Mechanical Equipment - Course 430.1

LUBRICATION METHODS - UNIT 2

OBJECTIVES

Given the three methods of lubrication, hydrodynamic, hydrostatic and boundary, the student will be able to list at least three characteristics for each as explain in the text.

LUBRICATION METHODS

As already mentioned, bearings help to reduce friction and wear in a machine. This we said earlier is more likely to occur in a well lubricated bearing.

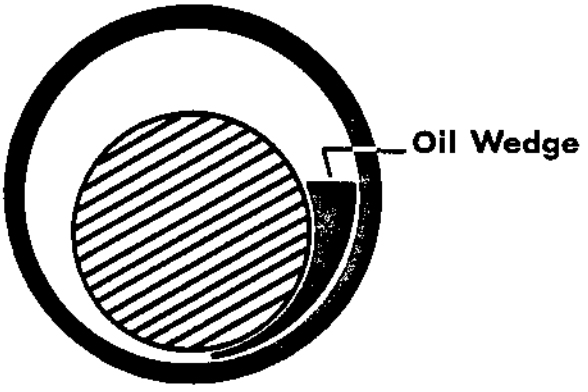
Plain bearings are mostly fluid film bearings. The fluid film generated separates the two surfaces of shaft and bearing and eliminates metal-to-metal contact. In doing so, friction and ultimately wear are reduced.

Two methods are employed to develop this fluid film. The methods are:

(1) hydrodynamic lubrication.

(2) hydrostatic lubrication.

Hydrodynamic lubrication uses a high pressure oil wedge to separate shaft and bearing surface materials. The "oil wedge" is developed internally by the bearing. When oil enters the bearing, it is picked up by the shaft surface. Oil on this surface is progressively fed towards the bottom of the shaft. Because of the geometry of the bearing, more oil enters an area towards the bottom of the shaft than leaves. Oil tends to, therefore, back up in a wedge-shaped area.



Since oil cannot be squeezed into a small volume, its pressure builds to separate the surfaces. To develop this oil wedge the following must be present:

(1) a supply of oil - low pressure.

(2) the shaft must be rotating.

(3) there must be a small clearance between shaft and bearing.

If a shaft in a journal bearing is not moving, how is the shaft separated from the bearing? Hydrostatic lubrication is used.

To separate the surfaces between a stationary shaft and a bearing, external high pressure oil is injected underneath the shaft. If the pressure is high enough, separation should take place. Again note that there should not be any metal-to-metal contact.

Rolling element bearings, on the other hand, permit motion between two loaded parts by rotation of balls and rollers. Metal-to-metal contact therefore occurs.

Although no special lubrication system is required, lube-oil or grease must certainly be present. Since most of the motion in these bearings is rolling of an element on a race with a small amount of slip, only a small amount of lubricant is required. Even though these bearings are called rolling element antifriction, a thin film of fluid separates the rollers and raceways except under very high load at low speeds (boundary lubrication). When low loads are combined with high speeds the tractive forces are not sufficient to maintain rolling, hence sliding occurs. This generates heat and additional lubrication must be available to keep temperatures down. Roller skidding can occur at constant speed but more common when rapid changes of speed are experienced. This skidding may occur in ball bearings but is more damaging in roller bearings.

EXERCISE

Write down as many points (characteristics) that you can think of for each of the following methods of lubrication in the space provided.

(1) Hydrodynamic.

(2) Hydrostatic.

(3) Boundary lubrication.

See next page of solution.

SOLUTION

Hydrodynamic Lubrication

- used in plain bearings.
- develops pressure by creating an oil wedge.
- no metal-to-metal contact is present.
- shaft must be rotating.
- clearances between shaft and bearing must be small.
- there must be a source of low pressure oil present.

Hydrostatic Lubrication

- no metal-to-metal contact.
- used on plain bearings.
- source of high pressure oil required underneath shaft

Boundary Lubrication

- thin layer of oil or grease present.
- used in rolling element bearings.
- there is some metal-to-metal contact.
- used to keep temperatures down when skidding occurs.