than that with the shorter wavelength (λ = 7555 Å). When the reflection coefficient of the mirrors was decreased, the intensity ratio changed in favor of the short-wave line, the long-wave line disappearing completely at coefficients R_1 = 99% and R_2 = 50%. A shift of the short-wave generation line towards the luminescence maximum, by 49 Å, was observed simultaneously. This change in frequency is in good agreement with the theoretical notions [4,5,7]. The emission generated by the solution of free phthalocyanine should include, in accordance with the calculation, a second generation line with λ = 9400 Å. No such line was registered because we did not have the required photographic material at our disposal.

The ratio of the energy generated by the solution to the energy of the exciting flux was 10% for cryptocyanine and methylene blue. Actually, the coefficient of conversion of the exciting energy of the ruby laser into energy generated by the solution is much higher, since the ruby emission was not effectively absorbed by the solution under our experimental conditions.

The effect described here offers experimental proof of the feasibility of obtaining generation with the aid of various complex organic compounds possessing broad absorption and emission bands. It turns out here that substances with exceedingly low luminescence quantum yields can be used for generation. At the same time, the experimental data show that complex molecules can be used for effective conversion of ruby-laser emission into coherent emission at long wavelengths. By varying the solvent, the concentration of the active medium, and the mirror reflection coefficients, the compounds used in this investigation can provide a large number of generation lines in the interval from 7000 to 10 000 Å.

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PRODUCTION OF FOURIER HOLOGRAMS WITH THE AID OF A PULSED RUBY LASER

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The use of powerful ruby lasers with short emission pulses for holography uncovers a possibility of investigating very fast processes. There are already published reports [1,2] of the production of Fresnel holograms in transmitted light. We report in this communication the use of ruby lasers to obtain Fourier holograms in light reflected from diffusely scattering objects.

The use of the Fourier method greatly relaxes the requirements imposed on the resolving power of the photographic emulsions [3].

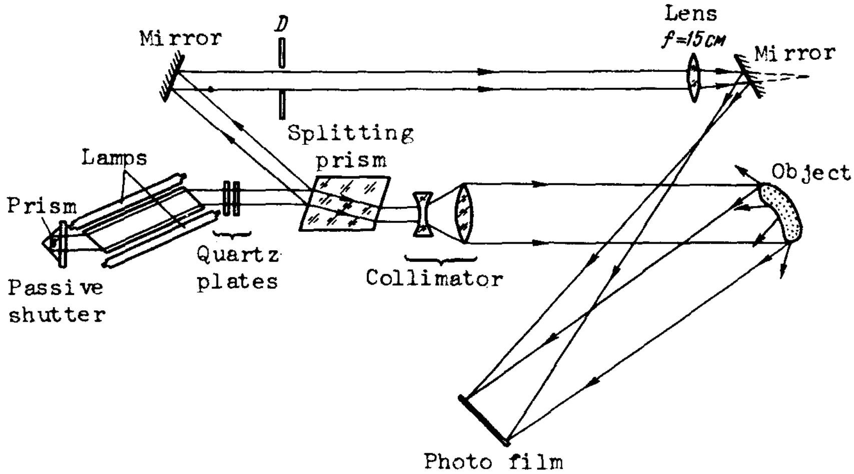

Fig. 1

To obtain these holograms we had to construct a highly efficient ruby laser operating in one longitudinal mode. The ruby rod was 12 cm long and its ends were cut at the Brewster angle. The shutter was a cell with a solution of phthalocyanine in nitrobenzene. The longitudinal-mode selection was with the aid of a system of quartz plates 10 mm thick spaced 4 mm apart. The system was used as one of the resonator mirrors (Fig. 1) and was monitored with a Fabry-Perot interferometer. The optical length of the resonator was approximately 40 cm. At a pump energy 600 J, the output power was 30 MW with a pulse duration $\approx 10^{-8}$ sec (output energy ≈ 0.3 J in one longitudinal mode).

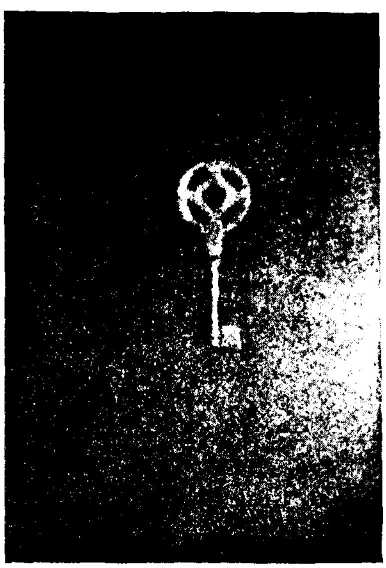

Fig. 2

The optical diagram of the experiment is shown in Fig. 1. The diaphragm D with diameter ≈ 2.5 mm was used to separate in the reference beam a section with uniform radiation-intensity distribution. The splitting prism diverted to the reference beam less than 10% of the radiation, so that almost the entire generator energy was incident on the object. The objects were small articles with dimensions ≈ 5 cm.

The film used in the experiments (type 18) had a resolution of 270 lines/mm and a sensitivity $W' \approx 10^{-7}$ J/cm^2 at 0.69 μ wavelength. This film makes it possible to obtain holograms at convergence angles up to 10° and at distances to the object on the order of several meters; the latter can be estimated from the formula $R = \sqrt{I/2\pi W'}$, where I is the energy of the radiation reflected from the object.

Upon reconstruction of the wave front, two images could be observed, symmetrical about the central beam. One of them is shown in Fig. 2. Longitudinal displacement of the lens changes the distance from the point source to the film. This causes one of the reconstructed images to become gradually less sharp and to vanish, corresponding to a transition from Fourier holography to Fresnel holography.

The experiments have shown that in order to improve the pulsed holography it is necessary to increase the spatial coherence of the ruby laser, by producing effective methods of transverse-mode selection and by greatly increasing the resolution of the films, which is of importance also for image noise suppression [4].

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OPTICAL BREAKDOWN "FIREBALL" IN THE FOCUS OF A LASER BEAM

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It is known that optical breakdown of gas in the focus of a laser beam (see the review [1]) is of explosive nature, owing to the short time and the large concentration of the absorbed-light energy, and that the resultant shock wave can be described sufficiently well by the solutions obtained in the case of the so-called strong explosion.

We show in this article that the light spark exhibits also another feature characteristic of a strong high-temperature explosion, namely the so-called "fireball" (see, for example, [2]), which is a strongly ionized region from which a shock wave is detached and moves forward when its ionizing action is noticeably weakened. The fireball (FB) is produced by the shock wave during that period when it exerts the strongest ionizing action (during the first stage, owing to photoionization, the FB front may lead the shock wave front). The following semiempirical relations [2] characterize the fireball as a function of the energy input, the FB radius at the instant of shock wave detachment $R_{FB} \approx AE^{2/5}$, where $A \approx 3 \times 10^3$ cm/(kt)$^{2/5}$, the time preceding the detachment, the time dependence of the radius, the maximum FB dimension, and its lifetime.

In our case the micro-explosion was produced by optical breakdown of air in the focus