KONTOROVICH, ISAAK YEFIMOVICH.

Termicheskaia obrabotka stali i chuguna. Dop. v kachestve uchebn. posobiia dlia tekhn. vyssh. uchebn. zavedenii. Moskva, Metallurgizdat, 1950. 683 p. illus. ports.

Bibliography: p. (680)-683.

(Heat treatment of steel and cast iron.)

DLC: TN731.K6h2

SO: Manufacturing and Mechanical Engineering in the Soviet Union, Library of Congress, 1953.

KONTOROVICH, I. Ye.

PHASE I TREASURE ISLAND BIBLIOGRAPHICAL REPORT AID 340 - I

BOOK Call No.: TN672.V8

Author: KONTOROVICH, I. YE, and VINOGRADSKAYA, YE. L.

Full Title: TRANSFORMATION OF AUSTENITE TO LOW CARBON STEEL WITH VARIABLE CONTENTS OF CHROMIUM AND MANGANESE

Transliterated Title: Prevrashcheniye austenita v malouglerodistoy stali s peremennym soderzhaniyem khroma i margantsa

Publishing Data

Originating Agency: All-Union Scientific Engineering and Technical Society of Machine Builders. Urals Branch

Publishing House: State Scientific and Technical Publishing House of Machine Building Literature ("Mashgiz")

Date: 1950 No. pp.: 8 No. of copies: 3,000

Text Data

This is an article from the book: VSESOYUZNOYE NAUCHNOYE INZHENERNO-TEKHNICHESKOYE OBSHCHESTVO MASHINOSTROITELEY. URAL'SKOYE OTDELENIYE, THERMAL TREATMENT OF METALS - Symposium of Conference (Termicheskaya obrabotka metallov, materialy konferentsii) (p. 73-80) see AID 223-II

Coverage: The experimental data on the effects of different concentrations of chromium and manganese on the alloyed steels' stability and on transformation of austenite are discussed

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KONTOROVICH, I. E.

1 9/3

4X2+

Nature of the hardness of stable and metastable structure in the iron-nitrogen system. I. E. Kontorovich and A. A. Sovalova. *Zhur. Tekh. Fiz.* 20, 53-65(1950).—Samples of com. Fe were nitrided at 640–800° and the Vickers hardness was detd. at the surface and at 0.02 mm. intervals from the surface by successive removal of nitrided layers between hardness detns. Specimens quenched after nitriding had a surface hardness of 224–340 and a max. hardness, ranging up to 700 for specimens nitrided at 700°, at a distance 0.06–0.10 mm. from the surface. Specimens nitrided at 670° and cooled slowly had a surface hardness of 330 decreasing uniformly to 130 at a depth of 0.22 mm. Microscopic examn. of the nitrided specimens indicated that the solid soln. of N in γ-Fe (nitrided austenite) upon slow cooling underwent eutectoid decompn. with formation of a mixt. of the α and γ′ phases having a hardness of 180. Nitrided austenite contg. over 2% N did not transform when quenched; when the N concn. was below 2% a martensitic structure was formed; when N was very low a ferrite-nitride mixt. similar to troostite and sorbite was formed. Nitrided austenite had a hardness of 220–260, nitrided martensite 560–700, ferrite-nitride mixt. 350–500, nitrided ferrite 130–160, nitrided phases having a columnar structure 458–687, and the mixt. of nitrides on the surface 224–340. H. W. Rathmann

KONTOROVICH, I. Ye.

"On the Nitriding of Steel for Surface Strengthening," pp. 61/80 in Modern Methods of Heat Treating Steel by Dom Inzhenera i Tekhnika imeni F E Dzerzhinskovo. Gosudarstvennoye Nauchno-Tekhnicheskoye Izdatel'stvo Mashinostroitel'noy Literatury, Moscow (1954) 404 pp.

Evaluation B-86350-30 June 55

KONTOROVICH, I.E.

1614* Effect of Electrical Heating on Phase Transformations in Carbon and Chromium Steels. Vliianie elektronagreva na fazovyye prevrashcheniia v uglerodistoi i khromistoi stalliakh. (Russian.) I. E. Kontorovich and A. G. Vinitskii. *Metallovedenie i obrabotka metallov*, 1955, no. 2, Aug., p. 21-25.

Effect of rate of heating on transformation temperature and resulting perlitic and sorbitic structures; effect of temperature and rate of electrical heating on transformation time; change of hardness and electrical resistivity in relation to temperature and rate of heating; effect of Cr in C steel on transformation temperature and time. Graphs, tables. 2 ref.

M6

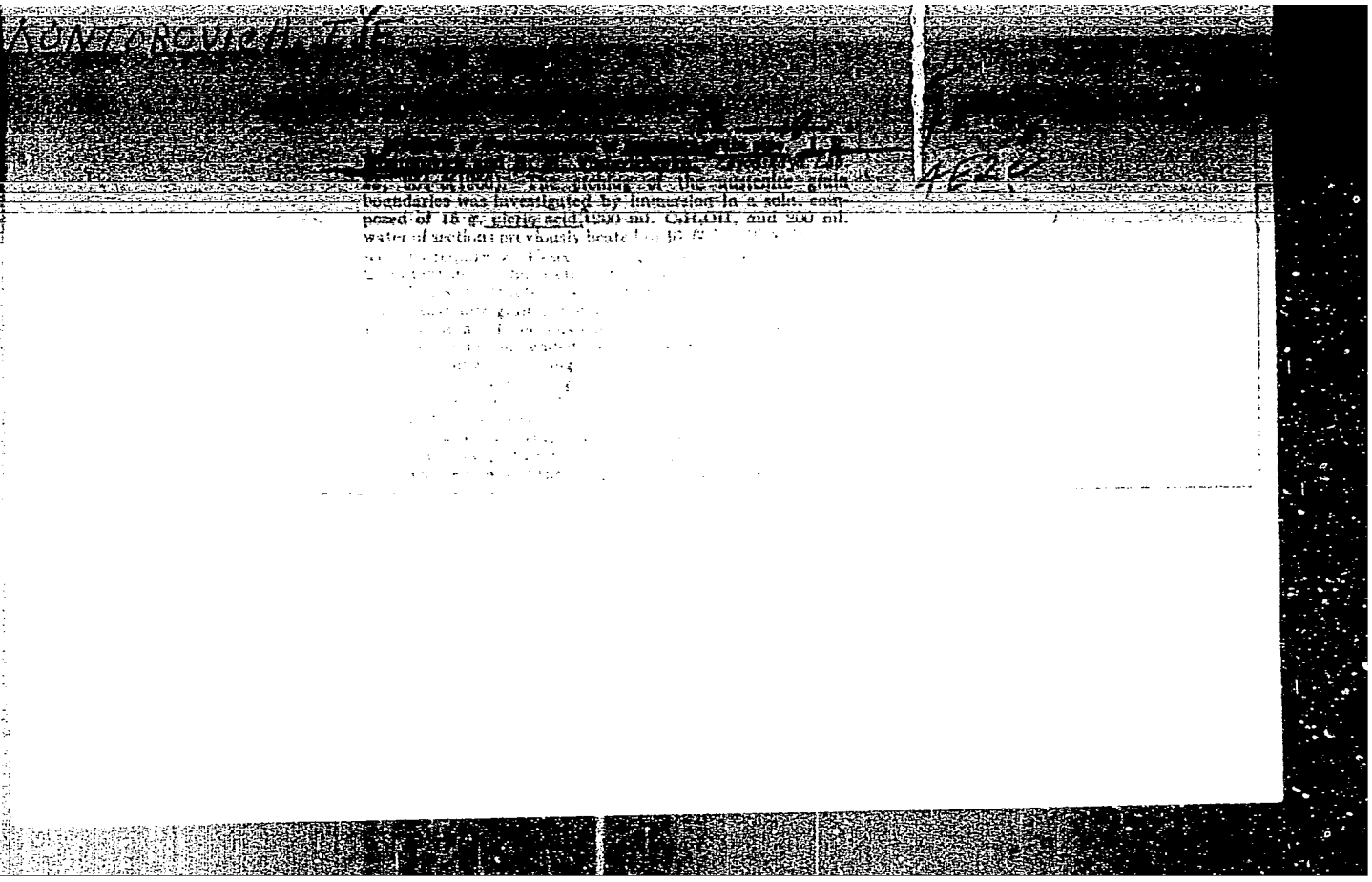
KONTOROVICH, I.Ye.

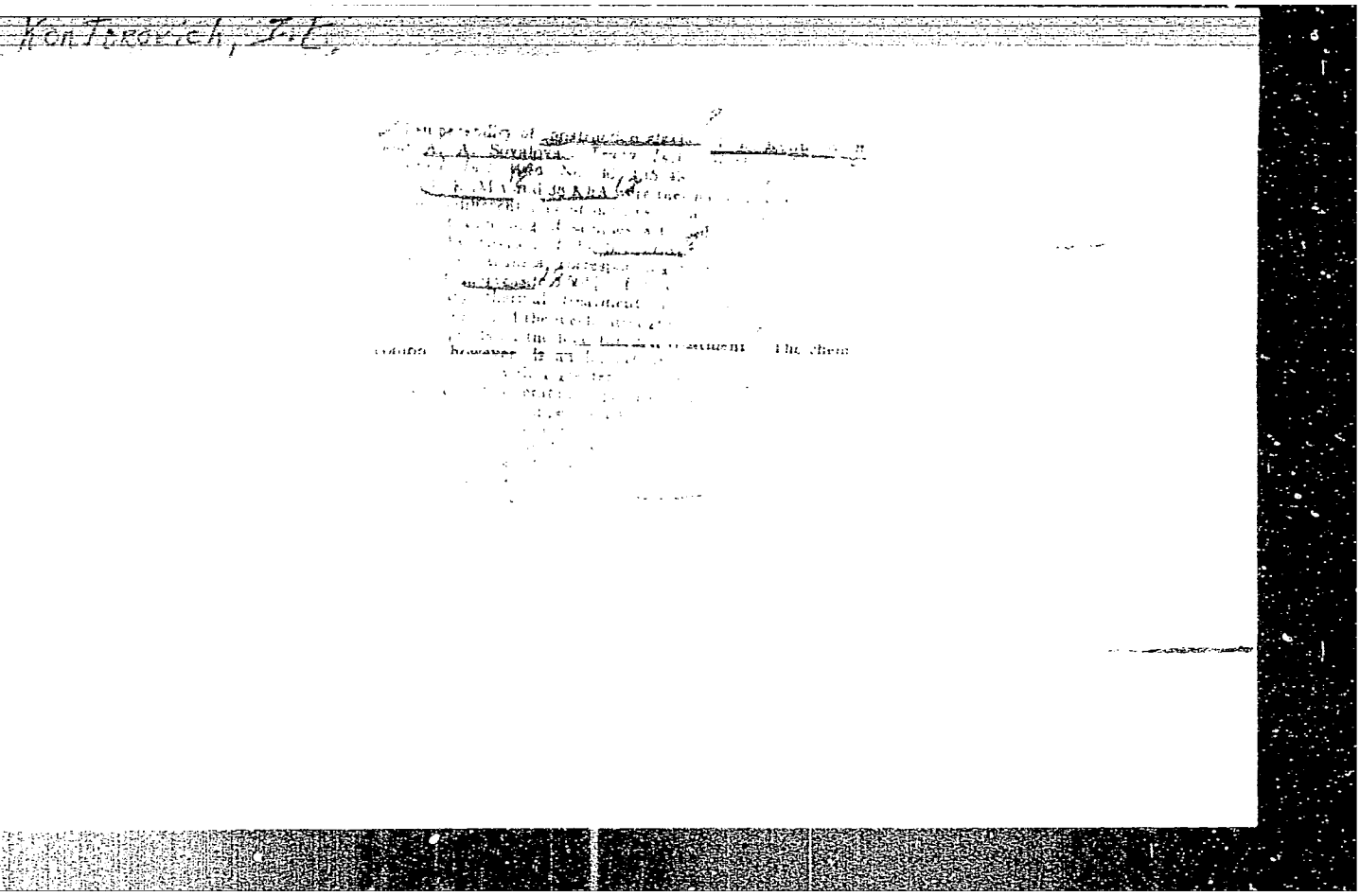
Influence of small quantities of certain alloying constituents on temper brittleness. Fiz.met. i metalloved. 3 no.3:553-555 '56.
(Steel--Brittleness) (MLRA 10:3)

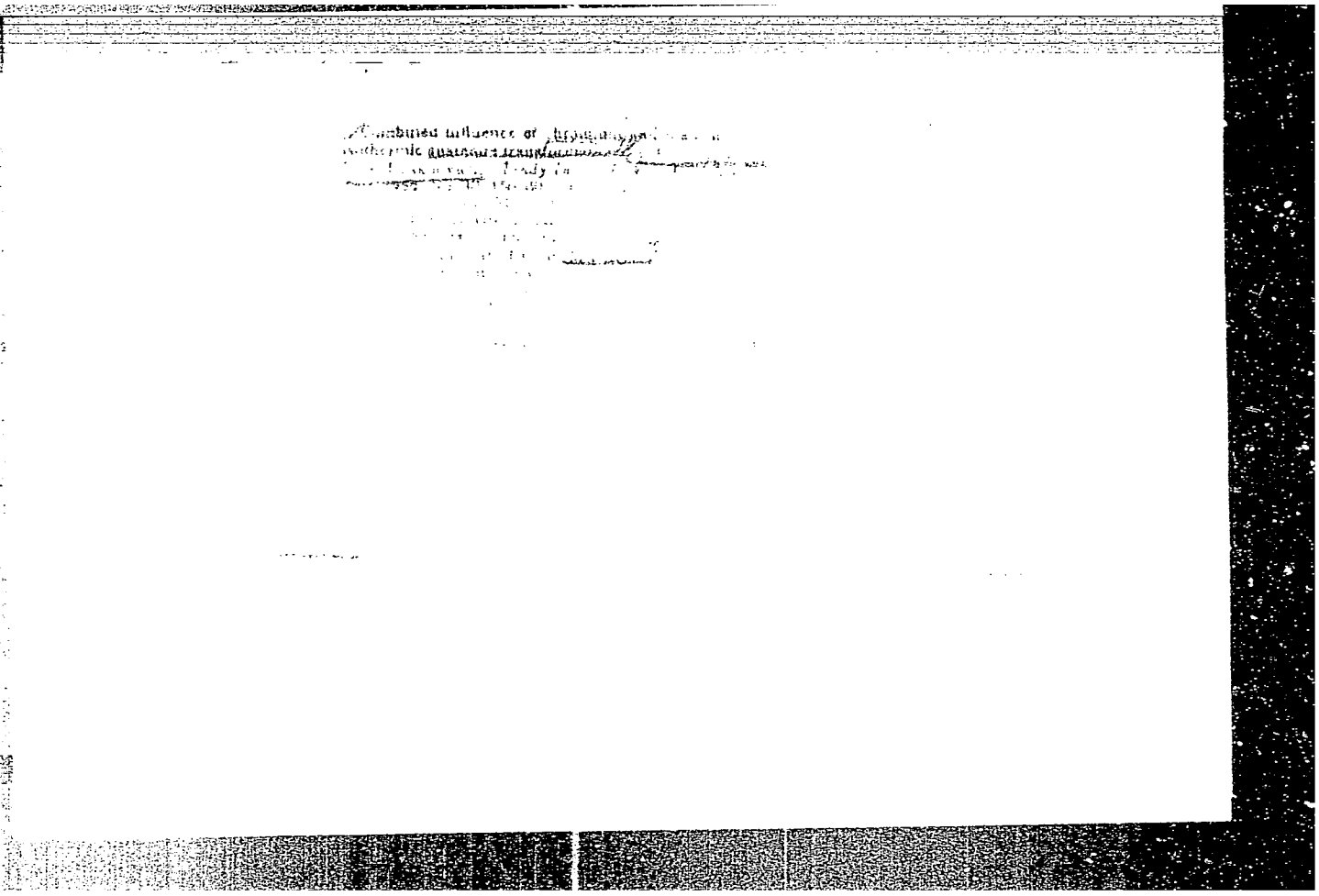
KONTOROVICH, I.Ye., doktor tekhnicheskikh nauk, professor; VOSHCHENKO, B.M., inzhener.

