e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:05/Conference:01/March-2023 Impact Factor- 7.868 www.irjmets.com
National Conference on Trending Technology for Achieving Sustainable Development Goals
NCTTASDG 2023 Organized by Shri Shankarprasad Agnihotri College of Engineering, Wardha

A REVIEW ON FLYWHEEL AND ITS APPICATION

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ABSTRACT

The flywheel and its applications are studied in this paper. In many mechanical machines, flywheel plays an important role and having more applications. A flywheel is a heavy wheel attached to a rotating shaft so as to smooth out delivery of power from a motor to a machine. The inertia of the flywheel opposes and moderates fluctuations in the speed of the engine and stores the excess energy for intermittent use. In automobile engines the flywheel serves to smooth out the pulses of energy provided by the combustion in the cylinders and to provide energy for the compression stroke of the pistons. The larger the rotational inertia of the flywheel, the smaller the changes in speed resulting from the intermittent power supply and demand. In power presses the actual punching, shearing, and forming are done in only a fraction of the operating cycle. During the longer, nonactive period, the speed of the flywheel is built up slowly by a comparatively low-powered motor. When the press is operating, most of the required energy is provided by the flywheel.

Keywords: Flywheel, machine, inertia, energy

I. INTRODUCTION

A flywheel is an inertial energy-storage device. It absorbs mechanical energy and serves as a reservoir, storing energy during the period when the supply of energy is more than the requirement and releases it during the period when the requirement of energy is more than the supply. The main function of a flywheel is to smoothen out variations in the speed of a shaft caused by torque fluctuations. Generally used materials for manufacturing of flywheels are Steel, Cast Iron, Aluminum Alloy, and Titanium. Cast iron is most preferred because of long term durability and its design can be easily modified by avoiding cost of complete replacement. Internal combustion engines with one or two cylinders are a typical example. Piston compressors, punch presses, rock crushers etc. are the other systems that have flywheel. [1]

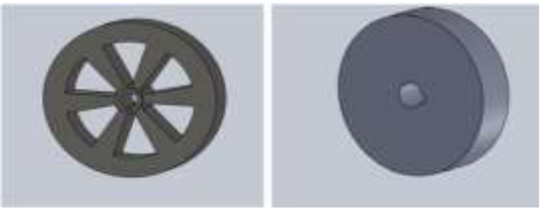

Figure 1: Flywheel

Several years ago pure mechanical flywheels where used solely to keep machines running smoothly from cycle to cycle, thereby render possible the industrial revolution. During that time many shapes and designs were implemented, but it took until the early 20th century before flywheel rotor shapes and rotational stress were thoroughly analyzed. Later in the 1970s flywheel energy storage was proposed as a primary objective for electric vehicles and stationary power backup. At the same time fiber composite rotors where built, and in the 1980s magnetic bearings started to appear. Thus the potential for using flywheels as electric energy storage has long been established by extensive research. More recent improvements in material, magnetic bearings and power electronics make flywheels a competitive choice for a number of energy storage applications.[2] Flywheels became the topic of intensive analysis as power storage devices for applications in vehicles. The energy storage of the flywheels is a better alternative for electrochemical batteries because of higher energy density capacity, higher life term, and settled charge state and also ecological clean nature.[3] Using high strength materials allows to store more kinetic energy in the flywheel. The capacity of the flywheel to store the energy mainly depends on the material, geometric design and the rotational speed.[4]

II. LITERATURE SURVEY

Ankita Shinde [1] made an attempt to redesign the existing flywheel in terms of its geometry and different materials. Different cross sections of the flywheel are designed using 3D designing software Solidworks 2015. Finite Element analysis is used to calculate the maximum rotational speed of the flywheel and the amount of Kinetic energy stored at that speed and concluded that with triangular cross sectional geometry and made of S-glass epoxy composite material stores highest kinetic energy per unit mass compare to all other combination of geometries and materials. This new design of flywheel saves weight by 65.252kg compared to existing designs.

