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NATIONAL ACADEMY OF SCIENCES OF UKRAINE

A. PIDGORNY INSTITUTE OF MECHANICAL ENGINEERING PROBLEMS

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The A.M. Pidgorny Institute of Mechanical Engineering Problems of NAS of Ukraine (IPMash) was found in 1972.

The first Director of the Institute from 1972 to 1996 was Academician of NAS of Ukraine, A.M.Pidgorny (1932-1996).

Yu. M. Matsevity, Academician of NAS of Ukraine, has been the head of the Institute since 1996.

Since December 2016 the director of the institute is A.V. Rusanov. He is a Corresponding Member of the National Academy of Sciences of Ukraine.

IPMash has 9 scientific departments with a staff of 242 specialists (120 research workers, including one Academician and four Corresponding Members of NAS of Ukraine; and 28 Doctors and 57 Candidates of Science). The Institute also has a special Design-and-Engineering Bureau, and a pilot production facility. The Scientific-and-Engineering Concern "IPMash NASU" was found in 2000.

Scientific schools which were formed in the Institute:

* Fluid mechanics and profiling blading in hydraulic machines (founder - Academician AS UkrSSR, G.F.Proskura);

Mechanical engineering in power machine building (founder - Academician AS UkrSSR,
A.P.Filippov);

* Optimization of processes and design of turbomachines (founder - Academician AS UkrSSR, L.A.Shubenko-Shubin);

* Mathematical simulation of physical processes (founder - Academician NASU, V.L.Rvachev);

* Nonconventional power engineering, in particular hydrogen power engineering (founder
- Academician NASU, A.M.Pidgorny);

* Heat physics in the area of simulation and identification of non-linear heat processes (founder - Academician NASU, Yu.M. Matsevity).

The Institute carries out basic and applied research in the following key areas:

- optimization of processes in power machinery and improving equipment design;
- energy saving technologies and nonconventional power engineering facilities;
- predicting the reliability, dynamic strength and life of power equipment;
- simulation and computer technologies in power machine building.

Applied researches in advanced integrated problems for the national economy are carried out in the Institute.

IPMash NAS of Ukraine is an active participant in the following activities: forming the "Energy strategy of Ukraine until 2030"; and the concept of the State programme for ensuring technological safety in the key branches of the economy; the Regional program "Resource"; the initiator of the Academic Scientific-and-Educational Complex (ASEC) for open-ended training of scientific personnel starting from school (academic lyceums) and through to post-graduate and Doctorate studies. The complex includes NSC KhPhTI and 8 leading higher educational institutes in Kharkov.

In the framework of the development of this area the Scientific Park was created in 2012 on the basis of the ASEC Resource. Aim – integration of scientific, educational and industrial potential of Kharkiv for realization of an innovative way of development of the economy of the region and the state in whole.

The Institute maintains a program for training scientific staff through post-graduate courses and Doctorate studies. There are two specialized Scientific Councils for maintaining Doctor's and Candidate's Theses.

The activities of the scientists have been recognized by awarding the State Prizes of the U.S.S.R. and Ukraine; named prizes of outstanding scientists of Ukraine; Prizes of the Presidium of NASU for young scientists; scholarships of the President of Ukraine and the Oblast State Administration named after renowned scientists of the Kharkiv Region; and diplomas of local self-administration organizations.

The results of scientific researches of the Institute's scientists are published in many specialized foreign journals.

The Institute publishes the international scientific and engineering journal titled in English as the *Journal of Mechanical Engineering*.

IPMash NAS of Ukraine is a participant of national and international exhibitions both in Ukraine and abroad.

POLYMER ANTICORROSIVE PROTECTION OF CHEMICAL WATER TREATMENT EQUIPMENT TERMAL POWER-STATION AND COMBINED HEAT-**POWER PLANT**

Application

Anticorrosion polymeric protection can be used to protect chemical water treatment installations in contact with liquid and gaseous media for:

- lengthening of service lifetime;
- protection of metal surfaces from aggressive acid, alkali and other environments;
- surface protection against mechanical impact;
- providing a decorative effect;

• providing reliable protection from aggressive weather conditions, water and aqueous salt

solutions.



Advantages

High technical characteristics increased chemical resistance, watertight integrity, elasticity, surface printing any curvature and complex form. maintainability and mechanical high strength. The durability of such printing is 12-15 years.

Fig. 1 Anticorrosion protection of the external and internal surfaces of the tank water softener.

