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Magnetic Bearing Application On Marine Main Engine Propulsion Controlled And Monitoring By AI Technology

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ABSTRACT *-This paper explores the application of magnetic bearings in the propulsion systems of marine engines. Magnetic bearings offer several advantages over traditional mechanical bearings, such as reduced friction, lower maintenance requirements, and the elimination of lubrication systems. The study examines the performance characteristics of magnetic bearings in high-stress environments, including their ability to withstand the dynamic loads encountered in marine propulsion. Additionally, the impact of magnetic bearing integration on engine efficiency, noise reduction, and overall system reliability is discussed. The findings suggest that magnetic bearings could significantly enhance the performance and longevity of marine propulsion systems, making them a promising alternative to conventional bearing technologies.*

The utilization of magnetic bearings in the main propulsion engines of ships presents a significant advancement in maritime engineering. This research investigates the design, implementation, and operational efficiency of active magnetic bearings (AMBs) within large-scale marine engines. The study focuses on the technical challenges associated with the integration of AMBs, including thermal management, control system precision, and load capacity. Experimental results from prototypes and real-world applications are presented, demonstrating the potential for improved fuel efficiency, reduced wear and tear, and extended service intervals. The paper concludes with a discussion on the future prospects of magnetic bearing technology in the maritime industry and its implications for sustainable shipping practices

Keywords: AMBs, RTCA, SMCM, AMC

1.INTRODUCTION

1.1 Frictionless Operation

Magnetic bearings in marine engines eliminate physical contact between the bearing and the shaft, resulting in virtually zero friction, which enhances efficiency and reduces wear.

1.2 Active Magnetic Levitation These bearings use controlled magnetic fields to levitate and stabilize the rotating shaft, providing precise control over the shaft's position and movement.

1.3 Reduced Maintenance

Due to the absence of mechanical contact and wear, magnetic bearings require significantly less maintenance compared to traditional bearings, leading to lower operational costs.

1.4 High-Speed Capability

Magnetic bearings are ideal for high-speed applications in marine engines, as they can operate smoothly without the limitations imposed by friction and wear in conventional bearings.

1.5 Vibration Control

Magnetic bearings offer superior vibration damping, improving the stability and performance of marine engines and reducing the risk of damage to engine components.

1.6 No Lubrication Required

These bearings do not need lubrication, eliminating the environmental risks associated with oil spills and reducing the complexity of engine lubrication systems.

1.7 Advanced Monitoring and Control

Magnetic bearings often come with integrated sensors and control systems, enabling real-time monitoring and active adjustment of the bearing's performance.

1.8 Future of Marine Propulsion

As marine engines evolve towards more advanced and efficient designs, magnetic bearings represent a cutting-edge technology that can significantly enhance performance, reliability, and sustainability in marine propulsion systems.

2.WORKING PRINCIPLE

2.1 Magnetic Levitation

Magnetic bearings use electromagnetic forces to lift and suspend the engine's rotating shaft, eliminating the need for physical contact between the bearing and the shaft.

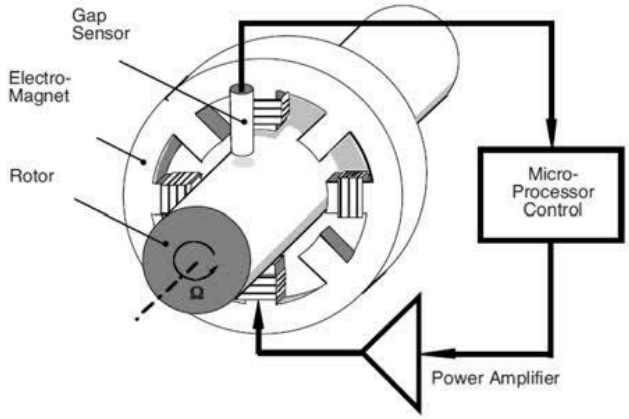

FIG: 3.1: Working Of Magnetic Bearing

2.2 AI Monitoring

AI Can be continuously track the shaft's position, detecting any slight movements or misalignments during engine operation.

2.3 Real-Time Control Adjustments

The data from the sensors is sent to a control system, which adjusts the magnetic fields in real-time to keep the shaft centered and stable, even under varying loads and speeds.

2.4 Frictionless Operation

Since there's no physical contact between moving parts, magnetic bearings operate without friction, reducing wear, heat generation, and energy losses.

2.5 No Need for Lubrication

Unlike traditional bearings, magnetic bearings don't require oil or grease, eliminating lubrication systems and reducing environmental risks associated with oil leaks.

3.CONSTRUTION

3.1 Electromagnetic Coils

The core components of magnetic bearings are electromagnetic coils, typically made of copper or aluminum windings. These coils generate the magnetic fields needed to levitate and stabilize the shaft.

3.2 Soft Magnetic Core Materials

The electromagnets are housed in soft magnetic core materials, such as silicon steel or laminated iron, which help concentrate and direct the magnetic flux to create strong and stable magnetic fields.

3.3 Rotor Shaft Materials

The rotor shaft in magnetic bearings is usually made from high-strength materials like stainless steel or titanium alloys, chosen for their durability, resistance to corrosion, and ability to withstand high rotational speeds.

3.4 Bearing Housing

The housing that encases the magnetic bearing system is often made from robust materials like cast steel or aluminum alloys, providing structural integrity and protection against harsh marine environments, including exposure to saltwater and extreme temperatures.

