PROCESSES AND PROPERTIES INDEX

Explosion limits of gaseous mixtures. III. Explosion limits of mixtures of carbon monoxide and of methane. M. Rivin and A. Sokolik (Acta Physicochim. U.R.S.S., 1937, 6, 105—114; cf. A., 1936, 1469).—The effect of addition of H_2 to $2CO + O_2$, and of N_2 to $CH_4 + 2O_2$, on the explosion limits of the respective mixtures has been studied. In the former the change in the explosion limit produced by H_2 is analogous to the change in ignition temp. and rate of propagation of the flame. In the CH_4 mixtures the lower limit is raised by addition of N_2 until $[N_2]/[O_2] = 2$, beyond which an explosion wave is not formed. The existence of two possible structures of the explosion wave is indicated.

F. L. U.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

Ca

25

Detonation in gas mixtures. III. Effect of lead tetraethyl on the formation of the detonation wave. IV. Influence of the "chemical presensitization" on the initiation of the detonation wave. K. Shchelkin and A. Sokolik. *Acta Physicochim. U. R. S. S.* 7, 581 (in English 580) (1937). Primary oxidation proceeds in the pre[illegible] zone in advance of the flame front and it is this reaction which is affected by $PbEt_4$. The behavior is the same in mixts. of C_6H_{14}, O and N as in hydrocarbon-air mixts. and is exhibited in tubes as well as in engines. $PbEt_4$ acts by effecting the decompn. of peroxides and aldehydes which are formed during the compression stroke. Gregg M. Evans

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

1ST AND 2ND ORDERS

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3A

A 55

1246. Limits of Detonation of Mixtures of Hydrocarbons and Air. M. Rivin and A. Sokolik. *Acta Physicochimica*, 7, 6, *pp.* 825–836, 1937. *In French.*—Experiments in a 30 m. tube reveal the impossibility of producing an explosion wave spontaneously in mixtures of ethyl ether, pentane and petroleum ether with air at normal pressures and temperatures and with ignition by powerful condenser discharge. In all cases the flame is extinguished within 10 in. from the spark. In hydrocarbon-air mixtures, analagous to mixtures in a petrol engine, the explosive wave is only propagated within narrow limits of concentration near the stoichiometric mixture but a "pseudo-detonative" wave is observed within wide limits of concentration. Detonation is not obtained in hydrocarbon-air mixtures containing 4 to 5% CO_2 which are closely similar to actual motor mixtures; it appears therefore that detonation in an internal combustion engine is entirely determined by the "chemical sensitisation" of the gas mixture during compression. The limits of detonation of C_2H_4-air mixtures are defined and the impossibility of ignition of ethane-air mixtures by an explosive wave is demonstrated. For the first time a detonating wave is produced in CO_2-air mixtures in the presence of insignificant quantities of H_2 or C_2H_2. J. E. K.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

Bc

A-1

Detonation of gas mixtures. III. Effect of lead tetraethyl on setting up of explosion wave. IV. Effect of "chemical preparation" on initiation of detonation in gas mixtures. K. SCHTSCHELKIN and A. SOKOLIK (J. Phys. Chem. Russ., 1937, 10, 479—483, 484—488).—III. The length of the pre-detonation period, *s*, of mixtures of C_6H_{12} with O_2 and N_2 at pressures, *p*, of 100—500 mm. has been determined. In presence of N_2 the *p-s* curve is stepped, and where *s* falls rapidly with increasing *p* addition of $PbEt_4$ lengthens *s*, whilst where *s* is changing slowly $PbEt_4$ has little effect. The curve is similar in form to the corresponding curve for the self-inflammation temp. of hydrocarbon-air mixtures. It is inferred that the effect of $PbEt_4$ depends on its action on primary oxidation reactions in the pre-detonation zone behind the flame-front.

IV. The effect on the formation of the detonation wave in a tube of preliminary "chemical prep." of the inflammable mixture by thermal treatment before ignition has been examined. *s* passes through a min. shortly after the appearance of a cold flame, then rises rapidly, the mixture ultimately failing to detonate. It appears that oxidation processes following the cold flame lead to degradation of the detonative properties of the mixture; premature oxidation may therefore suppress engine-knocking. R. C.

ASM-SLA METALLURGICAL LITERATURE

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Detonation in gases and knock in internal combustion engines A. S. Sokolik. *Uspekhi Khim.* 7, 970-1022 (1938). A review on the technique of studying gas detonation, the role of the sensitizing pre-inflammation reactions, critical conditions for formation of detonation waves and the role of chain reactions. F. H. R.

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1ST AND 2ND ORDERS

3RD AND 4TH ORDERS

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ca

21

Peroxides and detonation in internal combustion engines. A. S. Sokolik. *Acta Physicochim. U. R. S. S.* 9, 593-620(1938)(in French); cf. *C. A.* **33**, 5167[a]. —The nuclear idea of the peroxide theory is no longer tenable. Peroxides, which are formed during compression, are primary oxidation products and furnish active centers for the subsequent oxidation of the hydrocarbon by a chain-reaction mechanism. Detonation is caused by the sudden variation of the kinetic properties of the mixt. during the very short delay period and subsequent explosion wave. For detonation a certain concn. of peroxides must be reached immediately before ignition of the last portion of the charge. The max. concn. of peroxides very nearly coincides with the appearance of the cold flame; the concn. of aldehydes increases for some time thereafter, coinciding with the dissocn. of peroxides. Exptl. results show that detonation disappears not only (1) through the slowing down of the initial oxidation reaction, but (2) by its premature development and consequent degradation of the detonating properties of the mixt. as a result of premature dissocn. of peroxides. The oxidation of diisopropyl ether is discussed as an example of the latter type and the effects of preheating and of variation in the no. of revolutions of the motor are mentioned. Since naphthenes and paraffins oxidize more easily in the gaseous phase than in the liquid phase, and since with olefins the opposite is true, cracked gasolines show less antidetonating ability when preheated than do straight-run gasolines of the same octane no. Reduction of the time for chem. "sensitization" is a factor favorable to detonation. G. Ayers

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

1ST AND 2ND ORDERS

3RD AND 4TH ORDERS

PROCESSES AND PROPERTIES INDEX

BC

A-1

Explosion ranges of gaseous mixtures. VI. Influence of temperature on limits of detonation of hydrogen–air mixtures. A. SOKOLIK (Acta Physicochim. U.R.S.S., 1939, 11, 239—250; cf. A., 1938, I, 201).—The lower limit of explosion in H_2–air mixtures initiated by the detonation of $2H_2 + O_2$ is at ~21% of H_2 and is not affected by varying the temp. of the mixture between 20° and 150°. Above 200° the limit is lowered to 17—18%. H_2O formed in the initial stages hinders the formation of the explosion wave. The explosion wave is weakened by passage down a temp. gradient, but only if the composition of the mixture is near the limiting val.

F. L. U.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

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CA

22

Temperature coefficient of preflame reactions and the knocking value of motor fuels. A. S. Sokolik. *Acta Physicochim. U. R. S. S.* 11, 379–402(1939)(in English). —For spontaneous ignition of various hydrocarbon-air mixts. the relation of time lag to temp. is given by $te^{-\gamma/T} = C$ for the lower temp. zone and by $tp^n = c$ for the upper temp. zone (t = time lag, γ = temp. coeff., T = critical temp. of spontaneous ignition, p = critical pressure of spontaneous ignition, n = order of reaction). From exptl. data on ethane, propane, propylene, heptane, octane, iso-octane and diisopropyl ether as well as some other fuels, S. finds that the tendency of a fuel to knock is greater the greater the temp. coeff. of the preflame reaction, or (in the low-temp. zone) the higher the pressure. The behavior of a fuel can be predicted from $\gamma(1 - (1/\epsilon_{crit.} 0.32)) = A$. The calcd. and exptl. crit. compression ratios $\epsilon_{crit.}$ are, resp.: octane 2.2, < 2.8; heptane 2.6, 2.8; hexane 3.0, 3.3; pentane (mixt.) 4.0, 3.8–5.7; propane 12.3, 12; propylene 9.6, 8.4; ethyl ether 3.3, < 3.9; CS_2 5.3, > 5.15. The temp. coeffs. detd. as above are the av. values for the complete oxidation process rather than for any single definite reaction, and are a measure of the accumulation or destruction of the intermediate active products. For $(iso\text{-}Pr)_2O$, γ is negative at 280°.

F. H. Rathmann

Inst. Chem.-Phys., Leningrad.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

PROCESSES AND PROPERTIES INDEX

Ca

22

The spontaneous ignition of hexane air mixtures S. A. Yantovskii, B. A. Kravets and A. S. Sokolik. *Acta Physicochim. U. R. S. S.* 11, 721-5 (1939) (in English).—The "pressure minima" (cf. Townsend, *C. A.* 32, 2411[9]) on the low-temp. boundary zone disappear when the app. is clean and the gases are quickly introduced and p_{min} increases continuously with temp. The min. are ascribed to residual gases from the previous explosion. Adsorption of CO_2 on the walls causes a retardation of 25-90 in the low-temp. range similar to that produced by $Pb(Et)_4$, but has no effect in the high-temp. range. The upper limit for the low-temp. region of various hydrocarbons increases with the mol. wt. The shortening of the "time lag" found by Neumann and Kane was due to contamination by the products of the previous explosion. Cf. *C. A.* 33, 4008[4], 6575[4].

F. H. Rathmann

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

SOKOLIK4AS 60

1. SOKOLIK, A.

2. USSR (600)

"The Explosive Limits of Gaseous Mixtures". Part IV. "The Effect of Temperature on the Detonation Point of Hydrogen Air Mixtures". Zhur. Fiz. Khim. 13. No. 6, 1939. Leningrad, Inst. of Chemical Physics. Received 25 February 1929.

9. [redacted] Report U-1615, 3 Jan. 1939.

SOKOLIK,A.S. 600

1. KHAVETS, B. A.; YANTOVSKIY, S. A. ; SOKOLIK, A. S.

2. USSR (600)

"The Spontaneous Combustion of Mixtures of Hexane and Air," Zhur. Fiz. Khim, 13, No. 12, 1939. Leningrad, Inst. of Chemical Physics. Received 9 August 1939.

9. [redacted] Report U-1615, 3 Jan. 1952.

SOKOLIK,A.S.

Samovosplamenenie i sgoranie v gazkh. (Uspekhi fizicheskikh nauk, 1940, v.23, p.209-250)

Title tr.: Self-ignition and combustion of gases.

CSt-L CU NN

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

SOKOLIK, A. S. 600

1. SOKOLIK, A. S.

2. USSR (600)

"Temperature Coefficient of Preflame Reactions and the Antiknock Properties of Motor Fuel,", Iz. Ak. Nauk SSSR, Otdel. Tekh, Nauk, No. 4, 1940. Institute of Physical Chemistry, Leningrad

9. [redacted] Report U-1530, 25 Oct 1951.

1ST AND 2ND ORDERS

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Ca

24

Spontaneous ignition and combustion in gases. A. S. Sokolik. *Uspekhi Fiz. Nauk* 23, 209-50(1940).—A critical review of the literature, both exptl. and theoretical. S. considers the periods of induction, flame propagation, afterglow, flame-vibration, detonation and the laws governing them. 71 refs.

