Name of Faculty: Mukesh Ahirwar

Designation: Asst.Prof

Department: Mechanical Engineering

Subject: Turbomachinary

Unit: Fifth (Fluid System)

Topic: Hydraulic coupling and Gear Pump

THE FLUID OR HYDRAULIC COUPLING

The fluid or hydraulic coupling is a device used for transmitting power from driving shaft to drive shaft with the help of fluid (generally oil.) There is no mechanical connection between the two shafts. It consists of a radial flow pump impeller mounted on a driving shaft A and a radial pump flow reaction turbine mounted on the drive shaft B. Both the impeller and runner are identical in shape and they together form a casing which is completely enclosed and filled with oil.

In the beginning, both the shafts A and B are at rest. When the driving shaft A is rotated, the oil starts moving from the inner radius to the outer radius of the pump impeller as shown in figure 5.1. The Pressure energy and kinetic energy of the oil increases at the outer radius of the pump impeller. This oil of increased energy enters the runner of the reaction turbine at the outer radius of the turbine runner and flows inwardly to the inner radius of the turbine runner. The oil, while flowing through the runner, transfer its energy to the blades of the runner and makes the runner to rotate. The oil, from the runner then flows back into the pump impeller, thus having a continuous circulation.

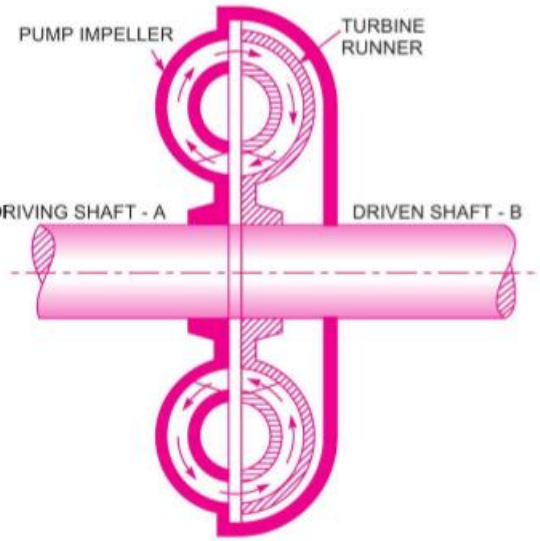


FIG- 5.1 The Hydraulic coupling

The power is transmitted hydraulically from the driving shaft and driven shaft and the driven shaft is free from engine vibrations. The speed of the driven shaft B is always less than the speed of the shaft A, by about 2 percent. The efficiency of the power transmission by hydraulic coupling is about 98%. This is derived as given below.

Efficiency of a fluid coupling = $\frac{Power\ output}{power\ input}$

Or $\eta = \frac{Power\ transmitted\ to\ shaft\ B}{Power\ available\ at\ shaft\ A}$ ...(i)

But power at any shaft $= \frac{2\pi\ NT}{60{,}000} \propto NT \propto SPEED \propto TORQUE$ (ii)

Let N_A = Speed of shaft A,

T_A = Torque at the shaft A,

N_B = Speed of shaft B,

T_B = Torque transmitted to shaft B,

From equation (ii), we have

Power available to shaft A $\propto (speed\ of\ shaft\ A) \propto Torque\ of\ A \propto N$

$\propto N_A \times T_A$

Similarly, power transmitted to shaft B $\propto N_B \times T_B$.

Substituting these values of powers in equation (ii),

$$\eta = \frac{N_B \times T_B}{N_A \times T_A}$$

But $T_B = T_A$ ($\because$ Torque transmitted is same.)

