BC

A-3

Pectin substances. I. Sugar-beet pectins. T. K. GAPONENKOV (J. Gen. Chem. Russ., 1937, 7, [No. 14] 1986—1991).—Sugar-beet protopectin, hydratopectin, araban, pectic acid, and galacturonic acid have been prepared, and certain consts. are recorded for the preps. R. T.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

The effect of mineral and organic substances on the viscosity of solutions of pectic substances. T. K. Gaponenkov. *J. Gen. Chem.* (U. S. S. R.) 7, 2008-8(in English 2009)(1937). [No. 24] Viscosity, η, of araban solns. in the presence of KCl, KOH, $Ca(OH)_2$, $Ba(OH)_2$, sucrose, EtOH, Me_2CO and Et_2O varies considerably. Addn. of KCl lowers η, while addn. of KOH, $Ca(OH)_2$, $Ba(OH)_2$ or sucrose increases it. In EtOH or Me_2CO addns., η first decreases rapidly, then with further addns. of the org. compds. it increases somewhat, but remains below its original value. Addn. of Et_2O lowers η considerably. Max. η was observed for the system araban + sucrose + satd. aq. soln. $Ca(OH)_2$; min. η, for the system araban + 40% aq. soln. EtOH + Et_2O. Increase of η produced by the addn. of bases is explained on the theory of formation of compds. between the dispersed phase and the bases. Decrease of η caused by the addn. of org. compds. is explained as due to dehydration of the dispersed phase.

S. L. Madorsky

1ST AND 2ND ORDERS

PROCESSES AND PROPERTIES INDEX

CA

1

Swelling of pectins. T. K. Gapomenkov. *Colloid J. (U. S. S. R.)* 4, 641-5(1938).—From the pectin of beet-root protopectin were isolated hydratopectin, Ca Mg salt of pectic acid and araban. Their swelling and heats of swelling in several H_2O-EtOH mixts. were detd. The heat of soln. in water of araban in various stages of swelling was measured also; it becomes immeasurably small when araban has taken up 1 H_2O for each free OH group.

J. J. Bikerman

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

CA

1ST AND 2ND ORDERS

PROCESSES AND PROPERTIES INDEX

3RD AND 4TH ORDERS

2

The structure of pectin substances. T. K. Gaponenkov. *J. Gen. Chem.* (U. S. S. R.) 9, 1752-4(1939).—Hydrolysis of pectin with 5% HCl for 6 hrs. at 80-5° gives a polygalacturonic acid which is insol. in H_2O and org. solvents, but sol. in 1:1 H_2O-pyridine below 60°. The mol. wt. by the viscosity method is 42,380 and the coeff. of polymerization is 165. Nitration with strong HNO_3 for 1 hr. gives a compd. contg. 8.96% N with a mol. wt. 19,900 and a polymerization coeff. 75. H. M. Leicester

Laboratory of Organic Chemistry, Voronezh Agricultrual Institute

ASB-SLA METALLURGICAL LITERATURE CLASSIFICATION

1ST AND 2ND ORDERS

PROCESSES AND PROPERTIES INDEX

3C

A-1

Coagulation of pectic substances at various p_H values. T. K. Gaponenkov and F. L. Movschevitsch (*Kolloid. Shurn.*, 1940, [illegible]).—Aq. solutions of hydratopectin (I) from beetroot, made acid or alkaline by HCl or NaOH, were pptd. by an Et_2O-EtOH mixture. The most complete coagulation (>90%) took place at p_H 4·8, at the same acidity the η of a 2% solution of (I) showed a max. It is known that the rates of hydrolysis and peptisation of pectin show a min. at this acidity. (I) exerts a slight buffering action. J. J. B.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

1ST AND 2ND ORDERS

PROCESSES AND PROPERTIES INDEX

3RD AND 4TH ORDERS

BC

Pectic substances in sugar beetroot. T. K. Gaponenkov (*Kolloid. Zhurn.*, 1940, 6, 541—544).—The % of pectin in beetroot is small in the beginning of the season, rises, and for 2—3 months remains const. at about 20% on watered fields, and at about 25% without watering. The ratio of water-sol. to water-insol. pectin is high in young beetroot and very low in ripe ones; watering reduces it. The amount of substances which are pptd. from normal juice by alcohol and ether decreases in the course of growth; it is lowered by watering. The amount of "bound" water increases during the growth and is higher for unwatered beetroot; accumulation of hydrophilic colloids is used by the plant to fight drought.

