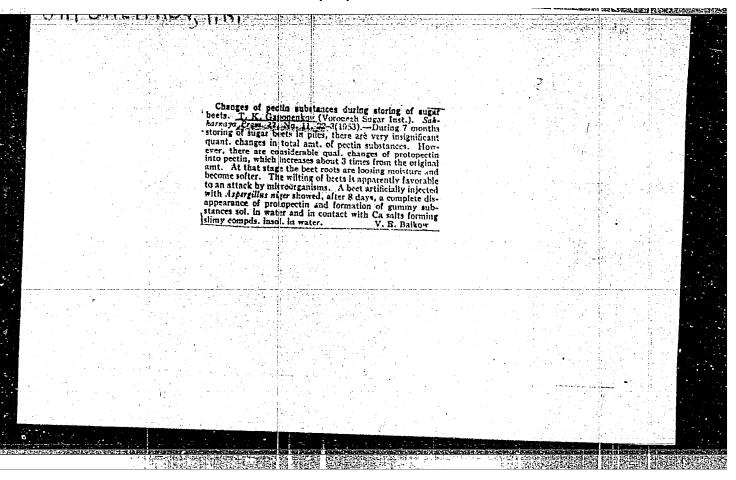


Obituary on Prof. I.D. Buromskiy.

Microbiologiya. Vol. 22. No. 3, P. 359, 1953.



USSR/Biology

FD 299

Card 1/1

Author

: Gaponenkov, T. K.

Title

The splitting of the pectin substances of plants by microorganic enzymes

Periodical

: Mikrobiologiya, 23, 317-321, May/Jun 1954

Abstract

: In order to determine the conditions favorable to the splitting of water soluble pectin and pectose found in the pulp of the roots of sugar beets and the composition of the pectose, experiments were carried out with the pectin-decomposing enzymes formed by a culture of Aspergillus niger. Pectose was found to be a heterogenous complex substance, the fermentative splitting of which was not consistent. The ash elements which entered into the composition of the pulp increased the stability of the pectose and caused it to split more slowly. It was concluded that the decomposition of pectose by the action of microorganic enzymes into galacturonic acid is a complicated process which depends on the composition of the pectose. Three tables, three graphs. Eight Soviet references.

Institution : The Voronezh Agricultural Institute

Submitted

: April 29, 1953

"APPROVED FOR RELEASE: 07/19/2001 CIA-RDP86-00513R000514310010-6 THE PROPERTY OF THE PROPERTY O

CTILL CINE MACY T. K.

USSR/Physiology of Plants. Respiration and Metabolism I-1

: Ref Zhur-Biologiya, No 2, 1958, 5605 Author

T. K. Gaponenkov Inst

Voronezh Agricultural Institute Title

On the Distribution of Pectin Substances in the

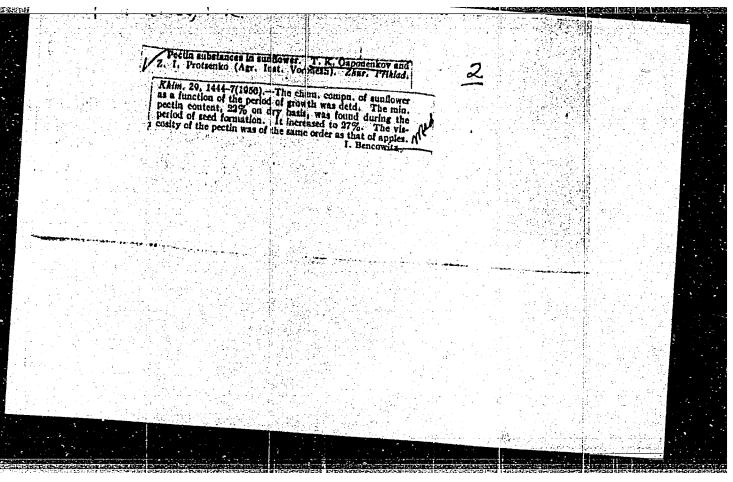
Orig Pub Sakharnaya svekla, 1956, No 10, 36-37

Abstract The largest quantity of pectin substances was

found in the head and the little tail of the root of sugar beet; the smallest quantity was found in outer cover layer of the root itself. Sacchariferous varieties contained less pectin substances than normal and harvested varieties. During the sugar accummulation period the transformation of pectin into protopectin was noted. The work was carried out at the Voronezh Agri-

cultural Institute.

Card 1/1



USSN/General Filely, Genetics. The Genetics of Plants.

1-5

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The Jour: Ref Zhur-Diol., No 20, 1958, 90434.

inther : Gaponentey, T.K., Percyslaye, J.M. Mast

: All-Union Leadery of Carlcultural Sciences in. V.I. Lonin.

Title : The Influence of Vegetative and Semual Spiridization

of Survey Duran Uncol on the Chemical Composition of the

Grain.

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Orig Pub: Poid. VISIDHIL, 19기, ID 9, 15-18.

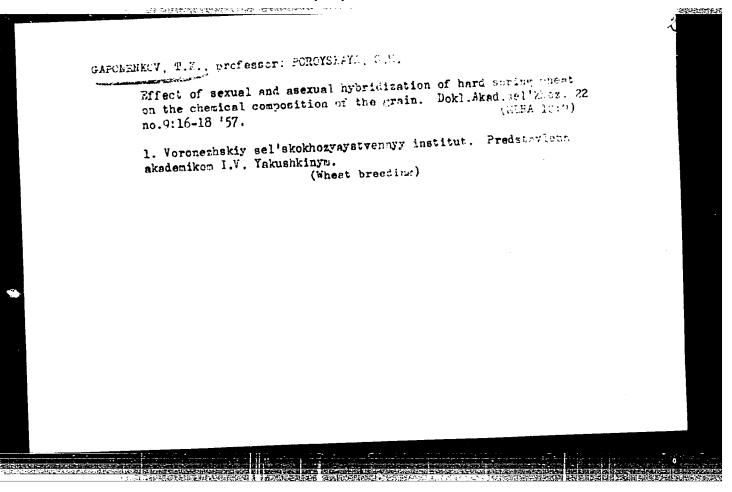
Abstract: A bischemical and physiological evaluation of sexual

and vegetative wheat species crosses of Melyanopus 69 with Persian wheat. The authors conclude that vegetative hybridization is an effective method of obtaining a very productive and high-quality surrer during wheat. A statistical treatment of the data is lacking. -- T.K. Lepin.

Card : 1/1

35

GAPONENKOV, T.K. Biosynthesis of pectic substances in plants [with summary in English]. Biokhimiia 22 no.3:565-567 My-Je '57. (MIRA 10:11) 1. Voronezhskiy sel'skokhozyaystvennyy institut. (PECTIC SUBSTANCES) (SUGAR BEETS)



GAPONENKOV, T.K.; PHOTSERKO, Z.I.

Pectins of sunflower heads. Izv. vys. ucheb. zav.; pishch. tekh.
no.1:43-47 *58. (MIRA 11:8)

1. Voroneshskiy sel*akokhozyaystvennyy institut, Laboratoriya organicheskoy khimii. (Feotin) (Sunflowers)

GAPONENKOV, T.K.; MUKHORTOV, Ya.N.; STANISLAVSKAYA, T.K.

Sifect of annual plants on the accumulation of organic matters and soil structure. Zemelodelie 6 no.1:23-26 Ja '58. (MIRA 11:1)

1. Voronezhskiy sel'skokhozyaystvennyy institut. (Soil physics) (Sudan grass)

GAPONENKOV. T.K.: PROTSENKO, Z.I.

Properties of the funflower pectin depending on the method of its extraction. Zhur. prikl. khim. 31 no.2:319-321 F '58. (MIRA 11:5)

1. Iaboratoriya organicheskoy khimii Voronezhskogo sel'skokhozyaystvennogo instituta. (Sunflowers) (Pectins)

PROTSENEO, Z.I.; GAPONEGKOV, T.K.

Gelation of pectin of sunflower heads. Izv.vys.uchob.zav.;
pishch.tekh. no.3:146-149 '59. (MIRA 12:12)

1. Voronezhskiy sel'skokhozyaystvennyy institut. Luboratoriya organicheskoy khimii.

(Pectins) (Sunflowers)

AUTHORS: Gaponenkov, T.K., Abros'kina, S.A. SOV/80-32-2-54/56

TITLE: Investigations of the Albumens of Winter Rye (Issledovaniya

belkov ozimoy rzhi)

PERIODICAL: Zhurnal prikladnoy khimii, 1959, Vol XXXII, Nr 2,

pp 465-467 (USSR)

ABSTRACT: Winter rye of the new type "Voronezhskaya SKhI" was tested on

the experimental field station of the Voronezh Agricultural Institute. The data of the Tables 1 and 2 show that the content of the different albumen fractions is higher than in the rye type "Lisitsyna". Considering its productivity and quality

it can be recommended for the Central Chernozem Zone of the

USSR.

There are 2 tables and 4 Soviet references.

