

FACTFILE: GCE TECHNOLOGY & DESIGN

1.47 MECHANICAL COMPONENTS AND SYSTEMS



Clutches

Learning outcomes

Students should be able to:

- demonstrate knowledge and understanding of:
 - clutches to include cone, single plate, diaphragm and centrifugal; and
 - methods employed to activate clutches and brakes.

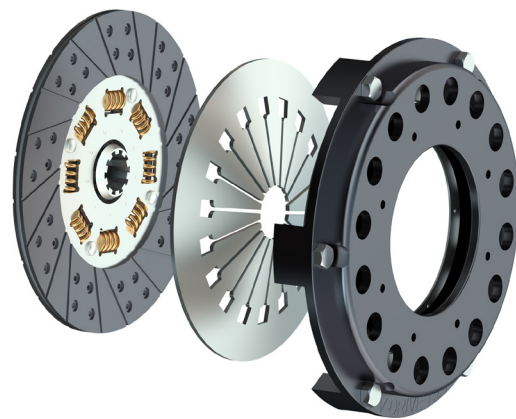
Course content

A clutch is a mechanical method of engaging or disengaging the power from the driving shaft of an engine or machine to the driven shaft. Clutches are used when the power or motion in a machine needs to be controlled and they are used in many situations. For example, an electric screwdriver contains a torque limiting clutch. It limits the amount of torque that is passed from the electric motor to the screwdriver bit making it controllable. If there were no clutch, the screwdriver would be in danger of working uncontrollably. A clutch in a car controls the power that is produced by the engine to the wheels. When the clutch pedal is pushed down, the road wheels become disengaged from the engine, when the clutch is engaged, the power is transmitted to the wheels and the car will be propelled along the road.

There are a number of different types of clutch including single plate, cone, diaphragm and centrifugal clutches, all of which have different applications.

Single Plate Clutch

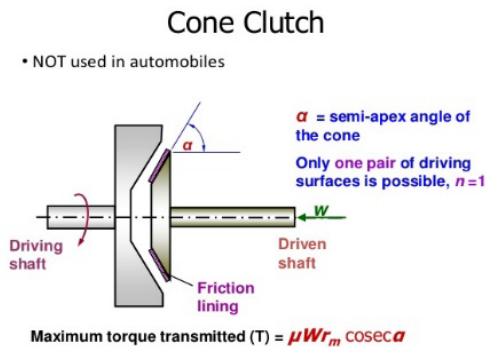
Most cars use single plate clutches to transmit power from the engine to the wheels. The best way of explaining the work of the clutch is to consider its application in the car. The flywheel is positioned at the rear of the engine and whilst the engine is running the flywheel rotates. When the clutch is activated, and the clutch pedal is pushed down, a pressure plate pushes the clutch disc away from the flywheel thus disengaging the engine from the wheels. Power is not transmitted to the wheels thus stopping the wheels of the car being driven. In a car, it means that when the clutch is depressed and the clutch plate is moved away from the flywheel the correct gears may be engaged. Once the correct gear has been selected, the clutch pedal is released and the power is resumed to the driving wheels.



Single plate clutch used in a car

The cone clutch

The cone or friction clutch works in a very similar way as a plate clutch. However, instead of a disc and flywheel coming together to transmit the power from the engine to the driving wheels, two conical surfaces are brought together. The advantage of a cone clutch is that higher torque can be transmitted between the motor and what is being driven. This is achieved because the cone has a higher surface area than the plate clutch. This type of clutch is usually used in specialist vehicles such as rally cars. They are used in rally cars because the clutch does not have to be pushed right in therefore making the gear change much quicker, an advantage in competition cars.

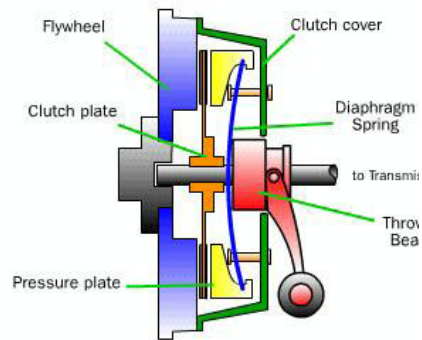


Cone clutch

<http://image.slidesharecdn.com/clutches-140430030215-phpapp01/95/clutches-for-automobile-38-638.jpg?cb=1398827225>

The diaphragm clutch

In the diaphragm clutch there are three main elements, the clutch plate, the pressure plate and the diaphragm spring. When the clutch is disengaged the clutch plate is not in contact with the flywheel. The flywheel is therefore free to rotate. Consequently, the drive from the engine will not be transmitted to the wheels. At this point the foot pedal is depressed. When the clutch pedal is up, the diaphragm spring forces the pressure plate against the flywheel and engages the clutch. The power is then transmitted to the wheels. This type of clutch is compact, lightweight, provides even pressure and is less expensive to manufacture.