P. H. Rathmann

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

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CA

14

Influence of temperature on the detonation limits of hydrogen-air mixtures. M. A. Rivin. *J. Phys. Chem.* (U. S. S. R.) **15**, 533-50(1941).—The conditions under which a stationary wave passes over into a detonation wave through a temp. drop from the burning into the cold mixt. are discussed on the basis of exptl. data for a 15-22% H_2-air mixt. at 20-100°. Inflamation by explosion waves must be detd. not only by their magnitude but also by their profile. Increasing the initial temp. lowers the lower explosion limit. CO-air mixts. with as little as 0.1% H_2 can be made explosive. The wave reaction has a pos. temp. coeff. For formation of an explosion wave in a motor cylinder only the initiating explosion wave is necessary. This can be formed only by explosive combustion as assumed by Serruys (*C. A.* **20**, 3279). The detonation wave theory of Sokolik (*C. A.* **33**, 0580) is criticized as in conflict with the thermodynamic foundations of the theory of detonation. Further errors in Sokolik's calcns. are claimed. **Answer to M. A. Rivin.** A. S. Sokolik. *Ibid.* 550-5. F. H. Rathmann

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

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ea

21

Oxidation of fuels in the intake system of motor. B. A. Kravets and A. S. Sokolik. *Bull. acad. sci. U. R. S. S., Classe sci. tech.* **1942,** No. 3/4, 27-32. -Expts. on a model of the intake system of a gasoline motor showed the reason for "sensitivity" of cracked gasoline to the increase of temp. of intake manifold. The quantity of peroxides formed in the liquid film (up to 700 mg. free O per l.) is sufficient substantially to lower the antidetonating power of the fuel. It is advisable to design the intake in such a manner as to assure complete and max. rapid vaporization of the fuel to eliminate the liquid film on the walls of the intake manifold. G. M. Kosolapoff

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

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3RD AND 4TH ORDERS

Kinetic conditions of knock and preignition in internal-combustion engines. **A. Sokolik and S. Yantovskii.** *Acta Physicochim. U.R.S.S.* 19, 329–59 (1944).—Air-fuel mixts. were let into a heated steel reaction vessel; the time of filling was about 0.05 sec. The pressure difference between the reaction vessel and the admission vessel was followed by means of an optical gage consisting of a thin steel membrane between two thicker perforated membranes. A small pressure difference, ΔP, caused a motion of the thin membrane, so that ΔP could be read to ±15 mm. Hg; at ΔP less than 0.2 atm. the thin membrane pressed against the thicker, and ΔP could then be read with less sensitivity up to several atm. This arrangement allowed the small pressure pulses from "cool flames" to be registered as well as the large pulses from explosions. Fuels studied were heptane, isoöctane, mixts. of these, C_6H_6, and iso-Pr_2O; in all cases the air excess coeff. was 0.8. The temp. range of 200–600° and the range of initial pressures, P, of 0–8 atm. were covered completely. At temps. below about 500°, as P was increased from 0, at first only slow reaction was observed; then beginning at a pressure P_1 a cool-flame pulse occurred after a time lag t_1. Above a higher pressure P_2 the cool flame was followed after a further time lag t_2 with a hot flame, yielding complete combustion. The height of the cool-flame pulse increased with increasing P, and the limit P_1 was ill defined. The decreasing value of P_2 in successive expts. showed that occurrence of combustion sensitized the vessel walls for hot-flame combustion. With increasing temp., P_1 and P_2 approached each other, coinciding at a temp. T_1. All the fuels except C_6H_6 showed the low-temp cool-flame combustion system. So far, the results showed complete qual. (though not exact quant.) agreement with those of Maccormac and Townend (*C.A.* 32, 4319[4]). As P increased beyond P_2, t_1 showed little change, but t_2 decreased rapidly, apparently showing an asymptotic approach to 0. At high pressures, t_2 became too small to register on the app., but the character of the $P - t_2$ curve shows that there is no essential change in the reaction mechanism, which presumably remains 2-stage at all pressures. Above T_1, a new phenomenon was found. As P was increased, first hot-flame combustion set in, then at higher pressures the 2-stage mechanism reappeared, a cool-flame pulse occurring before the hot flame. Thus at intermediate pressures only cool flames are found below T_1 and only hot flames above T_1, but at sufficiently high pressures the combustion always occurs in 2 stages. The curves of P_1 and P_2 vs. temp. cross at T_1 and continue without discontinuity to higher temps. The cool-flame time lags follow the law t_1P^n = const., where n increases with temp. but is always less than 1 for paraffins. At const. P, $t_1e^{-E/T}$ = const. The hot-flame time lags at const. temp. obey the same law t_2P^n = const., but n may be as large as 4. With increasing temp. at const. P, t_2 passes through a min. at about 350° for the paraffinic fuels (270° for ether), attains a max. about 100° higher, and falls again at still higher temps. The cool-flame pulse becomes less intense with rising temp. in this region. The concn. of peroxides, which provide active centers for the branching-chain reaction which leads to hot-flame

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

Inst. Chem. Phys., Moscow.

SOKOLIK, A.S.

Inst. Chem Physics, Acad. Sci., (1946)

"Kinetic Conditions of Detonation and Preignition in Internal Combustion Engines,"

Zhur. Fiz. Khim., No. 1, 1946.

SOKOLIK, A. S., and others.

Elektroakusticheskii metod registratsii detonatsii v aviatsionnykh dvigateliakh. (Tekhnika vozdushnogo flota, 1947, no. 5, p. 11-17, illus., diagrs.)

Title tr.: Electro-acoustical method of recording detonations in aircraft engines.

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

APPROVED FOR RELEASE: 08/25/2000 CIA-RDP86-00513R001651920018-8"

SOKOLIK, A. S.

USSR/Aeronautics
Engines, Aircraft - Detonations
Fuel, Aviation

Apr 1947

PA 28T9

"Electro-acoustic Method of Recording Knocks in Plane Engines," A. S. Sokolik, Dr of Chemical Sciences, A. S. Sokolik, B. K. Shapiro, Candidates in Technical Sciences, M. I. Rodman, 7 pp

"Tekh Voz Flota" No 5 (230)

In the process of testing plane engines and fuel, in connection with a knock, it is most important to have objective registration of the knock to determine the critical point of cylinders and to be able to record the data on a scale. This article explains a new

BS 28T9

USSR/Aeronautics (Contd) Apr 1947

method of recording the knock by acoustic means and is meant to familiarize specialists with the new development. The author presents apparatus layout diagram and also photographs of oscillograph recording of an engine under normal operation and when there is a knock.

BS 28T9

1ST AND 2ND ORDERS

PROCESSES AND PROPERTIES INDEX

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Cold flames and two-stage self-ignition in benzene-air mixtures. A. S. Sokolik, M. Ya. Gen, and S. A. Yantovskii (Inst. Chem. Phys., Acad. Sci. U.S.S.R., Moscow). *J. Phys. Chem.* (U.S.S.R.) 21, 1369-8(1947)(in Russian). —It was believed (cf. *ibid.* 20, 13(1946)) that C_6H_6 is fundamentally different from paraffinic hydrocarbons in that only the latter show a two-stage self-ignition. Now, this effect is reproduced with C_6H_6-air mixts. contg. less air than the air-fuel mixts. used in motors. This shows that there is no antiknock fuel; detonation is possible for any fuel if the air amt., temp., etc., are favorable. Benzene-air mixts. contg. air excesses equal to 0.35 and 0.68 were heated, and the pressure of the gas was recorded automatically. The pressure first was const. (induction period), then rose rapidly (cold flame), remained const. (2nd induction period), and rose again ("blue flame"), (cf. Spence and Townend, *C.A.* 30, 2087). The rise of pressure is so small that the gas temp. cannot be high. When the initial pressure is raised from 5 atm. to 5.8 atm., the 2nd induction period disappears; and when the initial pressure is 5.9 atm., hot detonation takes place. This is valid at 580°. At 620° detonation occurs at 5.4 atm. The region of cold flame could not be detd. with precision, as it is affected by the sensitivity of the manometer and by the previous history of the reaction vessel. The apparent activation energy of the cold flame is about 20,000 cal. between 525 and 580° and about 57,000 cal. between 580° and 670°.

J. J. Bikerman

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

[illegible], [illegible]., ed.

F [illegible]A [illegible] collection of translations per. statei s [illegible] Moskva, Gos. izd-vo inostrannoi lit-ry 1948 [illegible]
(5[illegible]-[illegible])

[illegible].F59

SOKOLIK, A. S.

PA 157T81

USSR/Physics - Combustion Dec 49
Engines, Combustion

"Influence of Chemical and Turbulent Factors on the Combustion Process Under Engine Conditions," A. S. Sokolik, A. N. Voinov, Yu. B. Sviridov, Inst of Chem Phys, Acad Sci USSR, 26 pp

"Iz Ak Nauk SSSR, Otdel Tekh Nauk" No 12

Attempts to eliminate errors of all previous investigations on subject and endeavors to conduct investigation of combustion speed at various stages of process under strictly constant physicochemical and dynamic conditions. Combustion

[redacted] 157T81

USSR/Physics - Combustion Dec 49
(Contd)

process in an engine is not uniform and must be divided into three basic stages. Both factors, turbulent and physicochemical, affect every phase of combustion, but their mechanisms of affect are different. Therefore, different factors must be used for regulating speed in various stages of combustion. Submitted by Acad N. N. Semenov.

(CA 47 no.16: 8355 '53)

[redacted] 157T81

Translation W-13951, 27 Sep 50

SOKOLIK, A. S.

PA 197T106

USSR/Physics - Shock Wave Oct 51

"Mechanism of Pre-Detonation Acceleration of Flame,' A. S. Sokolik, Inst of Chem Phys, Acad Sci USSR

"Zhur Eksper i Teoret Fiz" Vol XXI, No 10, pp 1164-1171

Studies mechanism of origin of shock and detonation waves in pipes. Finds that formation of shock waves depends on relative temp increase during burning and on ratio of basic flame velocity to sound's velocity in fresh air. Compared measured flame velocities with computed shock wave velocities

LC 197T106

USSR/Physics - Shock Wave (Contd) Oct 51

of a number of explosive mixts and found to be in complete agreement. Sokolik thanks Ya. K. Troshin for exptl work. Submitted 29 Apr 50.

LC 197T106

Fuel Abstracts

Other Prime Movers
N 11/1952

4742. PHASES OF C MBUSTION IN AN ENGINE Sokolik A.S. Voinov, A.N. and Sbiridov, Yu.B. (Izv. Akad. Nauk SSSR, Otdel. Tekh. Nauk (Bull. Acad. Sci. U.S.S.R. Sect. Tech. Sci.) Apr. 1952, 629-634). The authors' three phase theory (Fuel Abstr. June 1950, n.s.7, 5055) is defended against the criticism of Sergel (Fuel Abstr., July 1952, n.s.12, 663).

SOKOLIK, A. S.

Chemical Abst.
Vol. 48 No. 3
Feb. 10, 1954
Fuels and Carbonization Products

3

Phases of combustion in a motor. A. S. Sokolik, A. N. Voinov, and Yu. B. Sviridov. *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk* 1953, 783-8; cf. *C.A.* 47, 8355c.—Termination of a polemical discussion on an earlier paper with clarification of various points in light of discussion by other contributors to this topic. G. M. Kosolapoff

9-21-54
LM

SOKOLIK, A.S.; VOINOV, A.N.; SVIRIDOV, Yu.B.

