Testing Results on Overloading of Torque Limiter with Electromechanical Clutch using Open Belt Drive

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ABSTRACT

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 sudden 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.

Keywords: *Torque transmission. Overload, Isolation, Ball clutch. Limiter, etc*.

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1. INTRODUCTION

To protect the drive from failure what is available in market is a 'Flying ball clutch' 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 – thus disconnecting input and output. Thereby saving part failures. But;
comes as an advantage as the clutch can be preset without removing it from assembly, this will save considerable amount a) Rating of clutch is 1N-m 5 N-m, 20 N-.m etc. i.e. fixed value so if o/p torques changes. We have to replace clutch.
b) Every time ball comes out of assembly . We have to remove the clutch to replace ball. this increases down time of machine
c) Drive always remains coupled. There is no flexible arrangement like automobile clutch ie possibility to disengage at will
d) If temporary overload occurs the clutch will slip and remain disengaged till it is preset even though the overload is now removed, this leads to process down time.

Solution

Thus there is a need of Timer belt spindle drive with overload torque limiter with following features

a) Electromechanical disengagement so that drive can be temporarily disengaged for I in process inspection or other activity.
b) The torque limiter can be set over a range of torques (say 0 to 20 kg-cm) so that the machine operator can set it to desired value for given application, unlike the conventional clutches that are factory set.
c) The transmission elements i.e. the balls will not come out of assembly when there is overload slipping, this of downtime of process as compared to the conventional clutch.

If temporary overload occurs the clutch will slip and remain disengaged only till the overload is removed, thus if the overload is removed while in running condition the clutch shall automatically engage and start transmitting power this leads to minimal process down time saving a considerable amount of man and machine hours wasted due to breakage or presetting as in conventional clutches

2. LITERATURE REVIEW

- **2.1 Dynamic simulation of the safety clutches with balls Nicolae EFTIMIE[1]**

Found that

The most important parameters, which influence in a major manner the safety clutches working are: the ratio between the inertia moments at the driven and driving parts, the spring's type and consequently their rigidity and the pretension springs force

- **2.2 Modeling and Validation of a back–torque limiter using the example of a BMW motorcycle power train** Albert Albers Philipp Merkel, Martin Geier, I. Dreher, H. Städele

Came to know that

The introduced back torque limiter is used in a specific BMW motorcycle power train and can avoid a blocked rear wheel during braking and simultaneous shift down.

- **2.3 Elastic and safety clutches with intermediate rubber elements Stroe ioan** "Transilvania" University of Braşov

Concluded that

The elastic and safety clutches with metallic roles and elastic rubber elements present the following advantages:

1. The clutches ensure the limitation and the adjustment of the transmitted moment;
2. The clutch can take over technological and assembling deviations

- **2.4 Design development, testing and analysis of torque limiter for overload protection**. **Samarth Sanjay Khairnar1, Dr.S.N.Shelke**

Found that

Thus safety clutch is easily adjusted to transit a range of different torques

- **2.5 Torque Tender /Limiter For Overload Shaft** Kiran Kumar Chandrakant Labade

Concluded

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

- **2.6 Spring Loaded Torque Limiter** Mr. Kadam A. N1 Mr. Aitavade E. N2

Found that

The spring loaded ball clutch (torque limiter) ensures the,

(1) The limitation and the adjustment of the transmitted moment.

(2) The torque limiters can take over technological and assembling deviations.

(3) The torque limiters allow the damp of the torsion shocks transmitted in different transient regimes of the mechanical transmission.

(4) The torque limiter has a progressive characteristic and depends on elasticity of the rubber elements.

(5) The relative torsion angle between the semi clutches depends on the number of roles

- **2.7 landquist. Rock Ford University. "Radial ball torque limiter**. United states patent no 4792321, dec 20 1988

Mark S Landquist invented radial ball torque limiter which having a member with an annular wall defining a cavity with a plurality of rows of internal teeth extending circumferentially along the interior of the annular wall.

