correspondingly. The beam divergence was less than 10', and the distribution of the intensity over its cross section was more uniform than in the case of Q-switching with solutions.

The observed features of Q-switching with vapors of phthalocyanines can be attributed to double passive modulation.

The vapor is first bleached by the mechanism characteristic of passive shutters based on dye solutions. After bleaching of the vapor, the field density in the resonator increases more rapidly and reaches larger values than in the case of Q-switching by solutions, owing to the high homogeneity of the vapor. Indeed, introduction into the resonator of a cell with pure carbon tetrachloride greatly decreases the growth rate of the pulse (Fig. d) and its amplitude. In a light-absorbing solution, the perturbing action of the liquid medium, which is connected with the appearance of optical inhomogeneity, will undoubtedly be even larger.

At high field densities, two- and multiphoton stepwise excitation causes intense decomposition and ionization of the medium. Absorption of light by short-lived products of the intermediate stages of the complicated photochemical process leads to a rapid closing of the shutter. The results of the rapid Q-switching at high density of photons in the resonator is a sharp increase of the conversion coefficient of the energy and power of the pulse, as shown by Vuylsteke [2], although the parameters of our scheme greatly differed from those of the scheme considered in [2].

In conclusion we note that the decomposition of the medium does not prevent the repeated utilization of the phthalocyanine-vapor shutter, since the low-volatility decomposition products settle only on the side walls. We have obtained hundreds of pulses without cleaning the cell.

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TRANSVERSE SOUND IN LIQUIDS

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The fine structure of the Rayleigh-line wing, first observed in [1], was attributed to the modulation of the light by transverse thermal waves, a broad spectrum of which exists in liquids. Such a point of view was subsequently confirmed by optical experiments both with variation of the scattering angle [2, 3] and by experiments using lasers at different frequencies [4, 5]. The gist of these transverse phonons, the lifetimes of which in liquids is exceedingly short, lies in their collective associated motion, which embraces hundreds, and in some liquids also thousands of molecules. Such investigations, made for a number of low-viscosity objects [6], are of fundamental interest to the study of the structure of liquids. The present investigation, suggested by I.L. Fabelinskii, is the first attempt to study the physics of these phenomena by acoustic methods with artificial generation of transverse sound.

The experimental setup for our measurements employs a standard pulsed circuit [7 - 9] of the impedance type. The acoustic channel constitutes a flow-through coaxial resonator, in which a quartz or lithium niobate crystal of cylindrical shape with plane-parallel ends is placed at the maximum of its electric field. The transverse field configuration was produced by knife-edge electrodes. Orientation of the crystal in the electric field and special treatment of the crystal have made it possible to obtain in it hundreds of reflections of the transverse waves. Wetting the crystal with water leads to a decrease of the pulse amplitude, and the reflection coefficient is defined as

$$R = \sqrt[n]{A_\ell / A_W}\,, \tag{1}$$

where n is the number of reflections, and A_ℓ and A_W are the amplitudes of the n-th reflection with and without the liquid, respectively.

Figures 1 and 2 show oscillograms, in which the first pulse on the left corresponds to the 30th (glycerine) and 50th (quinoline) reflection of the pulse of a fast transverse wave in a quartz crystal with and without liquid, at a frequency 200 MHz. The reaction of the apparatus to the placement of a drop of liquid on the crystal is clearly seen and indicates that the transverse sound goes off into the liquid. The ratio of the impedances of the media can be expressed [7 - 9] in terms of the modulus of the reflection coefficient R and the phase shift ϕ in the form:

$$Z_2 = Z_1 \frac{1 - R^2 + 2i\,R\sin\phi}{1 + R^2 + 2R\cos\phi}. \tag{2}$$

Optical experiments [6] indicate a tremendous absorption of transverse waves in liquids; in our opinion, this absorption influences the measured parameters in the impedance method. We found a connection between the measured quantities in the form

$$R = \sqrt{\frac{[(\mu/2\pi)^2 + 1 - k]^2 + (\mu/2\pi)^2 k^2}{[(\mu/2\pi)^2 + 1 + k]^2 + (\mu/2\pi)^2 k^2}} \tag{3}$$

where μ is the absorption per wavelength and $k = \rho_2 v_2/\rho_1 v_1$ is the ratio of the densities and the sound velocities of the crystal and of the liquid,

