CENTRIFUGAL CLUTCH DESIGN FOR VARIOUS APPLICATIONS

Karan sehgal, Anuj pratap, and Ravi kuhar
Students, Department of Mechanical Engineering, Dronacharya college of engineering, Gurgaon, India
karansehgalgurgaon@gmail.com, anujprataphipa@gmail.com,ravi.kuhar@gmail.com

ABSTRACT:

The centrifugal clutch offers many advantages in motor and engine drive applications. Utilizing the centrifugal clutch enables the selection of normal torque motors for running loads rather than the selection of high torque motors for starting loads. The aim of this project is to be describing the torque carrying capacity at different speed which using in transmitting power. The entire work based on conventional design with Ferro do lining, driving shaft, spring, shoe, spider, cover plate, driven shaft.
Compliant clutch is made from polypropylene material and there is no anyone connecting parts. it has rigid body design since revolute joints are replaced by flexible segment. The potential energy store in flexible segment can replace springs and reduction in revolute joints reduces problem with backlash and wear. A mechanism is evaluated and synthesized specific force-deflection relationship. In many applications, compliant mechanism can maintain or even improve performance relative to conventional rigid body designs. It is cost benefitted. Also conventional clutch is expensive rather than compliant clutch.

INTRODUCTION

A) CENTRIFUGAL CLUTCH:

A clutch is a machine member used to connect the driving shaft to a driven shaft, so that the driven shaft may be started or stopped at will, without stopping the driving shaft. A clutch provides an interruptible connection between two shafts. The centrifugal clutch is usually used into motor pulley. It consists of number of shoe on the inside of a rim of pulley. The outer surface of pulley is covered with friction material.These shoes which can move radiallly in guides are held against the boss on the driving shaft by means of springs.The spring exert a radialy inward force which assumed to be constant. The weight shoes when revolving cause it to exert a radialy outward force (centrifugal force).The magnitude of centrifugal force depeded on speed at which shoes is revolving. A little consideration show that when centrifugal force is less than the spring force, the shoes remain same position as when driving shaft was stationary, but when centrifugal force is equal to spring force, spring is floating.
When centrifugal force exceed the spring force, the shoe moves outward and comes in contact with driven member and press against it. The force with which the shoe press against the driven member is the difference of the centrifugal and spring force. The increase of speed causes the shoe to press harder and enables to be transmitted.

