liquids. The method is intended for the determination of the pressure and density in the gradual "double" compression behind the fronts of the reflected shock waves. The objects of the experiment were light metals—aluminum and compounds with light atoms transparent to x rays such as water, paraffin, and plexiglas. For all the materials investigated, high pressures and densities of from 600,000 to 900,000 atm were maintained in the reflection region, and these were several times as great as the pressure due to the shock wave before the impact.

Nonequilibrium Dissociation of a Mixture of Gases behind a Shock Wave, Yu. P. Lun'kin and F. D. Popov, pp. 523–526.

The nonequilibrium dissociation of a two-component mixture of gases behind a direct shock wave is investigated.

The passage of a gas through a shock wave is accompanied by a disturbance in its internal degrees of freedom. The different times of relaxation of rotations, oscillations, and dissociation of the molecules significantly facilitate the study of the nonequilibrium processes in a real gas.

Elsewhere an approximate method was proposed for the solution of the system of equations that describes the nonequilibrium dissociation of a pure, diatomic gas behind a shock wave. In the present work, this method is made more precise and is generalized to the case of a two-component mixture consisting of diatomic or of monatomic and diatomic gases. If both components are diatomic, we restrict ourselves to the case where there dissociation energies differ considerably and we can consider the dissociation of each component separately.

Refraction of Detonation Waves Incident on the Boundary between Two Gas Mixtures, L. G. Gvozdeva, pp. 527–533.

We discuss one of the phenomena characteristic of detonation waves—the refraction of such a wave when it passes from one explosive mixture to another.

By using a high speed movie camera, photographs have been obtained of the phenomenon that occurs when a detonation wave moving through a medium capable of reaction passes through a boundary dividing this medium from an explosive or inert medium.

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Volume 5, Number 2, September–October 1962

Present State of the Theory of Liquids, I. Z. Fisher, pp. 239–250.

The present stage in the development of the theory of the liquid state originated for the most part in the numerous researches of Jacob Il'ich Frenkel, which he summarized in his classical book *Kinetic Theory of Liquids.* He was one of the first to point out that the approximately equal particle density in solid and fused crystals, and the consequent approximate equality of their intermolecular interaction intensity, is bound to make the structure and the character of thermal motion of the atoms and molecules nearly the same in both phases. This gives rise to the known parallelism between the physical properties of solids and liquids, and creates a real basis for the theory of the processes that relate both phases. The views developed by Frenkel proved equally fruitful for both the theory of crystals and the theory of liquids. These views presupposed the increasing *disorder* in real crystals with rising temperature, and the presence of elements of *order* in liquids. The notion of defects (in the broad sense) in crystals and of their role in thermodynamic, electric, kinetic, and optical properties of real solids was a most important step in the development of solid state theory. On the other hand, the ideas of short-range order and strong interaction between the particles of a liquid, and their specific influence on its physical properties, has given rise to a new branch of physics—the statistical theory of liquids.

We shall attempt to review briefly the present status of statistical theory of simple liquids, confining ourselves to nonquantum theory. Except for liquid helium and to some extent liquid neon, all monatomic liquids can be described satisfactorily by classical methods.

The lack of a simple and readily visualized model for liquids, one capable of serving as the "zeroth approximation" in the building of a theory of liquids (in contrast with the perfect-gas and ideal-crystal models in the theory of gases and solids) makes the development of the theory extremely difficult. The mathematical difficulties encountered on the path toward the development of the theory of the liquid state of matter are so great that only a statistical theory of simple monatomic liquids is feasible at present. Liquefied inert gases and fused metals are real examples of simple liquids. We can also include, with some degree of approximation, certain monatomic liquids with molecules and force fields that have some measure of specific symmetry.

Many problems in the statistical theory of liquids recently have been discussed in detail in reviews and books. Therefore we have attempted to pay more attention here to questions that are relatively new or insufficiently explained in the review literature. Many problems in the theory of liquids have not been touched upon at all.

Physical Theory of Plasticity and Strength, V. L. Indenbom and A. N. Orlov, pp. 272–291.

