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ELECTRONICS AND ELECTRICAL ENGINEERING

No. 31

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ELECTRONICS AND ELECTRICAL ENGINEERING

No. 31

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ELECTRONICS
Amplifiers

USSR UDC 621.375.2.029.64

MINIMUM NOISE FACTOR IN AN ARBITRARY BEAM MICROWAVE O-TYPE AMPLIFIER

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 22, No 2, Feb 77 pp 338-346
manuscript received 1 Dec 75

SHTYROV, A. I.

[Abstract] The problem of the minimum noise factor is solved here for an arbitrary beam microwave O-type amplifier, with the one-dimensional electron flux in such a device described in terms of current $I_1(\omega,z)$ and kinetic potential $V_1(\omega,z)= 2V_0 \frac{v_1(\omega,z)}{v_2(\omega,z)}$ as the variables. The law of power conservation and the noise invariants are established on this basis, whereupon the minimum noise factor in such an amplifier is calculated. The result does not agree with the Haus-Robinson formula, the discrepancy being attributed to inconsistent conceptions of the kinetic potential. It is shown, moreover, that the kinetic potential defined as $V_1(\omega,z) = \frac{1}{4\Im I_0} \int_0^\infty$ $(W-\langle W\rangle)\, \Psi\, dW$ does not correctly describe noise perturbations in an electronic flux. Figures 1; References 6: 2 Russian, 4 Western (one in translation).

USSR UDC 518.1

NUMERICAL STUDY OF A METHOD OF FORMING A RADIATION RANGE DIAGRAM

Moscow VYCHISLITEL'NYYE METODY I PROGRAMMIROVANIYE (CHISLENNYYE METODY V ZADACHAKH ELEKTRODINAMIKI) XXIV; SBORNIK RABOT VYCHISLITEL'NOGO TSENTRA MOSKOVSKOGO UNIVERSITETA in Russian 1975 pp 183-192

BEREZINA, N. I. and CHECHKIN, A. V.

[Abstract] This paper deals with problems in the numerical implementation of a method of forming a radiation range diagram, using examples of designing real discrete antennas. This method was described in previous studies. An equation is given which describes the relationship between points on the radiating elements and the polar diagram for the entire discrete antenna, involving the line to the peak of the main lobe. What is required is to find at least one set of currents to satisfy inequalities involved predetermined lines of direction in the region of the main lobe and segments in the region of the side lobes. The solution is based on a multiparameter variation problem. The algorithm for solving the problem is presented in detail. The unknown currents are found and the polar diagram for them is calculated. The algorithm is applied to a specific airborne radar antenna. The radiating elements of this antenna are rectangular waveguides on one of whose walls there are lengthwise slits. Twenty radiating elements are arranged in a circle. The method is applied to find the currents determining the radiation range pattern satisfying the inequalities mentioned. Tables of parameters are given and the values of various parameters at different stages in the iteration process are discussed. Figures are given which show radiation patterns at various stages in the iteration process. Solutions obtained at the 44th and 104th stages differed but slightly. Figures 3; tables 7; references: 3 Russian.

USSR UDC 518.1

METHOD OF ANTENNA POTENTIALS IN THREE-DIMENSIONAL DIFFRACTION PROBLEMS

Moscow VYCHISLITEL'NYYE METODY I PROGRAMMIROVANIYE (CHISLENNYYE METODY V ZADACHAKH ELEKTRODINAMIKI) XXIV; SBORNIK RABOT VYCHISLITEL'NOGO TSENTRA MOSKOVSKOGO UNIVERSITETA in Russian 1975 pp 118-122

KRAVTSOV, V. V.

[Abstract] The method of integral equations, one of the most effective methods used for the study of diffraction problems, is at the present time used for three-dimensional problems only in studying diffraction of waves in solids of revolution, because it is possible in this instance to reduce the differential problem to one-dimensional integral equations. In this paper a method is developed for solving essentially three-dimensional

diffraction problems on the basis of one-dimensional integral equations of the first kind. This method is illustrated with a very simple scalar problem It is demonstrated that it is possible to find an approximate solution in the form of antenna potential to Helmholtz's boundary value problem, whereby a three-dimensional region is bound by a closed surface of the Lyapunov type and it is required to find a solution to the problem which will satisfy Dirichlet's conditions for the Lyapunov surface and the conditions for emission at infinity. The theorem on which the method rests is presented, analyzed in detail, and proven. The solution in the form of antenna potential satisfies Helmholtz's homogeneous equation and the conditions for emission at infinity. An integral equation of the first kind is obtained to determine antenna potential density, by applying the equation of Euler to a functional reflecting boundary conditions on the Lyapunov surface. This integral equation can be solved with sufficient simplicity using a computer. The method presented of reducing a three-dimensional boundary value problem to an integral one-dimensional equation of the first kind can also be used for problems of other types, in particular for a numerical solution to multi-dimensional integral equations. References: 2 Russian.

USSR UDC 518.1

CONCERNING THE MATHEMATICAL THEORY OF RADIATION

Moscow VYCHISLITEL'NYYE METODY I PROGRAMMIROVANIYE (CHISLENNYYE METODY V ZADACHAKH ELEKTRODINAMIKI) XXIV; SBORNIK RABOT VYCHISLITEL'NOGO TSENTRA MOSKOVSKOGO UNIVERSITETA in Russian 1975 pp 161-170

CHECHKIN, A. V.

[Abstract] The theory of antenna synthesis has been developed on the basis of a mathematical analysis of the radiation of a linear antenna, and carrying over the results to analysis of more complicated antennas has involved great difficulty owing to the absence of suitable mathematical apparatus. At the mathematical physics laboratory of the Scientific Data Processing Center of Moscow State University an attempt has been made to introduce a new mathematical formalism making it possible to study any antenna just as easily as a linear antenna. The main concepts involved are the excitation vector, the radiation operator, and the total polar diagram, a type of relationship in common for all antenna systems, from the mathematical viewpoint, which has been found between the excitation vector and the total polar diagram. Information on the electrodynamics of radiating systems is analyzed and used to describe the radiation of any antenna in a form similar to the basic formula for a linear antenna. The excitation vector varies depending on the kind of antenna and represents a generalization of the idea of current in a linear antenna. The total polar diagram is a two-dimensional vector function which is defined in the same way for all types of antennas. The radiation operator is an operator from the Banach space of excitation vectors in the normed space of polar diagrams and is determined individually for each antenna.

Different types of antennas are discussed and it is shown how the excitation vector is introduced, the radiation operator transforming the n-dimensional excitation vector into a two-dimensional vector function, the total polar diagram. The underlying theorem is given but not proven. In general it states that the radiation operator for any antenna can be so defined as to be linear and continuous and determined by two vectors depending on the two angular spherical coordinates. The new mathematical apparatus introduced here is very convenient for the study of various problems in antenna theory. It makes it possible to study any antenna from a common mathematical viewpoint. This is demonstrated by the example of the problem of synthesizing antennas with maximum gain. The author thanks Professor V. I. Dmitriyev and Professor A. G. Sveshnikov for discussion and valuable council. References: 3 Russian.

USSR UDC 518.1

DIFFERENTIAL METHOD OF DESIGNING A DOUBLE-REFLECTOR FOCUSING ANTENNA

Moscow VYCHISLITEL'NYYE METODY I PROGRAMMIROVANIYE (CHISLENNYYE METODY V ZADACHAKH ELEKTRODINAMIKI) XXIV; SBORNIK RABOT VYCHISLITEL'NOGO TSENTRA MOSKOVSKOGO UNIVERSITETA in Russian 1975 pp 213-220

KOLOKOL'CHIKOVA, M. A. and REPIN, V. M.

[Abstract] Double-reflector antenna systems have a number of advantages over single-reflector systems, the second, smaller, reflector being used, besides, to control engineering parameters and to compensate for distortions in the shape of the large reflector. There are a number of methods based on beam geometry, such as the method of wave fronts and the method of focal curves, for designing the shape of the small reflector when the shape of the large one is known. But problems inevitably arise in using these methods to make the large and small reflectors conform approximately to experimental and calculated data, and in being able to evaluate the sufficiency of this data for achieving a specific degree of precision. A differential method is suggested here to solve approximation problems, along with the problem of designing a double-reflector system with a large reflector with a specific randomly-chosen sufficiently-smooth surface. The method is described and calculation formulas are derived in the form of a system of linear differential equations, which are used to write a program in ALGOL, which is run on a BESM-4 computer. The system of linear differential equations is solved by using a standard p 0745 program for integration by the Runge-Kutta method for fourth-order equations. The method itself is based on analyzing the local properties of the surfaces of the reflectors, making a two-dimensional mapping of a specific large reflector surface, and mapping points on the surface of the small reflector to conform with points mapped on the surface of the large. The algorithm for a numerical solution to the system of linear differential equations automatically gives a sufficient number of coordinate points on both surfaces to make possible accurate plotting of the reflector's surface.

This differential method makes it possible to solve the problem of making a reflector conform approximately with the design for a large reflector surface obtained from data obtained in some way by measuring an actual mirror, while at the same time controlling the shape of the small reflector. Results are given of calculations for several double-reflector focusing systems, confirming the effectiveness of this method for solving problems of this sort. Figures 4; references: 4 Russian.

USSR UDC 518.1

SYNTHESIS OF ANTENNA PHASE DISTRIBUTION

Moscow VYCHISLITEL'NYYE METODY I PROGRAMMIROVANIYE (CHISLENNYYE METODY V ZADACHAKH ELEKTRODINAMIKI) XXIV; SBORNIK RABOT VYCHISLITEL'NOGO TSENTRA MOSKOVSKOGO UNIVERSITETA in Russian 1975 pp 192-199

BRYANTSEV, S. F. and IL'INSKIY, A. S.

[Abstract] Various methods have been developed for solving problems of antenna synthesis. This paper examines the method of determining the specific distribution of emission field sources which will create an initial polar diagram closest in its main characteristics to a predetermined polar diagram while honoring specific restrictions on the distribution of emission field sources. The focus here is on solutions achieved by regulating only the phase distribution of emission field sources, because solutions of this sort can be implemented with available hardware and do not entail complication of the antenna's excitation system. Consideration is given to algorithms for phase distribution synthesis for a polar diagram which will make it possible to obtain the required level of side emission in specific directions. With this formulation it is necessary to ensure maximum directive gain in a specific direction, and that the magnitude of the antenna's side emission in one or more specific directions corresponding to the side lobe region does not exceed the required level. The following conditions are imposed on emission field sources: The phase distribution of these sources is represented in the form of a set of phase distributions for different groups of components, so that the phase distribution within the range of a group assures fulfillment of one of the requirements for the polar diagram as far as possible not impairing fulfillment of the remaining requirements, which are taken care of by the phase distributions of the other groups. Division of components into groups with separate control over phase distribution within the range of each group makes it possible to simplify and smooth out the algorithm for phase distribution synthesis. Maximum directive gain in a specific direction is achieved by formation in the antenna aperture of a linear phase distribution whose slope corresponds to the direction for formation of a main beam maximum. The algorithm presented was checked by simulation of the process of forming phase distribution for a flat-top antenna with a complex aperture profile and consisting of a large number of discrete components. The BESM-6 computer

was used for this purpose. Inputs into the computer's memory were data on the antenna's geometry, initial data on preset angular directions, relative source strength, magnitude of suppression level, and the like. Then the method described was used to simulate ordering of different types of phase distribution in the antenna and the voltage range of the signal at the antenna's output was computed for each distribution. The data obtained were used to calculate the unknown phase distribution, and the magnitude of the signal at the output corresponding to the distribution found was computed and compared with the threshold value. This process was repeated in cycles. Side lobe suppression in one direction was achieved rather quickly, in two or three cycles. The method of phase distribution synthesis described here can be used to solve various problems in antenna synthesis theory. Figures 3; references: 6 Russian.

USSR UDC 621.372.8

RESULTS OF EXPERIMENTAL INVESTIGATION OF MATCHING OF ANTENNAS BASED ON LIMITED WAVEGUIDES

Moscow RADIOTEKHNIKA in Russian Vol 32, No 2, 1977 pp 88-90 manuscript received after completion 29 Jan 76

GAZYAN, L. G.

[Abstract] In the last few years, in connection with miniaturization of radio-electronic equipment and the use of microwave integrated circuits, the question arose of decreasing the dimensions of radiating elements, with basic consideration of their characteristics. Several authors proposed to construct centimeter-range antennas based on limited [zapredel'nyy] waveguides. This made it possible sharply to reduce the dimensions of the radiating aperture and of the antenna as a whole, with a decrease of its transmission band and the introduction of some attenuation in the channel. In the present short communication the results are presented of experimental balancing of a 10-cm band antenna fulfilled on the basis of a waveguide with a 23 x 10 mm^2 cross section, as well as the results of an experimental investigation of matching radiating limiting waveguides with a strip feed line. The typical dimensions are determined of the matching elements with which the best match is attained. Figures 4; references 4: 1 Russian, 1 Western.

USSR UDC 517.63

NUMERICAL INVERSION OF A LAPLACE TRANSFORM

Novocherkasak IZVESTIYA VUZOV, ELEKTROMEKHANIKA in Russian No 2, Feb 77
pp 127-129 manuscript received 16 Apr 74

ZAYTSEV, VLADIMIR MIKHAYLOVICH, candidate of technical sciences, senior scientific research worker and PUTKOV, VIKTOR NIKITOVICH, candidate of technical sciences, dotsent Minsk Radio Engineering Institute

[Abstract] During computer-aided automated design and analysis of dynamic systems the problem arises of finding the inverse Laplace transform by some numerical method. The inverse Laplace transform of rational functions $Y(p)=\frac{R_m(p)}{Q_n(p)}$ $(m < n)$ is of particular practical interest. The application of Heaviside's expansion theorem becomes difficult in the case of multiple poles. A numerical method is proposed here, instead, where the transform is expressed as a sum of simplest fractions and the original of this sum is found. The algorithm consists of: 1) solving the algebraic equation $Q_n(p)=0$; 2) Constructing the coefficients of the base polynomials in those simplest fractions; and 3) Solving the system of algebraic equations whose matrix consists of the coefficients of the corresponding polynomials arranged in columns. The method is precise and easily implemented on a general-purpose computer. References 4: 2 Russian, 2 Western.

USSR UDC 62-525:[621.382:776]

DESIGNING OF PNEUMATIC PRINTED CIRCUITS USING DIGITAL COMPUTERS

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 12, 1976 pp 17-19

KOVACH, D., engineer, and MARTON, Y., candidate of technical sciences; Hungarian People's Republic. BERENDS, T. K., engineer, and RUDNEV, V. V., candidate of technical sciences; USSR

[Abstract] In 1975 a recurrent Soviet-Hungarian Seminar on Pneumatic Automatics took place in Moscow, with the participation of specialists of the Research Institute of Computing Technics and Automation of the Hungarian Academy of Sciences (IIVTiA AN VNIR) and the Institute of Control Problems of the Academy of Sciences, USSR (IPU AN SSSR), collaborators for many years in this field. The present paper is one of those read at the Seminar.

Miniaturization of elements and complication of pneumatic controlling devices has required the use of a new technology for connection of elements and units. As in electronics, pneumatic automatics followed the course of using printed assemblies, and the Laboratories of Pneumatic Automation of the IIVTiA and the IPU are jointly working on technical designing of pneumatic printed boards

with the use of digital computers. The present paper discusses the difference between designing of printed boards in electronics and pneumatics, the statement of problems, the program of elimination of errors and the construction of switching connections, the program of distribution with respect to containers, the layout program, the post-processor, and the future prospects. Figures 4; tables 1.

USSR UDC 621.3.049:681.3

A METHOD OF LAYING OUT THE CONNECTIONS IN MONOLITHIC LARGE-SCALE INTEGRATED CIRCUITS

Tashkent IZVESTIYA AKADEMII NAUK UzSSR, SERIYA TEKHNICHESKIKH NAUK in Russian No 6, 1976 pp 13-16 manuscript received 13 Nov 75

MAGRUPOV, T. M., "Order of Red-Star Labor" Institute of Cybernetics With Computer Center, UzSSR Academy of Sciences

[Abstract] The main difficulties in laying out the connections stem from the unavailability of effective algorithms which would take into account the particular features of any designed topology. The basic layout criteria are to minimize the total length of circuit connections, the number of connection crossovers, and the surface area of the LSI chip. Here a method is proposed by which all these criteria can be simultaneously satisfied, without solving the problems of component packaging (which would be a very tedious task) and thus applicable to the final version of a package. The procedure consists of four steps: 1) Constructing equipotential circuits with the minimum conductor length; 2) Determining the sequence in which these circuits are to be constructed; 3) Segregating the connections into layers; and 4) Compact packaging of the conductors. The algorithms in these steps reduce to the search for a certain "minimum tree" within a complete graph. Operational reliability requires that in the final compact package, while the width and the length of connections are both minimum, the separation between conductors is not smaller than permissible. References: 4 Russian.

POLAND UDC 621.395.34

CODING AND DECODING DEVICES MAKING USE OF CIRCULATING MEMORY

Warsaw PRZEGLAD TELEKOMUNIKACYJNY in Polish Vol 49, No 12, 1976 pp 366, 371

DZIECH, ANDRZEJ, Swietokrzyska Polytechnic, Kielce

[Abstract] Block diagrams of coding and decoding devices making use of circulating memory are presented and described. The functions of individual blocks of the system are discussed and dependences are given which permit the evaluation of operational reliability of devices. Figures 4; tables 1; references 5: 3 Polish; 2 Russian.

USSR UDC 681.3

CHOICE OF PARAMETERS OF DATA RECORDING DEVICES BASED ON A SET OF QUALITY CRITERIA

Novocherkassk IZVESTIYA VUZOV, ELEKTROMEKHANIKA in Russian No 2, Feb 77 pp 159-167 manuscript received 26 Mar 75; after completion, 9 Sep 75

SIGALOV, GDALIY GRIGOR'YEVICH, candidate of technical sciences, NII EVM [Scientific-Research Institute of Computers], Minsk, and ZYBITSKER, BORIS IL'ICH, senior engineer NII EVM, Minsk

[Abstract] Data recording and playback are an important part of many computer operations, with magnetic tape commonly used as the carrier medium most suitable for that purpose. Zonal recording is considered here and, on the basis of macroscopic discrete models of the processes, the effect is analyzed of the zone length and of the maximum number of attempts to clear a dropout on the packing density as well as on the mean recording and playback speeds. In addition, this analysis is based on the probabilities of three kinds of dropouts: those due to tape defects and thus unremovable, those removable by repeated recording, and those removable by repeated playback. Relations are derived which characterize the dependence of the three performance criteria on the zone length and the maximum number of repetitions. The criteria are found to be incompatible and subject to tradeoffs. The tradeoff ranges and optimization, depending on the relative importance of the various criteria, are also discussed here and typical data are shown for medium-quality magnet tapes. Figures 6; references: 4 Russian.

USSR UDC 681.3.06-681.39

CERTAIN FEATURES OF MODERN COMPUTER DESIGN AND TECHNOLOGY AND LATEST DEVELOPMENT TRENDS

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 6(26), Nov-Dec 76 pp 29-37 manuscript received 23 Aug 76

DERKACH, V. P.

