S/056/61/041/002/021/028
B111/B212

Theory of simple magnetohydrodynamic...

Waves are considered, for which the velocity, density, pressure, and magnetic field strength are not simply a function of $(t - x/u_{1,2})$ but a function of any combination of x, t. A study of (13) makes it possible to investigate the propagation of waves having various initial shapes. The expression (13) is transformed into an equation of the heat-conduction type by the substitution $v_x = \frac{2\delta}{\alpha W} \cdot \frac{\partial W}{\partial \tau}$ with $\tau = t - x/u_{1,2}$. It is solved for the following three boundary conditions: 1) $v_x = v_{ox} th\tau/\tau_o$ with $\tau_o \gg (\alpha v_{ox}/(2\delta))^{-1}$; $\alpha v_{ox}/(2w\delta) = Re$ (magneto-hydrodynamic Reynolds number $\gg 1$). From the solution for v_x the width of the shock wave L_Φ is calculated to be

$$L_\Phi = u_{1,2}\tau' = 2\frac{u_{1,2}}{v_{ox}}\left\{(u_{1,2}^2 - u_0^2)^2[\eta + \beta\rho_0] - (u_{1,2}^2 - u_0^2)\frac{H_y^2}{\pi^2\rho_0}\eta + \right.$$
$$\left. + \frac{H_y^2}{4\pi\rho_0}\left[u_0^2\frac{\gamma-1}{\gamma}\frac{\varkappa}{c_0} + u_{1,2}^2\left(\frac{4}{3}\eta + \zeta\right)\right]\right\} \times$$
$$\times \left\{\rho_0 u_{1,2}\left[(\gamma+1)\frac{H_y^2}{4\pi\rho_0}u_0^2 + 3(u_{1,2}^2 - u_0^2)^2\right]\right\}^{-1}. \qquad (21).$$

Card 2/4

2) $v_x = \begin{cases} -v_{ox} & -\infty \leq \tau \leq 0 \\ +v_{ox} & 0 \leq \tau \leq \infty \end{cases}$; $L_\Phi = 2u_{1,2}\sqrt{\delta x}$.

3) $v_x = \begin{cases} 2P_{ox}\beta^{-1}(1 - \tau/\beta) & 0 \leq \tau \leq \beta \\ 0 & \tau < 0;\ \tau > \beta \end{cases}$ $P_{ox} = \int_0^\beta v_{ox}(1 - \tau/\beta)d\tau$;

$[0,\beta]$ - interval. The solution for v_x is represented graphically. In general, it has been found that: 1) if a discontinuity is missing in the origin (x=0, y=0), it may occur at a distance x_1 (proportional to 1/M) from the origin; 2) a discontinuity in the origin will be blurred according to $\tau_\Phi = 2\sqrt{\delta x}$ and will reach a width of 1/Re at a distance $x_1 = 2\delta/(\alpha v_{ox})^2$. This blurring of the front occurs only if the quantity 1/Re represents a stationary front width; 3) the amplitude at a distance $x_2 \sim Re/M$ is not a function of the initial amplitude and the process of wave propagation in the range $x > x_2$ can be described by linear magnetohydrodynamic equations.

27199

Theory of simple magnetohydrodynamic... S/056/61/041/002/021/028
B111/B212

Ye. P. Sirotina and S. I. Syrovatskiy (Ref. 6: ZhETF, 39, 746, 1960) are mentioned. There are 2 figures and 9 references: 7 Soviet and 2 non-Soviet. The two references to English-language publications read as follows: Ref. 1: D. Bazer, Astro phys. J., 128, 686, 1958; Ref. 2: P. Lax, Comm. Pure Appl. Math., 10, 537, 1957.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: March 8, 1961

Card 4/4

KHOKHLOV, R. V.

"An approach in non-linear acoustic"

report submitted for the 4th Intl. Congress of Acoustics, Copenhagen, Denmark, 21-28 Aug 1962.

24.4300

40074
S/188/62/000/004/007/010
B108/B102

AUTHORS: Naugol'nykh, K. A., Soluyan, S. I., Khokhlov, R. V.

TITLE: Cylindrical waves of finite amplitude in a dissipative medium

PERIODICAL: Moscow. Universitet. Vestnik. Seriya III. Fizika, astronomiya, no. 4, 1962, 65 - 71

TEXT: The propagation of cylindrical waves in a viscous, heat conducting medium is examined through approximation techniques. Starting from the usual equations of motion, continuity, and state the solutions are got by two different methods: that of Krylov and Bogolyubov (Asimptoticheskiye metody v teorii nelineynykh kolebaniy (Asymptotic methods in the theory of nonlinear oscillations), GITTL, M., 1955) for slight distortion of the wave (small Reynolds number) and that proposed by Soluyan and Khokhlov ("Vestn. Mosk. un-ta", ser. fiz., astronomii, no. 3, 52 - 61, 1961) for large Reynolds numbers. Calculations are restricted to second order terms. The formation and "resorption" of shock wave fronts is examined. A divergent wave with a sinusoidal profile will, after a definite distance, turn into a sawtooth wave which then collapses and again forms a sinusoidal

Card 1/2

wave. This distance is determined by the specific heat of the medium and the velocity of sound therein as well as by the frequency and the radius of the cylindrical emitter. A convergent wave will always turn into a sawtooth wave, whether the Reynolds number be large or small. There are 3 figures.

ASSOCIATION: Kafedra teorii kolebaniy (Department for the Theory of Oscillations)

SUBMITTED: December 18, 1961

9.2572

41556
S/188/62/000/005/007/008
B102/B108

AUTHORS: Pogorelova, E. V., Khokhlov, R. V.

TITLE: Nonlinear theory of a parametric traveling-wave amplifier

PERIODICAL: Moscow. Universitet. Vestnik. Seriya III. Fizika, astronomiya, no. 5, 1962, 62 - 69

TEXT: The nonlinear processes that occur in a parametric traveling-wave amplifier are analyzed theoretically in continuation of an earlier study (Khokhlov, Radiotekhnika i elektronika, VI, no. 7, 116, 1961) where the fact that the waves propagated in the accelerator tube can be out of phase was taken into consideration. The study relates to the propagation of three waves having the phase velocities u_1, u_2, u_3, and the frequencies ω_1, ω_2, ω_3. The difference in the phase velocity is characterized by the parameter $|\Delta| = |\omega_2(\frac{1}{u_3} - \frac{1}{u_2}) + \omega_1(\frac{1}{u_2} - \frac{1}{u_1})|$ where $\omega_1 + \omega_2 = \omega_3$. Consequently the interaction between the waves decreases, and at sufficiently high $|\Delta|$ it disappears, allowing the waves propagate independently of each other. At any $|\Delta|$, both of the possible combinations of the signal wave with load wave

Card 1/3

and pumping wave are conserved in the partial phase velocities, the propagation being unchanged. The maximum amplification and the period of spatial beat decrease as $|\Delta|$ increases. If the attenuation in the system is taken into account, the processes are different. If the attenuation factor is approximately equal for all three frequencies, an attenuation beat will occur whose frequency depends on the parameter of nonlinearity $\eta\beta_3 v_{30}/2$, and on the attenuation factor δ. $v_1^2/\beta_1 + v_3^2/\beta_3 = v_{10}^2/\beta_1 + v_{30}^2/\beta_3$ where v_{10} and v_{30} are the voltage amplitudes of signal and pumping wave at the input of the system, $\beta_1 + \beta_2 = \beta_3 + \Delta$; $C = C_0(1 + \eta v)$. If all three waves are strongly attenuated ($\delta \gg \eta\beta_3 v_{30}/2$) then the period of beat may increase rapidly: the second or even the first "period" may become infinite. If $\delta_3 \gg \delta_1 \simeq \delta_2 \simeq \eta\beta_3 v_{30}/2$ and if the pumping wave is much attenuated, then the signal and the load waves are amplified in the section which begins at a distance of $1/\delta_3$ from the amplifier input. Both waves reach their maxima along this section. The heights of the maxima depend on the attenuation factors of the two waves and on $\beta_1 v_{30}/\delta_3$ and $\beta_2 v_{30}/\delta_3$.

The heights of the maxima are directly proportional to β_1 and β_2, inversely proportional to δ_1 and δ_2. At distances from the input that are large relatively to $1/\delta_3$, the signal and load waves do not interact in first approximation, and are attenuated according to their δ-values. The pumping wave "supported" by these waves has an amplitude of $v_3 = \eta\beta_3 v_1 v_2/2\delta_3$. There are 6 figures.

ASSOCIATION: Kafedra teorii kolebaniy (Department of the Theory of Oscillations)

SUBMITTED: February 20, 1962

S/141/62/005/004/005/009
E192/E382

AUTHORS: Akhmanov, S.A. and Khokhlov, R.V.

TITLE: Trigger properties of nonlinear waveguide systems

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Radiofizika, v. 5, no. 4, 1962, 742 - 746

TEXT: Nonlinear waveguide systems possess switching properties which make it possible to design suitable spatial analogues of dynamic switching circuits with lumped parameters (such as amplitude, phase or frequency-modulated trigger circuits). The situation is illustrated by considering a line with a nonlinearly distributed capacitance which is simultaneously excited at the input end with a pump-signal frequency $\omega_H = 2\omega$ and a signal $\omega_c = \omega$. The line is described by the following differential equation:

$$\frac{\partial^2 V}{\partial z^2} - L\frac{\partial^2 Q}{\partial t^2} - L\frac{\partial GV}{\partial t} = 0 \qquad (1)$$

Card 1/4

where V is the voltage in the line,
L is the distributed inductance,
Q is the charge,
G is the conductivity,
z is the length, and
t is time.

The solution of Eq. (1) can be assumed to be in the form:

$$V = V_1(\varepsilon z)\sin\left[\omega t - \beta_1 z + \varphi_1(\varepsilon z)\right] + V_H \sin\left[2\omega t - p_2 z\right] \quad (2)$$

where ε is a small parameter, while p_1 and β_2 are wave numbers. If Q is assumed to be in the form:

$$Q(V) = CV + DV^2 \quad (3)$$

and the method of slowly changing amplitudes is applied to Eq. (1), the simplified amplitude and phase equations for the signal are in the form:

$$\frac{\partial V_1}{\partial z} + \left[\delta - m_o V_H \cos(2\varphi)\right] V_1 = 0 \quad (4)$$

$$\frac{\partial \varphi}{\partial z} + \Delta + m_o V_H \sin(2\varphi) = 0 \qquad (5)$$

where $m_o = LDu\omega/4$, $\delta = LGu/4$ and u is the phase velocity of the signal wave. Eqs. (4) and (5) are analogous to the well-known simplified equations describing the variation in time of the amplitude and phase of the oscillations excited parametrically in a linear resonator (see, for example, Ref. 4. L.I. Mandel'shtam, N.D. Papaleksi, ZhTF, 3, 5, 1934 and Ref. 5. S.A. Akhmanov, Izv. vyssh. uch. zav. - Radiofizika, 4, 769, 1961). The parameter Δ in Eqs. (4) and (5) represents the attenuation and it is shown that the waves increase exponentially if:

$$\Delta < \sqrt{m_o^2 V_H^2 - \delta^2} .$$

The period T_1 occupied by one bit of information in such a system is expressed by:

$$T_1 \approx 1/2\omega . \qquad (9)$$

Card 3/4

Trigger properties of S/141/62/005/004/005/009
E192/E382

A similar switching system can be also based on a line whose conductivity is a function of voltage of the type:

$$G(V) = G_o - G_2V^2 + G_4V^4 \qquad (11).$$

ASSOCIATION: Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: December 20, 1961

Card 4/4

AKHMANOV, S.A.; KHOKHLOV, R.V.

Space-time analogies in the theory of systems with variable parameters. Radiotekh. i elektron. 7 no.8:1453-1455 Ag '62. (MIRA 15:8)

1. Fizicheskiy fakul'tet Moskovskogo gosudarstvennogo universiteta im. M.V.Lomonosova.

(Automatic control) (Electronics)

35262
S/046/62/008/001/011/018
B125/B102

24.1200 (1144, 1147, 1327)

AUTHORS: Polyakova, A. L., Soluyan, S. I., Khokhlov, R. V.