Critical temperature of the transition between the viscous state and the semi-brittle state in structural steel. Metalloved.i obr.met. no.5:19-24 My '56. (MLRA 9:8)

1. Moskovskiy aviatsionnyy tekhnologicheskiy institut.
(Steel, Structural)





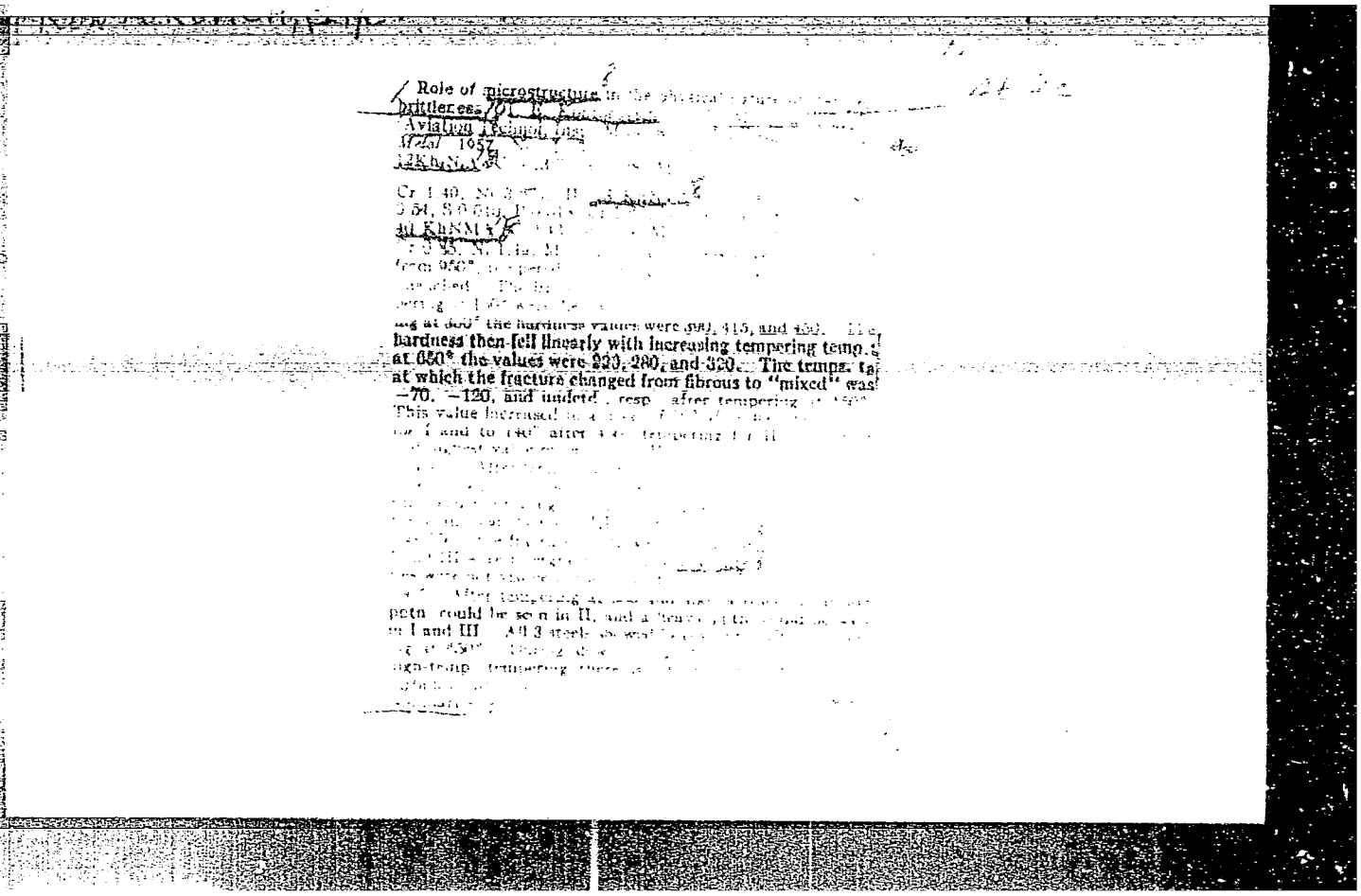


KONTOROVICH, I.Ye., professor, doktor tekhnicheskikh nauk; VINITSKIY, A.G., inzhener.

Effect of electric heating on phase transformations of carbon and chromium steels. Trudy MATI no.30:174-186 '56. (MLRA 10:2)
(Steel--Heat treatment)

KONTOROVICH, I.Ye., professor, doktor tekhnicheskikh nauk; DARCHINOV, E.N., inshener.

Investigating the transformation of pearlite to austenite. Trudy MATI no.30:187-195 '56. (MLRA 10:2)
(Pearlite) (Austenite)



Role of microstructure
brittleness
Aviation
1952
hardness then fell linearly with increasing tempering temp.;
at 650° the values were 320, 280, and 320. The temps. ta
at which the fracture changed from fibrous to "mixed" was
−70, −120, and indefd., resp. after tempering
This value increased
and to
ptn could be seen in II, and a
in I and III

KONTOROVICH, I. YE.

137-58-5-10535

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 5, p 236 (USSR)

AUTHOR: Kontorovich, I. Ye.

TITLE: On the Stability of Austenite and the Hardenability of Steel (Ob ustoychivosti austenita i prokalivayemosti stali)

PERIODICAL: Sb. tr. Mosk. vech. metallurg. in-ta, 1957, Nr 2, pp 156-162

ABSTRACT: An investigation is made of steel containing 0.14% C, 0.76-0.79% Cr, 2.75-2.80% Ni, and the same steel with 0.10% Be addition. Magnetometric analysis is employed to plot curves of isothermic decomposition of austenite, and the hardenability of the steel is determined by the end quench test. The major criterion formerly employed to judge the hardenability of steel - incubation time in the temperature interval of minimal austenite stability - is invalid in the case of Be alloy steel. When Be is added to the steel, the length of the incubation period does not undergo any significant change, while the hardenability of the steel increases markedly(a critical section 2.5 times as large will harden throughout). (The increase in hardenability is accompanied not by a rise but by some diminution in grain size

Card 1/2

On the Stability of Austenite and the Hardenability of Steel

from 5 or 6 point to 6 or 7 point, and not by a decline in the temperature of A_r transformations, but by an increase therein by 10°C for A_{r_1} and by 15° for A_{r_3}. In the presence of small amounts of Be there is a significant decline in the rate of austenite transformation. This is related to the effect of Be on hardenability. The effect of Be on the rate of transformation may be related to a diminution in the number of centers of crystallization coming into being per unit time and to the rate of crystal growth. The change in the parameters of crystallization on addition of Be to steel is related to the fact that Be concentrates primarily in the boundary layers and has little effect on change in the chemical composition of the grain of the solid solution. The change in the nucleation rate in the boundary layers of austenite grains creates compressive stresses within the grain, and these make it difficult for austenite to transform to martensite or to a mixture of ferrite and cementite. The extent of this pressure depends upon the thickness of the boundary layer, and this is related to the amount of additive stabilizing the grain boundary.

1. Steel--Hardening 2. Austenite--Stability

L. M.

Card 2/2

137-58-6-13376

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 6, p 319 (USSR)

AUTHORS: Kontorovich, I. Ye., Dalyayeva, L. I.

TITLE: On the Changes in Properties of Nitrided Iron After Tempering (Ob izmenenii svoystv azotirovannogo zheleza posle zakalki)

PERIODICAL: Sb. tr. Mosk. vech. metallurg. in-t, 1957, Nr 2, pp 163-175

ABSTRACT: The hardness of nitrided Armco iron was investigated after the latter has been subjected to tempering at temperatures of 600-750°C for periods ranging from 15 to 60 minutes. It is established that the hardness of a nitrided layer after tempering is attributable not only to the concentration of N achieved in different zones in the course of the nitriding processes, but that it is also related to variations in the N content which occur during repeated heating processes, the duration of which is of great importance. At relatively low temperatures of heating (600°), maximum hardness of a layer containing $\varepsilon + \gamma'$ phases is obtained only after a considerable exposure. At increasing temperatures and greater rates of diffusion of N into the iron, shorter exposures are required to achieve maximum hardness; variations in the duration of exposure affect

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137-58-6-13376

On the Changes in Properties of Nitrided Iron After Tempering

also the hardness of zones with columnar crystals as well as austenite-martensite zones. Every value of tempering temperature has a corresponding optimal exposure time. By means of a proper selection of optimal heating temperatures and holding periods it should be possible to attain a high degree of hardness directly on the external surface of a nitrided layer.

A. M.

1. Iron alloys--Hardening 2. Iron alloys--Heat treatment 3. Iron alloys--Phase studies 4. Nitrogen--Metallurgical effects

Card 2/2

137-58-4-8439

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 4, p 303 (USSR)

AUTHORS: Kontorovich, I. Ye., Semenchenkov, A. T.

TITLE: The Structure of Alloys of the Titanium-aluminum System (Stroyeniye splavov sistemy titan-alyuminiy)

PERIODICAL: Sb. tr. Mosk. vech. metallurg. in-t, 1957, Nr 2, pp 176-186

ABSTRACT: The structure and certain properties of Ti-Al alloys of up to 67 atomic % of Al were studied. The alloys were made of sponge Ti 99.80% pure and sheet Al 99.99% pure, the residue being 0.0035% Fe, 0.0025% Si and 0.0050% Cu. Smelting was in an arc furnace with water-cooled Cu bottom plate and a W electrode at 250-300 mm Hg Ar atmosphere. During smelting the alloys were shielded from saturation by gases (O_2 and N_2) having a powerful effect upon their properties. Ti alloys with 8, 15, 30, 44, 57, and 67 atomic % Al were made. The specimens were annealed in quartz ampoules exhausted at 1300°C for 1 hour, at 960° for 50 hours, and at 850° for 200 hours with subsequent quenching in water. Microscopic analysis was employed; hardness and microhardness were also studied. The work confirmed the existence of phase regions in the Ti-Al diagram and revealed

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137-58-4-8439

The Structure of Alloys of the Titanium-aluminum System

the structure of the alloys with up to 67 atomic % Al. It was shown that specimens hardened from the β region undergo diffusionless transformation of the β phase into spicular α' phase by a $\beta \rightarrow \alpha$ reaction. When alloys containing >15 atomic % Al are quenched, a solid α solution is found in the $\alpha+\beta$ region. Al very effectively increases the hardness of Ti, which rises from 200 units for pure Ti to 507 for an alloy containing 44 atomic % Al ($\alpha+\gamma$). When the Al contents are still higher (up to 67 atomic %), hardness drops to 415. Alloys containing high amounts of Al (57 and 67 atomic %) (γ and $\gamma+TiAl_3$ regions) are excessively brittle.

E. K.

1. Aluminum-titanium alloys--Microstructure 2. Aluminum-titanium alloys --Properties

Card 2/2

Kontorovich, I. Ye.

AUTHORS: Kontorovich, I. Ye., and Voshedchenko, B. M. 126-2-19/35

TITLE: Influence of overheating on the properties of heat treated structural steels. (Vliyaniye peregreva na svoystva termicheski obrabotannykh konstruktsionnykh staley).

PERIODICAL: Fizika Metallov i Metallovedeniye, 1957, Vol.5, No.2, pp. 340-348 (USSR)

ABSTRACT: There is no generally accepted opinion on the influence of the initial austenite grain on the microstructure, fracture and the mechanical properties of the steel after repeated recrystallization. The authors carried out experiments with the aim of establishing the influence of the character of the micro-structure and the appearance of the fracture on the mechanical properties of certain structural steels after preliminary overheating and subsequent recrystallization within a wide range of temperatures. The experiments were carried out with specimens made of three grades of steel with chromium contents between 1.49 and 0.75% and Ni contents of 3.67 to 1.48%, the chemical compositions of which are given in Table 1, p.340. Plates of 100 x 60 x 12 mm were heated at 900, 1000, 1100, 1200 and 1300°C for 75 minutes and then cooled in air. Following that, the

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Influence of overheating on the properties of heat treated structural steels.

of steel 12X2H4A (tempered at 650°C, cooled in the furnace and tested at 20°C). The graphs, Fig.2, show the influence of the temperatures of double recrystallization on the impact strength of structural steels (tempered at 650°C, cooled in the furnace). The graph, Fig.4, shows the change of impact strength of two of the tested steels as a function of the temperature of preliminary overheating (final hardening from 850°C in oil, tempering at 650°C followed by cooling in the furnace, testing at 20°C). Figs. 3, 5, 6 and 7 represent microstructures after various treatment programmes. Comparison of the mechanical properties shows that these either do not change at all or increase slightly with increasing temperature of preliminary heating and final hardening. In the case of impact test of structural steel specimens at temperatures corresponding to the semi-brittle state, intergrain formations also have an influence, in addition to the influence of the structure of the austenite grain. Depending on the subsequent cooling speed of the steel two types of structure may form, namely, a martensite-troostite structure with a definite orientation relative to the crystallographic planes of

Kontorovich, I.Ye.