[Abstract] The main features and trends in modern computer design and technology are an integrated logic circuitry, with either bipolar or MOS field-effect transistors, and high-speed high-capacity ferrite memories. Noteworthy is the gradual transition from discrete components and printed-circuit boards to large-scale integration, combined with higher degrees of automation and miniaturization. Other outstanding features are found in the peripheral equipment, namely in the area of data input and output techniques, whether electroacoustical or electrooptical.

USSR UDC 62-181.4:681.322

FAMILY OF DOMESTIC GENERAL-PURPOSE MICROCOMPUTERS

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 6(26), Nov/Dec 76 pp 27-39 manuscript received 6 Sep 76

GAL'PERIN, M. P., ZHUKOV, YE. I., KUZNETSOV, V. YA., MALINOVSKIY, B. N., MASLENNIKOV, YU. A., PALAGIN, A. V. and PANKIN, V. YE.

[Abstract] A new family of microcomputers is now produced in the USSR, on the basis of a small but universal complement of large-scale integrated circuits. Their design is based on a single technology, but allows for programmed control, and thus represents a compromise between production and application criteria. This microcomputer family includes both one-tier and multitier models, the former intended for operation as built-in control and data processing modules, and the latter intended as a replacement for minicomputers. The software serves two categories of users: computer centers engaging a staff of programmers, and engineering centers working in the areas of electronics, automation, or mechanics. Three software systems have been designed for these microcomputers: 1) Automation of program development; 2) Automation of microprogram development; and 3) Control of microcomputer functioning. Furthermore, three somewhat different hookup systems are available, each matching a particular storage capacity and input-output mode. Figures 1.

HUNGARY UDC 681.32.058

DIGITAL FUNCTION GENERATOR

Budapest HIRADASTECHNIKA in Hungarian Vol 28, No 3, Mar 77 pp 90-93 manuscript received 29 Nov 76

PAPP, LASZLO, Power Supply Engineering Directorate, BKV [Transportation Enterprise of Budapest]

[Abstract] This article briefly reviews the principles, system-engineering aspects, and uses of function generators. It discusses in some detail one with quartz-controlled, highly frequency-accurate digital circuits in terms of circuitry and the spectral purity of the synthesized sinusoial function. The clock frequency in the digital function generator is 1.048 MHz; the amplitude code generated by the multiplier is a linear function of the clock signal and is temporally periodic. The code of any given waveform may be realized by addressing a ROM memory with the outputs of the multiplier. The codes of the desired function are to be burned into the appropriate sections of the memory. The triangular sine converter may be realized by means of a resistor-diode network. The square voltage is preferably generated from a highly frequency-accurate sine voltage, using a type of squaring circuit, such as a comparator or a limiter. Distortion is reduced or eliminated by using a filter at the output of the appropriate mutual conductance. Figures 9.

USSR UDC 681.142:642

MACHINE ACCELERATION OF THE OPERATION OF MULTIPLICATION IN DIGITAL COMPUTERS

Novocherkassk IZVESTIYA VUZOV, ELEKTROMEKHANIKA in Russian No 2, Feb 77 pp 139-145

LYSIKOV, BORIS GRIGOR'YEVICH, candidate of technical sciences, dotsent Minsk Radio Engineering Institute

[Abstract] In solving scientific and technical problems, a digital computer uses about 70-80 percent of its machine time for multiplication operations. Multiplication can be accelerated, either by modification of the logic, or by addition of components in the arithmetic unit. Methods based on the latter principle are defined here as machine methods. Partial products are formed and added by the convolution process, in space rather than in time. The rank of such a method is defined as the number of multiplicand pairs processed together, and in each digit simultaneously forming a circuit for a partial product during matrix multiplication. The general procedure for synthesizing binary A-multipliers is shown here in three stages: 1) Synthesis of a one-digit quaternary (2i-nary) multiplier with four (2i) binary inputs; 2) Synthesis of a one-digit quaternary (2i-nary) adder with five (2i+ 1) binary inputs; and 3) Composition of a four-digit (multidigital) second-order (i-th order) A-multiplier. The final structure is analyzed in terms of time reduction and components buildup, as functions of the number of digits n contained in the multiplicands. The same concepts and procedure apply to A-multipliers-dividers: they fall within the general theory of speedup of all arithmetic operations and have a certain commonality with those involved in the design of A-adders. Machine methods of acceleration may, if necessary, be combined with logic methods. Lower-rank multipliers (dividers, adders) are already available for general-purpose as well as special-purpose computers. Following the general trend toward higher computer efficiency and large-scale integration, higher-rank A-multipliers (dividers, adders) should also become available in the future. Figures 6; tables 1; references: 7 Russian.

USSR UDC 681.323

DISCRETE TRANSFORMATION OF THE TRANSIENT CHARACTERISTIC OF TWO-PORT NETWORKS WITH THE AID OF MINI- AND MICROCOMPUTERS

Kiev UPRAVYAYUSHCHIYE SISTEMY I MASHINY in Russian No 6(26), Nov/Dec 76 pp 123-127 manuscript received 21 Oct 75; after completion, 15 Apr 76

MEL'NIK, YU. I., SLOBODYANYUK, A. I. and SOKOLOVSKIY, R. M.

[Abstract] With the transfer function of a two-port network given in analytical form, it is possible not only to determine the amplitude-frequency and the phase-frequency characteristics but also to optimize the circuit parameters and then to synthesize a device. Algorithms of the discrete Fourier

transformation for discrete processing of a measured transient output signal require a large number of points on the time scale, if a sufficiently high accuracy of the analytical expression is to be ensured. Here an algorithm is proposed, in two versions, which yields such an expression directly from the output signal. The principle has been tested on a minimal-phase linear passive network with lumped parameters, and then extended to the general case. The apparatus for implementing it consists of a noise generator, the tested network, an analog-to-digital(code) converter, a computer, and an indicator (display). The program consists of two stages: computing the coefficients of the normalized transfer function from certain data, followed by a discrete Laplace transformation. Trial tests on Butterworth and Chebyshev networks have established that an accuracy within 5 percent is feasible with modern mini- and microprocessors. Figures 3; references 6: 5 Russian, 1 Western (in translation).

USSR UDC 681.323

ESTIMATES OF TRANSFORMED ERRORS IN A DIGITAL CONTROL COMPUTER WITH A FLOATING DECIMAL POINT

Novocherkassk IZVESTIYA VUZOV, ELEKTROMEKHANIKA in Russian No 2, Feb 77 pp 130-133 manuscript received 28 Jan 74

POPOV, VYACHESLAV ALEKSYEVICH, candidate of technical sciences, dotsent, Khar'kov Aviation Institute, and NALAGIN, VIKTOR KUZ'MICH, candidate of technical sciences

[Abstract] A digital control computer processes input data which usually contain initial errors. These errors build up in the process, as a result of the various transformations. It seems worthwhile to estimate the transformed error contained in the operations of the command unit, so that the number of correct figures in the result can be determined. A method of solving this problem is proposed here and illustrated by the operation of division in a digital computer, when: 1) The mantissas of the input numbers are random quantities uniformly distributed on the $[1/2,1]$ interval; 2) The moduli of the absolute errors in the mantissas are expressed in units of the least significant figure and distributed uniformly on the $[0,1/2]$ interval; and 3) All random quantities are continuous and mutually independent. The problem is to determine the maximum error and the mean-squared error in units of the k-th figure. Here the error distribution density is determined for one specific case. The results indicate that the operation of division contains a large maximum but a much smaller mean-squared transformed error. The availability of one exact operand will reduce the former to one half but the latter insignificantly. An analysis shows that small errors are much more probable than large errors. References: 4 Russian.

POLAND

UDC 621.391

TASKS, ORGANIZATION AND TYPES OF MODERN COMPUTER NETWORKS

Warsaw PRZEGLAD TELEKOMUNIKACYJNY in Polish Vol 49, No 12, 1976 pp 356-358

NOWICKI, TADEUSZ and WESOLOWSKI, JACEK; Institute of Organization and Control, Polish Academy of Sciences and Ministry of Science, Higher Education and Technology

[Abstract] The article reviews the basic types of modern computer networks. Described are tasks of computer networks, typical network structures--centralized, decentralized and ringed networks, supervision of network operation, telecommunication problems connected with computer networks, application of computer networks and trends of their further development. Figures 4; references: 5 Western.

POLAND

UDC 535.89:621.39

OPTOELECTRONIC DEVICES IN TELECOMMUNICATION

Warsaw PRZEGLAD TELEKOMUNIKACYJNY in Polish Vol 49, No 12, 1976 pp 359-361

BOHDANOWICZ, JANUSZ and KORCZ, ZBIGNIEW, Institute of Quantum Electronics, Military Technical Academy

[Abstract] The authors discuss the general principles of optoelectronic telecommunications and review briefly the properties of semiconductor light sources and photodetectors. Among other things they discuss the electroluminescent (DEL) and laser (LD) diodes produced by Texas Instruments, Monsanto and Laser Diodes Laboratories. Characteristics are given of five optoelectronic devices developed by the Institute of Quantum Electronics and based on Series TIXL (DEL) and LD. Some examples of the possibilities of the application of optoelectronic communication are quoted. The prospects of commercial development of the optoelectronic communication are considered to be bright. Figures 5; tables 1.

USSR UDC 621.391.2

NONLINEAR FILTRATION OF A MULTIVARIATE RANDOM PROCESS WITH AN OBSERVABLE POISSON PROCESS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 22, No 2, Feb 77 pp 393-396 manuscript received 8 Dec 75

MIKHAYLOVSKIY, E. A.

[Abstract] In nonlinear filtration the observable process is sometimes one with a point distribution. This is the case when the phase coordinates of an object are to be determined from the space-time distribution of the photoelectron flux in an optical receiver. Here a bivariate process is considered where the observable component happens to be a Poisson process whose intensity depends on the nonobservable component. The fundamental equation of nonlinear filtration yields an estimate of the nonobservable input process. For the a posteriori correlation matrix the a posteriori correlation equation is now derived from which the equations of moments can then be constructed. Of interest is the second moment and, with the higher moments disregarded, the design of a quasi-optimum filter is shown suitable for statistically processing the optical signal directly from the photodetector signal. References 7: 3 Russian; 4 Western.

USSR UDC 621.391.262

DETECTION OF SHORT LASER PULSES BY RECEIVING DEVICES WITH INERTIAL PHOTORESISTORS

Moscow RADIOTEKHNIKA in Russian Vol 32, No 2, 1977 pp 80-83 manuscript received 8 Jul 75

KHUTAKHOV, V. P., MAYKO, A. G. and FEDYAYEV, YU. N.

[Abstract] In recent years more and more attention has been paid to the development of means of optical communication and location. Various types of lasers are used, including lasers with Q modulation. With lasers operating in a regime of Q modulation, it is easily possible to obtain pulses with a short duration down to tens and units of nanoseconds, and with the most widespread lasers such pulses are more easily obtained than pulses of longer duration. At the same time the majority of contemporary photodetectors (photodiodes and photoresistors) for short pulses are essentially inertial devices because there is a time constant from tens of nanoseconds to tens of microseconds. The opinion exists that for efficient operation of systems, the duration of a laser pulse must not be smaller than the time constant of a photodetector. Consequently, sometimes special measures are provided with respect to an increase of the duration of pulsed laser emission, which is combined with a worsening of its energy characteristics. In connection

with this piont, the present paper considers problems of detection of laser pulses of various durations by a receiving device, with the object of explaning the effect of pulse duration on the reliability of detection. Processes are briefly considered which take place in the material of a photodetector under the effect of emission. The paper concludes that in systems for detection of optical signals, in which exacting requirements with respect to resolving power are not imposed, it is possible to employ inertial photoresistors. Use of pulsed laser emission sources with a short duration of the pulse in systems with inertial photoresistors does not lead to significant energy losses; short pulses prove to be more favorable than pulses matched with the time constant of a photodetector, with a condition of conservation of energy in the optical pulse. Figures 2; references: 2 Russian.

USSR UDC 621.396.624

NOISE IMMUNITY OF ANALOG OPTICAL COMMUNICATION CHANNELS

Moscow RADIOTEKHNIKA in Russian Vol 32, No 2, 1977 pp 84-86 manuscript received after improvement, 27 Jan 76

GUS'KOV, N. A. and PANOV, O. L.

[Abstract] This short communication considers channels, with modulation of an optical carrier by an analog signal, in the case of reception by methods of direct and heterodyne detection, taking account of generated nonlinear distortions. As the result of analyzing the passage of a modulated optical signal through the elements of a photodetector, analytical expressions are obtained for the useful signal and its harmonic at the output of the system. Expressions shown in table form include those for the amplitude of the signal, the signal-to-noise ratio with respect to power, non-linear harmonic distortion coefficient, and the modulation capability index (conversion ratio of modulation), in optical communication channels with modulation of a carrier by amplitude intensity, polarization, frequency and phase. It is concluded that with direct reception it is advisable to use channels with intensity modulation: polarization modulation and frequency modulation, and with heterodyne reception--channels with linear AM and broad-band FM. Figures 1; tables 1; references 2: 1 Russian; 1 Western.

USSR UDC 621.396.964

MEASURING THE ANGULAR COORDINATES OF A COHERENT LIGHT SOURCE ON THE BASIS OF THE WAVE'S PHASE FRONT AT THE RECEIVER

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 22, No 2, Feb 77 pp 286-291 manuscript received 11 Dec 75

BAKUT, P. A., LOGINOV, V. A. and TROITSKIY, I. N.

[Abstract] A new algorithm is constructed for measuring the angular coordinates of a coherent light source. It is based on the advantages of digital holography, which makes it possible to separate in real time the complete useful information encoded in the phase front from the interfering information encoded in the amplitude distribution. The feasibility of this approach to constructing the optimum, i.e., insensitive to amplitude fluctuations, algorithm for this purpose is established on the basis of its accuracy characteristics in the simple case of a point source and a linear receiver. Tables 21; references 5: 3 Russian; 2 Western.

USSR UDC 621.376.4:621.394.662.2

CONCERNING TRANSIENT PROCESSES IN MODIFIED SYSTEMS OF PHASE AUTOMATIC FREQUENCY CONTROL

Moscow RADIOTEKHNIKA in Russian Vol 32, No 2, 1977 pp 39-43 manuscript received 5 May 74; after completion, 10 Jul 76

CHURKIN, YE. I. and ADZHEMOV, S. S.

[Abstract] Phase automatic frequency control systems (FAPCh) are more and more widely used in connection with the development of phase radiotechnical systems in communication engineering. During this, as a rule, the systems must satisfy contradictory requirements. The most widrespread is the requirement for a broad capture band and high filtering ability. This contradiction is resolved in a modified system (mFAPCh) which includes a free-tuning oscillator, a phase detector, and a d-c amplifier. Investigations of the mFAPCh system have shown that it possesses a higher noise immunity than a customary FAPCh system. However, so far as the authors know, the problem of the capture band in the mFAPCh system has not been covered in the literature. In the present paper precise formulas are found for the time of a transient process during phase adjustment and signal capture in a mFAPCh system of the 1st order. Recommendations are given with respect to practical application of a mFAPCh system. Figures 4; references: 6 Russian.

USSR UDC 621.391.264

PROBABILITY DISTRIBUTION OF AREAS OF OVERSHOOTS OF NARROW-BAND PROCESS ENVELOPES

Moscow RADIOTEKHNIKA in Russian Vol 32, No 2, 1977 pp 10-16 manuscript received after completion, 1 Dec 75

FILIN, G. D.

[Abstract] As a rule, an evaluation of the efficiency of schemes for information processing is connected with a calculation of the probabilities: regular solution (P_{RS}--power of Neumann-Pearson criterion) and false alarm (P_{FA}--the levels of significance of the criterion), which is performed on the basis of knowledge of the probability densities of the amplitudes of the envelope of the noise and the additive process--signal plus noise. Strictly speaking, such a procedure is correct if the duration of overshoots of the envelopes of these processes is infinitesimally small. Large errors do not appear even in those cases where the mean duration of the overshoots of the envelope noise is close to the duration of the useful signal, i.e., when the receiving channel is matched with the duration of the signal. With a random duration of the signal, variable over a wide range, such a scheme of calculation can lead to substantial errors. The most precise method of calculation of a processing scheme, which uses storage after the detector with a change of the duration of the signals within wide limits, must be based on knowledge of the distribution of the areas of overshoots of the envelope of the input process above a definite threshold level. The present paper, on the basis of the mathematical apparatus for analysis of overshoots of random processes developed in a paper by V. I. TIKHONOV [Overshoots of Random Processes. Moscow, "Nauka," 1970], finds the probability density of the areas of overshoots of the envelope of the narrow-band process f(s/c). The distribution obtained coincides exactly with the distribution of probability densities of overshoots of the normal steady-state process for a high positive level. References: 4 Russian.

USSR

CONCERNING THE POSSIBILITY OF COMBINED OPERATION OF TVU-12 AND IKM-30 SYSTEMS IN ONE CABLE

Moscow VESTNIK SVYAZI in Russian No 2, 1977 pp 16-17

SARAYEVA, V. M., USLOV, I. S., and YAROSLAVSKIY, L. I., Coworkers Kiyev Branch of TsNIIS [Central Scientific-Research Institute of Communications]

[Abstract] TVU-12 equipment is more and more widely used for organization of urban telegraph services. The TVU-12 is intended for multiplexing or urban and suburban cable lines and the organization of 12 two-way telegraph channels

in one four-wire physical circuit. IKM-30 equipment is used in urban and suburban communication lines for organization of 30 telephone channels in two two-way physical circuits of the cables of urban telephone exchanges in one- and two-cable systems. Theoretical and experimental investigations were conducted at the Kiyev Branch of TsNIIS in order to determine the possibility of combined operation of the TVU-12 and IKM-30 systems in the telephone cables of urban telephone exchanges of Types T and TPP, during which high quality of both telephone and telegraph communication would be assured. On the basis of the data obtained, recommendations were developed, fulfillment of which makes it possible to eliminate the mutual effect of the systems. Tables 2.

