A Review On Over Load Slipping Ball Clutch

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Abstract-In today's life science & technology are increasing at rapid rate. Due to rapid industrialization growth, quality & Quantities production requirement the automation of machines are increasing day by day. For this machine has to operate continuously a safety of machine plays on important role in today's industrial environment. Many industrial machine required electrical motor for its operations which are directly connected to electrical motors. If load on machine increase which in tarns overload the motor and chances of burning of motor winding or damage to electrical motor increases. Electrical motor is also used to drive the water pump to lift the water at high level. If the load on the impeller increased due to accumulation of dust or mud on outlet valve of pump, bearing failure or bearing damages improper lubrication then there is a chance of overloading the electrical motor. An attempt is made in this project to protect the electrical motor for moverloading by installing an Overload ball slipping clutch'' Many clutches required manual operation. In case of overloading the arrangement of ball clutch is such that the input and output shaft are disengaged from each other automatically. In this project we have fabricated "Overload ball slipping clutch". In this way the overload ball electrical motor and protects it form damages.

Keywords- Safety clutch with spring and ball; over load protection; torque limiting device; belt spindle drive.

1. INTRODUCTION

In the Automobile clutches provide a functional, magnetic, hydraulic, or mechanical connection between two elements. If both are connected elements can rotate, then it is called a clutch. A clutch rotate provides an interruptible connection between two rotating shafts. For the many applications electrical motor is used but there is no any safety element to protect it from damages and breakages when motor get overloaded. There are some problems related with the electrical motor.

In case of bearing ball damage, cooling arrangement not proper lubrication is not property. Then the motor have a chance to get overloaded. Thus for protecting the electrical motor we fabricated the "overload ball slipping clutch". The various types of clutches are used in the industrial application such as Single plate clutch, Multiplate clutch, Cone clutch.

In above mentioned catches there are some problems. In single plate clutch the spring has to be more stiff hence greater. Force is required by the driver for disengaging and the spring is used in machine are steel sparing which are not much stiff as compared to single plate clutch. In cone clutch the angle of cone is made smaller than 20^{0} the male cone tends to bind in the female cone and it became difficult to engage. This problem will not occur in the "overload ball slipping clutch.

Simply we can say that the "Overload ball slipping clutch is a safety device for electrical motors Safety ball clutch are Overload Safety Devices with Torque protection; torque limiting device; belt spindle drive. Limiters which provide reliable overload protection. When a jam-up or excessive loading occur the safety

Ball clutch will reliably and quickly release to prevent system damage. These torque limiters are tamperproof. 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 what spring is used during the assembly at the factory. The torque value can be changed in the field, however; the Safety ball clutch must be disassembled and the springs replaced to achieve the new torque value.

2. LITERATURE REVIEW

By Tobias wolf The concept of weight reduction through the use of high tech materials is not a new one. But for those involved in the design of motion control and automation systems, the elimination of excess mass and inertia is often the difference between success and failure. Energy savings, higher throughput rates, and reduced downtime, all without compromise to quality or accuracy, are the new requirements. To address them, R+W has introduced a new torque limiter, SL Series, with half the inertia and less than half the mass, allowing for a rapid and automatic recovery from torque overload even in the most advanced drive technology. The SL Series uses the proven spring loaded ball detent system, along with a

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previously patented preload for zero backlash operation. But to achieve its target of 50% weight reduction, we embarked on a two-year collaborative effort with local universities, designing the product from the ground up. The result is a torque limiter constructed from state of the art materials with unique surface treatments and innovative assembly technology–surpassing weight reduction targets and simultaneously reducing its footprint. One example of this size reduction is a torque limiter rated to disengage at 160 Nm, which in the past would have had at best a mass of 1.3 kg and

a moment of inertia of $1.6 \times 10-3 \text{ kgm2}$. It now weighs 370 grams with a moment of inertia of $0.8 \times 10-3 \text{ kgm2}$. What that amounts to is an automatic torque limiter with unparalleled power density. In addition to custom material specifications, specially designed spring systems, and some improvements to the ball detent configuration (resulting in a 40% increase in torque capacity for a given size) the weight reduction was also achieved through the compression of individual components. This, of course, is without negative impact on the precision or service life of the torque limiter. The SL Series can handle in excess of 10,000 disengagement events, depending on rotational speed [1].

By Andrew Lechner As a primary or redundant safety device, back lash free ball-detent torque limiters serve as a mechanical circuit breaker for machine drive protection, disconnecting drive and driven elements accurately (± 5 percent torque) and virtually instantaneously (&3 millisecond) in the case of a machine jam or crash. A common misconception is that limiting current supplied to the drive will inherently protect the mechanical system from overload, though when placed on the output of servo worm or planetary gearboxes for example, precision torque limiters protect the mechanical system from reflected load inertia, where sufficient energy to do harm has already been supplied well in advance of the impact. Backlash, repeatability and response time are key to the successful application of mechanical Torque limiters in high-speed servo applications. Traditional torque limiters would not respond fast enough to an overload situation in higher speed applications, where over travel would occur too rapidly," says Ben Cucci, design engineer, Schumacher Automation, Belmont, NH. "A high level of repeatability is desirable to ensure a consistent breakaway torque across the line," says Duncan Quinn, design engineer, NBS Card Tech, Paramus, NH. Servo-rated torque limiters normally possess internal preloads between mating components to eliminate backlash. But it is the digressive spring characteristic which stands out as the most significant adaptation in the development of precision mechanical torque limiters for servo-driven systems. Their

enhanced sensitivity to axial movement heightens accuracy and response, but also requires that greater

Nicolae Effimie In the paper titled "Dynamic Simulation Of The safety clutches with balls" states that, explored 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 [3].