AUTHORS: Kontorovich, I.Ye., Voshedchenko, B.M. 32-11-37/60

TITLE: Determination of the Critical Interval of Brittleness in the Extension of Samples With a Smooth Surface (Opredeleniye kriticheskogo intervala khrupkosti pri rastyazhenii gladkikh obraztsov)

PERIODICAL: Zavodskaya Laboratoriya, 1957, Vol. 23, Nr 11, pp. 1362-1365 (USSR)

ABSTRACT: It is said in the introduction that this field has not yet been sufficiently investigated, above all because the brittle destruction of the smooth samples is difficult to attain even at - 196° C, and also because of the lack of suitable methods of determination. In this work a method for the determination of the critical temperature of brittleness in the case of extension up to fracture of the annealed smooth samples of constructional steels is described. As samples the steels 12X2H4A and 23X2B A in form of rods 11 11 75 mm were used. They were first hardened at 1200° in oil and were then annealed at 650° (within 60 min.) with following cooling in the furnace (30-50° per hour). Herefrom the "shortened Gagarin samples" were made. (It may be seen from the drawing that the bolts have a length of 58 mm, are provided with a thread, and the threadless part has a length of 30 mm). Tests were carried out on a traction engine "P5" at a maximal stress of 5000 kg, and extension was automatically recorded. Extension in the case of

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Determination of the Critical Interval of Brittleness in the Extension of Samples With a Smooth Surface

32-11-37/60

cooling down to 196° was carried out by the application of a thermostat system consisting of a vessel which was mounted on the traction shaft and was filled for cooling with liquid nitrogen or, because of the less low temperatures of liquid nitrogen, with liquid nitrogen diluted with gasoline. The vessel contained the sample which, screwed on to the two ends of the shaft, was connected with the traction engine. A thermocouple was elastically connected with the sample. In the course of a series of tests carried out up to the point of breaking the diagrams of the extension of the samples were constructed. Investigations are described which were carried out with a view of avoiding certain kinds of fracture caused by tearing. There are 4 figures.

AVAILABLE: Library of Congress

Card 2/2

KONTOROVICH, I. Ye.

PHASE I BOOK EXPLOITATION SOV/1558

Moscow. Dom nauchno-tekhnicheskoy propagandy im. F.E. Dzerzhinskogo

Sovremennyye splavy i ikh termicheskaya obrabotka (Contemporary Alloys and Their Heat Treatment) Moscow, Mashgiz, 1958. 329 p. 12,000 copies printed.

Additional Sponsoring Agency: Obshchestvo po rasprostraneniyu politicheskikh i nauchnykh znaniy RSFSR.

Ed. (Title page): Yu. A. Geller, Doctor of Technical Sciences; Ed. (Inside book): V.V. Rzhevinskiy, Engineer; Tech. Ed.: B.I. Model'; Managing Ed. for Literature on Metal Working and Tool Making: R.D. Beyzel'man, Engineer.

PURPOSE: The book is intended for engineering and technical personnel of heat-treatment shops and test laboratories of machine-building plants.

COVERAGE: This collection of 26 articles, compiled by 33 authors, aims to acquaint the reader with modern practice in the heat treatment of steels. The authors are primarily concerned with the development of various types of structural, tool, and heat-resistant steels and with the use of their alloying elements. Materials-handling equipment is described at some length. The treatment of alloys, particularly those of titanium, [illegible] within the scope of the collection. The book is thoroughly diagrammed, and a good deal of the material is shown in graphical form. Among the problems dealt with are the minimization of deformations, the introduction of the automatic control of heat-treating equipment, together with fully mechanized tool manufacture, and the optimum proportions of different alloying elements. There are numerous tables and drawings. Bibliographic listings placed at the end of chapters are predominantly Soviet. The articles comprising this collection are reports delivered at a conference held in the Scientific and Technical Propaganda House imeni F.E. Dzerzhinskiy in Moscow.

Contemporary Alloys and Their Heat Treatment SOV/1558

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SOV/137-58-9-19964

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 9, p 268 (USSR)

AUTHORS: Kontorovich, I.Ye., Voshedchenko, B.M.

TITLE: Effect of Isothermal Quenching Upon the Temper Brittleness of 12Kh2N4A Steel (Vliyaniye izotermicheskoy zakalki na otpusknuyu khrupkost' stali 12Kh2N4A)

PERIODICAL: V sb.: Metallovedeniye i term. obrabotka. Moscow, Metallurgizdat, 1958, pp 104-111

ABSTRACT: An investigation is made of the influence of heating temperature in isothermal quenching and tempering, and of the effects of methods of cooling upon the temper brittleness of Nr 12Kh2N4A steel. Specimens were quenched from temperatures of 800, 900, 1100, and 1250°C in a potassium nitrate bath at 380-400°, being held for 15 minutes, and were tempered at 350, 450, 550, and 650° with cooling in water and in the furnace. In quenching from 800° and tempering at 450° the critical temperature of brittleness is minimal. An increase to 1250° in the temperature to which the metal is heated for hardening increases the critical temperature for brittleness from -30 to + 140°. An increase in the tempering temperature from 450 to 650° with water cooling

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SOV/137-58-9-19964

Effect of Isothermal Quenching Upon the Temper Brittleness (cont.)

reduces the critical temperature for brittleness in the entire interval of temperatures for hardening and increases the value of a_k.

F.U.

1. Steel---Mechanical properties 2. Steel--Temperature factors 3. Steel--Test methods

Card 2/2

SOV/126-6-5-8/43

AUTHORS: Kontorovich, I.Ye., and Mermel'shteyn, Yu.M.

TITLE: Influence of Grain Sizes on the Diffusion of Carbon in Iron (Vliyaniye velichiny zerna na diffuziyu ugleroda v zheleze)

PERIODICAL: Fizika Metallov i Metallovedeniye, 1958, Vol 6, Nr 5, pp 812 - 818 (USSR)

ABSTRACT: A distinction is made between diffusion through grain boundaries and grain bodies, the former being faster in some cases than the latter. Thus, in such cases, diffusion of an element through a polycrystalline metal aggregate is faster than through a monocrystal of the same metal, this being mainly due to the distortion of the lattice in the boundary layers of polycrystalline metals (Refs 1, 2, 4). However, this does not apply to diffusion of various elements through brass (Refs 3, 5). By applying radioactive silver to brass (Ref 6), it was found that the depth of penetration of silver through the grain boundaries was greater than through the grain bodies, the activation energy of diffusion through the grain boundaries being estimated to be half that occurring through the grain body. Ni, Pd and brass

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Influence of Grain Sizes on the Diffusion of Carbon in Iron

diffuse into commercially pure iron preferentially through grain boundaries, but small quantities of Ti, V, Nb, Mo and B retard the diffusion of nickel along the grain boundaries (Refs 7,8). The diffusion of silver through low palladium Fe-Pd alloys is intercrystalline (Ref 7). Self-diffusion of lead is independent of grain size (Ref 9) but the diffusion rate of radioactive isotopes of lead through fine-grained lead is considerably greater than through coarse-grained. All these data refer to systems forming substantial solid solutions. For interstitial solid solutions, the diffusion conditions and the energetic state are different. Thus, it was found (Ref 11) that the depth of diffusion of nitrogen into fine-grained iron is less than into coarse-grained so that the grain boundaries retard diffusion. The influence of grain size on diffusion of carbon in iron was studied by carburisation. The change in diffusion rate in relation to the austenitic grain size, in which diffusion proceeds during carburisation, was established. The change in austenitic grain size under definite heating conditions can be found from the change

Influence of Grain Sizes on the Diffusion of Carbon in Iron

in the original ferritic grain size, as there is a fundamental relationship between the two. Cylindrical specimens of Armco iron, 15 mm long and 14 mm dia were compressed by 3, 5, 7, 9, 12, 15, 20, 30, 40, 50 and 65% in order to get various grain sizes. After deformation, one part of the specimens were annealed at 680 °C for five hours, after which the recrystallised as well as the unannealed specimens were weighed and carburised in solid media. In order to establish the effect of temperature on the grain size, one part of the deformed specimens were put into an iron tube which was sealed at both ends and placed into the carburisation pot. Thus, these specimens, whilst being heated under the same conditions of temperature, were isolated from the carburising mixture. Carburisation was carried out at 950 °C for various periods of time, after which the specimens were furnace-cooled to room temperature. They were then cleaned and re-weighed and the gain in weight per unit area was worked out. The depth of case and the grain size in various portions of the specimens were determined metallographically. The austenitic grain size

Influence of Grain Size on the Diffusion of Carbon in Iron

was obtained from the cementite network in the hypereutectoid case of the carburised specimens, using Saltykov's method, in which the grain surface area per unit volume is calculated. Results of weight increase of the specimens in relation to different conditions of carburisation are shown in Figure 1. The quantity of carbon absorbed per 1 cm^2 of surface area of the specimen increases with decrease of surface area of the grains per unit volume ($\sum S$) which is equivalent to a coarsening of the structure. There is a linear relationship between the quantity of carbon absorbed and $\sum S$. This also holds true for prolonged heating conditions, but the absolute quantity increases and the difference in gain in weight for the coarse and fine grain states is even greater. Specimens which underwent recrystallisation prior to carburisation gained in weight as the structure became coarser and the $\sum S$ decreased, but the quantity of carbon absorbed was less than for un-recrystallised specimens. Also the difference in weight gain of specimens of different grain size was less than for specimens carburised immediately after deformation. This indicates

that carbon absorption depends on grain size as well as on the energetic state of the grains. For specimens which did not undergo recrystallisation prior to carburisation, the depth of carbon diffusion increased with increase in grain size (see Figure 2). The carbon absorbed during carburisation is concentrated preferentially in the layer nearest to the surface (Figure 3). For specimens carburised after preliminary carburisation the depth of the diffusion layer also increases with increasing grain size (see Figure 4) but the depth of carbon diffusion during carburisation in recrystallised specimens is considerably less than in deformed specimens. Increase of soaking time causes an increase in the average case depth (see Figure 5). This is due to growth of austenitic grains which reduces the quantity of grain-boundary material and hence enables carbon to diffuse more deeply. As the grain size decreases so the amount and size of separated cementite increases. Hence a refinement of structure causes carbon to concentrate in the surface zones and opposes its diffusion in depth. As the grain size increases, the cementite separated

Influence of Grain Size on the Diffusion of Carbon in Iron

in the hyper-eutectoid layer becomes thinner and distributes itself preferentially along the pearlite grain boundaries. As the number of $\sum S$ per unit volume increases, the quantity of cementite increases, the quantity of pearlite decreases and islands of ferrite form. Such anomalies in micro-structure are shown in Figures 6, 7 and 8. There are 9 figures and 11 references, 4 of which are Soviet, 3 German and 4 English.

ASSOCIATION: Moskovskiy vechernIy metallurgicheskiy institut (Moscow Evening Metallurgical Institute)

SUBMITTED: March 5, 1957 (initially)
May 28, 1957 (after revision)

KONTOROVICH, I.Ya., doktor tekhn.nauk prof.; VOSHEDCHENKO, B.M., kand. tekhn.nauk

Effect of heat treatment on the mechanical properties of structural steels at low temperatures. Izv.vys.ucheb.zav.; chern.met. 2 no.7:79-86 Jl '59. (MIRA 13:2)

1. Moskovskiy vecherniy metallurgicheskiy institut. Rekomendovano kafedroy metallovedeniya i termicheskoy obrabotki Moskovskogo vechernego metallurgicheskogo instituta.
(Steel, Structural--Heat treatment)

86940
S/149/60/000/006/015/018
A006/A001

18.1285

AUTHORS: Kontorovich, I. Ye., Semenchenkov, A. T.

TITLE: The Effect of Alloying Elements on Properties of Titanium-Aluminum Alloys

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Tsvetnaya metallurgiya, 1960, Vol. 3, No. 6, pp. 144-148

TEXT: The authors studied the effect of various alloying elements (V, Cr, Mn, Fe, Co, Ni, Cu, W, Mo, Nb and Zr) on alloys of titanium with 2 and 4 atomic % aluminum. For comparison alloys without Al were also investigated. The alloys were prepared from magnesium-thermic titanium (99.5%) containing in %: 0.1 Fe, 0.06 Mg, 0.06 Si, 0.04 C, 0.04 N_2, 0.02 H_2, 0.1 O_2 and $<$ 0.03 Ni. Electrolytical metals of 99.7% purity were used as admixtures. The alloys were melted in a hermetic arc furnace with non-consumable tungsten electrode and a water-cooled copper bottom. The alloys were homogenized at 1000°C for 50 hrs. To prevent oxidation, during annealing they were soldered into evacuated double quartz ampoules. Powder-like Ti was placed in the external ampoule to absorb oxygen penetrating from the atmosphere. After annealing, the alloys were forged into rods from which specimens

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S/149/60/000/006/015/018
A006/A001

The Effect of Alloying Elements on Properties of Titanium-Aluminum Alloys

of 4 mm in diameter and 60 - 70 mm length were made and subjected to microstructural analysis, and measurement of electric resistivity and hardness. It appeared that the alloying elements had different effects on the properties of the alloys investigated. Hardness and electric resistivity were most increased by Co, Fe and Ni; the effect of Mn was less, that of V, Cr, W and Mo still lesser and a minimum effect was produced by Zr and Nb. The main cause of this is the atomic diameter. The greater is the difference between the size of atoms of the solvent and that of the dissolved element, the greater an effect may be expected. The type of the crystalline lattice is another factor affecting the properties of Ti-Al alloys. There are 6 figures and 1 table.

ASSOCIATION: Moskovskiy vechernly metallurgicheskiy institut (Moscow Night School of the Metallurgical Institute) Kafedra metallovedeniya i termicheskoy obrabotki splavov (Department of Metal Science and Heat Treatment of Alloys)

SUBMITTED: October 3, 1959

Card 2/2

68624

18.7100

S/126/60/009/02/011/033
E111/E335

AUTHORS: Kontorovich, I.Ye. and Yemel'yanova, L.G.

TITLE: Transformations and Properties of Iron-nitrogen Phases After Isothermal Holding

PERIODICAL: Fizika metallov i metallovedeniye, 1960, Vol 9, Nr 2, pp 216 - 223 (USSR)

ABSTRACT: Comparatively little work has been published (Refs 3-6) on the structure of iron-nitrogen alloys after rapid cooling. The author's previous work (Refs 4,5) enabled tempering structures obtained with various nitrogen contents to be determined. In the present work the authors describe the study of the kinetics of phase transformations in such alloys by analysis of structures obtained after isothermal holding and hardening. Specimens were of armco iron, nitrided for 6 hours at 670 °C and cooled rapidly to 200-600 °C. After attaining the selected temperature, specimens were held in the bath for various times and quenched in water. Figures 1 and 2 show microstructures of nitrided layers after 3 and 30 min, respectively, holding time at 600 °C; the micro-hardness (determined with a type PMT-3 machine)

Card1/4

Transformations and Properties of Iron-nitrogen Phases After Isothermal Holding

of each layer is marked. Figures 3 and 4 show microstructures after 8 min holding time at 550 and 500 °C, respectively. Figure 5 shows macrohardness (Vickers) as a function of depth for various holding temperatures: each has a maximum. Maximum hardness after a short holding time and that of the products after complete decomposition (3 hours' holding time) is shown (Curves 1, 2, respectively) as functions of holding temperature in Figure 6; the depth of the maximum-hardness zone is shown as a function of isothermal holding temperature in Figure 8. A schematic representation of austenite stability at different temperatures is given in Figure 7. The authors conclude that the surface film of the layer obtained after nitriding at 670 °C consists of a mixture of ε and γ' phases and changes little on lowering holding temperature or on rapid quenching in water; the layer is probably formed during holding in the nitriding process. Decomposition

68624
S/126/60/009/02/011/033
E111/E335

Transformations and Properties of Iron-nitrogen Phases After Isothermal Holding

followed by hardening a martensite-type transformation occurs, giving very hard products. The products of austenite decomposition in iron-nitrogen alloys at sub-critical temperatures are similar to those of iron-carbon except for the apparent absence of needle-like troostite. There are 7 figures and 6 references, 3 of which are Soviet, 1 English and 2 German.