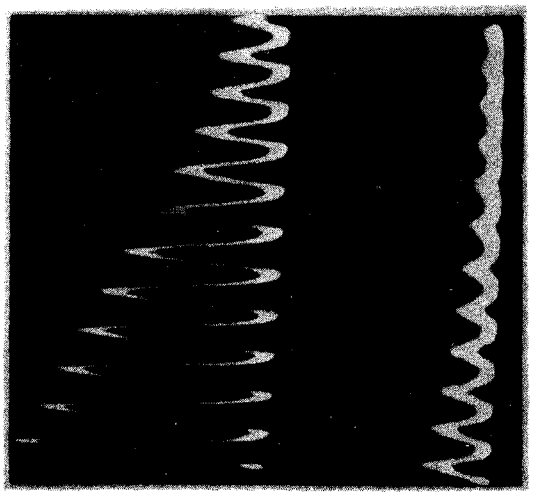

Fig. 1. Glycerine

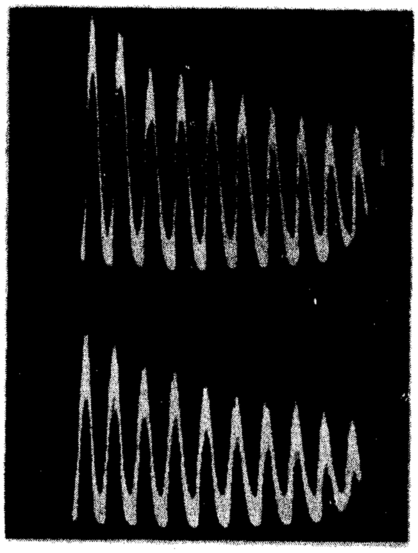

Fig. 2. Quinoline.

respectively. Expression (3), in particular, indicates that the velocity of the transverse sound in a liquid medium is strongly dependent on the sound absorption.

We did not measure the phase angle in our experiments, but the following conclusions can be drawn.

Measurements in such a setup can yield only the ratio of the absorption to the sound velocity in the liquid medium, but it is possible to obtain the complete information in conjunction with optical experiments.

Recognizing that the sound velocity in experiments with a transverse doublet is determined much more accurately than the absorption, we can state that the absorption given by Stegeman [6] for quinoline is overestimated by at least one order of magnitude. If this is not so, then we must assume an appreciable increase of μ, and consequently also of the absorption, with increasing frequency, with a simultaneous decrease of the velocity of the transverse sound.

The sound velocity in similar experiments cannot be smaller than v_{min} - which undoubtedly is a certain limiting parameter of the liquid:

$$v_{min} = v_{cryst}\frac{\rho_{cryst}}{\rho_{liq}}\,\frac{1\quad R}{1+R}. \qquad (4)$$

v_{min} = 218 m/sec and 37 m/sec for glycerine and quinoline, respectively (temperature 30°C, frequency 200 MHz).

An estimate of the amplitude losses of transverse sound on the crystal-liquid boundary for the object investigated by Rayleigh spectroscopy, as well as our experiments, show that at this stage there is no experimental technique capable of measuring the absorption and the velocity by a method in which the transverse sound is transmitted through a liquid layer.

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PROPAGATION OF TRANSVERSE HYPERSONIC WAVES IN LOW-VISCOSITY LIQUIDS

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A fine structure of the Rayleigh-line wing was observed in the investigation of the spectrum of light scattered in low-viscosity liquids [1]. This phenomenon was interpreted as being a result of modulation of the scattered