Exhaust System Design Improvements.

Design solutions for the exhaust system aim to generate wave processes that, on the one hand, facilitate the unimpeded exit of exhaust gases and, on the other hand, create a "blocking" pressure wave to reduce fresh charge losses during scavenging.

Direct Fuel Injection.

The use of direct fuel injection enables stratified charge formation and eliminates fuel-air mixture losses through the exhaust ports. Research shows that implementing direct injection can increase the effective thermal efficiency from 21% to 26% [2]. However, drawbacks include increased system complexity and overall engine cost. Therefore, the adoption of such systems must be economically justified for specific operational applications.

Conclusions. Global experience demonstrates that two-stroke engines with crankcase scavenging have considerable potential for improving performance efficiency. The development of microprocessor-based control systems allows for more effective management of the mixture formation process and monitoring of engine condition. Furthermore, the relevance of this topic is intensified by the growing interest in medium- and long-range UAVs.

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METHODS FOR MONITORING MECHANICAL LOADS IN METAL PRODUCTS

PhD student: Vasyl Oliinyk
Language support supervisor: Poliakova Tetiana Leonidivna
Department of Information and Measuring Technologies and Systems
National Technical University "Kharkiv Polytechnic Institute"

Abstract. This abstract outlines key methods for monitoring mechanical loads in metal products, highlighting their principles, advantages, and applications. Special attention is paid to electromagnetic methods, noted for their speed and non-contact nature. The study emphasizes the importance of precise, real-time load monitoring in industrial applications.

Keywords: mechanical load, monitoring methods, metal products, electromagnetic method, non-destructive testing.

Introduction. The relevance of studying methods for monitoring mechanical loads in metal products is driven by the need to ensure safety, reliability, and longevity in structures used in energy, transport, construction, and aviation. This research explores contemporary methods for monitoring mechanical stress in metal products operating under various load conditions. It examines a range of techniques used to assess structural integrity and detect early signs of stress-related damage. Particular attention is given to electromagnetic methods, which stand out for their ability to deliver rapid, non-contact diagnostics. These methods are especially effective in industrial settings where speed, reliability, and the ability to perform remote assessments are critical.

Presentation of the main research material.

This work reviews key methods used to monitor mechanical stress, including strain gauge, ultrasonic, acoustic emission, electromagnetic, and optical techniques. These methods were analyzed based on their operational principles, strengths, and weaknesses. Research focused on evaluating the adaptability of electromagnetic techniques in varying industrial conditions.

Method	Operating Principle	Advantages	Disadvantages	Application
Strain Gauge Method	Measures mechanical deformation through changes in resistance of strain gauges.	High measurement accuracy, local monitoring capability.	Requires contact with the object, sensitive to mechanical damage.	Laboratory conditions, small high-precision objects.
Ultrasonic Method	Uses changes in ultrasonic wave speed due to mechanical deformation.	Can detect internal defects, safe for the operator.	Requires surface preparation, difficult to apply to inhomogeneous materials.	Inspection of large metal structures, surface preparation needed.
Acoustic Emission	Detects sound waves generated by crack formation or material deformation.	Early defect detection, non-contact method.	Sensitive to external noise, complex result interpretation.	Monitoring large objects during operation.

Electromagnetic Method	Measures changes in the magnetic properties of a material under mechanical load.	Non-contact, high-speed measurement, remote monitoring possible.	Limited to magnetic materials, sensitive to external magnetic fields.	Real-time monitoring of metal products on production lines.
Optical Method	Uses laser interferometry to measure surface deformation of metal objects.	High measurement accuracy, non-contact material analysis.	Requires clean surface, expensive equipment, sensitive to environmental factors.	Monitoring of small and medium-sized objects with high accuracy.

Analysis of Electromagnetic Method Advantages:

Non-contact: The electromagnetic method allows for control without physical contact, reducing the risk of damage and simplifying the measurement process.

Speed: Provides fast results without lengthy setup or measurement time—crucial for serial production and operational settings.

Remote Monitoring: Enables monitoring from a distance, reducing the need for on-site presence and allowing inspection of hard-to-access parts of structures.

Variable Frequency: One key advantage is the ability to adjust signal frequency, enabling customization for different materials and load conditions. By changing the frequency, defects at various material depths under different conditions can be more accurately detected, improving measurement precision.

Conclusions. Effective monitoring of mechanical loads plays a crucial role in ensuring operational safety and optimizing maintenance strategies. Among the methods reviewed, electromagnetic techniques demonstrate the greatest promise for industrial use, thanks to their non-contact operation, high speed, and capacity for remote data collection. The ability to fine-tune signal frequency further enhances their accuracy and adaptability across different applications.

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OPTIMIZATION OF DUAL STATOR WINDING CONFIGURATION FOR ENHANCED PERFORMANCE OF SYNCHRONOUS RELUCTANCE GENERATORS

PhD student V. Olizarenko
Department of Heat Engineering and Energy-Efficient Technologies,
National Technical University "Kharkiv Polytechnic Institute",
Kharkiv, Ukraine

Abstract. This research presents a comparative analysis of dual stator winding configurations in synchronous reluctance generators (SRGs) aimed at enhancing energy efficiency and dynamic performance. Facing the growing demand for reliable and cost-effective generators, particularly for applications like diesel gensets and renewable energy integration, this study investigates single-layer versus two-layer stator winding arrangements. Through simulation analysis, the impact of varying the relative phase displacement between the main and excitation windings in the two-layer design is examined. Findings indicate that a two-layer configuration with an optimized two-slot phase shift significantly reduces torque ripple and output voltage harmonics while achieving a high efficiency of 92.5% for a 160kW SRG model.