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ELECTRONICS AND ELECTRICAL ENGINEERING

No. 112

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QUANTUM ELECTRONICS/ELECTRO-OPTICS

UDC: 531.383

INFLUENCE OF TECHNOLOGICAL FACTORS ON ERROR OF DYNAMICALLY TUNABLE GYROSCOPE WITH DISPLACED CENTER OF MASS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 4, Apr 83 (manuscript received 20 Jul 81) pp 52-56

ZBRUTSKIY, A. V., BALABANOV, I. V. and LIPATNIKOV, V. I., Kiev Polytechnical Institute

[Abstract] A study is made of the accuracy characteristics of a dynamically tunable gyroscope as a function of its technological errors resulting from the fact that the elastic axes of the support do not perfectly intersect and are not perfectly perpendicular, from displacement of the axes of sensitivity of the angle sensors, imprecise resonant tuning, static displacement of the center of mass of the Gimbal ring and rotor relative to the suspension point. All elements of the gyroscope are assumed absolutely rigid, the elastic torsion springs are assumed to permit only twisting deformation around their axes. The studies show that the technological imperfections analyzed may have a significant influence on the accuracy of the gyroscope and should be considered in analyzing gyroscope errors. The paper was recommended by the Department (Kafedra) of Theoretical Mechanics. Figures 1; references 7: 6 Russian, 1 Western.
[241-6508]

UDC: 629.7.054.001

MINIMIZATION OF ONE CLASS OF TEMPERATURE ERRORS IN FLOATING GYROSCOPIC INSTRUMENTS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 4, Apr 83 (manuscript received 15 Apr 82) pp 80-83

DZHASHITOV, V. E. and PANKRATOV, V. M., Saratov Polytechnical Institute

[Abstract] A study is made of the method of decreasing the thermal drift of floating gyroscopic instruments by acting on the primary cause of drift of the instrument--the temperature field itself, making it more uniform, considering that this method is more effective than the method of compensating

for the drift moments caused by temperature field irregularities in the gyroscopic instrument. In the mathematical simulation of the problem, the instrument is replaced by a grid analog, i.e., it is divided into a number of elementary equal volume geometric forms, the centers of which are taken as the calculation points. The numerical method of calculating the temperature field of the instrument is used to solve the problem in combination with methods of the theory of experimental planning, seeking optical conditions. The results of the study are used to construct a topogram of the distribution of the aperture drops over the inner surface of the body of the gyroscope and curves of the variation in convective force moment in the working gap as a function of time. Mathematical modeling of the thermal processes in floating instruments in combination with the theory of experimental planning can thus find the parameters for design changes in an instrument in order to minimize errors. The paper is recommended by the Department (Kafedra) of Theoretical Mechanics. Figures 2; references: 4 Russian.
[241-6508]

UDC 621.371.33

VOLTAGE AT INPUT OF SHORT-WAVE RECEIVERS IN URBAN DWELLINGS

Moscow ELEKTROSVYAZ' in Russian No 6, Jun 83 (manuscript received 20 Sep 82) pp 47-49

NIKONOV, G. I.

[Abstract] The standard relation for the voltage at a receiver set proportional to the square root of the incident signal power density is revised so as to make it applicable to short-wave receivers installed in urban dwellings, i.e., receivers of the transistor type with randomly oriented magnetic or rod antennas. The power absorbed and reflected by surrounding air on the way to a receiver set inside a structure with metal and dielectric objects is taken into account. A definitive dependence of both power components on the incidence angle of incoming electromagnetic waves is established. This dependence is qualitatively the same for urban and rural (open) territories. Calculations, confirmed by measurements in a large city, have yielded an expression for the signal-to-interference ratio as a function of the signal incidence angle. The results are useful for allocation of short-wave antennas and proper placement of short-wave receiver sets in apartments. Figures 2; tables 1; references: 5 Russian.
[271-2415]

UDC 621.373.42

DYNAMIC PROCESSES IN DIGITAL FREQUENCY SYNTHESIZER WITH PULSE-TYPE FREQUENCY-PHASE DETECTOR

Moscow ELEKTROSVYAZ' in Russian No 6, Jun 83 (manuscript received 15 Jul 80) pp 50-54

MALINOVSKIY, V. N. and ROMANOV, S. K.

[Abstract] A digital frequency synthesizer with a pulse-type frequency-phase detector is considered, the latter consisting of a voltage generator with a pulse modulator and a pulse shaper in a series behind. The generator is controlled by a logic circuit, both modulator and shaper are controlled by pulses from the variable-quotient frequency divider through a pulsing device. The detector is preceded by a reference-signal source. Behind the detector there is a low-pass filter followed by a control generator and then a shaping device before the frequency divider. The synthesizer can be in seven states and there are, correspondingly, seven transient modes. The mathematical model for analysis of the dynamic behavior consists of two integro-difference matrix equations, one of them transcendental, with the low-pass filter represented as a quadripole network and with the largest integer equal to or smaller than the ratio of pulse travel time to reference-signal period characterizing the existence of states. An algorithm is constructed for calculating the transient periods for a given pulse repetition rate at the modulator output. This algorithm has been programmed on a computer. Calculations are shown for the case of a proportional-integrating low-pass filter and a detector with a sawtooth characteristic. The results reveal that without the detector the duration of a transient does not significantly depend on the magnitude of the frequency jump. However, with the detector operating it can become much longer. Figures 6; tables 2; references: 6 Russian.
[271-2415]