ASSOCIATION: Moskovskiy vecherniy metallurgicheskiy institut (Moscow Evening Metallurgical Institute)

SUBMITTED: January 8, 1959, initially;
September 24, 1959, after revision.

Card 4/4

S/129/61/000/001/002/013
E111/E135

AUTHORS: Bokshteyn, S.Z., Doctor of Technical Sciences, Professor; Gubareva, M.A., Engineer; Kontorovich, I.Ye., Doctor of Technical Sciences; and Moroz, L.M., Candidate of Technical Sciences

TITLE: Peculiarities of the Diffusion of Carbon in Iron

PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov, 1961, No. 1, pp. 10-14 (+ 1 plate)

TEXT: Work by two of the authors (Refs 1-4) and by others (e.g. Refs 2, 3) has shown that diffusion is often non-uniform. This effect could be associated with difference in the activation energy of diffusion (Refs 8-10). In this present work the authors studied diffusion of carbon in technical purity iron (0.03% C) and iron alloys with 0.03% C and 0.14, 0.64 or 2.93% Si. Some alloys also contained a third component: 4.56 or 30% Ni, 0.36 or 1.61% Al, 0.88, 3.77 or 14.13% Cr, 0.21 or 3% Mo, 1.19 or 4.97% W, 0.1 or 2.29% Ti. This enabled the influence of carbide-forming and non-forming elements to be compared. Prismatic specimens 20 mm high and with a 10 mm base were used. C^{14} was deposited on the surface

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S/129/61/000/001/002/013
E111/E135

Peculiarities of the Diffusion of Carbon in Iron

from barium carbonate or from special specimens containing this isotope. The first technique was used for studies in the gamma, the second in the alpha states. Auto-radiographs were obtained on type НИКФИ (NIKFI) plates, contact prints being examined micro-photometrically with a type МФ-4 (MF-4) instrument. The diffusion coefficient was calculated by the method of Bokshteyn et al (Ref.11). Microstructural analysis was also carried out. Autoradiographs and microstructures for iron at 950 °C are shown in Fig.1a and b. Autoradiographs at 550 °C for alpha iron (unalloyed and with 0.64% Si, top and bottom, respectively) are shown in Fig.2a and b. Fig.5 shows plots of darkening against depth of diffusion of carbon in the grains (top curve) and along boundaries (bottom curve in each of the two diagrams), for ferrite (550 °C). The influence of concentration of the different alloying elements on depth of diffusion (mm) in iron at 950 °C is shown in Fig.6.

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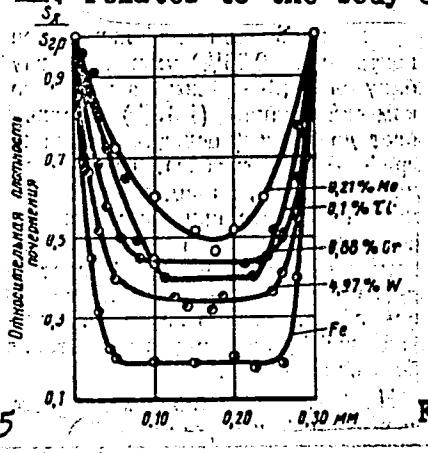
Peculiarities of the Diffusion of Carbon in Iron

Fig.7 shows relative darkening with respect to distance into ferrite grain for carbide forming (left-hand graph) and non-forming (right-hand graph) alloying elements. The left and right ends of the plots relate to the grain boundaries; the remaining space, corresponding to 0.30 mm, relates to the body of the grain.



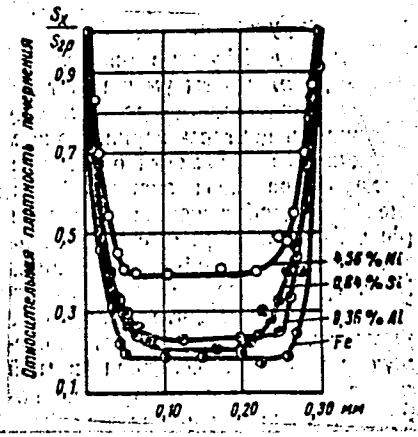


Fig.7

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S/129/61/000/001/002/013
E111/E135

Peculiarities of the Diffusion of Carbon in Iron

The work shows that carbon diffusion in both alpha- and gamma-iron occurs unevenly, the grain boundaries and adjacent alpha solid-solution regions becoming enriched with carbon. The diffusion coefficient for grain boundaries is 3-4 orders higher than for inside grains. Alloying modifies both rate of diffusion and distribution of carbon within the grain; depending on the effect of the element on the gamma region. Alloying reduces the carbon-concentration drop between the boundary and the body of the ferrite grain.
There are 7 figures and 11 references: 7 Soviet and 4 non-Soviet.

Card 5/5

KONTOROVICH, I.Ye., prof., doktor tekhn.nauk; VUL'F, D.A., inzh.; SEKEY, A.G., inzh.

Direct electric heating of wire for patenting. Stal' 22 no.2: 179-180 F '62. (MIRA 15:2)

(Wire—Heat treatment)

S/137/63/000/002/023/034
A006/A101

AUTHORS: Kontorovich, I. Ye., Mermel'shteyn, Yu. A.

TITLE: The effect of the grain size upon carbon diffusion in steel

PERIODICAL: Referativnyy zhurnal, Metallurgiya, no. 2, 1963, 3, abstract 2I11 ("Sb. tr. Mosk. vech. metallurg. in-ta", 1962, no. 4, 48 - 52)

TEXT: The authors studied the behavior of C in 12 XH3A (12KhN3A) steel containing in %: C 0.15, Mn 0.5, Cr 0.75, Ni 3.0. Specimens, 11 mm in diameter, were subjected to cold plastic deformation with 3- 65% reduction and carburizing at 925°C during 8 and 16 hours. The amount of C absorbed is calculated from the increase in weight; the grain size is determined by the secant method. The diffusion depth of C is determined by metallographical analysis. It was found that at a coarsening of the grains from $\Sigma S = 41.5$ to 28 mm^2/mm^3, the weight increased from 3.55 to 6.2 mg/cm^2. The amount of C absorbed depends much more upon the grain size than upon the duration of holding. It was established that the refining of austenite grains causes a decrease of both the surface diffusion and the depth of the layer with C absorbed. The C absorbed is mainly concentrated

S/137/63/000/002/032/034
A006/A101

AUTHORS: Kontorovich, I. Ye., Vul'f, D. A., Sekey, A. G.

TITLE: On non-oxidizing heat treatment of a 1X18H9T (1Kh18N9T) steel strip using electric preheating

PERIODICAL: Referativnyy zhurnal, Metallurgiya, no. 2, 1963, 121, abstract 2I693 ("Sb. tr. Mosk. vech. metallurg. in-ta", 1962, no. 4, 65 - 73)

TEXT: The authors established techniques for the non-oxidizing heat treatment of a 1Kh18N9T steel strip (excluding etching). It is recommended to preheat the strip for quenching (to 1,150 - 1,170°C) during 5 - 10 minutes in a muffle inductor with a transverse magnetic field in shielding atmosphere (argon) and to conduct subsequent quenching in a non-oxidizing atmosphere. Non-oxidizing heat treatment yields on the surface a very thin and dense passivating film, excludes metal loss during the formation of scale and etching. The use of non-oxidizing heat treatment with high-speed electric heating makes it possible to produce highly efficient automated continuous cold-rolling-heat treatment-lines. The economical profit of non-oxidizing heat treatment of the strip is confirmed by approximate technical and economical indices.
[Abstracter's note: Complete translation] A. Babayeva

Card 1/1

ACCESSION NR: AT4040797 S/2685/63/000/002/0031/0040

AUTHOR: Kontorovich, I. Ye.; Vinogradskaya, Ye. L.

TITLE: Oxidation resistance of low and high alloy steels at high temperatures

SOURCE: AN LatSSR. Institut avtomatiki i mekhaniki. Prevrashcheniya v splavakh i vzaimodeystviye faz, no. 2, 1963, 31-40

TOPIC TAGS: steel, steel oxidation, low alloy steel, high alloy steel, oxidation resistant steel, steel A, steel U8, steel 38KhA, steel 40KhNMA, steel EZh-2, steel B, steel V, steel G, steel D, steel calorizing, steel composition, high temperature steel, calorization film composition, high temperature diffusion

ABSTRACT: Samples of nine steels (see Table 1 in the Enclosure) were tested for up to 210 hrs. at 900C or up to 50 hrs. at 1000C, either prior to or after calorizing (49% Al, 49% Al_2O_3; 2% NH_4Cl, 5 hrs. 900C), to determine the effects of chemical composition on resistance to oxidation at high temperatures. It was found that calorizing improves oxidation resistance of high alloy steels. For steels with the highest resistance, improvement was noted during the initial oxidation period, while the effect was evident over extended periods for steels with substandard initial resistance. Chemical composition of the core continued to affect oxidation

Card 1/3

ACCESSION NR: AT4040797

resistance even after calorizing, due both to diffusion processes occurring during prolonged exposures to high temperatures and, equally so, to the varying composition of surface films forming during the calorization of various steels. Orig. art. has: 1 table and 4 graphs.

ASSOCIATION: Institut avtomatiki i mekhaniki AN LatSSR (Institute of Automation and Mechanics, AN LatSSR)

SUBMITTED: 00 DATE SEL: 15Jul64 ENCL: 01

SUB CODE: MM NO REF SOV: 002 OTHER: 005

Card 2/3

40KhNMA	0,41	0,65	0,40	1,09	—	—	—	—
EZh-2	0,18	0,47	0,37	0,77	1,72	—	—	—
B	0,11	1,3	0,32	13,1	—	—	0,25	—
V	0,41	6,5	0,71	16,3	25,4	—	—	—
G	0,45	0,60	0,53	13,4	6,2	—	6,25	0,15
D	0,3	0,81	0,34	14,2	15,4	1,5	—	—
			0,56	22,5	10,7	2,5	0,25	—
						2,33	—	—

Table 1.

Card 3/3

L 13800-65 EWT(m)/EWP(w)/EPF(n)-2/EWA(d)/EWP(t)/EWP(k)/EWP(b) Pf-4/Pu-4
ASD(m)-3 JD/HW/JG/MLK

ACCESSION NR: AT4046833 S/0000/64/000/000/0147/0149

AUTHOR: Kantorovich, I. Ye.; Savkina, L. Ya.; Estulin, G. V.

TITLE: Effect of titanium and molybdenum on the recrystallization and strengthening of niobium alloys

SOURCE: AN SSSR. Nauchny*y sovet po probleme zharoprochny*kh splavov. Issledovaniya staley i splavov (Studies on steels and alloys). Moscow, Izd-vo Nauka, 1964, 147-149

TOPIC TAGS: niobium alloy, niobium titanium alloy, niobium molybdenum alloy, alloy recrystallization temperature, alloy hot hardness, alloy tensile strength

ABSTRACT: The effect of individual alloying with 2, 5, or 10% Ti, or with 5, 7, or 10% Mo, on the recrystallization temperature and mechanical properties of niobium alloys has been investigated. (Niobium, Nb-Ti- and Nb-Mo-alloy ingots were vacuum-arc melted, forged at 1500—1550C into bars 30 mm in diameter, vacuum-annealed for 1 hr at 1400C and 1600C for Nb-Ti and Nb-Mo alloys, respectively, and then cold-forged with a 70% reduction into bars 15 mm in diameter. The temperature at

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L 13800-65

ACCESSION NR: AT4046833

the beginning of recrystallization was determined by measuring the hardness of the alloys annealed at 800—1600C for 1 hr in a vacuum of $5 \cdot 10^{-5}$ mm Hg. The most marked softening was observed in Nb-Ti alloys (2, 5, or 10% Ti) and Nb-Mo alloys (5 or 7% Mo) after annealing at 900—950 and 1150C, respectively. The hardness of the Nb-10% Mo alloy decreased gradually as the annealing temperature increased to 1400C. Microstructure analysis showed that unalloyed Nb begins to crystallize at 1050—1100C, Nb-Ti alloys with up to 10% Ti, at 1000—1100C, and Nb-Mo alloys with up to 7% Mo, at 1150—1250C. In Nb-10% Mo alloys, new recrystallized grains appeared after annealing at 1200C; at 1300C, the primary recrystallization ended and a marked grain growth began. Hot hardness and tensile tests were conducted at temperatures up to 1100C in a vacuum of $5 \cdot 10^{-4}$ mm Hg. The test results showed that the hot hardness of unalloyed Nb and Nb-Ti and Nb-Mo alloys decreases appreciably at 900—950C, although alloys with 10% Mo have a substantially higher hot hardness than Nb and Nb-Ti alloys. Alloying Nb with 2—10% Ti decreases the tensile strength of Nb alloys, whereas alloying with 2—10% Mo significantly increases it, e.g., from 20 kg/mm^2 in unalloyed Nb to 45—50 kg/mm^2 in annealed alloys with 7—10% Mo at 1000C. Orig. art. has: 3 figures.

Card 2/3

L 13800-65

ACCESSION NR: AT4046833

ASSOCIATION: none

SUBMITTED: 16Jun64	ENCL: 00	SUB CODE: MM
NO REF SOV: 002	OTHER: 001	ATD PRESS: 3132

Card 3/3

L 62599-65 EWP(z)/EWT(m)/EWP(b)/EWA(d)/EWP(t) Pad IJP(c) MJW/JD/HW/JG

ACCESSION NR: AP5018179 UR/0148/65/000/007/0145/0149
669.15-194:669.2624.66.046.51:620.193.91

AUTHOR: Kontorovich, I. Ye., Boshedchenko, B. M., Buntushkin, V. P. 35 33 B

TITLE: Effect of alloying elements on the aging of a Kh15N85 solid solution

SOURCE: IVUZ. Chernaya metallurgiya, no. 7, 1965, 145-149

TOPIC TAGS: nickel alloy, chromium alloy, aluminum, titanium, molybdenum, tungsten, cobalt, alloy hardening, alloy structure, alloy aging/Kh15N85 alloy

ABSTRACT: The effect of Al, Ti, Mo, W, and Co on the change in the structure and properties of the high-purity nickel-chromium solid solution Kh15N85 was investigated. [illegible] alloys of Kh15N85 containing one of the following elements: 0.95-6.77 Ti, 0.95-[illegible] 2.30% Co, 2.05-14.60% Mo, or 1.90-9.05% W were prepared by sintering [illegible] metal powders, and were studied immediately after sintering, after [illegible] from 1080C in air, and after aging at 680C for various periods of time. Metallographic methods were used, and the density, electrical resistivity, and microhardness of the various phases, as well as the macrohardness of the alloys, were determined. The data obtained for the changes in structure and properties lead the authors to certain conclusions concerning the mechanism of the hardening process during quenching

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L 62599-65

ACCESSION NR: AP5018179

2

and aging of the alloys. The presence of molybdenum and tungsten in complex alloys de- [illegible] rate of other elements and increases the strength of the interatomic [illegible] solid solution. As a result [illegible] elements [illegible] the capacity of the alloys for aging at high temperatures [illegible] yielding to [illegible] increased strength of the interatomic [illegible] heat resist- [illegible] resistance to [illegible] the structure and properties of the [illegible] the atomic struc- [illegible] close to that of nickel. Orig. art. has: 5 figures.

