BALANCING EQUIPMENT FOR HIGH RPM PULLEY

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This report is submitted
in fulfilment of the requirement for the degree of
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DECLARATION

I declare that this report entitled *"Balancing Equipment for High RPM Pulley "* is the result of my own research except summaries and quotations which have been acknowledged. The report has not been accepted for any other degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Plant and Maintenance).

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DEDICATION

I would like to dedicate to

My father,

SYED SYAMSUDIN BIN SYED AHMED

My mother,

ZAHARAH BT AHMAD

My supervisor,

DR. REDUAN MAT DAN

and

All my friend,

for their assistances & supportive efforts.

ABSTRACT

Unbalanced mechanical systems are always be the problem to engineers because of its impact can distrupt the smoothness and the reliability of a system. From the past, unbalance is known as the most causes of machine vibration and cause more vibration and generates excessive force in bearing area and will reduces the life of machine used. In oder to expert and understand the unbalance characteristics of these pulley, a pulley balancer equipment that can stand untill to 3000 RPM speed of motor must be designed in this project. In balancing the pulley, method of mass addition and vibration measurement technique are used. The design must consist the suitable material and strong to it stand untill the maximum speed. The result outcome the increasing of speed untill to 300 RPM without vibrate the pulley and unbalanced the pulley. As conclusion, the pulley must be designed by using the right method, requirement and properly assemble. Therefore helps in monitoring the health of rotating component where could be useful to prevent the breakdown.

ABSTRAK

Ketidakseimbangan sistem mekanikal sentiasa menjadi masalah kepada para jurutera kerana kesannya boleh menganggu kelancaran kebolehpercayaan sistem itu. Dari masa lalu, ketidakseimbangan dikenali sebagai punca utama getaran mesin dan menyebabkan lebih banyak getaran dan menghasilkan daya yang berlebihan di kawasan galas dan akan mengurangkan kehidupan mesin yang digunakan. Untuk pakar dan memahami ciri-ciri ketidakseimbangan takal ini, peralatan pengimbang takal yang bole bertahan sehingga 3000 RPM kelajuan motor mestilah direka dalam projek ini. Dalam mengimbangi takal, kaedah penambahan berat dan teknik pengukuran getaran digunakan. Reka bentuk mestilah terdiri daripada bahan yang sesuai dan kuat untuk bertahan sehingga kelajuan maksimum. Hasilnya adalah peningkatan kelajuan sehingga 3000 RPM tanpa gegaran takal dan ketidakseimbangan takal. Sebagai kesimpulan, takal mesti direka dengan menggunakan kaedah, keperluan dan pemasangan yang betul. Selain daripada itu, membantu dalam pemantauan kesihatan komponen berputar di mana berguna untuk mencegah pecahan.

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LIST OF ABBEREVATIONS

RPM	Rotation Per Minute
MFS	Machinery Fault Simulator
VSD	Variacle Speed Driver
CLF	Cyclic Load Factor
DFT	Discrete Fourier Transform
HZ	Hertz

LIST OF SYMBOL

T= belt tesion

p = average normal pressure between belt and pulley

p_2= average normal pressure at slack side end of belt

R= radius of pulley

θ= angle of contact

α= active angle

τ= average shear stress

A_a= real contact area

A= apparent contact area

μ= coefficient of friction

c, a, B= constant

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Unbalance in rotating machinering has been found to be one of the most common causes of machinery vibration. In any industry, rotating machinery is a basic part. Unbalance may develop in the system due to the operating conditions such as manufacturing, assembly, installed machines and other causes. Fabrication problems for example distorted castings, offbeat machining and poor gathering can also create unbalance. As example distortion problems is rotational stresses, aerodynamic and temperature change. Many of these occur during manufacture and others during operational existence of machine.

In addition, improper assembly is the reason why unbalance occurs when a rotor is being fabricated. As a theory, when a unbalanced shaft and unbalanced rotor united, a radial diplacement occurs from the necessary assembly which will produce an unbalance condition. These such as include consumption of the machine, wear and less right connection. The large unbalances will cause require large weight corrections and this can have negative impact on the integrity of the rotor.

