Problems related to Centrifugal clutch

1) A centrifugal clutch is to transmit 14.72 KW at 900 rpm. The Shoes are four in number. The Speed at which the engagement begins is 3/4 of the running speed. The inside radius of the pully rim is 150mm and the centre of gravity of the Shoe lies at 120 mm. from the centre of the Spider. The Shoes are lined with ferrodo for which the coefficient of friction may be taken as 0.25. Determine

(a) Weight of shoe and

(b) Size of Shoe if angle sustained by the Shoe at the centre of the spider is 60° and the pressure exerted on the Shoes is $9.81 \times 10^4 \ N/m^2$

Given data:

$P_w = 14.72 \ KW$

$N = 900 \ rpm$

$n = 4$

$\omega_e = \frac{3}{4}\omega$

$2\alpha = 60^\circ = \frac{\pi}{3} \ rad.$

$P = 9.81 \times 10^4 \ N/m^2$

$r = 150 \ mm = 0.15 \ m$

$r_c = 120 \ mm = 0.12 \ m$

$\mu = 0.25$

To find:

(i) W

(ii) b

Solution:

$$\omega = \frac{2\pi N}{60} = \frac{2 \times \pi \times 900}{60}$$

$$\boxed{\omega = 94.25 \text{ rad/s}}$$

$$\omega_e = \frac{3}{4} \omega$$

$$= \frac{3}{4} \times 94.25$$

$$\boxed{\omega_e = 70.7 \text{ rad/s}}$$

we know that,

$$\frac{60000 P_w}{2\pi N} = n \mu \frac{W}{g} (\omega^2 - \omega_e^2) \times r_c \times r$$

$$\frac{6000 \times 14.72}{2 \times \pi \times 900} = 4 \times 0.25 \times \frac{W}{9.81} (94.25 - 70.7) \times 0.12 \times 0.15$$

$$\boxed{W = 21.91 \text{ N}}$$

We know that,

$$\frac{W}{g} r_c (\omega^2 - \omega_e^2) = b l p$$

$$l = 2\alpha r$$

$$= \frac{\pi}{3} \times 0.15$$

$$\boxed{l = 0.1571 m}$$

$$\Rightarrow \frac{21.91}{9.81} \times 0.12 (94.25^2 - 70.7^2) = b \times 0.1571 \times 9.81 \times 10^4$$

$$\boxed{b = 0.0676 m}$$

Result:

(i) $W = 21.91 N$

(ii) $b = 0.0676 m$

2. A centrifugal clutch is to transmit 25·8 KW at 750 rpm when engaged at 75 percent of the running speed. The inside diameter is 0·36 m and the radial distance of the centre of gravity of each shoe from the shaft axis is 0·15 m. Assuming $\mu = 0.3$, determine the necessary weight of each shoe of the above clutch.

Given:

$P_w = 25.8$ KW

$N = 750$ rpm

$x = 75\% = 0.75$

$d = 0.36$ m $\Rightarrow$ $r = 0.18$ m

$r_c = 0.15$ m

$\mu = 0.3$

To find: W

Solution:

$$\omega = \frac{2\pi N}{60} = \frac{2 \times \pi \times 750}{60}$$

$$\boxed{\omega = 78.54 \text{ rad/s}}$$

$$\frac{60000 P_w}{2\pi N} = 4\mu \left(\frac{W}{g}\right) \omega^2 r_c \, r \, (1 - x^2)$$

$$\frac{60000 \times 25.8}{2\pi \times 750} = 4 \times 0.3 \left(\frac{W}{9.81}\right) \times 78.54^2 \times 0.15 \times 0.18 \times (1 - 0.75^2)$$

$$\boxed{W = 36.85\ N}$$

Result: $W = 36.85\ N$

3. A centrifugal clutch has four Shoes which Slides radially in a Spider keyed to the driving shaft and make contact with internal cylindrical surface of a rim keyed to the driven shaft. When the clutch is at rest, each Shoe is pulled against a stop by a spring. So as to leave a radial clearance of 5mm between the Shoe and the rim. The pull exerted by the spring is then 500. The mass centre of the Shoe is 160mm from the axis of the clutch. If the internal diameter of the rim is 400mm, the mass of each shoe is 8kg, Stifness of each Spring is 50 N/mm and the coefficient of friction between the shoe and the rim is 0.3. Find the power transmitted by the clutch at 500 rpm.

Given:

$n = 4$

$C = 5mm = 0.005m$

$S = 500N$

$r_c = 160mm = 0.16m$

$d = 400mm \Rightarrow r = 200mm \Rightarrow r = 0.2m$.

$m = 8kg$

$s = 50N/mm$

$\mu = 0.3$

$N = 500 rpm$

To find.

P_w

Solution

$$\omega = \frac{2\pi N}{60} = \frac{2 \times \pi \times 500}{60}$$

$$\boxed{\omega = 52.36 \text{ rad/s}}$$

Operating radius $r_0 = r_c + C$

$= 160 + 5$

$$\boxed{r_0 = 165 mm}$$

(or)

$$\boxed{r_0 = 0.165m}$$

Total frictional torque

$$T = \mu R r_n$$

Frictional force acting tangentially on each shoe $= \mu R = \mu(F - P)$

$$f = m\omega^2 r_0 = 8 \times (52.36)^2 \times 0.165$$

$$\boxed{F = 3619\ N}$$

$$P = S + (C \times S)$$

$$= 500 + (5 \times 50)$$

$$\boxed{P = 750\ N}$$

Frictional force acting tangentially on each shoe $= \mu R = \mu(F - P)$

$$\mu R = 0.3(3619 - 750)$$

$$\boxed{\mu R = 861\ N}$$

Total frictional torque

$$T = \mu R r_n$$

$$= 861 \times 0.2 \times 4$$

$$\boxed{T = 688.8\ N}$$

Power transmitted

$$P_w = T \times \omega$$

$$= 688.8 \times 52.36$$

$$\boxed{P_w = 36.1 \text{ KW}}$$

Result:

$$P_w = 36.1 \text{ KW}$$