ACC NR: AP7002739

deviation from this ratio is termed a dilatometric anomaly (Zel'dovich, V. I., Sorokin, I. P. FMM, 1966, 21, 223). The difference between the dilatometric effect of the transformation of a textured (deformed) alloy versus that of a statistically isotropic (nondeformed) alloy represents the measure of the dilatometric anomaly, on taking into account the amount of the transforming phase. In this connection, on the basis of an analysis of dilatometric anomalies and changes in texture due to $\alpha \rightarrow \gamma$ transformation, as well as on the basis of the change in transformation temperature owing to prior plastic deformation (92% reduction in area), the nature of $\alpha \rightarrow \gamma$ transformation during continuous heating is discussed with respect to N23, N28, N32 and N27T2 ferronickel alloys and G7 and G14 ferromanganese alloys. The temperatures at the beginning and end of the transformation were taken as the temperatures at which the dilatometric curve began to markedly deviate from its rectilinear couse. The dilatometric curves were plotted with the aid of a differential optical dilatometer, and the phase composition was determined by the magnetometric method. Findings: in ferronickel alloys with a low Ni content -- N12 (12.0% Ni), N15 (15.1% Ni), N23 (23.1% Ni) -- the decisive role in transformation is played by diffusion processes (the austenite texture becomes dispersed to a much greater extent), whereas in the alloys with a higher Ni content the martensitic mechanism is largely responsible for this transformation. The addition of Ti (1.9%) to the alloy with 27% Ni (N27T2) inhibits the recrystallization of asutenite and the development of disordered diffusion processes during transformation. This may be a definite factor in enhancing the strength of Fe-Ni-Ti alloys

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ACC NR: AP7002739

owing to phase strain hardening compared with Fe-Ni alloys. In ferromanganese alloys the initial temperature of $\alpha \rightarrow \gamma$ transformation markedly decreases under the influence of deformation, which points to a diffusion mechanism of $\alpha \rightarrow \gamma$ transformation in these alloys during their continuous heating. Orig. art. has: 2 tables, 2 figures.

SUB CODE: 13, 20/ SUBM DATE: 20Apr66/ ORIG REF: 007/ OTH REF: 002

Card 3/3

ACCESSION NR: AR4027681 S/0276/64/000/001/G008/G008

SOURCE: RZh. Tekhnologiya mashinostroyeniya, Abs. 1G60

AUTHOR: Gol'dshteyn, Ya. Ye.; Zel'dovich, V. I.; Shmatko, K. S.

TITLE: Peculiarities of the effect of rare earth metals on the structure and properties of structural steels

CITED SOURCE: Sb. Teoriya i praktika metallurgii. Vy*p. 5. Chelyabinsk, 1963, 123-131

TOPIC TAGS: rare earth metal, structural steel, steel metallurgy, rare metal admixture, rare metal alloy

TRANSLATION: The authors have established the possibility of immunizing steel from flake formation by increased additions of REM (rare earth metals). Such treatment simultaneously increases the resistance to brittleness and hardenability of the steel. The mechanism of long-term effects of REM additions is associated with the high absorptive ability of cerium with respect to hydrogen, and possibly with the formation of stable cerium hydrides. The introduction of 0.25% REM into

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ACCESSION NR: AR4027681

steel leads to the redistribution of sulfied in microvolumes of steel, as a result of which the high-melting cerium sulfides are localized in the dendrite axes and not in the interaxial spaces. The concomitant fragmentation of the dendrite crystallization is explained by the modification effect, as well as the purification of the melt of hydrogen, sulfur, and other admixtures. The maximum degree of disorganization of the dendritic crystallization is noted upon the introduction of increased portions of REM (0.6%). The purification of steels likewise promotes the removal of spot inhomogeneities. An important characteristic of steel treated with REM is the increased isotropism of its mechanical properties (yield point). The best results (the minimum anisotropy factor) are achieved upon the introduction of 0.25% ferrocerium. It was found that the optimal amount of REM additions depends on the thermal processing regime and the purpose of the steel; in the state following annealing and high-temperature tempering, an addition of 0.1% is optimal; in the state of low-temperature tempering it is 0.25% REM. The introduction of increased amounts of REM on the order of 0.4-0.6% for the elimination of flaking sensitivity of steel is permitted and is recommended only for alloyed steels to be annealed and quenched to low and medium temperatures. Such a dependence of the optimal REM addition on the conditions of subsequent thermal treatment is associated

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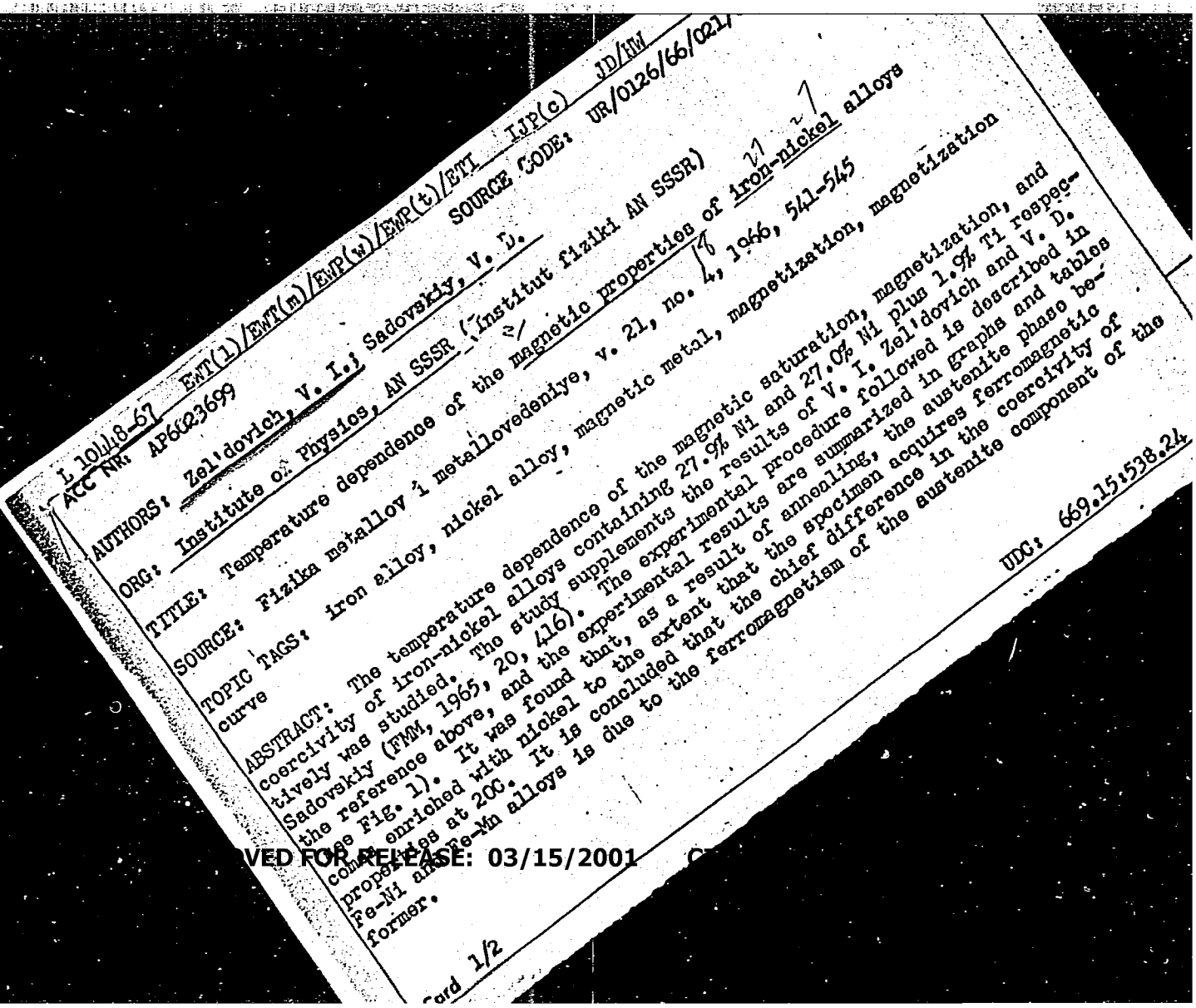
ACCESSION NR: AR4027681

with the variable solubility of cerium in α-Fe. Studies have confirmed the theoretical possibility of active extra-furnace desulfuration of steel through the addition of REM. The introduction of 0.6% ferrocerium leads to a drop in the sulfur content (in the main ingot body) by a factor of 4-5. A disadvantage of the treatment of steel with rare-earth elements with the usual technology of their introduction and deoxidation of steel is the incomplete evacuation of the treatment products into the slag and the head metal of the ingot. The successful solution of the problem of the completeness of flotation of these products will essentially determine the rates of introduction of REM into structural steel production.

DATE ACQ: 03Mar 64 SUB CODE: ML ENCL: 00

Card 3/3



L 10448-67 EWT(1)/EWT(m)/EWP(w)/EWP(t)/ETI IJP(c) JD/HW
ACC NR: AP6023699 SOURCE CODE: UR/0126/66/021/
AUTHORS: Zel'dovich, V. I.; Sadovskiy, V. D.
ORG: Institute of Physics, AN SSSR (Institut fiziki AN SSSR)
TITLE: Temperature dependence of the magnetic properties of iron-nickel alloys
SOURCE: Fizika metallov i metallovedeniye, v. 21, no. 4, 1966, 541-545
TOPIC TAGS: iron alloy, nickel alloy, magnetic metal, magnetization, magnetization curve
ABSTRACT: The temperature dependence of the magnetic saturation, magnetization, and coercivity of iron-nickel alloys containing 27.9% Ni and 27.0% Ni plus 1.9% Ti respectively was studied. The study supplements the results of V. I. Zel'dovich and V. D. Sadovskiy (FMM, 1965, 20, 416). The experimental procedure followed is described in the reference above, and the experimental results are summarized in graphs and tables (see Fig. 1). It was found that, as a result of annealing, the austenite phase becomes enriched with nickel to the extent that the specimen acquires ferromagnetic properties at 20C. It is concluded that the chief difference in the coercivity of Fe-Ni and Fe-Mn alloys is due to the ferromagnetism of the austenite component of the former.
UDC: 669.15:538.24

Card 1/2

L 10110-67 EWT(1)/EWT(m)/EWP(w)/EWP(t)/ETI IJP(c) JD/JW

ACC NR: AP6023699 SOURCE CODE: UR/0126/66/021/004/0541/0545

AUTHORS: Zel'dovich, V. I.; Sadovskiy, V. D. 23 22

ORG: Institute of Physics, AN SSSR (Institut fiziki AN SSSR)

TITLE: Temperature dependence of the magnetic properties of iron-nickel alloys

SOURCE: Fizika metallov i metallovedeniye, v. 21, no. 4, 1966, 541-545

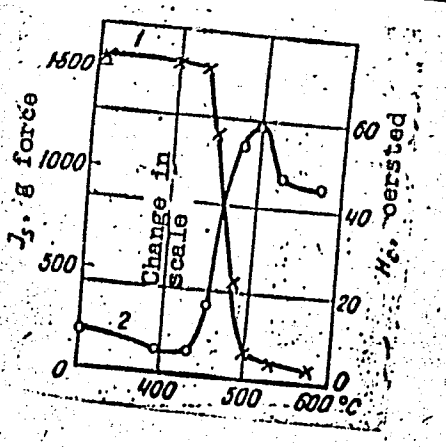
TOPIC TAGS: iron alloy, nickel alloy, magnetic metal, magnetization, magnetization curve

ABSTRACT: The temperature dependence of the magnetic saturation, magnetization, and coercivity of iron-nickel alloys containing 27.9% Ni and 27.0% Ni plus 1.9% Ti respectively was studied. The study supplements the results of V. I. Zel'dovich and V. D. Sadovskiy (FMM, 1965, 20, 416). The experimental procedure followed is described in the reference above, and the experimental results are summarized in graphs and tables (see Fig. 1). It was found that, as a result of annealing, the austenite phase becomes enriched with nickel to the extent that the specimen acquires ferromagnetic properties at 20C. It is concluded that the chief difference in the coercivity of Fe-Ni and Fe-Mn alloys is due to the ferromagnetism of the austenite component of the former.

Card 1/2 UDC: 669.15:538.24

ACC NR: AP6023699

Fig. 1. The dependence of the magnetization (1) and coercivity (2) of an iron-nickel alloy on the annealing temperature.



Orig. art. has: 1 table and 6 graphs.

SUB CODE: 11/ SUBM DATE: 08Jun65/ ORIG REF: 009/ OTH REF: 003

magnetic alloy

Card 2/2 bmp

AID Nr. 978-7 28 May

CHROMIUM-NICKEL STEEL WITH CERIUM (USSR)

Goldshteyn, Ya. Ye., V. I. Zel'dovich, A. I. Komissarov, and Ye. L. Korotkevich

Stal', no. 4, Apr 1963, 354-358.

S/133/63/000/004/007/011

The effects of the addition of ferrocerium containing 94% rare-earth metals on the mechanical properties of 40XH (0.37% C, 1.03% Ni, 0.57% Cr) steel were investigated at the Chelyabinsk Scientific Research Institute of Metallurgy and the Chelyabinsk Metallurgical Plant. The hardenability of steel increased only with the addition of 0.6% Fe-Ce (smaller additions did not affect the hardenability). Fe-Ce has little or no effect on austenite grain size or the rate of grain growth at high temperature. The addition of 0.10 and 0.25% Fe-Ce had a positive effect on notch toughness. With low-temperature tempering a maximum notch toughness of 5 kgm/cm^2 was obtained in

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CHROMIUM-NICKEL STEEL [Cont'd]

S/133/63/000/004/007/011

steel with 0.25% Fe-Ce; with high-temperature tempering a maximum of 22 kgm/cm² was obtained in steel with 0.1% Fe-Ce. Fe-Ce lowered the susceptibility of 40XH steel to temper brittleness. An addition of 0.25% Fe-Ce reduced the anisotropy of mechanical properties, 0.10% Fe-Ce had no effect, and 0.6% Fe-Ce increased the anisotropy. The addition of 0.6% Fe-Ce lowered the temperature of transition to brittle behavior by 30 to 40°C, which can be attributed to the purifying and refining effect of Fe-Ce. [WW]

ZEL'DOVICH, V.I.

82642
S/126/60/010/02/012/020
E021/E335

18.8200

AUTHORS: Gavranek, V.V., Bol'shutkin, D.N. and Zel'dovich, V.I.

TITLE: Thermal and Mechanical Action of a Cavitation Zone on the Surface of a Metal

PERIODICAL: Fizika metallov i metallovedeniye, 1960, Vol. 10, No. 2, pp 262 - 268

TEXT: The present work is an attempt to examine the change in temperature and pressure impulses arising in the surface layers of a solid in the cavitation zone. A magnetostriction vibrator was used in the experiments with a constant amplitude of 0.06 mm and a frequency of 7.5 kc/s. Phase changes in a quenched U7 steel and D1 duralumin were investigated in the cavitation zone by microhardness and X-ray investigations. Fig. 2 shows the relation of microhardness with time of cavitation erosion. Fig. 2a is for the steel and 2b for duralumin. The changes in hardness show that the temperature of micro-volumes during cavitation erosion reaches 470 °C. Fig. 3 shows the effect of a preliminary tempering treatment at various temperatures on hardness (Curve 2) and rate of erosion (Curve 1). The rate of erosion is practically unchanged by preliminary heat treatments

Card 1/3

Thermal and Mechanical Action of a Cavitation Zone on the Surface of a Metal

up to 400 °C. This shows that the damage occurs on micro-volumes of metal, the temperature of which is up to 400 °C. X-ray investigations show that the internal stresses arising in the steel in the process of quenching are removed by cavitation erosion. Similar results were obtained for duralumin. During the experiments, the duralumin became artificially aged, showing that high temperatures are reached during cavitation erosion.

The obtained results can be summarised thus:

1) the mechanical and the thermal effects in the cavitation zone produced by the magnetostriction vibrator were calculated. It was found that in the case of using a 7.5 kg/s vibrator, the pressure increases periodically to 550 kg/cm^2 during a period of about 10^{-5} sec and acts on an area of about 10^{-5} mm^2. The micro-volumes of the metal bordering on the cavitation bubble are heated to 300 - 500 °C.

2) It was established that during the process of cavitation erosion, hardened steel is being tempered at temperatures up

82642

S/126/60/010/02/012/020
E021/E335

Thermal and Mechanical Action of a Cavitation Zone on the Surface of a Metal

to 470 °C.

3) The speeds of cavitation erosion of steel hardened to obtain a martensitic structure and of steel tempered at temperatures below 400 °C are practically equal.

There are 4 figures and 10 Soviet references.

ASSOCIATION: Khar'kovskiy politekhnicheskiy institut im. V.I. Lenina (Khar'kov Polytechnical Institute im. V.I. Lenin

SUBMITTED: June 26, 1959, originally,
February 17, 1960, after revision.

Card 3/3

18.7520

34979
S/133/62/000/003/004/008
A054/A127

AUTHORS: Gol'dshteyn, Ya. Ye., Candidate of Technical Sciences, Zel'dovich, V. I., Keys, N. V., Kossovskiy, L. D., Vaynshteyn, O. Ya., Shmatko, K. S., Engineers

TITLE: The effect of treating liquid chrome-nickel steel with cerium on its crystallization

PERIODICAL: Stal', no. 3, 1962, 258 - 261

TEXT: Tests were carried out to study the effect of adding ferrocerium to chrome-nickel structural steel on the flake formation and crystallization. The tests were based on the chemical affinity of cerium to hydrogen, which increases when the temperature is raised. As rare-earth metals mostly tend to adsorb hydrogen in the 200 - 600°C range, where the hydrogen separation from the metal is particularly intensive, this phenomenon can be used to reduce flaking. Four 40 ХН (40KhN) steel ingots of the same melt were tested: one, checking specimen, without ferrocerium, the others containing 0.1, 0.25 and 0.6% ferrocerium, respectively. Lumps of ferrocerium, containing 94% rare-earth metal (primarily cerium) were used. The ingots were top-cast and weighed 2.65 ton. Lateral macrotemplates,

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cut from blooms rolled from the test ingots, (air-dried after rolling, non-annealed) were analyzed after 1 and 6 months. Flakes were not found in templates from steel to which at least 0.6% ferrocerium was added. The analysis also showed that the effect of cerium (lanthanum, etc.) actually does not manifest itself in the adsorption of hydrogen, but rather in bonding it in the form of stable hydrides. In steel, containing as much as 3.7 cm^3 hydrogen/100 g, there was no flaking, due to the addition of 0.6% ferrocerium, while flakes were found in steel containing not more than 0.56 cm^3/100 g hydrogen, if not treated with cerium. When ferrocerium is added to the liquid steel in amounts above 0.25%, the pattern of dendritic crystallization changes and sulfur will be re-distributed in the microareas of the metal. High-smelting cerium-sulfides pass from the interaxial areas into the dendritic axes. When ferrocerium is added in amounts of up to 0.6%, dendritic crystallization disappears, and, under the effect of cerium, the steel is cleaned from sulfur, antimony, stannum, bismuth, lead, etc. 0.6% ferrocerium reduces the sulfur-content of the metal 5 times. However, when ferrocerium is added in the ingot mold., the cerium-sulfides (oxy-sulfides) cannot entirely be removed into the slag and the feeding head. This results in a nonhomogeneity of the boundary zone. The high-temperature cerium-sulfides (oxy-sulfides of intricate composition) are forming already in the period prior to crystallization

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001964220011-5"

and are moved to the ingot surface during the casting. The liquation in the boundary zone can be prevented by smooth, rather slow filling of the ingot mold from the bottom and by an increase of the head temperature. Cerium containing steel with a liquation in the boundary zone shows a tendency to red shortness. This can be reduced by adding ferrocerium in the ladle instead of in the ingot mold, or by roughing the ingot before rolling. The addition of ferrocerium in amounts of at least 0.25% prevents spotty liquation, because a greater part of sulfur is bonded in the form of cerium-sulfides with a high melting point. There are 5 figures and 9 references: 8 Soviet-bloc and 1 non-Soviet-bloc. The reference to the English-language publication reads as follows: Russel, Journal of Metals, no. 4, 1954, 438 - 442.

ASSOCIATION: Chelyabinskiy nauchno-issledovatel'skiy institut metallurgii (Chelyabinsk Scientific Research Institute of Metallurgy) and Chelyabinskiy metallurgicheskiy zavod (Chelyabinsk Metallurgical Plant

ZEL'DOVICH, V.I.; SADOVSKIY, V.D.

Effect of heat treatment on the magnetic properties of certain alloys in the systems Fe - Mn and Fe - Ni. Fiz. met. i metalloved. 20 no.3:406-411 S '65.

(MIRA 18:11)

1. Institut fiziki metallov AN SSSR.

ABDULIN, A.; ALEKSEYEV, I.; BANTLE, O.; BOBROV, L.; BOZHANOV, B.; BOYKO, V.; BONDAREV, K.; BORZOV, V.; VERKHOVSKIY, N.; GUBAREV, V.; GUSHCHEV, S.; DEBABOV, V.; DIKS, R.; DMITRIYEV, A.; ZHIGAREV, A.; ZEL'DOVICH, Ya.; ZUBKOV, B.; IRININ, A.; IORDANSKIY, A.; KITAYGORODSKIY, P.; KLYUYEV, Ye.; KLYACHKO, V.; KOVALEVSKIY, V.; KNORRE, Ye.; KONSTANTINOVSKIY, M.; LADIN, V.; LITVIN-SEDOY, M.; MALEVANCHIK, B.; MANICHEV, G.; MEDVEDEV, Yu.; MEL'NIKOV, I.; MUSLIN, Ye.; NATARIUS Ya.; NEYFAKH, A.; NIKOLAYEV, G.; NOVOMEYSKIY, A.; OL'SHANSKIY, N.; OS'MIN, S.; PODOL'NYY, R.; RAKHMANOV, N.; REPIN. L.; RESHETOV, Yu.; RYBCHINSKIY, Yu.; SVOREN', R.; SIFOROV, V.; SOKOL'SKIY, A.; SPITSYN, V.; TEREKHOV, V.; TEPLOV, L.; KHAR'KOVSKIY, A.; CHERNYAYEV, I.; SHAROL', L.; SHIBANOV, A.; SHIBNEV, V.; SHUYKIN, N.; SHCHUKIN, O.; EL'SHANSKIY, I.; YUR'YEV, A.; IVANOV, N.; LIVANOV, A.; FEDCHENKO, V.; DANIN, D., red.

[Eureka] Evrika. Moskva, Molodaia gvardiia, 1964. 278 p. (MIRA 18:3)

ACC NR: AP6016664 SOURCE CODE: UR/0053/65/087/001/0113/0124

AUTHOR: Zel'dovich, Ya. B.; Okun', L. B.; Pikel'ner, S. B.

ORG: none

TITLE: Quarks: Astrophysical and physical-chemical aspects

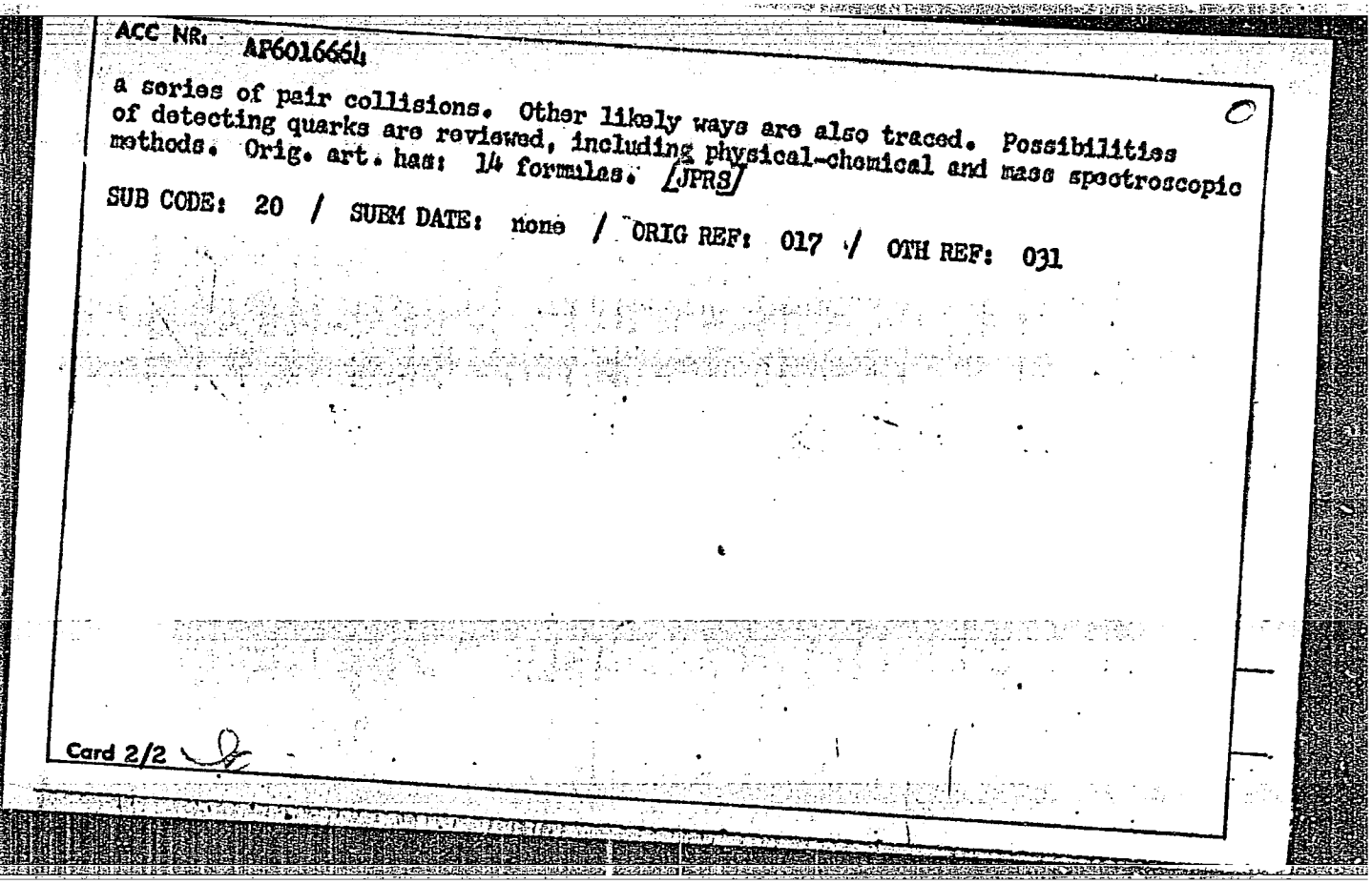
SOURCE: Uspekhi fizicheskikh nauk, v. 87, no. 1, 1965, 113-124

TOPIC TAGS: nucleon, cosmic ray, meson, baryon, mass spectroscopy

ABSTRACT: Various approaches to the search for new stable particles are reviewed: namely, three assumed quarks, having charges 2/3e, -1/3e, and -1/3e1.2, as well as others having integral charges. The lightest fractional-charge quark is supposed to be stable in vacuum as well as in contact with ordinary matter (nuclei, electrons). Conditions are given under which integral-charge particles can be stable. Various possible sources of quarks are reviewed, the most powerful being cosmic rays from superstars or quasistars. The annihilation of quarks is then discussed in detail. Since quarks are heavier than nucleons, the process $q_1 + q_1 \rightarrow q_3 + q_{-1}$ is possible, followed by $q_1 + q_{-1} \rightarrow nq_0$ (where the subscript indicates the number of quarks and the minus sign indicates an antiparticle;) q_3 is thus an ordinary baryon of three quarks, and q_0 is a meson. Quarks are therefore annihilated via

Card 1/2

UDC: 539.12



ACC NR: AF6016664

a series of pair collisions. Other likely ways are also traced. Possibilities of detecting quarks are reviewed, including physical-chemical and mass spectroscopic methods. Orig. art. has: 14 formulas. [JPRS]

SUB CODE: 20 / SUBM DATE: none / ORIG REF: 017 / OTH REF: 031

Card 2/2

L 46282-66 EWT(m)/EWP(w)/T/EWP(t)/ETI IJP(c) JD/HW

ACC NR: AP5025326 SOURCE CODE: UR/0126/65/020/003/0406/0411

AUTHOR: Zel'dovich, V. I.; Sadovskiy, V. D. 54 B

ORG: Institute of Physics of Metals, AN SSSR (Institut fiziki metallov AN SSSR)

TITLE: The effect of heat treatment on the magnetic properties of some Fe-Mn and Fe-Ni alloys

SOURCE: Fizika metallov i metallovedeniye, v. 20, no. 3, 1965, 406-411

TOPIC TAGS: ferrous alloy, nickel containing alloy, manganese containing alloy, ~~metal heat treatment~~, metal phase system, phase transition, ANNEALING, MAGNETIC SATURATION, MAGNETIC COERCIVE FORCE

ABSTRACT: The effect of annealing temperatures on the magnetic saturation intensity and coercive force of tempered and stressed ferrous alloys was studied. The samples, containing 0.5—10.6 wt% Mn, 0.1—31.8 wt% Ni, and 0.05 wt% C and 0.15—0.35 wt% Si, were tempered 30 min at 1180C, quenched in water, and annealed at temperatures to 720C in a salt bath. During annealing at temperatures corresponding to $\alpha \rightarrow \gamma$ transitions a high dispersion of magnetic martensite and nonmagnetic austenite is formed. Magnetic saturation intensity reaches a minimum and the coercive force a maximum, due to the appearance of an Mn- or an Ni-enriched austenite phase which is stable to $\alpha \rightarrow \gamma$ transitions close to room temperature.

Card 1/2

UDC: 539.292:536:538

L 46282-66
ACC NR: AP5025326

Deformation of the tempered Fe-Ni sample by rolling at room temperature prior to annealing caused a sharper decrease and increase of magnetic saturation and coercive force, respectively, during annealing at temperatures of $\alpha \rightarrow \gamma$ transition. For the alloy of 31.8 wt% Ni content, a decrease of magnetic saturation intensity but no essential increase of the coercive force was observed at $\alpha \rightarrow \gamma$ transition temperatures; a peak of the latter parameter appeared at 250C and on approach to the Curie point of the ferromagnetic austenite phase of this alloy. Orig. art. has: 5 figures and 1 table.

