to $(T_N - T)^{-0.8}$, whereas at $T > T_N$ it is proportional to $(T - T_N)^{-0.5}$.

In the second case no singularities of $(1/\rho)d\rho/dT$ were observed at the critical point. The conductivity at the Neel point passes through a clearly pronounced minimum, i.e., $d\rho/dT$ reverses sign.

The difference in the behavior of the crystals near the critical point can be attributed to the fact that the concept of second-order phase transition becomes meaningless in strongly doped crystals [1] and, as is well known, the specific-heat singularity disappears. It is quite natural that the similar singularity of $d\rho/dT$ disappears. The fact that the resistance passes through a maximum near the "former critical point" can be attributed to the role played in strongly doped semiconductors by impurity scattering. Besides scattering due to the electric field of the defects, an important role may be played also by scattering due to the disturbance of the magnetic order by the impurity. As shown in [2], the radius of the region in which the magnetic order is perturbed by the defect tends to infinity as $T \to T_N$, since this mechanism of scattering becomes most significant near T_N.

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NEW METHOD FOR GENERATING A GIANT PULSE IN OPTICAL GENERATORS

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In this paper we describe a new method of generating giant pulses in a ruby laser; this method does not call for additional modulating elements to be introduced into the resonator. Giant-pulse generagion is obtained in a definite class of resonators as a result of changes occurring in the active sample during the generation process. We first present the experimental results.

The construction of the generator in question was described in [1]. We used a ruby crystal with sapphire end pieces, of 7 mm diameter and 120 mm length (the total crystal length was 157 mm). The excitation was by a straight IFP-1200 flash lamp. The resonator consisted of a totally reflecting spherical mirror with curvature radius $R = 41$ cm and a plane-parallel quartz plate 6 mm thick. To eliminate self-excitation of the generator as the result of reflections from the end faces of the crystal, the axis of the latter was tilted approximately 1° to the resonator axis.

The generation regime of the described laser depends significantly on the resonator length L. At values of L corresponding to the region of resonator stability (i.e., smaller than the effective curvature radius of the spherical mirror ($R_{eff} = R + \ell(1 - 1/n)$, where n is the refractive index of ruby), the usual free generation takes place, accompanied by random pulsations of the radiation (spikes). When L is increased until the resonator becomes unstable, the character of the generation changes sharply, and giant pulses appear in addition to the free generation spikes. This is illustrated in Fig. 1a, which shows an oscillogram

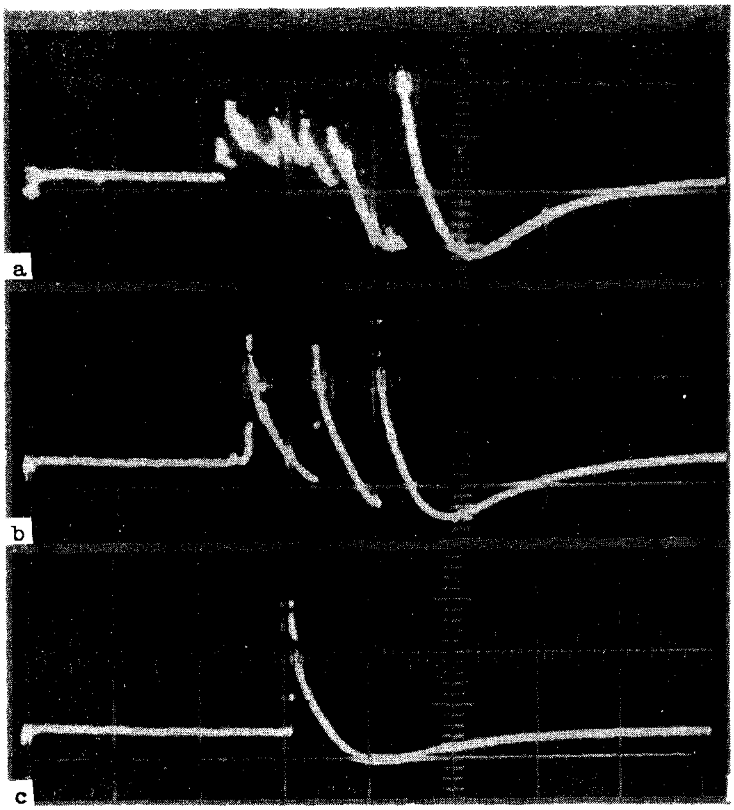

Fig. 1. Oscillograms of laser emission at different resonator lengths: a - L = 47 cm, b - 51 cm, c - 58 cm (scale 100 μsec/division).