UDC 621.391.2

CHARACTERISTICS OF DISCRETIZATION ERRORS IN REGULAR MEASURING DATA TRANSMISSION SYSTEM WITH DIRECT AND INVERSE ORTHONORMAL WALSH TRANSFORMATION

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE
in Russian Vol 26, No 2, Feb 83 (manuscript received 24 May 82) pp 7-11

ZHURAVIN, L. G., IVANOV, V. M. and SEMENOV, Ye. I., Leningrad Institute of Electrical Engineering imeni V. I. Ul'yanov (Lenin)

[Abstract] Regular discretization of an ensemble of continuous messages with noncorrelated or weakly correlated components in a measuring data transmission system with time division of channels and pulse-amplitude modulation by the Walsh group method is considered for improving both accuracy and interference immunity. The system structure includes an orthonormal Walsh transformer with a commutator switch at the sending end of the communication line and a pulse distributor followed by a set of approximators and then an inverse orthonormal Walsh transformer at the receiving end. The order of the Walsh matrix for continuous (in time) linear orthonormal transformation of random input processes is the same as the dimensionality of the vector function representing the input process. The characteristics of the discretization error, namely its dispersion and correlation moments, can be evaluated according to the general rules for random processes and Walsh transformations. Calculation of the correlation coefficients for the error components is generally difficult, but relatively simple in the two extreme cases of maximum and minimum effect of direct and inverse orthonormal Walsh transformations. The first case corresponds to N noncorrelated stationary random input processes. The second case corresponds to a single stationary random input process. Such an error analysis for a typical case of one active input signal $x_{15}(t) = -\alpha t$ with N = 16 and retrieval by means of zero extrapolation indicates that this method is much more accurate than the conventional method of separate regular discretization. The paper was recommended by the Department (Kafedra) of Information-Measuring Technics. Figures 2; tables 2; references: 3 Russian.
[262-2415]

UDC 621.391.837:621.371.222

PRECISE CALCULATION OF FIELD INTENSITY COVERING 30-1000 MHz FREQUENCY RANGE IN HILLY AND MOUNTAINOUS TERRAIN

Moscow ELEKTROSVYAZ' in Russian No 6, Jun 83 (manuscript received 30 Nov 82) pp 44-47

SHUR, A. A. and MEL'NIKOV, B. F.

[Abstract] A simple but precise model is proposed for calculating the electric field intensity, over the 30-1000 MHz frequency range which covers television and ultrashort-wave FM bands, in hilly and mountainous terrain according to the CCIR and OIRT definition of median intensity (50% of territory--50% of time). A receiving point is selected on an imaginary spherical surface above the earth surface, its radius extending to mid-height of the actual ground profile, assuming regular asperities with statistically uniform height distribution. Beyond approximately 15 km from a transmitter antenna of fixed height the propagation curve for decimetric waves runs below the propagation curve for metric waves so that receiver antennas stand in 50% of locations within the shadow of a topological obstruction. The clearance height and the field attenuation are calculated, as functions of the wavelength, on the basis of terrestrial geometry and surface profile statistics. An expression is obtained for the correction term to be added to the median electric field intensity at given locations on uneven terrain. Numerical values based on this theoretical model are higher than expected. So are experimental data available from extensive measurements made in Moldavia as well as in Stavropol and Krasnodar Krays. The correction term is adjusted accordingly, but the variance still remains very wide when correction is made for a small reception zone and the accuracy becomes good only when correction is made for a large enough reception zone. Figures 5; tables 3; references 5: 2 Russian, 3 Western (1 in translation). [271-2415]

UDC 621.395.344

ESTIMATION OF CAPACITY OF PERIPHERAL PROCESSOR FOR QUASI-ELECTRONIC AUTOMATED INTERURBAN TELEPHONE EXCHANGE

Moscow ELEKTROSVYAZ' in Russian No 6, Jun 83 (manuscript received 25 Nov 80) pp 30-31

GONCHAROK, M. Kh. and YAKOVENKO, D. A.

[Abstract] The capacity of a peripheral processor connecting peripheral control devices to the "Neva-1M" control complex in large quasi-electronic automated interurban telephone exchanges is estimated, assuming a passive rather than active telephone periphery. It is defined in terms of speed, i.e., time to execute an instruction in order to determine a change of state, this time being equal to the time for generating data on detection of a change of state plus the time of one communication between processor and control device.

