A REVIEW ON ANALYSIS OF FLYWHEEL BY FAILURE MODE EFFECTIVE ANALYSIS (FMEA)

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Abstract-Flywheel is an energy regulating device which controls the fluctuation in machines. In present analysis, flywheel have many reasons of their failure, between them, compeer alternating stress, bending stress, disservice and maximum tensile induced in the arm and in the rim under the amorousness of centrifugal forces. Due to this, there is a certain compeer alternating stress and disservice of the flywheel. In this paper, appraisal of compeer alternating stress and disservice of flywheel are studied by the finite element method. In FMEA model of flywheel under different state of loading applied on the flywheel and the minimum compeer alternating stress and disservice are determined by using ANSYS. We can compare the design and analysis the result with present flywheel.

Introduction

A flywheel is a bulky rotating body which is used to regulate the energy at the different loading condition in a machine.
A flywheel stores the excess amount of energy in the form of kinetic energy and release at when it require in the process. For example- in a four stroke engine, there are fore stroke (compression, heat addition, expansion, exhaust) to complete thermodynamic cycle. As we know that we get energy from the fuel in the power stroke and in remaining process we have to supply some energy to the system.

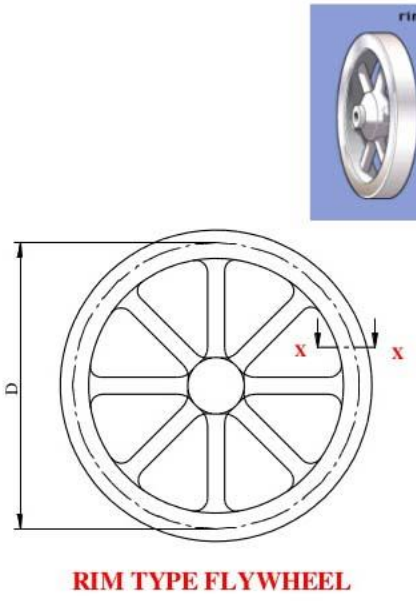


Fig. 1 Rim Type Flywheel

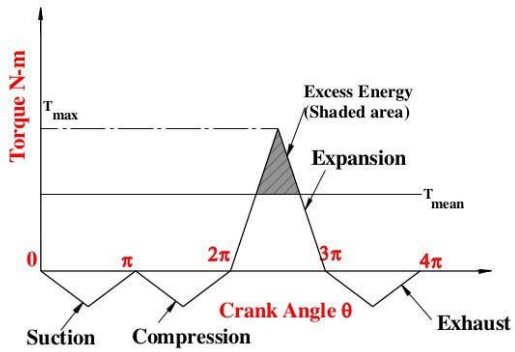


Fig.2 Turning moment (crank effort) Diagram for a 4-stroke IC engine.

For the continuous working of the system, so we provide a heavy body of rotating mass which store the excess amount of energy. During the power stroke in the kinetic form and release it during the other 3 stroke and our system run without disturbance.

Types of flywheel

1. On the basis of velocity:
(1) High velocity flywheel
(2) Low velocity flywheel

High velocity flywheel: - These are the flywheel where angular velocity lies in a range of 30000 rpm to 60000 rpm which may be reaching to 10000 rpm. These are lighter in weight but costly as compare to low velocity flywheel.

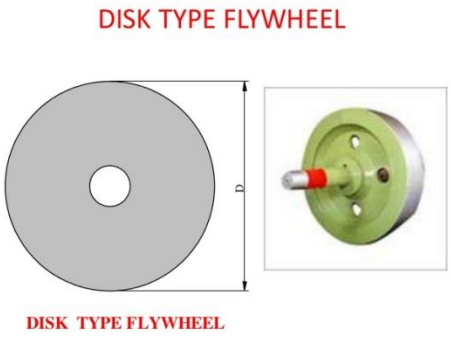
Low velocity flywheel: - These are the flywheels which have angular velocity up to 10000 rpm. Low velocity flywheels are heavy and cheap as compare to the high velocity flywheel.

2. On the basis of Design:

(1) Rim type flywheel
(2) Disc type flywheel
(3) Ring-gear type flywheel

Rim type flywheel: - A flywheel in which a rotating mass is connected to the centre of ring with the help of rim (4, 6). Rim type flywheels have lower life as compare to the disc type flywheel.

Disc type flywheel: - In a disc type flywheel wheel mass is connected as a plate of circular ring. Disc type flywheel used for heavy duty and have more life as compare to rim type flywheel.