Editorial. Discussing A.S.Sokolik's, A.N.Voinov's and Yu.B.Sviridov's article "Effect of chemical factor and of the factor of turbulence on the combustion process in an engine." Izv.AN SSSR Otd.tekh.nauk no.5:786-787 My '53. (MLRA 6:8)
(Gas and oil engine) (Sokolik, A.S.) (Voinov, A.N.) (Sviridov, Iu.B.)

SOKOLIK, A.S.

USSR/Chemistry - Physical chemistry

Card 1/1 : Pub. 147 - 10/22

Authors : Sokolik, A. S., and Basevich, V. Ya.

Title : About the kinetic nature of spontaneous combustion in Diesel conditions

Periodical : Zhur. fiz. khim. 28/11, 1935-1949 , November 1954

Abstract : The two-phase nature of spontaneous combustion of diffused fuel in Diesel conditions, with compulsory preliminary cold-flame formation, was established through direct investigation of combustion processes in Diesel engines. The relation between the two phases of the spontaneous combustion process and the kinetic and physico-mechanical factors involved is elucidated. The dependence of the hot detonation-induction period upon the cold flame intensity, was determined. The conditionality of the cetane number is explained. The results of low-temperature two-phase spontaneous combustion and the propagation of turbulent flame fronts are described. Four references: 1-USA and 3-USSR (1940-1952). Tables; graphs; drawing; illustrations.

Institution : Academy of Sciences USSR, Institute of Chemical Physics, Moscow

Submitted : February 27, 1954

SOKOLIK, A.S.

APPROVED FOR RELEASE: 08/25/2000 CIA-RDP86-00513R001651920018-8"

1742. PHYSICO-CHEMICAL NATURE OF IGNITION IN COMPRESSION IGNITION ENGINES. Basevich, V.Ya. and Sokolik, A.S. (Moscow Acad. Sci. U.S.S.R., 1956, "Proceedings of Conference on Piston Engines" (Trudy Konferentsii po Porshnevym Dvigatelyam), July 1954", 93-105).

BASEVICH, V.Ya.; SOKOLIK, A.S.

Role of flame propagation in the combustion process of a diesel engine (with English summary in insert). Zhur.fiz.khim. 30 no.4:729-734 Apr. '56. (MLRA 9:9)

1. Akademiya nauk SSSR, Institut khimicheskoy fiziki, Moskva. (Flame) (Diesel engine)

SOV/24-58-8-25/37

AUTHORS: Semenov, Ye. S. and Sokolik, A. S. (Moscow)

TITLE: Investigation of the Turbulence in the Cylinder of a Piston Engine (Issledovaniye turbulentnosti v tsilindre porshnevogo dvigatelya)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Otdeleniye Tekhnicheskikh Nauk, 1958, Nr 8, pp 130-134 (USSR)

ABSTRACT: The process of combustion in the cylinder of piston engines takes place under conditions of intensive turbulence which strongly influences spreading of the flame and, in injection engines, the atomization of the fuel. The present investigation had as the object the study not only of the mean velocity $\bar{v}$ (Refs 1 and 2) but also the following characteristics of the turbulence: root mean square of the fluctuating velocity $\sqrt{\overline{v'^2}}$ and the spectrum of the fluctuations F(f) at different phases of the cycle in different points of the combustion chamber. The readings were taken by means of an electro-thermo-anemometer (ETA-5A) (Ref 3) designed for analysis of unsteady flows with whirls. Full description of the apparatus for measuring the turbulence is given in Ref 4 and also in Refs 5 and 6 from which the formulae (3), (4) and (5) are taken. The coefficient of the heat loss from

Card 1/6

the wire placed perpendicularly to the direction of the flow is given by:

$$\alpha = C\lambda d^{m-1}\left(\frac{v\rho}{\mu}\right)^m \qquad (1)$$

α and therefore the current in ETA being a function of (v, ρ, t) and λ and μ being functions of t, where C and m are some empirical constants, λ, μ, ρ are thermal conductivity, viscosity and density of the gas respectively, v is the velocity of the flow and d is the diameter of the wire in ETA.

Putting $i_o = K_{\rho t} i$ (2)

where $K_{\rho t} = f(t)$ is the coefficient of adduction we get $i_o = f(v)$ only, i.e. it does not depend on ρ and t, from which the velocity may be obtained. The apparatus RTD (registration of turbulence in engines) producing a stress, by means of a resistance thermometer of small inertia, proportional to $K_{\rho t}$ when placed in the combustion chamber, was capable of performing the multiplication in conformity with Eq.(2), and of the linearization of dependence of the

SOV/24-58-8-25/37

Investigation of the Turbulence in the Cylinder of a Piston Engine

initial stress U_{in} on the velocity. From the signals of v, selected over the crank angle of 24° of each cycle (this was done by means of a cut-out operated by the crank) the temporal mean value $\bar{v}$ and the fluctuating component v' were determined by averaging 25 to 50 cycles. These values were read directly from suitably calibrated voltmeters. Measurements of the turbulence fluctuations was limited to frequencies between 300 and 6000 hertz. The experiments were carried out on the single cylinder engine SFR of variable compression ratio, the combustion chamber being a cylinder of diameter 82.6 mm. Fig.1 shows the layout of the measuring stations: 1 - inlet valve, 2 - exhaust valve, 3 - resistance thermometer, 4 - headpiece of the hot wire anemometer. The results of the experiments are shown on the graphs 2, 3, 4, 6, 7 and 8 as follows: Fig.2 shows the change in $\bar{v}$ versus the crank angle during the stroke of suction at various distances from the axis of the cylinder with compression ratio ε = 6 and n = 900 r.p.m. It is seen that there are striking differences in $\bar{v}$ at different points in the cylinder, this result being at variance with Ref 2; large

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Investigation of the Turbulence in the Cylinder of a Piston Engine

differences even at the point close to each other (r = 10-13, 13-15 mm) indicate that the flow is in a form of a concentrated jet during suction and not a widely spread one. Fig.3 shows the profiles of the mean velocity $\bar{v}$ across the chamber for three crank angles (60^0, 120^0 and 180^0) during the suction stroke and for three different speeds: 600, 900 and 1200 r.p.m. Compression ratio 6. Volumetric efficiency $\eta_v = 0.71$ is shown as the curve 1, and $\eta_v = 0.24$ as the curve 2. Fig.4a shows the variation of the mean velocity and the fluctuating velocity with the speed of the engine, while 4b shows how these velocities change with the volumetric efficiency (i.e. as a result of throttling) at the crank position of 120^0. The presence of intensive turbulent fluctuations is visible from Fig.5 (upper curve); the lower curve represents pressure changes. The notches are at 30^0 intervals. Figs.6,7 and 8 refer to the stroke of compression. Fig.6 shows the variation of the mean velocity as well as of the fluctuating component with the crank angle at the crank speed of 900 r.p.m. $\eta_v = 0.71$, r = 23 mm. The

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Investigation of the Turbulence in the Cylinder of a Piston Engine

coefficient K_0^1 is the correction factor necessary to compensate for the fact that $\bar{v} \gg v'$ was not satisfied in these experiments and therefore the effect of the wire length had to be taken into account. Fig.7 shows the mean and fluctuating velocities at O.D.C. (i.e. at the end of compression stroke) for $\varepsilon = 6$ and $n = 900$ r.p.m. as follows: a) across the cylinder, b) at a distance 10 mm from the axis as a function of the variable compression ratio ε, c) ditto as a function of the volumetric efficiency and d) ditto as a function of the crank speed n. Fig.8 shows the variation of the energy of the turbulence, where $w_1 = (\overline{v'^2} + \overline{v^2})$ is the energy of the high frequency pulsation and of the swirl motion per unit mass, $w_2 = \frac{1}{2}\overline{v'^2}$ and $w_3 = \frac{1}{2}\rho(\overline{v'^2} + \overline{v^2})$. Generally speaking $\sqrt{\overline{v'^2}}$ increases everywhere during the stroke of suction where grad $\bar{v}$ increases, e.g. with increase in n and η_v. There are, however, some points where $\sqrt{\overline{v'^2}}$ is large though grad $\bar{v}$ is small at those points. This may be due

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to the fact that only the components of $\bar{v}$ and grad $\bar{v}$ perpendicular to the wire can be measured experimentally with this apparatus, not their total values. It appears further that neither

$$\sqrt{\overline{v'^2}}$$

during compression stroke nor grad $\bar{v}$ during the suction stroke do depend upon the compression ratio, leading to the conclusion that the real cause of pulsation during the compression stroke is the turbulence produced in the stroke of suction.

There are 8 figures and 7 references, 2 of which are Soviet, 4 English, 1 German.

SUBMITTED: May 22, 1957

1. Combustion--Turbulence 2. Fuels--Atomization 3. Combustion chambers--Performance 4. Internal combustion engines

SOKOLIK, A. S.

with O. A. Machalicky (Czechoslovakian scientist) "Physico-chemical basis of the so called M-process in Diesel engines"

with Ye. S. Semenov "Dealt with the investigation of the working cycle in the cyclinder of the engine by means of a compensated thermo-anemometer"

with V. P. Karpov " Dealt with the antechamber torch ignition as basis of a new type of engines"

report presented at the conference on Combustion and Formation of the Mixture in Diesel Engines, convened by the Motor Laboratory, Acad. Sci. USSR, Moscow 10-12 June 1958.
(Vest. Ak Nauk SSSR, 1958, No. 9, 115-117)

APPROVED FOR RELEASE: 08/25/2000 CIA-RDP86-00513R001651920018-8"

SUKOLIK, A.S.

SOV/2541

17(1); 10(2); 24(8) PHASE I BOOK EXPLOITATION

Akademiya nauk SSSR. Energeticheskiy institut

Goreniye v turbulentnom potoke; diskussiya na obshchemoskovskom seminare po goreniyu pri energeticheskom institute AN SSSR (Combustion in Turbulent Flow; a Discussion in the All-Moscow Seminar at the Power Engineering Institute, USSR Academy of Sciences) Moscow, Izd-vo AN SSSR, 1959. 167 p. Errata slip inserted. 2,000 copies printed.

Ed.: L. N. Khitrin, Corresponding Member, USSR Academy of Sciences; Eds. of Publishing House: R. I. Kosykh and M. M. Knoroz; Tech. Ed.: P. S. Kashina.

PURPOSE: This collection is intended for research scientists in the fields of thermodynamics and fluid mechanics.

COVERAGE: The collection contains six papers which present the results of experimental and theoretical research on combustion phenomena under conditions of turbulent flow.

Card 1/6

Vlasov, K. P. Experimental Investigation of the Combustion Zone of a Turbulent Flame (Supplement to Ye.S. Shchetinkov's Report)
This paper gives details of the test setup and some results of an experimental study of the combustion zone in a turbulent flame. The test method was based on small-lag measurements of the ionized current and the temperature. Experimental data on the distributions of the ionized current and the temperature are given and the measured statistical characteristics of these quantities are presented as functions of the depth of the combustion zone and the flow velocity.

Kogarko, S. M. On the Model for Combustion in a Turbulent Flow 58
On the basis of the Damkoehler-Shchelkin hypothesis, this paper considers the mechanism of the combustion of a homogeneous mixture in turbulent motion in the cross section of a tube. The stabilization of the flame tongue is achieved with the aid of a pilot flame. The author questions the validity of the model of combustion proposed by Shchetinkov in the first paper in this collection.