During the 50 years that have elapsed since the discovery (in 1912) of diffraction of x rays by crystals and the development of the dynamic theory of the crystal lattice (1915), the physics of plasticity and strength has turned from a descriptive science with only formal premises into a major division of solid state physics, based on reliable experimental researches and on fully developed theoretical notions. The development of the physical theory of plastic deformation and failure is closely connected with the work of J. I. Frenkel, whose varied interests included basic problems in the theory of mechanical properties of both crystalline and noncrystalline solids. The present development of theoretical ideas and experimental methods of research on the real structure of solids has prepared the ground for the decisive stage in the development of the physics of plasticity and strength, namely, the direct investigation of the atomic mechanism of plastic deformation and failure. This is most clearly pronounced in the case of crystalline bodies.

Present State of Research on Atmospheric Electricity, I. M. Imyanitov and K. S. Shifrin, pp. 292–322.

Introduction
1. Basic information
2. Two theories
3. Vertical structure of field, conductivity, and current in "good weather"
4. Distribution of space charge in the atmosphere
5. Time variation of field and potential at high altitudes
6. Description of electric processes in regions of good weather
7. Electricity of stratified clouds
8. Electricity of cumulus and cumulus congestus clouds
9. Structure of shower and thunderstorm clouds
10. Accumulation of charges in thunderstorm clouds

References

Present State and Lines of Development of Optical Flame Pyrometry, A. E. Kadyshevich, pp. 347–363.

TELECOMMUNICATIONS AND RADIO ENGINEERING. PART 1. TELECOMMUNICATIONS (*Elektrosviaz'*). Published by American Institute of Electrical Engineers in conjunction with Scripta Technica, Inc., New York

Number 1, January 1962

Frequency Modulation of a Crystal Oscillator by Means of a Controlled Capacitance of a *p-n* Junction, Ye. G. Servinsky, pp. 25–35.

In this article the possibility of applying a controlled capacitance of a *p-n* junction to frequency modulation of a crystal oscillator by means of a series control circuit is discussed. Analytical expressions are developed from which it is possible to determine the limits of frequency deviation, the coefficients of nonlinear distortion, and frequency stability. The characteristics of several types of *p-n* junctions are also included.

The application of a controlled capacitance of a *p-n* junction to frequency modulation (FM) of oscillators has already found wide use. We shall discuss certain problems associated with the application of a *p-n* junction capacitance to FM modulation of a crystal oscillator. Some of these problems are: the choice of the p-n junction type, the possible limits of frequency swing (deviation), the coefficients of nonlinear distortions, frequency stability, etc. In view of the limited scope of this article, problems such as the amplitude of the oscillations and the amplitude stability within the frequency range of the oscillator are not discussed. However, it will be shown that the oscillator which was used to verify the results of this investigation displayed an amplitude variation within the range of frequency deviation $(\Delta\omega/\omega)_\partial = 0.25 \cdot 10^{-3}$ of no more than 0.25 db. The analytical results obtained in this article were verified empirically.

Filtering of Discrete Noise by Means of Phase Automatic Frequency Control Using an RLC Filter, W. W. Shakhgil'dyan, pp. 35–41.

With the increasing use of the system of phase automatic frequency control (PAFC) the need for a high degree of filtering of spurious oscillations at the output of the stabilized oscillator has drastically increased. This fact necessitates research into new ways of increasing the filtering capacity of such systems. It is known that simple RC filters cannot provide good filtering and at the same time preserve sufficiently wide locking range. Therefore, it was necessary to investigate the possibility of applying RLC filters to the system of PAFC.

There are various causes which produce noise in the PAFC system. In all cases this noise results in a parasitic frequency modulation of the stabilized oscillator, i.e., the appearance at the output of the oscillator of spurious frequencies. In the following discussion and analysis, we will consider that noise appears in the system during the production of standard frequency and cannot be separated from that frequency. This is the case of the greatest practical interest in connection with the difficult process of producing pure harmonics of the standard frequency.

Method for Determination of the Highest Order of a Differential Equation Describing a Linear Electrical Network, S. L. Friedman, pp. 54–60.

In this article a method is presented for determination of the highest order of a linear electrical network which contains electrical elements of all types. The determination of the highest order of the electrical network is made by a direct method of analysis of the network without a preliminary synthesis and expansion of the determinant of the network.

Synthesis of Low-Frequency Filters with Assigned Phase Characteristics, I. I. Trifonov, pp. 60–68.

Several variants are examined in order to solve the problem of approximating the effective transfer functions for low-frequency filters with assigned phase characteristics. An example of the filter calculations is presented.