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SELF-CONTAINED DEEP-SEA LIFTING GEAR

Application

It is used in the development of natural resources and study of the World oceans for recovering of sunken objects, removal of guide cables for large-capacity objects, delivery of equipment and structures for underwater oil and gas pipelines at a given depth



Advantages

Considering hydrogen as a lifting medium allows using the gear practically at any depths of the world Ocean. An effective layout of designed elements provides the device with self-relief from external pressure.

Fig. 1 device on deck of submersible vehicle

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RATIONAL MANAGEMENT OF HEAT RELEAS TWO-STAGE HEATING PLANT OF STEAM TURBINES

Application

The method of optimization of energy systems cogeneration turbines while ensuring reliability of the low-pressure cylinders for the heating mode, which will reduce the cost of electricity. produced by Ukraine The method and software are aimed to optimize the distribution of heat load between network heaters of cogeneration turbines.



Advantages

Due to additionally generated electricity produced during the heating season it is possible to save 3 million cubic meters of natural gas at cogeneration turbine T-100/120-130.

The software included in monitoring units is allowed to control them in a realtime and to optimize distribution of heat loads between network heaters.

Fig. 1 Blocks № 1 and № 2 with turbines T-100/120-130

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HYDROCAVITATION METHOD AND EQUIPMENT FOR PRODUCTION, COMPOSITE FUEL PREPARATION

Application

Composite fuels can be used in different power objects, industry and utilities to replace natural gas and fuel oil.



Advantages

Unlike traditional methods of producing from fuels waste (pyrolysis technologies and biogas plants) the presented method is zero-emission and considerably more cheap in realization.

Fig. 1 Hydrocavitatin converter

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SMART VIBRATION SENSOR WITH THE FUNCTION OF CONTROL AND ANALYSIS OF VIBRATION PARAMETERS

Application

The sensor is intended to estimation the vibration state (ISO 10816) of the inconvertible parts of mechanisms Thermal power-station, combined heat-power plant and other industrial objects. A sensor signals about exceeding of mean-square value of the vibration velocities of the set levels and the sharp change (jump) of vibration.



Advantages

Control mean-square value of the vibration velocity of the set measuring frequency bands and amplitudes of spectral constituents of vibrospeed.

Automatic verification of good condition of functioning.

RS-485 interface enables to remote access and data transfer.

Fig. 1 Original appearance of sensor

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HIGH PRESSURE OXYGEN-HYDROGEN CELL

Application

Development intended for a receipt ecologically of clean power medium - hydrogen and oxygen by electrolytic decomposition of water. A cell can be used in industry, energy, chemical, metallurgical, food industry, etc.



Advantages

The cyclic generating of hydrogen and oxygen eliminates a necessity for use of dividing membranes, that provides the generation of gases with high pressure in a range and promotes reliability and safety of exploitation of the electrolysis setting. In the worked out construction for activating of electrode materials rareearth metals and metals of platinum group are not used.

Fig. 1 High Pressure oxygen-hydrogen cell of 1,0^{M3}/hr hydrogen productivity

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ENERGY-SAVING WITH THE USE OF LOW POWER STEAM TURBINES INCLUDING ON LOW-BOILING WORKING MEDIUM

Application

For modernization of the energy business units with the aim to improve their technical and economic indicators. This method includes:

- analysis of energy flows;
- development of promising options preserving energy-saving decisions;
- feasibility study;
- investment analysis policy of solutions.



Advantages

Turbines on working medium have a row of advantages:

- high internal efficiency (~85 %);
- the large assured term of work is without repairing (50 thousand hours);
- are made of ordinary materials;
- are compact and have a small size of air condenser;
- no parking corrosion and erosion of wearing of blades by drip of moisture.

Fig. 1 Block supply turbines to 50 kW on working medium (Infiniti Turbine, USA)

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CRACKS INDICATOR IT-22

Application

Designed for the detection of surface cracks, cavities and other defects in metal products.



Advantages

In comparison with the analogous device it is easy to use and much cheaper.

Fig. 1 Cracks indicator IT-22

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COMPLEX PROGRAM FOR CALCULATION AND DESIGN OF FLOW PARTS OF STEAM, GAS AND HYDRAULIC POWER PLANTS.

Application

Complex programs intended to design of flow parts of steam, gas and hydraulic power plants using analytical methods of profiling and mathematical modeling of viscous turbulent flows. Complex programs can be of interest for enterprises of power engineering, aviation gas turbine, integrated systems for processing and transportation.



