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No. 94

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UDC 621.039.5.621.79

USE OF LARGE-SCALE PREASSEMBLY IN BUILDING THE THIRD GENERATING FACILITY OF KURSK NUCLEAR ELECTRIC POWER PLANT

Moscow ENERGETICHESKOYE STROITEL'STVO in Russian No 9, Sep 82 pp 5-7

MEN'KIN, Yu. A., SKOPOV, V. F. and KOTIKOV, A. F., engineers

[Abstract] The article gives details on preassembly work used to speed up construction of the third generating unit at Kursk Nuclear Electric Plant with RBMK-1000 reactor. Floors, reactor control system and entire rooms were preassembled in separate construction yards, transported to the construction site and installed by crane operations. In addition to shortening construction time, this technique makes work easier, and improves the quality of the finished structure. With proper coordination, there is a considerable savings of crane operation time. Experience with the special KP-640 crane with lifting capacity of 640 metric tons shows that cranes of this type could be extensively used in constructing the reactor departments of nuclear electric plants with RBMK-1000 reactors. Figures 3.
[82-6610]

UDC 621.165.697.34

THERMAL ECONOMY OF NUCLEAR HEAT AND ELECTRIC POWER STATIONS WITH TK-450/500-60 TURBINES

Moscow TEPLOENERGETIKA in Russian No 8, Aug 82 pp 13-15

VODICHEV, V. I., BENENSON, Ye. I., BARINBERG, G. D. and UDINTSEV, N. N., TMZ Production Association

[Abstract] The paper gives the results of research done at TMZ Production Association on the influence that temperature behavior has on generation of electric energy at nuclear heat and electric power stations with VVER-1000 reactors and TK-450/500-60 turbines. Provisions are made in this turbine for two additional steam taps for heating purposes: after the high-pressure cylinder with pressure of 0.8-1.0 MPa, and after the third stage with pressure of 2.2-2.5 MPa, increasing the temperature of the line water and enabling an increase in the nominal thermal load beyond 523 MW (1885 GJ/hr). Curves are given showing the reduction in turbine power with increasing line water

temperature as a function of outside air temperature, number of hours of the heating period, and reduction in generation of electric energy with increasing temperature of the line water. These graphs can be used in optimization calculations to determine the best temperature conditions for heating networks with nuclear heat and electric power stations. Figures 4, references 6 Russian.
[87-6610]

UDC 658.264.621.311.25:621.039

REGULATING HEAT OUTPUT FROM NUCLEAR HEAT SUPPLY STATIONS

Moscow TEPLOENERGETIKA in Russian No 8, Aug 82 pp 27-30

ZINGER, N. M., doctor of technical sciences, YESHE, G. G., GILEVICH, A. I., SAPRYKIN, I. M., YURTAYEV, V. G., LYUBARSKAYA, A. I. and BAYBAKOV, S. A., All-Union Scientific Research Institute of Thermal Engineering imeni F. E. Dzerzhinskiy, All-Union State Institute for the Design and Planning of Electrical Equipment for Heat Engineering Installations

[Abstract] An investigation is made of various methods of regulating the heat output from nuclear heat supply stations. Previous calculations have shown that the optimum arrangement for AST installations is one in which the peak load is carried by fossil-fuel boiler stations, while the AST covers about 50% of the heat load in its territory. Rather than going directly to the consumers, the output of the AST is sent to the peak boiler stations, where it is used for heating the line water and return water with mixing to bring the parameters to those necessary for the municipal heating network. Therefore regulation of heat output may be either qualitative, or by a quantitative method in which the water temperature in the network following the AST is held constant, while the thermal load is varied by changing the flowrate of water from the AST, or by a method of qualitative-quantitative regulation where both the temperature and flowrate of the line water are varied. Details are given on these three methods, and comparisons are made. The results of the study show that the quantitative method of regulating heat output from nuclear heat supply stations is to be preferred, maintaining a constant temperature of the water following the AST at 150°C throughout the heating season. Figures 4, references 3 Russian.
[87-6610]

UDC 621.311.25:621.039

STARTUP, ADJUSTMENT AND EARLY PERIOD OF OPERATION FOR FIFTH UNIT OF NOVOVORONEZHSK NUCLEAR ELECTRIC PLANT

Moscow TEPLOENERGETIKA in Russian No 7, Jul 82 pp 8-12

ZVEREV, V. A., SEDOV, V. K., FROLOV, V. N. and GABRIYCHUK, N. S.

[Abstract] The fifth unit of Novovoronezhsk Nuclear Electric Plant was put into operation on 30 May 1980. The water-cooled water-moderated reactor used

in this generating facility has thermal power of 3000 MW and electric power of 1000 MW. This is a pilot plant of such facilities to be introduced in the forthcoming years in the USSR and CEMA member nations. The equipment for the primary circuit is enclosed in a prestressed concrete domed cylinder that will take the maximum pressure in an accident (0.45 MPa). All safety systems incorporate three independent subsystems. Coolant pressure in the primary circuit is 16 MPa with temperature of 290°C at inlet to the reactor, and 322°C at outlet. There are 151 fuel assemblies measuring 238 mm in diameter and 4665 mm in length. The core is 3560 mm high with equivalent diameter of 3120 mm. Tests during startup and adjustment confirmed calculations of the physical characteristics of the nuclear fuel. Power generation start was done in a series of stages of 20, 35, 55, 75 and 85-100% of rated power with tests on each stage. By August 1980, the unit had been brought up to 500 MW output, the 750 MW level was reached in December 1980, and full power--on 20 February 1981. During the period of early operation in 1980-1981, the generating unit reached a "gross" efficiency of 32.25%, and "net" efficiency of 30.15%. By 15 January 1982, the facility had generated 5.7 billion kWh of electric energy. Radiation safety in rooms of the ionizing emissions zone corresponds to sanitation standards. Figures 4, references 7 Russian.
[88-6610]

UDC 621.311.25:621.039

BEHAVIOR OF GASEOUS AND ORGANIC IMPURITIES IN COOLANT OF NUCLEAR ELECTRIC PLANTS WITH RBMK REACTORS

Moscow TEPLOENERGETIKA in Russian No 7, Jul 82 pp 14-17

MAMET, V. A., candidate of technical sciences, BOGDANOV, N. I., candidate of chemical sciences, TYAPKOV, V. F., YURMANOV, V. A., ANDROPOVA, G. A., ARKHIPENKO, A. V. and YERPYLEVA, S. F., engineers, All-Union Scientific Research Institute of Nuclear Electric Power Plants, Chernobyl Nuclear Electric Plant

[Abstract] The paper gives the results of studies done in 1979-1980 on the first generating unit of Chernobyl Nuclear Electric Plant to determine concentrations of radioactive gases (oxygen and hydrogen), values of pH and electric conductivity of the coolant. It was found that the ratio of concentrations of radiolytic gases is systematically lower than the stoichiometric value. The cause of the imbalance is sought in internal sources of hydrogen production or oxygen consumption by analyzing the possible influence of corrosion processes on the ratio of H_2 to O_2. The results show that the most likely cause of imbalance is occurrence of a fine fraction of ion-exchange resins and products of their destruction in the coolant (70%), and also the presence of oils (30%). Thermoradiolysis of organic products causes acid compounds to predominate in the vapor. Figures 3, references 7: 6 Russian, 1 Western.
[88-6610]

UDC 621.039.564

EQUIPMENT COMPLEX FOR MONITORING NEUTRON FLUX OF REACTOR CONTROL SYSTEM IN WATER-COOLED WATER-MODERATED POWER REACTORS OF NUCLEAR ELECTRIC PLANTS

Moscow ATOMNAYA ENERGIYA in Russian Vol 54, No 1, Jan 83
(manuscript received 6 Jul 82) pp 27-36

BOROVIK, G. F., BURENKO, I. Ye., GUSAROV, A. M., ZHERNOV, V. S., KALENSKIY, M. S., KRASHENINNIKOV, I. S., MESHKOV, V. A., PROKHOROV, Yu. Ye. and YAKUSHEV, A. G.

[Abstract] The paper describes industrially produced third-generation USSR equipment for neutron flux monitoring that is part of the safety system in VVER-440 and VVER-1000 reactors used in nuclear electric plants. This equipment complex ensures safe and efficient reactor operation under all conditions, including during refueling. The system incorporates autonomous subsystems for monitoring fuel recharging, monitoring the neutron flux for the reactor control system, and monitoring neutron flux from a standby control panel. Structure and design principles are explained along with major engineering features. The Soviet AKNP series of neutron flux monitoring equipment is an outgrowth of the first such system installed at the "Lovisa-1" Nuclear Electric Plant in Finland. Directions for continued improvement are: increasing the sensitivity and accuracy of the measurement-information channels; improving radiation resistance and extending service life of detection modules; reducing the number of ionization chamber channels in the biological shielding of the reactor, eliminating complex mechanisms for moving the detector modules; reducing the work involved in manufacture and alignment, improving the metrological parameters of the equipment. Figures 7, references 6 Russian.
[137-6610]

UDC 621.039.61:533.9

USING VARIATIONAL METHOD OF CALCULATING PLASMA EQUILIBRIUM IN TOKAMAK FOR CONSISTENT SOLUTION OF PROBLEMS OF EQUILIBRIUM EVOLUTION AND HEAT TRANSFER

Moscow ATOMNAYA ENERGIYA in Russian Vol 54, No 1, Jan 83
(manuscript received 10 May 82) pp 66-67

KOLESNIKOV, V. K. and KHAIT, V. D.

[Abstract] Using the variational method of equilibrium developed by V. D. Khait [see FIZIKA PLAZMY, Vol 6, 1980, p 871], the authors propose a simultaneous solution of the problem of heat transfer and plasma equilibrium in a tokamak. The problem is maximally simplified in the part relating to transport phenomena. A one-component model of the plasma is used with the same electron and ion temperature. The only heat loss mechanism considered is heat conduction with constant coefficient κ (alcator scaling), and a

single heat source was considered: a fast atom injector producing power uniformly distributed through the plasma. The diffusion equation was disregarded, and density was taken as preassigned and constant over the cross section. Relations are given for the energy lifetime and coefficient of skewness of the heat source as functions of the "current beta" normalized by the aspect ratio, and for the energy lifetime and "current beta" in the steady state as functions of the normalized injector power. Figures 2, references 4: 3 Russian, 1 Western.
[137-6610]

UDC 621.039.526

COMPARING TECHNICAL-ECONOMIC CHARACTERISTICS OF NUCLEAR ELECTRIC PLANTS WITH MODERN THERMAL AND FAST REACTORS

Moscow ATOMNAYA ENERGIYA in Russian Vol 53, No 6, Dec 82
(manuscript received 15 Mar 82) pp 360-367

RINEYSKIY, A. A.

[Abstract] Comparative studies are done on the technical and economic characteristics of nuclear electric plants with BN-600 integrated semi-inductrial fast reactor and with VVER-1000 water-cooled water-moderated thermal power reactor. In addition, some specific indices and design features of RBMK channel reactors and fossil-fuel electric plants are also given. The investigated parameters include electric power, mass of equipment, pipelines, and shielding metal in tons per MW, volume of reinforced concrete structures in cubic meters per MW, labor inputs on construction and installation in man-days per kW, specific capital investments on the construction, and total specific capital investments as of mid 1981. It is concluded that full realization of the potential capabilities of fast reactors will necessitate radical changes in design from the standpoint of metal inputs and cost. Figures 2, tables 6, references 11: 6 Russian, 5 Western.
[138-6610]

UDC 621.039.539.1

CALCULATIONS OF PHYSICAL CHARACTERISTICS OF RBMK REACTORS IN TRANSITION PERIOD

Moscow ATOMNAYA ENERGIYA in Russian Vol 53, No 6, Dec 82
(manuscript received 29 Jan 82) pp 367-373

ROMANENKO, V. S. and KRAYUSHKIN, A. V.

[Abstract] The transition period of RBMK reactor operation is understood to mean the time from reactor startup to steady-state refueling operation. This period is typically 5-6 years. A peculiarity of RBMK reactors is an appreciable change in coefficients of reactivity during the transition period.

This paper describes an effective method of neutron-physics calculation of RBMK reactor operation during the transition period with analysis of the major physical processes occurring in the reactor during this period and indication of some reserves of the fuel cycle. The procedure is based on a computer model of fuel burnup and recharging, assuming a homogeneous core. The proposed program is used to determine the frequency of refueling, and to analyze the causes of variation in major parameters during the transition period. An investigation is made of the possibility of reducing initial fuel enrichment, axial reconfiguration of the fuel, and axial enrichment profiling. Figures 6, references 5 Russian.
[138-6610]

UDC 621.039.584

RADIATION ENVIRONMENT OF FIFTH PHASE OF NOVO-VORONEZH NUCLEAR ELECTRIC PLANT DURING STARTUP AND BRINGING UP TO POWER

Moscow ATOMNAYA ENERGIYA in Russian Vol 53, No 6, Dec 82
(manuscript received 16 Jun 82) pp 373-375

VERKHOVETSKIY, N. A., IVANNIKOV, V. P., KOZLOV, V. F., KRUGLOV, V. P., LUZANOVA, L. M., POSEVIN, A. T., SLAVYAGIN, P. D. and KHAM'YANOV, L. P.

[Abstract] The fifth phase of the Novo-Voronezh Nuclear Electric Plant is a pilot facility for a large series of nuclear electric plants with VVER-1000 reactors. Physical startup of the facility took place on 30 April 1980. In May of the same year, the plant was connected into the power grid and by February of 1980 had been brought up to the rated power (1000 MW). The paper gives a summary of the results of studies of the radiation environment of the facility during that period. It is shown that the biological shielding of the reactor meets design specifications with regard to neutron and gamma radiation, and that the radioactivity of the coolant and deposits of corrosion products on equipment does not exceed 10% of the permissible level. In this connection, exposure of personnel is half the level of power plants with VVER-440 reactors, and the radioactive emissions into the atmosphere and liquid radioactive wastes are two orders of magnitude less than the established permissible levels. Figure 1, table 1, references 3 Russian.
[138-6610]

UDC 539.175.3;621.039.6

SURFACE ANALYSIS AND EROSION OF GRAPHITE DIAPHRAGM IN T-3M TOKAMAK IN INTERMITTENT OPERATION

Moscow ATOMNAYA ENERGIYA in Russian Vol 53, No 6, Dec 82
(manuscript received 6 Apr 82) pp 396-398

BARATOV, D. G., GORDEYEVA, G. V., GUSEVA, M. I., DEM'YANCHENKO, V. N., MANSUROVA, A. N., MIRNOV, S. V., STEPANCHIKOV, V. A. and FOKIN, V. P.