Sokolik, A. S. On the Experimental Basis of the Theory of Turbulent Combustion 63

This paper is concerned with the experimental foundations of the theory of turbulent combustion. A "laminar" model of the turbulent combustion process is assumed. On this model, the turbulent flame is represented by an ordinary propagation of laminar flame with a normal laminar flow velocity which is constant along the entire separation surface (between luminous and ignited gas), but with an increased combustion surface. In the laminar model, it is considered that the possibility exists of an increase in normal combustion velocity under the action of small-scale turbulence. The development of large-scale turbulence accelerates the combustion. Experimental data are presented which tend to substantiate the physical concepts presented. A discussion of luminescence and ionization in laminar and turbulent flames is also given.

Discussion 81

Critical comments on the papers presented and additional observations on the mechanism of turbulent combustion are made by K. P. Vlasov, V. Ya. Basevich, and A. N. Voinov.

Prudnikov, A. G. Measurement of the Turbulence of Air Flows and Flames by the Optical Diffusion Method 88

This paper presents a new method for studying the turbulence of air flows and flames. The method is a modification of the diffusion method which combines the simplicity of the diffusion method with the speed of the thermodynamic method. The basic relationships are given, the accuracy of the method is analyzed, the experimental set-up is described, and a wide variety of experimental results are presented. Included are data for flows in tubes, submerged jets, and open flows with and without the presence of grids. A variety of results are also given for turbulence in flames, including the effects of grids and the scale of the turbulence.

Semenov, Ye.S. Investigation of the Turbulent Motion of a Gas Under Piston Engine Conditions 141

This paper investigates several turbulence characteristics of the motion of a gas. Included are studies of the characteristics of the gas motion during intake and compression in the presence of a source of turbulence, the variation of turbulence character-

S/081/60/000/017/001/016
A006/A001

11.7200

Translation from: Referativnyy zhurnal, Khimiya, 1960, No. 17, pp. 59-60,
68661

AUTHOR: Sokolik, A.S.

TITLE: On the Experimental Basis of the Theory of Turbulent Combustion

PERIODICAL: V sb.: Goreniye v turbulentnom potoke, Moscow, AN SSSR, 1959, pp. 63-80, Diskus., pp. 81-82

TEXT: The state of the problem on turbulent combustion is characterized, on the one hand, by unfounded experimental data on the combustion rate in turbulent flames, resulting form the impossibility of applying to them the principles of the Guy-Michelson method. On the other hand, it is marked by contradictions in the theoretical elaboration of the laminar model of turbulent flame by various authors. Known data on the structure of turbulent flame and laminar flame do not provide grounds to select either a laminar or a voluminar model of turbulent

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A006/A001

On the Experimental Basis of the Theory of Turbulent Combustion

flame. A new model of turbulent flame is proposed, representing intermittent com- B
bustion during the process of mixing the fresh and burnt gases.

A. Sokolik

Translator's note: This is the full translation of the original Russian ab-
stract.

the $|U'|$, which amounted to $(\bar{u}'^2)^{1/2}$ with respect to the turbulent diffusion. For the entire turbulence U'_Σ therefore $U'_\Sigma = \left\{|\bar{U}'|^2 + \bar{u}'^2\right\}^{1/2}$. It is shown in figure 4 that the rate U_T of turbulent combustion increases linearly with the intensity of the turbulence: $U_T = a.U'_\Sigma + b$, where coefficient a lies between 1 and 2 for low temperatures. There are 4 figures and 5 references, 2 of which are Soviet.

ASSOCIATION: Institut khimicheskoy fiziki Akademii nauk SSSR (Institute of Chemicophysics of the Academy of Sciences, USSR)

PRESENTED: June 11, 1959, by V. N. Kondrat'yev, Academician

SUBMITTED: June 5, 1959

4

66498

SOV/20-129-1-46/64

~~5(4)~~ 11.1000

AUTHORS: Sokolik, A. S., Karpov, V. P.

TITLE: The Dependence of the Rate of Turbulent Burning on the Laminar Rate and Temperature of Burning

PERIODICAL: Doklady Akademii nauk SSSR, 1959, Vol 129, Nr 1, pp 168-171 (USSR)

ABSTRACT: The two concepts of the mechanism of turbulent burning are analyzed: the model of laminar surface burning, and the concept of the turbulent flame as the propagation of a pulsating three-dimensional reaction (Refs 5-7). By reason of experiments with hydrogen - air mixtures it is proved that there is no direct connection between the rate U_T of turbulent and the rate U_L of laminar burning, and that U_T increases with rising temperature. The fundamental difference between the propagation of the flame in the range of constant values of U_T and at decreasing U_T is shown by means of moving-picture filming of the flames (Fig 3). When U_T decreases propagation becomes nonuniform. The latter is caused by a decrease in the reaction rate due to a change in the

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PHASE I BOOK EXPLOITATION SOV/4669

Sokolik, Abram Solomonovich

Samovosplameneniye plamya i detonatsiya v gazakh (Autoignition, Flame, and Detonation in Gases) Moscow, Izd-vo AN SSSR, 1960. 427 p. Errata slip inserted. 3,000 copies printed.

Sponsoring Agency: Akademiya nauk SSSR. Institut khimicheskoy fiziki.

Resp. Ed.: V. N. Kondrat'yev, Academician; Ed. of Publishing House: V. M. Cherednichenko; Tech. Ed.: P. S. Kashina.

PURPOSE: This book is intended for scientific and engineering personnel engaged in combustion research.

COVERAGE: The book discusses kinetic problems related to the three basic types of combustion phenomena - autoignition, flame propagation, and detonation. With but one exception the work is restricted to investigations of premixed gases. The studies are based on recent finding on the rates of chemical reactions embodied in the development of the chain theory of oxidation processes in gases. The Diesel process is briefly examined to illustrate the manner in

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which the kinetic laws of multistage autoignition manifest themselves against a background of simultaneous liquid fuel evaporation and air-vapor mixing. Classification of combustion phenomena is suggested on the basis of the role played by the mixing of fresh and burned gases in the development of the reaction. No personalities are mentioned. References accompany individual chapters.

TABLE OF CONTENTS:

SOKOLIK, A. S., prof., doktor khim.nauk

Flame. Znan.ta pratsia no.6:2-3 Je '60. (MIRA 13:8)
(Flame)

S/026/60/000/007/004/008
A166/A029

AUTHOR: Sokolik, A.S., Professor

TITLE: Flame

PERIODICAL: Priroda, 1960, No. 7, pp. 39 - 45

TEXT: The author examines the processes which take place in the flame of a normal gas burner and uses this as a basis to explain the process of combustion generally. Since heat is the random movement of molecules, the collision of molecules in the gas flame leads to the hot gas giving up its surplus movement energy to the cold gas, i.e., heat transfer. The random movement of the gas molecules also leads to diffusion of fresh and burnt gases within the flame. Heat transfer together with diffusion combine to produce flame spread. The great barrier to such chemical reactions as combustion is the strength of the intramolecular bonds. According to the chain theory of chemical reactions, direct reaction between the molecules is necessary only as a primer to produce a few chemically active particles with a free chemical bond, i.e., free radicals, which will react readily with the molecules to develop a chain reaction. This also has a snowballing effect in producing additional free radicals as active centers, so that the

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S/026/60/000/007/004/008
A166/A029

Flame

reaction rapidly gains momentum. This in turn liberates heat which heats the gases and further accelerates the reaction. Catalysts break down readily into free radicals and are used, therefore, to speed up technological processes by acting as primers. The glow of a flame is also connected with the reaction of free radicals. Energy is consumed in shifting the electrons of the gas molecules from a normal level to an excited level so that they orbit farther from the nucleus. When the electrons revert to their normal level they surrender this conversion energy in the form of incandescence. There are 3 photos and 5 diagrams.

Card 2/2

81408

S/020/60/132/06/33/068
B004/B005

11.1000

AUTHORS: Karpov, V. P., Sokolik, A. S.

TITLE: The Influence of Pressure on the Rate of Laminar and Turbulent Burning

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol. 132, No. 6, pp. 1341-1343

TEXT: For the rate of laminar burning, the authors write down equation (1): $u_{lam} \sim p_o^{n/2-1}$ (n = order of the gross reaction in the flame), and discuss the deviating values for $k = n/2 - 1$ indicated in Refs. 2-6. The experimental results represented in Fig. 1 show that combustion does not follow equations (2) and (3) at $p_o < 0.5$ atm abs. At reduced pressure, the temperature of combustion also decreases due to strong dissociation. The reduction of the rate of laminar burning in the pressure range investigated (0.4 - 1.76 atm abs) is assumed to be due to pressure reduction. The value 1.4 - 1.6 is indicated for n of equation (1). The results obtained in Refs. 4, 8-10, including papers by Doroshenko and Nikitskiy, are discussed

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81408

The Influence of Pressure on the Rate of Laminar and Turbulent Burning S/020/60/132/06/33/068 B004/B005

in a similar way. The authors' experimental results for the range of 0.5 - 1.76 atm abs give the equation $u_{turb} \sim p^{0.3}$; but the combustion rates at low pressure deviate from this equation. This is explained by an increase in the induction period τ_i of inflammation, and the reduction of the diffusion time t_o at low pressure. Therefore, the flame propagates irregularly as is shown by the photographs in Fig. 2. Under experimental conditions, a turbulent inflammation is impossible at $\tau_i > t_o$. There are 2 figures and 11 references: 6 Soviet and 5 English.

ASSOCIATION: Institut khimicheskoy fiziki Akademii nauk SSSR (Institute of Chemical Physics of the Academy of Sciences, USSR)

PRESENTED: February 25, 1960, by V. N. Kondrat'yev, Academician

SUBMITTED: February 24, 1960

Card 2/2

SOKOLIK, A.S., doktor khim.nauk

New class of internal combustion engines. Vest. AN SSSR 31 no.10:78-90 O '61. (MIRA 14:9)
(Gas and oil engines--Ignition)

11.7200
11.1210

24058
S/020/61/138/004/019/023
B103/B203

AUTHORS: Karpov, V. P. and Sokolik, A. S.

