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Vyngra A. V.

ALGORITHMS AND SOFTWARE SOLUTIONS FOR ASSESSING THE LEVEL OF INTERHARMONIC COMPONENTS OF VOLTAGE AND CURRENT

Abstract. Due to the increase in the number and power of electricity consumers, as well as the development of the power supply industry in the field of smart grids, increasing attention is being paid to ensuring the required indicators of power quality and electromagnetic compatibility in both industrial and household networks. The work discusses the standardization of power quality indicators and the development of algorithms for determining the parameters of current and voltage distortion to ensure their further suppression. An analysis of existing methods for identifying harmonics in a network has been carried out, and an original algorithm for determining a special case of harmonics - interharmonic components - has been proposed. Based on the algorithm, a PC program has been developed and presented, allowing the operator to evaluate the level of interharmonic components of current and voltage obtained from a digital oscilloscope. The proposed software and algorithms can serve as the basis for the software of active filters used to suppress interharmonic distortion
Keywors: interharmonic components, software, active filter

Golikov S.P., Smetyukh N.P., Povaley N.S.

THE USE OF BLOCKCHAIN TO TRACK THE PARAMETERS OF DISTRIBUTED SMART GRIDS

Abstract. In this paper, the introduction of new intelligent grids is considered. Their examples are given, advantages and disadvantages are revealed. To solve the main problems related to the operation and reliability of smart grids, blockchain technology was used, which has a number of advantages in use. The study also examined the concept of multiple blockchain platforms instead of one, which will ensure high modularity of the system and simplify data tracking. This technology will help to ensure the need for electricity for each end user based on real information about the consumption and generation of electricity from nearby participants of the combined electric market. The pricing of a unit of electricity based on a distributed power supply network containing renewable sources of electricity is shown. The limitations in modern smart grids are given. The necessary information for managing a blockchain-based energy system can be relatively easily obtained using neural networks based on a large volume of statistical data on electricity production and consumption.
Key words: smart grids, blockchain, solid-state transformer, distributed grids, alternative sources of electricity.

Klimenko N.P., Britskii V.O., Shishik S.A.

RELIABILITY OF SHIP MECHANISMS IS CALCULATED BASED ON THE RESULTS OF TESTS IN COMBINED MODES

Abstract. The article presents a method for the consistent accumulation of information about technological factors and their impact on the resource of similar objects, as well as the construction of appropriate mathematical models that allow us to limit the task of accelerated tests to assessing the impact on durability of only those structural and technological features of the object that distinguish it from its predecessor analogues. This approach makes it possible to reduce the degree of randomness (dispersion) of test results and, by controlling the technological parameters of the tested samples, to do with a significantly smaller volume of tests. When testing a new object and

its analogue, each pair of samples is tested at a certain value of the forcing parameter. The boost parameter varies at several levels during testing. The range of these changes makes it possible to provide a physical similarity of the loss of performance on the stand and in real conditions. The result of such multi-level tests is the average operating time to failure of new facilities and analogues corresponding to each other in pairs (according to the loading mode).
Keywords: reliability, ship technical means, reliability prediction, probability distribution, combined test mode.

Konyukov V.L.

ANALYSIS OF THE OPERATIONAL PARAMETERS OF A MARINE FOUR-STROKE DIESEL ENGINE WHEN CHANGING THE SCREW CHARACTERISTICS.

Abstract. The paper considers the issues of improving the operational parameters of a marine four-stroke diesel engine under changing sailing conditions, which are accompanied by a transition to a new type of screw characteristics. For this purpose, it is proposed to use an adjustable nozzle apparatus of the turbo supercharger, the range of change in the angle of rotation of the blades of which is limited by the conditions of mechanical stress of the cylinder piston group and the quality of cylinder purging. Comparison of the obtained performance characteristics with the results of previously conducted studies of the initial variant (without the use of adjustable nozzle apparatus) for the adopted range of the screw characteristic weighting coefficient has been performed. The studies have shown that the efficiency of the adjustable nozzle apparatus increases with the decrease in the relative power of the diesel engine for the whole range of the screw characteristic weighting coefficient studied. that the impact on the turbocharger parameters by rotating the PCA blades allows to significantly improve a number of the main operating parameters of the diesel engine at the modes of fractional loads. At that, first of all, the specific effective fuel consumption decreases, the excess air ratio at fuel combustion increases, the gas temperature along the cycle decreases, the indicators of thermal stress of cylinder-piston group decrease. However, at the same time, the maximum cycle pressure increases, which indicates some increase in mechanical tension.
Keywords: diesel engine, adjustable nozzle unit, turbochargers, operational parameters, screw characteristic, weighting coefficient, thermal and mechanical stress.

