Passage of Random Signals through a System with Variable Parameters, G. I. Rozhkova and V. S. Etkin, pp. 1364–1366.

In another paper an investigation was made of the problem of the passage of a weak random signal with carrier frequency ω through a nonlinear line, excited simultaneously by a periodic signal of frequency 2ω. It was shown that the phase of the weak output signal may be found only in one of the two rather narrow regions, located π apart, whereby under the specific conditions the relative times that the phase remains in these regions are determined solely by its statistical characteristics at the input of the line. On this basis a conclusion was drawn concerning the possibility of application of a similar system as a phase filter, in which the criterion of the existence of the signal is the variation of the relative time of the output phase existing in one of the possible states.

A comparison of the proposed system with the simplest circuit with variable parameters reveals a complete analogy in their action on a weak random signal. Thus, the input signal and the increase of the percentage modulation of the parameter in the circuit are compared with the boundary condition and the progress along the line (accompanied by an increase of amplitude of the signal).

RUSSIAN JOURNAL OF PHYSICAL CHEMISTRY (*Zhurnal Fizicheskoi Khimii*). Published by The Chemical Society, London

Number 2, 1962

Frozen Radicals and a Higher Peroxide of Hydrogen. VI. Magnetic Properties of Peroxide—Radical Condensates, I. I. Skorokhodov, L. I. Nekrasov, N. I. Kobozev, and V. B. Evdokimov, pp. 136–140.

The previous systematic investigation of peroxide-radical condensates obtained by different methods has shown that they are complicated systems containing, in addition to water and hydrogen peroxide, a higher peroxide of hydrogen (H_2O_4) and frozen HO_2 radicals. The results have enabled us to determine the heat of formation of the compound H_2O_4 from the elements, its heat of decomposition into H_2O_2 and O_2, and also the activation energy of the latter reaction. The presence of HO_2 radicals in peroxide-radical condensates has been observed directly by the electron-paramagnetic-resonance method.

However, in spite of all the data obtained, it has not proved possible to establish the structure of the H_2O_4 molecule. An attempt may be made to obtain some information on this point by a magnetic method. We have therefore measured the magnetic susceptibility of the peroxide-radical condensate both before and during decomposition.

Summary:

1) A study has been made of the magnetic properties between −150° and 20° of peroxide–radical condensates prepared both from dissociated water vapor and by reaction of atomic hydrogen with liquid 100% ozone.

2) Before the start of decomposition (below −110°) peroxide-radical condensates represent feebly diamagnetic systems with a susceptibility of $-(0.1\text{–}0.2) \times 10^{-6}$ emu. As the temperature rises, an increase in paramagnetism is observed, associated with the appearance in the tube of oxygen evolved by decomposition of the peroxide-radical condensate.

3) The results show that the molecular oxygen evolved on decomposition is not at present adsorbed or occluded in the condensates but is formed by decomposition of the unstable compound H_2O_4, a higher peroxide of hydrogen.

4) The magnetic susceptibility of the compound H_2O_4 has been estimated as 0 to -0.4×10^{-6} emu, which indicates that the valences in this compound are saturated and that it evidently has a chain structure:

$$H—O—O—O—O—H$$

Nomogram for Calculating the Composition of Liquid Filters Having a Specified Transmission Maximum in the Visible Spectrum, D. P. Shcherbov, pp. 177–180.

Narrow-band light filters having any specified transmission maximum in the visible region of the spectrum can be prepared by combining two colored solutions of inorganic substances, and are easily accessible. The chief substances selected here are usually available in chemical laboratories and, in contrast to organic dyes, readily yield reproducible spectroscopic properties on simple recrystallization of the original salts. Cells for liquid light filters are easily made of Perspex or from glass for photographic plates, glued together with glyptal.

Summary: A nomogram is proposed for calculating the composition of narrow-band liquid light filters composed of two solutions of colored inorganic substances. The nomogram enables light filters to be prepared with a specified transmission maximum in any part of the visible spectrum, and the absorption limits and spectral width of these light filters to be calculated. The discrepancies between experimental and calculated values do not usually exceed 3–5 mμ.