Literature Review

It is collection of information or data from the previous task which is performed by the different author or scholar and published in research journals. Few collection of information helps us to move our task by getting different idea and the previous work.

In 2004, Xiaolei XU, Zhiwei YU analysis the failure of diesel engine flywheel. Analysis was on the ring-gear flywheel used trucks. When engine start from low temperature (-25^0C) the ring-gear fractured. This fracture occurred lying on the side of the load contact surface from the root fillet region in all cases. A fractographic studies was made to study the fracture surface of the ring-gear flywheel. This study indicate that the fracture surface have similar fracture which reveal cleavage fracture insightful of low stiffness of the material. The unsuccessful ring-gears present common metallurgical characteristics that network of grain boundary ferrite even widmannstatten. Unbroken network of grain boundary ferrite appeared in the core, tooth groove regions and structure ferrite appeared in the bringing on toughened region. The presence of the arrangement ferrite decreases the strength of gear teeth in tooth groove region. It was also initiate that there are some forging cracks also present in root fillet region. Moreover, fillet radius makes the stress concentration in the fillet region. The analysis shows that inappropriate normalizing technology or forging technology should be liable for continuous network of grain boundary ferrite which is responsible for failure.

In 2005, Jihad said addasi analyzed the design of flywheel with a moving hole and find out the various properties of flywheel. In this analyzed he used a apparatus which consist of a flywheel, revolving in a horizontal plane. A hole is also made in flywheel which could be moved on a radial rail. The position of hole can be moved to get the various effect of hole on flywheel. A metallic sphere on this hole gives centripetal motion with certain radius to this sphere. A normal force acts on the metallic sphere and move it in circular path. By escalating the angular velocity of the metallic sphere has it is highest value when the sphere leaves the hole. So it is observed centripetal acceleration reliant only on the geometry of both sphere and hole.

In May 2015, Palak J Patel, Arvind S. Sorathiya work on Design analysis and weight reduction of car flywheel using finite element analysis. As we know that the flywheel have a significant moment of inertia and this moment of inertia can produce unbalancing in our system, so that Palak J Patel, Arvind S. Sorathiya Analysis the flywheel design and used different metal for the flywheel like gray cast iron. 5059 H321 Aluminium Alloy and Kevlar fibre and their relative performance have been observed. They used all these metals in this analysis were used in tetrahedron form. In this analysis they found total deformation, stress etc. and suggest that carbon fibre as better material for designing of wheel as it has lower weight.

In June 2015, K. Rajesh, J. Sri Lakshmi, V. Mallikarjuna, Dr. B. Rama Bhupal Reddy try to optimization of petrol engine flywheel for variable speed by using ANSYS. During their analysis they took cast iron and aluminium alloy A360 for the flywheel material. A 3D model is prepared by using ANSYS (A general-purpose finite element analysis software package) and different conditions are provided to the flywheel in this software and result is studied for the optimization of petrol engine flywheel for variable speed.

In July 2015, Rakesh analyzed the fatigue failure of the flywheel. During the working of flywheel there is variation in the magnitude and direction of the flywheel. Due to these fluctuations there is fatigue failure of the flywheel. To avoid or minimize this fatigue failure four arm of

flywheel was replaced by six or eight arm and a stress analysis was done in ANSYS and whole study says that four arm flywheel is better than six or eight arm flywheel.

In November 2015, Madhusudhan Reddy K, Suneel Kumar design analysis of flywheel by using finite element method. A 3D model of flywheel is produced by using CATIA. The material used for flywheel were aluminium A360, cast Iron etc. and complete property were compared in the software and find out which metal is suitable for flywheel.

In 2016, Prof. R.S Shelk, D.G Dighole gave a review on the dual mass flywheel system. Prof. R.S Shelk, D.G Dighole said that the combustion stroke of fly during torque generation also produces the torsional vibration and these vibrations can be isolate by dual mass flywheel. A dual mass flywheel is a multi-clutch device which is used to damp. Prof. R.S Shelk, D.G Dighole said that during the low operating speed of the engine , torsional resonance produce vibration that can be avoided using dual mass flywheel. The objective for developing the concept was to isolate the drive train from the torsional vibration.

Conclusion and future scope

It is observed that a design modification can reduce the failure of the flywheel in different condition and we can increase the life of the system.

1. Finite element analysis helps to design a wheel with minimum failure.
2. FEM can design a flywheel which have lower weight and reduce the inertia of the whole system.
3. As FEM helps in creations of a more balanced flywheel which improves the engine life as well as efficiency of engine.
4. Compact size of flywheel reduces the size of whole system which leads to generations of a more effective system.

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