ASSOCIATION: Moskovskiy vechernly metallurgicheskiy institut (Moscow Evening Metallurgical Institute)

SUBMITTED: 13Mar64 ENCL: 00 SUB CODE: MM

NO REF SOV: 006 OTHER: 000

Card 2/2

KONTOROVICH, I.Ye., doktor tekhn. nauk; KOLESNIKOV, A.P., inzh.;
TAMARINA, A.M., inzh.; TKACHENKO, V.I., inzh.; TSERLYUK, M.D., inzh.

Increasing engineering properties of steel castings at low temperatures. Stroi. i dor. mash. 10 no.4:32-33 Ap '65.
(MIRA 18:5)

KONTOROVICH, I. Ye.; LAYNER, Ye.V.

Standard nets of off-base projection axes for a hexagonal tightly packed lattice. Zav. lab. 31 no. 12:1480-1483 '65 (MIRA 19:1)

1. Moskovskiy vecherniy metallurgicheskiy institut.

15708-66 EWP(z)/EWT(m)/EWP(b)/T/EWA(d)/EWP(w)/EWP(t) IJP(c) MJW/JD/JG
ACC NR: AP6003302 (N) SOURCE CODE: UR/0129/66/000/001/0019/0021

AUTHOR: Kontorovich, I. Ye.; Voshedchenko, B. M.; Buntushkin, V. P.

ORG: Moscow Evening Metallurgical Institute (Moskovskiy vechernyy metallurgicheskiy institut)

TITLE: Effect of molybdenum on the properties of Kh15N85 Ni-Cr alloy

SOURCE: Metallovedeniye i termicheskaya obrabotka metallov, no. 1, 1966, 19-21

TOPIC TAGS: nickel containing alloy, chromium containing alloy, molybdenum, metal hardening, hardness, metal aging, phase composition / Kh15N85 Ni-Cr alloy

ABSTRACT: Melts of this alloy, containing different proportions of Mo and Cr (2.05, 4.20, 4.10 and 14.6% Mo and 15.2, 16.3, 15.25 and 13.0% Cr, respectively) were prepared by the powder-metallurgy method. The compression-molded specimens (10x10x70 mm) were sintered at 1180°C in ahydrogen atmosphere for 4 hr with subsequent cooling in a stream of hydrogen. Following hardening at 1080°C for 8 hr and aging at 680°C for 4 to 20 hr the properties of the specimens were investigated. Radiographic and chemical phase analyses showed that the melts containing up to 4.10% Mo after hardening have a single-phase, austenitic structure, while the melt with 14.6% Mo has a two-phase austenitic structure; the second phase, which segregates around the grain boundaries, is molybdenum-rich. The density of the melts increases with increasing Mo content: follow-

Card 1/2 UDC: 669.14.018.45'28

ACC NR: AP6003302

g quenching the specific weight of the melts with 2.05, 4.1 and 14.6% Mo increased 0.13, 1.8 and 4.6%, respectively, compared with the Mo-free Ni-Cr alloy. The hardness of the alloys increases with increasing Mo content: the specimens with 14.6% have a hardness of H_V = 335 compared with H_V = 217 for the Mo-free specimens. The addition of Mo also enhances the electric resistivity of the alloys. After aging 2-3 at 680°C the alloys acquire optimal hardness, since any longer aging causes a crease in the hardness of the austenite. The variations in hardness following brief ing apparently are a consequence of intragranular processes -- the redistribution alloy elements and, possibly, the variation in the density of dislocations. Orig. t. has: 2 tables, 3 figures.

B CODE: 11, 13, 20/ SUBM DATE: none/ ORG REF: 000/ OTH REF: 000

rd 2/2

ACC NR: AP6003302 (N) SOURCE CODE: UR/0129/66/000/001/0019/0021

AUTHOR: Kontorovich, I. Ye.; Voshedchenko, B. M.; Buntushkin

ORG: Moscow Evening Metallurgical Institute (Moskovskiy vechernyy metallurgicheskiy institut)

TITLE: Effect of molybdenum on the properties of Kh15N85

SOURCE: Metallovedeniye i termicheskaya obrabotka metallov, no. 1, 1966, 19-21

TOPIC TAGS: nickel containing alloy, chromium containing alloy, molybdenum, metal hardening, hardness, metal aging, phase composition / Kh15N85 Ni-Cr alloy

ABSTRACT: Melts of this alloy, containing different proportions of Mo and Cr (2.05, 2.20, 4.10 and 14.6% Mo and 15.2, 16.3, 15.25 and 13.0% Cr, respectively) were prepared by the powder-metallurgy method. The compression-molded specimens (10x10x70 mm) were sintered at 1180°C in ahydrogen atmosphere for 4 hr with subsequent cooling in a stream of hydrogen. Following hardening at 1080°C for 8 hr and aging at 680°C for 2 to 20 hr the properties of the specimens were investigated. Radiographic and chemical phase analyses showed that the melts containing up to 4.10% Mo after hardening have a single-phase, austenitic structure, while the melt with 14.6% Mo has a two-phase austenitic structure; the second phase, which segregates around the grain boundaries, is molybdenum-rich. The density of the melts increases with increasing Mo content: follow

UDC: 669.14.018.45'28

Card 1/2

ACC NR: AP6034382 SOURCE CODE: UR/0149/66/000/005/0124/0128

AUTHOR: Kontorovich, I. Ye.; Layner, Ye. V.; Rastorguyev, L. N.

ORG: Moscow Evening Institute of Metallurgy (Moskovskiy vecherniy metallurgicheskiy institut)

TITLE: Effect of heat treatment on the texture of titanium alloys with electrodeposited chromium and nickel

SOURCE: IVUZ. Tsvetnaya metallurgiya, no. 5, 1966, 124-128

TOPIC TAGS: electrodeposition, metal grain structure, x ray diffraction analysis, chromium plating, annealing, nickel plating, cold rolling, titanium, titanium alloy / VT1 titanium, OT4 titanium alloy

ABSTRACT: Texture of VT1 commercial-grade titanium and OT4 titanium alloy cold rolled with 20—30% reduction and plated with chromium and nickel has been investigated. In the initial condition or after vacuum ($5 \cdot 10^{-4}$ Hg) annealing at 600, 700, or 800C for 30 min, x-ray diffraction patterns showed that the dispersion of texture in VT1 and OT4 alloy was more sharply expressed and the slope of the basis plane to the rolling plane was greater compared to the texture of titanium rolled with a reduction of 75—97%. Annealing increased the angle between the rolling and the basis planes in OT4 alloy, but the opposite effect was observed in VT1 alloy. The texture of electrodeposited chromium and nickel has axial characteristics. No structure relationship between the titanium base and the chromium layer was observed because

Card 1/2 UDC: 669.546.821.548'76.542.65.74

ACC NR: AP6034382

chromium [illegible] growth. Orig. art. has: 2 figures and 3 tables.

SUB CODE: 11/ SUBM DATE: 19Jul65/ ORIG REF: 007/ OTH REF: 004/

Card 2/2

24(3)
AUTHORS: Levin, B. Ye., Kontorovich, L. I. SOV/48-23-3-29/34

TITLE: On the Report by N. A. Smol'kov and Yu. P. Simanov (Po dokladu N. A. Smol'kova i Yu. P. Simanova). "Properties of Solid Solutions $NiFe_2O_4 \rightarrow MgFe_2O_4$" (Vol 23, Nr 3, p 307) ("Svoystva tverdykh rastvorov $NiFe_2O_4 \rightarrow MgFe_2O_4$ (t.23, No 3, str.307)). On the Problem of Thermodynamics of the Reactions of Ferrite Formation (K voprosu o termodinamike reaktsiy ferritoobrazovaniya)

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, 1959, Vol 23, Nr 3, p 419 (USSR)

ABSTRACT: The formation of ferrospinels in solid phase takes place during the production of ferrites from pure oxides. In the temperature range of up to 1,350° approximately, applied to the production of ferrites, the liquid phase is either not formed at all or in small quantities only. The thermodynamic analysis of ferrite formation shows that the formation of ferrites in the solid phase is characterized by a system without degrees of freedom. There is a thermodynamic probability of ferrite formation from pure oxides at temperatures of up

Card 1/2

On the Report by N. A. Smol'kov and Yu. P. Simanov. SOV/48-23-3-29/34
"Properties of Solid Solutions $NiFe_2O_4 \rightarrow MgFe_2O_4$" (Vol 23, Nr 3, p 307).
On the Problem of Thermodynamics of the Reactions of Ferrite Formation

to 298° K and below. Depending on the presence of impurities the ferrite formation from technical substances proceeds in a complex thermodynamic system and may be characterized by several degrees of freedom. It is possible to determine the probability of the course of ferrite formation in these cases on the basis of experimental thermodynamic characteristics of ferrite formation. From publications (Refs 1-5) it was possible to obtain data on thermodynamic properties only in the case of magnesium ferrite ($MgO + Fe_2O_3 = MgFe_2O_4$). There are 5 references, 3 of which are Soviet.

Card 2/2

KONTOROVICH, L. I.

PHASE I BOOK EXPLOITATION SOV/4893

Vsesoyuznoye soveshchaniye po fizike, fiziko-khimicheskim svoystvam ferritov i fizicheskim osnovam ikh primeneniya. 3d, Minsk, 1959

Ferrity; fizicheskiye i fiziko-khimicheskiye svoystva. Doklady (Ferrites; Physical and Physicochemical Properties. Reports) Minsk, Izd-vo AN BSSR, 1960. 655 p. Errata slip inserted. 4,000 copies printed.

Sponsoring Agencies: Nauchnyy sovet po magnetizmu AN SSSR. Otdel fiziki tverdogo tela i poluprovodnikov AN BSSR.

Editorial Board: Resp. Ed.: N. N. Sirota, Academician of the Academy of Sciences BSSR; K. P. Belov, Professor; Ye. I. Kondorskiy, Professor; K. M. Polivanov, Professor; R. V. Telesnin, Professor; G. A. Smolenskiy, Professor; N. N. Shol'ts, Candidate of Physical and Mathematical Sciences; E. M. Smolyarenko; and L. A. Bashkirov; Ed. of Publishing House: S. Kholyavskiy; Tech. Ed.: I. Volokhanovich.

PURPOSE: This book is intended for physicists, physical chemists, radio electronics engineers, and technical personnel engaged in the production and use of ferromagnetic materials. It may also be used by students in advanced courses in radio electronics, physics, and physical chemistry.

COVERAGE: The book contains reports presented at the Third All-Union Conference on Ferrites held in Minsk, Belorussian SSR. The reports deal with magnetic transformations, electrical and galvanomagnetic properties of ferrites, studies of the growth of ferrite single crystals, problems in the chemical and physicochemical analysis of ferrites, studies of ferrites having rectangular hysteresis loops and multicomponent ferrite systems exhibiting spontaneous rectangularity, problems in magnetic attraction, highly coercive ferrites, magnetic spectroscopy, ferromagnetic resonance, magneto-optics, physical principles of using ferrite components in electrical circuits, anisotropy of electrical and magnetic properties, etc. The Committee on Magnetism, AS USSR (S. V. Vonsovskiy, Chairman) organized the conference. References accompany individual articles.

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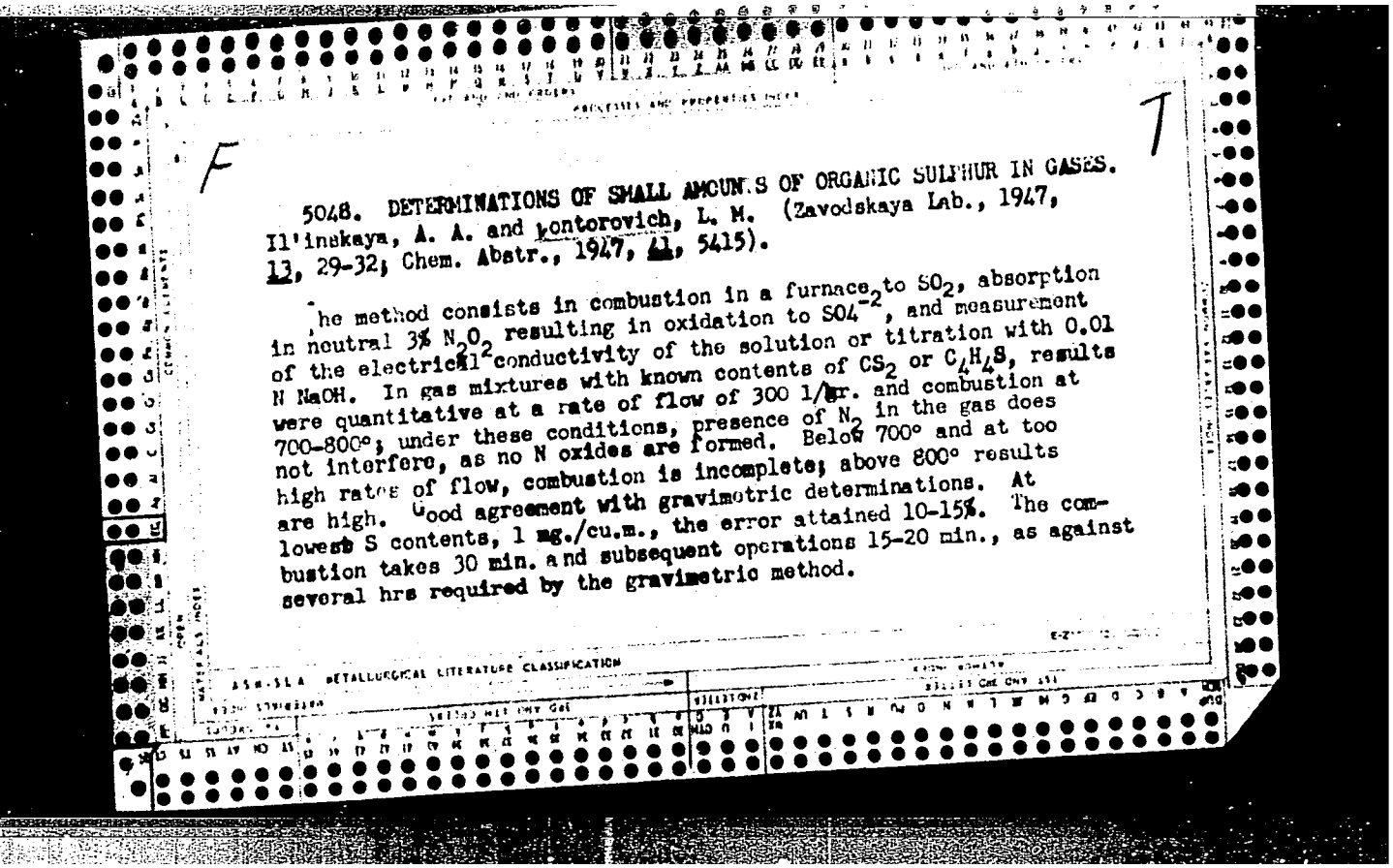
Ferrites (Cont.) SOV/4893

Card 7/18



F

T

5048. DETERMINATIONS OF SMALL AMOUNTS OF ORGANIC SULPHUR IN GASES. Il'inskaya, A. A. and Kontorovich, L. M. (Zavodskaya Lab., 1947, 13, 29-32; Chem. Abstr., 1947, 41, 5415).