Number 3, 1962

Emmision Spectrum during Detonation of a Solid Explosive in a Vacuum, V. A. Dement'ev and V. N. Kologrivov, pp. 240–242.

Apart from the work of Alentsev et al. there are no data in the literature on the energy spectrum during detonation of explosives. Investigation of such spectra may provide information on the physical and chemical processes in the reaction zone and on the temperature of the material during detonation. It is also important in connection with experimental techniques, since it may permit appropriate parts of the spectrum to be selected for temperature measurement by brightness, color, or other methods.

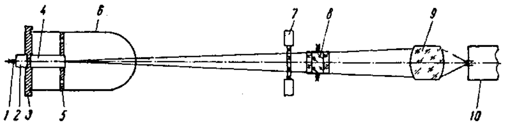

Fig. 1 Diagram of the apparatus: 1) detonating capsule; 2) tablet of TG 50/50; 3) lid; 4) charge; 5) supporting ring; 6) flask; 7) light source; 8) explosion-resistant diaphragm; 9) lens; 10) spectrograph.

In such experiments serious difficulties arise due to the high rate of the process and due to the shock wave formed on detonation in air, since its temperature is higher than that of the detonating charge itself. On the suggestion of M. A. Sadovskii, Corresponding Member of the USSR Academy of Sciences, we undertook experiments on the detonation of explosives in air under reduced pressure, where the air shock wave does not interfere with the observation of the glow of the detonating charge. Photographs obtained on an SFR photorecorder showed that when the detonation wave leaves the end-face of the charge in a vacuum there is a momentary glow, lasting approximately 1 μsec. The spectral range of such glow for charges of TG 50/50 was investigated in the present work.

Formation of Ozone from Dissociation Products of Carbon Dioxide in a Glow Discharge, I. V. Nikitin and E. N. Eremin, pp. 320–323.

Ozone is usually obtained from oxygen at pressures close to atmospheric in a barrier discharge, i.e., in a discharge effected with the aid of one or two dielectric (most often glass) barriers. An instrument of this sort is usually called an ozonizer, and has been the subject of numerous investigations, in particular by Filippov together with Yu. M. Emel'yanov, V. P. Vendillo, Yu.

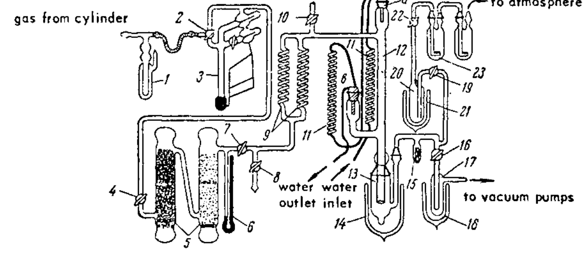

Fig. 1 Diagram of the apparatus for the synthesis of ozone in a glow discharge: 1) manostat; 2, 4, 7, 8, 10, 16, 19, and 22) taps; 3) flow meter; 5) columns; 6) manometer; 12) discharge tube; 13, 17, and 20) traps; 14, 18, and 21) Dewar vessels; 15) LT-2 thermocouple gage; 23) absorber with KI solution.

N. Zhitnev, and V. G. Samoilovich.

It is also known that ozone is formed when the dissociation products of oxygen are frozen out at the temperature of liquid nitrogen. Ushakova and Eremin began a study of the formation of ozone from the products of dissociation of carbon dioxide in a glow discharge, and the present work continues this investigation.

Summary:

1) A study has been made of the formation of ozone from the products of dissociation of carbon dioxide in a glow discharge (at 0.8–1.15 mm Hg and 50–400 mA).

2) Under the conditions investigated carbon dioxide dissociates in the discharge only to carbon monoxide and oxygen: $CO_2 \rightleftharpoons CO + O$.

3) The effectiveness of the discharge depends on the current. For this reason, the degree of conversion of carbon dioxide to ozone is not a function exclusively of the specific energy, as is sometimes observed in other reactions.