J. J. B.

ASB-SLA METALLURGICAL LITERATURE CLASSIFICATION

The reaction between pectic substances and acids. C. K. Gaponenkov. *J. Applied Chem.* (U. S. S. R.) 13, 251 (in French, 259)(1940); cf. C. A. 34, 3...—The Ca Mg salt of pectic acid obtained from sugar beets had buffer properties directly related to the Ca and Mg ions. These cations can be substituted in part with H ion by adding mineral acid. The amt. of H ion used up by pectic acid increased with an increase of the concn. of pectic acid. Ca and Mg ions can be completely removed only by repeated washing of the coagulated ppt. of pectin with alc. and ether.

A. A. Podgorny

GAPONENKOV, T.K. and CHEREMISINOV, NA.

Obituary on Prof. I.D. Buromskiy.

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

APPROVED FOR RELEASE: 07/19/2001 CIA-RDP86-00513R000514310010-6"

Changes of pectin substances during storing of sugar beets. T. K. Gaponenkov (Voronezh Sugar Inst.). *Sakharnaya Prom.* 27, No. 11, 22-3(1953).—During 7 months storing of sugar beets in piles, there are very insignificant quant. changes in total amt. of pectin substances. However, there are considerable qual. changes of protopectin into pectin, which increases about 3 times from the original amt. At that stage the beet roots are loosing moisture and become softer. The wilting of beets is apparently favorable to an attack by microorganisms. A beet artificially injected with *Aspergillus niger* showed, after 8 days, a complete disappearance of protopectin and formation of gummy substances sol. in water and in contact with Ca salts forming slimy compds. insol. in water. V. B. Baikow

USSR/Biology

Card 1/1 FD 299

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"

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

Abs Jour : Ref Zhur-Biologiya, No 2, 1958, 5605

Author : T. K. Gaponenkov
Inst : Voronezh Agricultural Institute
Title : On the Distribution of Pectin Substances in the Root of Sugar Beet

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 Agricultural Institute.

Card 1/1

2

Pectin substances in sunflower. T. K. Osponenkov and Z. I. Protsenko (Agr. Inst. Voronezh). Zhur. Priklad. Khim. 29, 1444-7(1956).—The chem. compn. of sunflower as a function of the period of growth was detd. The min. pectin content, 22% on dry basis, was found during the period of seed formation. It increased to 27%. The viscosity of the pectin was of the same order as that of apples.

I. Bencowitz

USSR/General Biology. Genetics. The Genetics of Plants. I-5

Abs Jour: Ref Zhur-Biol., No 20, 1958, 90434.

Author : Gaponenkov, T.K., Pereyshnya, S.M.
Inst : All-Union Academy of Agricultural Sciences im. V.I. Lenin.
Title : The Influence of Vegetative and Sexual Hybridization of Summer Durum Wheat on the Chemical Composition of the Grain.

Orig Pub: Dokl. VASKhNIL, 1957, No 9, 15-18.

Abstract: A biochemical 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 summer durum wheat. A statistical treatment of the data is lacking. -- T.K. Lepin.

Card : 1/1

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., professor; POROYSKAYA, G.M.

Effect of sexual and asexual hybridization of hard spring wheat on the chemical composition of the grain. Dokl.Akad.sel'khoz. 22 no.9:16-18 '57. (MIRA 10:9)

1. Voronezhskiy sel'skokhozyaystvennyy institut. Predstavlena akademikom I.V. Yakushkinym.
(Wheat breeding)

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

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

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

(Pectin) (Sunflowers)

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

Effect of annual plants on the accumulation of organic matters and soil structure. Zemledelie 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 sunflower pectin depending on the method of its extraction. Zhur. prikl. khim. 31 no.2:319-321 F '58. (MIRA 11:5)

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

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

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

1. Voronezhskiy sel'skokhozyaystvennyy institut. Laboratoriya 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 Agricultural Institute)

SUBMITTED: January 20, 1958

Card 1/1

GAPONENKOV, T.K.; STANISLAVSKAYA, 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 F '60. (MIRA 13:5)

1. Laboratoriya organicheskoy khimii Voronezhskogo sel'skokhozyaystvennogo instituta.
(Araban) (Ion exchange)

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

Effect of organic acids on the strength of pectin-sugar jellies. Izv. vys.ucheb.zav.;pishch.tekh. no.4:26-28 '60. (MIRA 13:11)

1. Voronezhskiy sel'skokhyaystvennyy institut. Kafedra organicheskoy khimii.
(Petin) (Acids, Organic)

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

Splitting of pectins by enzymes by micro-organisms and the chemical nature of the end products. Mikrobiologiia 29 no.5:668-672 S-O '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)

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.