[Abstract] An investigation is made of processes of diaphragm erosion during plasma disruption in operation of the T-3M tokamak. A diaphragm made up of two parallel plates of USB-15 graphite separated by an insulator and measuring 4x8 cm was placed across magnetic field B_z (1 tesla) in the T-3M tokamak with large radius R = 95 cm and small radius r = 16 cm in the discharge mode at current of 20-30 kA. The diaphragm could be moved 3 cm into the plasma column. Currents flowing "in the shadow" of the diaphragm were measured by electrically shunting the plates, and the scale of high voltage between the plasma and diaphragm was evaluated by measuring the voltage differential between the isolated plates. Analysis of the surface of the diaphragm showed that the predominant erosion mechanism in intermittent operation is an electrodynamic mechanism that causes arcing on the ionic side of the diaphragm. The occurrence of metal films on the ionic side of the diaphragm shows that the plasma column comes into contact with the walls during operation with disruptions despite the presence of the diaphragm. Besides, the metal ions either participate in directed motion along the torus at a velocity of $(2-4)\cdot 10^5$ cm/s, or are pulled out of the plasma and accelerated by the electric potential in the disruption itself. The asymmetry of the electronic and ionic sides of the diaphragm in a disruption should be taken into consideration in designing tokamak diaphragms. Figures 4, references 6: 4 Russian and 2 Western.
[138-6610]

UDC 621.311.22.002.51.681.3

USING MICROPROCESSOR CONTROLLING COMPLEXES IN AUTOMATED SYSTEMS FOR CONTROL OF TECHNOLOGICAL PROCESSES IN GENERATING UNITS OF NUCLEAR AND FOSSIL-FUEL ELECTRIC POWER PLANTS

Moscow TEPLOENERGETIKA in Russian No 10, Oct 82 pp 7-8

GRITSKOV, V. I., DEMENT'YEV, V. A. and GORELIK, A. Kh., State Central Scientific Research Institute of Large-Scale Automation

[Abstract] The authors discuss microprogrammable controlling complexes for individual functional groups of equipment designed around high-reliability logic control devices. These facilities handle the following jobs: gathering and primary processing of information from analog and discrete sensors; transmission of commands for actuating shutoff equipment in accordance with logic control algorithms; transmission of commands for direct digital control of process parameters; changing dynamic settings of direct digital control; transmission of commands for actuating and de-energizing regulators, and for altering regulator configuration; monitoring conformity to programmed control; exchanging information with control computers. Control panel modifications are provided with six and twelve programs. Software is designed to handle: automated development of working programs for specific controlling complexes; generation and correction of parameters of controlling complexes accessible to operators with minimum training in programming; expansion of the classes of control problems that can be handled. Analysis of control algorithms shows that 25-30 controlling complexes are needed to handle functional equipment groups in the generating units of 1000 MW nuclear electric plants, while 15-20 controlling complexes will suffice for energy generating units in an 800 MW fossil-fuel electric plant. Figure 1, references 2 Russian. [86-6610]

UDC 621.362:621.383.5

CALCULATING EFFICIENCY OF THERMOELECTRIC GENERATOR

Tashkent GELIOTEKHNIKA in Russian No 6, Nov-Dec 82
(manuscript received 5 Jan 81) pp 3-8

POKORNYY, Ye. G. and IORDANISHVILI, Ye. K., Leningrad Department of All-Union "Order of the Red Banner of Labor" Scientific Research Institute of Current Sources

[Abstract] The authors consider the electrical parameters of a thermopile, and also the thermotechnical and engineering parameters of the structural design, deriving formulas for calculating the main energy parameters of a thermoelectric facility as a unit whole. Analysis shows that the facility has an efficiency maximum that is determined by the temperature differential across the junctions for predetermined conditions. This contradicts the conventional assumption that increasing the temperature differential across the thermopile necessarily leads to increased efficiency of a thermoelectric facility. In each specific case, an analysis has to be made of the way that the efficiency of the whole facility depends on temperature difference both across the junctions of the thermoelectric battery, and across the boundaries of the "heat source - heat dump" system, i.e. the extremum for the thermoelectric facility is not the same as the analogous state for the thermopile. Figures 2, references 2 Russian.
[136-6610]

UDC 662.997:537.22

INVESTIGATION OF DEFORMATIONAL FACETING

Tashkent GELIOTEKHNIKA in Russian No 6, Nov-Dec 82
(manuscript received 8 Jun 82) pp 14-16

AZIMOV, S. A., ASROROV, M. I., KULAKHMEDOV, N. N. and PIRMATOV, I. I., Physicotechnical Institute imeni S. V. Starodubtsev, UzSSR Academy of Sciences

[Abstract] The paper is devoted to detailed analysis and numerical processing of the results of investigation of deformational shaping of facets of a paraboloidal solar concentrator with parameter P = 32 m [S. A. Azimov et al., GELIOTEKHNIKA, No 5, 1981]. The extent to which the surface of the facet approaches the corresponding fragment of an ideal paraboloidal surface is characterized by the rms deviation of the normal to the facet from the normal to the corresponding ideal framgent: $\sigma_{av}^2 = \frac{\int_S \sigma^2 \, dS}{S_f}$ where S_f is the area of a facet. To determine σ and integrate it in accordance with this formula, an equation was found for the surface of the facet $Z = f(x,y)$ from measured values of the depth of curvature. The shape of the surface of the facet at

all points was then established by interpolation with respect to the two variables (x,y) using Aitken's iterated method. The results can be used for determining requirements for accuracy of alignment and quality of surface shaping. Figures 4, references 8: 7 Russian, 1 Western.
[136-6610]

UDC 662.997.537.22

LIGHT LOSSES IN PRISM CONCENTRATORS

Tashkent GELIOTEKHNIKA in Russian No 6, Nov-Dec 82
(manuscript received 16 Sep 81) pp 17-21

ZHUKOV, K. V. and TVER'YANOVICH, E. V., All-Union "Order of the Red Banner of Labor" Scientific Research Institute of Current Sources

[Abstract] Principal light losses in prism solar concentrators (prismocons) are considered: losses to Fresnel reflection on the front surface, absorption in the concentrator material, reflection from the rear reflecting surface, to total internal reflection and with radiation output. Analysis shows that concentrators of the given type may have optical efficiency of the order of 80%. Experiments with two models of solar concentrators gave results coinciding with calculations within 0.9% and 1.4%. Figures 3, references 5: 4 Russian, 1 Western.
[136-6610]

UDC 662.997:662.93

DEVELOPMENT OF LARGE HELIOSTAT AND INVESTIGATION OF ITS ENERGY CHARACTERISTICS

Tashkent GELIOTEKHNIKA in Russian No 6, Nov-Dec 82
(manuscript received 3 May 82) pp 22-25

ZAKHIDOV, R. A., KLYSHEV, Sh. I., TVER'YANOVICH, E. V. BAZZROV, B. A. and KHODZHAYEV, A. Sh., Central Design and Planning Office of Scientific Instrument Making, UzSSR Academy of Sciences

[Abstract] A report on research and development of a heliostat with reflecting surface of 25 m^2. The square reflector is made up of 81 square facet mirrors each measuring 550x550 mm. These mirrors are made of back-aluminized glass with lacquer protection. The individual mirror mounts have alignment screws for adjustment of position at three points, and the reflector frame can be rotated from zero to 90° in the zenith plane, and in a range of $\pm 50^\circ$ in the azimuthal plane. The drives for both planes are of worm gear type with both electric and manual operation. Both coarse and fine tracking are provided with accuracy of 2.5 minutes of arc. The focal length of the reflector can be varied from 40 m to infinity (flat reflector). Total mass without counting

the foundation and tracking units is 2154 kg. Energy characteristics were measured in planes perpendicular to the reflected rays at different distances from the heliostat. Irradiance was measured photoelectrically. The experimental results agree satisfactorily with calculations at 120 m, and discrepancies observed at 40 m can be attributed to deviations of the facet surfaces from planar. Improvements can be made for more rapid replacement of damaged facets. Also, the overall weight can be reduced by better design of bearings, shafts, gear boxes and so on. Figures 4, references 3: 2 Russian, 1 Western.
[136-6610]

UDC 662.997:537.22

ENERGY CHARACTERISTICS OF EXPERIMENTAL MODULE OF PARABOLIC CYLINDER SOLAR FACILITY

Tashkent GELIOTEKHNIKA in Russian No 6, Nov-Dec 82
(manuscript received 23 Feb 82) pp 25-27

TARNIZHEVSKIY, B. V., KOKHOVA, I. I., ALIYEV, S. N., ANTONOVA, R. N. and ERGASHEV, S. F., State Power Engineering Scientific Research Institute imeni G. M. Krzhizhanovskiy

[Abstract] In situ test results are given on an experimental parabolic cylinder solar unit. The optical energy characteristics were studied, and also the operation of the facility as a producer of low-potential heat. The unit includes the main reflector, a solar heat receiver, rotator, pressure and storage tanks and an electric drive. The parabolic cylinder has dimensions B x L = 2 x 5 m, focal length f = 0.85 m and aperture $2\alpha = 120^{\circ}$. The reflecting surface is made of sheets of electropolished aluminum 1 mm thick with reflectivity R = 0.79-0.80. The heat collector is an aluminum tube 100 mm in diameter that is also the axis of rotation of the reflector. The exposed surface of the collector is coated with carbon black. The rotator is driven by a reversible electric motor with power of 10 W through two speed reducers, giving the necessary rate of rotation of 1 revolution per day. Measurements showed that energy distribution in the focal plane corresponds approximately to a Gauss curve. Efficiency is 47-52% at useful heat output of 3-4.5 kW for output water temperature of 52-95°C at air temperature of 18-20°C, wind speed of 3-6 m/s and solar radiation density of 600-850 W/m^2. Figure 1, table 1, references 3 Russian.
[136-6610]

UDC 662.997:662.93

RESULTS OF HEAT AND MASS EXCHANGE PROCESS STUDY IN SUBSOIL PEBBLE-REGENERATIVE STORAGE UNIT OF BLOCK SOLAR GREENHOUSE

Tashkent GELIOTEKHNIKA in Russian No 6, Nov-Dec 82
(manuscript received 10 Aug 82) pp 31-33

BARDIASHVILI, A. B. and KHAYRITDINOV, B., Karshi State Pedagogical Institute imeni Kh. Alimdzhan

[Abstract] Studies were done to determine the relation between processes of heat and mass exchange with air cooling in a heat storage facility, and to determine the way that such units are influenced by parameters like temperature, humidity, air flow and enthalpy. Air velocity was measured in a range of 0.01-0.5 m/s by an AOS-3 vane heat-loss anemometer. At high velocities, formation of a condensate film was observed with entrainment of moisture out of the subsoil pebble bed. Experiments were done at different air velocities under various air temperature conditions at the inlet and outlet. Analysis of the resultant data on heat and mass exchange shows that in order to maximize the accumulated solar energy in a subsoil regenerative-pebble heat storage facility, it is necessary to determine the optimum air velocity in the pebble bed for heat and mass exchange processes. Figure 1, reference 1 Russian.
[136-6610]

UDC 662.97.001.57

REGULATION OF HELIOSYSTEMS WITH FORCED CIRCULATION OF COOLANT

Tashkent GELIOTEKHNIKA in Russian No 6, Nov-Dec 82
(manuscript received 12 May 82) pp 38-40

FERT, A. R., Kiev Zonal Scientific Research Institute of Experimental Residential and Public Building Design

[Abstract] An examination is made of various methods of regulating heliosystems with forced circulation of coolant in which the circulating pump is the control unit, and the regulation problem involves heat transfer in one direction only: from the helioreceiver to the water that is being heated. Diagrams are given showing placement of heat sensors for using temperature difference regulators in heliosystems with constant flowrate of four types: with single loop, with large-capacity heat exchanger, with flow-through heat exchanger, and with constant temperature of the heated water. Control points for energizing and de-energizing the pump are determined for optimum regulation in the various systems considered. Figures 2, reference 1 Russian.
[136-6610]

UDC 621.472:662.997

OPTIMIZING TEMPERATURE CONDITIONS OF SOLAR ENERGY RECEIVERS

Tashkent GELIOTEKHNIKA in Russian No 6, Nov-Dec 82
(manuscript received 5 Jun 82) pp 43-46

YAKUBOV, Yu. N. and IMAMKULOV, A. I., Bukhara State Pedagogical Institute imeni S. Ordzhonikidze

[Abstract] An analysis is made of solar energy receiver operation for the purpose of maximizing the amount of accumulated energy and the amount of heat flux taken up by fluid circulating through the channel. It is assumed that the energy receiver has a given heat capacity, initial temperature equal to that of the ambient medium and is subjected to known thermal action. The optimum fluid flowrate is determined. An investigation is made of the way that the accumulation coefficients and efficiency depend on the heat output of sources for different temperature conditions. Figures 2, reference 1 Russian.
[136-6610]

UDC 551.521

ACCURACY OF DETERMINING SOLAR RADIATION INTENSITY IN CALCULATING HELIONIC UNITS

Tashkent GELIOTEKHNIKA in Russian No 6, Nov-Dec 82
(manuscript received 8 Dec 81) pp 47-50

VALOV, M. I., GORSHKOV, B. N. and NEKRASOVA, E. I., Central Scientific Research Institute for Economic Planning of Experimental Equipment for Cities, Dwellings and Public Buildings

[Abstract] The intensity of solar radiation (H) incident on the surface of a helioreceiver in large measure determines the performance and fuel economy characteristics of solar engineering facilities. Selection of the design value of H is complicated by the fact that it varies throughout the day and in the course of a year. It is impractical to use hourly values of H with subsequent summation over the working period. Values of H averaged over given periods (days, months and so on) can be used to simplify calculations, but in such cases there is a loss of accuracy. The authors analyze the error of calculating adjusted expenditures as a function of accuracy of selecting the design value of H. It is shown that the regions of variation in accuracy of determining useful energy δQ_u and intensity of solar radiation δH are defined by the inequalities $0.05 \leqslant \delta Q_u \leqslant 0.36$ and $0 \leqslant \delta H \leqslant 0.18$, assuming that the accuracy of estimating adjusted expenditures δE does not exceed 0.05. Figure 1, references 8 Russian.
[136-6610]

UDC 662.997:621.187.142

CHOOSING THE ROOF PITCH OF BLOCK HOTHOUSES

Tashkent GELIOTEKHNIKA in Russian No 6, Nov-Dec 82
(manuscript received 9 Mar 82) pp 59-61

SADYKOV, T., KHASANOVA, M. and KHAYRITDINOV, B., Karshi State Pedagogical Institute imeni Kh. Alimdzhan

[Abstract] Calculations are done to optimize the slope of the roof of a greenhouse at a latitude of 39° in winter with consideration of maximum solar energy, minimum cost of construction materials and minimum shading. The results of the analysis show that for block greenhouses at the winter solstice, an additional heating source is required to maintain optimum internal air temperature at slopes of 25-30° and 50-60°. To reduce expenditures on construction materials, the optimum pitch is taken as 25-30°, and for a zigzag roof -- 36°. Figures 2, references 2 Russian.
[136-6610]

