that it comes in contact with disc “C”.
- As soon as the contact is made, the force of friction between “C” and “D” will come in to play and consequently the disc “D” will also start revolving .
- The force of “D” depends upon the friction force present, which is turn, is proportional to the force “W” applied.
- If “W” is increased gradually, the speed of “D” will be increased correspondingly till the stage comes when the speed of “D” becomes equal to the speed of “C”
- Then the clutch is said to be fully engaged

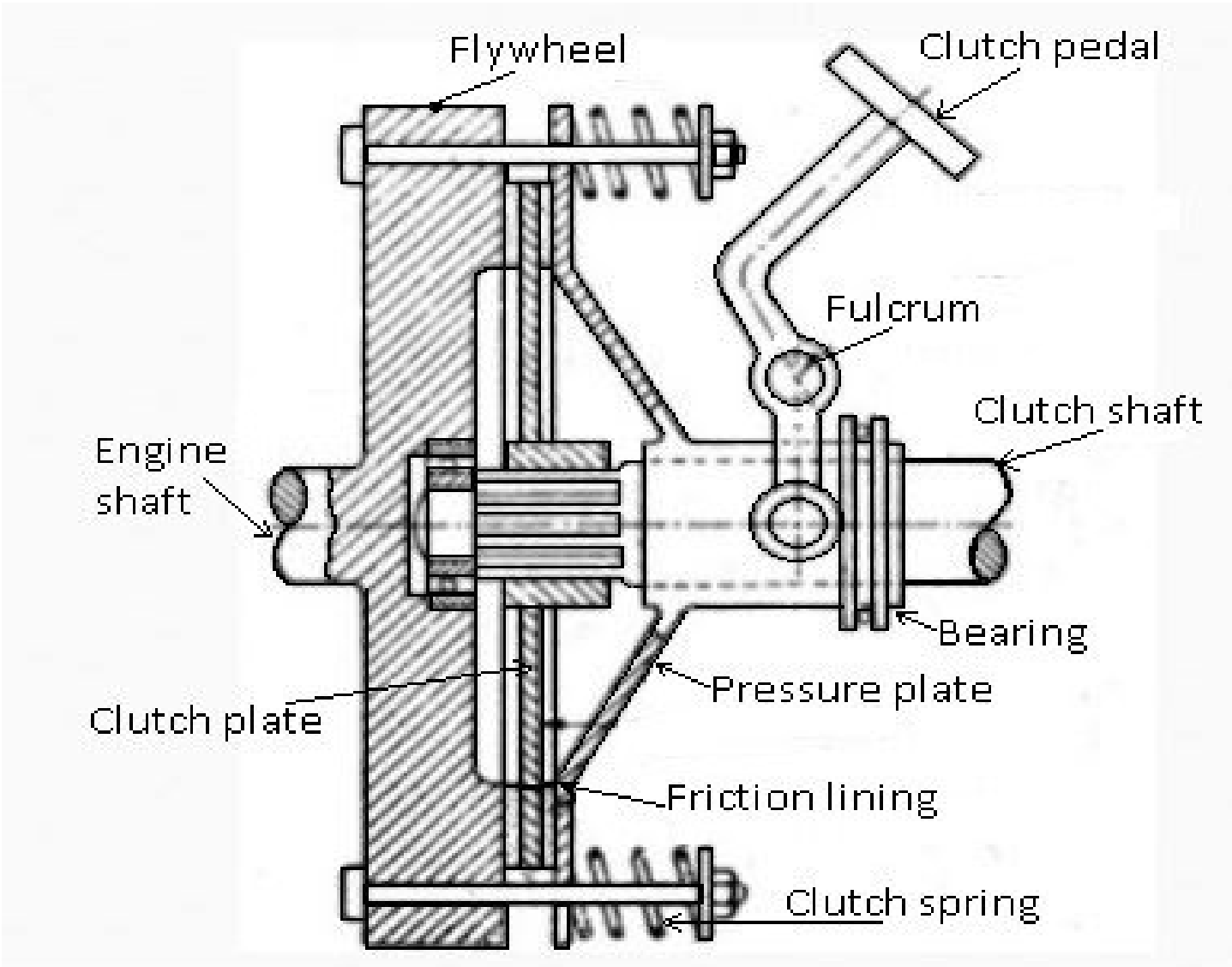
- *The torque transmission between the two surfaces depends upon*
- *i. Area of the surface (R-Radius),*
- *ii. Pressure applied upon them, (pedal force W)*
- *iii. Coefficient of friction of the surface materials (μ)*

$$T \propto WR$$

$$T = \mu WR$$

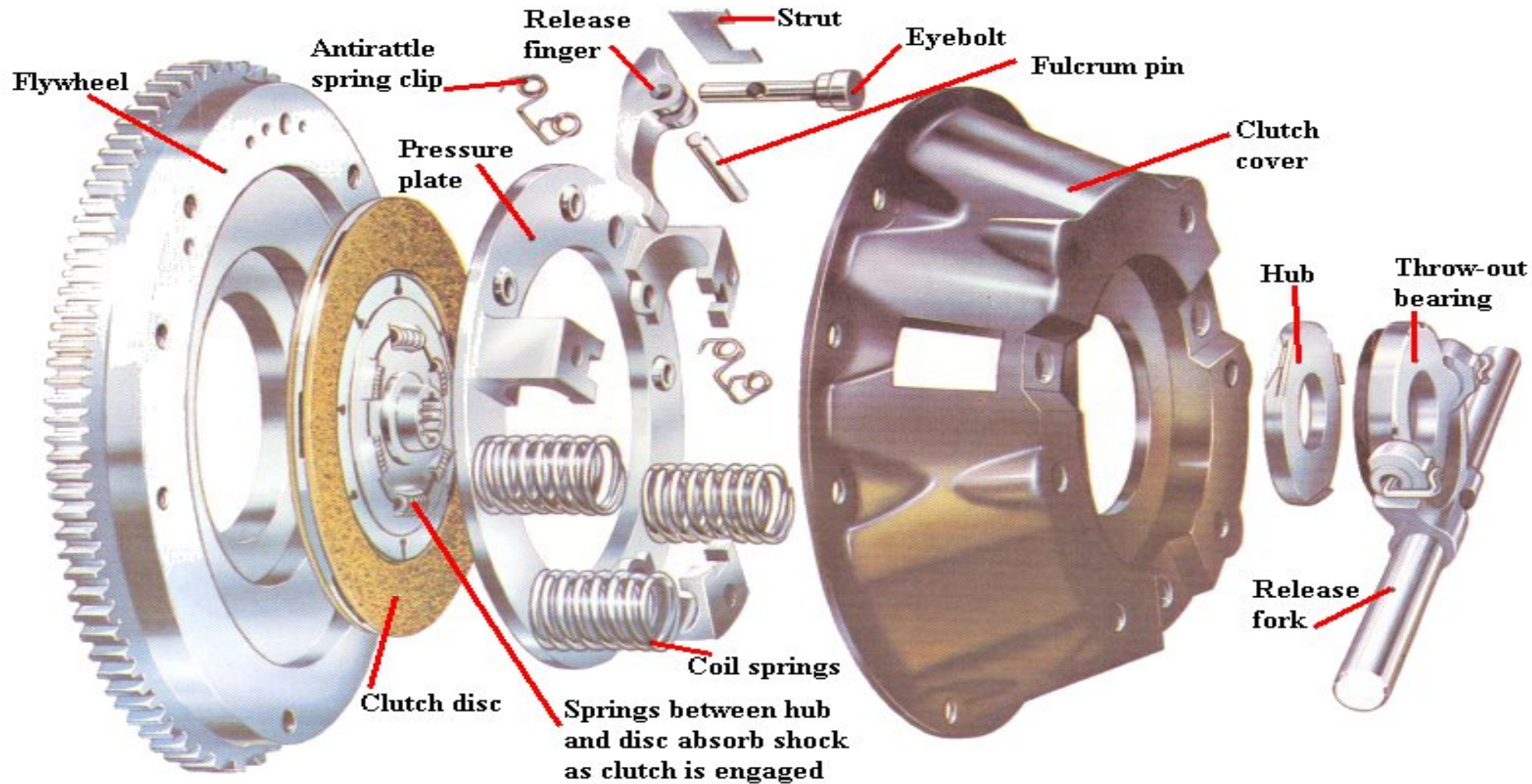
Single plate coil spring clutch

- The single-plate clutch has only one plate which is attached on splines of the clutch plate. Single plate clutch is one of the main components of the clutch. The clutch plate is simply thin metallic disc which has both side friction surfaces.
- It consists of a clutch plate, pressure plate, flywheel, bearings, coil(clutch) springs.



SINGLE PLATE CLUTCH

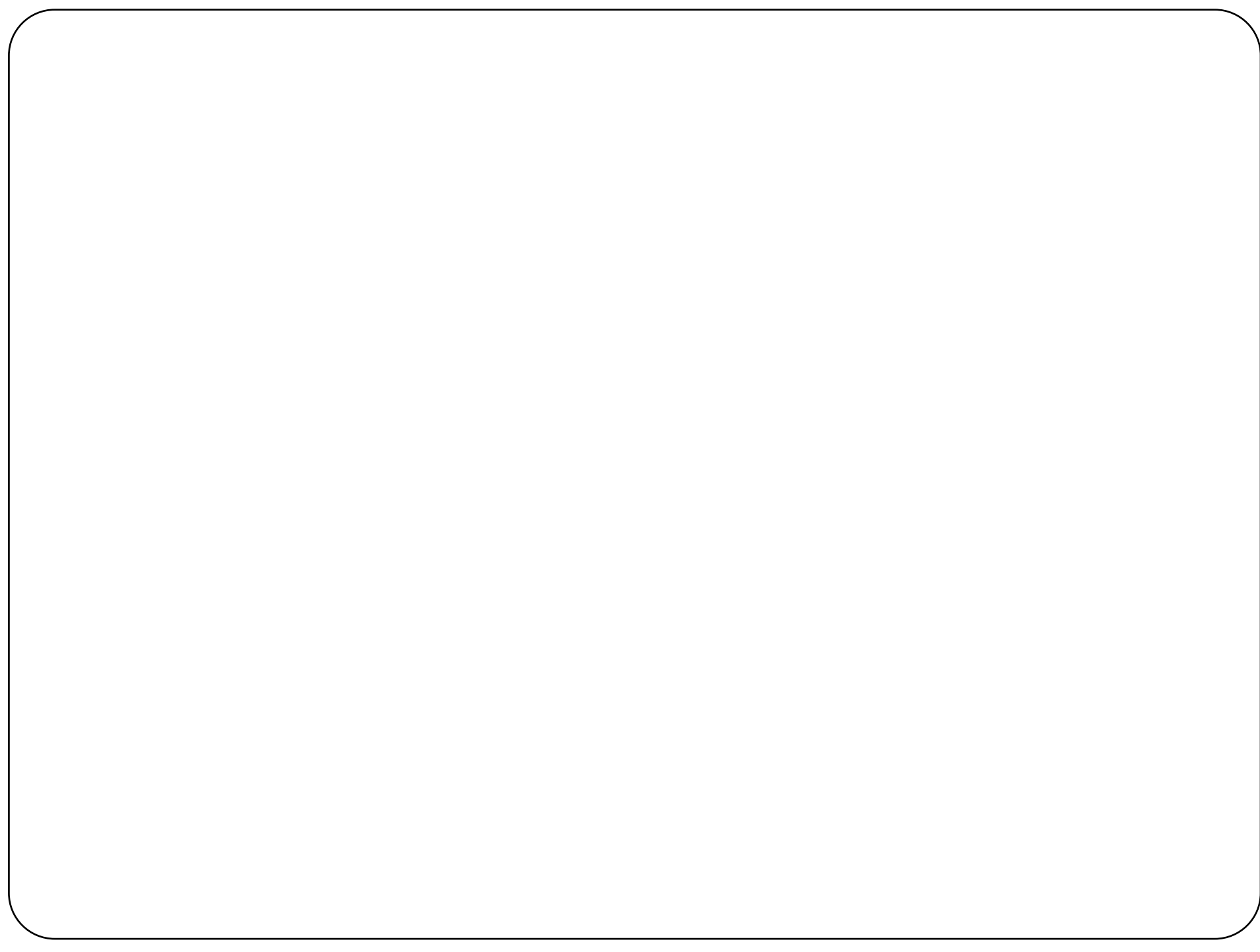
Exploded view of single plate coil spring clutch



- The flywheel is attached on the engine crankshaft and rotates with it. A pressure plate is bolted to flywheel through clutch spring, which provides the axial force to keep the clutch engaged position, and is free to slide on the clutch shaft when the clutch pedal is operated

Working:

- In a vehicle, we operate the clutch by pressing the clutch pedal for disengagement of gears. Then springs get compressed and the pressure plate moves backwards. Now the clutch plate becomes free between the pressure plate and flywheel.
- Due to this now the clutch is getting disengaged the engine power and able to shift the gear.
- This makes flywheel to rotate as long as the engine is running and the clutch shaft speed reduces slowly and then it stops rotating. As long as the clutch pedal is pressed, the clutch is said to be disengaged, otherwise, it remains engaged due to the spring forces. After releasing the clutch pedal the pressure plate comes back to its original position and clutch is again engaged.

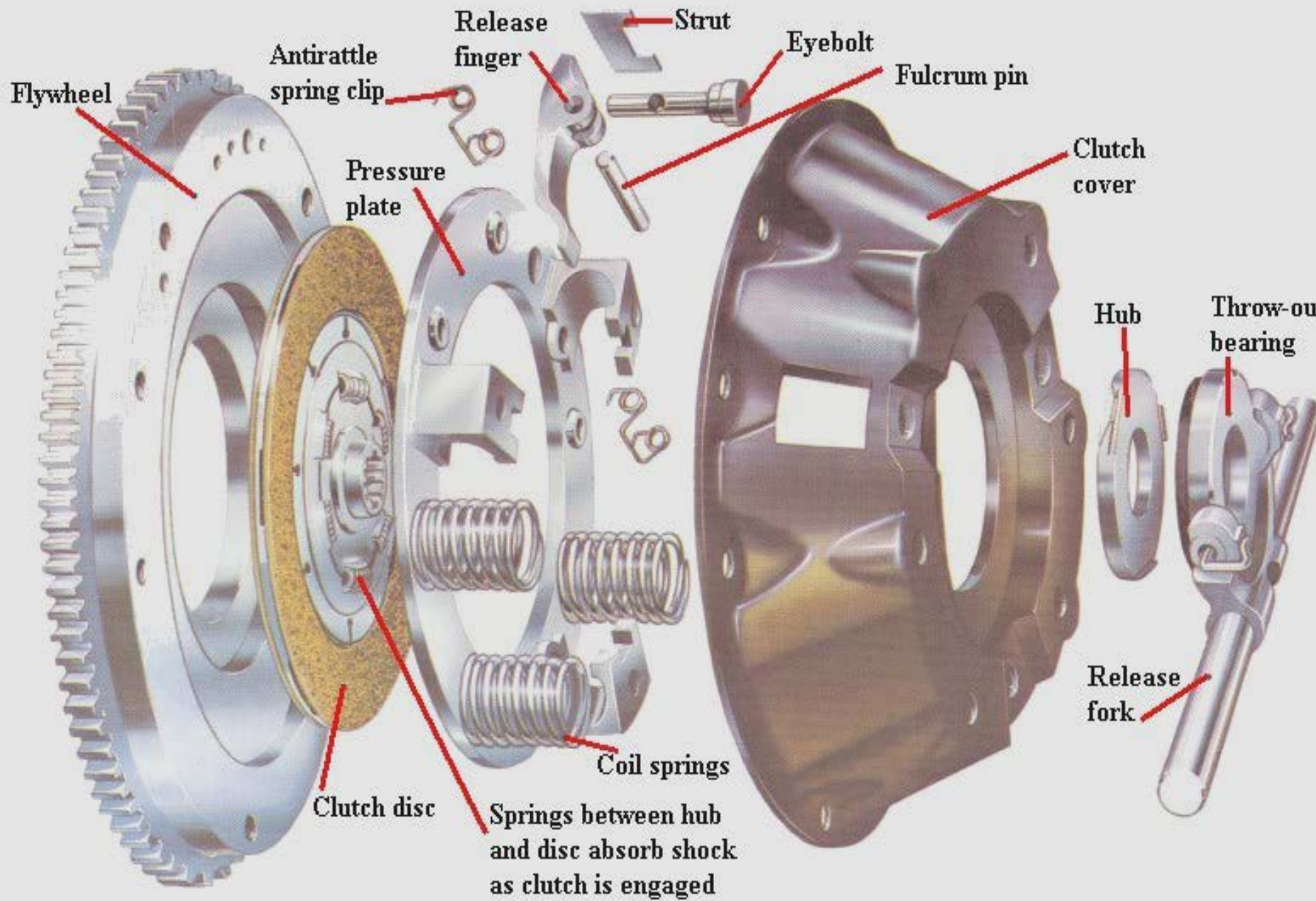


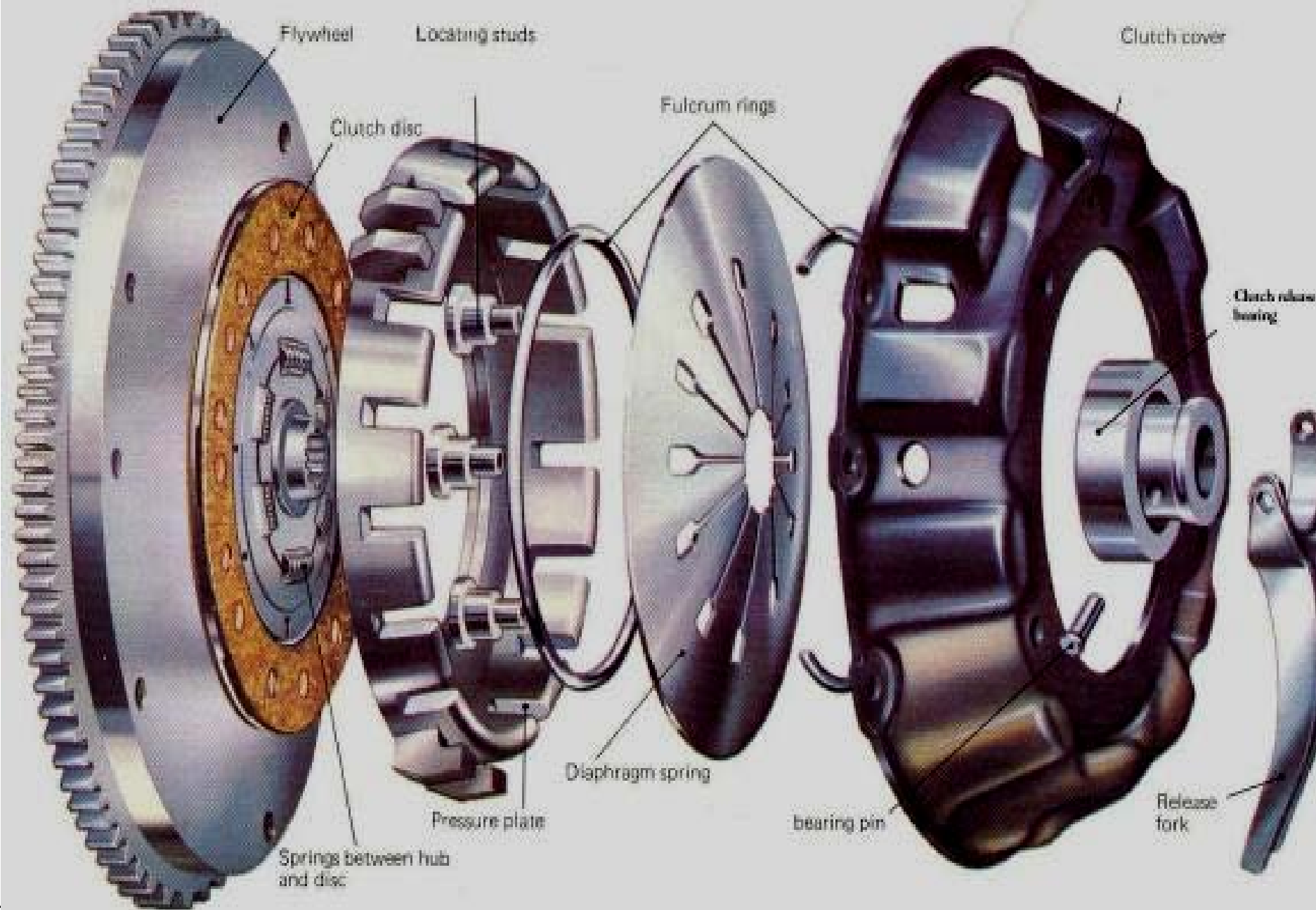
Diaphragm Clutch

- It is similar to a single plate clutch except that the diaphragm spring called *Belleville spring* is used instead of the ordinary coil spring.