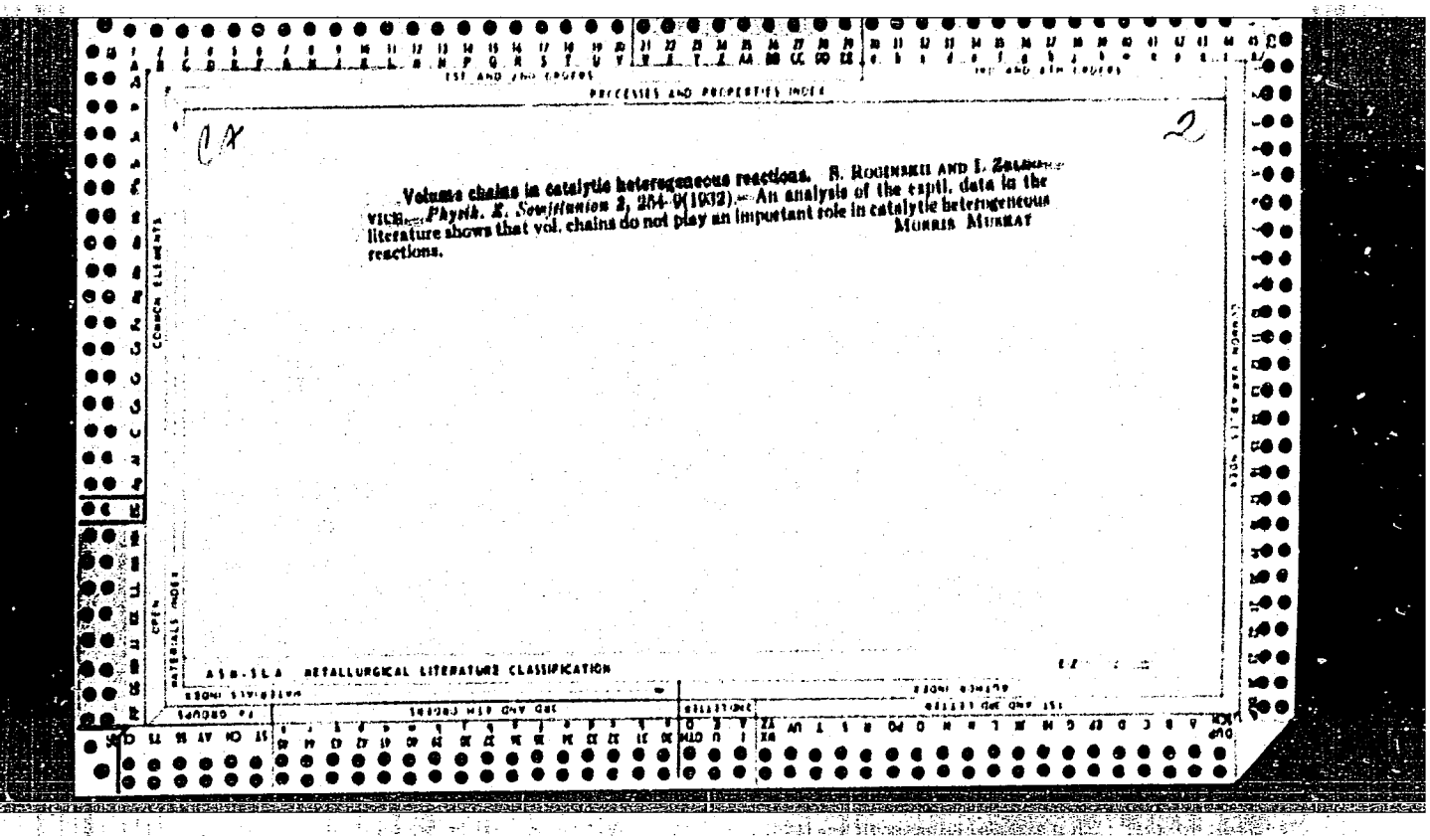
SUB CODE: 11,20/ SUBM DATE: 18Jan65 / ORIG REF: 006/ OTH REF: 001

LS
Card 2/2

ZEL'DOVICH, B.Ya. (Moskva)

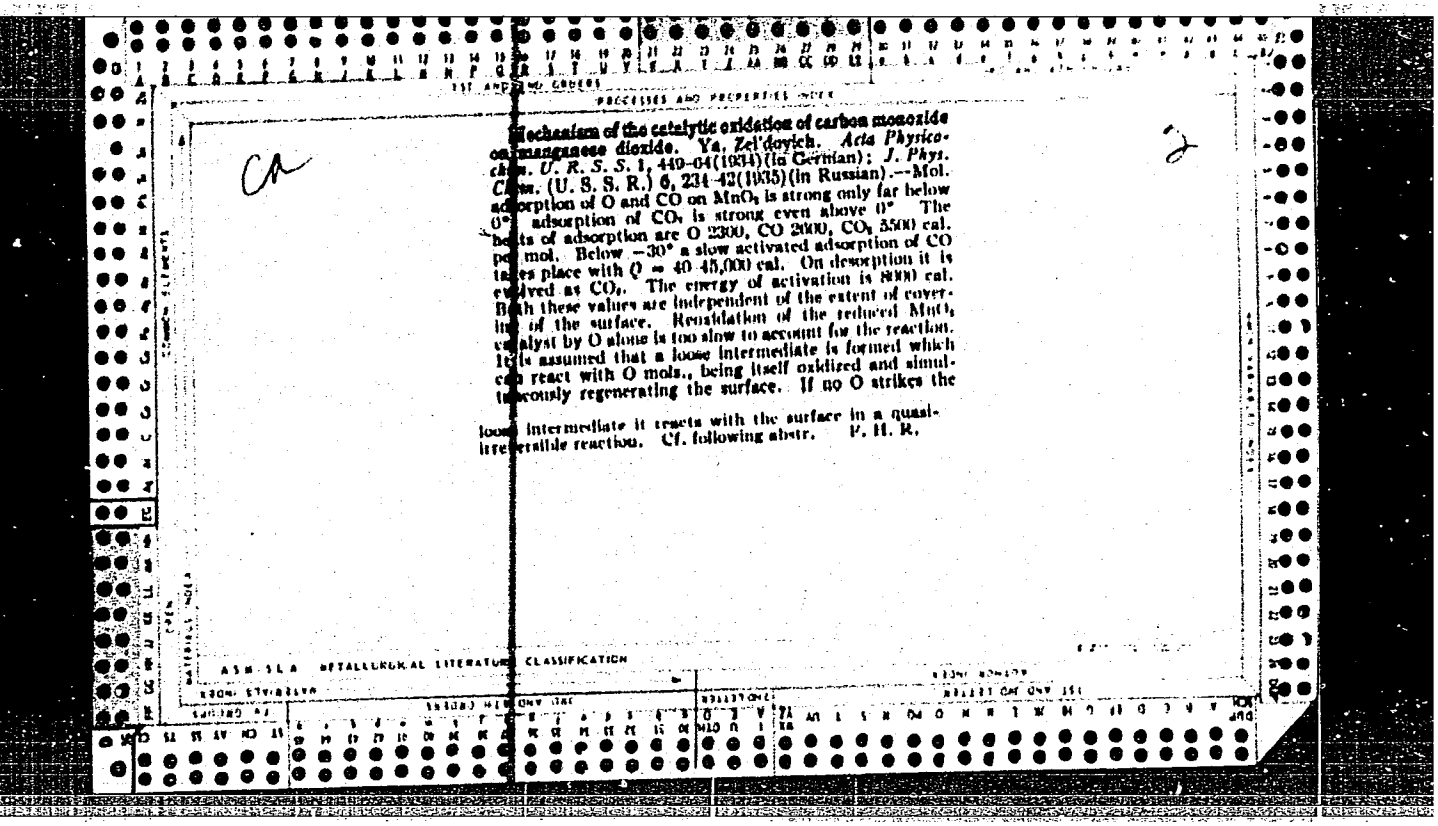
Phenomena of superconductivity. Fiz.v shkole 22 no.6:80-84 N-D '62. (MIRA 16:2)

(Superconductivity)

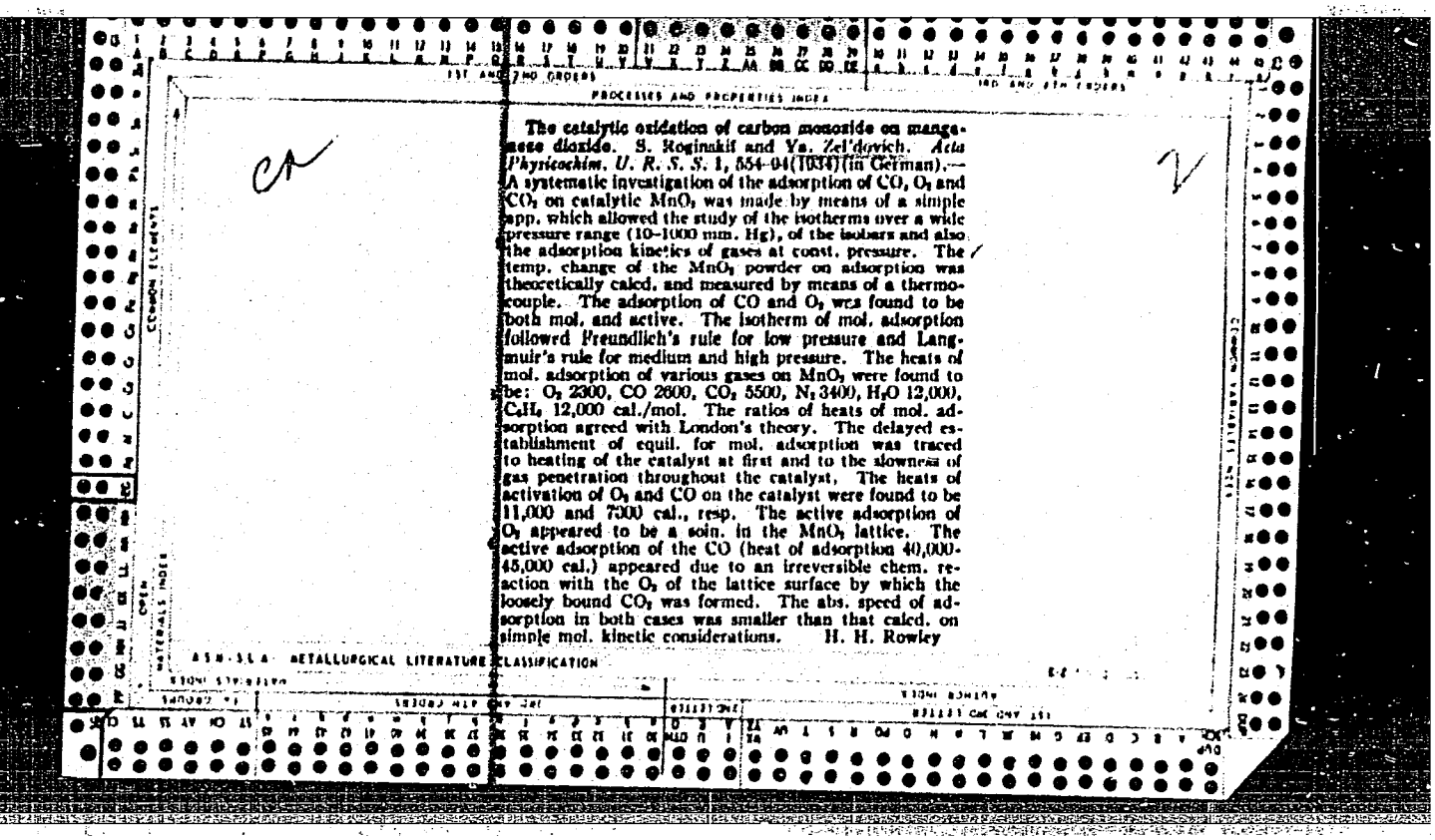


Volume chains in catalytic heterogeneous reactions. B. Rozinskii and I. Zaslavskii. *Physik. Z. Sowjetunion* 2, 284-9(1932).—An analysis of the exptl. data in the literature shows that vol. chains do not play an important role in catalytic heterogeneous reactions.

Morris Murray



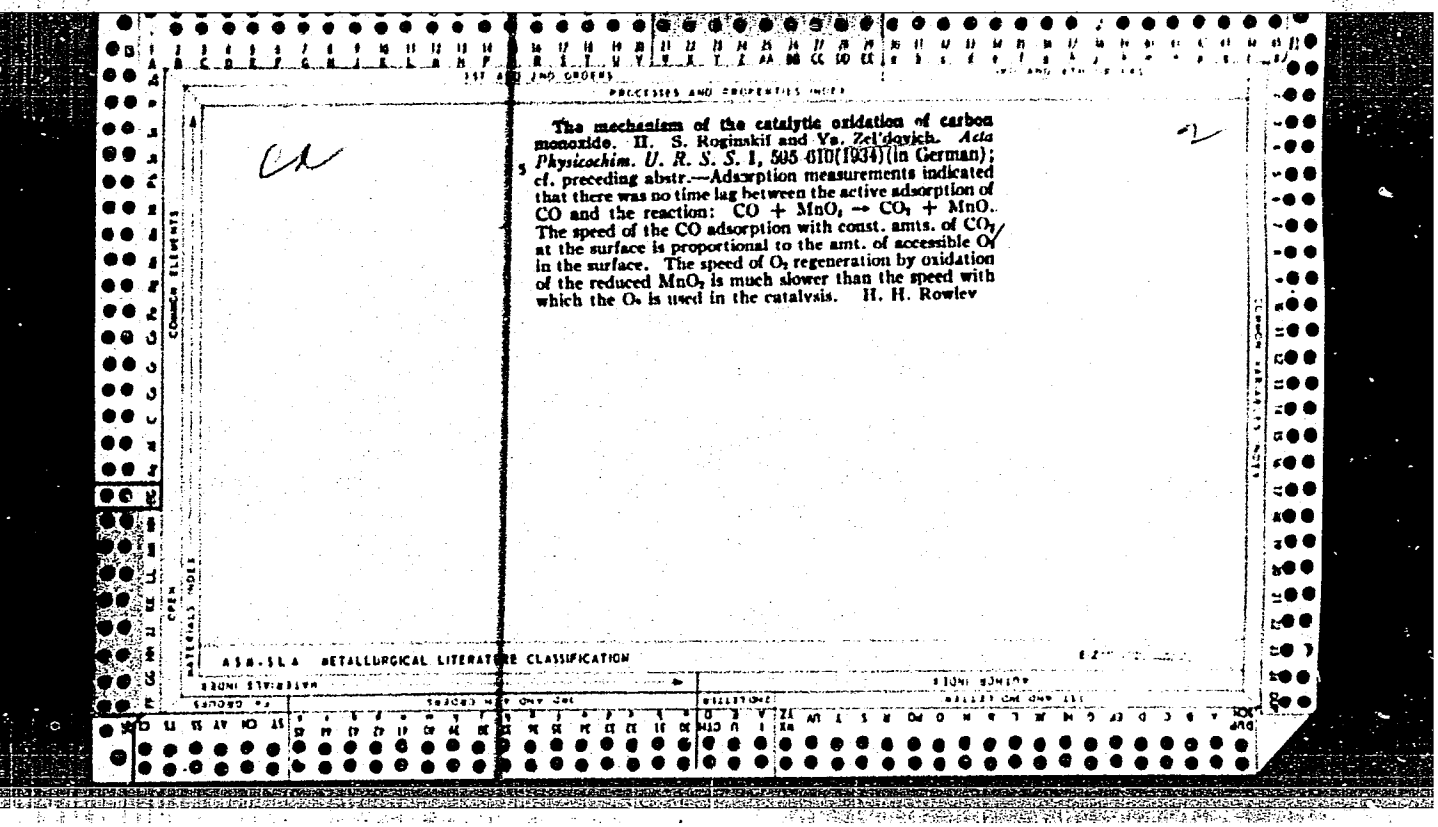
Mechanism of the catalytic oxidation of carbon monoxide on manganese dioxide. Ya. Zel'dovich. *Acta Physicochim. U. R. S. S.* 1, 449–64(1934)(in German); *J. Phys. Chim.* (U. S. S. R.) 6, 234–43(1935)(in Russian).—Mol. adsorption of O and CO on MnO_2 is strong only far below 0°; adsorption of CO_2 is strong even above 0°. The heats of adsorption are O 2300, CO 2000, CO_2 3500 cal. per mol. Below −30° a slow activated adsorption of CO takes place with Q = 40–45,000 cal. On desorption it is evolved as CO_2. The energy of activation is 8000 cal. Both these values are independent of the extent of covering of the surface. Reoxidation of the reduced MnO_2 catalyst by O alone is too slow to account for the reaction. It is assumed that a loose intermediate is formed which can react with O mols., being itself oxidized and simultaneously regenerating the surface. If no O strikes the loose intermediate it reacts with the surface in a quasi-irreversible reaction. Cf. following abstr. P. H. R.



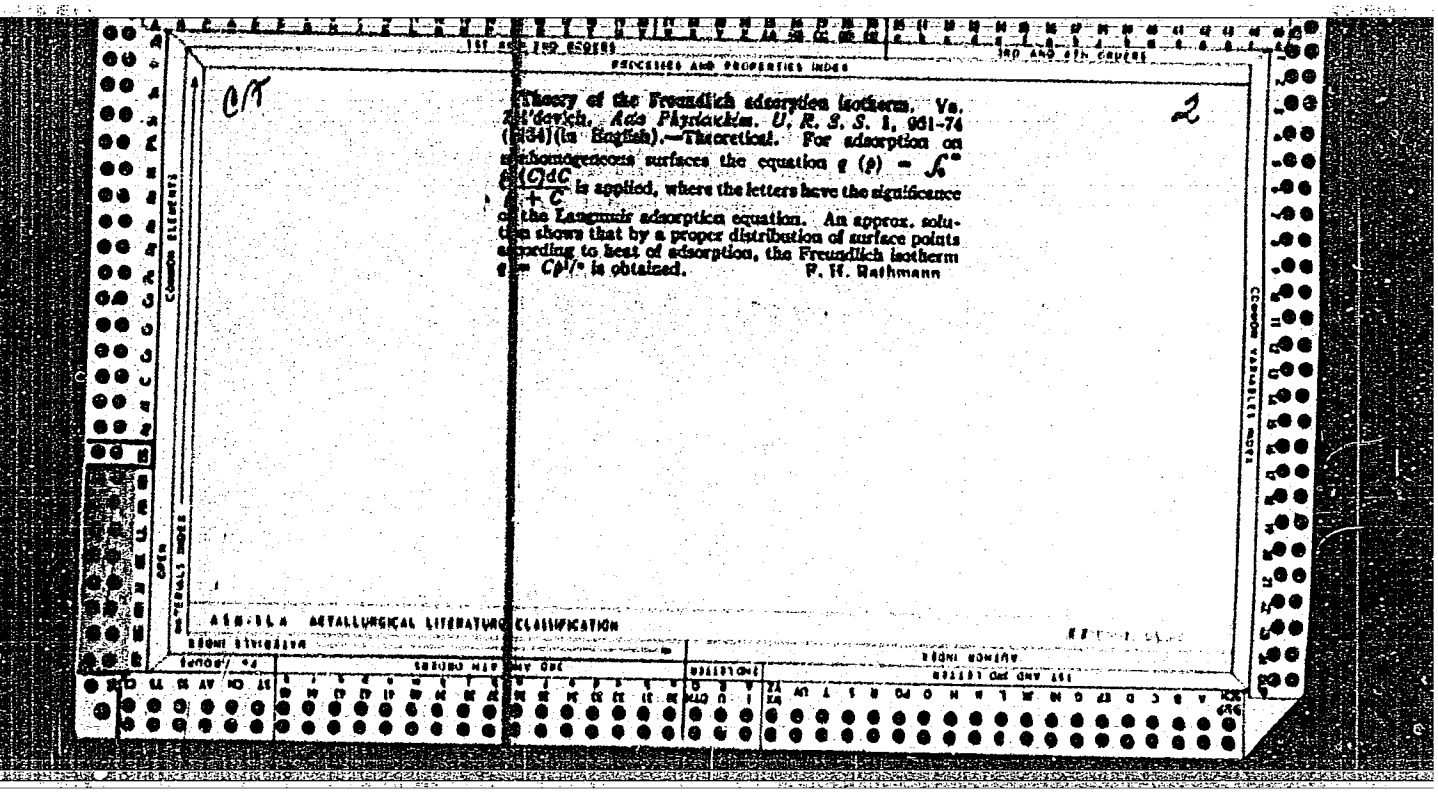
PROCESSES AND PROPERTIES INDEX

The catalytic oxidation of carbon monoxide on manganese dioxide. S. Roginskiĭ and Ya. Zel'dovich. *Acta Physicochim. U. R. S. S.* 1, 554-94(1934)(in German).—A systematic investigation of the adsorption of CO, O_2 and CO_2 on catalytic MnO_2 was made by means of a simple app. which allowed the study of the isotherms over a wide pressure range (10–1000 mm. Hg), of the isobars and also the adsorption kinetics of gases at const. pressure. The temp. change of the MnO_2 powder on adsorption was theoretically calcd. and measured by means of a thermocouple. The adsorption of CO and O_2 was found to be both mol. and active. The isotherm of mol. adsorption followed Freundlich's rule for low pressure and Langmuir's rule for medium and high pressure. The heats of mol. adsorption of various gases on MnO_2 were found to be: O_2 2300, CO 2600, CO_2 5500, N_2 3400, H_2O 12,000, C_6H_6 12,000 cal./mol. The ratios of heats of mol. adsorption agreed with London's theory. The delayed establishment of equil. for mol. adsorption was traced to heating of the catalyst at first and to the slowness of gas penetration throughout the catalyst. The heats of activation of O_2 and CO on the catalyst were found to be 11,000 and 7300 cal., resp. The active adsorption of O_2 appeared to be a soln. in the MnO_2 lattice. The active adsorption of the CO (heat of adsorption 40,000-45,000 cal.) appeared due to an irreversible chem. reaction with the O_2 of the lattice surface by which the loosely bound CO_2 was formed. The abs. speed of adsorption in both cases was smaller than that calcd. on simple mol. kinetic considerations. H. H. Rowley

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION



The mechanism of the catalytic oxidation of carbon monoxide. II. S. Roginskiĭ and Ya. Zel'dovich. *Acta Physicochim. U. R. S. S.* 1, 595-610(1934)(in German); cf. preceding abstr.—Adsorption measurements indicated that there was no time lag between the active adsorption of CO and the reaction: $CO + MnO_2 \rightarrow CO_2 + MnO$. The speed of the CO adsorption with const. amts. of CO_2 at the surface is proportional to the amt. of accessible O_2 in the surface. The speed of O_2 regeneration by oxidation of the reduced MnO_2 is much slower than the speed with which the O_2 is used in the catalysis. H. H. Rowley



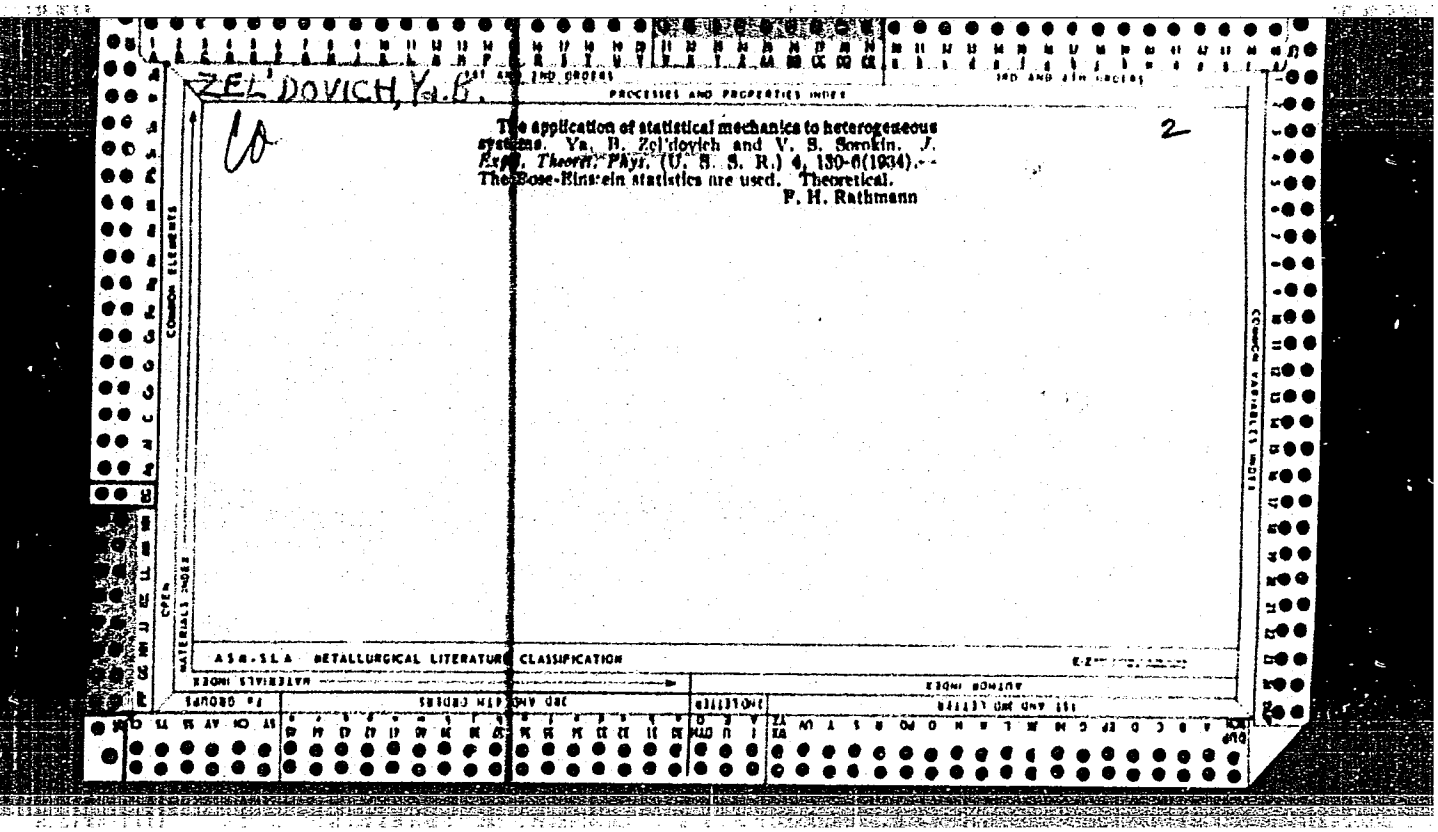
PROCESSES AND PROPERTIES INDEX

CIT

2

Theory of the Freundlich adsorption isotherm. Va. Zel'dovich. *Acta Physiochim. U. R. S. S.* 1, 961-74 (1934)(in English).—Theoretical. For adsorption on nonhomogeneous surfaces the equation $\theta(p) = \int_0^\infty \theta(C)dC$ is applied, where the letters have the significance of the Langmuir adsorption equation. An approx. solution shows that by a proper distribution of surface points according to heat of adsorption, the Freundlich isotherm $\theta = Cp^{1/n}$ is obtained. P. H. Rathmann

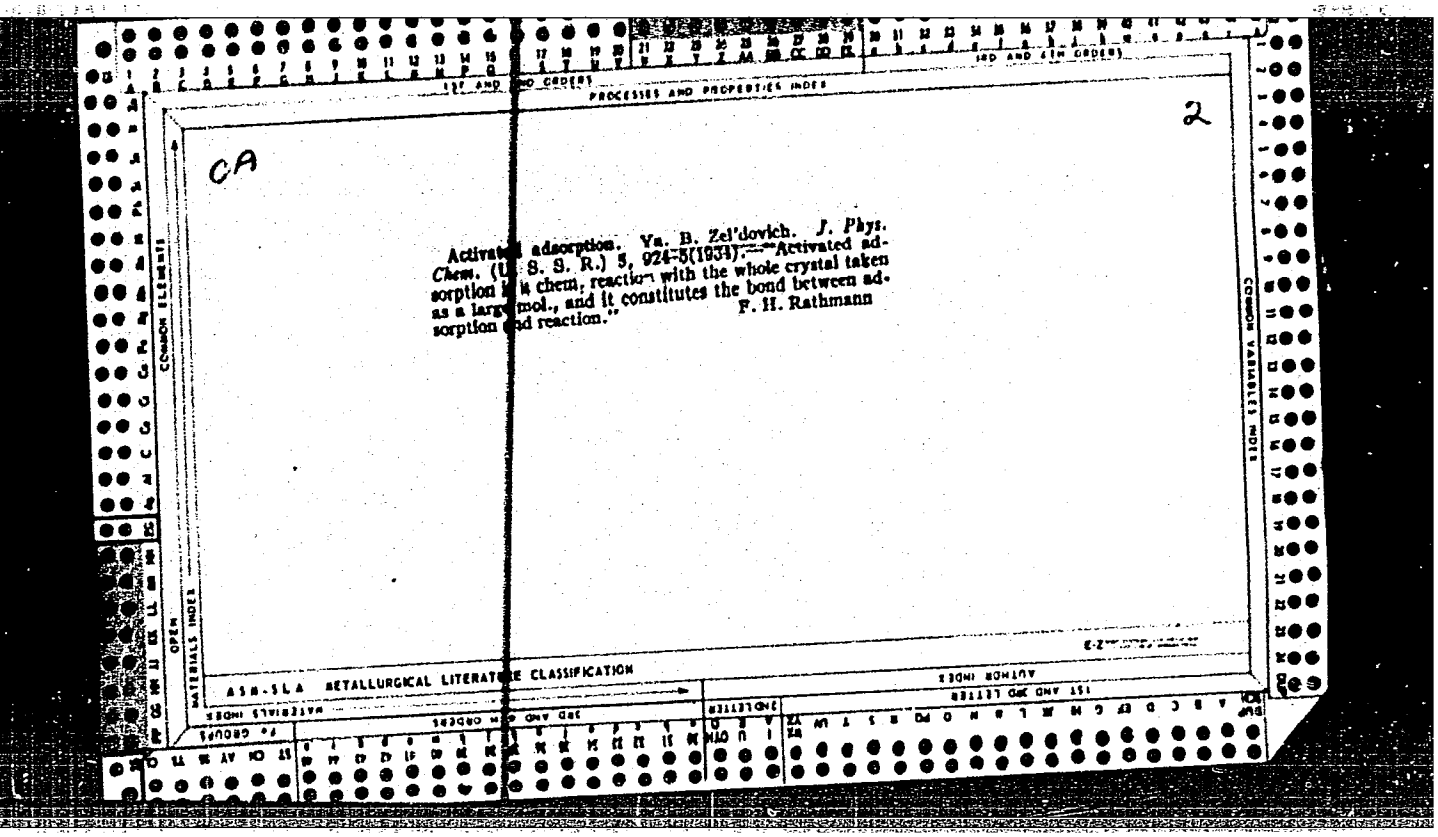
ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

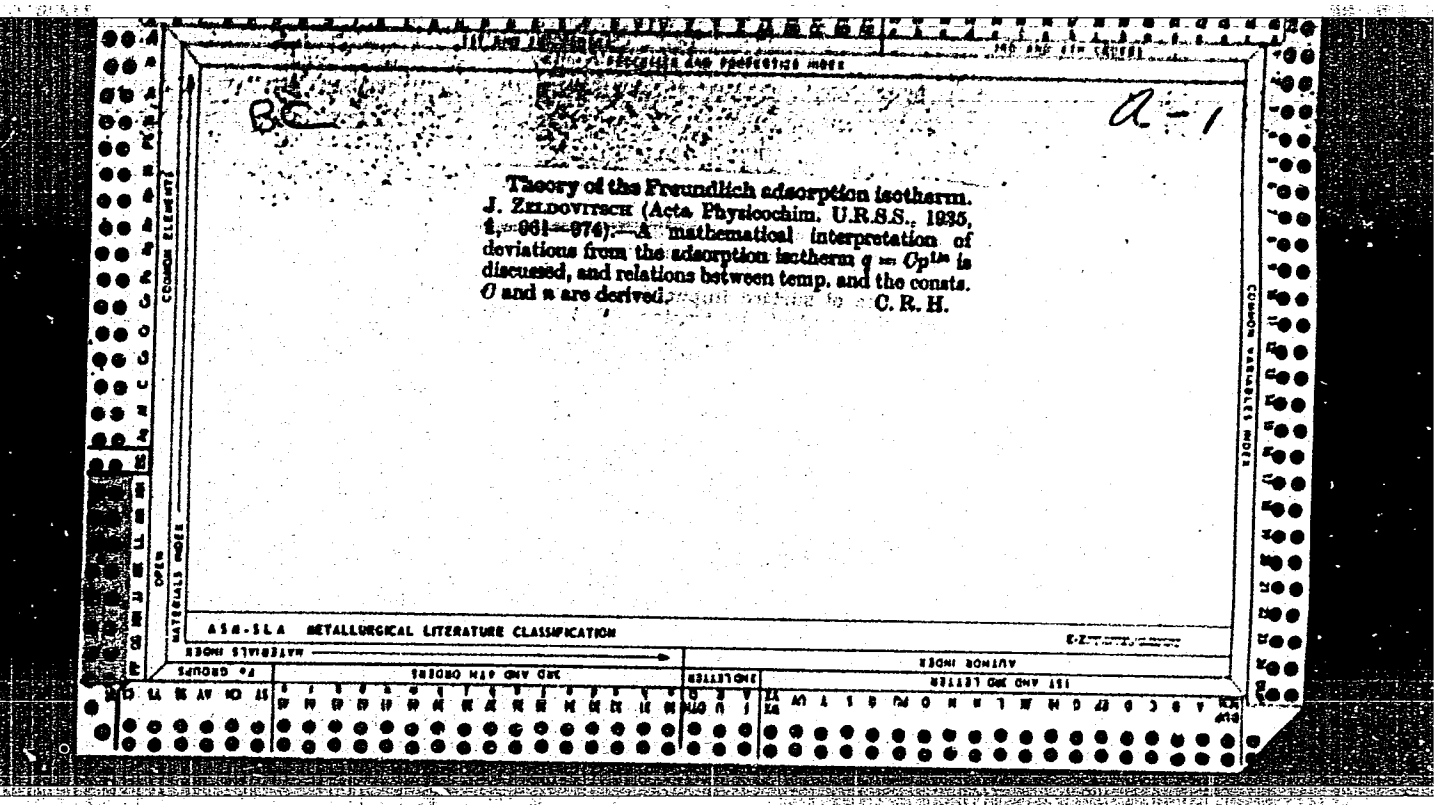

ZEL'DOVICH, Ya.B.

10

2

The application of statistical mechanics to heterogeneous systems. Ya. B. Zel'dovich and V. S. Sorokin. *J. Exptl. Theoret. Phys.* (U. S. S. R.) 4, 130-6(1934).—The Bose-Einstein statistics are used. Theoretical.
P. H. Rathmann



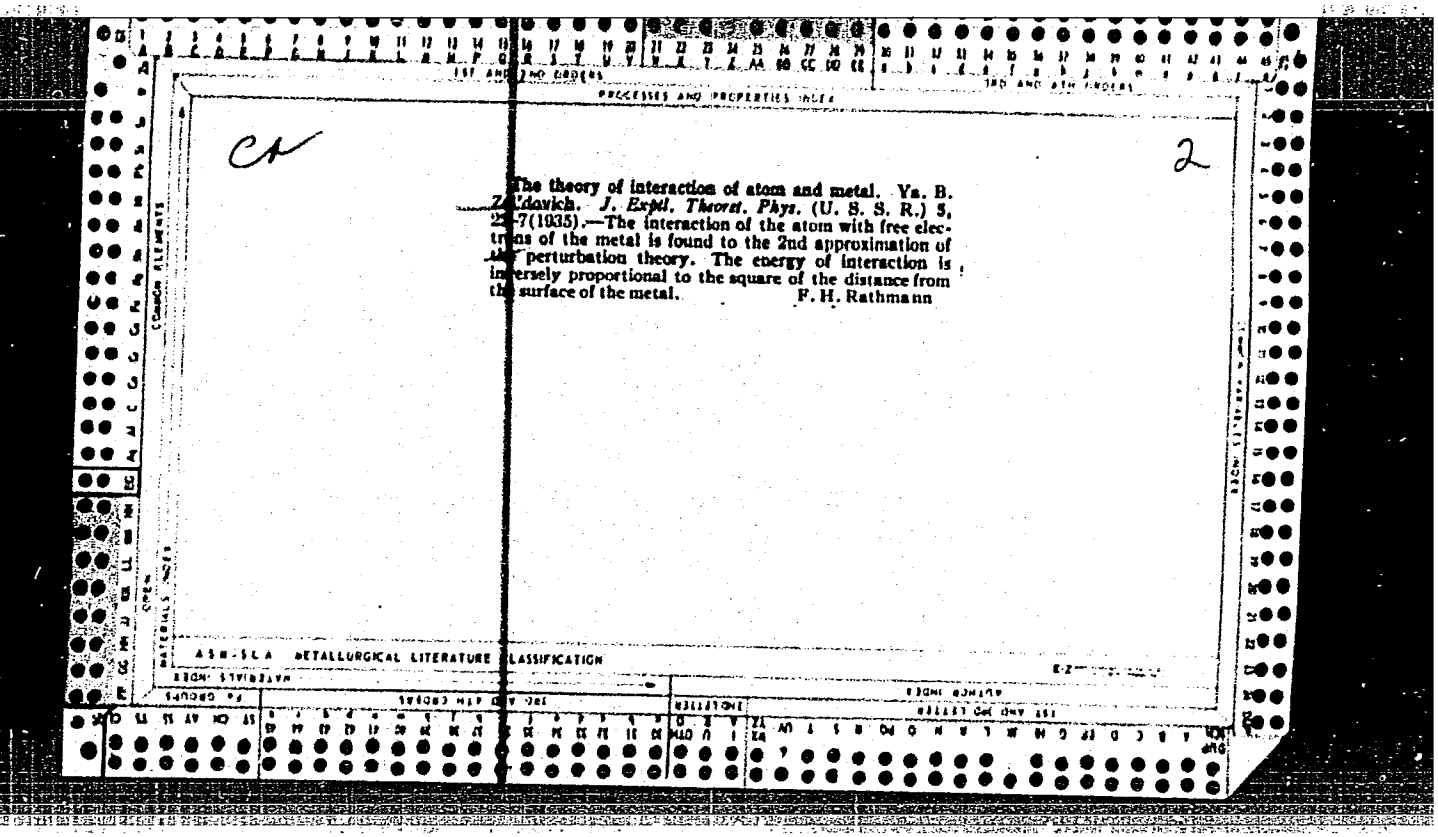


BE

A-1

Theory of the Freundlich adsorption isotherm. J. ZELDOVITSCH (Acta Physicochim. U.R.S.S., 1935, 1, 961–974).—A mathematical interpretation of deviations from the adsorption isotherm $q = Cp^{1/n}$ is discussed, and relations between temp. and the consts. C and n are derived. C. R. H.