4) In a number of cases the yield of ozone is proportional to the gas flow rate (is a hyperbolic function of the reaction time), so that, regardless of the reaction time, a steady-state degree of dissociation of carbon dioxide is set up at the given current.

5) The walls of the trap, cooled with liquid nitrogen, are the main site of the formation of ozone; here the previously formed oxygen molecules combine with oxygen atoms.

Adsorption of Gases on Metals, N. N. Kavtaradze, pp. 328–329.

1) Adsorption of gases on condensed metal layers is of two types: rapid reversible and irreversible or partially reversible.

2) The reversible adsorption is associated with the formation of gas-metal chemical compounds.

Number 4, 1962

Steady-State Concentrations of Nitric Oxide in the Electric Discharge. IV. Influence of the Composition of the Initial Mixture, A. N. Mal'tsev, E. N. Eremin, and I. N. Meshkova, pp. 405–409.

Summary:

1) A study has been made of the variation with the current of the steady-state concentrations of nitric oxide [(% NO)$_\infty$] in the synthesis of the latter from "reciprocal air" (N_2:O_2 = 18:82) and the stoichiometric mixture (N_2:O_2 = 46:54) in an electric discharge, at pressures of 50, 100, 200, and 300 mm Hg.

2) The variation is similar to that established earlier for air: at low pressures (% NO)$_\infty$ increases with the current and tends to a limit, which is approximately independent of the pressure; at higher pressures the concentration of NO passes through a maximum, which is close to the limit observed at lower pressures.

3) The limiting steady-state concentrations of nitric oxide are 5.5% for air, 8.1% for the stoichiometric mixture, and 6.8% for "reciprocal air." Although the limiting values of (% NO)$_\infty$ are different for air and "reciprocal air," the values of (% NO)$_\infty$ at low currents are similar for the two mixtures.

4) Volt-ampere characteristics have been obtained for the discharge in air, "reciprocal air," and the stoichiometric mixture. Contrary to expectation, the highest discharge voltage was found for air and the lowest for "reciprocal air."

5) Photographs of the voltage oscillograms for the mixtures studied show that the discharge-voltage curves corresponding to oxygen-rich mixtures exhibit high-frequency vibrations (1500–2000 c/s).

Applicability of Boltzmann's *e*-Theorem to Real Systems, I. P. Vyrodov, pp. 458–460.

The application of Boltzmann's *e*-theorem to real systems leads to a fundamental solubility equation, which in some cases describes fairly satisfactorily the solubility of gases and the miscibility of liquids. Elsewhere, the theorem has been applied to surface phenomena in solutions and experimentally justified for metals and alloys. It has been pointed out, however, that hypotheses based on Boltzmann's *e*-theorem cannot be applied to a heterogeneous equilibrium. In particular, it is stated that the theorem is not applicable to liquid-vapor and liquid-solid equilibrium systems. In the present paper the problem of the applicability of Boltzmann's *e*-theorem to equilibrium systems is solved in a slightly different aspect.

Summary: It has been established that Boltzmann's *e*-theorem is applicable to real equilibrium systems only if the mean value of the potential energy of the system U_a is independent of temperature and if the kinetic energies of the particles satisfy a relation given.

Measurement of Small Temperature Differences Using Thermistors, S. N. Gadzhiev, M. Ya. Agarunov, and K. A. Sharifov, pp. 472–473.

The technique of measurement described can be used whenever small temperature differences (2–3°) are to be determined with an accuracy of 0.0005°.

Number 5, 1962

Apparatus for Measuring Sorption from a Gas Stream, G. M. Panchenkov and I. M. Kuvshinnikov, pp. 587–589.