Rathod Balasaheb S [2] focused on the analytical design of arm type of flywheel which is used for punching press operation. To design of flywheel it is required to decide the mean diameter of the flywheel rim, which depends upon two factors such as availability of space and the limiting value of peripheral velocity of the fly wheel. However the current design problem is formulated for punching machine which has to be make holes of 30 holes/minute in a steel plate of 18mm thickness with space limitation that is the diameter of flywheel should not exceed 1000 mm, hence it can be observed that the design of the flywheel is to be carried out based on the availability of space limitation and accordingly the fluctuation of energy, dimensions of the flywheel, stresses induced in the flywheel are determined. Finally after detail analysis it is observed that the induced diameter of the flywheel is less than the allowable/permissible diameter and hence it can be concluded that the design is safe from availability of space point of view. O Hema Latha [3] is presenting all about harnessing lost energy when the vehicle loses speed without reversing the process in an engine. The simplest method is to recover this energy without transforming it to another form. The mechanical energy of the vehicle can be stored as kinetic energy, which can be used again for acceleration. It does not produce perpetual motion because of entropy, but it decreases the energy lost when the vehicle brakes and reduces the speed. Instead of releasing energy as heat through the brakes, the rotating flywheel stores it. The idea of how a kinetic energy of a flywheel can be stored and used for regenerative braking on any vehicle is explored with the experimental setup. Akshay Patil [4] suggested that by selecting the proper design and combining it with the suitable material having high strength and low weight the increased kinetic energy of the model should be achieved. Maximum and minimum stress levels: The optimum stress level should be obtain by performing the implicit analysis on the created flywheel models Ashish R. Sonekar [5] deals with the problem of weight minimization and energy maximization of flywheel. We take press machine flywheel and analyze it using ANSYS (finite element modeling and analysis software) to optimize weight and find out the resulting stresses. Also we compare the theoretical stress results with analysis software stress results and suggest smart profile of flywheel so it can store more amount of energy than solid disk flywheel. Suyog Gaware [6] studied various profiles of flywheel and the stored kinetic energy is calculated for the respective flywheel .Various profiles designed are solid disk, disk rim, webbed/section cut, arm/spoke flywheel. It shows that smart design of flywheel geometry could both have a significant effect on the Specific Energy performance and reduce the operational loads exerted on the shaft/bearings due to reduced mass at high rotational speeds.

III. TYPES OF FLYWHEEL

1. Solid Disc Flywheel

It is basically a solid circular disk. A solid disc flywheel is generally made of cast iron. It has a solid cross-section and provides better strength and stability. The solid disc flywheel is equipped with a flywheel hub and disc. The following figure shows a solid disc flywheel.

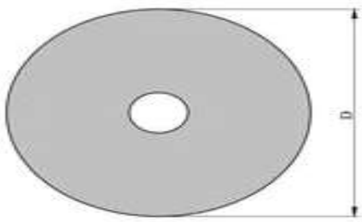

Figure 2: Solid disc flywheel

2. Rimmed Flywheel

A flywheel is heavy metal wheel attached to a drive shaft, having most of its weight concentrated at the circumference. Main function of flywheel is to reduce speed fluctuation by storing extra energy during part load as kinetic energy and same is released during overloading. The following figure shows a rimmed flywheel

