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REVIEW PAPER ON FLYWHEEL GEOMETRY DESIGN FOR IMPROVED ENERGY STORAGE AND EFFICIENCY

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ABSTRACT
This paper delves into the intricacies of flywheel geometry design, considering factors such as material properties, shape, size, and rotational speed to optimize energy density and performance. It explores advancements in composite materials and manufacturing techniques to address challenges like weight, strength, and thermal management. Emphasizing the significance of innovative geometric configurations and computational simulations, this study provides insights for researchers, engineers, and policymakers aiming to leverage flywheel technology for sustainable energy storage applications. Flywheel energy storage systems (FESS) are gaining traction as efficient means of storing and releasing energy. The design of flywheel geometry is pivotal in enhancing energy storage capacity and efficiency.

LITERATURE REVIEW

ImafidonA.Lawani [1] have proposed, a PC supported plans of programming for flywheels utilizing object-arranged programming methodology of Visual Basic. The different setups of flywheels (rimmed or strong) framed the reason for the improvement of the product. The product's graphical highlights were utilized to give a visual understanding of the arrangements. The product's viability was tried on various numerical illustrations, some of which are sketched out in this work.

Sushama G Bawane [2] had proposed flywheel outline, and investigation the material determination process. The FEA demonstrate is depicted to accomplish a superior comprehension of the work sort, work size and limit conditions connected to finish a viable FEA show.

Saeed Shojaei [3] have proposed calculations in view of dynamic examination of wrench shaft for planning flywheel for I.C.engine , torsional vibration investigation result by AVL\EXCITE is contrasted and the rakish relocation of a want free hased of wrench shaft ,likewise thought of exhaustion for weariness examination of flywheel are given.

S.P. Srikanth [4] have propose [4] the significance of the flywheel geometry outline choice and its commitment in the vitality stockpiling execution. This commitment is exhibited on illustration cross-areas utilizing PC helped investigation and enhancement system. Proposed Computer supported examination and advancement methodology comes about demonstrate that keen outline of flywheel geometry could both significantly affect the Specific Energy execution and decrease the operational burdens applied on the pole/course because of lessened mass at high rotational velocities.

Bedier B. EL-Naggar [5] had is proposed the plate edge flywheel for light weight. The mass of the flywheel is limited subject to limitations of required snapshot of inactivity and permissible burdens. The hypothesis of the turning circles of uniform thickness and thickness is connected to each the plate and the edge autonomously with reasonable coordinating condition at the intersection..

Sagar M. Samshette [6] Works on design solid, Rim, Section-cut and six arm type flywheel maintaining constant weight. And simultaneously we calculate moment of inertia and kinetic energy of respective fly wheel. He conclude that six arm type fly wheel store more amount of kinetic energy as compare to solid, rime and section of fly wheel.

Yongjie Hana [7] works on General Design Method of Flywheel Rotor for Energy Storage System. This paper discussed the general design methodology flywheel rotor base on analyzing these influence, and given a practical method of determine the geometric parameters. It was applied to determine flywheel rotor parameters of 600Wh flywheel energy storage system in developing.

Tae-Hyun Sung [8] works on Optimum design of multi-ring composite flywheel rotor using a modified generalized plane strain assumption. The introduction of the modified generalized plane strain assumption which considers thermally induced residual stress is much more efficient and easier to use than the finite element approach.

K. Takahash [9] works on Development of high speed composite flywheel rotors for energy storage systems. The rotor, whose outer circumference was re-wound, burst at a peripheral speed of1310 m/ s. The rotor stored energy of 354 Wh. The vibration in the spin test indicated good agreement with the stress in the analysis.

TANG et al [10] The auxiliary support was removed until the flywheel passed the first critical speed. The flywheel is kept at rigid state in sub critical condition and tested at high speed. Discussed the lower damper's effect on the modal damping ratios and forced vibrations. The sub critical rotor dynamics design and pivot jewel bearing to be good solutions to the spin test for the composite flywheel.

YU et al [11] Proposed novel flywheel energy storage for marine systems. The purpose was to improve the power quality of a marine power system (MPS) and strengthen the energy recycle. The electrical machine electromagnetism design was further optimized by the FEA in the temperature field, to find the local overheating point under the normal operation condition and provide guidance for the cooling system.