Diaphragm spring





Construction

- **Parts of the clutch**

A clutch consists of two parts, the pressure plate and the disc. The disc contains the friction material and is coupled to the input shaft of the transmission. The pressure plate contains the diaphragm spring, the pressure ring and the cover. The pressure plate bolts to the flywheel, which bolts to the engine.

- **Pressure plate**

The pressure plate design that just about all production cars use is called a diaphragm type. The main advantage of the diaphragm pressure plate is that it has a light pedal for the amount of clamping load delivered with a smooth linear engagement.

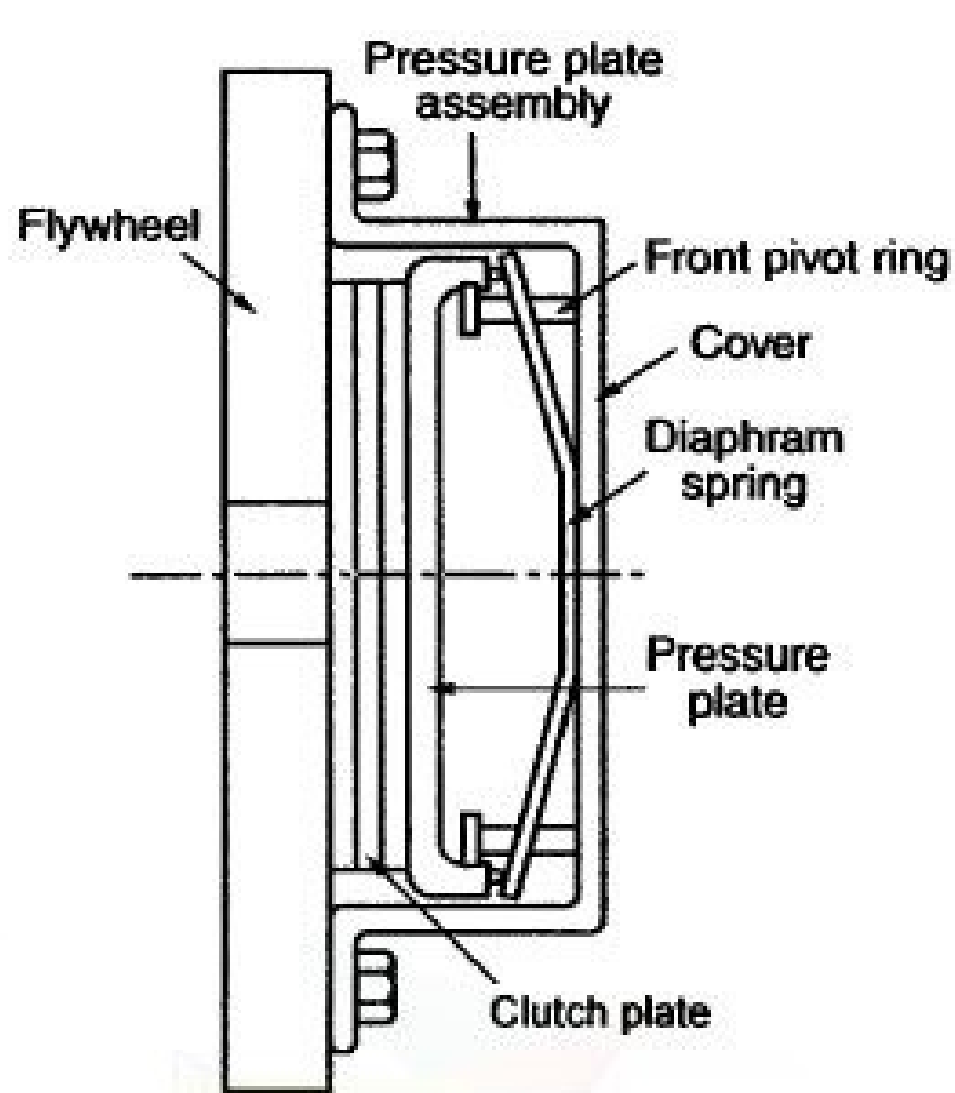
- **Clutch cover**

It is the clutch's housing, containing the clutch assembly. It is usually made of stamped steel that bolts to the flywheel. Some racing clutches have covers made of machined billet aluminum for stiffness and lightness in weight.

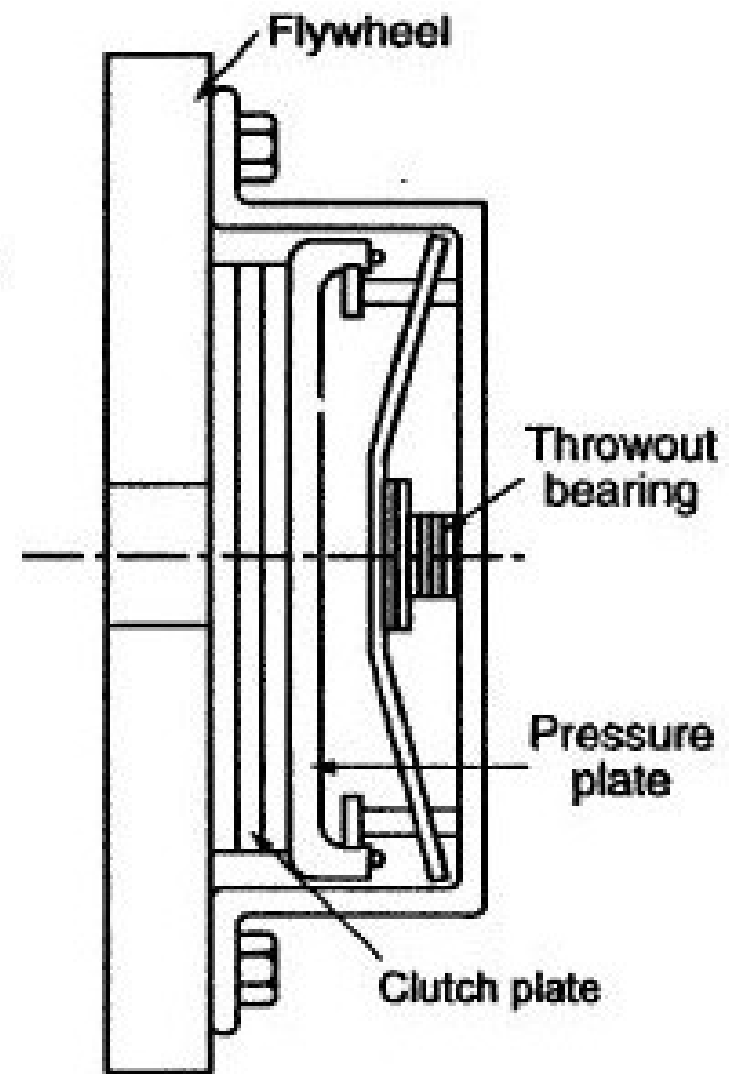
- **Diaphragm spring**

This clutch uses a circular, cone-shaped spring aptly called a diaphragm spring. It is used to apply clamping force to the pressure ring, a heavy circular plate of cast iron that pushes the clutch disk against the flywheel.

It is supported on a fulcrum retaining ring i.e. pivot ring so that any section through the spring can be regarded as a simple lever.



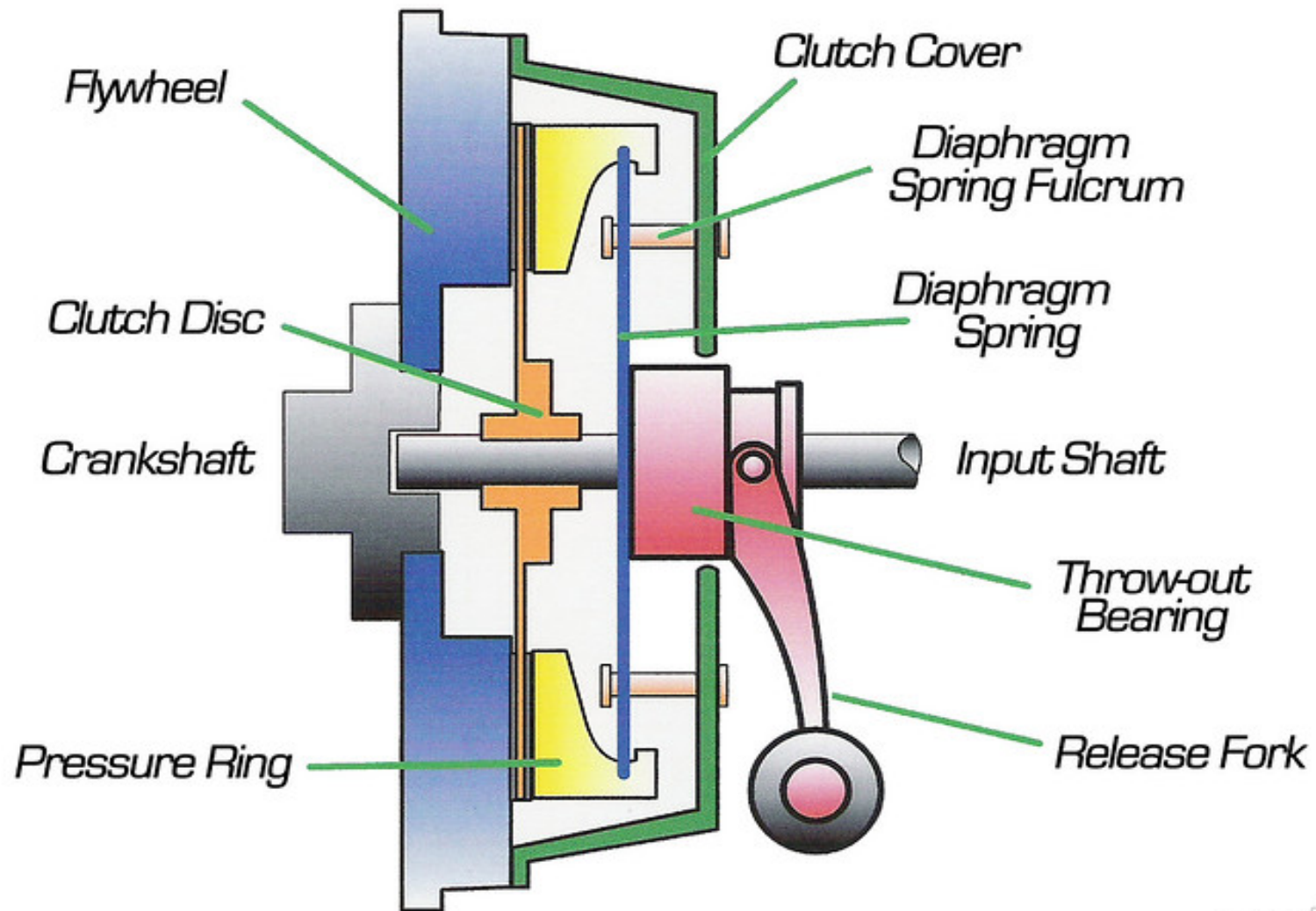
(a) Engaged position



(b) Disengaged position

Figure 3.10 Diaphragm clutch

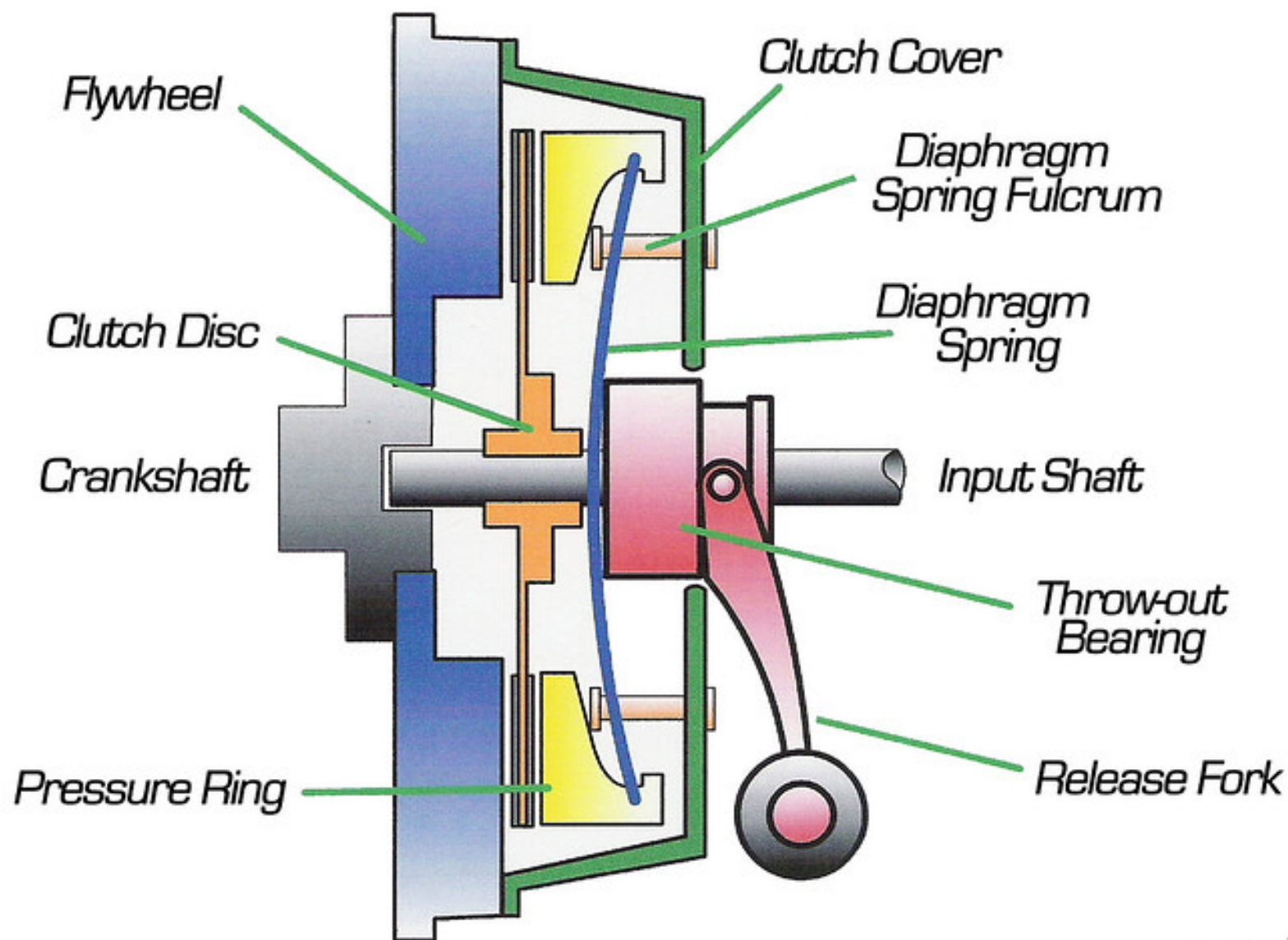
Engaged



Engaged position

- *When a clutch is engaged, the clutch cover, which is bolted to the flywheel, squishes the diaphragm spring down onto the pressure ring, which presses the clutch plate into the flywheel.*
- *The clutch plate is attached to the transmission via the input shaft and the flywheel is attached to the engine's crank. Drive torque from the engine is now transmitted to gear box shaft*

Disengaged



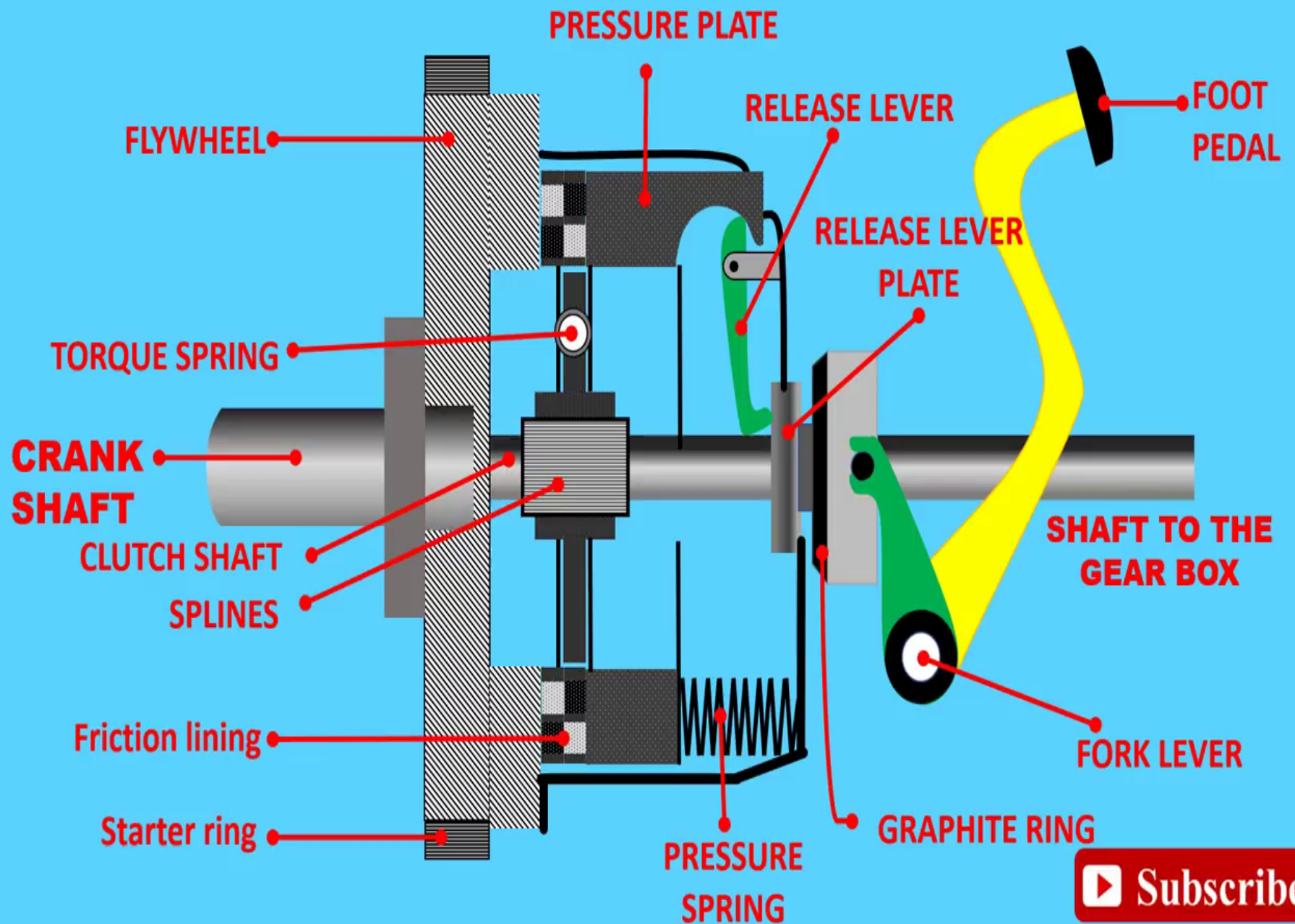
Disengaged position

- *When the clutch is disengaged the clutch pedal is pushed in which moves the release fork pushing down on the throwout bearing.*
- *This pushes the diaphragm spring inward, where it levers against the fulcrum on the clutch cover and pulls the pressure ring away from the clutch plate.*
- *The clutch is now disengaged and the engine can spin freely from the transmission.*

Advantages:

- 1. It requires lower operating effort due to reduced friction in the clutch mechanism.
- 2. There is a constant and uniform load on the driven plate throughout the life of a clutch.
- 3. At high speeds, the clamping load on the diaphragm springs is not affected as in the case of coil spring which starts bowing or distorting transversely.
- 4. The dangerous vibrations in the vehicles are altogether eliminated because it provides accurate balance at all times.
- 5. Due to its compact design, a clutch housing required is quite short.
- 6. Due to firm foundation and absence of vibrations, it eliminates squeaks and rafting

7. This type of clutch is more advantages because it requires and the spring itself acts as a series of levers. The pressure of the spring is always varying. It increases till the spring reaches to its flat position and decreases with the passing of this position. If this clutch is used, the driver does not require to exert such heavy pedal pressure to hold the clutch out of engagement as in the case of coil spring type clutch
9. The driver does not need to apply such heavy pedal pressure to hold the clutch disengaged as with the coil spring type in which the spring pressure increases more when the pedal is depressed to disengage the clutch.