ASSOCIATION: Voronezhskiy sel'skokhozyaystvennyy institut (Voronezh Agri-

cultural Institute)

SUBMITTED: January 20, 1958

Card 1/1

GAPONENKOV, T.K.: STANISIAVSKAYA, T.K.: IVANOVA, Z.A.

Preparation of araban from sugar-beet pulp with the use of ionites. Zhur.prikl.khim. 33 no.2:494-496 7 '60.

(MIRA 13:5)

1. Laboratoriya organicheskoy khimii Voronezhskogo sel'skokhozyaystvennogo instituta.

(Araban) (Ion exchange)

COAPOHRIKOV, T.K.; FROTSRIKO, Z.I.

Iffect of organic acids on the strength of pectin-sugar jellies. Izv.
vys.ucheb.zav.;pishch.tekh. no.4:26-20 '60. (MIRA 13:11)

1. Voroneshskiy uel'skokhyaystvennyy institut. Kafedra organicheskoy
khimii. (Petin) (Acids, Organic)

GAPONENKOV, T.K.; PROTSENKO, Z.I.

Splitting of pectins by enzymes by micro-prganisms and the chemical nature of the end products. Mikrobiologila 29 no,5:668-672 S-0 '60. (MIRA 13:11)

1. Voronezhskiy sel'skokhozyaystvennyy institut. (ASPERGILLUS NIGER) (PECTIN)

GAPONENKOV, T.K.; PROTSENKO, Z.I.

Extraction of galacturonic acid from pectin with the use of ion exchangers. Zhur.prikl.khim. 34 no.3:709-711 Mr '61.

(MIRA 14:5)

1. Laboratoriya organicheskoy khimii Voronezhskogo sel'skokhozyaystvennogo instituta.

(Glacaturonic acid) (Pectin)

"APPROVED FOR RELEASE: 07/19/2001

CIA-RDP86-00513R000514310010-6

GAPONENKOV, T.K.; PROTSENKO, Z.I.

Effect of metallic cations on the jellying power of sunflower pectin.
Izv. vys. ucheb. zav.; pishch. tekh. no.5:35-39 '61. (MIRA 15:1)

1. Voronezhskiy sel'skokhozyaystvennyy institut. Kafedra organicheskoy khimii. (Pectin) (Cations)

GAPONENKOV, T.K.

Golorimetric method of determining galacturonic acid content of pectin. Izv.vys.ucheb.zav.; pishch.tekh. no.4:160-163 (MRA 15:11) '62.

1. Voronezhskiy sel'skokhozyaystvennyy institut, kafedra organicheskoy khimii.

(Pectin) (Galacturonic acid) (Colorimetry)

GAPONENKOV, T. K.; PROTSENKO, Z. I.

Reaction of galacturonic and pectic acids with aluminum salts.

Izv. vys. ucheb. zav.; pishch. tekh. no.5:43-46 '62.

(MIRA 15:10)

1. Voronezhskiy sel'skekhozyaystvennyy institut, kafedra organicheskoy khimii.

(Aluminum salts) (Gelacturonic acids)

(Fectic acids)

GAPONENKOV, T.K.; FROTSENKO, Z.I.

Pectic substances and their role in plants. Bot. zhur.

47 no.10:1488-1493 0'62. (MIRA 15:12)

1. Voronezhskiy sel'skokhozyaystvennyy institut.

(Pectic substances)

GAPONENKOV, T.K., prof.; PROTSENKO, Z.I.

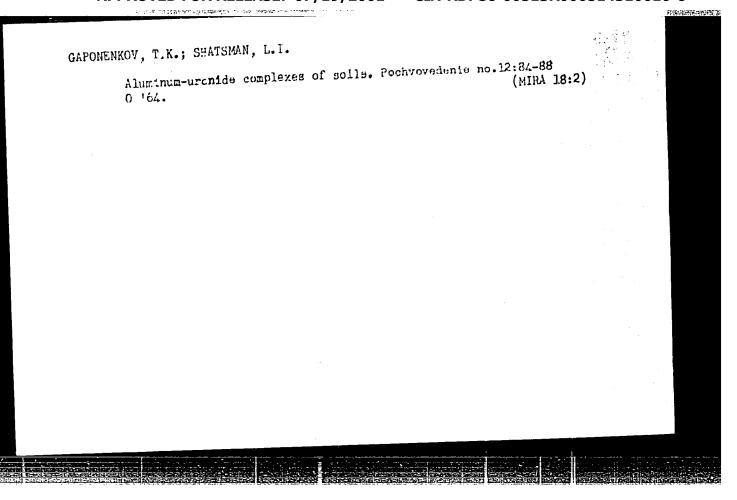
Pectin. Priroda 52 no.2:100-101 '63. (MIRA 16:2)

1. Voronezhskiy sel'skokhozyaystvennyy institut. (Pectin)

GAPONENKOV, T.K.; SHATSMAN, L.I.

Determination of uronic acids by a colorimetric method. Zhur.
prikl. khim. 37 no.2:462-464 F '64. (MIRA 17:9)

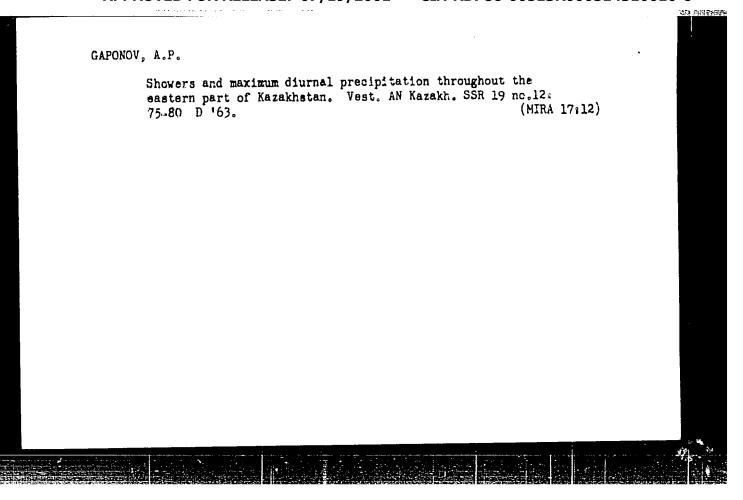
1. Voronezhskiy sel'skokhozyaystvennyy institut.



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GAFONOW, P.

I.I. Proknorry's 7-day glownography. Vest. N Kowske, SuR.
19 no.6185-86 do 463. (MIRA 17:7)
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AND THE PROPERTY OF THE PROPER GALCHEV, A. V. USSR/Electricity - Machines, Electric 11 Feb 52 Models "A Dynamic Model of a Commutator Machine," A. V. Gaponov, Physicotech Inst, Gor'kiy State U "Dok Ak Nauk SSSR" Vol 82, No 5, pp 719-723 Gaponov proposes a dynamic model of a commutator machine which "accurately shows its typical elec and mech properties." He says the linear model considered disregards all effects connected with satn. Submitted by Acad A. A. Andronov 21 Nov 51. 23019

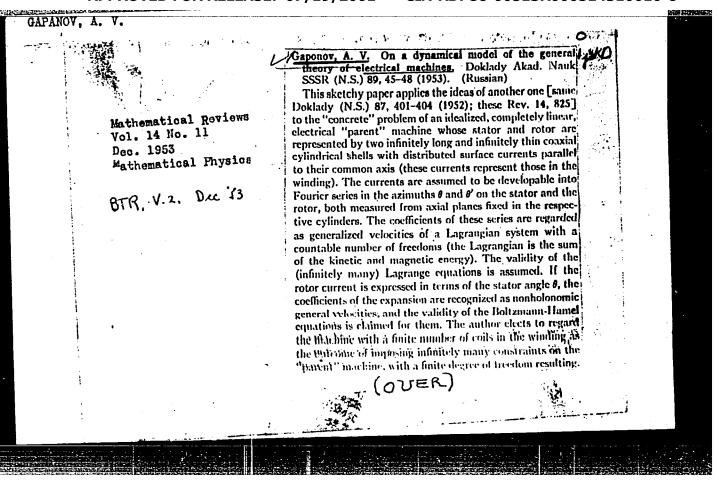
GAPONOV, A.V.

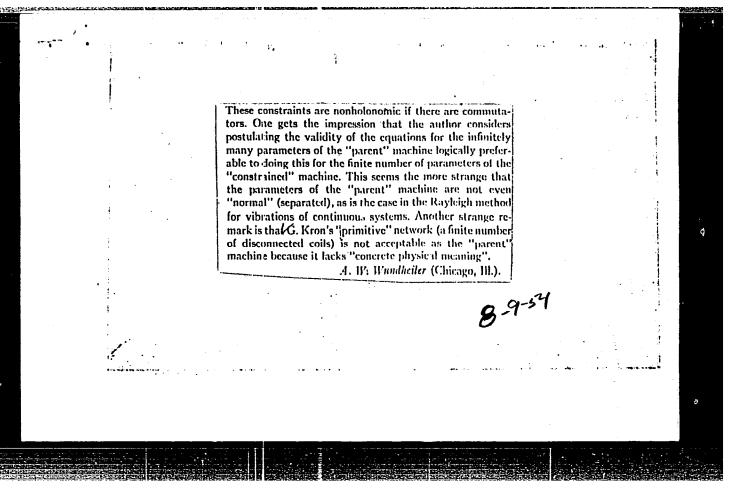
Gaponov, A. V. Nonholonomic systems of S. A. Čaplygin and the theory of commutator electrical machinery.

