GOLOVKO, P.T., inzh.; LOSHAK, M.Z., inzh.

The [illegible]-400M and NPS-400M high-pressure pumps. Mashinostroenie no.1:[illegible]-93 Ja-F '6[illegible] (MIRA 15:2)

1. Spetsial'noye konstruktorskoye byuro No.7 Khar'kovskogo sovnarkhoza.

(Pumping machinery)

POPOV, N.A.; LOSHAK, M.Z.

Pneumatic clamping devices. Mashinostroitel' no.5:33 My '63.
(MIRA 16:7)

(Lathes--Attachments)

LOSHAK, M.Z., inzh.

Bearing reductors for machine-tool attachments. Mashinostroenie no.
4:14 Jl-Ag '63. (MIRA 17:2)

APPROVED FOR RELEASE: 08/23/2000 CIA-RDP86-00513R000930610005-7"

LOSHAK, M.Z.

New design of an iar nozzle. Mashinostroitel' no.10:44 O '63. (MIRA 16:12)

LOSHAK, M.Z.

How to prevent the skewing of threaded holes. Mashinostroitel' no.7:48 Jl '64. (MIRA 17:8)

LOSHAK, M. F.

"Carbohydrate Metabolism of Horses Producing Antitetanus Serum." Cand Biol Sci, Khar'kov Veterinary Inst, Min Higher Education USSR, Khar'kov, 1955. (KL, No 8, Feb 55)

SO: Sum. No. 631, 26 Aug 55 - Survey of Scientific and Technical Dissertations Defended at USSR Higher Educational Institutions (14)

LIPOVTSEV, L.Ya., inzh.; LOSHAK, S.B., inzh.; MAKSIMOV, I.I., inzh.; PECHENIK, G.F., inzh.

First results of the operation of a 200 Mw. boiler-turbine unit. Teploenergetika 8 no.8:41-47 Ag '61. (MIRA 14:10)

1. Gosudarstvennyy trest po organizatsii i ratsionalizatsii elektrostantsiy.

(Boilers)
(Steam turbines)

SOKOLOV, B.M., kand.tekhn.nauk; DIREKTOR, B.Ya., inzh.; LOSHAK, S.B., inzh.; POLUKHIN, A.I., inzh.; YAKOVLEV, G.G., inzh.

Experience in the use of power units with supercritical pressures and prospects of their development. Teploenergetika 12 no.7:2-9 Jl '65. (MIRA 18:7)

1. Gosudarstvennyy trest po organizatsii i ratsionalizatsii rayonnykh elektrostantsiy i setey.

KAS'YANOV, L.N., inzh.; LIPOVTSEV, L.Ya., inzh.; LOSHAK, S.B., inzh.
RAYEV, B.Kh., inzh.; CHERNYA, G.A., inzh.; MUCHNIK, G.F.,
kand.tekhn.nauk

Load drops on the 200 mw. unit with subsequent loading.
Teploenergetika 8 no.10:44-49 O '61. (MIRA 14:10)

1. Gosudarstvennyy trest po organizatsii i ratsionalizatsii
elektrostantsiy i Zmiyevskaya gosudarstvennaya rayonnaya
elektricheskaya stantsiya.
(Steam turbines--Testing)

LOSHAK, S.B., inzh.; POLUKHIN, A.I., inzh.

Principal features of the equipment of a 300 Mw. block. Energetik 11 no.9:1-6 S '63. (MIRA 16:10)

DIREKTOR, B.Ya., inzh.; LOSHAK, S.B., inzh.; MIRONOV, D.K., inzh.; POLUKHIN, A.I., inzh.

First results of the preliminary starts and operation of a 300 Mw. block. Elek. sta. 36 no.6:2-9 Je '65. (MIRA 18:7)

LOPOYAN, Grach'ya Setrakovich, inzh. stroitel'stva; LOSHAK, V., red.

[Great pipeline] Velikaia magistral'. Sverdlovsk, Sredne-Ural'skoe knizhnoe izd-vo, 1964. 43 p. (MIRA 18:3)

LOSHAK, V. I.

Kotel'nyye ustanovki s parovoznymi kotlami (Boiler installations with locomotive boilers, by) N. I. Ivanova, V. I. Loshak (et al) Moskva, Transzheldorizdat, 1953. 243 p. illus., diagrs., tables.

SO: N/5
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APPROVED FOR RELEASE: 08/23/2000 CIA-RDP86-00513R000930610005-7"

LOSHAK, V.I.

AID P - 506

Subject : USSR/Engineering

Card 1/1 Pub. 78 - 20/27

Author : Loshak, V. I.

Title : Determination of the capacity of large tanks for petroleum products

Periodical : Neft. Khoz., v. 32, #6, 69-75, Ju 1954

Abstract : The author describes a practical method of measuring the relative and absolute deviations of diameters on the surface of welded tanks by means of a special equipment. Measurements are made by a horizontal scale suspended on a wire from a radial beam revolving on the tank roof. The recorded deviations in diameter in different points of the surface are used for the computation of arithmetical averages of the deviations and of the capacity of the tank. 7 drawings and one table.

Institution : Moscow State Institute of Measures and Measuring Instruments (M.G.I.M.I.P.)

Submitted : No date

LOSHAK, V.I.

IVANOVA, N.I.; LOSHAK, V.I.; METAKSA, V.A.; RATNER, M.P.; FUFRYANSKIY, N.A., kandidat tekhnicheskikh nauk, redaktor; VERINA, G.P., tekhnicheskiy redaktor

[Boiler installations with locomotive boilers] Kotel'nye ustanovki s parovoznymi kotlami. Moskva, Gos.transp.zhel-dor. izd-vo, 1955. 243 p. [Microfilm] (MIRA 9:3)

(Locomotive boilers)

LOSHAK, V.I., red.; KUZNETSOVA, M.I., red. izd-va; KONDRAT'YEV, M.A., tekhn. red.

[Instructions 256-57 for checking glass measuring burettes of nonautomatic chemical eudiometers] Instruktsiia 256-57 po poverke stekliannykh izmeritel'nykh biuretok khimicheskikh neavtomaticheskikh gazoanalizatorov. Izd. ofitsial'noe. Moskva, 1957. 10 p. (MIRA 14:5)

1. Russia(1923- U.S.S.R.) Komitet standartov, mer i izmeritel'nykh priborov. (Eudiometer--Testing)

LOSHAK, V.I.

ALEKSANDROV, A.M.; ALEKSEYEV, T.S.; KONSTANTINOV, N.N.; PAVLOVSKIY, A.N.; LOSHAK, V.I.; SARAYEV, V.P.; YEFREMOVA, T.D., vedushchiy red.; POLOSINA, A.S., tekhn. red.

[Computing volumes of petroleum products; manual for technical personnel of tank farms] Kolichestvennyi uchet nefteproduktov; rukovodstvo dlia tekhnicheskogo personala neftesk1adov. Moskva, Gos. nauchno-tekhn. izd-vo neft. i gorno-toplivnoi lit-ry, 1958. 330 p. (MIRA 11:8)

(Petroleum products)

AUTHOR: Loshak, V.I. SOV-115-58-3-33/41

TITLE: Calibration Errors of Horizontal Containers (Pogreshnost' kalibrovki gorizontal'nykh rezervuarov)

PERIODICAL: Izmeritel'naya tekhnika, 1958, Nr 3, pp 92 - 94 (USSR)

ABSTRACT: Error sources in the calibration of cylindrical horizontal containers by the conventional geometric method are analyzed and characteristic cases of deviation from true cylindrical shape (conical, barrel, elliptical shape, deformation) are considered and calculated. It is proved that a 1 : 100 non-horizontality of a container axis, which is permitted by technical specifications, can cause an error of between 0.2 and 10%, depending on the height of the filling. Calculations are made for a 2,000 mm diameter container. It is shown that the error for 10-15 m^3 containers amounts to 1 to 2 % and can reach 5% (with horizontal axis) when deformation is not taken into account. There are 2 tables.

1. Containers--Design 2. Containers--Calibration 3. Mathematics --Applications

Card 1/1

LOSHAK, V. I.

Accuracy of measuring moisture content in grains by the method of drying. Izm.tekh. no.11:20-23 N '60. (MIRA 13:11)
(Grain—Testing)

MARAKIN, Nikolay Fedorovich; LOSHAK, Mikhail Zakharovich; POSTERNYAK, Ye.F., inzh., red.; SHILLING, V.A., red. izd-va; GVIRTS, V.L., tekhn. red.

[High-pressure hydraulic devices]Gidravlicheskaia apparatura vysokogo davleniia. Leningrad, 1962. 22 p. (Leningradskii dom nauchno-tekhnicheskoi propagandy. Obmen peredovym opytom. Seriia: Mekhanicheskaia obrabotka metallov, no.8) (MIRA 15:8)
(Oil hydraulic machinery)

MARAKIN, N.F.; LOSHAK, M.Z.

Range of the DG hydraulic engines. Biul.tekh.-ekon.inform. no.1:44-45 '62. (MIRA 15:2)
(Oil-hydraulic machinery)

MARAKIN, N.F., inzh.; LOSHAK, M.Z., inzh.

Series of the DG hydraulic engines. Vest.mash. 42 no.3:90-91 Mr '62. (MIRA 15:3)

(Hydraulic engines)

L 1145-66 (A) EWP(c)/EWP(j)/EWP(k)/EWT(d)/EWT(m)/T/EWP(1)/EWP(v) RM

ACCESSION NR: AP5021996 UR/0286/65/000/014/0074/0074
678.058.3
678.065

AUTHOR: Gur'yanov, B. I.; Loshakevich, B. P.; Pinovskiy, M. L.; Gavrilova, F. A.; Yur'yev, S. I.; Pankov, A. A.; Mikushin, N. S.; Proselkova, Ye. P.