3. OBSERVATION AND RESULTS

SR NO	LOADING		UNLODING		MEAN SPEED
	WEIGHT (gm)	SPEED rpm	WEIGHT (gm)	SPEED rpm	
1	100	2100	100	2100	2100
2	150	1960	150	1960	1960
3	200	1750	200	1750	1750
4	250	1600	250	1600	1600
5	300	1250	300	1250	1250
6	350	1050	350	1050	1050
7	500	810	500	810	810
8	600	650	600	650	650
9	700	535	700	535	535
10	800	520	800	520	520
11	1000	380	1000	380	380

Table 1: Observation table with variation of speeds

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	14.8253625	92.65852
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

Table 2: Result table with torque, power, efficiency

4. ANALYSIS OF SET UP

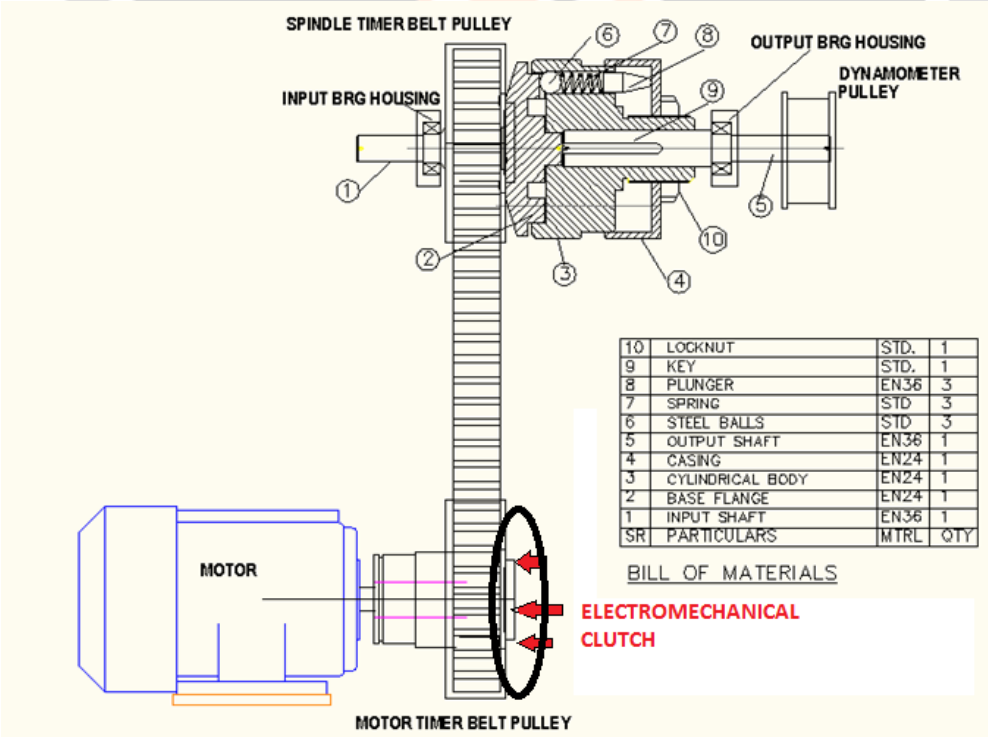
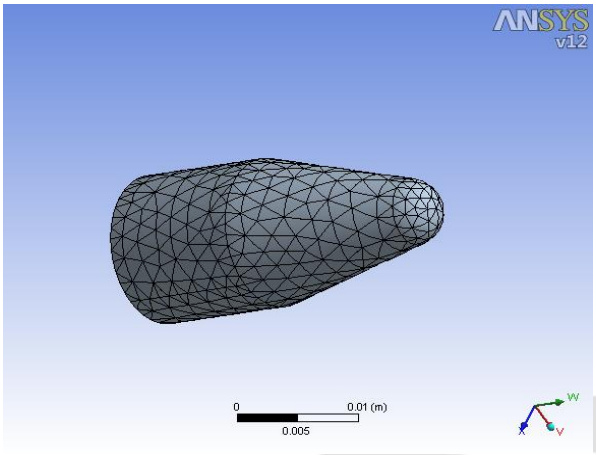