Popov V.V., Ivanovskaya A.V.

IMPROVING THE RELIABILITY OF THE HYDRAULIC DRIVE OF MARINE LIFTING EQUIPMENT

Abstract. The work examines shipboard deck lifting devices. To increase the reliability of the trawl winch of a fishing vessel, an adaptive feedback control system was selected. With the help of an adaptive load pressure feedback system, pressure and volume flow can be adjusted according to customer requirements. An integral stage in the creation of new designs of hydraulic drives for marine lifting devices with a control device is experimental research that allows us to determine the performance characteristics of these drives and control devices when their parameters change. The objectives of experimental research are given, the tasks to be solved in accordance with the set goal are considered, a methodology for conducting experimental studies of the hydraulic drive of a ship's winch is developed, a schematic diagram of an experimental stand is given. This installation can be used in the study of adaptive hydraulic drives operating under special conditions.
Keywords. the change of loading, hydraulic drive, ship's deck hoisting, adaptive control systems, hydraulic system, control device

Konyukov V.L., Gorbenko A.N.

COMPARISON OF FOUR-STROKE DIESEL PARAMETERS WHEN CHANGING THE FUEL SUPPLY ADVANCE ANGLE UNDER VARIOUS OPERATING CONDITIONS

Abstract. The work carried out the comparative analysis of the main operational parameters of a marine four-stroke diesel engine during its operation according to the propeller and load characteristics depending on the fuel supply advance angle. In contrast to the load characteristic, the diesel engine operation according to the propeller characteristic is accompanied by a decrease in rotation speed with a decrease in power, which leads to an increase in cycle duration. In this case, there is a change in the relationship between the combustion duration of the cyclic fuel supply and the operating cycle duration. In turn, the change in the fuel supply advance angle leads to the change in air parameters at moment of fuel injection into cylinder, which also affects the rate of its combustion. These factors change the cycle characteristics and affect the efficiency and reliability of the diesel engine. The research was carried out using a theoretical calculation method, quantitative and qualitative dependences of operational parameters on the fuel supply advance angle for propeller and load characteristics were obtained, and their comparative assessment was given. The modes most sensitive to changes in the fuel supply advance angle have been determined.
Keywords: diesel, operational parameters, fuel supply advance angle, propeller characteristics, load characteristics, thermal and mechanical stress.

Sharatov A.S.

ESTIMATION OF THE MOMENT OF RESISTANCE OF THE DUCT PROPELLER OF THE SCREW-STEERING COLUMN DURING THE JET SUPPLY OF ADDITIONAL WATER TO THE COOLING SURFACE OF THE BLADES

Abstract. The flow conditions of the main propeller-steering column of a maneuvering vessel are formed under the influence of an oblique flow. The deterioration of the working conditions of the propeller, observed when turning the main screw-steering column, leads to a significant increase in the mechanical tension of the elements of the main power plant. The paper analyzes the flow conditions of the elements of the ship's helical steering column. Numerical modeling and computational determination of the hydrodynamic characteristics of the propeller during oblique flow, at small and significant angles of rotation of the screw-steering column, with an assessment of the parameters of the additionally supplied water, was performed. Reducing the influence of the unevenness of the oblique flow on the propeller, and as a result, reducing the amplitude of the moment of resistance of the propeller helps to limit the possible overload of the main engine by mechanical tension.
Keywords. ship's hydro-mechanical complex, main screw-steering column, main engine, screw characteristic, maneuver, boundary layer control system, hydrodynamic characteristics of the propeller, the moment of resistance of the propeller.