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

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'skokhozyaystvennyy institut, kafedra organicheskoy khimii.

(Aluminum salts) (Galacturonic acids)
(Pectic acids)

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

Pectic substances and their role in plants. Bot. zhur. 47 no.10:1488-1493 O '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.

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

Aluminum-uronide complexes of soils. Pochvovedenie no.12:84-88 O '64. (MIRA 18:2)

APPROVED FOR RELEASE: 07/19/2001 CIA-RDP86-00513R000514310010-6"

GAPONOV, .P.

I.I. Prokhorov's 7-day plowography. Vest. AN Kazakh. SSR. 19 no.6:85-86 Je '63. (MIRA 17:7)

APPROVED FOR RELEASE: 07/19/2001 CIA-RDP86-00513R000514310010-6"

GAPONOV, A.P.

Showers and maximum diurnal precipitation throughout the eastern part of Kazakhstan. Vest. AN Kazakh. SSR 19 no.12: 75-80 D '63. (MIRA 17:12)

GAPONOV, A. V.

USSR/Electricity - Machines, Electric Models   11 Feb 52

"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.

230T9

GAPONOV, A.V. 3016765

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 three-dimensional 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 Čaplygin-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.*

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

GAPANOV, A. V.

Mathematical Reviews
Vol. 14 No. 11
Dec. 1953
Mathematical Physics

BTR, V.2, Dec '53

Gaponov, A. V. On a dynamical model of the general theory of electrical machines. Doklady Akad. Nauk SSSR (N.S.) 89, 45–48 (1953). (Russian)

This sketchy paper applies the ideas of another one [same Doklady (N.S.) 87, 401–404 (1952); these Rev. 14, 825] to the "concrete" problem of an idealized, completely linear, electrical "parent" machine whose stator and rotor are represented by two infinitely long and infinitely thin coaxial cylindrical shells with distributed surface currents parallel to their common axis (these currents represent those in the winding). The currents are assumed to be developable into Fourier series in the azimuths θ and θ' on the stator and the rotor, both measured from axial planes fixed in the respective cylinders. The coefficients of these series are regarded as generalized velocities of a Lagrangian system with a countable number of freedoms (the Lagrangian is the sum of the kinetic and magnetic energy). The validity of the (infinitely many) Lagrange equations is assumed. If the rotor current is expressed in terms of the stator angle θ, the coefficients of the expansion are recognized as nonholonomic general velocities, and the validity of the Boltzmann-Hamel equations is claimed for them. The author elects to regard the machine with a finite number of coils in the winding as the outcome of imposing infinitely many constraints on the "parent" machine, with a finite degree of freedom resulting.

(OVER)

These constraints are nonholonomic if there are commutators. One gets the impression that the author considers postulating the validity of the equations for the infinitely many parameters of the "parent" machine logically preferable to doing this for the finite number of parameters of the "constrained" machine. This seems the more strange that the parameters of the "parent" machine are not even "normal" (separated), as is the case in the Rayleigh method for vibrations of continuous systems. Another strange remark is that G. Kron's "primitive" network (a finite number of disconnected coils) is not acceptable as the "parent" machine because it lacks "concrete physical meaning".

A. W. Wundheiler (Chicago, Ill.).

8-9-54

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 : ....

Submitted : 15 Feb 1954

Gaponov, A.V.

★ Gaponov, A. V. Electromechanical systems with sliding contacts and the dynamical theory of electrical machines. Pamyati Aleksandra Aleksandrovica Andronova [In memory of Aleksandr Aleksandrovič Andronov], pp. 196–214. Izdat. Akad. Nauk SSSR, Moscow, 1955. 36.40 rubles.