Ordinarily adsorption of gases and vapors is studied by a static method under vacuum conditions. But this method is awkward or even impossible in some instances, as for example when the sorption process occurs at high vapor pressures and high temperatures, or in the study of adsorption from a gas stream at atmospheric pressure. Such processes are often met in industry, and need detailed investigation. In a static apparatus one cannot study sorption at a high temperature and at a sorbate pressure greater than its saturated-vapor pressure at room temperature, since the vapor would start to condense on the unheated parts of the equipment. In such cases it is convenient to investigate the sorption under dynamic (stream) conditions; recent researches have shown that this method is no less accurate than the vacuum technique.

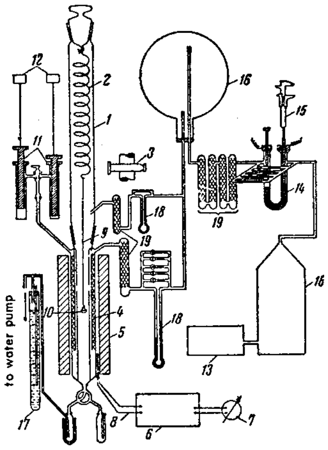

Fig. 1 Apparatus for measuring sorption from a gas stream.

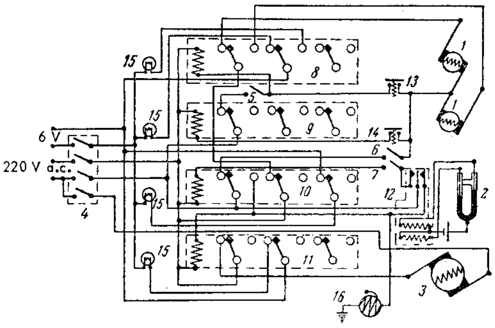

Fig. 2 Electrical circuit of the apparatus: 1) SD-2 synchronous motor; 2) mercury flow-meter; 3) pressure-pump motor; 4–7) switches; 8–11) relays; 12) polarized relay RP-5; 13 and 14) displacer contacts; 15) signal lamps; 16) bell.

This paper describes an apparatus for studying sorption from a stream of sorbate vapor. It is based on the design of Panchenkov and Skoblo, with considerable modification to improve accuracy and reliability. This equipment is simple in construction, occupies little space, and is not temperamental in operation.

Electrical Synthesis of Ozone. V. Synthesis of Ozone in a Flow at Reduced Pressures, V. G. Samoilovich, V. P. Vendillo, and Yu. V. Filippov, pp. 517–519.

Though the synthesis of ozone in ozonizers is usually carried out at pressures close to atmospheric or somewhat higher, study of the synthesis at reduced pressures is of considerable interest in connection with the kinetics of the process.

The formation of ozone below atmospheric pressure has been discussed by a number of investigators. According to Warburg, in the range 50–200 mm Hg the yield of ozone with respect to the current is proportional to the pressure. When the synthesis is carried out in a mixture of gases, the yield of ozone is proportional to the partial pressure of oxygen, but in a mixture of oxygen and nitrogen the yield is greater than at the corresponding pressure of pure oxygen. Hartman found that the yield of ozone with respect to the energy increases with the pressure, whereas in a reference it was noted that the yield is a maximum at 400 mm Hg. The effect of pressure on the synthesis of ozone has also been studied by Briner and Davins. In all the foregoing studies the formation of ozone was investigated either under steady-state conditions or at several arbitrarily selected flow rates of oxygen, which makes kinetic analysis difficult. Semiokhin studied the kinetics of the synthesis of ozone at various pressures, but most of his results refer to high pressures.

Summary:

1) The kinetics of the synthesis of ozone in a flow at reduced pressures have been studied. The shape of the kinetic curves is anomalous, maxima being present.

2) An explanation has been put forward in terms of decomposition of ozone outside the reactor. If the decomposition occurs outside the reactor on the inlet side, the maxima in the kinetic curves result from the competition between mass and countercurrent diffusion flows. When the ozone breaks down beyond the reactor, the maxima may arise because of the difference in the variation of the rates of formation of ozone in the reactor and of its decomposition beyond the reactor.

Heat of Formation of Fluorine Nitrate, O. G. Talakin, L. A. Akhanshchikova, E. N. Sosnovskii, A. V. Pankratov, and A. N. Zercheninov, pp. 561–563.