TITLE: A semiautomatic transfer machine for refilling the molds in autoclave tire vulcanization. Class 39, No. 172976

SOURCE: Byulleten' izobreteniy i tovarnykh znakov, no. 14, 1965, 74

TOPIC TAGS: industrial automation, vulcanization, rubber working machinery

ABSTRACT: This Author's Certificate introduces a semiautomatic transfer machine for refilling the molds in autoclave tire vulcanization. The machine is a closed circular device with a centrally located automatic operator and devices for angular orientation of the molds as well as for opening and steam cleaning them. The machine is designed for complete mechanization of the process of extracting the tire from the mold after opening, regardless of whether the finished tire is in the upper or lower half of the mold. The automatic extraction device is made in the form of a bracket which rotates on a vertical axle. This bracket carries a

L 1145-66

ACCESSION NR: AP5021996

pair of horizontal discs which move in the vertical direction. These discs are equipped with symmetrically telescoping clamps for grasping the tires from the inside in the upper or lower position.

ASSOCIATION: none

SUBMITTED: 16Oct61 ENCL: 01 SUB CODE: IE

NO REF SOV: 000 OTHER: 000

Card 2/3

L 1145-66

ACCESSION NR: AP5021996

ENCLOSURE: 01

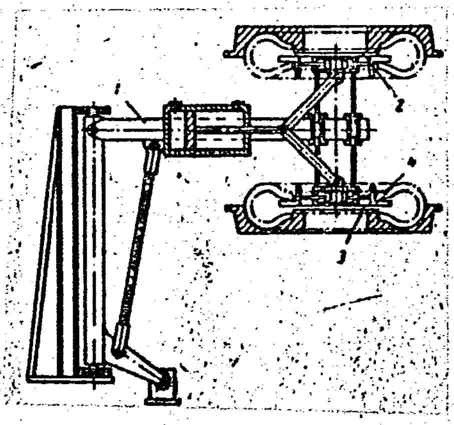

Fig. 1. 1--bracket; 2 and 3--discs; 4--clamps

Card 3/3

APPROVED FOR RELEASE: 08/23/2000 CIA-RDP86-00513R000930610005-7"

LOSHAKOV, A.M., inzh.; BIBIKOV, A.V., inzh.; OBUKHOV, Yu.V., inzh.; GORYASHCHENKO, Yu.N., tekhnik

Use of an A-564 gun for welding studs in an overhead position. Svar. proizv. no.1:36 Ja '65. (MIRA 18:3)

1. Trest "TSentroenergomontazh".

LOSHAKOV, A.M., inzh.; BIBIKOV, A.V., inzh.; VASIL'KOV, B.P.; GORYASHCHENKO, Yu.N.

Welding flanges to pipes simultaneously with two welds. Svar. proizv. no.3:31-32 Mr '65. (MIRA 18:5)

1. Trest "TSentroenergomontazh".

FED'KIN, A.I., tekhnik; LOSHAKOV, A.M., inzh.

Modernization of the ASSH-2 machine. Svar.proizv. no.4:39 Ap '62. (MIRA 15:3)

1. Moskovskiy kotel'no-mekhanicheskiy zavod tresta "TSentroenergomontazh".

(Metal cutting--Equipment and supplies)

LOSHAKOV, A.S., OGUL'CHANSKIY, A.YA.

Ducks

Passage of the eider (Somatera mollissima mollissima) on the Azov Sea. Priroda 41, no. 6, 1952.

9. Monthly List of Russian Accessions, Library of Congress, SEPTEMBER 1952 ~~1953.~~ Unclassified.

LOSHAKOV, K.; BARKOV, M.

Mechanized loading of railroad cars. Muk.-elev. prom. 26 no. 12:26 D '60.
(MIRA 13:12)

1. Atbasarskaya perevalochnaya baza khleboproduktov Akmolinskoy oblasti.

(Loading and unloading)

B66A

5A

3058. **Discontinuous Oscillations in a Circuit with Capacitance and Inductance.** S. Chaikin and L. Lochakov. *Techn. Phys. U.S.S.R.* 2. 2–3. *pp.* 161–184. 1935. *In French.*—It is shown theoretically that it is possible for a system comprising inductance and capacitance to change discontinuously from one oscillatory state to another. Hitherto discontinuous change had been shown to exist only for circuits without inductance or without capacitance. Experiments are described which confirm the theoretical conclusions. A. W.

1ST AND 2ND ORDERS
PROCESSES AND PROPERTIES INDEX
3RD AND 4TH ORDERS

CA

2

Measurement of the magnetic permeability of iron and permalloy by a new method in very weak fields of a high frequency. L. N. Loshakov. *J. Tech. Phys.* (U. S. S. R.) 9, 1840-7(1939).—The magnitude of the skin effect depends on the magnetic permeability μ of the material. If the skin effect is detd. by measuring the resistance of a metal in a high-frequency field, it is possible to calc. μ. The μ of Fe wire is almost independent of its diam. (0.1 to 0.5 mm.) and the frequency (7×10^6 to 23×10^6 cycles). The μ of permalloy band is smaller than that of Fe and also independent of the frequency. After annealing the μ of permalloy increases about tenfold and rises with rising wave length.

J. J. Bikerman

COMMON ELEMENTS
COMMON VARIABLES INDEX
A1B-SLA METALLURGICAL LITERATURE CLASSIFICATION
MATERIALS INDEX
3RD AND 4TH ORDERS
AUTHOR INDEX
1ST AND 2ND LETTER

LOSHAKOV, L.

Transmission

[illegible] INVESTIGATIONS ON ELECTRON BEAMS IN AN ELECTRICAL RETARDING FIELD [and the "Reflection Generator"]. —S. I. Gvosdover, L. Loschakow, & J. Terleski (*Comptes Rendus (Doklady) de l'Acad. des Sci. de l'URSS*, Vol. 30, 1941, p. 613 onwards.) Referred to in 1553, above.

LOSHAKOV, L. N.

"On the Theory of the Electron-Beam Conductor," Zhur. Tekh. Fiz., 15, No.3, 1945

Sci. Res. Lab. Artillery Apparatus Construction, Red Army, Moscow

PA 19T17

LOSHAKOV, I. N.

USSR/Oscillators, Klystron
Vacuum tubes, Klystron

Jun/Jul 1946

"The Theory of a Klystron with a Distributed Oscillatory System," L. N. Loshakov, Candidate of Physico-Mathematical Sciences, 10 pp

"Radiotekhnika" Vol I, No 3/4

An approximate theory for the excitation of oscillations in the klystron, proposed by the author and S. D. Gvozdover. The investigation of self-excitation is carried out with general equations established for systems approximately conservative and based on the input of the oscillatory system of the oscillator.

19T17

PROCESSES AND PROPERTIES INDEX

SA B 66

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621.396.615.142.2 : 621.385.1.029.6 = 82 2917

Theory of the single cavity transverse klystron. Loshakov, L. N., and Gvozdover, S. D. Bull. Acad. Sci. URSS, Ser. Phys., 10 (No. 1) 79-86 (1946) In Russian. - The type of valve suggested avoids the inefficiency of the reflex klystron where the beam modulating voltage is simultaneously applied to the conversion space. The proposed klystron consists of a cathode and two coaxial sylinders joined to a single cavity in such a way as to produce a modulator, an inductor and a convertor space. General equations are postulated, and the output current equation is derived, solved to a first approximation and interpreted physically. Though control experiments do not agree closely with theory, they indicate the feasibility of the proposed construction. A. L.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

LOSHAKOV, L. N.

"On the Theory of the Electron Beam Generator as an Auto-Oscillating System with Distributed Constanst," Zhur. Tekh. Fiz.,16, No.6, 1946

LOSHAKOV, L. N. PA 51T7

USSR/Electricity
Coaxial Lines
Waves, Electromagnetic

Mar/Apr 1948

"Theory of Coaxial Spiral Lines," L. N. Loshakov, Candidate Phys Tech Sci; Ye. B. Ol'derogge, 10 pp

"Radiotekh" Vol III, No 2

Gives approximate theory of distribution of electromagnetic waves in spiral coaxial line, and establishes method to calculate dependence of phase velocity upon geometry of the line and the frequency.

51T7

[illegible] da un cilindro metallico esterno e da una spirale di filo conduttore [illegible]

[illegible] delle spire e di conduttività nulla in direzione perpendicolare ad esse. L'autore imposta direttamente le [illegible]

[illegible] in cui il fascio elettronico ha densità [illegible] [illegible] nella pratica, [illegible]

[illegible] e la rimanente in senso inverso. Una delle onde dirette e l'onda inversa conservano ampiezza costante [illegible]

210
THEORY OF WAVE PROPAGATION IN AN ELECTRON BEAM. L. N. Loshakov. Zhur. Tekh. Fiz. 22, 193-202 (1952) Feb. (In Russian)

The theory of electromagnetic wave propagation in the presence of an electron beam in a wave guide filled with dielectric is described. It is assumed that electrons move freely along the wave-guide axis within the dielectric. Types and peculiarities of waves capable of propagating under various conditions are established. (G.Y.)

USSR/Electronics - Wave Guides

Card 1/1 Pub 90-3/12 FD-2223

Author : *Loshakov, L. N.
[redacted]

Title : A special case of matching radio-wave guides

Periodical : Radiotekhnika, 10, 25-28, Mar 1955

Abstract : A special case of matching two wave guides, for the purpose of confirming the correctness of Brillouin's physical concepts of electromagnetic wave propagation in wave guides, is presented in this article. Two wave guides of the same geometrical configuration, but filled with dielectric material of different dielectric constant, are studied here with an aim of determining the conditions for matching two such wave guides. Theoretical calculations of the conditions for wave guide matching, based on Brillouin's concept, were in good agreement with actual findings, and therefore may find some practical application. One USSR reference cited.