TITLE: Relationship between self-ignition and rate of laminar and turbulent combustion of paraffin hydrocarbons

PERIODICAL: Akademiya nauk SSSR. Doklady, v. 138, no. 4, 1961, 874-876

TEXT: The authors compare the change of the laminar and turbulent burning rate of a mixture of methane, propane, or butane with air, with the delay of self-ignition as a function of mixture composition. For this purpose, they use a bomb of constant volume. In the case of methane, the delay decreases at 700-750°C in mixtures poor in methane, in the case of propane and butane, however, in mixtures rich in alkane (Ref. 3: A.S.Sokolik, Samovosplameneniye, plamya i detonatsiya v gazakh, Izd. AN SSSR, 1960 (Self-ignition, flame and detonation in gases)). This difference detected 30 years ago (Ref. 2: C. A. Naylor, R. W. Wheeler, Chem.Soc., 1931, 2456; 1933, 1240) has so far not been studied closely. In a new model of the turbulent flame, the burning rate is directly determined by the delay of ignition during the mixing of fresh and burning gas. The

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24058
S/020/61/138/004/019/023
B103/B203

Relationship between self-ignition and ...

method of determining the turbulent burning rate was described earlier (by the authors and Ye. S. Semenov, DAN, 128, no. 6, 1220 (1959) (Ref. 4)). The laminar burning was determined on the basis of the recorded visible flame velocity $u_{vis} = dr/dt$ from the equation $u_{burn} \simeq u_{vis}/\varepsilon$. The propagation degree ε can be determined as $\varepsilon \simeq T_{ad}/T_c$ by replacing the real temperature of the flame T_f by the calculated adiabatic temperature and neglecting the change of the molar ratio n/n_o. The resulting error does not exceed the error of measurement. For methane and higher alkanes, the authors find a great difference for mixtures rich in alkane: methane shows much lower normal burning rates and a lower upper limit of flame propagation than higher alkanes. The authors explain this difference only with the differing reaction rate in the flame which in propane and butane is much higher than in methane. The same difference is even greater at the rate of turbulent burning. In the authors' opinion, this parallelism must not be taken as a proof that turbulent burning proceeds in laminar flames. For mixtures poor in alkane, the rate of turbulent burning of methane is higher than that of the two higher alkanes. Besides, the

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B103/B203

Relationship between self-ignition and ...

authors state that for mixtures rich in alkane the rate of turbulent burning is much lower in methane than in propane and butane, although the burning temperature of methane is higher than that of the higher alkanes. For these reasons, it is assumed that there are certain kinetic differences between methane and the higher alkanes which effect the above discrepancies. These kinetic differences are neither related to the stage of chain generation nor to the stage of chain branching. Therefore, it is assumed that the differing characteristics of self-ignition of methane and C_3- and C_4 alkanes as a function of mixture composition are due to differences between these two alkane types in the stage of chain generation: the reaction rate rises in this stage with the impoverishment of the mixture in alkane in the case of methane, and with the enrichment of the mixture in the case of C_3- and C_4 alkanes. Therefore, the authors recommend an investigation of the mechanism of this stage in self-ignition at higher temperatures and in the development of the reaction in flames. Besides, they conclude from the above results that the reaction in laminar and turbulent flames develops under similar conditions of the mixing of burning and fresh gas, i.e. according to a similar mechanism.

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S/020/61/138/004/019/023
B103/B203

Relationship between self-ignition and ...

The propagation mechanism of the reaction, however, is different in principle: in laminar flames, it proceeds by uninterrupted molecular heat and substance transfer, in turbulent flames, however, by turbulent mixing. There are 3 figures and 5 references: 3 Soviet-bloc and 2 non-Soviet-bloc. One of the references to English-language publications is cited above, the other reads: Ref. 5: K. Wohl, L. Shore, Ind. and End. Chem., 47, 828 (1955).

ASSOCIATION: Institut khimicheskoy fiziki Akademii nauk SSSR (Institute of Chemical Physics of the Academy of Sciences USSR)

PRESENTED: January 23, 1961, by V. N. Kondrat'yev, Academician

SUBMITTED: January 17, 1961

Card 4/4

30705

S/020/61/141/002/019/027
B101/B147

11.7100

AUTHORS: Karpov, V. P., and Sokolik, A. S.

TITLE: Limits of ignition in turbulent gaseous mixtures

PERIODICAL: Akademiya nauk SSSR. Doklady, v. 141, no. 2, 1961, 393-396

TEXT: The difference between laminar and turbulent combustion, and the dependence of ignition on the degree of turbulence are discussed, and present a quantitative value for the probability of extinction of a turbulent flame. The paper is based on a study by A. S. Sokolik (Samovosplaneniye, plamya i detonatsiya v gazakh (Self-ignition, flame and detonation in gases) Izd. AN SSSR, 1960). Excitation of constant turbulence in a closed space has already been described (DAN, 129, no. 1, 168 (1959)). Results: 1) At constant energy of the capacitor spark, the concentration ranges of ignition are narrowed with increasing intensity (U'), or the lower limit of ignition rises with increasing pressure. Decreasing spark energy also narrows the concentration range of ignition. 2) In contrast to laminar combustion, the combustion rate in turbulence does not depend on the heat conductivity of the mixture. In a wide range, it is proportional to the

X

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S/020/61/141/002/019/027
B101/B147

Limits of ignition in turbulent ...

intensity of turbulence. 3) Propane-oxygen and hydrogen-oxygen mixtures diluted with helium or argon showed that, in the presence of He, ignition occurs, at a turbulence lower than in the presence of Ar (Fig. 2). Also on increasing the spark energy by a factor of 20, the ignition limit for mixtures with He was lower than for mixtures with Ar. In H_2 - air mixtures (Fig. 4) with an excess of H_2 ignition occurred at a lower intensity of turbulence, although mixtures rich in air have a higher burning temperature (ratio $\alpha = 0.17$, burning temperature 1300°K; ratio $\alpha = 5.6$, burning temperature 860°C). 4) The nature of flame propagation is changed by turbulence. This was observed by schlieren cinematography. 5) The ratio between the real flame volume V_f and the volume V_m of the sphere, the radius of which is the longest flame tongue, is set up and $V_f/V_m \approx 0.35$ is found to be the limit of ignition for all mixtures investigated. This value is a quantitative characteristic for the probability for extinction of a turbulent flame. 6) Therefrom it is concluded that pulsating combustion is impossible as soon as the time of mixing becomes shorter than the induction period of ignition: $t_o = l_1/U' < \tau_i$. With increasing root-mean square value of the intensity U'_Σ

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35

S/020/61/141/002/019/027
B101/B147

Limits of ignition in turbulent ...

of turbulence, the probability increases that the inequality becomes valid. There are 4 figures and 6 references: 5 Soviet and 1 non-Soviet. The reference to the English-language publication reads as follows: Kimura Itsuro, Kumagai Seiichiro, J. Phys. Soc. Japan, no. 5, 599 (1956).

ASSOCIATION: Institut khimicheskoy fiziki Akademii nauk SSSR (Institute of Chemical Physics of the Academy of Sciences USSR)

PRESENTED: June 20, 1961, by V. N. Kondrat'yev, Academician

SUBMITTED: June 20, 1961

X

Card 3/5

41324

S/057/62/032/009/007/014
B125/B186

AUTHORS: Semenov, Ye. S., and Sokolik, A. S.

TITLE: Study of ionization in spherical flames by the method of probe characteristics

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 32, no. 9, 1962, 1074-1083

TEXT: The ion concentration distribution N(x) over the cross section of the flame zone in a centrally ignited spherical steel bomb (with two plane-parallel windows and two ignition electrodes) was measured by Langmuir's method of probe characteristics. The measurements were made with propane-air mixtures at pressures of 0.15 - 2 atm. When the flame passed the fixed probe an oscillogram was taken with a double-trace electron oscilloscope. The ionization current profile along the x-coordinate was determined from these oscillograms, using the equation $x = u_{vis}t$, u_{vis} being the visible flame velocity. The maximum concentrations of ions in the flame measured by two different methods are greater, by three or four orders of magnitude, than the thermodynamic equilibrium concentration calculated from the Saha equation. This fact indicates that the ions in

Card 1/4

the flames are immediately generated at the expense of the energy from the chemical elementary processes, and not by thermal ionization of the combustion products. The descending part of the concentration curve gives 10^{-7} cm^3/sec for the recombination coefficient. The diffusion coefficient D for the combustion products of hydrocarbons with ambipolar electron diffusion is $D \cong 20$ cm^2/sec at $p = 1$ mm Hg and 0^oC. The highest importance attaches to the convective term of the steady-state equation, followed by the recombination term, and lastly by the diffusion term. The boundary of the region in which ions are produced coincides almost with x_{max} in the current oscillogram. Here, the probe has zero potential with respect to the plasma. At subatmospheric pressures, the pressure dependences read $\delta \sim p - 0.8$ for the flame zone width, $\tau_{react} \sim p^{-0.7}$ for the reaction time, $W \sim p^{1.7}$ for the mean reaction rate, and $u \sim p^{-0.15}$ for the flame velocity. V. P. Karpov assisted in designing the experimental apparatus. There are 8 figures and 2 tables.

ASSOCIATION: Institut khimicheskoy fiziki AN SSSR, Moskva (Institute of Chemical Physics AS USSR, Moscow)

APPROVED FOR RELEASE: 08/25/2000 CIA-RDP86-00513R001651920018-8"

S/057/62/032/009/007/014
B125/B186

SUBMITTED: April 8, 1961 (initially)
June 25, 1961 (after revision)

Fig. 7. Structure of the flame reaction zone. Mixture containing 4.16% propane. Probe diameter 0.2 mm, p = 1 atm. N = ion concentration. Legend: q = ionization rates; T = temperature; j_o = current density in the probe at $U_3 = U_{3_o}$.

APPROVED FOR RELEASE: 08/25/2000 CIA-RDP86-00513R001651920018-8"

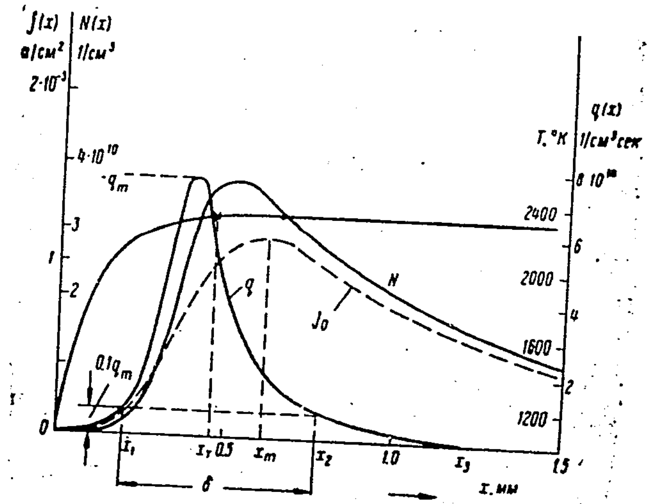
j(x) a/cm²
N(x) 1/cm³
2·10⁻³
4·10¹⁰
q_m
3
2
1
$0.1q_m$
0
q
N
J_0
T, °K
q(x) 1/cm³сек
8·10¹⁶
2400
6
2000
4
1600
2
1200
x_1
x_T 0.5
x_m
x_2
1.0
x_3
1.5
δ
x, мм

Fig. 7

39587
S/020/62/145/002/015/018
B145/B101

11.7200

AUTHORS: Semenov, Ye. S., and Sokolik, A. S.

TITLE: Characteristics of spherical flames in the state of formation

PERIODICAL: Akademiya nauk SSSR. Doklady, v. 145, no. 2, 1962, 369-372

TEXT: The characteristics of a flame in the state of formation were studied with a propane - air mixture (4.16% C_3H_8) at 250 mm Hg in a spherical bomb of 180 mm in diameter and ignition in the center. The velocity of flame propagation was measured by schlieren photography, the ionic current i was measured oscilloscopically with a single electrode probe (potential: 2 v) described earlier (ZhTF, 32, no. 9 (1962)) at the distance r = 10-30 mm from the point of ignition. The time dependence of the ion concentration N was obtained from the oscillographs of i at various r values. From this, the concentration at the distance x from the beginning of the ion formation zone was calculated by the apparent velocity U_v of flame propagation. The rate q of ion formation and thus also the profile q(x) were calculated from the equilibrium equation for

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B145/B101

Characteristics of spherical flames ...

the ions, since $\partial N/\partial t$ proved to be sufficiently small and could be put equal to zero even at small r values. The width δ of the reaction zone was calculated directly by means of U_v. δ increases as the point of ignition is approached, and exceeds the stationary value (1.2 mm at $r \geqq 35$ mm) by almost the tenfold at r = 10 mm. At the same time, q_{max} is reduced to 20-25% at r = 10 mm. Conclusions: In the state of formation the radius of the spherical flame has the same order of magnitude as the radius of the reaction zone. As soon as the radius of the reaction zone can be compared with the radius of curvation of the flame, the volume of the reacting gas is smaller than that of the heat-absorbing gas and the temperature is lower than the adiabatic temperature of the plane flame (with r = 10 mm, the difference is 250-300°C). Thus, the rate of combustion decreases. The values of the plane flame are reached but gradually. There are 4 figures. The English-language references are: E. F. Fiock, Ch. F. Martin, Jr., Chem. Rev., 21, 367 (1937); E. F. Fiock, Ch. F. Martin, Jr. et al., Nat. adv. comm. for aeronautics, Rep. no. 682 (1940).