M Jackel1, J Kloepfer, M Matthias, Seipel In the paper titled "The novel MRF-ball-clutch design a MRF-safety-clutch for high torque applications" states that the development of a safety clutch by using magneto rheological fluids(MRF) to switch the transmission torque between a motor and a generator in a bus-like vehicle [4].

Mr. S.Jegadeesan In the paper titled "Design of energy savings in metropolitan railway substations and communication based train control" states that, explored the reduction in energy consumption has become a global concern and the EU is committed to reducing its overall emissions to at least 20% [5].

Landquist rock ford university.radial ball torque limiter Mark S Landquist invented radial ball torque limiter which having a member with an annular wall defining cavity with a plurality of rows of internal teeth extending circumferentially along the interior of the annular wall [6].

3. CONSTRUCTION

Input motor is single phase alternating current motor coupled to input shaft directly by means of reduction pulley, Ball clutch is transmission element that connects input shaft, and output shaft bearing housing it is support member that holds input and output shaft along with clutch assembly.

4. WORKING

The overload slipping ball clutch is safety device used in the transmission line to connect driving and driven elements such that in case of occasional overload the clutch will slip by disconnecting input shaft and output members. This protects the transmission elements from damage. For particular loading conditions the clutch is preset to set the cylindrical body for slipping different overload, it is simply mounted on output member by means of key. Casing is adjusted in appropriate direction during which balls will remain pressed against the serrations thus setting operation is simple, rapid and reliable The clutch is there to the output member or load. When input shaft is in rotation through reduction pulley and motor, the base flange is rotated, along with it and balls pressed against Vee-serration also rotate. This motion is transmitted through springs, plunger to the cylindrical body which when rotates the output shaft. When load on output shaft exceeds the preset design

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of balls to more in direction of motion of base flange, thereby balls start slipping.



Fig. 1. Test rig of overload clutch

At one point balls completely come out of serretations into open space in base flange thereby disconnecting base flange and cylindrical body. Thus, input shaft keep rotating whereas the output shaft comes to stand still. The overload value at which clutch slips can be designed and preset by moving casing in either direction of cylindrical body.To increase overload value, move casing towards base flange whereas to reduce overload, move casing away from the base flange [7].

5. ADVANTAGES

The overload slipping ball clutch has the following advantages.

1. Overload slipping ball clutch prevents the burnout or damage to the electric drive motor due to sudden over load.

2. Over load slipping ball clutch can be easily preset after disengagement .

3. Overload slipping ball clutch is capable of transmitting a wide range of torque which can be precisely preset on the drive itself.

4. Low cost of manufacture.

5. Compact size,

6. Electromechanical dis-engagement so that drive can be temporarily disengaged for I in process inspection or other activity.

7. The Safety ball clutch 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.

8. The transmission elements that is, the balls will not come out of assembly when there is overload slipping this comes as an advantage as the clutch can be preset without removing it from assembly this will save considerable amount of downtime of process as compared to the conventional clutch.

6. DISADVANTAGES

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 failure.

1. Rating of clutch is 1N-m, 5 N-m, 20 N. etc. if fixed value so if output torque change we have to replace clutch.

2. Every time ball comes out of assembly we have to remove the clutch to replace ball this increases down time of machine.

3. Drive always remains coupled there is no flexible arrangement like automobile clutch i.e. possibility to disengage at will.

4. 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.

5. Thus there is a need of Timer belt spindle drive with overload Safety ball clutch with following features.

7. APPLICATIONS

7.1. Pump shaft drives

Pump shaft drives either electrical or engine drives are normally furnished with the overload slipping ball clutch to avoid the breakage or damages arising due to pump clogging or blockage.

7.2. Compressor drives

Compressor drives, especially in many mining applications re equipped with the over load slipping ball clutch.

7.3. Machine tool slide drives

Machine tool slides are driven by electrical drives connected to lead screw .The over load slipping ball clutch isolates the electrical drive from the output in case of overload.

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7.4. Hydraulic pump drives

It is used in pump drives for hydraulic power packs.

8. FUTURE SCOPE

1. In many cases pump shaft drives either electrical or engine drives are normally furnished with the overload slipping ball clutch to avoid the breakage or damages arising due to pump clogging or blockage Compressor drives, especially in many mining applications are equipped with the over load slipping ball clutch.

2. The size of the Torque limiter is very compact; which makes it low weight and occupies less space in any drive.

3. The changing of torques gradual one hence no calculations of speed ratio required for change

torque .Merely by rotating adjuster lock nut torque can be changed.

4. Machine tool slides are driven by electrical drives connected to lead screw. The over load slipping ball clutch isolates the electrical drive from the output in case of overload.

9. CONCLUSION

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. The idea behind the project is to effectively design, and construct an adjustable slipping type of ball-clutch which can be success fully incorporated in the original drive transmission to a machine to safeguard the driven elements against overloading.

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