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Design and Vibration Analysis of Worm and Worm Wheel Gearbox

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ABSTRACT

In this project Gears are important element in a variety of industrial applications such as machine tool and gearboxes. An unexpected failure of the gear may cause significant economic losses. For that reason, fault diagnosis in gears has been the subject of intensive research. Vibration signal analysis has been widely used in the fault detection of rotation machinery. To reduce this vibrations we are going to change the material of the worm and worm wheel , By selecting the proper material which has less tendency to vibration is selected and gears will be manufactured.

KEYWORDS:- Condition Monitoring, Vibration Analysis, Fault Diagnosois, Gearbox, etc.

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I. Introduction

All machines with moving parts give rise to sound and vibration. Each machine has a specific vibration signature related to the construction and the state of the machine. If the state of the machine changes the vibration signature will also change. A change in the vibration signature can be used to detect incipient defects before they become critical. This is the basic of many condition monitoring methods. Condition monitoring can save money through increased maintenance efficiency and by reducing the risk of serious accidents by preventing breakdowns.[1]The vibration techniques were developed with two main purposes. The first purpose is to separate the gearbox related signal from other components and to minimize the noise that may mask the gearbox signal, especially in the early stages of the fault. The second purpose is to identify the status of the gearbox, to distinguish the good and the faulty gear and to indicate the defective components.[2]Examples of widely used techniques for gearbox are such as Waveform analysis, Time-Frequency analysis, Faster Fourier Transform (FFT), Spectral analysis, Order analysis, Time Synchronous Average, and probability density moments. These vibration based diagnosis techniques has been the most popular monitoring technique because of ease of measurement. Vibration analysis was used former mainly to determine faults and critical operation conditions. Nowadays the demands for condition monitoring and vibration analysis are no more limited trying to minimize the consequences of machine failures, but to utilize existing resources more effectively.

ADVANCED SINGAL PROCESSING TECHNIQUES

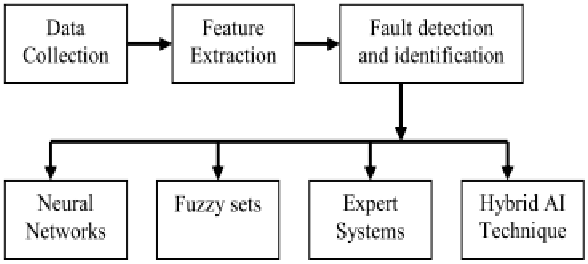

fig no 1: Intelligent fault Diagnosis

Intelligent diagnosis begins with the act of data collection which is followed by feature extraction usually employing the frequency spectra. Feature extraction techniques are widespread and can range from statistical to model based techniques and comprises a variety of signal processing algorithms which includes wavelet transforms. Fault detection and identification is a subsequent step and is further classified in this review into the four categories be treated separately.

1.1 vibration analysis:

The most commonly used method for rotating machine is vibration analysis Measurements can be taken on machine bearing casings with seismic or piezo-electric transducers to measure the casing vibrations and on the critical machines to measure the radial and axial vibration of the shaft. The level of vibration can be compared with historical baseline values to detect severity. Interpreting the vibration signal obtained is a complex process that requires specialized training and experience. The most common method is to examine the individual frequencies present in the signal.

II. MANUFACTURING PROCESS

To manufacture the gears CNC machine is used for worm and gear required blanks are taken and machined on CNC.

Gearbox casting manufactured by fabrication. In this sheet metal is taken and cut into required shape fabricated.

For base frame metal pipes are joined by using electric arc welding.

III. EXPERIMENTAL SETUP

The experimental set up consists of a four pole three phase induction motor coupled to a 4-speed automotive Gearbox. The coupling used is a shaft coupling. The input speed of the Gearbox is the mechanical speed of the induction motor. Induction motor is also connected to dimmer stat which controls the power to the motor by varying the input voltage which further drives the Gearbox output shaft. Then there are current probes to measure the current response. Voltmeter and an Ammeter are used here for measuring voltage and current readings.

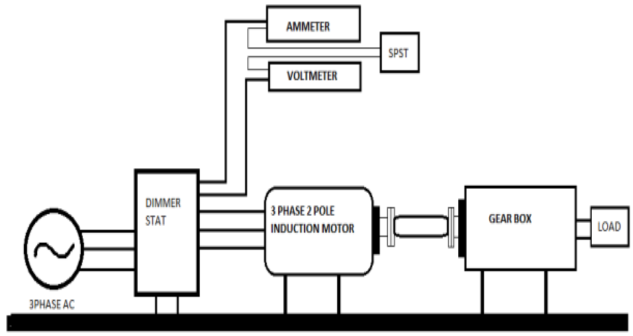

fig no 2: Experimental setup

IV. METHODOLOGY

In an experimental procedure gearbox is allowed to run at its rated power and speed by applying different load conditions on rope brake dynamometer is used. For vibration measurements magnetic base accelerometer is place on the top just below the location of bearing in axial & radial direction of gearbox. By making all above arrangements, readings are taken for healthy gear and good lubrication condition. This data is stored in FFT analyzer for further analysis. Vibration spectrums are taken for gears having various faults & the data is stored in computer for further analysis. For different condition of faults & different load conditions data is collected.

V. RESULTS

Modal Analysis Results-

1 Al alloy

Mode No.	Deformation	Frequency
1	31.119	77.517
2	31.212	80.221
3	33.136	84.936
4	30.799	167.98
5	46.633	223.96
6	32.056	268.9

2 Mild steel

Mode No.	Deformation	Frequency
1	18.542	76.848
2	18.599	79.561
3	33.704	88.978
4	30.782	168.78
5	40.943	226.79
6	19.109	267.58

3 Stainless steel

Mode No.	Deformation	Frequency
1	18.155	75.197
2	18.203	77.847
3	33.727	88.958
4	30.781	168.78
5	40.943	226.79
6	18.7	261.85

VI. CONCLUSION

This paper aims to introduce a review of the current techniques used for detecting incipient mechanical faults within the gearbox and Vibration measurements are conducted by using either vibration sensors. From above results and observations we can conclude that, from Stainless steel, Mild steel and Aluminium alloy, the best suited material is Stainless steel because it gives the minimum deformation. Due to which it has less vibration.

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