Fluorine nitrate NO_3F has been studied repeatedly but its heat of formation has not so far been determined experimentally. This is the aim of the present work. For the purposes of the investigation, use was made of the reaction of NO_3F with a concentrated solution of caustic potash:

$$NO_3F + 2KOH = KNO_3 + KF + \tfrac{1}{2} O_2 + H_2O \qquad (1)$$

We have confirmed that, as shown by Ruff and Kwasnik, the reaction is rapid and quantitative.

Summary:

1) The heat of formation of gaseous NO_3F at 21° is -4.2 ± 0.9 kcal mole^{-1}.

2) The calculated heat of formation of liquid NO_3F at $-45.9°$ is 0.5 ± 1.2 kcal mole^{-1}.

Number 6, 1962

Combustion of Model Binary Oxidant–Fuel Mixtures, P. F Pokhil, L. D. Romodanova, and O. P. Rysakova-Romashkan, pp. 706–707.

It has been established that the mechanism of the combustion of mixtures of $KClO_4$+ starch and of $KClO_4$+ naphthalene is the same as with Ballistite powders: i.e., the initial stage of burning takes place, with a net positive (exothermic) heat of reaction, in a reaction layer in the condensed phase, and finishes with the formation of a combustible mixture of smoke and gases, which then burns, above the surface of the condensed phase, to the final products of combustion.

Infra-Red Investigation of the Interaction between Water and an Aluminium Oxide Surface, A. V. Uvarov, pp. 117–119.

The present work represents a continuation of an infrared investigation of the interaction of aluminium oxide, an important industrial adsorbent and catalyst, with various substances in the vapor and liquid phases. The adsorption of alcohols on an aluminum oxide surface which had first been dehydrated by heating to 400° in a high vacuum was studied earlier. The present paper deals with the interaction of an aluminium oxide surface with water (in the air and in a vacuum).

Summary:

1) The interaction between water and an aluminium oxide surface has been studied by means of infrared spectroscopy. At room temperature the action of liquid water on aluminium oxide leads to the formation of a surface layer of the hydroxide $Al(OH)_3$, which breaks down at 250°.

2) Most of the adsorbed water is removed from the surface of the adsorbent in a high vacuum at 100°. The stretching vibrations of the surface hydroxyl groups of aluminium oxide give rise to three adsorption bands, at 3750, 3665, and 3560 cm^{-1}. The increased adsorption by the free surface hydroxyls after removal of adsorbed water indicates that they interact with molecules of the latter. The surface hydroxyls on aluminium oxide possess high thermal stability.

Number 7, 1962

Calculation of the Equilibrium Composition of Gas Mixtures at High Temperatures, V. F. Baibuz, pp. 751–754.

The calculation of equilibrium compositions of gas mixtures at high temperatures is often complicated by the necessity of taking into account a large number of different compounds. However, it also frequently happens that many compounds can be neglected. Sometimes the possibility of neglecting certain compounds is inherent in the initial composition of the mixture and may be predicted from analysis of material balance (conservation) equations, but in many cases it does not depend on the particular mixture composition but is valid for the given compound above a certain temperature in the pressure range considered. From a study of the thermodynamic stability of chemical compounds, it is possible to establish for each compound an upper temperature limit above which the compound need not be considered.

The aim of the present work was to develop a method for the determination of the temperature above which the partial pressure of a chemical compound in a gas mixture with the total pressure P becomes less than a given quantity g, even when conditions are otherwise most favorable for the formation of the compound. For simplicity, this temperature will henceforth be referred to as the limitation temperature.

Summary:

1) A method (applicable to any compound) is proposed for the calculation of the temperature above which the given compound need not be considered in the calculation of equilibrium compositions of gas mixtures.

2) These temperatures (limitation temperatures) have been calculated for some compounds, with allowance for the various limits of accuracy required.

Electrical Synthesis of Ozone. VI. Steady-State Concentrations and Mechanism of the Formation of Ozone, V. G. Samoilovich and Yu. V. Filippov, pp. 760–763.