UDC 621.01.007.52

SPEED OPTIMIZATION OF AUTOMATIC MANIPULATOR WITH CONSIDERATION OF OUTPUT COMPONENT ELASTICITY

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 1, Jan 83 pp 17-19

ARKHIPENKO, N. A., engineer, KRAVCHENKO, N. F., candidate of technical sciences, and MEL'NIKOV, A. V., engineer

[Abstract] An analysis is made of factors that influence the cycle time of an automatic manipulator with pneumodrive, considering the elasticity of the output link. The analysis is based on using a digital computer to solve dynamic equations that describe motion of such a manipulator, using special algorithms. Some of the results of calculations are experimentally verified. It is shown that speed of the manipulator can be optimized by appropriate choice of the diameters of the pneumatic cylinders of the drives for rotation and radial displacement, as well as the proper instants for engagement of the drives. The speed of automatic manipulators is considerably increased by designing them with consideration of combined operation of drives. Figures 3, references 6 Russian.
[117-6610]

UDC 621.225.2

INVESTIGATION OF LENS DISTRIBUTOR OF CONTROLLABLE AXIAL-PISTON PUMP

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 1, Jan 83 pp 20-21

KABAKOV, M. G., engineer, KONDRAKHIN, G. A., engineer, and PASYNKOV, R. M., candidate of technical sciences

[Abstract] The bearing of the movable lens distributor in a seven-piston pump is studied to determine the optimum dimensions of the bearing surface from the standpoint of reliability, regulation and efficiency. The analysis is based on a mathematical model of hydrodynamic lubrication conditions derived from solution of Reynolds equations. The behavior of fluid pressure was determined as well as the supporting capacity of the liquid film between the bearing surface of the distributor and the mating surface of the cover as a function of liquid viscosity and the rate of turn of the rocker with changing

volume and also the dependence of the squeeze-out force on the thickness of the liquid film at given rates of turn. Curves are given showing the results of calculations by the finite element method. Figures 5, references 3 Russian.
[117-6610]

UDC 621.822.2

TESTS OF HYDRODYNAMIC THRUST BEARING WITH COLLAR BASE AND PROFILED BUTT PLATE WORKING SURFACE

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 1, Jan 83 pp 26-27

GRITSENKO, Ya. I., engineer, SOLOV'YEV, S. N., candidate of technical sciences, and SHEVCHENKO, I. D., engineer

[Abstract] The article gives test results of a hydrodynamic thrust bearing with collar base in which the working surface of the butt plate has been specially profiled to increase load-bearing capacity. A universal test stand was used, enabling simultaneous or separate testing of radial, radial-thrust and thrust journal bearings under loads up to 25 kN at shaft speeds up to 43,920 rpm. The size of the gap in the bearing with specially shaped butt plate is described by the equation $H = m^{-2\Phi_0(5\varepsilon)}$, where $H = h/h_m$ is the dimensionless thickness of the lubricating layer, $m = h_m/h_0$ is the coefficient of constriction of the lubricating layer, $\Phi_0(5\varepsilon) = \frac{1}{\sqrt{2\pi}} \int_0^{5\varepsilon} e^{-\frac{t^2}{2}} dt$ is a probability integral, h_m, h_0 and h are the thicknesses of the lubricating layer at the initial, final and an arbitrary point respectively, $\varepsilon = \phi/\theta$ and ϕ are the relative and angular coordinates of an arbitrary point of the lubricating layer, $\theta = 2\pi/n$ is the angle of a sector of the butt plate, and n is the number of sectors. The bearing is also tested for a profile of constant inclination of the working surface of the butt plate, for which the analogous equation is $H = 1 + \frac{1 - m}{m}\varepsilon$. The results show that the specially shaped butt plate considerably enhances the load-bearing capacity of the bearing as compared with the profile of constant inclination. Figures 2, tables 2, references 3 Russian.
[117-6610]

UDC 621.833

DYNAMIC LOADS IN HIGH-TORQUE MULTIPLE-MOTOR INTEGRATOR DRIVES

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 1, Jan 83 pp 27-30

ZHITOMIRSKIY, B. Ye., doctor of technical sciences (deceased), POPOV, S. N., engineer, FILATOV, A. A., candidate of technical sciences, and GARTSMAN, S. D., candidate of technical sciences

[Abstract] Multiple-motor integrator drives can be used for transmitting torques of up to 10 MN·m. Calculation of the dynamic loads that arise in the components of such drives is difficult because the analytical models used for studying conventional drives cannot be applied to such systems. The authors consider models and results of studies of the transient processes in heavily loaded integrator drives with DC motors. The analysis is based on equations of motion of the drive relative to dimensionless moments of forces of elasticity and the electromagnetic moments of the motors with consideration of kinematic errors of engagements of the pinions with the integrating gear. It is shown that in such integrating drive systems cophased and non-cophased oscillations of the moments of forces of elasticity arise on the shafts of the pinions in the integrating gearbox. Figures 3, references 5 Russian.
[117-6610]

UDC 621.757-52

EFFECTIVENESS OF CHECK EQUIPMENT IN AUTOMATIC ASSEMBLY UNITS

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 1, Jan 83 pp 47-49

SEMYSHEV, K. I., candidate of technical sciences

[Abstract] An examination is made of the use of control and blocking systems to prevent improper assembly on automatic production lines. The analysis is based on work done by R. A. Mikel'son and K. Ya. Mutsenek ("influence of Check Equipment Complexity on Effectiveness of Automatic Assembly" in: "Avtomatizatsiya proizvodstvennykh protsessov v mashinostroyenii i priborostroyenii" [Automation of Production Processes in Machine Building and Instrument Making], No 4, Riga, Zvaygzne, 1968) and on the "Scientific Principles of Automating Machine Assembly" (edited by M. P. Novikov, Moscow, Mashinostroyeniye, 1976, p 79). Refinements are made in the relations proposed by Mikel'son and Mutsenek, using notation for the investigated parameters generally analogous to that used in the paper cited above. The systems are subdivided into two types: momentary, that stop the line upon detection of any failure; adjustable, that shut down the equipment after a set number of cycles. Conditions are determined relating to replacement or restitution of rejected components during automatic assembly. The criteria of effectiveness are taken as productivity losses and inputs on manufacture. Figure 1, references 4 Russian.
[117-6610]

UDC 621.983.3

CALCULATING OPERATIONAL DIMENSIONS OF WORKPIECES IN COLD EXTRUSION AND CALIBRATION

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 1, Jan 83 pp 53-55

POPOV, M. Ye., candidate of technical sciences

[Abstract] An analysis is made of factors that determine the accuracy of final dimensions of pieces produced by cold extrusion and calibration. The problem of determining the operational dimensions of initial workpieces is solved in accordance with the principle of constant volume, since material is not removed in these operations. An algorithm is proposed for calculating workpiece dimensions that is particularly adaptable to automated preparation of production, eliminating waste, and minimizing margins for subsequent machining. Two specific examples of calculation by the proposed technique are given. The principles given can be used to develop systems for automatically controlling the accuracy of these pressure-working processes. Figures 3, references 3 Russian.
[117-6610]

UDC 621.01

ARTIFICIAL INTELLIGENCE SYSTEM FOR TECHNOLOGY PLANNING

Moscow MASHINOVEDENIYE in Russian No 1, Jan-Feb 83
(manuscript received 5 Apr 82) pp 3-7

BRUYEVICH, N. G., BELYANIN, P. N. and CHELISHCHEV, B. Ye., Moscow

[Abstract] The major requirements to be met by automated design systems in machine building are outlined, and the basic principles of systems of algorithms for technology planning are described. Experience has shown that such systems reduce labor inputs in design by a factor of 2-10, and it can be assumed that this figure will increase to 50 or more for the most complicated designs. When combined with artificial intelligence, the system is capable not only of technology planning, but also modeling of manufacture, as well as operation in conjunction with other design systems to solve problems of planning manufacturing processes, assembly and so on, and control with versatility, i.e. the capability of handling new items without analogs in manufacturing practice. As the initial step, the planning process is represented as a diagram of logic constructions. In the final step, programs are generated for solving any problems involved in handling data that describe a drawing.
[116-6610]

UDC 621-387

INVESTIGATION OF ROW TYPE BALL AUTOBALANCER

Moscow MASHINOVEDENIYE in Russian No 1, Jan-Feb 83
(manuscript received 30 Jul 81) pp 25-27

KRAVCHENKO, V. I., Leningrad

[Abstract] Autobalancing devices of various designs are used to reduce rotor vibration due to imbalance. An idealized model of one such device is an unbalanced disk seated on a shaft. In this disk are concentric channels filled with lubricating oil and accommodating balls that automatically take up a position eliminating imbalance as the shaft rotates at a certain angular velocity. An analysis is made of such a ball autobalancer of row type with consideration of the different distances of the centers of the balls from the center of the disk and different densities of ball materials. It is shown that transcritical rotor speed is a necessary condition for stable operation of the device. Computer analysis shows that the overall dimensions of this kind of autobalancer can be reduced by making the balls from different materials. Figure 1, references 5 Russian.
[116-6610]

UDC 534.014

MOTION OF MATING PARTS IN AUTOMATIC ASSEMBLY

Moscow MASHINOVEDENIYE in Russian No 1, Jan-Feb 83
(manuscript received 8 Apr 81) pp 44-48

DZHALALOVA, I. V., Moscow

[Abstract] An investigation is made of a specialized assembly head of an industrial robot for joining cylindrical parts of the shaft and sleeve type. The first stage of assembly is considered where the end faces of the mating parts are brought into contact. The analysis applies to the dynamic process of assembly. Cases of viscous and dry friction between components are considered. In the case of viscous friction, a solution is found and analytical estimates are given for the entry problem. For dry friction, the limiting trajectory of motion is found for the moving component relative to the stationary one, and its stability is proved. Figures 2, references 5 Russian.
[116-6610]

UDC 621.9:621.89

CALCULATION AND INVESTIGATION OF AXIAL GAS STATIC BEARING WITH ELASTIC COMPENSATORS

Moscow MASHINOVEDENIYE in Russian No 1, Jan-Feb 83
(manuscript received 9 Feb 81, after revision 24 Mar 82) pp 93-98

KODNYANKO, V. A., SHATOKHIN, S. N. and SHATOKHINA, L. P., Krasnoyarsk

[Abstract] The paper gives a method of calculation and the results of investigation of axial active gas flowrate compensation with elastic compensators and double choking of the gas in the pressure line. The pressurized gas is fed through a throttling nozzle and an elastic washer into the controlling chamber, from which it escapes through a damping nozzle of the ring diaphragm type into the bearing support layer after which it is discharged into the ambient atmosphere. The static and dynamic characteristics of such a gas bearing are analyzed, and it is shown that the compliance of the supporting gas layer can be made as small as desired, as well as vanishing and taking on negative values. Relations and nomograms are given for calculating the parameters of the elastic washer, as well as optimizing other bearing parameters. Figures 3, references 9: 6 Russian, 3 Western.
[116-6610]

UDC 621.822.574:51

CALCULATING STATIC AND DYNAMIC CHARACTERISTICS OF ANNULAR GAS STATIC THRUST BEARING WITH MICROGROOVE

Moscow MASHINOVEDENIYE in Russian No 1, Jan-Feb 83
(manuscript received 13 Aug 81) pp 99-103

MORDVINKIN, V. A. and SNOPOV, A. I., Rostov-na-Donu

[Abstract] Annular gas static thrust bearings with microgroove are prone to air-hammer instability. The authors propose a method of calculating the static and dynamic characteristics of this type of bearing with the consideration of the feasibility of double choking: in the feeder, and upon entry to the microgroove. Analysis of the dynamic characteristics is based on determining the response of the lubricating layer to small harmonic oscillations of arbitrary frequency of the moving part of the bearing, when the clearance between the surfaces being lubricated varies in accordance with a known law. An expression is derived for the balance of flowrates, and then used for analyzing the static characteristics. Theoretical and experimental results are compared for different gas pressures and bearing parameters. It is found that the theoretical boundaries of the region of air-hammer instability with respect to loads and clearances agree well with experiment. Figures 3, references 4 Russian.
[116-6610]

UDC 621.007.52

STUDIES OF MECHANICAL TRANSMISSIONS FOR ELECTROMECHANICAL MODULES OF INDUSTRIAL ROBOTS

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 10, Oct 82 pp 6-9

LAKOTA, N. A., doctor of technical sciences, BULIN-SOKOLOV, I. V., candidate of technical sciences, GONCHAROV, A. S., engineer, KOKHANOVSKIY, G. I., engineer and SHUVALOV, S. A., candidate of technical sciences

[Abstract] In the modular principle of industrial robot design, the actuating part of the electric drive is incorporated into an electromechanical module that contains the actuating motor, the mechanical transmission from the motor to the driven link, feedback sensors (position sensor, speed-voltage generator) and other auxiliary elements. To a great extent, the mechanical transmission determines the working characteristics and design of the entire module. This paper examines three types of gear trains used in such modules: a harmonic drive with cam strain-wave generator; two-stage spur gearing with harmonic drive; two-stage spur and planetary gearing. Experimental studies show that the harmonic drive has the least play of the output shaft. Studies were also done to determine the efficiency and stiffness of the various drives for different working conditions, as well as the way that the driving torque depends on the loading torque for step-up and step-down gearing. It was found that gear trains containing harmonic drive components have advantages of less weight and smaller overall dimensions in addition to lower play of the output shaft, but they are also less rigid and less efficient. Figures 3, table 1, references 5 Russian.
[83-6610]

UDC 62-851.007.52

METHODS OF BRAKING PNEUMODRIVE OF INDUSTRIAL ROBOT

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 10, Oct 82 pp 9-10

PAROY, A. A., candidate of technical sciences

[Abbreviated version of article deposited in Scientific Research Institute of Machine Building, No 167-06, 1982]

[Abstract] An analysis is made of methods most suitable for setting up a braking force in the discharge cavity of the pneumodrive for an industrial robot: abrupt reduction in the cross sectional area of the exhaust orifice at a certain point of the stroke after which the opening is held constant to the end of piston travel; two stage braking in which the exhaust orifice is completely covered on the first stage, kept closed until the second stage when it is partly uncovered and then gradually closed completely in accordance with some set law. Equations are derived that describe the motion of the piston during braking for these two methods. Figures 3.
[83-6610]

UDC 621.822.5.001

STATIC CHARACTERISTICS OF HYBRID BEARING WITH TWO FEED SLOTS

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 10, Oct 82 pp 26-29

KEL'ZON, A. S., doctor of technical sciences, YAKOVLEV, V. I., candidate of technical sciences, and YAKOVLEVA, T. S., engineer

[Abstract] Continuous annular slots are used as throttles in radial bearings with external injection of lubricant. In this paper the authors use a method of numerical integration to study the static characteristics of a hybrid gas bearing with throttling through two continuous annular slots. It is assumed that the gas is injected at a fixed pressure and then flows to the end faces of the bearing where the pressure is at atmospheric level. Gas flow in the slot is described by a Reynolds equation in a cylindrical coordinate system. Equations are derived for pressure distribution, and numerically solved by Seidel's method. The lift force is determined by integrating the pressure in the layer over the surface washed by the gas. Expressions are found for the angle of displacement of the line of centers, the moment of friction of the bearing, and the flowrate of gas through the feed slot. Figures 4, table 1, references 10: 9 Russian, 1 Western.
[83-6610]

UDC Δ 62-229.7:534.282

SELECTION OF CHARACTERISTICS OF DAMPING DEVICES FOR AUTOMATIC MANIPULATORS

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 6, Jun 82 pp 11-12

GUSLITS, V. M., candidate of technical sciences

[Abstract] Because of the difficulties inherent in quantifying the forces of resistance in the braking devices used near the end of travel in automatic manipulators, experimental work is usually needed on the design stage with frictional or hydraulic dampers. Development of the necessary experimental method and equipment requires preliminary determination of major parameters that characterize the forces acting in the experiment, and that enable evaluation of the suitability of a proposed braking device for use in a specific manipulator. The author describes a stand developed by the Scientific Research Institute of Tractors and Agricultural Machinery for this purpose. The facility is essentially a physical model of an automatic manipulator in which the damper to be studied can be connected with provisions for controlling loads and recording all variable parameters. Figures 2.
[88-6610]

UDC 621.865.8

DEVELOPMENT AND INVESTIGATION OF INDUSTRIAL ROBOTS BASED ON Z-COORDINATES

Moscow STANKI I INSTRUMENT in Russian No 12, Dec 82 pp 21-24

KOLISKOR, A. Sh.