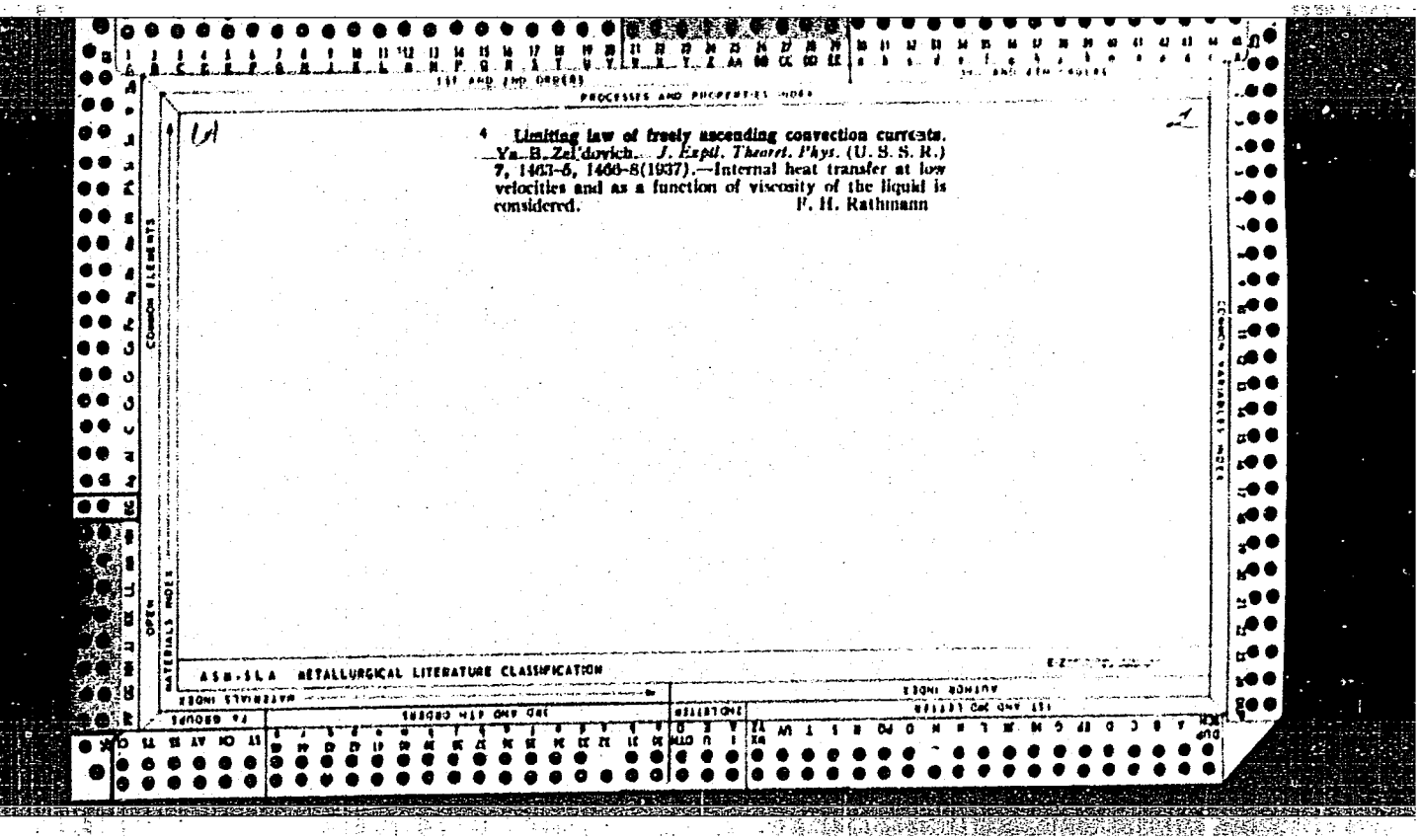
ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION



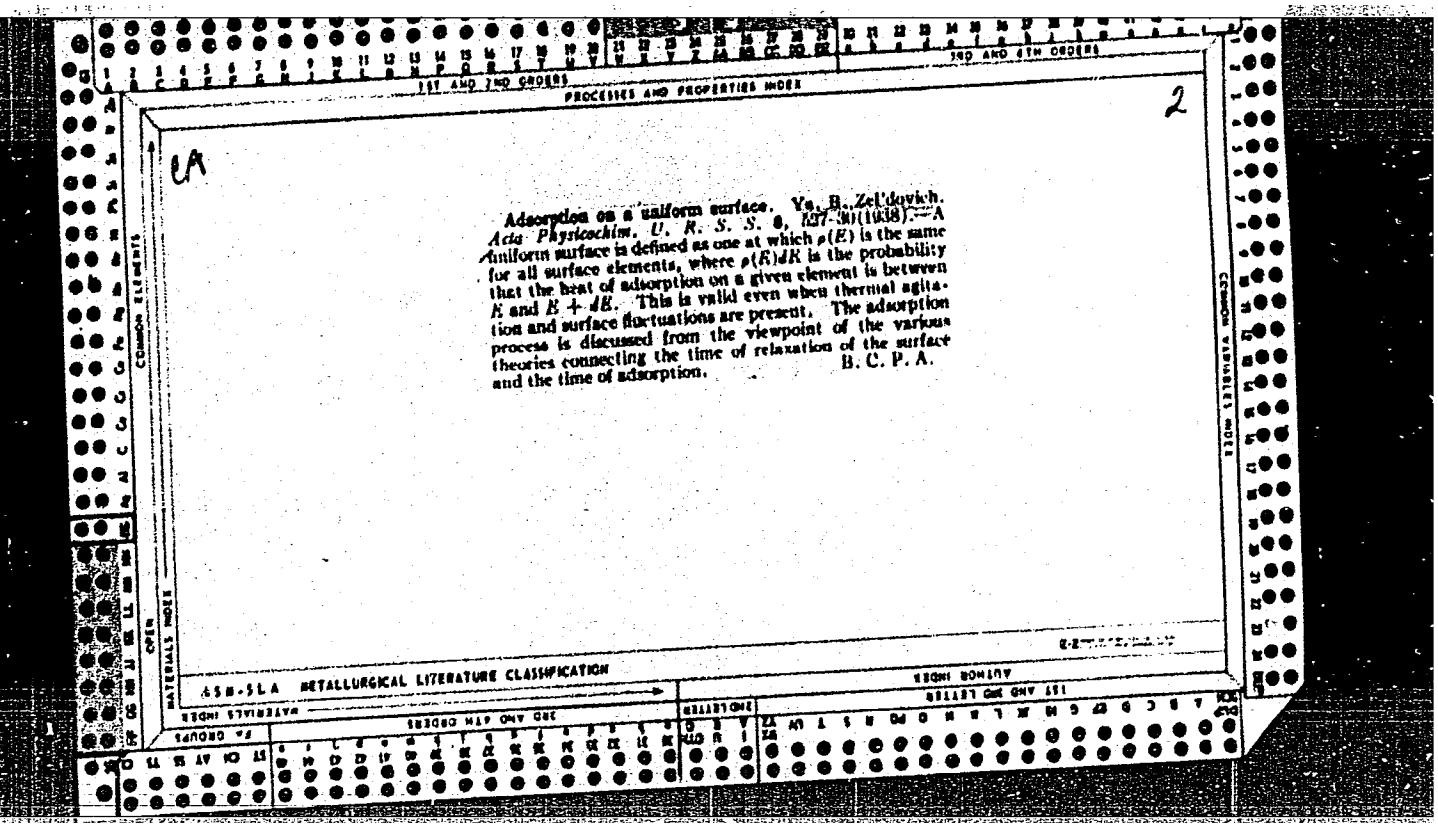
CR

2

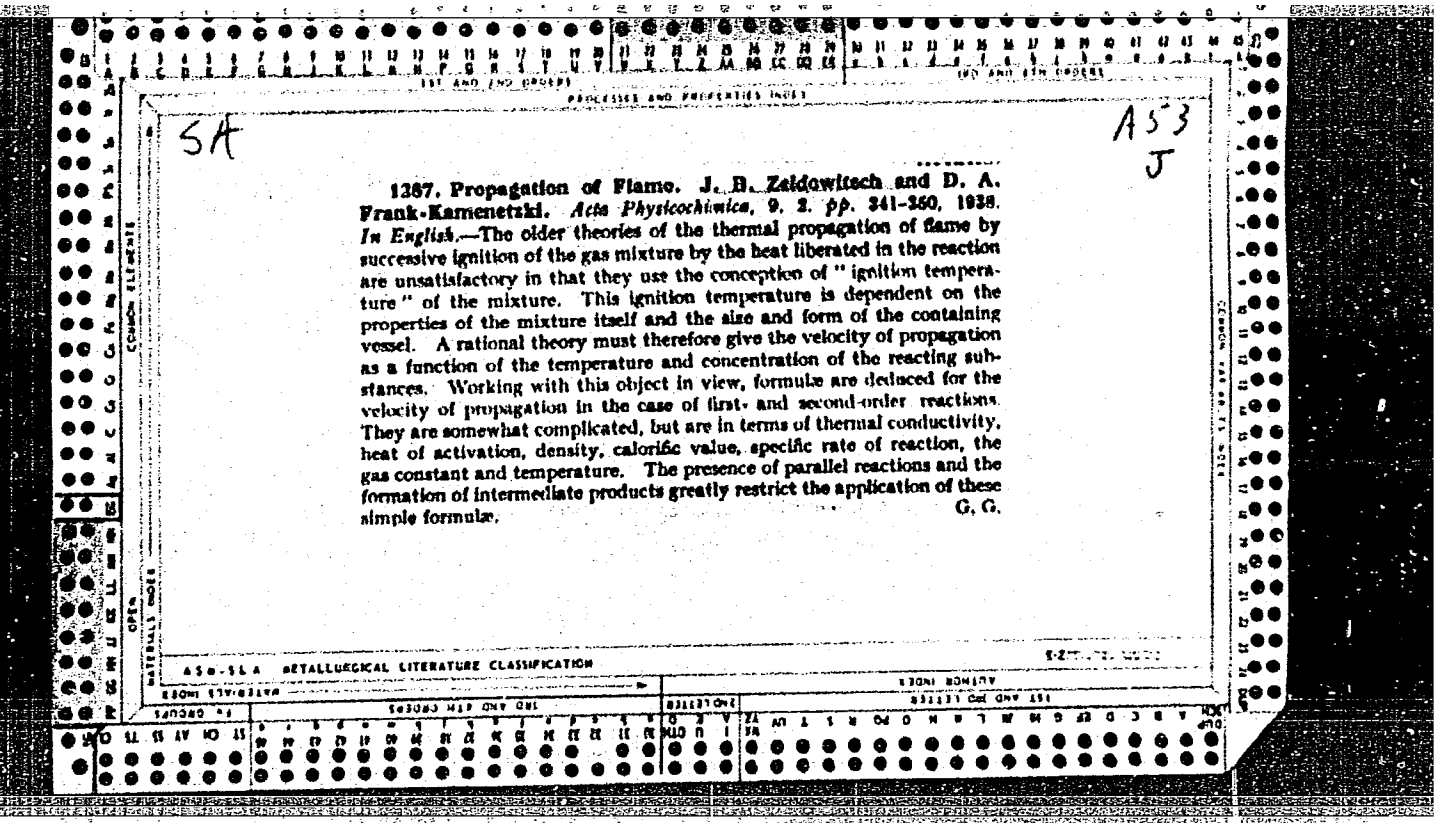
The theory of interaction of atom and metal. Ya. B. Zel'dovich. *J. Exptl. Theoret. Phys.* (U. S. S. R.) 9, 1233-7(1935).—The interaction of the atom with free electrons of the metal is found to the 2nd approximation of the perturbation theory. The energy of interaction is inversely proportional to the square of the distance from the surface of the metal. F. H. Rathmann



4 **Limiting law of freely ascending convection currents.** Ya. B. Zel'dovich. *J. Exptl. Theoret. Phys.* (U. S. S. R.) 7, 1463–6, 1468–8(1937).—Internal heat transfer at low velocities and as a function of viscosity of the liquid is considered. P. H. Rathmann



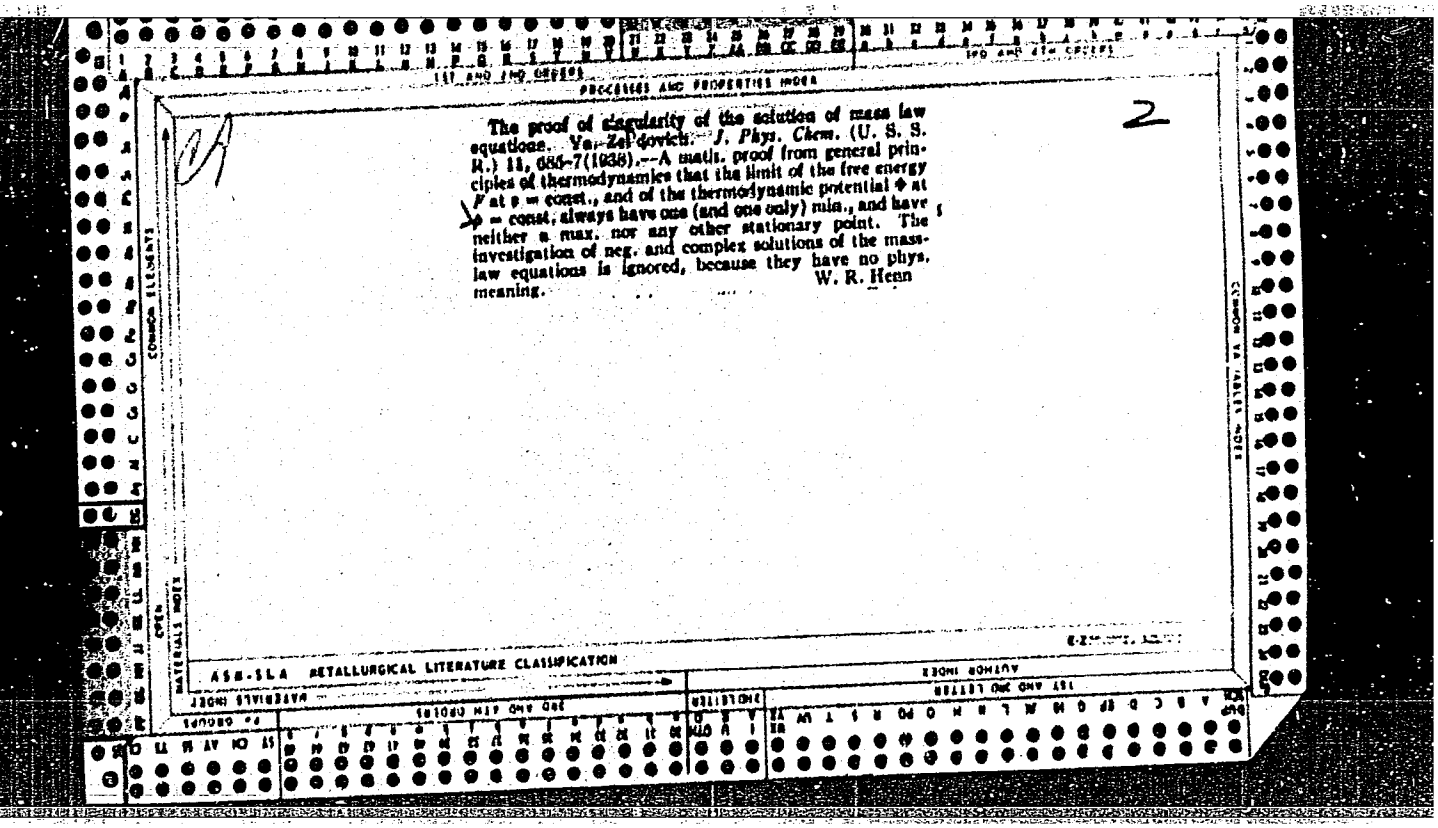
Adsorption on a uniform surface. Ya. B. Zel'dovich. *Acta Physicochim. U. R. S. S.* 8, 237-80(1938).—A uniform surface is defined as one at which $\rho(E)$ is the same for all surface elements, where $\rho(E)dE$ is the probability that the heat of adsorption on a given element is between E and $E + dE$. This is valid even when thermal agitation and surface fluctuations are present. The adsorption process is discussed from the viewpoint of the various theories connecting the time of relaxation of the surface and the time of adsorption. B. C. P. A.



5A

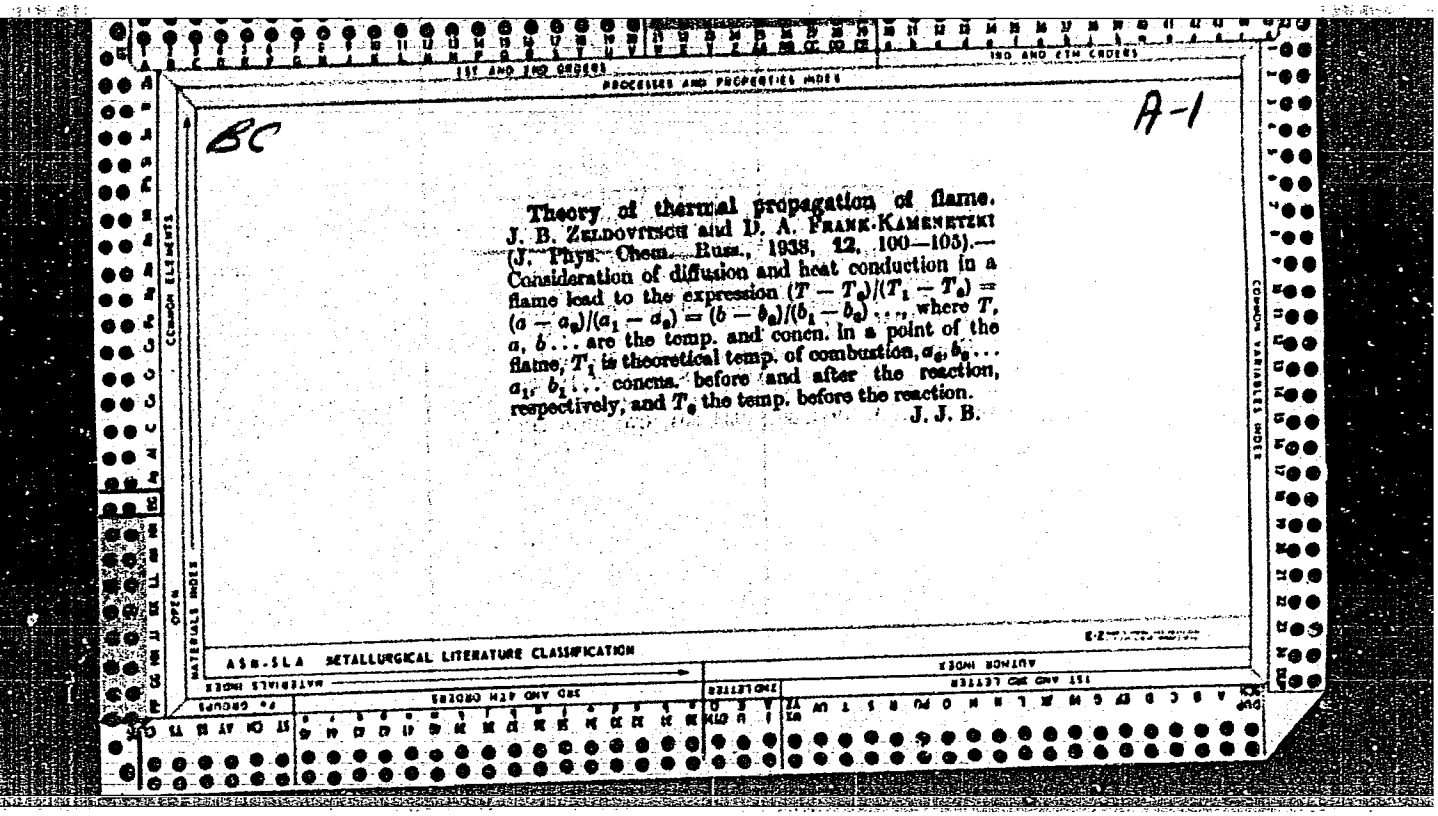
A53
J

1387. **Propagation of Flame.** J. B. Zeldowitsch and D. A. Frank-Kamenetzki. *Acta Physicochimica*, 9, 2, pp. 341-350, 1938. *In English.*—The older theories of the thermal propagation of flame by successive ignition of the gas mixture by the heat liberated in the reaction are unsatisfactory in that they use the conception of "ignition temperature" of the mixture. This ignition temperature is dependent on the properties of the mixture itself and the size and form of the containing vessel. A rational theory must therefore give the velocity of propagation as a function of the temperature and concentration of the reacting substances. Working with this object in view, formulæ are deduced for the velocity of propagation in the case of first- and second-order reactions. They are somewhat complicated, but are in terms of thermal conductivity, heat of activation, density, calorific value, specific rate of reaction, the gas constant and temperature. The presence of parallel reactions and the formation of intermediate products greatly restrict the application of these simple formulæ. G. G.



The proof of singularity of the solution of mass law equations. Ya. Zel'dovich. *J. Phys. Chem.* (U. S. S. R.) 11, 685-7(1938).--A math. proof from general principles of thermodynamics that the limit of the free energy F at p = const., and of the thermodynamic potential Φ at p = const, always have one (and one only) min., and have neither a max. nor any other stationary point. The investigation of neg. and complex solutions of the mass-law equations is ignored, because they have no phys. meaning.

W. R. Henn

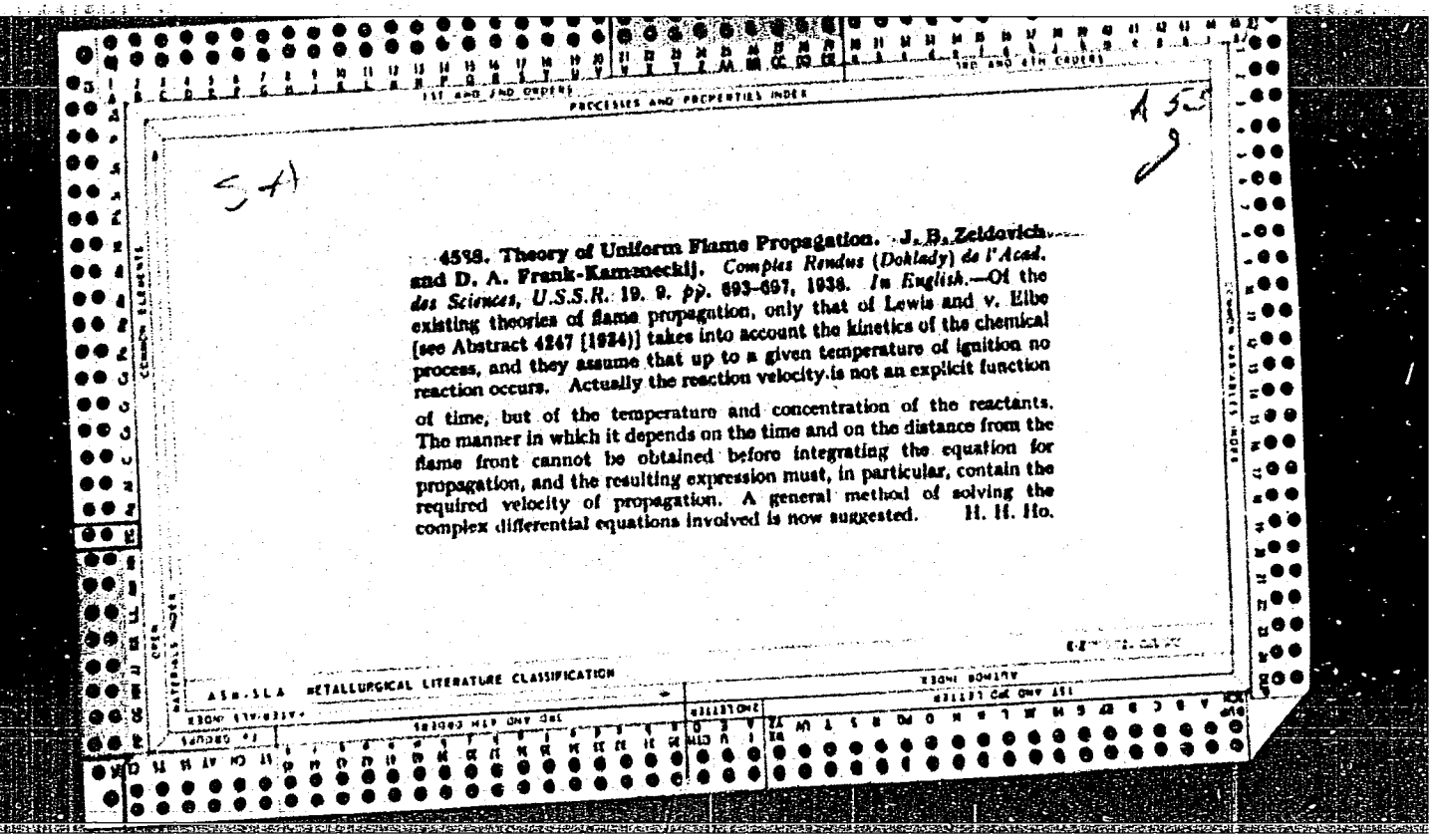


BC

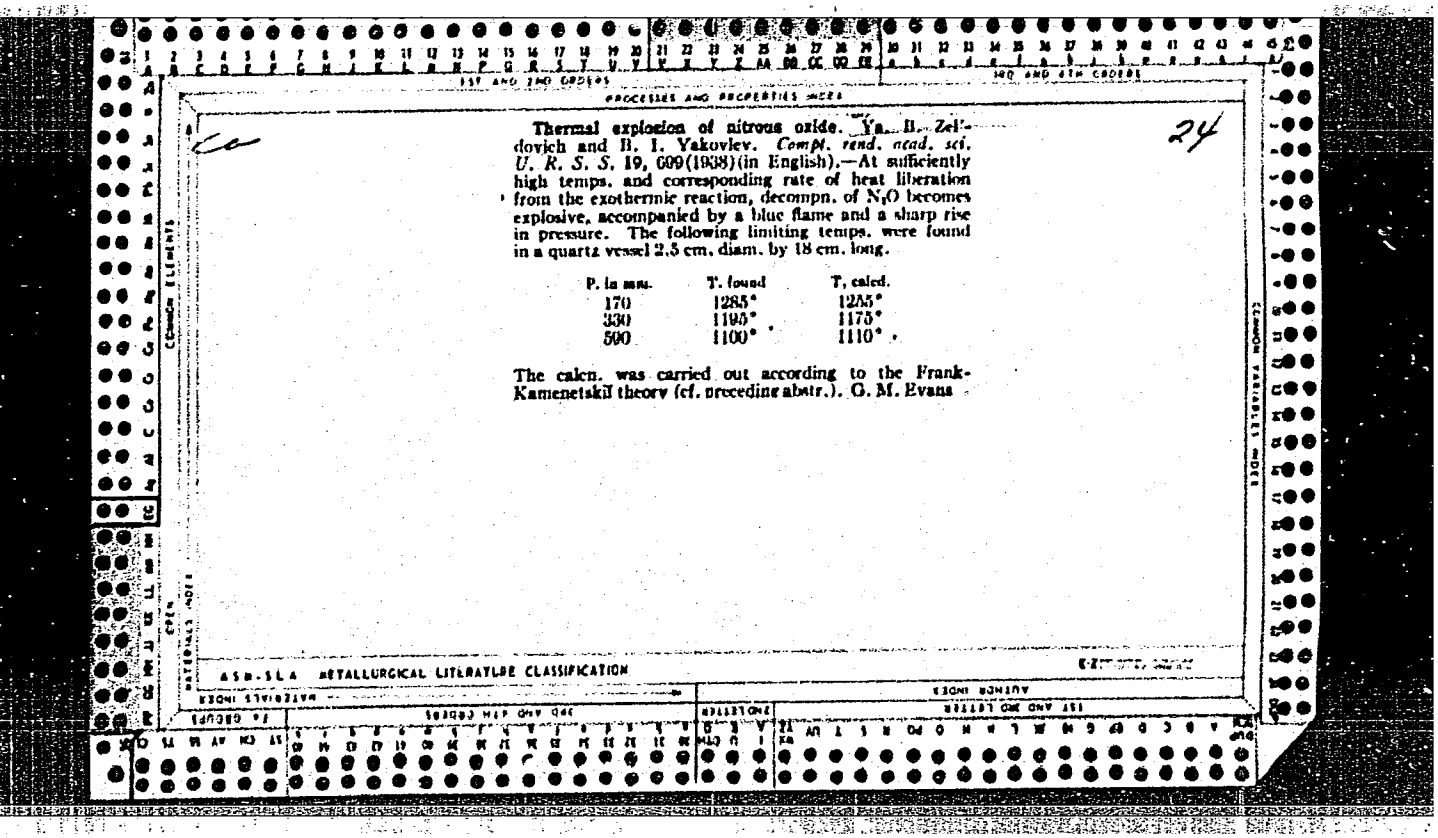
A-1

Theory of thermal propagation of flame. J. B. ZELDOVITSCH and D. A. FRANK-KAMENETZKI (J. Phys. Chem., Russ., 1938, 12, 100—105).—Consideration of diffusion and heat conduction in a flame lead to the expression $(T - T_0)/(T_1 - T_0) = (a - a_0)/(a_1 - a_0) = (b - b_0)/(b_1 - b_0) \ldots$, where T, a, $b \ldots$ are the temp. and concn. in a point of the flame, T_1 is theoretical temp. of combustion, a_0, $b_0 \ldots$ a_1, $b_1 \ldots$ concns. before and after the reaction, respectively, and T_0 the temp. before the reaction.

J. J. B.



4598. **Theory of Uniform Flame Propagation.** J. B. Zeldovich and D. A. Frank-Kamenecklj. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 693–697, 1938. *In English.*—Of the existing theories of flame propagation, only that of Lewis and v. Elbe [see Abstract 4247 (1934)] takes into account the kinetics of the chemical process, and they assume that up to a given temperature of ignition no reaction occurs. Actually the reaction velocity is not an explicit function of time, but of the temperature and concentration of the reactants. The manner in which it depends on the time and on the distance from the flame front cannot be obtained before integrating the equation for propagation, and the resulting expression must, in particular, contain the required velocity of propagation. A general method of solving the complex differential equations involved is now suggested. H. H. Ho.



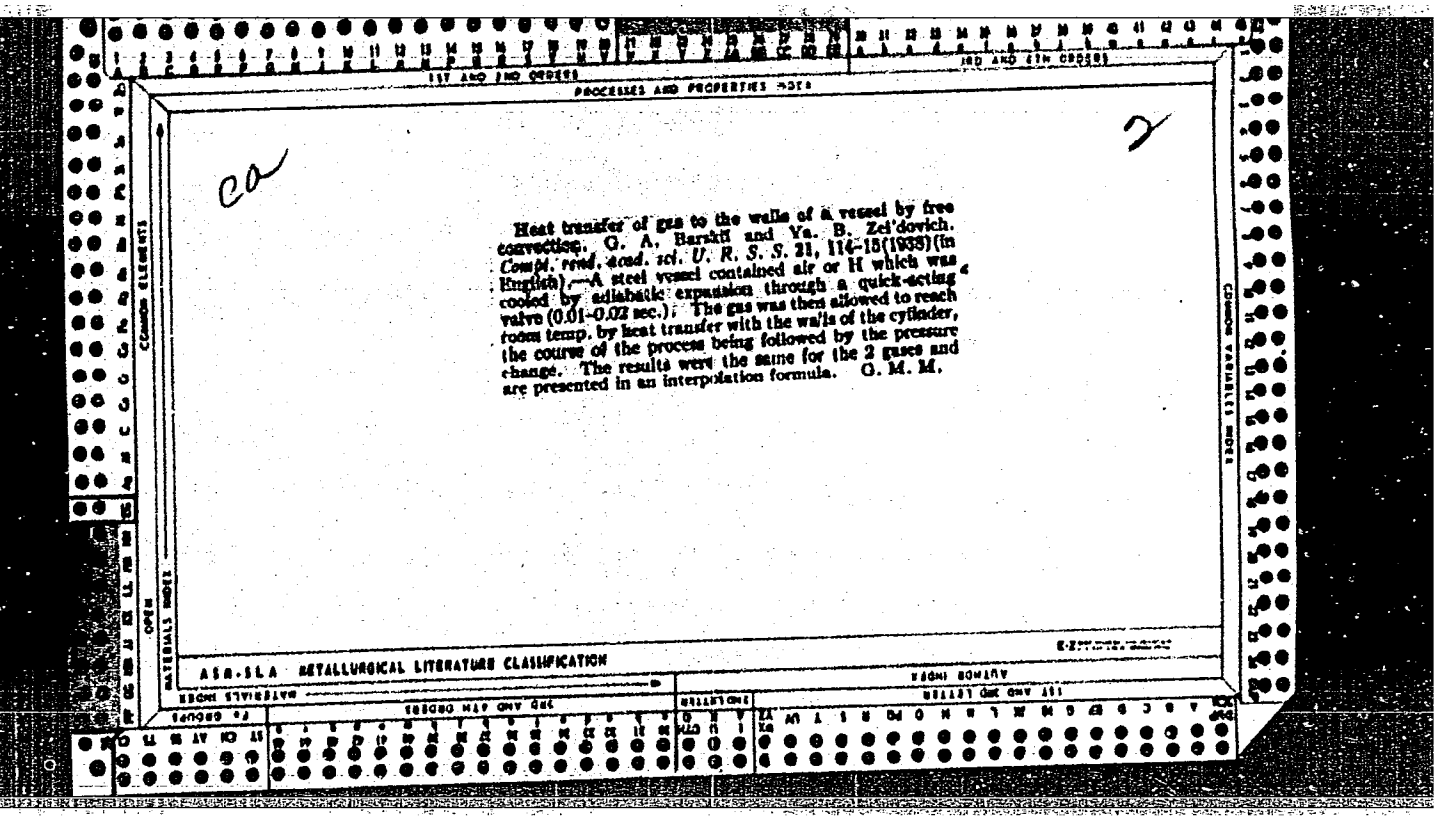
Ca

24

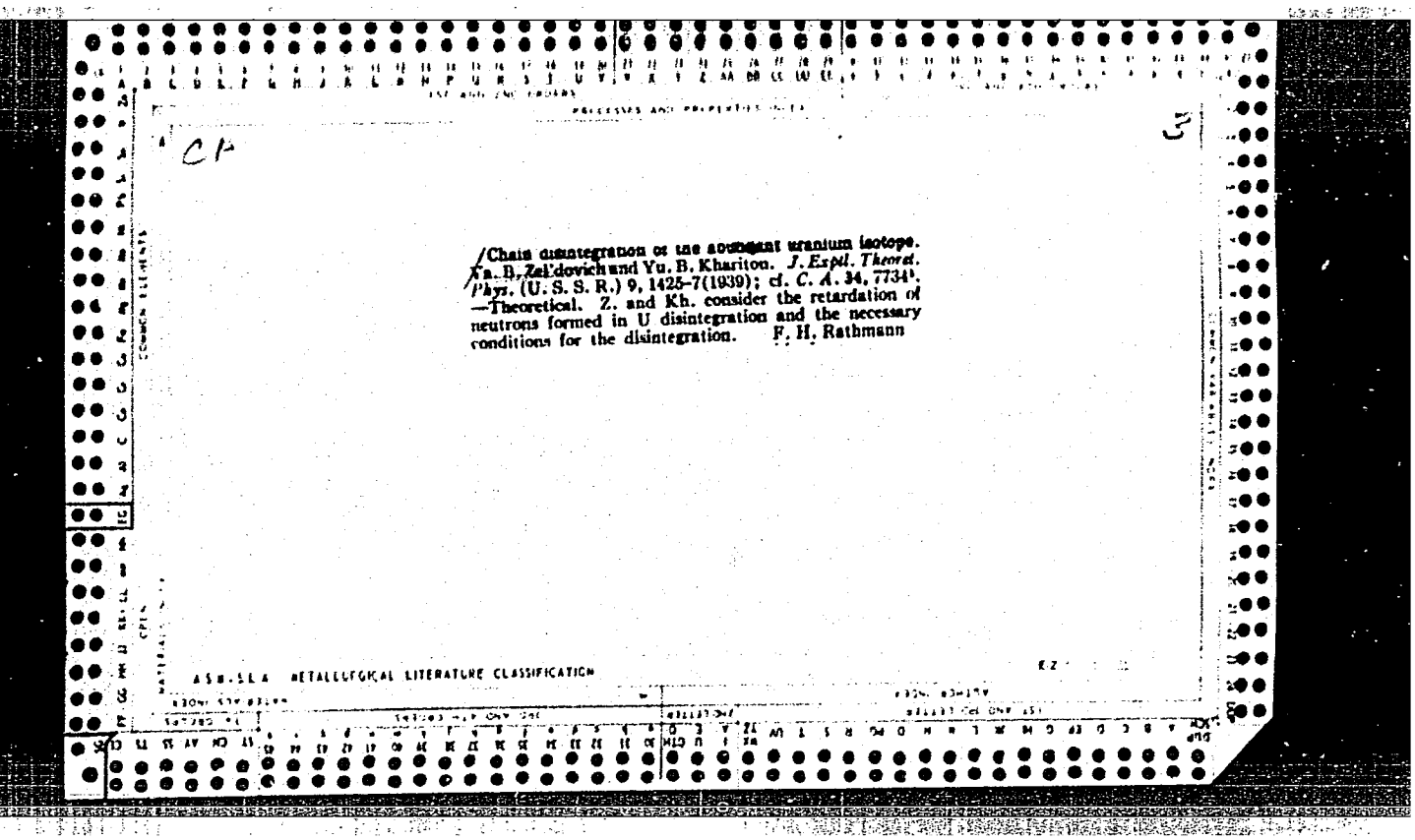
Thermal explosion of nitrous oxide. Ya. B. Zel'dovich and B. I. Yakovlev. *Compt. rend. acad. sci. U. R. S. S.* 19, 699(1938)(in English).—At sufficiently high temps. and corresponding rate of heat liberation from the exothermic reaction, decompn. of N_2O becomes explosive, accompanied by a blue flame and a sharp rise in pressure. The following limiting temps. were found in a quartz vessel 2.5 cm. diam. by 18 cm. long.