The method consists in combustion in a furnace to SO_2, absorption in neutral 3% N_2O_2 resulting in oxidation to SO_4^{-2}, and measurement of the electrical conductivity of the solution or titration with 0.01 N NaOH. In gas mixtures with known contents of CS_2 or C_4H_4S, results were quantitative at a rate of flow of 300 l/hr. and combustion at 700-800°; under these conditions, presence of N_2 in the gas does not interfere, as no N oxides are formed. Below 700° and at too high rates of flow, combustion is incomplete; above 800° results are high. Good agreement with gravimetric determinations. At lowest S contents, 1 mg./cu.m., the error attained 10-15%. The combustion takes 30 min. and subsequent operations 15-20 min., as against several hrs required by the gravimetric method.

KONTOROVICH, L. M.

1205. DETERMINATION OF SMALL AMOUNTS OF ORGANIC [illegible]
Il'inskaya, A. A., Kontorovich, L. M. and [illegible]
[illegible]

K. I. A. L. M.

Volumetric determination of moisture in salts. L. M. Kontorovich and I. G. Solov'eva. *Trudy Vses. [illegible]*

method for moisture [illegible]

with iodine-pyridine soln. (Mitchell and coll., *Gosudarst. Inotsen., Izdatel* 1952) without [illegible] of CH_3OH or blank test is described. If the moisture [illegible] approx 0.5 g of the [illegible] the iodine-pyridine [illegible] from yellow to reddish [illegible] drop of water [illegible] salt [illegible]

3

Card : 1/2

-57-

USSR/Physical Chemistry - Thermodynamics, Thermochemistry, Equilibria, Physical-Chemical Analysis, Phase Transitions. B-8

Abs Jour: Referat. Zhurnal Khimiya, No 2, 1958, 3820.

temperature of aqueous solutions of I of various concentration. A description of the used equipment is given.

Card : 2/2

-58-

KONTOROVICH, L.M.; KLEVKE, V.A., kand.tekhn.nauk

Physicochemical constants of nitrates. Part 2. Trudy GIAP no.7:33-37 '57. (MIRA 12:9)
(Nitrates)

KONTOROVICH, L.M.; SOLOV'YEVA, I.G.; LEVCHENKO, G.T., kand.khim. nauk

Determining the nitrogen content of ammonium salts by the formalin method. Trudy GIAP no.8:243-245 '57. (MIRA 12:9)
(Ammonium salts) (Formaldehyde)

KONTOROVICH, L.M.; LEVCHENKO, G.T., kand. khim. nauk

Use of infrared rays for desiccation in determining the moisture content and insoluble residue of salts. Trudy GIAP no.8:246-247 '57. (MIRA 12:8)

(Salts) (Infrared rays)

KONTOROVICH, L.M.; LOGANSEN, A.V.; LEVCHENKO, G.T.; SEMINA, G.N.; BOBROVA, V.P.; STEPANOVA, V.A.

Chromatographic analysis of acetylenic hydrocarbons. Zav.lab. 28 no.2:146-148 '62. (MIRA 15:3)

1. Gosudarstvennyy nauchno-issledovatel'skiy i proyektnyy institut azotnoy promyshlennosti i produktov organicheskogo sinteza.
(Hydrocarbons) (Chromatographic analysis)

SAVEL'YEV, V.P.; KOVAL'SKAYA, A.V.; BERUKOV, F.V.; GALKIN, Yu.P.; KROKHOTIN, A.I.; SINEGUBKIN, V.V.; EPSHTEYN, A.L.; TSIRKIN, M.Z.; LAVRUSHINA, N.S.; GUBAREV, A.A.; KONTOROVICH, L.M.; KOROLEV, V.N.; USTIMENKO, I.L.; KURNAKOV, S.N.; POLUSHKIN, M.K.; LIBE, N.A.; IVANOV, N.P.; D'YACHENKO, G.I.; FILIPPOV, I.F.; KHUTORETSKIY, G.M.; VARTAN'YAN, G.P.; RUSOV, Ye.Kh.; BARKAN, L.Z.; KOLONSKAYA, L.M.; GORBATENKO, F.I.

Inventions. Energ. i elektrotekh. prom. no.4:39 O-D '64.
(MIRA 18:3)

KOROLEV, V.N., inzh.; TSIRKIN, M.Z., inzh.; LAVRUSHINA, N.S., inzh.; KONTOROVICH, L.M., inzh.; GUBAREV, A.A., inzh.; Prinimal uchastiye MEL'SHTEYN, L.G.

Insulation of bar winding heads of the stators of hydrogenerators and turbogenerators. Elektrotekhnika 36 no.8:16-18 Ag '65. (MIRA 18:9)

1. Leningradskiy filial Vsesoyuznogo nauchno-issledovatel'skogo instituta elektromekhaniki (for Mel'shteyn).

MINTS, L.Ye., starshiy nauchnyy sotr.; NEMCHINOV, V.S., akademik,otv. red.; KONTOROVICH, L.V., red. toma; KULEV, I.A., red. toma; NOVOZHILOV, V.V., prof., red. toma; LUCHKINA, A.N., red. izd-va; SHEVCHENKO, G.N., tekhn. red.; GOLUB', S.P., tekhn. red.

[Transactions of the Scientific Conference on the Application of Mathematical Methods in Economic Research and Planning] Trudy Nauchnogo soveshchaniia o primenenii matematicheskikh metodov v ekonomicheskikh issledovaniiakh i planirovanii. Moskva, Izd-vo Akad. nauk SSSR. Vol.1. [General problems in the use of mathematics in economics and planning] Obshchie voprosy primeneniia matematiki v ekonomike i planirovanii. 1961. 291 p. (MIRA 15:1)

1. Nauchnoye soveshchaniye o primenenii matematicheskikh metodov v ekonomicheskikh issledovaniyakh i planirovanii. 1960. 2. Chlen-korrespondent Akademii nauk SSSR (for Kontorovich).
(Economics, Mathematical)

S/125/61/000/003/009/016
A161/A133

AUTHORS: Safonnikov, A.N.; Medovar, B.I.; Kontorovich, L.Ye.; Khimushin, F.F.

TITLE: Heat-resistant ЭИ703 (EI703) alloy welded by electro-slag process with plate electrodes

PERIODICAL: Avtomaticheskaya svarka, no. 3, 1961, 68 - 74

TEXT: The EI703 alloy is a substitute of the ЭИ435 (EI435) and ЭИ602 (EI602) nickel alloys used for combustion chambers and rings in gas turbines. It has a slightly higher heat-resistance at high temperatures than EI435 and nearly the same as EI602, and a high ductility. Its chemical composition is the following: 0.06 - 0.12% C, ≤0.8% Si, ≤0.7% Mn, ≤0.020% S, ≤0.030% P, 20 - 23% Cr, 35 - 40% Ni, 2.5 - 3.5% W, 0.7 - 1.2% Ti, or 1.2 - 1.7% Nb, ≤0.5% Al, 0.05% Ce. The article presents details of electro-slag welding tests with EI703 alloy forgings with 120 by 120 mm cross section area, produced by the "Elektrostal'" Plant. Plate electrodes used as filler metal had the same width as the forgings being joined, and 12 to 18 mm thickness. The welding equipment consisted of a A-550 apparatus and a ТШС-3000/1 (TShS-3000/1) transformer. The A-550 welder permit-

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Heat-resistant ЭИ703 (EI703) alloy welded by....

ting plate electrode feed variations in a range of from 0.9 to 17 m/h had been described (Ref. 2: Opyt vnedreniya avtomata A-550 dlya elektroshlakovoy svarki plastinchatym elektrodom. Avtomaticheskaya svarka, no. 11, 1959). Four types of flux were tried: three fused fluoride type АНФ-6 (ANF-6), АНФ-7 (ANF-7), and АНФ-14 (ANF-14) and nonfused АНФ-1 (ANF-1) (fluorite concentrate). The latter flux proved not suitable for the EI703 alloy because of a dangerous defect - the weld metal did not fuse with the base metal. [Abstracter's note: The chemical composition of the fluxes is not given.] The following welding technology is recommended as a result of experiments welding the EI703 alloy with EI703 plate electrodes and the base metal dimensions as above (120 x 120 mm): plate electrode 12 by 120 mm; 1,500 ÷ 2,000 amp; plate electrode feed velocity 2.3 ÷ 2.5 m/h; starting voltage 33 v; voltage in established process 28 ÷ 31 v; either ANF-14 or ANF-7 flux; flux quantity of 300 g; slag pool depth of 18 mm; gap between welded elements 40 mm. The soundness of joint is illustrated in a photo. The mechanical strength of welds was slightly lower than that of the base metal, but the heat resistance was close to the one required by specifications. It is stressed that the required quality of welded joints is only possible when the prescribed process technology is followed strictly. Hot cracks are possible when the metal pool is deep. The rupture strength of the welded joints amounted to

S/125/61/000/003/009/016
A161/A133

Heat-resistant 703 (EI703) alloy welded by....

about 75% of the heat resistance of base metal. Technician B.R. Kleinerman is mentioned having participated in the tests. There are 6 figures, 3 tables and 4 Soviet-bloc references.

ASSOCOATIONS: Ordena Trudovogo Krasnogo Znanemi Institut elektrosvarki imeni Ye. O. Patona AN USSR ("Order of the Red Banner of Labor" Electric Welding Institute im. Ye.O. Patona AS UkrSSR) (A.N. Safonnikov and B.I. Medovar); L.E. Kontorovich and F.F. Khimushin (Moscow)

SUBMITTED: June 8, 1960

Card 3/3

1.2300

32960
S/125/62/000/001/007/011
D036/D113

AUTHORS: Safonnikov, A.N.; Medovar, B.I. (see Association); Kontorovich, L.Ye.; Khimushin, F.F. (Moscow)

TITLE: Electroslag welding of VZh100 (EP126 brand) iron-chrome-nickel heat-resistant alloy by a plate electrode

PERIODICAL: Avtomaticheskaya svarka, no. 1, 1962, 59-63

TEXT: The authors describe the technology developed for the electroslag welding of ВЖ100 (VZh100) (ЭП126 [EP126]) brand iron-chrome-nickel heat-resistant alloy by a plate electrode. This alloy, which contains less nickel than the ЭИ703 (EI703) alloy, is recommended for parts working at high temperatures and under considerable loads; the chemical composition is as follows: (in %) 0.04 C, 0.51 Si, 0.27 Mn, 19.6 Cr, 27.8 Ni, 4.78 W, 2.90 Mo, 1.05 Nb, 0.2 N_2, 0.008 B. The electroslag welding experiments were carried out with 90 x 90 mm forgings by means of 90 x 700 mm forged plate electrodes whose thickness varied from 12 to 35 mm. The welding conditions were as follows: welding current - 1,200-6,000 amps and 20-40 v, electrode feed - 0.9-5.0 m/hr, depth of slag pool - 10-22 mm. АНФ-6 (ANF-6), АНФ-7 (ANF-7)

Card 1/3

Electroslag welding of ...

and AN-14 (ANF-14) welding fluxes were tried. The butt-joint gap varied from 30 to 42 mm. Preliminary tests showed that welding with large currents and low voltages caused hot crystallization cracks to form in the weld metal. Increasing the voltage when welding with ANF-6 flux sometimes led to the appearance of slight cold shuts and slag inclusions in the weld metal and along the fusion line. Perfect welds were obtained with ANF-14 and ANF-7 fluxes under the following welding conditions: welding current - 1,500-1,800 amps; electrode feed - 2-3.5 m/hr; idle-run voltage - 33 v; welding voltage - 30 v; gap - 36 mm; depth of slag pool - 22 mm; thickness of plate electrode - 12 mm. After heat treatment, the hardness of the weld metal approached that of the base metal. When a VZh100 electrode was used, the ultimate strength and yield limits of the weld metal at room temperature were 80% of the limits of the base metal; for extension and contraction this percentage was 50-60% and for toughness - 40%. At 650°C the ultimate strength of the weld metal was about 80% of that of the base metal, while the extension and contraction values of the weld metal approached those of the base metal. Tests for long-term heat-resistance showed that the weld metal was not inferior to the base metal in this respect. The conclusions made, are as fol-

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L 14422-63 EWP(k)/EWP(q)/EWT(m)/BDS AFFTC/ASD Pf-4 JD/HM
ACCESSION NR: AP3001117 S/0125/63/000/007/0029/0033

AUTHOR: Safonnikov, A. N.; Kontorovich, L. Ye. (Moscow); Khimushin, F. F. (Moscow)

TITLE: Electroslag welding of Kh10N20-type chromium-nickel steels (EI696, EI696A, EI696M) with a flat electrode

SOURCE: Avtomaticheskaya svarka, no. 7, 1963, 29-33

TOPIC TAGS: EI696 steel electroslag welding, EI696A steel electroslag welding, EI696M steel electroslag welding, EI696 steel weldability, 10—20-type steel welding, EI696 steel weld properties, EI696 steel rupture life

ABSTRACT: Forgings of EI696 (90 x 90 mm), EI696M (90 x 90 mm), and EI696A (120 x 120 mm) chromium-nickel steels were electroslag-welded with forged flat electrodes made of the same steels and EI435 and EI437B alloys [AISI Nimonic 75 and Nimonic 80A, respectively]. The fluxes used were ANF-7 and ANF-14, containing respectively 1.2 and 14.9% silicon dioxide, 78.4 and 61.4% calcium fluoride, and 2.6 and 4.6% aluminum oxide. (Flux ANF-14 also contained 7.0% MgO.) In welding with the EI696M electrode, hot cracks occurred in the welds when high current and high welding speed were employed. Lack of fusion was noted with the use of

