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A Review on "Failures of Power Transmission Drives"

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Abstract: *This paper present information's about different types of drives used in Industry for power transmissions. The power transmission drives are used frequently in mechanical, electrical, automobile industry. The information about the failure of drives will help for selection of drives as per the working conditions. The failure of drives can occur any time during the operations and may create the major breakdown. So the purpose of this paper is to provide information about the possible failure of these drives and to avoid the sudden breakdown in Industry. At once if we have knowledge of failure we can take corrective action as early as possible if any drive fails during the running conditions.*

Keywords: Drives, Power Transmission, Failure, Breakdown

I. INTRODUCTION

In most of the mechanical, electrical and electronics industries power transmission drives are used. Depending upon the applications power transmission drives are varies. Mostly we are focusing on the failure of power transmission drives used in mechanical industries like Belts Drives, Rope drives, Gear drives, chain drives. For knowing the failures of each drives, we should go through the different types of mechanical drives and their applications. These drives are used in most of the machineries for power transmission and frequently get failed because of some reasons like speed, load etc. If we know the failures, we can identify the problem and find the solution.

1.1 EMakevet Itzhak Roman

Failure analysis of a final drive transmission in off-road vehicles. This paper presents a case study in failure analysis of a final drive transmission in an off-road vehicle. The failure involved a satellite gear mounting shaft that departed from the differential assembly as a result of fracturing of a retaining pin. An investigation of the mechanical condition of various transmission components, consisting primarily of visual (macroscopic) inspection, geometrical investigation and analysis of mechanical loads, led to the assignment of two principal causes of failure. Firstly, it was established that the retaining pins installed in the assembly were shorter than required, allowing them to shift in their guide holes and assume a single-shear position. Secondly, in this position they were loaded to failure in shear by abnormally high frictional forces acting at the shaft/satellite interface. These loads were attributed to severe usage and handling of the vehicle.

1.2 Engineering Failure Analysis 14 (2007) 716–724

H. Bayrakceken *, S. Tasgetiren, _ I. Yavuz Worked on Power transmission system of vehicles consist several components which sometimes encounter unfortunate failures. Some common reasons for the failures may be manufacturing and design faults, maintenance faults raw material faults, material processing faults as well as the user originated faults. In this study, fracture analysis of a universal joint yoke and a drive shaft of an automobile power transmission system are carried out.

Spectroscopic analyses, metallographic analyses and hardness measurements are carried out for each part. For the determination of stress conditions at the failed section, stress analyses are also carried out by the finite element method.

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1.3. 108-010_Failure-Analysis-Gears,-Shafts,-Bearings,-Seals

The purpose of this paper is to describe a number of distress and failure modes of each of these components and to indicate probable causes and possible remedies for these failure modes. For drives that are properly designed and manufactured, abnormal distress or failure can result from misapplication or poor installation or poor maintenance.

Continuous steady state overloads can result from erroneous initial power requirement calculations, over motoring, increased output demands, etc. Such loading should be detectable by motor overheating or from electrical meter readings on the driving motor. Momentary or transient peak loads are of such short duration that electrical meters do not respond accurately to them. In such cases torque meter readings of instantaneous loads.

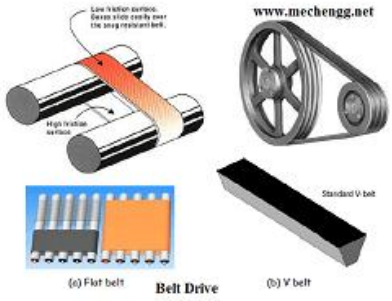
Different Types of power transmission drives and their failures

Belt Drives:

To transmit power from one shaft to another, pulleys are mounted on the two shafts. The pulleys are then connected by an endless belt passing over the pulleys. The connecting belt is kept in tension so that motion of one pulley is transferred to the other without slip. The speed of the driven shaft can be varied by varying the diameter of the two pulleys. Belt drives are one of the common methods used whenever power or rotary motion is required to transmit between two parallel shafts.

