Issue 6 volume 4 (sspace) ISSN: 2321-8134

IJFEAT

INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

DESIGN AND FABRICATION OF ADJUSTABLE TORQUE SPRING BALL CLUTCH SETUP

Ajay N. Ingale, Shivam P. Gujar, Vaibhav H. Kawale ,

Rajat K. Moglevar,Raj R. Pise,Yash N. More

Ajay N. Ingale, Mechanical Engineering, DMIETR, Maharashtra, India, ajayingale10@gmail.com
Shivam P. Gujar Mechanical Engineering, DMIETR, Maharashtra, India, shivamgujar44@gmail.com
Vaibhav H. Kawale, Mechanical Engineering, DMIETR, Maharashtra, India, kawalevaibhav91@gmail.com
Rajat K. Moglevar, Mechanical Engineering,DMIETR, Maharashtra, India, rajat.moglewar22@gmail.com
Raj R. Pise, Mechanical Engineering, DMIETR, Maharashtra, India, rajpise130@gmail.com
Yash N. More,Mechanical Engineering,DMIETR, Maharashtra, India ,yashmore6287@gmail.com

Abstract

In today's life science and technology are increasing at rapid rate. Due to rapid industrialization growth, quality and quantities production requirement the automation of machine are increasing day by day. For this machine has to operate continuously a safety of machine plays an important role in today's industrial environment. Many industrial machine required electrical motor for its operations which are directly connected electrical motors. If load on machine increases which in turns overload the motors and chances of burning the motor winding or damage to electrical motor increases.

An attempt is made in this project the electrical motor from overloading by installing a "Spring Ball Clutch". Many clutches required manual operations for engaging and disengaging the input and output shaft. The Spring Ball Clutch done this automatically.

In case of overloading the arrangement ball clutch is such that the input and output shaft are disengage from each other automatically.

Keywords: Safety clutch with spring and ball, over load protection, torque limiting device, adjustable torque value etc.

--- *** ---

1. INTRODUCTION

In an industry there is always need of more rapid, more rigid and precise equipment to increase capacity and productivity.

Such requirement demands various mechanisms like gearing arrangements, high capacity motors and shaft drive mechanism. The output load on driving member exceeds in some of the applications like centrifugal pumps, grinders, ship propellers etc. When machine gets overloaded it results in failure of components such failure of shafts, burning of motor, gear teeth rupture. In order to avoid overloading some preventive measures are incorporated between driving and driven mechanism,use of spring ball clutch is one of them.

Spring ball clutch is of a Flying ball type which transmits torque from input to output using balls held by a spring in assembly when overload occurs the balls will come out of assembly and thus disconnecting input and output thereby saving part failures. Hence in this paper the spring ball clutch is so designed that the balls will not come out of assembly when there is overload. There will only be slipping of the balls, this comes as an advantage as the clutch can be preset without removing it from assembly and this will save considerable amount of downtime of process as compared to the conventional clutch.

1.1 OBJECTIVE

1. To reduce machine break down time so as to improve productivity.
2. To reduce the maintenance cost.

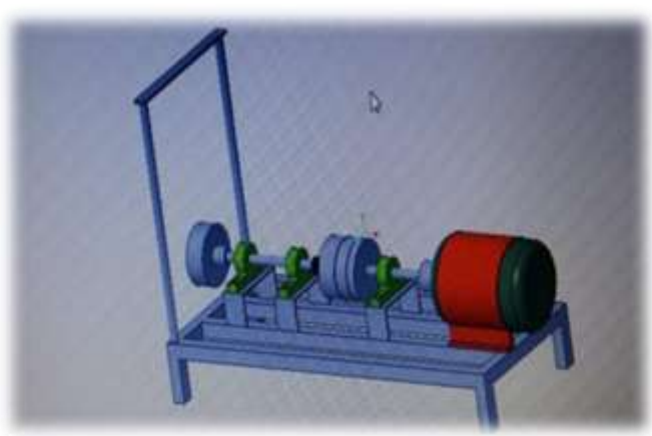

Fig. –Testing Setup (3D Design)

2. METHODOLOGY

System design

In this section there is design of the system which is Shown in the figure. It contains the motor of 373 watt, 230 Volt (50 Hz), 0.5 amp and speed range 1500 rpm.
Here we are designing the spring ball clutch to limit the Value of torque to 1.25 Nm i.e., by considering 25% of Overload.