Institution: *Active member of the All-Union Scientific and Technical Society of Radio Engineering and Electric Communications imeni A. S. Popov, Moscow

Submitted : 12 Jan 1953

LOSHAKOV, L.N.

Nonlinear phenomena in a wave guide in the presence of an electron beam traveling at velocities near to electron and wave-motion velocities. Zhur.tekh.fiz. 25 no.10:1768-1787 S '55. (MLRA 9:1)
(Wave guides)

APPROVED FOR RELEASE: 08/23/2000 CIA-RDP86-00513R000930610005-7"

LOSHAKOV, L.N.

Category : USSR / Radio Physics. Radiation of Radio Waves. Transmission Lines and Antennas I-5

Abs Jour : Ref Zhur - Fizika No 3, 1957, No 7286

Author : Loshakov, L.N.
Title : Concerning One Method of Calculating the Propagation Constants in Waveguides With Walls of Finite Conductivity.

Orig Pub : Radiotekhnika, 1956, 11, No 9, 8-11

Abstract : An approximate method is described for the calculation of the propagation constants in a waveguide whose walls are not ideally conducting, based on the use of the conjugate lemma. The correctness of the above method is confirmed and the results of its application are considered.

Card : 1/1 - 28 -

USSR/Radiophysics - Superhigh Frequencies, I-11

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 35443

Author: Loshakov, L. N.

Institution: None

Title: Approximate Calculation of the Propagation Constants in Transmission Lines in the Presence of an Electron Beam

Original Periodical: Zh. tekhn. fiziki, 1956, 26, No 4, 809-820

Abstract: A method is described for approximate calculation of the constants of propagation in transmission lines in the presence of an electron beam, based on using the electronic equations and of an associated lemma analogous to the Lorenz lemma established by Ya. N. Fel'd (Dokl. AN SSSR, 1947, 56, 481). The results of the theoretical investigation are used to calculate a particular case of operation of the traveling wave tube employed as an amplifier with a decelerating system in the form of a helical line. Bibliography, 10 titles.

Card 1/1

LOSHAKOV, L. N.

AUTHOR: Loshakov, L.N.

109-4-11/20

TITLE: Application of the Lorentz Lemma to the Determination of the Propagation Constants for the Interaction of an Electron Beam with Spatial Harmonics. (Primeneniye lemmy Lorentsa dlya opredeleniya postoyannykh rasprostraneniya pri vzaimodeystvii elektronnogo potoka s prostranstvennymi garmonikami.)

PERIODICAL: Radiotekhnika i Elektronika, 1957, Vol.2, No.4, pp. 461 - 469 (USSR).

ABSTRACT: Note: The material contained in this paper was presented at the International Congress on High-frequency Devices, Paris, 1956. In an earlier work [Ref.1], the author indicated a possibility of employing the Lorentz lemma in an approximate evaluation of the propagation constants in a delay line in the presence of an axial electron beam. Here, the application of the lemma is extended to the case of the so-called "non-distributed" EH waves (where each transverse field component is expressed by axial magnetic and electric fields). The case is of practical importance in backward-wave tubes (with a spiral line). For the purpose of analysis it is assumed that there are no losses in the delay line. The basic equations of the system are [Ref.1]:

Card 1/5

109-4-11/20

Application of the Lorentz Lemma to the Determination of the Propagation Constants for the Interaction of an Electron Beam with Spatial Harmonics.

$$\frac{\partial}{\partial z}\iint_S \left\{ \left[\bar{E}_2 \bar{H}_{11}^* \right] + \left[\bar{E}_{11}^* \bar{H}_1 \right] \right\} \bar{a}_z ds = -\int_{S_o} iE_{11z}^* ds \qquad (1)$$

and:

$$\bar{E}_I = ji/\omega\varepsilon + \bar{E}_2 \qquad (2)$$

where $\bar{E}_1$, $\bar{H}_1$ are electric and magnetic fields of the line with the beam (the unknown quantities) $\bar{E}_2$ is a component of the unknown field (which is rotational); $\bar{E}_{11}$, $\bar{H}_{11}$ are electric and magnetic fields of the liner in the absence of the electrons and damping (auxiliary fields), i is a.c. component of the electron current density, ε is the dielectric constant of the medium, ω is the angular frequency, $\bar{a}_z$ is the unit vector of the axis z , S is the cross-sectional area of the

Card 2/5

line and S_o is the cross-sectional area of the electron beam; the asterisk in the equations denotes the conjugate quantities. Solution of the equations leads to the following expression for the propagation constant of the system:

$$\delta\left[\left(\delta + \frac{1-\pi}{\chi}\right)^2 - M\right] \pm M \frac{\omega\varepsilon}{4\,\beta_{oo}P_o} \int_{S_o} \left| E_{onz} \right|^2 ds = 0 \qquad (45)$$

where δ is a deviation of the propagation function due to the electron beam, which is defined by:

$$\gamma_n = j\beta_{on} - j\beta_{oo}\delta \qquad (33)$$

where β_{oo} is the propagation constant for the fundamental, while the propagation constants of the harmonics are:

$$\beta_{on} = \beta_{oo} + \frac{2\pi}{h} n \qquad (29)$$

109-4-11/20

Application of the Lorentz Lemma to the Determination of the Propagation Constants for the Interaction of an Electron Beam with Spatial Harmonics.

in which h is the pitch of the periodic structure. The remaining parameters in equation (45) are as follows:

$\eta = k_o/\beta_{on}$, where $k_o = \omega/u_o$,

u_o = average velocity of the electrons

$\chi = \beta_{oo}/\beta_{on}$

and $M = q/\beta_{oo}^2$, $q = ei_o/meu_o^3$,

in which e and m are the charge and the mass of an electron and i_o the d.c. density of the beam current;

P_o is the average power transmitted along the system, and E_{onz} in the integral are components of E_{11z} as given by:

$$E_{11z} = \sum_{n=-\infty}^{+\infty} E_{onz} \tag{17}$$

Card 4/5

109-4-11/20

Application of the Lorentz Lemma to the Determination of the Propagation Constants for the Interaction of an Electron Beam with Spatial Harmonics.

The sign (-) in equation (45) relates to the interaction of the beam with a forward harmonic and the sign (+) to the interaction with a backward harmonic. The coefficient by M in equation (45), i.e. the expression:

$$K_{cn} = \frac{\omega e}{2\beta_{oo}P_o} \int_{S_o} \left| E_{onz} \right|^2 ds \qquad (46)$$

is referred to as the coupling coefficient of the system for the nth harmonic. General expressions for K_{cn} are derived. There are 5 references, 2 of which pertain to the works of the author.

SUBMITTED: May 30, 1956.

AVAILABLE: Library of Congress.

Card 5/5

LOSHAKOV, L. N.

103-6-5/13

AUTHOR LOSHAKOV L.N., Regular Member of Society OLDEROGGE Ye.B.

TITLE Fast Waves in a Coaxial Spiral Line.
(Bystryye volny v koaksial'noy spiral'noy linii-Russian)

PERIODICAL Radiotekhnika, 1957, Vol 12, Nr 6, pp 25 - 30 (U.S.S.R.)

ABSTRACT An approximate theoretical investigation of the propagation of fast waves of various kinds in a coaxial spiral line is carried out. The conditions under which such a propagation is possible are determined. The analysis is carried out within the frame of idealization, i.e. the spiral is replaced by an anisotropically conducting cylindrical surface with a radius similar to that of the average spiral radius. First the initial relations and then the equations for the phase constant and the critical frequencies are found. For the purpose of simplification of the calculation an ideal conduction of the spiral as well as of the screen are assumed. Six independent equations are formed by means of which 5 of the 6 integration constants of the equations for the fields can be expressed by one. A Transcedent equation is obtained required for the phase constant β_m of the waves of various types, which can propagate in the line investigated. The determination of the phase constant β_m leads to the graphical solution of the transcedent equation for the given geometry of the line as well as of the frequency. The equation for the critical frequencies is obtained and the evaluation of the roots of this equation shows that the basic types of the waves in the line investigated which have the lowest frequency are the a-

Card 1/2

XXXXXXXXX
105-2-5/12

Fast Waves in a Coaxial Spiral Line.

symmetrical waves with the indices n=1, m=1 and m=-1. (n is the ordinal number of the root of the transcedent equation if m is given, where m= 0, ±1, ±2....). The investigation of these three types follows: axial-symmetrical waves (m=0,n=1) and asymmetrical waves of the type m=±1, n=1.
(7 illustrations and 4 Slavic references).

ASSOCIATION Not Given.
PRESENTED BY
SUBMITTED 20.11.1956
AVAILABLE Library of Congress.
Card 2/2

AUTHOR: Loshakov, L. N.