Card 2/3

Characteristics of spherical flames ... S/020/62/145/002/015/018
B145/B101

ASSOCIATION: Institut khimicheskoy fiziki Akademii nauk SSSR (Institute of Chemical Physics of the Academy of Sciences USSR)

PRESENTED: March 15, 1962, by V. N. Kondrat'yev, Academician

SUBMITTED: January 16, 1962

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ACCESSION NR: AP4041761 S/0076/64/038/006/1660/1662

AUTHOR: Karpov, V. P.; Sokolik, A. S.

TITLE: Laminar and turbulent flames from hydrazine decomposition

SOURCE: Zhurnal fizicheskoy khimii, v. 38, no. 6, 1964, 1660-1662

TOPIC TAGS: hydrazine decomposition, rocket fuel, laminar flame, turbulent flame

ABSTRACT: The burning velocities of laminar and turbulent flames from hydrazine decomposition were determined as a function of pressure and temperature (1500—1900K) by Schlieren photography and oscillographic pressure recording in a duraluminum bomb equipped with mixing propellers and sight windows. The reaction rates of the laminar and turbulent flames were calculated on the basis of the thermal combustion theory and the pulsating combustion model, respectively. It was found that the kinetic characteristics are identical for both types of flame. The results provide evidence supporting the correctness of the pulsating model for turbulent combustion. Orig. art. has: 4 figures and 8 formulas.

ACCESSION NR: AP4041761

ASSOCIATION: Akademiya nauk SSSR, Institut khimicheskoy fiziki (Academy of Sciences SSSR, Institute of Chemical Physics)

SUBMITTED: 25Jun63 ATD PRESS: 3048 ENCL: 00

SUB CODE: FP NO REF SOV: 005 OTHER: 005

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L 13809-65 EPA/EWT(1)/EPA(s)-2/EWT(m)/EPF(c)/EPR/EPA(w)-2/EWP(j)/EEC(t)/T/EWA(m)-2 Pc-4/Paa-4/Pab-10/Pr-4/Ps-4/Pt-10 IJP(c)/SSD(a)/AFETR/AEDC(b)/AEDC(a)/AS(mp)-2/ ASD(d)/SSD/BSD/AFWL/AFTC(p)/ESD(t) WW/JW/JWD/RM

S/0076/64/038/007/1784/1790

ACCESSION NR: AP4042597

AUTHOR: Sokolik, A. S. (Moscow); Semenov, Ye. S. (Moscow)

TITLE: The nature of the chemical ionization of flames

SOURCE: Zhurnal fizicheskoy khimii, v. 38, no. 7, 1964, 1784-1790

TOPIC TAGS: hydrocarbon flame, ionization, chemical ionization, flame reaction, turbulent flame, laminar flame, detonation wave, combustion mechanism, thermal ionization, combustion

ABSTRACT: The most probable ionization mechanism in the reaction zone of hydrocarbon flames, $CH + O \rightarrow CHO^+ + e$, is based on the transport of active centers, mainly H atoms, within the reaction zone. The subsequent transfer of the proton to water: $CHO^+ + H_2O \rightarrow CO + H_3O$ is favored by small activation energy for the reaction, the short life of the CHO^+ ion, and the abundance of H_3O^+ in the system. The original CH radical had been formed by the reaction $CC + OH \rightarrow CH + CO$. The role played by diffusion exchange in the reaction zone is confirmed by results of the present investigation of the ionization in tur-

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bulent flames, which showed that the velocity pulsations are accompanied by fluctuations in the ionization current, and the maximum amplitude of the turbulent ionization current considerably exceeds (by 10-20 times) that of a laminar flame at the same temperature and increases with increased turbulence. Analysis of the available data on ionization in a detonation wave of hydrocarbon-oxygen mixtures leads to two alternative concepts of the combustion mechanism in a detonation wave: (1) in which chemical ionization is absent, or (2) where at a high level of thermal ionization the weaker chemical ionization is masked. The choice of one of these is possible from results obtained from ionization studies in the reaction zone of high temperature hydrocarbon-oxygen flames; if detonative combustion is a homogeneous reaction developed throughout the entire volume of the compressed gas, chemical ionization is not possible. If the process includes the formation of one or more reaction sites and the remaining volume of the compressed gas in the detonation wave is enclosed by the flame, either laminar or turbulent, then chemical ionization can originate in the reaction zone of the detonation wave. Orig. art. has: 7 figures and 4 equations.

L 13809-65
ACCESSION NR: AP4042597

ASSOCIATION: Akademiya nauk SSSR Institut khimicheskoy fiziki (Academy of Sciences SSSR, Institute of Chemical Physics)

SUBMITTED: 20Aug63 ENCL: 00

SUB CODE: FP, GC NO REF SOV: 004 OTHER: 009

Card 3/3

SOKOLIK, A.S.; SEMENOV, Ye.S.

Nature of the chemical ionization of flames. Zhur. fiz. khim. 38 no.7:1784-1790 Jl '64. (MIRA 18:3)

1. Akademiya nauk SSR, Institut khimicheskoy fiziki.

L 1715-66 EPA/EWT(m)/EPF(c)/ETC/EWP(f)/EWG(m)/EWP(j)/T/EWA(c)/ETC(m) RPL
DS/BW/WW/WE/RM
ACCESSION NR: AP5023687 UR/0076/65/039/009/2202/2207
541.126
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B

AUTHOR: Sokolik, A. S.; Semenov, Ye. S.

TITLE: Study of macrokinetic characteristics of turbulent propane flames by ionization current measurements

SOURCE: Zhurnal fizicheskoy khimii, v. 39, no. 9, 1965, 2202-2207

TOPIC TAGS: turbulent combustion, combustion, propulsion, combustion theory, ion current

ABSTRACT: Turbulent combustion of homogeneous gas mixtures was studied theoretically and by experiments in which the ionization currents of propane-air flames were recorded using an oscillograph. The mean pulsation periods θ_1 were found to be fully independent of the chemical nature of the fuel, the air-fuel ratio, and the combustion temperature. This proved that θ_1 is controlled by turbulence characteristics only. The oscillograms also showed longer intervals θ_2 between the instants when the ionization current decreases to zero, i.e., the periods of combustion between flame extinctions at the given measuring point. The mean reaction time $\overline{\tau}_r$ can be calculated from the mean value of $\overline{\theta}_2$ by the formula $\overline{\tau}_r = \overline{\theta}_2 \frac{\varepsilon + 1}{2}$, where ε is the

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ACCESSION NR: AP5023687

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volumetric expansion of the combustion mole. By comparing τ_r at various temperatures and pressures, the macrokinetic characteristics, i.e., the effective reaction orders and activation energies, can be calculated. Therefore, the macrokinetic characteristics can be obtained by two completely independent methods: ionization current measurements as discussed above and turbulent burning velocity measurements based on the pulsating ignition model. Orig. art. has: 9 formulas and 6 figures. [PV]

ASSOCIATION: Institut khimicheskoy fiziki, Akademiya nauk SSSR (Institute of Chemical Physics, Academy of Sciences SSSR) 44,55

SUBMITTED: 03Jun64 ENCL: 00 SUB CODE: FP

NO REF SOV: 008 OTHER: 001 ATD PRESS: 4095

Card 2/2

K

CZECHOSLOVAKIA/Optics - Physical Optics.

Abs Jour : Ref Zhur Fizika, No 12, 1959, 28401

Author : Sokolik, Bohuslav

Inst : -

Title : Electron Optical Measurements of Distances

Orig Pub : Slaboproudy obzor, 1958, 19, No 10, 678-681

Abstract : The author describes an electron optical range finder with a Kerr cell, which permits measuring distances from 20 meters to 20 km with an accuracy of ±1 and ±20 cm respectively. The receiving device compares the phases of the modulated direct and reflected rays. The modulation frequency is 5 -- 10 Mcs; the length of the light pulse is 0.3 microseconds approximately. -- Yu. M. Kutev

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96120
Z/024/60/006/005/001/001
A201/A126

3.2100
3.4000

AUTHORS: Delong, Bořivoj, Candidate of Techical Sciences, Engineer; Sokolík, Bohuslav, Engineer; Neuman, Přemek, Engineer.

TITLE: Electro-optical geodimeter of the VÚGTK

PERIODICAL: Geodetický a kartografický obzor, no. 5, 1960, 83 - 86

TEXT: The article describes the principle, design and performance of a new Czechoslovak geodimeter developed and built in 1959 jointly by the Výzkumný ústav geodetický, topografický a kartografický (Geodetic, Topographic and Cartographic Research Institute) in Prague, and the Ústav radiotechniky elektrotechnické fakulty ČVUT (Institute for Radio Engineering, Department for Electrical Engineering, ČVUT) in Prague. The theoretical basis of the instrument has been described in the 2nd collective volume of the Edice VÚGTK under the title "Research on the electro-optical geodimeter of the VÚGTK". The operating principle of the instrument is shown in Figure 1. The light source L emits isotropic light waves which are focused by the condenser K into the center of the annulus formed by the electrodes of the quartz crystal Kr, which acts as a light modulator in addition to its stabilization function. As a result, the quartz modulator Kr, together with two polarization foils P and A, of which the former acts as the polarizer and

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Electro-optical geodimeter of the VÚGTK

the latter as the analyzer, produce the amplitude modulation of the light waves. The modulated light is sent to the terminal point of the measured distance by the transmitting lens O_1. At the terminal point, the light is reflected by the mirror R and returns to the initial point of the measured distance. The reflected light strikes the receiving lens O_2 which focuses it onto the cathode of the photomultiplier F. The receiving system photoelectrically determines the phase difference between the transmitted and the reflected modulated light-waves on a low frequency. Therefore, the instrument is equipped with two oscillators: The main oscillator O operating on the 5 Mc frequency, and the auxiliary oscillator Po operating on a frequency differing from that of the main oscillator by 10 kc. The signal from the auxiliary oscillator is mixed in the mixer Sm with the signal from the main oscillator and with the signal from the last dynode of the photomultiplier. In this manner two low-frequency signals of the same frequency and of an unchanged phase relation are obtained which are fed to the synchronous detector Sd. Connected to the detector is the galvanometer G whose hand indicates the magnitude of the phase difference. When the galvanometer hand is set to zero, the measured distance D is given by the relation

$$2D = N \cdot L + 1 \quad (1)$$

where N is the integral amount of modulated light-wave lengths, L is the modulation