1-FW

2

GAPONOV-GREKHOV, Andrey Viktorovich.

Gor'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, Byulleten' 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 : 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

USSR/Physics - Antennas

Card 1/1 Pub. 153 - 14/24 FD-3115

Author : Gaponov, A. V.

Title : Excitation of field resonator by thin antennas

Periodical : Zhur. tekh. fiz., 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

Gaponov, A V.

AVERKOV, S. I., ANIKIN, V. I., BRAVO-ZHIVOTOVSKIY, D. M., GAPONOV, A. V., GREKHOVA, M. T., YERGAKOV, V. S., LOPYREV, V. A., MILLER, M. A., and FLYAZIN, V. A.

S. I. Averkov, V. I. Anikin, D. M. Bravo-Zhivotovskiy, A. V. Gaponov, M. T. Grekhova, V. S. Yergakov, V. A. Lopyrev, M. A. Miller, and V. A. Flyazin. Radiotekhnika i Elektronika, No 6, energy in the generator proper. In both cases, the zone of matching and emission were evaluated in the article as well as the value of the spectral noise power. The spectral noise power was linearly regulated by

GAPONOV, A. V.

621.372 1644

Influence of Inhomogeneities on the Propagation of Electromagnetic Waves in Periodic Structures.—V. I. Bespalov & A. V. Gaponov. (*Radiotekhnika i Elektronika*, June 1956, Vol. 1, No. 6, pp. 772-784.) The effect on the propagation of e.m. waves of 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.

4
1JWM
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GAPONOV, A.V.

7164. ON THE INTEGRAL EQUATION FOR CURRENTS IN THE THEORY OF METALLIC AERIALS. A.V.Gaponov and M.A.Miller. 621.396.67

Zh. tekh. Fiz., Vol. 26, No. 12, 2768-70 (1956). In Russian.

Discussion of an error in the use of integral equations in the theory of aerials when the field due to the magnetic currents is ignored. Since an arbitrary field can be represented as a field of purely electric currents distributed over a closed surface Σ, the introduction of fictitious magnetic currents does not appear necessary. It is, however, a convenient expedient when calculating the impedance characteristics of these aerials. For the case of an aerial under load or for a finite conductivity of the metal, the tangential components of the electric and magnetic fields over Σ are related by the relation $E_T = f(H_T)$.

Z.F.Voyner

5

2 {1-4E4c, 1-4E1d}

NS omf

Gaponov, A.V.

USSR/Radiophysics - 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

56-1-44/56

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

TITLE: On the Potential Wells for Charged Particles in a High--Frequency Electromagnetic Field (O potentsial'nykh yamakh dlya zaryazhennykh chastits v vysokochastotnom elektromagnitnom 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-Frequency Electromagnetic Field 56-1-44/56

$\vec{E}(\vec{r},t) = E(\vec{r})e^{i\omega t}$, $H(\vec{r},t) = H(\vec{r})e^{i\omega t}$. In nonrelativistic approximation the equation of motion reads $\ddot{\vec{r}} = \eta\vec{E}(\vec{r},t) + (\eta/c)[\dot{\vec{r}}\,\vec{H}(\vec{r},t)]$, where $\eta = e/m$ applies. At a sufficiently high frequency ω of the outer field the solutions of the just-mentioned equation can be represented in the form of a sum of a function $\vec{r}_o(t)$ 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 $\vec{r}_o(t)$: $\ddot{r}_o(t) = -\nabla\Phi$, $\Phi = (\eta/2\omega)^2|E|^2$. 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 strength 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 $\Phi(\vec{r})$. 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

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

equations. When $\vec{E} = 0$ applies in the center of the potential well, the particles with an energy of $\approx V_0$ are localized within a certain domain on whose boundaries the conditions $L\omega^2/|\eta| \gg |E| > 2\omega(V_0/|\eta|)^{1/2}$ 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 $\Phi(\vec{r}_0,t)$ 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 ($\pm z$). With equal frequencies and amplitudes they form a standing wave $\vec{E}_0(x,y,z)e^{i\omega t}$, where $\vec{E}_0(x,y,z)$ 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-

