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Torque Tender /Limiter For Overload Shaft

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Abstract--Design and development of test-rig and Testing of drive to derive performance characteristics for

a) Torque Vs Speed

b) Power Vs Speed

c) Efficiency Vs Speed

And the process consist the following experiments and checks the validity of experimental results with theoretical results and carry out comparative study of experimental and experimental analysis results to decide the optimization of number of balls and overload slip torque and also to carry out comparative study of torque capacity by changing spring dimensions(3 sets of springs with variable rod diameter and pitch will be used) then finally Interpretation of results will be done to suggest the modifications to improve the design of groove profile , plunger geometry , number of ball springs for desired overload torque outputs

TEST & TRIAL ON TORQUE TENDER

This selection is based on standard catalogues or data books;

E.g.:- (PSG DESIGN DATA BOOKS) (SKF BEARING CATALOGUE) etc.

APPROACH TO MECHANICAL DESIGN OF 'OVERLOAD SLIPPING BALL CLUTCH'

In design the parts we shall adopt the following approach;

a) Selection of appropriate material.

b) Assuming an appropriate dimension as per system design.

c) Design check for failure of component under any possible system of forces.

d) Design of Unidirectional Clutch.

e) Ref:- PSG DESIGN DATA HAND BOOK (Fig.1)

f) Ball Clutch Nomenclature

g) d = Diameter of ball , mm

h) D = Pitch circle diameter of groove , mm

i) F = Total tangential force on balls, N

j) Fs = Total spring force, N

k) F = spring force on each ball, N

l) $\propto$ = Angle of inclination of groove

m) Ks = Spring stiffness, N/mm

n) Lf = Free length of spring, mm

o) Mt = Torque transmitted, N mm

p) N = Number of turns in the spring

q) P = Pitch of spring coil, mm

r) Zb = Number of balls in the clutch

s) μ = Coefficient of friction

t) K1 = Stiffness per turn N /mm

u) $\delta 2$=Movement of ball while Clutch is slipping ,mm

v) $\delta 1$ = Compression of spring to exert force F,mm

1. INTRODUCTION

Positive clutches are used to transmit power between two coincident shafts. The positive engagement between the clutch elements ensures 100% torque transmission on but occasionally the output shaft may the subjected to a suddenly overload which may make the driving motor or engine to stall; which will lead to burnout of the electric motor.

In extreme cases this overload will lead to the breakage of drive elements or the clutch itself. In order to avoid the damage of the transmission elements it is necessary that the input and output shafts be disconnected in case of sudden overloads

.The isolation of the input driver member i.e. motor from the output member is absolutely necessary to avoid damage and it is possible by called ball clutch.

Torque-Limiters are Overload Safety Devices with Torque Limiters which provide reliable overload protection. When a jam-up or excessive loading occurs the Torque Limiter will reliably and quickly release to prevent system damage.

a) These torque limiters are tamper-proof. Once installed, the torque value cannot be changed. This is an important feature that ensures the integrity of the machine design. Costly and potentially risky calibration procedures are not necessary. The torque value is controlled by the part number that is ordered. That value determines which spring is used during the assembly at the factory.

b) The torque value can be changed in the field, however; the torque limiter must be disassembled and the springs replaced to achieve the new torque value.

c) Standard Torque-Limiters are bidirectional. The torque value is the same regardless of rotation. If specified, these torque limiters can be configured at the factory to release at different torque ratings for different rotational directions.

d) In the coupling configuration, the Torque-Limiter fulfills two functions:

e) A flexible shaft coupling

f) A mechanical torque limiter.

g) The Torque-Limiter in the shaft to shaft configuration will handle angular shaft misalignment up to 1.5 degrees and a .005" to .015" maximum parallel misalignment.

The enclosed design of the mechanical torque limiter enables it to operate in a wide variety of industrial environments. Special designs and materials can be made to withstand even more adverse conditions.

2. LITERATURE REVIEW

2.1 Dynamic Simulation of the Safety Clutches With Balls

By .Nicolae Eftimie.

1. The clutches are used largely in machine buildings, and by the correct selection of these depends to a great extent the safe and long working, both of these and of the kinematic chain equipped with them. The guarantee of these demands, for the mechanical power transmission between shafts, represents a ticklish problem for all areas and engineering applications that require compact, simple and reliable systems. By their advantages, the safety clutches are preferred in different top techniques areas: cars, naval industry and so on

2. For a correct, safe and economical machine working, it is necessary that the component elements of this to be designed and accomplished properly. It is important that, still from the

conceiving stage, to work both on the machines and equipment's gauge and on their reliability (so implicitly on the materials and energy consumptions). Taking into consideration all of these, one

of the solution is represented by the use of some safety clutches. In this way, the designers can decrease the value of the safety coefficient for the dimensioning of the mechanical transmissions of equipment's. The safety clutches fulfill besides the main function of the torque transmission and rotational motion transmission between two consecutive elements of a kinematic chain the function of transmitted torque limitation, in the case of some overloads occurrence, during the performance. In this way it is avoided the kinematic chain elements overstressing and their deterioration.