TITLE: Propagation of finite interferences in a relaxing medium

PERIODICAL: Akusticheskiy zhurnal, v. 8, no. 1, 1962, 107 - 112

TEXT: The generalized equations of gas dynamics for relaxing media derived for steady state flows are valid in the case of small Mach numbers and low energy dispersion in the medium. Motion in relaxing media is completely described by the continuity equation, the equation of state $p = p(\varrho, S, \xi)$ (1) and the reaction equation $d\xi/dt = -(\xi - \xi_0)/\tau$ where p denotes the pressure, ϱ the density, S the entropy, τ the relaxation time, ξ a parameter which characterizes the internal state of the substance and ξ_0 the equilibrium value of ξ. The values of v/c, $(\varrho - \varrho_0)/\varrho_0$ and $(\xi - \xi_0)/\xi_0$ (3) and $m = (c_\infty^2 - c_0^2)/c_0^2$ are in the order of μ since the studies are limited to media with a small velocity of sound dispersion. The present problem can be treated either in Euler or

Card 1/4

Lagrange's variables. The system of equations consisting of

$$\frac{dp}{dt}-\left[c_{\infty}^2+\left(\frac{\partial^2 p}{\partial \rho^2}\right)_{\xi,}\rho'\right]\frac{d\rho}{dt}+\frac{1}{\tau}\left[p-p_0-c_0^2\rho'-\frac{1}{2}\left(\frac{\partial^2 p}{\partial \rho^2}\right)_{\xi,}\rho'^2\right]=0 \qquad (8)$$

and the continuity equation $\varrho = \varrho_0(\partial a/\partial x)$ (10), $(\partial v/\partial t) + (1/\varrho_0)(\partial p/\partial a)=0$ (11) describes the propagation of interferences of finite amplitudes in a relaxing medium. After various substitutions the system is reduced to equation

$$\mu\frac{\partial \eta}{\partial z}-\frac{\varepsilon}{c_0^3}v\frac{\partial v}{\partial y}-\frac{m\tau}{2c_0}\frac{\partial^2 v}{\partial y^2}+\tau\frac{\partial}{\partial y}\left(\mu\frac{\partial v}{\partial z}-\frac{\varepsilon}{c_0^3}v\frac{\partial v}{\partial y}\right)=0. \qquad (14).$$

Its general form cannot be integrated. The coordinate of a fixed particle belonging to the medium in equilibrium is used as a Lagrange coordinate a. In Euler's coordinates the pressure can be eliminated and the continuity equation and equation of motion in a second approximation read as follows:

$$\mu\frac{\partial v}{\partial z}+\frac{1}{c_0}\left(1+\frac{\rho'}{\rho_0}\right)\frac{\partial v}{\partial y}+\frac{1}{\rho_0}\left(1-\frac{v}{c_0}\right)\frac{\partial \rho'}{\partial y}=0, \qquad (15)$$

$$\mu\frac{\partial \rho'}{\partial z}+\frac{\rho_0}{c_0^2}\left(1-\frac{v}{c_0}\right)\frac{\partial v}{\partial y}-\frac{1}{c_0}\left[1-\frac{\rho'}{\rho_0}+\frac{2\rho_0}{c_0^2}\left(\frac{\partial^2 p}{\partial \rho^2}\right)_{\xi,}\frac{\rho'}{\rho_0}\right]\frac{\partial \rho'}{\partial y}=\frac{B\tau}{c_0^2}\frac{\partial^2 \xi}{\partial y^2} \qquad (16),$$

Card 2/5

suitable substitutions change it to

$$\mu \frac{\partial v}{\partial z} - \frac{\varepsilon}{c_0^3} v \frac{\partial v}{\partial y} = - \frac{B\tau}{2\rho_0 c_0^3} \frac{\partial^3 \xi}{\partial y^3}, \qquad (20).$$

The relation $v/c_0 = \varrho'/\varrho_0$ of the linear acoustics is extended by quadratic terms and terms governed by internal degrees of freedom which are proportional to $\partial\xi/\partial y$. (20) and the reaction equation $\tau(d\xi/dy) + \xi = -m\varrho_0 c_0 v/B$ (21) written in the new coordinates $z = \mu x$, $y = t - x/c_0$ completely describe the propagation of interferences of finite amplitudes in a relaxing medium. $v(y)$ is shown in Fig. 1: a) the case $k \gg 1$ corresponds to relatively weak nonlinear effects, b) At $k > 1$ the shape of the shock wave becomes unsymmetrically with respect to the center level, c) at $k > 1$ $v(y)$ becomes theoretically ambiguous; this corresponds to a nonsteady real function. The compression jump can be described with a parameter which is proportional to the shear viscosity parameter δ by $\varrho \frac{d^2v}{dy^2} + \left(v + \frac{mc_0}{2\varepsilon} + \frac{\delta}{\tau}\right) \frac{dv}{dy} + \frac{\varepsilon}{2\tau} (v^2 - v_0^2)$ (25). Substituting

Card 3/5

$w = dv/dy$ gives for the trajectories on the phase plane $\frac{dw}{dv} = -\frac{1}{\delta}\left(v + \frac{mc_0}{2\varepsilon} + \frac{\delta}{\tau}\right)w + \frac{\varepsilon}{2\tau}(v^2 - v_0^2)$. A. V. Gaponov is thanked for the suggestion. There are 2 figures and 6 references: 5 Soviet and 1 non-Soviet. The reference to the English-language publication reads as follows: J. S. Mendousse. Nonlinear dissipative distortion of progressive sound waves at moderate amplitude, J. Acoust. Soc. America, 1953, 25, 1, 51 - 54.

ASSOCIATION: Akusticheskiy institut AN SSSR Moskva (Acoustics Institute of the AS USSR Moscow); Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: May 17, 1961

24.1200

S/046/62/008/002/011/016
B104/B138

AUTHORS: Soluyan, S. I., Khokhlov, R. V.

TITLE: Acoustic waves of finite amplitude in a medium with relaxation

PERIODICAL: Akusticheskiy zhurnal, v. 8, no. 2, 1962, 220 - 227

TEXT: With small Mach numbers and low energy dissipation the propagation of acoustic waves in a relaxing medium can be described approximately by the following system:

$$\frac{\partial v}{\partial x} - \frac{\varepsilon}{c_0^3} v \frac{\partial v}{\partial y} = - \frac{B\tau}{2\rho_0 c_0^3} \frac{\partial^2 \xi}{\partial y^2}, \quad (1)$$

$$\tau \frac{\partial \xi}{\partial y} + \xi = - \frac{m p_0 c_0}{B} v^2. \quad (2)$$

For $\omega\tau \ll 1$ the dispersion losses can be neglected and the system is reduced to $\partial v/\partial z - (\varepsilon/c_0^2) v \partial v/\partial y = 0$. $\omega y = \arc\sin(v/v_0) - \frac{\varepsilon\omega v z}{c_0^2}(v/v_0)$ is the solution of this equation under the boundary conditions $z = 0$, $v = v_0 \sin\omega y$. This solution describes the distortion of the sinusoidal

Card 1/3

Acoustic waves of finite...

waves until discontinuities have formed. A discontinuity, e.g., is formed at z_1; z_1 is determined from the relation $\varepsilon\omega v_0 z_1/c_0^2 = 1$. The solutions of the system (1) - (2) in the region $\omega\tau \gg 1$ is obtained from the transformed system

$$\frac{\partial v}{\partial z} + \frac{\partial G}{\partial y} = 0, \quad G = -\frac{\varepsilon}{2c_0^3} v^3 + \frac{B\tau}{2\rho_0 c_0^3} \frac{\partial \xi}{\partial y}, \tag{8}$$

$$\tau \frac{\partial \xi}{\partial y} + \xi = -\frac{m\rho_0 c_0}{B} v. \tag{9}$$

$$v = \frac{v_0}{\left(1 + \frac{\varepsilon\omega v_0 z}{c_0^2}\right)} \left(-\omega y + \pi \operatorname{th} \frac{\omega y}{\Delta}\right), \tag{13}$$

where

$$\Delta = \frac{1 + \varepsilon\omega v_0 z/c_0^2}{\pi} \frac{1}{\varepsilon \mathrm{Re}_0}. \tag{14}$$

for the dimensionless width of the front. For relaxing media Re is analogous to the Reynolds number: $\mathrm{Re} = M/\omega\tau m$. It follows from (13) and (14) that at sufficiently large z distances, under the condition $\varepsilon\omega v_0 z_4/c_0^2 \simeq 4\varepsilon \mathrm{Re}$, the waves are again sinusoidal in first approximation. The amplitude is then $v = v_0/\varepsilon \mathrm{Re}$ and, at large Reynolds numbers, it is in-

dependent of the initial amplitude. The propagation of acoustic waves is also studied for $0 < \omega\tau < \infty$. There are 3 figures.

ASSOCIATION: Kafedra teorii kolebaniy Moskovskogo gosudarstvennogo universiteta (Department of Theory of Vibrations of the Moscow State University)

SUBMITTED: June 8, 1961

Card 3/3

NAUGOL'NYKH, K.A.; SOLUYAN, S.I.; KHOKHLOV, R.V.

Cylindrical waves of finite amplitude in a dissipative medium.
Vest. Mosk.un.Ser.3:Fiz,astron. 17 no.4:65-71 Jl-Ag '62.
(MIRA 15:9)

1. Kafedra teorii kolebaniy Moskovskogo universiteta.
(Sound waves)

POGORELOVA, E.V.; KHOKHLOV, R.V.

Nonlinear theory of a traveling-wave parametric amplifier. Vest. Mosk. un. Ser.3: Fiz., astr. 17 no.5:62-69 S-O '62. (MIRA 15:10)

1. Kafedra teorii kolebaniy Moskovskogo universiteta.
(Parametric amplifiers)

39679
S/056/62/043/001/054/056
B102/B104

24.3200

AUTHORS: Akhmanov, S. A., Khokhlov, R. V.

TITLE: A possibility of light wave amplification

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 43, no. 1(7), 1962, 351-353

TEXT: Light waves may be generated and amplified in optical transparent crystals where the polarization is a nonlinear function of the field strength E of the propagating wave. Here it is shown that if this function is quadratic a parametric amplification of traveling light waves may occur. The medium considered is assumed to be semiinfinite, with

$$\varepsilon(t, x, \omega) = \varepsilon_0(\omega)\{1 + m[e^{i(\omega_m t - k_m x)} + e^{-i(\omega_m t - k_m x)}]\} \quad (2),$$

x being the normal to its surface plane. In this medium waves with the frequencies ω_1 and ω_2 are propagated, their components are $E_y = E; H_x; H_z$, with wave vectors cutting the x-axis at angles θ_1 and θ_2. The electric

Card 1/3

A possibility of light wave amplification

field in the medium is described by

$$\frac{1}{c^2}\frac{\partial^2 D}{\partial t^2} = \frac{\partial^2 E}{\partial x^2} + \frac{\partial^2 E}{\partial x^2}, \quad D = \varepsilon E, \tag{3}$$

and the total field is

$$E = E_1(x)\exp\{i(\omega_1 t - k_1 r)\} + E_2^*(x)\exp\{-i(\omega_2 t - k_2 r)\} + \text{к. с.},$$
$$k_i = \omega_i c^{-1}\sqrt{\varepsilon_0(\omega_i)}. \tag{4}$$

If $\omega_1 + \omega_2 = \omega_{ampl.}$, $\vec{k}_1 + \vec{k}_2 = \vec{k}_{ampl.}$, differential equations can be derived for determining the spatial amplitudes $E_{1,2}$. Since the modulation coefficient m is small ($\sim 10^{-4}$-10^{-5}), $d^2E_i/dx^2 \ll k_i dE_i/dx$ and

$$\frac{dE_1}{dx} = -\frac{im_1 k_1}{2\cos\theta_1}E_2^*, \quad \frac{dE_2^*}{dx} = \frac{im_2 k_2}{2\cos\theta_2}E_1$$
$$\frac{d^2E_1}{dx^2} = \frac{m_1 m_2 k_1 k_2}{4\cos\theta_1\cos\theta_2}E_1 \quad (m_i = m(\omega_i)). \tag{6}$$

Card 2/3

A possibility of light wave amplification

Thus, in this medium waves may grow exponentially with a growth factor $a = \frac{1}{2}\left[m_1 m_2 k_1 k_2/\cos\theta_1 \cos\theta_2\right]^{1/2}$. If for $x = 0$ $E_1 = E_0$ and $E_2 = 0$,

$$E_1 = E_0 \operatorname{ch} ax,$$

$$E_2 = iE_0\sqrt{m_2 k_2 \cos\theta_2/m_1 k_1 \cos\theta_1}\operatorname{sh} ax. \qquad (7).$$

If $\omega_1 \approx \omega_2 = \omega$, $n(\omega) > n(2\omega)$. This amplification mechanism may be used in designing coherent optical generators with a reasonable efficiency. There is 1 figure.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: May 29, 1962

Card 3/3

IL'INOVA, T.M.; KHOKHLOV, R.V.

Wave processes in lines with shunting nonlinear resistances.
Radiotekh. i elektron. 8 no.12:2006-2015 D '63. (MIRA 16:12)

1. Kafedra teorii kolebaniy Fizicheskogo fakul'teta Moskovskogo gosudarstvennogo universiteta im. M.V.Lomonosova.

S/046/63/009/001/010/026
B104/B186

AUTHORS: Naugol'nykh, K. A., Soluyan, S. I., Khokhlov, R. V.

TITLE: Spherical waves of finite amplitude in a viscous heat-conducting liquid

PERIODICAL: Akusticheskiy zhurnal, v. 9, no. 1, 1963, 54-60

TEXT: In the studies of N. M. McLachlan and A. L. Meyers (Proc. Phys. Soc., 1935, 47, 644-656) and K. A. Naugol'nykh (Akust. zh., 1959, 5, 1, 80-84) non-linear distortion of the shape of spherical waves during propagation is described by a gradual growth of the high-frequency components of the waves which have initially been monochromatic. At great distances from the emitter these solutions do not hold. Starting with the equation of motion

$$\rho\left(\frac{\partial v}{\partial t}+v\frac{\partial v}{\partial r}\right)=\rho-\frac{\partial p}{\partial r}+b\left[\frac{1}{r}\frac{\partial^2(rv)}{\partial r^2}-\frac{2}{r^2}v\right], \quad (1),$$

with the equation of continuity

$$\frac{\partial p}{\partial t}+v\frac{\partial p}{\partial r}+\rho\frac{\partial v}{\partial r}+2\frac{pv}{r}=0 \quad (2)$$

Card 1/2

and with the equation of state

$$p = p_0 + c^2(\rho - \rho_0) + \frac{\gamma - 1}{2}\frac{\rho_0}{c_0^2}(\rho - \rho_0)^2. \qquad (3),$$

the propagation of convergent and divergent spherical waves in a non-linear viscous and heat-conducting medium is studied. Here v, ρ, p, r and c are symbols commonly used in gasdynamics, $b = \frac{4}{3}\eta + \zeta + \varkappa(1/c_v - 1/c_p)$, η and ζ are the coefficients of shear and volume viscosity, $\varkappa$ is the heat conduction coefficient, $\gamma = c_p/c_v$. The equations are solved by means of an approximation method assuming $1/k_r$ to be a small parameter. k is the wave number, r the radius of the sphere. By means of the approximate solutions, the formation and the resorption of the wave fronts are studied and it is shown that the problem studied is equivalent to the problem of propagation of plane waves in a medium in which viscosity varies exponentially. There are 3 figures.