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glect the difference in the structure of the fields of oppositely running waves. Then the expression $\vec{E} = \vec{E}_0(x,y,z - v_0 t)e^{i(\omega t - z\Delta h)}$ is obtained for the whole field, where $2\Delta h = h(\omega_1) - h(\omega_2)$ holds, and where $h(\omega)$ denotes the propagation constant. The potential corresponding to this field has the form $\Phi = \Phi_0(x,y,z - v_0 t)$. The velocity $v_0 = 2\Delta\omega/[h(\omega_1)-h(\omega_2)]$ 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 v_0 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

On the Use of Moving High-Frequency Potential Wells for the Acceleration of Charged Particles SOV/56-34-3-36/55

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 H_z = const is present in the accelerator also waves of the transverse-electric type can be used. There are 2 references, 2 of which are Soviet.

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

SUBMITTED: November 25, 1957

Card 3/3

GAPONOV A. V.

М. Б. Голант,
А. С. Тагер

О нелинейной работе параметрических усилителей СВЧ, в которых используются потоки свободных электронов

Э. О. [illegible]

О предельных параметрах мощных электронных приборов [illegible] диапазона

9 июня

(с 18 до 22 часов)

А. Д. [illegible]

О методе [illegible] частоты в теории электронных пучков

Г. А. [illegible]

О взаимодействии электронного потока с электрическим полем

М. Б. Голант

Метод расчета параметров электронно-лучевых СВЧ генераторов [illegible] типа

Л. Н. [illegible],
Ю. Н. [illegible]

Об определении коэффициента управления для [illegible] распространения в замедляющей системе при наличии электронного пучка

32

А. В. Гапонов

Взаимодействие электромагнитных волн с [illegible] электронными потоками

10 июня

(с 10 до 16 часов)

А. Н. [illegible],
В. А. [illegible]

О возможности улучшения параметров резонаторной системы магнетрона посредством изменения формы резонаторов

М. Н. [illegible],
Л. В. [illegible]

К вопросу о [illegible] флуктуаций в магнетроне

М. Н. [illegible],
М. Н. [illegible],
В. Е. [illegible]

Экспериментальное исследование флуктуаций в магнетроне

Н. М. [illegible],
Н. Н. [illegible],
В. В. [illegible]

[illegible] для решения уравнений движения заряженных частиц в электрических и магнитных полях

33

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

GAPONOV, A.V.

12 июня

(с 10 до 16 часов)

А. В. Гапонов,
~~Л. А. Островский,~~
Г. И. Фрейдман

К теории ударных электромагнитных волн в нелинейных средах

В. Я. [illegible]

Новый метод измерения ширины кривой [illegible] в ферритах

В. А. [illegible]

К теории нелинейных явлений в ферритах на СВЧ

В. А. [illegible],
А. В. [illegible]

Исследование нелинейных явлений в ферритах на СВЧ

12 июня

(с 18 до 22 часов)

А. К. [illegible],
А. Л. [illegible]

Резонансные ферритовые вентили

70

Н. М. [illegible]

Резонансные [illegible] [illegible]

К. М. [illegible],
А. В. [illegible]

Исследование [illegible] [illegible] с ферритом

Н. В. [illegible]

[illegible]

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

9,3100

67539

AUTHOR: Gaponov, A.V.

SOV/141-2-3-16/26

TITLE: Excitation of a Transmission Line by a Non-rectilinear Electron Beam 21 25

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Radiofizika, 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_B , are

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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...

SOV/141-2-3-16/26

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

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

SUBMITTED: May 17, 1959

4

Card 3/3

67540

9,3100

SOV/141-2-3-17/26

AUTHOR: Gaponov, A.V.

TITLE: The Interaction of Non-rectilinear Electron Beams with Electromagnetic Waves in Transmission Lines

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

ABSTRACT: It is usually assumed that in the absence of the high-frequency 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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The Interaction of Non-rectilinear Electron Beams with Electromagnetic Waves in Transmission Lines

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; it has 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). The 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 trochoidal beam is Eq (19); the result for a helical beam

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The Interaction of Non-rectilinear Electron Beams with Electromagnetic Waves in Transmission Lines

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_m. 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;
2) 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 Waves in Transmission Lines

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suitable as Type O for the amplification and generation of power.

