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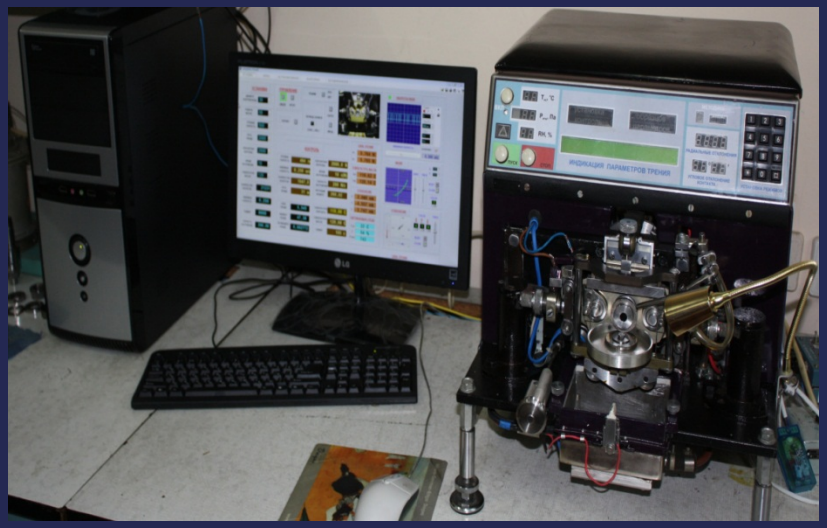
FRICTION AND WEAR TESTING MACHINE ASK-01



Functionality and scope of applicability

The device is designed and developed at the Nanoscale Tribology Laboratory of the National Aviation University with the aim of triboengineering testing of engineering materials, fuels and lubricants and their additives by the original multiple stage techniques. The device is designed for application in oil refining and engineering industries, in particular for development and production of high effective lubricants and their additives as well as power plants (gas-turbine engines, internal combustion engines, transmission lines, etc.). The device is intended for acceptance control of fuel and lubricants according to tribotechnical characteristics for design engineering laboratories, manufacturers of innovative machinery and operators consuming large volumes of fuel and lubricants; it could also be applied at standard bodies.

Significant features characterizing the level of scientific results obtained

The friction and wear testing machine ASK-01 is characterized by high fidelity of tests of wear and antifriction features of turbine systems taking into account secondary structures on working faces allowing simulation of real friction areas under laboratory conditions. Innovation of ASK-01 is in three degrees of freedom of the linear contact at friction of a flat sample against a countersample of a cylinder shape enabling accurate measurements of a frictional force without disrupting the contact at shifting of a sensitive element.

Development

A test model was produced, techniques were developed, metrological characteristics were experimentally verified. In 2009 it was tested by Ukrainian Research and Educational Center of Chemmotology and Certification of Fuels, Lubricants and Technical Liquids for assessment of its performance characteristics.

Copyright protection

A patent of an invention issued by the Russian Federation and a utility patent issued by Ukraine.

Basic technical specification

The device provides a stable contact regardless an accuracy of a model sample installation and allows initial contact strength according to the Hertzian theory up to 5,000 MPa.

Marketing

The friction and wear testing machine ASK-01 is on demand on the market including 25 verification centers in Ukraine, dozens of design engineering laboratories, dozens of manufacturers of lubricants.

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CONTACTLESS PUMP – GENERATOR OF TWO PHASE LUBRICANTS FOR CIRCULATION LUBRICATION SYSTEMS OF ELECTRIC POWER UNITS

Functionality and scope of applicability

The contactless pipes were designed and developed within the frames of scientific research program at the Nanoscale Tribology Laboratory of the National Aviation University. The devices allow two simultaneous functions: generation of air and steam microbubbles in diffuse areas of operation zones, which saturate a bulk of lubricant and in the convergent zones this mixture is discharged under pressure into a circulation system through receivers during operation time as well as when the system is stopped. Electric power systems include gas-turbine engines, internal combustion engines of equipment, electric generators, etc.

Significant features characterizing the level of scientific results obtained

Contactless pumps – generators have unique features; under excessive pressure up to 10 bars due to contactless operation zones the consumed power is 15 W allowing alternative power sources like solar batteries.

Development

Laboratory prototypes and models have been produced, which are currently studied and tested. Drawing and 3D simulation has been finished and new technological ways for improvement of operation and performance effectiveness of the device are researched.