ASSOCIATION: Akusticheskiy institut AN SSSR, Moskva (Acoustics Institute AS USSR, Moscow)

SUBMITTED: December 11, 1961

ACCESSION NR: AP3000820 S/0046/63/009/002/0192/0197

AUTHORS: Naugol'nykh, K. A. (Moscow); Soluyan, S. I. (Moscow); Khokhlov, R. V. (Moscow)

TITLE: Nonlinear interaction of sound waves in an absorbing medium

SOURCE: Akusticheskiy zhurnal, v. 9, no. 2, 1963, 192-197

TOPIC TAGS: nonlinear interaction, sound wave, absorbing medium, high frequency wave, spectral maximum, amplitude modulated wave, hydrodynamic medium, Reynolds number, spherical wave, cylindrical wave

ABSTRACT: The authors study nonlinear interaction of sound waves in a viscous, heat-conducting medium. They investigate the case where waves of various frequencies, arising as a result of interaction, weakly decaying, may exceed in intensity the original high-frequency waves, which leads to displacement of the spectral maximum of the process in the region of low frequencies. They show that with propagation of an amplitude-modulated wave in a nonlinear hydrodynamic medium, detection of a signal is realized. They study the problem for both small

Card 1/2

ACCESSION NR: AP3000820

and large Reynolds numbers. The results are generalized to spherical and cylindrical waves. Orig. art. has: 20 formulas and 4 figures.

ASSOCIATION: none

SUBMITTED: 29Jun62 DATE ACQ: 03Jun63 ENCL: 00

SUB CODE: PH, AI NO REF SOV: 005 OTHER: 001

Card 2/2

AKHMANOV, S.A.; KOVRIGIN, A.I.; KHOKHLOV, R.V.; CHUNAYEV, O.N.

Length of coherent interaction of light waves in a nonlinear medium. Zhur. eksp. i teor. fiz. 45 no.5:1336-1343 N '63. (MIRA 17:1)

1. Moskovskiy gosudarstvennyy universitet.

ACC NR: AM5004030 MONOGRAPH UR

Akhmanov, S. A.; Khokhlov, R. V.

Problems in nonlinear optics; electromagnetic waves in nonlinear dispersing mediums; for 1962 to 1963 (Problemy nelineynoy optiki; elektromagnitnyye volny v nelineynykh dispergiruyushchikh sredakh; 1962-1963) Moscow, 64. 0294 p. illus., biblio. Errata slip inserted. 1,500 copies printed. (At head of title: Itogi nauki. Akademiya nauk SSSR. Institut nauchnoy informatsii)

TOPIC TAGS: optic transmission, optic material, electromagnetic wave, optic dispersion

PURPOSE AND COVERAGE: This book describes the principles of nonlinear optics of transparent dispersive media and discusses the present state of nonlinear optics. It contains a bibliography of 227 works published up to July 1963. The book is intended for scientific workers and engineers in the field of optics and radiophysics, as well as for professors, aspirants, and senior students at physics and physicotechnical departments. The authors thank V. G. Dmitriyev in collaboration with whom research was carried out and the results used in Ch. III and Ch. IV, V. I. Zharikov for helping to write Ch. V, A. I. Kovrigin for his useful discussion of problems in experimental nonlinear optics, T. M. Il'inova and O. N. Chunayev for putting the manuscript in shape, Prof. S. M. Rytov for his interest in this work and for his discussions, A. M. Prokhorov, Corresponding Member AN SSSR, for constructive criticism of the manuscript, F. V. Bunkin and V. P. Silin for their valuable comments, Y. L. Klimontovich (scientific editor) for writing parts 5, 6, and 8.2 of Ch. I and part 7 of Ch. II, and

Card 1/2

ACC NR: AM5004030

Prof. S. D. Gvozdover and Prof. V. V. Migulin for their interest in and support of this work.

TABLE OF CONTENTS [abridged]:

SUB CODE: 20/ SUBM DATE: 26Aug64/ SOV REF: 116/ OTH REF: 111

Card 2/2

L 16888-65 EEO-2/ENT(d)/EEC-4/EEC(b)-2/EED-2 Pm-4/Pac-4 SSD/AFWL/ASD(a)-5/SSD(n)

ACCESSION NR: AP5000845

AUTHOR: Zhabotinskiy, V. A.; Krokhlov, R. V.

TITLE: Light modulation by traveling waves

SOURCE: Radiotekhnika i elektronika, v. 9, no. 12, 1964, 2113-2121

TOPIC TAGS: modulation, light modulation, traveling wave, standing wave modulation, dielectric constant modulation, constant light modulation

ABSTRACT: [illegible] with a sufficiently large [illegible]

plane wave in an anisotropic nonlinear medium [illegible] first [illegible] equation for a modulated [illegible] and simplified it by excluding the less significant terms. The general equation was first applied to plane-wave modulation, then to resonant-cavity modulation, where the modulating field exists in the form of a standing wave. The two traveling-wave components of the standing wave interacted equally with the modulated wave under [illegible]

Card 1/2

L 16888-65

stances, as shown in earlier experiments by [illegible].

[illegible]

effective when the group velocity component of light in the direction of propagation of the modulating wave equals the phase velocity of that wave. The modulation index then increases [illegible] tensity [illegible].

ASSOCIATION: none

SUBMITTED: 21May63 ENCL: 00 SUB CODE: [illegible]

NO REF SOV: 002 OTHER: 007 ATD PRESS: 3150

Card 2/2

ACCESSION NR: AP4040584 S/0040/64/028/003/0557/0563

AUTHORS: Anisimov, V. V. (Moscow); Khokhlov, R. V. (Moscow)

TITLE: Shock waves formed by viscous gas flow about thin profiles

SOURCE: Prikladnaya matematika i mekhanika, v. 28, no. 3, 1964, 557-563

TOPIC TAGS: shock wave, viscous gas flow, thin profile, weak viscosity, wave parameter, quasilinear parabolic equation, condensation jump, wave front, pointed profile

ABSTRACT: The authors reduce the problem of a plane steady-state supersonic flow about a thin profile to the solution of a quasilinear parabolic equation

$$\frac{\partial u}{\partial y} + 2au\frac{\partial u}{\partial \tau} = \delta\frac{\partial^2 u}{\partial \tau^2} \qquad \left(a = \frac{1}{4}(\gamma+1)\frac{M^4}{m},\ \delta = \frac{1}{2}\nu\frac{M^4}{m}\right), \tag{1}$$

under the following assumptions. The gas has weak viscosity, and the arising shock waves have small intensity. Also, the characteristics of the flow are not only functions of the wave parameter $\tau = x - my$ but also weakly depend on one of the coordinates. In the approximation they use, they are able to compose a complete picture of the behavior of the shock wave at any distances from the profile. The interaction of the shock wave with a wave of vacuum has an essential effect on

Card 1/2

ACCESSION NR: AP4040584

the dissipation of the front of the shock wave. The authors show (by estimating the width of the front of the jump of condensation on the basis of the parabolic equation) that before the front of the shock wave contacts the wave of vacuum its width is almost constant. When interaction of the waves occurs, the front begins to spread, proportional to the square root of the distance from the profile, and the position of the shock wave also changes, while its rectilinearity is violated. The authors reduce this problem, in certain cases, to simplified equations: linear

$$\frac{\partial u}{\partial y} = \delta \frac{\partial^2 u}{\partial \tau^2}, \qquad (2)$$

and quasilinear

$$\frac{\partial u}{\partial y} + 2au\frac{\partial u}{\partial \tau} = 0. \qquad (3)$$

Limits of applicability of these equations are indicated. "The authors are grateful to Kh. A. Rakhmatulin, M. D. Lady*zhenskiy and V. A. Yeroshin for their valuable discussions." Orig. art. has: 6 figures and 47 formulas.

ASSOCIATION: none

SUBMITTED: 24Jan64 DATE ACQ: 19Jun64 ENCL: 00

SUB CODE: ME NO REF SOV: 003 OTHER: 005

Card 2/2

ACCESSION NR: AP4019220 S/0056/64/046/002/0555/0559

AUTHORS: Platonenko, V. T.; Khokhlov, R. V.

TITLE: On the operating mechanism of a Raman laser

SOURCE: Zhurnal eksper. i teor. fiz., v. 46, no. 2, 1964, 555-559

TOPIC TAGS: laser, Raman laser, stimulated Raman scattering, laser emission, Raman line, Stokes component, laser self excitation, Raman laser self excitation

ABSTRACT: In view of recent observations of stimulated Raman scattering laser lines from various organic liquids stimulated by intense light waves of a different frequency (G. Eckhardt et al., Phys. Rev. Lett. v. 9, 455, 1962) and the resultant feasibility of a new type of laser (Raman laser), the authors first present a classical description of stimulated Raman scattering and the nonlinear theory of a traveling wave amplifier based on the use of this phe-

Card 1/2

ACCESSION NR: AP4019220

nomenon, follows by derivation of the self excitation condition for the Raman laser. It is shown that during the course of interaction of the waves the energy goes from the wave with the larger frequency (pump) to that with the lower frequency (signal). This explains why the amplification occurs only for the Stokes component of the Raman scattering. A theoretical limit is shown to exist for the energy transferred from the pump to the signal and that the energy transformation ratio is equal to the signal to pump frequency ratio ω_s/ω_p.

It is pointed out that the Raman laser is a new type of generator, distinct from all others known in optics. Its oscillation energy is proportional to $(\omega_s/\omega_p)E_p^2$, as in parametric generators, but unlike the latter there is no need for satisfying rigorous dispersion relations and the self-excitation coefficient is determined by the square of the amplitude of the pumping wave and not by the first power. "The authors are grateful to S. A. Akhmanov and D. N. Klyshko for a discussion of the results." Orig. art. has: 14 formulas.

Card 2/2

ACCESSION NR: AP4042577 S/0056/64/046/006/2126/2131

AUTHOR: Platonenko, V. T.; Khokhlov, R. V.

TITLE: Wave interaction in stimulated Raman scattering

SOURCE: Zh. eksper. i teor. fiz., v. 46, no. 6, 1964, 2126-2131

TOPIC TAGS: Stokes wave component, Rayleigh wave component, anti-Stokes wave component, stimulated Raman scattering, Raman laser, stimulated Raman effect, coherent light effect

ABSTRACT: The amplifying properties of a medium based on stimulated Raman scattering were investigated. The case of the interaction between the Stokes and Rayleigh light wave components propagating along different directions as well as the case of the interaction between these components and an anti-Stokes component, when this interaction is effective, have been considered. It is shown that the efficiency of interaction between the Stokes and Rayleigh wave components of the field is determined by the angle between the electric field of the Rayleigh component and the wave vector of the Stokes component. The interaction of these three (Rayleigh, Stokes,

Card 1/2

ACCESSION NR: AP4042577

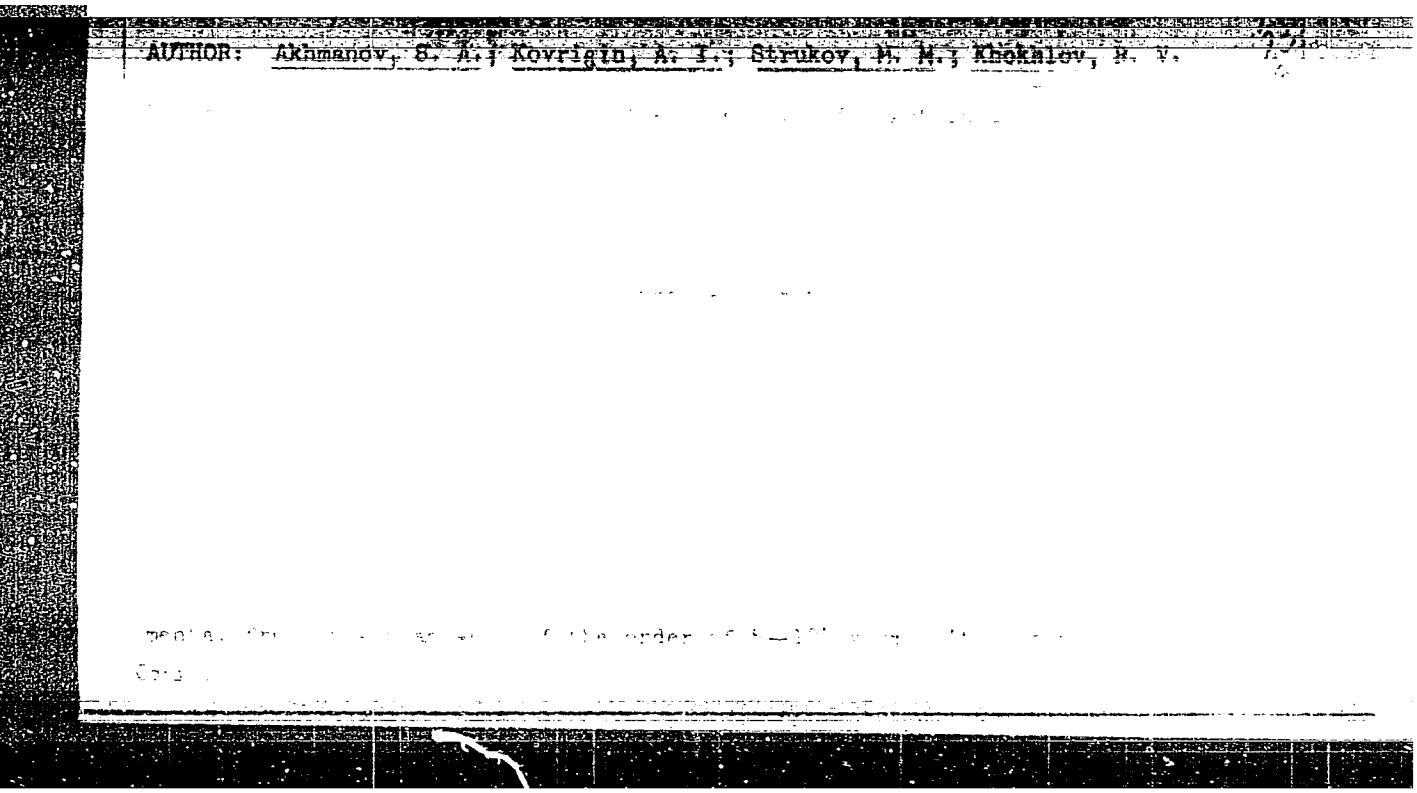
and anti-Stokes) wave components is possible only for some definite direction of their wave vectors. However, as a rule, this interaction is much less effective than the interaction between only the Rayleigh and Stokes components. Orig. art. has: 15 formulas.