[Abstract] A system of Z-coordinates is proposed as a mathematical basis for development of a robotic complex. In such a system, the position of a solid in space is assigned by six numbers corresponding to the lengths $Z_1, Z_2, \ldots, Z_6$ of six lines that connect the solid to a stationary base in such a way that a geometrically invariant structure is formed upon assignment of the values of $Z_1, Z_2, \ldots, Z_6$. It is shown that such a system can be used to advantage in robotics by restricting movement to linear displacements and measurements to lengths. Jobs that can be handled by such systems include control of motor systems in industrial robots with six or more degrees of mobility, measuring absolute coordinates of the momentary position of a manipulator in motion control, compensating for deformations of the components of an arm and evaluating accuracy of robot operation, and also development of sensors of forces and torques and bionic control systems. Figures 10, references 5: 3 Russian, 2 Western.
[113-6610]

UDC 53.084.2:621.9.077

ROBOT ACTIVATION SENSORS

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 1, Jan 83 pp 15-17

KLYUYEV, V. V., doctor of technical sciences, director general of Spektr Scientific Production Association, KONDRAT'YEV, Yu. A., candidate of technical sciences, LEGKOBYT, A. K. and BOBYLEV, V. P., engineers

[Abstract] An examination is made of working principles and devices used in robot activation sensors of five types: locating, force-moment, tactile, visual, and those giving internal information on the parameters of working components of robotic complexes. A brief summary is given of the use of these sensors in assembly, welding, stamping, machining, casting, manipulation and transfer. Some characteristics of representative Soviet sensors for each of the above mentioned groups are given. Figures 5, tables 2, references 10: 4 Russian, 6 Western.
[112-6610]

UDC 621.865.8

DEVELOPMENT OF VERSATILE AUTOMATIC PRODUCTION PLANTS

Moscow STANKI I INSTRUMENT in Russian No 1, Jan 83 pp 3-6

KORENDYASEV, A. I., SALAMANDRA, B. L. and TYVES, L. I.

[Abstract] An analysis is made of the level of organization of the environment in production plants with different scales of series production, and of the influence that this level of organization has on production versatility, i.e. on the possibility of switching rapidly to production of another item. Technically and economically feasible methods of automating small-series and series production are proposed. A qualitative analysis of the components of the information volume necessary for carrying out a technological process demonstrates the feasibility of unmanned production plants for items with similar technological bases and processing methods. An example of such a plant is given. Figures 4, references 3: 2 Russian, 1 Polish.
[114-6610]

UDC 62-82-83:621.865.8

DYNAMIC CHARACTERISTICS OF ELECTROHYDRAULIC POSITIONAL DRIVE FOR ROBOTIC SYSTEMS

Moscow STANKI I INSTRUMENT in Russian No 1, Jan 83 pp 6-8

TSUKHANOVA, Ye. A. and VINITSKIY, Ye. Ya.

[Abstract] The authors describe the hydraulic, electrical and mechanical design and operating principles of a device for controlling an electrohydraulic drive. The facility uses modern computer technology and displacement sensors for improved positioning precision and speed of operation with on-off control of discrete hydraulic distributors. Experiments were done to determine the dynamic characteristics of the drive. Pressures were measured by diaphragm sensors with strain gages, velocity was measured by magnetoelectric sensors, acceleration--by semiconductor strain gages, and displacement by a special transducer. Positioning accuracy was determined by digital readout on a display with resolution of 0.01 mm. Operation of the drive is explained. Tests were done at maximum steady-state velocity of 0.5 m/s, supply pressure of 5 MPa, and mass of the object to be positioned of 200 kg. The results show that the drive is capable of stable operation with maximum positioning accuracy of 0.01 mm at minimum steady-state velocity of less than 2.6 mm/s. Since the duration of braking and positioning processes is close to the minimum possible, the proposed drive is quasi-optimum with respect to speed of operation. Figures 3, references 3 Russian.
[114-6610]

UDC 621.914.4-233.2

HYDROSTATIC BEARING FOR HEAVY-DUTY BORING MILL SPINDLE

Moscow STANKI I INSTRUMENT in Russian No 1, Jan 83 pp 11-12

PROKOPENKO, V. A., YATSKEVICH, A. A. and FAYNGAUZ, V. M.

[Abstract] The paper describes a four-support hydrostatic bearing 255 mm in diameter with load capacity of 25 kN used on a heavy-duty boring mill with hollow extensible spindle 200 mm in diameter rotating at maximum speed of 800 rpm. The diametral clearance of the bearing is 120 μm, working fluid I-20A mineral oil with coefficient of dynamic viscosity 0.09 Pa·s at 20°C, supply pressure 4 MPa, working fluid flowrate 4-7 l/min, no-load power 2-3.5 kW, oil temperature differential 10-30°C. The method of calculation is given along with diagrams of the design. It is shown that the vibration stability of the bearing can be considerably improved by using RC correcting circuits to increase the damping factor on the natural frequency by a factor of 4-5. Figures 3, references 4 Russian.
[114-6610]

UDC 621.825.52.038

IMPROVING STABILITY OF TECHNICAL PARAMETERS OF ELECTROMAGNETIC GEARED COUPLINGS

Moscow STANKI I INSTRUMENT in Russian No 1, Jan 83 pp 12-13

ALEKSANDROV, V. I. and SUSLOV, V. I.

[Abstract] An examination is made of the conditions of occurrence of edge contact in the teeth of geared clutches upon engagement and disengagement under load. Steps are given for increasing the stability of transmitted torque and time of disengagement under load, which are parameters that determine the quality of couplings of this type. It is shown that a circular tooth is effective in such couplings. Expressions are derived for designing clutches that eliminate edge contact leading to instability of technical parameters in coaxial and non-coaxial arrangement of the coupling teeth. Elimination of edge contact reduces the scatter of transmitted torque from 35-43% to 2-5%, and the spread in time of disengagement under load from 200-500% to about 20%. Figure 1, references 6 Russian.
[114-6610]

UDC 621.923.019:621.822.72

ERRORS OF BEARING RING FACES IN BILATERAL SURFACE GRINDING

Moscow STANKI I INSTRUMENT in Russian No 1, Jan 83 pp 27-28

SHAKHNOVSKIY, S. S.

[Abstract] An analysis is made of errors that arise in surface-grinding the faces of bearing rings on a horizontal two-face grinder. It is found that the resultant error has nine components: a recess due to contact between the ring and the calibrating edge of the grinding wheel; error due to cyclic oscillations of the grinding wheels; an error due to the surface conditions of the workpiece; error due to free motion of the ring between the calibrating feed mechanism and the grinder; the error due to the change in cutting properties as the wheel wears nonuniformly; an error due to instability of operation of the automatic width-adjusting mechanism; an error due to misalignment of the wheel with the guide; error in relative placement of wheels in the vertical and horizontal planes; thermal deformations. Each of these factors is evaluated, and it is shown that the major components of the resultant error are nonuniform wheel wear, fluctuations in automatic adjustment, and thermal deformations. Figures 5, references 2 Russian.
[114-6610]

UDC 621.9.06-52:658.527]:681.5

DESIGNING SYSTEMS FOR CONTROLLING AUTOMATIC TRANSFER MACHINES BASED ON PROGRAMMABLE COMMAND UNITS

Moscow STANKI I INSTRUMENT in Russian No 11, Nov 82 pp 3-5

MIKOV, I. N., CHERPAKOV, B. I., ADALIN, Yu. N. and MESHKOV, S. V.

[Abstract] Experience in using general-purpose computers to control transfer machines on automatic mass production lines has shown that this solution is not entirely satisfactory. This has led to the development of special facilities called programmable command units. These come in two varieties: "small" units that perform logic operations are intended only for controlling the equipment work cycle; "large" units that perform logic, arithmetic, comparison, and word processing operations, and print out or display textual messages, and are intended for cycle control and organization of line servicing. The MA2999 automatic production line control system developed by the Experimental Scientific Research Institute of Metal Cutting Machine Tools is given as an example. This system is designed for machining resistor bodies. The hardware of the facility includes two PK1 command units, an adjustment panel and an M-6000 computer. The software is described. Operation on the automatic production line has shown that its productivity is near the theoretical value. Figures 3, references 6 Russian.
[115-6610]

UDC 621.9.06-529

MICROPROCESSOR CONTROL OF AUTOMATIC EQUIPMENT ON MACHINE TOOLS WITH PRESET NUMERICAL CONTROL

Moscow STANKI I INSTRUMENT in Russian No 11, Nov 82 pp 10-13

SOSONKIN, V. L., GUREVICH, V. M. and STUKALO, V. A.

[Abstract] A technique is proposed for designing software for control of the automatic system in a machine tool with preset numerical control with microprocessor. The automatic system of the machine tool subsumes functional groups of mechanisms that control the main drive, switches in the feed drives, automatic tool changes, insertion and removal of the workpiece, jigs and fixtures, cooling, chip removal, guide and spindle bearing lubrication, oil temperature stabilization and other functions. In the proposed technique, control of this multicoordinate system is treated as a process of translation from the setup language to objective output code. This approach permits the use of formal linguistics. In the resultant system, the main programming unit is the interpretor, which is assigned one of two levels: a lower level for control of individual operations, and an upper level for realizing dispatcher functions. Figures 4, table 1, references 3 Russian.
[115-6610]

UDC 62-462.002:621.941.23.047.7

MAKING PIPES OF CHURLISH MATERIALS ON ELECTROCHEMICAL TURRET MACHINE TOOL

Moscow STANKI I INSTRUMENT in Russian No 11, Nov 82 p 30

GEVORKYAN, G. G. and BAYRAMYAN, A. Sh.

[Abstract] The authors describe a technological process developed at Armstanok Association for making pipes of churlish materials like tungsten and molybdenum from a single workpiece by electrochemical calibration on an E3-98 five-station electrochemical turret machine tool. The electrode tools are designed for broaching holes, hole calibration, premachining outside diameter, calibrating inside diameter and cutoff. Machining parameters are given for making a pipe from a tungsten single crystal with electrolyte of caustic soda, temperature of 34-35°C, pressure of 1.4 MPa and voltage of 8-12 V to produce pipes 15.5 mm in diameter and 50-55 mm long. The cathodes are made of brass with a central opening for feed of the electrolyte. Total time for making the pipe is 100 minutes as compared with the electroerosion time of 6.5 hours. Technical specifications of the E3-98 facility: maximum workpiece diameter 20 mm, maximum chuck-to-turret distance 340 mm, turret travel 240 mm, spindle speed 350 rpm, turret feed range 0.25-15 mm/min, electrolyte tank capacity 300 liters, electrolyte circulation pressure 16 MPa, area taken up by machine 6.8 m^2. Figures 2.
[115-6610]

UDC 621.165.001

VENTILATION PROCESS IN AXIAL TURBOMACHINE STAGE

Moscow ENERGOMASHINOSTROYENIYE in Russian No 11, Nov 82 pp 7-12

NEUYMIN, V. M. and USACHEV, I. P., engineers

[Abstract] A general method is given for calculating ventilation losses in an axial turbomachine stage based on a thermomechanical model of the process. It is found that an increase in radial clearance always increases ventilation losses. As long as the working blades are ventilating the gaseous medium as relatively short vanes, ventilation losses increase with increasing axial clearances of side compartments of the chamber. As soon as the working blades begin to ventilate as relatively long vanes (with continuing increase in axial clearances), ventilation losses may decrease. In real low-pressure stages of steam turbines the influence of the chamber can be disregarded in calculating ventilation losses. When calculating high-pressure stages and microturbines (especially those that operate on molten metal vapor), the geometry of the chambers must be taken into consideration. Analysis of conventional formulas for calculating ventilation losses shows that the Sutter-Traupel and Markov-Tarent'yev formulas give good results for steam turbines of moderate and low power. Figures 5, references 11: 9 Russian, 2 Western. [105-6610]

UDC 621.822.6

EXPERIMENTAL INVESTIGATION OF HIGH-SPEED TURBOMACHINE JOURNAL BEARINGS WITH SELF-ADJUSTING BLOCKS

Moscow ENERGOMASHINOSTROYENIYE in Russian No 11, Nov 82 pp 23-25, 27

MAKSIMOV, V. A., SHNEPP, V. B., candidates of technical sciences, and KHAMIDULLIN, I. V., engineer

[Abstract] Experimental studies are done to determine the way that characteristics of high-speed turbomachine journal bearings are influenced by the pressing coefficient, the coordinate of the pillow block support point, and the number of pillow blocks in the bearing for various arrangements relative to the line of action of the external load. Tests were done with simultaneous determination of the distribution of temperatures, pressures, and the shape

of the lubricating layer of separate blocks in the bearing. The position of shaft in the bearing was determined by means of two inductive sensors set at 90° to each other. It was found that the influence of unloaded blocks on static characteristics of reversible bearings can be disregarded. A simple bearing that is economic and will carry a heavy load is a reversible bearing with four pillow blocks in which the load is directed between blocks. In this arrangement, the coefficient of preliminary pressing should lie in a range of 0-0.3, and for lightly loaded or vertical rotors--0.5-0.6. Experimental data confirm the correctness of the proposed method of calculation. The lubricant flowrate through the bearing must be set on the basis of the temperature state of operation of the loaded block. Maximum temperature should not exceed 110-120°C. Figures 6, references 6 Russian.
[105-6610]