It is calculated as a function of two parameters characterizing, respectively, the hardware structure and the software structure of the detector array. The processor speed, the number of operations per unit time, increases linearly with the number of lines in the detector array which the processor can scan while executing a single change-of-state group instruction. Upper and lower limits of the acceptable processor performance range are established on this basis, for a typical exchange with a capacity of 8000x2 lines. For one with a fixed microcycle of $\tau_0 \leq 10$ μs duration is recommended only a two-channel peripheral processor with $\alpha \geq 5$, for one with a floating microcycle of $\tau_0 \leq 6$ μs duration are recommended only either a two-channel processor with $\alpha \geq 2$ or a single-channel processor with $\alpha \geq 5$. Figures 2; tables 2; references: 1 Russian.
[271-2415]

UDC 621.395.374

SPECIAL FEATURES OF FITTING ARM-20 EXCHANGES IN LARGE NODAL CENTERS

Moscow ELEKTROSVYAZ' in Russian No 6, Jun 83 (manuscript received 18 Apr 82) pp 32-35

GERCHIKOV, Z. Ye.

[Abstract] Regional (republic-wide) interurban telephone networks throughout the Soviet Union use ARM-20 crossbar equipment in terminal exchanges and sometimes also tandem exchanges, lines being connected through corresponding FUR outgoing and FIR incoming sets. Various configurations were considered for fitting this equipment into a large nodal center of the Moscow interurban network with three such exchanges. These three exchanges could be functionally separated, with two fitted as outgoing ones and the third fitted as an incoming one, or all three could be fitted as outgoing and incoming ones. The first variant ensures stronger connections and simplifies the overall equipment, but excludes the possibility of cutting into a line for inspection while subscribers are connected without first determining the number of the caller. More economical is a hookup of each zonal automatic exchange to only one interurban exchange. In this setup one of the two outgoing exchanges is designed to operate with a high channel utilization factor, while the other is designed for high quality of service with capacity to take up excess load from the first one. Figures 4; references 2 Russian.
[271-2415]

UDC 681.326:621.395.34

SOFTWARE OF 'KVARTS' QUASI-ELECTRONIC AUTOMATED INTERURBAN TELEPHONE EXCHANGES

Moscow ELEKTROSVYAZ' in Russian No 6, Jun 83 (manuscript received 10 Dec 81) pp 19-22

DEDOBORSHCH, V. G. and SHNEPS-SHNEPPE, M. A.

[Abstract] The software of "Kvarts" quasi-electronic automated telephone exchanges is based on the use of a special-purpose control computer complex, which ensures high reliability of all line equipment. This computer complex is centralized and control is effected through peripheral as well as distributing and scanning equipment. A connection between subscribers is made in three basic steps: call, selection, answer. Each step may involve repetitive procedures. The necessary software has been designed to cover four stages of conversion to the "Kvarts" system: installation and debugging of the first "Kvarts" exchange, pilot operation, actual service operation, commercial operation of "Kvarts" exchanges. It was proved out during 3 years of experimental operation in the Leningrad interurban network. The scope of this software is vast, the programs contain up to 250,000 instructions for starting up an exchange alone and required over 500 programmer man-years to be written. The last stage, successful commercial operation, requires setting up a programming center and a standard engineering procedure for programmatically controlled hardware operation. It also requires a complete facility for program debugging and establishment of a hardware inspection-correction procedure. Control computers as well as larger computers, say YeS Unified System computers, can be used for solving the problems of stage four. Figures 2; references: 2 Russian.
[271-2415]

UDC 681.372.8

IDENTIFICATION OF SIGNALS WITH TWO DEGREES OF FREEDOM

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 2, Feb 83 (manuscript received 23 Mar 82) pp 24-28

ATROSHCHENKO, V. G., Leningrad

[Abstract] Identification of signals with two degrees of freedom $S_t=\sum_{i=1}^{2}\alpha_i\varphi_{it}$, $t\in[0,T]$ (φ_{1t}, φ_{2t} - basis in functional space $\emptyset$; α_1, α_2 - scaler coordinates of signal S_t in space $\emptyset$, T- length of observation time interval) is considered, an example being signals with combined amplitude and phase modulation. The problem is solved by the Mayes method of testing mutually exclusive hypotheses, both states assumed to be equiprobable

and the Bayes penalty matrix assumed to be a simple one $C_{ij} = 1 - \delta_{ij}$ ($i,j = \overline{1,L}$; L- power of finite set; δ- Kronecker delta). Synthesis of the optimum Bayes identifier is difficult, because satisfying the condition of equal probability densities requires a solution of integral equations. Synthesis of a quasi-optimum Bayes identifier satisfying the approximate condition of minimum distance from the membership set is simpler. For illustration, such a quasi-optimum identifier is synthesized here for amplitude-and-phase modulated signals with usually regular phase coding. References 2: 1 Russian, 1 Western in translation.
[262-2415]

IMPROVING EFFECTIVENESS OF RADIO RELAY EQUIPMENT

Moscow VESTNIK SVYAZI in Russian No 5, May 83 pp 33-35

MEDYANIK, P. M., chief, Government Inspection of Electrical Communication Systems, Production-Engineering Management of Communications, Chechen-Ingushskaya ASSR