Sviatskii V.V.

AUTOMATION OF CALCULATIONS OF UNDER KEEL SPACE WHEN PASSING A SHIP IN CONFINED WATER AREAS

Abstract. This research work is aimed at the development of an automated system for calculating the UKC (depth to keel) when a ship passes through confined waters, based on modern methods and regulations of maritime transportation companies. The calculation for the Kerch-Yenikalsky channel passage was simulated, based on existing and well-proven methods of UKC calculation,

a program was developed, which allowed to automate the whole process of UKC estimation, which will lead to reduction of human factor influence on these calculations. This system will not only reduce the time spent on the calculations, but will also improve the accuracy and reliability of the results obtained. The automation of the UKC assessment process will simplify and speed up the decision-making process of the master to ensure the safety of navigation and prevent potential accidents when the vessel passes through confined waters.
Keywords: navigation, navigation safety, under keel clearance

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Avdeev B.A.

APPLICATIONS OF SOLID-STATE TRANSFORMERS IN THE SHIP'S ELECTRIC POWER SYSTEMS

Abstract. Solid-state transformers are an innovative solution in the field of energy, offering a number of advantages over traditional low-frequency transformers. The features and potential of using solid-state transformers in marine power systems are considered, and also present a comparative analysis with traditional low-frequency transformers. The study shows that solid-state transformers can significantly improve the efficiency, reliability and compactness of marine electric power systems, which makes them a promising solution for small-sized and coastal marine transport. The article presents basic one-line schemes for the use of solid-state transformers in schemes for generating and distributing electricity on ships. Particular attention is paid to the use of DC systems that allow the potential of power converter technology to be revealed in order to be reliable, economical and compact. Attention is also paid to the integration of a rowing electric drive into a ship's power plant and the efficiency of using several DC buses with high and medium voltage for more economical operation of ship's electric receivers.
Keywords: solid-state transformer, direct current, marine power plant, synchronous generator, MSB, rowing electric motor

Krivtzov K.A., Zhukov V.A.

MODERNIZATION OF THE COOLING SYSTEM OF THE PROJECT 90600 TUGBOAT

Abstract. The article describes the upgraded cooling system of the auxiliary engine of the tugboat project 90600. The purpose of the modernization is to increase the reliability of cooling of marine engines during operation in ice conditions. During the modernization process, the open outboard circuit was replaced by a closed circuit, which includes a stern ballast tank used as a skin heat exchanger. The description of the design changes of the system is given. The upgraded cooling system has passed operational tests. The theoretical studies carried out and the subsequent operation of the vessel with an upgraded cooling system confirmed the operability and effectiveness of the proposed type of closed-circuit cooling system. Subsequent research should be directed to assessing the possibility of expanding the use of such systems on ships of other projects, developing methods to ensure effective heat removal from the liquid through the hull of the vessel and creating systems for automatic control of the temperature of the liquid in a closed circuit when operating conditions change.
Keywords: marine diesels, cooling systems, modernization, closed circuit, ballast tank

Ivanovskaya A.V.

MODELING OF THE CABLE PART OF THE WINCH BY THE EULER-BERNOULLI METHOD

Abstract. The paper presents one of the methods for modeling one of the components of the system under study – a cable. A feature of the method is the representation of a cable in a flexible thread consisting of a finite number of elements that are considered non-deformable. Therefore, the Euler-Bernoulli equation is used as a basis for their description. To describe the dynamics of the movement of elements, the main components in the model are vector quantities. The resulting mathematical model will subsequently make it possible to design the ship's lifting equipment with

an increased level of reliability. A feature of the operation of this kind of equipment is the unsteadiness of processes that take place even in transient modes. To reduce the risk factors of failure of lifting devices, it is necessary to provide for possible loads, which is impossible without the development of adequate mathematical models, the creation of which is one of the stages of designing an adaptive control system.

Keywords: lifting equipment, fishing vessel, non-stationary processes, reliability, generalized coordinates, the Euler-Bernoulli method

Konyukov V.L., Gorbenko A.N.