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 of Gor'kiy University)

SUBMITTED: May 17, 1959

4

Card 4/4

68559

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S/141/59/002/05/023/026
E041/E321

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

TITLE: Type "O" Interaction in Systems With Centrifugal Focusing

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 "O" interaction in a centrifugal field is Eq (6). Two examples are now evaluated: in the first a coaxial transmission line has a negligibly small inner conductor with a positive potential with respect to the outer tube and a spiral beam interacts

4

Card1/2

APPROVED FOR RELEASE: 07/19/2001 CIA-RDP86-00513R000514310010-6"

9.9000

S/141/59/002/05/026/026
E041/E321

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 Transmission 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 "O" interaction is Eq (1), where β is the electron velocity normalized to that of light. The detailed modifications to the previous article are small and are given.

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68562

Letter to the Editor

S/141/59/002/05/026/026
E041/E321

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 l. The circuit is shown in Fig 3. The scattering equation of the system is given by:

$$\cos \varphi = \cos kl \left(1 + \frac{C_0 + \tilde{C}_0}{2C_1}\right) - \frac{kC_T}{2C_1} \sin kl, \qquad (1)$$

where k is the wave number, l is the length of the stubs, C_0 and $\tilde{C}_0$ are the capacitances between the

stubs and the "base", respectively; C_1 is the capacitance between neighbouring stubs (per unit length); $j\omega C_T = jB_T$ 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:

$$\mathrm{tg}^2 \frac{kl}{2} = \frac{C_0 + 4 \sum_{n=1}^{m+1} C_n \sin^2 \frac{n\varphi}{2}}{C_0 + 4 \sum_{n=1}^{m+1} C_n \sin^2 \frac{n}{2}(\varphi + \pi)} \qquad (2)$$

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

$$K^m_{\alpha\beta} = \frac{E^m_\alpha E^m_\beta}{2h^2_m P}, \qquad (6)$$

where E^m_α and E^m_β are the spatial harmonics of the electric field component, which interact with the electron beam of the system; h_m 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 Amplifiers

"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 cm wavelengths. The method of evaluating the dispersion characteristics proposed by the author is comparatively simple and is sufficiently accurate for most practical applications.

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

SUBMITTED: July 9, 1957

9.1000

75341
SOV/57-29-10-13/18

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. V., the authors of the paper state that apparently Braude, B. V., somewhat modified his original views with which the authors did not agree and which were erroneous. There are 2 Soviet references.

Card 1/1

21(3)

AUTHORS: Gaponov, A. V., Freydman, G. I. SOV/56-36-3-65/71

TITLE: On Electromagnetic Shock Waves in Ferrites (Ob udarnykh elektromagnitnykh volnakh v ferritakh)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 3, pp 957 - 958 (USSR)

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 $\vec{B}$ and field strength $\vec{H}$ 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 $\vec{H}_0$, 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 $\vec{M}$ (magnetization) and $\vec{H}$ (z,t) it holds that

$$\partial\vec{M}/\partial t = \gamma\left[\vec{M},\vec{H} + \vec{H}_o\right] - \lambda M^{-2}\left[\vec{M}\left[\vec{M}, \vec{H} + H_o\right]\right] \quad (3)$$

(γ= magnetomechanical ratio for the electron spin, $\lambda = 1/\tau_o$ = relaxation frequency). Further, the case $T \gg \tau_o$ is subjected to a short investigation. As it is found impossible to write down a general solution of the Maxwell equation 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. The result shows that $\vec{M}$ rotates round the direction of propagation of the wave z (precision angle φ) with the velocity $\omega = \partial\varphi/\partial t$, $\omega = \gamma\left\{H_y' \cos\theta/\sin\theta' - (H_o - 4\pi M \cos\theta)\right\}$ (θ = 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 wave 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

SOV/56-36-3-65/71

ASSOCIATION: Radiofizicheskiy institut Gor'kovskogo gosudarstvennogo universiteta (Radiophysical Institute of Gor'kiy State University)

SUBMITTED: December 18, 1958

Card 3/3

69416

S/141/60/003/01/008/020
E032/E414

24.7900

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

TITLE: On the Theory of Electromagnetic Shock Waves in 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 on H. The paper is divided into the following sections.
1. Simple waves in a non-linear isotropic uniform medium. Production of discontinuities.
2. Conditions on the Discontinuity Surface.
3. Structure of the shock wave front.
4. 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 is

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

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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E032/E414