USSR

MEANS OF IMPROVEMENT OF GEODESIC SECURITY OF RADIO-TELEVISION MASTS AND TOWERS

Moscow VESTNIK SVYAZI in Russian No 2, 1977 pp 17-18

BRIKMAN, G. A., chief geodesist, All-Union Radio-Television Transmitting Station imeni 50 Years of October

[Abstract] At a number of projects of the Ministry of Communications, USSR, considerable attention has been given in recent years to problems of the organization of geodesic control over the condition of high structures. Thus, for the last 3 years, Lithuanian communication personnel together with specialists of the Vil'nyus Institute of Engineering Research have carried out geodesic control of all high communication structures of the republic. Much work in this direction is also conducted in Central Asia. There communication personnel with the assistance of coworkers of the Tashkent Polytechnical Institute inspected the state of more than 30 high objects. However, cases are known when regulations with respect to inspection of masts and towers are violated at republic and oblast radio-television transmitting stations. Consequently, instead of the established norms of a yearly cycle, the regulation measurements are fulfilled much less often. The quality of measurements during this is extremely low, which is explained, not only by the absence of special training for the workers of radio-television transmitting stations and the use of non-adjusted geodesic devices, but also by the complication of attracting specialized organizations to an inspection of the verticality of masts and towers. At present, in connection with the increase of the number of objects found in prolonged exploitation, and with the growth, as a result of this, of the technological complexity of geodesical servicing, the urgent necessity has arisen for the creation of a single effective system of geodesic security of communication objects in connection with the Central Geodesic Laboratory. This would make it possible not only to combine positive practice with respect to inspection of these structures stored at various enterprises but also to improve the organization of control over the state of high structures. This practice must be taken into account in a single "Regulation With Respect to Geodesic Security of Communication Objects" for the Ministry of Communications, USSR. Such regulations are necessary not

only for an increase of the quality and determination of the requisite order and extent of measurements, but also for standardization of geodesic documentation. The most important problems of the Central Geodesic Laboratory remain: inspection of geodesic control which is performed at republic and oblast radio-television transmitting stations and the introduction of the above-mentioned "regulations"; systematic assistance, instruction, and development of standard programs of control, taking account of structural peculiarities and the state of the object; formulation and management of a single defect catalog for project, repair and other communications organizations; and fulfillment of control and inspection at certain structures with the use of especial equipment.

POLAND

A REVIEW OF THE ACTIVITIES OF THE POLISH COMMITTEE FOR MATTERS PERTAINING TO THE CISPR

Warsaw PRZEGLAD TELEKOMUNIKACYJNY in Polish Vol 49, No 12 1976 pp 372-373

T. S.

[Abstract] By the terms of the agreement concluded between the Minister of Communications and the Chairman of the Polish Committee of Standards and Measures the cooperation with the CISPR [Comite International Special des Perturbations Radioelectriques - International Committee on Radio Interference] is being conducted by the State Radio Inspectorate, within the framework of which a National Committee for Matters Related to the CISPR has been created. The Committee, in accordance with the organizational structure of the CISPR, is divided into subcommittees and working groups which were put in charge of scientists who specialize in radio interference. On 27 September 1976 a special meeting of the National Committee was held with the participation of the Chairman of the CISPR, J. H. L. Meyer de Stadelhofen (Switzerland). At this meeting the chairmen of subcommittees and working groups presented their reports, the details of which are given.

USSR UDC 518.1

SYNTHESIS OF THE RADIATION PATTERN OF TWO OPEN WAVEGUIDES

Moscow VYCHISLITEL'NYYE METODY I PROGRAMMIROVANIYE (CHISLENNYYE METODY V ZADACHAKH ELEKTRODINAMIKI) XXIV; SBORNIK RABOT VYCHISLITEL'NOGO TSENTRA MOSKOVSKOGO UNIVERSITETA in Russian 1975 pp 206-212

KRAVTSOV, V. V. and SKOROKHVATOVA, I. V.

[Abstract] This paper deals with the problem of synthesizing the radiation pattern for two open waveguides, taking their interaction into account. Solution of synthesis problems of this sort requires use of the regularization method, owing to the nonuniformity of input data. A new approach to problems of antenna synthesis was proposed in an earlier study, in which the synthesis problem was formulated as a variation problem with specific requirements for a solution utilizing regularizing algorithms. An earlier study gave a concise formulation of the problem of synthesizing emission from a system of open waveguides. In this paper a regularizing algorithm is used, not to limit the solution's norm, but to limit the number of normal waves exciting the waveguides, i.e., a minimum number of waves is sought creating emission from the waveguide system close to that of a specific polar diagram. The solution is based on calculating partial radiation patterns for each waveguide excited by one of the normal waves. A brief description is given first of the method of solving the problem of emission from a system of waveguides taking interaction between them into account. The problem is reduced to a system of Fredholm's integral equations of the first kind using Green's functions. The final synthesis problem consists in determining the type of excitation for the system which will make possible a radiation pattern with the properties required. These properties can be different, but here the synthesis problem is formulated with the requirement that a specific radiation range pattern be approximated with a certain degree of precision. The algorithm is applied to this problem and the results are presented in the form of a comparison between the radiation pattern desired and that achieved by synthesis. These results are in good agreement. Values are given for the minimum number of waves and the excitation vector. Figures 2; references: 5 Russian.

USSR UDC 621.372.853.1

CALCULATION OF THE CUTOFF CONDITIONS IN A CIRCULAR COMB WAVEGUIDE WITH DIELECTRIC ROD

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 22, No 2, Feb 77 pp 379-381
manuscript received 22 Dec 75

DEYGEN, M. I.

[Abstract] The cutoff conditions in a circular comb waveguide with a dielectric rod are calculated from the fundamental electromagnetic field equations, with

consideration of the appropriate boundary values and field symmetries. Insertion of the infinite Bessel-trigonometric series results in an infinite system of linear homogeneous equations which can be reduced to a finite order. The solution is evaluated in terms of two design parameters: the dielectric constant of the rod material and the ratio of rod radius to cavity radius, both varied over wide ranges, with the other design parameters held constant. The results shown for modes H_{11}, H_{31}, and E_{11} indicate the effect of those design parameters on the critical wavelength. They also explain, among others, why a Faraday rotator with a comb waveguide has a wider band than one with a plain circular waveguide. The author thanks D. N. Pokusin for the statement of the problem and attention to the work, as well as Ya. N. Fel'd for a number of useful comments. Figures 2; references 2: 1 Russian; 1 Western.

USSR UDC 621.372.061

DETERMINATION OF THE STRUCTURAL PARAMETERS OF HETEROGENEOUS LINES WITH RESPECT TO SPECIFIED VALUES OF THE Q OF A RESONATOR

Moscow RADIOTEKHNIKA in Russian Vol 32, No 2, 1977 pp 44-47 manuscript received after improvement, 19 Feb 76

KOZLOVSKIY, V. V.

[Abstract] A method is considered for determining the dependence of the structural parameters of a heterogeneous line, on the instantaneous geometrical length X or the electrical length τ with respect to specified values of the Q of a loaded resonator. It is possible to employ the proposed method when losses in the loads and in the walls are commensurate. If the losses in the loads considerably exceed losses in the resonator walls, then it is impossible to use the method in question, because in this case the losses R(X) and G(X) in resonators with a large inherent Q have little effect on the Q of the loaded resonator. Figures 1; references: 4 Russian.

USSR UDC 621.372.412/414

STARTING CONDITIONS IN GYRORESONANCE DEVICES WITH AN ARBITRARY RESONATOR PROFILE AND A WEAKLY NONUNIFORM MAGNETOSTATIC FIELD

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 22, No 2, Feb 77 pp 415-417 manuscript received 5 Nov 75

KURAYEV, A. A. and SHESTAKOVICH, V. P.

[Abstract] The efficiency of interaction processes in gyroresonance devices can be greatly improved by optimization of the resonator profile and of the

magnetostatic field distribution. The optimization of energy characteristics is, however, limited by the starting requirements. While the output stage of the amplifier must also remain stable (its running current must be lower than its starting current), the generator must have an optimum structure and running performance for maximum efficiency and soft self-excitation (its running current must be higher than its starting current). Accordingly, nonlinear as well as linear equations which establish the starting conditions must simultaneously enter into the optimization problem. These equations are derived here for axisymmetric gyroresonance devices and put in a form convenient for computer calculations. References: 6 Russian.

USSR UDC 621.317.761

QUASI-ELECTRONIC PULSE DISTRIBUTOR

Moscow PRIBORY I SISTEMY UPRAVELENIYA in Russian No 1, 1977 pp 45-46

KORCHINSKIY, YE. K., candidate of technical sciences, MALYSHEV, G. P., and SOSINOVICH, V. A., engineers

[Abstract] Developers of various types of equipment intended for psychological and physchophysiological experiments, instructive machines, trainers, teaching complexes, various illuminating objects, etc., always investigate a well-known difficulty before choosing the type of distribution of clock pulses. This difficulty results from the fact that the technique being developed far from always fulfills the functional problems, the solution of which it is possible to realize by sending clock pulses through one channel (in this case a generator of relaxation pulses, e.g., with a multivibrator). Considerably more frequently, distribution is required of electrical pulses from a generator through many separate channels, during which the pulses being sent must have a different duration. Solution of such a problem, even with the use of noncontact elements, is not simple and pulse distributors turn out to be expensive, insufficiently precise, large-scale, and power-consuming. An increase of the current intensity to values necessary for function of terminal operating devices, still further increases the shortcomings of the circuits mentioned above. In the present paper a circuit for a quasi-electronic pulse distributor is proposed, which makes it possible from one pulse generator (multivibrator) to dispatch pulses with the frequency of the generator through n separate channels in the order of priority of their arrival from the generator. A simple timer is provided for synthesis of n identical pulses which are directed along separate channels into a different number of pulses which have a frequency and duration corresponding to a program of work of the operating elements. A prototype of the proposed quasi-electronic pulse distributor was successfully applied to a device for training of an operator. This training devices operated in a complex with the TK-1 electron model training apparatus, modelling an energy unit with a power of 200 MW. Figures 1; references: 2 Russian.

HUNGARY UDC 621.372.54.011.733

FEN [FREQUENCY EMPHASIZING NETWORK] CIRCUITS

Budapest HIRADASTECHNIKA in Hungarian Vol 28, No 3, Mar 77 pp 65-70

NEMESSZEGHYI, GYORGY, Banki Donat Technical College

[Abstract] This article discusses active filters with FEN circuits, which may be classified as active circuits simulating passive LC circuits. The filters with FEN circuits may be separated into chains of second-degree filters with FEN circuits. The goal is to have the frequency-dependence of the voltage transmission the same as in an LC circuit. The FEN circuit contains two operational amplifiers, one inverting and the other non-inverting. The latter is in the feedback branch of the former, together with a dual T bridge. Thus, the FEN circuit performs frequency highlighting at that frequency where the dual T member breaks. Formulas are available for the calculation of the sensitivity of the FEN circuit and the active filter containing a FEN circuit. Such a filter with medium Q is described and illustrated. The parameters for designing, and the parameters of performance (frequency center, frequency bandwidth, primary resistance, secondary resistance, and amplification) are calculated by computer. An ALGOL program was described for these calculations. The program was run on an ODRA 1024 computer. The program has two parts, one an iterating step for the calculation of the coefficients of the transfer function of the active filter from the read-in data, and the other for the determination of the parameters of the active filter. Figures 11; tables 2; references 4: 1 Western; 3 Hungarian.

USSR UDC 621.372.542.2

TRANSVERSAL FILTERS WITH OPTIMIZED PULSE RESPONSE CHARACTERISTICS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 22, No 2, Feb 77 pp 292-298 manuscript received 30 Jun 75

KRUKHMALEV, V. V. and KRUKHMALEVA, V. D.

[Abstract] The synthesis of networks with optimum pulse response characteristics is an important step in the design of data transmission systems, automatic control systems, and generally in the shaping of signals with a limited spectrum. Such a pulse response is defined here in terms of its coefficients. The corresponding transfer function of an analog filter with multiple poles is determined next, and a transversal digital filter matching it is synthesized on the principle of invariance with regard to the pulse response characteristic. Figures 6; tables 3; references 4: 3 Russian; 1 German (in translation).

USSR UDC 621.372.543.3

DISCRETELY TUNABLE BAND ELIMINATION FILTER

Moscow RADIOTEKHNIKA in Russian Vol 32, No 2, 1977 pp 95-98 manuscript received 26 Jun 75; after completion, 18 Dec 75

GOLOVKOV, V. P., ZABOLOTNYY, N. I. and SHIKHMANOV, S. S.

[Abstract] In wide-band receiver-amplifier channels of radiotechnical devices a significant part of the exterior noise is noise from outside radio stations, the spectrum of which is considerably narrower than the spectrum of the useful signal. It is shown in the literature that for abatement of such noise, band elimination filters are used, tuned to the carrier frequencies of the troublesome radio stations. If these frequencies are unknown or change in time, it is desirable to automate the elimination process, which it is possible to accomplish by a band elimination filter with discrete retuning of frequency. The present paper derives the principal relations and proposes a procedure for calculation of a band elimination filter based on RLC components. The required trap frequency of the filter is determined by switching its components in accordance with control binary codes. The parameters are shown of a concrete band elimination filter, and the results of experiment are presented. The proposed filter can be used in various automatic devices with a discrete change of the trap frequency. The expressions obtained also make it possible to calculate components of LC channels with a discrete change of the resonance frequency. Figures 5; tables 1; references: 4 Russian.

USSR UDC 389.6:658.562:621.3.059.75:620.19

NONDESTRUCTIVE QUALITY INSPECTION OF MULTILAYER PRINTED-CIRCUIT BOARDS

Moscow NADEZHNOST' I KONTROL' KACHESTVA in Russian No 2, Feb 77 pp 65-74

DANILIN, N. S., BAKLANOV, O. D., MALKOV, A. B., KOPYLOV, YU. A. and LABETSKIY, V. V.

[Abstract] Experience has shown that of all failures in radioelectronic apparatus 40-45 percent are caused by design errors, 20 percent are caused by manufacturing errors, 30 percent are caused by incorrect operation or maintenance, and only 5-7 percent are caused by natural wear or aging. In the case of multilayer printed-circuit boards, it seems particularly appropriate to focus attention on design and manufacturing errors. Most significant here are defects caused by latent breakdowns which depend on the technological process, inasmuch as they cannot be detected at the plant by conventional electrical measurements. The proper method of detecting such defects is by measuring the volt-ampere characteristics of a circuit component and examining its nonlinearity. The Ericson test for passive elements is based on applying a purely sinusoidal voltage across the element and measuring the current through that element. Here, the inherent nonlinearity of an element may mask the nonlinearity caused by a defect in it. Measuring directly only the third harmonic (usually the largest of all harmonics) is expedient where the resistance of a crack is higher than 0.3 Ω but fails, because of overwhelming distortion, where that resistance is lower. In this case a biharmonic input signal produces excellent results. A detailed analysis of the output signal and its frequency with 1) One input frequency not a multiple of the other; 2) Both input frequencies in a ratio of two natural numbers without common factors; and 3) One input frequency a multiple of the other shows that the last combination (2:1 ratio, for example) is most expedient for inspection purposes because, except for beats which may be suppressed by means of filters, it reduces the test to zero harmonic, i.e., d-c measurements. This method has been found effective in detecting partial cracks, short circuits, oxide films, and photoresist residues on multilayer printed-circuit boards. Figures 4; references 4: 3 Russian; 1 Western (in translation).

USSR UDC 621.374.32

A HIGH-SPEED DECADE COUNTER BASED ON INTEGRATED CIRCUITS WITH A DIGITAL DISPLAY

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 3, Mar 77 p 39

ALIMOV, V. A.

[Abstract] The schematic diagram is presented of a high-speed decade counter with a seven element light-emitting diode digital indicator of Type 2L105B. The counter contains a pulse counter using 1TK331 elements, the control

circuit of the 2L105B seven-segment light-emitting diode display, which consists of 1LB337 microcircuits and a decoder of a binary-decimel code in septenary, using 1LB332, 1LB338, 1LB334 and 1LB331 microcircuits. The entire system is assembled on a 60x90 mm^2 printed-circuit board. It draws a power of 0.8 W and its cutoff frequency is 10 MHz. The series 331 microcircuits in the high-speed decade counter may be interchanged with series 155 integrated circuits without change of the specifications of the lead outs. Figures 1; references: 3 Russian.

USSR UDC 621.374.322

REVERSIBLE PULSE COUNTER

Moscow PRIBORY I SISTEMY UPRAVLENIYA No 12, 1976 pp 40-41

CHERKASHIN, F. A., SHINKARENKO, V. L., engineers, ZINCHENKO, V. M., and BURENKO, A. S., candidates of technical sciences

[Abstract] Reverisble pulse counters (RC), especially binary-decimal, are widely used units of many automatic devices of discrete action. Mostly they are used together with decoders (D) for conversion of information into a decimal code (RC--D). In the literature a large number of RC-D are known with different circuit solutions for the code 2-4-2-1, which results from various assignments of RC--D. However, for industrial automation devices, the greatest practical interest is offered by RC constructed on a base of standard elements which are manufactured in series by industry, e.g., "Logic." In works devoted to this problem, binary-decimal RC in the code 2-4-2-1 are not cited, although the demand for them is large. At the NII Achermate [Achermete (meaning unknown) Scientific-Research Institute] at Dnepropetrovsk a binary-decimal RC with D based on elements of the T series "Logic" was developed and checked in prolonged exploitation under industrial conditions. The RC-D in question is used in an arithmetic unit, entering into a device for automatic weighing of cast iron, which is poured off from a mixer. During this the RC--D assures delivery of weight information to a digital display and to print. At present two of the devices mentioned are operated at the Zaporozh'ye Metallurgical Plant and four are incorporated into other enterprises. The present work discusses the block diagram of a reversible pulse counter in the code 2-4-2-1 and the circuit of a decoder. Operation of the counter is described. Figures 2; references: 8 Russian.

USSR UDC 533.581.001.24:621.315.626.1

DESIGN OF THERMODYNAMICALLY OPTIMIZED CURRENT LEADS FOR CRYOGENIC ELECTRICAL POWER APPARATUS

Moscow ENERGETIKA I TRANSPORT in Russian No 1, 1977 pp 60-66 manuscript received 29 Jan 76

ANTONOV, YU. F. and MAKSIMOVA, K. P., Leningrad

[Abstract] Superconductive electrical equipment for power purposes requires for its power supply high current from an external source, this current being fed to cryostats with a low-temperature fluid. The method of optimizing current leads depends on the method of cooling the equipment and the operating cycle of the cryogenic unit. For open-circuit cooling with employment of a liquefier, or for closed-circuit cooling with a refrigerator and inflowing saturated coolant vapors, current leads are optimized with minimum heat flow at the cold end as the criterion, whereas for closed-circuit cooling where a refrigerator is used and coolant vapors are admitted at medium temperatures, optimization is performed with minimum energy consumption to compensate for the heat admitted to the entire circulation loop of the cold-transfer agent as the criterion. This latter type is called "thermodynamic" optimization, which is the subject of this paper. Thermodynamic optimization is carried out here by a variation method, using Lagrange's method of multipliers, beginning with the heat balance equation for a gas-cooled current lead. This method is used to find the optimum distribution of heat flows over the length of the current lead when component segments are cryostated by an infinite number of refrigerator units operating in a Carnot cycle. Formulas are also presented for thermodynamic optimization of current leads for units operating under real conditions, which is complicated by the fact that the efficiency of the unit is a function of the temperature at which coolant vapors enter. Efficiency in this case is approximated by an analytical formula taken from an earlier study. This method of optimization makes it possible to determine the optimum geometrical dimensions of current leads, the conditions required for blasting them with a vaporized coolant, and minimum inflow of heat at the cold end. It is demonstrated that it is not feasible to make a thermodynamically optimum current lead with a nonuniform cross section. Reduction of comparatively long current leads to acceptable sizes leads to an increase in heat flow along the lead, at the cold end in particular, and to an increase in energy consumption to cool it. Thermodynamic optimization should be carried out for strong-current leads for cryogenic equipment for power purposes and air and land transportation in which the capacity of the refrigeration unit is restricted out of considerations of size and weight. Figures 5; references 6: 2 Russian; 4 Western.

