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Experiment No - 1

* Name of the experiment → Determination of speed ratio in a power transmission system.

* Aim → To study power transmitting elements and determine the speed ratio of a simple gear train.

* Objective → To understand the working of different power transmitting elements such as couplings, Gears and Bearings.

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Summary

Machine elements used for transmitting the power are called as power transmitting elements. Various power transmitting elements are gears, shafts, clutches and brakes, pulleys, belts, chain, and sprocket. One of the most commonly used power transmitting elements is a gear. A gear is a toothed wheel that engages with another toothed wheel or with a rack in order to change the speed or direction of transmit motion.

- Gears can be classified according to the relative positions of their shaft axes as follows-

1.) Parallel shafts -

Regardless of the manner of contact, uniform rotary motion between two parallel shafts is equivalent to the rolling of two cylinders, assuming no slipping.

- Spur Gears -

They are straight teeth parallel to the axis and thus, are not subjected to axial thrust due to tooth load. If the gears have external teeth on the outer surface of the cylinder, the shafts rotate in the opposite direction. An internal gear can mesh with an external pinion only and the two shafts rotate in the same direction.

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- Spur Rack And pinion-

Spur Rack is a special case of spur gear where it is made of infinite diameter so that the pitch surface is plane. The spur rack and pinion combination converts rotary motion into translatory motion, or vice versa. It is used in a lathe in which the rack transmits motion to the saddle.

- Helical or helical spur gears -

In helical gears the teeth are curved, each being in helical in shape. Two mating gears have the same helix angle, but have teeth of opposite hands. Therefore, helical gears can be used at higher velocities than the spur gear and have greater load carrying capacity.

2) Intersecting shafts -

Kinematically, the motion between two intersecting shafts is equivalent to the rolling of two cones, assuming no slipping. When teeth formed on the cones are straight, the gears are known as straight bevel and when inclined, they are known as spiral or helical gear.

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- Determination of speed ratio:

A gear consists of toothed wheels attached to shafts. It creates a mechanical advantage in a range of applications, for example a cyclist uses gears to intensify the power output of his pushing pedals.

- Gear Ratio -

The ratio of the turning speed of the input gear to that of the output gear is called gear ratio.

- Speed Ratio -

The difference between the speeds of the two gears is called the speed ratio.

- Belt drive -

A belt is a looped strip of flexible material used to mechanically link two or more rotating shafts. A belt drive offers smooth transmission of power between shafts at a considerable distance.

- Types of Belt Drives -

1) Open belt drives -

An open belt drive is used to rotate the driven pulley in the same direction of driving pulley.

2) Crossed belt drives:

A crossed belt drive is used to rotate driven pulley in the opposite direction of driving pulley.

- Advantages of belt drives:-

① Belt drives are simple and economical.
② They don't need parallel shafts.
③ They are lubrication-free.

- Disadvantages of belt drives:

① In Belt drives, angular velocity ratio is not necessarily constant or equal to the ratio of pulley diameters, because of slipping and stretching.
② operating temperatures are usually restricted to -35 to 85°C.

- Chain drive:

A chain drive consists of an endless chain wrapped around sprocket wheels. chains are used for power transmission and as conveyors. chains are sized according to their pitch.

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Questions

Q1.) Driver wheel has 40 teeth, and the driven wheel has 60, calculate the gear ratio and also calculate the RPM of driven wheel if the driver is rotating at 600 RPM.

Ans → Given -

$Z_d = 40$ teeth

$Z_D = 60$ teeth

$N_d = 600$ RPM

$N_D = x$ RPM

Soln -

Gear Ratio $= \frac{60}{40} = \frac{3}{2} = 3:2 \Rightarrow 1.5$

RPM of driven wheel -

$\Rightarrow \frac{N_D}{N_d} = \frac{Z_d}{Z_D}$ (Inverse of gear ratio)

$\Rightarrow \frac{x}{600} = \frac{2}{3} \Rightarrow 3x = 1200$

$\therefore \underline{x = 400 \text{ RPM}}$

$\therefore$ The RPM of driven wheel is 400 RPM

→

Q.2) Find the number of teeth required on driven gear to reduce the RPM by half, if number of teeth on driver gear is 80.

Ans → Given:-

$Z_d = 80$ teeth

$Z_p = x$ teeth

Soln:-

$\therefore$ Gear ratio $= \frac{Z_p}{Z_d} \left(\frac{80}{x}\right)$

To reduce RPM by half,

$\frac{1}{2} = \frac{80}{x}$ $\therefore x = 160$

$\therefore$ So the number of teeth required on driven gear is 160

Q3) Suggest type of gear pair used if the two shafts are intersecting perpendicularly.