In the article by A. F. Beletskii, "Synthesis of Filters with Linear Phase Characteristics," the problem of the synthesis of low-frequency (lf) filters was formulated. The synthesized filter must satisfy the following conditions:

a) The transfer function of the filter is expressed through a function of the form

$$S(p) = \frac{a_0p^n + a_1p^{n-1} + a_2p^{n-2} + \ldots + a_n}{p^m + b_1p^{m-2} + b_2p^{m-4} + \ldots + b_{m/2}} = \frac{v(p)}{f(p)} \quad (1)$$

b) In the frequency band $0 \leqslant \omega \leqslant \omega_{0a}$ the deviation from linearity of the dependence of phase on frequency, or the deviation of the group delay time from a specified constant, does not exceed values which are considered acceptable.

c) The attenuation at $\omega = 0$ is equal to zero.

d) In the frequency band $\omega \geqslant \omega_{0b}$ the lowest value of attenuation, with other conditions remaining equal, must be the least possible.

In the indicated article, the problem was solved for even powers n of the Hurwitz polynomial $v(p)$. Let us solve this problem for the case of odd powers of the polynomial $v(1)$:

$$n = 2l+1 \quad (2)$$

For odd powers of the polynomial $v(p)$, the degree of the polynomial $f(p)$ is always less than n. Therefore, the filter will have infinite attenuation at $\omega = \infty$; consequently, the possibility exists for realizing a ladder-type circuit without mutual inductances.

Let us also solve the problem of synthesizing lf filters which satisfy the conditions a, b, and c of A. F. Beletskii's problem, and which have the lowest possible attenuation in the frequency band $\omega_1 \leqslant \omega \leqslant \omega_2$.

Number 2, February 1962

Amplifiers with Negative Feedback through a Twin T-Bridge Network, V. O. Kobak, pp. 9–15.

The report presents an analysis of the properties and uses of selective amplifiers with negative feedback through a twin T-bridge network. Practical versions of the more interesting circuits are described.

Numerous reports devoted to the investigation and design of various circuits for low-frequency selective amplifiers with twin T-bridge networks have appeared in the literature. A large number of circuits described in the literature present difficulties in the selection of one or another version. It appears useful to evaluate and compare the various circuits and also to classify them with regard to their prospective applications.

It is known that in investigating circuits with twin T-bridge networks it is necessary to consider the influence of the parameters of the generator and load on the network properties. This considerably complicates analysis but does permit us to obtain design formulas which are in excellent agreement with practice. Elementary analysis of circuits with twin T-bridge networks without consideration of the parameters of the generator and load does not provide such accuracy in calculation; however, they are distinguished by simplicity and clarity and give a proper indication of all qualitative characteristics. It is the purpose of the present report to use such simplified analysis in attempting a generalized examination of the various circuits of selective amplifiers with negative feedback through a twin T-bridge network.

Analysis and Design of a Tuned Amplifier with Frequency-Dependent Feedback, E. B. Gribov, pp. 16–25.

On the basis of matrix analysis of four-terminal networks, the report derives formulas for gain and input resistance of a multistage amplifier with negative feedback and analyzes the amplifier properties and resonance characteristics of an amplifier with a series-resonant network in the emitter circuit. Formulas are derived for engineering design of a multistage amplifier and an example of design is given. Experimental data are presented for checking the design procedure.

Frequency Stability of Double-Tuned Parametric Oscillator, S. A. Akhmanov and Yu. Ye. D'yakov, pp. 25–31.

The possibility of using a double-tuned parametric oscillator for purposes of wideband frequency stabilization is evaluated. The self-excitation conditions of the oscillator are subjected to theoretical investigation. An analysis of the factors determining the stability of the generated frequencies is given in linear approximation. It is established that, under certain conditions, the effect of unilateral deviations in the parameters of tuned circuits at the generated frequencies is compensated, so that the frequency stability of the double-tuned oscillator may substantially exceed the partial-frequency stability of oscillatory circuits. The results of calculation are in excellent agreement with experimental data.

