FRICTION AND BELT DRIVES

When you rub two rough surfaces against each other, there is always a resistance to the free movement of the surfaces. Again, when you rub the palms of your hands together without applying oil, there will be a feeling of opposition to the free movement of your palms. In the two cases mentioned heat is generated. The heat is produced by the opposing forces. These forces are known as friction.

Friction and its Application

Friction is always required in engineering. For example, a car must maintain friction between its tyres and the road to be able to move forward. Friction is equally required to bring it to a stop by applying the brakes.

Friction is required in most of the things we do. For instance, to be able to run, friction is required between the shoe and the ground; otherwise, you will not be able to run but slide about.

It can be stated that: *the rougher the surfaces rubbing against each other, the more the friction and vice versa*.

Disadvantages of Friction

When one solid part of a machine rubs constantly against another solid part, there is always heat created as a result of friction. Friction leads to wear and tear, which may lead to damage on the weaker part or even on both parts.

Again, when a tool is sharpened on the grinding wheel, it gets hot. This is caused by friction, and if not cooled, can lead to the burning out of the cutting edge of the tool.

What is a lubricant?

A lubricant is an oily substance, e.g. oil, grease, or other material, that makes surfaces smooth and slippery, thereby reducing heat, wear, friction and vibration caused when two or more surfaces rub together. To lubricate

therefore means to make smooth and slippery by the application of a lubricant such as oil.

Belt Drives and Chain Drives

Belt and chain drives are used to:

- Transmit energy from one shaft to another when both shafts are separated by a distance greater than that required for gears.
- Change the speed of a pulley.
- Change the running direction of a pulley.
- Carry materials as conveyors from one point to another.

Belts are made of rubber and materials whose length and nature change with temperature. So the rotation of the shafts cannot be guaranteed to remain in the same fixed ratio. In belt and chain drives, friction is generally needed, as it is the sustaining factor. If friction is lacking, it is possible for the belt, particularly, to slip over its drum or pulley. Common examples of belt drives are seen in sewing machines, corn and rice grinders, record players, turn tables, radio and air conditioners.

Types of Belts and Pulleys

There are various types of belt and pulley arrangements. These include the:

1. Open belt
2. Crossed belt
3. V-belt
4. Chain belt

An open belt connecting two pulleys makes them run in the same direction while a crossed belt change the direction of the pulleys.

V-belts run on pulleys. Both the pulley and the belts are V-shaped. V-belts are most often made of a combination of rubber, cord and canvas. A common use of the V-belt and V-pulley is the fan belt of an automobile. For heavy loads, several V-belts are often used side by side.

A chain belt is a gear type pulley.

Relationship between Belts and Pulleys

A pulley is the wheel on which a belt runs. Cone pulleys, also called *step pulleys*, have several steps and are used in pairs to get different speeds. The pulley from which power is taken is called the *driving pulley or driver*. The pulley to which power is carried is called the *driven pulley*. Flat pulleys are larger in diameter at the centre of the rim than at the edges, because the belt always runs to the highest point on the pulley. This highest part or top of the rim is called the *crown* of the pulley.

When the driving pulley is enlarged, or the driven pulley is decreased in size, the speed of the machine is increased. The increase in speed also means *less power*, just as an automobile has more power (or *decreased speed*) in a low gear than in a high gear.

Materials used for making belts

Belts are made of the following materials:

- Leather
- Rubber
- Rope
- Chain
- Special composition materials
- Canvas (strong clothing material)

Leather belts are made from the hides of bulls, cows, etc. Rubber belts are used in moist or damp places. They cannot function where there is dust or oil. However, canvas belts are used where leather or rubber belts would be ruined. Rope belts are used because they are cheap and easy to install. On the other hand, chain belts are used for high speeds, heavy loads and close connections.

Belts and chain drives are used to transmit energy from one shaft to another; this is especially when the distance between the shafts are greater than that required for gears. It means that gears are only used for transmitting energy at very close distances. Where the distances are far apart, belt or chain drives are used.

In belt drives, slip-free motions are not always possible. That is, the belt may slip in some cases. When there is a slip, it is not possible to use the speed of rotation of one shaft to calculate the exact speed of rotation of another shaft. Only an estimate can be made. For example, suppose a motor whose pulley is 50mm in diameter, is rotating at 300 revolutions per minute. If it is connected by a belt to another pulley of 30mm diameter, the rotating speed of the smaller pulley cannot be calculated exactly because of a slip. It may, however, be easily estimated by assuming that the slip is negligible. This estimate is made as follows:

$$\frac{300rpm}{1} \times \frac{60mm}{30mm} = 300 \times 2 = 600rpm.$$

The chain drive, on the other hand, ensures a constant and fixed ratio between the speeds of the drive and the drive shafts. The ratio between the drive and the drive shafts is referred to as the fixed speed ratio. Thus, the chain drive is used when it is necessary to maintain a fixed speed ratio. Chain drives are commonly used in bicycles, motorcycles, etc.

Similar to belt and chain drives, the gear system requires friction. The sliding action as well as the pushing action are features of the gear system. The difference is that the friction in gear system as against that of belt drives, is so high that lubrication is needed to reduce the friction. The pushing action enables one gear to move another gear, as well as transfer energy to that gear.