UDC 621.165.001.539.433

VIBROSTRENGTH OF GTN-25 COMPRESSOR ROTOR VANES

Moscow ENERGOMASHINOSTROYENIYE in Russian No 11, Nov 82 pp 16-18

BAVEL'SKIY, D. M., BOGORADOVSKIY, G. I., candidates of technical sciences, VEDISHCHEV, A. F., engineer, and STEPANOV, A. M., candidate of technical sciences

[Abstract] Experiments are done to determine vibration stress on the working blades of the axial low-pressure compressor in the GTN-25 gas pumping unit. Model and in situ measurements were done with strain gages. The compressor turns at a speed of 4350 rpm, has 7 stages with degree of pressure increase of 3.57, relative blade length $\bar{l} = l/b = 1.47\text{-}2.25$, relative pitch of working blades on average diameter $t = t/b = 0.95\text{-}1.08$. In addition to strain gage measurements, the temperature and pressure of the gas flow were determined following each stage. The results of harmonic analysis showed that changes were needed to improve vibration reliability of working blades in the sixth and seventh stages. Modifications included off-resonance running and placement of ribs on the periphery, thus minimizing amplitudes of dangerous harmonics. As a result, vibration stresses in the blades of the final stage were reduced to less than 60 MPa. Figures 3, table 1, references 3 Russian.
[105-6610]

UDC 531.74

DETERMINING ORIENTATION OF INSTRUMENT TRIHEDRON FROM DATA ON ANGLES

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 6, Nov-Dec 82 (manuscript received 20 May 81) pp 15-21

TKACHENKO, A. I., Kiev

[Abstract] A perfectly rigid undeformable object moving at an absolute angular velocity ω is tied to an orthonormalized basis E (right-hand triad of mutually orthogonal vectors e_1, e_2, e_3). On this object is mounted a three-coordinate tachometer consisting of a set of sensors which read unambiguously the three principal components of angular velocity $\omega_1,\omega_2,\omega_3$. The object is also tied to another orthonormalized basis $J(j_1,j_2,j_3)$ with an invariant orientation, in inertial space, to some orthonormalized basis $I(i_1,i_2,i_3)$, this orientation being defined by Euler angles ψ,ϑ,φ. The problem is to determine the position of basis E relative to basis I from the readings of velocity components $\omega_1,\omega_2,\omega_3$ and the measurable Euler angles ψ,ϑ,φ. The problem is solved by the method of vector matching, with use of quaternions as intermediate quantities and Rodrigues-Hamilton parameters for characterizing position of basis E relative to basis I. The transformation due to finite rotation θ_f is replaced with a sequence of two finite component rotations θ_q and θ_s. After the solution has been obtained, the effect of errors in the tachometer readings is estimated. When the vector components of the quaternions are not very small, the resulting errors in determination of the orientation of basis E are of the same order of magnitude as the errors in angular velocity readings. References 8 Russian.
[102-2415]

UDC 531.383

STEADY MOTION OF GYROSTAT WITH DEFORMABLE PLATES AND MOTION STABILITY IN NEWTONIAN CENTRAL FORCE FIELD

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 6, Nov-Dec 82 (manuscript received 27 Feb 81) pp 10-14

NABIULLIN, M. K., Irkutsk

[Abstract] Steady motion of a gyrostat with a symmetric pair of rectangular plates rigidly attached to it is considered in a Newtonian central force field. Integral characteristics of such a motion are analyzed by the direct Lyapunov method. The first variation of the corresponding Jacobi integral H, when equated to zero, yields three groups of equations describing the motion with appropriate natural and geometrical boundary constraints. The second variation of the Jacobi integral H, when reversing sign, determines the stability limit for such a motion. Calculations reveal that deformability of the plates has a destabilizing effect. In order to satisfy the sufficient conditions for stability, it is necessary that the gyrostat with undeformed and "frozen in" plates satisfy the stability conditions for a gyrostat and a solid body, respectively, in a circular orbit. References 19: 14 Russian, 5 Western.
[102-2415]

UDC 531.55:521.1

NONLINEAR RESONANCES IN PROBLEM OF MOVEMENT OF BODY AROUND CENTER OF MASS UNDER ACTION OF LORENTZ FORCES

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA: MATEMATIKA, MEKHANIKA, ASTRONOMIYA in Russian No 1, Jan 83 (manuscript received 21 Jan 82) pp 85-91

CHIKOVA, N. V.

[Abstract] An examination is made of parametric resonances in motion of a body with electrostatic shield gravitationally stabilized in a circular orbit about its center of mass. The analysis is limited to terms of second degree in the equations of motion and expressions for perturbing moments. It is assumed that a triaxial body oriented in a gravitational field is perturbed by the moment of Lorentz forces that arise as the charged surface of the body interacts with the earth's magnetic field. An analysis is made of oscillations of the body in the orbital system with displacement of the center of the charged surface relative to the center of mass when third-order resonance relations are satisfied. References 3 Russian.
[142-6610]

UDC 537.312.62

SUPERCONDUCTING SOLENOID FOR ELECTRON-PARAMAGNETIC-RESONANCE SPECTROMETER

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 6, Nov-Dec 82 (manuscript received 25 May 81) pp 154-155

KUROCHKIN, V. I., LAPTIYENKO, A. Ya., TARYANIK, N. V., SUKHOY, V. V. and SHAPARENKO, V. V., Special Design-Engineering Office, Donetsk Physico-Technical Institute, UkSSR Academy of Sciences

[Abstract] A superconducting solenoid has been designed for the EPR5-04 radiospectrometer. It consists of two 190 mm long concentric cylinders with a 2 mm radial gap between them. Sixth-order uniformity of the magnetic field is ensured by two symmetrically cut circumferential grooves: one 100 mm wide and 3 mm deep around the outside surface of the outer cylinder (OD = 142 mm), one 45 mm wide and 1.5 mm deep around the inside surface of the inner cylinder (ID = 43 mm). The solenoid is wound with NT-50 (low-temperature alloy) wire 0.5 mm in diameter, 10,475 turns in 32 layers (50% space factor) on the outer cylinder and 13,912 turns in 50 layers (30% space factor) on the inner cylinder. The magnetic constant of this solenoid is 0.155 T/A, its critical magnetic induction is 7.5 T, the magnetic field is uniform within $3 \cdot 10^{-3}$%/cm and the magnetic constant does not vary more than 0.1% over the 1.5-7.0T range. The solenoid performs satisfactorily with a superconductor shorting switch and with a sweep modulating magnetic field. It was used successfully for measurements in the 2-mm wave band. Figures 2, references 3: 2 Russian, 1 Western.
[100-2415]

UDC 621.373.826.038.823:621.387.132.22:621.373.5

THYRATRON-THYRISTOR GENERATOR OF PUMPING PULSES FOR METAL-VAPOR LASERS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 6, Nov-Dec 82 (manuscript received 21 Jul 81) pp 145-147

DASHUK, S. P. and POTAPOV, S. Ye.

[Abstract] A push-pull generator of pumping pulses for copper-vapor lasers has been built using a hydrogen-filled thyratron with two thyristors as basic elements. The thyratron operates from a 300 V d.c. source and delivers 10 kV

pulses to the plate circuit with an average power of 1.6 kW at a repetition rate up to 12 kHz. The generator includes also a control circuit for thyristor firing pulses and a submodulator for thyratron grid pulses, a protective transformer with two windings in opposition and an output pulse transformer, two diodes with series resistors, a diode bridge, and two charging-discharging capacitors. Stability of operation of this generator is ensured by the protective transformer, by delaying the thyratron grid pulses much longer than the capacitor charging time, and by application of a sufficiently high reverse voltage across the thyristors for some time immediately after cutoff as well as immediately before firing. The generator design has been optimized for a 635 mm long and 16 mm in diameter discharge gap of a 10 W copper-vapor laser operating at 0.6% efficiency as load. Figures 2, references 7 Russian.
[100-2415]

UDC 537.533.2:533.9.03

ELECTRON GUN WITH PLASMA EMITTER FORMED BY VACUUM-DISCHARGE ARCS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 6, Nov-Dec 82 (manuscript received 6 Nov 81) pp 110-112

BUGAYEV, S. P., KLIMOV, A. I. and CHESNOKOV, S. M., Institute of High-Current Electronics, Siberian Department, USSR Academy of Sciences, Tomsk

[Abstract] An experimental study was made of Pierce flat electron gun with plasma emitter for producing electron ribbon beams. The gun consisted of a copper expander at a floating potential, a row of four spark gaps designed for the same ignition current, two focusing cathodes, and an anode with a hollow or flat collector immediately behind. The expander was filled with plasma generated by the four arc discharges. The cathodes were made of duralumin, with 6.5x30 or 6.5x50 mm slots; the anode and collectors were made of 0.1 mm thick titanium foil, the anode with 8x32 or 8x52 mm slot correspondingly. The current in each of the two high-voltage arc discharges was regulated by means of one variable resistor, the current in each of the two low-voltage arc discharges was regulated by one variable resistor for each and a common variable resistor for both. The anode and collector current was measured with Rogowski loops shielded against pickups. The gun voltage was regulated by means of a variable-gap air discharger operating in the spontaneous breakdown mode and was measured by an oscilloscope through a divider. The short-circuit current was limited by another resistor. The vacuum was maintained at the $3 \cdot 10^{-5}$ torr level. The construction of the electrodes had been optimized to yield a plasma concentration profile $n_e \propto 1/r^2$ (r- distance from spark gap). Electron beams with currents up to 20 A (current density 10 A/cm^2 at emission boundary of the cathode spot) were produced with accelerating voltage of 24 kV, the beam current increasing linearly with the arc-discharge ignition current. Figures 2, references 4 Russian.
[100-2415]

UDC 539.27

HIGH-VOLTAGE LONG-FOCUS ELECTRON GUN

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 6, Nov-Dec 82 (manuscript received 12 Nov 81) pp 108-110

VENIAMINOV, N. N., KUZAKOV, A. K. and RAMBIDI, M. G., All-Union Scientific Research Center for Study of Surface Properties and Vacuum, Moscow

[Abstract] An electron gun has been built for use in research equipment designed to measure differential cross sections for electron scattering $d^2\sigma/d\Omega\, dE$ by gaseous and solid targets. It consists essentially of a high-voltage long-focus Steigerwald triode capable of operation under a poor vacuum of the order of 10^{-4} torr. Its geometry and focusing characteristics are similar to those of the triode for a precision electron spectrometer. All metal components are made of austenitic stainless steel (12Kh18N10T) and all insulators are made of acrylic plastic. The movable tungsten cathode with a Wehnelt cylinder is surrounded by an external third electrode, the latter mounted on a platform through a guide bushing. The fixed anode disk with deflecting plates behind faces the cathode. The design has been optimized empirically, the Wehnelt cylinder being most critical. A 2.5 mm long conical tip with a 40° vertex angle around a straight axial hole 1 mm in diameter on a conical transition with a 94° vertex angle at the end of the Wehnelt cylinder was found to be best. The power supply for this electron gun is the same as for an EMMA-2 electron microscope. It includes a high-voltage transformer and selector switch for changing the accelerating voltage level, a cathode heater and bias voltage source. The unnecessary electromagnetic lens and x-ray microanalyzer have been eliminated. The gun can produce electron beams with a current of up to 230 μA and a half-width down to 0.2 mm at a distance of 0.8 m from the cathode, when the cathode is tapered to a point and the accelerating voltage is 25 or 50 kV. Figures 2, references 8: 2 Russian, 6 Western.
[100-2415]

UDC 621.384.649

PULSED ELECTRON ACCELERATOR IN WHICH BEAM OF LARGE CROSS SECTION IS COUPLED OUT INTO ATMOSPHERE

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 82 (manuscript received 21 Jul 81) pp 28-30

ABROYAN, M. A., BOGOMAZOV, P. M., SVEREV, S. F., KOSOGOROV, S. L., LAGUTIN, V. A., RODICHKIN, V. A., SUSAROV, A. D., TOKAREV, G. M. and SHARKOV, K. A., Scientific Research Institute of Electrophysical Equipment

[Abstract] A pulsed electron accelerator is described with a simple planar triode optoelectronic system in which the grid is at the cathode potential. The accelerator consists of a vacuum chamber in which the cathode block is

installed via a feed-through insulator. In the cathode block is a flat shaping screen, thoriated carbidized tungsten emitters, and a grid in the form of cylindrical rods 1.2 mm in diameter spaced 10 mm apart. The elements of the cathode block are enclosed in an electrostatic shield. The emitters, each with a cross section measuring 2 x 0.6 mm, are spaced 50 mm apart. The distance from the emitter plane to the shaping screen is 15 mm, and to the plane of the grid is 50 mm. The size of the accelerating gap, i.e. the distance between grid and anode, is 100 mm. The anode is an exit window with cross section of 20 x 80 cm made of a copper grid covered with AMg-2N foil 30 μm thick. The vacuum in the chamber is maintained at $5 \cdot 10^{-6}$ mm Hg. At accelerating voltage of 140 kV and pulse duration of 40 μs, the output beam current density reaches 8 mA/cm^2 with inhomogeneity of current density distribution of $\leq$10% over 90% of the nominal area of the beam cross section. Figures 3, references 6: 5 Russian, 1 Western.
[90-6610]

UDC 621.318.34(088.8)

PRECISION STABILIZER OF CURRENT IN MAIN CYCLOTRON WINDING FOR OPERATION IN MULTIPLY CONNECTED CONTROL SYSTEM

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 82 (manuscript received 11 Oct 79, after revision 4 May 81) pp 30-32

SAKHNO, V. I., TEPLOV, P. P. and TSYVINSKIY, V. G., Kiev Polytechnical Institute

[Abstract] An examination is made of the specific design features of a system for automatically regulating the current in a multiple-winding cyclotron magnet. Based on the example of a current stabilizer for the main winding of a 240-cm isochronous cyclotron, it is shown that including an additional resistance control circuit improves stabilization accuracy and gives the capability of computerized control. Figures 2, references 4: 3 Russian, 1 Western.
[90-6610]

UDC 621.384.6

GUN POWER SUPPLY AND CONTROL SYSTEM FOR HIGH-CURRENT PULSED ELECTRON ACCELERATOR

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 82 (manuscript received 18 Sep 81) pp 121-123

BAMBUROV, Yu. G. and KAZAREZOV, I. V.