Conclusion: The results of this investigation indicate the possibility of using a double-tuned circuit with nonlinear reactive element for creation of a wideband oscillator with frequency stabilities exceeding the stabilities of the partial frequencies of the tuned circuits. As the nonlinear reactive element it is extremely convenient to use capacitance of a p-n junction, associated with the possibility of obtaining considerable capacitance modulation factors in the presence of low pumping voltages, as well as with the extremely low temperature coefficient of this capacitance. An important advantage of the discussed oscillator is the possibility of avoiding the use of vacuum tubes and, consequently, of eliminating such sources of fluctuation as shot effect or flicker effect. Also of importance is the fact that in the absence of vacuum tubes the problem of temperature stabilization of the parameters of passive elements of the circuit is considerably simplified.

Double-tuned parametric oscillators may be of interest from the standpoint of the problem of wideband stabilization of frequency in the usual radio range and at microwavelengths. The increased frequency stability may also make it convenient to use such oscillators in synchrodyne receiving circuits.

Single-Section Narrowband Magnetostrictive Filters, Ya. I. Velikin, E. V. Zelyakh, and A. I. Ivanova, pp. 51–60.

By analyzing a narrowband magnetostrictive filter in a bridged circuit, equations for the calculation of the components of the total impedance of a magnetostrictive resonator and for the calculation of the operating attenuation of the filter including resonator losses are obtained. Experimental results obtained during the investigation of filters designed by the given methods are presented.

Electrical filters that include magnetostrictive resonators as elements have been known for a long time. By using magnetostrictive resonators alone or in combination with inductive coils, one may obtain filters having a relatively narrow transmission band; by introducing additional capacitors into the circuit one may widen the transmission band. Such filters may be constructed for a frequency range of a few tens to hundreds of kilocycles.

Filters having magnetostrictive resonators did not easily find wide application. This can be explained by the fact that the magnetostrictive materials which are employed in these resonators introduce considerable energy losses; the available resonators had very low Q, and, in addition to this, their parameters were too dependent on the magnitude of the current flowing through the coil of the resonator. As a result there was large attenuation in the transmission band of the filter and distortion of the transmitted signal.

This situation changed considerably during recent years when resonators employing the magnetostrictive effect in ferrites made their appearance. In resonators with ferrite cores, the losses are considerably lower and the quality factor is greatly increased. At the same time, the parameters in these resonators are less dependent on the current.

An investigation has been conducted by the authors to determine the feasibility of applying magnetostrictive resonators with ferrite cores to electrical filters. The present article concerns the results of these investigations of narrowband single-section filters.

Number 3, March 1962

Interpolation of Continuous Information at Discrete Transmission, A. I. Velichkin, pp. 1–6.

A discussion is given of certain problems arising in the discrete transmission of continuous information (TV, telemetric, and speech signals) through discrete communication channels. In this case, the information $\xi_j(t)$ on the transmitting side is quantized in amplitude and time. As a result of this operation we obtain a sequence of readings x_{ji}, which are spaced on the time axis in intervals $\Delta = t_i - t_{i-1}$. In order to transmit this through the communication channel, each of the readings must be coded in the interval Δ. In the receiver decoding is performed, as a result of which readings are obtained similar to those formed on the transmitting side. By interpolation within the intervals, these readings are transformed into the received information $\eta_j(t)$.

From among the many problems which are associated with the transmission of continuous information through discrete communication channels, we will select and discuss only two. The first problem concerns the determination of a method for the interpolation which would guarantee the smallest possible RMS deviation of the received signal from the transmitted one. The second problem resides in the investigation of the relationship between the distortion of the information and the magnitude of intervals Δ.

For the investigation of the forementioned problems, we make the following assumptions:

1) The transmitted information is a stationary and ergodic process having a correlation function $K(\tau)$ and a variance σ^2. The average value of the process is zero.

2) The amplitude quantization is performed for such a large number of levels that the signal will not undergo any distortion for all practical purposes. This assumption causes us to consider only those distortions that are associated with the time quantization.

3) As may be seen from the description of the transmission process, the effect of the interference will be that the receiver, instead of receiving certain code combinations, will receive others. Certain readings will become distorted due to this phenomenon; therefore, the character of distortions will be defined by the noise as well as the code used. In order to be able to concentrate our attention on the time quantization, we must assume that the interference will not distort the readings associated with the information.

Relationship between the Instability of the Modulus and Phase of Single-Channel Feedback Amplifier Gain, M. S. Shmilevich pp. 28–32.

Concise expressions for the instability of the modulus and phase of the gain of an amplifier with feedback are obtained, and relationships between these magnitudes are established. The article proposes a graphical method for determining the modulus and phase sensitivity of an amplifier.