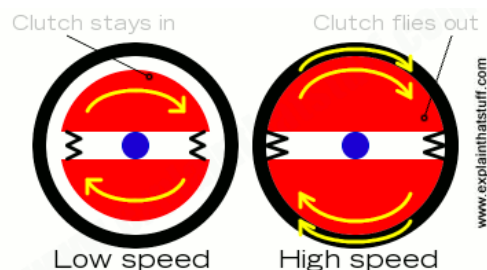
Sectional drawing of a diaphragm clutch

www.pearltrees.com/smatt82/clutch/id12648207/item125387821

The centrifugal clutch

The centrifugal clutch is a clutch that utilises centrifugal force to connect a drive shaft with the driven shaft. The higher the rotational speed of the driving shaft the more the clutch engages. The theory is that as the engine revolutions increase, as a result of centrifugal force, weighted arms, called flyweights within the clutch drum itself, swing out and engage with the driven shaft causing the shaft to rotate. The flyweights themselves have a friction pad attached to them that enable the clutch to become engaged. Within the clutch drum, attached to the flyweights, are a number of springs that as the motor slows down when the speed of the driving shaft reduces, causes the flyweights to come away from the drum thus disengaging the clutch.

Advantages of this type of clutch are that no type of control mechanism is necessary and it is cheaper than other clutches. Disadvantages are that since it involves friction and slipping between driving and driven parts there can be a loss of power and so is not for use in heavy torque applications. Typical examples of the use of centrifugal clutches is in strimmers, chain saws and go-karts



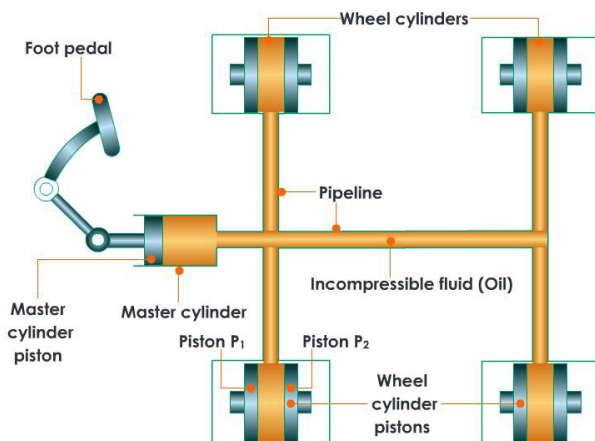
Centrifugal clutch

<http://www.explainthatstuff.com/how-chainsaws-work.html>

Activation of clutches and brakes

1. Hydraulic Systems for brakes and clutches

In this method of operating brakes and clutches the activation is undertaken using hydraulics. Hydraulics systems use a liquid as a means of transmitting force from the clutch or brake pedal to the clutch on the engine or the brakes on the wheels. It is important to note that the liquid that is used in all hydraulic systems is not compressible and is not corrosive. For this reason highly specialised hydraulic fluids are used.



Hydraulic brake system

<http://www.ustudy.in/node/3432>

In a hydraulic system, such as the simplified brake system illustrated above, when the foot pedal is depressed, a piston exerts a force on the hydraulic fluid in the master cylinder. This causes the fluid in the system to be forced along pipes to the cylinders at the brake drums. These cylinders in the brake drum, are often referred to as slave cylinders. The slave cylinder forces the shoes with the brake pads onto a spinning drum or disc. Hydraulic clutch activation works in a very similar way to hydraulic brakes.

2. Cable activation of brakes and clutches

In motor cycles, brakes and clutches are often activated by cables. The rider of the motorcycle has a lever on the handlebars that is connected to the either the brake or clutch by means of a cable. When the lever is activated on the handlebars the cable is pulled thus disconnecting the clutch or applying a brake. When the handle is released, the clutch is engaged or the brake released. The disadvantage of using a cable system as opposed to a hydraulic system is that cables do stretch and periodically brake and clutch cables do need to be adjusted to take into account any lengthening of the cable. It should be pointed out that the rear wheel of some motorcycles have brakes that are activated by rods from a foot brake.

Sectional drawing of a diaphragm clutch

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? Revision Questions

1 Explain the advantages and disadvantages of a centrifugal clutch as opposed to a single plate clutch in a car.

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2 Describe the activating sequence of the diaphragm clutch.

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3 Evaluate the advantages and disadvantages of hydraulic brakes when compared with cable activated brakes.

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