Different types of belt drives

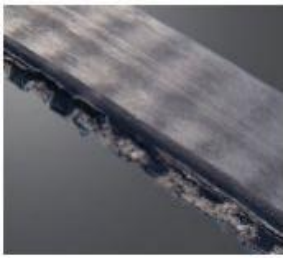
1. Open belt drive
2. Cross belt drive
3. Quarter turn belt drive
4. Belt drive with idler pulley
5. Fast and loose pulley drive
6. Cone pulley drive
7. Compound belt drive



Failures of Belt Drives:

1. Rapid wear of belt side wall

Side wall wear can be a sign of bigger wear. It can be due to the worn or damaged wall of pulley. Also using belt in condition where more exposed to heat, excessive oil or grease, using belt in more abrasive environment.



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2. Belt soft or swollen

It is because of oil, grease or chemical contamination. This may result in to the throwing of belt from the pulley. So keeps these contaminations away from the belt during the working.

3. Cracking

This failure caused because of improper size selection of pulleys. Improper storage of belts and excessive hot or cold working condition.

4. Break due to tension

This failure is due to crimping or shock loads on the belts. Crimping can be caused by mishandling of the belt, improper tension, or shock loads.

5. Wear on top and bottom corner

This belt failure is caused due to belt fitting on the pulley is incorrect. During the operation belt rubbing with the guard. The bottom corner wear may occur due to warm pulley.

Top Corner Wear

Bottom corner wear

Failures of wire rope:

Wire ropes are the important drives which are mostly used in cranes, hoists, lifts etc. The wire ropes fails, Rubbing on irregular surface;- The wire ropes used in various machines may fails due to rubbing with improper machined surface of pulley, overloading, incorrect sheave groove, wire having more diameter etc.

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Gear Drives and its failures:

Gear drives are the more commonly used drives in Automobiles and Industry machinery for power transmission.

Spur Gear: Spur Gears are used where power is to be transmitted between two parallel shafts.

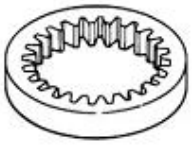
Helical Gear: These gears can transmit power in heavy loads. Gears having teeth's inclined with the axis.

Rack and Pinion Gear: Gear rack consists of same shaped teeth's as on pinion.

Bevel Gear: Bevel gears are used to transmit the power where shafts are at right angle.

Worm and worm gear: It is having two elements, worm and gear mounted together on non - intersecting shaft.

Internal Gear: Internal gears have teeth's cut on the internal side of the cylinder and used to pair with the external



Failure of Gears:

Gears play very important role in our day to day life. Any failure to the gears leads to the major failure in the system. Imagine driving a car with a broken gear in the gearbox. Knowing the various failures helps one to identify the problem at an initial stage and rectify the problem related to the gear. Now let us see the various modes of failure of gears,

- Gears fails due to shock loading
- Due to wear
- Fatigue Failure
- Scuffing

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Brake by shock load: When the gear system is subjected to a sudden shock load more than the designed value, it instantly breaks.

General Tooth wear: Gear tooth wear can occur in three main categories abrasions, adhesions, and polishing. In abrasions, contaminants in a lubricant wear away at the gear. In adhesions, outside materials attach themselves to the tooth. Polishing is a type of abrasion at the smallest scale.

Fatigue Failure

Bending Fatigue: - Occurs due to repeated loading. The fatigue in the gears induces cracks in the roots of gear tooth which propagates with rotational cycle and result in to the failure.

Contact Fatigue: - It happens due to repetitive, direct stresses cause abrasions or otherwise deteriorates the integrity of the gear. Contact fatigue can occur as micro pitting, less than 1 mm in diameter, or macro pitting, more than 1 mm in diameter.

Scuffing: Scuffing is essentially a severe form of adhesion wear, when metal from one gear tooth transfers to another over time.

Chain Drives and its Failures:

Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. It is also used in a wide variety of machines besides vehicles.

Chain Failure Modes:-Overload- chain subjected to excessive oneoff load which causes permanent deformation of material and leads to very short chain life.

Fatigue- chain subjected to repetitive high load beyond the endurance limit, causing it to eventually fracture.

Wear- Load normally between pin and bush eventually wears away material such that the chain stretches beyond its usable limit. Most chain is designed to fail due to wear.

Other less common chain failure modes are

- Galling
- Corrosion
- Abrasion

II. Conclusion

Here we conclude that transmission drives which played very important role in our day to day activity like used in automobiles, Industry machinery for power transmission. Failure of these drives is also important to know to avoid the major failure which may result in to the system failure. If we know these failures we can take preventive measure to avoid the system failure and major damage to the system. Through this paper we at least aware with the different failures of the transmission drive which helps to avoid major failure and take necessary action.

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