Advantages

The developed complex of programs allows to provide high level of efficiency of flowing parts, to reduce the design time, and for all the main indicators, better than existing analogues in Ukraine.

Fig. 1 Rotor turbine of turboexpander MTDA-3,0-10,4-MP-U2

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PROPERTIES OF CRYOGENIC RECEIVING OF POWDERED METAL COMPOSITIONS FOR RESTORATION AND STRENGTHENING OF METAL SURFACES

Application

It is intended to obtain powdered metal compositions of given dispersion. Such powders are used in spray technology when manufacturing or restoring heat-resistant and highly loaded parts of knots and mechanisms.



Advantages

The cryogenic method allows to obtain non-oxide powder compositions of the given dispersion of different component composition, that is, from several metals non-metals simultaneously. and The possibility of obtaining metal, metal ceramic. carbon-ceramic other and compositions opens the prospects for the further development of structural material science.

Fig. 1 Cryogenic atrium

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MAGNETIC TREATMENT OF WATER SYSTEMS IN THE MAGNETS VORTICAL HYDRODYNAMIC ACTIVATOR FOR REMOVAL AND PREVENTION OF DEPOSITS ON HEAT TRANSFER SURFACES

Application

The magnets vertical hydrodynamic activator (MVHDA) designed to prevent and reagentfree removal of previously formed scale.

Advantages

The advantages of magnetic treatment devices MVGDA are:

1. MVHDA has a magnetic system on permanent magnets with high performance on stability and durability over a wide temperature range.

2. Basic design of MVHDA is provided by magnetic induction sensors for monitoring the effectiveness of treatment.

3. The screens of magnetic systems allow to reduce to a minimum the external influences on performance tuning MVHDA in a working gap.

4. It is possible to create MVHDA automatic, self-control and manual magnetic induction permanent magnet in a range of operating temperatures up to 230 ° C and pressures up to 30atm.



Fig. 1 Apparatus MVHDA

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STRENGTH CALCULATION METHOD FOR ELEMENTS LAMINATED GLAZING WITN ELECTRICAL HEATING OF MODERN AIRCRAFT

Application

Aircraft industry. The effective method is proposed for strength analysis of glazing with electrical heating for aircraft.



Advantages

The proposed method allows to decrease design time, significantly reducing the costs of field experiments and improve the quality and reliability of the design, ensuring the safety and working conditions required for a crew.

The main difference from existing methods is the completeness and accuracy of the account of all the main operating modes of glazing; original mathematical models of laminated glazing; refined mathematical model of bird collisions with a glazing.

Fig. 1 Element of glazing TSK 008U of aircraft AN-148

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TECHNIQUE OF SYSTEM DIAGNOSTIC OF VAPOR COMPRESSION REFRIGERATION AND HEAT PUMP SYSTEMS ENERGY EFFICIENCY.

Application

The technique can be used in the calculation complex of monitoring system of operating heat pump and refrigeration systems to improve their energy efficiency by thermoeconomical optimization and upgrading equipment.



Advantages

Unlike traditional technical and economic analysis the technique allows to identify the cause of anomalies in the system of each element and to assess their impact on the driving energy of compressors, to calculate the monetary value of the thermodynamic losses to determine their contribution to the total cost of cold or heat produced bv the installation.

Fig. 1 Introduction of results of modernisation of ammoniac refrigeration unit is on at the Pyryatynsky cheese factory on the offered methodology

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MODEL TESTS OF REACTION HYDROMACHINES AT ENERGY-CAVITATION STANDS

Application

The composition of the laboratory of hydromachines includes two closed hydrodynamic stands ECS-15 and ECS-30, which are designed to:

- provide implementation comprehensive experimental research in creating highperformance of flow parts of hydromachines;
- perform the research studies of the workflow in hydromachines;
- acceptable testing of all types models of vertical reactive hydromachines.



Advantages

Hydrodynamic stands in its parameters and equipment are unique installations, which have no analogues in Ukraine. It is confirmed to work on metrological certification and calibration equipment stands and calibration installation UG-1.

Fig. 1 Model unit of rotary-blade hydroturbine PL30 installed on energy-cavitation stand ECS-15

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THE METHOD OF IMPROVEMENT EFFICIENCY OF MOTOR BIOFUELS

Application

To improve the economic and ecological performance of internal combustion engines.



Advantages

Cost-effective

adaptation method provides spark ignition engines on biofuel and does not require installation of specialtyequipment on the vehicle and does not require additional certification.