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 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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9.4230

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E192/E382

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

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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_o is described by the following nonrelativistic equation:

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

where $\underline{E}_\sim$ and $\underline{H}_\sim$ are the high-frequency electric and magnetic fields, $\underline{E}_o$ is the electrostatic field having components E_{ox} and E_{oy}, e is the charge of an electron, m_o is its rest mass and $\eta = e/m_o$. If the motion along the axis z is uniform and if the high-frequency field can be

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

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

The zero approximation of the electron motion can be described by Eqs. (3), where the function E_x 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 $T_E = 2\pi/\omega_E$ 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 $E_\sim$ is the x-component of the high-frequency electric field. The general solution of this homogeneous equation should be

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in the form of Eq. (6), where $u(\tau)$ is a periodic function of time, C_1 and C_2 are arbitrary constants and M is the so-called parameter of non-isochronism, which is proportional to the derivative of the oscillation frequency ω_E with respect to the oscillator energy W_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_0 is the velocity corresponding to the drift velocity v_0 and V_0 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_0 is the beam current, N is a normalising coefficient and $\tau = z/v_0$ is the transit time of an electron

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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:

$$\delta(\delta - \varepsilon)^2 = - C_m^3 = - \frac{I_o}{2U_o} \frac{h_e}{a_1^2 h_o^3 N} M \left| G_m \right|^2 \quad (12)$$

where only the resonance terms of the order $\left[\delta(\delta - \eta)^2\right]^{-1}$ are considered. This equation determines the correction factors to the propagation constants $\delta h_o = h - h_o$. Eq. (12) is analogous in form to the dispersion equation of the normal travelling-wave tube of the type "O". 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 $(\delta - \varepsilon)^{-1}$. 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 δ. 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

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absence of absorption is given by:

$$G = - 9.54 + 47.3\ CL/\lambda$$

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 $\Gamma(z)$ 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_o 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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21176

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E192/E382

9,1300 (also 1130)

AUTHORS: Antakov, I.I., Bokov, V.M., Vasil'yev, R.P. and Gaponov, A.V.

TITLE: Interaction Between a Trochoidal Electron Beam and Electromagnetic Waves in a Rectangular Waveguide

PERIODICAL: 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 $h_o(1 + \varepsilon) = h_e + mh_H$ or:

$$\omega = \frac{m\omega_H}{(1 + \varepsilon)v_{\parallel}/v_{\phi} - 1} \qquad (1)$$

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where $m = 0, \pm 1, \pm 2, \ldots$ $|\varepsilon| \ll 1$ and $h_o = \omega/v_{\phi}^{(0)}$ is the propagation constant of the corresponding normal wave in a "cold" waveguide; $v_{\parallel} = E_o/B_o$ is the drift velocity of the electrons moving along a trochoid and having an oscillation amplitude a in crossed fields E_o and B_o ; $h_e = \omega/v_{\parallel}$, $h_H = \omega_H/v_{\parallel}$, $\omega_H = (e/m)B_o = \eta B_o$ 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 $\delta = (h - h_o)/h_o$ 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):

$$E_y = h_n \cos(\varkappa_n x)\, \mathrm{ch}(\gamma y); \quad H_x = -\frac{k^2 - \varkappa_n^2}{kZ_0} \cos(\varkappa_n x)\, \mathrm{ch}(\gamma y); \qquad (3) \qquad (3)$$

$$H_z = -i\frac{h_n \varkappa_n}{kZ_0} \sin(\varkappa_n x)\, \mathrm{ch}(\gamma y).$$

where I_o is the beam current,

$U_o = v_{\parallel}^2/2\eta$ is the voltage corresponding to the drift velocity,

$\beta_{\perp} = v_{\perp}/c$ (where c is the velocity of light, $v_{\perp}$ is the transverse electron velocity),

G_{xp}, G_{yp}, G_{zp} are the Fourier coefficients of the high-frequency Lorenz force acting on an electron moving along a stationary trajectory in the field of a non-perturbed normal wave,

N is the normalising coefficient of this wave.

Eq. (2) is used to analyse the interaction between the H_{01}-wave in a smooth-walled rectangular wave with the 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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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 "O", i.e. the self-phasing and the spatial debunching, are equally effective and can be employed in microwave amplifiers and oscillators. There are 6 figures and 11 references: 10 Soviet and 1 non-Soviet.