3.The overloads – that occur in transmission thanks to some causes like machine starting or stopping, the passing through resonance zone, too high overloads of the driven mechanism – can be dynamic (with shocks), with very short duration or quasi-static with long duration. Indifferently of the overloads type, these can lead to the machine deterioration and its retirement. Taking into consideration all overloads, for the transmission calculus, it can lead to an excessive over-measure of this, situation that cannot be accepted. If a safety clutch is assembled in the kinematic chain of the mechanical transmission, then the mechanical properties of the materials, for the transmission component elements can be used to maximum. The following features must characterize the safety clutches check your margins to see if your print area fits within the space allowed.

3. PROBLEM FORMULATION

1. These are not flexible.

2. We get constant torque value for every another value we have to use the different size of ball.

3. Construction is difficult and the ball should be changed on site only.

4. Time consuming process.

5. Ball comes out in case of overload condition.

6. It is not possible to change the ball clutch everywhere and to get different output torque.

7. In case of zeromax torque there is chances of breakage of plunger as it is not strong.

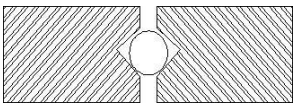


Fig .3.1 normal running

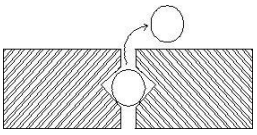
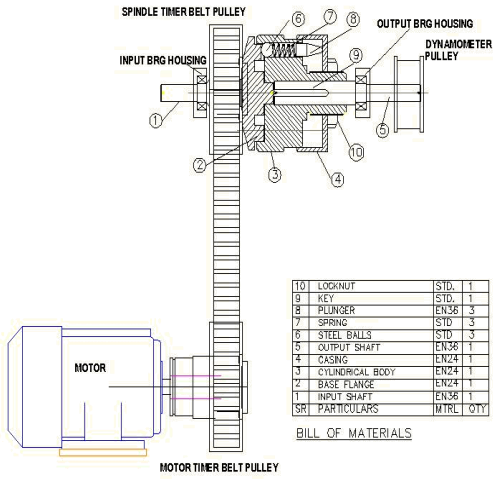


Fig. 3.2 overload condition

In case when there is no overload the shaft running in well condition i.e in engaged condition but when overload in output shaft then the ball comes out for disengaging this is happens in previous.

4. METHODOLOGY

The project involves the design, construction and testing of an proto type model of an 'Ball –clutch' which can be preset to various overload torque conditions.



SR	PARTICULARS	MTRL	QTY
10	LOCKNUT	STD.	1
9	KEY	STD.	1
8	PLUNGER	EN36	3
7	SPRING	STD	3
6	STEEL BALLS	STD	3
5	OUTPUT SHAFT	EN36	1
4	CASING	EN24	1
3	CYLINDRICAL BODY	EN24	1
2	BASE FLANGE	EN24	1
1	INPUT SHAFT	EN36	1

Fig.4.1 Schematic Of Test Rig The Aim Of Project Can Be Categorized Into Two

classes.

5. CONSTRUCTION OF BALL-CLUTCH

A] INPUT SHAFT

Input shaft is the main shaft which is mounted in the ball bearing in the bearing housing .It is driven by an input motor by means of reduction pulley.

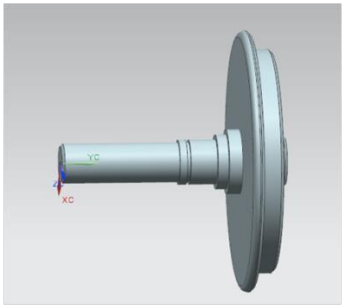


Fig. 4.2 Input shaft

B] CYLINDRICAL BODY

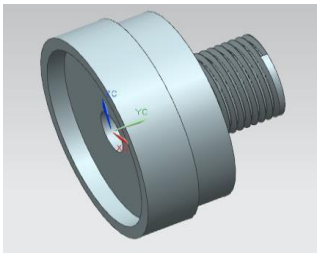


Fig4.4 Cylindrical body

The cylindrical steel body of the ball clutch is keyed to the driven shaft but it is made slightly longer than the shouldered end of that member so that the short smaller diameter concentric portion of its bore is a slip fit over the adjoining end of the shaft .Projecting beyond the base flange as shown

. The purpose of this arrangement is to maintain a body of the clutch perfectly concentric with the base flange for ensuring the smooth and accurate engagement of the balls in the base flange serrations

The left hand end of the body is recessed a small depth to admit the serrated portion of flange, the outside diameter of which has a tight clearance fit in recess.

Six holes are accurately drilled and reamed passing axially through the body, The holes are spaced exactly 60^0 a part around the same pitch circle, the diameter of which is equal to pitch diameter of the serrations in the annular band of base flange.

The right hand end of the body is reduced in diameter and threads to receive the hardened steel casing.