[Abstract] The paper describes the design and peculiarities of a gun control module developed for the ELIT-L high-current pulsed electron accelerator. Voltage is fed from a 400 Hz line to the gun control module via a two-layer

secondary winding through LC filters placed at the beginning and end of the winding. The filter capacitance of 1 μF ensures a voltage of $\leq$ 1 kV across the ends of the winding with loop current of 200 A at 40 kHz in each of the branches of the windings upon application of the accelerating voltage pulse. Supply voltage is 750 V to minimize active losses on the secondary winding to 20 ohms at a current of 4 A. The line voltage pulse amplitude is controlled from a separate panel. The device uses pulsed charging of the shaping lines from a capacitor that is fed from a rectifier through a charging resistor. A thyristor switches all the energy from the charged capacitor through a pulse transformer to the shaping lines. Voltage across the grid is measured by a light-emitting diode that shunts the low-resistance arm of a divider connected in parallel with the grid-cathode gap. The LED output pulses are conducted by fiber optics from the high-voltage electrode to ground and are sensed by a photomultiplier. The output signal of the photomultiplier repeats the pulse shape of the LED output. Figures 3, references 4 Russian. [90-6610]

UDC 621.378.325

ALIGNING LASER BEAMS ON SPHERICAL TARGET IN DEL'FIN-1 FACILITY

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 82 (manuscript received 9 Nov 81) pp 158-161

BASOV, N. G., GUNKEL', Kh., DYNNEBIYER, G., KIRSANOVA, I. V., KUSH, S., RAYNIKE, V., RIKER, R., RUSS, N., SAVCHENKO, S. M., SKLIZKOV, G. V., FEDOTOV, S. I., SHENNAGEL', Kh. and YUNGE, K., Physics Institute, USSR Academy of Sciences, Moscow

[Abstract] The Del'fin-1 laser-driven fusion facility has an output energy of 4 kJ in 6 composite beams with diameter of 290 mm, each beam consisting of 18 elementary component beams. The authors describe a system for focusing and alignment of laser beams on the spherical fusion target. The system contains an aiming and focusing unit, and an electronic control module for scanning the focus of the channel in a range of $\pm$2.5 mm in the plane perpendicular to the axis of the channel, and $\pm$5 mm along the axis. Pneumatically controlled shutters protect the aiming and focusing unit from the intense laser pulse. The optical diagram of the system is given, and the alignment procedure is described. Beam positioning accuracy is $\pm$5 μm with respect to x and y coordinates and 15 μm along the beam axis. In experiments with this system, the output energy of the Del'fin-1 facility was concentrated in a zone with diameter of ~250 μm. Energy density on the target surface reached ~$5 \cdot 10^{13}$ W/cm^2. Spherical polystyrene and glass shell targets 300-800 μm in diameter were heated to temperatures $T_e \cong$700-800 eV. The laser energy absorbed in the target reached 500 J. Figures 3, references 4: 3 Russian, 1 Western. [90-6610]

UDC 621.384.8

ION SOURCE FOR MI-1201 MASS SPECTROMETER

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 82
(manuscript received 15 Jun 81) p 232

RAT'KOVSKIY, I. A., NALIVAYKO, A. G. and SUROVTSEV, V. V.

[Abstract] An ion source is described that is designed for studying processes of vaporization of low-volatility substances under conditions close to thermodynamic equilibrium (Knudsen method) in the temperature range of 700-2400 K. The ion-optical system of the source is compatible with the MI-1201 source for gas analysis. An effusion cell measuring 16 x 16 mm is heated by electron bombardment and a tungsten resistance furnace reinforced with aluminum oxide. The system includes an additional high-vacuum system for exhaustion of the water-cooled vaporization region, and an automatic gate that covers the molecular beam of vapor effused from the cell. The cell is aligned with respect to the ionization region by micrometer screws. The system has a sensitivity of 6 V relative to ion current corresponding to isotope $^{107}Ag^+$ with electrometric registration system at T = 1400 K. The vaporizer measures 140 x 320 mm with mass of 4 kg. Figure 1.
[90-6610]

UDC 621.039.624

INFLUENCE OF RADIAL DIFFUSION ON POSSIBLE EROSION OF OPEN TRAP PLASMA

Moscow ATOMNAYA ENERGIYA in Russian Vol 54, No 1, Jan 83
(manuscript received 12 Jan 82) pp 23-26

PETROV, V. G.

[Abstract] In designing reactors based on an adiabatic trap with tandem mirrors it is necessary to overcome erosion of the lateral surface of the end trap plasma due to the ambient neutral gas. This problem can be dealt with by increasing the transverse coefficients of diffusion and heat conductivity in a narrow peripheral zone of the plasma to achieve balance of ions and heat throughout the region of elevated transport coefficients. In this paper, calculations are done to find the requisite coefficient of diffusion and thickness of the region with high transport coefficients, assuming that the density of neutral particles is given on the outer boundary of this region. The analysis is based on the equation for radial diffusion of plasma in a thin region. It is assumed that the interface between plasma and neutral gas has a thickness of about the cyclotron radius of ions, and the appropriate conditions are stated. An expression is derived for the necessary plasma density on the inner boundary of the region as a function of the elevated constant coefficient of diffusion. It is shown that the lateral surface of the plasma in the end trap can be stabilized if the density of the ambient neutral gas is

held at 10^{11} cm^{-3} (a technically attainable vacuum) by increasing the coefficient of diffusion in the narrow peripheral region (e.g. by producing axial asymmetry or destroying the magnetic surface) and supplying additional power to the electrons. Figures 2, references 3: 2 Russian, 1 Western. [137-6610]

UDC 621.039.-78:621.384.633.8

RADIATION ENVIRONMENT ON THE 16 MeV MICROTRON ACCELERATOR

Moscow ATOMNAYA ENERGIYA in Russian Vol 54, No 1, Jan 83
(manuscript received 22 Mar 82) pp 38-43

BELOV, A. G., KOMENDANTOVA, G. A., TETEREV, Yu. G. and CHEREVATENKO, A. P.

[Abstract] The 16 MeV microtron accelerator used at the Joint Institute of Nuclear Research in Dubna for gamma-activation of geological specimens produces an electron beam with average current of up to 30 μA in pulses lasting 2.5 μs with recurrence rate of 90-800 Hz. Efficiency of electron beam extraction is greater than 90%, beam power at the stopping target is up to 0.48 kW. The target is 2 mm of tantalum. The neutron converter is uranium+beryllium, and yield is $3 \cdot 10^{11}$ neutrons/s. The neutron moderator is a cube of graphite 1 m on a side. The facility is in a room with volume of 140 m^3, ventilation rate is 1,400 m^3/hr, and accelerator cooling water flow-rate is 2 m^3/hr. The authors determine the adequacy of readings and limits of applicability of various radiation monitoring systems in the radiation fields of the microtron. It is shown that gamma dosimeters based on a gas-discharge detector have a much lower upper limit of dose measurements than for cw emission, while those based on a scintillation detector operate satisfactorily, but that neutron dosimeters based on scintillation detectors cannot be used under microtron radiation conditions. A corona-discharge neutron counter in combined polyethylene moderator is recommended. It is shown that the radiation hazard in operating with the microtron is determined mainly by bremsstrahlung. Induced radioactivity at this energy level presents no problems for organizing servicing. No special facilities are needed to make the water-cooling and ventilation systems radiation safe. Figures 5, tables 2, references 24: 19 Russian, 5 Western.
[137-6610]

UDC 621.039.343

ELECTROMAGNETIC MASS SEPARATOR FOR RADIOISOTOPE SEPARATION

Moscow ATOMNAYA ENERGIYA in Russian Vol 54, No 1, Jan 83
(manuscript received 22 Feb 82) pp 43-46

LYUBTSEV, R. I., ORLOV, V. I., BELYKH, V. S., YEVDOKIMOV, A. G., VOYCHISHIN, V. N., AKOPOV, G. A., MISHIN, V. Ya., ROGOZEV, B. I., ABDULAKHATOV, M. K. and RUBTSOV, Ye. M.

[Abstract] The paper gives the general characteristics of an electromagnetic mass separator that has been put into operation for radioisotope separation at the Radium Institute imeni V. G. Khlopin. The analyzing magnet sector has an angle of 2 radians, the average radius of the ion trajectory is 1 m, the distance from the foci to the effective field boundary is 2.0 m, the current of ions from the source is 1-10 mA, dispersion (for 1% $\Delta m/m_0$) is 20 mm, resolution of mass peaks at half-amplitude is 1500, and relative enrichment is at least 250. The facility is designed for separating radioactive isotopes of intermediate and heavy nuclei in a range of 100-250 amu. Data are given on separation of uranium and tin isotopes resulting in enrichment with ^{234}U and ^{119m}Sn. With certain modifications, the facility can be used for enrichment of plutonium, americium, curium, and fission products such as ^{85}Kr, ^{90}Sr, ^{93}Zr, ^{106}Ru, ^{135}Cs, ^{137}Cs and ^{144}Ce. Figures 2, references 8 Russian. [137-6610]

UDC 539.1.074.8

PLASTIC SCINTILLATORS FOR REGISTRATION OF FAST NEUTRONS

Moscow ATOMNAYA ENERGIYA in Russian Vol 54, No 1, Jan 83
(manuscript received 18 Feb 82) pp 58-60

VIKTOROV, D. V., GORBUNOV, L. A., ROZMAN, I. M., SIRENKO, A. M. and SHONIYA, V. M.

[Abstract] Plastic scintillators doped with fluorine (SPS-A1) and iodine (SPS-A2) are studied for suitability as detectors of neutrons with energy of about 15 MeV. To do this, the scintillators were exposed in a known neutron field, and the cross section of (n, 2n) reactions on fluorine and iodine was determined from the induced activity. The results confirm the suitability of the extrapolation method of measuring activity of nuclides ^{18}F and ^{126}I formed inside the plastic scintillator upon exposure to fast neutrons. Such scintillators may thus be used for measuring neutron fluence. In a stationary field of monoenergetic neutrons, assuming that the linear dimensions of the scintillator are much less than the mean free path of a neutron, the fluence is given by

$$F = \frac{\theta A(\theta)}{\sigma M[1 - \exp(-\lambda\theta)]},$$

where θ is the duration of exposure, $A(\theta)$ is the activity at the end of exposure, σ is the radionuclide production reaction cross section, λ is the radionuclide decay constant, and M is the number of nuclides of fluorine or iodine in the plastic scintillator. Scintillators with fluorine are preferable for exposures that are not excessively long. An important point for dosimetry is that the number of primary interactions of 14-15 MeV neutrons with nuclides can be determined even in large plastic scintillators because of the high energy threshold of reaction $^{19}F(n, 2n)^{18}F$ (greater than 12 MeV).
Table 1, references 9: 6 Russian, 3 Western.
[137-6610]

UDC 543.53

IMPROVING EFFICIENCY OF USING NEUTRON FLUX IN NEUTRON-ACTIVATION FACILITY WITH CENTRAL PLACEMENT OF CALIFORNIUM SOURCE

Moscow ATOMNAYA ENERGIYA in Russian Vol 54, No 1, Jan 83
(manuscript received 26 Feb 82) pp 60-61

VAKHTIN, B. S. and KUZNETSOV, G. A.

[Abstract] To determine the feasibility of using californium sources in fast neutron activation analysis, an experiment was done in which specimens were sequentially doubly and triply irradiated with fast and thermal neutrons from plutonium-beryllium and californium sources in various configurations, their induced activity was registered in the vicinity of a selected analytical photopeak, and the results were compared. The specimens were quartz glass powder (100% silica), and a mixture of chemically pure aluminum oxide and calcium carbonate (10% alumina). The plutonium-beryllium sources surrounded the specimens, while the californium source was "centrally" placed inside the specimen. The results show that californium sources with yield of no more than 10^7 neutrons/s can be used for simultaneous neutron-activation determination of silicon and aluminum. The effect of aluminum activation by thermal neutrons is nearly doubled by a californium source as compared with plutonium-beryllium sources of the same yield. There is a slight loss of 20-25 rel.% when californium is used for activation analysis of silicon, which can be compensated by using a source with somewhat greater yield. Table 1, figures 2, references 3 Russian.
[137-6610]

UDC 621.3.038.624

ADDITIONAL RADIATION FACTORS ON HIGH-CURRENT ELECTRON ACCELERATORS

Moscow ATOMNAYA ENERGIYA in Russian Vol 54, No 1, Jan 83
(manuscript received 1 Mar 82) pp 62-63

BELOVODSKIY, L. F., YEGEREV, V. D., ZAVADA, N. I., KOMAROV, P. L., MISHIN,N.A., PILIPENKO, A. V. and VOLODIN, M. D.

[Abstract] First-generation high-current electron accelerators are mainly based on direct discharge of a pulse voltage generator across a vacuum diode. Because of the pulse nature of the diode and placement behind biological shielding, the radiation hazard of such installations is minimal, and even induced radiation from γ-n reactions can be disregarded. In second-generation facilities, a double shaping line is placed between the pulse voltage generator and vacuum diode. The resultant induced activity must be taken into consideration when determining the radiation environment of such installations. Experimental data on the ORION-1 accelerator are analyzed to determine the contribution of various factors to personnel exposure; induced β^+-activity of structural materials, gaseous activation products, and positron annihilation radiation. It is found that the major factor that presents the greatest radiation hazard is exposure of the hands in disassembling the vacuum diode. Table 1, references 5 Russian.
[137-6610]

UDC 539.1.83

USING COUNTER WITH PLASTIC SCINTILLATOR TO MEASURE HIGH-ENERGY NEUTRON SPECTRA

Moscow ATOMNAYA ENERGIYA in Russian Vol 54, No 1, Jan 83
(manuscript received 2 Jul 82) pp 68-69

ALEYNIKOV, V. Ye., KOMOCHKOV, M. M., SOLODILOV, A. V. and TIMOSHENKO, G. N.

[Abstract] A method is proposed for measuring the energy spectra of neutrons in the energy range of 15-500 MeV that is largely free of the disadvantages of conventional techniques: low sensitivity and poor performance at high energies. A polystyrene scintillator is used surrounded by a guard scintillator scanned by a photomultiplier connected to a coincidence gate to prevent registration of the charged component of the radiation field. Example spectra are given. Figures 6, references 12: 5 Russian, 7 Western.
[137-6610]

UDC 621.039.637

DIRECT CONVERSION OF CHARGED PARTICLE ENERGY IN SYSTEM COMPRISING CONICAL MAGNETIC EXPANDER AND FLAT COLLECTOR

Moscow ATOMNAYA ENERGIYA in Russian Vol 53, No 6, Dec 82
(manuscript received 14 May 82) pp 400-401

DIMITROV, S. K. and MAKHIN, A. V.