Doklady Akad. Nauk SSSR (N.S.) 87, 401-404 (1952). (Russian)

The paper considers electric networks made up of threedimensional conductors [without capacitance?] in which the current distribution is known (making for a finite number of independent current parameters) and which have a finite number of mechanical freedoms. Without proofs and explanation of notations, the author claims that the equations of motion and current distribution assume the Lagrangian form, with Caplygin-type corrective terms if commutators are present (in this case the electric constraints are non-holonomic). The specialization of these equations for an electric generator is indicated. A. W. Wundheiler. 3016765

SO: PATHERATICAL REVIEW (Unclassified)
Vol XIV No 8, Soptember 1953, pp 713-830





GAPONOV, A. V. USSR/Technical Physics - Theory of UHF Radio

Card 1/1

Authors

: Gaponov, A. V. and Levin, M. L.

Title

: Regarding the theory of thin antennas of endo-oscillators.

Periodical

: Dokl. AN SSSR 95, 6, 1193 - 1196, 21 Apr 1954

Abstract

: A solution of the problem of excitation of thin antennas of an endo-oscillator is given.

Institution

1

Submitted

: 15 Feb 1954

★ Gapon Coulact Pamya Increase 196-21 36-40 re	A. Y. Electromechanical systems with sliding I-FW and the dynamical theory of electrical machines. Aleksandra Aleksandrovica Andronova IIn of Afeksandr Aleksandrovic Andsonov), pp. Izdat. Akad. Nauk SSSR, Moscow, 1955.

GAPONOV-GREKHOV, Andrey Viktorovich.

for kiy Polytechnic Inst imeni Zhdanov. Academic degree of Doctor of Physical and Mathematical Sciences, based on his defense, 22 March 1955, in the Council of Leningrad Polytechnic Inst imeni Kalinin, of his dissertation entitled: "Dynamic models of Electric Machines presented in competing for the academic degree of Candidate of Sciences and for the academic title of Docent for the chair: "Radiotechnics."

Academic degree: Doctor of Sciences

Academic title: Docent

SO: Decisions of VAK, List no. 15, 25 June 55, Eyulleten' MVO SSSR, No. 15, Aug 56, Moscow, pp. 5-24, Uncl. JPRS/NY-537

USSR/Physics - Antennas

FD-3114

Card 1/1

Pub. 153 - 13/24

Author

: Gaponov, A. V.

Title

THE RESERVE THE PARTY OF THE PA Theory of thin antennas in field resonators

Periodical

Zhur. tekh. fiz., 25, No 6 (June), 1955, 1069-1084

Abstract

: The author considers the free oscillations of a field resonator within which are situated thin metal antennas and in the walls of which are cut thin slits. He obtains formulas for the natural frequencies and the eigenfunctions of such a system, and also for the decrement of damping and goodness of the resonator. He uses the obtained results for solving the problem of the excitation of a field resonator by thin antennas. Twelve references: e.g. G. V. Kisun'ko, Elektrodinamika polykh sistem VKAS, 1949; A. A. Samarskiy, DAN SSSR, 63, 661, 1948; M. L. Levin and A. V. Gaponov, DAN SSSR, 95, 1193, 1954; A. I. Akhiyezer and G. Ya. Lyubarskiy, ZhTF, 24, 1697, 1954; V. B. Shteynshleger, DAN SSSR, 65, No 5, 1949; Ya. N. Fel'd, "Principles of theory of slit

antennas," Sov. radio, 1948.

Institution

Submitted : November 11, 1954

FD-3115

USSR/Physics - Antonnas

Card 1/1

Pub. 153 - 14/24

Author

: Caponov, A. V.

Title

: Excitation of field resonator by thin antennas

Periodical

: Zhur. tekh. £1z., 25, No 6 (June), 1955, 1085-1099

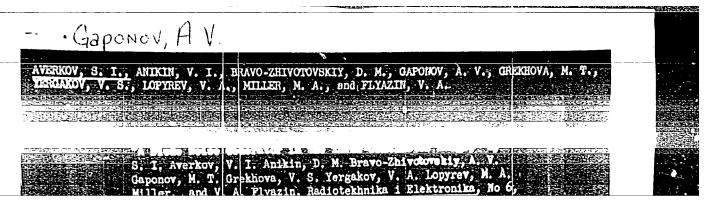
Abstract

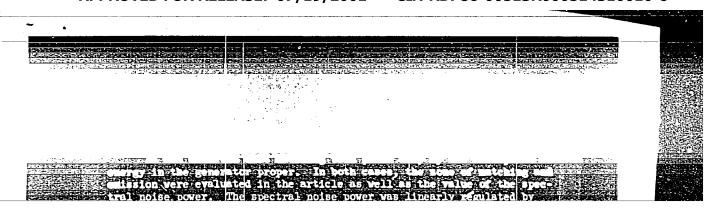
: The author solves the problem of the excitation of a thin resonator by thin antennas in the case where the current distribution in the antennas is not given. In the solution he utilizes the principal integro-differential equations of the theory of thin antennas. He claims that the most important problem in the theory of antennas is the finding of the currents established in antennas under the action of given lateral currents and fields. The author thanks M. L. Levin and M. A. Miller for discussions of problems. Five references: e.g. M. A. Miller, V. N. Pobedonostsev, I. F. Belov, Uch. zap. GGU [Scientific note of State Gorkiy University], 27, 135, 1954.

Institution

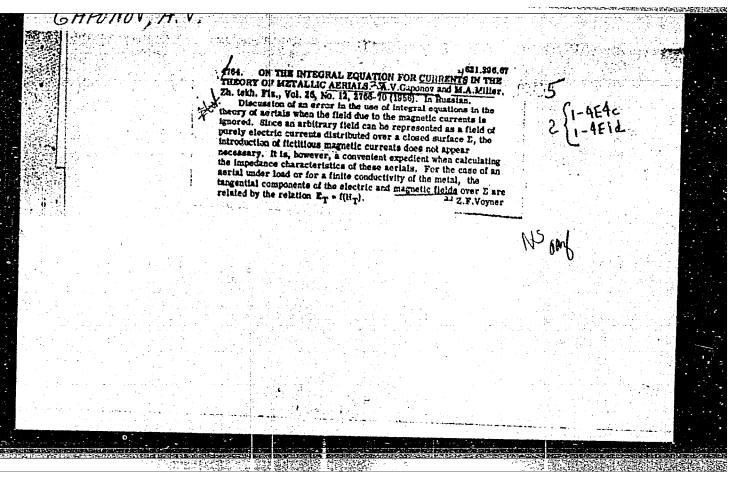
Submitted

: November 11, 1954





GALCNONG A.			
	201 270		
	influence of Islamogenetities on the Propagation of Electromagnetic Waves in Periodic Structures.—V. I. Bespalov & A. V. Ganquev. (Radioukhnika i Elektronika, June 1936, Vol. 1, No. 6, pp. 772-784.) The effect on the propagation of e.m. waves of	4 1JWM 14E4C	
	random inhomogeneities in transmission lines with periodic-profile guide surfaces is considered theoretically using equivalent circuits. The treatment leads to a difference equation of the second order with random coefficients which is solved by pertubation		
	methods. Formulae are obtained for the dispersion of the reflection coefficient at the entrance to the inhomogeneous section of the line. Examples considered include a comb delay line and an interdigital system.		
	aw x	Many	



CAPENEO, AL.

USSR/Radiophysica - General Problems, I-1

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 35238

Author: Gaponov, A. V.

Institution: None

Title: Method of Superimposing Ideal Couplings in General Theory of

Electric Machines

Original

Periodical: Uch. zap. Gor'kovsk. un-ta., 1956, 30, 142-158

Abstract: None

Card 1/1

CEPONIU 20

AUTHORS:

Gaponov , A. V., Miller, M. A.