P. in mm.	T. found	T. calcd.
170	1285°	1255°
330	1195°	1175°
590	1100°	1110°

The calcn. was carried out according to the Frank-Kamenetskil theory (cf. preceding abstr.). G. M. Evans

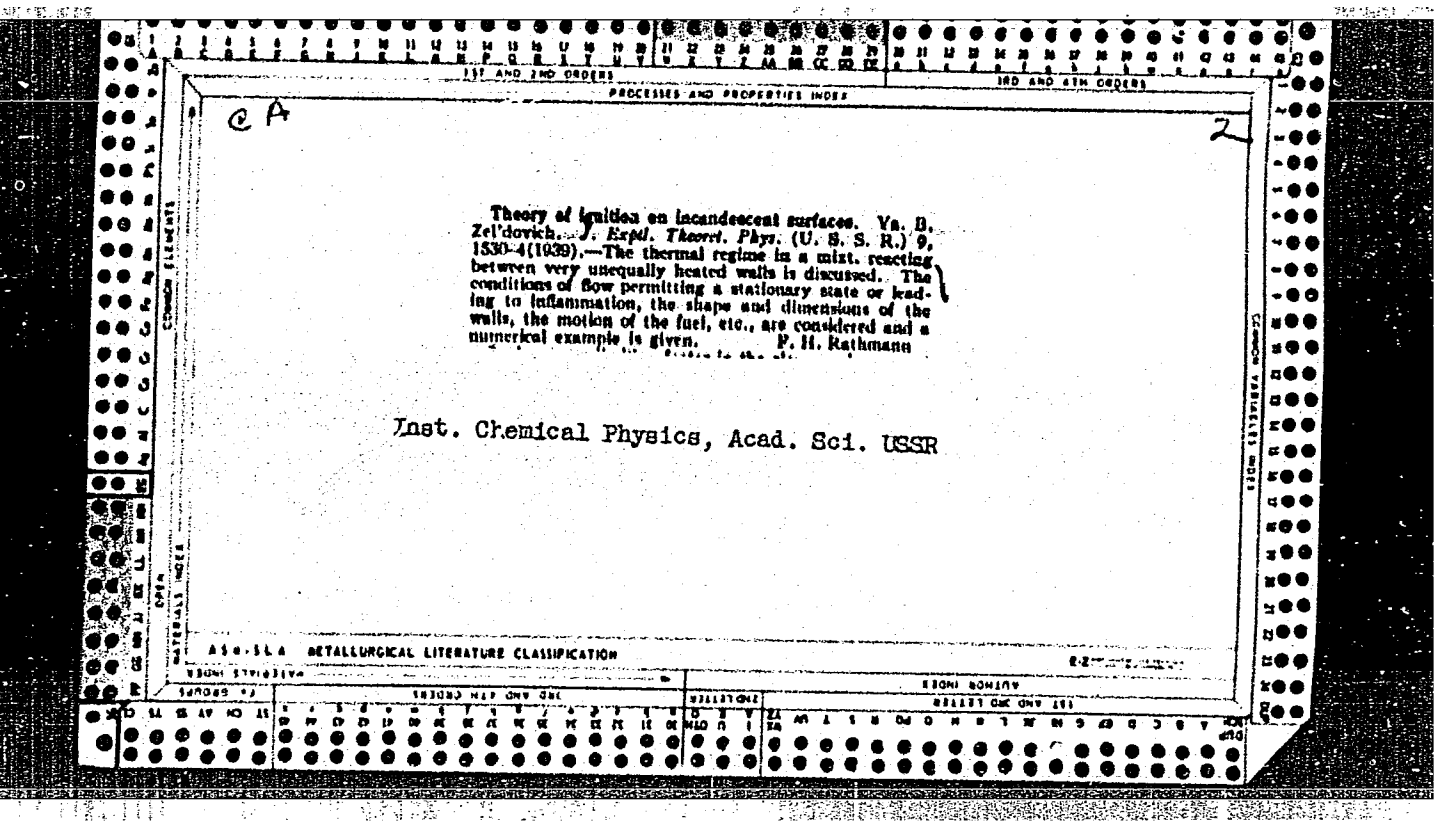


Heat transfer of gas to the walls of a vessel by free convection. G. A. Barskii and Ya. B. Zel'dovich. *Compt. rend. acad. sci. U. R. S. S.* 21, 114-15(1938)(in English).—A steel vessel contained air or H which was cooled by adiabatic expansion through a quick-acting valve (0.01-0.02 sec.). The gas was then allowed to reach room temp. by heat transfer with the walls of the cylinder, the course of the process being followed by the pressure change. The results were the same for the 2 gases and are presented in an interpolation formula. G. M. M.



Chain disintegration of the resultant uranium isotope. Ya. B. Zel'dovich and Yu. B. Khariton. *J. Exptl. Theoret. Phys.* (U. S. S. R.) 9, 1425–7(1939); cf. *C. A.* 34, 7734⁵. —Theoretical. Z. and Kh. consider the retardation of neutrons formed in U disintegration and the necessary conditions for the disintegration. F. H. Rathmann

A S M - S E A METALLURGICAL LITERATURE CLASSIFICATION



1ST AND 2ND ORDERS

PROCESSES AND PROPERTIES INDEX

3RD AND 4TH ORDERS

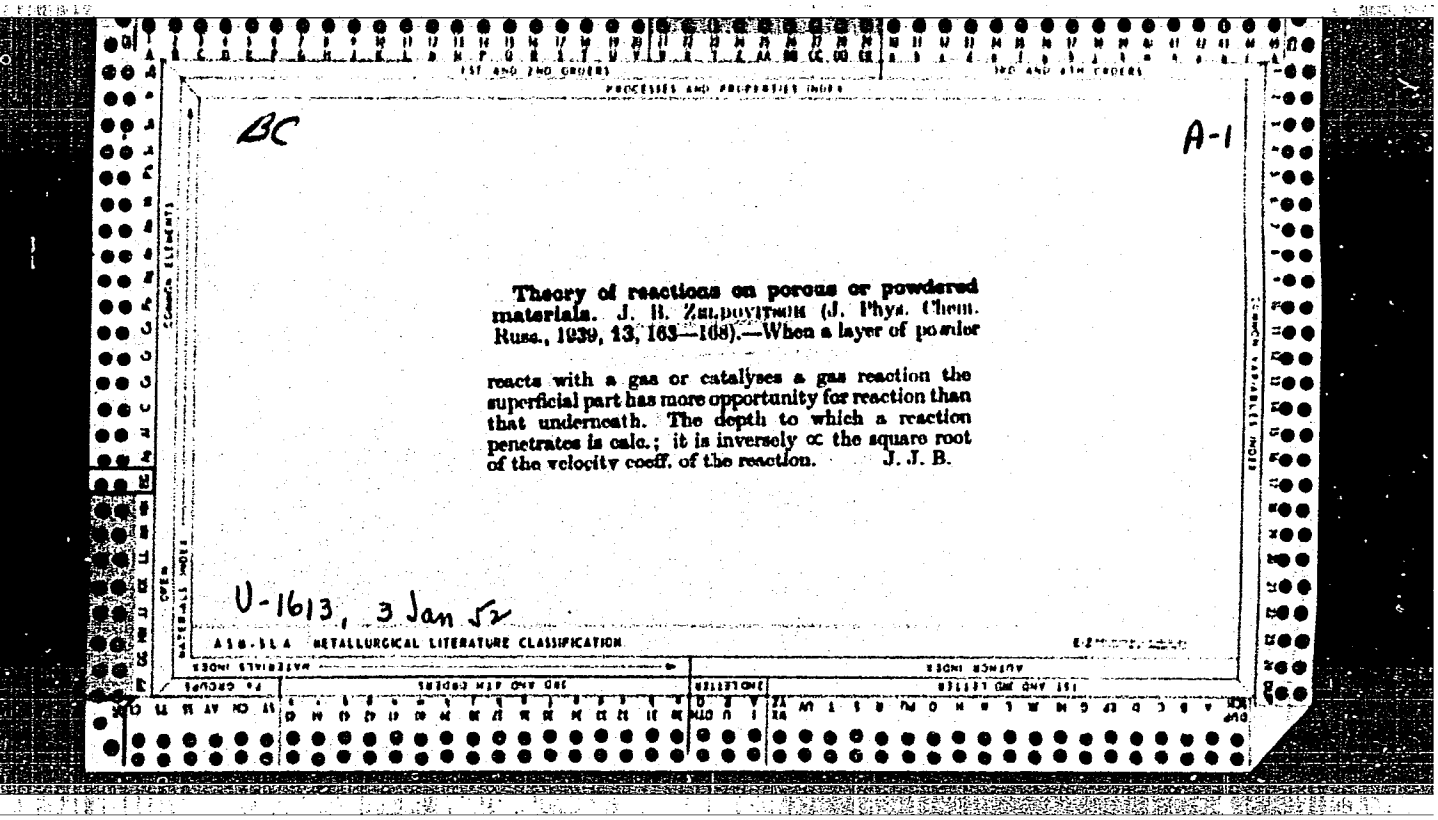
CA

2

Theory of ignition on incandescent surfaces. Ya. B. Zel'dovich. *J. Exptl. Theoret. Phys.* (U. S. S. R.) 9, 1530-4(1939).—The thermal regime in a mixt. reacting between very unequally heated walls is discussed. The conditions of flow permitting a stationary state or leading to inflammation, the shape and dimensions of the walls, the motion of the fuel, etc., are considered and a numerical example is given. P. H. Rathmann

Inst. Chemical Physics, Acad. Sci. USSR

A30-5L4 METALLURGICAL LITERATURE CLASSIFICATION



BC

A-1

Theory of reactions on porous or powdered materials. J. B. Zeldovitch (J. Phys. Chem. Russ., 1939, 13, 163—168).—When a layer of powder reacts with a gas or catalyses a gas reaction the superficial part has more opportunity for reaction than that underneath. The depth to which a reaction penetrates is calc.; it is inversely oc the square root of the velocity coeff. of the reaction. J. J. B.

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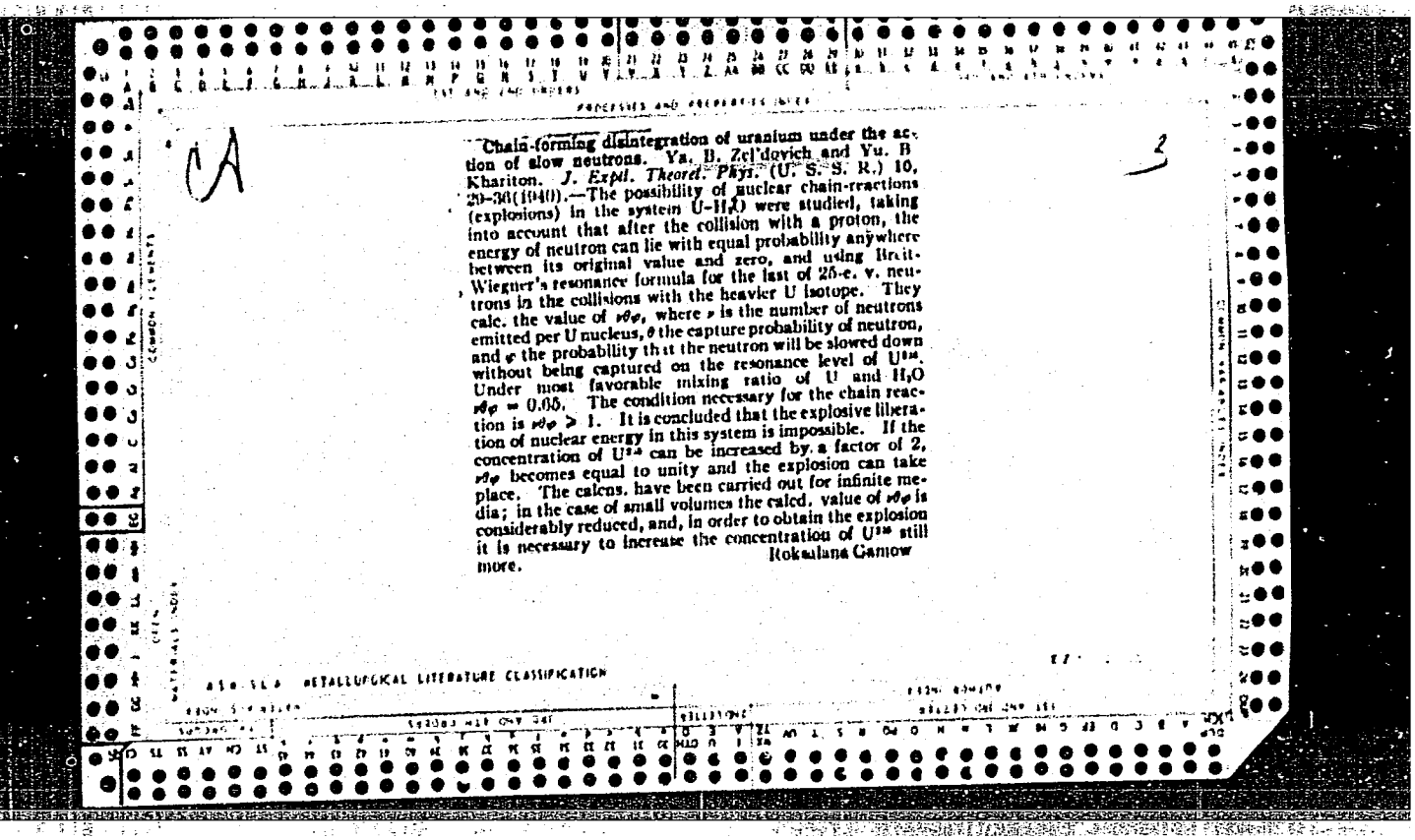


CA

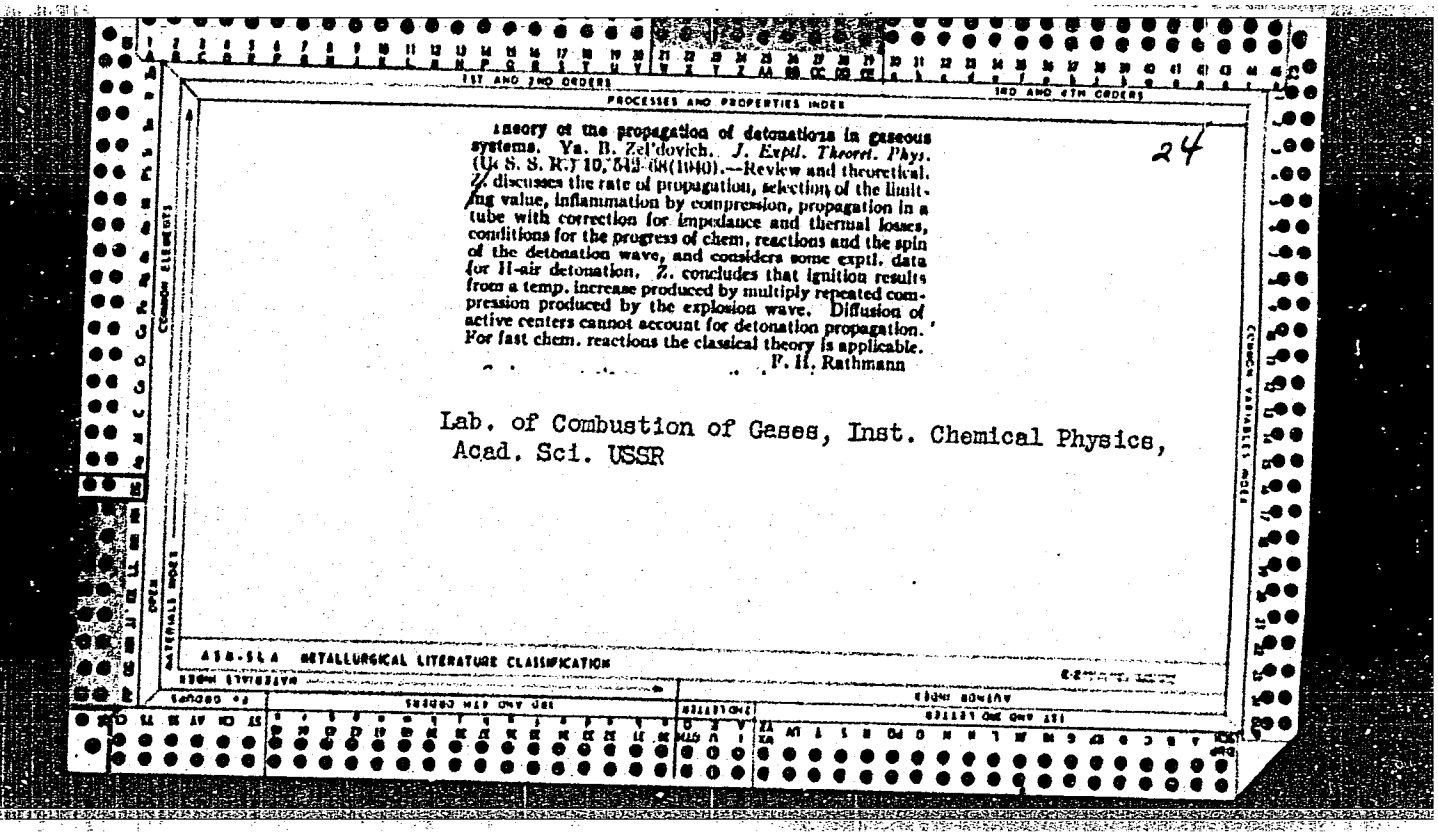
Chain-forming disintegration of uranium under the action of slow neutrons. Ya. B. Zel'dovich and Yu. B. Khariton. *J. Expil. Theoret. Phys.* (U. S. S. R.) 10, 29-36(1940).—The possibility of nuclear chain-reactions (explosions) in the system U-H_2O were studied, taking into account that after the collision with a proton, the energy of neutron can lie with equal probability anywhere between its original value and zero, and using Breit-Wiegner's resonance formula for the last of 25-e. v. neutrons in the collisions with the heavier U isotope. They calc. the value of $\nu\theta\varphi$, where ν is the number of neutrons emitted per U nucleus, θ the capture probability of neutron, and φ the probability that the neutron will be slowed down without being captured on the resonance level of U^{238}. Under most favorable mixing ratio of U and H_2O $\nu\theta\varphi = 0.65$. The condition necessary for the chain reaction is $\nu\theta\varphi \geq 1$. It is concluded that the explosive liberation of nuclear energy in this system is impossible. If the concentration of U^{238} can be increased by a factor of 2, $\nu\theta\varphi$ becomes equal to unity and the explosion can take place. The calcns. have been carried out for infinite media; in the case of small volumes the calcd. value of $\nu\theta\varphi$ is considerably reduced, and, in order to obtain the explosion it is necessary to increase the concentration of U^{238} still more.

Rokaiana Gamow

A 1 0 S L A METALLURGICAL LITERATURE CLASSIFICATION

ZEL'DOVICH, IA.B.

RT-963 (Kinetics of chain decomposition of uranium) Kinetika tsepnogo raspada urana.
ZHURNAL EKSPERIMENTAL'NOI I TEORETICHESKOI FIZIKI, 10(5): 477-482, 1940.

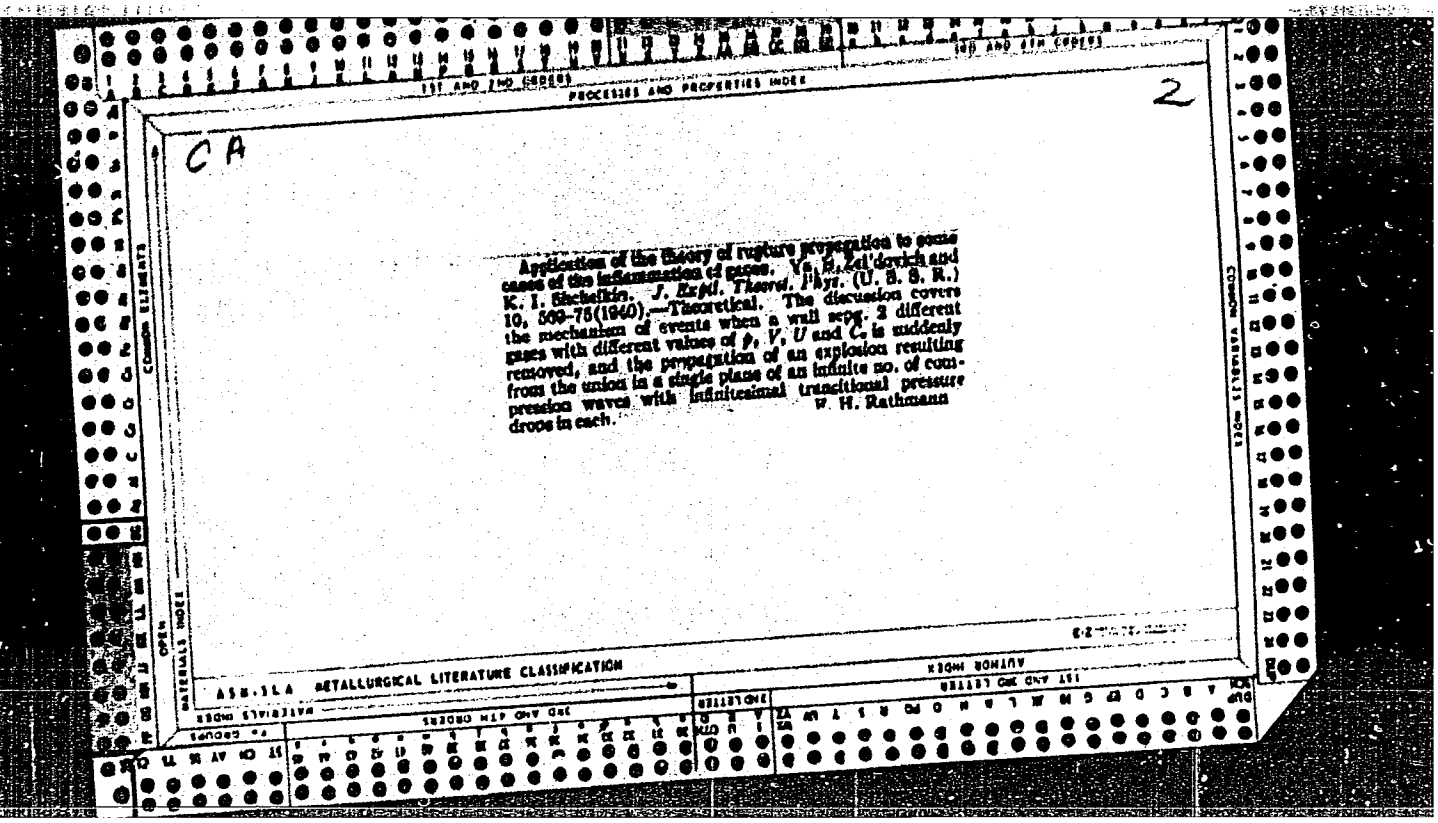


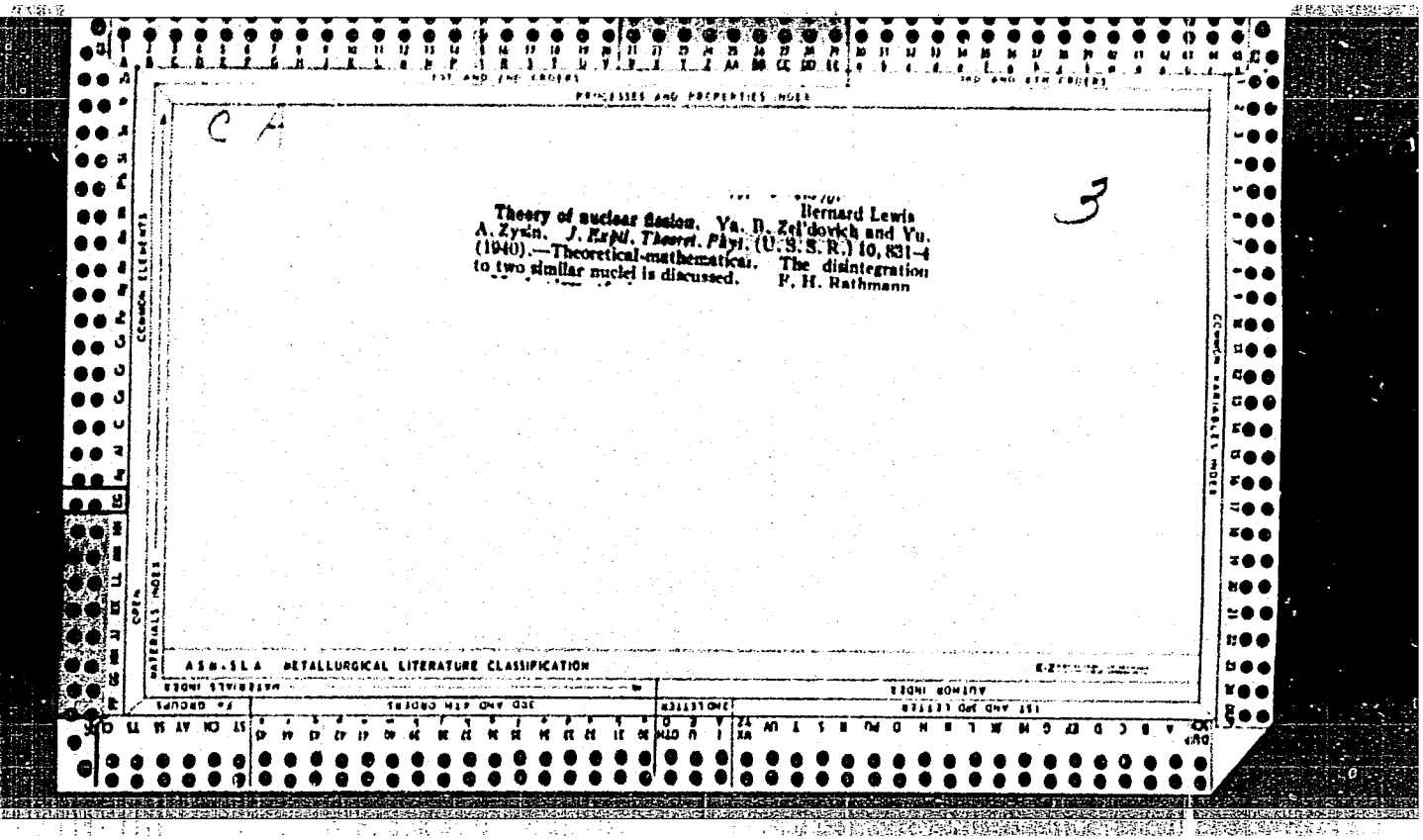
PROCESSES AND PROPERTIES INDEX

24

Theory of the propagation of detonations in gaseous systems. Ya. B. Zel'dovich. *J. Exptl. Theoret. Phys.* (U. S. S. R.) 10, 542-68(1940).—Review and theoretical. Z. discusses the rate of propagation, selection of the limiting value, inflammation by compression, propagation in a tube with correction for impedance and thermal losses, conditions for the progress of chem. reactions and the spin of the detonation wave, and considers some exptl. data for H-air detonation. Z. concludes that ignition results from a temp. increase produced by multiply repeated compression produced by the explosion wave. Diffusion of active centers cannot account for detonation propagation. For fast chem. reactions the classical theory is applicable.
F. H. Rathmann

Lab. of Combustion of Gases, Inst. Chemical Physics, Acad. Sci. USSR



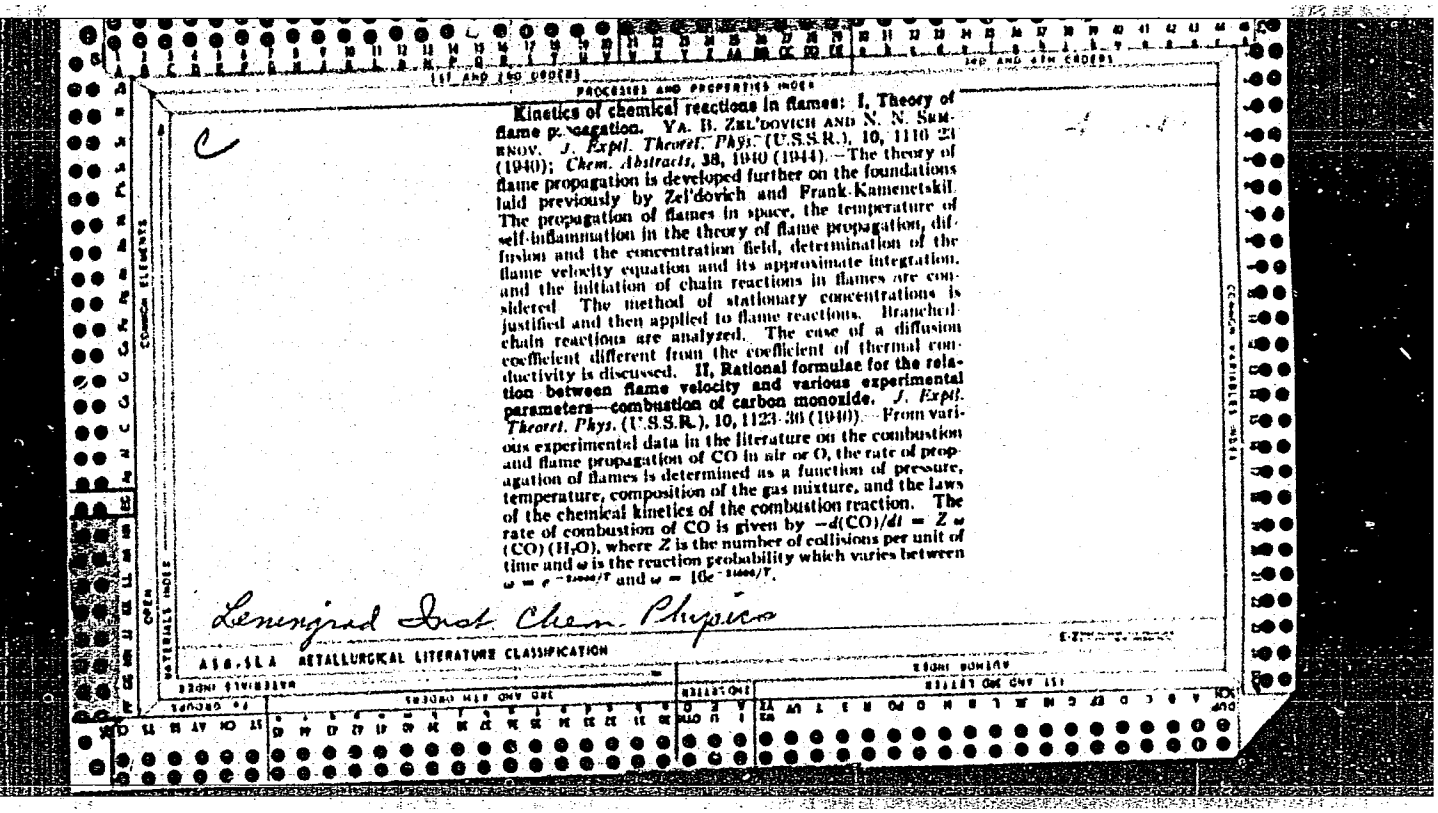


C A

3

Bernard Lewis

Theory of nuclear fission. Ya. B. Zel'dovich and Yu. A. Zysin. *J. Exptl. Theoret. Phys.* (U.S.S.R.) 10, 831–4 (1940).—Theoretical-mathematical. The disintegration to two similar nuclei is discussed. F. H. Rathmann



PROCESSES AND PROPERTIES INDEX

Kinetics of chemical reactions in flames: I, Theory of flame propagation. YA. B. ZEL'DOVICH AND N. N. SEMENOV. *J. Expll. Theoret. Phys.* (U.S.S.R.), 10, 1116-24 (1940); *Chem. Abstracts*, 38, 1940 (1944).—The theory of flame propagation is developed further on the foundations laid previously by Zel'dovich and Frank-Kamenetskii. The propagation of flames in space, the temperature of self-inflammation in the theory of flame propagation, diffusion and the concentration field, determination of the flame velocity equation and its approximate integration, and the initiation of chain reactions in flames are considered. The method of stationary concentrations is justified and then applied to flame reactions. Branched-chain reactions are analyzed. The case of a diffusion coefficient different from the coefficient of thermal conductivity is discussed. **II, Rational formulae for the relation between flame velocity and various experimental parameters—combustion of carbon monoxide.** *J. Expll. Theoret. Phys.* (U.S.S.R.), 10, 1123-30 (1940).—From various experimental data in the literature on the combustion and flame propagation of CO in air or O_2, the rate of propagation of flames is determined as a function of pressure, temperature, composition of the gas mixture, and the laws of the chemical kinetics of the combustion reaction. The rate of combustion of CO is given by $-d(CO)/dt = Z\omega (CO)(H_2O)$, where Z is the number of collisions per unit of time and ω is the reaction probability which varies between $\omega = e^{-21000/T}$ and $\omega = 10e^{-21000/T}$.