Ans → If the two shafts are intersecting perpendicularly then type of gear pair is spiral bevel gear

→

Q4) what is gear and what are different types of gears and its application?

Ans → Gear -

A gear is a toothed wheel that engages with another toothed wheel or with a rack in order to change the speed or direction of transmit motion.

Different types of gears are -

① Spur gear - They have parallel shaft gear and used in balls mills that require speed reduction and torque multiplication.

② Spur Rack and pinion - Spur Rack is a special case of spur gear where it is made of infinite diameter so that the pitch surface is plane. It is used in lathe in which the rack transmits motion to saddle.

③ Helical or helical spur gears - Helical gears are one type of cylindrical gears where teeth are curved into a helix shape. They are used in industries and can be used at higher velocities than the spur gears and have greater load carrying capacity.

④ Spiral bevel gear - when the teeth of a bevel gear are inclined at an angle to the face of the bevel, they are called spiral bevel or helical bevels. They are used to drive the differential of an automobile.

Q5) What is the difference between flat belt and v belt drive?

Flat Belt drive	V - Belt Drive.
① Flat belts have a rectangular cross section, where width of belt is much larger than thickness	① V-belts have a trapezoidal cross section where maximum is almost same with the thickness.
② The pulleys for flat belt drive is cylindrical type. These are simple in construction and thus cheaper	② Pulleys must contain V-slot in the periphery having slot angles compatible with that of the belt. Thus these pulleys are costier
③ Only one surface of the belt remains in contact with the pulley	③ Two inclined surfaces continously remain in contact with the pulley.
④ Flat belts are hinged so their operation is noisy	④ V-belts are endless, so their operation is quite.
⑤ It can be used either in open belt configuration or in crossed belt configuration	⑤ V-belt is always used in open belt configuration

Q6) What is the difference between Gear drive, Belt drive and chain drive?

Ans →

1) Gear Drive -

① Here power and motion are transferred by means of successive engagement and disengagement of teeth of mating gears.

② No additional element is required in gear drive.

③ It is not one flexible drive. Thus it cannot protect the driver unit from vibrations induced in driven unit.

④ Gear drive require full lubrication.

⑤ Gear drive requires precise centre distance and alignment for satisfactory performance.

2) Belt Drive -

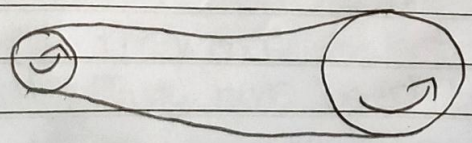
① Belt drive is one friction type mechanical drive where force (friction) between belt and pulley is used to transmit power & motion.

② It is preferred for medium for long centre distance between driver and driven shafts.

③ Although, belt driver is suitable for parallel shafts, slight parallel error is tolerable and does not water retracable problem.

④ Slippinge occurs in belt drive when load exceeds frictional force.

⑤ Belt drive requires minimum maintenance.



openbelt drive

3) Chain Drive -

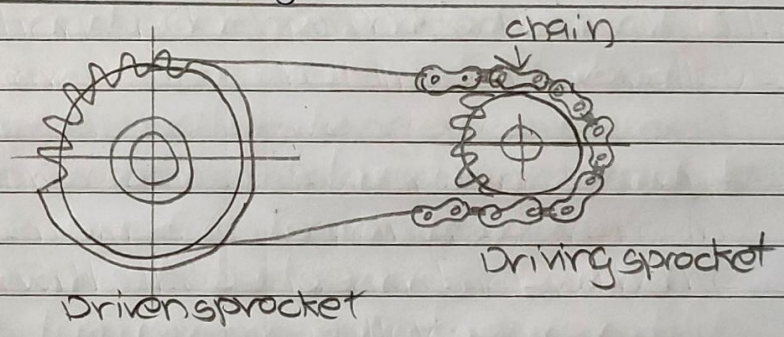
① chain drive is one arrangement type mechanical drive where power and motion are transmitted by successive engagement and disengagement of chain with sprocket.

② chain drive can be used for short to medium centre distances.

③ No such slippage occurs in chain drive.

④ In chain drive, parallelism must be maintained precisely, otherwise chain may leave sprocket without any warnning.

⑤ chain drive requires regular maintenance.



chain drive.