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Electro-optical geodimeter of the VÚGTK

wave length, and l is the increment which is a function of the phase difference φ

$$l = \frac{\varphi}{2\pi} \cdot L. \qquad (2)$$

The zeroing of the galvanometer hand is done by the phase shift of the signals from the main oscillator and from the mixer in relation to the signal from the photomultiplier. This phase shift is made possible by the phasing element which in turn has two elements: The rough-phasing element, Fh, by which the phase is shifted over the range of 0-180° in ten steps of 18°, each step representing a change in distance of 1.5 m; and the fine-phasing element Fj, by which the phase is shifted continuously over 20° providing for sufficient overlapping of the adjacent steps. At zero position of the galvanometer hand, the value can be determined from the readings of the rough and the fine-phsing element scales using equation (2). The value N in equation (1) can be determined from the results of the distance measurements with two different modulation frequencies according to the relation

$$N = \frac{l_2 - l_1}{L_1 - L_2}$$

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where L_1, L_2 are the respective modulation wavelengths pertaining to the modulation frequencies F_1 and F_2 respectively, and l_1, l_2 are the respective increments. The modulation wavelength L is calculated from the modulation frequency of the oscillator F using the relation

$$L = \frac{v}{F},$$

where v is the light velocity in the atmosphere. The polarization foils are the only foreign components used in the instrument. The metacrylate-base foils, developed by the Meopta Bratislava n. p. (Meopta Bratislava, National Enterprise) in cooperation with the národní podnik Meopta Praha (Meopta Praha, National Enterprise) have proved to be unsatisfactory since they were ineffective for the marginal values of the spectrum and, consequently, could not be employed with the high-performance photomultiplier, developed by the Výzkumný ústav vakuové techniky (Research Institute of Vacuum Engineering), which is used in the receiving part of the instrument and which has its best spectral sensitivity in the region of the lower boundary of the visible spectrum. The quartz modulator of the instrument consists of a polished quartz plate of the BT crystal section and of annular contact electrodes which are pressed against the crystal by two steel springs. The entire assembly is mounted in a modified "Telefunken" crystal holder. (Previous models prepared by the Výzkumný ústav elektrotechnické keramiky (Research

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Electro-optical geodimeter of the VÚGTK

Institute of Electrotechnical Ceramics) in Hradec Králové, and subsequently by the Výzkumný ústav pro elektrotechnickou fysiku (Research Institute of Electrotechnical Physics) in Prague, using vapor-deposited electrodes (silver, gold, aluminum, and silver-aluminum) were found inadequate due to their instability). The optimum modulation effect of the modulator is in the vicinity of the parallel resonance of the crystal. A modulation depth of about 0.4 was obtained at about 70 v. This depth is sufficient for the measurement of short distances. For the main oscillator a connection was chosen in which the modulating crystal is the element which determines the oscillator frequency. This arrangement secures a frequency stability in the order of 5×10^{-5} which is adequate for the testing stage of the instrument and for measurements of short distances. For the auxiliary oscillator a connection with crystal control was used since the stability of this oscillator determines the stability of the differential frequency. For the rough phasing element a delay chain, shown in Figure 2, was used. Fine phasing is done by the element the wiring diagram of which is shown in Figure 3. By a simultaneous, continuous variation of the resistors R_1 and R_2, the phase difference between the voltages E_1 and E_2 can continuously be varied. The scale of the element is graduated in 100 parts permitting a reading of the measured distance with an accuracy within 1.5 cm. The synchronous detector is formed by two 6H31

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Electro-optical geodimeter of the VÚGTK

vacuum tubes in bridge connection, with the galvanometer connected between their anodes. The signal from the photomultiplier is fed to the first two grids in phase, the signal from the main oscillator is fed, after mixing, to the third grids in the opposite phase. The optical system is of temporary nature, as readily available components had to be used in its construction. Normal camera lenses with a focus distance of 100 mm and an F-number of 1:2.8 were used for the transmitting and the receiving lenses. A point tungsten bulb of 30 watt (6v, 5a) serves as the light source. Tests with this instrument showed that this optical system has a range of about 250 m which is rather little. For geodimeters with longer ranges optical systems consisting of lenses and mirrors, such as one used in the NASM-2A geodimeter, will have to be used. It is planned to replace the temporary optical system with a new one, specially designed for the specific uses of this geodimeter. The new optical system will extend the range of the instrument to 2-3 km. The geodimeter has been tested under laboratory conditions only. It was found that the instrument was capable of indicating distance changes above 5 cm. This value represents the inherent error of the phasing element which is independent of the distance measured. Also there is the error due to the instability of the frequency. Consequently, the mean error in each measurement can be determined from the relation

$$m = \pm (5 \cdot 10^{-5} \cdot D + 5 \text{ cm})$$

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Electro-optical geodimeter of the VÚGTK

where D is the distance measured. The accuracy of the instrument can be improved by improving the frequency stability of both oscillators and by a more precise execution of some of the electronic components. The geodimeter weighs little over 5 kg and is mounted on a tripod. The power supply has about the same weight. Laboratory tests have confirmed the soundness of the original design conception and the capability of the instrument of measuring geodetic distances. Further development will be aimed at the improvement of the optical system and of the stability of the crystal frequency. There are 5 figures and 3 Soviet-bloc references.

ASSOCIATION: VÚGTK, Praha (VUGTK, Prague) (B. Delong); Ústav radiotechniky, Praha (Institute of Radio Engineering, Prague) (B. Sokolík and P. Neuman).

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Z/030/60/000/011/001/002
A121/A026

3,4000

AUTHORS: Neuman, F.; Sokolik, B.; Delong, B.; - Engineers

TITLE: Electro-Optical Range Finder With Quartz Modulator

PERIODICAL: Jemná Mechanika a Optika, 1960, No. 11, pp. 336 - 342

TEXT: The prototype of an electro-optical range finder with quartz modulator, range up to 3 km, mounted on a tripod (Fig. 8), has been developed in cooperation of the Výzkumný ústav geodeticki, topograficki a kartograficki (Geodetic, Topographic and Cartographic Research Institute) in Prague and the Ústav radiotechniky elecktrotechnické fakulty ČVUT (Radiotechnical Institute at the Electrotechnical Faculty of ČVUT) in Prague, and was constructed by the Výzkumný ústav elektrotechnické keramiky (Electrotechnical Ceramics Research Institute) in Hradec Králové. Figure 1 shows its block-diagram; the upper part is the transmitting system, the lower part the receiving system. A description of the main component parts is given. Equation (1) is the basic equation of the measured distance D at the initial galvanometer adjustment; Equation (2) serves for the precise computation. The author develop the quartz modulator theory, discuss the maximum modulation effect arising in case of rectangular angle adjustment of the

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polarizer and analyzer oscillation direction, whereby this angle is parted by the plane formed by the optical axis of the crystal and the direction of the transmitted light (Equations 3, 4; Figs. 2, 4). Equation (5) expresses the relative electro-optical transmission factor of the modulator, the graphic representation of which is called the electro-optical phenomenon characteristic (Equation 6 and Fig. 3). Equations (7) to (14) serve for the computation of the quartz modulator characteristic. Applying Equations (13), (14) (Refs. 1, 2, 3 and 5), (15), (16) and using a 125 v biassing modulator, the Equations (17) and (18) are obtained, showing the effective voltage Ve and, by comparison of Equations (18) and (6), the constant $k_1 = 6.28 \cdot 10^{-3}$. The maximum electro-optical transmission at a modulating voltage v = 125, achieved by double refraction of light in the quartz crystal (V_p = 125 v) is according to Figure 3 too high and will cause deformations; therefore, the amplitude of up to 100 v is being chosen corresponding to a modulation depth of 0.90. A comparison with the Kerr modulator, a description of the quartz modulator current capacity (Fig. 5) amounting to 1.8 w at 100 v modulating voltage, and a description of constructional elements is given. Czechoslovak polarizing foils (Meopta Bratislava), tested at the Meopta Laboratory in Prague, were not found suitable; the maximum spectrophotoelectric sensitivity of the receiving system's photomultiplier tube, supplied by the Výzkum-

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A121/A026

Electro-Optical Range Finder With Quartz Modulator

ný ústav vakuové techniky (Vacuum Engineering Research Institute), is in the lower region of the visible spectrum (blue color); therefore, foils from abroad were used. A detailed description of the prototype quartz modulator follows. A modulation depth of about 0.4 has been obtained at a modulation voltage of 70 v. A phase comparison between emitted and reflected modulated light waves may be photoelectrically performed at low frequency; therefore, the apparatus is equipped with two oscillators, i.e., the main oscillator O and the auxiliary oscillator Po (Fig. 1). The low-frequency signal of about 10 kc/sec oscillation frequency arising by transformation of modulated light in the photomultiplier cathode, the arrangement of synchronized detectors (Sd), the phase adjustment and phase change, whereby each phase difference of 18° is equal to a change of about 1.5 m in distance, total phase range 0 - 180° are described. A reciprocal functional replacement of both oscillators, described in detail, is ensured. Figure 6 shows the phasing element (Fh) diagram consisting of a phase-shifting section ending with its characteristic resistance. Figure 7 shows the diagram of the fine phasing element (Fj); two 6H31 electrone tubes in bridge connection serve as synchronized detectors (Sd) with attached galvanometer). A common 100 mm lens, 1 : 2.8, is used as condenser and transmitting-receiving objective; a 30 w, 6 v, 5 amp tungsten lamp serves as light-source. The computed range amounts

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Electro-Optical Range Finder With Quartz Modulator

to 250 m, the laboratory tests were performed at a distance of 55 m. A lens-reflector system as used at the NASM-2A type geodimeter should be applied to obtain a range-finder of longer measuring range. The mean error in range-finding is expressed by Equation on Page 342 (D = measured distance). The range finder and the feeding apparatus weigh 5 kg each. Figure 8 shows the control panel, Figure 9 the inner arrangement of the emitting system, Figure 10 the quartz modulator of light, and Figure 11 the coarse-phasing equipment. Further development requires an accomplishment of the range finder's optical system and stability-increase of the crystal frequency. There are 8 references: 1 Swedish, 2 English, 3 Czechoslovak amd 2 German.

ASSOCIATIONS: Ústav radiotechniky ČVUT (Radiotechnics Institute of ČVUT), Prague (Neuman and Sobolík); Výzkumný ústav geodetický (Geodetic Research Institute), Prague (Teicng)

SUBMITTED: February 29, 1960

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22357

Z/023/61/000/001/002/006
A207/A126

3.4000

AUTHORS: Delong, Bořivoj; Sokolík, Bohuslav, and Neumann, Přemek

TITLE: Electrooptical distance meter with quartz modulator

PERIODICAL: Studia Geophysica et Geodaetica, no. 5, 1961, 8 - 20

TEXT: In 1959, an electrooptical distance meter - the first instrument of its kind in Czechoslovakia - was developed for measuring geodetic distances, by the Research Institute of Geodesy, in co-operation with the Institute of Radio Engineering. The distance meter can determine the phase difference of the emitted and reflected modulated light waves on a low frequency by an electronic method. It has 2 oscillators: a primary one O, with a frequency of 5 Mc/s, and a secondary one P_o, with a frequency differing from that of the former by about 10 kc/s, (Fig. 1). The upper part of the scheme represents the transmitting system, the lower part the receiving system. The source L emits a beam of white light conducted by the condenser K to the center of the spherical ring, formed by electrodes of the quartzite modulator K_r. The latter, together with 2 thin polarized plates P and A, the first of which acts as a polarizer and the second as an analyser, per-

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Electrooptical distance meter with...

form the light modulation depending on the amplitude. The modulated light passes through the transmission lense O_1 and is passed on to the reflector R located at the other end of the measured line. The light beam emanating from the latter is returned to the initial point of the measured line. If instrument and reflector are properly located as to direction, the reflected light passes through the receiving lense O_2 which then directs it to the photomultiplier F cathode. The signal from the auxiliary oscillator is mixed with the signal from the main oscillator in the mixer S_m and also with the signal from the photomultiplier F on its last emission electrode. Two low-frequency signals are thus produced having the same frequency with unchanged phase ratios, which are led to the synchronous detector S_d. A galvanometer G is connected to the synchronous detector and indicates the phase difference. When the dial of the galvanometer is on zero, the following relation is valid for the measured distance D:

$$2D = NL + l \quad (1),$$

where N is the whole number of modulation wave lengths, L - the wavelength of modulation and l - the residual which is a function of the phase difference φ:

$$l = \frac{\varphi}{2\pi}L \quad (2).$$

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Electrooptical distance meter with...