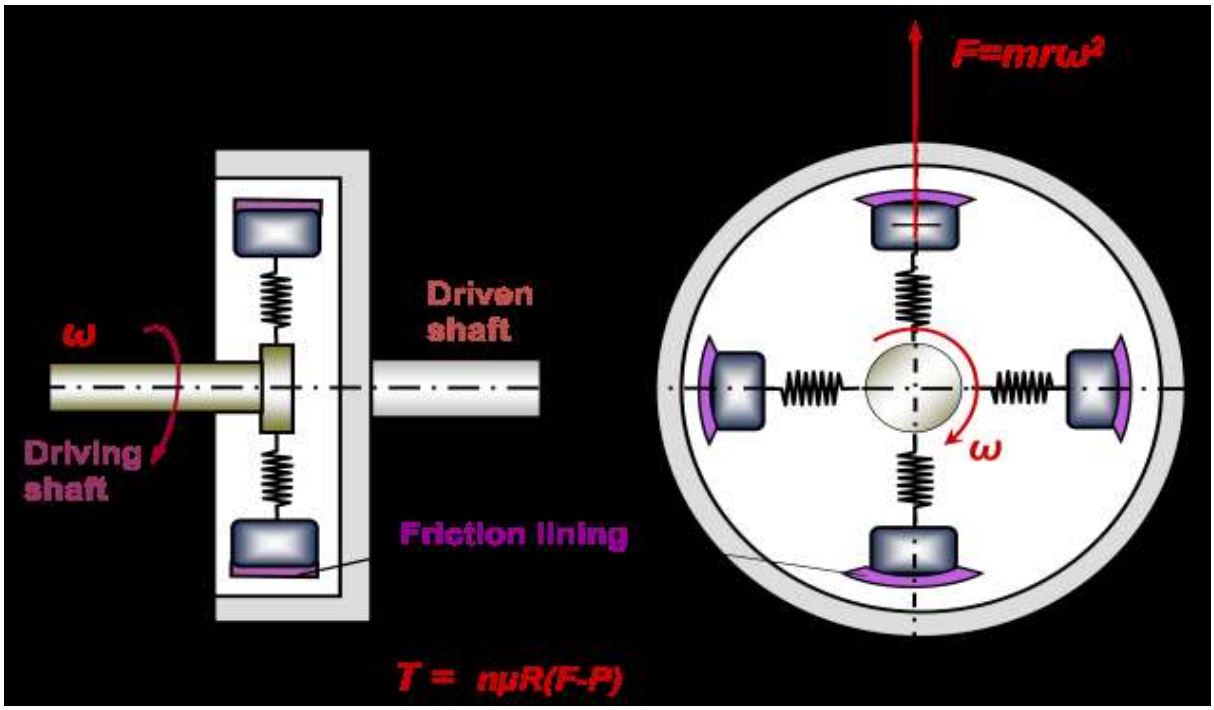

FIG.-1 Centrifugal clutch

B) *COMPLIANT CLUTCH*:

Compliant mechanisms are mechanisms that obtain some or all of their motion through the deflection of their members. In a compliant mechanism, a single flexible link often replaces two or more rigid links of an equivalent rigid-body mechanism. This decreases the mechanism's part count, wear points, and backlash. In the mechanism the centrifugal force is utilised to deflect the members and get friction on rotating drum to synchronise motion.

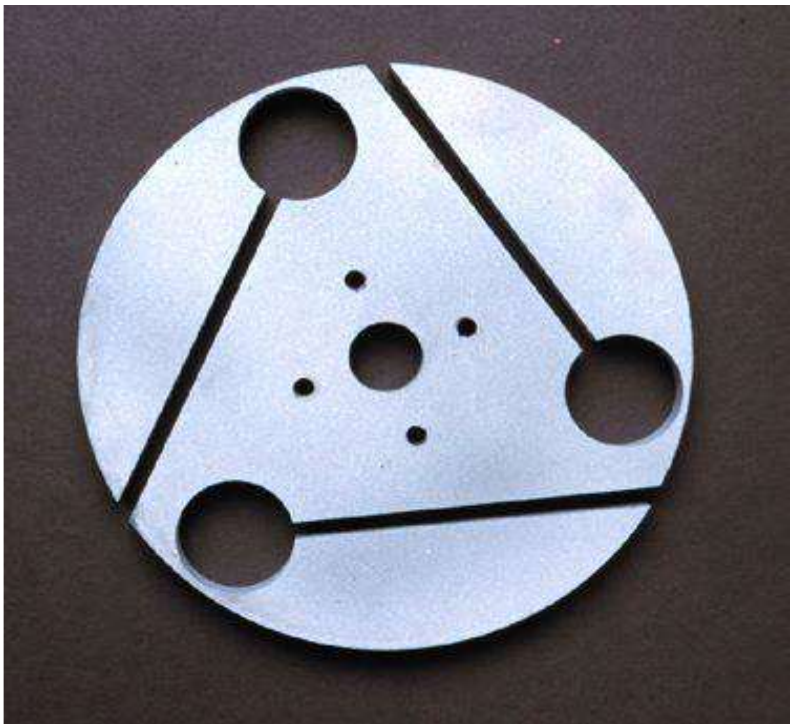

Fig: COMPLIANT CLUTCH

DESIGN FORMULATION

A) *DESIGN FORMULATION OF CONVENTIONAL CENTRIFUGAL CLUTCH:*

1.) TRANSMITTED TORQUE

$$T = P \times 60 / 2\pi N$$

Where, T = Transmitted Torque, N.mm

P = Intensity of Pressure, N/mm²

N = Running speed of Pulley, rpm

2.) MASS OF SHOE

Centrifugal force acting on each shoe

$$Pc = m.\ \omega^2.r$$

Where, Pc =Centrifugal force acting on each shoe, N

m =Mass on each shoe, Kg

r = Distance of center of the shoe from the center of the spider, mm

3.) DIMENSION OF SPRING

$$Ps = 9/16\ m w^2 r$$

Where Ps = force extered on shoe by spring, N

m = mass of shoe, kg

w = angular running speed, rad/sec
r = distance of center of shoe from the center of the spider, mm

B) DESIGN FORMULATION OF COMPLIANT CENTRIFUGAL CLUTCH:

A design of compliant clutch is based on empirical formulas. Here centrifugal and normal force is derived graphically from force diagram. A force which is acting on a shoe has force components in different direction at the point of
contact. Here tangential and normal forces are considered in the design.