USSR UDC 537.311.62.001

CRITICAL STATE STABILITY IN SUPERCONDUCTIVE SYSTEMS

Moscow ENERGETIKA I TRANSPORT in Russian No 1, 1977 pp 67-76 manuscript received 5 Mar 76

KREMLEV, M. G., MINTS, R. G. and RAKHMANOV, A. L., Moscow

[Abstract] Magnetic instabilities present in hard superconductors limit to a great deal the possibility of obtaining a current density on the order of 10^5 to 10^6 A/cm^2 and the maintenance of their properties in strong magnetic fields, properties which are theoretically possible for superconductive systems. This paper is a survey devoted to presenting the consistent theory recently developed regarding the origin of these instabilities and to the application of this theory. Superconductors operating in different types of apparatus are found in a so-called critical state, whereby the effect of the transport flow on vortex filaments is balanced by interaction with flaws in the crystal structure (pinning). In the critical state in a hard superconductor a current density equal to a critical value arises in response to any difference in potential applied. The critical state is a state of dynamic equilibrium and can therefore become unstable under certain conditions, e.g., with an increase in temperature in a portion of the superconductor, leading to an avalanche-type process. Disturbances of temperature and the electric field increasing in a related manner and resulting in penetration of magnetic flux into the superconductor represent a phenomenon known as flux jumping. The theory of flux jumping is discussed here from both a qualitative and quantitative viewpoint. Consideration is given to the stability of hard and composite superconductors with respect to flux jumping. Stability criteria are derived and the parameters of a number of superconductive systems are calculated by means of these criteria. Such parameters are, for example, the critical number of elements in a conductor with which its stability as a whole is lost before instability arises in a single core. It is concluded that the theory developed up to the present time and elaborated here make calculations possible for the stability of various superconductive systems and to determine at the same time dimensions of conductors, thicknesses of normal cladding, the magnetic field gradient in a superconductor, optimum cooling conditions, number of cores, and the time required for the development of instability. It is also possible to take various physical effects into consideration, such as thermal and magnetic diffusion and the relationship between the pinning force and the temperature and field strength. Figures 4; references 14: 3 Russian; 11 Western.

USSR UDC [537.311.62:621.3.051.024]001

RELATIONSHIP BETWEEN TRANSIENT PROCESSES IN REGULATED D.C. TRANSMISSION AND THERMAL PROCESSES IN A SUPERCONDUCTIVE CABLE

Moscow ENERGETIKA I TRANSPORT in Russian No 1, 1977 pp 53-59 manuscript received 22 Sep 75

BOCHKOVAYA, G. P., NEPOPALOV, V. N. and SHIPULINA, N. A., Leningrad

[Abstract] Much research is being done on utilizing the phenomenon of superconduction in power engineering, in particular for transporting electrical energy through superconductive d.c. transmission lines (SDCTL's). One of the many problems which arises in designing SDCTL's is ensuring the thermal stability of the line during accidental current overloads. Previous studies in this area have not considered the relationship between transient processes in the transmission line and thermal processes in the superconductive cable. In this paper, for the purpose of analyzing the thermal stability of an SDCTL, joint consideration is given to transient processes during accidental current overloads and to thermal processes in the superconductive cable (SCC), with the aim of determining the amplification factor of the current regulator, the inductance of the line reactor, and the geometrical parameters of the cable. Thermal stability is defined here as the property of an SDCTL enabling it, under the effect of thermal disturbances in the low-temperature region, either to remain in the superconductive state or, after leaving the superconductive state, to return to it when the effect of the thermal disturbances has been curtailed. The energy characteristics of transient processes with maximum possible current overloads (with a sudden drop to zero of the counter emf at the inverter end of the line, for example) are used to provide the necessary information for analyzing thermal stability. The energy characteristics chosen are those whereby it is possible to determine whether the cable remains in the superconductive state when the accident occurs, whether conditions exist enabling the cable to return to the superconductive state in the event of accidental transition to the resistive state, and those making it possible to calculate the parameters of the line with which thermal stability is possible. These characteristics are: The breakdown current factor, defined as the maximum value of the breakdown current divided by the rated current for prebreakdown conditions; the accidental current overload time, defined as the time from the moment the overload begins to the moment the line current returns to the current value prior to the accident; the integral characteristic of the intensity of occurrence of transient processes; and the velocity characteristic of the increase in breakdown current, defined as the maximum breakdown current divided by the time during which the maximum value of the line's breakdown current is reached. Curves are derived showing the relationship between the amplification factor of the current regulator and the breakdown current factor, the velocity characteristic of the increase in breakdown current, and the accidental current overload time. An equation is derived which expresses the relationship between permissible transient processes in a d.c. transmission line and thermal processes with which thermal stability is maintained. Equations are also derived making it possible to calculate simply the parameters of the line, the dimensions of the superconductive cable, and

thicknesses of the superconductor and normal-metal plies of the coaxial cable. This paper was written on the basis of work done on the initiative of Academician L. R. Neyman (deceased) who also gave constant attention to it. Figures 4; references 7: 3 Russian; 4 Western.

USSR UDC 518.1

THE INTEGRAL EQUATION METHOD IN THE PROBLEM OF DIFFRACTION IN PERIODIC STRUCTURES

Moscow VYCHISLITEL'NYYE METODY I PROGRAMMIROVANIYE (CHISLENNYYE METODY V ZADACHAKH ELEKTRODINAMIKI) XXIV; SBORNIK RABOT VYCHISLITEL'NOGO TSENTRA MOSKOVSKOGO UNIVERSITETA in Russian 1975 pp 249-262

IL'INSKIY, A. S. and REPIN, V. M.

[Abstract] Modern radio engineering makes use of equipment composed to a great extent of multicomponent arrays, such as antennas consisting of open-end waveguides. Studies of the electromagnetic properties of these devices entail the necessity of dealing with problems of wave diffraction in infinite periodic structures. Strictly valid methods are necessary owing to the fact that resonance phenomena are observed because the typical dimensions of array components are commensurate with the wavelength of the diffracting wave. The situation of near periodicity for fields in infinite arrays makes it possible to formulate the problem within the scope of methods for studying electromagnetic coupling of spaces via apertures, and in a number of instances it is possible to construct Green's tensors and reduce the problem to a system of integral equations which can be solved numerically by deriving integrated singularities in kernels and using information on the evenness of fields from an earlier published study. This paper is devoted to studying one of these instances, corresponding to a three-dimensional vector-type diffraction problem. A system of integral differential equations is derived and reduced to a system of integral equations with integrated kernels. The procedure for doing this and the algorithm for a numerical solution to the resulting equations are given in an earlier study. Singularities in kernels are derived, and a determination is made of the tangential components of the electric strength vector in the coupling apertures, from which it is possible to compute the integral characteristics of the diffracted field. The equations given make it possible to deal simply with the problem of diffraction of a plane electromagnetic wave in a periodic system of apertures in a screen. In addition, this method can be used with emendations for periodic structures whose components contain other types of regions making it possible to construct suitable Green's tensors, such as those for round waveguides and resonators, as well as for multilayer structures. Figures 2; references: 6 Russian.

USSR UDC 518.1

DIFFRACTION OF ELECTROMAGNETIC WAVES IN A RECTANGULAR OPENING IN A SCREEN

Moscow VYCHISLITEL'NYYE METODY I PROGRAMMIROVANIYE (CHISLENNYYE METODY V ZADACHAKH ELEKTRODINAMIKI) XXIV; SBORNIK RABOT VYCHISLITEL'NOGO TSENTRA MOSKOVSKOGO UNIVERSITETA in Russian 1975 pp 50-68

REPIN, V. M.

[Abstract] An algorithm is proposed for a numerical solution to the problem of diffraction of electromagnetic waves in a rectangular opening in an infinitely thin, ideally conducting screen, making it possible to determine distribution of current in the opening and also to find radiation characteristics. The problem is formulated for a plane wave and the numerical analysis proceeds from formulas for the electromagnetic field in each of the two half-spaces connected via the opening. A determination is made of the tangential components of the vector of electrical intensity in the opening and then the components of the electromagnetic field in the remote region are computed using spherical axes. Equations are derived for the energy re-emitted by the opening into the upper and lower half-spaces. Figures and tables are given showing the results of solving the diffraction problem for a square opening with the same electrical intensity vector range for normal and glancing wave incidence. A curve is given expressing the relationship between the radial component of the Poynting vector of the field caused by the presence of the opening in the remote region and the angle of incidence with different azimuthal angles for normal and glancing incidence of a plane wave onto the opening. The results obtained prove the effectiveness of this numerical method in solving the problem of diffraction of electromagnetic fields in openings whose dimensions are commensurate with the wavelength. The author expresses deep appreciation to A. G. Sveshnikov for scientific direction of the work and discussion of the results. Figures 10; tables 4; references: 3 Russian.

USSR UDC 523.53

SCATTERING OF RADIO WAVES BY PLASMA CYLINDER

Gor'kiy IZVESTIYA VUZ:RADIOFIZIKA in Russian Vol 20, No 1, 1977 pp 51-55
manuscript received 16 Jan 76

CHUMAK, YU. V. and MOYSYA, R. I., Kiyev State University

[Abstract] Plasma formations in the upper atmosphere, which have both a natural and an artificial origin, are presently intensely investigated by radiophysical methods. A meteor trail can serve as an example of such a type of object. With a precision sufficient for the solution of many

theoretical and applied problems, it is possible to approximate a meteor trail by an infinite plasma cylinder with Gaussian distribution of the electrons along the radius. The present paper considers an infinite plasma cylinder in a vacuum with an electron density varying with the cross section. A plane electromagnetic wave of arbitrary polarization impinges on the cylinder, perpendicular to its axis. The cylinder expands radially under the effect of ambipolar diffusion. The complex dielectric constant of the plasma $\varepsilon(\gamma)$ is a function of the radius only and does not depend on angular coordinates. Two equations are derived, the input data for the numerical solution of which are the linear electron density α and the collision frequency $\bar{\nu}$. In the present case, α fluctuated from 10^{11} and 10^{13} cm^{-1}. Allowing for conditions valid for meteor radar, two values $\bar{\nu} = 0.1$ and 0.01 were taken. The problem is solved numerically by two methods: calculations made on a M-220 electronic computer by the power series methods, and for a check the Runge-Kutta method with automatic selection of a step. The results of calculations of the back scattering coefficient of the reflected signal as a function of the dimensionless magnitude A with $\bar{\gamma} = 0.01$ for various values of the electron density $\bar{\nu}$ are presented in graphic form for the cases of parallel and perpendicular polarization. The polarization ratio does not exceed two. The form of the amplitude and phase polarization for an arbitrary polarization satisfactorily agrees with radar meteor experiments, which makes it possible to use the results during interpretation of test data. Figures 5; references 10: 4 Russian; 6 Western.

USSR UDC 533.951

CONCERNING EXCITATION BY ELECTRON BEAMS OF SURFACE OSCILLATIONS IN A PLASMA WAVEGUIDE WITH METAL SHIELD

Gor'kiy IZVESTIYA VUZ:RADIOFIZIKA in Russian Vol 20, No 1, 1977 pp 56-66
manuscript received 18 Mar 75; after completion, 31 May 76

KONDRATENKO, A. N., KUKLIN, V. M. and PENEVA, I. KH., Khar'kov State University

[Abstract] Excitation by relativistic beams of low density of surface electromagnetic oscillations propagating along the boundaries of two media is considered in various works found in the literature. The instability of relativistic beams combined or spatially-separated with a cylindrical plasma waveguide relative to excitation of surface oscillations has also been studied. At the same time it has been assumed that the radius of the metal shield surrounding the plasma waveguide is very great. Consequently, it is of interest to study the effect of a metal shield on the interaction of a relativistic beam with a plasma cylinder. The present work considers excitation by monoenergetic electron beams of low density of the surface axially-symmetric oscillations in a plasma waveguide, which is a plasma cylinder of radius a, symmetrically arranged in a metal shield with a radius b greater than a. An exterior magnetic field is absent. The unperturbed densities of the plasma and the beam, both combined or spatially separated with the plasma

are constant, and the boundaries of homogeneous regions are assumed to be sharp, i.e., the characteristic lengths of the oscillations under consideration remain much larger than the width of the boundary of the inhomogeneous transition layer. A general dispersion equation is derived which is used in a study of the following: 1) Semi-bounded plasma; 2) Cylindrical waveguides. Excitation by low density beams of axially-symmetrical surface oscillations in cylindrical waveguides of finite radius. Consideration is confined to excitation by relativistic electron beams of comparatively long-wave surface oscillations; and 3) Effect of boundary inhomogeneity and particle collisions on excitation of surface oscillations. The effect is considered of boundary inhomogeneities on the excitation of surface oscillations in a semi-bounded plasma with a metal shield, by a monoenergetic electron beam of low density located in the gap between the surface of the plasma and the conductor. It is finally shown that a metal shield located at a finite distance from a plasma boundary may considerably change the dispersion of surface oscillations, increments, and conditions of instability. With large radiuses of the plasma cylinder or for sufficiently short wave oscillations an approximation of a semibounded plasma with a metal shield holds true. References 6: 5 Russian; 1 Western.

USSR UDC 538.56:519.25

CONCERNING THE EFFECT OF DISCONTINUITIES ON THE STATISTICAL CHARACTERISTICS OF NONLINEAR WAVES

Gor'kiy IZVESTIYA VUZ:RADIOFIZIKA in Russian Vol 20, No 1, 1977 pp 112-117
manuscript received 23 Jan 76

GURBATOV, S. N., Gor'kiy State University

[Abstract] During propagation of a wave in a nonlinear medium, distortion of its initial profile takes place. If the wave is generated by a noise source, then its statistical characteristics change. The paper considers the effect of discontinuities on the one-dimensional probability distribution, energy, and asymtotics of the energy spectrum of a random wave propagating in a nonlinear medium with low viscosity. It is shown that at the initial stage, attenuation of the mean energy of the random wave, connected with energy absorption at discontinuities, is determined by the first moments of the energy spectrum at the input and increases with growth of the initial spectrum width. The asymtotics of the energy wave spectrum are found to have a universal power form $S(k,t) \sim k^{-n}$, where n changes from 2 to 3 with a decrease of the wave number, during which the region of discontinuity of the power spectrum moves in time to the side of large wavelengths. The investigation conducted can be generalized to media with an arbitrary form on nonlinearity. In contrast to the case considered above, change of the magnitude of the discontinuity and the attenuation of energy at it will be determined by the magnitude of the velocity at which the discontinuity is generated. Consequently, attenuation of the mean energy will substantially depend on the

initial distribution of the velocity. The author thanks A. N. Malakhov and A. I. Saichev for consideration and helpful remarks on the work. Figures 1; references: 11 Russian.

USSR UDC 538.574.4

SCATTERING OF ELECTROMAGNETIC WAVES AT SMOOTH PERFECTLY REFLECTING OBJECTS SITUATED IN A SMOOTHLY INHOMOGENEOUS MEDIUM

Gor'kiy IZVESTIYA VUZ:RADIOFIZIKA in Russian Vol 20, No 1, 1977 pp 118-133
manuscript received 24 Jun 75

KONDRAT'YEV, I. G., Scientific-Research Radiophysics Institute

[Abstract] The paper is concerned with an investigation of the structure of a field, which originates as the result of scattering of an incident electromagnetic wave created by a point source, at a smooth (in the scale of a local wavelength) perfectly reflecting object in a smoothly inhomogeneous medium with plain (smooth) caustic surfaces. Typical dimensions of the reflecting object are assumed to be sufficiently small in comparison with the typical scale of inhomogeneity L_ε. For the purpose of simplification of all expressions, and the achievement thereby of great accuracy and clearness in interpretation of the results (essentially without loss for the physical content) consideration is given to the problem, using as an example two-dimensional systems where neither the characteristics of the incident field, the properties of the medium, or the characteristics of the dispersive object depend on one of the Cartesian coordinates--the coordinate $y(\frac{\partial}{\partial y} = 0)$. Consideration is limited to the Kirchhoff approximation (an approximation of physical optics) and thereby does not take into account corrections connected with formation of diffraction beams. Expressions are obtained for the apparent cross section of the scattering object. It is shown, in particular, that the scattering properties of sufficiently small objects are described with the aid of their real (vacuum) scattering cross sections. The principal physical results obtained in the work remain correct, both for arbitrary (and not only the well selected) two-dimensional systems, but also three-dimensional (at least in a quasi-scalar approximation). The respective generalizations do not encounter fundamental difficulties; they lead, however, to a significant complication of all expressions. Figures 5; references 17: 12 Russian; 5 Western.

USSR UDC 538.574.6

FRESNEL DIFFRACTION OF ULTRASHORT RADIOWAVES

Moscow RASPROSTRANENIYE RADIOVOLN: SBORNIK STATEY in Russian, Izd-vo Nauka, 1975 pp 355-364

ANDRIANOV, V. A.

[Abstract] The author examines Fresnel diffraction of ultrashort radiowaves in their propagation around a planet remote from the Earth. He gives the basic formulas of the asymptotic theory of diffraction of electromagnetic waves on a sphere for the region of Fresnel half-shadow. He discusses the results of the experiment using the robot space station "Luna-1" in the lunar shadow. The data obtained correspond to the Fresnel diffraction. The author analyzes the influence of the heterogeneous atmosphere surrounding the sphere on the Fresnel diffraction and evaluates the effects observed, such as the refraction displacement of the light-shadow boundary to the area of the planet's shadow, refraction attenuation of the radiowaves and change in the oscillation cycle of the Fresnel diffraction pattern, with respect to the propagation of radiowaves in the Martian atmosphere. Figures 4; references 17: 10 Russian; 7 Western.

USSR UDC 621.371

DIFFRACTION OF ULTRASHORT RADIOWAVES ON MOUNTAIN RIDGES

Moscow RASPROSTRANENIYE RADIOVOLN: SBORNIK STATEY in Russian, Izd-vo Nauka, 1975 pp 154-186

TROITSKIY, V. N.

[Abstract] The author makes a careful examination of the solution to the problem of radiowave diffraction on mountain ridges with irregular crests and takes into account the heterogeneous atmosphere with time-variable values of the dielectric constant gradient. The author obtains expressions for the space and frequency correlation functions for fluctuations in signal level. He determines the supplemental attenuation of signal that is caused by the finite dimensions of the crest and the antenna directionality. The author cites the distributions of signal level and the angular characteristics of the scattered field. The experimental characteristics of the diffraction propagation of decimeter and centimeter waves on mountainous areas of different sizes are compared with the theoretical characteristics. Figures 10; references 9: 6 Russian; 3 Western.

USSR UDC 621.371.2

REFRACTION OF ELECTROMAGNETIC WAVES IN THE EARTH'S ATMOSPHERE

Moscow RASPROSTRANENIYE RADIOVOLN: SBORNIK STATEY in Russian, Izd-vo Nauka, 1975 pp 56-65

KOLOSOV, M. A. and SHABEL'NIKOV, A. V.