ASSOCIATION: Moskovskiy gosudarstvenny*y universitet (Moscow State University)

SUBMITTED: 16Dec63 ATD PRESS: 3075 ENCL: 00

SUB CODE: OP, ME NO REF SOV: 002 OTHER: 006

Card 2/2



AUTHOR: Akhmanov, S. A.; Kovrigin, A. I.; Strukov, M. M.; Khokhlov, R. V.

L 09416-65

ACCESSION NR: AP5013...

... study of the breakdown frequency ...

lished elsewhere. Orig. art. has: 2 formulas.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet (Moscow State ...

AUTHOR: Aksnayev, I [illegible], Akhmanov, S. A.; Khokhlov, R. V

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu

[illegible] and insert facing

[illegible] ruby laser. Resonator mirrors 1 and 2 were 98% reflective at wave

Card [illegible]

L 53580-65

through the air in the cuvette, enters the upper part of the [illegible]
The second portion of the beam passes through air [illegible]
aluminum mirrors [illegible]

[illegible] Orig. art. has: 1 table and 2 figures. [ZK]

ASSOCIATION: Moskovskiy gosudarstvennyy universitet im. M. V. [illegible]
State University)

SUBMITTED: 06Apr65 ENCL: 01

L 8323-66 EWT(1)/EWA(h)

ACC NR: AP5026099 SOURCE CODE: UR/0386/65/002/005/0223/0227

AUTHOR: Akhmanov, S. A.; Kovrigin, A. I.; Piskarskas, A. S.; Khokhlov, R. V.

ORG: Moscow State University im. M. V. Lomonosov (Moskovskiy gosudarstvennyy universitet)

TITLE: Generation of ultraviolet radiation by using cascade frequency conversion

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 2, no. 5, 1965, 223-227

TOPIC TAGS: nonlinear optics, laser, frequency conversion, harmonic generation, second harmonic, UV radiation, crystal, Raman scattering

ABSTRACT: Experiments are described in which coherent monochromatic radiation was generated in the frequency range between 0.53 and 0.26 μ. The power output of the ultraviolet radiation attained by cascade frequency conversion of the unfocused radiation in two successive KDP or ADP crystals was not less than 3 Mw. The experimental arrangement used is shown in Fig. 1. A beam from a Q-switched neodymium laser (λ_1 = 1.06 μ) with a power output P_1 was incident on a 3-cm-long KDP crystal. The power of the second harmonic (λ_2 = 0.53 μ) P_2 from the first KDP crystal was sufficient to produce the fourth harmonic (λ_4 = 0.26 μ) by doubling the frequency of the second harmonic, or the third harmonic (λ_3 = 0.35 μ) by mixing the fundamental and the second harmonic in the second KDP crystal. A whole series of discrete spec-

Card 1/3

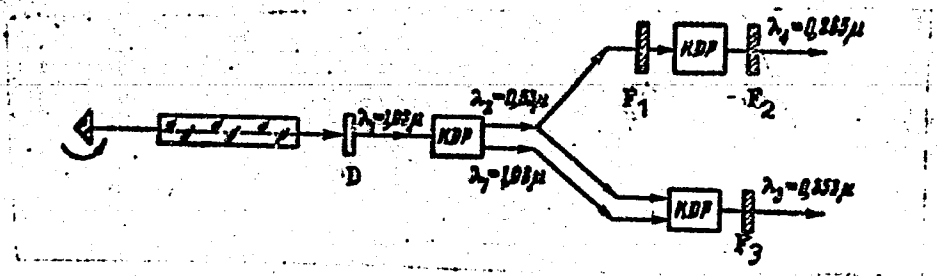


Fig. 1. Experimental setup

D - Discriminator; F_1, F_2, F_3 - filters.

tral lines was also generated by stimulated Raman scattering of the fundamental or the second harmonic. The line intensity of stimulated Raman scattering was 5—10% of the intensity of the fundamental radiation. The efficiency of the frequency

L 8323-66
ACC NR: AP5026099

Table 1.

	P_2	P_3	P_4	θ_0*	Interaction employed
Fourth harmonic generation	150 MW/cm²	-	3 MW/cm²	77°	$\gamma_o(2\omega) + \gamma_o(2\omega) \rightarrow \gamma_e(4\omega)$
Third harmonic generation	150 MW/cm²	8 MW/cm²	-	49°	$\gamma_o(\omega) + \gamma_o(2\omega) \rightarrow \gamma_e(3\omega)$
				58°	$\gamma_e(\omega) + \gamma_o(2\omega) \rightarrow \gamma_e(3\omega)$

*θ_0 is the angle between the optical axis and the index matching direction for the interactions listed in the last column.

doubling P_2/P_1 was about 30—35% and that of the P_4/P_2, 10%. Some of the important results are summarized in Table 1. Orig. art. has: 1 figure and 1 table. [CS]

SUB CODE: 20/ SUBM DATE: 08Jul65/ ORIG REF: 004/ OTH REF: 004/ ATD PRESS: 4149

Card 3/3

L 7690-66 EWA(k)/FBD/EWT(1)/EEC(k)-2/T/EWP(k)/EWA(m)-2/EWA(h) SCTB/IJP(c) WW

ACC NR: AP5027987 SOURCE CODE: UR/0386/65/002/007/0300/0305

AUTHOR: Akhmanov, S. A.; Kovrigin, A. I.; Piskarskas, A. S.; Fadeyev, V. V.; Khokhlov, R. V.

ORG: Physics Faculty of the Moscow State University (Fizicheskiy fakul'tet Moskovskogo gosudarstvennogo universiteta)

TITLE: Observation of parametric amplification in the optical range

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. (Prilozheniye), v. 2, no. 7, 1965, 300-305

TOPIC TAGS: parametric amplifier, laser, laser amplifier, optical pumping

ABSTRACT: The authors report the results of an experiment in which they observed parametric amplification of an optical signal with wavelength $\lambda_s = 1.06\ \mu$ by its second harmonic at $\lambda_p = 0.53\ \mu$. The feasibility of such an effect in the optical band and its theory were detailed earlier (ZhETF v. 43, 351, 1962). The experimental setup is shown in Fig. 1. A beam from a neodymium-glass laser was fed into a KDP frequency modulator producing the second harmonic (KDP-I crystal $\ell = 3$ cm long), and served simultaneously as the signal beam. At the output of the frequency modulator, the power ratio of the second harmonic (P_2) to the radiation at the fundamental frequency (P_1) was $P_2/P_1 = 0.2$--0.3. After passing through the filter system F_1, this ratio became equal to $P_2/P_1 = 10^4$--10^5. Thus, the second, amplifying KDP crystal was

Card 1/3

L 7690-66

ACC NR: AP5027987

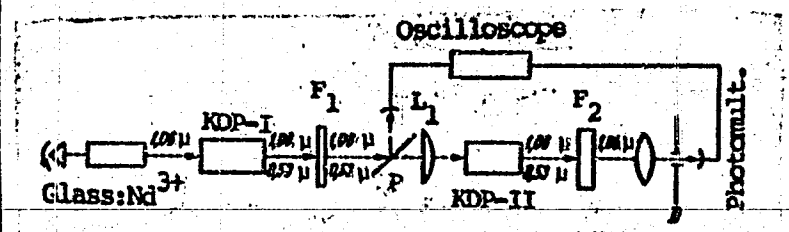


Fig. 1. Block diagram of experimental setup; F_1 - filter, F_2 - infrared filter, D - diaphragm, L_1 - cylindrical lens, P - plane-parallel plate.

fed a weak signal beam (λ_s = 1.06 μ) and a powerful pump wave (λ_p = 0.53 μ). The pump was focused on crystal KDP-II (ℓ = 3 cm) with the aid of a cylindrical lens L_1 (focal distance 13 cm) so that the pump power density in the second crystal reached S_2 = 100 MW/cm^2. A two-channel photoelectric circuit or photographic film was used to register the change in the signal intensity in the KDP-II crystal. The curves show that appreciable parametric amplification takes place only in a relatively narrow angle between the amplified signal and the index matching direction, Q = 10'. The maximum gain corresponded to the index matching direction, but fluctuated from flash to flash; the average experimental gain was ~2.5, compared with a theoretical value of 14. The appreciable fluctuations of the parametric amplification from pulse to pulse and the small average gain (compared with the theoretical) may be due to singularities of the parametric interaction in the degenerate mode. The authors deem the gain attained by them sufficient for the realization of a parametric light

Card 2/3

L 7690-66
ACC NR: AP5027987

generator in which continuous tuning of the frequency of coherent optical oscillations is possible. The authors are grateful to V. G. Dmitriyev for useful discussions. Orig. art. has: 2 figures and 2 formulas. [02]

SUB CODE: OP, EC/ SUBM DATE: 23Jul65/ ORIG REF: 002/ OTH REF: 004/ ATD PRESS: 4143

Card 3/3

L 9494-66 EWA(k)/FBD/EWT(1)/EEC(k)-2/T/EWP(k)/EWA(m)-2/EWA(h) SCTB/IJP(c)
ACC NR: AP6000742 WG/WW/GG SOURCE CODE: UR/0386/65/002/009/0435/0437

AUTHOR: Platonenko, V. T.; Khokhlov, R. V.

ORG: Moscow State University im. M. V. Lomonosov (Moskovskiy gosudarstvennyy universitet)

TITLE: Stimulated Raman scattering and parametric processes

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 2, no. 9, 1965, 435-437

TOPIC TAGS: laser, nonlinear optics, parametric amplification, Raman scattering, stimulated emission

ABSTRACT: A theoretical analysis is conducted of the possibility of obtaining parametric amplification and frequency conversion using coherent molecular vibrations induced during stimulated Raman scattering as a source of excitation (pumping). The analysis is performed for an electric field in a medium

$$\bar{E} = \bar{E}_H e^{i\omega_H t} + \bar{E}_a e^{i\omega_C t} + E_1 e^{i\omega_1 t} + E_2 e^{i\omega_2 t},$$

where $\omega_H - \omega_C = \omega_1 + \omega_2 = \omega_0$ (ω_0 is the natural frequency of the molecules of the medium active in SRS). Assuming that $\bar{E}_H \parallel \bar{E}_C \parallel \bar{E}_1 \parallel \bar{E}_2$, the authors derive an expression for the nonlinear polarization of the medium which they substitute into the Maxwell equations. Assuming that $\bar{E}_1\bar{E}_2 \ll \bar{E}_H\bar{E}_C$, they derive a symmetric equa-

Card 1/2

L 9494-66

ACC NR: AP6000742

tion for $\bar{E}_2$ describing the interaction of $\bar{E}_1$ and $\bar{E}_2$ with the molecular vibration wave $\bar{E}_H \bar{E}_C^* e^{i\omega_0 t}$. A criterion is then obtained for the amplification of $\bar{E}_1$ and $\bar{E}_2$ ($/\omega_1/ + /\omega_2/ = \omega_0$). It is shown that the threshold power $|\bar{E}_H|^2$ for parametric amplification can substantially exceed the threshold power for generation of the Stokes wave. In the case of amplification, the criterion $\bar{k}_H - \bar{k}_C = \bar{k}_1 + \bar{k}_2$ can probably be satisfied in liquids whose index of refraction is large. Orig. art. has: 2 formulas. [CS]

SUB CODE: 20/ SUBM DATE: 09Sep65/ ATD PRESS: 4162

Card 2/2

L 12816-66 FBD/EWT(1)/EWP(e)/EEC(k)-2/T/EWP(k)/EWA(m)-2/EWA(h) SCTB/IJP(c)

ACC NR: AP6001771 WG/WW/GG/WH SOURCE CODE: UR/0386/65/002/010/0458/0463

AUTHOR: Akhmanov, S. A; Yershov, A. G.; Fadeyev, V. V.; Khokhlov, R. V.; Chunayev, O. N.; Shvom, Ye. M.