SOV/108-13-9-1/26

TITLE: E-Type Surface Waves in Round Wave Guides (Poverkhnostnyye volny tipa E v kruglom volnovode)

PERIODICAL: Radiotekhnika, 1958, Vol. 13, Nr 9. pp. 3-7 (USSR)

ABSTRACT: As in reference 1 no mathematical presentation is given of the considerations involved in the study of axially symmetrical electric surface waves with a small lag in annular wave guides the interior surface of which is coated with a thin dielectric layer this is presented in this paper. First equation (6) is derived specifying the unknown phase constant β of the surface waves. Equation (6) can be solved graphically. Its analysis shows that at not very high frequencies the arguments of the Bessel (Bessel') function in the right part of equation (6) are very great. Hence equation (6) can be simplified for most cases occurring in practice. The asymptotic formulae (7) are applied to (6), yielding (10). This equation (10) has no solution if the frequency is below a certain level. This means that the E_{on} waves possess critical frequencies. They are specified by formula (11) and (12), respectively. (11) has an infinite number

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E-Type Surface Waves in Round Wave Guides SOV/108-13-9-/26

of solutions which are within the interval $(n-1)\pi < y_n < (2n-1)\frac{\pi}{2}$ $(n = 1, 2, 3, \ldots)$. To each value of y_n there corresponds a critical frequency for a certain type of wave (E_{on}). When the frequency increases, the phase velocity of the surface wave drops. By solving equation (10) the lag occurring in each specific case can be obtained. As it was desired to draw more thorough conclusions from the theory discussed the results of a numerical solution of equation (10) are given for a few specific examples. There are 3 figures and 2 references, 1 of which is Soviet.

SUBMITTED: June 11, 1957

Card 2/2

LUSHAKOV L. N.

М. Б. Голант,
А. С. Тагер

О механизме работы параметрических усилителей СВЧ, в которых используются потоки свободных электронов.

В. О. Сазаов

О предельных параметрах мощных электронных приборов миллиметрового диапазона.

9 июня

(с 18 до 22 часов)

А. Д. Власов

О методе граничной частоты в теории электронных пучков.

Г. А. Зейтленок

О взаимодействии электронного потока с электрическим полем.

М. Б. Голант

Метод расчета параметров электронно-лучевых СВЧ генераторов нерезонансного типа.

Л. Н. Лошаков,
Ю. Н. Пчельников

Об определении коэффициента усиления для постоянных распространения в замедляющей системе при наличии электронного пучка.

А. В. Гапонов.

Взаимодействие электромагнитных волн с непрямолинейными электронными потоками.

10 июня

(с 10 до 16 часов)

А. Н. Терещенко,
В. А. Коробкин

О возможности улучшения параметров резонаторной системы магнетрона посредством изменения формы резонаторов.

М. Н. Кузнецов,
Л. В. Розырин

К вопросу о механизме флюктуаций в магнетроне

М. Н. Кузнецов,
М. М. Бордасов,
В. Е. Нечаев

Экспериментальные исследования флюктуаций в магнетроне.

Н. М. Блейвас,
Я. М. Мостовенко,
В. В. Хомич

Малогабаритный траекторограф для решения уравнений движения заряженных частиц в электрических и магнитных полях.

report submitted for the Centennial Meeting of the Scientific Technological Society of Radio Engineering and Electrical Communications im. A. S. Popov (VNORIE), Moscow, 8-12 June, 1959

88698

S/058/60/000/010/007/014
A001/A001

9,4231

Translation from: Referativnyy zhurnal, Fizika, 1960, No. 10, pp. 309-310, # 27427

AUTHORS: Ol'derogge, Ye.B., Loshakov, L.N.

TITLE: Calculation of Coupling Coefficient in a Backward-Wave Tube With a Double Spiral

PERIODICAL: Tr. Konferentsii po elektronike SVCh, 1957, Moscow-Leningrad, Gosenergoizdat, 1959, pp. 23 - 24

TEXT: The authors derive a formula for calculating the coupling coefficient K_c for the interaction of an electron beam with a field of arbitrary space harmonic in a backward-wave tube with a double spiral. The spiral is assumed to be of the strip type, screen effect and losses in the spiral are neglected. Numerical calculations of K_c are performed by the formula obtained for a number of particular cases. It turned out that the way of current distribution over the spiral strip affects the magnitude of K_c only insignificantly. K_c-values decrease sharply with the increasing number of the harmonic. The coupling coefficient of the first reverse harmonic, K_{c-1}, was investigated in detail. The graphs of K_{c-1}

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Calculation of Coupling Coefficient in a Backward-Wave Tube With a Double Spiral

are presented as functions of geometry of the spiral, frequency and dimensions of the beam, which are of interest for the selection of characteristics of the backward-wave tube. It is found out that there is an optimum value of the spiral pitch, corresponding to the K_{c-1} maximum, for the fixed values of frequency and radius of the spiral. It is mentioned that annular beams are expedient for the operation of backward-wave tubes at sufficiently low voltages. Spirals with relatively large diameters can be used in this case.

G.N. Shvedov

Translator's note: This is the full translation of the original Russian abstract.

Card 2/2

AUTHOR: Loshakov, L.N. SOV/109-4-4-15/24

TITLE: Taking into Account the Space-charge Field in the Evaluation of the Propagation Constant of a Delay System in the Presence of an Electron Beam by Means of the Lorentz Lemma (Ob uchete polya ob'yemnogo zaryada pri raschete postoyannykh rasprostraneniya v zamedlyayushchey sisteme v prisutstvii elektronnogo puchka s pomoshch'yu lemmy Lorentsa)

PERIODICAL: Radiotekhnika i elektronika, 1959, Vol 4, Nr 4, pp 688 - 694 (USSR)

ABSTRACT: In two earlier works (Refs 1, 2) the author described a method for calculating the propagation constants of the waves in delay systems in the presence of a longitudinal electron beam. The method was based on the use of the Lorentz lemma and was not very accurate. In the following, the author makes an attempt to modify the method in such a way as to improve its accuracy. The electron beam considered has a circular cross-section and is a sinusoidal function of time. The wave equation with regard to the longitudinal component of the electric field E_{1z} can be written in the form of Eq (1) where Ω is given by Eq (2).

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Taking into Account the Space-charge Field in the Evaluation of the Propagation Constant of a Delay System in the Presence of an Electron Beam by Means of the Lorentz Lemma

The remaining symbols in these equations are: γ - the propagation constant; $k_o = \omega/u_o$; u_o is the steady component of the electron velocity; q is the square of the plasma wave number; i_o is the steady component of the electron current, ω_p is the plasma frequency; ε is the permittivity of the medium and μ is the permeability of the medium. The solution of Eq (1) is in the form of Eq (3), so that the transverse component of the magnetic field is given by Eq (4). For the region outside the beam, the wave equation is in the form of Eq (5), where p is defined by Eq (6). The fields are, therefore, given by Eqs (7). The condition of continuity of the tangent fields at the boundary of the beam (r = a) is given by Eq (8). The propagation constants of the possible waves can, therefore, be determined from Eqs (2), (6) and (8). For slow waves which fulfil the conditions described by

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Taking into Account the Space-charge Field in the Evaluation of the Propagation Constant of a Delay System in the Presence of an Electron Beam by Means of the Lorentz Lemma

Eqs (9), the propagation constants are given by Eq (10), where g is defined by Eq (11). The quantity g takes into account the influence of the transverse dimensions of the beam on the propagation constant, it is referred to as a depression coefficient. The electric field (on the basis of the Lorentz Lemma and the preceding equations) can be written as:

$$E_I = g \frac{j}{\omega \varepsilon} i + \bar{E}_2 \qquad (14)$$

The alternating current component can be written in the form of Eq (15) or as Eq (17). It is necessary to determine the correction factor δ ; the relationship between δ and the propagation constants γ_m of the waves is expressed by Eq (21), where the phase constants β_{om} are defined

Taking into Account the Space-charge Field in the Evaluation of the Propagation Constant of a Delay System in the Presence of an Electron Beam by Means of the Lorentz Lemma

by Eq (22); h denotes the period of the system. The sign - (minus) in Eq (21) refers to the case of the interaction with the first harmonic, while the sign + (plus) refers to the interaction with a backward harmonic. For a smooth delay system with "separated" waves of the EH type, the propagation constants can be determined from Eq (23), where the index n is neglected. This equation permits the determination of the propagation of all the four simple waves which exist in the presence of an electron beam. The depression coefficient can be approximately evaluated from Eq (8). The results of the calculations are shown in Figure 1. The results are compared with accurate values (Ref 5); the comparison is given in Figure 2. From Figures 1 and 2, it is seen that if $a\gamma_0 < 1.6$ and $a/b < 0.6$, the values of the depression coefficients, as determined from Eq (8), are very near to those obtained by means of the exact theory.

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Taking into Account the Space-charge Field in the Evaluation of the Propagation Constant of a Delay System in the Presence of an Electron Beam by Means of the Lorentz Lemma

There are 2 figures, 1 table and 9 references, 8 of which are Soviet and 1 German.

SUBMITTED: January 10, 1958

Card 5/5

LOSHAKOV, L.N.

Theory of coupled helices in the presence of an absorbing medium.
Radiotekhnika 14 no.1:14-24 Ja '59. (MIRA 12:2)

1. Deystvitel'nyy chlen Nauchno-tekhnicheskogo obshchestva radiotekhniki i elektrosvyazi im. A.S.Popova.
(Radio waves)

9.1400

S/109/60/005/07/007/024
E140/E163

AUTHOR: Loshakov, L.N.

TITLE: On the Theory of a Multi-Conductor Transmission Line Consisting of a System of Alternating-Phase Conductors on the Surface of a Circular Cylinder

PERIODICAL: Radiotekhnika i elektronika, Vol 5, No 7, 1960, pp 1092-1099 (USSR)

ABSTRACT: The propagation of a TEM-wave along a system of alternating-phase conductors on the surface of a circular cylinder in the presence of two coaxial screens is calculated approximately. The electrodynamic method is employed with the simplifying assumption that the azimuthal electric field in the narrow gaps between adjacent conductors may be represented in the form of a rectangular function. It is assumed that the basic conductors are infinitely thin and that the conductors and screens are ideal conductors. This type of multi-conductor line has been employed recently in helitron devices (Ref 1). It is found that the localisation of the field improves with increase in the number of conductor pairs. The wave over the cross-section has the properties of a surface wave but with the absence of delay in the direction of propagation, characteristic of surface waves.

