International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 12 Issue: 01 | Jan 2025 www.irjet.net p-ISSN: 2395-0072

Automated Vessel Anchoring System in FG Vessel Assisting with AI Technology

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ABSTRACT

The automatic anchor system is a pivotal advancement in maritime technology, designed to enhance the safety, precision, and efficiency of the anchoring process in modern ships. This system automates the deployment and retrieval of anchors, significantly reducing the need for manual intervention. By incorporating advanced sensors, real-time monitoring, and remote operation capabilities, automatic anchor systems mitigate risks associated with traditional anchoring methods, such as anchor dragging and chain slippage.

This paper examines the technological components of these systems, their integration with other navigational tools, and their impact on operational efficiency. As shipping demands evolve, the automatic anchor system represents a critical innovation in ensuring safe and reliable maritime operations.

An automatic anchor system is designed to automate the anchoring process for vessels, ensuring safe and efficient operation without the need for manual intervention. The system typically integrates sensors, motors, and control units to detect the appropriate depth, seabed conditions, and environmental factors. Upon receiving the command, the system lowers or raises the anchor automatically, adjusting based on real-time data to secure the vessel in place.

Advanced versions may include GPS integration for dynamic positioning, enabling the vessel to maintain its location despite changes in tides or currents. This technology improves operational safety, minimizes human error, and enhances the ease of anchoring in complex marine conditions.

Keyword: Automatic anchor, AI technology, suitable for all vessels, automation method, safest operation.

1. INTRODUCTION

The anchoring process is a fundamental aspect of maritime operations, crucial for the safe and secure mooring of vessels. Traditionally, anchoring has relied heavily on manual labour, with crew members physically handling the anchor and its chain. This process, while effective, presents several challenges, including the risk of human error, physical strain on the crew, and inefficiencies, particularly in adverse weather conditions or complex docking environments.

In response to these challenges, the maritime industry has seen the development and widespread adoption of automatic anchor systems. These systems revolutionize the anchoring process by integrating automation and advanced control technologies, allowing for precise, efficient, and safe anchor handling. The automatic anchor system operates by automating the deployment, monitoring, and retrieval of the anchor, significantly reducing the need for manual intervention and enhancing the overall safety of the operation.

Modern automatic anchor systems are equipped with a range of features, including real-time monitoring, tension control, and integration with the ship's navigation and dynamic positioning systems. These features ensure that the anchor is deployed and retrieved with optimal accuracy, reducing the risk of anchor dragging or fouling. Additionally, the ability to control the anchoring process remotely from the bridge further enhances operational safety and efficiency.

This paper explores the technological advancements in automatic anchor systems, their integration into modern ship design, and their impact on the efficiency and safety of maritime operations. By understanding these systems' capabilities and limitations, we can better appreciate their role in the evolving landscape of maritime technology.

2. WORKING PRINCIPLE

The automatic anchor system uses a combination of Electric or hydraulic motors, Gearboxes and winches, Chain wheels and gypsy wheels, Sensors (position, speed, direction, tension, and seabed), Control units and software, Power supply and backup systems. This integrated system ensures precise and efficient anchor handling, reducing the risk of accidents and improving overall safety.

Sensors monitor the ship's position, speed, and direction, as well as the anchor's status and seabed conditions. The control unit processes data from sensors and executes commands based on pre-programmed algorithms and

operator input. The system deploys the anchor at the designated location, controlling the speed and direction of the anchor chain.

The system uses GPS or other location-detecting technologies to monitor the vessel's position and identify the optimal time for anchoring based on predefined parameters like depth, seabed conditions, and environmental factors.

Automatic Deployment: Upon command from the captain or as part of a pre-set program, the system automatically begins lowering the anchor. Sensors monitor the depth and rate at which the anchor chain or rope is released. The anchor is dropped at a controlled speed to prevent damage or tangling.

Anchor Locking: Once the anchor reaches the seabed, the system continues to monitor the tension and position. If necessary, it adjusts the length of the chain to ensure the anchor is securely lodged in the seabed. The system may perform automatic "dragging checks" by pulling slightly to test the grip.

Position Maintenance: Advanced systems can integrate with GPS or dynamic positioning systems to maintain the vessel's location, compensating for drift due to tides, winds, or currents by automatically adjusting the chain length or reactivating the anchoring process if the vessel shifts from its set position.

Automatic Retrieval: When the vessel needs to move, the system will automatically retrieve the anchor by reversing the motorized mechanism, pulling the anchor chain back onboard while monitoring for potential obstacles or tangling.