In the calculation of the effect of negative feedback on the stability of an amplifier, usually only the modulus of the gain of the amplifier is considered, apparently assuming that the stability of the phase has no importance. In many cases, however, phase stability may be just as important as amplitude stability, as, for example, in multichannel feedback amplifiers, especially in the case when the feedback amplifier is part of an element operating on the principle of phase coincidence, or in pulse amplifiers, etc. Therefore it appears to be important to discuss the phase stability of a feedback amplifier and its relation to the gain stability.

Conclusion:

1) The functions that characterize a single-channel feedback amplifier βK, φ, S_m, and S_{ph} are interrelated. It is sufficient to know only two of them in order to be able to determine the other two. The unknown magnitudes may be determined conveniently by a graphical method.

2) In a given frequency range it is impossible to have simultaneity by both high modulus and high phase stability for the gain. For most practical applications satisfactory results may be obtained by using Bode's ideal deep feedback.

Synthesis of Electrical Filters from Cascades of RC Sections and an Amplifier with RC Feedback, Teng Nai-tiung, pp. 33–42.

At the present time the synthesis of passive LC sections is already sufficiently well developed. However, the use of LC sections at low and ultralow frequencies becomes difficult and often impossible due to a considerable increase in the size of the sections and a decrease of the Q factor of induction coils. It is practical to utilize RC sections in this band.

Passive RC sections are advantageous from the standpoint of their small size, low cost, and reliability. However, the realization of the given transmission function in the form of a rational fraction with complex poles and zeros, using passive RC sections, requires a large number of elements and results in a large attenuation in the transmission band.

The disadvantages of passive RC sections may be removed by introducing active elements into the circuit. The well-known circuits of active section may be classified according to the active elements employed in them in the following manner: 1) circuits with negative impedance converters; 2) circuits with gyrators; 3) circuits with positive feedback amplifiers; and 4) circuits employing amplifiers with negative feedback.

The synthesis of active circuits from the first three classes of circuits is described sufficiently well in the literature. As far as circuits of the fourth class are concerned, the synthesis of RC sections on the basis of these circuits is rather poorly described in the literature. The present article deals with the latter problem.

Error Detection by Summation Methods, A. G. Usol'tsev, pp. 68–72.

PPM Communication Systems Performance in Noise Environment, A. G. Zyuko, pp. 72–76.

Number 4, April 1962

Noise Immunity of Communications Systems Using Pulse Position Modulation in the Presence of Strong Signals, V. I. Ayzenberg, pp. 1–9.

The effect of the synchronizing train in communications systems using pulse position modulation (PPM) on the noise immunity of communication channels is discussed. It is shown that in order to decrease this effect, it is in many cases desirable to normalize the width of the extracted sync pulses.

Experimental Investigation of the Action of Normally Distributed Noise on a Difference Detector, V. T. Goryainov and M. A. Kirillov, pp. 20–26.

An experimental determination has been made of the uniform probability densities and mean number of noise bursts at the output of a difference detector when Gaussian stationary fluctuations appear at the detector input, for certain relationships between the resonant frequency of the difference-detector tuned circuits, and the mean frequency of the input Gaussian noise power spectrum. We shall describe the method and equipment used in the experimental investigation.

Magnetostrictive Band-Elimination Filters, Ya. I. Velikin, E. V. Zelyakh, and A. I. Ivanova, pp. 49–56.

We examine magnetostrictive band-elimination filters, based on a bridge circuit containing a magnetostrictive resonator and capacitors. Formulas are given for designing filter elements, for calculating the working attenuation of single- and double-section filters, and for designing elements of filters having two stop bands. Experimental results are given.

Number 5, May 1962

Synchronization of an Oscillator Using a Tracking AFC, S. I. Yevtyanov and G. D. Shemanayev, pp. 1–10.

A system of a synchronized oscillator using a tracking AFC is discussed. It is established that the synchronization band of such a system is similar in span to the modulation characteristic of the reactance tube. Moreover, the phase shift in the band is near zero and the amplitude of the carrier is constant.

Conclusion: A tracking alignment circuit using a reactance tube controlled from a discriminator widens the band of synchronism of an oscillator and reduces phase shifts and nonuniformity of the amplitude within the limits of the band. Zero phase shift and constant carrier amplitude in the band of synchronism is achieved with an optimal alignment factor satisfying relationship (3). Moreover, the band is basically determined by the spread, linear portion of the modulation characteristic of the reactance tube. For achieving the most precise alignment, besides (3), it is necessary to fulfill the condition of tuning the circuits (4) and the equation of instability (5).