[Abstract] Narrow-band radio relay equipment is used for aircraft navigation within the assigned 390-470 MHz frequency range. Because of this, electromagnetic compatibility superimposes large limitations on the use of this spectrum, interference from sources within a 15-30 km radius being the most objectionable. Rumble and spurious actuation of cross-bar automatic telephone exchange equipment in the 435-453 MHz channel, for instance, can easily occur and cause jamming of all lines. For this reason, "Konteyner" radio relay stations are built for operation at frequencies of the first pair in a four-frequency scheme. Radio relay junctions should be allowed to operate also at frequencies of the second pair so as to accommodate twice as many outgoing lines. Channel equipment for such a scheme of operation must have high interference immunity and a linear frequency characteristic, typically within $\pm$0.2 dB over a 4-120 kHz band. Accordingly a station will be laid out with two bays, one existing and one modified, and two-way equipment connected for transmission or reception, respectively. Provision will be made for checking the channel performance, according to specifications and norms, through intermediate stations or by direct link. Experience has already shown that correct frequency assignment can ensure reliable interference-free operation of regional "Konteyner" radio relay systems with sufficiently high channel capacity. Figures 4.
[247-2415]

UDC 681.335(088.8)

CALCULATION OF AFFINE FUNCTION GENERATOR OF TWO VARIABLES

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE
in Russian Vol 26, No 4, Apr 83 (manuscript received 24 Aug 82) pp 39-44

KALININ, G. A., Kharkov Institute of Electronics

[Abstract] Function generators of 1 and 2 variables can reproduce a broad class of nonlinear functions and are used in computing technology and control systems either as independent modeling units or as analog and analog-digital computing machines and systems. Interpolating and approximating function generators are differentiated. Previous works have described both types and indicated means for their construction. This work studies the planning and utilization of these function generators which reproduce affine representations of piecewise-linear functions. The results of computer approximation are printed out in tabular form. A flow chart is presented of an affine function generator of two variables. The sequence of operations of static design of a two variable affine function generator is formulated. The paper was recommended by the Department (Kafedra) of Computing Technology.
Figures 1; tables 1; references: 6 Russian.
[241-6508]

UDC 62-5(088.2)

METHOD OF CALCULATING ANGLE OF ORIENTATION OF PART FOR ADAPTIVE INDUSTRIAL ROBOT CONTROL SYSTEM

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 4, Apr 83 (manuscript received 16 Jun 82) pp 61-64

ZHABOTINSKIY, Yu. D. and VINOGRADOV, I. G., Rybinsk Institute of Aviation Technology

[Abstract] A method is suggested for calculating the angle of orientation of a part based on the effect of its rotation when clamped by a robot. It is assumed that the part, which is a simple geometric shape, is clamped by plane parallel jaws. The effect of rotation of the part as it is clamped can significantly simplify the process of determining the angle of orientation. The required accuracy of calculation of the angle between the side of the part clamp section and the clamp jaw required to assure rotation of the part is determined. A block diagram of a specialized computer implementing the equations derived in this article is presented and briefly expalined. The device is said to use 25% fewer microcircuits than a similar device functioning by the method of two-arc circular scanning. The paper was recommended by the Department (Kafedra) of Theoretical Mechanics. Figures 3; references: 3 Russian.
[241-6508]

UDC 681.323:007.52

MODELING COMPUTER SYSTEM TO STUDY INDEPENDENT ROBOT MANIPULATOR CONTROL SYSTEMS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 4, Apr 83 (manuscript received 25 May 82) pp 30-35

KRYUKOV, R. M., PITERSKIY, A. I. and PITERSKAYA, L. N., Taganrog Electronics Institute imeni V. D. Kalmykov

[Abstract] A study is made of the principles of constructing the module which controls the motion of the manipulator of an independent robot by seminatural modeling and the method of cross development using both digital and specialized computers. Planning and control systems based on digital and specialized

computers are analyzed, as are methods of planning motion-control systems using these devices. The combination of the two types of computers allows the following tasks to be performed: identification of a dynamic model of the manipulator; debugging of special computer algorithms and programs; and analysis of the quality of the control systems of the actual object. Debugging utilizing digital computers in cooperation with specialized computers can save approximately 20 man-days per 100 man-days which would normally be required in this operation. This approach to the study and planning of manipulator control systems has the advantages of simple implementation and broad applicability for analysis of the quality of various actual objects in real time. The paper was recommended by the Institute. Figures 3; references 6: 4 Russian, 2 Western.
[241-6508]

UDC 535.8

SPECIFICS OF OPTICAL SYSTEM OF SCANNING MIRROR FOURIER SPECTROMETER

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE
in Russian Vol 26, No 4, Apr 83 (manuscript received 16 Jun 82) pp 73-75

TSUKANOVA, G. I. and SMIL'TNEK, T. P., [deceased], Leningrad Institute of Precision Mechanics and Optics

[Abstract] A study is made of the specifics of calculating the optical system of a mirror-type Fourier spectrometer with a broad angular field. The input lens is a reflector and consists of two hyperbolic mirrors and a flat mirror, operating with two reflections from the primary mirror and correcting spherical aberration, coma and astigmatism. Only image curvature remains uncorrected, necessary for internal scanning which is performed by rotating the flat mirror installed at a distance from the plane of the image equal to the radius of curvature of the image surface. Protection of the image plane from light reflected from the first and second mirrors alone is studied, as is protection of the image plane from extraneous light reflected from the first mirror and the flat mirror. The diameter of the circle of confusion of the entire system over the entire field is not over 0.09 mm, with vignetting around the edge of the field not over 25%. The paper was recommended by the Department (Kafedra) for the Theory of Optical Devices. Figures 1; references: 5 Russian.
[241-6508]