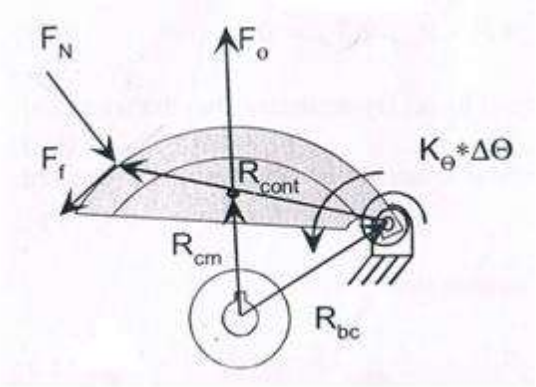

FIG.-5 Forces acting on a member of compliant clutch

1. DIAMETER OF CLUTCH

Dclutch = 11.91x Dhole

2. DIAMETER OF DRUM

Ddrum=12.80 x Dhole

3. HOLE DIAMETER OF SHAFT

Dhole =2, mm

4. NO OF ARM IN A CLUTCH;

n=3

5. ANGLE OF HOLE FROM CENTER OF SHAFT ;

Θ=37°

6. WIDTH OF SLOT IN A CLUTCH

W =0.675d

CALCULATION

A) *CALCULATION BY ANALYTICAL METHOD FOR A CONVENTIONAL CLUTCH:*

Given Data for Sample Calculation of Loan mover:

P= 1119 w
N=2800 Rpm
n=3;
R=42.5mm=0.0425m;
μ=0.28

1.) TORQUE TRANSMITTED

T = P x 60 / 2□N= 1119 x 60 / 2□□x 2800 = 3.81Nm

2.) MASS OF THE SHOES

M= mass of shoes

Assuming the center of shoes lies at distance 5 mm less then R.

r = 37.5mm = 0.0375m

3.) SIZE OF THE SHOE

l= contact length of the shoe
b= Width of shoe; Area(A) = l.b = 44.5b mm2
p=Intensity of pressure exerted on shoe=0.1N/mm2

F= A .p

B) *CALCULATION BY GRAPHICAL METHOD FOR A COMPLIANT CLUTCH:*

1. DIAMETER OF CLUTCH

Dclutch=75 mm

2. DIAMETER OF DRUM

Ddrum= 85 mm

3. HOLE DIAMETER OF SHAFT

Dhole = 20 mm

RESULTS AND DISCUSSION

A. CALCULATED VALUES FOR CONVENTIONAL CLUTCH:

A conventional clutch is design analytically to determine torque transmitting capacity from given power and speed for particular application. Mass of shoe is calculated from centrifugal force and spring force.

B. CALCULATED VALUES FOR COMPLIANT CLUTCH:

A compliant clutch is designed graphically to determine torque transmitting capacity from force analysis on arm of clutch for particular application. The transmitted torque is calculated from centrifugal force and normal force acting on a contact point of drum and rotating arm. The table shows calculated values of required parameters for clutch as given below.

Sr. No.	Applications	Transmitted torque (Nm)	Mass of the shoe (kg)	Centrifugal force (N)	Spring force (N)
1	Lawn mover	3.81	0.076	241.78	137.81
2	Chain saw	2.675	0.0150	21.45	181.51
3	String trimmer	1.011	0.00408	118.54	66.78
4	Tvs moped	4.96	0.0306	328.64	798

CONCLUSION

Here we have calculated torque by Conventional analytical method for clutch used in different applications. Then we introduced compliant clutch in place of conventional one. It is design graphically and compared their capabilities with respect to torque transmitting capacity. The shaft diameter and drum diameter are considered same for both the methods for comparison of clutch used in different applications.

From this comparison we conclude that compliant clutch is more efficient if we used in chain saw and in other applications, it gives nearly same value of torque than conventional clutch. The main advantage of compliant clutch is cost benefitted and having no movable component in its design. The problem of backlash and wear is eliminated by using this type of clutch.

REFERENCES:

[1] R.S.Khurmi, J.K.Gupta, "Machine Design Book", fourteenth edition, S.Chand & company ltd, New Delhi.
[2] B.L.Singhal, F.B.Sayyad, "Machine Design Book"(GTU),second edition,Tech- max publication,Pune.
[3] P.S.G.Design Data Book, second editon, Koimbtoor.
[4] Richard G. Budynas, J. Keith Nisbett, *"Mechanical engg. Design"*,ninth edition, Mcgraw hill publication, New Delhi.
[5] Ananthasuresh, G.K., and Kota, *"Designing Compliant Mechanisms",* Mechanical Engineering, Vol. 117, No.11, pp. 93-96.