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ELECTROMAGNETIC AIRCRAFT LAUNCHING SYSTEM

A Review Paper on ELECTROMAGNETIC AIRCRAFT LAUNCHING SYSTEM

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Abstract: The paper titled "ELECTROMAGNETIC AIRCRAFT LAUNCHING SYSTEM: A Review" comprehensively explores the evolution, design principles, operational advantages, and future prospects of Electromagnetic Aircraft Launching Systems (EMALS). This review paper provides valuable insights into the transformative potential of EMALS in modern naval aviation, highlighting its superiority in terms of efficiency, flexibility, and adaptability compared to traditional steam catapults. Through a meticulous synthesis of existing literature and analysis of key developments, the paper offers a comprehensive overview of EMALS technology and its implications for the future of carrier-based aviation.

Title: ELECTROMAGNETIC AIRCRAFT LAUNCHING SYSTEM

Reference:
https://www.irjmets.com/uploadedfiles/paper//issue_5_may_2023/37996/final/fin_irjmets1684748835.pdf

Abstract: The Electromagnetic Aircraft Launch System (EMALS) represents a significant advancement in aircraft carrier technology. Replacing the conventional steam-powered catapult system, EMALS employs electromagnetic energy to launch aircraft efficiently and reliably. This paper provides a comprehensive analysis of EMALS, covering its design, operation, advantages, and limitations. It begins with the rationale behind EMALS, traces its evolution, and delves into the system's intricacies. Moreover, it discusses the current deployment status, exemplified by the USS Gerald R. Ford (CVN 78), and outlines potential future applications. Keywords: EMALS, Aircraft Carrier, Catapult, Efficiency, Reliability.

Introdution: The advent of EMALS signifies a groundbreaking departure from steam-powered catapults on aircraft carriers. Developed by General Atomics, EMALS addresses the shortcomings of its predecessor, offering heightened efficiency, reliability, and cost-effectiveness. The transition from steam to electromagnetic propulsion was spurred by the need for a more sustainable and adaptable launching mechanism.

Literature Review: A review of existing literature underscores EMALS's superiority over steam catapults. Studies by the United States Navy and the Naval Research Laboratory highlight its technical prowess and operational advantages. Research articles in journals like the Journal of Electromagnetic Waves and Applications and the Journal of Ship Production and Design delve into EMALS's design optimization and comparative benefits

Proposed Methodology: The proposed methodology entails a systematic approach encompassing design, simulation, construction, testing, and force analysis. Utilizing CAD software, the EMALS system is meticulously modeled and subjected to simulation to preempt potential operational glitches. Subsequently, real-world testing validates its efficacy, with force analysis determining the requisite launch parameters.

Conclusion: The conclusion encapsulates the expected outcomes of EMALS testing, emphasizing comprehensive performance evaluation, safety analysis, and efficiency comparisons. Findings from these assessments will inform future deployment decisions and drive continual improvements in EMALS technology

In summary, EMALS stands as a testament to naval innovation, embodying a paradigm shift in aircraft launching systems. While challenges persist, its transformative potential in enhancing carrier operations underscores its pivotal role in modern maritime strategy.

Title: EMALS

Reference: EMALS" authored by Michael R. Doyle, Douglas J. Samuel, Thomas Conway, and Robert R. Klimowski

Abstract: The paper titled "Electromagnetic Aircraft Launch System - EMALS" authored by Michael R. Doyle, Douglas J. Samuel, Thomas Conway, and Robert R. Klimowski provides a comprehensive overview of the Electromagnetic Aircraft Launch System (EMALS) developed by the U.S. Navy in collaboration with Kaman Electromagnetics. The paper discusses the rationale behind the development of EMALS, its design, technological components, operational impacts, advantages, disadvantages, and compatibility issues for aircraft carriers

INTRODUCTION: The introduction sets the context by highlighting the limitations of steam catapults, the existing launch system on aircraft carriers, and the need for a more advanced alternative. EMALS is introduced as a solution, leveraging advancements in pulsed power, power conditioning, energy storage devices, and controls to achieve higher launch energy capability and improved operational efficiency.

Literature Review: The paper details the design and components of EMALS, including the disk alternator, cycloconverter, and linear synchronous motor. It explains how these components work together to generate and deliver high-frequency power to launch aircraft from the carrier deck efficiently. The advantages of EMALS over steam catapults are elucidated, such as reduced weight, volume, maintenance requirements, and increased controllability and reliability.

Operational impacts are discussed, focusing on the potential for reduced stress on aircraft airframes, extended service life, and improved operational safety. The paper also addresses compatibility with future aircraft and ship designs, highlighting EMALS' flexibility and integration potential with all-electric ship propulsion schemes.

CONCLUSION: The conclusion emphasizes the significance of electromagnetic launch systems in providing improved performance, reduced weight and volume, and increased operational safety for aircraft carriers. It underscores the importance of continued development in this area to meet the evolving needs of naval aviation.

Overall, the paper provides a thorough examination of EMALS, covering technical details, operational implications, and future prospects, making it a valuable resource for researchers and engineers in the field of naval aviation technology.

Title: DTRC Electromagnetic Launcher With Feedback Control

Reference: DTRC Electromagnetic Launcher With Feedback Control F. P. Emad, * J. P. Borraccini, D. J. WaItman T. H. Fikse, W. R. Ruby, M. J. Superczynski David Taylor Research Center Annapolis, Maryland 21402 R. C. Whitestone, E. V. Thomas

Abstract: The paper titled "DTRC Electromagnetic Launcher With Feedback Control" presents the development and implementation of a high-power electromagnetic launcher with feedback control. Authored by F. P. Emad, J. P. Borraccini, D. J. Waltman, T. H. Fikse, W. R. Ruby, M. J. Superczynski, R. C. Whitestone, and E. V. Thomas, the paper describes the analytical modeling, design methods, and experimental validation of the launcher.

Introduction: The introduction provides context by referencing previous work on electromagnetic launchers and introduces the improved design and control methods presented in the paper. The authors describe a new launcher with double the size of the previous one, emphasizing its increased diameter and improved design methods.

The paper explains the operation of the launcher, detailing the configuration of stator and rotor coils and the sequence of coil activation. It highlights the decision to use repulsion rather than attraction for rotor movement and the use of continuous coil currents to prevent voltage spikes.

A key aspect of the paper is the presentation of feedback control mechanisms to smooth the force curve during launch. The authors introduce a compensating winding on the rotor, whose current is modulated to produce a smoother force curve. They describe the proportional control scheme used to adjust the compensating winding's current based on the difference between the desired force curve and the actual force curve.

Simulation Review: Simulation results demonstrate the effectiveness of the feedback control in smoothing the force curve, leading to more stable and controlled launches. Actual test results confirm the simulation findings, validating the efficacy of the feedback control approach in real-world scenarios.

CONCLUSION: The paper concludes by summarizing the key findings and emphasizing the utility of simulation in developing empirical control schemes for electromagnetic launchers. The authors acknowledge limitations due to time and resource constraints but highlight the potential for further optimization with additional testing.