56-1-44/56

TITLE:

On the Potential Wells for Charged Particles in a High-Frequency Electromagnetic Field (O potentsial nykh yamakh
dlya zaryazhennykh chastits v vysokochastotnom elektromegnitnom pole)

PERIODICAL:

Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, 1958. Vol. 34, Nr 1, pp. 242-243 (USSR)

ABSTRACT:

As is well-known there exist no absolute maxima and minima of the potential in an electromagnetic field in solenoidal domains, which excludes the possibility that a charged particle remains in the state of stable equilibrium. This fact also prevents the possibility of the localization of a particle, provided that under localization a state is understood in which a particle with an energy staying below a certain limit can leave a limited domain under no initial conditions whatever. This statement, however, does not apply to the case of a high-frequency electromagnetic field where the particle (as shown here) can be localized. The authors investigate a particle with the charge e and with the mass m which moves in the outer electromagnetic field

Card 1/3

On the Potential Wells for Charged Particles in a High- 56-1-44/56 -Frequency Electromagnetic Field

 $\vec{E}(\vec{r},t) = \vec{E}(\vec{r})e^{i\omega t}$, $\vec{H}(\vec{r},t) = \vec{H}(\vec{r})e^{i\omega t}$. In nonrelativistic approximation the equation of motion reads $\vec{r} = \eta \vec{E}(\vec{r},t) +$ $+(\eta/c)$ [\vec{r} $\vec{x}(\vec{r},t)$], where $\eta = e/m$ applies. At a sufficiently high frequency wof the outer field the solutions of the just-mentioned equation can be represented in the form of a sum of a function r (t) slowly varying (with regard to the period of the oscillations of the outer field) and of a function $\vec{r}_1(t)$ oscillating with the frequency ω . After averaging the above-mentioned equation over the period of the high-frequency field the following equation is obtained for $\vec{r}/(t)$: $\vec{r}(t) = -\nabla \phi$, $\phi = (\eta/2\omega)^2 |E|^2$. By averaging over the time the force acting upon the particle becomes a potential force, where the potential of the force is proportional to the square of the modulus of the electric field strenth and is not dependent on the sign of the charge. There exists an infinite number of possibilities for the construction of the potential wells for \oplus (\overrightarrow{r}). The simplest of them is realized in the quasielectrostatic multipole fields. In order to determine the nature of the motion of the particle within the potential well, the authors investigate the first integral of the last-mentioned

Card 2/3

On the Potential Wells for Charged Particles in a High-Frequency 56-1-44/56 Electromagnetic Field

> equations. When $\overrightarrow{E} = 0$ applies in the center of the potential well, the particles with an energy of = V are localized within a certain domain on whose boundaries the conditions $L\omega^2/|\eta|\gg|E|>2\omega(V/|\eta|)^{1/2}$ are valid. It is also possible to build up threedimensional potential wells of unidimensional and two-dimensional potential wells. There are 3 references, 2 of which are Slavic.

ASSOCIATION: Gor'kiy State University (Gor'kovskiy gosudarstvennyy

universitet)

SUBMITTED: October 15, 1957

AVAILABLE: Library of Congress

Card 3/3

AUTHORS: Gaponov, A. V., Miller, M. A.

SOV/56-34-3-36/55

TITLE:

On the Use of Moving High-Frequency Potential Wells for the Acceleration of Charged Particles (Ob ibpol'zovanii dvizhushchikhsya vysokochastotnykh potentsial'nykh yam dlya uskoreniya

zaryazhennykh chastits)

PERIODICAL:

Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, 1958,

Vol. 34, Nr 3, pp. 751-752 (USSR)

ABSTRACT:

When using oscillations of different frequencies generally a potential relief $\Phi(r_0,t)$ changing with increasing time is obtained. This way especially an accelerated motion of potential wells can be realized and consequently charged particles localized in such wells can be accelerated. The authors investigate 2 wave running in opposite directions (+z). With equal frequencies and amplitudes they form a standing wave $E_0(x,y,z)e^{i\omega t}$, where $E_0(x,y,z)$ is a real function. The potential corresponding to

 $E_0(x,y,z)$ is a real function. The potential corresponding to this field may give absolute minima. For the reason of a displacement of the potential wells on the z-axis the phase of one of the oppositely running waves must be changed. The authors restrict themselves to a non-relativistic motion $\Delta\omega \ll \omega_0$ and ne-

Card 1/3

On the Use of Moving High-Frequency Potential Wells for the Acceleration of Charged Particles

glect the difference in the structure of the fields of oppositely running waves. Then the expression $E = E_0(x,y,z - v_0t)e^{i(\omega t - z\Delta h)}$ is obtained for the whole field, where $2\Delta h = z$ = $h(a_1)$ - $h(a_2)$ holds, and where $h(\omega)$ denotes the propagation constant. The potential corresponding to this field has the form $\Phi = \Phi_0(x,y,z-v_0t)$. The velocity $v_0 = 2\Delta\omega \left[h(\omega_1)-h(\omega_1)\right]$ of the displacement of the potential wells is proportional to the difference of the frequencies of the oppositely running waves so that the capture and the subsequent acceleration of the particle can be realized by a change of the frequency of the generator exciting one of these waves. When the velocity vo is relativistic the potential wells in the corresponding supply system are a little deformed. However, the velocity of their displacement also then satisfies the last mentioned relation. As the particle to be accelerated in the corresponding supply system constantly oscillates with the frequency of the external field the degree of efficiency of such an accelerator is smaller than that of a normal linear accelerator. The here discussed accelerators with high-frequency potential wells have, however, also their advantages. First of all in the use of transverse magnetic waves there is no necessity of an

Card 2/3

'On the Use of Moving High-Frequency Potential Wells for the Acceleration of Charged Particles

sov/56-34-3-36/55

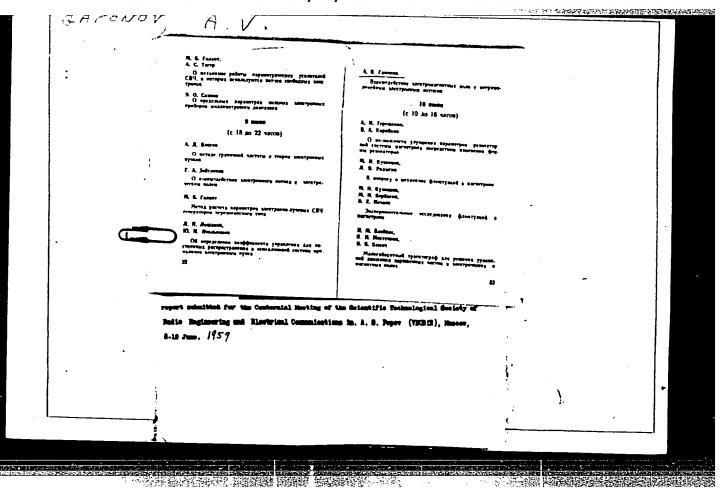
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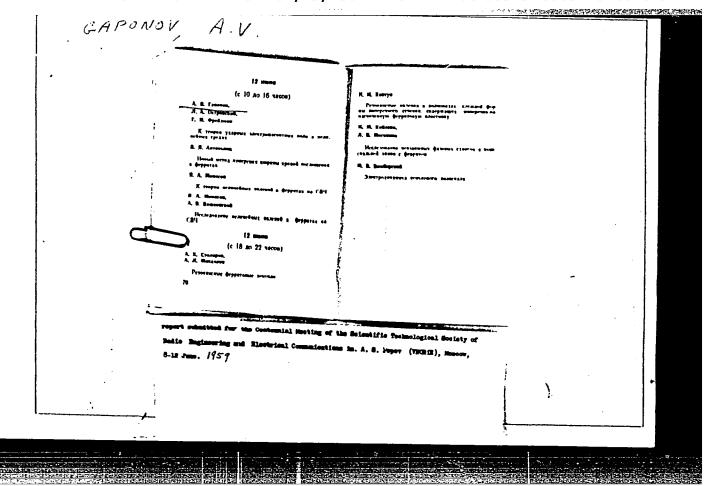
additional focusing of the particles in the transverse cross section. As the capture and the acceleration of the particles do not depend on the sign of their charge this principle can also be used for the acceleration of quasineutral plasma concentrations. After all, waves with random phase velocities (greater and smaller than light velocity) can be used. Therefore also the usual smooth-walled waveguides can be used in place of periodic structures. When an additional focusing magnetic field \hat{H}_{Z} = const is present in the accelerator also waves of the transverse-electric type can be used. There are 2 references, 2 of

ASSOCIATION: Gor'kovskiy gosudarstvennyy universitet (Gor'kiy State University)

SUBMITTED: November 25, 1957

Card 3/3





"APPROVED FOR RELEASE: 07/19/2001

्रां व्याप्तिक मित्रपुर्वे राष्ट्रप्त पूर्वित केला प्राचनित व्याप्तिक स्थापिक व्याप्ति व्याप्ति व्याप्तिक स्थाप

CIA-RDP86-00513R000514310010-6

9,3100 AUTHOR:

Gaponov, A.V.

