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Title

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ABSTRACT
Vibration caused by mass unbalance in rotating machinery is an important engineering problem. The objective of balancing is to reduce rotor vibration to a practical minimum. Reducing rotor vibration generally increases the service life of the rotating machinery. Presence of vibration in structure and machine components leads to cyclic stresses resulting in material fatigue, failure and loss of energy vibration in mechanical system result in loosening of part and can in general create hazardous situation. The analysis of vibration has become increasingly important in the resent year owing to the current trend towards high speed machines. The dynamic forces of such high order produces hammering action, sets up vibration, and have a tendency to lift the machine from the foundation. It is realized that, no foundation will normally be able to withstand forces of such a high magnitude and frequency. Hence to avoid the unpleasant effects, precise balancing is essential. Balancing is necessary to have optimum performance of rotating system. An important application for study of vibration is the analysis of torsion l rotary system. It's absolutely essential to ensure that the rotating speed is nowhere near the resonance frequencies of the system, as that would mean failure of line shaft and its components. The study of vibration is thus aimed at its reduction, by proper mounting of machines. Thus, balancing is necessary to have optimum performance of a rotating system. It reduces vibration due to the centrifugal forces caused by unbalance mass and provides smooth operation, increasing the bearing life and the result in better efficiency with reduced wear.

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I. INTRODUCTION

Balancing is the process of correcting or eliminating either partially or completely, the effects due to resultant inertia forces and couples acting on the machine parts or components. Thus, the purpose of balancing is to avoid the vibration of the machine by balancing resultant inertia forces and couples. The balancing is highly essential, especially in high speed applications such as: electric motors, generators, turbines, pumps, air crafts, machine tools, etc. If the center of gravity of the rotating components of a machine such as flywheel or rotor of an alternator etc. does not lie on the axis rotations, there is centrifugal disturbing force, which is given by,

$Fc = m.r.\omega^2$ N

Where,

m = mass of the rotating components in kg
w = angular velocity of the rotating components, rad/sec
r = eccentricity i.e. the distance of the center of gravity from the axis of rotation

It may noted that magnitude of the force is constant, but its direction varies as
Components rotate. Square of speed and also be directly proportional to the eccentricity.
There are two types of Balancing:
1.Static balancing
2. Dynamic Balancing

1.1.1 Need of Balancing

In comparison with the static forces, the dynamic forces are very large in magnitude. For example, consider two tone of rotor of steam turbine running at 3000rpm. The distance of center of gravity of the rotor from axis of rotation is 2 mm due to imperfect machining, inaccurate pitch of blades non-homogeneity of materials etc. Then the resultant dynamic forces (centrifugal force) will be equal to,

$Fc = mr\omega^2$
$Fc = 1000*2/1000(2*\pi*3000/60)^2$
$Fc = 197.39*10^3$ N or 197.39 KN

The dynamic forces of such high order produces hammering action, sets up vibration, and have a tendency to lift the machine from the foundation. It is realized that, no foundation will normally be able to withstand forces

of such a high magnitude and frequency. Hence to avoid the unpleasant effects, precise balancing is essential. Balancing is necessary to have optimum performance of rotating system. It reduces vibration due to the centrifugal forces caused by unbalanced masses and provides a smooth operation, increasing the bearing life and result in the better efficiency with reduced wear. Balancing is necessary especially in high speed application.

1.1.2 BASIC CONCEPT

One of the applications of the study of the inertia force is the balancing of machinery. Moving parts of the engine have reciprocating motion similar to that of the piston of an engine. Rotating motion such as that of the crankshaft of an engine or a rotor of a turbine, electric generator or motor etc. If the moving part is not in balancing or if the part are subjected variable speed that are to acceleration, inertia force ,are set up and tend to produce vibration in the frame of the machine and then to the foundation of the machine. Such vibration particularly those occurring at high speed produce excessive noise, cause under wear and tear of the machinery and its supports. Further if frequency of the vibration of any part of the supporting frame or foundation happens to be coincide with the frequency of moving part. Then the disturbance can happen which is dangerous. The purpose of balancing is therefore to neutralize or at least minimize those unpleasant vibrations as far as may be practicable.

1.2. Balancing Machine

Although every care may be taken in the design of a rotating part of the machine to ensure that there is no out of balancing force or couple .residual error will always exits in the finished part. These error may be due to the slight vibration in the density of the material or due inaccurate in casting or machinery of the part of large diameter and relatively small axial length .it is often sufficient to ensure that it is statically balanced, Since the dynamic couple even if it is persist will be so small as to be of no practical importance .

But in other cases where the axial length is appreciable it is not sufficient merely to have static balance , the dynamic couple vary with the square of the speed even small error of the speed, even small error of balance may be serious at high speed of rotation . It is therefore necessary to measure those residual out of balance errors and make suitable correction to the part so as reduce the final error to the smallest possible proportion. Many different type of machines have been devised in order to measure the extent to which rotating parts are out of balance some of these machine measure the static unbalancing, some the dynamic unbalance, while some measure both the static as well as dynamic unbalance.

1.2.1 Function of balancing machine

A rigid body having any nom of unbalancing rotating masses can be completely balanced by addition of one mass in each of the two arbitrary chosen planes .if follows that the total unbalanced pressure equivalent unbalanced masses one in each of chosen planes for an actual rotor .then problem of unbalancing involves .

1) The selection of the two planes in which it's convenient toad balancing weights (or remove unbalance)
2) The determination of the amount and location of equivalent unbalanced mass in each of selected planes. the two masses too represent the total of all the unbalance actually present

1.2.2 Principle of dynamic balancing

The primary aim of (dynamic balancing machine) of our project is to provide an apparatus, which experimentally proves analytical solution for balancing problems. The dynamic balancing machine is defined as the "apparatus which experimentally proves the analytical solution for balancing problems ". A complete balancing of rotor system is possible providing balance weights in any two planes. Then magnitude of radius of rotation and angular position analytical calculated.

Certain amount of known unbalance is provided by fix weights in the slots provided on the rotors of known radii and angular position. The analytical solution is

II. CONCLUSION

As amplitude increases with speed an unbalance force is also increases at horizontal direction. That may cause a breakdown of bearing of rotor system in future.

Therefore vibration analysis helps in monitoring the health of rotating component.

Thus, balancing is necessary to have optimum performance of a rotating system. It reduces vibration due to the centrifugal forces caused by unbalance mass and provides smooth operation, increasing the bearing life and the result in better efficiency with reduced wear.

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