The application of a tracking alignment appears to be particularly useful in a synchronous frequency multiplier. If, in the oscillator without alignment, the synchronous mode is hardly detectable because of a small band of synchronism, then with alignment the oscillator is synchronized very stably: the band is widened by one order and in a large portion of the band the phase shift equals zero.

Numerous advantages are bought at the cost of the complication of the synchronized system. In composition the tracking circuit resembles a simple frequency and phase self-tuning system. However, in these systems there is inevitably a residual frequency or phase difference, because their effect is principally related to the presence of statistical errors, namely, the error providing regulation of the reactance circuit of the oscillator. This system of tracking alignment does not have a feedback loop and does not require one for its operation in the residual misaligned frequency or phase.

The absence of a feedback loop also has a negative side: the tracking alignment appears to be unable to eliminate the departures of frequency and phase, associated with the inaccurate fulfillment of conditions (3) to (5). Besides, the experimental data show that the effect of these errors is of little significance.

Regulation of the Passband in Narrowband Filters, G. I. Levitan, V. N. Bel'dyugin, and O. I. Vostryakov, pp. 11–23.

Methods are examined for regulating the passband in bandpass filters (polynomial and with attenuation peaks). It is assumed that regulation of the band does not impair the selectivity of the filter which it potentially possesses. Particular attention is paid to the problems of electrical control of the passband. Most of the circuits are original.

Feedback in Electronic Circuits, A. A. Rizkin, pp. 36–40.

In this paper the lack of definitiveness and convention in the concepts on feedback in electronic circuits are noted. Reasons are given for the differences of viewpoints in the literature on the subject of feedback in transistor stages.

Conclusions:

1) Determination of feedback in an electronic circuit on the basis of its equivalent circuit is not straightforward, since the result depends both on the selection of the equivalent circuit and on selection of the dependent sources within it. These dependent sources, in addition to the dependent sources that are found within the equivalent circuit, may be selected in terms of any element present in the circuit, such as R, L, or C, or their combination.

2) In some cases, one can judge the feedback in a circuit by bringing its basis to a form typical of the simplest circuit consisting of two networks K and β. This indicates that the internal feedback in transistor stages, independently of the stage, is always positive at low frequencies, given resistive external impedances.

3) For an analysis of questions of stability, any equivalent circuit can be used, where selection of dependent sources, with respect to which the regeneration coefficient is determined, is arbitrary. The Nyquist diagram, constructed for the regeneration coefficient, in all cases produces the correct result.

4) Although introduction of the feedback concept (or the regeneration coefficient) is frequently convenient and fully justifiable (this applies primarily to single-stage transistor circuits), the concept is in itself conditional and not compulsory, since it does not contain any information on a circuit that cannot be obtained by other means.

We have discussed this question in detail because, in recent years, many works have appeared in the literature devoted to the subject of feedback in transistor circuits. These works do not always serve to simplify calculation of circuits; they also contain a great deal of contradictory information and errors and frequently result in meaningless discussion, although from the viewpoint taken in this paper there is little basis for this.

Electronic Filters for Rectifying Systems, K. B. Mazel', pp. 40–51.

As is known, a low level of the ripple of a rectified voltage may be obtained at the cost of an increase in the inductance and capacitance of the rectifying filter, whereas a low output (internal) resistance of the rectifier may be obtained at the cost of an increase in the output capacitance of the filter. However, if the ripple frequency is low, and the load current varies at a very low frequency (on the order of a few tens of cycles), then the filter dimensions grow to such an extent that it becomes impractical to utilize it.

Electronic voltage stabilizers, having in the negative feedback loop a direct current amplifier, and reacting to constant as well as to varying output voltages, may guarantee readily a ripple of the rectified voltage on the order of hundredths to thousandths of a percent and an output (internal) resistance on the order of units to tens of ohms in a wide band of frequencies, beginning at zero cycles per second.