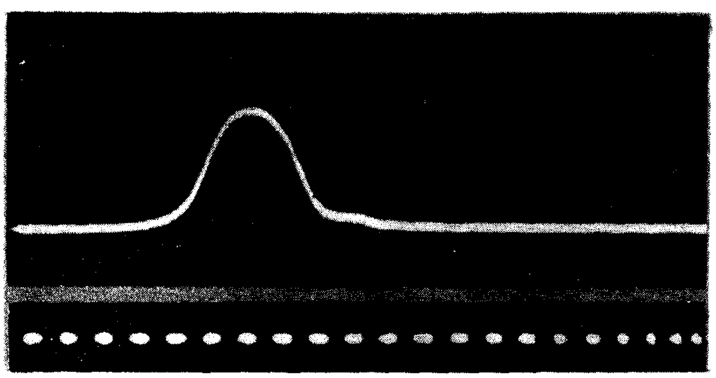

Fig. 2. Oscillogram of giant pulse. The period of the markers is 100 nsec.

of the radiation, photographed from the screen of a long-persistence oscilloscope S1-37 (bandwidth 1 MHz) at L = 47 cm and a pump energy 730 J. We note that the critical length of the resonator, corresponding to the boundary of the stability region, is approximately 48 cm, which corresponds to the semi-concentric configuration described in [1]. With further increase of L, the free generation vanishes and the laser radiation constitutes a sequence of several giant pulses, the distance between which amounts to 80 - 100 μsec (Fig. 1b). By choosing a sufficiently long resonator it is possible to ensure generation of one pulse (Fig. 1c). The range of L in which stable generation of one giant pulse was observed was approximately 3 cm (at a fixed pump level). At values of L exceeding 60 cm, the laser generation stopped. At a fixed resonator length of 52 cm, a single giant pulse was generated when the pump energy threshold (380 J) was exceeded by approximately 10%.

Figure 2 shows a typical oscillogram of the giant pulse, taken from an I2-7 oscilloscope with a resolution time 0.5 nsec. The pulse duration was 25 nsec, the radiation power approximately 6 MW. The power density at the generator output was very high ($\sim 6 \times 10^8$ W/cm^2), as is confirmed also by the fact that the ruby crystal was frequently damaged on the side of the flat reflector.

The mechanism of the observed phenomena can in our opinion be attributed to a change in the path of the rays in the resonator, due to variation of the refractive index over the ruby cross section as a function of the field in the resonator. At the initial instant of time, the loss in the resonator is large and particles are accumulated at the upper level. As soon as emission begins (it begins in the central part of the ruby), the distribution of the refractive index in the cross section changes as a result of the change in the population, and the point of convergence of the rays emerging from the ruby moves farther away. This is equivalent to increasing the radius of curvature of the mirror, and consequently to a changeover to a low-loss resonator configuration, which is indeed the cause of the generation of the giant pulse. It is important to emphasize here that these effects are particularly strongly pronounced in resonator configurations in which the field becomes highly concentrated in the active sample.

Analogous phenomena were observed also in resonators made up of spherical and flat reflectors, or of convex and concave spherical mirrors. These effects were weaker for the latter configuration.

In conclusion we note that the described principle of generating giant pulses does not depend on the radiation wavelength and can apparently be employed in neodymium glass and other active media that generate in the infrared region.

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NONLINEAR MICROWAVE PROPERTIES OF THIN SUPERCONDUCTING FILMS

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1. Nonlinear effects in microwave resonators containing thin superconducting films have been described and discussed in a number of papers [1-2]. However, no satisfactory model capable of explaining, for example, the low values of the microwave power at which these effects arise has been proposed as yet.

The purspose of the present paper is to show that these nonlinear phenomena are connected with the structure produced in the films by vortices whose symmetry axes are normal to the plane of the film [3,4]. Such a structure differs strongly from the usual mixed state of bulky superconductors of the second kind, and this is indeed the reason why very small values of the fields suffice for this occurrence.

2. Let us consider a model of an experiment of the Clorfeine type [1], in which a rectangular dielectric resonator ($\epsilon \gg 1$) is produced with dimensions $a_x \times a_y \times a_z$, with $a_z \ll a_{x,y}$ [1]. For such a resonator, the principal oscillation modes are H_{mno} and E_{mno} [5], for which the vectors $\vec{H}$ and $\vec{E}$ are respectively perpendicular to the larger faces of the resonator. We consider only the oscillation modes H_{mno}, which are noticeably coupled to the incident microwave.

Assume now that a superconducting film is now coated on the larger face of the resonator. Then the field of the oscillations in the resonator, having a vector component $\vec{H}$ normal to the film, excites Meissner currents in the film. Solving the boundary value problem by the method of the potential of a simple layer, for a film of small thickness ($d_0 \ll \delta,\ \xi_0$),

1) An analysis of experiments of other types [2] yields practically analogous results.