Copyright protection

Two utility patents issued by Ukraine, a patent of an invention issued by Ukraine and a patent issued by Germany.

Basic technical specification

In a reverse mode, the vacuum is 0.1 Bar, in a discharge mode the excessive pressure could reach 16 Bars at the power consumption up to 20 W.

Marketing

The pump generators market is under study because it goes beyond the frames of the circular lubrication systems market segment and could be on demand on the market of vacuum equipment, rectification systems for volatile matters, they could be applied in the food industry, environmental protection and medicine.

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BEARING QUALITY CONTROL SYSTEM – QCS - 01

Functionality and scope of applicability

The device was developed at the Nanoscale Tribology Laboratory of the National Aviation University with the aim of quality control of bearings by their vibration properties and lifetime criterion. All the enterprises involved in maintenance and machinery production in Ukraine are in urgent need of such kind of systems.

Development

Operating models of the unit were tested at State-owned Companies «Plant №410 Civil Aviation», «ZMKB «Ivchenko–Progress» and «Motor Sich», JSC. And demonstrated their high effectiveness. The specifications are under development and need work out taking into account customization.

Significant features characterizing the level of scientific results obtained

The QCS – 01 system differs from the existing ones in its unique technique of bearing assessment due to its contactless rolling and contactless axis and radial loading with electromagnetic inducers and electromagnetic devices allowing avoiding defects of all the existing vibration diagnostic systems with their contact technique contributing vibration component and leading to errors.

Copyright protection

Two utility patents issued by Ukraine, a patent of invention is under expertise at "Ukrainian Intellectual Property Institute"(Ukrpatent).

Marketing

The market segment covers all the design engineering laboratories, repairing and manufacturing enterprises of the machine building industry in Ukraine (including avionics and space, engineering and other industries).

Basic technical specification

QSC – 01 effectiveness is up to 30 bearings an hour depending on the task of test or its scope. The control system is automated and allows multiple online monitoring of bearings applying specialized software. The unit provides bearing control in a wide range of types and sizes as well as estimation of their lifetime by vibration acceleration and operation time. The unit allows special spectrum comparative analysis of the initial signals in a real-time mode.

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LASER SCANNING DIFFERENTIAL – PHASE MICROSCOPES

Functionality and scope of applicability

The devices were designed and developed at the Nanoscale Tribology Laboratory of the National Aviation University with a team of scientists from the T.Shevchenko National University within the frame of a scientific research project focused on refraction of a translucent target, definition of its density and building of a high contrast two-dimensional and three-dimensional images of a "refraction map" (density) as well as two – and three – dimensional study of opaque surfaces. The devices can be applied in all fields of human activities including medicine, microbiology, histology, cytology, etc., bearing, aggregate and other precision production, standardization, verification, metrology, nanometry, avionics and space and other engineering industries.

Significant features characterizing the level of scientific results obtained

The microscope – refractometer produces super contrast images without application of any chemical dyes in the forward scattering mode. The microscope – profilometer provides sensitivity with the height of a surface relief less than 1 ηm in the refraction mode of operation.

Development

Pilot samples were produced, techniques and procedures were developed, state tests were finished by Ukrmetteststandard of Ukraine, the device is still under testing. Specifications for the main units of optical mechanical and software modules were worked out.

Marketing

Pilot applications of the microscope allowed revealing demands of the Ukrainian verification centers on linear- angular measurement within a manometer range, burning problems of medical and microbiological laboratories, design and engineering laboratories as well as works laboratories estimating quality in avionics, bearing production, aggregate and other fields of the Ukrainian machine building industry.

Basic technical specification

Scanning is produced without shifting of a target and the microscope components thus being protected from vibration. A number of points measured within a scanning area is more than 2.5 million, sensitivity to the profile height makes up to 1 ηm. 3D imaging and configuration of friction surfaces is a new feature of their tribological properties as a friction vector allows new technologies at the stage of tribosystems design.

Copyright protection

A patent of the Russian Federation and three patents of Ukraine, PCT patenting has been finished, positive assessment of the International Copyright Organization.