ORG: Physics Department of the Moscow State University (Fizicheskiy fakul'tet Moskovskogo gosudarstvennogo universiteta)

TITLE: Observation of two-dimensional parametric interaction of light waves

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 2, no. 10, 1965, 458-463

TOPIC TAGS: ruby laser, laser modulation, parametric amplifier, laser emission coherence

ABSTRACT: The authors report the results of an experiment in which two-dimensional parametric interaction was realized in the optical band, using a ADP nonlinear crystal. The pump was the second harmonic of ruby laser emission ($\lambda_p = 0.3471\ \mu$), and the signal was the laser emission itself ($\lambda_s = 0.6943\ \mu$). A degenerate interaction mode was thus realized ($\omega_s = \omega_1 = \omega_2 = \omega_p/2$). The two-dimensional interaction of the signal wave with the pump in the ADP crystal gave rise to still another wave at frequency ω_{sup} (the supplementary wave), the wave vector of which $\vec{k}_{sup}$ had a direction determined by the relation $\vec{k}_1 + \vec{k}_2 = \vec{k}_p$ and by the dispersion characteristics of the crystal. The tuning curves of the parametric amplifier are presented and expressions for the signal and supplementary power are derived. It is noted that whereas the process of degenerate parametric amplification in one-dimensional interaction is de-

Card 1/2

L 12816-66

ACC NR: AF6001771

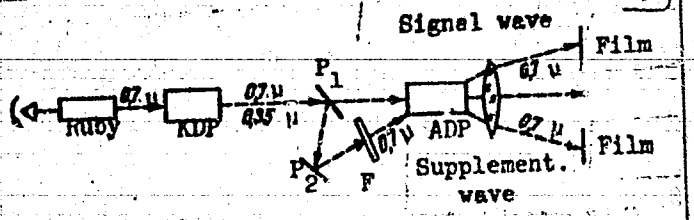


Fig. 1. Block diagram of experimental setup. P_1 and P_2 - plane-parallel plates, F - filter absorbing the pump radiation ($\lambda_p = 0.3471\ \mu$).

termined essentially by the phase shift between the pump and the signal, the phase dependence disappears for the two-dimensional degenerate interaction. A block diagram of the experimental setup is shown in Fig. 1. The Q-switched ruby laser excites an optical frequency doubler (with a KDP crystal 2 cm long) and is simultaneously the generator of the amplified signal. The unfocused pump and signal waves interact in the ADP crystal (3 cm long); the way the two-dimensional interaction is realized is clear from the figure. The experiment yielded $P_{sup}/P_S(0) = 0.02$ and $P_S/P_S(0) = 0.8$, as against the theoretical $P_{sup}/P_S(0) = 0.2$ and $P_S/P_S(0) = 1.0$. The angular aperture of the two-dimensional parametric interaction exceeds the corresponding value for the one-dimensional amplification, and is equal to the angular aperture of the pump beam. In the experiment the divergence of the pump was 2', equal to the divergence of the supplementary wave. The theoretical value of the capture angle calculated for the conditions of the experiment is 10". Authors thank V. G. Dmitriyev, with whom the theoretical research was carried out, G. V. Venkin for help in the experiment, and V. V. Yurlov for the KDP and ADP crystals. Orig. art. has: 3 figures and 4 formulas. [02]

SUB CODE: 20/ SUBM DATE: 23Jul65/ ORIG REF: 002/ OTH REF: 007/ ATD PRESS 4183

Card 2/2 jw

L 9439-66 EWT(1)/EWT(m)/EWP(e)/T IJP(c) WH

ACC NR: AP5026705 SOURCE CODE: UR/0141/65/008/005/0899/0908

AUTHOR: Il'inova, T. M.; Khokhlov, R. V.

ORG: Moscow State University (Moskovskiy gosudarstvennyy universitet)

TITLE: Nonlinear properties of a laser amplifier

SOURCE: IVUZ. Radiofizika, v. 8, no. 5, 1965, 899-908

TOPIC TAGS: laser, nonlinear optics, traveling wave laser, laser amplifier

ABSTRACT: Pulse propagation in a traveling wave laser amplifier with a homogeneously broadened line is analyzed using semiclassical methods. The effect of relaxation processes (finite width of the transition line) on deformation of an amplitude-modulated signal in a one-dimensional medium with an inverted population in the presence of nonresonant losses is considered. It is shown that at a certain attenuation $\delta = \delta_{th} < 2\pi\omega_0 aN$ all input signals at a distance $Z \geq p(c/2\delta)/2N_2 - N_1/N_1 - N_2$, where $p > 1$, become unique steady-state pulses (where ω_0 is the transition frequency, $a = (k^2/2\omega_0)T_2$, $k^2 = 2\mu/h^{-2}$, μ is the electric dipole moment of the molecule, T is the relaxation time, $N = h\omega_0 n$ is the energy of a unit volume of the medium, c is the velocity of light on the medium, and indexes 1 and 2 refer to the lowest two of the three levels in the system). The power, duration, and the energy of the steady-state pulses were found to be dependent on T_2 and δ. At $\delta_{th} > \delta$ all input signals are damped. A qualitative estimate of the optimal operation of a ruby laser amplifier

Card 1/2 UDC: 621.378.325

L 9439-66

ACC NR: AP5026705

is given. The results of the analysis are in complete agreement with the numerical calculations of J. P. Wittke and P. J. Warter (Journal of Applied Physics, v. 35, no. 6, 1964, 1668-1672). Orig. art. has: 34 formulas and 4 figures. [CS]

SUB CODE: 20 SUBM DATE: 25Apr64/ ORIG REF: 002/ OTH REF: 007/ ATD PRESS: 4156

Card 2/2

AUTHOR Kharkov, V. ... Khokhlov, R. V.

TITLE: Cubic-crystal light modulator

SOURCE: Radiotekhnika i elektronika, v. 10, no. 1, ...

TOPIC TAGS: light modulator, laser

ABSTRACT: A ... light-wave modulation ... A ... medium (crystal) is presented. A 1-f electromagnetic modulat... phase modulation of the light wave with or without rotation of the plane of polarization. The modulating field can be applied in a direction perpendicular to the direction of light propagation; hence, two modulating signals can be applied at right angles. Some light-beam divergence can be tolerated. The electro-optical coefficient for ZnS is one-fourth that of KDP, which is acceptable. Class $\bar{4}3m$ crystals ... considered best for this type of modulation as the ...

Card 1/2

2722b-65
ACCESSION NR: AP5002900

natural optical activity. A general formula (14) is developed for the [illegible] amplitude of a light wave (modulated light field). Also, formulas describing the modulation by plane waves are derived. When a circularly polarized initial light wave is modulated by a circularly polarized field, a frequency [illegible] harmonics represents an [illegible] The [illegible] art has 1 figure and 47 [illegible]

ASSOCIATION: none

SUBMITTED: 03Dec63 ENCL: 00 SUB CODE: EC

NO REF SOV: 002 OTHER: 007

Card 2/2

ACCESSION NR: AP5004842

17
B

AUTHOR: Platonenko, V. T.; Khokhlov, R. V.

TITLE: Stimulated Raman scattering in media consisting of anisotropic molecules

SOURCE: Optika i spektroskopiya, v. 18, no. 3, 1965, 369-376

TOPIC TAGS: anisotropic molecule, stimulated [illegible], Rayleigh wave, Stokes wave, polarization

ABSTRACT: A brief analysis of the interaction of waves with frequencies [illegible] Rayleigh and Stokes frequencies in this case. Relations are derived between the [illegible] amplitude. It is shown that, unlike the case of isotropic molecules, the waves

Card 1/2

L 34477-65

ACCESSION NR: AP5006427

D

of the Stokes and Rayleigh frequency can interact at arbitrary orientations of the [illegible]. It is shown that the energy of the Rayleigh wave is completely consumed in amplification of the Stokes wave and in excitation of molecular vibrations. This phenomenon can possibly be used for amplifier construction. Orig. art. has: 1 figure and 26 formulas.

ASSOCIATION: none

SUBMITTED: 02Feb64 ENCL: 00 SUB CODE: OP, EM

NO REF SOV: 004 OTHER: 002 ATD PRESS: 3213

Card 2/2

KHOKHLOV, R.V.

EWA(k)/FBD/EWG(r)/EWT(l)/EWT(m)/EEC(k)-2/EWP(j)/EEC(t)/T/EWP(b)-2/
EWA(m)-2/EWA(h) Pn-4/Pu-4/Po-4/Pf-4/Pr-4/Peb/P1-4/P1-4 SCTB/IJP(c)
WW/GH

ACCESSION NR: AP5010522 UR/0056/65/048/004/1202/1204

AUTHOR: Akhmanov, S. A.; Kovrigin, A. I.; Kulakova, N. K.; Romanyuk, A. K.; Strukov, N. M.; Khokhlov, R. V.

TITLE: The threshold and line intensity of stimulated Raman scattering in liquids

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 48, no. 4, 1965, 1202-1204

TOPIC TAGS: stimulated Raman scattering, Raman scattering threshold, Raman scattering line intensity

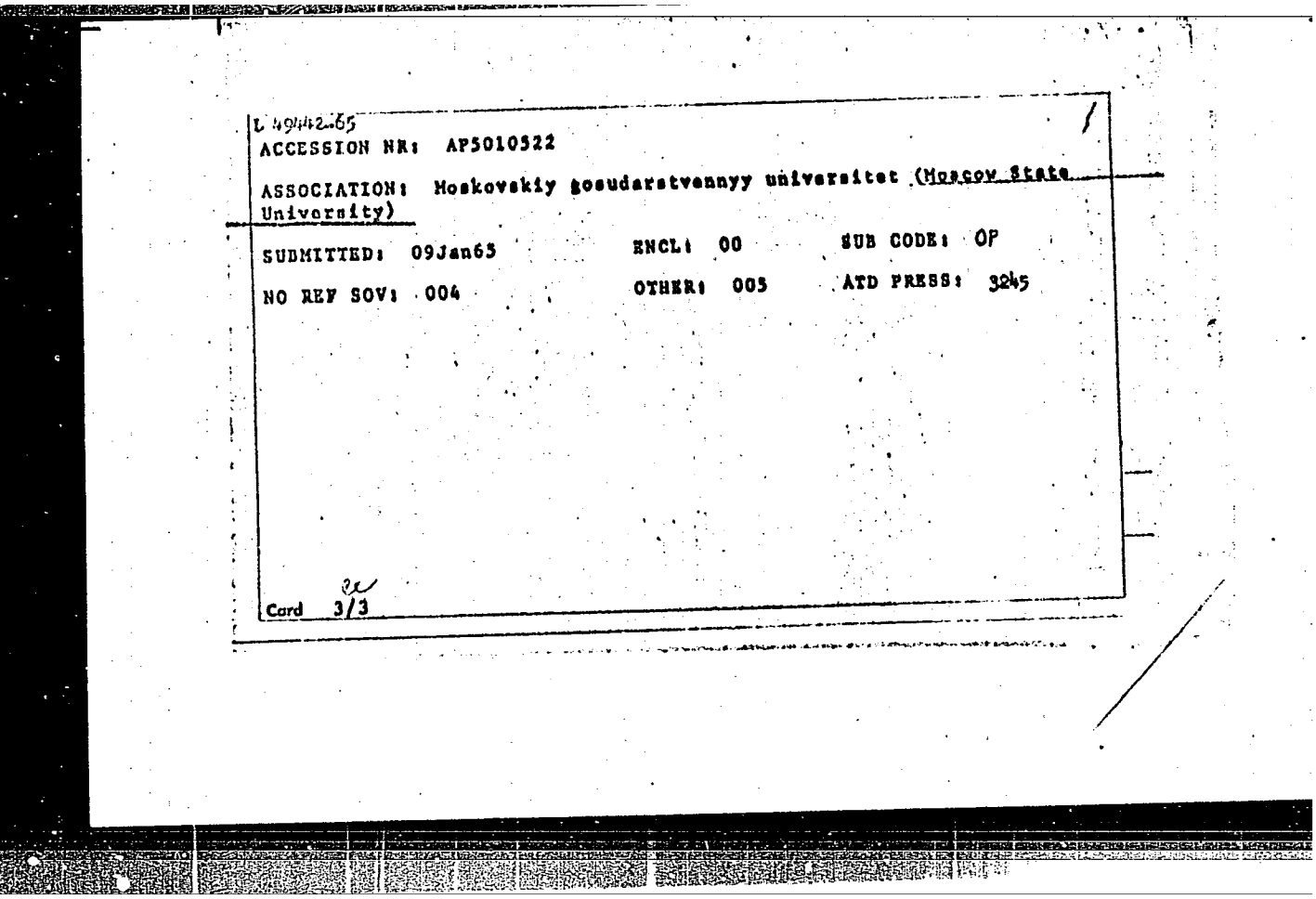
ABSTRACT: Stimulated Raman scattering (SRS), at which coherent oscillation of molecules of the scattering medium is generated, has a threshold $\beta_{ci}E_0^2 \geq \delta_{ci}$, where E_0 is the field intensity of the incident wave, (frequency ω_0), β_{ci} is a value determined by the polarization of the molecule of the scattering medium at frequency $\omega_0 - \Omega = \omega_{ci}$ (Ω is the natural frequency of molecular oscillation), and δ_{ci} is the absorption coefficient of the medium at ω_{ci} frequency. Experiments on the excitation of SRS were performed with organic liquids (benzene and

Card 1/3

L 49442-65
ACCESSION NR: AP5010522

cyclohexane) in order to establish the factors which determine the value of the threshold and line intensity in ranges shorter than that of ruby laser ($\lambda_0 \approx 0.69\mu$). The second harmonic of a neodymium glass laser ($\lambda_0 = 0.53\ \mu$) was used to excite SRS. The investigations showed a substantial decrease in SRS threshold in comparison to corresponding values at $\lambda_0 \approx 0.7\mu$. In benzene, SRS was approximately half that at $\lambda_0 \approx 0.7\mu$ under the same investigation conditions. This could be the result of the fact that 1) with the rise of operational frequency the generator of optical harmonics can be considerably smaller than that of the ruby laser, due to a smaller divergence of the harmonic beam. The intensity of SRS grows with the distance between the forward edge of the vessel and the focus. Generators of harmonics, in addition to their use for observation of SRS in the vicinity of electron absorption bands, can also be used for the investigation of SRS and nonlinear absorption effects in intensive biharmonic fields (including both Raman scattering of the harmonic field by coherent molecular oscillations excited by a wave of fundamental frequency and nondegenerated multiphoton absorption). Orig. art. has: 2 formulas and 2 tables. [JA]

Card 2/3



L 49442-65

ACCESSION NR: AP5010522

ASSOCIATION: Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: 09Jan65 ENCL: 00 SUB CODE: OP

NO REF SOV: 004 OTHER: 005 ATD PRESS: 3245

Card 3/3

L 8322-66 FBD/EWT(1)/EEC(k)-2/T/EWP(k)/EWA(m)-2/EWA(h) SCTB/IJP(c) WG/GG

ACC NR: AP5026612 SOURCE CODE: UR/0056/65/049/004/1190/1196

AUTHOR: Platonenko, V. T.; Stamenov, K. V.; Khokhlov, R. V.