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S/109/60/005/07/007/024
E140/E163

On the Theory of a Multi-Conductor Transmission Line Consisting of a System of Alternating-Phase Conductors on the Surface of a Circular Cylinder

Theoretical formulae and simplified formulae for the numerical calculation of wave impedance are given. The simplified formulae are derived on the assumption that screens are absent. Consideration of the effect of screens shows that they reduce the wave impedance where, other conditions being equal, the screen influence decreases with increase of the number of conductor pairs. There are 2 figures and 5 references, of which 4 are Soviet and 1 is English.

SUBMITTED: July 27, 1959

Card 2/2

83265

S/109/60/005/009/011/026
E140/E455

9.4230 1052 1071

AUTHOR: Loshakov, L.N.

TITLE: On the Theory of Microwave Electron Devices With Transverse Interaction

PERIODICAL: Radiotekhnika i elektronika, 1960, Vol.5, No.9, pp.1448-1457

TEXT: A microwave device with current flowing transversely to the electromagnetic-wave-delay system could have very much higher electron beam current than the existing longitudinal-beam devices. Dunn and Harman (Ref.1,2) described tubes in which current was introduced uniformly along the entire interaction space at an angle to the longitudinal axis. In such tubes, the amplification effect apparently fully corresponded to longitudinal interaction. The present article describes a preliminary theoretical analysis of phenomena in a device with true transverse interaction. An idealized waveguide model is adopted, consisting of a rectangular waveguide with ideally-conducting walls, filled by a lossless dielectric. It is assumed that the side walls have an electron stream completely filling the inner regions of the waveguide, moving parallel to the wide walls. The wave excited is assumed to

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On the Theory of Microwave Electron Devices With Transverse Interaction

be of the type LM_{mn} $(m,n \neq 0)$, which has the necessary field components for transverse interaction. The basic relationships in such a system are obtained for the small-signal case. Further, the author limits himself to the case of low gain. The solution indicates that two growing waves are possible, directed in opposite directions along the z-axis. The maximum value of the real part of the propagation constant is obtained with electron velocities exceeding the phase velocity of the unperturbed waves travelling in the direction of motion of the electron. Agreement of this result with the crestatron theory (Ref.6) is considered as confirmation of the assumption made in the present work. It is expected that with adequate gain in the interaction region, the dependence of the growth factor of the wave as a function of beam current density will approach the case of the ordinary TWT with longitudinal interaction. To develop an amplifier, it will be necessary to suppress reflection of the waves travelling in the direction from the load to the exciter. Utilization of the backward wave may lead to an oscillator with distributed feedback.

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On the Theory of Microwave Electron Devices with Transverse Interaction

The practical design of devices with transverse interaction may be based on multi-row stub systems in the waveguide. A more detailed study of the model and a generalization of the theory to arbitrary systems will be the subject of a further paper. There are 1 figure and 6 references: 2 Soviet, 3 English and 1 French.

SUBMITTED: January 26, 1960

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22262

S/109/61/006/005/009/027
D201/D303

9,4230

AUTHOR: Loshakov, L.N.

TITLE: The coefficient of coupling between the electron beam and the retarding system in the transverse field SHF devices

PERIODICAL: Radiotekhnika i elektronika, v. 6, no. 5, 1961, 767 - 769

TEXT: In his previous article (Ref. 1: K teorii elektronnogo pribora SVCh s vzaimodeystviyem v poperechnom napravlenii, Radiotekhnika i elektronika, 1960, 5, 9, 1448) the author gave the results of evaluating the interaction process between the electron beam and the electromagnetic wave field in a wave guide model of a SHF electron device with a transverse field (for the movement of electrons in a direction perpendicular to the power stream in the wave guide). Since the problem is a new one and the results given above were

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The coefficient of ...

provisional only, in the present article the author analyzes the problem in more detail and in particular tries to relate the coupling coefficient as introduced in Ref. 1 (Op.cit.) to the known coefficient of coupling of an ordinary TWT with a transverse field. In Ref. 1 (Op.cit.) the following expression was obtained for the coefficient of coupling between the electron beam and the wave K_c in a tube with transverse field interaction:

$$K_c = \frac{k^2 - \frac{m^2\pi^2}{a^2}}{\frac{m^2\pi^2}{a^2}} \qquad (1)$$

where $k = \omega\sqrt{\varepsilon\mu}$ - the phase constant of the medium and $m\pi/a$ - the phase constant of the wave propagating in the retarding system in the direction of the x - axis and not affected by the electron beam.

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The coefficient of ...

According to B.A. Vvedenskiy and A.G. Arenberg (Ref. 2: Radiovolnovody (Radio Wave Guides) Ch. 1, OGIZ, 1946, str. 60-61) the field inside the wave guide in the absence of the electron beam can be expressed by Eqs.

$$E_{ox} = A \cos \frac{m\pi}{a} x \sin \frac{n\pi}{b} y \, e^{j(\omega t - \beta_o z)}, \quad (2)$$

$$E_{oy} = -\frac{\frac{m\pi}{a}\frac{n\pi}{b}}{k^2 - \frac{m^2\pi^2}{a^2}} A \sin \frac{m\pi}{a} x \cos \frac{n\pi}{b} y \, e^{j(\omega t - \beta_o z)}, \quad (3)$$

$$E_{oz} = \frac{j\beta_o \frac{m\pi}{a}}{k^2 - \frac{m^2\pi^2}{a^2}} A \sin \frac{m\pi}{a} x \sin \frac{n\pi}{b} y \, e^{j(\omega t - \beta_o z)}, \quad (4)$$

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The coefficient of ...

$$H_{0y} = \frac{\omega\varepsilon\beta_q}{k^2 - \frac{m^2\pi^2}{a^2}} A \cos\frac{m\pi}{a} x \sin\frac{n\pi}{b} y\, e^{j(\omega t - \beta_q z)}, \quad (5)$$

$$H_{0z} = -j \frac{\omega\varepsilon \frac{n\pi}{b}}{k^2 - \frac{m^2\pi^2}{a^2}} A \cos\frac{m\pi}{a} x \cos\frac{n\pi}{b} y\, e^{j(\omega t - \beta_q z)}, \quad (6)$$

$$m = 1, 2, 3, \ldots; \; n = 1, 2, 3, \ldots.$$

According to Brillouin, the wave guide wave L M_{mn} is formed as a result of superimposition of a homogeneous transverse wave, propagated in four intersecting directions. This transverse wave interacts with the electron beam along the x-axis and has component fields given by

$$E_{01x} = j \frac{A}{4} e^{j\omega t - jk(x \cos\alpha + y \cos\beta + z \cos\gamma)}, \quad (8)$$

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The coefficient of ...

$$E_{01y} = -j \frac{\frac{m\pi}{a} \frac{n\pi}{b}}{k^2 - \frac{m^2\pi^2}{a^2}} \frac{A}{4} e^{j\omega t - jk(x \cos\alpha + y \cos\beta + z \cos\gamma)}, \quad (9)$$

$$E_{01z} = -j \frac{\beta_0 \frac{m\pi}{a}}{k^2 - \frac{m^2\pi^2}{a^2}} \frac{A}{4} e^{j\omega t - jk(x \cos\alpha + y \cos\beta + z \cos\gamma)}, \quad (10)$$

$$H_{01y} = j \frac{\omega\varepsilon\beta_0}{k^2 - \frac{m^2\pi^2}{a^2}} \frac{A}{4} e^{j\omega t - jk(x \cos\alpha + y \cos\beta + z \cos\gamma)}, \quad (11)$$

and

$$H_{01z} = -j \frac{\omega\varepsilon \frac{n\pi}{b}}{k^2 - \frac{m^2\pi^2}{a^2}} \frac{A}{4} e^{j\omega t - jk(x \cos\alpha + y \cos\beta + z \cos\gamma)}, \quad (12)$$

while the directional cosines of the propagation are equal

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The coefficient of ...

$$\cos\alpha = \frac{m\pi}{ak};\quad \cos\beta = \frac{n\pi}{bk};\quad \cos\gamma = \frac{\sqrt{k^2 - \frac{m^2\pi^2}{a^2} - \frac{n^2\pi^2}{b^2}}}{k} = \frac{\beta_0}{k}. \quad (13)$$

For the transverse wave the ratio of the electric field E_{01} to the magnetic field H_{01} is equal to the characteristic impedance of the medium

$$\frac{|E_{01}|}{|H_{01}|} = \frac{\sqrt{|E_{01x}|^2 + |E_{01y}|^2 + |E_{01z}|^2}}{\sqrt{|H_{01y}|^2 + |H_{01z}|^2}} = \sqrt{\frac{\mu}{\varepsilon}} \quad (14)$$

While the magnitude of the Umov-Poynting vector is equal to

$$\Pi_{01} = \frac{1}{2}\sqrt{\frac{\varepsilon}{\mu}}|E_{01}|^2. \quad (15)$$

and the angle α_1 between the vector E_{01} and the x-axis is given by

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The coefficient of ...

$$\cos^2 \alpha_1 = \frac{|E_{01x}|^2}{|E_{01}|^2} = \sin^2 \alpha. \quad (16)$$

In Eqs. (2) - (6) the following notation is used: a and b - the wave guide dimensions, β_0 - the phase constant along its longitudinal axis z; the phase constant β_0 is related to the phase constants along axes x and y by the known relation of

$$\beta_0^2 = k^2 - \frac{m^2\pi^2}{a^2} - \frac{n^2\pi^2}{b^2}. \quad (7)$$

From Eqs. (1), (13), (15), (16) and

the required expression for the coefficient of coupling of a tube with a transverse field (interaction) can be determined, where $m\pi/a = k \cos \alpha$.

$$K_0 = \frac{k^2}{\frac{m^2\pi^2}{a^2}} \sin^2 \alpha = \frac{\omega\varepsilon |E_{01}|^2 \cos^2 \alpha_1}{2\frac{m\pi}{a}\Pi_{01} \cos \alpha}, \quad (17)$$

Expression (17) describes the physical picture of

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the tube action and to determine the analogy between a transverse field tube and a TWT. A similar method to the above could be used to determine the coupling coefficient of a wave guide model of an ordinary TWT as stated by the author (Ref. 3: Priblizhennyy raschet postoyannykh rasprostraneniya v liniyakh peredachi pri nalichii elektronnogo puchka, ZhTF, 1956, 26, 4, 809), which is then given by

$$K_{\text{о.лбв}} = \frac{k^2 - \beta_0^2}{\beta_\text{ц}^2} = \frac{\omega\varepsilon |E_{01}|^2 \cos^2 \gamma_1}{2\beta_0 \Pi_{01} \cos \gamma}. \quad (18)$$

Comparison of Eqs. (17) and (18) shows a similarity in the mechanism of interaction of the transverse field and of a TWT tube. The above result may also be considered as a generalization of the expression for K_c. There are 1 figure and 3 Soviet-bloc references.