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the ANF-7 flux. Welds made with EI435 electrodes were flawless. The EI696M parent metal, the EI696M electrode used, and the weld metal obtained with ANF-7 flux had roughly the same composition: 0.04—0.06% C, 0.32—0.43% Si, 0.38—0.48% Mn, 11.20—11.47% Cr, 23.2—23.6% Ni, 1.35—1.53% Mo, 2.04—2.88% Ti, 0.35—0.70% Al, and 0.015—0.020% B. Welding caused a slight loss of Ti and Al. After annealing at 1170C for 2 hr and aging at 750C for 16 hr, the room-temperature tensile strength of the weld metal, 78.4—90.8 kg/mm^2, and of the welded joint, 76.8—78.2 kg/mm^2, were lower than that of the parent metal (86.8—104.7 kg/mm^2). The corresponding figures for yield strength were 48.3—70.3, 48.0—48.8, and 62.4—70.2 kg/mm^2; for elongation, 12.0—17.2, 14.8—16.3, and 20.8—26.0%; and for reduction of area, 16.4—31.2, 24.9—35.5, and 19.7—30.3%. At 700C, the difference in properties was considerably less: the weld and the parent metal had, respectively, tensile strength of 72.6 and 69.2—76.0 kg/mm^2; elongation of 5.6 and 10.2—20.8%; and reduction of area of 13.6 and 14.7—28.0%. Compared with the hardness of the parent metal (HB 260) the weld-metal hardness in the as-welded condition was much lower; however, it rose to 180—200 HB after heat treatment (the specifications call for HB 265). Welds made with the EI[illegible]7B electrode had a hardness of HB 220, which increased to HB 265 after heat

L 14422-63
ACCESSION NR: AP3001117

treatment. In stress-rupture tests at 700C, the joints welded with the EI435-alloy electrode had very poor heat resistance and rupture life under a stress of 30 kg/mm^2 was only 5 hr; the joints welded with the EI437B and EI696M electrodes under a stress of 40 kg/mm^2 had a rupture life of 65—76 hr and 152—281 hr (specifications call for 100 hr). Welding of EI696 and EI696A steels (which contain no molybdenum) produced sufficiently heat-resistant welds, provided the electrodes used were of the same composition as the steels being welded. The welds, however, were very susceptible to hot cracking, which could not be prevented by conventional means. It is possible that the weldability of these steels can be improved by the electroslag melting of the parent metal. Orig. art. has: 4 figures and 3 tables.

ASSOCIATION: Institut elektrosvarki im. Ye. O. Patona AN USSR (Electric Welding Institute, AN USSR)

SUBMITTED: 16Mar61 DATE ACQ: 02Aug63 ENCL: 00

SUB CODE: MA, ML NO REF SOV: 001 OTHER: 000

Card 3/3

KONTOROVICH, M. I.

"On a Method of Solution of Some Problems of the Diffraction Theory,"
Acta Phys., 1, No. 3, 1939.

Leningrad Industrial Inst.

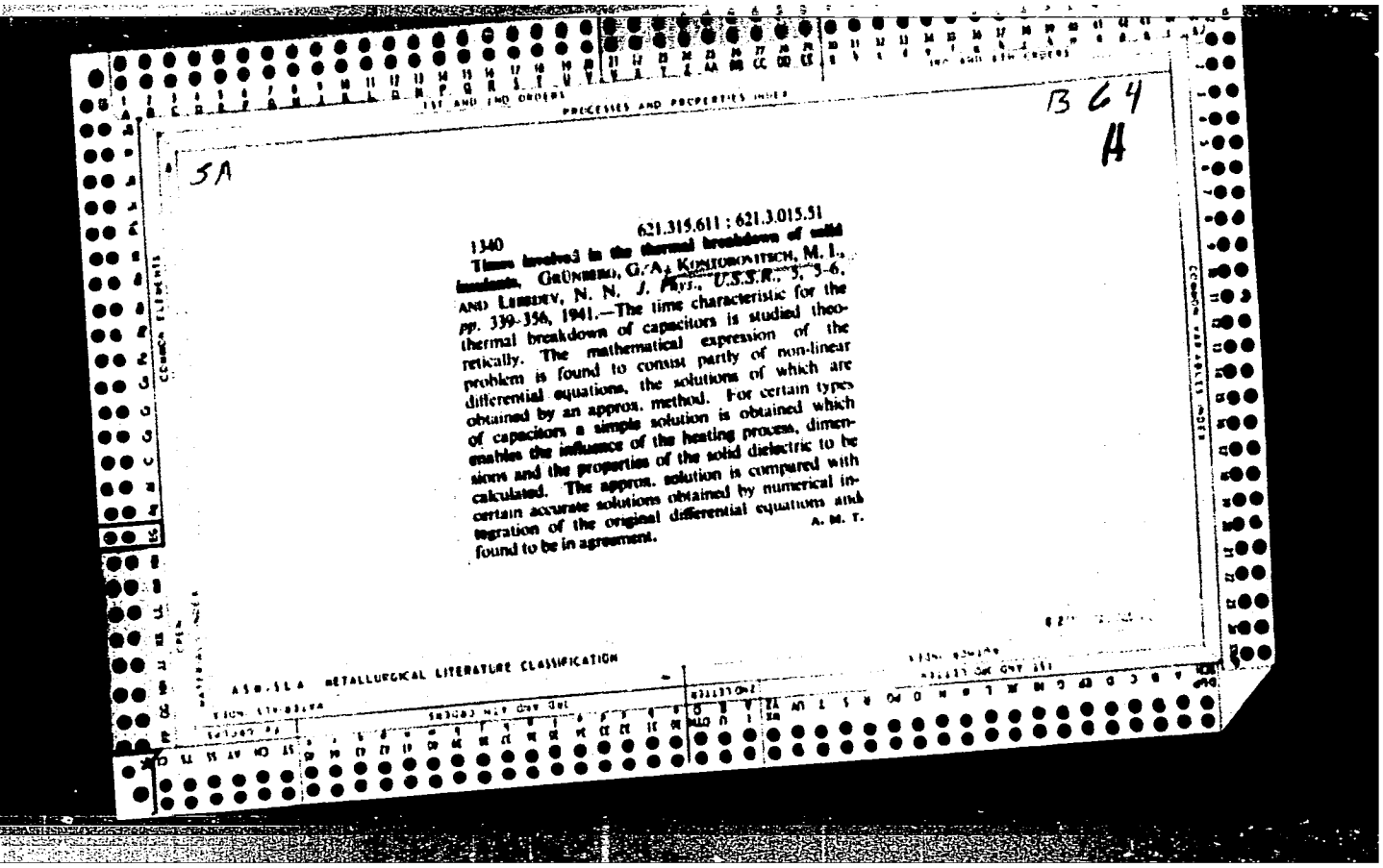
X

KONTOROVICH, M. I.

"Concerning the Screening or Shielding Effects of Closed Grids," Journal. Tech. Phys. vol. 9, No. 24, 1939.

Leningrad Industrial Inst.

A practical method for calculating mesh screen dimensions by evaluating a solid screen of equal dimensions.



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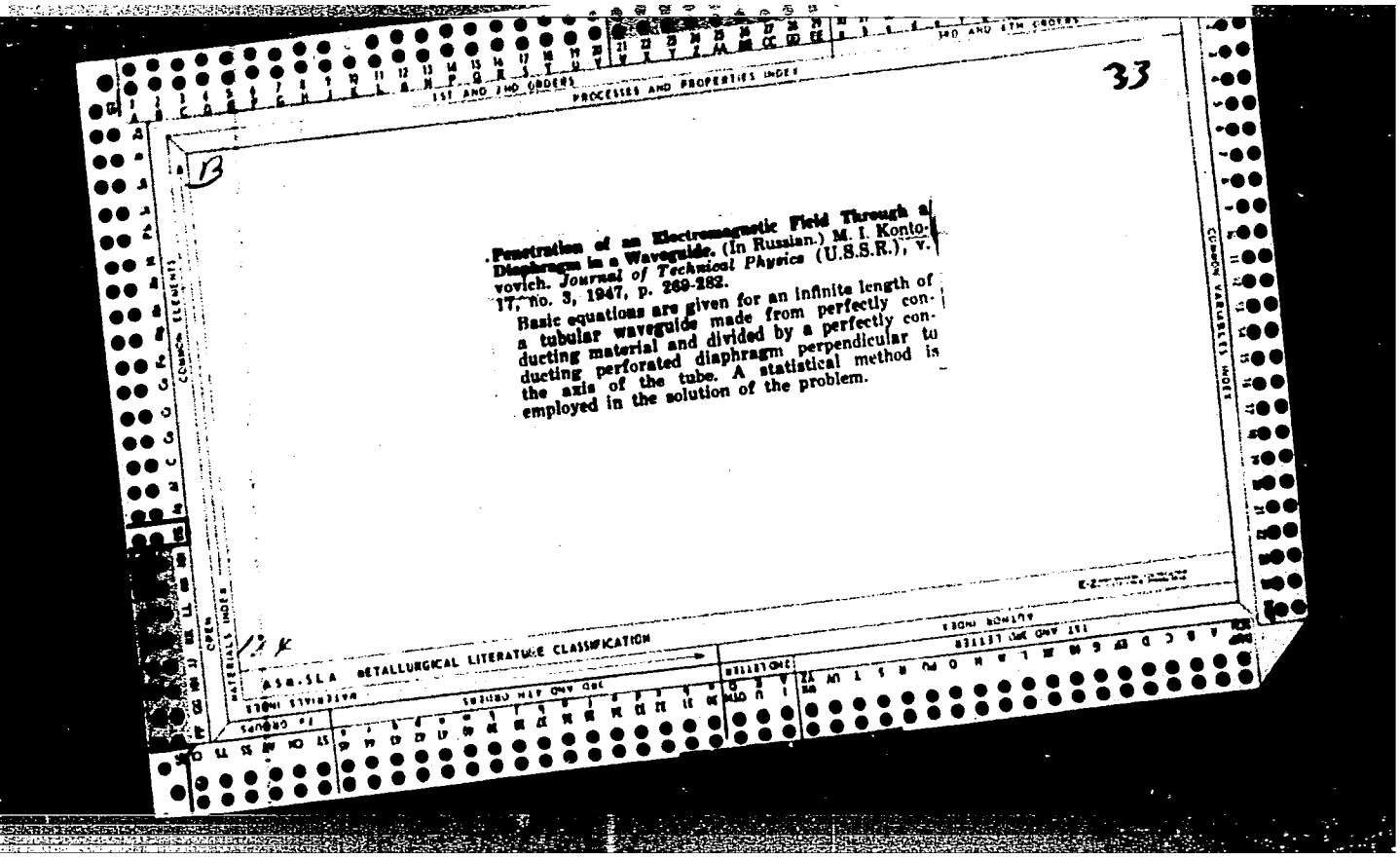
1340 621.315.611 : 621.3.015.51

Times involved in the thermal breakdown of solid insulants. GaŭNBERG, G. A., KONTOROVITSCH, M. I., AND LUBIMOV, N. N. *J. Phys., U.S.S.R.*, 3, 5-6, pp. 339-356, 1941.—The time characteristic for the thermal breakdown of capacitors is studied theoretically. The mathematical expression of the problem is found to consist partly of non-linear differential equations, the solutions of which are obtained by an approx. method. For certain types of capacitors a simple solution is obtained which enables the influence of the heating process, dimensions and the properties of the solid dielectric to be calculated. The approx. solution is compared with certain accurate solutions obtained by numerical integration of the original differential equations and found to be in agreement. A. M. T.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION



33

13

Penetration of an Electromagnetic Field Through a Diaphragm in a Waveguide. (In Russian.) M. I. Kontorovich. *Journal of Technical Physics* (U.S.S.R.), v. 17, no. 3, 1947, p. 269-282.

Basic equations are given for an infinite length of a tubular waveguide made from perfectly conducting material and divided by a perfectly conducting perforated diaphragm perpendicular to the axis of the tube. A statistical method is employed in the solution of the problem.

12 K

KONTOROVICH, M. I.

Kontorovich, M. I. Operational calculus and the non-stationary phenomena in electric circuits Leningrad, Gos. izd-vo tekhn.-teoret. lit-ry, 1949. 214 p. Fiziko-matematicheskaia biblioteka inzhenera (50-21900) QA432.K6

KONTOROVICH, M. I.

PA 244T100

USSR/Physics - Geometrical Optics; Electrodynamics   Mar 52

"Derivation of the Laws of Reflection of Geometrical Optics by Means of an Asymptotic Treatment of the Diffraction Problem," M. I. Kontorovich and Yu. K. Murav'yev

"Zhur Tekh Fiz" Vol 22, No 3, pp 394-408

Derives an asymptotic formula for surface integrals of oscillating functions (method of stationary phase). Using this formula, establishes the connection between the laws of reflection of geometrical

244T100

optics and the laws of classical electrodynamics, starting from an integral formulation of the diffraction problem. Submitted 8 Aug 51.

244T100

KONTOROVICH, MIKHAIL IOSIFOVICH.

Operatsionnoye Ischisleniye I Nestatsionarnyye Yavloeniya V. Elektricheskikh Tsepyakh (Operational Calculus and Non Stationary Phenomena in Electrical Circuits) Moskva, Gostekhizdat, 1953.

V. Diagrs
Includes Bibliography.

KONTOROVICH, M.I.

Контор..., М.И.

1-F\W

★ Конторович, М.И. [Kontorović, M. I.] Операционное вычисление и нестационарные явления в электрических цепях. [Operational calculus and non-stationary phenomena in electric circuits.] [illegible]
[illegible] Gostekhizdat, Leningrad, [illegible]
224 pp. 4 Roubles.

This book contains a greatly abbreviated [illegible] the application of the Laplace transformation to problems in electric circuit theory. For the most part, it is written for those who have completed only the calculus but a few other topics (e.g. Fourier series and integrals, and contour integration) would be necessary at times. Most of the book is devoted to a strictly formal, almost cursory, introduction to the Laplace transformation, with many examples showing its application to simple electric circuits. Problems involving long lines [illegible] terminal networks are given some [illegible] treatments. The Mellin inversion [illegible] formally, but used very little. [illegible] the Fourier transform and its applications [illegible] limitations imposed by the [illegible] fortunate that a few simple but useful extensions to mechanical and electro-mechanical systems were not made.) *R E Gaskell* (Seattle, Wash.)

1/1

USSR/Electronics - Circuits FD-2536
KONTOROVICH, M. I.
Card 1/1 Pub. 90 - 1/12

Author : Kontorovich, M. I., Active Member, VNORiE

Title : Basic Equations of a Tube Oscillator Under Steady-State Operating Conditions in the Presence of Grid Currents

Periodicals : Radiotekhnika 10, 3-12, 1955

Abstract : Stating that the influence of grid currents on the operation of a self-excited tube oscillator has not been sufficiently clarified, the author derives equations of a tube oscillator under conditions of steady state oscillations, taking into account the influence of grid currents. An oscillator with automatic bias is used as an example of calculations. Diagrams, graph. Three USSR references (1939, 1940)

Institution : All Union Scientific and Technical Society of Radio Engineering and Electric Communications imeni A. S. Popov (VNORiE)

Submitted : December 23, 1954

KONTOROVICH, M.I.