3. SAFETY FEATURES

Modern systems are equipped with alarms or alerts to notify the operator in case of any malfunction, unexpected slippage, or environmental changes that could affect anchoring safety.

The safety of an automatic anchor system in a ship is ensured by Redundant systems and backup power sources. Advanced sensors and monitoring systems for real-time feedback. Automated emergency release and retrieval systems.

The system continuously monitors the anchor's status and adjusts the chain's length and tension as needed the system retrieves the anchor, controlling the speed and direction of the chain. The system stows the anchor and chain in the designated storage area.

Regular maintenance and inspection schedules. Crew training and familiarization programs. Compliance with international safety standards and regulations. Fail-safe defaults to prevent accidental deployment or release. Secure and reliable communication between system components. Protection against cyber threats and hacking.

Continuous software updates and performance enhancements. Integration with other safety systems, such as propulsion and navigation. Emergency shutdown and manual override capabilities.

3.1. ADDITOINAL SAFETY FEATURES

- Anchor lock preventers
- Chain stoppers
- Brake systems
- Emergency release systems
- Alarm and warning systems
- Redundant control systems

Regular system testing and certification.

4. ARRANGEMENTS

Anchor winch: Electric or hydraulic winch for deploying and retrieving the anchor.

Anchor chain locker: Storage space for the anchor chain.

Chain wheel and gypsy: Guides the anchor chain during deployment and retrieval.

Anchor control unit: Houses the control system, sensors, and actuators.

Sensors: Monitor anchor position, chain tension, and seabed conditions.

Actuators: Control the anchor winch, chain wheel, and gypsy.

Power supply: Electric or hydraulic power source for the system.

Control panel: User interface for monitoring and controlling the system.

Anchor deployment and retrieval system: Automatic system for deploying and retrieving the anchor.

Mooring system: Integrates with the automatic anchor system for secure mooring.

Navigation system: Provides data for accurate anchor positioning.

Alarm and warning system: Alerts crew to system status and potential issues.

These arrangement enables automated anchoring operations, improving safety, efficiency, and reducing crew workload. The specific components and layout may vary depending on the ship's size, type, and operational requirements.

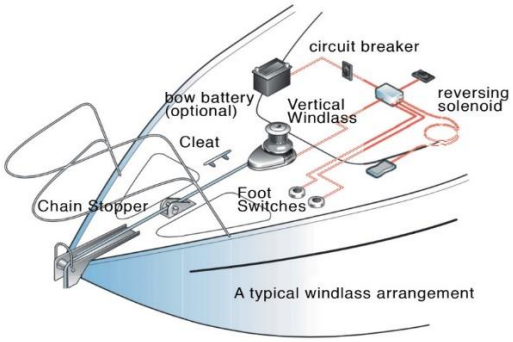

Fig: 1 Model Anchor Arrangement

5. ADVANTAGES

Improved Safety: Reduced risk of accidents and injuries during anchoring operations.

Increased Efficiency: Faster and more precise anchoring, saving time and fuel.

Reduced Workload: Automated anchoring reduces physical demands on crew members.

Enhanced Accuracy: Precise control over anchor deployment and retrieval.

Better Monitoring: Real-time monitoring of anchor status and seabed conditions.

Reduced Damage: Minimized risk of damage to the ship, anchor, and surrounding environment.

Environmental Benefits: Reduced risk of damage to marine ecosystems and habitats.

Cost Savings: Reduced fuel consumption, lower maintenance costs, and minimized damage.

Improved Reliability: Automated system reduces human error and ensures consistent performance.

Enhanced Situational Awareness: Real-time data and alerts for improved decision-making.

Reduced Anchor Loss: Automated retrieval and securing of the anchor reduces loss risk.

Compliance with Regulations: Meets and exceeds international safety and environmental regulations.

Increased Crew Productivity: Automation allows crew to focus on other critical tasks.

Improved Ship Stability: Precise anchoring ensures stable ship positioning.

Reduced Weather-Related Risks: Automated system adapts to changing weather conditions.

These advantages make automatic anchor systems a valuable investment for shipowners and operators, enhancing safety, efficiency, and productivity while reducing costs and environmental impact.

Fig: 2 Anchor with enclosing door

6. CONCLUSION

- Improved safety and reduced risk of accidents
- Increased efficiency and reduced anchoring time
- Reduced workload and physical demands on crew members
- Better monitoring and real-time data analysis
- Reduced damage to the ship, anchor, and surrounding environment
- Cost savings through reduced fuel consumption and maintenance.

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