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VISUAL AIDS – EDUCATIONAL SCIENTIFIC LABORATORY DEVICES FOR CONTACT HYDRODYNAMICS

Functionality and scope of applicability

The devices were produced in the Nanoscale Tribology Laboratory of the National Aviation University with the aim of demonstration of the hydrodynamic processes in lubricated layers of turbine systems under laboratory conditions. Applicability – technical universities, colleges and secondary schools, i.e. educational institutions as well as design engineering laboratories and scientific research laboratories and tribology centers.

Development

Devices are produced, designed design documentation.

Significant features characterizing the level of scientific results obtained

Small size of the devices, autonomous power source, rather large size of the friction area with a stable contact zone, seed oil could be used as lubricant allowing safe laboratory demonstration for researchers and environment. The devices applying the following particular techniques allow visual observation of hydrodynamic processes originated at friction, namely, tribocavitation, reverse flows, generation of air and steam microbubbles and enrichment of a liquid under study at friction of sliding and rolling.

Basic technical specification

Rate of sliding is to 0.5 m/sec., optional loading is up to 1 MPa, additional light for the contact area is available, study of reverse flows at sliding and rolling is provided.

Copyright protection

A utility patent issued by Ukraine.

Marketing

Pilot application of the devices at design and engineering laboratories (State-owned ZMBK «Invchenko – Progress») and enterprise («Motor-Sich», JSC), at scientific and educational centers (Technical University, Dresden; Polytechnic University, Beijing, etc.) as a visual demonstration model for lectures on new adhesive – hydrodynamic theory of friction and wear showed their effectiveness for understanding of a complete set of tribo – hydrodynamic processes in the contact area enabling wear.

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UNIT FOR BEARING PRE-STARTING PROCEDURE

Functionality and scope of applicability

The device is developed in the laboratory of nanotribs of NAU and is intended for the preparation of new bearings, as the final stage of the preservation, before direct installation in the product; cleaning of bearings from wear products that are generated during the operation, and at the stage of repair of the product (aircraft gas turbines, internal combustion engines, their transmissions, etc.). Actual consumers are serial engineering and repair companies and design bureaus.

Significant features characterizing the level of scientific results obtained

Analogues of the developed method of contactless cleaning of non-separable ball bearings with combined pulsed magnetic turbulent fields and stands of its implementation were not found. Important indicators are contactlessness of the purification process, the possibility of simultaneous cleaning up to 100 pieces of bearings of various sizes, complete visualization of the process of removing micro and nanosheets of ferromagnetic and other nature.

Basic technical specification

The existing models of stands are manufactured in the production of PJSC "Motor Sich" and SE "MMCB" Ivchenko-Progress ". Development of design documentation is ongoing and needs to be finalized in view of the specifics of specific consumers.

Copyright protection

2 patents for the utility model and 1 patent for the invention of Ukraine were received, an application for the invention was filed under the PCT procedure, a positive opinion of the WIPO was obtained, a patent patent was obtained, and the patent was completed in Germany.

Basic technical specification

After the pre-operational preparation of ball bearings on the stand, the level of their vibration and noise decreases by 5 ... 35%, the resource increases by more than 2 times, repair bearings, rejected by the defect of "external noise", are restored and 92% for further operation.

Marketing

The market segment covers all design bureaus, serial and repair production of the machine-building complex of Ukraine (aerospace, land and other industries).

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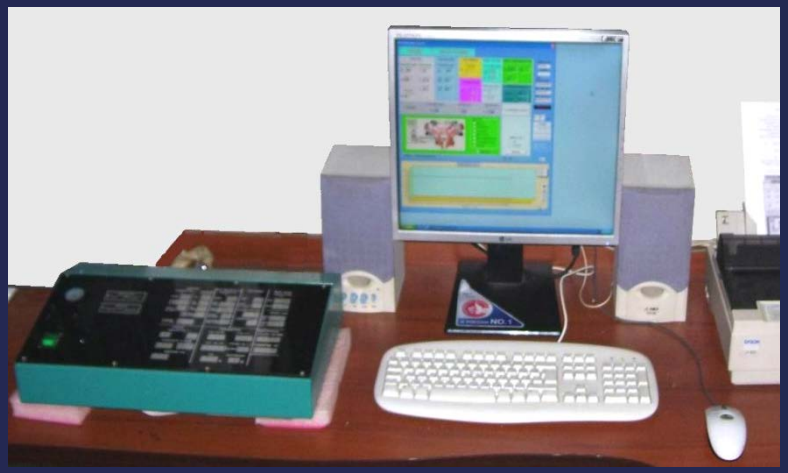
SYSTEM OF ACTIVE CONTROL OF PARAMETERS OF ENGINES OF INTERNAL BURIAL



Functionality and scope of applicability

The software and hardware measuring complex developed at the Nanoscale Tribology Laboratory of the National Aviation University is intended for automated electronic registration of the main parameters of the internal combustion engine (DIC) during testing at various stages and regimes.