The galvanometer indicator is set to zero by the phase shift of the signal from the main oscillator and from the mixer with regard to the signal from the photomultiplier. This, in turn, is done by the phase shifter which has 2 parts: One for rough phasing Fh, by which the phase position is changed by jumps, and one for fine phasing Fh, by which the phase of the signal between the neighbouring rough phase position is changed smoothly. The scales of the rough and fine phase shifters provide data at the zero position of the galvanometer from which the measured length is determined. The mean error of one measurement of length is expressed by the relation

$$m_D = \pm(5 \times 10^{-5}D+5 \text{ cm}).$$

The wavelength of the modulation L is obtained from the modulation frequency of the oscillator F from the relation L = v/F, where v is the speed of light distribution in the atmosphere. The elctro-optical effects used in the electro-optical distance meters described are linear in the quartzite modulator. The latter is based on the validity of Hook's law. The authors have attempted to determine the conditions for the design of a modulator where a maximum modulation effect is achived. This maximum effect is reached at maximum changes in the ratio of the light beam emanating from the mod-

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Electrooptical distance meter with...

ulator to the light beam entering it. It is assumed that the relative permeability of both polarization plates and that of the artificial anisotropic medium of the modulator is equal to 1. The amplitudes of the light oscillation are determined from the relation

$$A_o = a \sin\alpha \ \sin\beta \ , \ A_e = a \cos\alpha \ \cos\beta \qquad (3),$$

where a is the amplitude measured. Since the light beam is directly proportional to the square of the amplitude of the light oscillations, the expression

$$F = F_o\{\cos^2(\alpha-\beta) - \sin 2\alpha \sin 2\beta \sin^2 \tfrac{1}{2}\varepsilon\} \qquad (4)$$

is derived, where F_o is the light beam entering the modulator and F - the light beam coming out of the modulator. It is concluded that the maximum modulation effect in the quartzite modulator takes place when the directions of oscillations of the polarizer and the analyser form an angle of 90°, and when this angle divides the plane in two, formed by the optical axes of the crystal and the direction of the passing light. The relative electro-optical permeability of the modulator is determined from the ratio of the light beams F and F_o:

$$T_m = F/F_o = \sin^2 \tfrac{1}{2}\varepsilon \qquad (5),$$

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Electrooptical distance meter with...

where $\mathcal{E}$ is the phase difference. Equation

$$T_m = \sin^2 k_1 V \qquad (6),$$

derived from equation (5), gives the characteristics of the linear electro-optical phenomenon. An equation characterizing the quartzite modulator is derived by replacing the phase difference $\mathcal{E}$ of the usual and unusual beams by their refractive index:

$$\Delta t = t_e - t_o = l(1/v_e - 1/v_o) \qquad (7),$$

where the speed of the ordinary beam in an anisotropic medium is the v_o and the speed of the unusual beam - v_e; t_o - time needed by the usual beam to pass in the anisotropic medium; l and t_e - the time needed by the unusual beam to pass the same distance. The final equation representing the characteristics of the quartzite modulator is given as

$$T_m = \sin^2 \left\{ \pi \left(C \frac{l}{\lambda} - \frac{\Delta n_o}{\Delta E} \frac{V}{300\lambda} \right) \right\} \qquad (14).$$

The phase difference of the usual and unusual beams of the quartzite crystal is found to be, according to

$$\mathcal{E} = 2\pi l/\lambda \cdot (n_e - n_o) \qquad (8),$$

where n_e and n_o are the refractive indices:

$$\varepsilon = 2\pi\left(C\frac{1}{\lambda} - \frac{\Delta n_0}{\Delta E}\,\frac{V}{300\lambda}\right), \qquad (13).$$

From the latter formula it is concluded further that, with a change in voltage, the thickness of the crystal will also change within small limits, and that the change in this thickness will effect only the constant element - the phase difference ε - and will not affect the element, altered with the voltage. It is pointed out that distance meters working with quartzite modulators consume much less power, they are lighter and more easily transportable, as compared to distance meters with Capp's modulators. The modulation voltage was estimated at being as high as 100 v, and it is also pointed out that, if the quartzite modulator works accurately according to the resonance frequency, the modulation voltage should not come even close to the value of 100 v. The greatest range of the distance meter is found to be limited to 250 m for the time being, due to the optical system used. However, the authors note that if the present optical system is replaced by a system especially developed for the given purpose, distances up to 2 or 3 km may be obtained without difficulty. The distance measuring unit of the instrument rests on a normal tripod and weighs over 5 kg. The power block has approximately

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A207/A126

Electrooptical distance meter with...

the same weight but somewhat smaller dimensions. In conclusion the authors state that laboratory tests of the electrooptical distance meter model with a quartzite modulator showed the validity of the initial assumptions and the suggested principle, and also the expediency of the applied method for measuring geodesic distances. Further perfection of the instrument would involve an improvement of the optical system and an increase in the stability of the crystal frequency. These measures would lead to an increase of the range and of the accuracy of the instrument. There are 7 figures and 8 references: 5 Soviet-bloc and 3 non-Soviet-bloc. The reference to the English-language publication reads as follows: E. J. Post: Note on Safe Resonator Current of Piezoelectric Elements. Proc. IRE, 40 (1952), 7, 835.

ASSOCIATION: Issledovatel'skiy institut geodezii, Praga (Research Institute of Geodesy, Prague), (Delong); Kafedra radiotekhniki elektrotekhnicheskogo fakul'teta Prazhskoy politekhniki (Institute of Radio Engineering of the Electrotechnical Department, Prague Polytechnic), (Sokolík and Neumann)

SUBMITTED: March 1, 1960

Card 7/8

SOKOLIK, E.

Treatment of severe cases of ocular burns. Cesk. ofth. 9 no.3:222-225 June 1953. (CLML 25:4)

SOKOLIK, E., MUDr.

Considerations on the theory of vision on the principle of television. Cesk. ofth. 13 no.2:95-98 Apr 57.

1. Ocny lekar, Ruzomberok.
(VISION, physiol.
comparison with principle of television (Cz))
(TELEVISION
principle, comparison with theory of vision (Cz))

PETRUNYA, S.P., kand.med.nauk; SOKOLIK, E.Ye., ordinator

Cornea transplantation in children. Oft. zhur. 16 no.5:276-281 '61. (MIRA 14:10)

1. Iz Luganskoy oblastnoy klinicheskoy bol'nitsy.
(CORNEA--TRANSPLANTATION)

Sokolik, G.

530.145

1979. THE THEORY OF PARTICLES OF ARBITRARY ISOTOPIC SPIN AND THE METHOD OF FUSION. D.Ivanenko and G.Sokolik.
Dokl. Akad. Nauk SSSR, Vol. 97, No. 4, 635-7 (1954). In Russian.

De Broglie's method of fusion is extended to include isotopic as well as ordinary spin. An equation of Paris (Abstr. 2008/1954) is discussed as a particular case of the theory.

Mathematical Reviews

FD-1883

SOKOLIK, G. A.

USSR/Nuclear Physics - Fusion

Card 1/1 Pub. 146-3/21

Author : Sokolik, G. A.

Title : Remarks on the theory of fusion

Periodical : Zhur. eksp. i teor. fiz. 28, 13-16, 1955

Abstract : Generalizes the theory of de Broglie (Theorie generale des particles a spin, Paris 1943) in adapting it to equations of infinite dimensions. Four USSR and four foreign references.

Institution: Moscow State University

Submitted : February 25, 1955

SOKOLIK, G. A.

USSR/ Physics - Bose-Einstein field

Card 1/1 Pub. 22 - 9/51

Authors : Sokolik, G. A.

Title : Regarding the theory of relativistically invariant non-linear equations

Periodical : Dok. AN SSSR 101/5, 817-820, Apr. 11, 1955

Abstract : There is a description of a method by which all relativistically invariant non-linear equations, used for the presentation of the Bose-Einstein field can be found. By this method, non-linearity can be interpreted as some physical property of the Lorentz' space group and it is analogous to the spin of a particle in ordinary space. Seven references: 6 USSR and 1 French (1943-1955).

Institution : M. V. Lomonosov's State University, Moscow

Presented by : Academician N. N. Bogolyubov, December 28, 1954

SOKOLIK, G. A.

B-4

USSR/Theoretical Physics - Quantum Mechanics.

Abs Jour : Ref Zhur - Fizika, No 4, 1957, 8413

Author : Konstantinova, E.I., Sokolik, G.A.
Inst : Physics Institute, Academy of Sciences, USSR.
Title : Two-Dimensional Schroedinger Equation and Representations of the Group of Plane Motions.

Orig Pub : Zh. eksperim. i teor. fiziki, 1956, 30, No 2, 430-431

Abstract : Irreducible unitary representations of the group of plane motion are derived -- they have an infinite number of dimensions, are given by the β numbers, and are realized in the space of Bessel functions. The representations do not contain the maximum vectors, and consequently all the representations of the group of plane motion turn out to be irreducible. It is particularly advantageous to classify the states of quantum two-dimensional system, given by the Schroedinger equation, in accordance with the above representations. All the states of the system given by the new quantum number turned out to be pure in this case.

Card 1/1

Sokolik, G. A.

1

Sokolik, G. A. Classification of non-linear equations and relativistically invariant interactions by representations of the Lorentz group, and the fusion theory. Dokl. Akad. Nauk SSSR (N.S.) 106 (1956), 429–432. (Russian)

The method of the author's earlier paper [Dokl. Akad. Nauk SSSR (N.S.) 101 (1955), 817–820; MR 17, 331] is here applied to the classification of types of non-linear relativistic equations. In particular, the classification is outlined for a single spinor field, and for a Fermi field interacting with a Bose field. The results are shown to be generalizations of those obtained by de Broglie's "method of fusion". *F. J. Dyson* (Princeton, N.J.).

Moscow State Univ im M. V. Lomonosov

56-6-34/47

AUTHOR: Sokolik, G. A.

TITLE: Interpretation of the "Anomalous" Representation of the Inversion Groups (Interpretatsiya "anomal'nogo" predestavleniya gruppy inversiy)

PERIODICAL: Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, 1957, Vol. 33, Nr 6, pp. 1515 - 1516 (USSR)

ABSTRACT: The operators of "anomalous" representation satisfy the condition:

$$\left[T_{i'k'} \quad T_{i''k''}\right]_+ = 0; \; i, k = 0, 1; \; i \neq k.$$

For the case of a scalar representation of the entire Lorentz group the "anomalous" representation is equivalent to the expression of a parity doublet.

It is shown that the interpretation of the "anomalous" representation of inversion groups of the four-dimensional space is possible by means of terms of a five-dimensional orthogonal eigen-group with a pseudoeuclidian metric. There are 4 references, 3 of which are Slavic.

Card 1/2