[Abstract] To increase the efficiency of an open-trap fusion reactor, and to solve the problem of heat transfer from structural components, designers use direct conversion of the energy of charged particles emanating from the mirrors. The authors study the deceleration of electron flux in a converter modeled by a conical magnetic expander and flat collector. An electron gun is placed at the vertex of a cone-shaped vacuum chamber with taper angle of 30° in the vicinity of the maximum magnetic field. The beam is 3 cm in diameter with energy of 500 eV, perveance of 0.25 and angle of divergence of 45-60°. At the large end of the chamber, 30 cm from the electron gun, is a system of decelerating grids and the flat collector. The first grid is at ground potential, and a second grid serves as anti-dynatron. For reactors that have been developed up to the present with ambipolar adiabatic trap, such a collector facilitates conditions of heat removal, and increases overall reactor efficiency by 1-3%. Figures 3, references 3: 2 Russian, 1 Western. [138-6610]

UDC 533.6.011.55.011.6

NONSTEADY THREE-DIMENSIONAL HYPERSONIC FLOW OF RELAXING GAS AROUND THIN WING

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 266, No 5, Oct 82 (manuscript received 16 Mar 82) pp 1090-1093

KUZNETSOV, M. M.

[Abstract] The problem of nonsteady three-dimensional hypersonic flow is solved for a nonequilibrium stream of ideal gas around a thin wing at a constant angle of attack on the windward side. Analysis of the problem is based on the thoery of a thin shock layer, with the wing assumed to have a small aspect ratio (length $L= 1$, half-width $b= O(\sqrt{\varepsilon})$, half-thickness $c= O(\varepsilon)$, $\varepsilon \ll 1$ ratio of gas densities at front of bow wave). The corresponding system of equations of motion for a gas with physico-chemical transformations is formulated using the asymptotic representation of stream parameters in the form of series in ε. These equations, with appropriate boundary conditions, are integrated. The form of the bow wave is determined, first generally and then specifically for the case of a shock wave attached to the leading wing edge. Figure 1, references 6: 4 Russian, 2 Western.
[103-2415]

UDC 533.6.011

ASYMPTOTIC SOLUTION NEAR SHOCK LAYER DETACHMENT POINT IN HYPERSONIC FLOW AROUND POINTED BODIES

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA: MATEMATIKA, MEKHANIKA, ASTRONOMIYA in Russian No 1, Jan 83 (manuscript received 19 Nov 82) pp 64-69

IGNATENKO, V. G.

[Abstract] The two-dimensional (plane or axisymmetric) problem of steady-state flow of an ideal gas around pointed bodies at infinite Mach number is considered. As the adiabatic exponent $\kappa \to 1$, the problem degenerates, the region behind the shock wave becomine infinitesimally thin and infinitely dense. The method of asymptotic integral iterations is used to find an asymptotic solution near the point of detachment for a pointed body. The method of analysis consists in coverting the initial equations to integral

form, isolating the asymptotic principal part and integrating the residual part with secondary expansion of the singularity with respect to the variable of integration at the point of divergence. An explicit analytical solution is found for small $\varepsilon = \frac{(\kappa - 1)}{(\kappa + 1)}$ that is applicable to an extensive class of contours with continuous radius of curvature. References 6 Russian.
[142-6610]

UDC 532.525.6

PRESSURE ON FLAT ARBITRARILY ORIENTED SURFACE IN STRONGLY UNDEREXPANDED RAREFIED GAS JET FLOW

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA: MATEMATIKA, MEKHANIKA, ASTRONOMIYA in Russian No 1, Jan 83 (manuscript received 24 Nov 81) pp 74-80

PANOV, B. F.

[Abstract] An experimental investigation is made of the influence that rarefaction has on the magnitude and distribution of pressure on an arbitrarily oriented flat surface exposed to a rarefied gas jet escaping from an aperture in a thin diaphragm. Generalization of the experimental results yields an empirical formula for calculating the pressure on the spreading line at arbitrary angles between the axis of the jet and the plane of the obstacle. Curves are given that can be used to find the pressure at any point of an arbitrarily oriented obstacle if the pressure distribution is known in some initial position (e.g. normal to the axis of the jet). A procedure is given for determining the pressure from these curves, and an empirical formula is given for rough estimates. Figures 6, references 12: 10 Russian, 2 Western.
[142-6610]

UDC 534.1

SELF-EXCITED OSCILLATIONS IN SYSTEMS WITH INERTIAL EXCITATION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 266, No 5, Oct 82 (manuscript received 18 Mar 82) pp 1087-1089

BABITSKIY, V. I., Institute of Machine Scineces imeni A. A. Blagonravov, USSR Academy of Sciences, Moscow; LANDA, P. S., Moscow State University imeni M. V. Lomonosov

[Abstract] A class of dynamic systems is considered which can be described by the differential equations

$$\ddot{x} + 2\delta\dot{x} + [\omega_0^2 + f(x,y)]x = -ky$$

$$\ddot{y} + \gamma y = ax - n\dot{x} - \varphi(x,\dot{x},y)$$

with $f(0,0,0) = 0$, $\varphi(0,0,0) = 0$, $\varphi_x(0,0,0) = \varphi_{\dot{x}}(0,0,0) = \varphi_y(0,0,0) = 0$ and

where self-excitation can occur owing to inertial couplings between variables x and y (with parameter γ sufficiently small). Self-excitation is established and the character of resulting oscillations is determined in five specific cases: 1) vessel moving on calm water (periodic or stochastic oscillations); 2) Helmholtz resonator (periodic oscillations); electromechanical vibrator (periodic oscillations); rotating machine with speed regulator (form of non-linearity and of consequent oscillations depend on kind of motor and regulator); 5) heat convection in layer of fluid describable by E. N. Lorenz in three-mode approximation (stochastic oscillations). References 7: 6 Russian, 1 Western.
[103-2415]

UDC 539.3

CHARACTERISTICS OF WAVE FIELD IN SEMIINFINITE ELASTIC CYLINDER (BOUNDARY RESONANCE)

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 6, Nov-Dec 82 (manuscript received 20 Jan 81) pp 81-89

GRINCHENKO, V. T. and MELESHKO, V. V., Kiev

[Abstract] The solution to the problem of propagation of harmonic waves along an infinite isotropic elastic closed circular cylinder with a force-free lateral surface and the solution to the corresponding dispersion equation serve as basis for describing the wave field in a semiinfinite such cylinder. The analysis involves calculation of nonaxisymmetric vibrations ($n \geqslant 2$) of the cylinder under a force acting on its base. The algorithm of analytical solution of the corresponding infinite system of equations yields the state of stress and the dynamic response of the cylinder, its displacements satisfying the Lamé equations of motion. Numerical results obtained for $n = 2$ and $n = 3$ with impulse excitation $f_j = \delta_{ij}$ and a typical Poisson ratio $\nu = 0.3317$ reveal that such a semiinfinite cylinder vibrating in nonaxisymmetric modes has a natural frequency below the first critical. This frequency of "boundary resonance" does not depend much on the Poisson ratio, while in the case of axisymmetric vibrations it does and decreases fast as the Poisson ratio becomes smaller. Figures 4, references 22: 11 Russian, 11 Western.
[102-2415]

UDC 534.014

OPTIMUM CONTROL OF PERIODIC VIBRATIONS FOR VIBRATION AND SHOCK SYSTEM

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 6, Nov-Dec 82 (manuscript received 18 Mar 81) pp 40-47

KOVALEVA, A. S., Leningrad

[Abstract] The problem of optimum control is formulated and solved for a vibration and shock system where shock serves as basis of a technological process, to be maximized with limited control energy. The system is assumed to behave linearly between successive shocks occurring at a given repetition period. The maximum attainable shock pulse is determined from the equation of controllable motion and the shock-frequency characteristic of the system, assuming first zero external perturbations. The loss of shock action due to movement of the system caused by perturbations is then determined and near-optimality of the control established for this case. Optimum shock control and optimum initial clearance are calculated for an impactor on elastic suspension. References 9 Russian.
[102-2415]

UDC 534.014

THEORY OF VIBRATORY DISPLACEMENT DUE TO ANHARMONIC EXCITATION

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 6, Nov-Dec 82 (manuscript received 26 Jun 81) pp 34-39

BESPALOVA, L. V. and METRIKIN, V. S., Gor'kiy

[Abstract] Action of a 2π-periodic piecewise-continuous external force $f(\tau)$ on the motion of a pile in soil is considered, assuming that the magnitude of dry friction f_1 between lateral pile surface and surrounding stationary soil depends on the sliding velocity and the magnitude of soil drag f_2 does not depend on the sinking depth. Solution of the equations of motion for the pile and soil

$$\dot{v} = p + f(\tau) + f_1 + f_2$$

$$\dot{u} = \begin{cases} v & (u<0 \vee (u=0 \wedge v<0)) \\ 0 & (u=0 \wedge v>0) \end{cases}$$

(τ - dimensionless time, u- dimensionless coordinate defining relative position of bottom soil, v- dimensionless coordinate defining velocity of vibratory sinking, p- dimensionless overload parameter) yields the system trajectories in the three-dimensional (u,v,τ) phase space. As special cases are considered vibratory motion of piling without lengthy pauses and action of an external pulse force with arbitrarily large off-duty factor.
References 5 Russian.
[102-2415]

UDC 534.014.4

QUENCHING PLANE VIBRATIONS OF PLATFORM BY MEANS OF UNBALANCE-TYPE SUPPRESSORS

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 6, Nov-Dec 82 (manuscript received 30 Nov 81) pp 29-33

BABITSKIY, V. I. and BURD, V. Sh., Moscow

[Abstract] To a horizontal platform are hinge-joined two identical unbalance-type vibration suppressors, their axes of rotation (shafts collinear and perpendicular to the plane of the platform. The constraints on the platform allow only translatory motion of the latter in its horizontal (xy) plane. A harmonic force is assumed to act on the platform in one (x) direction. The motion of the system is analyzed, assuming that the unbalancer mass m is much smaller than the platform mass M and using the ratio $\varepsilon = m/M \ll 1$ as the small parameter in solution of the equation of motion. Upon a change of variables, relating angular displacement and time, the problem is reduced to analysis of the zeroth-order solution and the conditions are established under which stable synchronous rotation of the two unbalancers in opposite directions will quench vibrations of the platform. Figure 1, references 2 Russian.
[102-2415]

UDC 534.014.5

PERIODIC OSCILLATIONS OF SYSTEM WITH TWO DEGREES OF FREEDOM STRIKING AGAINST ABSOLUTELY INELASTIC STOP

Moscow MASHINOVEDENIYE in Russian No 1, Jan-Feb 83
(manuscript received 16 Apr 81, after revision 3 Mar 82) pp 8-10

BELYAYEV, Yu. V. and GERT, T. Ya., Moscow

[Abstract] The authors consider a vibroimpact mechanism with two degrees of freedom used in soil tampers. The striker is connected by an elastic element to a slider of the crankgear in the machine. Conditions are determined that give rise to periodic oscillations of the striker. The initial system of equations of motion and displacements of the individual components of the system is reduced to a system of two transcendental equations in two unknowns, which can be solved to get the values of six unknown constants. Figures 3, references 4 Russian.
[116-6610]

UDC 534.222

SOLITONS IN APPRECIABLY NONLINEAR SYSTEMS OF IMPACT TYPE

Moscow MASHINOVEDENIYE in Russian No 1, Jan-Feb 83
(manuscript received 30 Jun 81) pp 11-15

BEDENOVA, Ye. G., Moscow

[Abstract] The author considers a one-dimensional chain of masses connected by an imponderable beam or a string, and interacting with a strongly nonlinear elastic base as a model of a mechanical vibroimpact system. In the finite difference approximation, the equations of motion of this system are

$$m\ddot{w}_j + c_1 (6w_j - 4w_{j+1} - 4w_{j-1} + w_{j+2} + w_{j-2}) + c(2w_j - w_{j-1} - w_{j+1}) + 2n\dot{w}_j + F(w_j) = 0,$$

$$j = \ldots, -2, -1, 0, 1, 2, \ldots,$$

where w_j is transverse displacement of the j-th mass, m is the magnitude of each of the lumped masses, l is the distance between masses, 2n is the coefficient of viscous friction, $c = S/l$, $c_1 = EJ/l^2$, EJ is the flexural rigidity of the beam, S is longitudinal tensile force. On the basis of known analytical solutions and results of numerical analysis, the author studies the role of solitons in description of free oscillations of a chain of this kind with initial conditions of general type. A Runge-Kutta method is used to integrate the equations of motion, the number of masses being taken as 40 or 41, with boundary conditions corresponding to hinged support. First the simpler case of a string with lumped masses is considered, and then an investigation is made of the influence that "beam" terms have on the process. Solitons are distinguished that correspond to intense shock modes. A tendency of localization was observed when the initial conditions did not correspond to the exact profile of the soliton. Figures 4, references 5: 4 Russian, 1 Western.
[116-6610]

UDC 534.1

EXCITATION OF OSCILLATIONS IN MOVING ELASTIC STRUCTURAL ELEMENTS

Moscow MASHINOVEDENIYE in Russian No 1, Jan-Feb 83
(manuscript received 23 Oct 81) pp 16-17

VESNITSKIY, A. I. and KRYSOV, S. V., Gorkiy

[Abstract] An analysis is made of vibrations induced in an infinite homogeneous elastic rod as it is pulled at constant velocity in the horizontal direction over a stationary support that makes an oblique angle to the horizontal. The resultant excitation of flexural oscillations is due to the Vavilov-Cherenkov effect [see I. Ye. Tamm, "Nobel Lectures", USPEKHI FIZICHESKIKH NAUK, Vol 68, No 3, 1959], i.e. emission of energy as traveling waves by a constant source in uniform motion. The conclusions of the analysis are confirmed by an experiment with a rubber rod stretched between pulleys. Figures 2, references 3 Russian.
[116-6610]

UDC 531.3:534.01:621.01

VIBROACTIVITY OF ANNULAR MECHANISMS WITH CONSIDERATION OF IMPACTS IN GAPS

Moscow MASHINOVEDENIYE in Russian No 1, Jan-Feb 83
(manuscript received 2 Sep 81) pp 18-24

VUL'FSON, I. I., KLIMOV, V. A., KRYLOV, K. V. and MAZIN, L. S., Leningrad

[Abstract] In mechanical systems formed by mechanisms of annular structure, the driven component, which is usually a massive working part, is put into motion by several mechanisms working in parallel. The authors investigate the frequency properties of such systems, stressing the relation between vibroactivity of the system and pulsed perturbations associated with gaps in kinematic couples. The system is modeled by two torsional subsystems interconnected by kinematic, inertial and elastically dissipative components. The analysis is based on pairwise position functions that correspond to profiled surfaces geometrically closing a kinematic couple. A method of computer solution is proposed. A relation is derived for choosing coefficients of rigidity of links in the mechanism with consideration of the necessary force conditions and technological clearances. Figures 4, references 6 Russian.
[116-6610]

UDC 534.1

ANALYZING RESONANCE CONDITIONS IN NONLINEAR OSCILLATORY SYSTEMS

Moscow MASHINOVEDENIYE in Russian No 1, Jan-Feb 83
(manuscript received 26 Oct 81) pp 28-34

