rotation). At large longitudinal velocities, the usual "linear" induced absorption, which is not taken into account by (1), becomes significant. This explains the disparity between experiment and the curves calculated from (1) at large values of $v_{\parallel}$ (Fig. 2).

The power of the generated radiation increased monotonically in the investigated apparatus with increasing rotation electron velocity and with decreasing longitudinal velocity (Fig. 3), and also with increasing electron current. In the generator with $\omega \approx \omega_H$ the power obtained was 6 W at current 80 mA, beam voltage 8 kV, and $v_{\perp} \sim 3v_{\parallel}$, while in the generator with $\omega \approx 2\omega_H$ the power was 190 W at 320 mA, 19 kV, and $v_{\perp} \sim 3v_{\parallel}$. Further increase in power was hindered by difficulties in cooling the generators. Furthermore, a gyroresonance discharge was produced in the residual gas in the apparatus with $\omega \approx \omega_H$. The same causes kept the electron efficiency from reaching the theoretically predicted value 19% [6]. In experimental maser models with trochoidal electron beams and traveling waves, the efficiency reaches 10 - 15%.

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1) The most convenient is a δ-function distribution of the electrons with respect to the free-oscillation frequencies.

STIMULATED RAMAN SCATTERING AND PARAMETRIC PROCESSES

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We discuss in this note the feasibility of a parametric amplifier (oscillator) and frequency converter, in which the pumping is produced by non-coherent molecular oscillations induced by stimulated Raman scattering. Assume that a field of four frequencies $\vec{E} = \vec{E}_p \exp(i\omega_p t) + \vec{E}_s \exp(i\omega_s t) + \vec{E}_1 \exp(i\omega_1 t) + \vec{E}_2 \exp(i\omega_2 t)$ is produced in the medium, with $\omega_p - \omega_s = \omega_1 + \omega_2 = \omega_0$, where ω_0 is the natural frequency of the molecules of the medium active in the Raman scattering. For simplicity we put $\vec{E}_p \parallel \vec{E}_s \parallel \vec{E}_1 \parallel \vec{E}_2$. It can be shown that the nonlinear part of the polarization of the medium, $\vec{P}^{nl}$, is of the form

$$\vec{P}^{nl}(\omega_1) \simeq -i\sigma_1|\vec{E}_1|^2\vec{E}_2 - i\sigma|\vec{E}_p\vec{E}_s^*|\vec{E}_2; \quad \vec{P}(\omega_2) = -i\sigma_1|\vec{E}_1|^2\vec{E}_2 - i\sigma|\vec{E}_p\vec{E}_s^*|\vec{E}_1, \tag{1}$$

where σ_1 and σ are constants that depend on the properties of the medium and on the frequencies of the field. Substituting (1) in Maxwell's equations and assuming that $E_1E_2 \ll E_pE_s^*$, we get

$$[\nabla^2 + (\omega_1^2 c^{-2})(\epsilon_1' + i\epsilon_1'')] E_1 = -i4\pi (\omega_1^2 c^{-2}) \sigma \vec{E}_p \vec{E}_s \vec{E}_2^* \tag{2}$$

and a symmetrical equation for $\vec{E}_2$. These equations describe the parametric interaction of the waves $\vec{E}_1$ and $\vec{E}_2$ with the wave of the molecular oscillations, which is given by the product $\vec{E}_p\vec{E}_s \exp(i\omega_0 t)$. In such an interaction, in general, we can get either amplification (absorption) of the waves $\vec{E}_1$ and $\vec{E}_2$ simultaneously, if $|\omega_1| + |\omega_2| = \omega_0$, or frequency conversion if $|\omega_1| - |\omega_2| = \pm\omega_0$.

Let us assume that the wave-vector synchronism condition $\vec{k}_p - \vec{k}_s = \vec{k}_1 + \vec{k}_2$ is satisfied. As follows from Eq. (2) for $\vec{E}_1$ and $\vec{E}_2$, the amplification of $\vec{E}_1$ and $\vec{E}_2$ ($|\omega_1| + |\omega_2| = \omega_0$) is possible if $16\pi^2\sigma^2|\vec{E}_p\cdot\vec{E}_s| > \epsilon_1''\epsilon_2''$. The condition for the excitation of the Stokes wave is $4\pi\sigma|\vec{E}_p|^2 > \epsilon_s''$. Let $|\vec{E}_s| = 0.1|\vec{E}_p|$ (actually, larger values of $|\vec{E}_s|/|\vec{E}_p|$ are permissible). Then the power $|\vec{E}_p|^2$, which is the threshold value for paramagnetic amplification, exceeds by $10(\epsilon_1''\epsilon_2'')^{1/2}/\epsilon_s''$ the threshold power for the excitation of the Stokes wave. Under reasonable values of $(\epsilon_1''\epsilon_2'')^{1/2}/\epsilon_s''$ this power can be readily attained.

Frequency conversion, as is well known, is a process having no threshold.

The condition $\vec{k}_p - \vec{k}_s = \vec{k}_1 + \vec{k}_2$ can be readily satisfied only in the frequency-conversion mode. There probably exist liquids for which this condition can be satisfied also in the amplification mode, since the frequencies ω_1 and ω_2 usually lie to the left of the series of absorption bands where the refractive index should be large.

In conclusion we note that excitation of stimulated Raman scattering in the focus of a laser beam can cause generation of waves with frequencies $0 < \omega < \omega_0$. We know of no attempts to record the radiation of such frequencies.