UDC 621.3.06

COMPUTATION OF AMPLITUDE AND PHASE-FREQUENCY CHARACTERISTICS FROM TRANSIENT CHARACTERISTICS USING SINGLE-USER MICROCOMPUTERS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE
in Russian Vol 26, No 4, Apr 83 (manuscript received 7 Jul 82) pp 69-72

D'YAKONOV, V. P., Smolensk Branch of Moscow Power Engineering Institute

[Abstract] The advent of large numbers of microcomputers has made it possible to calculate the amplitude-frequency characteristics and phase-frequency characteristics of linear systems and electronic circuits based on their transient characteristics over a very broad frequency range, from 0 to tens of GHz, where experimental determination of these characteristics is difficult

or impossible. Calculation of the two characteristics by computer is reduced to the numerical integration of two equations presented in the text, a rather complex task, because the equations include rapidly oscillating factors. A method of curve displacement is shown which makes the problem accessible to microcomputers. A program which calculates the amplitude and phase frequency characteristics based on the transient characteristics by means of the "Elektronika B-34" programmable calculator is appended. A second program is also presented which calculates the same characteristics using the "Elektronika D3-28" desk top microcomputer. The paper was recommended by the Department (Kafedra) of Industrial Electronics. References: 4 Russian.
[241-6508]

UDC 621.378.9:535.8

INFLUENCE OF SIGNAL FIELD PHASE DISTORTIONS ON PHOTODETECTOR CURRENT LEVEL

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE
in Russian Vol 26, No 4, Apr 83 (manuscript received 8 Nov 82) pp 75-79

MINAYEV, I. V. and RUBTSOV, S. V., Moscow

[Abstract] A method is developed for estimating the decrease in effectiveness of coherent optical systems with heterodyning caused by optical track aberrations characteristic of communications channels outside the atmosphere, for example space systems. It is considered that the optical track is adjusted and that there are no phase distortions of the heterodyne field. This means that the leading edge of the signal wave at the output of the optical system is monotonic and symmetrical relative to the optical axis. The results produced indicate the desirability of using the decrease in current level at the output caused by optical track aberrations as an index of the effectiveness of coherent optical systems with heterodyning. There is no need to produce the wave aberration functions by calculating ray paths through the optical system over the entire width of the optical beam. It is sufficient to calculate transmission of a single beam striking the edge of the aperture of the photodetector. Figures 2; references 6: 3 Russian, 3 Western in translation.
[241-6508]

UDC [625.1:621.311.4:621.33:621.314.632:621.382.2].004.68

PREDICTING DEMAND FOR DIODES FOR REPLACEMENT IN TRACTION RECTIFIER SUBSTATIONS IN RAILROAD SYSTEM DURING SERVICE

Moscow ELEKTROTEKHNIKA in Russian No 5, May 83 (manuscript received 9 Sep 82) pp 52-55

BOBROV, Ye. G., candidate of technical sciences, and SOBOLEV, Yu. V., candidate of technical sciences, All-Union Scientific Research Institute of Railroad Transportation, Ural Department

[Abstract] Following the introduction of semiconductor-type rectifiers UVKE1, PVE-3 with forced air cooling and PVKYe, PVE-5 with natural air cooling into railroad traction-power substations in 1982, reliability studies have been made concerning the life characteristics of V200 and VL200 power diodes with pin construction and soldered connections. High thermal resistance was found to be the principal factor contributing to excessive temperature rise and shrinking overvoltage margin, according to data produced by periodic inspections. Fatigue-resistant V8-250 and V2-320 diodes have been developed subsequently for replacement on the basis of a probabilistic failure analysis. All rectifier diodes in service have been classified into four groups according to rate of aging (high, medium, low) in substations delivering over or under 50,000 kW·h of electric energy daily to trains running on single-track or double-track lines in the mountains or in the plains. The integral distribution curve of thermal resistance has been calculated on the basis of a log-normal law and its statistical characteristics determined accordingly. The results yield simple relations for the life of diodes and for the replacement demand. On the assumption that all diodes have been installed simultaneously and are inspected for thermal resistance at intervals not longer than their mean useful life, the relative mean demand for replacement (percentage of the total number of diodes installed) as a function of the length of operating time oscillates first widely and then with decreasing amplitude about a level which corresponds to the end of the mean useful life and at which it remains fairly constant after the length of operating time has exceeded three times the mean useful life. The results of calculations are confirmed, with fair accuracy, by operating experience in the Sverdlovsk Railroad system. Figures 4; references: 3 Russian.
[265-2415]

UDC 62-83:007.052

A DEEPLY CONTROLLABLE MICROELECTRODRIVE

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE
in Russian Vol 26, No 4, Apr 83 (manuscript received 9 Mar 82) pp 27-29