SUBMITTED: October 17, 1960

29315
S/109/61/006/010/013/027
D266/D302

9.3130 (1140, 1141, 1538)

AUTHOR: Loshakov, L.N.

TITLE: A convenient form of the coupling coefficient characterizing the interaction of an electron beam with the space harmonics of a slow wave structure

PERIODICAL: Radiotekhnika i elektronika, v. 6, no. 10, 1961, 1685 - 1687

TEXT: The purpose of the present work is to revise the definition of coupling coefficient used by the author in two previous papers (Ref. 1: Radiotekhnika i elektronika, 1957, 2, no. 4, 461) and (Ref. 2: Radiotekhnika i elektronika, 1959, 4, no. 4, 688). In the first half of the paper the earlier formulation is reiterated. The propagation coefficient in the presence of the beam is expressed with the aid of the propagation coefficients of the space harmonics and of a correction term δ which can be determined from a characteristic equation. According to the previous definition the coupling coefficient of the n-th space harmonic is given by the follow-

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A convenient form of the ...

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ing expression;

$$K_{cn} = \pm \frac{\omega\varepsilon}{2\beta\ [redacted]\ P_o} \int_{s_o} /E_{onz}/^2\, ds \qquad (3)$$

where ω - angular frequency, ε - dielectric constant, [redacted]$_o$ - propagation [redacted]cient of the zeroth space harmonic, P_o - time average current, E_{onz} - amplitude of the electric field associated with the n-th space harmonic, s_o - cross-section of the electron beam. The ± sign applies for forward and backward harmonics respectively. It was pointed out by L.P. Lisovskiy that the coupling coefficient should be independent of the way, in which the space harmonics are numbered. In order to satisfy this condition the author replaces β_{oo} in Eq. (3) by $/\beta_{on}/$. Having redefined the coupling coefficient the author rewrites all the expressions by taking account of this modification. Finally the connection between the parameters intro-

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Convenient form of the ...

duced by the author and those of Pierce are shown (the relationship is a simple algebraic one). It is claimed that the author's parameters are more suitable for evaluating the relative merits of slow wave structures. There are 2 Soviet-bloc references.

SUBMITTED: March 24, 1961

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30433

S/109/61/006/012/008/020
D201/D305

9,4230 (1532)

AUTHOR: Loshakov, L.N.

TITLE: Applying the Lorentz's Lemma to the approximate evaluation of propagation constants in a transverse field TWT

PERIODICAL: Radiotekhnika i elektronika, v. 6, no. 12, 1961, 2012 - 2016

TEXT: In the present article the presence of space harmonics is neglected. To simplify the problem it is assumed that the transverse field TWT has a retarding system, in which the wave propagation is best described in the Cartesian system of coordinates, z axis coinciding with the direction of propagation of energy and the electron beam travelling along the transverse x axis. The basic relationship is obtained in the form of

$$\frac{\partial}{\partial x}\int_0^b ([\vec{E}_I\vec{H}^*_{II}]_x + [\vec{E}^*_{II}\vec{H}_I]_x)\,dy + \frac{\partial}{\partial z}\int_0^b ([\vec{E}_I\vec{H}^*_{II}]_z + [\vec{E}^*_{II}\vec{H}_I]_z)\,dy = -\int_{b_1}^{b_2} iE^*_{IIx}\,dy. \quad (3)$$

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Applying the Lorentz's Lemma ...

$\vec{E}_I$ and $\vec{H}_I$ are the electric and magnetic fields respectively in the system in the presence of the electron beam; $\vec{E}_{II}$ and $\vec{H}_{II}$ - fields in the same delay system with no electron beam present. The acting type of wave in the device is assumed to be the longitudinal - magnetic wave LM_{mn} at $H_x = 0$ and $m \neq 0$, $n \neq 0$. Applying the theory of an ordinary TWT the components of the sought electric field in the presence of an electron beam are given by

$$E_{Ix} = E_{2x} + j \frac{\Gamma}{\omega \varepsilon} i, \quad E_{Iy} = E_{2y}, \quad E_{Iz} = E_{2z}, \tag{4}$$

if $\vec{E}_2$ is circulating, where Γ - the dispersion coefficient. By isolating from the standing wave the incident wave in the direction of possible movement of electrons and denoting this wave by components $\vec{E}_{II}$, $\vec{H}_{II}$ producing thus an auxiliary field, it is shown that the presence of electric beam results in a distortion of this subsudiary field. This in turn produces the required field $\vec{E}_I$, $\vec{H}_I$. If the

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Applying the Lorentz's Lemma ...

electron beam has a small current density (disturbance is small) and $v \simeq -j\beta_0$, $\gamma \simeq -j\omega_0$

$$(v^2+\beta_0^2)[(v+jk_0)^2+\Gamma q]+(\gamma^2+w_0^2)(v+jk_0)^2 N+q\frac{\omega\varepsilon\beta_0}{2P'_{0x}}\int_{b_1}^{b_2}|E_{0x}|^2 dy=0. \quad (16)$$

is obtained, where N is given by

$$N=\frac{P'_{oz}}{P'_{ox}}\frac{\beta_o}{w_o}.$$

Eq. (16) is the required characteristic equation, relating the unknown propagation constants v and γ. The validity of Eq. (16) is tested by applying it to a waveguide model of a transverse field TWT, in which the beam does not affect dependence on y-coordinate (as assumed previous 1_v). If so $b_1 = 0$, $b_2 = b$ and

$$p'_{ox}=\frac{\omega\varepsilon\beta_o}{2(k^2-\beta_o^2)}\int_0^b /E_{ox}/^2\, dy;\ N=1,\ \Gamma=1 \quad (17)$$

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Applying the Lorentz's Lemma ...

and instead of Eq. (16)

$$(\nu^2 + \beta_0^2)\,[(\nu + jk_0)^2 + q] + (\gamma^2 + w_0^2)(\nu + jk_0)^2 + q\,(k^2 - \beta_0^2) = 0. \quad (18)$$

is obtained. Retaining the term $(\nu^2 + \beta_0^2)\Gamma q$ and introducing dimensionless variables by means of

$$\nu = -j\beta_0(1 + \delta), \qquad \gamma^2 = -w_0^2(1 + 2\Theta), \quad (19)$$

$$\eta = \frac{k_0}{\beta_0}, \qquad M = \frac{q}{\beta_0^2}, \qquad R = \frac{w_0^2}{\beta_0^2} \quad (20)$$

Eq. (16) becomes

$$\delta^4 + 2(2-\eta)\delta^3 + [4(1-\eta) + (1-\eta)^2 + 2NR\theta - \Gamma M]\,\delta^2 + 2\,[(1-\eta)^2 + (1-\eta)\,2NR\theta - \Gamma M]\,\delta + (1-\eta)^2\,2NR\theta + MK_0 = 0, \quad (21)$$

where

$$K_0 = \frac{\omega e}{2\beta_0 P'_{0x}} \int_{b_1}^{b_2} |E_{0x}|^2\,dy \quad (22)$$

in the coupling coefficient between the electron beam and the delay

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system. The value of Γ depends on dimensions of the electron beam and its coupling to the delay system. The value of N depends on the structure of the delay system. Both are difficult to determine and require further analysis.

$$\operatorname{Re}\gamma = w_0 \frac{\beta_0 a M K_c}{16NR} = \frac{\beta_0 a M \omega \varepsilon}{32P'_{0z}} \int_{b_1}^{b_2} |E_{0x}|^2 dy. \quad (23)$$

follows which does not contain P'_{ox}. If P'_{ox} and P'_{oz} are considered as time average powers per unit length and width of the system respectively, then it is said that the results obtained above may be applied to cases when the periodicity of the delay system is so taken into account. There are 1 figure and 6 Soviet-bloc references.