ORG: Moscow State University (Moskovskiy gosudarstvennyy universitet)

TITLE: Stimulated Raman scattering in strong fields

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 49, no. 4, 1965, 1190-1196

TOPIC TAGS: Raman effect, Raman scattering, nonlinear optics, Stokes component, stimulated Raman scattering, Raman laser, strong magnetic field

ABSTRACT: A quantum mechanical treatment is conducted of the stimulated Raman scattering by molecules with nonequidistant vibrational levels in a strong magnetic field. The kinetic equation for the density matrix in the energy representation is used in the analysis. A condition for the appearance of the Stokes doublet (i.e., splitting of the Stokes line) is derived. The fields of the exciting waves required for the splitting are shown to be smaller than those at which the saturation effect will appear. At a large pump power, the Stokes line should be asymmetrically broadened, making it possible to evaluate the energy levels making the main contribution to stimulated Raman scattering. Orig. art. has: 15 formulas. [CS]

SUB CODE: 20/ SUBM DATE: 23Apr65/ ORIG REF: 004/ OTH REF: 003/ ATD PRESS: 4149

Card 1/1

KHOKHLOV, R.V.

Nonlinear wave processes. Usp. fiz. nauk 87 no.1:17-21 S '65. (MIRA 18:9)

L 07274-67 EWT(1) GG
ACC NR: AP6025278 SOURCE CODE: UR/0188/66/000/003/0095/0105

29
B

AUTHOR: Sukhorukov A. P.; Khokhlov, R. V.

ORG: Department of Wave Processes, Moscow State University (Kafedra volnovykh protsessov, Moskovskiy gosudarstvennyy universitet)

TITLE: Parabolic equation for the description of diffraction in anisotropic media

SOURCE: Moscow. Universitet. Vestnik. Seriya III. Fizika, astronomiya, no. 3, 1966, 95-105

TOPIC TAGS: Electromagnetic wave diffraction, uniaxial crystal, wave propagation, parabolic differential equation

ABSTRACT: With an aim at contributing to the development of approximate methods of diffraction theory for anisotropic media, the authors describe an extension of the method of slowly-varying amplitudes to include the description of diffraction of electromagnetic waves in a linear anisotropic medium, such as a uniaxial crystal. The extraordinary wave propagating in the crystal is represented as an almost plane-wave with an amplitude that varies slowly in space. An abbreviated parabolic equation is derived from the Leontovich-Fock parabolic equation, general-

Card 1/2 UDC: 548.0535

ized to include an anisotropic medium, and is used to ascertain which diffraction effects in the anisotropic medium are described by the resultant abbreviated equations. The abbreviated parabolic equation is used to consider diffraction of a plane wave by a slit and diffraction of a converging cylindrical wave at the focus. Among the diffraction effects that can be described by the method of slowly varying amplitudes is the transition from the illuminated region to the shadow region, the diffraction of a converging wave in the focus, and others. The analysis of the equations discloses a feature characteristic of the anisotropic medium, namely the asymmetry between the amplitude and phase characteristics of the wave propagation. Among the effects which cannot be described by the parabolic equation, and which are governed by the fact that the wave is actually not plane, are possible aberrations, phenomena occurring near the edges of a screen, and the like. Orig. art. has: 5 figures and 41 formulas.

SUB CODE: 20/ SUBM DATE: 18Jan65/ ORIG REF: 002/ OTH REF: 001

L 24203-66 FBD/EWT(1)/EEC(k)-2/T/EWP(k)/EWA(h) IJP(c) WG

ACC NR: AP6014614 SOURCE CODE: UR/0386/66/003/009/0372/0378

AUTHOR: Akhmanov, S. A.; Kovrigin, A. I.; Kolosov, V. A.; Piskarskas, A. S.; Fadeyev, V. V.; Khokhlov, R. V.

ORG: Physics Department of the Moscow State University (Fizicheskiy fakul'tet Moskovskogo gosudarstvennogo universiteta)

TITLE: Tunable parametric light generator with KDP crystal

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 3, no. 9, 1966, 372-378

TOPIC TAGS: laser r and d, parametric converter, parametric amplifier, frequency controal

ABSTRACT: The authors present in this communication the results of an experimental investigation that has led to the construction of a continuously tunable parametric generator of coherent light waves in the region of $\lambda \approx 1\ \mu$, using a KDP crystal. Continuous tuning of the wavelength was effected mechanically in a band from 9575 to 11775 Å, and the oscillation power reached several kilowatts. The frequency is tuned by rotating a nonlinear crystal in an optical resonator (Fig. 1). Such a scheme has made it possible not only to construct a generator with larger bandwidth than hitherto, but also to attain better reproducibility of the generated frequencies. The pump produced coherent oscillations at 0.53 λ (second harmonic of laser with Nd^{3+}), the maximum pump power in the unfocused beam reached 30--35 Mw/cm^2, the pump pulse duration was 25×10^{-9} sec, and the beam divergence was ~7'--8', with the

Card 1/2

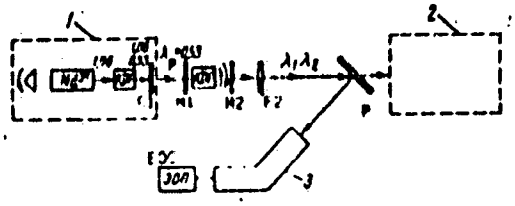


Fig. 1. Block diagram of the experimental setup: M_1, M_2 -- mirrors of parametric generator, F_1, F_2 -- filters, P -- plane-parallel plate, 1 -- pump generator, 2 -- meter, 3 -- spectrograph.

length of the KDP crystal 3 cm. The theory of the parametric generator is discussed in detail. Tests have shown the degenerate parametric oscillations ($\lambda_1 = \lambda_2 = 1.06$ μ) to occur at a pump power $P_p \geq 8$--10 Mw/cm^2 (inside the resonator). With increasing deviation from the degenerate mode, the threshold pump power increased. Self-escitation was manifested by the appearance of an intense signal which exceeded the indicator background by a factor of at least 10^3; the produced radiation had good directivity and its divergence angle did not exceed 1.5°. At $P_p \approx 30$--35 Mw/cm^2 the power of the parametric oscillations reached 5 kw. Tuning curves of the parametric light generator are presented and agree essentially with the presently accepted theory. The limiting tuning range is found to be determined only by the position of the absorption bands; estimates show that it should be not smaller than 4000 Å. The authors thank N. K. Podgot-skaya for help with the measurements and I. V. Nizhegorodova for help with the data reduction. Orig. art. has: 3 figures and 3 formulas. [02]

SUB CODE: 20/ SUBM DATE: 17Mar66/ ORIG REF: 006/ OTH REF: 006/ ATD PRESS: 4245

L 35876-66 EWT(l)/EWP(e)/EWT(m)/T/EWP(j) IJP(c) RM/WH/WG

ACC NR: AP6023636 SOURCE CODE: UR/0386/66/004/001/0022/0026

AUTHOR: Akhmanov, S. A.; Venkin, G. V.; Zubov, B. V.; Khokhlov, R. V.

ORG: Physics Department of the Moscow State University im. M. V. Lomonosov (Fizicheskiy fakul'tet Moskovskogo gosudarstvennogo universiteta)

TITLE: Generation of coherent radiation in the infrared band by nonlinear-optics methods

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 4, no. 1, 1966, 22-26

TOPIC TAGS: coherent light, ir radiation, ir source, laser application, electromagnetic mixing, semiconductor crystal, nonlinear effect

ABSTRACT: The authors report experimental results offering evidence that sufficiently intense sources of coherent infrared radiation, at least in the 2 - 5 μ range, can be produced by using the effect of optical mixing in nonlinear media. Radiation from a Q-switched ruby laser (6943 Å) was mixed with radiation of the first Stokes component of stimulated Raman scattering in cyclohexane (8657 Å) and n-heptane (8677 Å) in an $LiNbO_3$ crystal (Fig. 1). This produced at the output of the crystal radiation pulses with wavelengths 4.5 and 3.47 μ respectively, with power not less than 1 - 10 W. The use of the $LiNbO_3$ crystal as the mixer eliminated some of the difficulties hitherto encountered in this field. The conditions for synchronized mixing in a nonlinear crystal are derived and the angles between the beam direction and the crystal axis,

Card 1/2

L 35876-66

ACC NR: AP6023636

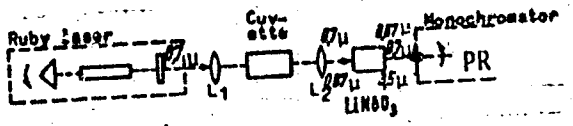


Fig. 1. Block diagram of experimental setup. L_1, L_2 - lenses (7 and 10 cm focal length), PR - photoresistor

required for the synchronization, are calculated. It is estimated that the potential output of such a setup is not less than 500 W once the adverse effect of the multi-domain structure of the $LiNbO_3$ crystal used in the experiment is eliminated. Better results can be expected by using for the mixed oscillations spectral lines obtained from a tunable parametric light generator, which would permit operation in the 100 - 150 cm^{-1} range. The authors thank A. S. Bebchuk and Yu. I. Solov'yeva for supplying the crystals, V. I. Pchelkin for help with the experiment, and A. G. Yershov and V. V. Fadeyev for a discussion. Orig. art. has: 3 figures and 4 formulas. [02]

SUB CODE: 20/ SUBM DATE: 03May66/ ORIG REF: 001/ OTH REF: 004/

ATD PRESS: 5037

Card 2/2

L 04517-67 EWT(1)

ACC NR: AP6033287 SOURCE CODE: UR/0141/66/009/005/0932/0941

AUTHOR: Grigor'yev, Yu. V.; Rudenko, V. K.; Khokhlov, R. V. 51 B

ORG: Moscow State University (Moskovskiy gosudarstvenny universitet)

TITLE: Theory of an optical parametric oscillator 15

SOURCE: IVUZ. Radiofizika, v. 9, no. 5, 1966, 932-941

TOPIC TAGS: nonlinear optics, parametric amplifier, harmonic generation, frequency conversion, resonator

ABSTRACT: Parametric excitation of oscillations in a Fabry-Perot-type resonator which is filled with an optically transparent nonlinear medium with quadratic polarizability was analyzed as a single-mode approximation. Primary attention is given to the behavior of a system when the phase matching of modes interacting in the cavity is disturbed and the resonant and parametric frequencies are dissimilar. A condition for excitation of oscillations is derived and the stationary states and their stability are analyzed. A comparison of parametric oscillations is made for systems with distributed and lumped parameters. Orig. art. has: 7 figures and 26 formulas.

SUB CODE: 20/ SUBM DATE: 17Jan66/ ORIG REF: 009/ OTH REF: 007/ ATD PRESS: 5100

Card 1/1 UDC: 621.373.93:621.378.001:621.372.413

L 30392-66 EWT(1)

ACC NR: AP6016828 SOURCE CODE: UR/0046/66/012/002/0188/0191

52
B

AUTHOR: Zabolotskaya, Ye. A.; Soluyan, S. I.; Khokhlov, R. V.