VODOVOZOV, V. M., VYAZEMISKIY, V. O. and DANILIN, S. N., Leningrad Institute of Electric Engineering imeni V. I. Ul'yanov (Lenin)

[Abstract] The microelectrodrive analyzed in this work is distinguished by the simplicity of the regulator circuit, and can be used with transducers with resolution of not over 1000 discrete pulses per revolution. The two ranges of speed regulation of the drive correspond to two different structural states of the system. In the "walking" speed range, the signal from a pulse sensor is sent to a frequency-to-duty factor converter controlling the transistor amplifier of the microelectrodrive. Upon transition to the high-speed mode, on the order of 100 revolutions per second, a frequency divider is automatically included in the sequence, the output of the divider controlling the amplifier. The variable structure of the microelectrodrive thus allows stabilization of speeds of rotation of the electric motor which differ by a factor of more than 100 over a broad range of loads on the shaft with fixed power supply voltage. The paper was recommended by the Department (Kafedra) of Electrofication and Automation of Industry. Figures 3; references 2: 1 Western, 1 East European.
[241-6508]

UDC 62.501

METHOD OF SOLVING BADLY-STIPULATED IDENTIFICATION PROBLEMS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE
in Russian Vol 26, No 2, Feb 83 (manuscript received 25 May 82) pp 20-24

CHERNORUTSKIY, I. G., Leningrad Polytechnic Institute imeni M. I. Kalinin

[Abstract] A method of solving identification problems is proposed, applicable to badly stipulated optimization problems as well. Its gist is a coordinate-wise search for the optimum of the sought functional according to a minimization criterion of the "gullied" kind, the axes of coordinates

changed sequentially so as to match the eigenvectors of Hess matrices of quadratic functionals approximating the sought one. The five-step algorithm makes use of plane Jacobi rotations and applies to any badly-stipulated problem, provided information about the Hess matrices is readily available. It is demonstrated by two examples, a dynamic system with an exponential phase trajectory and a quadratic functional with an $s = 10^{12}$ "gully" between eigenvalues. The author thanks V. I. Gorodetskiy for discussion and helpful comments. The paper was recommended by the Department (Kafedra) of Information and Control Systems. References 9: 6 Russian, 3 Western in translation.
[262-2415]

UDC 621.317.39:519.24

IDENTIFICATION OF SMALL SHIELDED EDDY-CURRENT TRANSDUCER BY METHOD OF PLANNED EXPERIMENT

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 2, Feb 83 (manuscript received 23 Oct 82) pp 48-52

ZAPUSKALOV, V. G. and KARPOV, V. M., Moscow Higher Technical School imeni N. E. Bauman

[Abstract] A small eddy-current transducer with an 8-form induction coil wound on a split toroidal core and wrapped in an electromagnetic shield is the best type of displacement transducer for monitoring the movement of narrow-profile surfaces such as those of turbine blades with difficult accessibility, inasmuch as this configuration makes it possible to localize the maximum sensitivity so that the transducer can be made to fit into the available space. An analytical design optimization of such a transducer is difficult, because there are no engineering formulas available for the relations between geometrical dimensions and winding parameters of an 8-form coil. A classical theoretical method of calculations involves Fourier-Bessel transformations and unwieldy equations. Preferable, therefore, is an empirical method of mathematical statistics: planned experiment. The appropriate mathematical model is $Y = b_0 + \sum_{i=1}^{n} b_i x_i + \sum_{i<j}^{n} b_{ij} x_i x_j$ and the transducer Q-factor ($Q = 2\pi fL/R$) is expediently selected as the optimization parameter. A full 2^n-factorial experiment with $n = 3$ has yielded the necessary polynomial regression equation for Q as a function of three significant variables (wire diameter $d = 0.03$-0.1 mm, operating frequency $f = 0.5$-2.0 MHz, coil width $\delta = 1.6$-2.0 mm), with seven parameters held fixed (outside and inside shield diameters $D_o = 6.0$ mm and $D_o/D_i = 1.08$, coil height $h = 0.083D_i$, electrical conductivity and magnetic permeability of PNET-IMID copper wire and 12Kh18N10T steel foil for shield). A subsequent statistical analysis has yielded the relation $Q = -2.649 + 123.57d + 3.648f + 0.018\delta + 22.875df - 21.429d\delta$. The paper was recommended by the school. Figures 2; tables 1; references: 5 Russian.
[262-2415]

UDC 621.317.76

EXTRAPOLATION METHOD OF FREQUENCY MULTIPLICATION

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE
in Russian Vol 26, No 4, Apr 83 (manuscript received 23 Jun 81) pp 14-18

BARANOV, L. A. and LYZLOV, S. S., Moscow Institute of Railroad Transport Engineering