Leningrad Inst Chem. Physics

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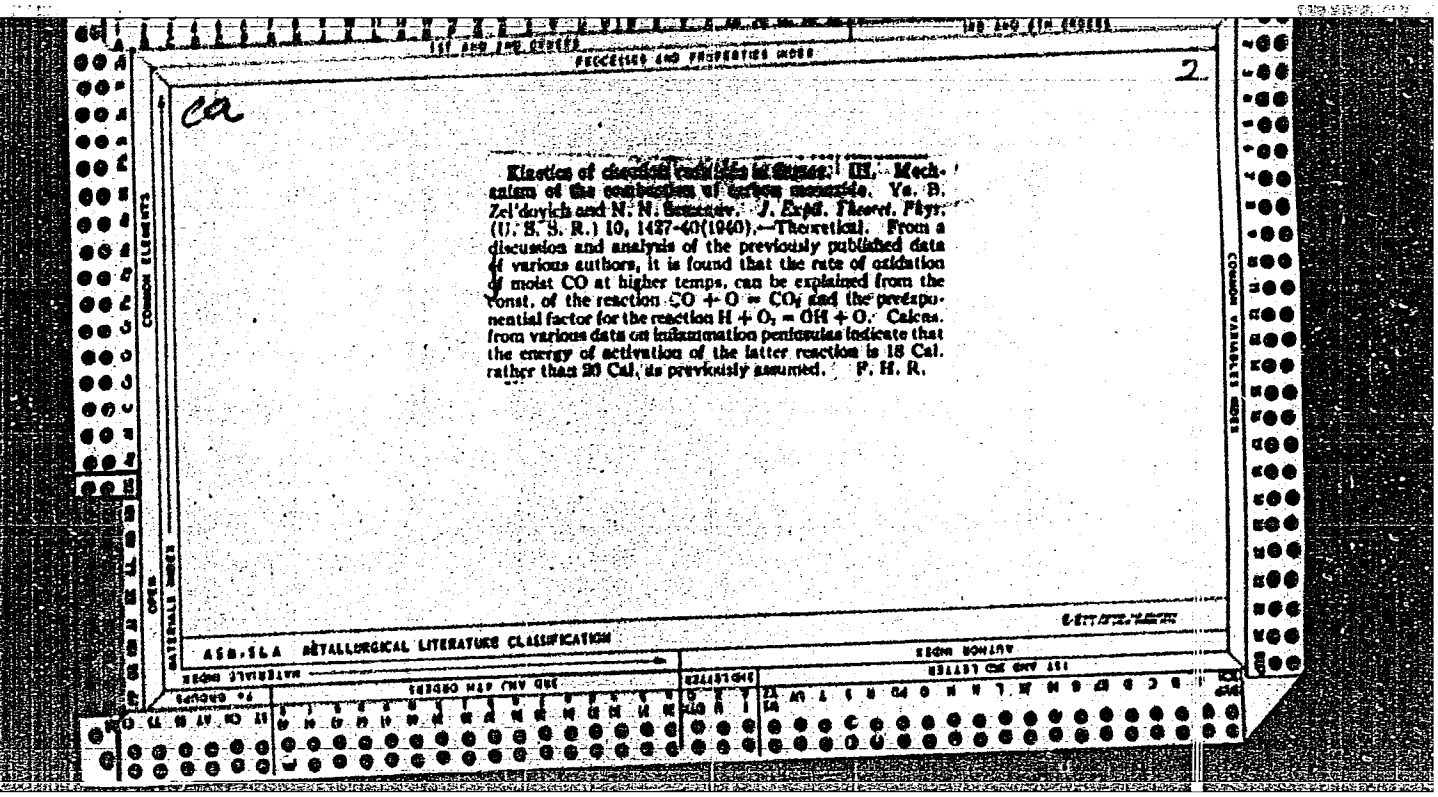
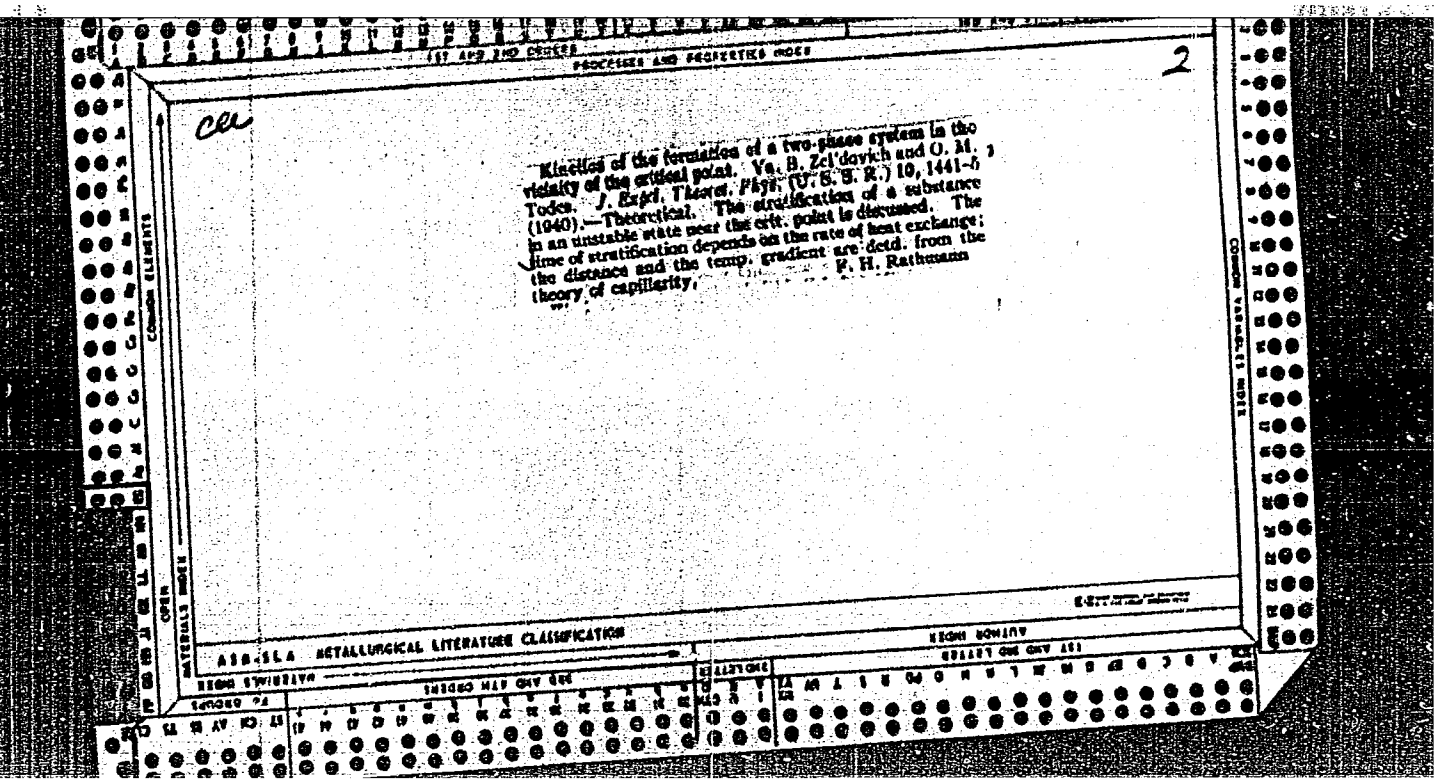


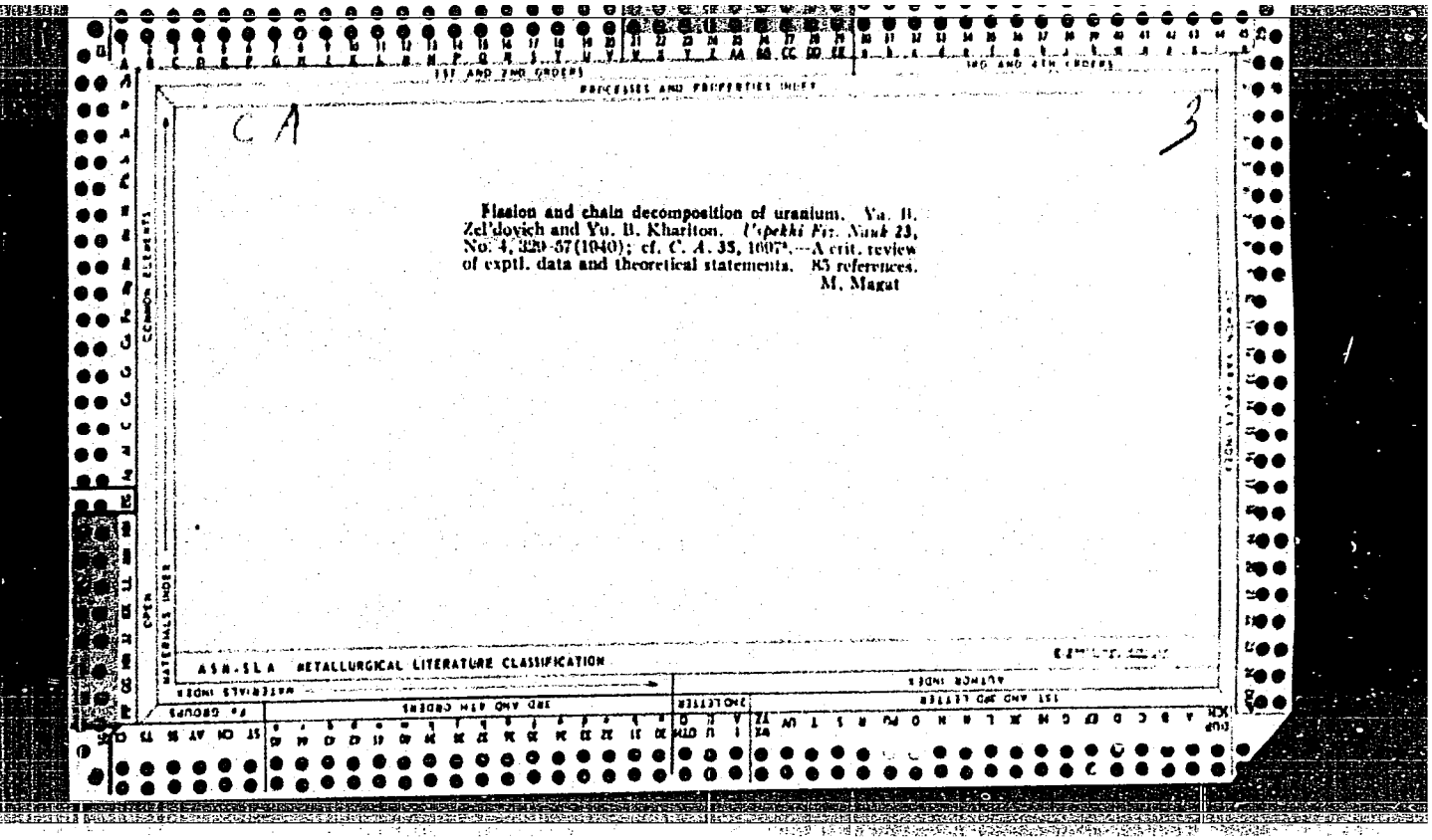
2.

CA

Kinetics of chemical reactions in gases. III. Mechanism of the combustion of carbon monoxide. Ya. B. Zel'dovich and N. N. Semenov. *J. Exptl. Theoret. Phys.* (U. S. S. R.) 10, 1427-40(1940).—Theoretical. From a discussion and analysis of the previously published data of various authors, it is found that the rate of oxidation of moist CO at higher temps. can be explained from the const. of the reaction $CO + O = CO_2$ and the preexponential factor for the reaction $H + O_2 = OH + O$. Calcns. from various data on inflammation peninsulas indicate that the energy of activation of the latter reaction is 18 Cal. rather than 30 Cal. as previously assumed. F. H. R.

ASB-SLA METALLURGICAL LITERATURE CLASSIFICATION

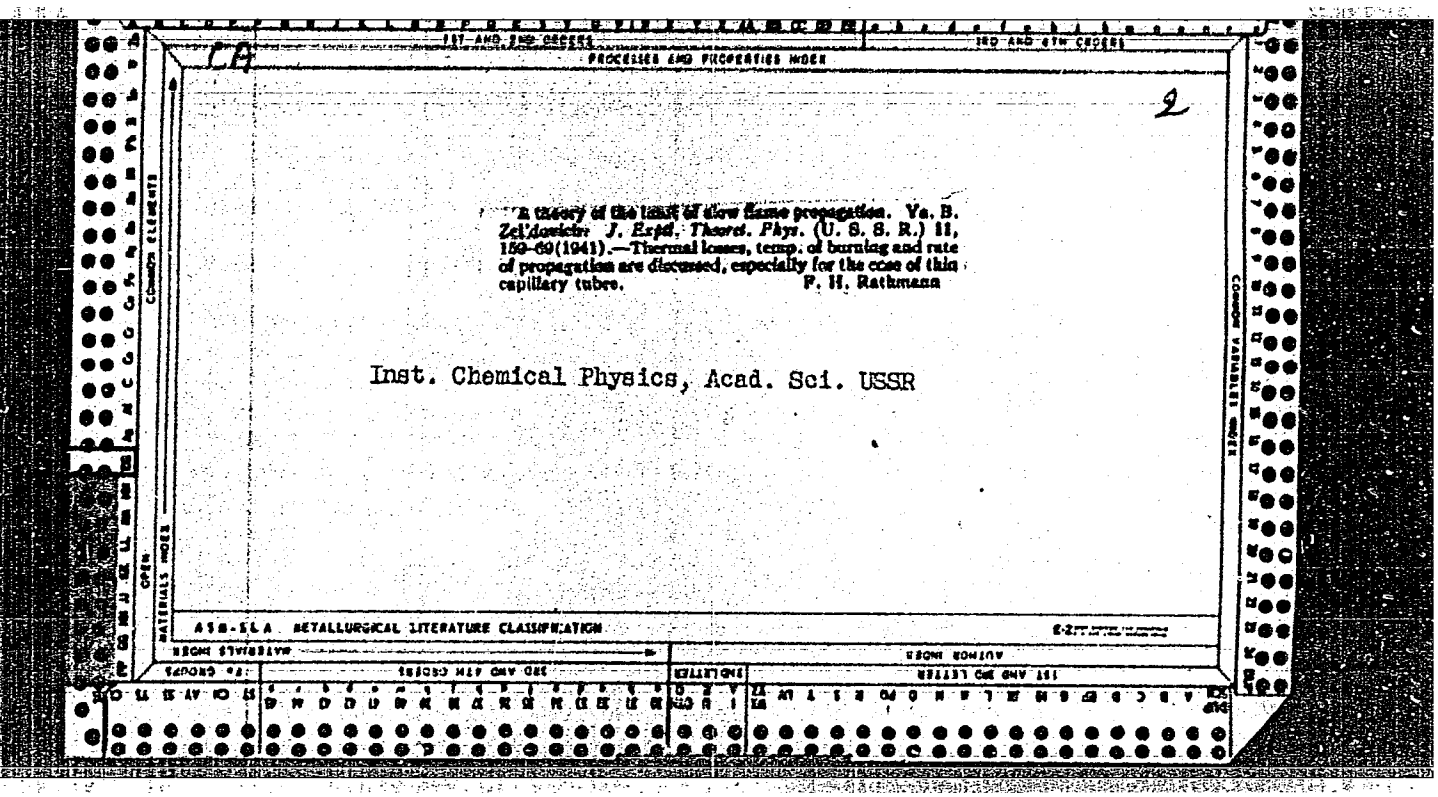




CA

3

Fission and chain decomposition of uranium. Ya. B. Zel'dovich and Yu. B. Kharlton. *Uspekhi Fiz. Nauk* 23, No. 4, 329-57(1940); cf. *C. A.* 35, 1007⁸.—A crit. review of exptl. data and theoretical statements. 83 references.
M. Magat



A theory of the limit of slow flame propagation. Ya. B. Zel'dovich. *J. Exptl. Theoret. Phys.* (U. S. S. R.) 11, 159–69(1941).—Thermal losses, temp. of burning and rate of propagation are discussed, especially for the case of thin capillary tubes. P. H. Rathmann

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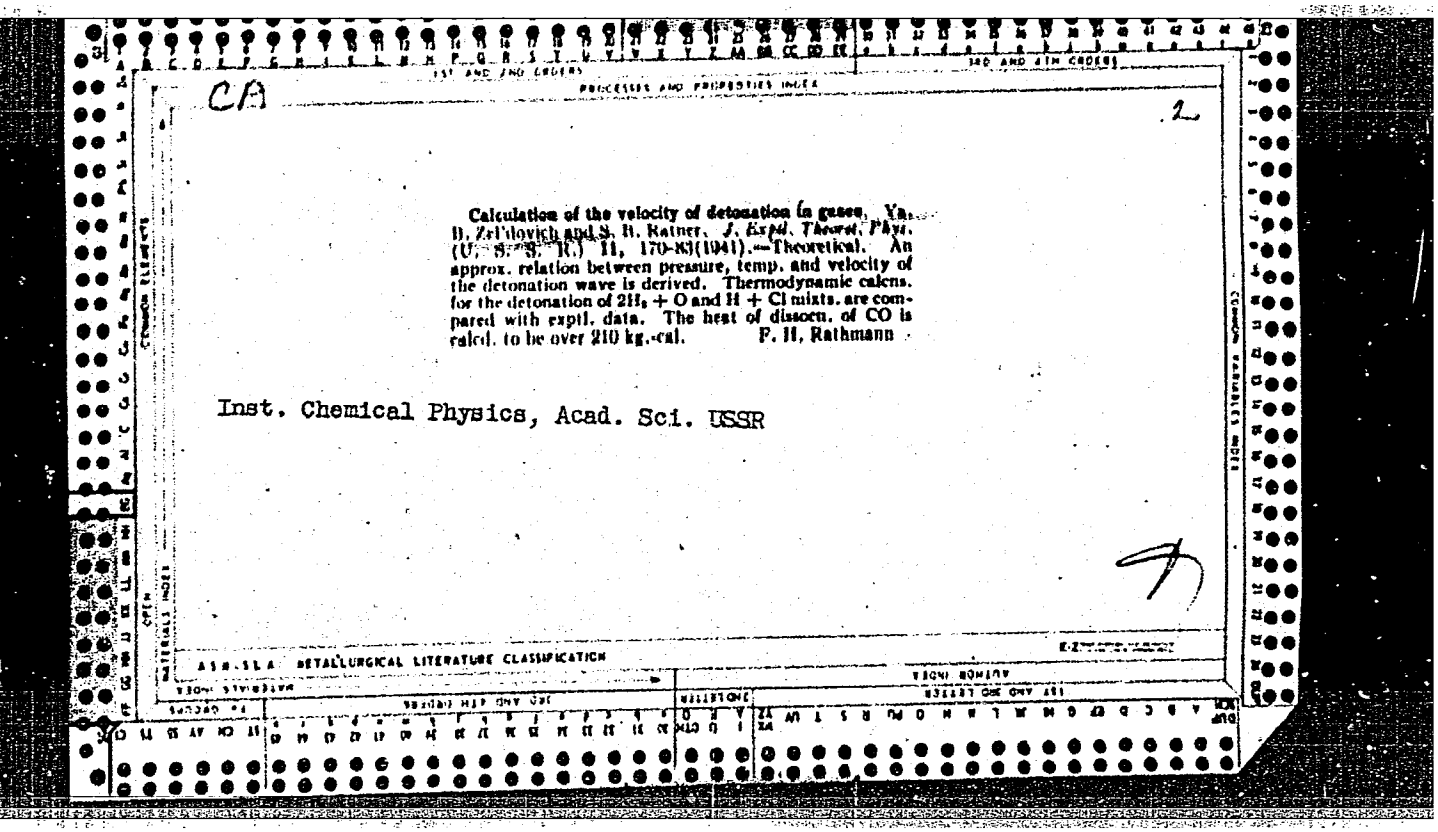


CA

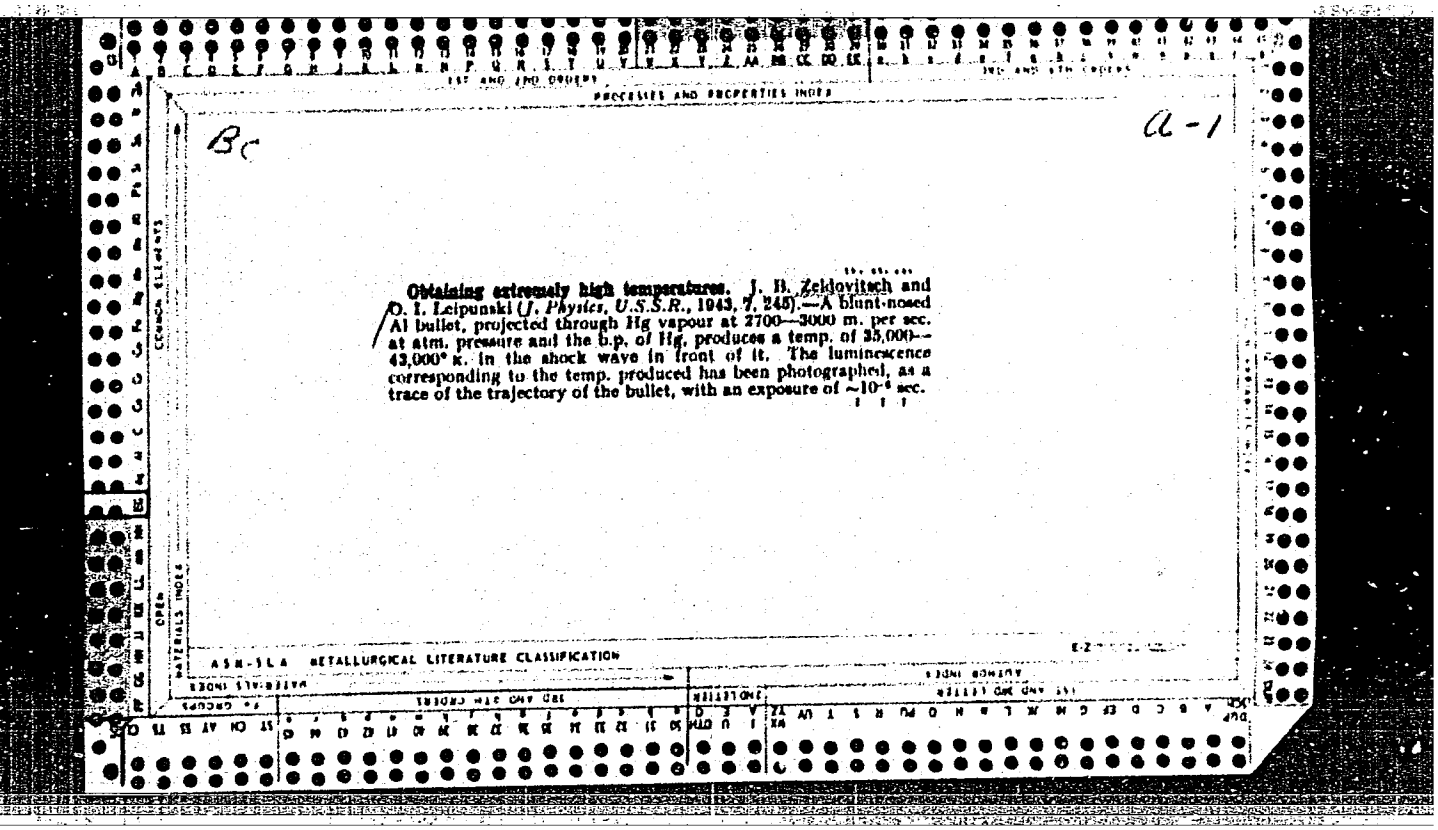
2

Calculation of the velocity of detonation in gases. Ya. B. Zel'dovich and S. R. Rainer. *J. Expl. Theoret. Phys.* (U. S. S. R.) 11, 170-83(1941).—Theoretical. An approx. relation between pressure, temp. and velocity of the detonation wave is derived. Thermodynamic calcns. for the detonation of $2H_2 + O$ and $H + Cl$ mixts. are compared with exptl. data. The heat of dissocn. of CO is calcd. to be over 210 kg.-cal. F. H. Rathmann

Inst. Chemical Physics, Acad. Sci. USSR

4

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

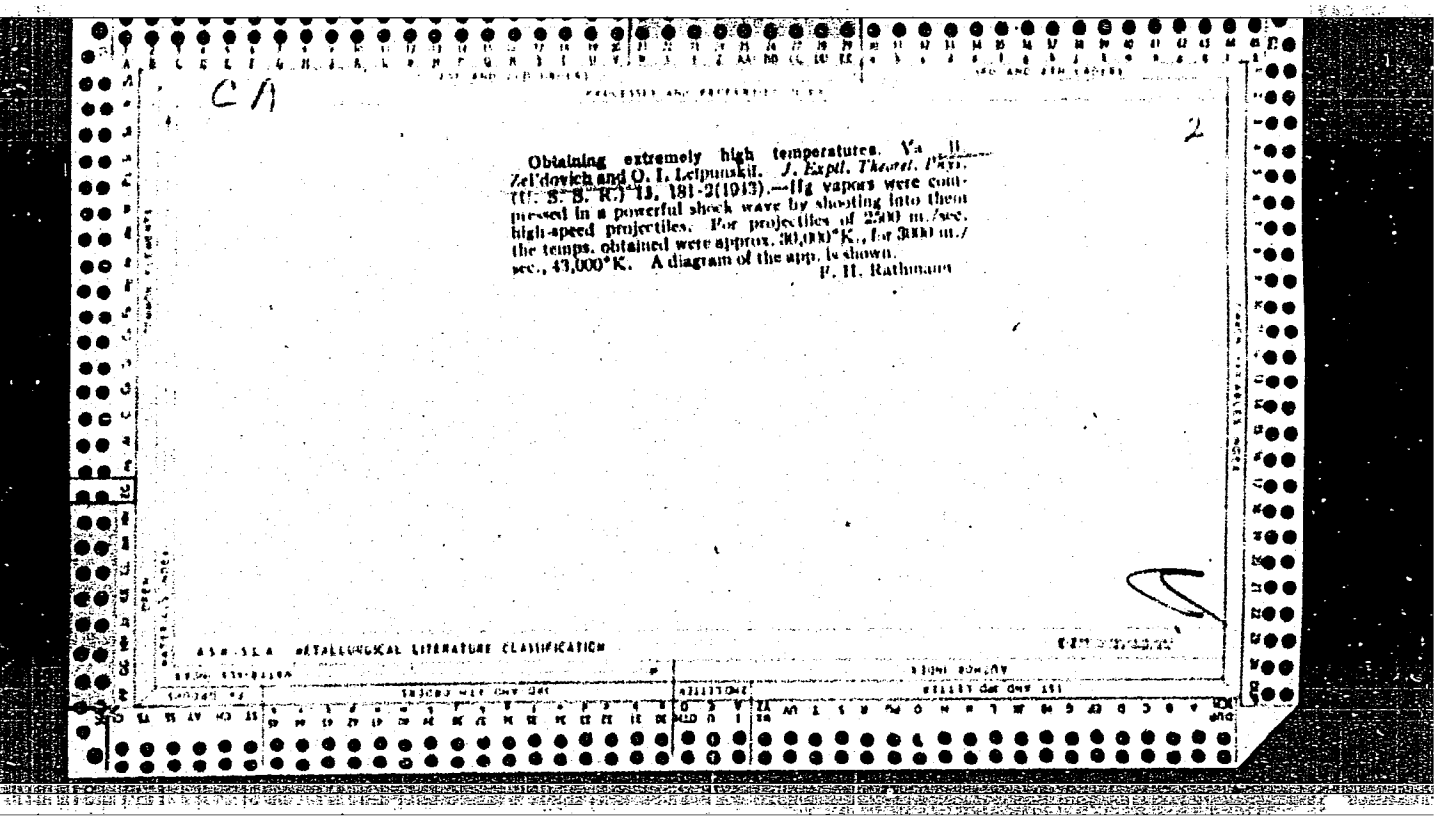


Bc

A-1

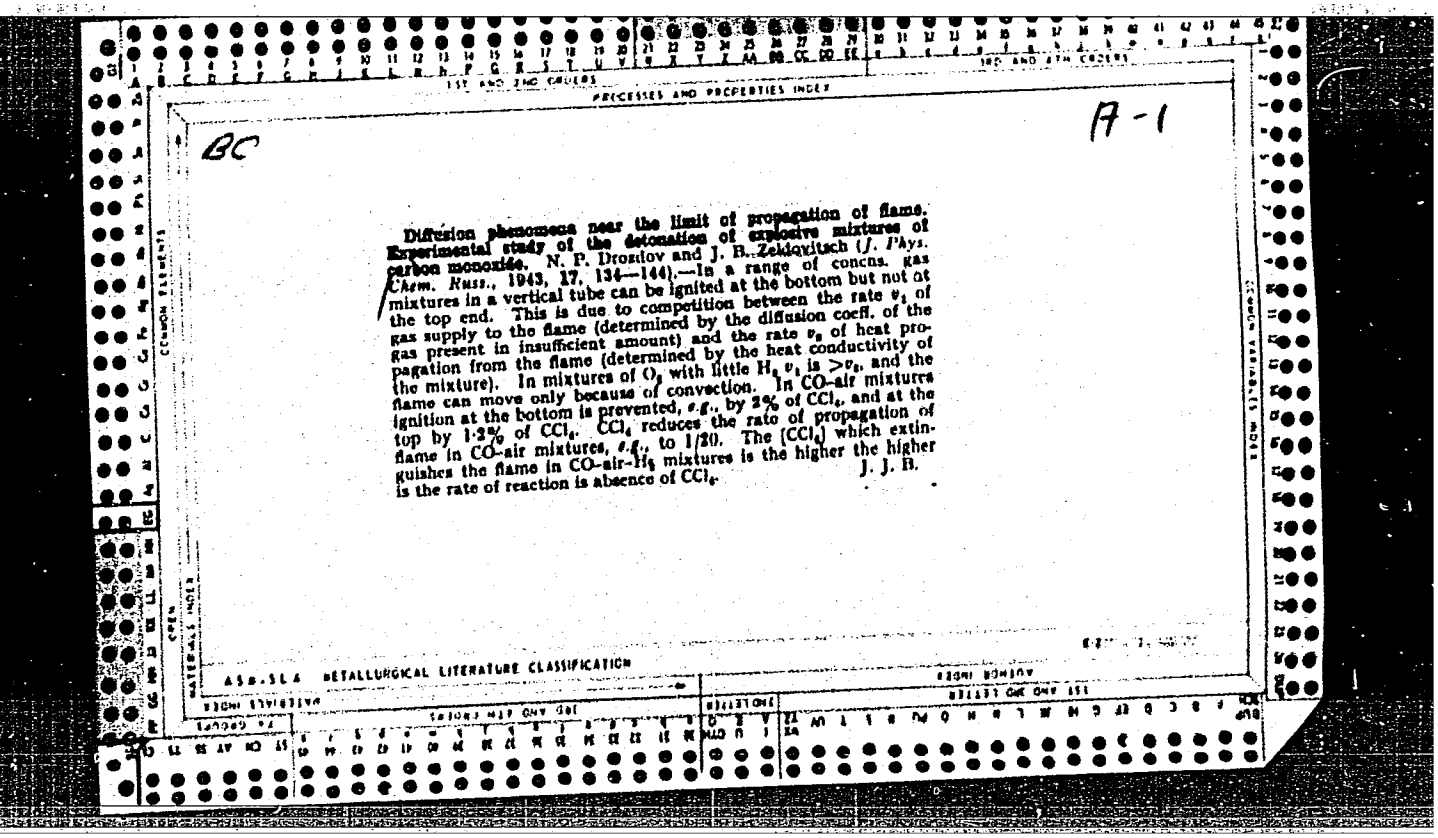
Obtaining extremely high temperatures. J. B. Zeldovitsch and O. I. Leipunski (*J. Physics, U.S.S.R.*, 1943, 7, 245).—A blunt-nosed Al bullet, projected through Hg vapour at 2700—3000 m. per sec. at atm. pressure and the b.p. of Hg, produces a temp. of 35,000—43,000° K. in the shock wave in front of it. The luminescence corresponding to the temp. produced has been photographed, as a trace of the trajectory of the bullet, with an exposure of $\sim 10^{-6}$ sec.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION



Obtaining extremely high temperatures. Ya. B. Zel'dovich and O. I. Leipunskii. *J. Expl. Theoret. Phys.* (U. S. S. R.) 13, 181-2(1943).—Hg vapors were compressed in a powerful shock wave by shooting into them high-speed projectiles. For projectiles of 2500 m./sec. the temps. obtained were approx. 30,000° K., for 3000 m./sec., 43,000° K. A diagram of the app. is shown.
P. H. Rathmann

A.S.M.-S.L.A. METALLURGICAL LITERATURE CLASSIFICATION



BC

A-1

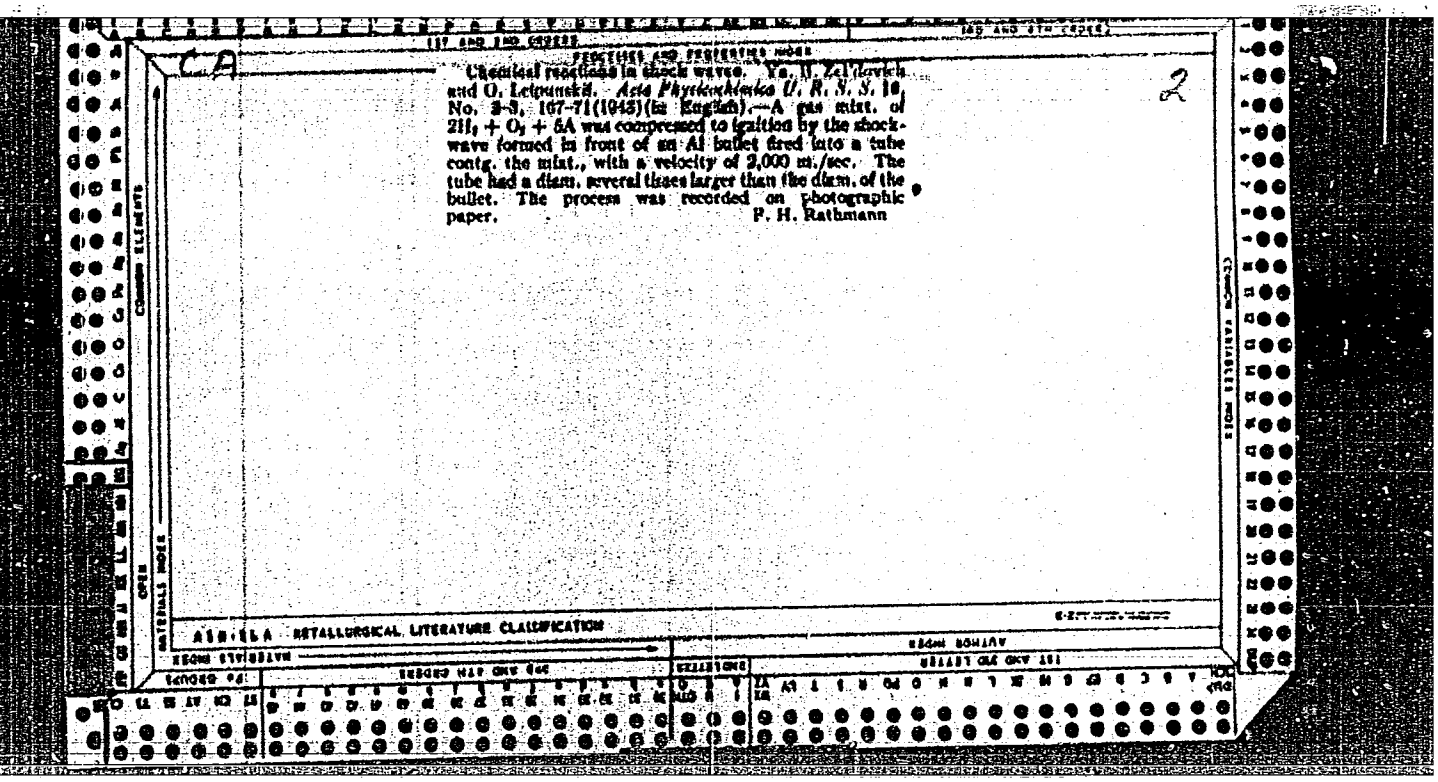
Diffusion phenomena near the limit of propagation of flame. Experimental study of the detonation of explosive mixtures of carbon monoxide. N. P. Dronlov and J. B. Zeldovitsch (*J. Phys. Chem. Russ.*, 1943, 17, 134—144).—In a range of concns. gas mixtures in a vertical tube can be ignited at the bottom but not at the top end. This is due to competition between the rate v_1 of gas supply to the flame (determined by the diffusion coeff. of the gas present in insufficient amount) and the rate v_2 of heat propagation from the flame (determined by the heat conductivity of the mixture). In mixtures of O_2 with little H_2 v_1 is $>v_2$, and the flame can move only because of convection. In CO–air mixtures ignition at the bottom is prevented, *e.g.*, by 2% of CCl_4, and at the top by 1·2% of CCl_4. CCl_4 reduces the rate of propagation of flame in CO–air mixtures, *e.g.*, to 1/20. The $[CCl_4]$ which extinguishes the flame in CO–air–H_2 mixtures is the higher the higher is the rate of reaction is absence of CCl_4. J. J. B.