Shortened equations for electron-tube oscillators in the presence of grid currents. Trudy LPI no.181:5-17 '55. (MLRA 10:1)
(Oscillators, Electron-tube)

9.2580, 9.3260

77784
SOV/109-5-2-17/26

AUTHOR: Kontorovich, M. I.

TITLE: On the Question of Developing Equations for Auto-Oscillators

PERIODICAL: Radiotekhnika i elektronika, 1960, Vol 5, Nr 2, pp 310-322 (USSR)

ABSTRACT: An equation with a small nonlinearity, describing the behaviour of a tube oscillator with an arbitrary finite number of degrees of freedom, is analyzed. Equations with finite differences are developed and used for setting up abbreviated equations and also for periodic solutions. Some specific cases are analyzed, and a method of developing higher approximations is indicated. Introduction. The theory of oscillators, especially of those generating the probably most important sinusoidal oscillations, has been studied by many scientists, but of these many investigations, only a relatively small group deals

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with the general methods of analyzing problems with small nonlinearity, and are of a type convenient for use by engineers. Among this group, the author first mentions the works of Yu. B. Kobzarev, who developed the most widely used method of average steepness. N. M. Krylov and N. N. Bogolyubov describe in their monograph, "New Methods of Nonlinear Mechanics," a so-called "symbolic method". N. N. Bogolyubov and Yu. A. Mitropol'skiy describe several methods in their monograph, "Asymptotic Methods in the Theory of Nonlinear Oscillations". S. I. Yevtyanov did apply the "symbolic method" of Krylov and Bogolyubov to problems of radioengineering (theory of auto-oscillators). The theory of tube oscillators was intensively developed by the investigations of Academicians L. I. Mandelshtam, N. D. Papaleksi, A. A. Andronov, and other Soviet scientists. Van der Pol made valuable contributions concerning the establishing of oscillations in auto-oscillators. Up to

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the present, the methods of investigating transient conditions in tube oscillators stand separate from those concerned with determining periodic conditions in systems with small nonlinearity. An attempt is made in the present paper to combine these two methods, and to give such an interpretation as would deduce the method of Poincaret and the asymptotic methods from the same common premises. In addition, this paper also has the purpose of simplifying the calculations necessary for the setting up of differential equations of tube oscillators. For this purpose methods of operational calculus are used. In the present paper, a tube oscillator with an arbitrary finite number of degrees of freedom, in general under the influence of an external force, is analyzed. The grid currents are not considered in this case, but this could be done. Equations for the established mode of operations of a tube oscillator considering grid currents for an autonomous system

On the Question of Developing Equations for Auto-Oscillators

77784
SOV/109-5-2-17/26

have already been developed by the author (Trudy Leningradskogo politekhnicheskogo instituta (Works of Leningrad Polytechnic Institute) Nr 181, 1955). (1) Development of Basic Relations. Figure 1 shows an auto-oscillatory or potential-auto-oscillatory system, assembled on a three-electrode tube:

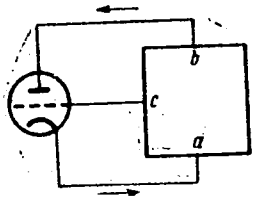

Fig. 1

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The grid current is assumed to be zero. The rectangle on the figure shows a system consisting of constant inductances, capacitances, and resistances. The constant anode feed voltage E, and the varying voltage e = e(t) are considered as located inside the rectangle. The tube current is designated by i, the operating impedance between contacts ab by Z; a feedback coefficient k = k(p) as ratio of voltages on contacts ac and ab (modified per Laplace) is introduced under the assumption that the emf's inside the rectangle are zero and the voltages u_{ac} and u_{ab} exist only due to current i. Taking the linearity of the rectangle scheme into account and using the method of superposition, the equations are written:

$$\begin{aligned} \bar{u}_a &= -\bar{u}_{ab} = -(\bar{i}Z + F_{a1}\bar{E} + F_{a2}\bar{e}), \\ \bar{u}_g &= -\bar{u}_{ac} = -(\bar{i}Z\bar{k} + F_{g1}\bar{E} + F_{g2}\bar{e}), \quad i = f(u_g, u_a). \end{aligned} \tag{1}$$

Here and further on, the dash above a letter denotes

Card 5/19

a value transformed per Laplace. F_{a1}, F_{a2}, F_{g1}, and F_{g2} are rational fractions of p and have an obvious meaning, i.e., F_{a1} is the transformed voltage on contacts ab related to $\bar{E}$, when e = 0 and current i = 0 (anode circuit interrupted). The other coefficients are determined similarly. It is usually assumed that the current in the tube is determined by the governing voltage $u_e = u_g + Du_a$ where D = permeability of tube, and thus $i = f(u_e)$. System (1) can now be reduced to one equation:

$$\bar{u}_a = -(k + D)Z\bar{f}(u_e) - \bar{E}(F_{g1} + DF_{a1}) - \bar{e}(F_{g2} + DF_{a2}). \tag{2}$$

Since the system consists of concentrated parameters, Equation (2) can be modified as:

Card 6/19

$$\bar{u}_\bullet = \sum_{k=0}^{n} \bar{u}_k + \bar{\mathbf{E}}, \tag{7}$$

where

$$c_k = \frac{U(p_k)}{\left(\frac{dV}{dp}\right)_{p=p_k}} = \frac{U(p_k)}{V'(p_k)}. \tag{6}$$

$$\bar{u}_0 = c_0 \bar{f}(u_\bullet);\ \bar{u}_k = \frac{c_k}{p - p_k} \bar{f}(u_\bullet)\ (k = 1, 2, \ldots, n), \tag{8}$$

$$\bar{\mathbf{E}} = -\bar{E}(F_{g1} + DF_{a1}) - \bar{e}(F_{g2} + DF_{a2}).$$

Now from the equations for the transformed functions, the equations for the original functions are derived:

$$u_0 = c_0 f(u_\bullet)$$

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$$\frac{du_k}{dt} - p_k u_k = c_k f(u_\bullet) \tag{10}$$

$$V(p)\bar{\mathbf{E}} = U_1(p)\bar{E} + U_2(p)\bar{e}. \tag{11}$$

Further substituting $\mathbf{E}$, E and e for $\bar{\mathbf{E}}$, $\bar{E}$ and $\bar{e}$, and the respective derivation for p, the differential equation for E is derived. The unknown quantity:

$$u_\bullet = \sum_{k=0}^{n} u_k + E$$

follows the differential equation of the n-th degree

and needs for its determination n initial conditions. The term $\sum_{k=o}^{n} u_k$ determined by Eq. (10) contains in itself n independent arbitrary constants, which can be used forthe satisfaction of the required n conditions. Thus for **E** any partial solution of the differential equation which can be set up from (11) as outlined above may be taken, and it is not necessary to take the general integral. It is further assumed that the system is close to the conservative; wherefore, $p_k = \alpha_k + j\omega_k$ have a small real part α_k. The current i is also assumed small. The periods of the separate oscillations are selected $T_{ok} = 2\pi/\omega_{ok}$ and $T_o = 2\pi/\omega_o$, and therefore:

$$T_{01}\nu_1 = T_{02}\nu_2 = \cdots = T_{0n}\nu_n = T_0. \qquad (14)$$

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For a selected finite time interval $(t_1 \leqslant t \leqslant t_2)$ the approximated solution of (10) for the assumed conservative system is found by the method of successive approximations:

$$u_{os} = \sum_{k=1}^{n} u_{ks} + E^*, \qquad (15)$$

$$u_{ks}(t) = u_k(t_1)\, e^{j\omega_{0k}(t-t_0)} +$$

$$+ e^{j\omega_{0k}t} \int_{t_1}^{t} \left((p_k - j\omega_{0k})\, u_{k,s-1}(\tau) + c_k f(u_{s,s-1})\right) e^{-j\omega_{0k}\tau} d\tau, \quad s = 1, 2, \ldots,$$

where for s = 1 the integral of the right side is taken equal zero. From (15) the value of u_k can be determined at any point of the interval Δt expressed through the values of the same functions at the beginning of the interval. Dividing the arbitrary time interval into partial intervals Δt,

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(15), substituting t_r for t_1. Development of Equations for Slowly Changing Complex Amplitudes. Equations (17) are now transformed into a shape more common in the theory of oscillations; they can be connected with the method of periodic solutions by the small parameter (Poincaret's method). By-passing this problem, it is pointed out that if a periodic solution is possible, it can be found by making $u_k(t_r + T_o) = u_k(t_r)$. Equations (17) are used for setting up so-called abbreviated equations, or equations for slowly changing complex amplitudes. From (15) and (17) after several transformations, the shortened equations for a system with an arbitrary number of degrees of freedom are derived:

$$\frac{du_k}{dt} = [(p_k - j\omega_{0k}) + c_k S_k]\, u_k(t). \qquad (21)$$

Card 13/19 Using the expressions for c_k, Eq. (21) is transformed

into:

$$\frac{du_k}{dt} = (p_k - j\omega_{0k})\, u_k \left[1 + (k_k + D)\, Z_k S_k\right] \qquad (23)$$

Here, index k denotes that $k_k(p)$ and $Z_k(p)$ are taken for $p = j\omega_{ok}$. Equations (23) resemble Barkhausen's equation for established processes, and are a generalization of it for a nonsteady process in systems with many degrees of freedom, the last equations (as compared with 21) requiring an additional condition--absence of close roots of equation $V(p) = 0$. For the special case, often encountered in practical applications, when the system contains closely tuned and weakly coupled circuits, (21) are valid, while (23) are not valid. For an autonomous system with one degree of freedom, the average steepness is:

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$$S_1 = \frac{1}{2\pi |u|} \int_0^{2\pi} f(|2|u|\cos\xi|)\, e^{-j\xi} d\xi. \qquad (25)$$

where $\omega_0(\tau - t) + \varphi = \xi$ and φ is argument of $u_1(t)$.

(3) Analysis of Some Special Cases. In cases when the frequency of the external force is close to the frequency of one of the oscillations, or if two close frequencies are present, it is advisable to transform the previous equations so as to combine the oscillations of close frequencies into one. (a) Frequency of the external force is close to one of the shown frequencies. A combined frequency is introduced and equation:

$$\frac{du_1^0}{dt} = (p_1 - j\omega + c_1 S)\, u_1^0 - \frac{1}{2}(p_1 - j\omega) E_1 e^{j\varphi}. \qquad (26)$$

$$\frac{1}{2}V''(j\omega_0)\frac{d^2u}{dt^2} + V'(j\omega_0)\frac{du}{dt} + V(j\omega_0)u = -U(j\omega_0)F - U'(j\omega_0)\frac{dF}{dt} \quad (28)$$

Here, F can be substituted by Su, where S = average steepness and u = complex amplitude of the combined u_1 and u_2. (4) Setting Up Equations of Higher Approximations. The equation of the first approximation was developed above by replacing in Eq. (19):

$$u_k(t_r + T) - u_k(t_r) = (p_k - j\omega_{0k})Tu_k(t_r) + c_kF_k(u_1, u_2, \ldots, u_n; E), \quad (19)$$

the differences by derivatives. To obtain the equation for the second approximation, the well-known relation of the theory of interpolation must be used:

$$\Delta x \frac{df}{dx} = \Delta f - \frac{1}{2}\Delta^2 f + \frac{1}{3}\Delta^3 f + \dots$$

If the differences of a higher order than the second are small, only the first two terms need be used. Thus, the following equation is developed:

$$\frac{du_k}{dt} = \frac{1}{T}\left[P_k(t) - \frac{1}{2}P_k(t+T) + \frac{1}{2}P_k(t)\right] = \frac{1}{2T}[3P_k(t) - P_k(t+T)], \quad (30)$$

where $P_k(t)$ is given by $P_k(t_r)$ by replacing t_r with t. All calculations are made with precision up to the third order terms (keeping the second order terms). Conclusions. The developed difference Eqs. (19) give the periodic solutions describing the behaviour of tube oscillators. From these equations are developed Eqs. (21) and (23) describing a system of nonperiodic processes, and

9.3260, 9.4310

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ABSTRACT: For investigations of transistor self-oscillators, the triode is sometimes substituted by an equivalent scheme with constant parameters, but this is possible only for small oscillations; hence, the investigation of the most important aspects of transistor oscillators is excluded. Another group of scientists applied the approach used for tube oscillators, thus, considering the transistor oscillators as a nearly conservative system, which is also possible only for limited conditions, because the voltage changes of the transistor oscillator must be close to sinusoidal. The present paper investigates the oscillator operating with nonsinusoidal oscillations and with certain limitations. Notwithstanding a certain idealization, it is possible

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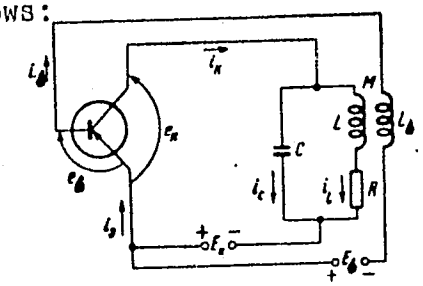
to determine the frequency of self-oscillations, the voltage and magnitude of the induced currents. All these investigations were made for plane triodes, under operating conditions where it is possible to ignore the inertia of the transistor. The experimental data agree very closely with the theoretical calculations. 2. Setting of the Problem and Basic Relations. Figure 1 shows a self-oscillator with a plane transistor (triode). For this scheme, the oscillator equation can be written as follows:



$$\left.\begin{aligned} E_b - e_b &= \frac{d}{dt}(L_b i_b + M i_L), \\ E_k - e_k &= \frac{d}{dt}(M i_b + L i_L) + i_L R, \\ i_k &= i_L - C\frac{de_k}{dt}. \end{aligned}\right\} \quad (1)$$

Fig. 1. Schematics of the oscillator: (b) base; (k) cathode; (c) capacitance.

To these equations the following relations giving the characteristics of the triode have to be added:

$$\left.\begin{aligned} i_a &= i_a(e_a, e_b), \\ i_b &= i_b(e_a, e_b). \end{aligned}\right\} \qquad (2)$$

For practical application, the most important case is when $L_b \ll |M| \ll L$ (the base currents are ignored here), and the previous equation can be rewritten:

$$\left.\begin{aligned} E_b - e_b &= M\frac{di_L}{dt}, \\ E_a - e_a &= L\frac{di_L}{dt} + i_L R, \\ i_a &= i_L - C\frac{de_a}{dt}, \end{aligned}\right\} \qquad (3)$$

$$i_a = i_a(e_a, e_b). \qquad (4)$$

Excluding i_L and e_K from these expressions the differential equation can be set up:

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