$\therefore$ $\eta = \frac{N_B}{N_A}$ ...(iii)

Slip of fluid coupling is defined as the ratio of the difference of the speeds of the driving and driven shaft to the speed of the driving sharp. Mathmatically,

Slip, $s = \frac{N_A - N_B}{N_A} = 1 - \frac{N_B}{N_A} = 1 - \eta$ $(\because \frac{N_B}{N_A} = \eta)$ ...(iv)

THE HYDRAULIC TORQUE CONVERTER

The hydraulic torque converter is a device used for transmitting increased torque at the driven shaft. The torque transmitted at the driven shaft may be more or less than the torque available at the driving shaft. The torque at the driven shaft may be increased about five times the torque available at the driving shaft with an efficiency of about 90%. The power at any shaft is proportional to the product of the product of torque and speed of the shaft. Hence, if the torque at the driven shaft is to be increased, the corresponding value of the speed at the same shaft should be decreased. The speed of the driven shaft is decreased by decreasing the velocity of oil, which is allowed to flow from the pump impeller to the turbine runner and then through stationary guide vanes as shown in fig 5.2. Due to the decrease in speed at the driven shaft, the torque increases.

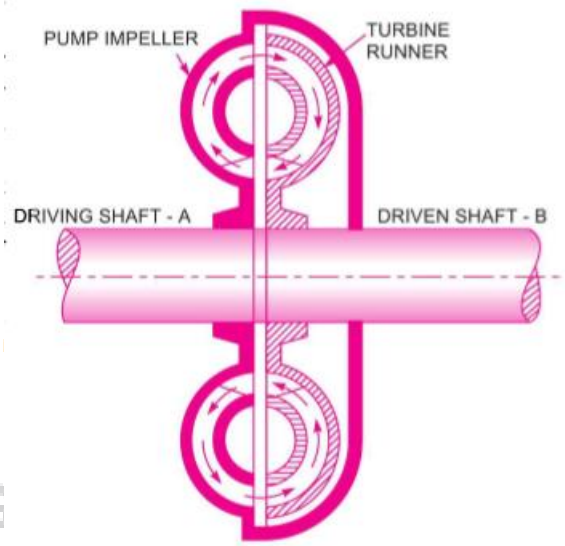


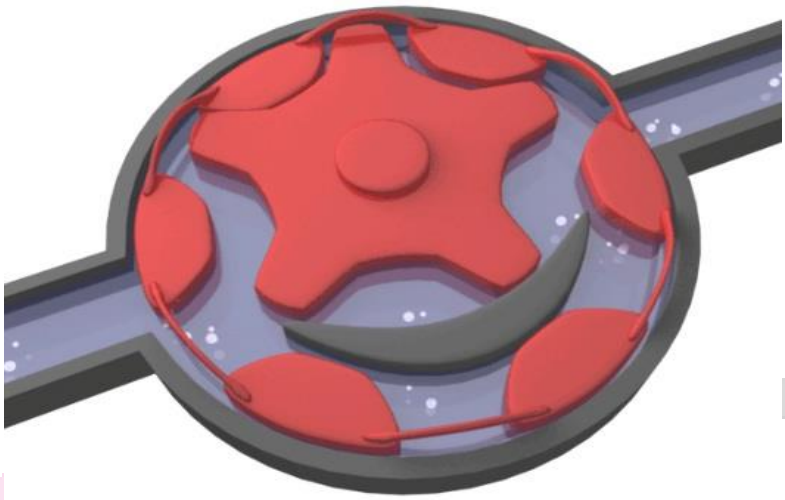
Fig. 5.2 Fluid of hydraulic torque converter.

Gear Pump Types and Its Working

The gear pumps essential as well as most frequently used pumps. As the name suggests, these pumps are inbuilt with gears. The main function of these gears is to provide force energy to the water within the pumps. In simple terms, the function of this pump is to transfer the water from one location to another location with the help of gear instrument. If the system's force remains similar then they'll supply you the fixed flow speed. This article discusses an overview of Gear-Pumps. So let us discuss an overview of these pumps with types, working, advantages, disadvantages and their applications.

What is a Gear Pump?

The **gear pump definition** is, it is a PD (positive displacement) rotating pump which assists you to move water otherwise fluid with the help of inbuilt gears. This type of pump includes two or more gears that create vacuum force to drive the liquid within the pump. This pump can be built with different parts like shaft, rotors, and casing.