[Abstract] The authors discuss a method of computing the angles of total, true and photogrammetric refraction of electromagnetic waves of the optical, submillimeter and radio bands in the earth's atmosphere with an exponential dependence of the refractive index on altitude at various distances of the radiator and receiver from the surface of the earth. They obtain analytical expressions for the angles of refraction and examine the specific cases of the general formulas which correspond to the various types of electromagnetic wave refraction in the earth's atmosphere. Figures 2; references 26: 22 Russian; 4 Western.

USSR UDC 551.510.535

LOCALIZATION OF THE HEIGHT OF NONLINEAR CURRENTS RESPONSIBLE FOR LOW-FREQUENCY RADIATION IN THE IONOSPHERE

Gor'kiy IZVESTIYA VUZ:RADIOFIZIKA in Russian Vol 20, No 1, 1977 pp 83-86
manuscript received 22 Dec 75

BUDILIN, L. V., GETMANTSEV, G. G., KAPUSTIN, P. A., KOTIK, D. S., MITYAKOV, N. A., PETROVSKIY, A. A., RAPOPORT, V. O., SAZONOV, YU. A., and SMIRNOV, S. YU., Scientific-Research Radiophysics Institute

[Abstract] The results are presented of direct measurements of the height of the generation region of low-frequency radiation produced when the ionosphere is affected by the modulated signals of a ground-based shortwave transmitter. Heating of the ionosphere was carried out with the aid of a short-wave transmitter which operated at frequencies of 4.61 and 5.75 MHz with a mean power of 100 kW. The transmitting antenna had a gain $G \sim 100$ in a vertical direction and emitted a wave with normal polarization. The transmitter was modulated by a sinusoidal signal (percentage of modulation $\sim$ 90 percent) successively at 24 fixed frequencies in the range $f = 1.25 \div 7$ kHz. At each modulation frequency, heating was continued for 4.5 minutes with the total time of running through the range of frequencies, 2 hours. From the experimental data obtained on 6-11 June, 10-14 July, and 16-18 July 1975, the mean value of the height of the generation region was found to be approximately 70 km. Figures 2; tables 1; references: 4 Russian.

USSR UDC 621.371.3

INVESTIGATION OF A COMPLEX SIGNAL DURING IONOSPHERIC PROPAGATION OF DECAMETER WAVES

Moscow RASPROSTRANENIYE RADIOVOLN: SBORNIK STATEY in Russian, Izd-vo Nauka, 1975 pp 262-290

NAMAZOV, S. A. and RYZZKINA, T. YE.

[Abstract] The authors discuss a method of probing the ionosphere by a complex signal with a spectral width of 100 kHz and give a brief description of models of the experimental devices. They cite the results of an experimental and theoretical study of the contraction distortion of a complex signal in the decameter band during vertical probing of the ionosphere as well as the use of complex signals for raising the resolving power of the ionospheric station. They demonstrate that the use of complex signals permits the ion probe resolution to be raised by approximately one order of magnitude. Because of this the authors investigate the fine structure of the reflected signal and the ionosphere itself in greater detail than before. Figures 12; references: 20 Russian.

USSR UDC 621.371.59

PROPAGATION OF SUBMILLIMETER INFRARED AND OPTICAL WAVES IN THE EARTH'S ATMOSPHERE

Moscow RASPROSTRANENIYE RADIOVOLN: SBORNIK STATEY in Russian, Izd-vo Nauka, 1975 pp 187-227

AGANBEKYAN, K. A., BISYARIN, V. P., ZRAZHEVSKIY, A. YU., IZYUMOV, A. O., SOKOLOV, A. V. and SUKHONIN, YE. V.

[Abstract] The authors give a survey of the state of the art on propagation of submillimeter, infrared and optical waves in the earth's atmosphere. Use of waves of the bands allows utilization of a huge range of frequencies for transmission of a practically unlimited volume of information and accomplishment of a high antenna directionality with comparatively small antenna dimensions. Use of such waves leads to a substantial reduction in size and weight of the equipment. The waves are attenuated by molecular absorption in atmospheric gases and by scattering on hydrometeors (rain, snow, storms, clouds, etc). The authors cite data in this work on the damping of radiations under various meteorological conditions. Figures 23; tables 5; references 162: 89 Russian; 73 Western.

USSR

UDC 621.371.24

INVESTIGATIONS OF ULTRASHORT WAVE PROPAGATION UP TO DISTANCES ON THE ORDER OF DIRECT VISIBILITY

Moscow RASPROSTRANENIYE RADIOVOLN: SBORNIK STATEY in Russian, Izd-vo Nauka, 1975 pp 66-126

KALININ, A. I. and NADENENKO, L. V.

[Abstract] The authors are concerned with the results of experimental and theoretical investigations on ultrashort wave propagation, which they analyze and generalize up to distances on the order of direct visibility. They make a thorough examination of the statistical characteristics of the signal, the correlation functions, the influence of precipitations, and the methods of computing the direct visibility path. The authors mention the trends for future investigations and find that a more careful study is required of the fine structure of the circumterrestrial layer of the troposphere using refractometric methods. Their results allow a better understanding of the numerous aspects of ultrashort wave propagation up to distances on the order of direct visibility. Figures 33; tables 8; references 182: 57 Russian; 125 Western.

USSR

UDC 621.371.251

PROPAGATION OF SUPERLONG RADIOWAVES IN THE EARTH'S IONOSPHERE

Moscow RASPROSTRANENIYE RADIOVOLN: SBORNIK STATEY in Russian, Izd-vo Nauka, 1975 pp 228-261

AKSENOV, V. I., LISHIN, I. V. and NAZAROVA, M. V.

[Abstract] The authors examine a strict solution to the problem of superlong radiowave transmission through plane-stratified magnetoactive ionospheric plasma with an arbitrary mutual orientation of the wave normal and geomagnetic field vector. They investigate the angular, frequency, latitudinal and azimuthal dependences of the coefficient of transmission of superlong radiowaves through the lower ionosphere. For the case of vertical incidence of the wave on the ionosphere the authors developed an approximate method for computing the transmission of superlong radiowaves; they also found an analytical solution to the problem for a model of the lower ionosphere with exponential profiles N and ν. They computed the field strength of the ground superlong radiowaves of a radiator in the ionosphere based on the radiation interpretation of the field in the waveguide Earth-ionosphere. The results of the theoretical investigations are compared with the experimental data obtained on the artificial earth satellites "Kosmos-142" and "Kosmos-259." Figures 18; references 35: 17 Russian; 18 Western.

USSR UDC 621.371.243

INVESTIGATIONS OF THE LONG-RANGE TROPOSPHERIC PROPAGATION OF ULTRASHORT WAVES

Moscow RASPROSTRANENIYE RADIOVOLN: SBORNIK STATEY in Russian, Izd-vo Nauka, 1975 pp 127-153

KALININ, A. I., TROITSKIY, V. N. and SHUR, A. A.

[Abstract] The authors examine a broad range of questions involving the phenomenon of the long-range propagation of ultashort waves. They discuss the results of the investigations and cite the experimental data concerning the dependence of signal level on distance, wavelength, antenna directionality and character of the path; they also give data on the fluctuation characteristics of the signals and discuss the nature of long-range tropospheric propagation as well as the possible trends for future investigations. Of special significance are the tests on studying long-range tropospheric propagation at distances beyond 1000 kilometers. The current detection of atmospheric heterogeneities at high altitudes makes these tests especially important. Figures 17; references 123: 52 Russian; 71 Western.

USSR UDC 621.391.812.62

STATISTICAL CHARACTERISTICS OF SIGNALS OF DECIMETER WAVES AT A DISTANCE ABOVE 1000 KM

Moscow RADIOTEKHNIKA in Russian Vol 32, No 2, 1977 pp 90-91 manuscript received after completion, 29 Jun 76

KALININ, A. I., PETRUSHKO, YU. I., TROITSKIY, V. N. and SHUR, A. A.

[Abstract] The results are presented of an experimental investigation of the propagation of radio waves at a frequency of approximately 800 MHz on a route with a length of 1025 km; its equivalent range amounted to 1100 km. The route passed above dry land in fixed conditions; measurements were in the summer (July, August). Antennas with an amplification factor of 43.5 db (at the transmitting point) and 35.2 db (at the receiver) were used in the investigations. An analysis of the continuous 24-hour recording of the signal during 1.5 months showed that the median value of the attenuation factor during the total period of observations amounted to $V = -136$ db (with the losses of amplification of the antennas used taken into account). A comparison of the data presented with experimental data obtained by some of the authors listed above shows that there is obviously a trend towards a steeper decrease of the medium value V with distance, beginning with an equivalent distance on the order of 1000 km. At the same time, the experiment showed that with an increase of the distance to more than 1000 km, dispersion of the slow fadings at least does not decrease with an increase of the length of the route; it is even somewhat larger in comparison with the results at a

distance of 90 km. Thus, with equivalent distance of more than 1000 km, in spite of the decrease of the medium value V with an increase of the distance, in small percentages of time significant levels of the signal were observed which can create an unfavorable situation for the electromagnetic compatability of the radio means. Figures 3; references: 2 Russian.

USSR UDC 621.371.332.4

THE LAW OF ENERGY CONSERVATION IN RELATION TO SCATTERING OF RADIO WAVES AT A ROUGH SURFACE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 22, No 2, Feb 77 pp 268-274
manuscript received 21 Jul 75

PAVEL'YEV, A. G.

[Abstract] The scattering of radio waves at a rough surface is analyzed, in the Kirchhoff approximation, with regard to the law of energy conservation. The author's earlier derived expressions for the scattering indicatrix and the scattering diameter are shown to be consistent with that law and thus found to be exact all the way to the limit $\lambda \to 0$ of the short-wave range. The analysis here refers to a surface $z(x,y)$ unbounded in both coordinates which constitute a realization of a random process $\{z(x,y)\}$ stationary in time and uniform in space. It also constitutes the boundary between free space and a homogeneous medium with a complex dielectric permittivity, struck by an incident wave and reflecting the latter. Figures 2; references 11: 10 Russian; 1 Western.

USSR UDC 621.391.32

STUDY OF THE PROPAGATION OF ELECTROMAGNETIC WAVES IN THE EARTH'S CRUST

Moscow RASPROSTRANENIYE RADIOVOLN: SBORNIK STATEY in Russian, Izd-vo Nauka, 1975 pp 312-354

ZVEREVA, YE. V., RYAZANTSEV, A. M., SAMUYLOV, I. N. and SHAKHSUVAROV, D. N.

[Abstract] The authors are concerned with a survey based on Soviet and foreign investigations on the propagation of electromagnetic waves in the earth's crust. They examine in detail the electromagnetic parameters of rocks in the earth's crust and discuss several of the basic methods used to compute the electromagnetic fields in stratified media. The authors cite certain of the results obtained from experimental investigations in the propagation of electromagnetic waves in the earth's rocks. Figures 22; references 232: 95 Russian; 237 Western.

USSR UDC 531.77:621.313.13-181.48

DEVICE FOR MEASUREMENT OF SMALL UNEVENNESS OF ROTATION OF SHAFTS OF MINIATURE MOTORS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 2, 1977 pp 56-57

FILATOV, I. A. and GRINEV, G. A.

[Abstract] In a previous paper by I. A, Filatov and others, the block diagram is presented of a device for measurement of the instantaneous variation of the angular speed of rotation from the mean value within the limits 10^{-6}--10^{-3}. However, this device, because of the existence of a contact current-collecting unit, the relatively large mass and the moment of inertia which is used in its converter of the angle of rotation, is not suitable for measurement of the parameters of the rotation of the shafts of miniature motors with a moment of inertia of the rotor, $J_R = 10^{-16}$ mg.m^2. These shortcomings are also inherent in other measurers described in the literature. The present paper describes a modification of the device by I. A. Filatov and others mentioned above, in which for measurement of the variation of the angular speed of rotation and the rolling angle of the rotors of miniature motors, a noncontact and practically momentless photoelectric converter is used. From the results of experiments the value $\gamma_{\omega_{thresh}} \approx 3.10^{-5}$ is obtained. Figures 2; references: 5 Russian.

USSR UDC 621.311.(018.4+016.2):621.398

DIGITAL INDICATION OF FREQUENCY, TIME, AND TOTAL POWER

Moscow ELEKTRICHESKIYE STANTSII in Russian No 3, Mar 77 pp 86-88

SHAMSHURIN, S. L., Omskenergo [Omsk Power System]

[Abstract] A new instrument panel with digital indication and luminous display of frequency, time, and total power has been installed in the control room of the Omsk power station. The frequency meter consists of a model F205 instrument series manufactured at the Omsk "Elektrotochpribor" [Precision Electrical Instruments] Plant, with a power supply, transistor switches, diode matrices, thyristors, and lamps. It reads from 48 to 52 Hz and can, if necessary, be used separately. The watt meter is a digital device operating with a model SM-1 adder bank. Analog-to-digital conversion is effected here by the simplest and most reliable time-pulse method, with a sawtooth voltage generator and two identical comparators which fix the start and the end of a count. Use of these instruments has eliminated subjective readout errors and experience so far has established their high reliability. Figures 4; references: 2 Russian.

USSR UDC 621.317.799

COMPARATOR USING TUNNEL DIODES

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 2, 1977 pp 77-78

RYSKIN, E. M.

[Abstract] As the result of the conversion of voltage into an inversely proportional magnitude, with the aid of the operational integrating amplifier devised in 1973 by the author, a time interval $\Delta t = 1/U$ is formed which is determined by the moment of equalizing of two voltages--the linearly variable and the constant. A comparator serves to compare these voltages and fix the moment of their equalizing. In the converter mentioned a comparator of any type can be used. However, well-known circuits of a comparator are sensitive to the reverse course of sawtooth voltage. To avert false responses special devices are introduced into the circuit for quenching the reverse course or blocking the measuring channel at this time, which complicates the circuit. It is possible to eliminate the sensitivity of a comparator to a reverse course if the moment of equalizing the two voltages is fixed by the formation of a pulse, the polarity of which is different for a forward and reverse course. This condition can be realized in the circuit of a comparator with a tunnel diode, trigger, and switch device. Such a circuit is described and graphs illustrative of its operation are presented. In order that the non-linearity of the initial section of the sawtoothed voltage have no effect on the operation of the comparator, a two-channel circuit is used. Figures 2; tables 1; references: 6 Russian.

USSR UDC 621.317.799:681.319

COMPLEX OF APPARATUS FOR MEASURING THE NOISE IMMUNITY OF DIGITAL DEVICES

Moscow PRIBORY I SISTEMY UPRAVLENIYE in Russian No 1, 1977 pp 25-28

GURVICH, I. S., KORNEYEV, B. A., candidates of technical sciences, and SAMUYTIS, V. P., engineer

[Abstract] A number of investigations of noise in power supply networks and the noise immunity of digital devices, performed at the Special Design Office of Computing Machines (Vil'nyus) made it possible to work out RTM [? Guiding Technical Materials] 25.93-72 "Recommendations with respect to protection of the means of digital computing technics from the noise of an a-c power supply," intended for enterprises and organizations of Minpribor [Ministry of Instrument Buildings, Means of Automatization, and Control Systems]. In the RTM, for the first time in native practice, the technical requirements are recommended with respect to the necessary degree of protection of devices from the noise of the power supply network, methods are recommended for determining the degree of noise immunity, and requirements are formulated for apparatus able

to imitate noise from a power supply network. Corresponding imitating apparatus was also developed at the Special Design Office of Computing Machines and the denomination obtained of a complex of noise imitators (KIMP). The design and exploitation documentation was also fulfilled at the Special Design Office, which in general was fully satisfactory for organizational production of KIMP. Now more than 15 test-pieces of KIMP have already been produced and transmitted to users. The present paper discusses the purpose and composition of the KIMP, and the purpose, principles of action and technical data on devices of the KIMP. These include the imitator of pulse noise, the imitator of prolonged noise, and the selector of prolonged noise. Basic technical data are given for each. The applications of the KIMP and methods, measurement circuits and control of the noise immunity of digital devices are also discussed. Figures 7.

USSR UDC 621.318.2

OPTIMIZATION OF THE DESIGN AND THE PERFORMANCE MODE OF SQUARERS USED FOR MEASURING THE MAXIMUM ENERGY PRODUCT OF PERMANENT MAGNETS

Novocherkassk IZVESTIYA VUZOV, ELEKTROMEKHANIKA in Russian No 2, Feb 77 pp 152-158 manuscript received 22 Jan 76; after completion, 14 Jun 76

DROBASHCHENKO, IVAN TIKHONOVICH, senior teacher Novocherkassk Polytechnical Institute, and KHANZHONKOV, YURIY BORISOVICH, candidate of technical sciences, dotsent Novocherkassk Polytechnical Institute

[Abstract] Only the second quadrant of the hysteresis loop plays a role in determining the energy of a permanent magnet. An instrument has been developed for measuring the maximum energy product in accordance with the relations

$$BH = \frac{1}{4}[(B+H)^2 - (B-H)^2] \text{ and } \frac{B}{B_r} = \left(1 - \frac{H}{H_c}\right)^N.$$

The instrument consists essentially of two algebraic adders, two squarers, and a third algebraic adder which generates a signal proportional to the energy product. The amplitude of that signal, proportional to the maximum energy product $(BH)_{max}$ is measured with a peak-to-peak voltmeter. Both squarers are function converters by piecewise-linear approximation. The accuracy of measurements depends largely on that of the squarers, inasmuch as the latter contribute most to the overall error. The squarer accuracy is analyzed here, accordingly, in relation to the range of amplitudes of the input signals. With the absolute measurement error Δ, the relative error of the squarers (both assumed identical) is $\delta = \frac{\Delta}{BH}$ 100 percent, equal to 0.25 percent for N= 0 (square-loop magnetic material) and 0.5 percent for N= 1. On the basis of this analysis, the measuring circuit is further improved by adding two voltage dividers and another rectifier. Figures 5; tables 1; references: 2 Russian.

USSR UDC 621.317.42.029.4:621.371.3

MEASUREMENT OF FIELDS OF LONG RADIO WAVES WITH THE AID OF AN ANTENNA LOCATED IN THE VICINITY OF A BODY DISTORTING THE FIELD

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 2, 1977 pp 71-74

KRASNUSHKIN, P. YE., and FEDOROV, YE. N.

[Abstract] Precise measurements of the fields of long and superlong radio waves on the earth's surface are performed with the assistance of antennas remote from objects which disturb the field. However, in the case of measurements on vessels and aircraft, it does not seem possible to avoid the effect of transportation facilities on a field in the vicinity of an antenna, and in the case of precise measurements of the fields of long and superlong waves with on board antennas it is necessary to take this effect into consideration. The present paper analyses the disturbance of an electromagnetic field by a metallic body, the dimensions of which are much smaller than the length of the wave. Experimental tests with a rotating loop antenna were conducted on a passenger vessel which travelled in the White Sea along the southern shore of the Kol'skyy Peninsula between Archangel and Kandalaksha. The fields were measured of two Norwegian stations: "Omega" (10.2 kHz) and JXZ (16.4 kHz) located on the western shore of Norway close to the Arctic circle. All measurements of the fields were made at the end of July and beginning of August 1975, when on the routes of the radio waves a large part of each 24 hours was daylight. A small-sized loop antenna with a ferrite core was used during tests with an Il-18 airplane (time of test not shown). A receiver developed and produced by Engineer M. I. Beloglazov was used on both the vessel and aircraft. Figures 2; references 5: 2 Russian; 3 Western.