ORG: Department of Physics of Vibrations, Moscow State University (Kafedra fiziki kolebaniy Moskovskogo gosudarstvennogo universiteta

TITLE: Parametric amplifier for ultrasound 15

SOURCE: Akusticheskiy zhurnal, v. 12, no. 2, 1966, 188-191

TOPIC TAGS: ultrasonic amplification, parametric amplifier, Cauchy problem, ULTRASOUND

ABSTRACT: In view of recent interest in the problem of ultrasound amplification, the authors propose a parametric ultrasound amplifier, in which use is made of interaction of two intersecting waves propagating in an isotropic solid. The wave of the signal is directed at an angle to the pump wave, thus causing spatial separation of the combination waves. At a certain angle between the directions of the signal and pump wave propagations the condition for effective interaction is satisfied for one of the combination waves. The theory of this amplifier is presented and an estimate of the gain is given. The problem reduces to a Cauchy problem, so that the solution obtained is unique. The nonlinearity of the medium gives rise to pump harmonics, so that at a certain distance from the input to the system the pump wave will have a sawtooth form. It is shown that if the condition of effective interaction of the waves is satisfied for the fundamental harmonic components, it is not satisfied for the higher combination components. It is concluded on the basis of the results that

Card 1/2 UDC: 534.222

L 30392-66
ACC NR: AP6016828

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a parametric amplifier for ultrasound is feasible. Orig. art. has: 1 figure and 11 formulas. [02]

SUB CODE: 20/ SUBM DATE: 04Dec64/ ORIG REF: 004/ OTH REF: 002/ ATD PRESS: 5017

Card 2/2 CC

ACC NR: AP7000145 SOURCE CODE: UR/0046/66/012/004/0435/0442

AUTHOR: Zabolotskaya, Ye. A.; Soluyan, S. I.; Khokhlov, R. V.

ORG: Chair of Oscillations Physics, Moscow State University (Kafedra fiziki kolebaniy Moskovskogo gosudarstvennogo universiteta)

TITLE: A combined cadmium sulfide ultrasound amplifier

SOURCE: Akusticheskiy zhurnal, v. 12, no. 4, 1966, 435-442

TOPIC TAGS: ultrasound, ultrasound amplification, ultrasound parametric amplification, cadmium sulfide ultrasound amplifier, CdS ultrasound amplifier, piezoelectric ultrasound amplifier

ABSTRACT: An ultrasound amplifier utilizing the nonlinearities of CdS crystals is described and the mechanism of amplification analyzed. The nonlinearity stemming from the interaction of free electrons with piezoelectric fields makes it possible to amplify the signal wave parametrically at the expense of the pumping wave, while application of a constant electric field to the crystal compensates for acoustic damping of the oscillations. The aim of this approach is to expand the mechanism of amplification to combine it with the parametric interaction between the signal and the pumping waves under conditions of a nonlinear interdependence of the carrier flow and the electric field of the acoustic wave within the crystal. Although the nonlinearity coefficient is dependent on too many parameters to be analyzed in general terms, some numerical computations indicate the feasibility of a parametric amplification. The high degree of nonlinearity of CdS, the possibility of [illegible] acoustic waves by application of a constant field, and the low absorption of the material, all contribute to the conditions under which the amplification takes place sufficiently far below the self-excitation point, thereby ensuring a lower noise level than that of existing types of acoustic amplifiers. Orig. art. has: 2 figures, 1 table, and 31 formulas.

UDC: 534-16:621.375

SUB CODE: 20/ SUBM DATE: 12Feb65/ ORIG REF: 003/ OTH REF: 007/ ATD PRESS: 5108

Card 1/2

Card 2/2

ACC NR: AP7000145

APPROVED FOR RELEASE: 09/17/2001 CIA-RDP86-00513R000722130009-7"

L 16154-66 EWT(1)/T IJP(c) AT

ACC NR: AP6007229 SOURCE CODE: UR/0056/66/050/002/0472/0473

AUTHOR: Barynin, V. A.; Khokhlov, R. V.

ORG: Moscow State University (Moskovskiy gosudarstvennyy universitet)

66
B

TITLE: On the mechanism of laser-induced gas breakdown

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 50, no. 2, 1966, 472-473

TOPIC TAGS: nonlinear optics, gas breakdown, laser induced breakdown, argon, helium, photoionization, ruby laser

ABSTRACT: The mechanism of laser-induced gas breakdown—cascade ionization—advanced theoretically by Ya. B. Zel'dovich and Yu. P. Rayzer (ZhETF, v. 47, no. 3, 1964, 1150) and based on the experimental data of Meyerhand and Haught (Phys. Rev. Letts., v. 11, no. 9, 1963, 401) would be defined more precisely if photoionization of molecules excited by electron impact were taken into consideration. The assumption that cascade ionization alone is responsible for gas breakdown indicates that the threshold ionization energy is proportional to the square of the frequency, which is at variance with the experimental data obtained by one of the authors and

Card 1/2

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L 16154-66

ACC NR: AP6007229

his colleagues (S. A. Akhmanov, A. I. Kourigin, M. M. Strukov, R. V. Khokhlov, ZhETF, Pis'ma v redaktsiyu, Prilozheniye, 1, 1, 42, 1965). Also, comparison of the calculated and experimental data indicates that the higher the gas pressure, the more the computed breakdown fields exceed those achieved experimentally. Although this can be explained by nonuniform distribution of the radiation field, the authors show that such disagreement is practically nonexistent if photoionization of excited molecules is assumed. Two- and multi-photon ionization is neglected. The values of β, representing that part of the molecules excited by electron impact whose electron binding energy is $< \hbar\omega$, and values of the threshold field are tabulated for Ar and He at frequencies corresponding to the fundamental and second harmonic of a ruby laser. The frequency-dependence of threshold energy was explained in terms of a ratio of threshold energies at 2ω and ω, which without allowing for photoionization would be 4. The effect of β is higher the greater the gas pressure, and β increases with frequency. Thus, photoionization of electron-beam-excited molecules can be neglected only for low frequencies and pressures. Orig. art. has: 5 formulas. [YK]

SUB CODE: 20/ SUBM DATE: 13Aug65/ ORIG REF: 003/ OTH REF: 002/ ATD PRESS: 4204

L 20731-66 EWA(h)/EEC(k)-2/EWP(k)/EWT(l)/FBD/I IJP(c) WG

ACC NR: AP6007230 SOURCE CODE: UR/0056/66/050/002/0474/0486

AUTHOR: Akhmanov, S. A.; Sukhorukov, A. P.; Khokhlov, R. V.

ORG: Moscow State University (Moskovskiy gosudarstvennyy universitet)

49

B

TITLE: Theory of optical harmonic generation in converging beams

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 50, no. 2, 1966, 474-486

TOPIC TAGS: laser, nonlinear optics, harmonic generation, second harmonic

ABSTRACT: A theory of nonlinear optical effects at the focus of a converging laser beam is developed by analyzing the evolution of the nonlinear effect in the whole region of the beam rather than the region near the focal plane. The analysis is based on the method of parabolic equations extended to the nonlinear problem, which makes it possible to take into account the diffraction effects. The parabolic equation, which is a solution of the equation for the wave propagation in a nonlinear medium, is then used for a detailed analysis of the second-harmonic generation by a weakly converging cylindrical wave in a medium with a quadratic dependence of polarization on the field intensity of the laser beam. The theoretical data on the intensity and spatial structure of the second harmonics are in good agreement with the available experimental data. It was established that from the energy point of view the optimal focusing is such that one of the semi-axes of the elliptical focal

Card 1/2

L 20731-66

ACC NR: AP6007230

spots of the beam is about equal to the length of the nonlinear sample. The method used can be extended to the analysis of other nonlinear effects, such as parametric amplification and stimulated scattering with the diffraction effects taken into account. Orig. art. has: 44 formulas and 3 figures. [CS]

SUB CODE: 20/ SUBM DATE: 25Aug65/ ORIG REF: 006/ OTH REF: 005/ ATD PRESS: 4123

Card 2/2

L 31961-66 EWT(1) IJP(c) WW/GG

ACC NR: AP6020209 SOURCE CODE: UR/0056/66/050/006/1537/1549

AUTHOR: Akhmanov, S. A.; Sukhorukov, A. P.; Khokhlov, R. V.

ORG: Moscow State University im. M. V. Lomonosov (Moskovskiy gosudarstvennyy universitet)

TITLE: Self-focusing and self-trapping of intense beams of light in a nonlinear medium

SOURCE: Zh eksper i teor fiz, v. 50, no. 6, 1966, 1537-1549

TOPIC TAGS: nonlinear optics, self focusing, high power laser

ABSTRACT: A stationary theory of the self-trapping of finite beams in a nonlinear medium is developed in the quasi-optical approximation. The calculations are performed in the geometrical-optics approximation as well as in the approximation in which diffraction effects are taken into account. The conditions under which the medium exerts a focusing effect on the beam are elucidated. It is found that, generally speaking, the self-focusing takes place with aberration. It is shown that the saturation of the nonlinear refraction index plays an essential role in self-trapping. Conditions for self-trapping of two- and three-dimensional beams in a nonlinear medium are determined. The size of

Card 1/2

L 31961-66

ACC NR: AP6020209

the focal spot is calculated for a beam self-trapped in a nonlinear medium. The significant effect of nonlinearity on the structure of the focal region is noted, especially for a cylindrical Gaussian beam. Self-focusing mechanisms achievable under experimental conditions are discussed. Orig. art. has: 4 figures and 54 formulas. [CS]

SUB CODE: 20/ SUBM DATE: 14Dec65/ ORIG REF: 015/ OTH REF: 004/ ATD PRESS: 5122

Card 2/2 LC

L 38194-66 EWT(1)

ACC NR: AP6024890 SOURCE CODE: UR/0056/66/051/001/0296/0300

AUTHOR: Akhmanov, S. A.; Sukhorukov, A. P.; Khokhlov, R. V.

ORG: Moscow State University (Moskovskiy gosudarstvennyy universitet)

TITLE: Development of an optical waveguide during propagation of light in a nonlinear medium

SOURCE: Zhurnal eksperimental'noy teoreticheskoy fiziki, v. 51, no. 1, 1966, 296-300

TOPIC TAGS: nonlinear optics, laser theory, self focusing, self trapping, electrostriction, Kerr effect, refractive index

ABSTRACT: The self-trapping of a laser pulse in a nonlinear medium was studied theoretically as a nonstationary problem. The effects associated with the finite duration of the laser pulse were analyzed in detail. The spatial and temporal development of an optical waveguide was considered as the quasi-optic approximation by taking the inertia of the nonlinear properties of the medium into account. The equations for the self-focusing rate, length, and efficiency were derived and discussed in terms of two possible mechanisms of self-trapping: quadratic Kerr effect and electrostriction. Orig. art. has: 12 formulas. [YK]

SUB CODE: 20/ SUBM DATE: 09Feb66/ ORIG REF: 007/ OTH REF: 003/ ATD PRESS: 5144

Card 1/1 JS

L 30081-66 FBD/EWT(l)/EEC(k)-2/T/EWP(k) IJP(c) WG

ACC NR: AP6011485 SOURCE CODE: UR/0053/66/088/003/0439/0460

AUTHOR: Akhmanov, S. A.; Khokhlov, R. V. 54

ORG: Moscow State University im. M. V. Lomonosov (Moskovskiy gosudarstvennyy universitet) B

TITLE: Parametric amplifiers and generators of light

SOURCE: Uspekhi fizicheskikh nauk, v. 88, no. 3, 1966, 439-460

TOPIC TAGS: laser r and d, parametric amplifier, parametric converter, nonlinear effect, laser emission

ABSTRACT: This is a review article dealing with latest efforts at tending the tunable range of lasers and thereby exploit more fully the hitherto unrealized research opportunities afforded by the development of high-power coherent optic emission and its interaction with matter. The various research problems in which tunable lasers can be useful are briefly described and it is shown that an effective method for producing continuously tunable lasers is the use of parametric interaction between light waves in an optically transparent medium. The principles of the parametric amplifiers and optical generators developed to date are presented in detail, along with computer methods of determining the stationary

Card 1/2 UDC: 621.375.9

L 30081-66
ACC NR: AP6011485

parametric light generator, and features of parametric amplification and generation of real beams. Parametric interaction and induced scattering are also briefly discussed. It is concluded from a review of the present state of the art that the principle of parametric amplification and generation in the optical band is perfectly feasible, and its further progress depends on the development of suitable nonlinear materials, resonator systems, and pump sources. Orig. art. has: 7 figures, 38 formulas, and 1 table.

SUB CODE: 20/ SUBM DATE: 00/ ORIG REF: 024/ OTH REF: 024

Card 2/2

KHOKHLOV, S.

Synchronization of flashlights. Sov.foto 22 no.4:33 Ap '62.
(MIRA 15:4)

(Photography, Flashlight)

MASHUKOV, V.I., inzh.; VEDUTIN, V.F., inzh.; KHOKHLOV, S.D., inzh.

Indices of ore breaking in chambers depending on the design of borehole charges. Vzryv. delo no.57/14:339-344 '65. (MIRA 18:11)

1. Vostochnyy nauchno-issledovatel'skiy gornorudnyy institut.

KHOKHLOV, S.D. (Ryazan', Shkol'naya ul., 63a, kv.14)

Palliative resections in cancer of the stomach; from data of the Ryazan Province oncological dispensary. Vop. onk. 10 no.6:98-100 '64. (MIRA 18:3)

1. Iz Ryazanskogo oblastnogo onkologicheskogo dispansera (glavnyy vrach - I.G.Kochetkov, zav. khirurgicheskim otdeleniyem - Yu.N. Stepanova).

KHOKHLOV, S. F., Cand Tech Sci -- (diss) "Research into the hydrodynamics and mass exchange in centrifugal field tower." Moscow, 1960. 16 pp; (Ministry of Higher and Secondary Specialist Education RSFSR, Moscow Order of Lenin Chemical Technology Inst im D. I. Mendeleyev); 200 copies; price not given; (KL, 22-60, 140)

KHOKHLOV, S.F., inzh.