[Abstract] The extrapolation method of frequency multiplication is based on predicting the duration of interval n+1 of a pulse frequency signal with known intervals n, n-1, ..., n-M intervals, where M is the extrapolation order. Knowing $\tau^*[n+1]$ allows a supplementing interval n+1 of the pulse sequence of k-1 pulses so that the time interval between the supplementary pulses is equal to $\tau^*[n+1]/k$. The sequence produced corresponds to multiplication of the frequency by a factor of k. If $\tau^*[n+1]$ is equal to $\tau[n+1]$ and is the true length of interval n+1, the phase is preserved. This is generally not the case. However, considering the properties of the modulating function, an order of extrapolation can usually be selected corresponding to practically acceptable preservation of the phase in multiplication of the frequency. The method is illustrated by analyzing a simple method of multiplication using zero order extrapolation and predicting the duration of time interval n+1 based on that of time interval n. The method was used to develop a pulse-frequency device to measure the speed and acceleration of a locomotive in a digital automatic train driving system. The multiplier was based on medium scale integration elements and multiplied the frequency by a factor of 4. The pulse-frequency sequence was generated by a device which produced 60 pulses per wheel rotation. The paper was recommended by the Department (Kafedra) of Automatics and Telemechanics. Figures 4; references: 3 Russian. [241-6508]

UDC [621.3.045.12:537.312.62].001.3

SUPERCONDUCTOR WIRE FOR MAGNETIC SYSTEMS GENERATING ALTERNATING AND PULSED MAGNETIC FIELDS

Moscow ELEKTROTEKHNIKA in Russian No 5, May 83 (manuscript received 10 Jun 82) pp 42-44

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[Abstract] A material and a technology have been developed by the All-Union Scientific-Research Institute of the Cable Industry (VNIIKP) and the Institute of High Temperatures (IVT), USSR Academy of Sciences, for a superconductor wire. The superconductor material is NT-50 alloy (50%Nb + 50% Ti). An elementary wire strand consists of 126 superconductor fibers 25 micrometer in diameter each embedded in a composite copper-nickel matrix. Two specimens were evaluated experimentally, one with 6 superconductor strands twisted around a solid copper conductor 0.5 mm in diameter and one with a second layer of 12 superconductor strands twisted around the other six. The wires were insulated with Dacron fiber or Teflon tape to an electric strength of 1.0 and 4.5 kV respectively. The critical current and the maximum transport current as well as losses in an exponentially pulsed magnetic field with 1-50 T/s rates of change of magnetic induction were measured as functions of the magnetic induction from 0 to 6 T. Also measured were the minimum current for formation of a normal domain and the current dependence of its velocity of propagation. An analysis of experimental data, with the aid of theoretical relations, reveals how the apparent critical current density decreases with increasing wire size and with decreasing magnetic induction relative to the "true" critical current density in a single-strand wire. The data also reveal that the normal domain propagates at a velocity which increases approximately as the current squared. The stability limit can be estimated at $164 \cdot 10^{10}$ A/m^2. The results indicate the feasibility of attaining current densities up to $0.33 \cdot 10^9$ A/m^2, in a magnetic field of 5 T, in wire consisting of three layers of superconductor strands (6+ 12+ 18). Figures 4; tables 1; references 10: 8 Russian, 2 Western, 1 in translation.
[265-2415]

UDC 621.313.333.1:621.311.25:621.039.526

ELECTRIC MOTORS FOR MAIN CIRCULATION PUMPS IN ATOMIC ELECTRIC POWER PLANTS WITH BN-600 FAST REACTOR

Moscow ELEKTROTEKHNIKA in Russian No 5, May 83 (manuscript received 14 Oct 82) pp 2-6

VERBER, O. L., engineer, GERASIMENKO, Yu. N., candidate of technical sciences, ZHOROV, S. I., engineer, NARUTS, Ye. V., engineer, and NEYMAN, Z. B., candidate of technical sciences, "Uralelektrotyazhmash" (Ural Heavy Electrical Machinery) Industrial Association

[Abstract] BN-600 fast reactors in the third unit of the Beloyarsk atomic electric power plant are cooled with liquid sodium flowing through loops I and II. The main circulation pumps are of the immersible centrifugal type and of vertical construction. They are driven by series VAKZ wound-rotor induction motors specially developed for this application: 16-64-6AU4 for loop I (3400 kW, 100-990 rpm, efficiency 95% and power factor 91.5% with rotor winding shorted, overload factor 2.6) and 15-51-64U4 for loop II (1600 kW, 250-990 rpm, efficiency 94.8% and power factor 88% with rotor winding shorted, overload factor 2.4). These motors have been designed to match the torque-speed characteristics of the pumps, their rotors with flywheels have large moments of inertia (17,000 and 14,000 $N \cdot m^2$ respectively) to ensure better reliability during fault conditions. They have been designed for operation at 6000 V - 50 Hz nominal supplied from an asynchronous inverter bank, also during large voltage dips down to 60% nominal and with automatic restarting after 1.2 s long interruption of voltage supply. The stators have two-speed windings with pole switching with speed regulation by means of a thyristor-type frequency converter. The rotors have delta-connected windings, the brush life is 4000 hours. Special structural features are large stator bore and small active length for maximum stability in vertical position, thrust bearing between two guide bearings, all segmental with babbit journals, direct mounting on pump case to avoid decentering due to temperature fluctuations, thermosetting insulation of phase windings, self-cooling, and protective enclosure for operation in radioactive environment. The performance of these motors in service so far has been satisfactory, but vibrations and resonances as well as effects of temperature fluctuations need to be further monitored. Figures 3; tables 3; references: 4 Russian.
[265-2415]