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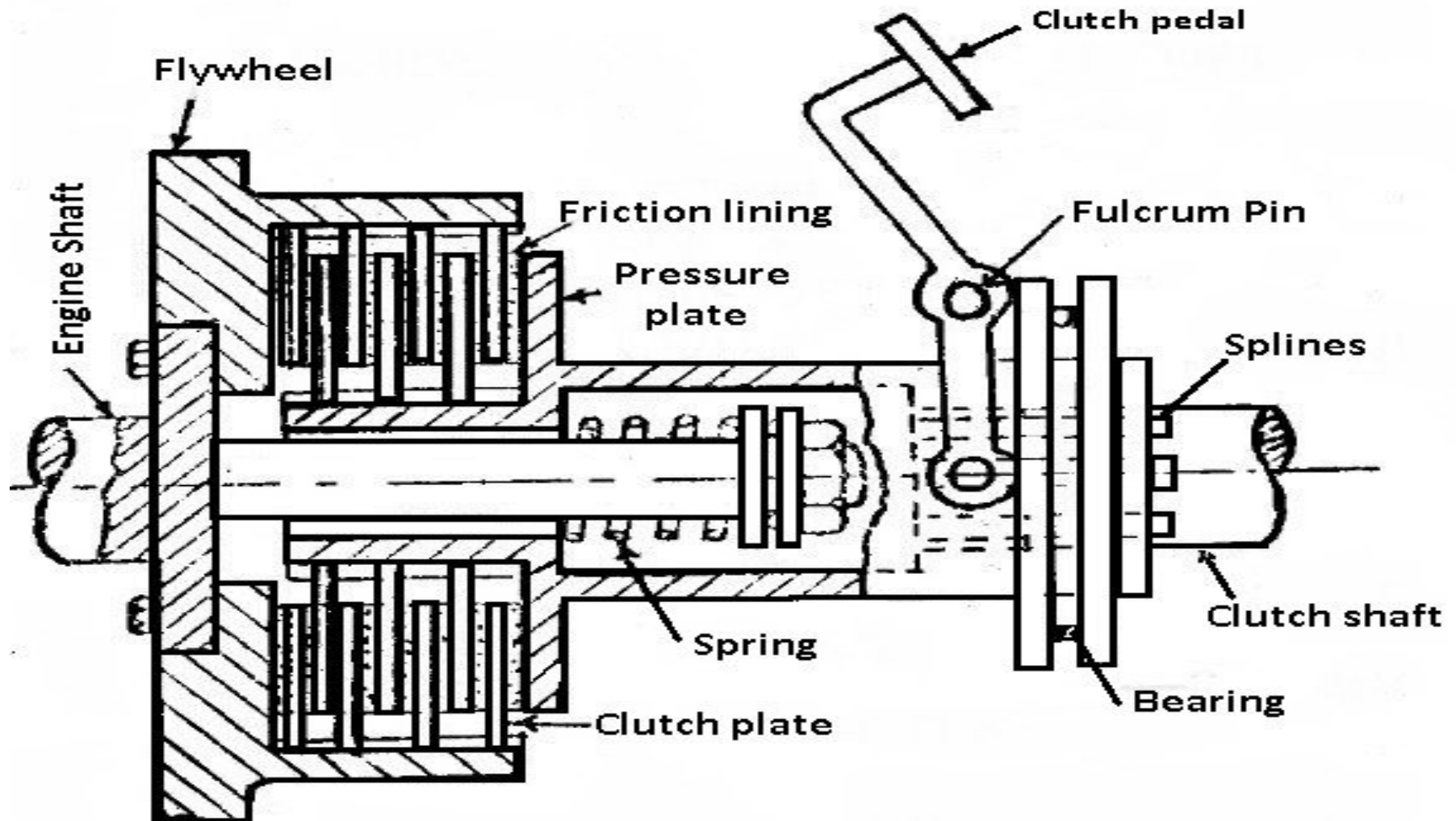
Multiplate Clutch

- Multiplate clutch is used when **large torque is to be transmitted** e.g. **motor cars** and machine tools
- Multiplate clutch is used when **compact construction is required** e.g. **scooters** and motor cycles.

Need of a Multi-Plate Clutch

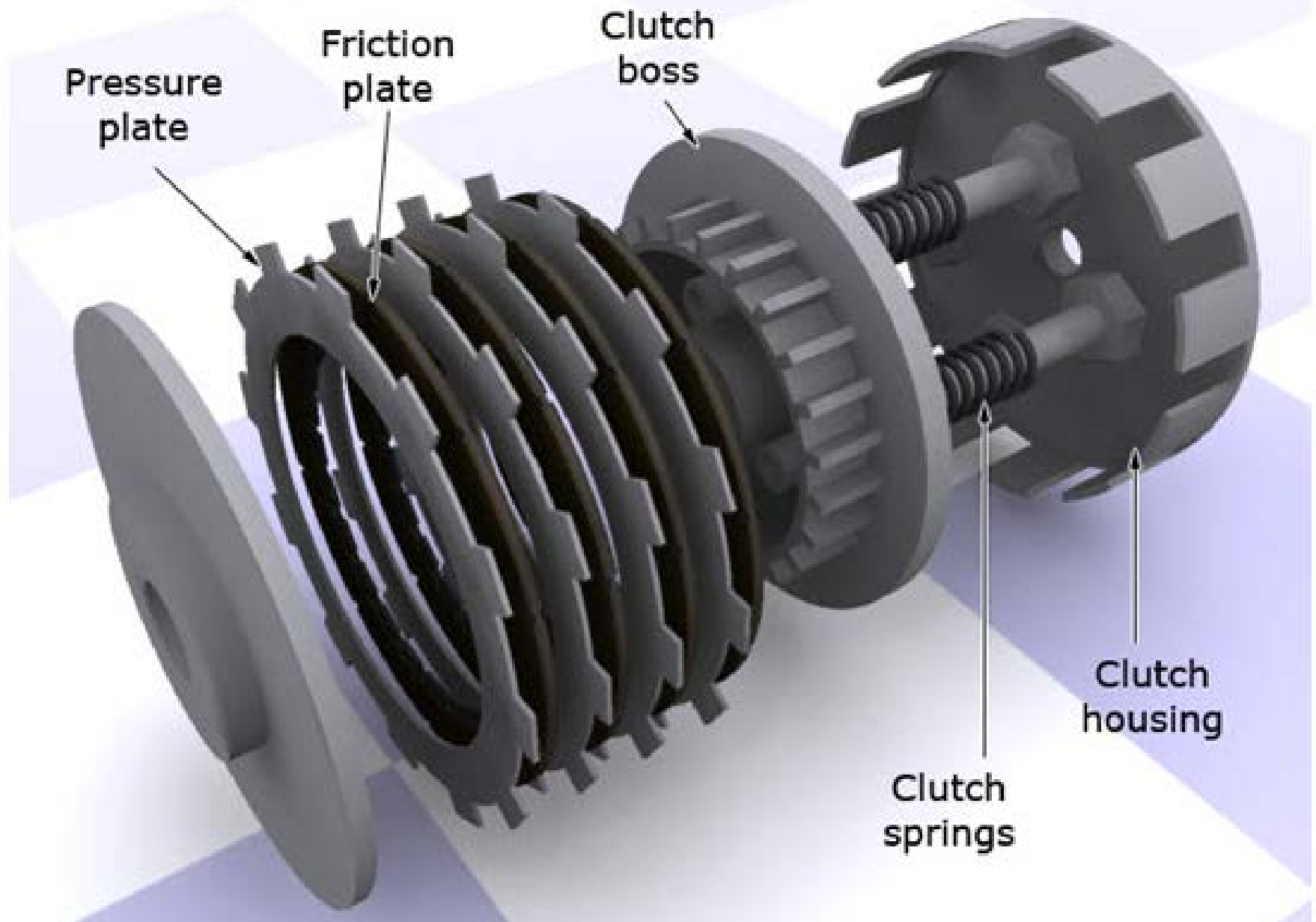
- Where there is a need of high torque output like in pick-up truck, a single plate clutch fails to provide that much frictional force (between flywheel and clutch plates) that is required to provide such a high torque, so in heavy vehicle like pickup trucks multi-plate clutches are used.
- In 2 wheeler vehicles like bikes and scooters there is a problem of packaging due to their small size, So to fulfil the need of required torque output, instead of a large single plate clutch , A multi-plate clutch having small clutch plates is used to transmit power between engine shaft and the transmission shaft.
- When there is the engagement of the clutch (in order to transmit power between flywheel and the transmission shaft) multiple plates of a multi-plate clutch provides more frictional force between the flywheel and the pressure plate as compared to single plate clutch, due to which the chances of slip is almost negligible in multi plate clutch.
- The efforts required by the driver on the clutch pedal in order to engage or disengage the clutch is less in multi-plate clutch as compared to single plate clutch

Multi plate clutch



Multiplate Clutch

Exploded view of multiplate plate clutch



1. PRESSURE PLATE

- A plate attached to the splined sleeves which are further attached to the pedal fulcrum such that when the clutch pedal is pressed, the sleeves attached to the pedal fulcrum moves outward which in turn moves the pressure plate attached with this splined sleeve.
- This pressure plate used in clutch applies pressure over the clutch plates with the help of coil springs that helps the pressure plate to maintain its frictional contact with the clutch plates.

2. Clutch Plate

- It is the metallic plate having frictional lines at its outer surfaces and is used to make frictional contact with the flywheel in order to transmit power between engine shaft and the transmission shaft.
- The inner frictional surface of the clutch plate makes contact with the flywheel and the outer frictional surface makes frictional contact with the pressure plate whose movement is operated by the clutch pedal.
- In multi-plate clutch multiple clutch plates are used in which number of clutch plates are placed over each other which in turn increases the frictional force required for engagement of the clutch

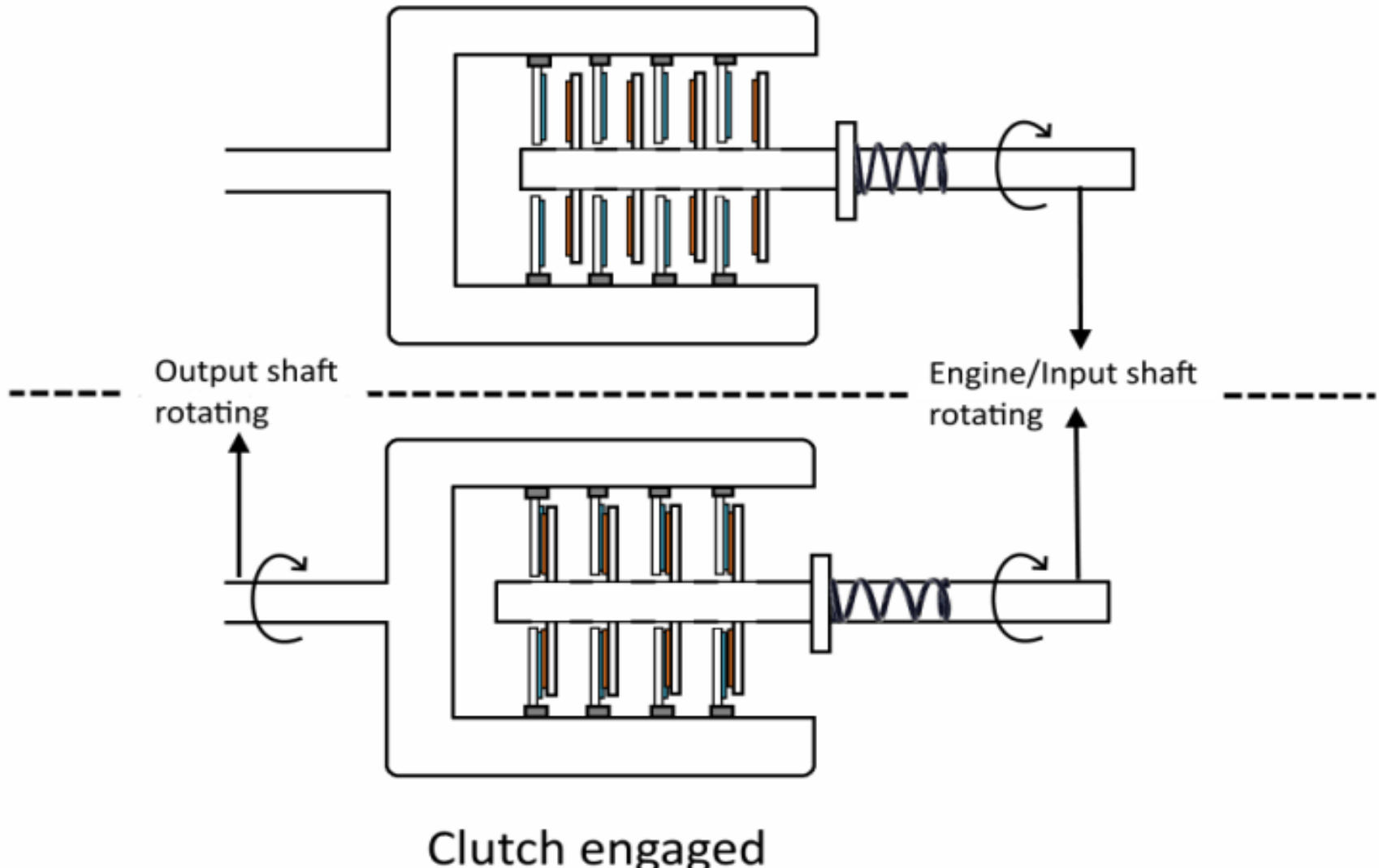
3.coil Springs

- These are the springs used behind the pressure plate and the stiffness of these springs is used by the pressure plate to maintain the frictional contact with the clutch plates which in turn maintain the clutch engagement.
- Numbers of coil springs are placed over the outer surface of the pressure plate in circular fashion.
- The force applied by the driver over the clutch pedal is transferred to these coil springs which in turn causes movement of these springs and the disengagement of the clutch occurs

Working of Multiplate clutch



Clutch disengaged



DISENGAGED.

- When the clutch is disengaged, work is done by the human. Clutch pedal is **PRESSED**.
- As the pedal movement is transferred via levers, work is done on spring & the pressure plates move back as shown in the image.
- At this time, there is no contact between pressure plates and the friction discs and because of this, only input shaft rotates & vehicle does not move.

ENGAGED.

- When the clutch is engaged, work is done by the spring by expanding itself. Clutch pedal is NOT pressed.
- The spring deformation pushes the pressure plates forward. This exerts an axial force on the friction discs.
- This generates a frictional force since the pressure plates are rotating while the friction plates aren't. The friction then forces even the output shaft to rotate.
- More the axial force, more the power transmission & vice versa.

Advantages

- For same size of single plate clutch, multi-plate clutches can deliver significantly higher amount of power.
- It has a very compact size.
- Since they are small in size, they have low rotational inertia.

Disadvantages

- They heat up quickly.
- The oil used for heat dissipation reduces the friction between plates. Hence this factor must always be considered while designing multi plate clutches and is sometimes compensated by adding an extra pair of friction discs.
- Multi plate clutches have many parts. Hence if anything goes wrong, it takes time to identify, disassemble & troubleshoot the problem.

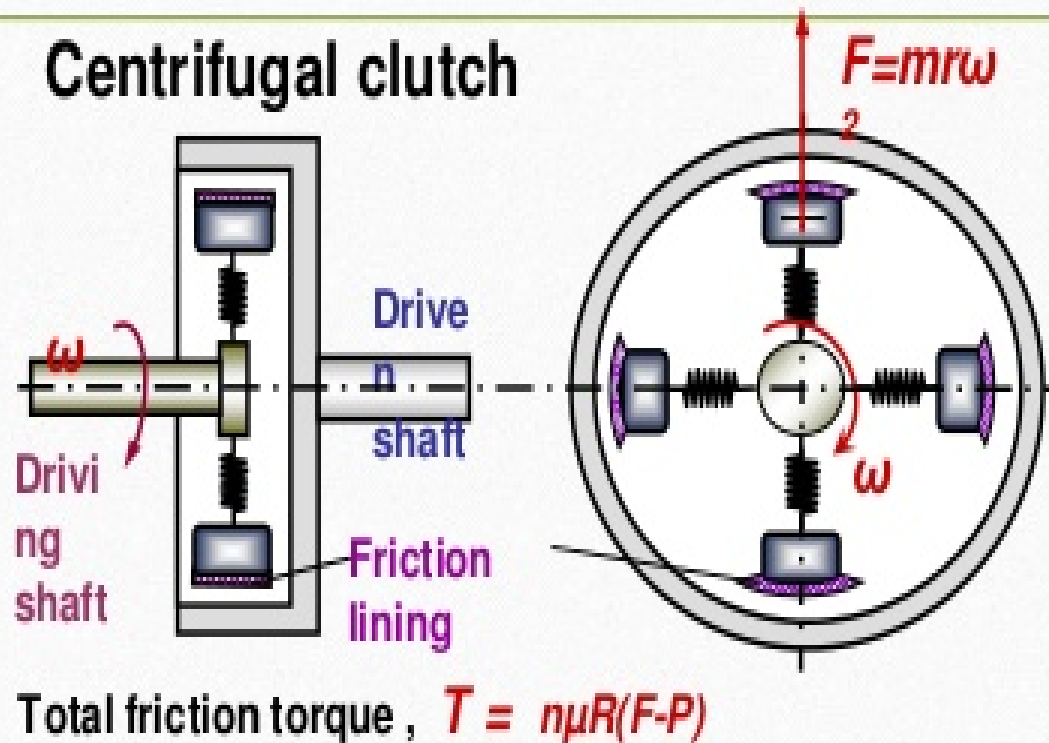
Applications

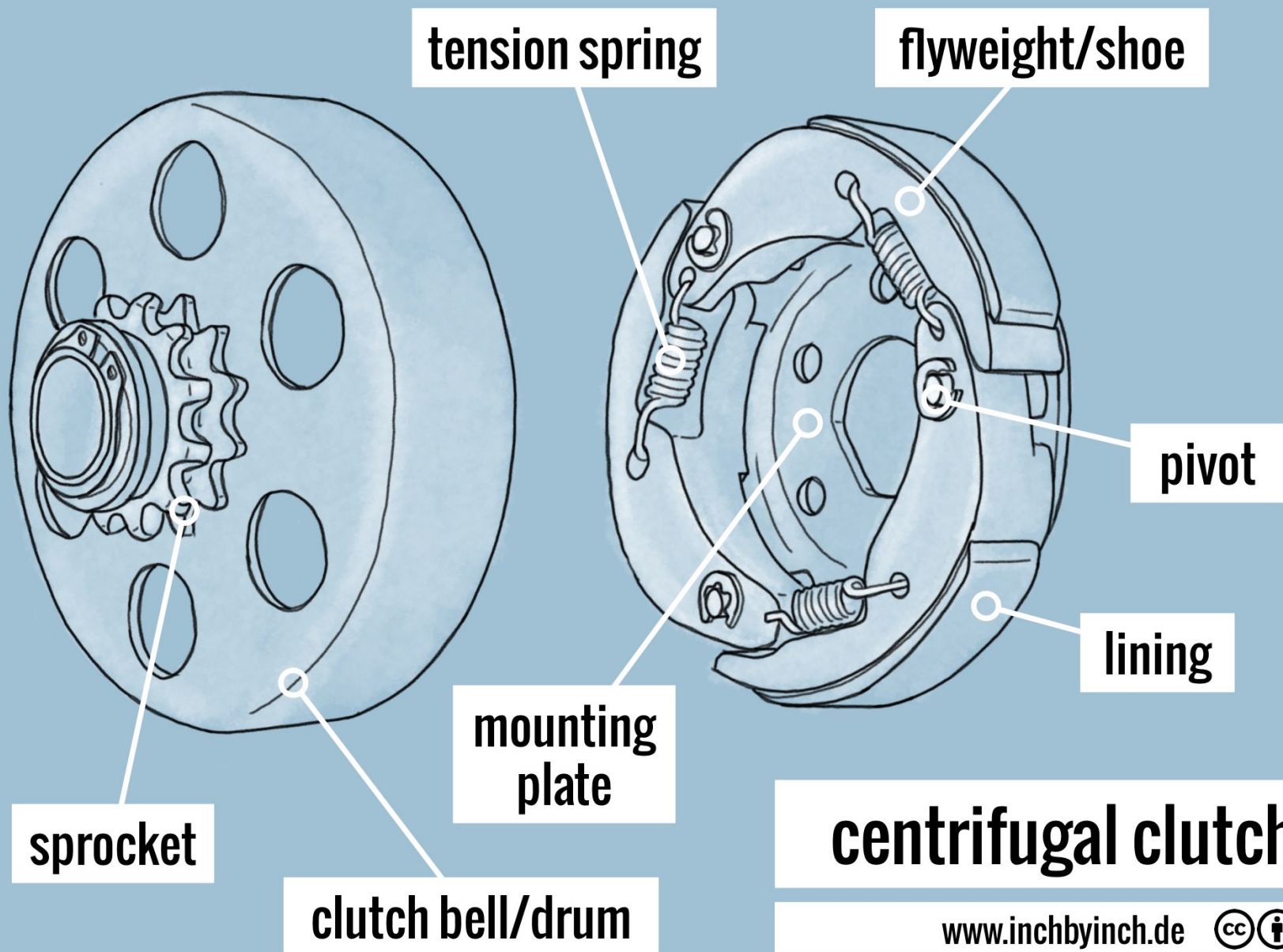
- They are used in a variety of applications.
- Multi plate clutches are used in bike ,locomotive engines, ships, and industrial machines.
- They are greatly found in drag racings as well as in F1 cars.
- They are also used in heavy machinery such as excavators, crawlers, bulldozers & tanks!