67539 SOV/141-2-3-16/26

TITLE:

Excitation of a Transmission Line by a Non-rectilinear

Electron Beam 2

Izvestiya vysshikh uchebnykh zavedeniy, Radiofizika, PERIODICAL:

1959, Vol 2, Nr 3, pp 443 - 449 (USSR)

ABSTRACT: The existence of a transverse component of velocity in

a beam of electrons causes the convection current in the fixed system to have a non-sinusoidal density-variation with time. This considerably complicates the calculation of interaction with even a monochromatic wave. It is thus of interest to discover under what conditions the field excited in the line by the beam can be represented by the

superposition of monochromatic normal waves and to express the amplitudes of these components in terms of beam

parameters. A strict solution would use "waveguide equations" but for simplicity the quasi-state approximation

will first be used. The line and beam are shown in Figure 1, where it is assumed that the transverse dimension of the

line, d, and the fundamental wavelength in it, λ_{n} , are Card 1/3

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67539

SOV/141-2-3-16/26 Excitation of a Transmission Line by a Non-rectilinear Electron Beam

so small that the electric field can be calculated from the potential in Eq (1). The "telegraph equations", Eqs (2), become an inhomogeneous wave equation in voltage after elimination of the current term, i.e. Eq (4). It follows that a monochromatic wave will be excited in the system if the space charge M(z,t) is a sinusoidal function of time. This is not generally so but in the majority of practical cases the wave amplitude is such that the field due to space charge can be neglected as a first approximation. However, starting from Eq (3), integrating with respect to time under the integral sign and using the continuity conditions, M(z,t) may be easily expressed through the longitudinal and transverse components of current density in the beam, Eq (6). For a thin beam this simplifies to Eq (7). The wave equation may now be written as Eq (9). The result may be generalised for any cylindrical structure using the "waveguide equations". Eq (16) gives the amplitudes of the normal waves, while Eq (19) is a similar expression in terms of electron position.

Card 2/3 There are 1 figure and 4 Soviet references.

67.1-

Excitation of a Transmission Line by a Non-rectilinear Electron Beam

ASSOCIATION: Issledovatel'skiy radiofizicheskiy institut pri Gor'kovskom universiteta (Radiophysics Research Institute of Gor'kiy University)

SUBMITTED: May 17, 1959

Card 3/3

ALBERTHERING AND HOUSE CONTROL OF PARTIES.

67540

9,3100 AUTHOR:

1

A.V. Gaponov,

SOV/141-2-3-17/26

TITLE:

The Interaction of Non-rectilinear Electron Beams with

Electromagnetic Waves in Transmission Lines, 5

Izvestiya vysshikh uchebnykh zavedeniy, Radiofizika, PERIODICAL: 1959, Vol 2, Nr 3, pp 450 - 462 (USSR)

ABSTRACT: It is usually assumed that in the absence of the highfrequency field the electron trajectories are rectilinear. It is known that static modulation of the beam velocity causes essentially different effects when interaction takes place. By using one of the fast spatial harmonics of the beam it is possible to have interaction with an undelayed waveguide mode. A periodic structure may still be used, not for delaying the wave but for modulating the electron beam. Careful focusing is also necessary. There is, therefore, a practical advantage in considering an alternative form of beam modulation not requiring an intricate periodic. structure. The most convenient method is the use of a uniform, constant magnetic field. The analysis is based on formulae derived in the author's paper published in this issue (Ref 6). If the high-frequency field is considered as a perturbation, the solution to the equation of motion

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can be expanded as a series and the first approximation is given by Eq (26). The latter applies to two classes of system. The first has a non-uniform periodic electrostatic field along the z-axis and zero magnetic field; been studied in Refs 4, 5. The second has uniform static fields and , in a particular case, zero electric field. The spatial modulation is achieved by the beam being trochoidal or helical. The perturbation equation for the arrangement of Figure 1 is Eq (6), having the solution, Eq (10). most general solution, however, is the sum of this and the solution to Eq (6) as a homogeneous equation. For a thin helical beam, Eq (10) becomes (10a). To obtain the dispersion equation for the general case of crossed electric and magnetic fields the results derived earlier (Ref 6) are used. Only the most interesting practical case, of feeble currents, is treated since it is then only necessary to take into account interaction of the electron beam with the synchronised normal wave. The dispersion equation for a Card 2/4 trochoidal beam is Eq (19); the result for a helical beam

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> is of the same form. Compared with the corresponding formula for an ordinary travelling wave tube the only difference is the numerical value of the interaction impedance K_ . Amplification and generation is possible in association with waves in smooth-walled guides. This is referred to as Type O interaction and requires non-zero coefficients G_{xm} . If, however, $G_{xm} = 0$, the mode of interaction is different, called Type M and the dispersion equation is Eq (20). In spite of the formal similarity between the results for helical and trochoidal beams the mechanism of interaction is essentially different. The following examples are described in detail: 1) a helical beam directed along a magnetic field in the

- field of a slow TM wave;
- a helical beam with an undelayed TE wave;
- 3) a trochoidal beam in crossed electric and magnetic fields in the field of a slow TM wave;
- 4) a trochoidal beam with an undelayed TE wave.

Card 3/4 In the majority of cases, Type M interaction is not as

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The Interaction of Non-rectilinear Electron Beams with Electromagnetic

suitable as Type O for the amplification and generation

There are 3 figures and 11 references, 7 of which are Soviet, 2 German, 1 English and 1 Swiss.

ASSOCIATION: Issledovatel skiy radiofizicheskiy institut pri Gor'kovskom universitete (Radiophysics Research Institute

SUBMITTED:

May 17, 1959

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Bokov, V.M. and Gaponov, A:041/E321

AUTHORS:

Type "O" Interaction in Systems With Centrifugal

Focusing

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PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Radiofizika,

1959, Vol 2, Nr 5, pp 831 - 833 (USSR)

ABSTRACT:

Previous studies have dealt with interactions between an electron beam and either a longitudinal magnetic field or crossed electric and magnetic fields. Electron motion in a centrifugal electrostatic field is described

by Eq (1). Using the method of perturbations the effective electric field is Eq (2) and the component vectors are Eq (3). For a sufficiently weak electron beam the resonance condition for interaction with one of the normal waves is Eq (4) and an approximate dispersion equation is Eq (5). If the conditions of Eq (3) are now satisfied the type "0" interaction in a centrifugal field is Eq (6). Two examples are now evaluated in the first a coaxial transmission line has a negligibly appear conductor with a positive potential with

small inner conductor with a positive potential with respect to the outer tube and a spiral beam interacts

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AUTHOR:

Gaponov, A.V.

TITLE: Letter to the Editor

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Radiofizika,

1959, Vol 2, Nr 5, pp 836 - 837 (USSR)

ABSTRACT: In the author's article "Interaction of Non-rectilinear Electron Streams with Electromagnetic Waves in Trans-mission Lines - in this journal, 1959, Vol 2, Nr 3, p 450, the propagation of waves was considered in waveguide systems threaded by spiral or trochoidal beams. In deriving the dispersion equation a non-relativistic expression was used for particle motion in the beam. A subsequent examination of the relativistic correction shows that while the interaction mechanism is not essentially changed there is the possibility of an effect connected with the azimuthal bunching of particles rotating in a constant magnetic field. The dispersion equation describing a type "0" interaction is Eq (1), where β is the electron velocity normalized to that of light. The detailed modifications to the previous article are small

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and are given.

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Letter to the Editor

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V.V. Zheleznyakov is thanked for drawing attention to the need for the correction.

There is 1 Soviet reference.

SUBMITTED: October 19, 1959

Card 2/2

SOV/109---4-3-22/38

AUTHORS: A.M. Belyantsev, A.V. Gaponov, Ye.V. Zagryadskiy

TITLE: A Delay System of the "Counter-Stub" Type for Travelling-

Wave Amplifiers (Zamedlyayushchaya sistema tipa

"Vstrechnyye shtyri" dlya usiliteley s begushchey volnoy)

PERIODICAL: Radiotekhnika i Elektronika, Vol 4, Nr 3, 1959, pp 505-516 (USSR)

ABSTRACT: The possibility of employing a counter-stub system (of the type illustrated in Fig 1) was mentioned by Fletcher in 1952 (Ref 1). Here the problem is investigated in some detail. It is assumed that a counter-stub system of the type shown in Fig 1 can be represented by means of an equivalent circuit which consists of a parallel-conductor transmission line with capacitances connected across the line at spacings 1. The circuit is shown in Fig 3. The scattering equation of the system is given by:

 $\cos \varphi = \cos kl \left(1 + \frac{C_o + \widetilde{C}_o}{2C_1}\right) - \frac{kC_T}{2C_1} \sin kl, \qquad (1)$

Card 1/5 where k is the wave number, 1 is the length of the stubs, $C_{\rm o}$ and $\widetilde{C}_{\rm o}$ are the capacitances between the

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A Delay System of the "Counter-Stub" Type for Fravelling-Wave Amplifiers

stubs and the "base", respectively; C_1 is the capacitance between neighbouring stubs (per unit length); $j \omega C_T = j B_T$ is the equivalent capacitance of a node. The above circuit does not take into account the cross-coupling capacitances of the system. If these capacitances are taken into account, the equivalent circuit becomes more complicated and is in the form of the diagram shown in Fig 4. For this case the characteristic equation of the system is given by:

$$tg^{2} \frac{k1}{2} = \frac{C_{0} + \frac{1}{2} \sum_{n=1}^{m+1} C_{n} \sin^{2} \frac{n \varphi}{2}}{C_{0} + \frac{1}{2} \sum_{n=1}^{m+1} C_{n} \sin^{2} \frac{n}{2} (\varphi + \pi)}$$
(2)

where C_n is the capacitance (per unit length) between the stubs which are situated at distances nD/2 from each card 2/5 other. The summation in Eq (2) is carried out up to the values of n such that the cross-coupling capacitances

