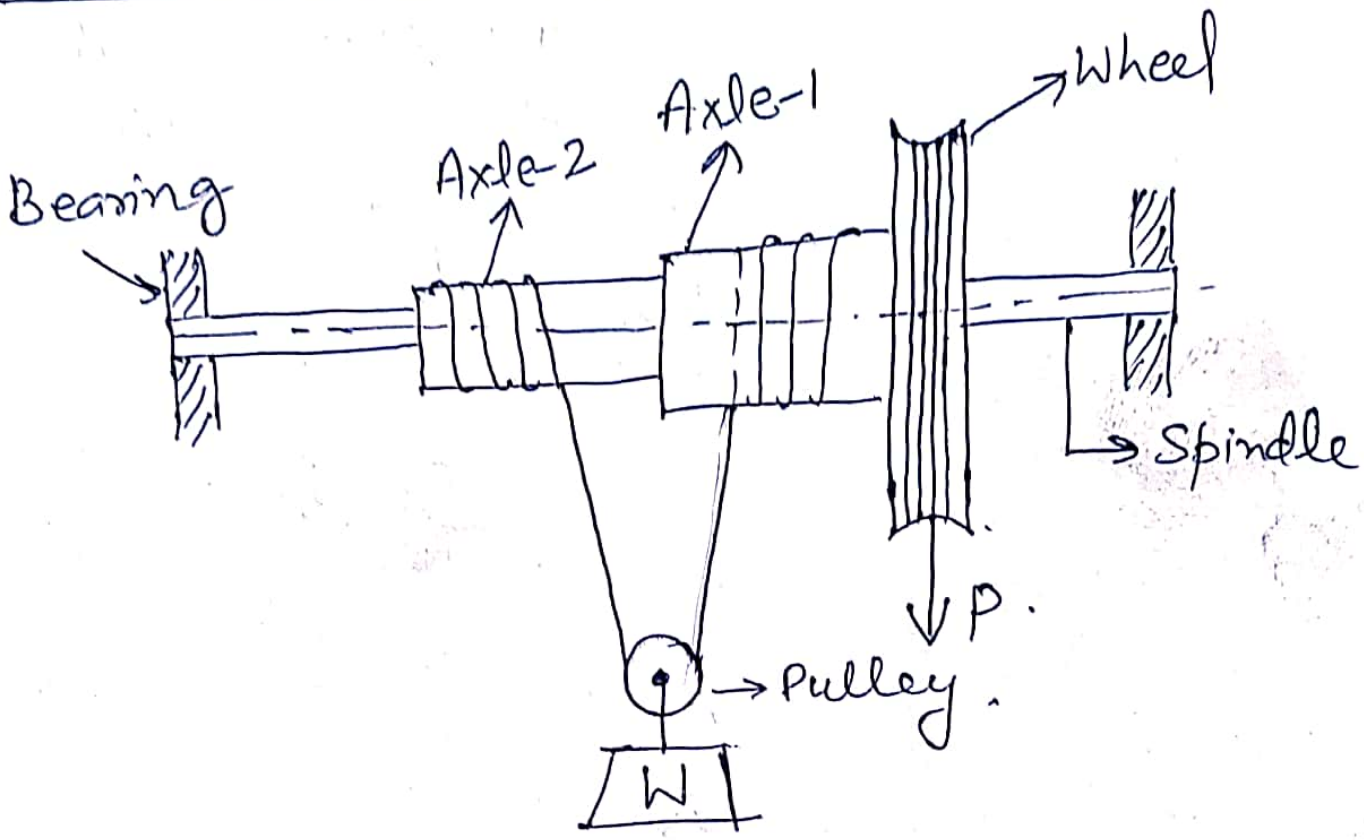
Differential Wheel and Axle



In this machine, the axle used is a compound axle, i.e. axle in made in two parts having different diameters.

* This compound axle and the wheel are fixed on same spindle.
* The spindle or shaft is supported in bearing as shown in figure.

⇒ A rope is wound round the two parts of axle through a pulley. The pulley has a hook to lift the load W.

* The direction of winding of rope is opposite to each other.

⇒ Another rope is wound over the wheel where effort P is applied

Let, D = diameter of wheel

d_1 = diameter of larger axle-1

d_2 = diameter of smaller axle-2

In one revolution of wheel,

Distance moved by effort P = πD

Rope wound on larger Axle-1 = πd_1

Rope unwound on smaller Axle-2 = πd_2

Since $d_1 > d_2$, so winding of rope on axle-1 is more than unwinding of rope on axle-2.

∴ Length of rope which is wind in one revolution of wheel

$= \pi d_1 - \pi d_2 = \pi (d_1 - d_2)$

Now, distance moved by load is half of this length. As the rope is passing over the pulley,

∴ Distance moved by load $= \frac{\pi(d_1 - d_2)}{2}$

So, V.R. $= \frac{\text{Distance moved by effort}}{\text{Distance moved by load}}$

$= \frac{\pi D}{\frac{\pi(d_1 - d_2)}{2}} = \frac{\pi D \times 2}{\pi(d_1 - d_2)}$

$$\text{V.R.} = \frac{2D}{d_1 - d_2}$$

$$\text{M.A.} = \frac{W}{P}$$

Efficiency, $$\eta = \frac{\text{M.A}}{\text{V.R}} \times 100$$