UDC 621.315.23.3.017.71/72.001.24

CALCULATION OF TEMPERATURE FIELD OF UNDERGROUND CABLES UNDER PERIODICALLY VARYING LOAD

Moscow ELEKTROTEKHNIKA in Russian No 5, May 83 (manuscript received 2 Aug 82) pp 45-46

KHOLODNYY, S. D., doctor of technical sciences, and GALAN, V. V. (Viktor Vong), candidate of technical sciences, Moscow Institute of Power Engineering

[Abstract] A method of calculating the thermal field of a buried cable under a periodically repetitive load is proposed, for the purpose of estimating the current carrying capacity of such a cable. The power loss (heat source) in the cable is represented as the sum of a constant component and a Fourier series of harmonics, the fundamental period being 24 hours long and retention of only the first 10 harmonics usually yielding sufficiently accurate results. Calculations are based on the one-dimensional differential equation of heat conduction for the ground. Its solution gives the temperature rise produced by the cable as a function of the radial coordinate and time. The complex thermal resistance of the soil is determined from the boundary condition for power at the cable surface, in terms of zeroth-order and first order Hankel functions of the second kind. The algebraic equations of power balance are then set up according to the thermal equivalent circuit. The instantaneous total temperatures in cable core, cable insulation and cable sheath are determined according to the procedure in electric circuit theory. Numerical results have been obtained for PILCA 3x3 AWG - 15 kV cable operating in Cuba and found to differ by not more than 5°C from experimental data. Figures 2; references 4: 2 Russian, 2 Western.
[265-2415]

UDC [621.316.31:621.315.213].001.24

METHOD OF REDUCING COST OF CABLE NETWORK BY ORGANIZATION OF THROUGH CONNECTIONS

Moscow ELEKTROTEKHNIKA in Russian No 5, May 83 (manuscript received 21 May 82) pp 46-48

LUKIN, V. I., engineer, State Planning Institute "Elektrotyazhkhimproyekt" (Heavy Electrical and Chemical Equipment Design)

[Abstract] A method of reducing the cost of control cable networks is proposed and evaluated in which through connections are organized, not for minimum total cable length but for optimum cable consolidation. The gist of the consolidation concept is demonstrated on the example of combining two 0.66 kV AKVVG cables (2.5 mm^2 cross section) into a single one. The cost in rubles/km and the cost reduction in percent are calculated for all possible combinations of numbers of active strands in each cable. General formulas are derived for the cost effectiveness of combining any number, three or more, of

cables and for determining the region of effectiveness of through connections. Installation cost and distances between points to be through-connected are taken into account. The optimum combination, regardless of the distances between points, is one cable completely "absorbed" by another. A typical example is a 4-strand cable with 3 active strands and a 27-strand cable with 22 active strands combined into a single 22-strand cable with only 2 inactive strands. In three points to be through-connected the region of effectiveness is an ellipse with foci at two of the points and the positive economic effect (cost reduction) is not constant. The general cost optimization procedure begins with the design of a technically feasible network with minimum total cable length, whereupon the cost of stranding in each cable is reduced sequentially by iterations. The final pattern of through connections is obtained on the basis of modeling and simulation. The iteration process ends when the last step has yielded no positive economic effect. Calculations according to this procedure have revealed that combining of cables is expedient only up to maximum strand utilization and that combining two cables into two others is usually not expedient. Figures 2; tables 2; references: 4 Russian.
[265-2415]

UDC 535.362

ABSORPTION AND SCATTERING CHARACTERISTICS OF THERMALLY INSULATING CLOTH MATERIALS IN INFRARED RANGE OF SPECTRUM

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 3, Mar 83 (manuscript received 20 Apr 82) pp 10-11

MOROZOVA, L. N. and SEREDENKO, M. M.

[Abstract] Thermal insulation systems often include layers of cloth, single or multiple, which contribute to the reflection characteristics of the entire system. Here the spectral reflection coefficient $\rho(\lambda)$ and transmission coefficient $\tau(\lambda)$ for middle-infrared radiation are determined for single cloth layers on the basis of measurements and calculations. Calculations are made in the two-flux approximation according to the Gurevich-Kubelki-Munk two-parameter theory of scattering. Both spectral coefficients depend exponentially on the layer thickness according to the Bouguer-Lambert law, with the extinction coefficient $\alpha = 2\sqrt{K^2+2KS}$ (K- absorption coefficient, S- scattering coefficient) and the reflection coefficient squared R^2 for an infinitely thick layer as parameters. Calculations of K and S for single layers of three insulating cloth materials (0.1 mm thick white and green TSON-SOT glass cloth and 0.01 mm thick art. 56003 nylon cloth), also for a stack of four layer of art. 56003 nylon cloth, agree closely with measurements made in an IKS-21 spectrometer using a half-sphere mirror. The results indicate that K increases and S decreases with increasing wavelength.
Tables 2; references: 8 Russian.
[270-2415]

CSO: 1860

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