Scope – in mechanical engineering at industrial enterprises in the manufacture and repair of ICE; military enterprises specializing in the repair of military equipment; departments and laboratories of research institutions of the National Academy of Sciences and Ministry of Education and Science of Ukraine in the development and testing of new ICEs.

Significant features characterizing the level of scientific results obtained

Automatic data processing of the main measured operational parameters of ICE in real time; control of measurement results in the most acceptable form for the operator, automatic processing and printing of protocols of the conducted tests of the IC on the given patterns; saving of accumulated measuring information and protocols in electronic form; creation of a data bank.

Development

Made model devices, designed design documentation.

Marketing

These systems will require repair companies of internal combustion engines, including ground armored vehicles.

Basic technical specification

The system provides for measurement and control of the current parameters of the ICE for OST B3-3607-86 during the test, namely: loading stand; lubrication systems; cooling systems; fuel system; exhaust system.

Copyright protection

The development is at the stage of patenting.

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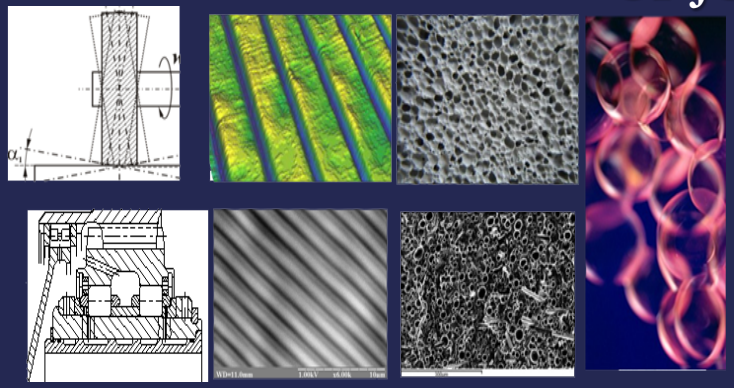
ADVANCED TRIBOTECHNOLOGIES OF WEAR RESISTANCE IMPROVEMENT OF JOINTS UNDER FRICTION



Functionality and scope of applicability

On the basis of adhesive deformation friction model developed at the Nanoscale Tribology Laboratory of the National Aviation University a number of unique design, mechanical processing, material science and rheological advanced technologies were developed focused on wear resistance improvement and effectiveness of joints under friction. The highest effectiveness of them is reached by their complex application. The above technologies can be applied at design laboratories and their further application in avionics and space production, machine building and other engineering industries in Ukraine.

Significant features characterizing the level of scientific results obtained

The most significant feature of the above development is improvement of wear resistance and operation effectiveness defining lifetime of individual joints as well as an entire product. Pilot and operation tests proved the possibility of increasing lifetime of high loaded gas-turbine engines more than 7 times due to the advanced tribotechnology applications.

Basic technical specification

Basic technical specification includes multiple improvement of wear resistance of tribosystems (currently 7 times higher) in the way of avoiding conditions for adhesive interaction of friction surfaces and their molecular interaction. Due to the above a significant increase of operation time is reached with lower energy consumption for friction, vibrations, noise and other disturbing factors under operation.

Development

Pilot and operation tests of different technological methods including individual and complex design and mechanical processing, material science and rheological technologies are currently performed by the team of the laboratory applying modern testing and measurement equipment.

Marketing

Reliability of each tribosystems defines safe equipment operation for products and transportation, their efficiency and long lifetime, which is required by design engineering laboratories, manufacturers and operation enterprises. Increase of inter repairmen lifetime of modern equipment in urgent for all the existing machine building industries in Ukraine.

Copyright protection

11 utility patents and 4 patents of inventions were issued by Ukraine, 2 PCT applications, 2 patents issued by Germany and 3 patents issued by the Russian Federation.