Fig. 1 General view of the upgraded vehicle engine MEMZ-307.1 spark-ignition

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IMPROVING THE POWER RECOVERY OF LOW-TEMPERATURE PROCESSING OF NATURAL GAS

Application

It is proposed to improve the power recovery of low-temperature processing of natural gas for fields on various pressure wells. In a typical power recovery introduces an additional turboexpander unit. In the proposed power recovery, the excess pressure of natural gas from highpressure wells is used in turboexpander that drives the compressor, which serves to increase the pressure of low-pressure gas wells. The power recovery comprises: an input reservoir; separators; turboexpanders; compressors; regenerative heat exchanger.



Advantages

The power recovery allows to improve the quality of transported gas, extend the life of the field without the use of the compressor. Actually the payback period of additional equipment is about~2 years.

Fig. 1 The production of such equipment is carried out by "Turbogaz", Kharkov

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DEVICE OF THE CONTROL OF A QUALITY OF SOLDER CONNECTIONS "LINER - STATOR WINDING" SYNCHRONOUS GENERATORS

Application

Device is intended to determine the level of quality of soldering controlled compounds is based on the experimentally established connection between the device and the testimony of a quality of soldering these compounds that affects reliability.



Advantages

Smart algorithm of the device allows you to customize its settings according to the control objectives.

Fig. 1 Devise of control

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PROGRAMME COMPLEX FOR THE CALCULATION OF THE AEROELASTIC OSCILLATIONS OF TURBOMACHINE AND COMPRESSOR ROTOR BLADES

Application

A complex of software can be used:

• for the calculation of three-dimensional non stationary flow of gas flow through the stage (department) of a turbomachine into account the rotation of rotor wheel and oscillations of blades under the action of non-stationary forces (without the division of non-stationary effects, caused the external non uniformity of flow and oscillations of blades);

• for forecasting of autooscillation and flutter of rotor blades.

The complex of programmes may be used in constructor offices and works which project and manufacture steam- and gasturbine machinery of energy engineering, aviation engines.



Advantages

This development has world priority. There are no analogues

Fig. 1 The results of the calculations with the help of a complex of programmes

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THE INSTALLATION FOR THE CLOSED WATER PURIFICATION

Application

It is designed for the purification of water which is suitable for its use for drinking, as well as various technical purposes.

Advantages

- the main impurities of the water division are produced in the form of commodities suitable for further use;
- significant reduction in the cost of energy (up to 40%);
- the service life of the membrane is upgraded to 5-10 years (instead of 2 years on average);
- use of organic additives for fuel production



Fig. 1 The appearance of the closed mine water processing plant performance 150 m3/h

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THE CHARACTERISTICS AND EQUIPMENT FOR INTEGRATED WATER DISPOSAL

Application

It is intended to virtually complete destruction of pathogenic microorganisms



Advantages

• optimal hydrodynamics of the flow, ensuring uniformity of irradiation of different layers of water;

•in one reactor of the plant as a result of the combination of two mechanisms of antibacterial action, the third mechanism is generated: in the cavitation bubbles under the influence of ultraviolet radiation active radicals of the hydroxyl group (OH), atomic oxygen and ozone that are produced are the most powerful oxidizers that complete decontamination.

Fig. 1 The installation for the complex of non-infectious water.

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THE TECHNOLOGY OF A COMPLEX OF WATER-THERMOBAROCHEMICAL INFLUENCE ON THE PRIVILEGE ZONE OF PRODUCTION PLAST

Application

It is intended to the intensification of hydrocarbon extraction from problematic oil, gas and gas condensate wells, in which is due to the fragmentation of the catchment zone of the formation, the flow rate is decreased.



Advantages

The high efficiency of the technology proposed is achieved through the use of chemically active hydrogen at various stages of the thermochemical treatment process at the vibrational zone of the formation. In addition, in comparison with methods other of intensification of hydrocarbon production (acid, alkaline, heat treatment wells). presented of the technology is complex. It combines both thermal and acid effects on the formation, and hydrogen.

Fig. 1 The scheme for the implementation of the technological process

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THE TECHNIQUE OF A FRACTURE TOUGHNESS ESTIMATION OF HIGH-TEMPERATURE ELEMENTS OF POWER EQUIPMENT UNDER LOW-CYCLE FATIGUE AND CREEP

Application

The technique is created for resource estimation of energy machine elements with identified or hypothetical cracks.



Advantages

The technique of the influence of operational and structural factors on the durability of the elements of power is taking into account.

Fig. 1 The stressed state in the lock joint with a crack

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