Most experiments on the electrical synthesis of ozone are carried out under flow conditions. However, complications then usually arise, particularly at low pressures, due to diffusion processes or to the specific effect of the discharge intensity (power). Experiments under static conditions are also difficult because of the relatively small volume of the reaction space in ozonizers, so that the volumes of the inlet and connecting tubes and of the measuring system cause considerable experimental error. More reliable results may be expected in studies on the synthesis of ozone in apparatus with gas circulation. This paper deals with

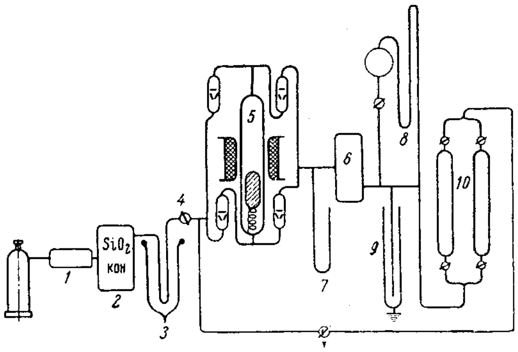

Fig. 1 Diagram of the apparatus: 1) furnace for the combustion of hydrogen on copper oxide at 350°–400°; 2) drying train—three columns with SiO_2 and three columns with KOH; 3) trap with SiO_2 cooled with an acetone-dry ice mixture; 4) tap isolating the purification system during an experiment; 5) circulation pump; 6) intermediate gas container; 7) vacuum gage; 8) sulphuric acid manometer; 9) ozonizer; 10) gas pipettes.

such experiments on the electrical synthesis and steady-state concentrations of ozone, which gave information on the mechanism of its formation.

Summary:

1) The steady-state concentration of ozone in a circulating system is independent of the current through the ozonizer. It is also independent of the pressure when the latter is high. With decrease in the pressure there is at first a smooth, and then, at relatively low pressures, a sharp fall in the ozone concentration.

2) A mechanism is proposed for the formation and decomposition of ozone, taking into account both bulk and surface processes. The latter are particularly important in the synthesis of ozone at low pressures.

Combustion of Ammonium Perchlorate, L. D. Romodanova and V. I. Roshchupkin, pp. 834–835.

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Volume 13, Number 5, November 1961

Certain Problems in Relativistic Gasdynamics of Charged Particles, V. N. Tsytovich, pp. 933–937.

The relativistic motion of a conducting gas is characterized by a number of features, which can lead to effects that are qualitatively different from those found for nonrelativistic motion. For example, Veksler has shown that when an ionized gas mass collides with a concentration of magnetic force lines the ions transfer an appreciable part of their energy to the electrons; the electrons then become relativistic, even if the initial gas velocities are nonrelativistic. At relativistic gas velocities this limiting-current effect becomes still more important. It leads to a situation such that even for negligibly small collision frequencies ν_{eff} between the electrons and ions (i.e., high conductivity), in the reference system attached to a given gas element $\mathbf{E} + \mathbf{v} + \mathbf{H}$ does not vanish and is determined by the inertia force which, in the ultrarelativistic limit, can be large because of the relativistic mass increase. The magnetic field flux through the fluid contour is therefore not conserved and the "freezing" of the magnetic lines of force is disturbed.

Thus, one of the peculiarities of relativistic motion of a conducting gas mass is that the magnetic lines of force may not be frozen. As a result, the description of this motion by equations which contain the two vectors $\mathbf{v}$ and $\mathbf{H}$, the hydrodynamic velocity and the magnetic field (relativistic magnetogasdynamics), is no longer possible. The remark pertains especially to transient processes in which the inertia force in the accompanying reference system may be large.

In order to investigate the relativistic motion of a conducting gas it is convenient to consider relativistic two-component gasdynamics in electromagnetic fields. By virtue of what has been indicated, interest attaches in the relativistic case only to the situation in which the friction of one component against the other is negligibly small compared with the effect of the interaction with the self-consistent field. For this reason, we can consider the equations separately for each of the components in the electromagnetic fields, including in the latter external fields and the fields produced by all the gas components.