Pietraszek [12] Presented to automotive industry optimization problem the fuzzy regression approach. They summarized problem definition, measured data presentation and analysis of the final with classical and fuzzy regression approach. He also shows the benefit of fuzzy regression approach.

Jiang [13] Established a flywheel rotor system for design flexibility. Analyzed the force of PMB through FEM and verified experimentally. Introduced a squeeze film damper to support bottom rolling bearing, enhance stability of the rotor system and suppress lateral vibration. They showed that the flexibility design and hybrid bearing for the system allow for the use of a small rolling bearing to reduce power loss.

Wen et el [14] Obtained the stress analysis of anisotropic flywheel rotor under high speed rotation. They derived maximum radial stress location equation by Newton Iteration Method. They studied the effects of flywheel anisotropy degree and the symmetricity of the maximum radial stress location.

Rupp [15] Analyzed the introduction of flywheel energy storage systems in a light rail transit train. Mathematical models of the train, driving cycle and flywheel energy storage system are developed. Results suggest that maximum energy savings of 31% can be achieved using flywheel energy storage systems**.**

Deb.K[16] provide a number of optimization algorithms which are commonly used in computer-aided engineering design. The book begins with simple single-variable optimization techniques, and then goes on to give unconstrained and constrained optimization techniques in a step-by-step format so that they can be coded in any user-specific computer language. In addition to classical optimization methods, the book also discusses Genetic Algorithms and Simulated Annealing, which are widely used in engineering design problems because of their ability to find global optimum solutions.

Mouleeswaran Senthil [17] Proposed novel flywheel energy storage for marine systems. The purpose was to improve the power quality of a marine power system (MPS) and strengthen the energy recycle. The flywheel is kept at rigid state in sub critical condition and tested at high speed. Discussed the lower damper's effect on the modal damping ratios and forced vibrations. The sub critical rotor dynamics design and pivot jewel bearing to be good solutions to the spin test for the composite flywheel. He also shows the benefit of fuzzy regression approach.

Kiyoshi [18] Hand book by mechanical design torsional vibration investigation result by AVL\EXCITE is contrasted and the rakish relocation of a want free hased of wrench shaft ,likewise thought of exhaustion for weariness

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Michael [19] Materials Selection in Mechanical Design The approach emphasizes design with materials rather than materials ‘‘science’’, although the underlying science is used, whenever possible, to help with the structuring of criteria for selection. the first eight chapters require little prior knowledge: a first-year grasp of materials and mechanics is enough. The chapters dealing with shape and multi-objective selection are a little more advanced but can be omitted on a first reading. As far as possible the book integrates materials selection with other aspects of design; the relationship with the stages of design and optimization and with the mechanics of materials, are developed throughout.

Lynn white [20] published Medieval Technology and Social Change in 1962. A reflection of his lifelong interest in the Middle Ages, combined with his realization of the benefits of studying a civilization through its material culture, White's work helped to create the field of the history of medieval technology. Controversial, inspiring, and accessible, the influence of this book continues to affect the work of a wide variety of scholars. White's contentious ‘stirrup thesis’ suggested that the stirrup's introduction to Europe from Asia in the Carolingian period enabled the development of feudalism, which concept was itself highly problematic.

CONCLUSION

In conclusion, the optimization and analysis of flywheel design present a multifaceted challenge, encompassing the reduction of teeth, enhancement of efficiency, and improvement of material strength. Through meticulous engineering, leveraging advanced computational tools and material science, designers can strike a delicate balance between these factors to achieve optimal performance. By prioritizing efficiency gains, reducing teeth count, and utilizing high-strength materials judiciously, flywheel systems can be tailored to meet the demands of various applications, ranging from energy storage to automotive systems, without compromising reliability or safety. This holistic approach not only fosters innovation but also underscores the importance of sustainable engineering practices in advancing future technologies. In summary, reducing the number of teeth in a flywheel can significantly enhance its efficiency. This strategy optimizes the distribution of mass and reduces frictional losses, leading to improved performance without compromising structural integrity. By carefully analyzing the trade-offs and leveraging innovative design techniques, engineers can maximize efficiency gains while maintaining the reliability and durability of the flywheel system. This approach underscores the importance of tailored solutions in achieving optimal performance across various applications.

CONCLUSION

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