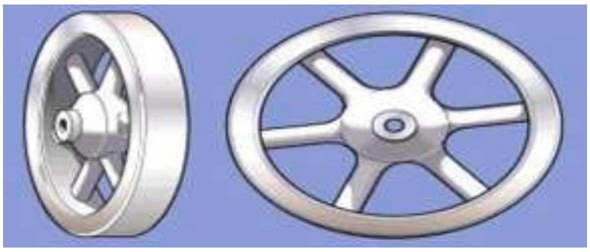

Figure 3: Rimmed flywheel

IV. MATERIALS FOR FLYWHEEL

Flywheels are made from many different materials, the application determines the choice of material. Cast iron flywheels are used in old steam engines. Flywheels used in car engines are made of cast or nodular iron, steel or aluminum. Flywheels made from high-strength steel or composites have been proposed for use in vehicle energy storage and braking systems. The efficiency of a flywheel is determined by the maximum amount of energy it can store per unit weight. As the flywheel's rotational speed or angular velocity is increased, the stored energy increases; however, the stresses also increase. Carbon steel 1065, Alloy steel AISI 4340, Maraging steel 18ni, Alloy steel AISI E9310 and Stainless steel are also used as a flywheel material . In future more suitable materials and properties will be chosen for analysis which will provide more accurate results and the same method can be applied for selection of materials for other applications. Stronger materials could undertake large operating stresses, hence could be run at high rotational speeds allowing to store more energy

V. APPLICATIONS OF FLYWHEEL

1. AUTOMOBILE ENGINE: A flywheel is one of the most important components of an automobile engine. It's a mechanical device that is specifically designed for storing rotational energy (kinetic energy). It's proportional to the square of its rotational speed and mass.

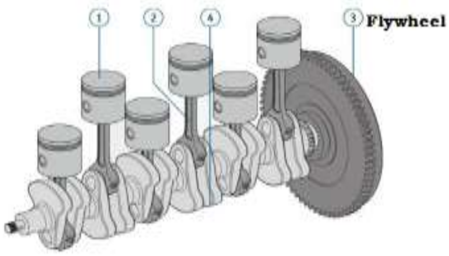

Figure 4: Application of flywheel in automobile engine

2. PUNCHING PRESS: The flywheel can also be used to perform the same function when the torque is constant and the load varies during the cycle. Such an application is found in punching press or in a riveting machine.

Figure 5: Punching press or riveting machine

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3. STONE CRUSHER: The flywheel stores the energy of the jaw crusher during the empty stroke and releases it when the material is squeezed. It means when the movable raft leaves the fixed raft, the flywheel accumulates energy, and when it is closed, the flywheel transfers the accumulated energy for the material of the crusher. This makes the load of the motor tend to be uniform, thereby reducing the rated power of the motor. Due to the flywheel, the energy consumption of the jaw crusher is even.

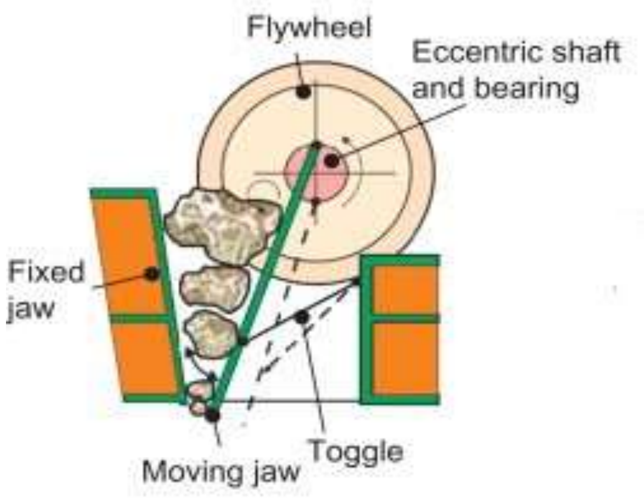

Figure 6: Stone crusher

4. SHEARING MACHINE: In a shearing machine where the operation is intermittent, the flywheel stores energy from the power source during the greater portion of the operating cycle and gives it up during a small period of the cycle.

Figure 7: Shearing machine

The introduction should be typed in Times New with font size 10. In this section highlight the importance of topic, making general statements about the topic and Presenting an overview on current research on the subject. The simplest way is to replace(copy-paste) the content with your own material. Your introduction should clearly identify the subject area of interest.

VI. CONCLUSION

This paper is the short summery on flywheel and its application and will help in study of flywheel in short. In this paper, we have studied and reviewed the solid disc flywheel and rimmed flywheel. These flywheels are used in various machineries like automobile engines, punching presses, stone crushers, shearing machines, etc, Also various papers have been reviewed for this study.

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