CENTRIFUGAL CLUTCH

- A **centrifugal clutch** is a **clutch** that uses **centrifugal** force to connect two concentric shafts, with the driving shaft nested inside the driven shaft. When the **centrifugal** force exceeds the spring force, the shoes move outward and come into contact with the driven member presses against it

Operation of Centrifugal Clutch





centrifugal clutch

Major parts of centrifugal clutch

- **1. Shoes:**

The shoes are of sliding types which slides in the guideways. It consists of friction lining at the end and this friction lining makes contact with the drum during the engagement.

- **2. Spring:**

Spring is used to disengage the clutch when the engine rotates at a slower speed.

● **3. Spider or guides:**

The spiders are mounted on the driver (engine) shaft or motor shaft. The spiders are equally spaced. Equally spaced means, if they are four guides then each guide is separated from each other by 90 degree. The sliding shoes are kept in between these guides and each guide is holding a spring.

● **4. Friction lining:**

The outer surface of sliding shoes has friction lining. It helps in making a grip with the inner surface of the drum.

- **5. Drum:**

The drum of the clutch act as housing which encloses all the parts of the clutch that includes sliding shoes, guides, springs etc. It is connected to the driven shaft of the transmission system or chains or belt

CENTRIFUGAL CLUTCH

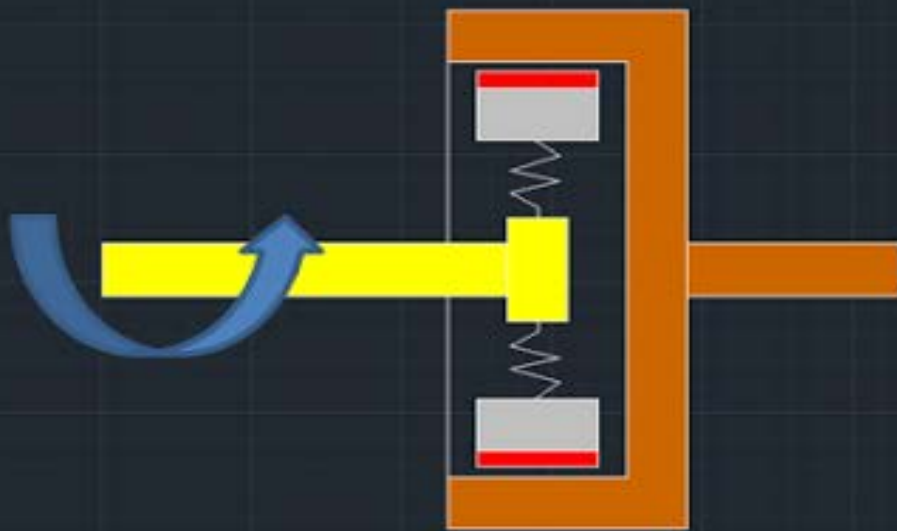
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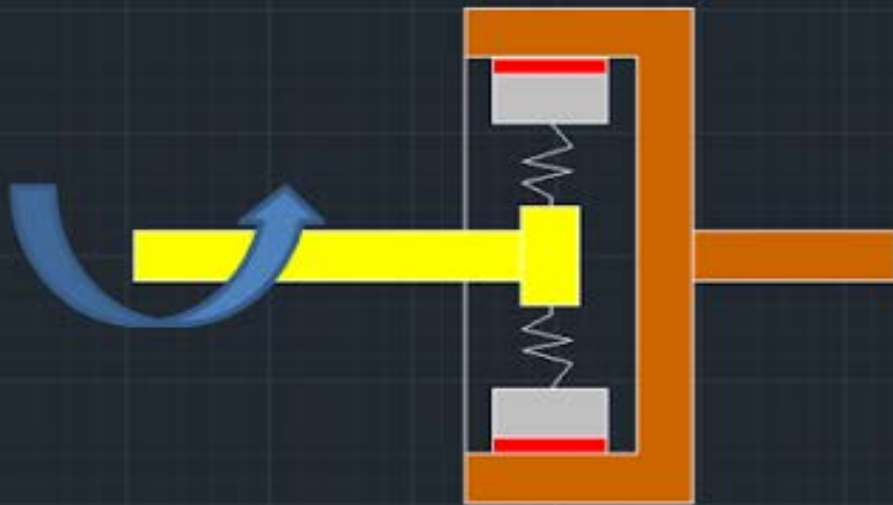
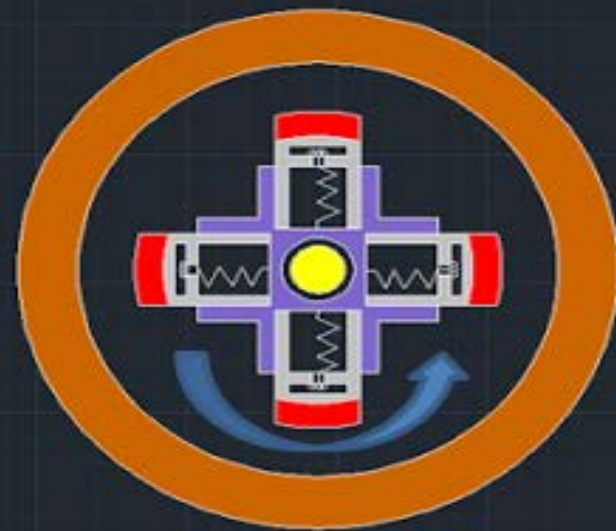
- ✓ This clutch system employs centrifugal force to automatically engage the clutch when the engine rpm rises above a threshold and to automatically disengage the clutch when the engine rpm falls low enough.
- ✓ A centrifugal clutch is used in some vehicles (e.g., mopeds) and also in other applications where the speed of the engine defines the state of the clutch, for example, in a chainsaw.

Working Principle

- It's working totally depends upon the centrifugal force created by the driving member (engine or motor). The centrifugal force is used to engage the clutch with driven shaft. As the engine starts rotating, it produces a centrifugal force which makes the sliding shoes to move outward.
- The friction lining of the shoes gets connected to the inner surface of the drum and it starts moving. Since the drum is connected to the driven shaft, so the power is transmitted from the engine shaft to the transmission shaft and finally to the load.



Clutch in Disengage Position



Clutch in Engage Position



Working

- As the engine rotates, the inside assembly of the centrifugal clutch starts rotating but drum remains stationary and no power is transmitted. At lower speed, the centrifugal force produced is not sufficient to overcome the spring force. So the clutch remains disengaged. But as the speed increases, the centrifugal force also increases and now the centrifugal force becomes greater than the spring force.

- As the centrifugal force becomes greater than the spring force, this allows the sliding shoes to move outward against the spring and get engaged with the inner surface of the drum.
- The drum starts rotating and transfers the rotating power from the engine to the driven shaft of the transmission.
- When the load on the engine increases, its speed decreases and disengages the clutch.

Advantages

- It is simple and requires less maintenance.
- It is inexpensive.
- Since it is automatic, so it does not need the necessary control mechanism.
- Its engagement speed can be controlled by selecting an appropriate spring.
- It helps to prevent the engine from stalling.

Disadvantages

- There is a loss of power in it due to slipping and friction.
- It is not capable of transferring a high amount of power and it shoes slip in heavy load condition.
- It experiences overheating problem.
- Its engagement depends upon the speed of the driving shaft.

Application

- Centrifugal clutch is mainly used in lawn movers, mopeds, go-karts, mini bikes, chainsaws etc. It is also used in some boats to keep the engine running during stalling and disengage loads during starting and idling.

DUAL CLUTCH

- A **transmission (DCT)** (sometimes referred to as a **twin-clutch transmission** or **double-clutch transmission**) is a type of automatic transmission in automobiles, closely related to a manual transmission. **It uses two separate clutches for odd and even gear sets.**

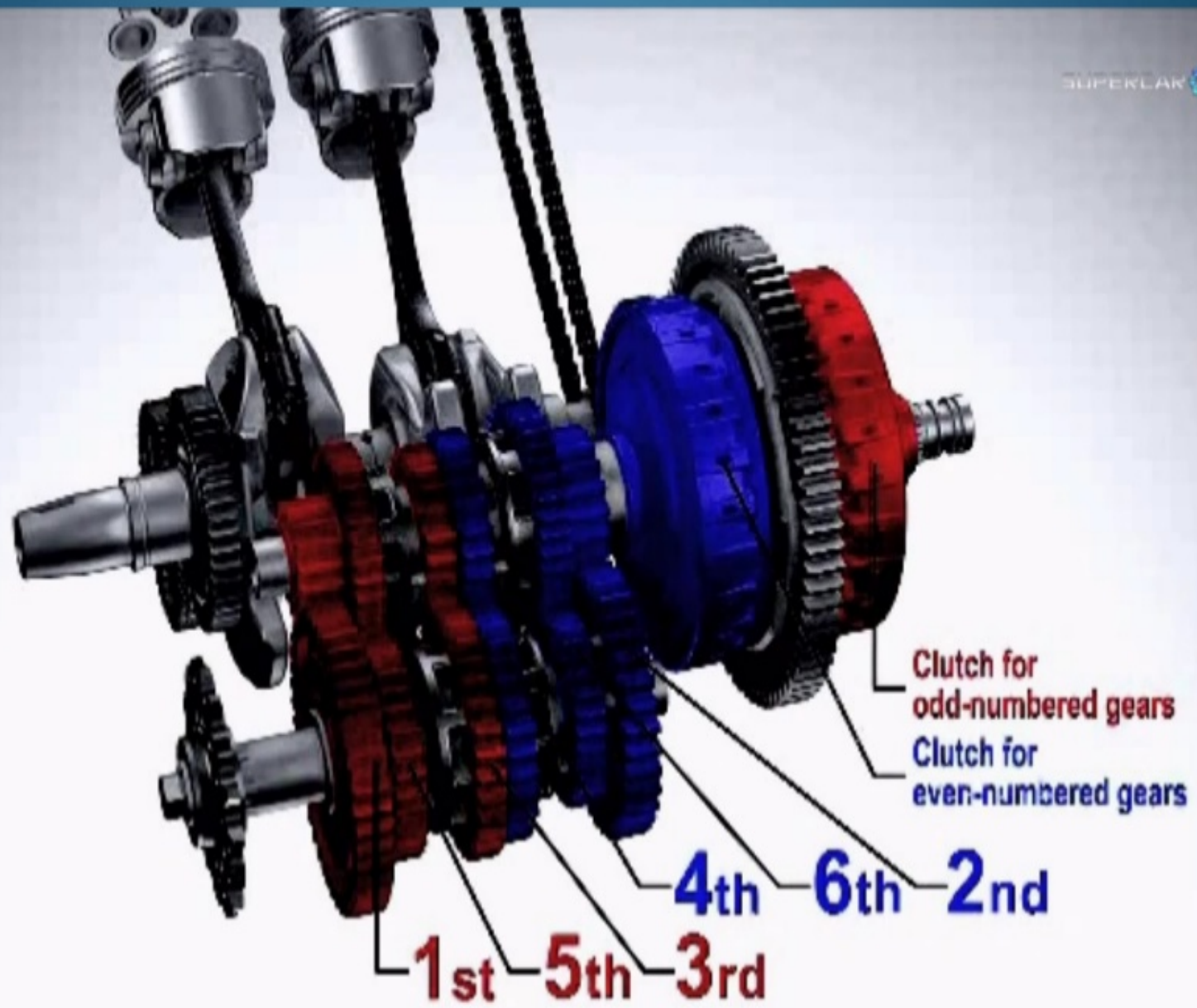


INTRODUCTION

- Power Transmission from Engine to wheels.
- Dual clutch Transmission
Semi automatic or automated manual transmission system which uses two separate clutches for odd and even gears in synchromesh.
- The gears are controlled Hydraulically by a Electronic control module which senses the gear position and shifting in semi-automated manner.

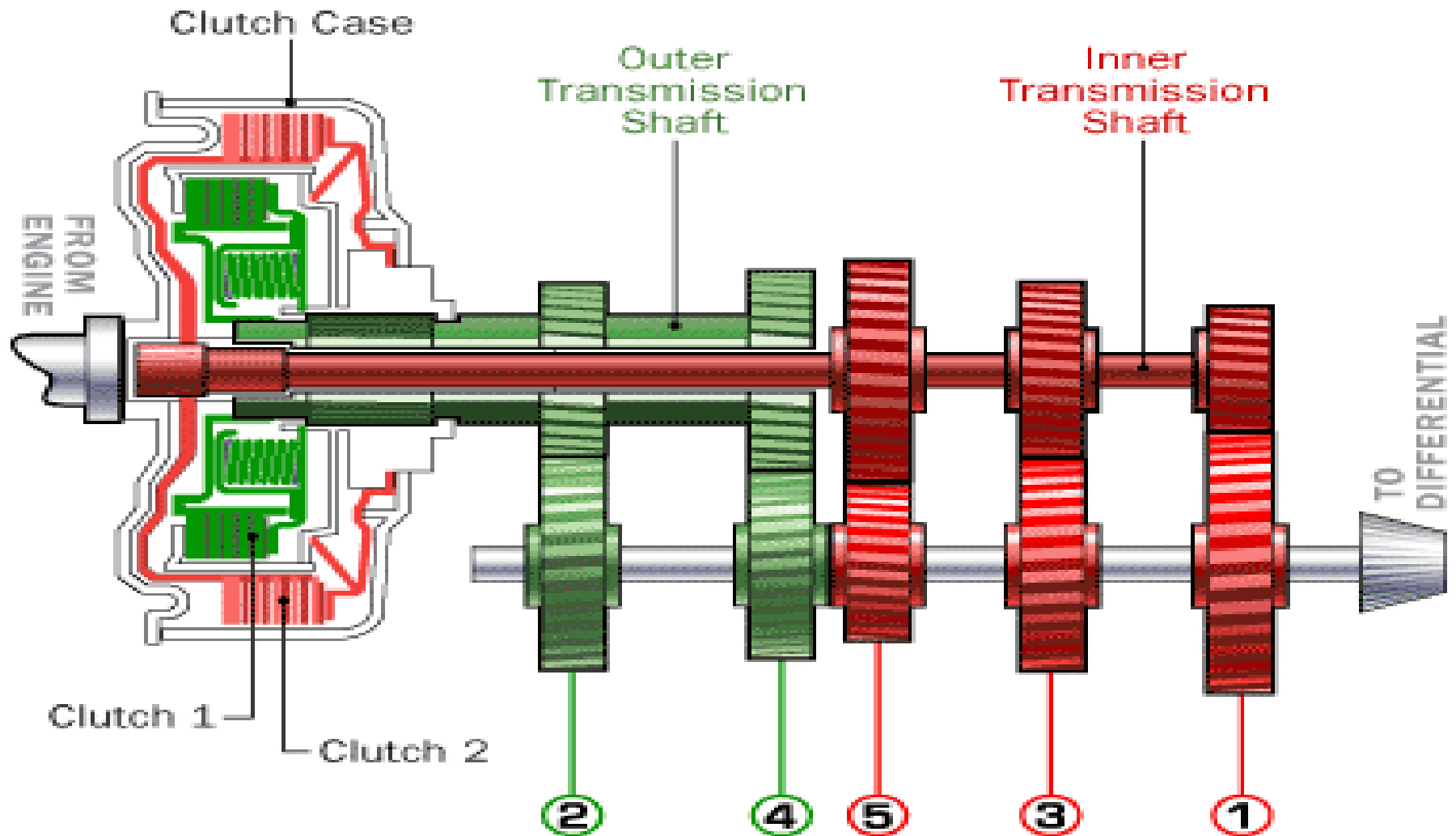
INTRODUCTION

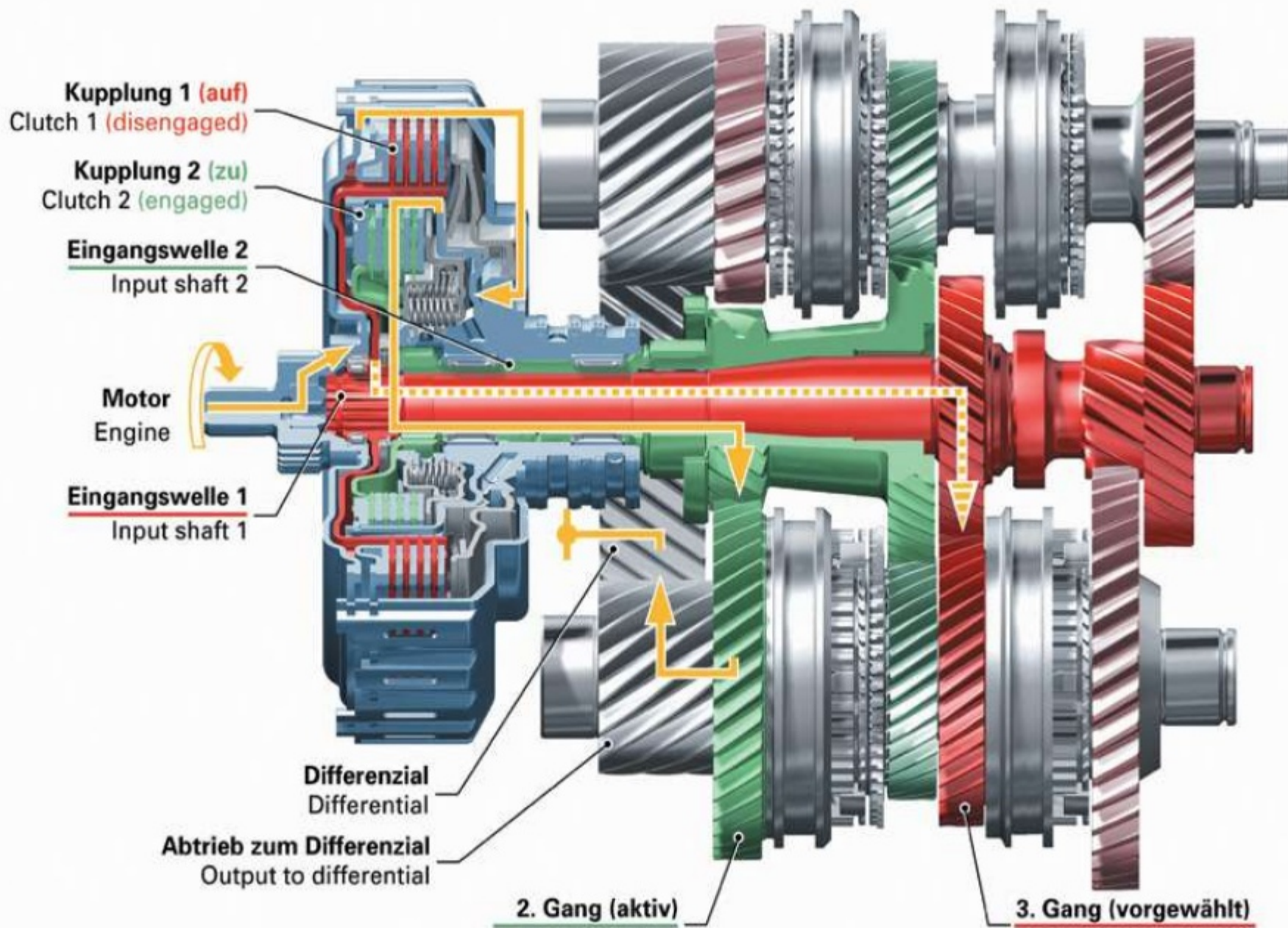
- Dual clutch transmission is the design to replace commonly used conventional transmission systems.
- Conventional transmission systems will generate lower torque.
- Lower torque resulting in increased fuel consumption.
- In dual clutch transmission system automatic or manual transmission system is used.
- Dual clutch transmission creates a new revolutionary change in automobile field.