Torque Calculation

$$T = \frac{P \times 60}{2\pi N}$$

$$T = \frac{373 \times 60}{2\pi \times 1500}$$

$T = 2.37 \times 10^3$N-mm

Considering 25% overload

$T_d = 1.25 \times 2.37 \times 10^3$N-mm

$T_d = 2.96 \times 10^3$ N-mm

Calculation of Tangential force on balls (F_t)

Assume pitch circle of groove diameter =90 mm

$$F_t = \frac{2 \times Td}{D}$$

$$F_t = \frac{2 \times 2.96 \times 1000}{90}$$

$F_t = 65.77$ N

Calculation of total spring force on balls (F_s)

$F_s = Ft\left[\frac{\cos\alpha - \mu \sin\alpha}{\sin\alpha + \mu\cos\alpha} - \mu\right]$

$F_s = 65.77\left[\frac{\cos 45 - 0.08 \sin 45}{\sin 45 + 0.08 \cos 45} - 0.08\right]$

$F_s = 50.75$

Where,

α =Angle of inclination of Groove=45°

β = Coefficient of friction between the balls and body of the clutch=0.08

Calculation offorce on each spring (F)

$$F = \frac{F}{Zb}$$

$$F = \frac{50.75}{3}$$

$$F = 16.91 \text{ N}$$

Where, Z_b=Number of ball in clutch=3

Table 1 : Stiffness and permissible static and dynamic load for helical compression spring

Rod Diameter of spring(mm)	Outer Diameter (mm)	Stiffness Of spring per turn K1 (N/mm)	Permissible load	
			Static Load (N)	Dynamic Load (N)
1.0	12.0	7.98	32.4	14.5

Stiffness of spring(K_s)

$Ks = \frac{F1}{n} = = \frac{7.981}{3}$ = 1.33 N/mm

Where,

K1=Stiffness of spring per turn K1(N/mm)

=7.98 (From Design Data Book)

n=Number of turns of spring=6

Compression of spring to exert a force (δ1)

$\boldsymbol{\delta 1} = \frac{F}{Ks}$

$\boldsymbol{\delta 1} = \frac{16.91}{1.33}$

$\boldsymbol{\delta 1} = 12.71$ mm

Movement of ball while the clutch is sleeping (δ2)

$$\boldsymbol{\delta 2} = \frac{d(1 - \cos\alpha)}{2}$$

$$\boldsymbol{\delta 2} = \frac{14(1 - \cos 45)}{2}$$

$\boldsymbol{\delta 2} = 2.05$ mm

Where,

d = Diameter of a ball = 14 mm

Maximum Deflection of spring (δmax)

$\delta max = \delta 1 + \delta 2 = 12.71 + 2.05 = 14.76$ mm

Free Length of a spring (L_f)

L_f = Solid length + Maximum deflection + Clearance between adjacent coils

$L_f = n'd + \delta max + (n' - 1)$

Where,

n' = n + 2 = 6 + 2 = 8

$L_f = 8 \times 14 + 14.76 + (8-1) = 133.76$ mm

Table 2 : Parameters of Spring Ball Clutch

Sr.No.	Parameters	Notation	Value
1.	Diameter of ball	d	14 mm
2.	PCD of grooves	D	90 mm
3.	Angle of inclination of grooves	α	45 °
4.	Free length of spring	L_f	24mm
5.	Number of ball in clutch	Z_b	3
6	Outside diameter of spring	D’	12 mm
7	Rod diameter of spring	d’	1 mm

Table 1 : Stiffness and permissible static and dynamic load for helical compression spring

4. CONCLUSION

1. The input and output shaft is necessarily disconnect in case of sudden loading.
2. By designing this type of clutch it is possible to disengage the motor from the transmission automatically .
3. Overload slipping ball clutch prevent the breakage of coupling of other drive members which are subjected to overloads.

REFERENCES

1) D. T. Gawande, R. V. Mahamuni, S. H. More “Design and analysis of a justable torque spring ball clutch”, International Journal Innovation Engineering, Research and Technology.vol.4,year-2015

2) Pankaj ThakujiThorve, Dr. S. B. Zope “Testing and analysis of torque limiter time belt spindle drive for overload protection”, International Journal of Engineering , Research and Technology.vol.1, year-2015

3) L B. raut , Rohan N. Kare ,“Performance testing of torque limiter timer belt spindle drive for overload protection” American journal of engineering research.Vol.4,year-2015