The driven pulley and belt also must be studied. Forces is produced from normal and tangential and friction characteristics between an abrasive belt and pulley. Then, suitable size and material that can be used to withstand until 3000 RPM speed. As a theory, classical Euler equation state that for a flat belt power transmission assumes a constant coefficient of friction between pulley and belt. It also state that the coefficient of friction between rubber structure and hard surface depends to normal pressure, material consistent and shear stress. (Kim,H., 1987)

There are many equipment that are used to verify the imbalance system.The equipment will be used based on to check either the system is unbalance or not. One of the equipment is using Machinery Fault Simulator (MFS) and Vabbit pro vibration machinery diagnostic system by analyzing generated frequency at spectrum. The equipment can detect faults in gears, bearings and other mechanical components. A parameter-free method to analyze sensor signals that incorporates two or more frequency demodulation, phase demodulation of the raw signal data and amplitude demodulation. Any of equipment will use a sensors to detect the unbalance condition.

One example of sensors is an accelerometer. This device can measures a proper acceleration and have multiple applications in science or industry. It can detect and monitor vibration in rotating machinery and has a single or multi-axis to detect direction and magnitude of proper acceleration. Accelerometer works in many ways, two from it are capacitance sensor and piezoelectric effect. The capacitance accelerometer senses changes in between microstructures located next to the device and if a force moves, the capacitance will change to voltage for interpretation. For the piezoelectric effect, it is the most common form accelerometer and uses microscopic crystal structures that become accelerative forces. (Natalia, 2013)

1.2 PROBLEM STATEMENT

As known, the pulley is one of the important component in many machinery and industry users. However, the manufacturing is not perfect and there will be some defects occurred. Unbalance pulley will result in vibration that can affect bearing and many others component. In addition, the vibration sensor might not detect at very low rpm, but if the speed increase to 3000 RPM, the unbalance might become significant. This project would fabricate and test unbalance pulley with the speed of 3000 RPM.

1.3 OBJECTIVE

The objectives of this project are as follows :

1. To investigate unbalance pulley at various speed.
2. To do balancing on pulley using vector method.

1.4 SCOPE OF PROJECT

The scopes of this project are:

1. The cheapest way to design pulley balancing equipment with 3000 RPM speed of rotation motor.
2. Result of balancing testing to it stand until 3000 RPM speed of motor.

CHAPTER 2

LITERATURE REVIEW

2.1 THEORY OF BALANCING

Unbalance in the general definition is the combination between the "dynamic" unbalance and "static" unbalance (Krysinski, T., & Malburet, F, 2007). It also one of the conventional vibratory sources in rotating systems. The mass that circulate in rotating parts around the axis of rotation may generate inertial effects in specific cases. These will create vibrations in cyclic loads in the links and bearer structure involved. These loads generally noticeable and it is important for the structure to rotate at high speeds or when the structure is rotate there has a large mass with an inappropriate mass contribution around the axis of rotation and circulation. In mechanical systems rotating machinery is commonly used, including industrial turbomachinery, machining tools and etc. Vibration caused by mass unbalance is a normal problem in rotating machinery. Unbalance occurs if the geometric axis is not coincident with the principal axis of inertia of the rotor.

The center of inertia is on the axis of rotation and the axis of rotation is a principal axis of inertia must be to sure so that the equilibrium is obtain and to avoid unbalance. The systems are in equilibrium when the masses of rotating elements are distributed equitably around the axis of rotation and the resultant inertial effects are zero. The vibration and noise will not happened when a machine is in equilibrium. For a proper dynamic operation of machines these two parameters are important to be considered. A slight of asymmetry in rotating parts is enough to create an unbalance that causes dynamic responses at the bearings for high rotation speeds. Higher rotation speeds also can cause much greater centrifugal unbalance forces and current pattern of rotating equipment toward higher operational speeds to higher power density openly leads.

2.2 TYPES OF UNBALANCE

There are three types of unbalance :

i. Static unbalance
ii. Couple unbalance
iii. Dynamic unbalance

2.2.1 Static unbalance

Defined as the eccentricity of the center of gravity (MacCamhaoil, 1989) of a rotor that caused when the center of rotation has point mass at a certain radius. It also defines when the rotor will roll and it stops when its heavy spot is at the lowest position and has *in-phase* motion between both end of the rotor. It required to restore from the center of gravity to the center of rotation when an equal mass is placed at angle of 180° to the unbalanced mass and at the same radius. The static balancing including settling primary forces into one plane and adding a correction mass into that plane only. Many rotating parts that have most their concentrated mass in or very near one plane, such as car wheels, flywheels or etc can be determined as static balancing problems.