FEATURES OF SETTING UP THE FUEL EQUIPMENT OF A FOUR-STROKE DIESEL ENGINE WHEN USING AN ADJUSTABLE TURBOCHARGER NOZZLE

Abstract. The paper presents the results of computational and theoretical studies of the influence of the fuel supply start angle on the operational parameters of a four-stroke diesel engine operating according to the load characteristic with a direct impact on the charge air consumption by turning blades of the adjustable nozzle apparatus of the turbocharger turbine. The studies were carried out for a wide range of diesel loads, at which the fuel supply advance angle varied from -8 degrees. up to -28 degrees of crankshaft rotation before top dead center. The rotation of the blades was carried out in the direction of decreasing their installation angle and was limited by one of two factors: either the combustion pressure or the minimum degree of pressure reduction when purging the cylinders. An increase in the excess air coefficient for fuel combustion with such a turning of the blades caused a decrease in the level of gas temperatures in the cylinder during diesel operation and, as a consequence, a decrease in its thermal tension.

Controlling the angular position of the blades of the adjustable nozzle apparatus of a turbocharger turbine makes it possible to reduce the specific effective fuel consumption of a diesel engine over a wide loads range. In this case, the fuel supply start angle, corresponding to the minimum specific fuel consumption, shifts to the zone of its large absolute values. Based on an analysis of diesel engine efficiency and its mechanical tension, recommendations are given for setting up an automatic fuel supply control system.

Keywords: diesel engine, fuel advance angle, adjustable nozzle, turbocharger, operating parameters, load characteristic, thermal and mechanical stress.

Khalyavkin A.A., Ivanovskaya A.V., Simagina V.B.

INVESTIGATION OF THE DEFLECTION OF THE PROPELLER SHAFT, TAKING INTO ACCOUNT INCOMPLETE CONTACT WITH THE AFT DEADWOOD BEARING

Abstract. The paper examines the contact of the propeller shaft of the shaft line with the aft deadwood bearing. The design feature of the shaft line itself is described. The current loads on the ship's power plant are indicated. A general view of cracks in the intermediate and propeller shafts from torsional and transverse vibrations is presented. It is indicated that the reliability of the ship's power plant is characterized by the working condition of the deadwood device. The design scheme of the beam is considered, which is based on an elastic base with a coefficient of rigidity k and loaded with a distributed load from the own weight of the propeller shaft and a concentrated load from the propeller. The static calculations carried out made it possible to evaluate the effect of incomplete contact of the propeller shaft with the deadwood bearing and the malleability of the deadwood bearing itself on the value of its own frequency of transverse vibrations.

Key words: ship shafting, propeller shaft, stern tube device, stern tube bearing, elastic base, stiffness coefficient.

Ivanovskii N.V.

EXPERIMENTAL RESEARCH OF HULL STRUCTURES HYDRODYNAMIC FORCES OF VORTEX NATURE FISHING VESSEL

Abstract. Mathematical modeling of the dynamics of the motion of a marine vessel faces a number of problems. As you know, a marine vessel moves in two environments: aquatic and airless. When describing the movement of a vessel in the air, we have difficulties determining the sail area of a vessel depending on the orientation of the vessel's hull to the wind. Plus, during operation, the sail area is not a constant. The description of the process of vessel movement in the aquatic environment is faced with the experimental determination of a large number of parameters. It is obvious that in order to determine the coefficients of hydrodynamic and aerodynamic drag, it is necessary to conduct a large number of experiments. Over a long period of research, a large database of experimental data has been accumulated to determine various types of parameters of a marine vessel. Analytical expressions were used to calculate the parameters of the ship model. At the moment, they are actively used, but taking into account the development of computing tools, it has become possible to more accurately assess these parameters and obtain appropriate analytical expressions describing the parameters of the ship model. In this paper, one of the possible approaches to solving this problem is proposed. As a result, the proposed method made it possible to reduce the calculation error by 5%, which is significant, since there are about 170 such parameters in the basic model of the vessel.

Keywords: ship model, hydrodynamic forces, aerodynamic forces, fishing vessel, processing of results, mathematical model.