How Dual-Clutch Transmissions Work

Basic Arrangement





WORKING OF DCT

- In DCT system two clutches are used.
- First clutch is used to engage odd gears.
- Second clutch is used to engage even gears.
- If the transmission is automatic, then gears are controlled by ECM which senses the gear positioning and shifting.
- If it is a manual transmission, then gears are changed manually.



DISADVANTAGES

- Relatively expensive to manufacture and therefore increases new vehicle purchase price
- Heavier than a conventional manual transmission
- Expensive transmission fluids/lubricants with dedicated additives are required, which need changing on a regular basis

ADVANTAGES



- Better fuel economy up to 15% improvement than conventional transmission.
- No loss of torque transmission from the engine to the driving wheels during gear shifts
- Extremely fast up-shift time of 8 milliseconds
- Very smooth gear-shift operations.

Introduction

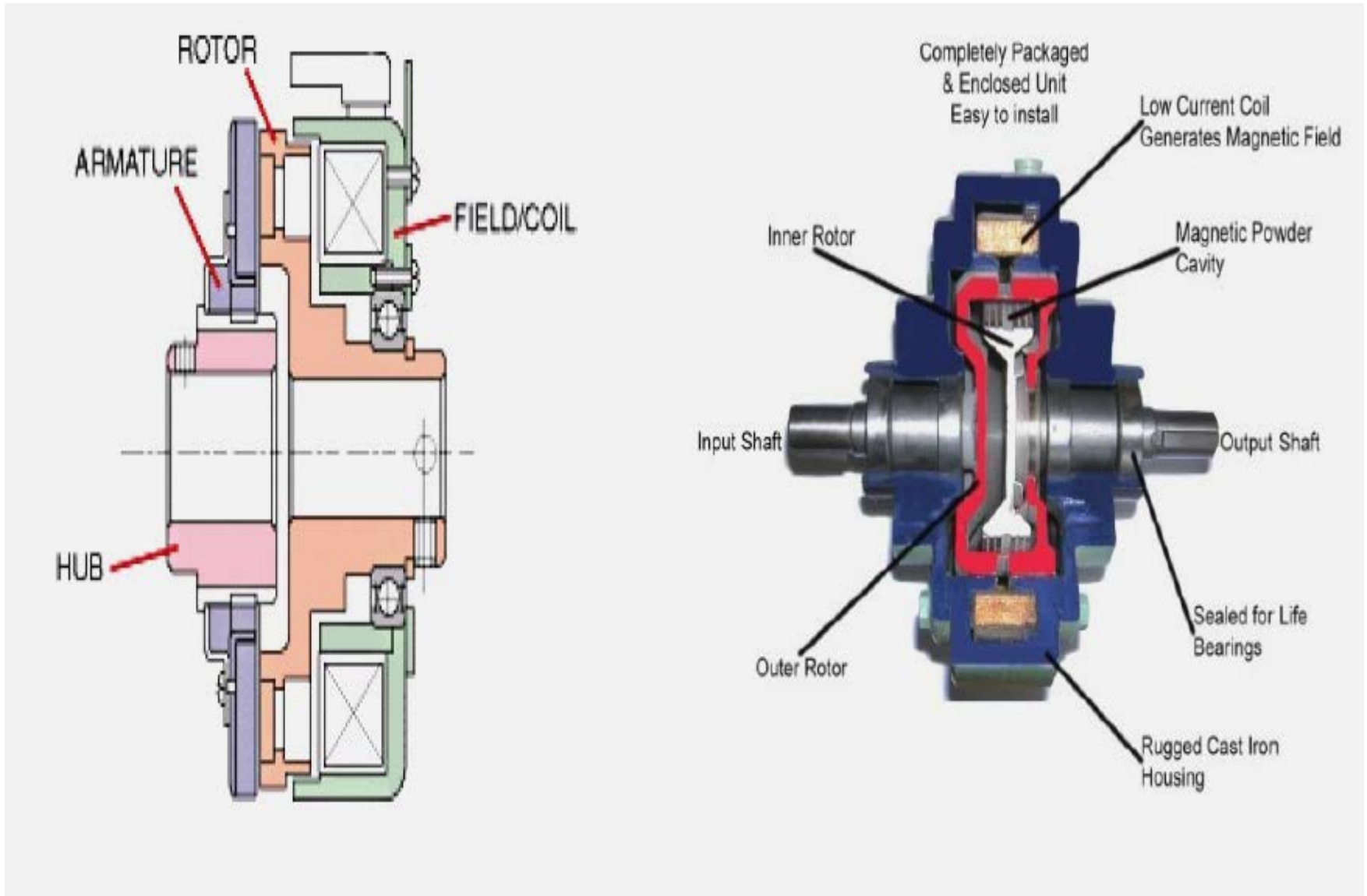
- Warner Electric designed the first electromagnetic clutch.
- Electromagnetic clutches operate electrically but transmit torque mechanically.
- That's the reason we also called electromechanical clutches.



E.M. Clutch Specifications

- Engagement & disengagement is electrically operated.
- No linkages are required to control its engagement.
- Easy to handle.
- High torque to size ratio.
- Response is fast.

Electromagnetic clutch



How it works

Engagement

When the clutch is required to actuate, current flows through the electromagnet, which produces a magnetic field. The rotor portion of the clutch becomes magnetized and sets up a magnetic loop that attracts the armature. The armature is pulled against the rotor and a frictional force is generated at contact. Within a relatively short time, the load is accelerated to match the speed of the rotor, thereby engaging the armature and the output hub of the clutch. In most instances, the rotor is constantly rotating with the input all the time.

Disengagement

When current is removed from the clutch, the armature is free to turn with the shaft. In most designs, springs hold the armature away from the rotor surface when power is released, creating a small air gap.

Automobiles

When the electromagnetic clutch is used in [automobiles](#), there may be a clutch release switch inside the gear lever. The driver operates the switch by holding the gear lever to change the gear, thus cutting off current to the electromagnet and disengaging the clutch. With this mechanism, there is no need to depress the clutch pedal.

Alternatively, the switch may be replaced by a [touch sensor](#) or [proximity sensor](#) which senses the presence of the hand near the lever and cuts off the current. The advantages of using this type of clutch for automobiles are that complicated linkages are not required to actuate the clutch, and the driver needs to apply a considerably reduced force to operate the clutch. It is a type of [semi-automatic transmission](#).

Electromagnetic clutches are also often found in [AWD](#) systems, and are used to vary the amount of power sent to individual wheels or axles.

A smaller electromagnetic clutch connects the air conditioning compressor to a pulley driven by the crankshaft, allowing the compressor to cycle on only when needed.



Applications Of E.M. Clutch

- Machinery.

e.g. printing machinery, conveyors, lawnmowers etc.

- Automobiles.

e.g. Outdoor use, in some Renaults cars.

- Locomotives.

e.g. Diesel locomotives.



Advantages Of E.M. Clutch

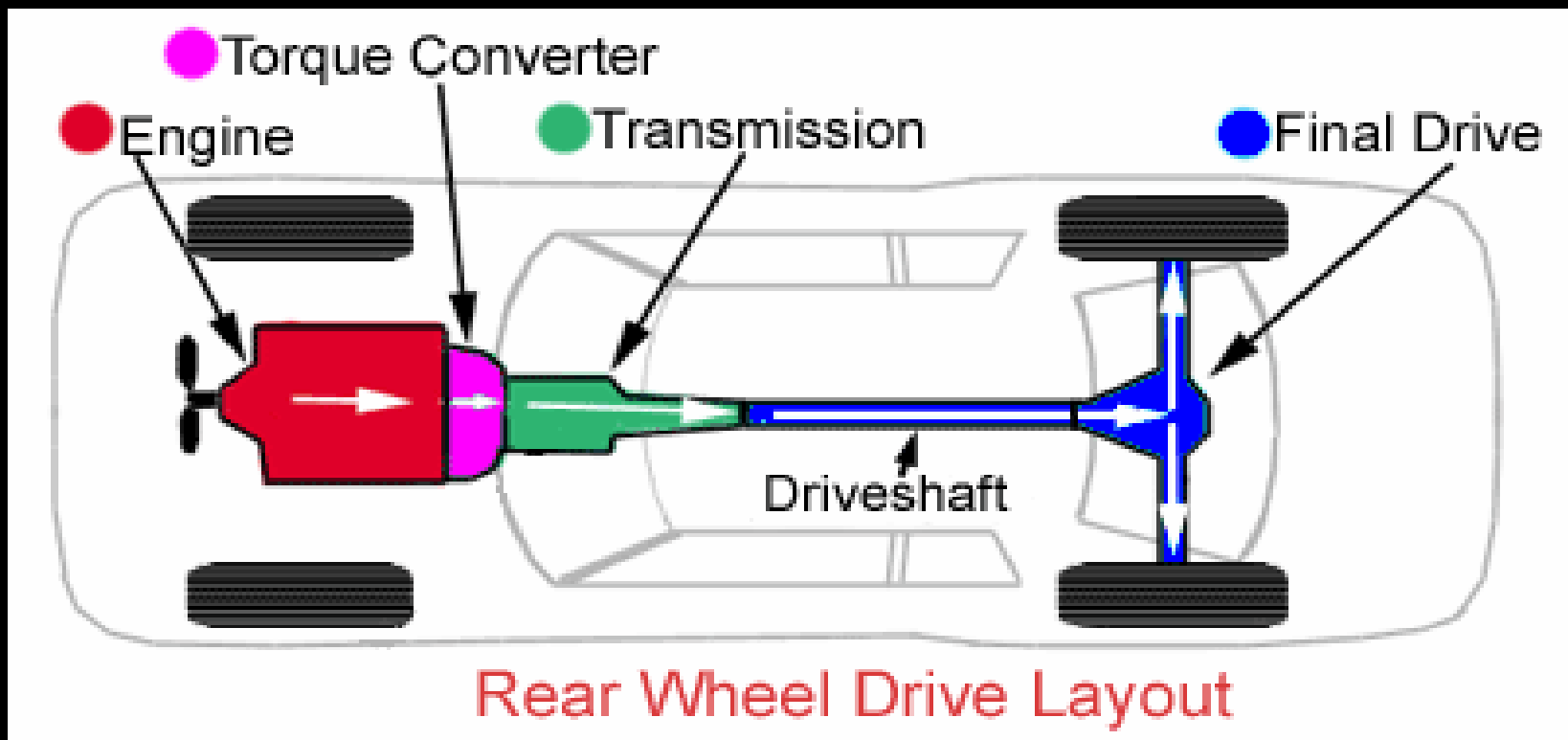
- Complicated linkage is not required.
- Wear & tear is almost eliminated.
- Requires less current with no load condition.
- It can work on 24V D.C. with low wattage.



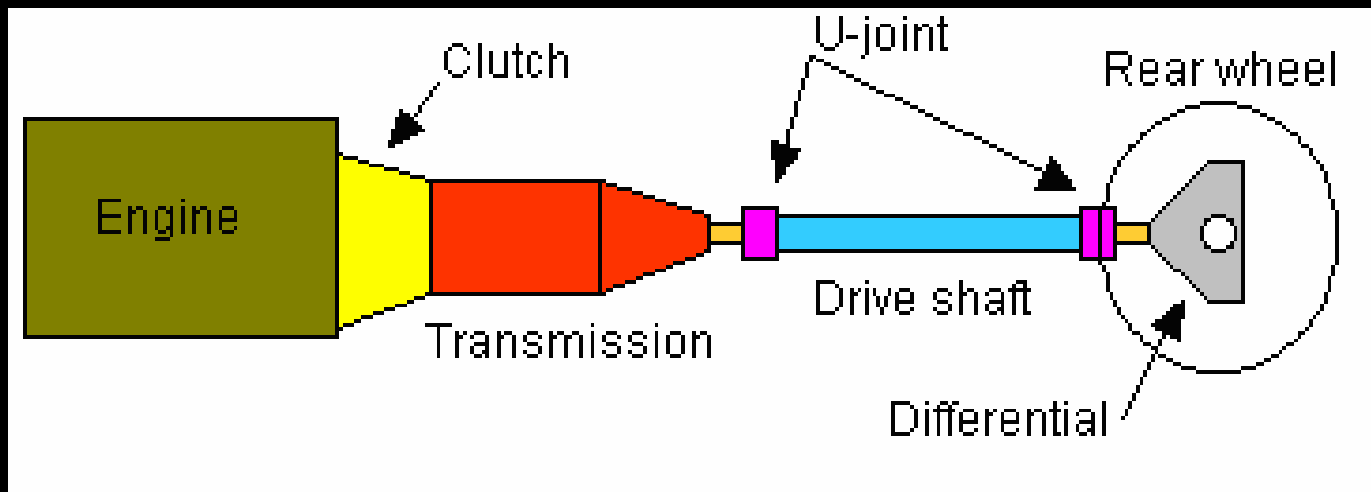
Disadvantages Of E.M. Clutch

- Risk of overheating during engagement.
- High initial cost
- If the current falls, torque will also decrease.

Automotive Transmission



TRANSMISSION SYSTEM



REQUIREMENTS OF TRANSMISSION SYSTEM

- To provide for disconnecting the engine from the driving wheels.
- When the engine is running , to enable the connection to the driving wheels to be made smoothly and without shock.
- To enable the leverage b/w the engine and driving wheels varied.
- Speed reduction b/w engine and the drive wheels in the ratio of about 5:1.
- To enable power transmission at varied angles and varied lengths.
- To drive the driving wheel at different speeds when required.
- To enable diversion of power flow at right angle.

Types of transmission system

```
graph TD; A[Types of transmission system] --> B[Electrical & Electromagnetic transmission]; A --> C[Hydraulic transmission]; A --> D[Mechanical transmission]; C --> E[a) Fluid coupling]; C --> F[b) Torque converter]; C --> G[c) Automotive transmission]; D --> H[a) clutch, gear box, and line axle transmission]; D --> I[b) clutch, gear box, and dead axle transmission]; D --> J[c) clutch, gear box, axeless transmission];
```

Electrical &
Electromagnetic
transmission

Hydraulic transmission

Mechanical transmission

a) Fluid coupling

b) Torque converter

c) Automotive
transmission

a) clutch, gear box,
and line axle
transmission

b) clutch, gear box,
and dead axle
transmission

c) clutch, gear box,
axeless transmission

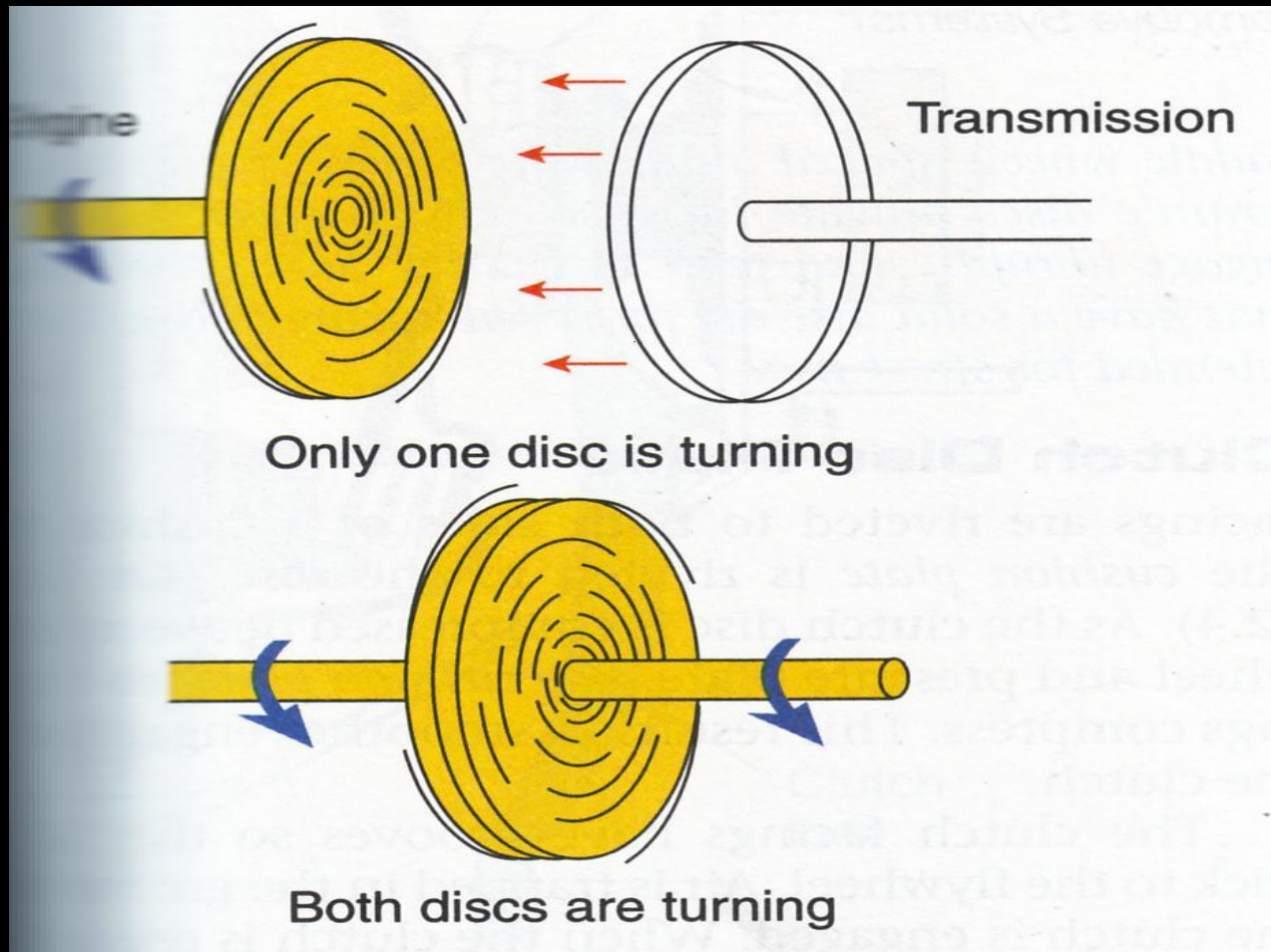
CLUTCH

- ❑ A clutch is a mechanism which enables the rotary motion of one shaft to be transmitted to second shaft, whose axis is coincident with that of first.
- ❑ The clutch is located b/w the engine and gear box
- ❑ When the clutch is engaged, the power flows from the engine to the rear wheels through the transmission system and the vehicle moves.
- ❑ When the clutch is disengaged, the power is not transmitted to the rear wheels and the vehicle stops while the engine is still running.
- ❖ The clutch is disengaged when
 - i) Starting the engine
 - ii) Shifting the gears
 - iii) Stopping the vehicle
 - iv) Idling the engine
- ❖ The clutch is engaged only when the vehicle is to move and is kept engaged when the vehicle is moving

Function of a clutch

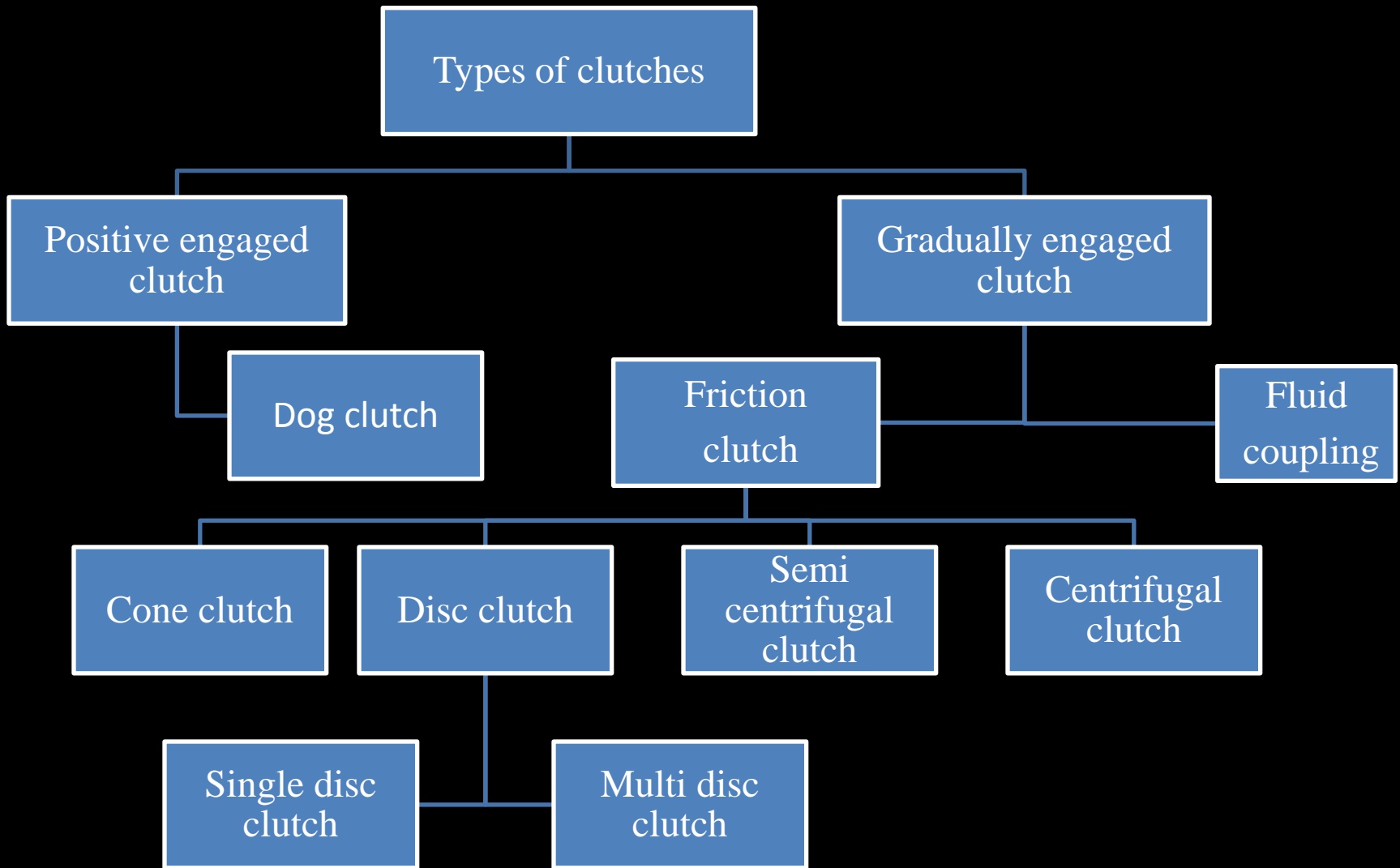
- To permit **engagement or disengagement** of a gear when the vehicle is stationary and the engine is running.
- To transmit the engine power to the road wheels smoothly **without shock to the transmission system** while setting the wheel in motion.
- To permit the engaging of gears when the vehicle is in motion **without damaging the gear wheels**.