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A Delay System of the "Counter-Stub" Type for Travelling-Wave Amplifiers

become negligible. For the counter-stub system in which the "hairpins" are displaced vertically (see Fig 2) or with "hairpins" whose teeth have different cross-sections (see Fig 5), the scattering equation is given by Eq (4). The meaning of the various symbols in Eq (4) should be clear from Fig 5. The scattering curves for two different systems with displaced and differing "hairpins" are shown in Figs 6 and 7. Fig 6 corresponds to the system with similar but displaced "hairpins"; curves (1) and (3) of the figure are corroborated by some experimental points. Fig 7 illustrates a system in which the "hairpins" have different cross-sections. It was found that a decrease in the scattering and an increase in the transmission bandwidth of the system could be obtained, if one of the "hairpins" was removed (screened) from the "base". Examples of such systems are illustrated by the scattering curves of Fig 8. The relative magnitude of the electric field in a counter-stub system can be represented by the so-called interaction impedance or coupling impedance. This is defined by:

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Amplifiers

 $K_{\alpha\beta}^{m} = \frac{E_{\alpha}^{m} E_{\beta}^{m}}{2h_{m}^{2} P}, \qquad (6)$

where \mathbf{E}_{α}^{m} and \mathbf{E}_{β}^{m} are the spatial harmonics of the electric field component, which interact with the electron beam of the system; \mathbf{b}_{α} is the propagation constant of the m-th harmonic, while P is the power carried by the wave. The coupling impedance of the circuit shown in Fig 3 is given by Eq (10°), where the first term is defined by Eq (10°). The coupling impedance of the system shown in Fig 7, in which the first fundamental harmonic is "separated", is given by Eq (14°). On the other hand, in the systems where the "hairpins" are displaced in the horizontal plane, the impedance is also given by Eq (14°), except that the amplitude is represented by Eq (15). The amplitudes of the coupling impedance for the first harmonic of the system shown in Fig 7 is illustrated in Fig 10. Fig 11 shows the coupling impedance of a system with horizontally displaced

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A Delay System of the "Counter-Stub" Type for Travelling-Wave

"hairpins". The coupling impedance of the system was also measured experimentally, and the results are shown by the lower curve of Fig 12; the upper curve of Fig 12 was calculated; this is in poor agreement with the experimental data which is not surprising since Eqs (13) and (14) should be regarded as comparatively rough approximations. On the basis of the above analysis, it is concluded that the counter-stub systems with separated fundamental waves can be successfully employed in travelling-wave amplifiers operating at im wavelengths. The method of evaluating the dispersion characteristics proposed by the author is comparatively simple and is sufficiently accurate for most practical applications. There are 12 figures and 5 references.

Card 5/5 There are 12 figures and 5 references, 2 of which are English, 2 Soviet and 1 French.

SUBMITTED: July 9, 1957

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75341 SOV/57-29-10-18/18

AUTHORS:

Gaponov, A. V., Miller, M. A.

TITLE:

Letter to the Editor. A Reply to the Letter Written by B. V. Braude on the Subject of a Paper by the Authors, Entitled "On Integration of an Equation for Currents in the Theory of

Metallic Antennae"

PERIODICAL:

Zhurnal tekhnicheskoy fiziki, 1959, Vol 29, Nr 10, p 1291 (USSR)

ABSTRACT:

In their reply to the letter by Braude, B. I., the authors of the paper state that apparently Braude, B. I., somewhat modified his original views with which the authors d.d not agree and which were erroneous. There are 2 Soviet references.

Card 1/1

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AUTHORS:

Gaponov, A. V., Freydman, G. I.

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TITLE:

On Electromagnetic Shock Waves in Territes (Ob udarnykh elektromagnitnykh volnakh v ferritakh)

PERIODICAL:

Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959,

Vol 36, Nr 3, pp 957 - 958 (USSR)

APPROVED FOR RELEASE: 07/19/2001

ABSTRACT:

In the present "Letter to the Editor" the authors investigate the propagation of plane homogeneous electromagnetic waves in a medium for the case in which induction B and field strength H of the magnetic field are in nonlinear connection. The medium is assumed to be isotropic and that B=B(H), $\mu(H) = \partial B/\partial H$. Basing upon the Maxwell (Maksvell)equation and its partial solutions, the authors in the following investigate the boundary conditions holding for the field on both sides of the discontinuity, and subject the front

of the electromagnetic shock wave to a thorough theoretical investigation extending, for the time being, to the simple case of a plane homogeneous wave in ferrite which is magnetized up to saturation point by a homogeneous magnetic field \hat{H}_{o} , which is longitudinal with respect to the direction

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On Electromagnetic Shock Waves in Ferrites

SOV/56-36-3-65/71

of propagation of the wave. For the connection of M (magnetization) and H (z,t) it holds that

 $\partial M/\partial t = \gamma [M,H + H_0] - \lambda M^{-2} [M[M,H + H_0]]$ (3) (y= magnetomechanical ratio for the electron spin, $\lambda = 1/\tau_0$ =

relaxation frequency). Further, the case T γ_0 is subjected to a short investigation. As it is found impossible to consideration of (3), the authors consideration in

consideration of (3), the authors confine themselves to dealing with the case of a steady plane shock wave. For this case it is easy to integrate the equation. Theresult shows that \overline{M} rotates round the direction of propagation of the wave z (precision angle φ) with the velocity $\omega = \frac{\partial \varphi}{\partial t}$, $\omega = \frac{\gamma}{M} \frac{H_1^* \cos \theta}{\sin \theta} - \frac{(H_1 - 4\pi M_1 \cos \theta)}{(H_2 - 4\pi M_2 \cos \theta)} (\theta = the angle between$

M and z, the primed quantities denote values at a great distance from the wave front, i.e. at $z \to -\infty$). Expressions are further given for the time width of the shock waves front and the special cases of strong and weak shock waves are described in short. There are 4 Soviet references.

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On Electromagnetic Shock Waves in Ferrites

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ASSOCIATION:

Radiofizicheskiy institut Gor'kovskogo gosudarstvennogo universiteta (Radiophysical Institute of Gor'kiy State

SUBMITTED:

December 18, 1958

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Gaponov, A.V. and Freydman, G.I.

TITLE:

AUTHORS:

On the Theory of Electromagnetic Shock Waves

Non-Linear Media

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Radiofizika, 1960, Vol 3, Nr 1, pp 79-88 (USSR)

ABSTRACT:

The propagation of electromagnetic waves in ferrites and ferroelectrics is usually discussed in terms of the linear approximation. The present paper gives a detailed discussion of the propagation of plane uniform electromagnetic waves in non-linear media, ie media in which the magnetic induction B depends non-linearly The paper is divided into the following sections.

Simple waves in a non-linear isotropic uniform medium. Production of discontinuities.

2. Conditions on the Discontinuity Surface.

Structure of the shock wave front.

Effect of the finite conductivity of the medium.

The Maxwell equations are written down in the form given

by Eq (1) and (2); the relation between D and ϵ Card 1/5

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On the Theory of Electromagnetic Shock Waves in Non-Linear Media

assumed to be linear. Special solutions of these equations can then be shown to be given by Eq (3) where c is the velocity of light in vacuum, $\mu(H) = dB/dH$ and $f(\xi)$ and $f_1(\xi)$ are arbitrary functions determined by the boundary conditions. Eq (3) describes travelling waves such that each point on the wave profile moves with a velocity which depends on the magnetic field at that point. If the permeability decreases with the magnetic field, then those points on the profile at which the numerical magnitude of the magnetic field is large will move with a large velocity. Consequently, whenever the magnetic field increases (in its absolute magnitude) in a direction opposite to the direction of propagation, the slope of the front will increase until the continuity of the field vector breaks down (Fig 1). If μ is not a monotonic function of H, the situation is much more complicated. The boundary conditions on the moving shock wave-front are obtained by assuming that its

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velocity changes slowly in the case of a plane wave. The boundary conditions are given by Eq (6) and (6a). It is shown that if the discontinuity in the travelling wave is a weak one, then the behaviour of the travelling wave can be discussed in terms of the special solution given by Eq (3) and the boundary conditions given by Eq (6a). The problem is thus reduced to the determination of the position of the discontinuity in a simple wave. Weak shock waves can only exist for a limited time. In order to discuss the structure of the front of an electromagnetic shock wave, the relation between B and H and D and E must be known. In the present paper a simple case of a plane uniform wave propagated in ferrite magnetized to saturation by longitudinal uniform magnetic field is considered. If one neglects internal fields, then the connection between the

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On the Theory of Electromagnetic Shock Waves in Non-Linear Media

magnetization and the magnetic field strength is given by Eq (14) (Ref 7). The structure of the front of the electromagnetic shock wave, ie the solution of Maxwell's equations subject to Eq (14), cannot be carried out in a general form. However, the present paper succeeds in deriving the corresponding solutions for a stationary plane shock wave. It is shown that the frequency of field components in the region of the front of the shock wave depends mainly on the magnitude of the magnetic field in the wave. The length of the front is reduced as the magnetic field increases. The character of the structure of the front of the shock wave is determined only by the properties of the medium. There are 4 figures and 12 references, 10 of which are Soviet, 1 English and 1 French.