The relativistic gasdynamics of a neutral gas have been considered by Khalatnikov. In Sec. 1 of the present work we extend the corresponding results of Khalatnikov to include self-consistent fields and external electromagnetic fields. Despite the fact that the magnetic lines of force may not be frozen for relativistic motion of an electron-ion plasma, it is found that in those cases for which the ion current is small it is possible to extend the theorem of conservation of magnetic flux along a fluid contour.

In problems which are of interest in accelerator technology, for example, the case of a charged electron gas, either the inertia term in the equations of motion is considerably greater than the term that contains the pressure derivatives, or else the external fields have an important effect on the motion. In both cases the characteristic dimensions and the time intervals, which determine the possibility of applying the hydrodynamic analysis, are, to a large extent, determined by the initial and boundary conditions, and by the variations in the external field.

In the present work we consider one-dimensional relativistic breakup of a charged gas layer in vacuum when the inertia term is the principal one. We also consider relativistic collisions between a charged layer and constant external fields. The electric fields produced by breakup of a quasineutral plasma layer in a vacuum are also analyzed.

Racah Method in the Theory of Relativistic Equations, L. A. Shelepin, pp. 963–972.

By using the Racah technique we investigate the group properties of relativistically invariant equations of the type $\alpha\sigma\partial\sigma\psi + \kappa\psi = 0$. The treatment presented is a further development of the work of the author. A consistent procedure is given for finding the commutation relations which completely determine the algebra of the α matrices, by using the technique of j symbols and transformation matrices. As simple examples we give the complete commutation relations for the Duffin-Kemmer equation with spin 1 and for the generalized Pauli-Fierz equation. A classification is given of covariants which form a U (α)-algebra with respect to reflection and charge conjugation. We obtain relations by means of which the infinitesimal matrix I_{ij} is expressed in terms of the α matrices. We discuss the structure of the complete Lagrangian interaction.

Volume 13, Number 6, December 1961

Magnetohydrodynamic Combustion, R. V. Polovin and V. P. Demutskii, pp. 1229–1234.

Possible combustion modes in a magnetohydrodynamic medium are determined. The types of magnetohydrodynamic shock and self-similar waves which can accompany magnetohydrodynamic combustion waves in the presence of a moving perfectly conducting piston are investigated. The piston velocity, the Alfvén velocity, and the reaction energy are assumed to be sufficiently small. The conductivity of the medium is assumed to be infinite.

Singularity in the Schwarzschild Solution of the Gravitation Equations, Yu. A. Rylov, pp. 1235–1236.

Schwarzschild's solution of the gravitational field equations has a singularity at the gravitational radius. It is shown that this singularity can be removed by a suitable choice of coordinate system. Examples of such coordinate systems are given.

Singularities of Cosmological Solutions of Gravitational Equations. III, E. M. Lifshitz, V. V. Sudakov, and I. M. Khalatnikov, pp. 1298–1303.

A general geometric analysis is given of the situation that leads to the appearance of a time singularity in solutions of gravitational equations in a synchronous system of reference [a system satisfying conditions (1)]. This analysis, together with the previous results, leads to the conclusion that such a singularity is absent in the general case of an arbitrary distribution of matter and gravitation field in space.

Volume 14, Number 1, January 1962

Diamagnetic Perturbations in Media Caused by Ionizing Radiation, G. A. Askar'yan, pp. 135–137.

Diamagnetic perturbations in media produced by intense ionizing radiation are studied. It is shown that diamagnetism is produced predominantly by fast electrons. Estimates are given of the perturbation in the magnetic field and of the bursts of radio waves accompanying powerful bursts of ionization. It is noted that these effects can be used for remote dosimetry and for recording bursts of ionization, for the investigation of the behavior of fast electrons in a medium, for the transmission of force to a medium from an inhomogeneous magnetic field, etc.