By U.

AT & Reactions

Theory of new phase formation : cavitation. J. B. Zeldovitch. *Acta Physicochim. U.R.S.S.*, 1943, 18, 1—22).—The probability of formation of a bubble in a liquid is treated as a particular case of the formation of a new phase. An equation of the Fourier-Fick type is obtained for the relationship between the rate of the direct and reverse processes of nucleus formation. In the case of cavitation, with a fluid of low v.p. under the action of a high negative pressure, the rate of formation of nuclei is determined by the η of the fluid. The dependence of the probability of cavitation on the duration of application of the negative pressure, and on the vol. of the region submitted to that pressure, is investigated.

A. J. M.

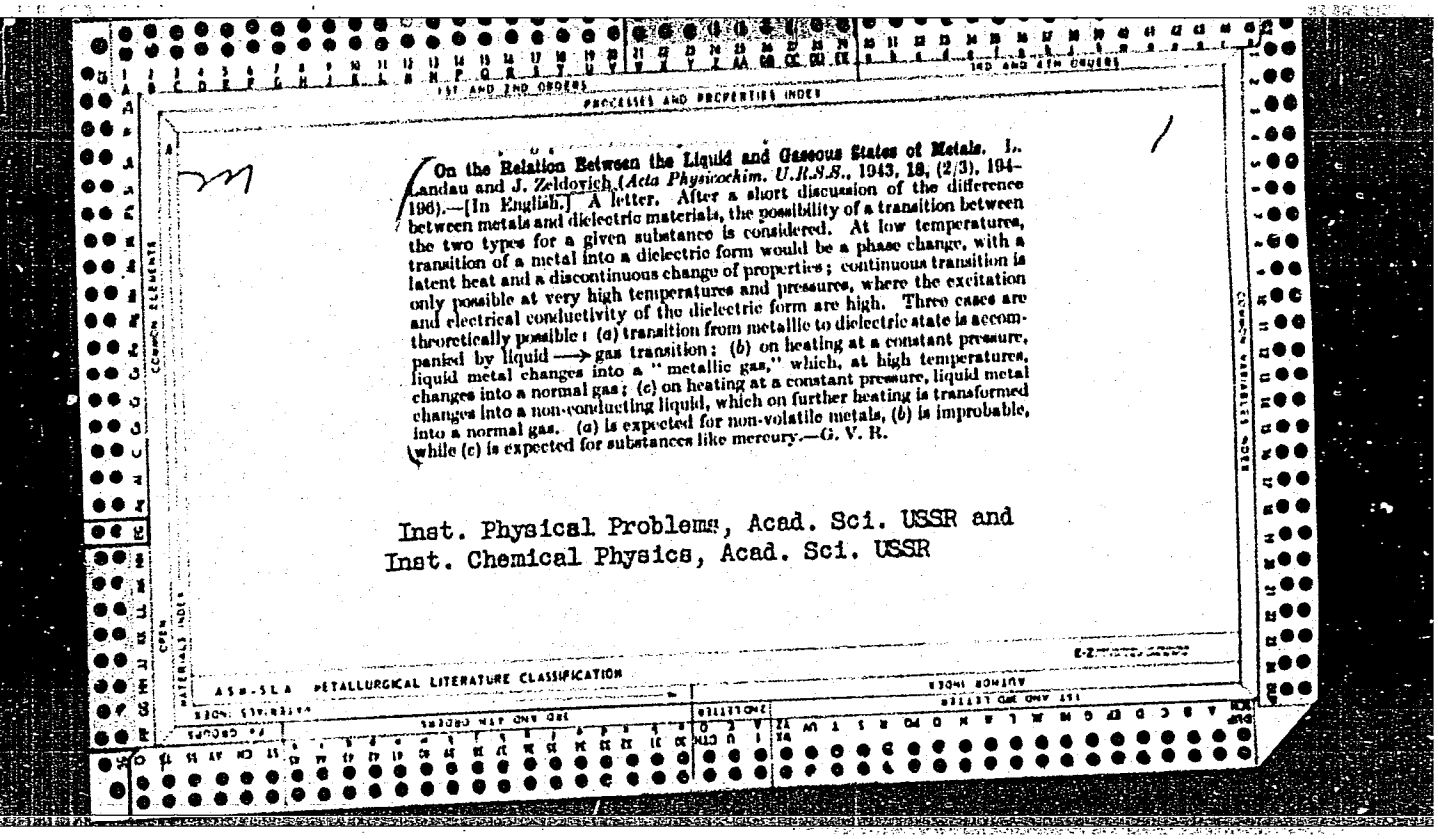


CA

2

Chemical reactions in shock waves. Ya. B. Zel'dovich and O. Leipunskii. *Acta Physicochimica U. R. S. S.* 18, No. 3-5, 167-71(1943)(in English).—A gas mixt. of $2H_2 + O_2 + 5A$ was compressed to ignition by the shock-wave formed in front of an Al bullet fired into a tube contg. the mixt., with a velocity of 2,000 m./sec. The tube had a diam. several times larger than the diam. of the bullet. The process was recorded on photographic paper.

P. H. Rathmann



PROCESSES AND PROPERTIES INDEX

On the Relation Between the Liquid and Gaseous States of Metals. L. Landau and J. Zeldovich. (*Acta Physicochim. U.R.S.S.*, 1943, 18, (2/3), 194–196).—[In English.] A letter. After a short discussion of the difference between metals and dielectric materials, the possibility of a transition between the two types for a given substance is considered. At low temperatures, transition of a metal into a dielectric form would be a phase change, with a latent heat and a discontinuous change of properties; continuous transition is only possible at very high temperatures and pressures, where the excitation and electrical conductivity of the dielectric form are high. Three cases are theoretically possible: (*a*) transition from metallic to dielectric state is accompanied by liquid ⟶ gas transition; (*b*) on heating at a constant pressure, liquid metal changes into a "metallic gas," which, at high temperatures, changes into a normal gas; (*c*) on heating at a constant pressure, liquid metal changes into a non-conducting liquid, which on further heating is transformed into a normal gas. (*a*) is expected for non-volatile metals, (*b*) is improbable, while (*c*) is expected for substances like mercury.—G. V. R.

Inst. Physical Problems, Acad. Sci. USSR and
Inst. Chemical Physics, Acad. Sci. USSR

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

ZEL'DOVICH, YAKOV BORISOVICH.

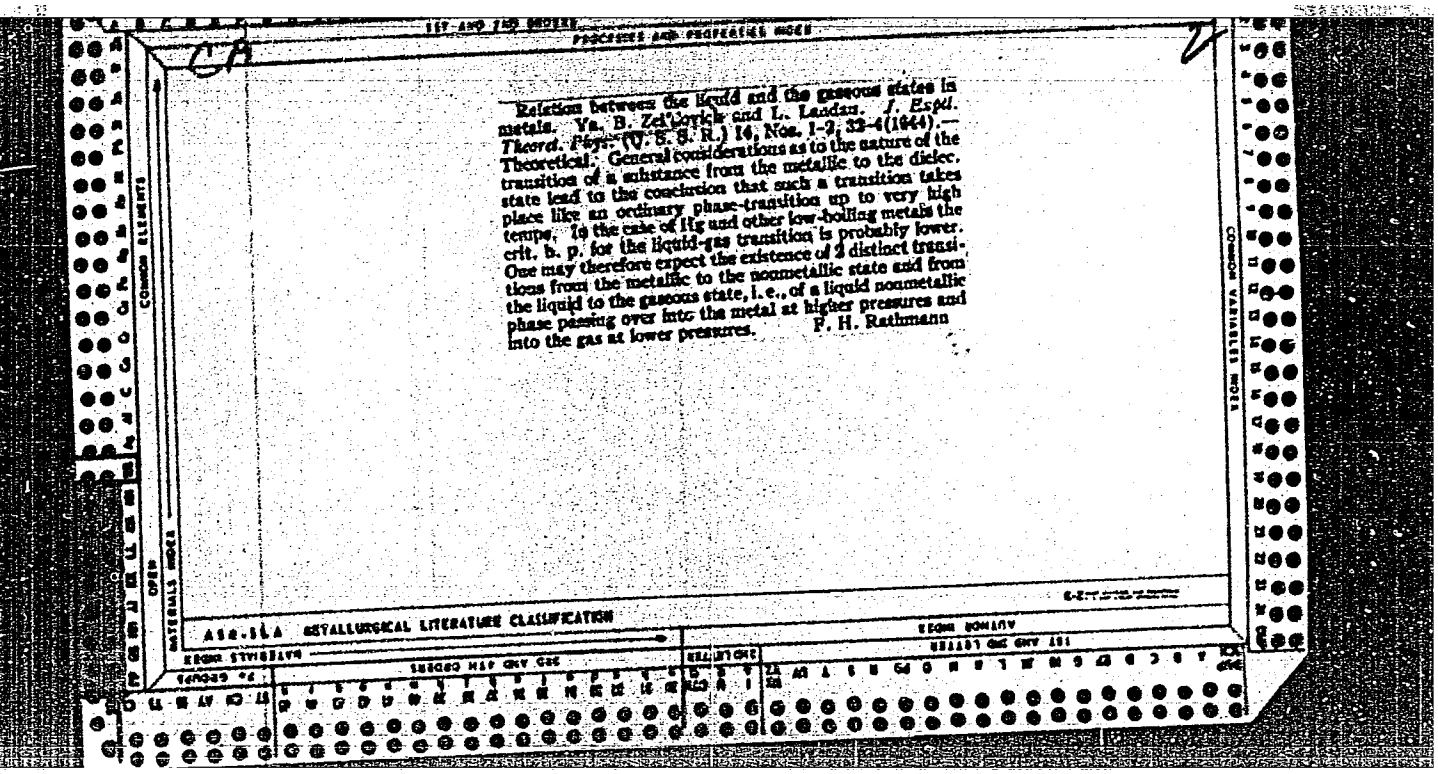
Teoriia goreniia i detonatsii gazov. Moskva, Izd-vo Akademii Nauk SSSR, 1944, 70 p., diagrs.

Bibliography: p.69-70.

Title tr.: Theory of combustion and detontion of gases

QD516.Z4

SO: Aeronautical Sciences and Aviation in the Soviet Union, Library of Congress, 1955.



Relation between the liquid and the gaseous states in metals. Ya. B. Zel'dovich and L. Landau. *J. Exptl. Theoret. Phys.* (U. S. S. R.) 14, Nos. 1-2, 32-4(1944).—Theoretical: General considerations as to the nature of the transition of a substance from the metallic to the dielec. state lead to the conclusion that such a transition takes place like an ordinary phase-transition up to very high temps. In the case of Hg and other low-boiling metals the crit. b. p. for the liquid-gas transition is probably lower. One may therefore expect the existence of 2 distinct transitions from the metallic to the nonmetallic state and from the liquid to the gaseous state, i. e., of a liquid nonmetallic phase passing over into the metal at higher pressures and into the gas at lower pressures. F. H. Rathmann

ZEL'DOVICH, YA. B.

Teoriya undarnykh voln i vvedeniye v gazodinamiku.
(Theory of Shock Waves and Introduction to Gas Dynamics)
1946. 186 p.

IN This monograph special care was given to the accurate presentation of basic laws of the dynamics of gases and to the methods of calculation of simple problems.

Translation 5 52464

Inst. Chemical Physics, USSR

ZEL'DOVICH, YA.

USSR/Physics Jul/Aug 1946
Rarefaction Waves
Shock Waves

"The Possibility of the Rarefaction Shock Waves," Ya. Zel'dovich, Inst Chem Phys, Acad Sci USSR, 2 pp

"Journal of Physics USSR" Vol X, No 4

Demonstrates that for gases with large molar heat capacity C there exists a region where the rarefaction waves must propagate in the form of shock waves and compression waves must be blurred in the course of propagation. Received, 5 Sep 1945.

54T89

PA 54T88

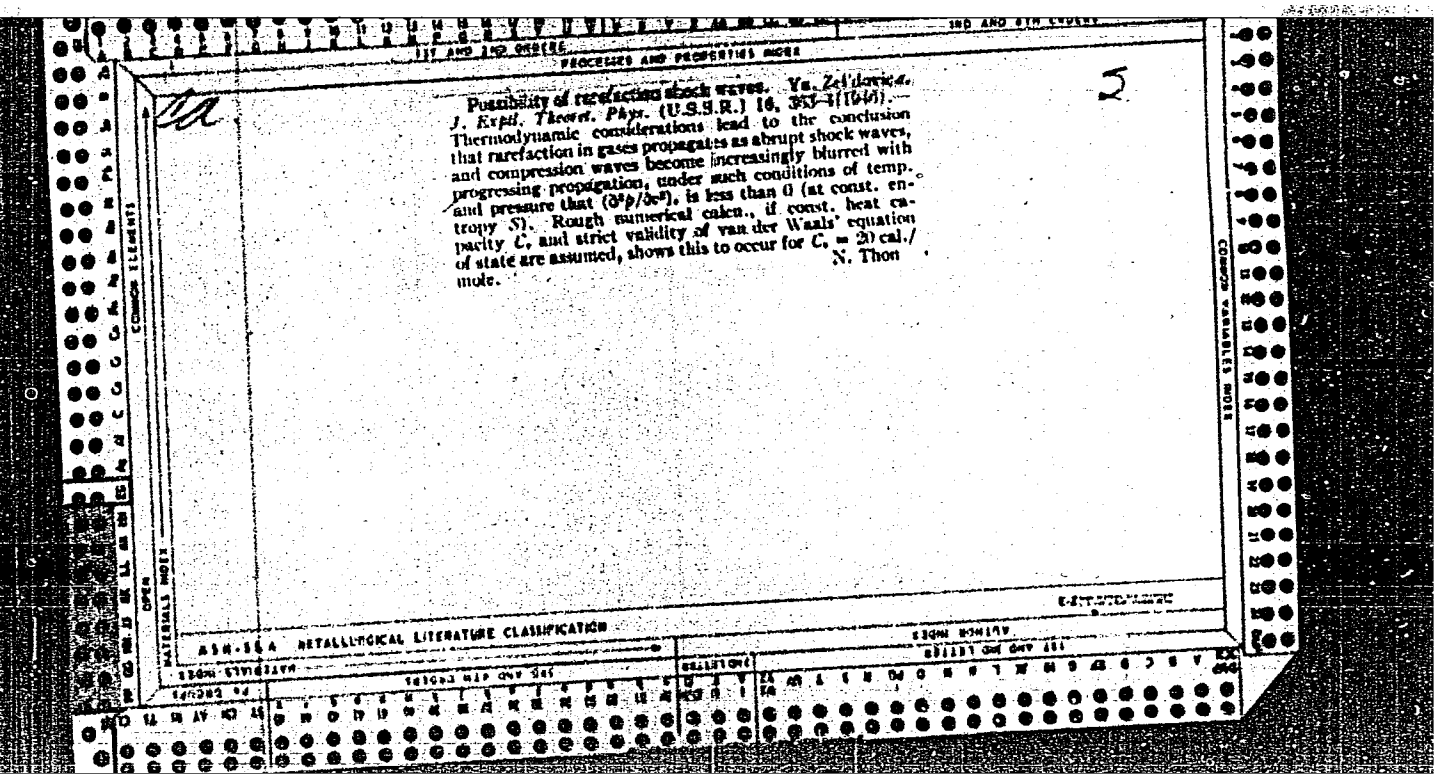
ZEL'DOVICH, YA.

USSR/Physics Jul/Aug 1946
Shock Waves
Wave Propagation

"The Propagation of Shock Waves in Gas With Reversible Chemical Reactions," Ya. Zel'dovich, Inst Chem Phys, Acad Sci USSR, 4 pp

"Journal of Physics USSR" Vol X, No 4

Study of propagation of shock waves in gas with reversible chemical reaction, or retarded excitation of the part of the heat capacity which induces a great expansion of the shock wave front, structure of which depends on wave amplitude. This effect used in investigation of energy transfer to inner degrees of freedom of molecules. Received, 5 Sep 1945. 54T88



Possibility of rarefaction shock waves. Ya. Zel'dovich. *J. Exptl. Theoret. Phys.* (U.S.S.R.) 16, 363-4 (1946). Thermodynamic considerations lead to the conclusion that rarefaction in gases propagates as abrupt shock waves, and compression waves become increasingly blurred with progressing propagation, under such conditions of temp. and pressure that $(\partial^2 p/\partial v^2)_S$ is less than 0 (at const. entropy S). Rough numerical calcn., if const. heat capacity C_v and strict validity of van der Waals' equation of state are assumed, shows this to occur for $C_v = 20$ cal./mole. N. Thon

ZEL'DOVICH, YA.

USSR/Shock Waves - Propagation
Gases

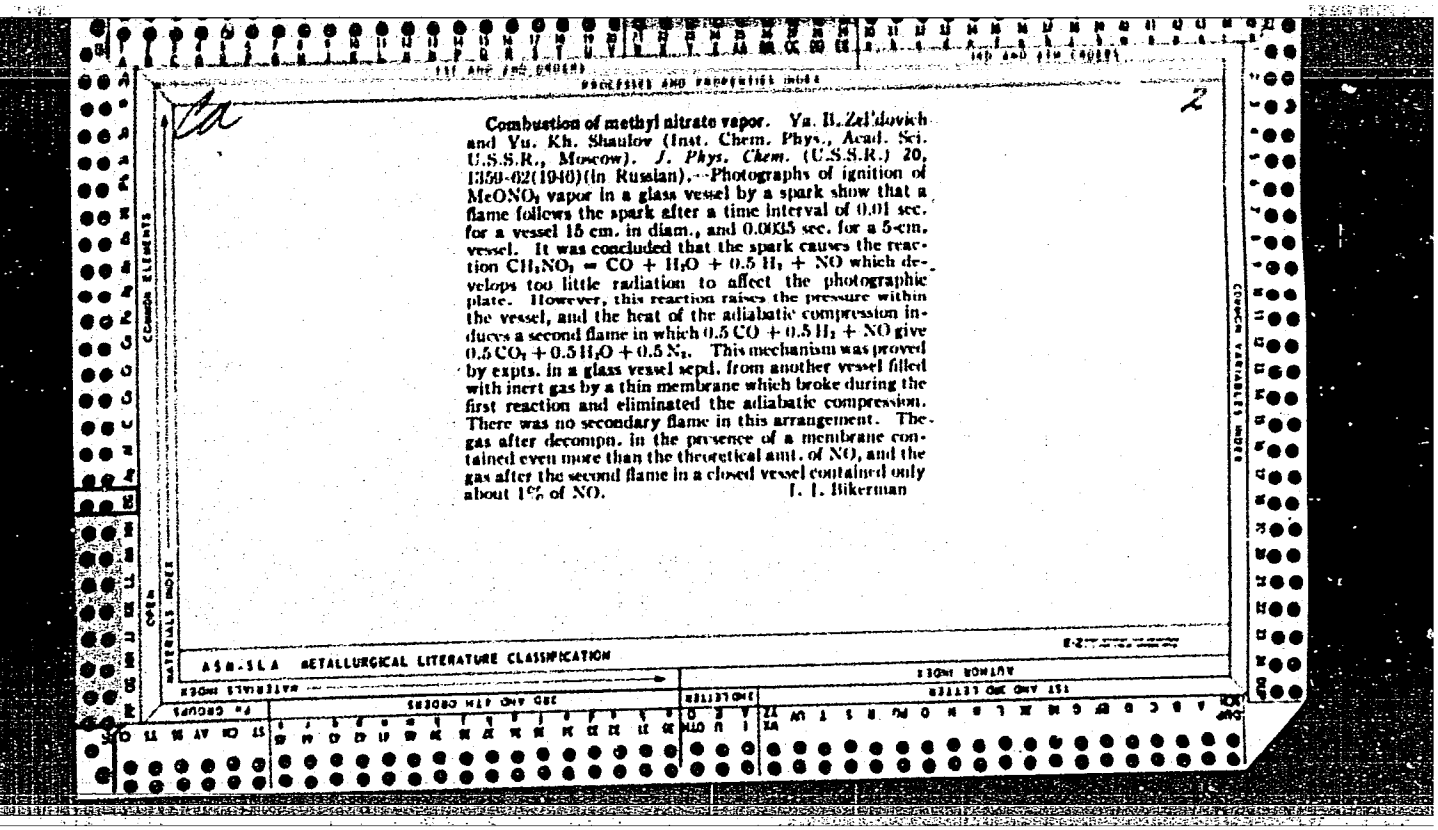
Apr 1946

"The Propagation of Shock Waves in Gases with a Reversible Chemical Reaction," Ya. Zel'dovich, 4 pp

"Zhur Eksp i Teor Fiz" Vol XVI, No 4

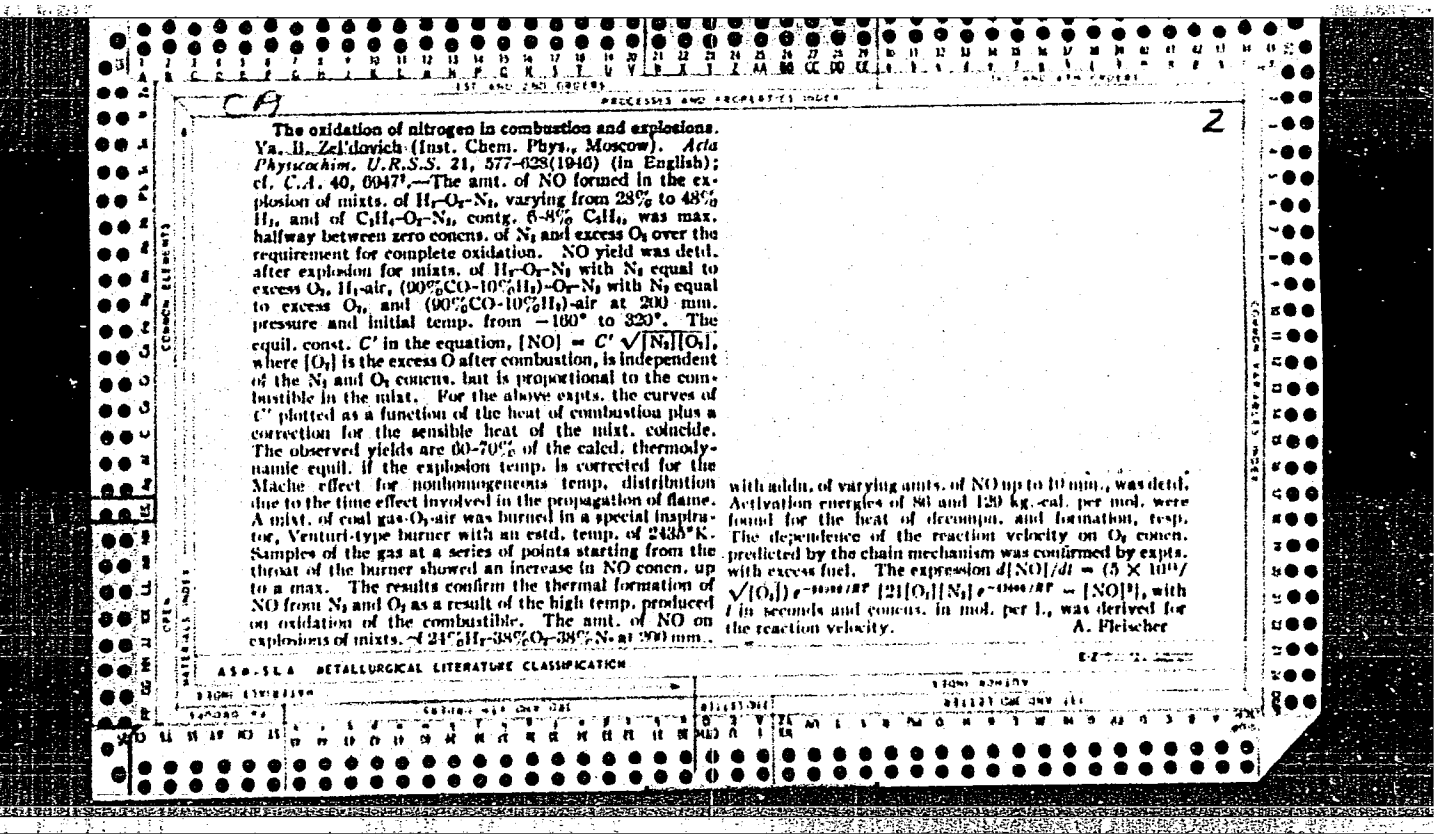
Consideration of the propagation of shock waves in a gas with a reversible chemical reaction or a delayed excitation of part of its specific heat, which peculiarities cause a sharply pronounced expansion of the shock wave front.

13T52



Combustion of methyl nitrate vapor. Yu. B. Zel'dovich and Yu. Kh. Shaulov (Inst. Chem. Phys., Acad. Sci. U.S.S.R., Moscow). *J. Phys. Chem.* (U.S.S.R.) 20, 1359-62(1940)(in Russian).—Photographs of ignition of $MeONO_2$ vapor in a glass vessel by a spark show that a flame follows the spark after a time interval of 0.01 sec. for a vessel 15 cm. in diam., and 0.0035 sec. for a 5-cm. vessel. It was concluded that the spark causes the reaction $CH_3NO_3 = CO + H_2O + 0.5\ H_2 + NO$ which develops too little radiation to affect the photographic plate. However, this reaction raises the pressure within the vessel, and the heat of the adiabatic compression induces a second flame in which $0.5\ CO + 0.5\ H_2 + NO$ give $0.5\ CO_2 + 0.5\ H_2O + 0.5\ N_2$. This mechanism was proved by expts. in a glass vessel sepd. from another vessel filled with inert gas by a thin membrane which broke during the first reaction and eliminated the adiabatic compression. There was no secondary flame in this arrangement. The gas after decompn. in the presence of a membrane contained even more than the theoretical amt. of NO, and the gas after the second flame in a closed vessel contained only about 1% of NO.

I. I. Bikerman

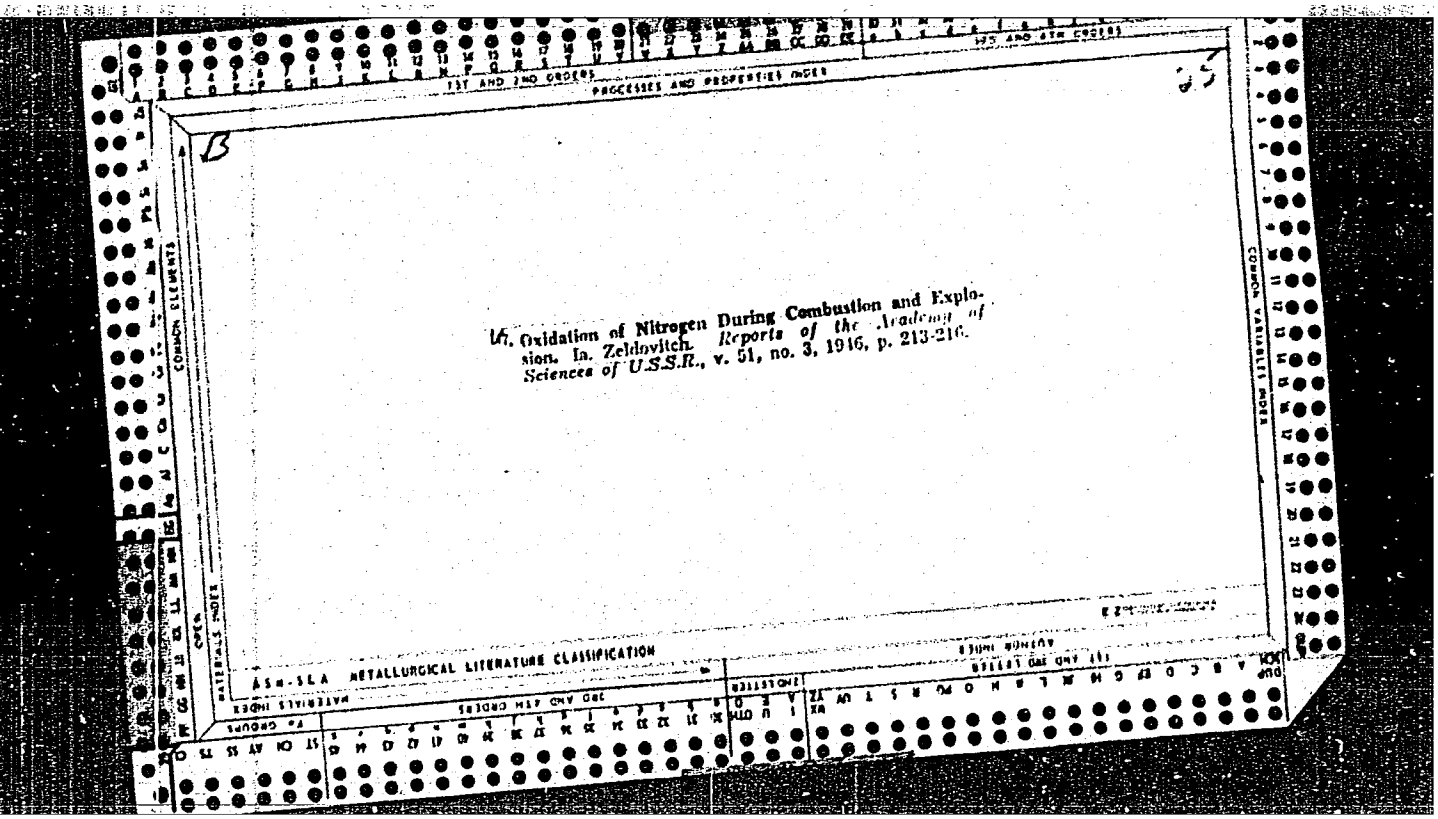


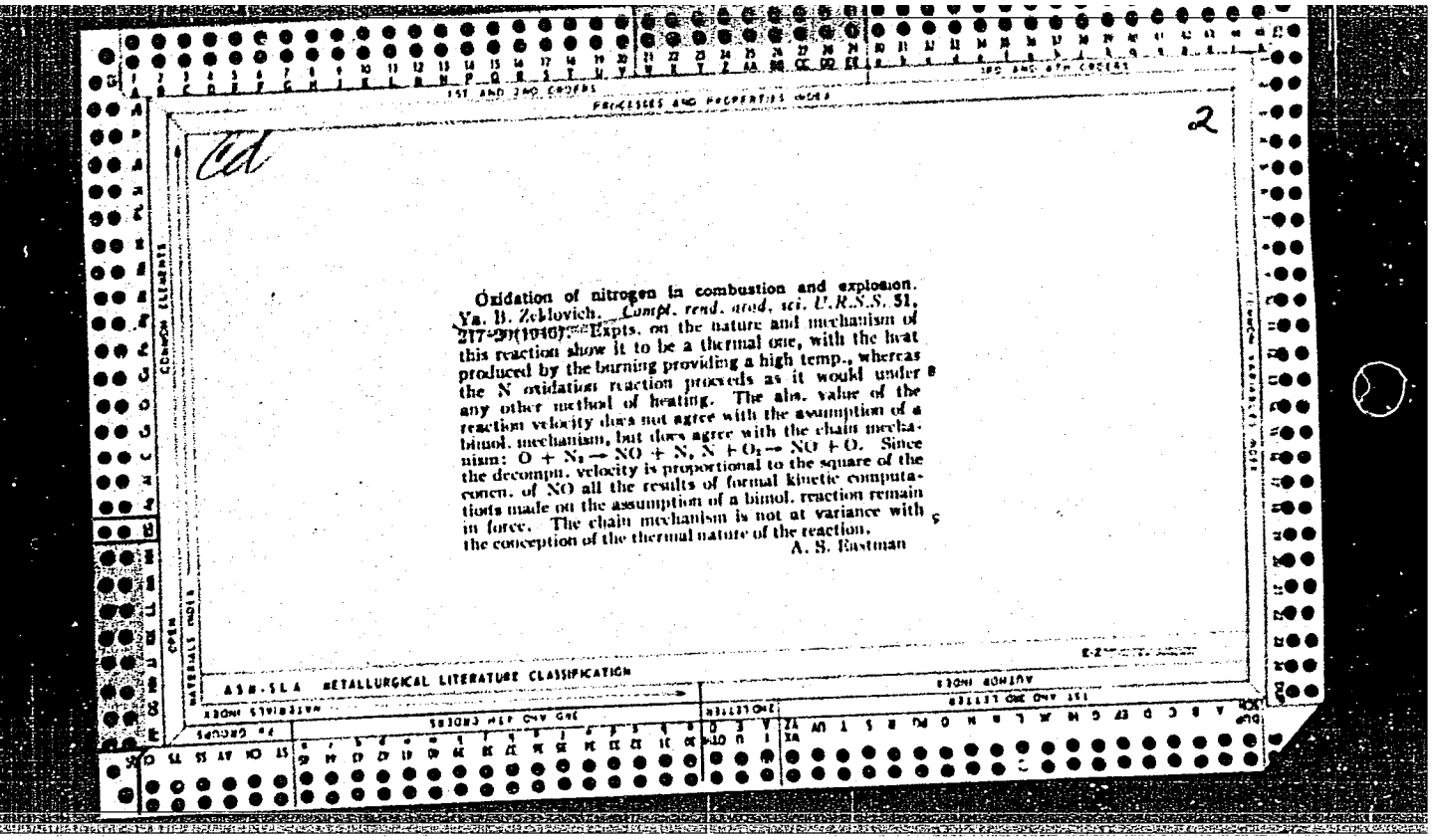
CA

2

The oxidation of nitrogen in combustion and explosions. Ya. B. Zel'dovich (Inst. Chem. Phys., Moscow). *Acta Physicochim. U.R.S.S.* 21, 577–628(1946) (in English); cf. *C.A.* 40, 6947⁹.—The amt. of NO formed in the explosion of mixts. of H_2–O_2–N_2, varying from 28% to 48% H_2, and of C_2H_4–O_2–N_2, contg. 6–8% C_2H_4, was max. halfway between zero concns. of N_2 and excess O_2 over the requirement for complete oxidation. NO yield was detd. after explosion for mixts. of H_2–O_2–N_2 with N_2 equal to excess O_2, H_2-air, (90%CO-10%H_2)–O_2–N_2 with N_2 equal to excess O_2, and (90%CO-10%H_2)-air at 200 mm. pressure and initial temp. from −180° to 320°. The equil. const. C' in the equation, $[NO] = C'\sqrt{[N_2][O_2]}$, where $[O_2]$ is the excess O after combustion, is independent of the N_2 and O_2 concns. but is proportional to the combustible in the mixt. For the above expts. the curves of C' plotted as a function of the heat of combustion plus a correction for the sensible heat of the mixt. coincide. The observed yields are 60–70% of the calcd. thermodynamic equil. if the explosion temp. is corrected for the Mache effect for nonhomogeneous temp. distribution due to the time effect involved in the propagation of flame. A mixt. of coal gas-O_2-air was burned in a special inspirator, Venturi-type burner with an estd. temp. of 2435°K. Samples of the gas at a series of points starting from the throat of the burner showed an increase in NO concn. up to a max. The results confirm the thermal formation of NO from N_2 and O_2 as a result of the high temp. produced on oxidation of the combustible. The amt. of NO on explosions of mixts. of 24%H_2–38%O_2–38%N_2 at 200 mm., with addn. of varying amts. of NO up to 10 mm., was detd. Activation energies of 80 and 120 kg.-cal. per mol. were found for the heat of decompn. and formation, resp. The dependence of the reaction velocity on O_2 concn. predicted by the chain mechanism was confirmed by expts. with excess fuel. The expression $d[NO]/dt = (5 \times 10^{13}/\sqrt{[O_2]})\,e^{-80000/RT}\,[2[O_2][N_2]\,e^{-120000/RT} - [NO]^2]$, with t in seconds and concns. in mol. per l., was derived for the reaction velocity. A. Fleischer

ASS-SLA METALLURGICAL LITERATURE CLASSIFICATION





Oxidation of nitrogen in combustion and explosion. Ya. B. Zeldovich. *Compt. rend. acad. sci. U.R.S.S.* 51, 217–20(1946). Expts. on the nature and mechanism of this reaction show it to be a thermal one, with the heat produced by the burning providing a high temp., whereas the N oxidation reaction proceeds as it would under any other method of heating. The abs. value of the reaction velocity does not agree with the assumption of a bimol. mechanism, but does agree with the chain mechanism: $O + N_2 \rightarrow NO + N$, $N + O_2 \rightarrow NO + O$. Since the decompn. velocity is proportional to the square of the concn. of NO all the results of formal kinetic computations made on the assumption of a bimol. reaction remain in force. The chain mechanism is not at variance with the conception of the thermal nature of the reaction.