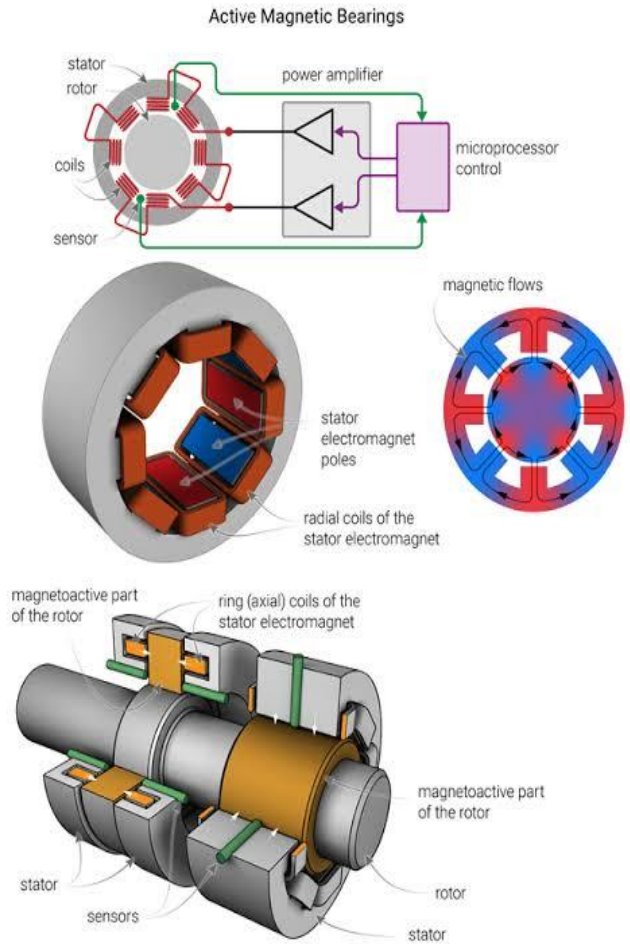

FIG: 4.1: Main Parts Of Magnetic Bearing

4. SAFTIES IN MAGNETIC BEARING

4.1 No Lubrication Required

Magnetic bearings eliminate the need for oil lubrication, reducing the risk of fire and environmental hazards associated with oil leaks or spills.

4.2 AI Monitoring and Control

These bearings are equipped with sensors and control systems that continuously monitor performance, allowing for early detection of faults and automatic adjustments to maintain optimal operation.

4.3 Reduced Mechanical Contact

With no physical contact between moving parts, magnetic bearings significantly reduce the risk of mechanical failure, improving the overall safety and reliability of the propulsion system.

4.4 Emergency Backup Systems

In the event of power loss or system failure, magnetic bearings typically have built-in backup systems (like auxiliary bearings) to safely support the load until normal operation can be restored.

5.DIFFERENCE BETWEEN MAGNETIC BEARING AND MAIN BEARING

MAGNETIC BEARING	MAIN BEARING
Magnetic Bearing support a shaft without making contact with it	Plain Bearing support a shaft on a flat or curved surface with direct contact
Magnetic bearing use a sensor or AI to monitor the shaft's position and a controlled to adjust the magnetic force	Plain bearings have a thin lining on the surface that mates with the journal, and the bearing surface is often coated with a soft metal
Magnetic bearings are used in Ship's Propulsion like compressor, turbines, pumps, motors, and generators	Plain bearings, also known as bushes, Crankshaft, are used for sliding, rotating, reciprocating motion.
Magnetic bearings is a frictionless operation	Magnetic bearings is a friction operation
No Lubrication ; No wear and tear	Need Lubrication ; wear and tear
Less maintenance	More maintenance

6.ADVANTAGES OF MAGNETIC BEARING

- Smooth rotation
- AI Optimized Roto dynamic control
- Low friction
- Low Maintenance
- High reliability
- Improved Safety
- Low energy consumption
- Noise emissions
- Environmental benefits

7.GRAPH ANALYSIS FOR MAGNETIC BEARING USED IN MAIN ENGINE PROPULSION

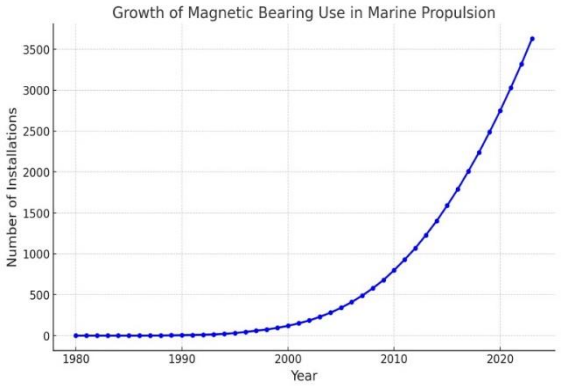

FIG: 7.1: Graph Analysis

8. CONCLUSION

In conclusion, the use of magnetic bearings in main engine propulsion systems presents a significant advancement in marine technology. Magnetic bearings offer several advantages over traditional bearing systems, including reduced friction, minimal wear, and lower maintenance requirements. These bearings enhance the efficiency and reliability of propulsion systems by enabling smoother operation, reducing noise and vibrations, and improving overall fuel efficiency. However, the adoption of magnetic bearings also comes with challenges, such as the need for precise control systems and potential higher initial costs. Despite these challenges, the long-term benefits in terms of durability, reduced operational costs, and environmental impact make magnetic bearings a promising technology for future marine propulsion systems. Continued research and development in this area are likely to further improve their performance and broaden their application in the maritime industry.

REFERENCE

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[2] Active Magnetic Bearings in Marine Applications" by H. Bleuler and R. Larsonneur* - A research paper that discusses the specific applications of active magnetic bearings in the marine industry, highlighting their advantages over 3traditional bearing systems.

[3] "Marine Propulsion: Challenges and Innovations" published by the Institution of Mechanical Engineers* - This publication includes discussions on the adoption of advanced technologies like magnetic bearings in modern marine propulsion systems. nability.

BIOGRAPHIES

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