Fig: 2D diagram of set up of Overload torque limiter


ANSYS
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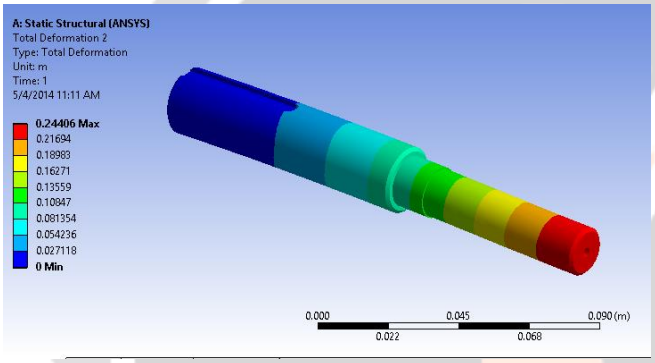
0
0.01 (m)
0.005
W
V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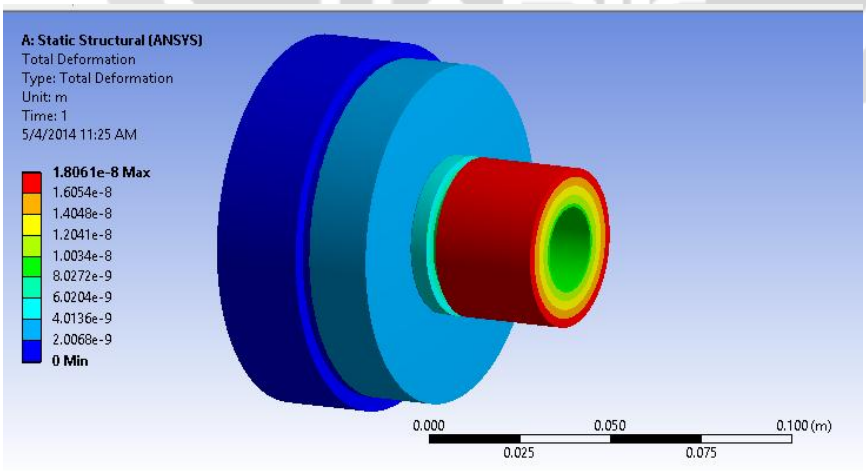
0.022
0.068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0.075

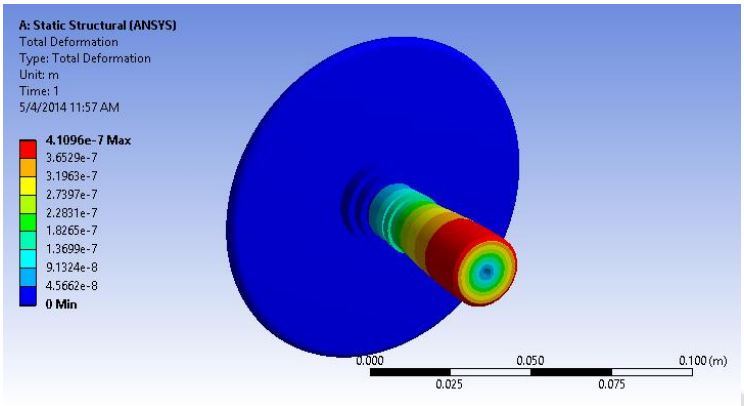

Fig: Ansys analysis of set up

5. CONCLUSION

1) From the result table, it is observed that; as load increases speed reduces.
2) Torque and efficiencies are inversely proportional to speed.
3) And most important, we can have disengagement at output shaft when there is overload also, can disengage at our will.

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