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ASSOCIATION: Nauchno-issledovatel'skiy radiofizicheskiy institut pri Gor'kovskom universitete (Scientific Research Radiophysics Institute of Gor'kiy University)

SUBMITTED: July 13, 1960

83182

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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'noy i teoreticheskoy fiziki, 1960, Vol. 39, No. 2(8), pp. 326-331

TEXT: A current of charged particles 19 which moves rectilinearly and uniformly (velocity v) is instable with respect to electromagnetic disturbances if v is greater than the velocity of light in the surrounding medium c_n. 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 coherent 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 $v < c_n$. 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

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The Instability of a System of Excited Oscillators With Respect to Electromagnetic Disturbances S/056/60/039/002/019/044 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_0, 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 $\vec{e} = \vec{e}(\vec{r})e^{i\omega t}$, $\vec{h} = \vec{h}(\vec{r})e^{i\omega t}$ 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 oscillator in weak external field, two different phasing mechanisms are possible: 1)"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

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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 Soviet, 1 US, and 1 Swedish.

X

ASSOCIATION: Radiofizicheskiy institut Gor'kovskogo gosudarstvennogo universiteta
(Institute of Radiophysics of Gor'kiy State University)

SUBMITTED: February 1, 1960

Card 3/3

9,3130(1539,1538)
9,4230

32765
S/141/61/004/005/016/020
E/E382

AUTHOR: Gaponov, A.V.

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

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Radiofizika, 1961, v. 4, no. 3, pp. 547 - 559

TEXT: The results presented in this work were reported in a paper read at the 13th 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.M. 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

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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 electon 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:

$$E_\omega = \sum_s \left(V_s^+ E_s^+ + V_s^- E_s^- \right) - \frac{4\pi}{i\omega} (j_\omega Z_0) Z_0;$$

$$H_\omega = \sum_s \left(V_s^+ H_s^+ + V_s^- H_s^- \right), \qquad (1)$$

where $\underline{E}_s^{\pm} = \underline{e}_s^{\pm} e^{\mp ik_{os} z}$ and $\underline{H}_s^{\pm} = \underline{h}_s^{\pm} e^{\mp ik_{os} z}$ are the intensities of the electric and magnetic fields of the normal waves at the frequency ω, respectively, $\underline{Z}_o$ is the unit vector of the axis z, which is parallel to the axis of the waveguide and $\underline{j}_\omega$ is the Fourier component of the current

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Relativistic scattering ....

density $\underline{j}(t) = \int \underline{j}_\omega e^{i\omega t} d\omega$. 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 $\underline{r} = \underline{r}(\tau, t)$ and the expression for V_s is integrated with respect to the transit time τ (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

$$r = r_0(\tau) + r_{1\omega}(\tau) e^{i\omega t} \qquad (|r_{1\omega}| \ll D);$$
$$\tau = \tau_0(z) + \tau_{1\omega}(z) e^{i\omega t} \qquad (|\tau_{1\omega}| \ll T)$$

where $\underline{r}_0$ is the stationary value of $\underline{r}$. The amplitudes can thus be written as:

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Relativistic scattering ....

$$V_s^{\pm} = \pm \frac{I_0}{N_s} \left\{ i\omega \int_{\tau_0^{1,2}}^{\tau_0(t)} r_{1\omega} \left[G_s^{\pm} \{ r_0(\tau) \} \right]^* d\tau + \right.$$

$$\left. + \int_{\tau_0^{1,2}}^{\tau_0(\tau)} \left[r_{1\omega} + v_0(\tau)\, \tau_{1\omega} \right] E_s^{\pm} \{ r_0(\tau) \} \right\}, \qquad (2)$$

where $\tau_o^{1,2}$ are transit times corresponding to the start and termination of the beam,

I_o is the DC component of the beam current,

N_s is the normalising factor and

$\underline{v}_o(\tau)$ is the electron velocity in a non-perturbed beam.

The quantity $\underline{G}_s^{\pm}$ is the Lorentz force, which is defined by:

$$\underline{G}_s^{\pm} = \underline{E}_s^{\pm} + \frac{1}{c} \left[\underline{v}_o \underline{H}_s^{\pm} \right] \qquad (3) .$$

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