ASSOCIATION: Nauchno-issledovatel' skiy radiofizicheskiy institut Card 4/5 pri Gor'kovskom universitete (Scientific Research

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On the Theory of Electromagnetic Shock Waves in Non-Linear Media

Radio-Physical Institute of the Gor'kiy University)

SUBMITTED: October 21, 1959

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AUTHORS: Bokov, V.M. and Gaponov, A.V.

TITLE; Theory of a Travelling-wave Strophotron

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Radiofizika, 1960, Vol. 3, No. 5, pp. 826 - 836

TEXT: The so-called strophotron (Refs. 4, 5) is an example of a system with anharmonically excited oscillations, which employs the electrons oscillating in an electrostatic potential well along a stronguniform magnetic field. A simple model of a strophotron (described in Ref. 4) is illustrated in Fig. 1, where an oscillatory circuit can be connected to any pair of electrodes. Such a device can be used as the high-frequency oscillator or a regenerative amplifier. Another type of strophotron based on a different type of electrostatic potential well is illustrated in Fig. 2; this is a coaxial strophotron (Ref. 5). In the following the strophotrons of the above type are investigated but it is assumed that the electrons interact with a travelling electromagnetic wave. In the derivation of the Card 1/8

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Theory of a Travelling-wave Strophotron

principal equations it is assumed that; the beam current is small; the length of the interaction space is comparatively large and that the interaction takes place with only one synchronous wave. The motion of an electron in a two-dimensional potential well in the presence of a constant magnetic field H is described by the following nonrelativistic equation:

$$\frac{\ddot{r}}{\dot{r}} = - \eta \left(\underline{E}_{O} + \underline{E}_{\sim} \right) - \frac{\eta}{c} \left(\underline{\dot{r}}, \underline{H}_{O} + \underline{H}_{\sim} \right)$$
 (1)

where \underline{E} and \underline{H} are the high-frequency electric and magnetic fields. \underline{E}_0 is the electrostatic field having components \underline{E}_0 and \underline{E}_0 , e is the charge of an electron, \underline{m}_0 is its rest mass and $\underline{\eta} = e/\underline{m}_0$. If the motion along the axis z is uniform and if the high-frequency field can be Card 2/8

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Theory of a Travelling-wave Strophotron

regarded as a perturbation the solution of Eq. (1) can be in the form of:

$$\underline{\mathbf{r}} = \underline{\mathbf{z}}_{0}\mathbf{Z} + \underline{\mathbf{x}}_{0}(\mathbf{X} + \mathbf{x}^{(1)}), \quad |\mathbf{x}^{(1)}| \ll |\mathbf{X}| \qquad (2).$$

The zero approximation of the electron motion can be described by Eqs. (3), where the function E_{χ} changes its sign at

x=0 . The solution of the first of these equations corresponding to the real initial conditions and being a periodic function of t with a period $T_E=2\eta/\omega_E$ is

assumed to be in the form of Eq. (4). The derivative of this is given by Eq. (4.8). The equation for the first approximation is obtained by substituting Eq. (2) into Eq. (1) and is in the form of Eq. (5), where $\Phi(x) = \eta(\partial E_x/\partial x)$, and

E is the x-component of the high-frequency electric field. The general solution of this homogeneous equation should be Card 3/8

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Theory of a Travelling-wave Strophotron in the form of Eq. (6), where $u(\tau)$ is a periodic function of time, C_1 and C_2 are arbitrary constants and Mis the so-called parameter of non-isochronism, which is proportional to the derivative of the oscillation: frequency $^{\omega}_{E}$ with respect to the oscillator energy $^{\omega}_{0}$. The parameter of non-isochronism M is expressed by Eq. (7). If it is assumed that the high-frequency field in the interaction space is in the form of a plane nonhomogeneous wave, the solution of Eq. (5) is approximately given by Eq. (10), where U is the velocity corresponding to the drift velocity v and v is the amplitude of the plane wave. On the other hand, the amplitude of the synchronous wave excited in the system by the electron beam is expressed by Eq. (11), where I is the beam current, N is a normalising coefficient and $\tau = z/v_0$ is the transit time of an electron Card 4/8

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Theory of a Travelling-wave Strophotron

to the cross-section z . By substituting Eq. (10) into Eq. (11) and integrating it with respect to t , the following scattering equation is obtained:

$$\delta(\delta - \epsilon)^2 = -c_m^3 = -\frac{I_o}{2U_o} - \frac{h_e}{a_1^2 h_o^3 N} M |G_m|^2$$
 (12)

where only the resonance terms of the order $\left[\delta\left(\delta-\eta\right)^2\right]^{-1}$ are considered. This equation determines the correction factors to the propagation constants $\delta h_0 = h - h_0$. Eq. (12) is analogous in form to the dispersion equation of the normal travelling-wave tube of the type "0". If the relativistic effects in the tube are taken into account, the equation of the first approximation is in the form of Eq. (13), where X(t) is the solution of the zero approximation. The parameter of non-isochronism in this case is given by Eq. (14). The

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scattering equation is now similar to Eq. (12) except that M is replaced by the expression of Eq. (14). When the electron oscillations in the potential well can be regarded as being harmonic and the parameter M is small, it is necessary to introduce the resonant components of the order $(\delta - \epsilon)^{-1}$. In this case, the scattering equation is in the form of Eq. (15). This can further be written as Eq. (16). For strong currents, Eq. (16) is approximately expressed by Eq. (16a). This represents the so-called "M" type of oscillator systems. Such systems give the possibility of generating electromagnetic oscillations, this being due to the presence of complex roots in Eq. (16a). The amplification coefficient of such systems is determined by the imaginary component of the correction factor 6. Its dependence on current is illustrated in Fig. 4. The above formulae are used to analyse a coaxial strophotron with a travelling wave. It is shown that the gain of this system for the direct wave in the Card 6/8

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Theory of a Travelling-wave Strophotron absence of absorption is given by:

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 $G = -9.54 + 47.3 \text{ CL/}\lambda$

where C is defined by Eq. (18) and L is the length of the system. A graph of C as a function of a/b (Fig. 2) is given in Fig. 5. The above interaction mechanism is dependent on the self-phasing of the particles in the field. However, if the beam passes in the vicinity of the wall of a transmission line, the situation is different. The mechanism of the interaction of nonlinear beams with electromagnetic waves can be analysed on the basis of the results obtained by V.M. Bokov (Ref. 11). In this case, the first approximation can be written in the form of Eq. (19), where T(z) is a slowly changing function of z. By analysing this equation it is found that for a beam with uniformly distributed current, the gain is expressed by the third equation on p. 835, where j is the current density.

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Theory of a Travelling-wave Strophotron

There are 6 figures and 12 references; 3 English and 9 Soviet; one of the Soviet references is translated from English.

ASSOCIATION:

Nauchno-issledovatel'skiy radiofizicheskiy

institut pri Gor'kovskom universitete

(Scientific Research Radiophysics Institute

of Gor'kiy University)

SUBMITTED :

June 18, 1960

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9,1300 (also 1130

Antakov, T.I., Bokov, V.M., Vasil'yev, R.P. and

Gaponov, A.V.

TITLE:

AUTHORS:

Interaction Between a Trochoidal Electron Beam

and Electromagnetic Waves in a Rectangular Waveguide

FERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Radiofizika, 1960, Vol. 3, No. 6, pp. 1033-1044

TEXT: A detailed analysis of the interaction between a trochoidal electron beam and electromagnetic waves in a rectangular waveguide with three ideally conducting walls and "one" impedance wall is presented. A sufficiently weak electron beam interacts effectively with one of the normal waves in a transmission line or waveguide only under the condition that $h_0(1+\epsilon) = h_e + mh_H$ or:

$$\omega = \frac{m\omega_{H}}{(1 + \epsilon)v_{\parallel}/v_{\varphi} - 1}$$
 (1)

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Interaction Between

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where $m = 0, \pm 1, \pm 2, \dots | \varepsilon | \ll 1$ and $h_0 = \omega/v_0^{(0)}$ propagation constant of the corresponding normal wave in a "cold" waveguide; $v_{\parallel} = E_0/B_0$ is the drift velocity of the electrons moving along a trochoid and having an oscillation amplitude a in crossed fields E_0 and B_0 ; $h_e = \omega/v_{||}$, $h_H = \omega_H/v_{||}$, $\omega_H = (e/m)B_o = \eta B_o$ which is the gyromagnetic frequency. If the condition of synchronism given by Eq. (1) is fulfilled, the scattering equation for the correction of the order $\delta = (h - h_0)/h_0$ for the propagation constant of the electromagnetic wave in the waveguide for comparatively weak signals (without taking into account the space charge) is in the form (Refs. 2, 5):

 $E_y = h_n \cos(x_n x) \operatorname{ch}(\gamma y); \ H_x = -\frac{k^2 - x_n^2}{k Z_0} \cos(x_n x) \operatorname{ch}(\gamma y);$