The clutch disengages and engages the engine to the transmission



Requirements of a clutch

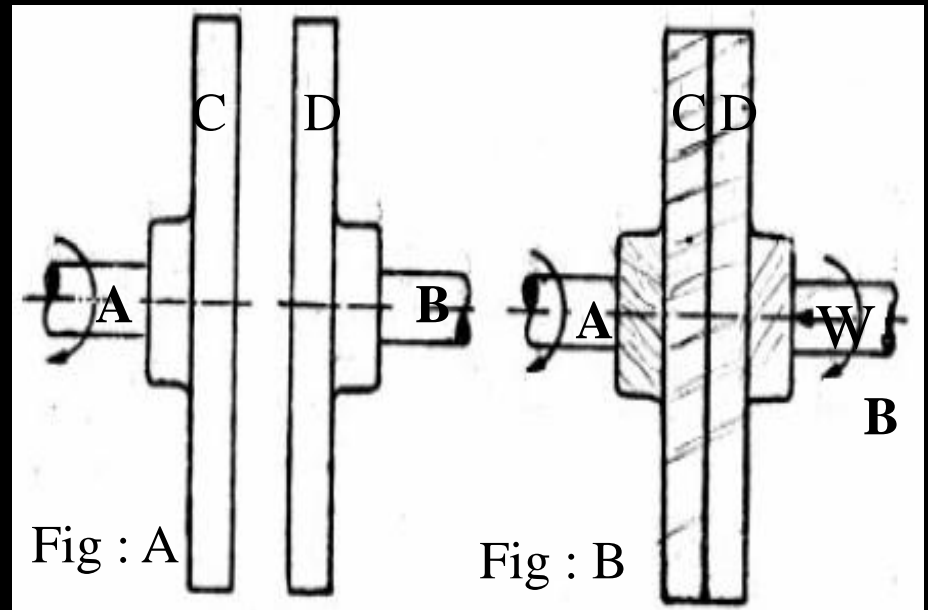
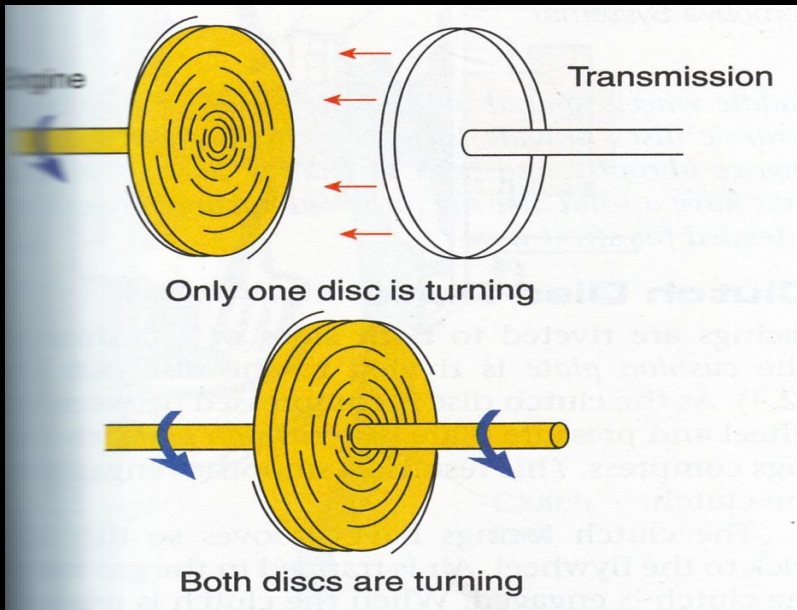
- It should be **engage gradually** to avoid sudden jerks.
- It should be **easily operated** (i.e it should consume minimum physical effort at the time of engagement and disengagement)
- It should be **dynamically balanced** (particularly required in case of high speed engine clutches)
- It should be **free from slip** when engaged.
- It should be as possible so that it will **occupy minimum space**.
- It should be **easily accessible** and have simple means of adjustment.
- It should be suitable mechanism **to damp vibrations** and to eliminated noise produced during the power transmission.
- It should be able to **dissipate large amount of heat** which is generated during the clutch operation due to friction.
- The **wearing surfaces** should have long life.



Positive clutches

- ❖ The positive clutches are used when a positive drive is required.
- ❖ The simplest type of a positive clutch is a jaw or claw clutch.
- ❖ The jaw clutch permits one shaft to drive another through a direct contact of interlocking jaws.
- ❖ A square jaw type of clutch will transmit power in either direction of rotation.
- ❖ The spiral jaws may be left-hand or right-hand, because power transmitted by them in one direction only.

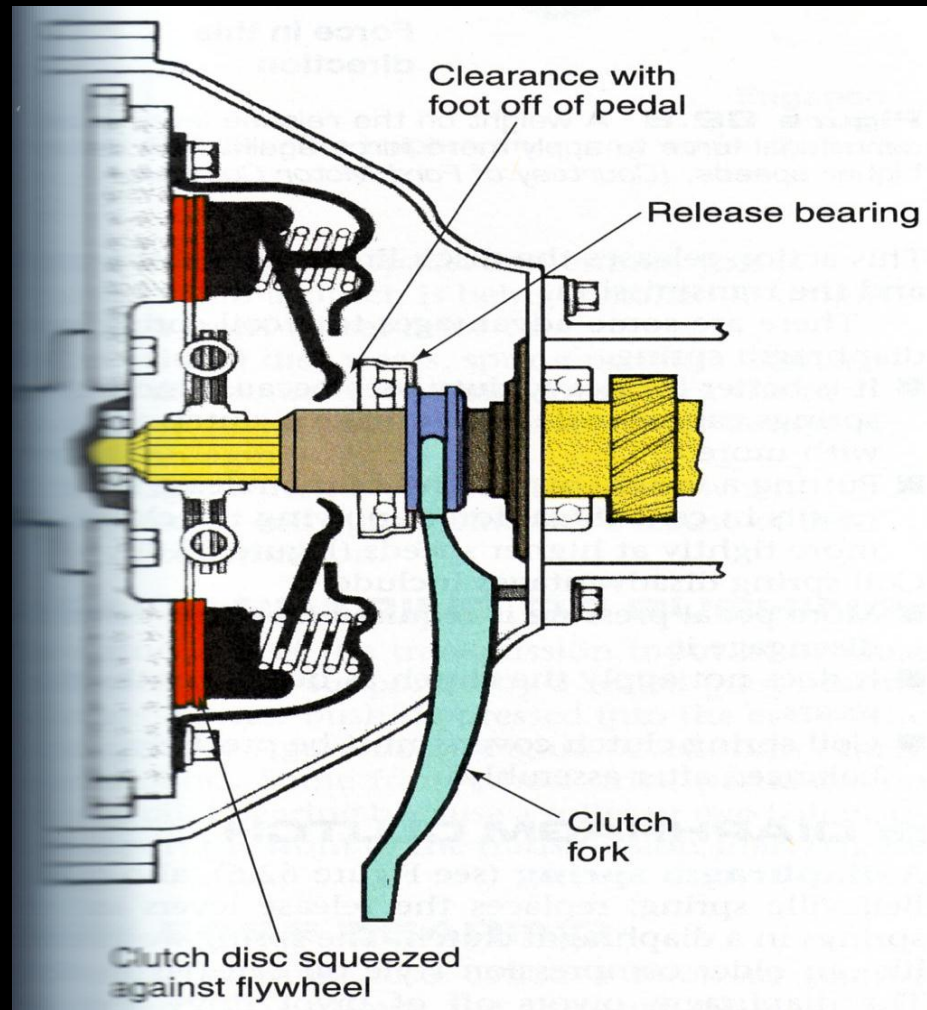
Basic Principle of friction clutch



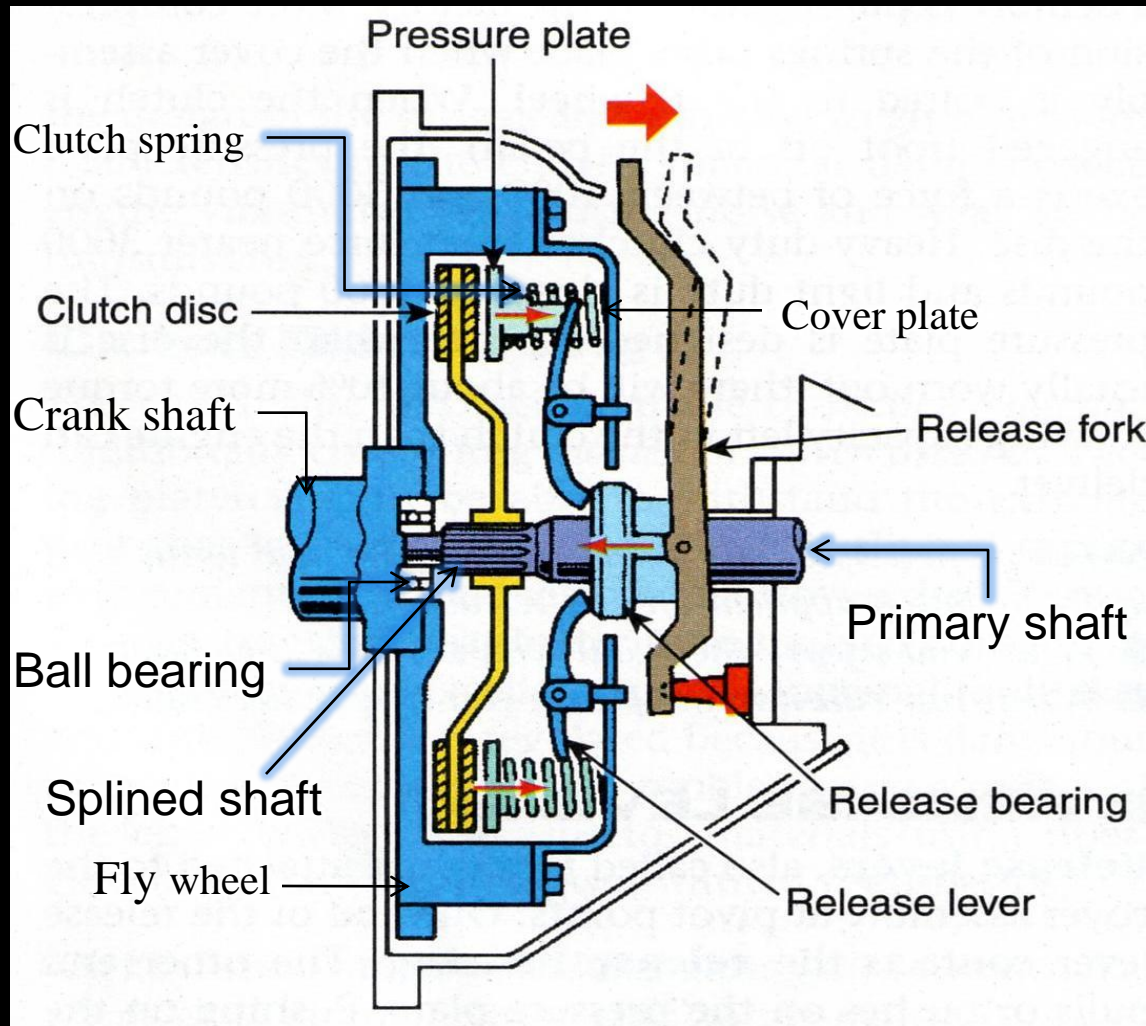
Principle of friction clutch explanation

- Let shaft “A” and disc “C” be revolved at same speed, say N r.p.m
- Shaft “B” and the disc “D” keyed to it are stationary, initially when the clutch is not engaged.
- Now apply some axial force “W” to the disc “D” so that it comes in contact with disc “C”.
- As soon as the contact is made, the force of friction b/w “C” and “D” will come in to play and consequently the disc “D” will also start revolving .
- The force of “D” depends upon the friction force present, which is turn, is proportional to the force “W” applied.
- If “W” is increased gradually, the speed of “D” will be increased correspondingly till the stage comes when the speed of “D” becomes equal to the speed of “C”
- Then the clutch is said to be fully engaged

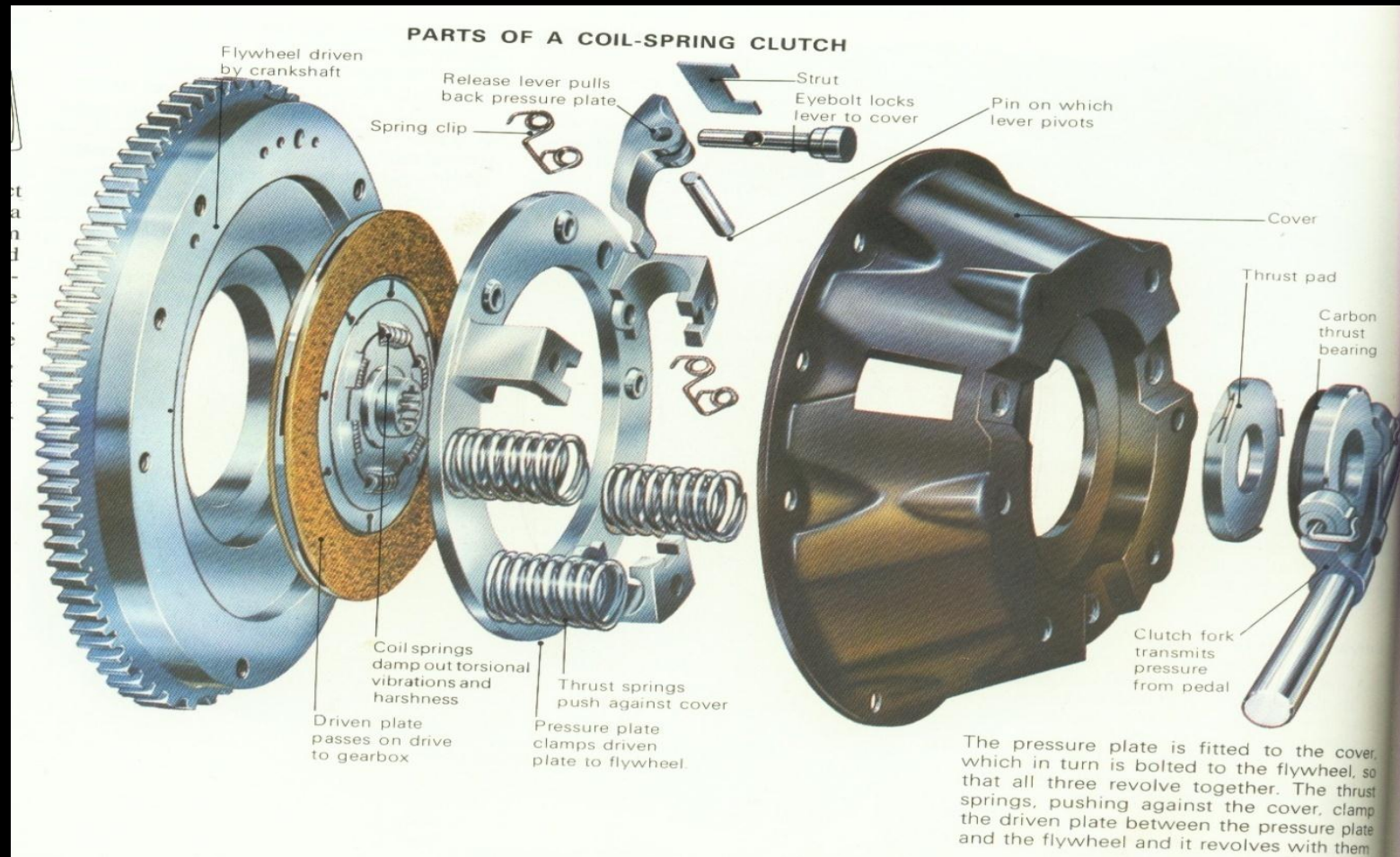
The clutch disc is squeezed against the flywheel by spring pressure when the pedal is up



Pushing on the pedal moves the pivot lever to pull the pressure plate away from the disc.



Exploded view of single plate coil spring clutch



CONSTRUCTION OF MULTI COIL SPRING SINGLE PLATE CLUTCH

- A typical clutch actuated by a number of coil springs on a pitch circle nears the periphery as shown.
- The driven shaft which normally is a forward extension of gearbox primary shaft is supported at its front end in ball bearing in a hole in the centre of flywheel web, which is spigot and bolted onto a flange at the rear end of the crankshaft.
- In this clutch, the coil springs force the pressure plate forwards to clamp the driven plate between it and the rear face of the flywheel.
- Three lugs extend rearwards from periphery of pressure plate both to rotate the pressure plate and to cause it to rotate with the rest of the assembly.
- The driven plate of course is splined onto the shaft

Contd...

- There are three release levers pressing the coil springs at the outer end.
- The inner ends of the levers can be forced forward by means of thrust bearing made of graphite and slide along the clutch shaft when clutch pedal is depressed.
- The driven plate mounted between flywheel and pressure plate makes the clutch shaft to rotate to transmit power.
- It has the clutch facing made of friction materials around the periphery of disc.

WORKING OF MULTI COIL SPRING SINGLE PLATE CLUTCH

- When the clutch is engaged, the clutch plate is gripped between the flywheel and pressure plate.
- The friction linings are on both sides of clutch plate.
- Due to friction between flywheel, clutch plate and pressure plate, the clutch plate revolves with the flywheel.
- As clutch plate revolves the clutch shaft also revolves.
- Thus, engine power is transmitted to the clutch shaft.
- When the clutch pedal is pressed the pressure plate moves back against the spring force and clutch plate becomes free between flywheel and pressure plate.
- Thus flywheel remains rotating as long as the clutch pedal is pressed, the clutch is said to be disengaged and clutch shaft speed reduces slowly and finally it stops rotating.

Advantages to a coil spring.

- It is better for heavy-duty uses because more coil springs can be installed to make a clutch apply with more force.
- Putting a weight at the end of the release lever results in centrifugal force applying the clutch more tightly at higher speeds

Coil spring disadvantages include:

- More pedal pressure is required from the driver to disengage it.
- It does not apply the clutch as heavily as the disc wears.
- Coil spring clutch covers must be precisely balanced after assembly.