However, in those cases for which stabilization of the rectified voltage is not needed, the utilization of electronic stabilizers with the sole purpose of decreasing the amplitude of the ripple and the internal resistance is far from always practical, especially at output voltages higher than 500–700 v. During the stabilization of high voltages, difficulties arise which are related to the choice of the regulating tube, which must tolerate high variations of the anode voltage, permitting at the same time a high power loss at the anode. The low efficiency of electronic stabilizers is also in a number of cases a serious disadvantage, which makes it impossible to utilize them.

The noted disadvantages of electronic stabilizers appear to a far lesser extent in circuits of electronic filters which have in their negative feedback loops an alternating voltage amplifier, and react only to variations of the alternating component of the output voltage. It is especially advantageous to use electronic filters to reduce the ripple and the output resistance in unstabilized high voltage rectifiers. Thus, for instance, if one utilizes an electronic stabilizer in a rectifier having a voltage of 4 kv and a load current of 200 ma, then the anode voltage of the regulating tube would vary from 200 to 1000 v, and the maximum power loss at its anode would reach 200 w. When an electronic filter is used, however, the anode voltage of the regulating tube varies from 200 to 400 v, and the power loss at the anode does not exceed 60 w.

Number 6, June 1962

Graphical Design Computation of Automatic Gain Control Filters in Receiving Instruments, V. V. Lebedev, pp. 9–21.

A simplified graphical method for use in designing AGC filters in receiving devices is presented. The properties of pulse AGC, as well as stability and envelope-demodulation problems, are discussed. Examples of the calculation method are given.

Analysis of a Selective Amplifier Using a Detuned Twin-*T* Bridge Network in the Feedback Circuit, Ye I. Kuflevskiy, pp. 21–32.

We know that small deviations from precise tuning in elements of a twin-*T* bridge have a strong effect on the properties of the selective amplifier (filter) containing the twin-*T* bridge in a negative feedback circuit. Apart from the intentional detuning sometimes used for the purposes of regeneration, arbitrary deviations inevitably will appear as well and they are a very important factor in filter-parameter instability.

In the studies available, the effect of detuning is taken into account for the special case of an unloaded balanced twin-T bridge. Such an analysis is far from adequate in every case for the purposes of optimum engineering design: initially, as has been shown elsewhere, it is precisely the unbalanced bridge that provides the maximum filter Q in the absence of regeneration; second, in actual circuits (especially those using transistors) it is very frequently impermissible to idealize the operating conditions for a twin-T bridge.

The present study considered the effect of detunings on filter properties in the general case of a loaded unbalanced twin-T bridge. A statistical approach to random deviations makes it possible to replace semiqualitative considerations with rigorous mathematical methods from the theory of probability in the analysis of instabilities and to furnish a basis in particular for recommendations as to the magnitude of tolerances in the assembly of a twin-T bridge.

Differentiation of Random Processes, E. Ya. Ryskin, pp. 73–76.

Number 7, July 1962

Analysis of a New Circuit for a Square Wave Pulse Generator, A. S. Vladimirov, pp. 17–28.

Generators shaping symmetrical oscillations of accurate square waves are frequently required in the design and development of various radio devices. A number of methods for shaping such oscillations are known, although, as a rule, the circuits of such generators are relatively complex and cumbersome. In particular, a frequently used method for forming square wave pulses from a sinusoidal voltage requires the use of shaping and amplifying stages. The difficulties incurred in using such a circuit are greatly increased when low frequency (several cps) pulses of high quality are required. When used by itself, a multivibrator cannot form accurate square wave pulses without spikes. As a result, such generators must also contain shaping and amplifying stages.

Ideally shaped square wave pulses, obtainable under easily fulfilled conditions, may be produced by triggered circuits having two stable equilibrium states in which constant plate voltage for tubes is insured. However, the triggered circuit is not a generator and consequently requires external control pulses. A new circuit for a one-tube square wave pulse generator in which the forementioned triggered circuit is used is discussed.

Application of Laguerre Functions to Parametric Coding of Speech Signals, V. I. Kulya, pp. 34–42.

An investigation is made of the possibility of constructing a system for compressing the speech spectrum by using the principle of transmitting a limited number of parametized signals proportional to the coefficients of a Laguerre function series expansion of the instantaneous autocorrelation function of the speech signal. The use of Laguerre functions makes it possible to construct an analyzer and a synthesizer for a synthetic-telephony channel using RC elements. A special feature of the method is that the accuracy of approximation to the envelope of the instantaneous spectrum varies along the frequency scale proportionally with the properties of auditory reception of speech.