SUBMITTED: May 4, 1961

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S/108/61/016/002/005/011
B107/B212

AUTHOR: Loshakov, L. N., Member of the Society of Radio Engineering and Electric Communication

TITLE: Approximate calculation of the depression coefficient for tubular electron beams

PERIODICAL: Radiotekhnika, v. 16, no. 2, 1961, 30-33

TEXT: 1. Starting relations. Natural waves of E mode in homogeneous tubular electron beams which are in free space are taken into consideration. It is assumed that the electrons are moving only along the z-axis. The study is limited to small oscillations (angular frequency ω), furthermore it is assumed that the beam is located between cylindric surfaces with radii $r=a_1$ and $r = a_2$ ($a_1 < a_2$). The following holds for the investigated dependence of the field from the time t, the coordinate z and the angle φ: $E, H \sim \exp(i\omega t + \gamma z + im\varphi)$ (1). The longitudinal component of the electric field E_z, the wave equation

$$\frac{\partial^2 E_z}{\partial r^2} + \frac{1}{r}\frac{\partial E_z}{\partial r} + \left(\Omega^2 - \frac{m^2}{r^2}\right) E_z = 0. \quad (2)$$

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have been derived from Maxwell's equations and electronic equations. The radial constant Ω of Eq. (2) and the propagation constant γ are connected by

$$\Omega^2 = (\gamma^2 + k^2)\left[1 + \frac{q}{(\gamma + i k_0)^2}\right], \quad (3)$$

where $k = \omega\sqrt{\varepsilon\mu}$ is the phase constant of the medium having the parameters ε and μ; $k_o = \frac{\omega}{u_o}$; u_o is the constant component of the electron velocity $q = \frac{ei_o}{m\varepsilon u_o^3}$ is the square of the plasma wave number of an unlimited wide beam; e is the charge and m the mass of an electron, i_o is the constant component of the current density of the beam. Practical units are used. In the inner $(0 < r < a_1)$ and outer $(r > a_2)$ zones which are free of charge the wave equation for the longitudinal electric field component for slow waves has the following form:

$$\frac{\partial^2 E_z}{\partial r^2} + \frac{1}{r}\frac{\partial E_z}{\partial r} - \left(p^2 + \frac{m^2}{r^2}\right)E_z = 0, \quad (4)$$

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where $p^2 = -\Gamma^2 - k^2$ (5). In order to find the dispersion equation (6), Eqs. (2) and (4) are solved. With the expressions found from (2) and (6), the transverse fields are determined by applying Maxwell's equations and the continuity conditions for the tangential components of the fields at the outer and inner boundary of the beam

$$\frac{p\frac{I_m'(a_1p)}{I_m(a_1p)}J_m(a_1\Omega)-\Omega J_m'(a_1\Omega)}{p\frac{K_m'(a_2p)}{K_m(a_2p)}J_m(a_2\Omega)-\Omega J_m'(a_2\Omega)} = \frac{p\frac{I_m'(a_1p)}{I_m(a_1p)}N_m(a_1\Omega)-\Omega N_m'(a_1\Omega)}{p\frac{K_m'(a_2p)}{K_m(a_2p)}N_m(a_2\Omega)-\Omega N_m'(a_2\Omega)}, \quad (6)$$

where J_m, N_m are Bessel functions, I_m, K_m are the modified Bessel functions, their arguments are given in brackets, the derivations of these functions with respect to the arguments are denoted by primes. Slow waves with large delays are also investigated and, here, the electron beam is assumed to be sufficiently weak. Therefore, $|\gamma| \gg k$, $\gamma \approx -ik_o$ and also $p \approx k_o$ (7). Under these conditions the system of equations (3), (5), and (6) which determines the propagation constant γ can be solved approximately. p is assumed to be known ($p = k_o$); Ω_s is obtained from Eq. (6) (to each value of p there is a discrete set of values for Ω), if this value is substituted into Eq. (3) the following approximate expression is obtained by considering also Eq. (5)

$$\gamma = -i\kappa_0 \pm i\sqrt{\Gamma q}, \quad (8),$$

where, the wanted depression coefficient Γ has been introduced:

$$\Gamma = \frac{1}{1 + \frac{\Omega_s^2}{p^2}}, \quad (9),$$

it characterizes the attenuation effect of the space charge. (The depression coefficient is equal to the square of the "attenuation coefficient of the plasma frequency", and this has been used in a number of papers

(W. Kleen and K. Pöschl. Einführung in die Mikrowellen-Elektronik, B. II, Lauffeldröhren, Stuttgart 1958)). Furthermore, results of the evaluation of Γ are given for various concrete cases. 2. results of numerical computations. It is of greatest interest to find the depression coefficient for low mode space charge waves (the lowest mode is given by the first root of Ω for Eq. (6) at a given p and for m = 0, ±1). If m = 0 (axial symmetrical waves) the dispersion equation is found to be

$$A_1 B_1 [J_0(nx) N_1(x) - J_0(x) N_0(nx)] + A_0 x [J_1(x) N_0(nx) - J_0(nx) N_1(x)] + B_0 x [J_1(nx) N_0(x) - J_0(x) N_1(nx)] = x^2 [J_1(nx) N_1(x) - J_1(x) N_1(nx)], \quad (10)$$

where

$$A_0 = y \frac{I_1(ny)}{I_0(ny)}, \quad B_0 = y \frac{K_1(y)}{K_0(y)}, \quad (11)$$

and

$$n = \frac{a_1}{a_2}; \; x = a_2 \Omega; \; y = a_2 p. \quad (12)$$

For asymmetric waves with index m = ±1 the dispersion equation (6) yields the following expression

$$A_1 B_1 [J_1(nx) N_1(x) - J_1(x) N_1(nx)] + A_1 x [J_1(nx) N_0(x) - J_0(x) N_1(nx)] + B_1 x [J_1(x) N_0(nx) - J_0(nx) N_1(x)] = x^2 [J_0(nx) N_0(x) - J_0(x) N_0(nx)], \quad (13)$$

where $$A_1 = y\frac{I_0(ny)}{I_1(ny)}, \quad B_1 = y\frac{K_0(y)}{K_1(y)}, \qquad (14).$$

Table 1 gives the numerical results for the lowest roots of Eq. (10) (for space charge wave pairs of the lowest mode). Fig. 1 shows the dependence of the depression coefficient Γ on a_2k_0 at various values of n and m = 0. These data have been obtained from Eq. (9) and information given in Table 1. The curve numbers 1, 2, 3, 4, 5 correspond to values of n = 0.1, 0.2, 0.5, 0.7, and 0.9. Table 2 represents the evaluation (lowest roots) of Eq. (13) for asymmetric waves with m = ±1; Fig. 2 represents the corresponding functions Γ of a_2k_0. Comparing Figs. 1 and 2 shows that under otherwise equal conditions the depression coefficient for axisymmetric waves is larger than that for asymmetric waves with m = ±1. For all cases investigated the depression coefficient decreases with decreasing width of the beam and it increases with increasing frequency and increasing outer diameter of the beam. If the electron velocity decreases, Γ will increase. For thick tubular beams (n = 0.1) the coefficient Γ differs slightly for axisymmetric waves from that of

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compact beams with the same outer radius (L. N. Loshakov, "Radiotekhnika i elektronika", 1959, Vol. 4, No. 4). [Abstracter's note: This is a full translation of the original]. There are 2 figures, 2 tables, and 2 references: 1 Soviet-bloc.

SUBMITTED: September 25, 1958

Fig. 1

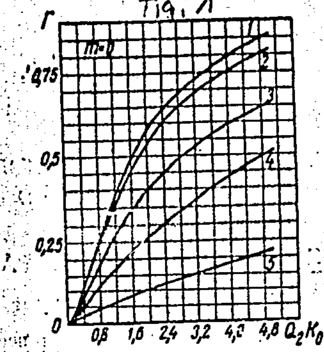
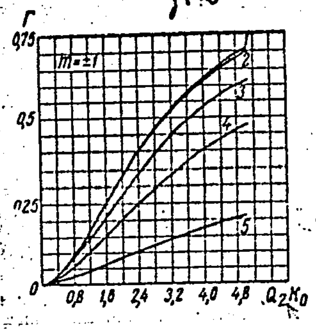


Fig. 2



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9,4230 (1532)

AUTHOR: Loshakov, L.N., Member of the Society

TITLE: The design of two coupled parallel helices

PERIODICAL: Radiotekhnika, v. 16, no. 10, 1961, 20 - 25

TEXT: In the present article, the author gives the results of a simplified treatment of slow wave propagation in the two parallel helices when the distance between them is great compared with their diameters. To obtain the equations for the propagation constants a system of two parallel helices is considered as shown in Fig. 1. Assuming $d \gg a_1, a_2$, the fields induced by the other helix is taken as uniform within the given helix cross-section and the axial assymmetry due to helix currents is neglected. From the known theory of a single helix, for the system in Fig. 1 the following are the approximate equations for the electric (E) and magnetic (H) fields of the slow waves: inside helix 1

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$$\left.\begin{aligned} E_{1z} &= A_1 I_0(r_1 \tau)e^{=i\beta z}; & H_{1z} &= C_1 I_0(r_1 \tau)e^{-i\beta z} \\ E_{1r_1} &= \frac{i\beta}{\tau^2}\frac{\partial E_{1z}}{\partial r_1}; & H_{1r_1} &= \frac{i\beta}{\tau^2}\frac{\partial H_{1z}}{\partial r_1} \\ H_{1\varphi_1} &= \frac{i\omega\varepsilon}{\tau^2}\frac{\partial E_{1z}}{\partial r_1}; & E_{1\varphi_1} &= -\frac{i\omega\mu}{\tau^2}\frac{\partial H_{1z}}{\partial r_1} \end{aligned}\right\}; \quad (1)$$

inside helix 2

$$\left.\begin{aligned} E_{2z} &= A_2 I_0(r_2 \tau)e^{-i\beta z}; & H_{2z} &= C_2 I_0(r_2 \tau)e^{-i\beta z} \\ E_{2r_2} &= \frac{i\beta}{\tau^2}\frac{\partial E_{2z}}{\partial r_2}; & H_{2r_2} &= \frac{i\beta}{\tau^2}\frac{\partial H_{2z}}{\partial r_2} \end{aligned}\right\}; \quad (2)$$