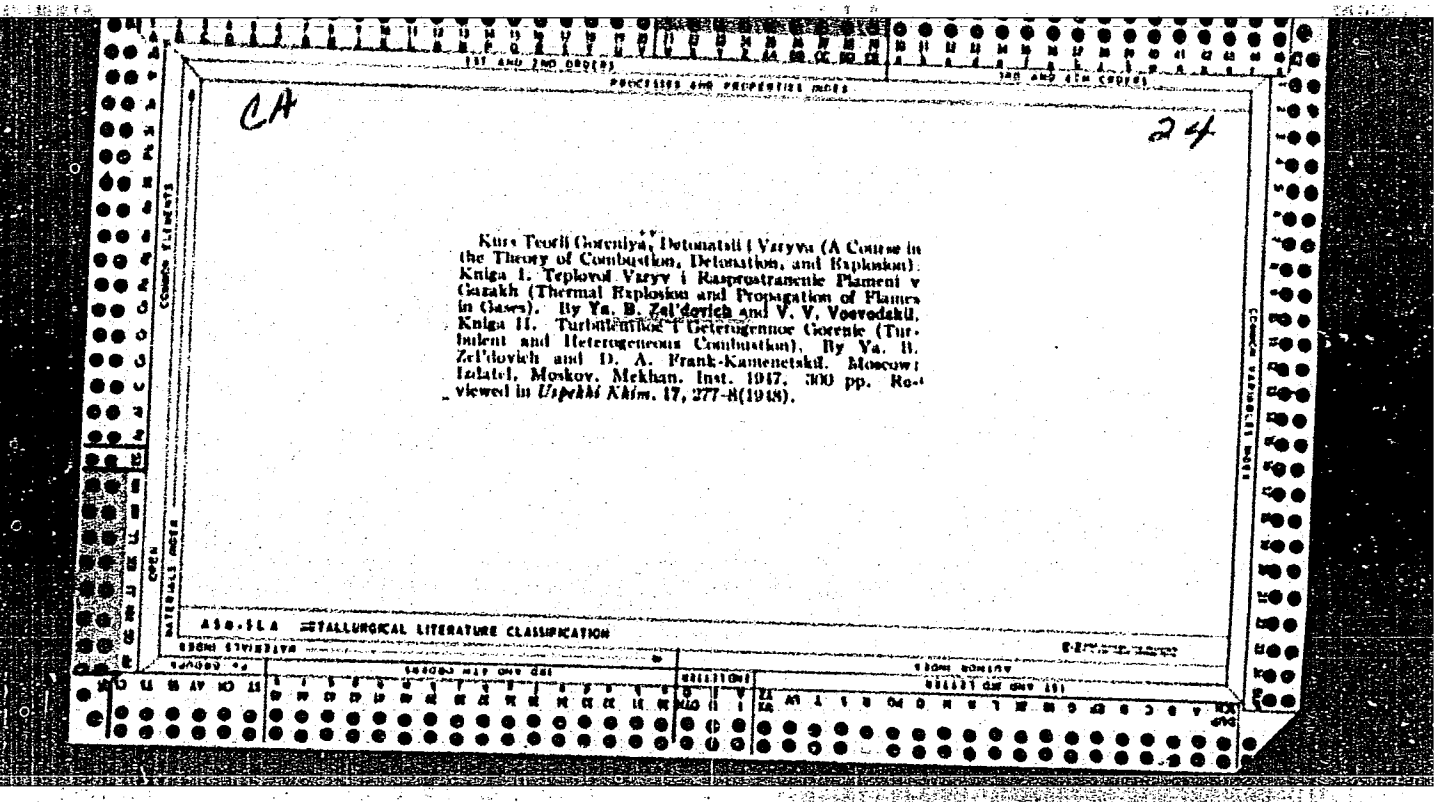
A. S. Eastman

ZEL'DOVICH, Ya. B., and POLYARNYI, A.I.

Raschety teplovykh protsessov pri vysokoi temperature (Calculations of thermal processes at high temperatures), Izd. Byuro Novoi Tekh. bez Goroda, Moscow, 1947, 68 pp. 16 references.
Reviewed in Uspekhi Fiz. Nauk, Vol. 34, 1948, pp. 462-463.

ZEL'DOVICH, Ya.B.; SADOVNIKOV, P.Ya. [deceased]; FRANK-KAMENETSKIY, D.A.; VOYEVODSKIY, V.V., redaktor; SEMENOV, N.N., akademik, redaktor; ZALYSHKINA, O.V., tekhnicheskiy redaktor

[Oxidation of nitrogen during combustion] Okislenie azota pri gorenii. Moskva, Izd-vo Akademii nauk SSSR, 1947. 144 p.
(Nitrogen) (MLRA 9:3)

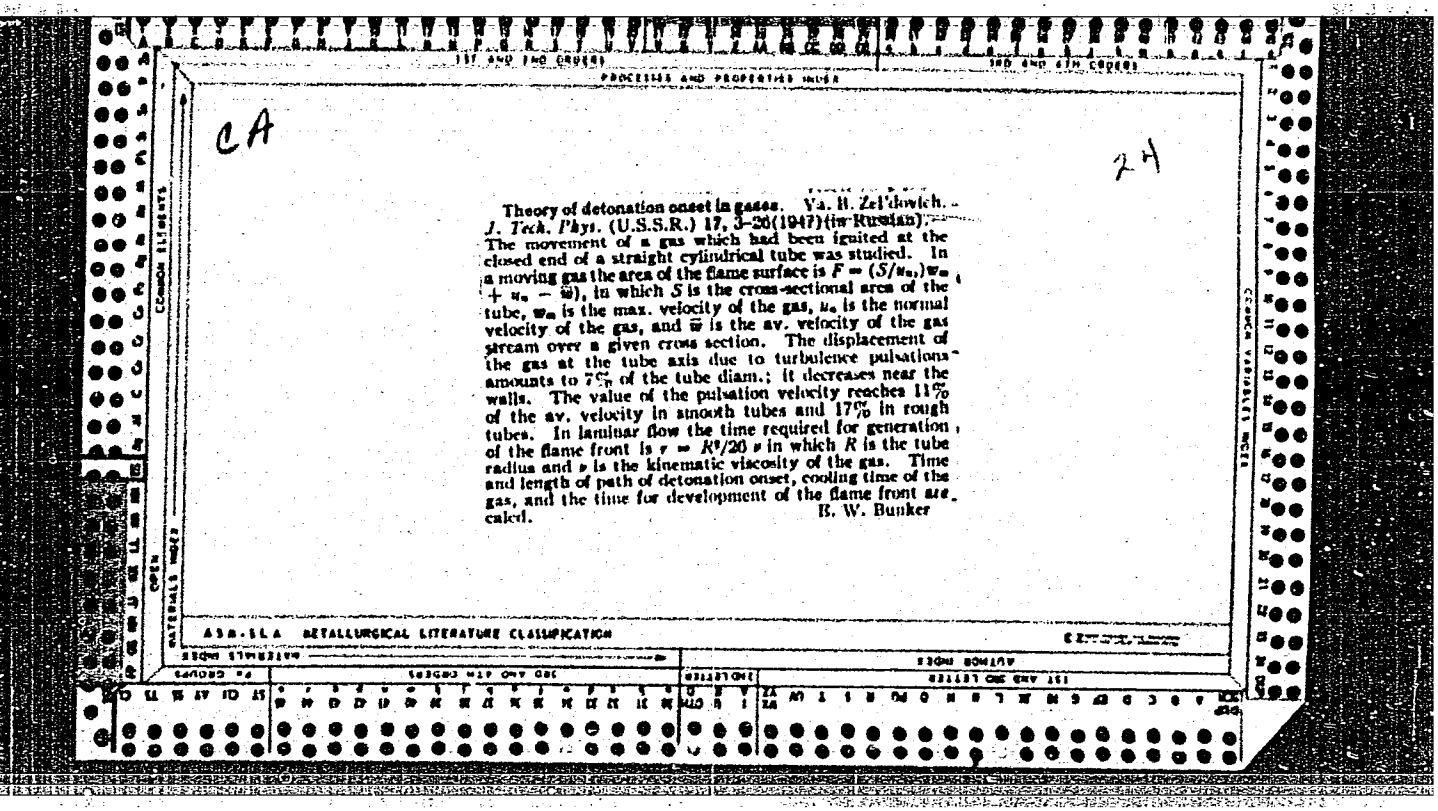


CA

24

Kurs Teorii Gorenlya, Detonatsii i Vzryva (A Course in the Theory of Combustion, Detonation, and Explosion). Kniga I. Teplovoi Vzryv i Rasprostranenie Plameni v Gazakh (Thermal Explosion and Propagation of Flames in Gases). By Ya. B. Zel'dovich and V. V. Voevodskii. Kniga II. Turbulentnoe i Geterogennoe Gorenie (Turbulent and Heterogeneous Combustion). By Ya. B. Zel'dovich and D. A. Frank-Kamenetskii. Moscow: Izdatel. Moskov. Mekhan. Inst. 1947. 300 pp. Reviewed in *Uspekhi Khim.* 17, 277-8(1948).

A50-51A METALLURGICAL LITERATURE CLASSIFICATION



CA

24

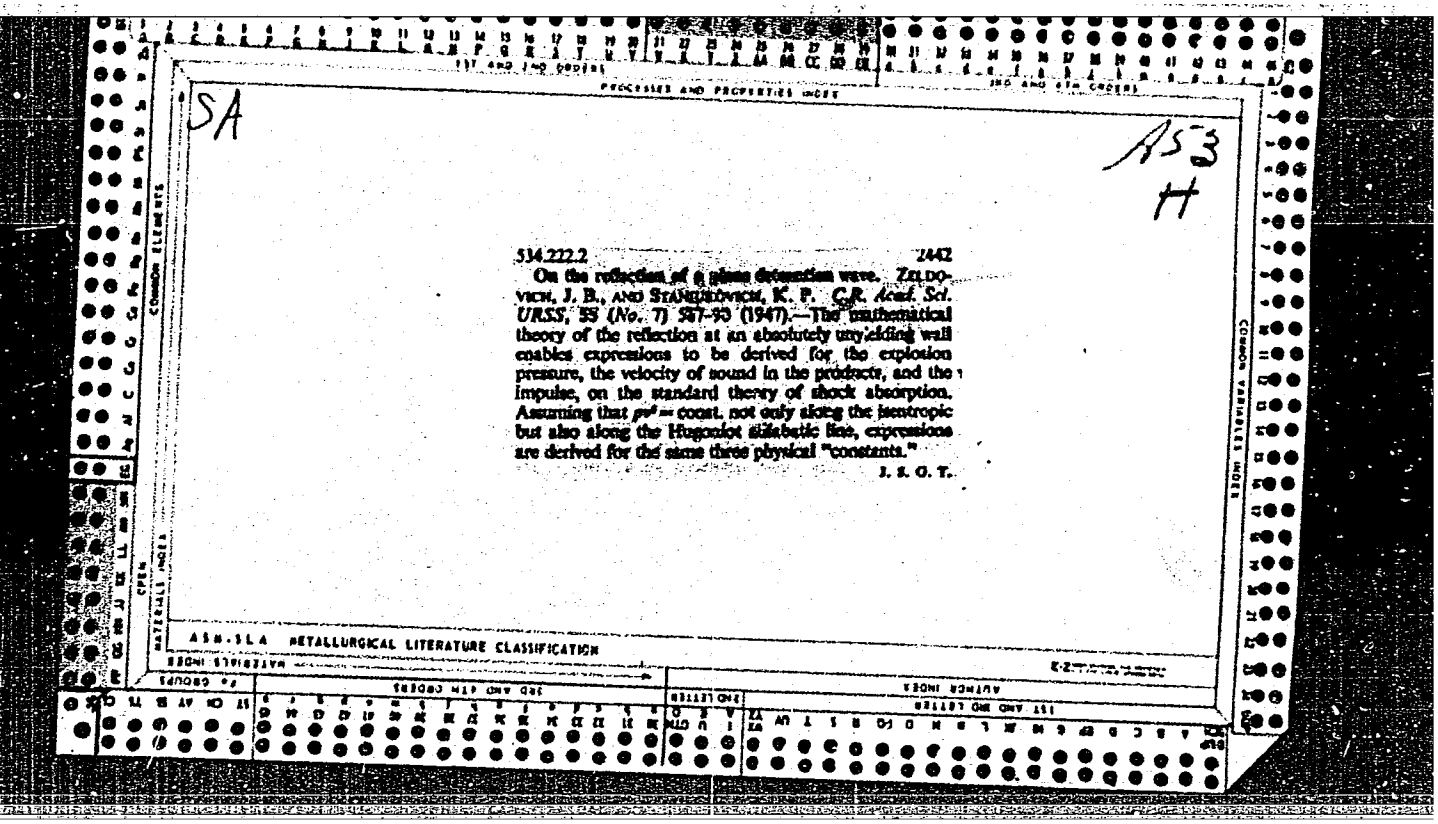
Theory of detonation onset in gases. Ya. B. Zel'dovich. *J. Tech. Phys.* (U.S.S.R.) 17, 3-26(1947)(in Russian). The movement of a gas which had been ignited at the closed end of a straight cylindrical tube was studied. In a moving gas the area of the flame surface is $F = (S/u_n)w_m + u_n - \bar{w})$, in which S is the cross-sectional area of the tube, w_m is the max. velocity of the gas, u_n is the normal velocity of the gas, and $\bar{w}$ is the av. velocity of the gas stream over a given cross section. The displacement of the gas at the tube axis due to turbulence pulsations amounts to 7% of the tube diam.; it decreases near the walls. The value of the pulsation velocity reaches 11% of the av. velocity in smooth tubes and 17% in rough tubes. In laminar flow the time required for generation of the flame front is $\tau = R^2/20\nu$ in which R is the tube radius and ν is the kinematic viscosity of the gas. Time and length of path of detonation onset, cooling time of the gas, and the time for development of the flame front are calcd.

B. W. Bunker

CA

24

Formation of supercompressed detonation in a constricted tube. B. V. Alvazov and Ya. B. Zel'dovich. *Zhur. Eksptl. Teoret. Fiz.* 17, 889-900(1947).—In wide tubes at the moment of transition into detonation, the velocity increases from a relative value of 0.38–0.43 to a relative value of 1. In narrow tubes the propagation velocity prior to transition is the same, within exptl. error, as the detonation velocity in wide tubes. An exptl. arrangement was made in which propagation was initiated at the wide end of a tube 80 cm. long consisting of a 50-cm. section 4.5–5.0 cm. in diam. and a 30-cm. section 0.8–1.0 cm. in diam. Elementary methods of calcn. for reflected and transitional waves indicated that in the narrow tube the pressure in reflection was 2.5 times greater. The calcd. results agreed with expt. H. K. Livingston



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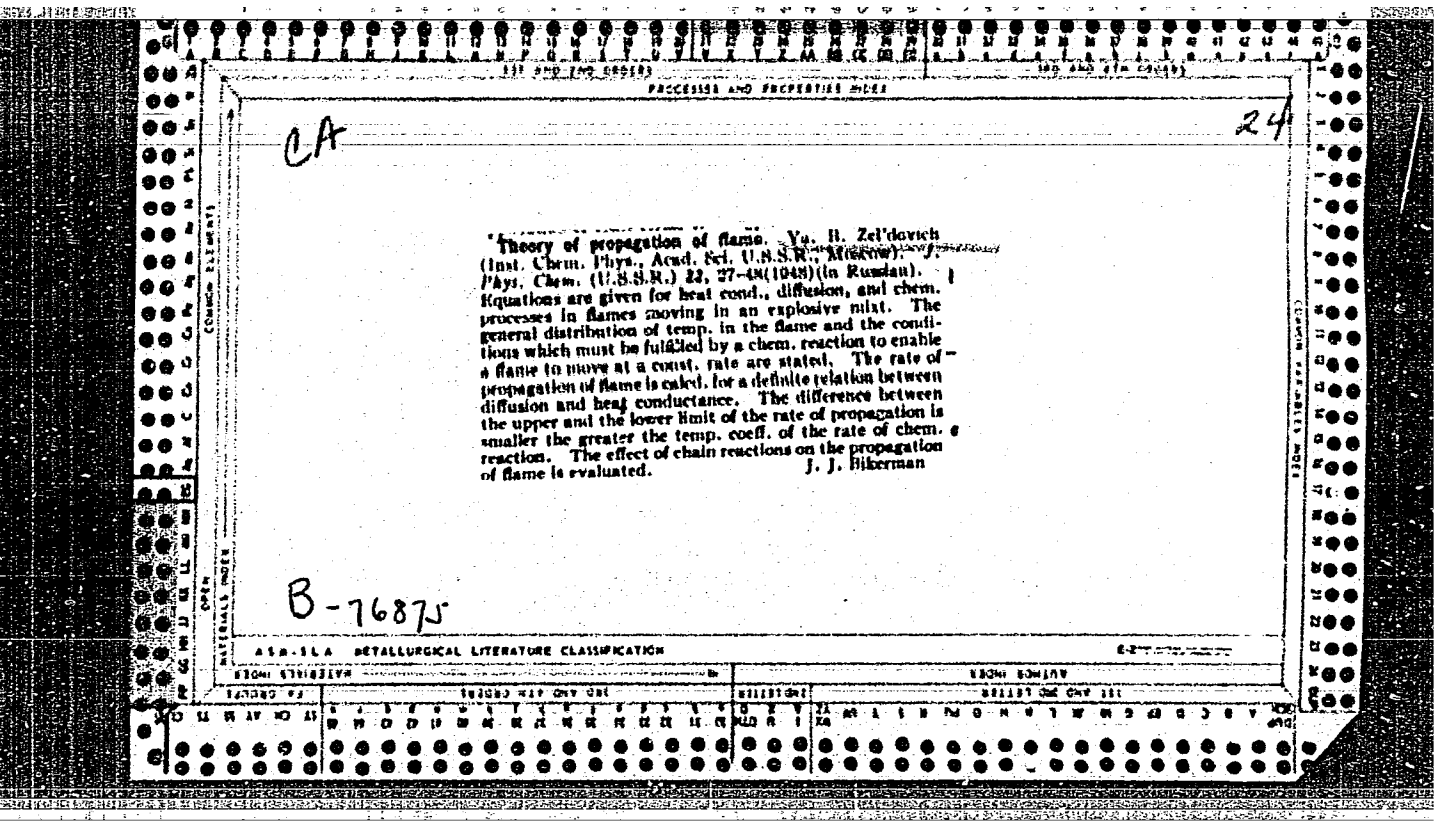
On the reflection of a plane detonation wave. ZELDOVICH, J. B., AND STANYUKOVICH, K. P. *C.R. Acad. Sci. URSS*, 55 (*No. 7*) 587-90 (1947).—The mathematical theory of the reflection at an absolutely unyielding wall enables expressions to be derived for the explosion pressure, the velocity of sound in the products, and the impulse, on the standard theory of shock absorption. Assuming that $p\rho^{\gamma} = \text{const.}$ not only along the isentropic but also along the Hugoniot adiabatic line, expressions are derived for the same three physical "constants."

J. S. G. T.

CA

Conditions for establishment of instability of normal combustion. Transition of spherical flame into detonation. Ya. B. Zel'dovich and A. I. Rozlovskii. *Doklady Akad. Nauk S.S.S.R.* 57, 365-8 (1947). —Burning H_2-O_2 mixts. (with CS_2 added for clearer definition of photography) in a steel bomb with a 1 × 10 cm. slit was recorded by high-speed photography. At a total pressure of about 1 atm. sparking such a mixt. leads to a region of propagation of the flame with essentially constant velocity (as seen through the slit) of 8400 cm./sec. After traverse of 6 cm. and combustion of 6% of the mixt. the pressure rises to 1.7 atm., near the end of combustion the pressure rises to 10 atm. and intensity of radiation rises sharply. No autoturbulence is observed. At an initial pressure of 10 atm. the constant flame propagation velocity is 22,000 cm./sec. for a 2.5 cm. path, after which detonation is reached, probably as a result of autoturbulence.

G. M. Kosolapoff



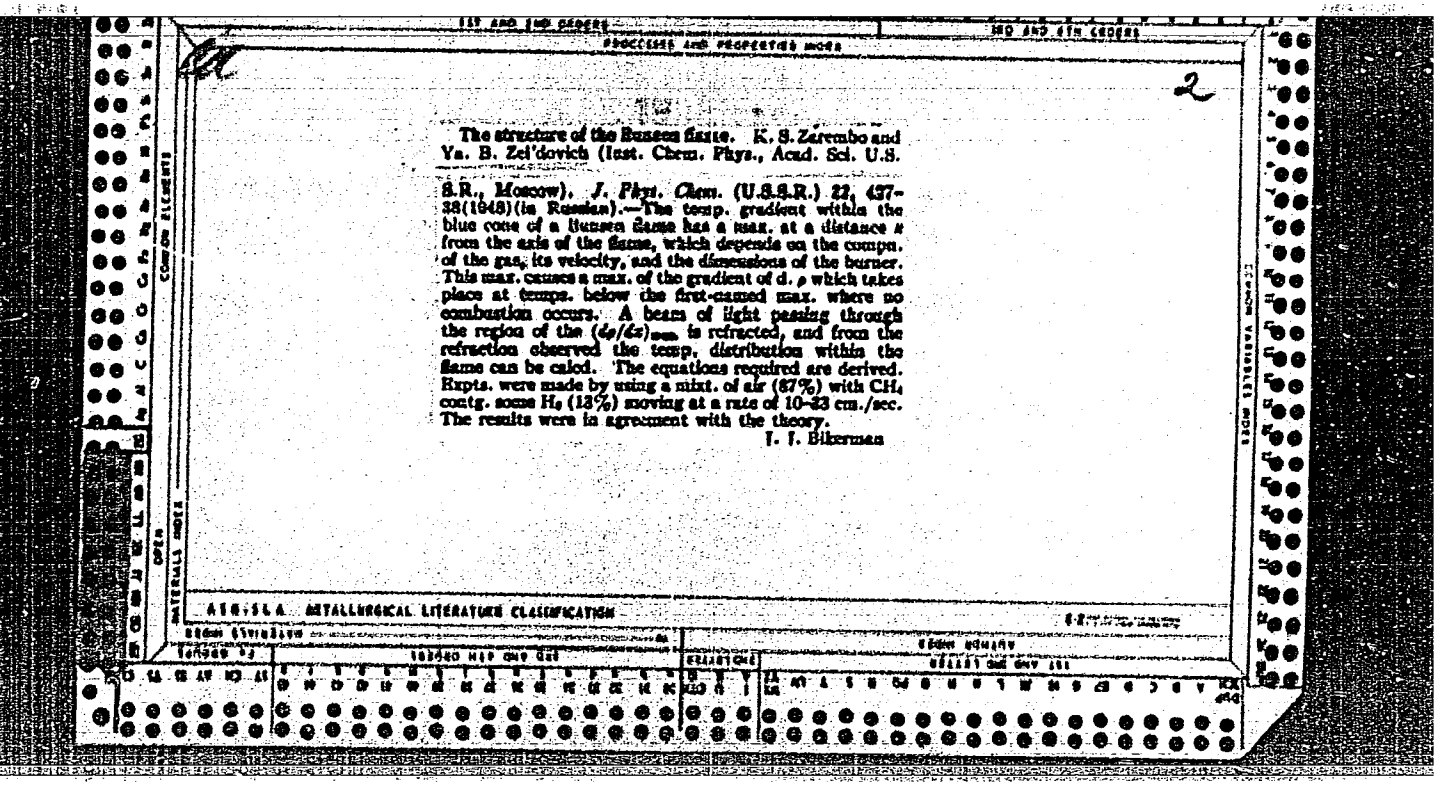
CA

24

"Theory of propagation of flame. Yu. B. Zel'dovich (Inst. Chem. Phys., Acad. Sci. U.S.S.R., Moscow). *J. Phys. Chem. (U.S.S.R.)* 22, 27-48(1948)(in Russian). Equations are given for heat cond., diffusion, and chem. processes in flames moving in an explosive mixt. The general distribution of temp. in the flame and the conditions which must be fulfilled by a chem. reaction to enable a flame to move at a const. rate are stated. The rate of propagation of flame is calcd. for a definite relation between diffusion and heat conductance. The difference between the upper and the lower limit of the rate of propagation is smaller the greater the temp. coeff. of the rate of chem. reaction. The effect of chain reactions on the propagation of flame is evaluated. J. J. Bikerman

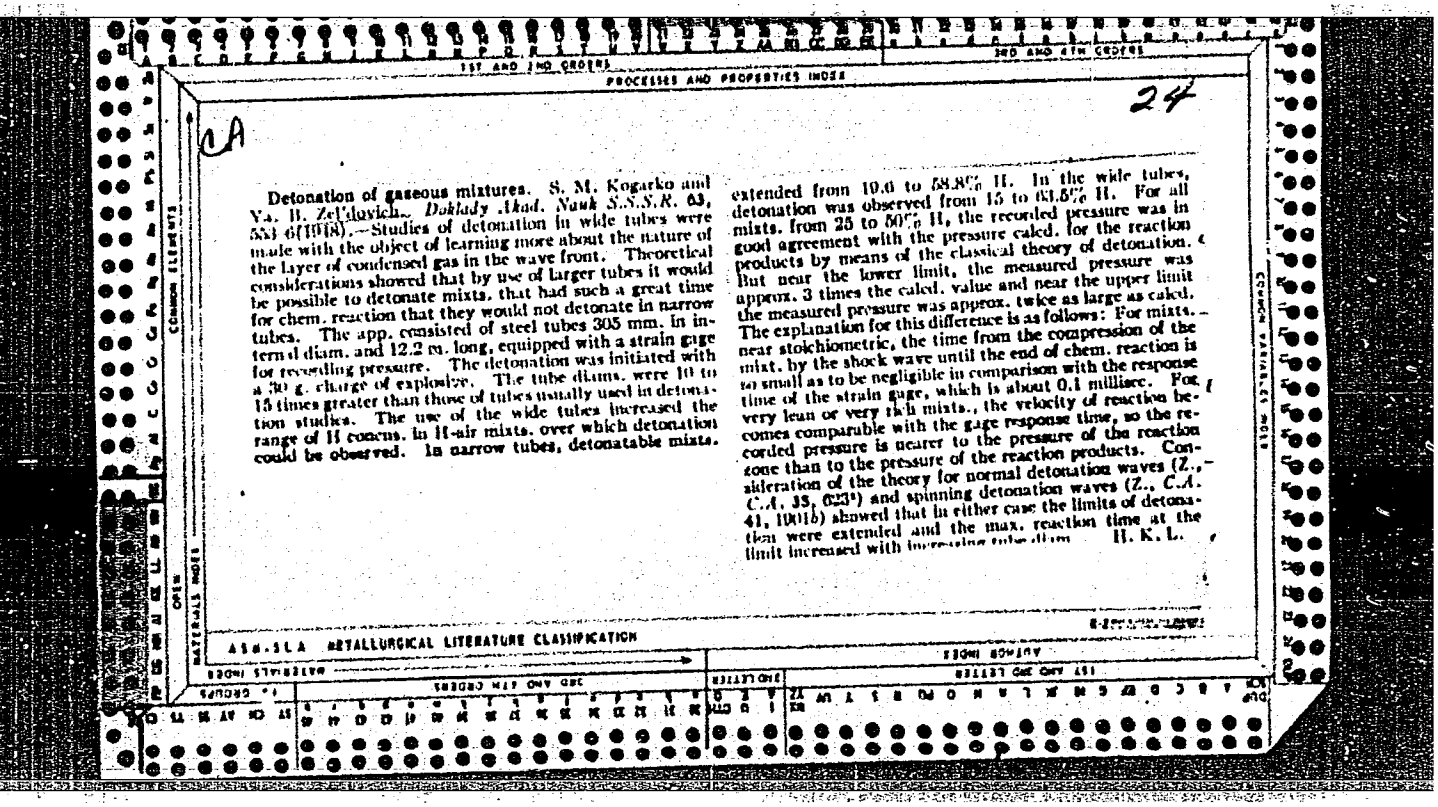
B-7687

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION



The structure of the Bunsen flame. K. S. Zarembo and Ya. B. Zel'dovich (Inst. Chem. Phys., Acad. Sci. U.S.S.R., Moscow). *J. Phys. Chem.* (U.S.S.R.) 22, 427-38(1948)(in Russian).—The temp. gradient within the blue cone of a Bunsen flame has a max. at a distance *x* from the axis of the flame, which depends on the compn. of the gas, its velocity, and the dimensions of the burner. This max. causes a max. of the gradient of d. ρ which takes place at temps. below the first-named max. where no combustion occurs. A beam of light passing through the region of the $(d\rho/dx)_{max.}$ is refracted, and from the refraction observed the temp. distribution within the flame can be calcd. The equations required are derived. Expts. were made by using a mixt. of air (87%) with CH_4 contg. some H_2 (13%) moving at a rate of 10-23 cm./sec. The results were in agreement with the theory.

I. I. Bikerman



1ST AND 2ND ORDERS

PROCESSES AND PROPERTIES INDEX

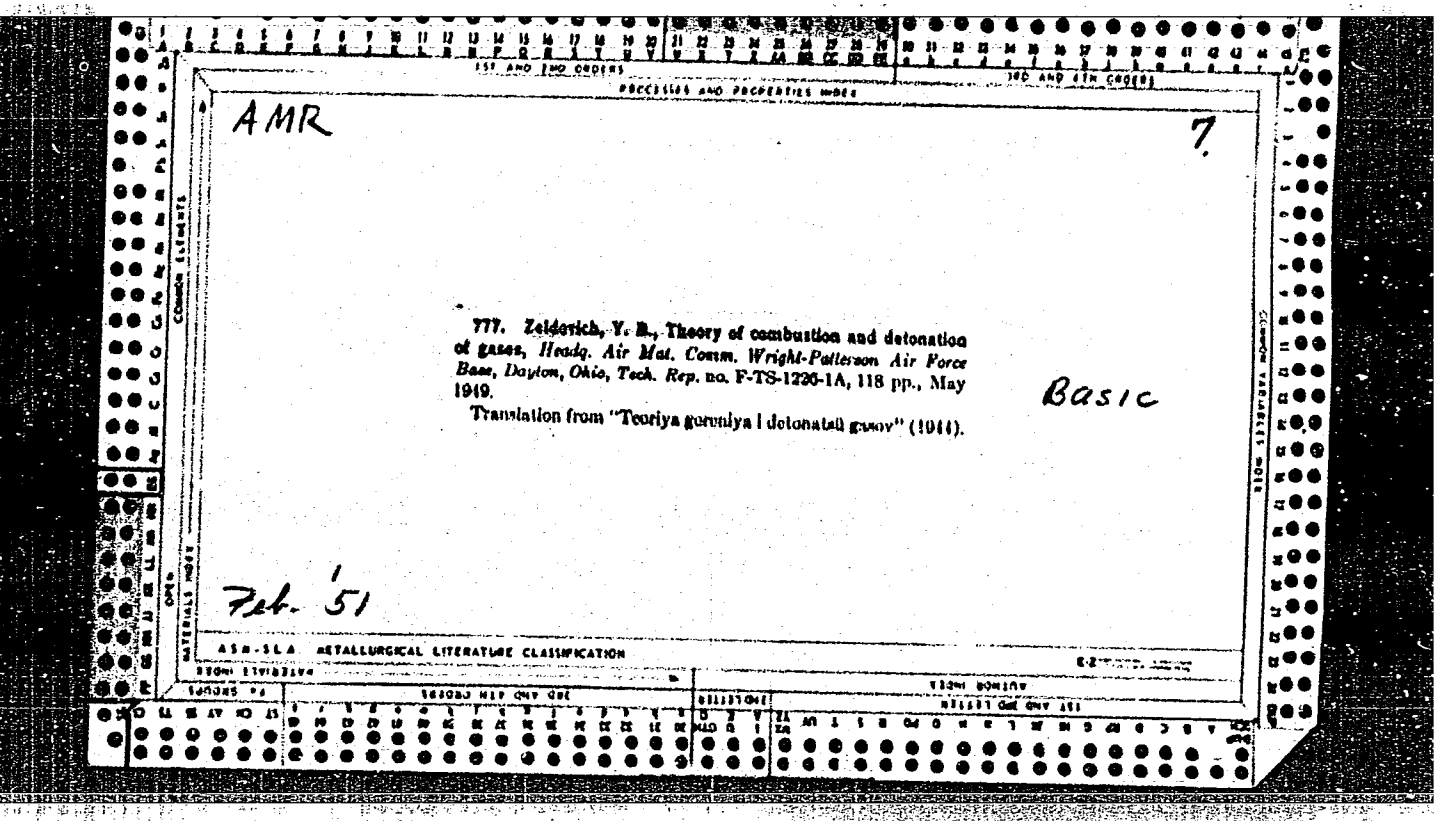
3RD AND 4TH ORDERS

24

CA

Detonation of gaseous mixtures. S. M. Kogarko and Ya. B. Zel'dovich. *Doklady Akad. Nauk S.S.S.R.* 63, 553-6(1948).—Studies of detonation in wide tubes were made with the object of learning more about the nature of the layer of condensed gas in the wave front. Theoretical considerations showed that by use of larger tubes it would be possible to detonate mixts. that had such a great time for chem. reaction that they would not detonate in narrow tubes. The app. consisted of steel tubes 305 mm. in internal diam. and 12.2 m. long, equipped with a strain gage for recording pressure. The detonation was initiated with a 30 g. charge of explosive. The tube diams. were 10 to 15 times greater than those of tubes usually used in detonation studies. The use of the wide tubes increased the range of H concns. in H-air mixts. over which detonation could be observed. In narrow tubes, detonatable mixts. extended from 19.6 to 58.8% H. In the wide tubes, detonation was observed from 15 to 63.5% H. For all mixts. from 25 to 50% H, the recorded pressure was in good agreement with the pressure calcd. for the reaction products by means of the classical theory of detonation. But near the lower limit, the measured pressure was approx. 3 times the calcd. value and near the upper limit the measured pressure was approx. twice as large as calcd. The explanation for this difference is as follows: For mixts. near stoichiometric, the time from the compression of the mixt. by the shock wave until the end of chem. reaction is so small as to be negligible in comparison with the response time of the strain gage, which is about 0.1 millisec. For very lean or very rich mixts., the velocity of reaction becomes comparable with the gage response time, so the recorded pressure is nearer to the pressure of the reaction zone than to the pressure of the reaction products. Consideration of the theory for normal detonation waves (Z., *C.A.* 35, 623[1]) and spinning detonation waves (Z., *C.A.* 41, 1001b) showed that in either case the limits of detonation were extended and the max. reaction time at the limit increased with increasing tube diam. H. K. L.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION



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777. Zeldovich, Y. B., Theory of combustion and detonation of gases, *Headq. Air Mat. Comm. Wright-Patterson Air Force Base, Dayton, Ohio, Tech. Rep.* no. F-TS-1236-1A, 118 pp., May 1949.