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Number 1, January 1962

Reaction of an Inertial System to Zero Beats, M. I. Dorman, pp. 11–20.

The peculiarities of the passage of zero beats through linear inertial systems are analyzed. Time and spectral relations are presented which characterize the output process under periodic frequency modulation.

Sequential conversion of the spectrum by the use of heterodyning is often found in different apparatus in which frequency modulation is used. The process of heterodyning an FM signal when its center frequency is close to the heterodyne frequency is accompanied by the formation of so-called "zero beats," which are a complex oscillation containing difference and sum components. If the mixer load is sufficiently inert and its passband is in the comparatively low frequency range, then only the difference frequency component need be considered. At those instants when the difference frequency passes through the zero value, the shape of the oscillations at the mixer output differs radically from a sinusoid and a more or less wide domain distorted by zero beats is formed. These distortions also determine the unique nature of the output process.

In the sequel we shall analyze the two simplest and, moreover, the most characteristic selective systems; a single-section, low-frequency RC filter and a single resonant circuit, whose impulse responses equal, respectively:

$$g(t) = \alpha \cdot e^{-\alpha t} \qquad \alpha = 1/\mathrm{RC} \qquad [1]$$

and

$$g(t) = \Omega_p e^{-\alpha t} \sin \Omega_p t \qquad [2]$$

where Ω_p is the resonant frequency; $\alpha = \Omega_p/2Q$; and Q is the quality factor.

Delay Lines with Distributed Constants for Nanosecond Pulse Circuits, V. A. Solov'yev, pp. 21–31.

Delay lines are widely used in pulse technique and particularly in electronic automation and computer technique. The tendency to raise the efficiency of electronic automation and computer technique substantially leads at present to systems operating with extremely narrow pulses at the greatest repetition frequency. In this connection, the following requirements are imposed on delay lines: 1) high resolving power; 2) low wave resistance; 3) miniature construction; and 4) simplicity of construction facilitating the organization of mass production.

Only delay lines with distributed constants satisfy the requirement of high resolving power or low rise time of the transient characteristic τ_l to the required degree. The great advantage of these lines, as compared with delay lines with lumped constants, is the absence of separate structural elements of inductance cores and capacitors. This is particularly important for small-scale constructions, which are based on monolithic elements in order to simplify the technology and give the greatest possibility for diminution of the volume.

Existing constructions of delay lines with distributed constants do not satisfy the requirements of prospective high-frequency circuits [pulse duration $\tau_p = (25–100) \times 10^{-9}$ sec]. They do not permit wave resistances $\rho < 300$ ohm to be obtained, have large dimensions (a volume $v > 10$ cm^3 for a delay of $T_d \geqslant 6\tau_l$), and are structurally complex; the simplest among them have poor resolving power (rise time of $\tau > 50 \times 10^{-9}$ sec).

In this connection, the delay lines with distributed constants considered here were developed and they permit structurally simple lines to be obtained with $\tau_l \geqslant 10 \times 10^{-9}$ sec, $\rho \geqslant 30$ ohm, magnitude of the delay $T_d \geqslant 6\tau$, in a volume $v = 0.7–1.4$ cm^3. For the computation it is proposed to use a method recommended in practice, which is based on time relations. On the basis of a computation of the phase-frequency distortions which are characteristic for helical lines, expressions are derived for the computation of the rise time of the transient characteristic. On the basis of an analysis of the line construction, a formula is derived for the computation of the distributed capacitance.

Conclusion: Use of the method of computation explained and the formulas derived in order to estimate the magnitude of the distributed capacitance and the rise time is highly recommended in practice. They guarantee the efficiency of constructing small-scale delay lines for high frequency circuits. Use of the new lines, with a multiconductor helix and twin reverse conductor, would permit obtaining low resistance ($\rho = 30–300$ ohm) lines which would surpass other lines in resolving power at a considerably reduced size.

Design of Chebyshev Directional Couplers with Weak Coupling, A. L. Fel'dshteyn and Ye. S. Zhavoronkova, pp. 39–50.

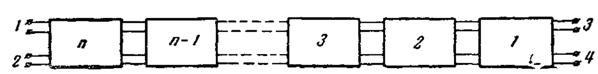

Fig. 1

A method is proposed for the synthesis of multielement directional couplers which possess optimum properties. Typical