USSR UDC 621.317.732.089.6:621.372.824

EQUIPMENT FOR ATTESTATION OF THE DEGREE OF IMPEDANCE IN A COAXIAL WAVEGUIDE

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 2, 1977 pp 69-70

PETROV, V. P., KONOPLEV, V. P. and BERKHOYER, A. L.

[Abstract] Equipment is described, used for attestation of the standard measurements of impedance in a coaxial waveguide with a Type P coupling (GOST 13317-73) in the frequency range 0.3-1.2 GHz (six discrete points); the equipment is constructed according to a two-channel scheme of parallel substitution based on microwaves. The construction, tuning, and attestation of the comparator (a slotless measuring line) -- the principal element of the equipment -- are described. An evaluation is made of the total errors and the results of attestation are compared. The equipment is included in the constitution of the State Standard for Wave Impedance as a comparator of input impedance. Figures 2; references: 4 Russian.

USSR UDC 621.374.3

EVALUATION OF LENGTH OF WIRE CONNECTIONS IN DIGITAL DEVICES, ALLOWING FOR NOISE IMMUNITY OF PULSE CIRCUITS

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 1, 1977 pp 23-25

IVANOV, V. V., engineer

[Abstract] During planning of digital devices based on microelectronic circuits, it is necessary to take into consideration the fact that the reliability of functional pulse circuits in an integrated form (e.g., a trigger) is determined not only by the probability of breakdown of the integrated circuit itself which is dependent on the circuit-technical characteristics, but also the probability of false switching (malfunctioning) of pulse circuits under the influence of exterior action. The probability of malfunctioning in a pulse circuit, in its turn, depends on the degree of the mutual electromagnetic effect of exterior intercircuit couplings, resulting by virtue of mutual crossfires, and, as a final result, on the technical realization of assembly connections. The present paper calculates the permissible length of the assembly connections in digital devices based on microelectronic circuits and their arrangement, taking account of the requirements of noise immunity for a trigger, which is the most common type of pulse circuit. The relatively high response with respect to triggering, the ability not only to transfer but also to fix the effect of interference and to convert it into false information makes the trigger the element in digital devices which is most vulnerable to interferences. An evaluation is made of the permissible length of wire connections for the control device of a EUM-23 digital printing machine, constructed with series 204 integrated circuits. The power circuits of this device were taken as the principal source of interference. The data obtained make it possible to conclude that, with the presence in the intercircuit connections of the power circuits of the EUM-23, laying out of them in one bunch, together with the wire connections of the memory elements, or in separate bunches approximately 10 cm apart is intolerable in practice. To get rid of the limitations mentioned above, it is necessary to use a different approach with respect to localization (screening) of circuits, to employ supplementary means for protection of logical element circuits from the effect of interference, e.g., decoupling filters or a decrease of the magnitude of the reactive parameters of the circuits of interference sources by means of diode shunting. Figures 5; references: 5 Russian.

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UDC 621.375.018.756

ELECTRIC WAVES IN DECOUPLED CHAIN NETWORKS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 22, No 2, Feb 77 pp 299-308
manuscript received 22 Oct 75

YEGOROV, YE. A., KABANOV, D. A., and KOROLEV, YU. A.

[Abstract] Nonlinear chain networks are considered which consist of identical stages not affecting one another's conversion process and containing unidirectional components such as, for example, a tunnel diode or a differential capacitance in series with a constant resistance. The steady state is analyzed, and electric voltage or current waves are found to occur, by converting the fundamental difference equations to partial differential equations and then, with the aid of a traveling coordinate, to ordinary differential equations which are solved either in quadratures or by a qualitative evaluation. The transient state is analyzed by the method of a functional Volterra series, either numerically through successive approximations or iteratively through convolutions. The results obtained with the aid of an analog computer indicate the possibility of electric shock waves, solitons, and neuristor propagation occurring in such networks. Figures 6; references 17: 13 Russian; 4 Western (two in translation).

USSR UDC 621.373

OSCILLATOR OF MILLIMETER DIFFRACTION RADIATION WITH OPEN RESONATOR OF PAIRED CYLINDRICAL MIRRORS

Gor'kiy IZVESTIYA VUZ:RADIOFIZIKA in Russian Vol 20, No 1, 1977 pp 134-138 manuscript received 17 Nov 75

KORNEYENKOV, V. K. and SHESTOPALOV, V. P., Institute of Radiophysics and Electronics, Academy of Sciences, UkrSSR

[Abstract] Optimum dimensions are found for an open resonator of paired cylindrical mirrors and on the basis of the investigations described, oscillators of diffraction radiation are created which operate efficiently in the millimeter wave band. The advantages of this resonator over a sphere-cylinder resonator are considered. For an investigation of the output characteristics of an oscillator of diffraction radiation, in which an open resonator with paired cylindrical mirrors is used, as a function of the radii of the cylinders and the distances between their centers, a model of an oscillator of diffraction radiation was developed which operates under continuous pumping in an electric magnet with a magnetic field H = 3.8 kOe. The results of the investigation of the output parameters of the oscillator for various parameters of the upper paired cylindrical mirror are presented in a table. An optimum open resonator is chosen. Figures 3; tables 1; references: 2 Russian.

USSR UDC 621.373.42

INVESTIGATION OF THE DYNAMICS OF SYSTEMS OF MUTUAL SYNCHRONIZATION

Moscow RADIOTEKHNIKA in Russian Vol 32, No 2, 1977 pp 3-9 manuscript received 26 Dec 74; after completion, 10 Jun 76

RIMAS, I. Z.

[Abstract] A method is developed for a precise analytical solution of the equations of state of systems of mutually synchronized timing pulse generators (SVSG), and the general solution of these equations for a SVSG with filters and various delays, with an arbitrary structure of connections between the generators, establishes the basis for an analysis of systems of mutually synchronized generators of a network. The matrices of transient responses obtained can be used for finding the responses of linear SVSG for various effects, determination of the characteristics of a transient process of concrete systems, and calculation of the statistical characteristics of the variable states of a SVSG. Figures 6; references 8: 4 Russian; 4 Western.

POLAND UDC 621.396.619

ANALYSIS OF A DOUBLE-BALANCED MODULATOR HAVING A UL 1000 INTEGRATED CIRCUIT

Warsaw PRZEGLAD TELEKOMUNIKACYJNY in Polish Vol 49, No 12, 1976 pp 353-355

ZIENTALSKI, MARIAN; Institute of Telecommunication, Gdansk Polytechnic

[Abstract] The author presents a method devised for the analysis of a double-balanced modulator with a Polish-designed UL 1000 4-transistor integrated circuit. The method described makes it possible to calculate the modulator output voltage and to determine the types of modulation products and the attenuation or amplification factor of the modulator for the utilized side band. The measurements performed confirm the correctness of the method. Figures 5; references: 5 Polish.

USSR UDC 621.391.25

EFFICIENCY OF BINARY STORAGE OF PULSE SIGNALS DURING DECODING OF INTERVAL CODES

Moscow RADIOTEKHNIKA in Russian Vol 32, No 2, 1977 pp 86-88 manuscript received after abridgement, 8 Apr 76

KATIKOV, V. M. and CHERNYKH, B. N.

[Abstract] Interval coding of pulse signals is widely used in radar and communication engineering. The coded signal is a sequence of pulses of identical form and duration, arranged at fixed time intervals, one with respect to another. Decoding of such signals is accomplished with the assistance of delay elements and coincidence circuits. The effect of noise at the decoder of the interval code leads to suppression of a useful code group, the appearance of spurious code groups, and to cross distortion of the codes. An analysis of these phenomena during decoding of identical code samples is found in the literature. The present short communication investigates the possibility of improving the quality of decoding of interval codes with the aid of binary storage. The results of numerical calculations which are presented make it possible to determine the energy gain from the use of binary storage. Figures 2; references 4: 3 Russian; 1 Western.

USSR UDC 621.396.96:621.391.82

DIGITAL PROCESSING OF A PHASE-MANIPULATED SIGNAL ON A BACKGROUND OF SIMILAR NOISE

Moscow RADIOTEKHNIKA in Russian Vol 32, No 2, 1977 pp 17-20 manuscript received 4 Jul 75; after completion, 30 Dec 75

STARIKOVSKIY, A. I. and NEZLIN, D. V.

[Abstract] Recently, digital devices have been widely used in radars for matched filtration of binary-code phase-manipulated (PM) signals. The most interesting of them is a quasi-optimum filter with quantization of the input voltage at two levels. As shown in the literature, such a filter, in spite of the presence of a clearly nonlinear device for binary quantization, displays quasi-linear properties during processing of a mixture of weak PM signals with normal noise, correlated within the limits of the signal element. In the case of other statistical properties of the noise, suppression is possible of the useful signal in the amplitude quantizer of the filter. The propagated form of the noise for PM signals is a similar noise, i.e., the PM signal differs from the useful signal by an amplitude and phase shift. Energy relations have been considered, with digital filtration of a completely known PM signal on a background of similar noise, with a constant amplitude and a random initial phase. The probability of passage of a weak PM signal to the output of a digital filter (DF) has been obtained for

analogous conditions. The present paper considers the passage through a DF with a binary quantizer, of a radar signal on a background of intense similar noise under the assumption of Rayleigh distribution of the amplitude of the signal and noise and the equally probable distribution of their initial phase. Such characteristics are typical for large radar targets. It is found that with Rayleigh distribution of amplitude and equally probable distribution of the phases of a PM signal and similar noise, the probability P of the passage of a signal to the output of a DF for K [signal-to-noise ratio at DF input] < 0.09 higher than with constant amplitudes of the signal and noise. Losses of the DF in comparison with a linear filter in the case of $K \ll 1$ are small ($\rho \approx 0.91$). With these same statistical characteristics of the signal and noise the mean value of the time intervals during which the PM signal is present at the output of the filter, and the mean interval between such time intervals depends on the frequency shift of the heterodyne voltage ω. It is shown that controlling the time characteristics of the output signal by means of a change of ω, it is possible to increase the probability of detection of a signal in accordance with the results of the observation of one packet of pulses. Figures 3; references: 6 Russian.

USSR

UDC 621.396.628:621.317.757.32

CONCERNING SENSITIVITY OF RECEIVERS-MEASURERS OF FREQUENCY WITH PARALLEL COVERAGE OF FREQUENCY RANGE

Moscow RADIOTEKHNIKA in Russian Vol 32, No 2, 1977 pp 53-58 manuscript received 13 Mar 75; after completion, 20 Oct 75

RUDNEV, L. N.

[Abstract] Tunable receivers with parallel coverage of the frequency range, together with paroramic tunable receivers, have received reasonably wide distribution. They include, for example, simple multichannel receivers based on parallel filters, and receivers of matrix and binary-code types. In spite of the absence in these receivers of frequency tuning, their sensitivity is reduced. This is caused by the fact that the principal form of signals analyzed are signals with unknown parameters. Consequently, with a duration of the pulse characteristics of the receiving filter τ_f, the most general is the case of reception of a signal of arbitrary duration τ_s, with a frequency separation $F = f_s - f_f$, where f_s, f_f are the center frequency of the signal spectrum and the pass band of the filter. In addition, in some cases a reduction of the sensitivity of such receivers is caused by the principles of their own construction. At the same time, a procedure for evaluation of their sensitivity, suitable for practical use, is not shown in the literature. In the present work, a procedure is presented for calculation and evaluation of the sensitivity of receivers of the matrix and binary-code types. The evaluation is made on the basis of a comparison of the sensitivity of the receivers under consideration with the sensitivity of a receiver matched with a signal taken for a standard. It is concluded that losses of receivers of the matrix and binary-code types are caused by the existence in them of a series connection of filters with different pass bands. A matrix receiver has the maximum loss of sensitivity. In the majority of cases, the sensitivity losses of binary-code receivers are less than in a matrix. A peculiarity of a binary-code receiver is the fact that losses of sensitivity prove to be dissimilar, not only for different reception channels, but also in each channel as applied to units, identical with respect to location, of the frequency codes of different signals. The sensitivity of a binary-code receiver proves to be dissimilar, not only to a signal of a different frequency and duration, but also to digits, dissimilar with respect to location, of the frequency code of one and the same signal. In matrix and binary-code receivers, it is possible for each frequency separation to find a signal of such a duration, during which losses of sensitivity prove to be minimal. Losses of sensitivity of matrix and binary-bode receivers-measurers of the frequency of signals limits the possibility of a choice of a large number of channels (lines and columns), with the object of improving the resolution with respect to frequency and expansion of the range of measurable frequencies. Figures 4; references: 4 Russian,

USSR UDC 539.293

HIGH-FREQUENCY CONDUCTIVITY OF A SEMICONDUCTOR IN LASER RADIATION FIELD

Gor'kiy IZVESTIYA VUZ:RADIOFIZIKA in Russian Vol 20, No 1, 1977 pp 151-155
manuscript received 30 Dec 75

MALEVICH, V. L.

[Abstract] It is shown in the literature that intense laser radiation can affect the kinetic, optical, and other effects in semiconductors by means of an alteration of the scattering probability of electrons by phonons or impurities. In particular, the effect has been considered of an intense electromagnetic wave on the absorption of a weak wave of another frequency. It has been assumed that the quantum energies of both waves are much greater than the mean energy of an electron, i.e., the quantum frequency region was considered. In the present work the effect is studied of intense laser radiation on the high-frequency conductivity of the degenerated electron gas in semiconductors. It is assumed that the frequency of a weak variable field lies in the classical region, and consequently in this instance, at the integral of collisions will affect only the field of laser radiation. It appears that in the conditions under consideration the Drude formula may be violated, during which, in the case of ionized impurity scattering of electrons, dispersion of high-frequency conductivity can begin at considerably lower frequencies. The author thanks E. M. Epshteyn for discussion of the work. Figures 1; references: 5 Russian.

USSR UDC 621.315.592

CONDUCTION REVERSAL EFFECT IN GERMANIUM IRRADIATED WITH ELECTRONS WITH ENERGY OF 2.5 MeV

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 11, No 3, 1977
pp 476-480 manuscript received 2 Jul 76

ABIYEV, A. K., GASUMOV, G. M., UKHIN, N. A. and CHURAKOV, YU. I., section of radiation research of the Presidium, Azerbaydzhan SSR Academy of Sciences, Baku

[Abstract] The effect of conduction reversal caused by photosensitive radiation defects in germanium is observed both in p-type specimens and in specimens which have undergone n-to-p conversion. The presence of these defects in the material makes it possible to reverse the specimen from the high-ohmic to low-ohmic state with white light at 77°K if the specimen is first annealed in the 150 to 220°K range. There has been no clear-cut explanation of this phenomenon up to the present time. This paper presents experimental evidence showing that the main mechanism explaining this phenomenon is the rearrangement of the electron-hole subsystem of defects introduced by irradiation. Specimens of n-type Ge doped with antimony, with

a carrier concentration of $2 \cdot 10^{13}$ to $2 \cdot 10^{15}$ cm^{-3} were irradiated with electrons with an energy of 2.5 MeV at 90°K. A unit utilizing variable magnetic and electric fields made it possible to make a continuous measurement of the Hall constant when heating and cooling the specimens. Curves are shown which express the relationship between temperature and the Hall constant in the process of isochronous annealing for a specimen of n-type Ge with an initial concentration of $9 \cdot 10^{14}$ cm^{-3}, converted into p-type by irradiation with an "average" integral electron stream of 10^{16} to 10^{17} electrons per square centimeter. It is shown here for the first time that in specimens of Ge converted to p-type by irradiation with "average" integral streams of electrons the effect of light-related n-to-p reversal of conduction is observed, after specimens converted to p-type (annealed at 110 to 220°K) again have n-type conduction as the result of cooling to 77°K. A study is also made of the effect reported in the published data whereby specimens of Ge converted to p-type by irradiation are reversed by light from the high-ohmic to low-ohmic state without a change in the type of conduction. It is demonstrated that both reversal effects are associated with rearrangement of the electron-hole subsystem of photosensitive radiation defects. Figures 2; references 7: 4 Russian; 3 Western.

USSR

UDC 621.315.592

THEORETICAL QUESTIONS RELATING TO LOW-FREQUENCY NOISE IN INHOMOGENEOUS ELECTRON-HOLE JUNCTIONS

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 11, No 3, 1977 pp 553-558 manuscript received 10 Sep 76

TARATUTA, A. S., Kiyev Higher Military Engineering Communications School imeni M. I. Kalinin

[Abstract] Real p-n junctions are inhomogeneous, and the presence of any kind of local region possessing the property of capturing and then releasing charges creates unidentical conditions for the passage of current through different sections of the junction. A mechanism is suggested here for the generation of low-frequency noise in inhomogeneous forward- and reverse-biased p-n junctions. Two effects distinguish this mechanism. Fluctuations in current and/or voltage arise from the effect of an independent source of random disturbance, as follows: Fluctuations first occur in charges in local regions located in the space-charge region and these cause changes in the thickness of the junction and/or the magnitude of the potential barrier, and, consequently, fluctuations in current through the corresponding section. These in turn bring about relaxation of temperature in the junction, which, in turn, has an effect on fluctuations in current. A system of linear differential equations is given to describe this mechanism. This effect is manifested at frequencies of far less than 10^{-6} Hz in germanium and silicon junctions and it makes the noise level zero when the noise level is defined by the reciprocal of the frequency and the frequency is zero.

The second effect consists in the following: The initial fluctuation in the charge in the depletion layer is apparent in the current through the junction not directly, but mainly as the result of its influence on the width of the junction or the height of the potential barrier. A change in these brings about fluctuation in the current. The theoretical discussion here proceeds from a determination of the Fourier components of fluctuations in current, with an investigation of the one-dimensional case of propagation of heat in an unbounded medium. The second half of the paper discusses the spectral relationship of the mean square noise current in a specific frequency range, calculation formulas are derived for this noise current, and a comparison is made between calculated and measured values of the mean square noise current. Figures 1; references: 2 Russian.

USSR UDC 53.085.34

REALIZATION OF DEVICE FOR CONTROL OF VACUUM-LUMINESCENT INDICATORS USING INTEGRATED TRANSISTOR-TRANSISTOR LOGIC CIRCUITS

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 12, 1976 pp 38-39

KIRPICHNIKOV, V. M., candidate of technical sciences, and SKLYAROV, V. A., engineer

[Abstract] Vacuum-luminescent indicators differ profitably from other types of their parameters: low-voltage power supply, low consumable power, low cost and high luminescence. The shortcoming of such indicators is their incompatibility with integrated TTL circuits. This problem is solved by the introduction of special shapers for matching the level of the voltage at the output of TTL circuits with the voltage of the power supply of the anodes and grids. An excitation circuit for an IV-3 vacuum luminescent indicator is shown in the present work. The circuit contains a multivibrator based on a 1LB333 microcircuit, a 1LB336 and a 1LB337 microcircuit, a pulse transformer, and a Type MP11 transistor. A calculation is presented of the parameters for conversion of the voltage at the output of the integrated microcircuits into the voltage of the power supply of the indicators. A brief description is given of the static and dynamic methods of indicators with the use of vacuum-luminescent indicators. Recommendations are presented with respect to the choice of method and the procedure for connecting the indicator. Figures 3; references: 7 Russian.