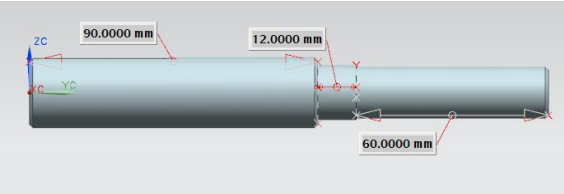
C] CASING

Hardened steel casing is of the same outside diameter as the front end of the body. The sleeve is deeply bored at one side to be close fit over the reduced portion on the outside of the body. By fitting the casing over the body at that point its correct and accurate location relative to the body is not determined by the fit in the threads . The three plungers bear simultaneously against the inner left hand face of the sleeve; thus as that members advanced longitudinally, all springs will be compressed or expanded by an equal amount.

D] LOCKNUT

A threaded lock nut is screwed on the body behind the sleeve for locking the sleeve in any desired setting.

E] OUT PUT SHAFT



The output shaft carries the cylindrical body which is keyed to it at one end; whereas on the other end the output shaft carries the dyno brake pulley.

5.1 MECHANICAL DESIGN

In mechanical design the components are listed down and stored on the basis of their procurement in two categories,

- Design parts
- Parts to be purchased.

For designed parts detailed design is done and dimensions there obtained are compared to next dimensions which are already available in market

. This simplifies the assembly as well as the post production and maintenance work. The various tolerances on work are specified .The process charts are prepared and passed to manufacturing stage.

The parts to be purchased directly are selected from various catalogues and are specified so as to have case o f procurement.

In mechanical designed at the first stage selection of appropriate material for the part to be designed for specific application is done.

FURTHER MODIFICATIONS

The capacity of the ball clutch is basically dependent on the helical compression spring used in the ball clutch.

Using the same clutch construction and by only changing the springs it is possible to increase the capacity of clutch. The following table indicates the possible clutch arrangements with the previously designed configuration.

Wire Diameter Mm	Outer Diameter mm	Permissible load	
		Static Load (N)	Dynamic Load(N)
1.0	12.0	32.4	14.5
1.3	12.0	60.8	29.4
1.6	12.0	115.0	54.0

6.0 RESULTS AND INTERPREATION

1. Design and development of test-rig

2. Testing of drive to derive performance characteristics

a) Torque Vs Speed b) Power Vs Speed

c) Efficiency Vs Speed

[1] To check the validity of experimental results with theoretical results.

[2] To carry out comparative study of experimental and experimental analysis results to decide the optimization of number of balls and overload slip torque.

[3] To carry out comparative study of torque capacity by changing spring dimensions(3 sets of springs with variable rod diameter and pitch will be used)

[4] Interpretation of results will be done to suggest the modifications to improve the design of groove profile , plunger geometry , number of ball springs for desired overload torque outputs

RESULT TABLE

SR NO	LOAD (gms)	SPEED (rpm)	TORQUE (N.M)	POWER (watt)	EFFICIENCY
1.	100	2100	0.036788	11.1760425	55.32694
2.	150	1960	0.055181	11.1760425	55.32694
3.	200	1750	0.073575	13.3048125	65.86541
4.	250	1600	0.091969	15.2055	75.27475
5.	300	1250	0.110363	14.25515625	89.09473
6.	350	1050	0.128756	13.97005313	87.31283
7.	500	810	0.183938	15.39556875	96.2223
8.	600	650	0.220725	15.3153625	90.25852
9.	700	535	0.257513	14.23614938	88.97593
10.	800	520	0.2943	15.81372	98.83575
11.	1000	380	0.367875	14.445225	90.28266

REFERENCES

1. Ingenious mechanisms for designers and inventers ,(VOl-iii)
2. Mechanisms and Mechanical linkages –
3. Artobolevesky
4. www.zeromax.com.torqlimiter
5. Eftimie, E. Elastic and Safety Clutch Editura Ecran Magazin, Braşov (2001)
6. Design Procedure of Elastic and Safety Clutches using Cam Mechanisms.
7. Theoretical and Experimental Feature Elastic and Safety Clutch Roller. Part- II. ANNALS of the Oradea University. Fascicle of Management and Technological Engineering. May 2012.
8. ANNALS of the ORADEA UNIVERSITY. Fascicle of Management and Technological Engineering, Volume XI (XXI), 2012, NR1 3.39
9. The calculus and the building of the clutches.
10. Editura Tehnică, Bucuresti, 1978.
11. DudiŃă. Fl., Diaconescu, D.V. The structural optimization of the mechanisms. Editura Tehnică,
12. Bucuresti, 1987.
13. f) Norton, R.L. Effect of Manufacturing Methods on Dynamic.

BIBLIOGRAPHY

1) Ingenious Mechanism for Designers & Inventors (Vol. Iv) - Newell & Horton.
2) Machine Design–V.B.Bhandari.
3) Automobile Engineering –Dr. Kirpal Singh.
4) Theory Of Machines– Shigley
5) PSG Design Data Handbook.