KRUPENIN, V. L., Moscow

[Abstract] Perturbing forces are generally taken as sine waves in analyzing nonlinear resonances that arise in machines when such forces compensate forces of dissipation. However, there are many situations where higher harmonics must be considered. In this paper, a method of averaging is used to study resonant conditions of some systems on the assumption that the external force is described by a periodic polyharmonic time function. It is shown that in this case when higher harmonics predominate, several pairs of resonant modes arise in contrast to the two fundamental pairs that occur in the case of sinusoidal stimulation. The relation between the method of averaging and the energy balance method enables analysis of systems of arbitrary dimensionality. As an example, the author considers the case of biharmonic periodic excitation of a vibroimpact system. The results are compared with exact solutions. Figures 2, references 9 Russian.
[116-6610]

UDC 534.082

METHOD OF MEASURING SPATIAL OSCILLATIONS OF VIBRATION DEVICES

Moscow MASHINOVEDENIYE in Russian No 1, Jan-Feb 83
(manuscript received 16 Nov 81) pp 35-40

MATVEYEV, V. B. and FRIDMAN, B. E., Leningrad

[Abstract] Conventional methods of measuring spatial oscillations of solids involve the use of electric acceleration sensors with output to an oscilloscope. Measurement accuracy is limited by oscilloscope resolution (5-10%), and mathematical processing does not provide for checking the accuracy of the results. In this paper, a method of measuring spatial harmonic oscillations is described that is free of these deficiencies thanks to the use of optical methods of measurement and regressional analysis in processing the results of observations. A measurement microscope is used to determine the parameters of an ellipse produced by motion of a bright spot on the harmonically oscillating solid. To match measurements of the phases of different oscillating points of the solid, the image of the trajectory is strobed by a signal with phase that is constant for all points, and is synchronized with the phase of the vibrator. An algorithm is derived for statistical evaluation of the parameters of oscillations from the results of observations. It is shown that for a certain choice of points of observations, there is no correlation between these estimates, thus simplifying the algorithm. Figures 2, tables 2, references 5: 4 Russian, 1 Western.
[116-6610]

UDC 539.388.1

ELASTIC-PLASTIC CALCULATION OF STRESSED STATE OF LENS COMPENSATORS DURING BENDING AND COMBINED BENDING WITH AXISYMMETRIC LOADS

Moscow MASHINOVEDENIYE in Russian No 1, Jan-Feb 83
(manuscript received 14 Aug 81, after revision 22 Jul 82) pp 67-74

BERLYAND, V. I., Kharkov

[Abstract] An approximate method is proposed for solving a boundary value problem in statics for shells of revolution under nonaxisymmetric loading with consideration of physical nonlinearity. Two examples illustrate the application of the proposed technique to calculation of the stressed and strained state of lens compensators subjected to the action of an axisymmetric and a bending load. The accuracy of the solution is analyzed. It is shown how the physical nonlinearity of the compensator influences bending stiffness. Figures 5, tables 3, references 12: 11 Russian, 1 Western.
[116-6610]

UDC 539.3

LOSS OF STABILITY OF SPHERICAL SHELLS

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA A: FIZIKO-MATEMATICHESKIYE I TEKHNICHESKIYE NAUKI in Russian No 10, Oct 82 (manuscript received 14 Dec 81) pp 29-31

BABENKO, V. I., Physicotechnical Institute of High Temperatures, UkSSR Academy of Sciences

[Abstract] The author considers the axisymmetric problem of loss of stability of a linearly elastic (isotropic) thin singly connected spherical shell stiffened along the edge and subjected to uniform external pressure. Analysis of forms of buckling shows that when the pressure is near the critical (classical) value, loss of stability of a spherical shell is accompanied by buckling in a small neighborhood of the apex. A theoretical investigation is made of this form of loss of stability in the approximation of the small parameter of relative thinness of the shell, assuming that post-critical deformation is localized in the vicinity of the apex of the shell. It is shown that this form of loss of stability is preferable from the standpoint of energy. Figures 3, references 4 Russian.
[84-6610]

UDC 539.3

PRINCIPAL NONLINEAR EQUATIONS IN THEORY OF IMPERFECT RIBBED SHELLS OF REVOLUTION

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA A: FIZIKO-MATEMATICHESKIYE I TEKHNICHESKIYE NAUKI in Russian No 10, Oct 82
(manuscript received 3 Dec 81) pp 34-39

GAVRILENKO, G. D., Institute of Mechanics, UkSSR Academy of Sciences

[Abstract] Systems of nonlinear equations in displacements or in mixed form are used to describe subcritical behavior of smooth or structurally orthotropic shells. There are no such equations for imperfect ribbed shells of revolution with discrete ribs. The author suggests a method of getting nonlinear differential equations of equilibrium of imperfect shells of revolution with consideration of discrete arrangement of ribs. It is assumed that a thin-walled nonideal ribbed shell of revolution is reinforced by mutually orthogonal elastic ribs arranged in the direction of the coordinate lines. The ribs are assumed to have bending stiffness in the radial and tangential planes, and also twisting stiffness. The ribs are placed discretely over the surface of the shell and are eccentrically located relative to the middle surface. The Kirchhoff-Love hypothesis is used, according to which a rectilinear element normal to the middle surface remains rectilinear and normal after deformation, retaining its length. Special cases of the proposed equations disregarding flexure and ribs reduce to known nonlinear equations for smooth shells. References 4 Russian.
[84-6610]

UDC 534.6.08

INSTRUMENT FOR MEASURING VELOCITY OF ACOUSTIC WAVES IN SOLIDS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 6, Nov-Dec 82 (manuscript received 30 Nov 81) pp 158-160

KOROBOV, A. I., BRAZHKIN, Yu. A. and BUGA, S. G., Moscow State University

[Abstract] An instrument has been built for measuring the velocity v of acoustic waves in solids by the pulse and modulation method with fixed time delay, namely measuring the length of travel time τ through a specimen of given length. Both a constant electric field $E_{=}$ and a harmonically alternating electric field $E_{\sim}(t)= E_m \cos\Omega t$ are applied across the specimen. Expansion of the resultant electric field $E_{=} + E_{\sim}(t)$ in a Taylor series yields $\Delta\tau/\tau = -\Delta v/v$ and $d^n\tau/\tau\, dE^n = d^n v/dE^n$. The time difference $\Delta\tau$ here is converted to a proportional voltage difference ΔU and Fourier analysis of the latter yields the amplitudes of the signal at frequencies $n\Omega$, from which the magnitudes of the derivatives $d^n v/dE^n$ can be determined. The instrument measuring these derivatives consists of a generator of nanosecond video pulses with a triggering time-delay generator, a 30 MHz quartz transducer, three voltage amplifiers, a high-voltage rectifier, an a.c. voltage generator with step-up transformer, two synchronous detectors, a frequency doubler, and a stroboscopic oscilloscope. The sensitivity of this instrument is limited by 20-30 mV noise in the oscilloscope with its input amplifier and output amplifier. The time difference is measured with a maximum error of $\pm$0.005 ns, the velocity determination is accurate within 0.1%. Figure 1, references 4.
[100-2415]

UDC 621.924

FINISHING STEELS WITH ABRASIVE PASTES CONTAINING WATER CONDENSATE

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 1, Jan 83, p 46

MASLOVSKIY, V. V., candidate of technical sciences, SMAL', N. M., engineer, and TOVSTOVYAK, I. G., engineer

[Abstract] An investigation is made of the modification of abrasive properties of polishing powder by additives based on water condensate waste of Shchebekinskiy Chemical Plant. Such condensate contains 30% by mass of such

low-molecular acids such as acetic, formic and caproic. Laboratory and industrial tests were done on final grinding of cutters in electric razors by using abrasive finishing paste with and without the water condensate additive. It was found that the operation using the paste with additive removed more metal and left a cleaner edge than without the additive. The amount of metal removed increases with concentration of the additive up to about 4 mass %, and then begins to fall. It is concluded that water condensate containing low-molecular acids of the C_1-C_4 fraction is a promising raw material for abrasive finishing pastes. Figure 1.
[117-6610]

UDC 621.822

METHOD OF CHECKING AXIAL TIGHTNESS OF BALL BEARING BY MEASUREMENTS OF SUPPORT STIFFNESS

Moscow MASHINOVEDENIYE in Russian No 1, Jan-Feb 83
(manuscript received 18 Jun 81) pp 49-51

PETRENKO, V. Ye., Kiev

[Abstract] An investigation is made of the influence of axial tightness on the axial and radial stiffnesses of a mechanical system that contains a rotor seated on a shaft of finite stiffness turning in radial thrust ball bearings with the outer rings in elastic covers. It is assumed that the stresses and strains in force contact of the bearing components are related by Hertz law $F_i = F_i w_i^{3/2}$, where F_i is the contact reaction, w_i is contact deformation, K_i is a constant coefficient, and deformations are such that the effect of hysteresis friction on the elastic characteristic of the ball bearings can be disregarded. The covers and the shaft are deformable only in the axial and radial directions respectively. The elastic characteristics of the covers are identical, and are linear as are those of the shaft. The materials of the ball bearing components are homogeneous and isotropic. It is shown that the finite rigidity of the covers and shaft reduces the sensitivity of the axial and radial stiffnesses to a change in axial tightness. Assuming that the axial rigidity of the two covers is equal to or greater than the shaft rigidity, the sensitivity of axial stiffness to a change in axial tightness of the given structure is greater than the radial stiffness for contact angles in the ball bearings of less than 63.5°. Figure 1, references 6 Russian.
[116-6610]

UDC 621.527

ULTRAHIGH-VACUUM HELIUM EVAPORATIVE CRYOPUMP

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep-Oct 82 (manuscript received 2 Jun 81) pp 196-198

KANTER, B. Z. and KOZHUKHOV, A. V., Institute of Semiconductor Physics, Siberian Department, USSR Academy of Sciences, Novosibirsk

[Abstract] The authors describe a cryopump intended for use in a heated molecular-beam epitaxy facility. The evacuating components of the pump are a coiled tube and a hollow disk. Helium vapor is admitted to the coil from a Dewar flask and evacuated from the disk through a system of coaxial thin-walled cylinders. The coaxial arrangement of the channels for helium supply and exhaustion reduces heat influx by radiation, reduces the overall dimensions of the supporting part of the pump and makes the construction more feasible from the technological standpoint. Fittings are provided for installing the pump in any position on a standard vacuum chamber flange. The entire unit can be heated to 300-350°C during outgassing of the vacuum system. The pump removes active and heavy inert gases by condensation on a surface cooled by helium vapor to a temperature of 20-22 K. Evacuation rate of the pump with respect to nitrogen is 2400 ℓ/s. Startup time is 12 minutes, limiting pressure is $<10^{-9}$ Pa, and consumption of liquid helium is 1 ℓ/hr. This evaporative cryopump has been used in a molecular-beam epitaxy facility in conjunction with a magnetodischarge pump with evacuation rate of 200 ℓ/s, maintaining pressure of $5 \cdot 10^{-7}$ Pa in the working chamber during deposition with a gas load of 10^{-3} $\ell \cdot$Pa/s. Figures 3, references 9: 5 Russian, 4 Western.
[90-6610]

UDC 621.822-251:531.781

MEASURING RADIAL FORCES IN ROTOR BEARINGS

Moscow VESTNIK MASHINOSTROYENIYA in Russian No 10, Oct 82 pp 30-31

GRINKEVICH, V. K., doctor of technical sciences, NESELOVSKIY, E. A., candidate of technical sciences, and SUSANIN, V. I., candidate of technical sciences

[Abstract] A method is described for using a ball or roller bearing to measure the radial forces acting in rotor bearings. The sensing element that takes the load is the stationary ring of the bearing weakened by six recesses arranged uniformly around the circle and made in various shapes. Strain gages are cemented in the weakened areas in such a way that the center of the grid of strain gages coincides with the midsection of weakened regions, while the longitudinal axis of the grid is located in the plane of the ball races. The least thickness of the weakened cross section of the ring is determined by considering the weakened areas as a beam of constant cross section over which

a concentrated variable load moves with a certain velocity. The calculation is based on the maximum admissible deformation of the strain gage resistor. Diametrically opposed strain gages are connected in half-bridges with output to strain-measuring equipment. The proposed method can be automated by output to an analog computer. Figures 3, references 2 Russian.
[83-6610]

UDC 621.362:621.383.5

SELECTIVE OPTICAL COATINGS BASED ON BLACK OXIDE FILMS OF COBALT PRODUCED BY PYROLYSIS

Tashkent GELIOTEKHNIKA in Russian No 6, Nov-Dec 82
(manuscript received 5 Feb 82) pp 28-30

KOLTUN, M. M., RYABOVA, L. A. and AGAYEV, E. A., All-Union "Order of the Red Banner of Labor" Scientific Research Institute of Current Sources

[Abstract] High-quality cobalto-cobaltic oxide films are produced by pyrolysis of cobaltic acetylacetonate in a carrier gas flow. The backing was aluminum foil. The Co_3O_4 films had a successful combination of optical properties and high stability. Oxygen was used as the carrier gas to prevent contamination of the Co_3O_4 film with carbon produced by dissociation of the hydrocarbon gas products. Film thickness ranged from 0.15 to 0.3 μm. The thicker coatings had the best optical and mechanical characteristics. The films have low reflectivity in the vicinity of the solar spectrum, with a considerable increase at $\lambda \geq 3$-5 μm. These selective films can be produced on practically any metal surface at comparatively low temperatures (350-450°C) under industrial conditions. Figures 2, references 4: 3 Russian, 1 Western.
[136-6610]

UDC 621.384.326.22.536

ABSOLUTE RECEIVER FOR MEASURING SOLAR RADIATION DENSITY IN VACUUM

Tashkent GELIOTEKHNIKA in Russian No 6, Nov-Dec 82
(manuscript received 28 Oct 80) pp 50-53

PADERIN, L. Ya., GORSHENEV, V. G. and SUVOROV, V. P., Moscow

[Abstract] A design is considered for an absolute radiation receiver for measuring the density of solar radiation. The device is essentially a disk-shaped sensing element fastened on a housing equipped with a resistive heater and thermal converters. The sensor is held on the housing by heat insulators or thermoelectrode wires. The face of the element is a profiled surface formed by annular grooves and projections of triangular shape. The coating on this face combined with the roughness produced by the grooves

forms a surface that simulates an ideal black body. The back side of the disk and the inside of the housing are mirror surfaces to minimize radiant heat exchange between disk and housing. The bottom of the cylindrical housing is a frustum of a cone with upper base of radius smaller than that of the disk, and taper angle greater than the angle of divergence of the rays in the solar flux, so that when the sensor is perpendicular to the solar flux the radiation reflected from the housing does not reach the disk. Calculations and experimental results are given, showing that the measurement error of the receiver is less than 3%. Figures 2, references 7 Russian.
[136-6610]

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B3 - COLLECTION CODE:   3
B6 - MANAGEMENT CODE:   XR
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B18- ANNOUNCE:          0000
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B21- LIMITATION:        0
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B42B-SUPPLIER SRC CD:   n
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ipment, No. 94.[                    @@@
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