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 $H_2 = -i \frac{h_n x_n}{k Z_0} \sin(x_n x) \cosh(\gamma y).$

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Interaction Between

is the beam current, where $U_0 = v_{\parallel}^2/2\eta$ is the voltage corresponding to the drift velocity, (where c is the velocity of light, v_ is the transverse electron velocity),

are the Fourier coefficients of the high-frequency Lorenz force acting on an electron moving along a stationary trajectory in the field of a nonperturbed normal wave,

is the normalising coefficient of this wave. Eq. (2) is used to analyse the interaction between the H -wave in a smooth-walled rectangular wave with the 01

electron beam and its interaction with a non-symmetrical wave in a comb-type (periodic) waveguide. The interaction between the electron beam and a symmetrical wave in a comb-type strip waveguide is also investigated; the following special cases in

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Interaction Between

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the above type of interaction are considered: a magnetron amplifier with a trochoidal beam; interaction with a fast electromagnetic wave and interaction with a slow electromagnetic wave. The problem was also investigated experimentally on two specially constructed models, provided with comb-type delay systems. Such a system is illustrated in Fig. 4; this consists of: 1 - a comb-type anode; 2 - cathode; 3 - focusing electrode; 4 - electron beam and 5 - a cathode plate. Both models were designed for the 3-cm operating range. The results of the experiments are in good agreement with the calculated data and indicate that for the electrons rotating in a constant magnetic field both mechanisms of interaction of the type "0", i.e. the self-phasing and the spatial debunching, are equally effective and can be employed in microwave amplifiers and osciliators. There are b figures and 11 references: 10 Soviet and 1 non-Soviet.

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ASSOCIATION:

Interaction Between

Nauchno-issledovatel'skiy radiofizicheskiy

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of Gor'kiy University)

SUBMITTED:

July 13, 1960

Card 5/6

"APPROVED FOR RELEASE: 07/19/2001

CIA-RDP86-00513R000514310010-6

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S/056/60/039/002/019/044 B006/B056

24, 4500 author:

Gaponov, A. V.

TITLE:

The Instability of a System of Excited Oscillators With

Respect to Electromagnetic Disturbances

PERIODICAL:

Zhurnal eksperimental'ncy i teoreticheskoy fiziki, 1960,

Vol. 39, No. 2(8), pp. 326-331

TEXT: A current of charged particles which moves rectilinearly and unifomly (velocity v) is instable with respect to electromagnetic disturbances if v is greater than the velocity of light in the surrounding medium of classically, this instability is considered to be the consequence of a grouping (autophasing) of particles in the electromagnetic wave field; these waves propagate in the Cherenkov cone; the clusters produce comberent Cherenkov radiation. Analogous instabilities may be observed also in currents of excited electric oscillators, with the only difference that here a coherent radiation is emitted also if v < 0. In the present paper,

the author discusses the possible mechanisms of the autophasing of excited oscillators in a radiation field leading to instability of the Card 1/3

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The Instability of a System of Excited Oscillators S/056/60/039/002/019/044
With Respect to Electromagnetic Disturbances B006/B056

system with respect to electromagnetic disturbances. The attempt is made to explain these instabilities both classically and quantum-theoretically. For this purpose, a current of excited oscillators is investigated. where each oscillator is assumed to be a charged particle oscillating freely in a reference system at the frequency ω_0 . At the instant t , the oscillation amplitudes of all particles are assumed to be equal, so that the macroscopic current vanishes, and no electromagnetic radiation occurs. By means of an electromagnetic disturbance of the form $\frac{1}{2} = \frac{1}{2} (r) e^{i\omega t}$, $\vec{h} = \vec{h}(\vec{r})e^{i\omega t}$ the motion of the oscillators is disturbed, and a variable polarization current occurs. First, the case of a harmonic oscillator is briefly discussed; the grouping of excited oscillators according to phases which is necessary for instability, is possible only if the motion of the oscillators in the external field obeys nonlinear equations. For an anharmonic oscillators in weak external field, two different phasing mechanisms are possible: !)"A phase grouping" of the anharmonic oscillators, and 2) A spatial grouping of the moving oscillators in an inhomogeneous field. Both cases are treated, and the mathematical results are discussed. The instability of such a system may be explained classically, and is not related with pure quantum effects; nevertheless, a quantum theoretical Card 2/3

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The Instability of a System of Excited Oscillators With Respect to Electromagnetic Disturbances

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interpretation is of interest as shown by the author in the last part of this paper. Two possibilities are discussed on the basis of the most simple idealized system: a) The instability of the system of anharmonic oscillators is related with a difference in the spacings of their energy spectra. b) The displacement of a moving excited oscillator in an inhomogeneous electric field is connected with a recoil in the emission (or absorption) of a photon. The author finally thanks V. L. Ginzburg and V. M. Fayn for discussions. V. I. Gayduk is mentioned. There are 18 references: 16 Scviet, 1 US, and 1 Swedish.

ASSOCIATION:

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(Institute of Radiophysics of Gor'kiy State University)

SUBMITTED:

February 1, 1960

Card 3/3

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9,4230

AUTHOR: Gaponov, A.V.

TITLE:

Relativistic scattering equation for the waveguide systems with helical and trochoidal electron beams

Izvestiya vysshikh uchebnykh zavedeniy, PERIODICAL: Radiofizika, 1961, v. 4, no. 5, pp. 547 - 559

The results presented in this work were reported in TEXT: a paper read at the 15th General Assembly of URSI in September, 1960.

When considering the interaction of electrons and electromagnetic field, it is often necessary to introduce the relativistic corrections into the scattering equations of the systems which operate with helical or trochoidal electron beams (Ref. 1 - this journal, 2, 441, 1959 and 2, 450, 1959, Ref. 4 - R.H. Pantell, Proc. of the Symp. on millimetre waves, Politechn. Press, Brooklyn, New York, 1959, and Ref. 5 the author - this journal, 2, 836, 1959). This work is concerned with the derivation of the relativistic scattering equation for this type of system; the equation is derived Card 1/10

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Relativistic scattering

under the usual assumption that the electron concentration is small and that the signals are comparatively weak. The problem of excitation of a waveguide by a thin non-rectilinear electron beam was considered in Ref. 1 and the final formulae from that work are used. The Fourier components for the field excited in a waveguide can be written in the form of a sum of normal waves:

 $E_{m} = \sum_{s} \left(V_{s}^{+} E_{s}^{+} + V_{s} E_{s}^{-} \right) - \frac{4\pi}{im} (j_{m} Z_{0}^{-}) Z_{0};$ $H_{m} = \sum_{s} \left(V_{s}^{+} H_{s}^{+} + V_{s}^{-} H_{s}^{-} \right), \tag{1}$

where $\underline{E}_{s}^{+} = \underline{e}_{s}^{-} e^{-ik_{os}z}$ and $\underline{H}_{s}^{-} = \underline{h}_{s}^{-} e^{-ik_{os}z}$ are the

intensities of the electric and magnetic fields of the normal waves at the frequency ω , respectively, Z_0 is the unit

vector of the axis z , which is parallel to the axis of the waveguide and j_{ω} is the Fourier component of the current Card 2/10

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Relativistic scattering

density $j(t) = \int_{-\frac{1}{2}\omega} e^{i\omega t} d\omega$. The amplitudes of the normal waves V_S^{\pm} can be calculated if the equation of the electron beam which excites the waveguide is written in a parametric form $\underline{r} = \underline{r}(\gamma, t)$ and the expression for V_S is integrated with respect to the transit time γ (i.e. integrated along the electron trajectories). It can also be assumed that the electrons in the beam undergo small harmonic deviations at the frequency ω so that

$$r = r_0(z) + r_{1n}(z) e^{int} \qquad (|r_{1n}| < D);$$

$$z = z_0(z) + z_{1n}(z) e^{int} \qquad (|z_{1n}| < T)$$

where \underline{r}_{o} is the stationary value of \underline{r} . The amplitudes can thus be written as:

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Relativistic scattering

$$V_{s}^{\pm} = \pm \frac{I_{0}}{N_{s}} \left\{ i_{0} \int_{\tau_{0}^{1/2}}^{\tau_{s}(t)} r_{1m} \left\{ G_{s}^{+} \left\{ r_{0}(\tau) \right\} \right\}^{+} d\tau + \right. \\ \left. + \int_{\tau_{0}^{1/2}}^{\tau_{s}(\tau)} r_{1m} + v_{0}(\tau) \tau_{1m} \left\{ E_{s}^{+} \left\{ r_{0}(\tau) \right\} \right\},$$

$$(2)$$

where to are transit times corresponding to the start and termination of the beam,

I is the DC component of the beam current,

N is the normalising factor and

 $\underline{v}_{0}(u)$ is the electron velocity in a non-perturbed beam.

The quantity \underline{G}_{s}^{+} is the Lorentz force, which is defined by:

$$\frac{G_{S}^{+}}{G_{S}} = \frac{E_{S}^{+}}{G_{S}} + \frac{1}{G_{S}} \left[\underbrace{v_{O}H_{S}^{+}} \right] \qquad (5) .$$

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