Multi-plate Clutch

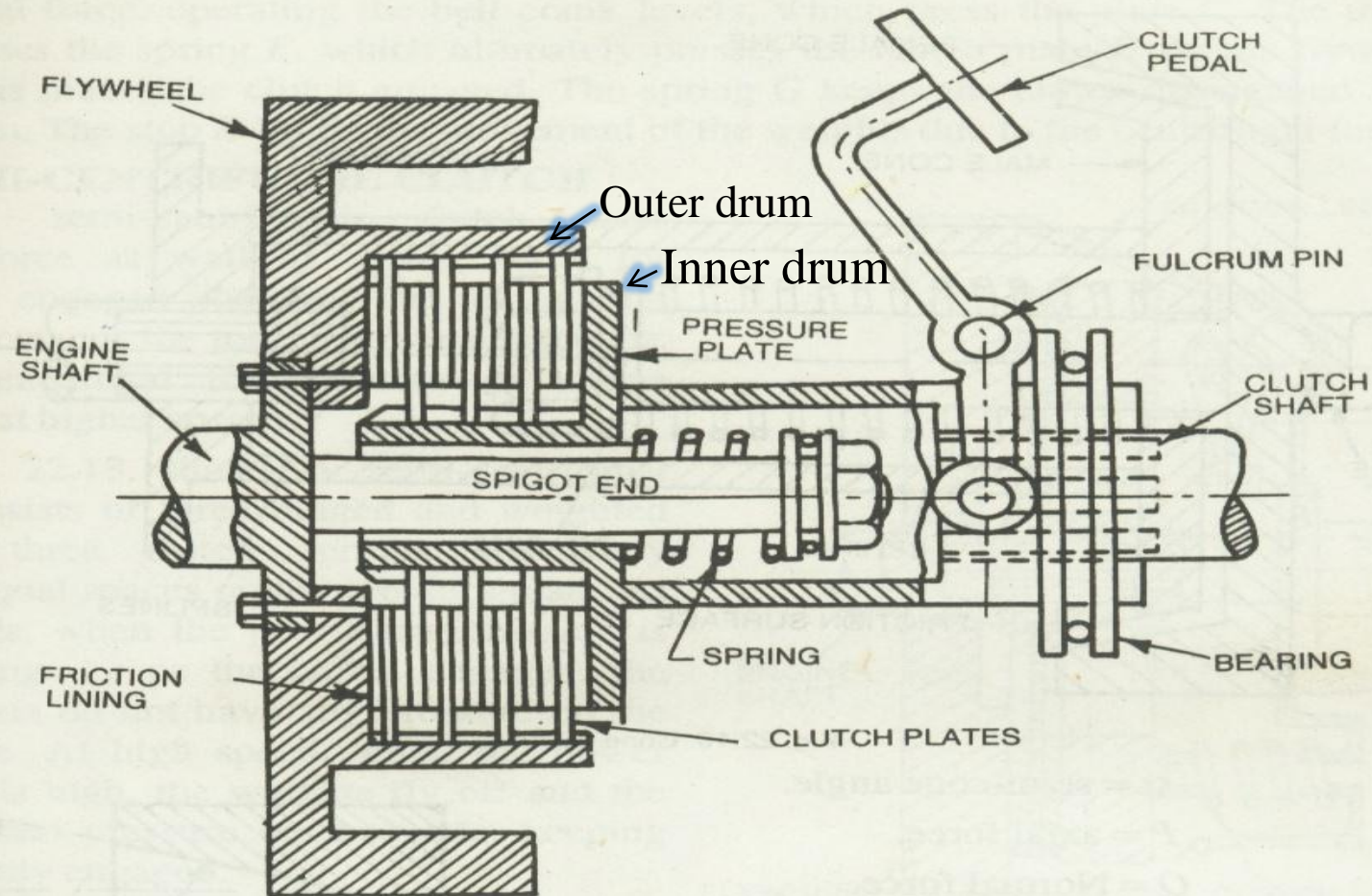


Fig. 22.8. Multiplate clutch.

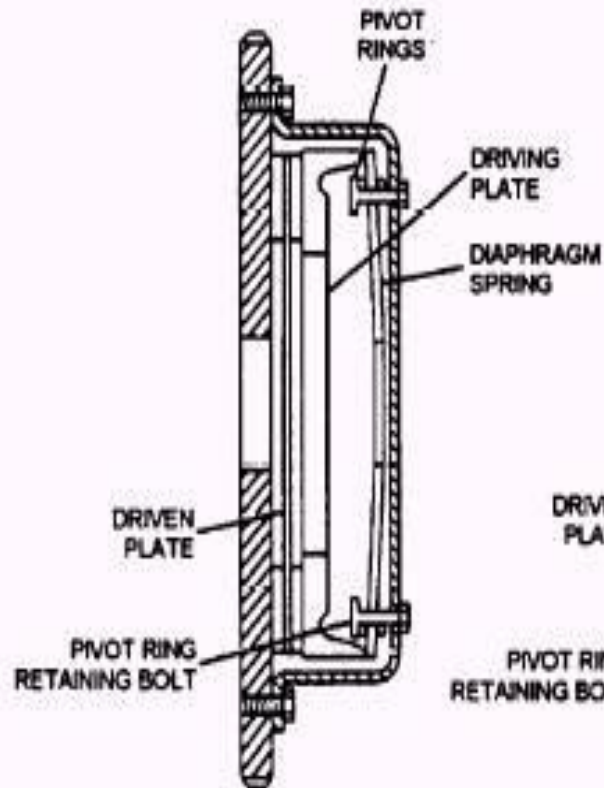
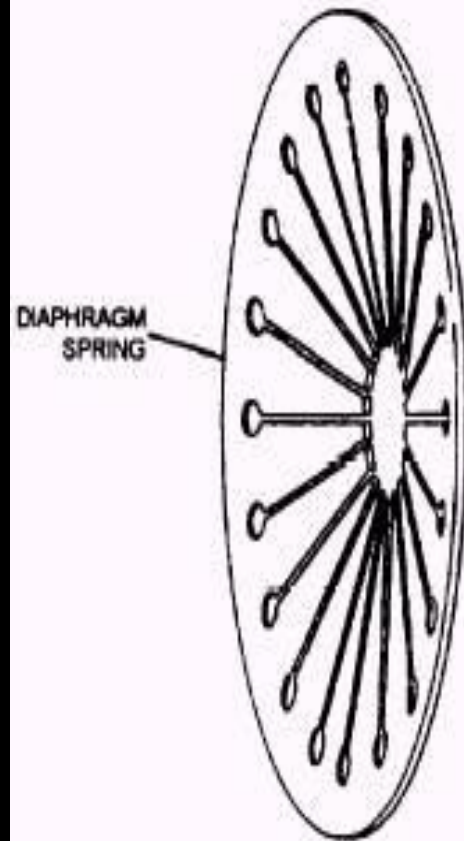
Explanation about the Multi-plate clutch

- The multi-plate clutch is an extension of single plate type where the number of frictional and the metal plates are increased. The increase in the number of friction surfaces obviously increase capacity of the clutch to transmit torque, the size remaining fixed.
- Alternatively, the overall diameter of the clutch is reduced for the same torque transmission as a single plate clutch.
- This type of clutch is, used in some heavy transport vehicles, in epicyclic gearboxes and racing cars where high torque is to be transmitted.
- Besides, this finds applications in case of scooters and motorcycles, where space available is limited.
- Extension of flywheel is a drum; which on its inner circumference is splined to carry a number of thin metal plates. These must consequently revolve with drum but are able to slide axially.
- Interleaved with these outer plates are a number of inner plates that are splined to an inner drum which is coupled rotationally to the gearbox shaft.

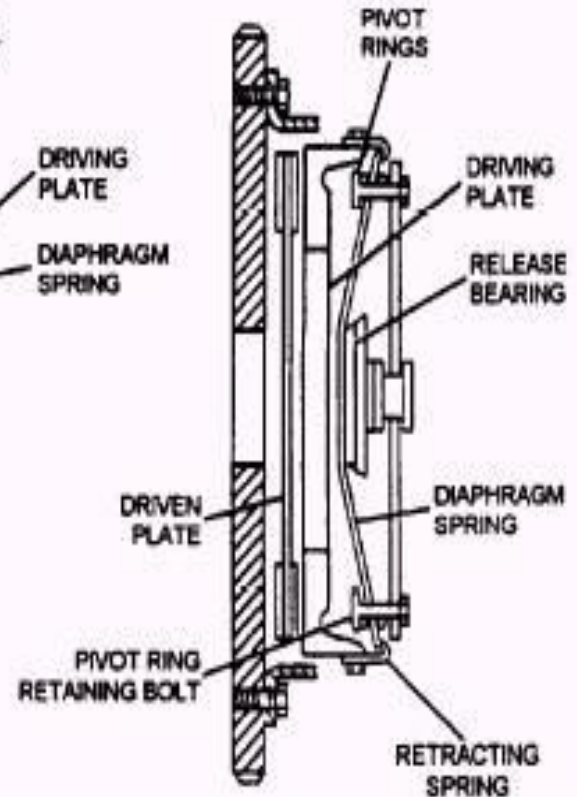
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- This drum is supported on a spigot extension of the crankshaft with a bush bearing. Between the web of inner drum and a sleeve screwed in to the cover plate of the outer drum is a strong coil spring.
- Thus inner drum is pressed to left, squeezing both outer and inner plates.
- Thus driving torque is transmitted due to friction between the plates.
- The clutch is disengaged by pulling inner drum right against spring force.
- The plates of multi-plate clutch were made of steel and phosphor bronze alternately but now are all of steel or one set may be lined with a friction material.
- With metal to metal contact lubrication is essential. So clutch is made oil-tight and partly filled with oil. The oil tends to make the Plates drag when clutch is disengaged so a clutch stop (or) brake is fitted to avoid this drag.

Diaphragm Clutch

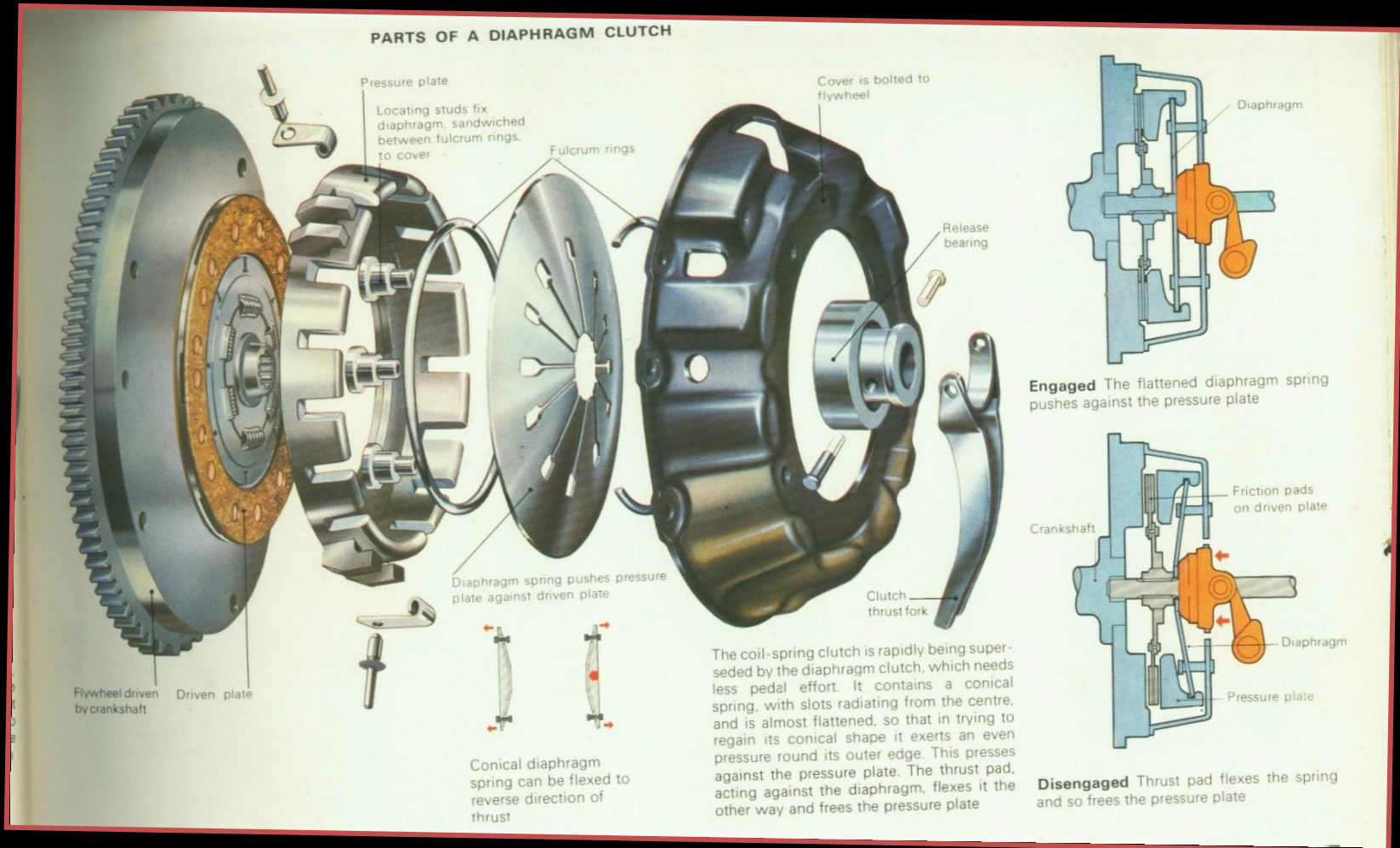


ENGAGED

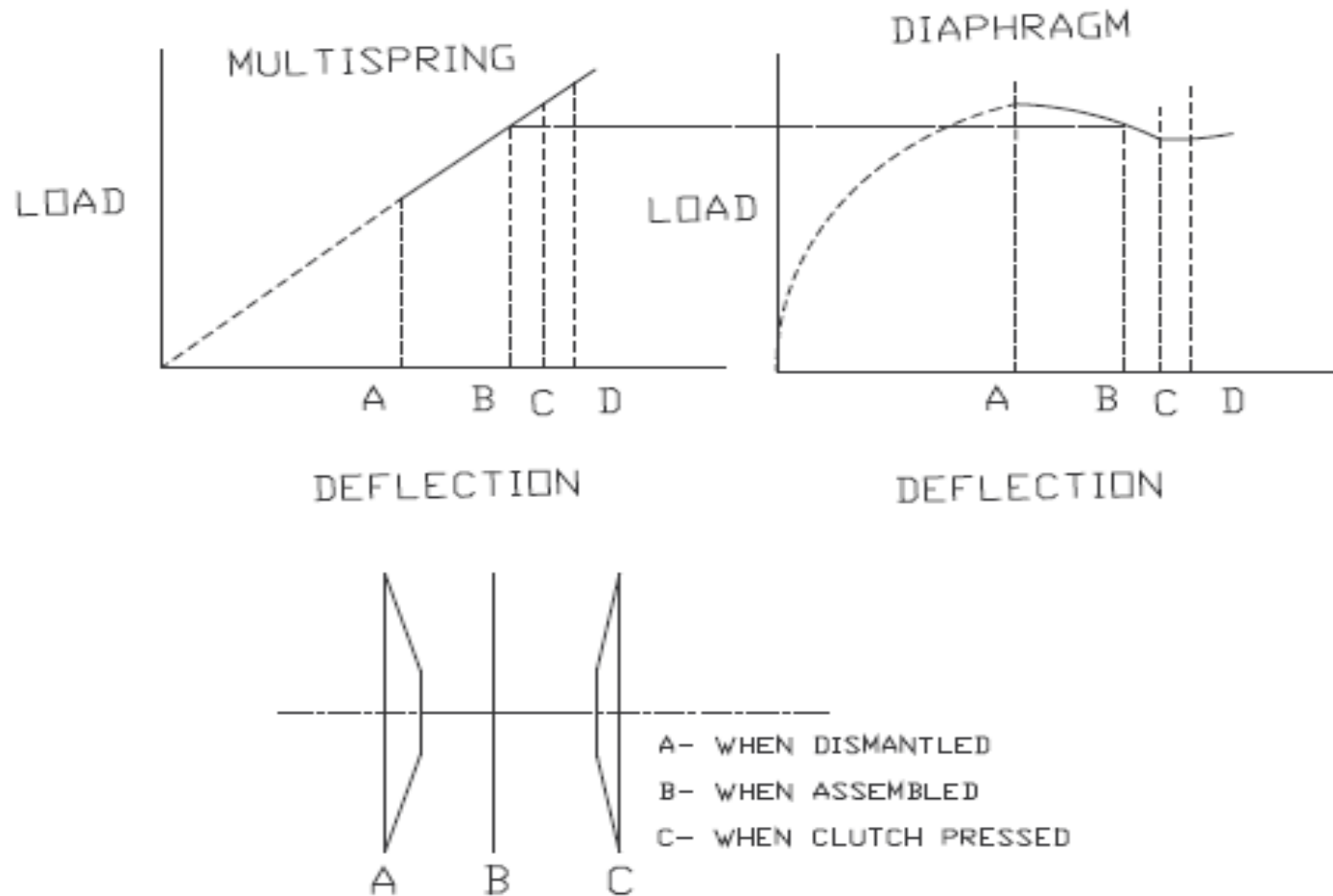


DISENGAGED

Exploded view of diaphragm spring clutch



Load Vs Deflection



Explanation about the diaphragm spring clutch

- Diaphragm spring pressure plate assemblies are widely used in most modern cars.
- The diaphragm spring is a single thin sheet of metal which yields when pressure is applied to it.
- When pressure is removed the metal springs back to its original shape.
- The centre portion of the diaphragm spring is slit into numerous fingers that act as release levers.
- During disengagement of the clutch the fingers are moved forward by the release bearing.
- The spring pivots over the fulcrum ring and its outer rim moves away from the flywheel.
- The retracting spring pulls the pressure plate away from the clutch plate thus disengaging the clutch.

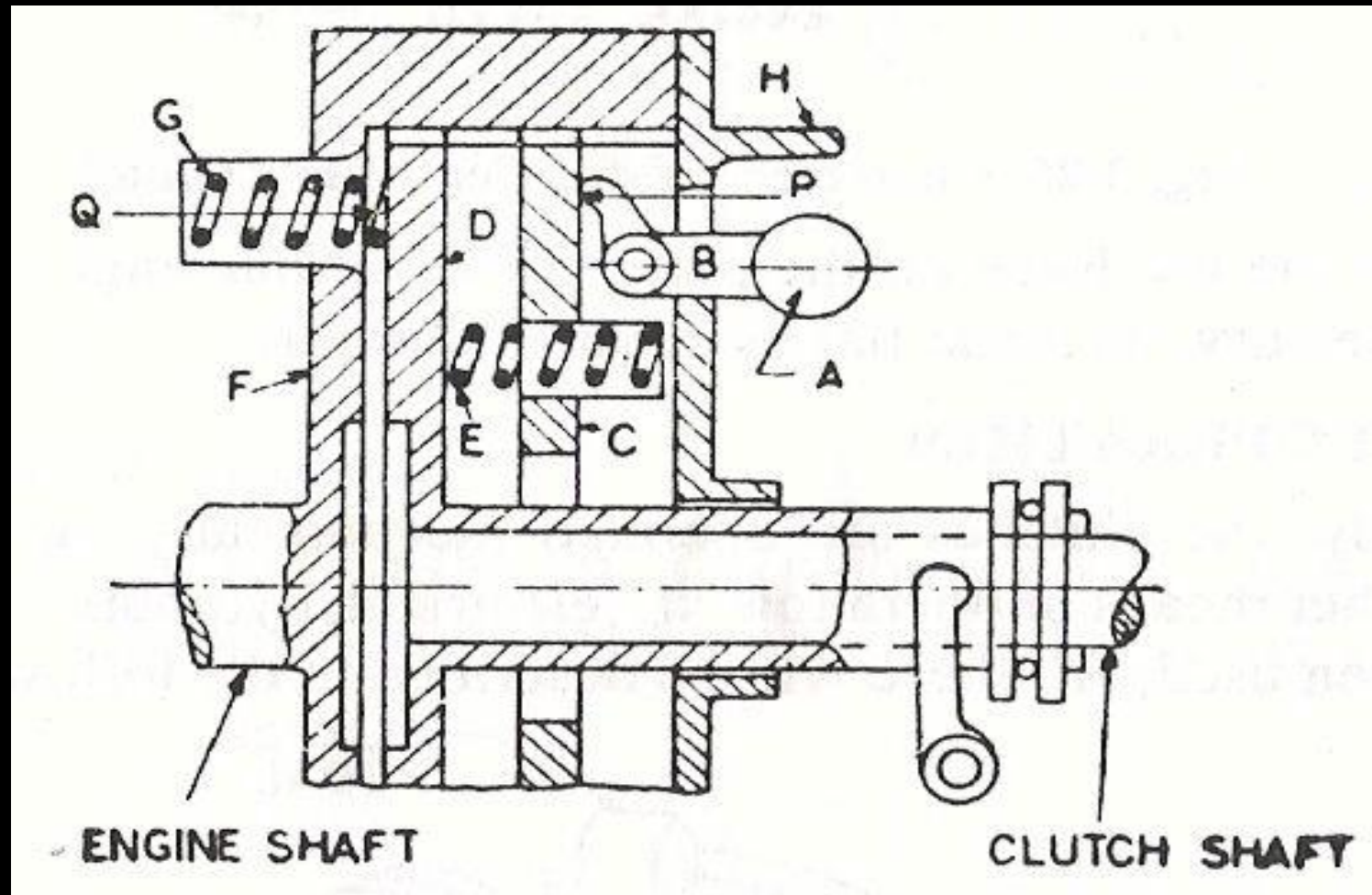
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- When engaged the release bearing and the fingers of the diaphragm spring move towards the transmission.
- As the diaphragm pivots over the pivot ring its outer rim forces the pressure plate against the clutch disc so that the clutch plate is engaged to the flywheel.