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$$H_{2\varphi_2} = \frac{i\omega\varepsilon}{\tau^2}\frac{\partial E_{2z}}{\partial r_2}; \qquad E_{2\varphi_2} = -\frac{i\omega\mu}{\tau^2}\frac{\partial H_{2z}}{\partial r_2} \qquad (2)$$

and in the region between them

$$\left.\begin{aligned}
E_{3z} &= E'_{3z} + E''_{3z} = [B'_3 K_o(r_1\tau) + B''_3 K_o(r_2\tau)]e^{-i\beta z} \\
E_{3r_1} &= \frac{i\beta}{\tau^2}\frac{\partial E'_{3z}}{\partial r_1}; \qquad E_{3r_2} = \frac{i\beta}{\tau^2}\frac{\partial E''_{3z}}{\partial r_2} \\
H_{3\varphi_1} &= \frac{i\omega\varepsilon}{\tau^2}\frac{\partial E'_{3z}}{\partial r_1}; \qquad H_{3\varphi_2} = \frac{i\omega\varepsilon}{\tau^2}\frac{\partial E''_{3z}}{\partial r_2} \\
H_{3z} &= H'_{3z} + H''_{3z} = [D'_3 K_o(r_1\tau) + D''_3 K_o(r_2\tau)]e^{-i\beta z}
\end{aligned}\right\} \qquad (3)$$

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$$H_{3r_1} = \frac{i\beta}{\tau^2}\frac{\partial H'_{3z}}{\partial r_1}; \quad H_{3r_2} = \frac{i\beta}{\tau^2}\frac{\partial H''_{3z}}{\partial r_2}$$
$$E_{3\varphi_1} = -\frac{i\omega\mu}{\tau^2}\frac{\partial H'_{3z}}{\partial r_1}; \quad E_{3\varphi_2} = -\frac{i\omega\mu}{\tau^2}\frac{\partial H''_{3z}}{\partial r_2} \qquad (3)$$

In Eq. (1)-(3) the time factor $e^{j\omega t}$ is omitted and the following notation used: u - parameters of the medium, β - phase constant along the longitudinal Z-axis of the system

$$\tau = \sqrt{\beta^2 - K^2} = \omega^2 \varepsilon \mu;$$

I_0, I_1, K_0 and K_1 - modified Bessel functions of arguments in parantheses. The fields must satisfy the known boundary conditions at helix 1 and 2

$$E_{1,2z} = E_{3z}; \; E_{1,2\varphi} = E_{3\varphi} \qquad (4)$$

$$\left.\begin{aligned} E_{1.2\varphi} \sin \Phi_{1.2} + E_{1.2z} \cos \Phi_{1.2} = 0 \\ H_{1.2z} \cos \Phi_{1.2} + H_{1.2\varphi} \sin \Phi_{1.2} = H_{3\varphi} \sin \Phi_{1.2} + H_{3z} \cos \Phi_{1.2} \end{aligned}\right\} \quad (4)$$

where Φ_1 and Φ_2 - angles between the turns and z-axis for helix 1 and 2 respectively. For the assumptions made above, the boundary conditions (4) become for surface $r_1 = a_1$

$$A_1 I_0(a_1\tau) = B_3' K_0(a_1\tau) + B_3'' K_0(d\tau), \quad (5)$$

$$-C_1 I_1(a_1\tau) = D_3' K_1(a_1\tau), \quad (6)$$

$$-\frac{i\omega\mu}{\tau} C_1 I_1(a_1\tau) \sin\Phi_1 + A_1 I_0(a_1\tau)\cos\Phi_1 = 0, \quad (7)$$

$$\frac{i\omega\varepsilon}{\tau} A_1 I_1(a_1\tau)\sin\Phi_1 + C_1 I_0(a_1\tau)\cos\Phi_1 =$$

$$= -\frac{i\omega\varepsilon}{\tau} B_3' K_1(a_1\tau)\sin\Phi_1 + [D_3' K_0(a_1\tau) + D_3'' K_0(d\tau)]\cos\Phi_1; \quad (8)$$

and for the surface $r_2 = a_2$

$$A_2 I_0(a_2\tau) = B_3' K_0(d\tau) + B_3'' K_0(a_2\tau), \tag{9}$$

$$-C_2 I_1(a_2\tau) = D_3'' K_1(a_2\tau), \tag{10}$$

$$-\frac{i\omega\mu}{\tau} C_2 I_1(a_2\tau)\sin\Phi_2 + A_2 I_0(a_2\tau)\cos\Phi_2 = 0, \tag{11}$$

$$\frac{i\omega\varepsilon}{\tau} A_2 I_1(a_2\tau)\sin\Phi_2 + C_2 I_0(a_2\tau)\cos\Phi_2 = -\frac{i\omega\varepsilon}{\tau} B_3'' K_1(a_2\tau)\sin\Phi_2 + [D_3' K_0(d\tau) + D_3'' K_0(a_2\tau)]\cos\Phi_2. \tag{12}$$

in which the influence of transverse fields of distant helix has been neglected. The dispersion equation for the phase constant β is given then, reducing to

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$$\left[\frac{\kappa^2}{\tau^2}\frac{I_1(a_1\tau)K_1(a_1\tau)}{I_0(a_1\tau)K_0(a_1\tau)}\mathrm{tg}^2\Phi_1-1\right]\left[\frac{\kappa^2}{\tau^2}\frac{I_1(a_2\tau)K_1(a_2\tau)}{I_0(a_2\tau)K_0(a_2\tau)}\mathrm{tg}^2\Phi_2-1\right]=$$
$$= a_1\tau I_1(a_1\tau)\,a_2\tau I_1(a_2\tau)K_0^2(d\tau)\left[1+\frac{\kappa^2}{\tau^2}\frac{K_1(a_1\tau)K_1(a_2\tau)}{K_0(a_1\tau)K_0(a_2\tau)}\mathrm{tg}\,\Phi_1\,\mathrm{tg}\,\Phi_2\right]^2. \qquad (18)$$

The RHS of Eq. (18) represents the coupling and it may be seen that it is maximum with the helices wound in the same direction ($\tan\Phi_1$, $\tan\Phi_2 > 0$). For identical helices ($a_1 = a_2 = a$; $\Phi_1 = \Phi_2 = \Phi$) the dispersion Eq. (18) can be simplified and becomes

$$\frac{\kappa^2}{\tau^2}\frac{I_1(a\tau)K_1(a\tau)}{I_0(a\tau)K_0(a\tau)}\mathrm{tg}^2\Phi-1= \pm a\tau I_1(a\tau)K_0(d\tau)\left[1+\frac{\kappa^2}{\tau^2}\frac{K_1^2(a\tau)}{K_0^2(a\tau)}\mathrm{tg}^2\Phi\right]. \qquad (19)$$

Applying the perturbation method and putting

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$$\beta = \beta_0 + x, |x| \ll \beta_0, \tau^2 = \beta^2 - \kappa^2 = \tau_c^2 + 2\beta_0 x, \tau = \tau_0 + \frac{\beta_0}{\tau_0} x, \tag{20}$$

denoting the LHS of Eq. (19) by $G(\tau)$

$$G(\tau) = G(\tau_0) + \frac{\beta_0}{\tau_0} x \frac{dG}{d\tau}\bigg|_{\tau=\tau_c} = \frac{\beta_0}{\tau_0} x \frac{dG}{d\tau}\bigg|_{\tau=\tau_0}. \tag{21}$$

is obtained and hence, putting $\tau = \tau_0$

$$x = \mp \frac{\tau_0^2}{\beta_0} \frac{I_1(a\tau_0)}{F_1(\tau_0)} K_0(d\tau_0)\left[1 + \frac{\kappa^2}{\tau_0^2} \frac{K_1^2(a\tau_0)}{K_0^2(a\tau_0)} \mathrm{tg}^2\Phi\right], \tag{22}$$

in which $F_1(\tau_0)$ - a function used in the theory of travelling wave tubes and related to G by

$$\frac{dG}{d\tau}\bigg|_{\tau=\tau_0} = -aF_1(\tau_0). \tag{23}$$

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The approximate values of phase constants of the two possible waves in the system propagating in one direction are determined from (20) and (22) and the results calculating the dependence of a τ on ak tan Φ for different values of d/a are given in the Table. It is stated in conclusion that the results of experimental study of dispersion of the two variants of a four-helix line, as given in Ref. 1 (Op.cit.) seem to indicate a strong coupling between identical helices, which has been proved in the present article. There are 1 figure, 1 table and 6 references: 4 Soviet-bloc and 2 non-Soviet-bloc. The reference to the English-language publication reads as follows: J.L. Putz, G.C. Van Hoven, Wescon conv. record, v. I, VIII, p. 3, 138, 1957.

ASSOCIATION: Nauchno-tekhnicheskoye obshchestvo radiotekhniki i electrosvyazi im. A.S. Popova (Scientific and Technical Society of Radio Engineering and Electrical Communication im. A.S. Popov [Abstractor's note: Name of Association taken from first page of journal]

SUBMITTED: September 20, 1960

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LOSHAKOV, L.N.

Suitable expression of a coupling coefficient for the interaction of an electron flow with the space harmonics of a delay system. Radiotekh. i elektron. 6 no.10:1685-1687 O '61. (MIRA 14:9)
(Traveling-wave tubes) (Delay networks)

LOSHAKOV, L.N.

Application of Lorenz' lemma for the approximate calculation of propagation constants in an electronic tube-type device with transverse interaction. Radiotekh. i elektron. 6 no.12:2012-2016 D '61. (MIRA 14:11)

(Microwaves) (Traveling-wave tubes)