USSR

UDC 621.382.8

METHODS OF PRODUCTION OF MASKING FILM IN THE PRODUCTION OF PHOTOMASKS

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 12, 1976 pp 46-48

KOSTAN'YAN, M. G., engineer

[Abstract] The block diagram of a technological scheme for manufacture of effective photomasks is considered. Various methods of producing masking films are analyzed. The respective characteristics of metallized and transparent photomasks are presented. It is concluded that, with the characteristics of photomask production taken into account, it is advisable to organize their centralized production at one or two enterprises of a branch. For a maximum decrease of the period of development and production of photomasks and, consequently, also integrated circuits, it is necessary to equip such centralized sections with progressive technological equipment, instruments and computer technics. Use of an electronic computer for control of technological processes and the availability of automatic equipment makes it possible substantially to reduce the labor intensity and net cost of photomasks. It is necessary to turn particular attention to the development of series-production technology for the manufacture of wafers with flawless masking films ocfered by a layer of photoresist. A solution of these complicated problems will make it possible sharply to increase the quality of the output produced. Of the new promising methods, one must mention ion-plasma deposition and etching of masking films. Figures 1; tables 1; references: 1 Russian.

USSR UDC 518.1

PLOTTING CURRENT DISTRIBUTION IN A SLIT FROM A KNOWN NEARBY FIELD

Moscow VYCHISLITEL'NYYE METODY I PROGRAMMIROVANIYE (CHISLENNYYE METODY V ZADACHAKH ELEKTRODINAMIKI) XXIV; SBORNIK RABOT VYCHISLITEL'NOGO TSENTRA MOSKOVSKOGO UNIVERSITETA in Russian 1975 pp 199-206

REPIN, V. M. and NIKOLAYEV, V. A.

[Abstract] It is possible to compute both integral and local emission characteristics from knowledge of the distribution of tangential components of the electric field strength vector in an emitting aperture in an ideally conducting screen. In a number of instances it is possible to plot this distribution in an aperture from the known, e.g., measured, distribution of field strength vector components above the aperture. This paper demonstrates the application of integral equations for a numerical solution to the problem of plotting the tangential components of the electrical field strength vector in a slit in an ideally conducting screen. Curves are given showing the deviation in the absolute value and phase of the field plotted from integral equations of the first and second kind from the absolute value and phase of a reference field. The degree of error in plotting the field increases as the edges of the slit are approached. Use of an integral equation of the second kind makes it possible to improve mapping of field distribution, especially at the edges of the aperture, when using an elliptical system of coordinates. Even better results are obtained when using an elliptical system of coordinates and fixing the Y-axis. Improvement in the results of mapping the field when converting to an elliptical system of coordinates is caused by the complete utilization of information on the structure of the field in the vicinity of the edge. The study made here proves the effectiveness of the method suggested for mapping field distribution in an emitting aperture from the results of measuring a nearby field in the vicinity of the aperture in regions which permit formulation of Green's function. The presence of a numerical algorithm for solving integral equations in problems of diffraction in apertures in screens, as described in an earlier study, makes it possible also to use this method for the three-dimensional vector case. This method can be used in making engineering measurements. Figures 6; references: 4 Russian.

USSR UDC 535.853.31

ELECTRODYNAMIC CHARACTERISTICS OF A TWO-LAYER ASYMMETRIC DIFFRACTION GRATING

Gro'kiy IZVESTIYA VUZ-RADIOFIZIKA in Russian Vol 20, No 1, 1977 pp 160-162
manuscript received 29 Mar 76

KAZANSKIY, V. B., KOLCHIGIN, N. N., REZNIK, I. I. and PROSVIRNIN, S. L.,
Khar'kov State University

[Abstract] Two-layer gratings are widely used in various microwave devices, e.g., interferometers, filters, and antenna radomes. In the literature the electrodynamic properties of a two-layer strip of diffraction grating are described, in the case when simple strip gratings which form a two-layer unit are identical and arranged so that the strips are strictly one under another. The present short communication investigates the effect of a parallel shift of simple gratings on the properties of a two-layer grating. The structure in question consists of two unbounded plane strip metal gratings positioned in the planes $z = 0$ and $z = -a$. The metal planes are parallel to the axis 0_x and are positioned with a period L in the direction of the axis 0_y. The origin of the coordinates is chosen to be in the middle of one of the slits at the upper grating. The width of the slits of both gratings equals d. The lower grating is shifted with respect to the upper in the direction of the axis 0y to a magnitude δ. A plane polarized E- or H-polarized electromagnetic wave of unit amplitude impinges on the upper grating at an angle α which is measured from the axis 0_z. The diffraction field originating during incidence of a plane electromagnetic wave on a two-layer grating is a one-dimensional spectrum of spatial harmonics, which it is possible to determine with the use of generalized scattering matrices. On the basis of numerical analysis and experimental tests it is concluded that in the single-wave band $X < (1 + |\sin \alpha|)^{-1}$, the greater the distance between the gratings, the weaker is the affect of the shift of the lower grating with respect to the axis 0_y on the position of the interference extremum and the width of the resonance curve of the null harmonic of the diffraction spectrum. The effect of the shift proves to be weak even with $a/L = 0.5$. A two-layer grating with a shift $\delta = L/2$ can be used to increase the mechanical strength of antenna radomes. A two-layer grating with a shift $\delta \neq 0, L/2$ is an asymmetric structure in which positive and negative harmonics can substantially differ with respect to amplitude. It is determined that the maximum asymmetry of the diffraction field is observed at $\delta \approx 0.25$ L and in the case when the width of the slit is greater than the width of the strip. The analysis conducted shows that shift of one of the gratings which form a two-layer structure can be used for control of the distribution of energy in the diffraction spectrum. Figures 2; tables 1; references: 4 Russian.

USSR UDC 621.372.2.029.74

INSTABILITY OF THE ELECTRICAL LENGTH OF RADIATION GUIDES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 22, No 2, Feb 77 pp 381-385
manuscript received 1 Dec 75

VARD'YA, V. P., DUBROV, M. N. and KORSHUNOV, I. P.

[Abstract] The instability of the electrical length of a radiation guide is determined by the variability of its geometrical length and by the variability of the refractive index of the filler medium. Variations of the former may be caused by shifts of rotators and optical components. Variations of the latter may be caused by temperature, pressure, and humidity fluctuations. Accordingly, a study was made to establish the degree of correlation between variations of the electrical length and variations of the air density inside the guide. Lens optics and mirror optics were tested synchronously under atmospheric conditions in March 1975. Variations of the electrical length were measured and recorded by the interference method. An analysis of the experimental data indicates that long-time variations of the electrical length are the same, within $\pm 2 \cdot 10^{-8}$, both systems, and that a correction for these variations on the basis of meteorological data can increase the stability of the electrical length to within the order of 10^{-7}. Figures 3; references 6: 4 Russian, 2 Western.

USSR

NEW CONTACTOR-TYPE AND CONTACTLESS CONTROL APPARATUS

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 3, Mar 77 pp 46-47

Staff Report

[Abstract] The All-Union Scientific-Research Institutes of Relay Construction, Electrical Equipment, and Electrical Drive, and the Stavropol'skiy Plant Electroautomatics have developed and implemented a complex of contactor-type and contactless control apparatus, which is manufactured at the Moscow Electrical Equipment Plant, the Orgeyev Low-Voltage Electrical Equipment Plant, the Aleksandriysk Electromechanical Plant, and the Stavropol'skiy "Elektroavtomatika" Plant. The design is based on hermetically sealed contactors and on semiconductor T-logic respectively. Of special interest are: 1) The model RPG-3 miniature intermediate relay for operation on 12 V and 24 V d.c. or rectified three-phase current with a not larger than 6 percent ripple at a frequency of 300 Hz or higher, and the model RPU-0.616 set consisting of two model RPU-0 relays, also for operation on 12 V and 24 V d.c. The contactors switch d.c. under inductive loads with a time constant not exceeding 0.01 s and a.c. with a power factor not below 0.4, with the following ratings: closing 5.0 A d.c. (all voltages), 16 A a.c. (12-24 V), 10 A a.c. (110-220 V), and opening 4.0 A d.c. (12 V), 2.5 A d.c. (24 V), 0.4 A d.c. (110 V), 0.2 A d.c. (220 V), 4.0 A a.c. (12-24 V), 2.5 A a.c. (110 V), 2.0 A a.c. (220 V).

USSR

UDC 621.31.003.13

QUALITY OF ELECTRIC POWER AND ELECTROMAGNETIC COMPATIBILITY OF ENTERPRISE ELECTRICAL EQUIPMENT

Moscow ELEKTRICHESTVO in Russian No 3, Mar 77 pp 1-8 manuscript received 31 May 76

KONSTANTINOV, B. A., Doctor of Technical Sciences, Leningrad, ZHEZHELENKO, I. V., Doctor of Technical Sciences, LIPSKIY, A. M., SLEPOV, YU. V., Engineers, Zhdanov, KOZYR', V. N., Candidate of Technical Sciences, Moscow, BOZHKO, V. M., Engineer and RABINOVICH, M. L., Candidate of Technical Sciences, Kiev

[Abstract] According to the authors the quality of electric power in the electric circuits in many enterprises of various branches of industry fails to meet the requirement of GOST 13109-67 for one or more reasons. In a number of cases this results in a disruption in the conditions of electromagnetic compatibility of electrical equipment and also causes a significant economic loss. The authors examine the economic, mathematical and technical aspects of the problem of electric power quality in electric supply systems of enterprises. Tables 1; references: 10 Russian.

USSR UDC 621.313.8:621.318.1.001.5

PROSPECTS FOR THE DEVELOPMENT OF MAGNETOELECTRIC GENERATORS USING HIGHLY COERCIVE PERMANENT MAGNETS

Moscow ELEKTRICHESTVO in Russian No 3, Mar 77 pp 54-58 manuscript received 11 May 75

BALAGUROV, V. A., Doctor of Technical Sciences, Professor, KETSARIS, A. A. and LOKHNIN, V. V., Engineers, Moscow Power Institute

[Abstract] The authors are concerned with the development of magnetoelectric generators and find that the discovery of magnets with a rare-earth element and cobalt alloy base allows development of generators which have improved weight-size indicators. Both their experiment and their computations reveal that in this case it is feasible to employ inductors with tangentially magnetized magnets. They find that generators having a toothless stator, two inductors and sequentially combined excitation are especially promising. Figures 4; references: 3 Russian.

USSR UDC 621.313.333.048"401.7"

PREDICTING SERVICE LIFE OF INSULATION IN ELECTRIC MOTORS

Moscow ELEKTRICHESKIYE STANTSII in Russian No 1, 1977 pp 53-57

SIVOKOBYLENKO, V. F. and KOSTENKO, V. I., Donets Polytechnical Institute

[Abstract] Methods for predicting the service life of electrical insulation in electric motors in terms of conditions of impact loads occurring in starting modes are cited. A program is developed for computer calculation (Minsk-22) of relationships of the limiting number of engine starts as a function of the amplitude of displacement of winding rods of the stator beyond the groove and the probability of motor damage with an increase in the number of starts. Nomograms are given for analysis of service life as a function of rigidity of attachment of motor winding parts. An example of calculation is given. As experience is accumulated during mechanical inspections, these data can be used to set tolerance levels for new motors. Figures 3.

USSR UDC 621.315.623.5.027.3.001.5

RESEARCH ON SUPPORT INSULATORS WITH HIGH-CONDUCTIVITY GLAZING

Moscow ELEKTRICHESKIYA STANTSII in Russian No 1, 1977 pp 57-62

TRUSOVA, V. N., Elektrokeramika [Electrical Ceramics]

[Abstract] Research results are cited for specialized and general designs of substation support insulators (35 and 110 kV) with a total or partial coating of semiconductive glazing of domestic manufacture. Recommendations are made on the choice of the most advantageous designs for insulators made in the USSR and on the resistance ranges of semiconductive coatings for regions with different forms of pollution. Figures 3; tables 4; references 6.

USSR UDC [621.316.1:621.315.2].011.32.001.24

COMPUTATION OF THE MUTUAL INDUCTANCE OF CONDUCTORS BENT AS ARCS OF COAXIAL CIRCLES

Moscow ELEKTRICHESTVO in Russian No 3, Mar 77 pp 76-79 manuscript received 11 Jun 76

DANTSIS, YA. B., candidate of Technical Sciences, Leningrad

[Abstract] The author is concerned with the mutual inductance of conductors bent as arcs of coaxial circles and obtains a general formula for computing it. The author demonstrates that the familiar Maxwell formula for computing the mutual inductances of two coaxial round circuits is a partial case of the general formula obtained for computing the mutual inductances of conductors bent as arcs of coaxial circles. The author uses the results obtained to compute the inductances of flexible cables and bands of short networks of electric arc furnaces, unclosed round circuits, etc. Figures 3; references 4: 3 Russian; 1 Western.

USSR UDC 621.316.923.001.4

TESTING CIRCUIT BREAKERS FOR MAXIMUM CUT-OFF ABILITY

Moscow ELEKTRICHESKIYE STANTSII in Russian No 1, 1977 pp 72-74

KUZ'MIN, A. F., UFAYEV, G. V., KOLPAKOVA, N. M., and KREZHEVSKIY, YU. S., AUSRI/Elektroapparat, Ul'yanov Division of Ul'yanov Polytechnical Institute

[Abstract] The moment of occurrence of a short-circuit affects the operation of current-limiting circuit breakers. Relationships are shown among the limiting current, Joule integral and surge level as a function of the switching angle. Based on experimental data, circuit breakers undergo their heaviest commutation load during cut-off tests when the angle of switching is 90°, and at 0°. Thus, present methods used in designing circuit breakers lead to significant errors.

USSR UDC 621.316.925.2

ACCELERATION OF THE TIME OF EFFECT OF CURRENT BUSBAR SHIELDS AND MAIN 6-10 kV CABLE LINES

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 3, Mar 77 pp 35-38

DUDAREV, L. YE., candidate of technical sciences, PAVLENKO, N. S., engineer, Donets Polytechnic Institute; BOGDANOV, V. P., engineer, MURATOV, SH. A., engineer and NIKOL'SKIY, G. I., electrician, Volga Automobile Plant

[Abstract] To prevent large-scale breakdowns in equipment by short-circuit currents along with an increase in its arc resistance, the authors find that it is necessary to use high-speed shields. Acceleration of the effect of maximum current busbar shields and cable lines permits a sharp reduction of the time of short-circuit existence for small expenditures. Simultaneously with acceleration of short-circuit current shields on the busbar sections, they find that it is feasible to prohibit the effect of automatic closing and automatic reserve switching and instantaneous disconnection of 6-10 kV synchronous motors. The authors demonstrate that their positive experience in developing and testing the complete equipment for accelerating the effect of shields shows the possibility of series production at enterprises of the electrical engineering industry and the large-scale implementation of such devices in electrical supply systems of large industrial enterprises. Figures 4; references: 4 Russian.

USSR UDC 621.316.925.2:621.314.223.001.3

STUDY OF DIFFERENTIAL PROTECTION WITH NEW TYPE CURRENT TRANSFORMERS

Moscow ELEKTRICHESKIYE STANTSII in Russian No 1, 1977 pp 62-65

ZASYPKIN, A. S., GARMASH, V. A., SHELEST, V. A., ALLILUYEV, V. A., and BERKOVICH, M. A., Novocherkassk Polytechnical Institute

[Abstract] Electrical current transformers with closed ferromagnetic cores should be replaced: their shortcoming is oversaturation under transient conditions with an aperiodic component in the primary current. These should be replaced by electromagnetic current transformers which transform the periodic component of the primary current without substantial distortions, even with the maximum possible aperiodic component. The operating principle of new current transformers is to reduce resistance of the magnetizing branch of the transformer, or shunt the primary winding by external inductance; this reduces the aperiodic component of induction in the core of the transformer, and it is either unsaturated or saturated only slightly. During diagnosis of modes of switching transformers to idle, external and internal short-circuit, as well as in developing a simple, reliable method for measuring a selected diagnostic parameter, the additional device is made as an interlock for a series relay. References: 11.

USSR UDC 621.365.622.693.4:62-78

ANALYSIS OF ELECTRICAL SAFETY IN THE VICINITY OF PIPELINES WITH DIRECT ELECTRIC HEATING

Minsk IZVESTIYA VUZOV, ENERGETIKA in Russian No 2, Feb 77 pp 36-41 manuscript received 7 Sep 76

PATSUK, A. A., engineer, Norilsk Evening Industrial Institute

[Abstract] Direct electric heating of pipelines, with the pipe also serving as the heater element, is in many ways preferable to indirect heating but raises the problem of safety. Heating with reactified current has the advantage over heating with alternating current in that: 1) Longer pipe segments can be heated from a single source so that fewer sources need to be installed; and 2) Much higher voltages are safe (for 3-10 seconds) for a human body and thus are permissible to operate with. The performance and the safety of such a system for a pulp transporting pipelines are analyzed here, on the basis of standard specifications and a worst-case superposition of heater voltage and line (phase) voltage when a short to the ground through a human body occurs. Figures 1; tables 1; references 9: 7 Russian; 2 Western.

USSR UDC 621.3.012:621.3.014.31.001.8

FREQUENCY ANALYSIS OF THE CHARACTERISTICS OF AN ELECTRIC ARC

Novocherkassk IZVESTIYA VUZOV, ELEKTROMEKHANIKA in Russian No 1, 1977 pp 69-73 manuscript received 15 Dec 75

MIKHAYLOV, VLADIMIR VLADIMIROVICH, candidate of technical sciences, dotsent OKB SATK [Special (or Experimental) Design Office SATK (expansion unknown)] with Novocherkassk Polytechnical Institute, and YELISEYEV, IVAN NIKOLAYEVICH, graduate student Novocherkassk Polytechnical Institute

[Abstract] The authors discuss a method for the frequency analysis of the current and radiation force of a short-circuit electric arc in a direct current grid, based on utilization of the mathematical apparatus used in the theory of random functions. They demonstrate that the current and radiation force of the arc are random stationary functions. They found that by uisng the method described in the article they were able to make a substantial reduction in the amount of work involved in the frequency analysis of the characteristics of a short-circuit electric arc because only one application of the random function is required to carry it out. Figures 4; references: 3 Russian.