Hydrodynamics and the mass-exchange capacity of a centrifugal hollow tower. Khim.mash. no.1:24-27 Ja '60. (MIRA 13:5)

(Gas flow) (Absorption)

DYATLOV, A.V.; KHOKHLOV, S.F.

Theory of disc sprayers. Trudy DKHTI no.10:27-36 '60.
(MIRA 14:1)
(Spraying and dusting equipment)

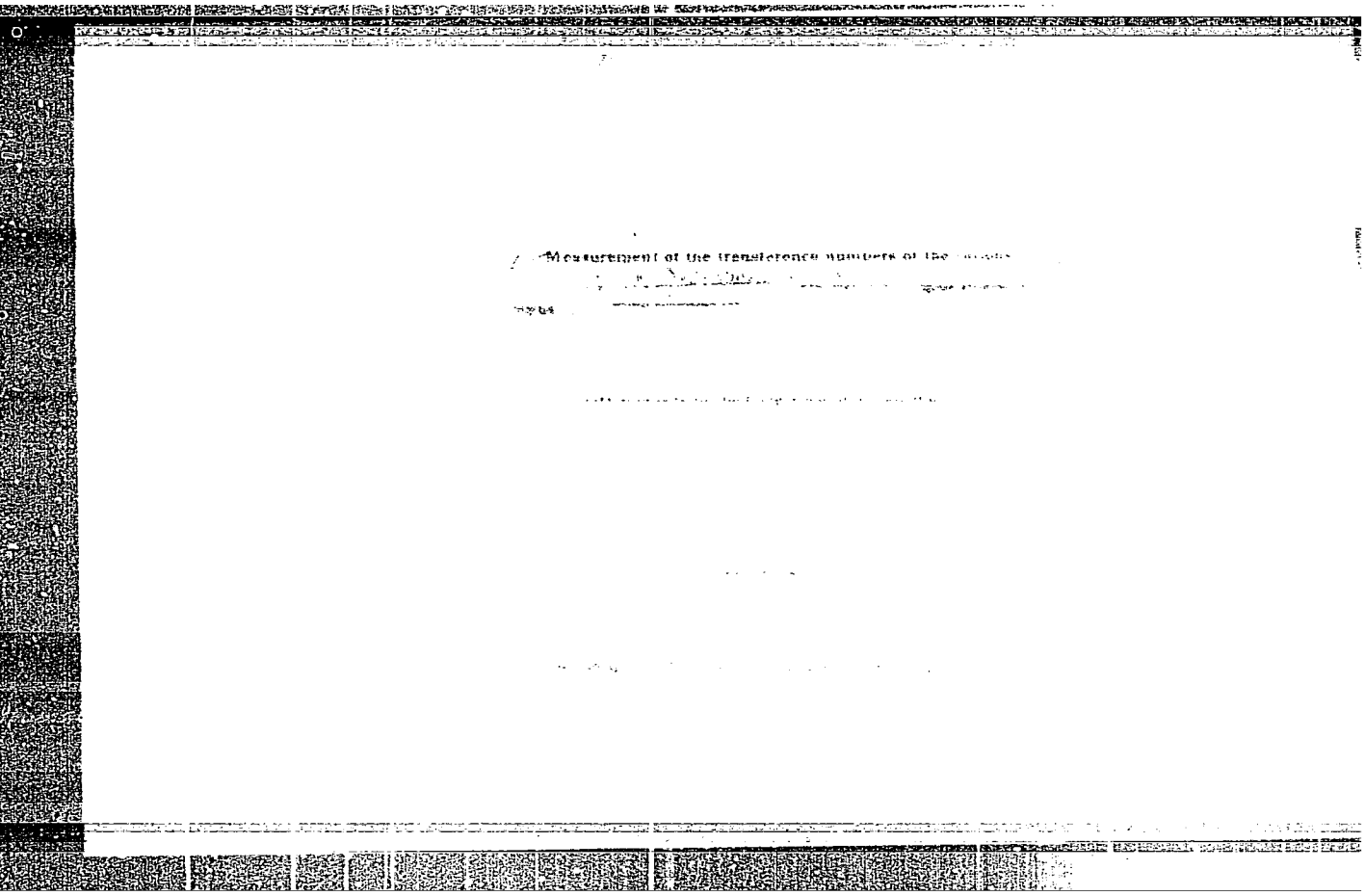
DYATLOV, A.V.; KHOKHLOV, S.F.

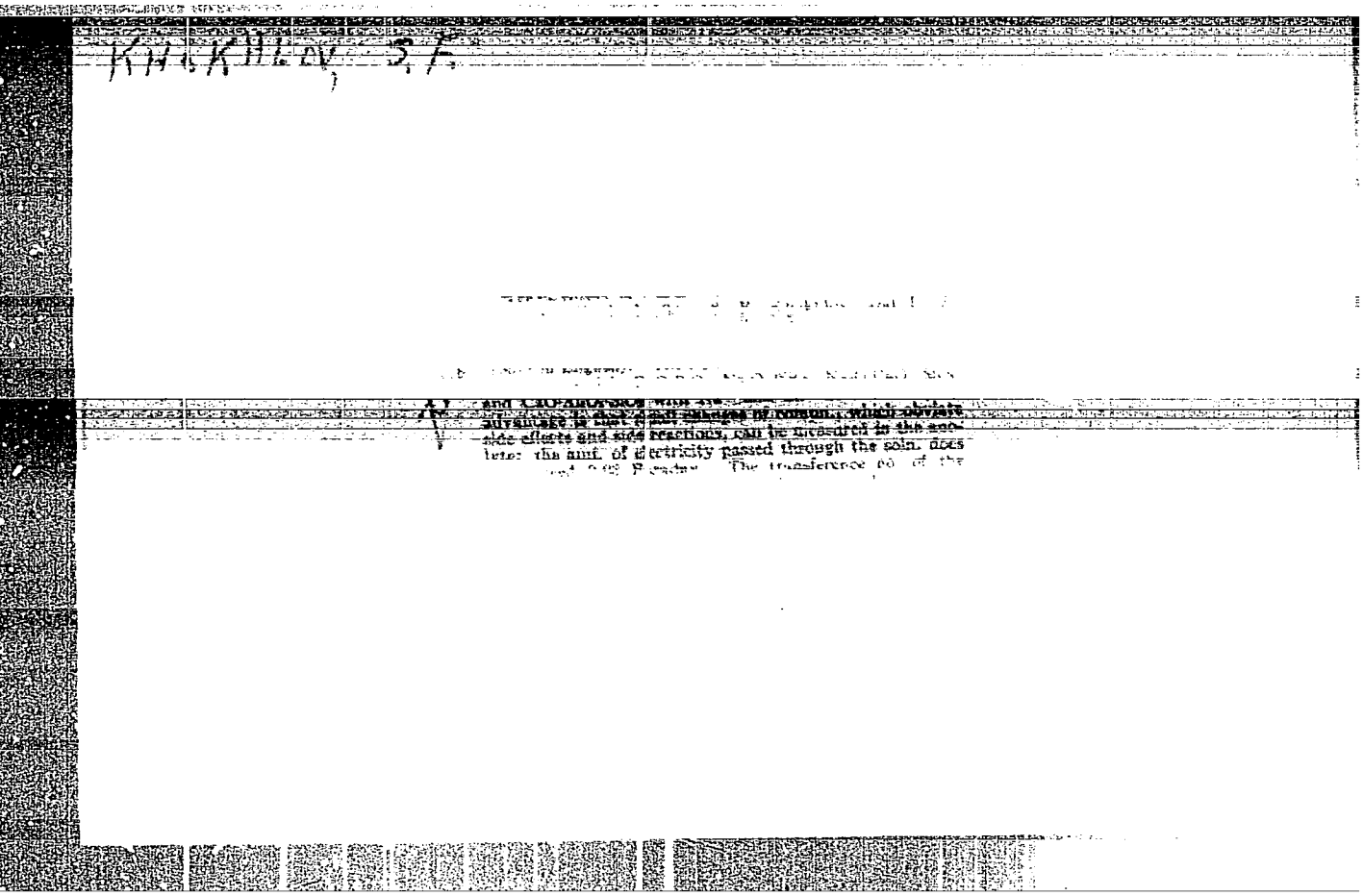
Motion of a drop on the surface of a rotating disc. Trudy DKHTI no.10:43-50 '60. (MIRA 14:1)
(Drops) (Spraying and dusting)

KHOKHLOV, S.F.

Design of a granulator of ammonium nitrate. Trudy DKHTI no.10:61-64 '60. (MIRA 14:1)

(Ammonium nitrate)
(Chemical engineering—Apparatus and supplies)





KHOKHLOV, S.F.

AUTHORS: Tomilin, I.A., Khokhlov, S.F. and Shvartsman, L.A.(Moscow).

24-4-26/34

TITLE: Influence of admixtures of calcium and sodium oxides on the distribution of the sulphur between the iron and the acidic slag. (Vliyaniye dobavok okislov kal'tsiya i natriya na raspredeleniye sery mezhdu zhelezom i kislym shlakom).

PERIODICAL: "Izv. Ak. Nauk, Otd. Tekh. Nauk" (Bulletin of the Ac. Sc., Technical Sciences Section), 1957, No.4, pp.152-156 (USSR).

ABSTRACT: In a previous paper (Izv. Ak. Nauk, Otd. Tekh. Nauk, 1953, No.12) the authors studied the distribution of sulphur between the iron and the acidic slag consisting of a melt of iron oxides which were saturated with silica. In this paper the results are described of studies of the influence on this equilibrium of additions of calcium and sodium oxides to the acidic slag. The used technique was described earlier (1) and (2). The slag was first smelted and the mixture for smelting was prepared from chemically pure iron oxide and quartz powder to which a certain quantity of calcium and sodium carbonate were added. The investigations were carried out by means of the radio-active isotope S^{35}. The curves of self-absorption were also measured for a slag consisting of iron oxides and a slag of a complex composition containing about 20% Na_2O, about 30% iron oxides and about 50% SiO_2; the results of these measurements are given in Fig.1. The results of the tests

Card 1/2

Influence of admixtures of calcium and sodium oxides on the distribution of the sulphur between the iron and the acidic slag. (Cont.).

24-4-26/34

in which the equilibrium was studied are given in the Tables 2 and 3 and in the graphs 2 and 3. The heat of transition of the sulphur from the iron into the slag of the system $FeO-SiO_2$ which is saturated with silica, decreases if calcium oxide is added to the slag. For a calcium concentration of about 20% the reaction heat amounts to about 13 000 cal/g-atom, which almost corresponds to the heat of transfer of the sulphur from the iron into the ferrous slag. In addition, an increase in the CaO concentration in the slag brings about some increase in the entropy of the FeS. The overall result of these processes is a decrease of the sulphur distribution coefficients compared to the acidic slag not containing CaO. Introduction of Na_2O into the investigated slag causes the same phenomena to a still more intensive degree. These phenomena are attributed to the specific interaction of the ions in the acidic melt. There are 3 figures, 3 tables, 8 references, 7 of which are Russian.

Card 2/2

ASSOCIATION: Institute of Metallography and Metal Physics, TsNIIChM.

SUBMITTED: July 17, 1956.

AVAILABLE:

KHOKHLOV, S.F.

Determination of the cation transport numbers in the melt $Na_2O.B_2O_3.4SiO_2$

ASSOCIATION: Institute for Metallurgy and Metal Physics, Central Scientific Research Institute of Ferrous Metallurgy, Moscow (Institut metallovedeniya i fiziki metallov, Tsentral'nyy nauchno-issledovatel'skiy institut chernoy metallurgii, Moskva)

SUBMITTED: July 14, 1956

AVAILABLE: Library of Congress

Card 2/2

KHOKHLOV, S.F., Cand Chem Sci--(diss) "~~Measuring the number~~ ~~about the figure~~ ~~measuring the number~~ of the transfer of cations in silicate alloys." Len, 1958. 16 pp (Len State Order of Lenin U im M.V. Lomonosov), 150 copies (KL,28-58,109)

KHOKHLOV, S.F.

24-58-3-13/38

AUTHORS: Malkin, V.I. and Khokhlov, S.F. (Moscow)

TITLE: Measurement of the Transport Numbers for Ca^{++} in Melts in the $CaO-MgO-SiO_2$ and $CaO-MgO-Al_2O_3-SiO_2$ Systems.

(Izmereniye chisel perenosa iona kal'tsiya v rasplavakh sistem okis' kal'tsiya-okis'magniya-kremnezem i okis' kal'tsiya--okis'magniya-okis' alyuminiya-kremnezem)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Otdeleniye Tekhnicheskikh Nauk, 1958, Nr 3, pp 108-110 (USSR)

ABSTRACT: Structure studies on multicomponent silicate melts are of substantial interest in metallurgy. The behaviour of the various components in slags, which are ionic melts, can be judged from the relative ionic mobilities, data on which are given by transport number measurements. The behaviour of oxides such as MgO and Al_2O_3 in silicate melts is of interest, since it has been claimed (Refs.1,2) that these oxides are amphoteric in melts in the $CaO-MgO-Al_2O_3-SiO_2$ system.

In relation to the ionic nature of the slag the amphoteric behaviour appears in the metal being present in cation form (in which it has an appreciable mobility) and in complex anion form (where the mobility is very small). The authors of this paper observed an amphoteric behaviour of Al_2O_3 in $CaO-Al_2O_3-$

Card 1/6