Translation from "Teoriya goreniya i detonatsii gazov" (1944).

Basic

Feb. '51

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

APPROVED FOR RELEASE: 03/15/2001 CIA-RDP86-00513R001964220011-5"

ZEL'DOVICH YA. B.

25533. O.Povyerkhnost Nom Natyazhyenin Granitsy Razdyela Vzaimno Vastuovimykh Zhidkostyey. Zhurnal Fiz. Khimii, 1949, VYP. 8, c 931-35

SO: Letopis' Zhurnal'nykh Statey, Vol. 34, Moskva, 1949

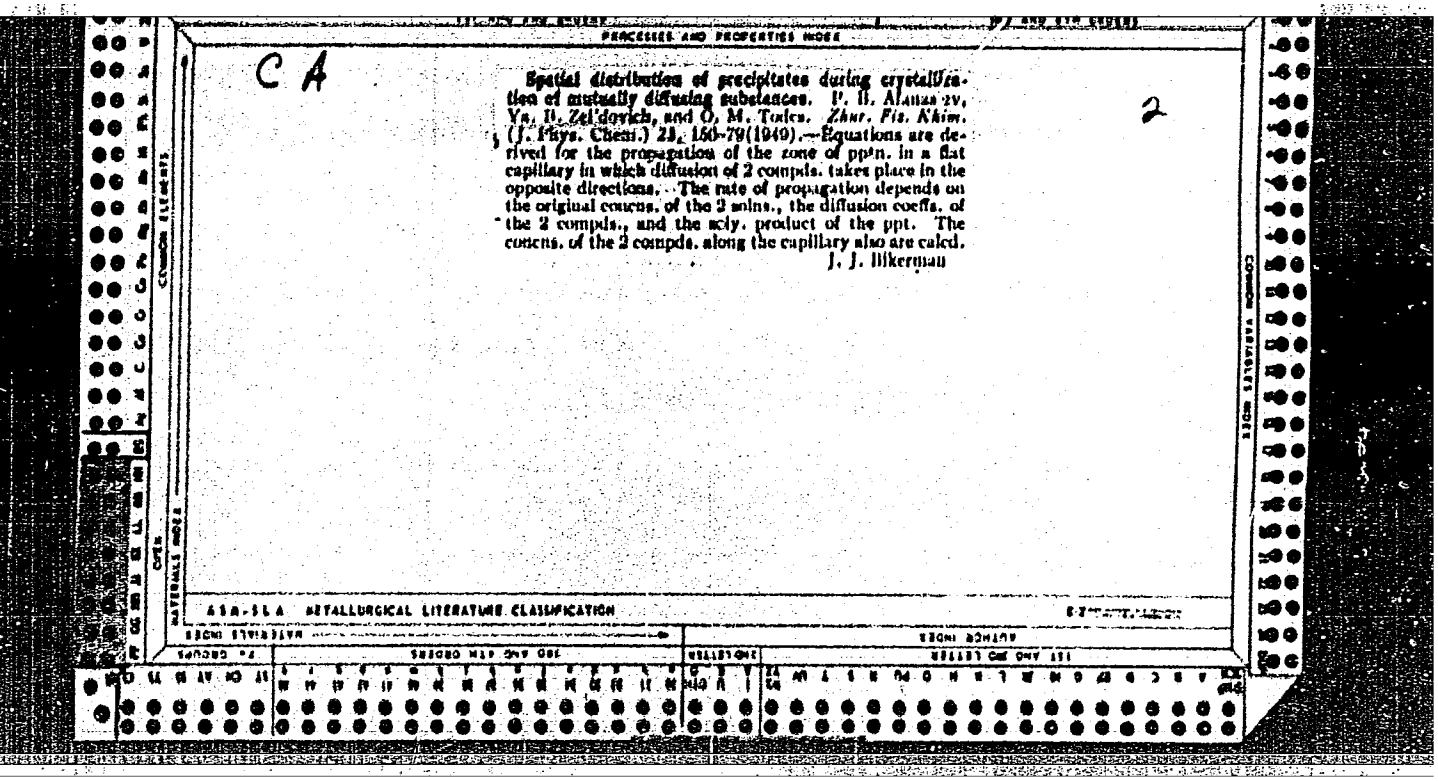
ZEL'DOVICH, Ya. B.

36594. ZEL'DOVICH, Ya. B. i SIMONOV, N. N. K Teorii Iskrovogo Vosplameneniya Gazovykh Vzryvchatykh Smesey. Zhurnal Fiz. Khimii, 1949, Vyp. 11, c. 1361-74 - Bibliogr: 12 Nazv.

SO: Letopis' Zhurnal'nykh Statey, Vol. 50, Moskva, 1949

CA ZELDOVICH, YAKOV BORISOVICH 2

Theory of combustion of initially unmixed gases. Ya. B. Zel'dovich. *Zhur. Tekh. Fiz.* 19, No. 10, 1199 (1949); *Natl. Advisory Comm. Aeronaut. Tech. Mem.* No. 1296, 20 pp. (1951).—A theoretical study is presented of laminar diffusion flames. With the assumption of rapid reaction rates and no loss of energy by radiation (cf. Shvab, *Gazodavst. Energ. Ind. Moscow-Leningrad*, 1948), equations are developed for the shape of the flame surface, distribution of reactants, and the flame temp. The latter is calcd. to be identical with the temp. of a pre-mixed flame of the same compn., which is contrary to expt. This is due to the fact that the radiation loss in real diffusion flames is not negligible, as has been assumed here. Limits of combustion of unmixed gases are also considered. Here the fact that reaction velocities are actually finite and temp.-dependent must be taken into account, and expressions for upper and lower combustion limits can then be derived. C. Fanford



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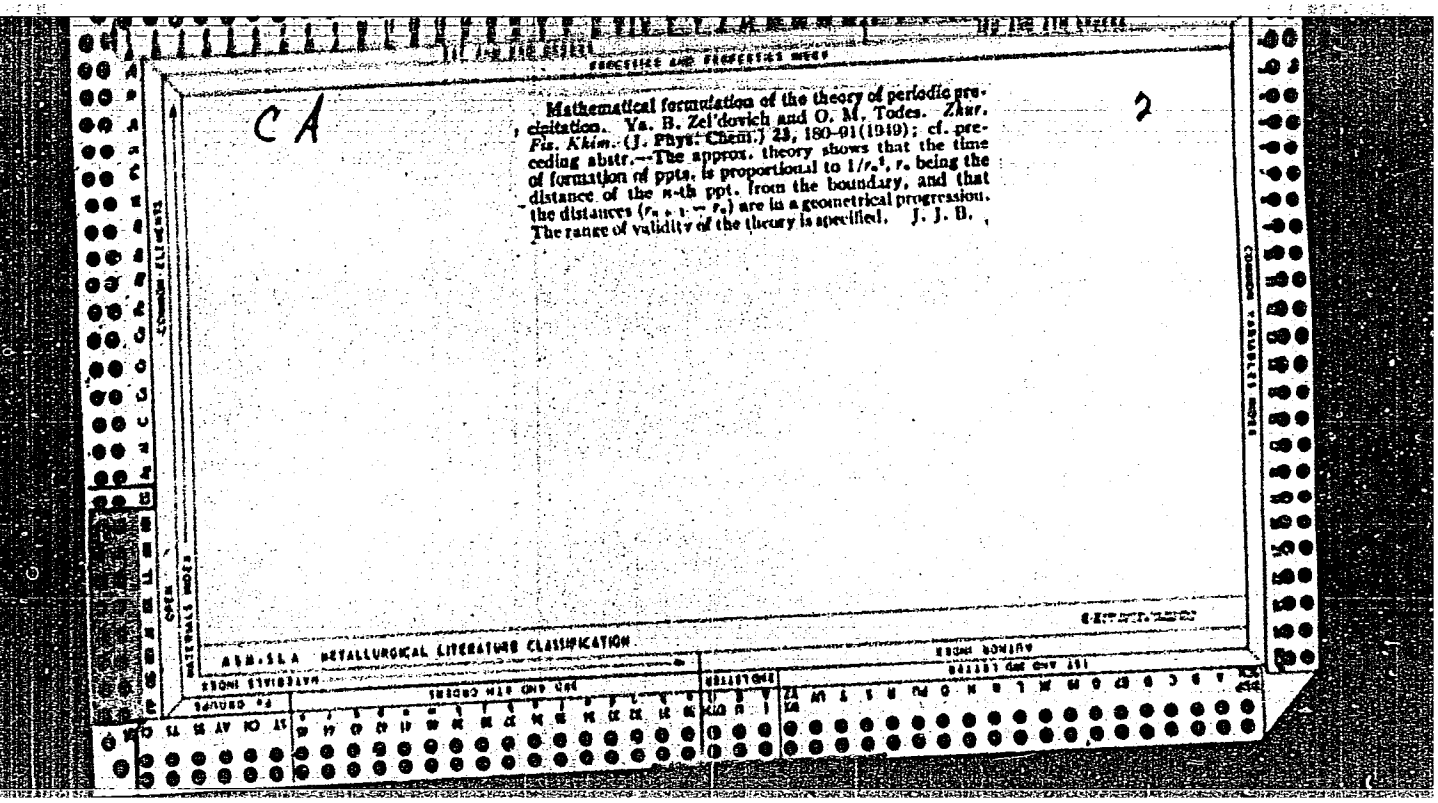
Spatial distribution of precipitates during crystallization of mutually diffusing substances. P. B. Alanas'ev, Ya. B. Zel'dovich, and O. M. Todes. *Zhur. Fiz. Khim.* (J. Phys. Chem.) 23, 150-79(1949).—Equations are derived for the propagation of the zone of ppn. in a flat capillary in which diffusion of 2 compds. takes place in the opposite directions. The rate of propagation depends on the original concns. of the 2 solns., the diffusion coeffs. of the 2 compds., and the solv. product of the ppt. The concns. of the 2 compds. along the capillary also are calcd.

J. J. Ilkerman



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Mathematical formulation of the theory of periodic precipitation. Ya. B. Zel'dovich and O. M. Todes. *Zhur. Fiz. Khim.* (J. Phys. Chem.) 23, 180–91 (1949); cf. preceding abstr.—The approx. theory shows that the time of formation of ppts. is proportional to $1/r_n^4$, r_n being the distance of the n-th ppt. from the boundary, and that the distances $(r_{n+1} - r_n)$ are in a geometrical progression. The range of validity of the theory is specified. J. J. B.

ZEL'DOVICH, IA. B.

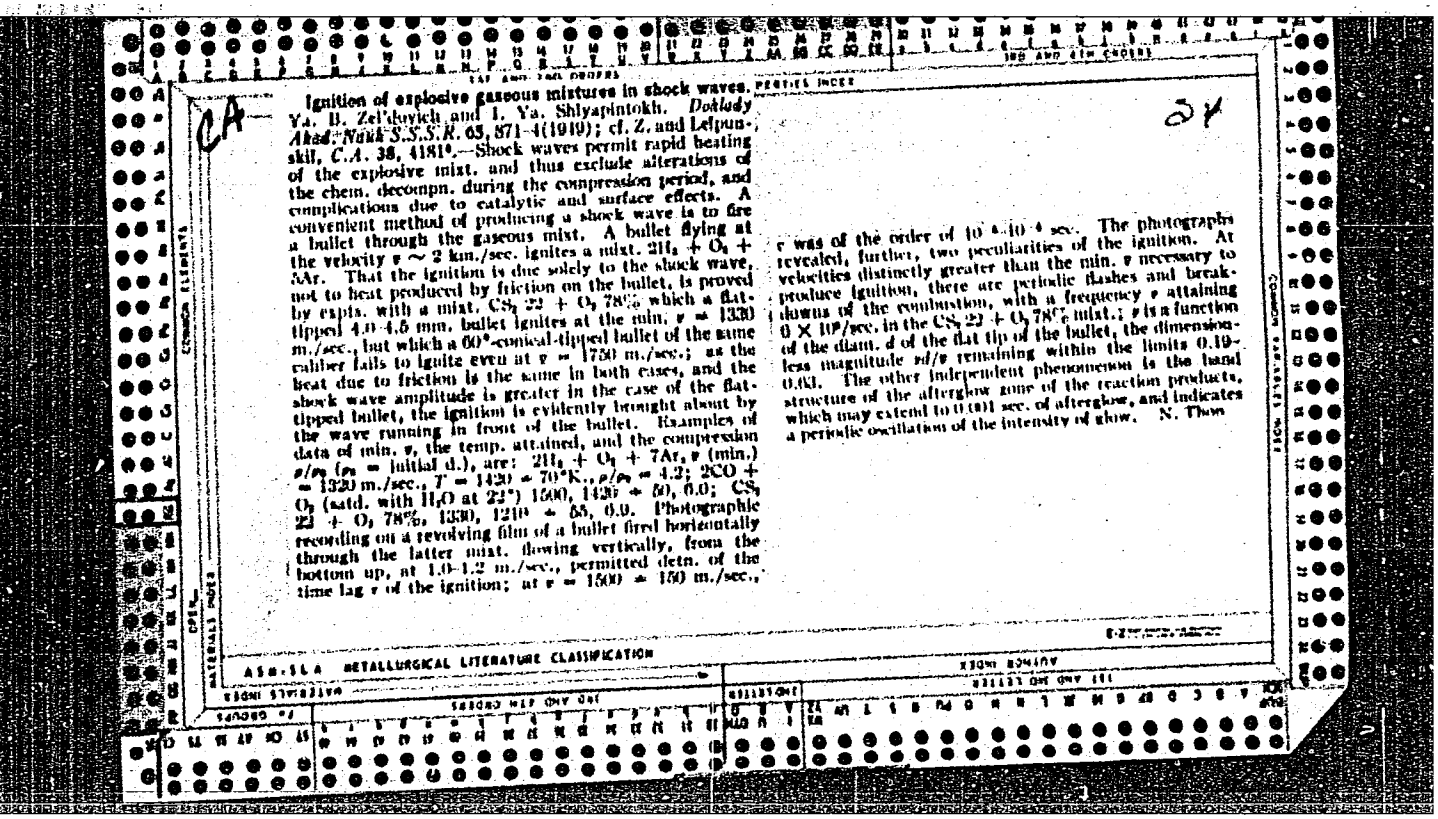
Zel'dovich, Ia. B., On the surface tension of the border of division of mutually soluble liquids. P. 931

The border of division of mixing liquids has a positive surface tension (that is, has the same sign as the non-mixing liquids have). This surface tension is inversly proportional to the thickness of the layer of the mixture formed on the border of division in the process of diffusion and therefore decreases with time.

Inst. of Chemical Physics
Acad. of Sci., USSR
Oct. 10, 1948

SO: Journal of Physical Chemistry, (USSR) 23, No. 8, (1949)

Theory of the spark ignition of explosive gas mixtures. Ya. B. Zel'dovich and N. N. Simonov (Acad. Sci. U.S.S.R., Moscow). *Zhur. Fiz. Khim.* 23, 1381-74(1949).—If a gas explosion is induced by spark whose energy is E, $E = Qk\lambda^2/q\alpha^2C_p\rho$; k is const., Q the heat of reaction, q the coeff. of utilization of the energy, α the linear velocity of flame propagation, C_p the heat capacity, λ the heat cond., and ρ the heat d. of the reaction products. The q was detd. by discharging condensers (capacity C microfarad) at the lowest discharge voltage through NH_3 gas (pressure P mm. Hg) and measuring the amt. of NH_3 decompd., assuming that 23,000 cal./mol. are spent on the decompn. The q was independent of the no. and of the length of the spark gap, was proportional to $C^{-0.25}$ when C varied from 0.0026 to 4.0, and somewhat increased with P (40-760); it was, e.g., 0.11 at $C = 0.0026$ and $P = 40$ and 0.025 at $C = 4$ and $P = 760$. The equation was applied to mixts. of CO (87–89%) with O_2 (11%) and H_2 (0–3%) and to H_2-O_2 mixts. Q, λ, C_p, and ρ were calcd. For u (cm./sec.) of CO-H_2-O_2 mixts., Barskii found $u = 81\ [H_2]^{1/2}P^{1/4}$, $[H_2]$ is the H concn. in %. The min. E was detd. at P of 50-760. k proved to be about 12 w, i.e. the calcd. radius R of the sphere raised by the spark to the flame temp. was 3 times as great as the width δ of the heated zone in the stationary flame. The rule $R = 3\delta$ is approx. satisfied also by the expts. of Lewis and Von Elbe (*C.A.* 42, 762f) whose theory is incorrect. On photographs of the spark in CO-H_2-O_2 mixts. the radius of the luminous sphere was about 1.3 R while the corresponding radius in CO-H_2O mixts. (at the same P) was 0.7 R. J. J. Bikerman



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Ignition of explosive gaseous mixtures in shock waves. Ya. B. Zel'dovich and I. Ya. Shlyapintokh. *Doklady Akad. Nauk S.S.S.R.* 65, 871–4(1949); cf. Z. and Leipunskii, *C.A.* 38, 4181⁹.—Shock waves permit rapid heating of the explosive mixt. and thus exclude alterations of the chem. decompn. during the compression period, and complications due to catalytic and surface effects. A convenient method of producing a shock wave is to fire a bullet through the gaseous mixt. A bullet flying at the velocity $v \sim 2$ km./sec. ignites a mixt. $2H_2 + O_2 + 5Ar$. That the ignition is due solely to the shock wave, not to heat produced by friction on the bullet, is proved by expts. with a mixt. CS_2 22 + O_2 78% which a flat-tipped 4.0–4.5 mm. bullet ignites at the min. $v = 1330$ m./sec., but which a 60°-conical-tipped bullet of the same caliber fails to ignite even at $v = 1780$ m./sec.; as the heat due to friction is the same in both cases, and the shock wave amplitude is greater in the case of the flat-tipped bullet, the ignition is evidently brought about by the wave running in front of the bullet. Examples of data of min. v, the temp. attained, and the compression ρ/ρ_0 (ρ_0 = initial d.), are: $2H_2 + O_2 + 7Ar$, v (min.) = 1320 m./sec., $T = 1420 \pm 70°K.$, $\rho/\rho_0 = 4.2$; $2CO + O_2$ (satd. with H_2O at 23°) 1500, 1430 ± 50, 6.0; CS_2 22 + O_2 78%, 1330, 1210 ± 55, 6.0. Photographic recording on a revolving film of a bullet fired horizontally through the latter mixt. flowing vertically, from the bottom up, at 1.0–1.2 m./sec., permitted detn. of the time lag τ of the ignition; at $v = 1500 \pm 150$ m./sec., τ was of the order of 10^{-4}–10^{-5} sec. The photographs revealed, further, two peculiarities of the ignition. At velocities distinctly greater than the min. v necessary to produce ignition, there are periodic flashes and breakdowns of the combustion, with a frequency ν attaining 0×10^5/sec. in the CS_2 22 + O_2 78% mixt.; ν is a function of the diam. d of the flat tip of the bullet, the dimensionless magnitude nd/v remaining within the limits 0.19–0.03. The other independent phenomenon is the band structure of the afterglow zone of the reaction products, which may extend to 0.001 sec. of afterglow, and indicates a periodic oscillation of the intensity of glow. N. Thon

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Adiabatic ignition of rapidly burning gas mixtures. Ya. T. Gershanik, Ya. B. Zel'dovich, and A. I. Rozlovskii (Acad. Sci. U.S.S.R., Moscow). *Zhur. Fiz. Khim.* 24, 85-96(1950).—A vertical glass tube (length 150 cm., internal diam. 2.1 cm.), sealed at the bottom and stoppered at the upper end, was filled with a gas mixt. at a low pressure p and heated to temp. T. Then the stopper was withdrawn, and the air rushing in compressed the mixt. to atm. pressure p_0 (temporarily also to higher pressures) and adiabatically raised its temp. to T_0 (calcd. from Poisson's equation). The mixt. did or did not ignite. If the ignition was caused by adiabatic heating only, the line sepg. "ignition" from "no ignition" in a plot "log p_0/p against log T" should be straight and have the tangent = $(1 - \gamma)/\gamma$; γ is the ratio of the heat capacities at const. pressure and const. vol. Extrapolation of this line to $p_0 = p$ would give the ignition temp. T_1. The theory proved correct except at very low p, at which the mixt. was dild. with, rather than compressed by, air. T_1 was 577° for $2H_2 + O_2$ between $p = 0.124$ and 0.244 atm.; 607° for 59% H_2 + 39% O_2 + 2% CS_2 (I); approx. 400° for $CS_2 + 4O_2$; and approx. 480° for $C_2H_2 + O_2$. The detn. of T_1 for this last mixt. was difficult, because the tube burst. A deposit of KCl on the glass wall and variation of the shape of the sealed end did not affect T_1. Moving pictures showed that the stopper was withdrawn (by a device described) at a speed of 3-4 m./sec. and the air moved in (this movement was made visible by forming metal vapor clouds in the air) at a speed of 80-300 m./sec. The indection period of the mixt. $2H_2 + O_2$ is about 0.01 sec. Contrary to Rakipova, *et al.* (cf. preceding abstr.) spherical detonation of I in their expts. could not be caused by adiabatic heating. J. J. Bikerman

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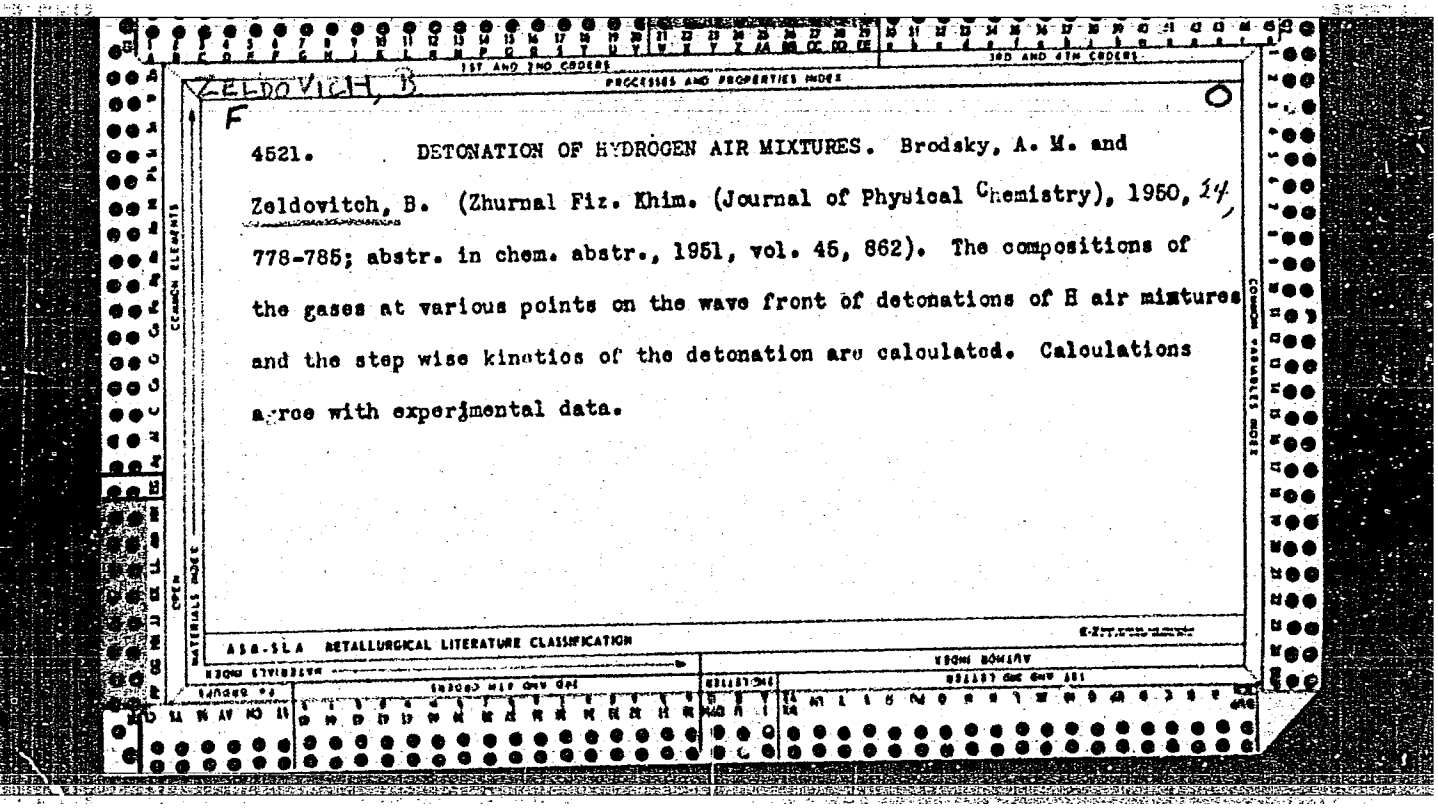
Slow propagation of flame in tubes. G. A. Barskil and Ya. B. Zel'dovich (Acad. Sci. U.S.S.R., Moscow). *Zhur. Fiz. Khim.* 24, 889–90(1950).—When gas in a horizontal tube closed at one end is ignited at the open end, the flame front is concave toward the ignition point. This is so because of convection: hot gases push cold gases back at the upper wall, and the cold gases flow down to the bottom wall near which they burn. If u is the normal velocity of flame (disregarding convection), w the velocity of gas parallel to the axis at a given point, w_0 the greatest w (i.e. along the axis), S the area of the flame front, and F the cross-section of the tube, then the gas vol. burning at any point is $udS = (u + w_0 - w)dF$; at the bottom wall w is neg. and the rate of combustion is great. The shape of the flame depends on the dimensionless ratio $w_0/\sqrt{gd}$; g is acceleration due to gravity and d is the diam. of the tube. The equations obtained are confirmed for burning mixts. of CO or CH_4 with O_2 (literature data) when u varied from 8 to 50 cm./sec. Excessive increase in u may cause retardation of combustion. A *method* for detg. the flame front from photographs of the flame is described. Photographs of vibrating flames are given. J. J. Bikerman



ZELDOVICH, B.

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4521. DETONATION OF HYDROGEN AIR MIXTURES. Brodsky, A. M. and Zeldovitch, B. (Zhurnal Fiz. Khim. (Journal of Physical Chemistry), 1950, 24, 778-785; abstr. in chem. abstr., 1951, vol. 45, 862). The compositions of the gases at various points on the wave front of detonations of H air mixtures and the step wise kinetics of the detonation are calculated. Calculations agree with experimental data.

S. H.
Sect. B

536.46 : 541.127

5738. **On the mechanism of pre-detonation acceleration of a flame.** A. S. SOKOLIK; YA. B. ZELDOVICH. *Zh. Eksper. Teor. Fiz.*, 21, 1164–71 (No. 10, 1951) *In Russian.*

It is suggested that a weak shock-wave is generated by ignition of the gas-mixture, and travels ahead of the flame; behind this shock-wave the unburnt gas moves in the same direction as the flame, so that, although the flame-velocity remains the same relative to the gas in which it is moving, it accelerates relative to the tube-wall. The accelerating flame itself generates a continuous series of weak shock-waves into the unburnt gas, each travelling slightly faster than its predecessor. Consequently the flame accelerates continuously, until all the shocks coalesce into one shock-wave of large amplitude. At this point a detonation wave is set up. Since the flame-speed relative to the gas is small (5–10 m/s) compared with the forward velocity of the gas, it would be expected, on this theory, that the final pre-detonation flame-speed would approx. equal the gas-velocity behind the detonation shock-front. In a wide range of gas-mixtures this is shown to be so. An exception (C_2H_2–O_2 mixtures near the limit of detonation) is attributed to the fact that in this mixture, detonation "spin" takes place, when the onset of detonation is brought about by localized ignition ahead of the flame-front due to the reflection of shock-waves at irregularities in the inner surface of the containing tube. Commenting on the suggested mechanism, Zeldovich points out that no mechanism for the formation of the shock-waves is put forward, and draws attention to an alternative theory due to Shchelkin and himself, in which the flame-acceleration is attributed to pre-flame turbulence. He also believes that the correspondence between final flame-speed and the gas-velocity behind the detonation shock is fortuitous, and not a verification of the suggested mechanism, because Sokolik has, in calculating the gas-velocity, used the final pressure of the products of detonation, whereas it has been shown (by Zeldovich) that the shock pressure in the detonation front exceeds the final pressure by a factor of two. In reply, Sokolik mentions that Zeldovich himself has earlier demonstrated that the critical Reynolds number is not exceeded ahead of accelerating flames, as Shchelkin supposed, and that no distortion of the accelerating flame-front has been observed photographically. He also states that as the only basis for believing that the pressure in the detonation-shock-front is twice that in the reacted products is the theory due to Zeldovich, which has for a long time remained unsupported by direct experimental proof, he has felt himself free to ignore this in his calculations.

A. SCHOFIELD

3

Kinetics of combustion of carbon monoxide. G. A.
Barskiĭ and Ya. B. Zel'dovich (Chem. Phys. Inst., Acad.
Sci. U.S.S.R., Moscow). *Zhur. Fiz. Khim.* 25, 523-37
(1951).—The kinetics of CO oxidation is studied at flame
temps. by means of the normal flame velocity u_n and its
variation with mixt. compn., temp. of combustion, H_2O
content, addn. of reaction products, and pressure. The
photographic method is used to det. u_n in a horizontal tube,
a glass balloon or a metallic bomb. Combustion theory
(Zel'dovich, *C.A.* 36, 6309[1]; 42, 5220b) serves to find a
rate equation from the observed changes in u_n. The latter
is detd. by the max. reaction rate in the interval of temp.
and concns. realized in the flame. The max. reaction rate
is reached in a zone where combustion is nearing completion
and where the rate can be assumed to depend on temp.
according to Arrhenius' law and to be proportional to the
1st power of the deficient component. The latter is pro-
portional to $(T_b - T)$, where T_b is the theoretical combus-
tion temp. and T the temp. in a zone of given concn. (cf.
Z. and Frank-Kamenetskiĭ, *C.A.* 33, 7570[9]). Thus the
rate w = const. $(T_b - T)\exp(-A/RT)$, where A is the
activation energy and its max. corresponds to a temp.
T_m given by $T_b - T_m = RT_m^2/A \approx RT_b^2/A$. The compn.
in the zone of max. rate is also given by $(T_b - T_m)$. The
effect of H_2O is studied in 2 series of expts. (I and II) at 200
mm. in a glass balloon. In each series, to a dry mixt. of
const. compn. (24% CO + 76% O_2 in I; 89% CO + 11% O_2
in II) is added an increasing amt. of a $H_2 + O_2$ mixt. (24%
H_2 + 76% O_2 in I; 89% H_2 + 11% O_2 in II). It is found
that the flame velocity, which is proportional to the sq.
root of w, is proportional to $(p_{H_2O})^{0.25}$ in series II and to
$(p_{H_2O})^{0.5}$ in series I. Thus $w \propto p_{H_2O}$ in mixt. with excess
CO, in agreement with earlier data (Ubbelohde, *et al.*,
C.A. 9, 242; 12, 1527) and $w \propto (p_{H_2O})^{1/2}$ in O_2-rich mixts.
In order to study the effect of concn. of the excess com-
ponent on u_n and thus w, it is necessary to compare mixts.
with identical T_b. This can be done by diln. with N_2,
e.g. the following mixts. (18.0, 7.5, 74.5), (21.0, 7.5, 71.5),
(27.0, 7.5, 65.5), (39.0, 7.5, 53.5), (63.1, 7.6, 29.3), where
the figures in parentheses designate % CO, O_2, and N_2,
resp., have the same T_b = 1600°K. In this fashion, 5
series of mixts. with excess CO with T_b = 1430, 1600,
1775, 2115, and 2250°K., 3 mixts. with T_b = 2400, 2600,
and 2850°K. and 3 series of mixts. with excess O_2 with T_b =
1670, 2180, and 2535°, are prepd. and u_n is measured for
each one. From u_n, a standard value u_{15} is calcd. by means
of $u_{15} = u_n(15/p_{H_2O})^{1/4}$, since all mixts. did not have the
same H_2O concn. Then u_{15} is plotted against α, the effective

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ZEL'DOVICH, YA. B.

PA 234T93

USSR/Physics - Compton Scattering

1 Mar 52

"Polarization of Gamma Quanta During Compton Scattering at 180°," Ya. B. Zel'dovich, Corr Mem, Acad Sci USSR Inst. Chemical Physics, AS USSR

"Dok Ak Nauk SSSR" Vol 83, No 1, pp 63-66

Considers the backward scattering of quanta polarized in a circle. Depolarization does not occur for any value of the quanta. Considers the scattering on oriented electrons. The cross section of scattering depends on the direction of rotation of the polarization plane. Proposes that the scattering of gamma

234T93

quanta by magnetized iron be employed for measuring the circular polarization of the gamma quanta. Gives a descriptive explanation of the results obtained. Submitted 8 Jan 52.

234T93

ZEL'DOVICH Ya. B.

neutrinos [illegible]
nuclear charge is then based on the fact that the total nu[illegible]
protons and neutrons remains const. Without such a prin-
ciple the decay of neutral [illegible] particles could lead either to pro-
tons or to antiprotons [illegible] and 2
neutrons could transform [illegible] protons pair
$n + \pi \rightarrow p + \pi^- + \pi \rightarrow K^+ + \pi - \bar{p} + \pi^- + \pi \rightarrow \bar{p} + p.$
But if the antiproton has the nuclear charge -1, such a proc-
ess is not compatible with the principle of conservation of
nuclear [illegible]. An antiproton [illegible] can then only be ob-
tained in [illegible] de-
cluster [illegible] half-integer and
integer [illegible]

ZEL'DOVICH, Ya. B.

"Isobar of a Nucleon as an Intermediate State of the Beta Processes," Dok AN SSSR, Vol. 89, No 1, pp 33-36, 53.

Cor. Mbr., Acad. Sci,, SSSR; Inst. Chem. Phys., AS USSR.

Four fermions simultaneously take part in beta processes. Author attempts to prove deficiency of meson theory and to explain beta decay from viewpoint of his isobar theory. Indebted to Prof. L.D.Landau and V.V.Sudakov. Received 9 Jan 53

259T74