USSR UDC 621.311.052.333.015.3

FERRORESONANCE PHENOMENA IN NETWORKS WITH A SOLIDLY GROUNDED NEUTRAL AND PREVENTATIVE MEASURES

Moscow ELEKTRICHESKIYE STANTSII in Russian No 3, Mar 77 pp 71-75

TSIREL', YA, A., candidate of technical sciences, and POLYAKOV, V. S., LVS [expansion unknown] Lenenergo [Leningrad Regional Administration of Power System Management]

[Abstract] Ferroresonance in networks with a solidly grounded neutral is a rare phenomenon, but its probability increases when model VVB air circuit breakers with high-capacitance voltage dividers are installed. When the last breaker disconnects the voltage transformer at the busbar from the network with a solidly grounded neutral, they remain coupled through the breaker capacitance. A subsequent opening of that breaker's switches increases the impedance so as to cause the ferroresonance to die out. Ferroresonance currents and the resulting overvoltages are very high, they produce shorts in the transformer primary, but the transformer incurs damage only upon subsequent reclosing of the circuit. A theoretical computer-aided analysis on the basis of a simple equivalent circuit diagram and the equations for current and voltage, applicable to many operating modes and various combinations of circuit parameters, has been augmented by an experimental analysis of a typical 220 kV system. Calculations and test results indicate that the

probability of ferroresonance decreases with higher voltage ratings. Practical preventative measures include definite switching sequences in routine shutdowns, in the protective differential relaying during emergency shutdowns, and in returning to operation. These recommendations are tentative, however, and require further evaluation. The damage which ferroresonance may cause to air circuit breakers, in breaking down their insulation system, also requires further study. Figures 4; references: 2 Russian.

USSR UDC 621.315.1.002.72

EXPERIENCE IN THE INSTALLATION OF FLEXIBLE HIGH-CURRENT CONDUCTORS

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 3, Mar 77 pp 29-30

POLOUS, G. S., engineer "Donbasspromelektromontazh" [expansion unknown]

[Abstract] A two-arm system of flexible high-current conductors 0.72 km long has been installed in the Donets Cotton-Paper Combine for feeding power to it from a 220/110/10 kV substation. The poles were erected first, together with cross arms and anchors. The conductors were mounted next, from a truck with cable cars and winches. The conductors were transposed intraphasally after their installation, by rehooking them in a helical pattern. Feeder taps were put in last. Experience has shown that for such an installation, blueprints are needed of the entire route with all obstacles and intersections as well as proprer scheduling, especially for the delivery of nonstandard parts.

USSR UDC 621.315.1.004.15

TECHNICAL-ECONOMIC PERFORMANCE OF TUBULAR CONDUCTORS IN 6-10 kV LINES WITH CABLE SUSPENSION

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 3, Mar 77 pp 27-29

OVCHARENKO, A. S., candidate of technical sciences, POLESHCHUK, S. I., engineer, and RABINOVICH, M. L., candidate of technical sciences, Kiev Branch of UGPI [expansion unknown], "Tyazhpromelektroproyekt" [State Planning Institute for the Planning of Electrical Equipment for Heavy Industry]

[Abstract] Bare tubular conductors in 6-10 kV lines constitute a symmetric system forming, in cross section, two equilateral triangles. The outside diameter of all three conductors in both arms is the same and varies from 100 to 250 mm. The conductors are suspended on cables inside conducting sheaths and are fastened to the steel transmission pole through a string of insulators. The span between poles may exceed 90 m, depending on their

height. Such systems, recently installed in various industrial enterprises, have not been in operation long enough for a statistical reliability analysis. Their performance can be evaluated, however, by extrapolation from that of existing 35 kV overhead lines with directly suspended conductors--if proper corrections are made for the different voltage levels. Enough design data are available also for a cost estimate. Cable-suspended tubular conductors are found more economical, according to all indicators, on account of their lower overall installation cost and expected higher reliability. Figures 1; tables 3; references: 4 Russian.

USSR UDC 621.315.2.016.2.027.5.019.3-111.1

RELIABILITY OF THE VERTICAL SEGMENTS IN 10-kV CABLE LINES

Moscow ELEKTRICHESKIYE STANTSII in Russian No 3, Mar 77 pp 66-70

FEDOSENKO, R. YA., candidate of technical sciences, and VOLKOV, M. I., VNIIE-ORGRES [All-Union Scientific Research Institute of Electric Power Engineering--State Trust for the Organization and Rationalization of Regional Electric Power Plants and Networks]

[Abstract] In connection with converting from 6-kV to 10-kV operation, the reliability of vertical cable segments under this higher voltage level has been analyzed, for the purpose of establishing the proper replacement requirements. Vertical segments were found to be more prone to failure than horizontal segments, with the failure rate also correlated to the segment length. Drainage of the impregnating compound occurs during the initial period of operation, the viscosity and thus also the dryness depending on the temperature. The electric strength of dry insulation depends on its effectiveness, and these characteristics have been tested and evaluated with due consideration of the time factor. On the basis of failure probabilities, combined with technical-economic criteria, it seems that replacement of vertical cable segments for 10-kV operation is necessary only where no standby is available. On the other hand, where a standby is available, only those segments which have actually failed in test or in operation need to be replaced. Figures 2; tables 7; references: 5 Russian.

USSR UDC 621.315.2:614.842.6.001.45

THE USE OF HEAT-SENSITIVE PAINTS IN THE STUDY OF CABLE FIRE-HAZARD

Moscow ELEKTRICHESKIYE STANTSII in Russian No 1, 1977 pp 68-72

KARAVAYEV, YU. A., AUSRI/Canning Industry

[Abstract] Heat-sensitive paints were used to analyze temperature and detect the thermal field in ignition of cables either by a short-circuit arc or under experimental fire conditions. A bundle of nine power cables laid horizontally will not be ignited by a short-circuit arc at currents up to 15 kA lasting 0.4-3.2 seconds. Heat-sensitive paints and thermal fusion indicators should be used which have a temperature range of 67-650°C. Figures 4; tables 2; references: 4.

USSR UDC 621.316.1:621.316.722

REGULATION OF THE VOLTAGE AT A DISTRIBUTION CENTER SUPPLYING DIVERSE USERS

Minsk IZVESTIYA VUZOV, ENERGETIKA in Russian No 2, Feb 77 pp 9-14 manuscript received 30 Jun 76

KHAMZA, ALI KHALID, Moscow Order of Lenin Power Institute, and ZHELEZKO, YU. S., candidate of technical sciences, All-Union Scientific-Research Institute of Electric Power

[Abstract] Often several loads differently varying in time are to be supplied from the same distribution center. Such a load diversity may exist within one feeder or between separate feeders. According to GOST 13109-67, voltage regulation is a major criterion in the design of distribution networks, and is particularly critical in high-voltage (6-10 kV) systems. The proper design must be based on complete information about the load and demand pattern, extreme conditions, the allowable voltage fluctuations, and the equipment capability. An algorithm is developed in the paper, programmable on a digital computer, which will yield a regulation of the voltage at the distribution center compatible with all requirements throughout the network. Figures 2; references: 4 Russian.

USSR UDC [621.316.37+621.3.051.2]001

OPTIMUM SHAPE OF SUPPORT SPACERS FOR GAS-INSULATED EQUIPMENT

Moscow ENERGETIKA I TRANSPORT in Russian No 1, 1977 pp 133-142 manuscript received 23 Aug 76

POPKOV, V. I., LYAPIN, A. G., MAZURIN, I. M. and SHCHERBINA, O. V., Moscow

[Abstract] Theoretical and experimental studies of high-voltage gas-insulated lines are used in discussion of a technic for selecting the optimum shape of a support spacer for a coaxial system of electrodes. The basic problem is to find a way of making the surface flashover voltage of the support spacer in a compressed gas environment approximately equal in practice to the breakdown voltage. Solid dielectric materials are used for these spacers under actual conditions, but the task at hand is to bring the surface flashover voltage of these actual spacers to the level of the breakdown strength of a pure gas insulation under similar conditions. Although the intrinsic strength of any solid dielectric is always substantially higher than the breakdown voltage of a gas gap of the same size within a reasonable pressure range, the presence of a solid dielectric--gas zone creates a distorted electric field region because of the difference in dielectric constants, and this makes local ionization possible, leading an increase of both the aging rate of the solid insulation and facilitation of conditions for the origin and promulgation of breakdown along the side surface of the support spacer. Distortion of the field is also caused by the presence of a process-related gas gap between the electrode (sheath or current-carrying core) and the face surface of the support spacer. The presence of this gap is practically impossible to avoid in designs of actual gas-insulated equipment. Theoretical ways of avoiding this gap are enumerated. The most practical way is to counteract the effect of the gap by designing a support spacer of special shape and size and furnishing it with additional shielding electrodes built into its design, whose function is to bypass the effect of the gap electrically. Although this solution somewhat complicates the process of manufacturing the support spacer, it facilitates installation of the spacer on the core. The optimum design is sought by varying the dimensions, geometry, and form of both the spacer itself and the built-in shield. A review of spacers recommended as optimum for gas-insulated equipment by other authors is given. A disc-shaped spacer is recommended as fulfilling the requirement of providing insulation at the level of the breakdown strength of a pure gas gap of similar configuration. The built-in shielding electrodes have a positive effect on the flashover voltage only if their dimensions are strictly coordinated with those of the space between electrodes. One of the optimum forms of support spacer is a body which conforms completely to the shape of a flux tube obtained by taking the built-in shields into account. Figures 5; tables 2; references 11: 4 Russian; 7 Western.

USSR UDC 621.316.925:51.001.57

MATHEMATICAL MODEL OF A RECTIFIED-CURRENT DIFFERENTIAL BUSBAR PROTECTION WITH TIME DELAY

Minsk IZVESTIYA VUZOV, ENERGETIKA in Russian No 2, Feb 77 pp 20-27 manuscript received 23 Dec 75

ALEKSEYEV, V. V., engineer, Belorussian Branch, Power Engineering Institute imeni G. M. Krzhizhanovskiy

[Abstract] Power systems in the Soviet Union are now converting to semiconductor components in the differential busbar protection with time delay. The secondary current of instrument CTs is reduced through intermediate CTs and then fed through half-wave bridges to electromagnetic relays: current relays with time delay and current-balance relays respectively. The performance of such a system, as that of a conventional system, is largely affected by transients and is usually analyzed with the aid of a mathematical model. Such a model is shown here, for calculating the protection system of a typical and simple double-busbar system. The instantaneous values of the electromagnetic process parameters are related to the physical parameters of the protective devices by systems of algebraic and differential equations, the latter converted to finite-difference equations and all solved numerically. These equations are set up in accordance with Kirchoff's circuit laws and on the basis of a topological tree diagram of the network. The algorithm developed here, programmable on a digital computer, renders this model a useful tool for thoroughly evaluating the sensitivity of a protection system to excursions and faults. The concept and the method of analysis can be extended to other types of relay systems. Figures 2; references: 3 Russian.

USSR UDC 621.385.632

THE METHOD OF REFERENCE PARTICLES IN THE ONE-DIMENSIONAL NONLINEAR THEORY OF TRAVELING-WAVE TUBES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 22, No 2, Feb 77 pp 327-337
manuscript received 8 Jul 76

VAYNSHTEYN, L. A., NAZAROVA, M. V. and SOLNTSEV, V. A.

[Abstract] The digital simulation of electron devices by the "method of large particles" is encumbered by discretization noise. This noise has been suppressed in the "method of reference particles," which is shown here and applied to the one-dimensional nonlinear theory of traveling-wave tubes of the backward-wave type. The nonlinear differential equations of such a tube are given and the conventional method of their integration is discussed first. The new method of their integration is outlined next and a precise criterion, also known as the Gauss criterion, is established for separating significant from insignificant coefficients in the trigonometric approximation. This criterion yields automatically the optimum number of reference particles and adjusts this number in the course of computations. The advantages of trigonometric interpolation and trigonometric approximation with this criterion become evident when those nonlinear differential equations are now integrated numerically by the Runge-Kutta method. The solution obtained is analyzed for irrerversibility and randomization, an important problem under conditions of turbulence because of a nonlinear buildup of perturbations. The authors thank G. P. Prudkovskiy and V. N. Melekhin for helpful discussions. Figures 5; references 12: 8 Russian; 4 Western (three in translation).

USSR UDC 621.385.632

EXPEDIENCY OF DENSE ELECTRON BUNCHING FOR THE EXCITATION OF THE OUTPUT STAGE OF A TRAVELING-WAVE TUBE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 22, No 2, Feb 77 pp 400-402
manuscript received 18 Aug 75

IVANOVA, N. N., MIROSHNKOV, YU. A. and FILIMONOV, G. F.

[Abstract] The efficiency of energy conversion in a traveling-wave tube is usually improved by increasing the coupling resistance at the delay line. This technique has its limitations, however, so that other more circuitous methods are sought. Short electron bunches for exciting the output stage of a microwave device yield excellent results over a wide range of space-charge densities, when the output stage is a resonator cavity. On the other hand, in traveling-wave tubes with a matching delay line at the output, higher efficiencies have been obtained only at low space-charge densities. Theoretical calculations in this and earlier studies indicate that generation

of dense electron bunches at a practical space-charge density cannot substitute for a higher coupling resistance at the delay line, so far as improving the efficiency, but in a tube with an already high coupling resistance it will further increase the efficiency 1.5-2.0 times at any practical space-charge density. Figures 2; references: 4 Russian.

USSR UDC 621.385.633.14

SYNTHESIS OF DIODE GAPS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 22, No 2, Feb 77 pp 347-356
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BOBROVSKIY, YU. L., VOROB'YEV, O. V. and STARIKOV, V. V.

[Abstract] Any physically feasible interelectrode gap in a microwave electron device can be reduced to an equivalent diode. This principle is applicable to the analysis of low-power microwave resonators, in order to solve the problem of higher efficiency. Such a representation takes into account the effect of space charge, the static angle of electron emission, and the entrance current density. Simple expressions are derived for the basic characteristics of static fields in such gaps (minimum potential and its coordinate, potentials at the boundaries) as well as for the gap width. Three possible operating modes are considered, with the anode potential: 1) Positive; 2) Zero; and 3) Negative (either the collector or the grid being regarded as the anode and the cathode-emitter potential assumed to be positive). These expressions are explicit and provide a convenient model for the synthesis of diode gaps in the process of optimizing a new electron device. Figures 3; references: 7 Russian.

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METHOD OF CHARGING ENCAPSULATED SILVER-CADMIUM CURRENT SOURCES

Moscow ELEKTROTEKHNIKA in Russian No 2, 1977 pp 55-57

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[Abstract] Methods used at the present time for charging encapsulated current sources with silver electrodes are not always effective and sufficiently reliable. These sources have gas-tight film-type separators which prevent hydrogen and oxygen from entering and being absorbed on the electrodes, and it is necessary to charge them with minimal relase of gas. The best way to charge encapsulated current sources with silver electrodes is with diminishing current and stabilized voltage. This paper deals with the feasibility of using as a criteria for charging termination the voltage in individual cells and the current in the dropping segment. The conditions making minimal gas liberation possible were determined by using a charger developed at the Leningrad Polytechnical Institute imeni M. I. Kalinin. A schematic diagram of this charger, which utilizes a P-202 transistor, is given, along with the transistor's current characteristic. Data are given for the variation in current and voltage when batteries consisting of 15 encapsulated silver-cadmium cells and rated at 15 A/h are charged. Ten experiments were conducted with varying ambient temperature, initial current, and stabilized voltage, and a determination was made of the parameters with which O_2 begins to be released in one of the cells, such as the current and voltage in the cell, the time, and capacity in A/h. Gasometric burets were used to measure gas release. It was demonstrated that at temperatures of 15 to 35°C the release of oxygen in different cells does not begin at the same time. When the temperature is increased to 50 to 65°C or with an increase in charging time, this nonuniformity in behavior of the cells smooths out. Increasing initial current and stabilizing voltage ultimately leads to speeding up of the charging process, but at the same time there is an increase in the current value with which liberation of O_2 begins. Within the range of 15 to 35°C conditions for terminating the charging process can be determined more precisely the faster the charging process and the higher the current value with which release of O_2 begins. A formula is derived for determining the charging current for a cell using the charger described. Figures 4; tables 1; references 9: 1 Western; 8 Russian.

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STUDIES OF MORE RAPID ELECTROFORMING OF LEAD STORAGE BATTERY PLATES WITH CURRENT WHICH CHANGES POLARITY

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[Abstract] A method has been developed for electroforming lead storage battery plates with direct current of periodically varying polarity. Current pulse length in the forward direction is 3 min and in the reverse 25 s. Varying the polarity of the current leads to a reduction of the internal resistance of storage battery plates, creating good conditions for homogeneous electroforming of the active mass, which then exhibits better mechanical properties, and results in a reduction in consumption of the electrical energy required for forming the plates. Studies have demonstrated that varying the polarity of the forming current leads to considerable reduction of the time for the electrochemical process and to an increase in the beta modification of PbO_2. The new method was tested using a commercial unit. In forming plates by the new method, current density increased by a factor of 3.48 and the time for forming plates was reduced by a factor of 3.6. X-ray crystallographic analysis of positive plates showed the content of beta PbO_2 to be 68 to 89 percent with the new method, as opposed to 38 to 48 percent in control tests. There was thus an increase in the yield of the modification with the higher energy capacity. Rejects were reduced from 5.9 to 12.7 percent to 0.43 to 2.3 percent with the new method. Plates were also tested for charging time, rated capacity, and service life. Service life tests showed that plates formed by the new method last 25 percent longer. The advantages of the new method are as follows: The process of electroforming plates is shortened by approximately 70 percent; a 15 to 20 percent savings of electrical energy is realized; the energy parameters of storage batteries are improved considerably; and the performance rating of storage batteries are higher. Tables 3; references: 7 Russian.

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MATCHING FUNCTIONING OF AN ELECTROCHEMICAL CURRENT SOURCE AND VOLTAGE TRANSFORMER

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[Abstract] Power units based on electrochemical current sources have requirements which are satisfied successfully by adding voltage transformers to them. Voltage transformers, defined here as devices which match the voltage of the current source and load, are used to transform direct voltage into alternating and to increase and stabilize the output voltage, as well as to solve a number of other problems indicated in earlier studies. This article examines the problem of matching the functioning of the electrochemical current source and transformer for the purpose of improving their power characteristics. Losses caused by leakage current are considerable in electrochemical current sources of many types, and these losses increase with an increase in the number of series-connected cells. It is characteristic of a transformer to show an increase in efficiency with an increase in input voltage while the output voltage remains constant. There is thus a certain optimum voltage value corresponding to a specific number of series-connected cells in the battery whereby total losses caused by leakage current and losses in the transformer will be minimal. Under specific conditions these losses can be lower than those in a separately functioning battery with the same output parameters. Proceeding from an equation expressing the conditions for maximum efficiency, the conditions are found for the existence of a certain voltage range in which it is possible to improve the characteristics of the current source by adding a transformer. A separately functioning source is used as a reference. Curves are given showing the relationship between efficiency and the number of series-connected cells and a formula is given making it possible to determine commutation of cells in a battery operating in conjunction with a voltage transformer. A series of necessary and sufficient conditions determines the range of application of a transformer for reducing losses from leakage current. Figures 2; tables 1; references 6: 3 Russian; 3 Western.

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