Advantages of the diaphragm clutch

- It is more compact than other designs.
- It is easier to balance rotationally and is less subjected to unwanted effects due to centrifugal force at high rotational speeds.
- It gives uniformly distributed pressure on pressure plate.
- No needs release levers.
- Minimum effort is sufficient to disengage the clutch.
- It provides minimum number of moving components and hence minimum internal friction is experienced.
- This is very commonly used in cars, light Lorries and mini trucks but is not much used in heavy vehicles

Centrifugal Clutch

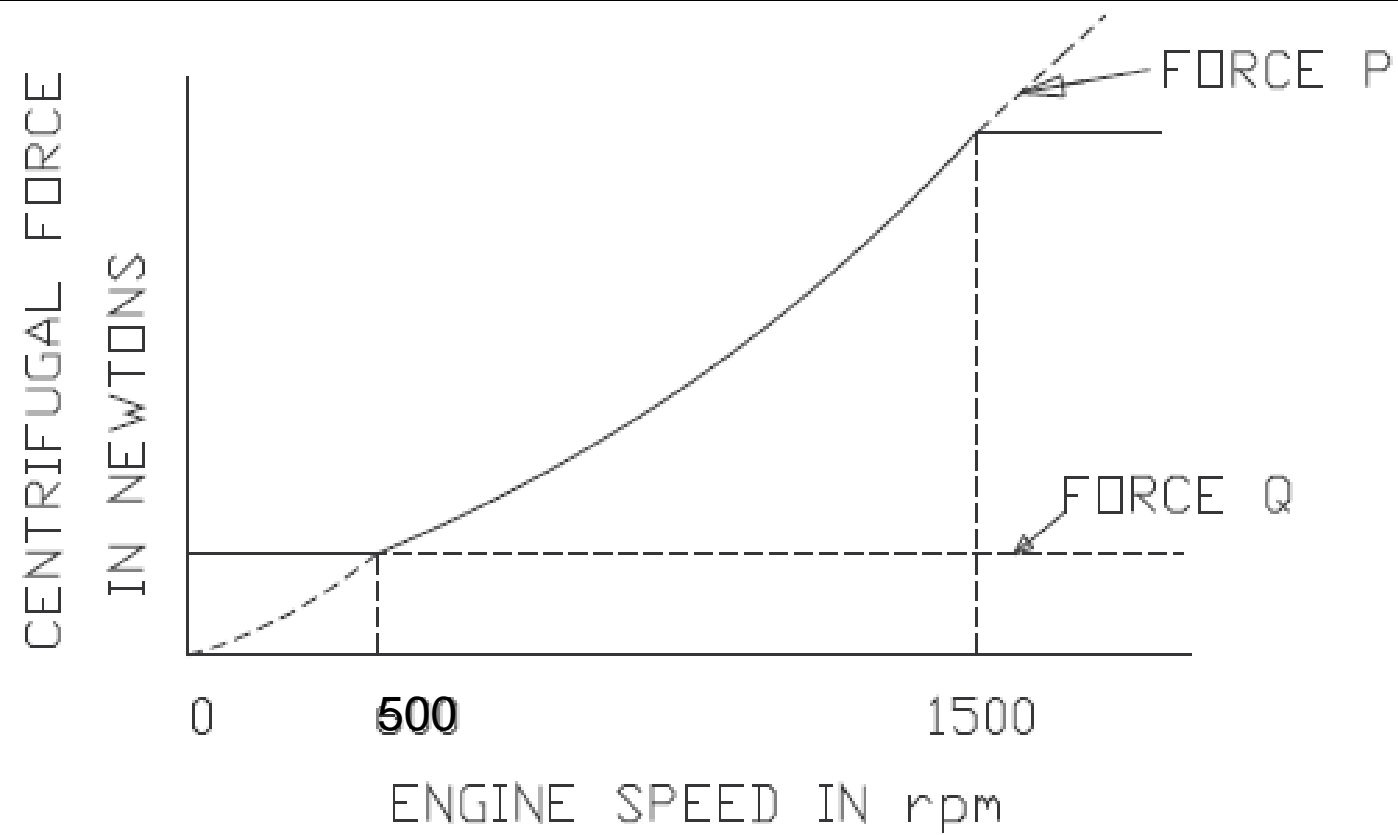


Explanation about the centrifugal clutch

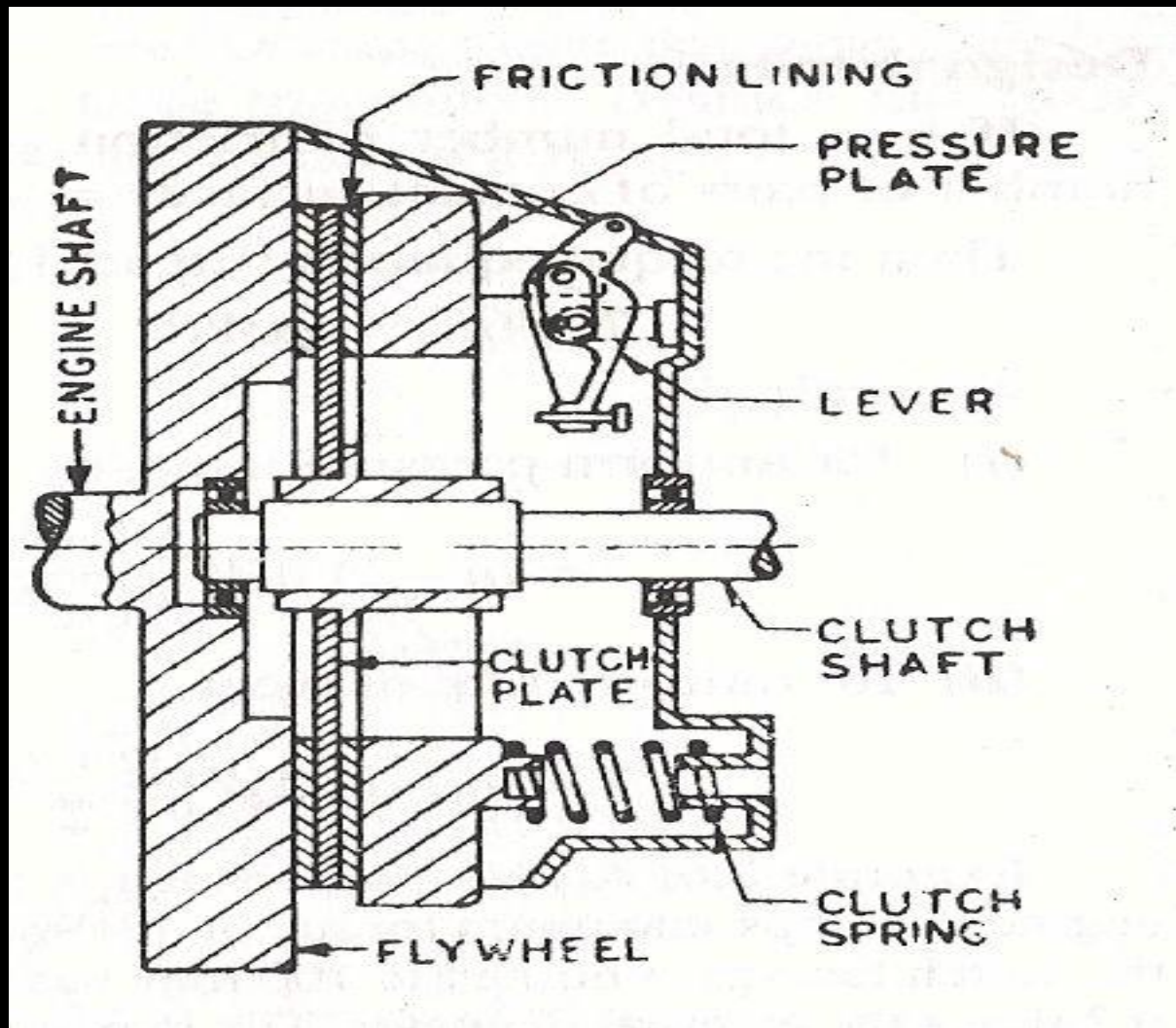
- In this type of clutches the springs are eliminated altogether and only the centrifugal force is used to apply the required pressure for keeping the clutch in engagement position.
- The advantage of the centrifugal clutch is that no separate clutch pedal is required.
- The clutch is operated automatically depending upon the engine speed.
- This means that car can be stopped in gear without stalling the engine.
- Similarly while starting, the driver can first select the gear, put the car into the gear and simply press the accelerator pedal. This makes the driving operation very easy.
- Figure shows a schematic diagram of a centrifugal clutch. As the speed increases, the weight A flying, thereby operating the bell crank lever B that presses the plate C.

Contd....

- This force is transmitted to the plate D by means of springs E. The plate D containing friction lining is thus pressed against the flywheel F thereby engages the clutch.
- Spring G serves to keep the clutch disengaged at low speed say 500 rpm.
- The stop H limits the amount of centrifugal force
- The operating characteristics of this type of clutch will be then as shown in figure.
- Force P is proportional to the centrifugal force at a particular speed, while force Q exerted by spring G is constant at all speeds.
- The firm line in the figure shows that net force on the plate D for various engine speeds. At the upper end the curve is made flat by means of stop H.



Semi Centrifugal Clutch



Explanation about the semi-centrifugal clutch

- It uses both centrifugal and spring force for keeping it in an engaged position of the clutch.
- The springs are designed to transmit torque at normal speed, while centrifugal force assists in torque transmission at high speed.
- This clutch consists of three hinged and weighted levers and three clutch springs alternately arranged at equal spaces on the pressure plate.
- At low speeds the springs keep the clutch engaged and the weighted levers do not have any pressure on pressure plate.
- At high speeds when power transmission is high, weights fly off and the levers also exert pressure on plate, keeping the clutch firmly engaged.
- When the speed decreases the weights do not exert any pressure on the pressure plate.
- Only spring pressure is exerted on pressure plate which keeps the clutch engaged.

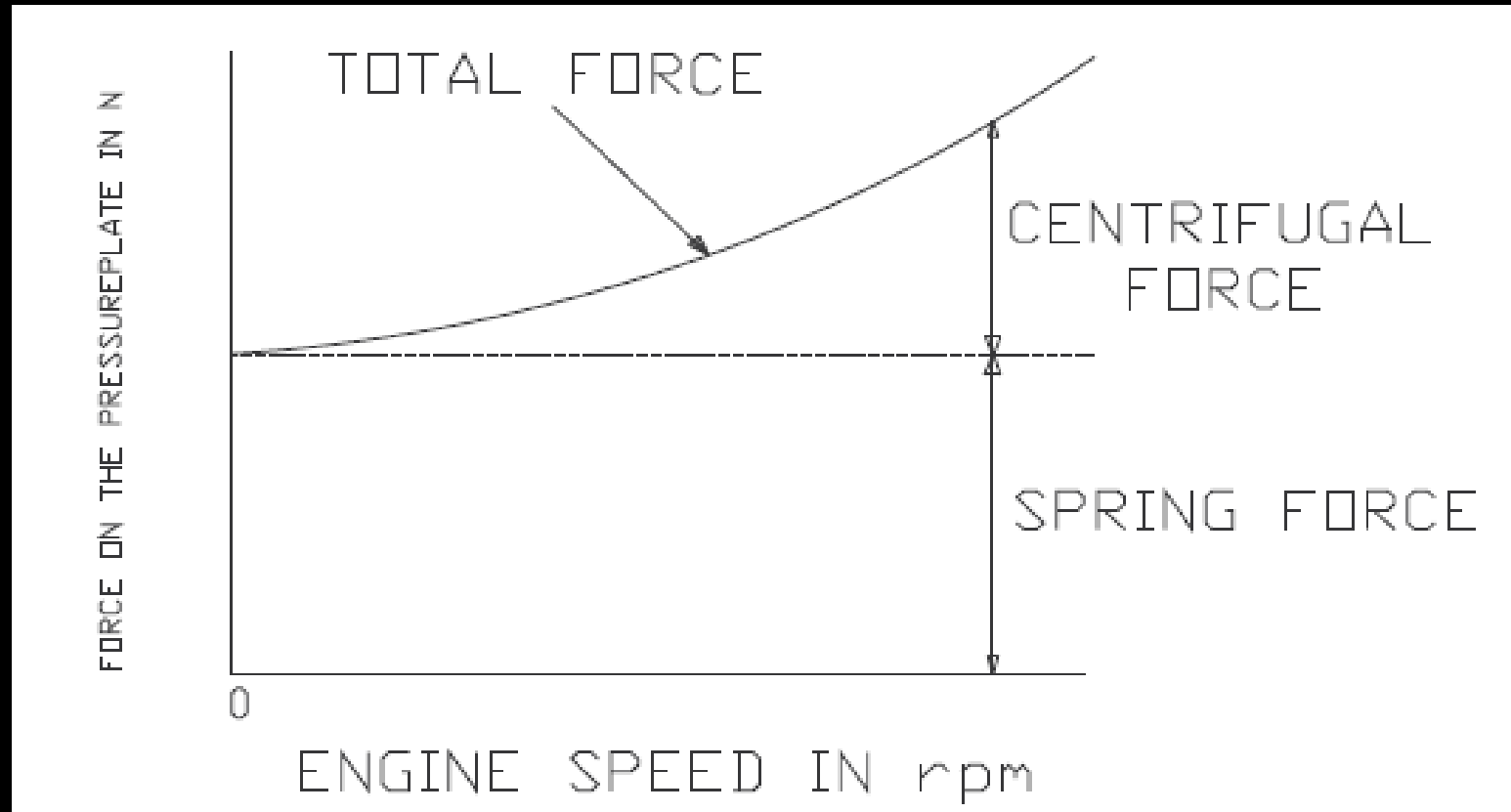
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- An adjusting screw is provided at the end of the lever by means of which the centrifugal force on pressure plate can be adjusted.
- At low speeds pressure on the spring is sufficient to transmit the torque required .
- However at high speeds, the centrifugal force due to weight moves about the fulcrum thereby pressing the pressure plate.
- The centrifugal force is proportional to the square of speed so that adequate pressure level is attained.

Graph shows the variation of force on the pressure plate as speed increases.

At low speeds spring alone applies the force on the pressure plate.

But when speed of the engine raises the centrifugal force also applied by the weights.



Electromagnetic clutch

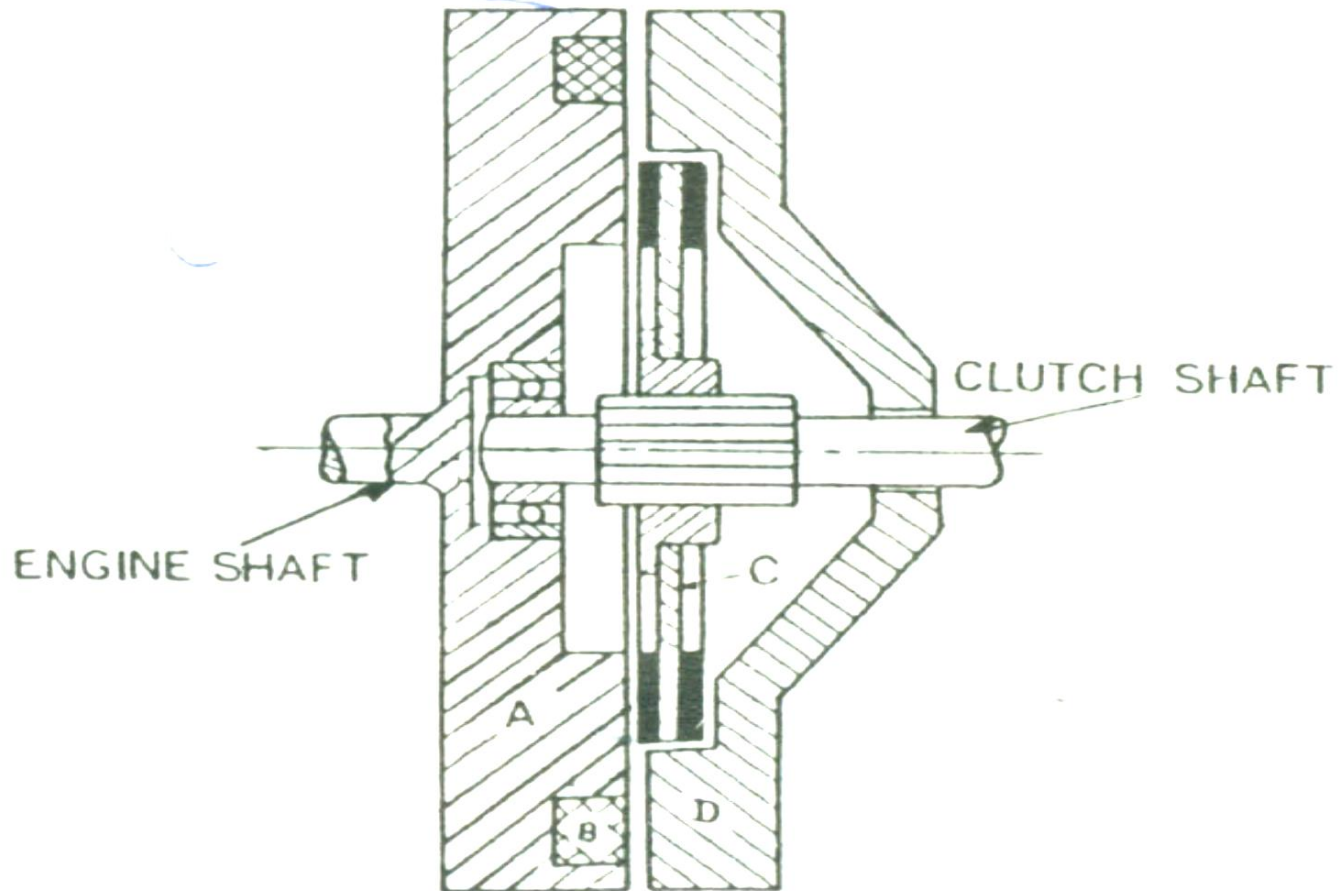


Fig. 3.30. Electromagnetic clutch.

Explanation about the Electromagnetic clutch

- This type of clutch has been employed on some Renault cars.
- The construction and working of this clutch may be understood by means of simplified fig.
- **A** is the engine flywheel incorporating the winding **B**.
- clutch plate **C** is lined with friction surfaces and is free to slide on splines on the clutch shaft.
- **D** is the pressure plate.
- The winding **B** is supplied with current from battery dynamo.
- When the winding **B** is energized, it attracts the pressure plate **D**, thereby engaging the clutch.
- When supply to winding **B** is cut off, the clutch is disengaged.
- There is a clutch release switch in the gear lever.
- This switch is operated as soon as the driver holds the gear lever change the gear, cutting off current to the winding and thus causing clutch disengagement.

Contd...

- Ordinarily the winding is connected to engine dynamo. At lower engine speeds, dynamo output is also low which makes the force in winding very small.
- Three springs are also provided in the clutch (not shown) to balance this reduced electromagnetic force at low speeds, thus disengaging the clutch.
- During normal operation, the electromagnetic force of the winding is regulated by means of an electrical resistance, which itself is controlled by means of accelerator pedal.
- As the acceleration pedal is pressed the resistance is gradually cut, thus increasing the electromagnetic force.
- The electromagnetic type of clutch is best suited remote operation is desired since no linkages are required to control its engagement.
- A major limitation of this type is that of heat capacity since the clutch-operating temperature is limited by the temperature rating of the insulation of the magnetic coil.
- Another disadvantage is its higher initial cost.