Gear Pump

These pumps have high-pressure and are available in tiny sizes to supply constant liquid flow & a pulseless as contrasted to other types of pumps such as diaphragm & peristaltic pumps. The main benefits of using these pumps are superior like it can drive high thickness fluids, easy to use, operate and also maintain.

How does it Work?

The **gear pump working principle** is, it uses the gears actions otherwise rotating actions to move liquids. The rotating part extends the seal of liquid by the pump case to create suction at the inlet of the pump. Liquid drawn into the pump can be included in the rotating gears cavities and moved to the expulsion.

Types of Gear Pumps

These pumps are classified into different types but some of the basic **gear pump designs** are classified into two types which include the following.

- External Gear Pump
- Internal Gear Pump

1). External Gear Pump

An external gear-pump can be built with two gears namely interlocking and identical where interlocking gear is held up with separate shafts. In general, single gear can be driven with the help of a motor to drive the other gear. In a few cases, shafts can be driven by electrical motors, and these are held with bearings on every casing side.
When the gears appear from the mesh on the pump's inlet side, they make an extended quantity. Fluid supplies into the cavities as well as trapped with the teeth of gear because the gears continue for rotating next to the casing of the pump. The trapped liquid can be moved from the inlet side to the discharge side in the region of the casing.

When the gears teeth become linked on the discharge surface of the gear-pump, then the amount can be decreased & the liquid is forced out beneath force. No liquid can be moved back throughout the centre, among the gears, since they are linked. Close tolerances among the gears as well as the covering let the pump to expand suction on the inlet & stop liquid from leaking reverse from the expulsion side. The designs of these pumps can use helical, spur, otherwise herringbone gears.

Features of External Gear Pump

The features of this pump include the following

- These pumps are solid in size with a simple design
- These are sufficient to distribute high capacities because of their huge outlets.
- It manages the pressures like low, medium otherwise high
- The shaft support as well as close tolerance on both surfaces of gears.

2). Internal Gear Pump

An internal gear pump works on a similar principle except the two linking gears sizes are different with one revolving within the other. The rotor is a larger gear and also an inner gear, and it has the teeth projecting inside. A minor external gear is mounted, and this is mainly designed for linking by the rotor so that the teeth of the gear connected at a single end. A bushing and pinion can be connected to the pump case that holds the idler within the location.

A permanent semi-circular formed divider otherwise spacer seals the void shaped through the off-centre mounting location of the idler & performs like a seal among the ports like inlet & outlet. When the gears appear from the mesh on the pump's inlet side, they make an extended quantity. Fluid supplies into the cavities as well as trapped with the teeth of gear because the gears continue for rotating next to the casing of the pump. The trapped liquid can be moved from the inlet side to the discharge side in the region of the casing.

When the gears teeth become linked on the discharge surface of the pump, then the amount can be decreased & the liquid is forced out beneath force. Inner gear pump plans only utilize spur gears.

Features of Internal Gear Pumps

The features of internal gear pumps include the following

- It can be run for a small phase.
- It has a huge and big footprint.
- The net positive suction head (NPSH) requirement is very low.

Advantages and Disadvantages of Gear Pumps

The advantages of these pumps include the following.

- Maintenance is simple
- It handles an extensive range of viscosities
- Output is controllable
- Easy to reconstruct
- Cavitations are less sensitive

The disadvantages of these pumps include the following.

- The liquid should be free of abrasives
- Interlocking gears can also be loud

Applications of Gear Pumps

The gear pumps applications include the following.

- These pumps are usually used for driving high thickness fluids like oil, resins, paints, otherwise foodstuffs.

- These pumps are chosen where a high force o/p is necessary. These pipes are preferred in any condition wherever the supply is unequal. Because the pump output is not really influenced by force.
- Both the internal and external pumps are commonly used in different fuel, lube oils, solvents and alcohols
- The external pumps are used in chemical preservative, polymer metering, mixing and blending of chemical, agriculture, industrial, and mobile hydraulic applications.

Thus, this is all about the gear pump, this pump can be used to move a liquid with frequently surrounded a permanent volume in linking cogs otherwise gears, moving it automatically to push a flat pulse-free flow relative to the rotating velocity of its gears.