Table 5

Parameters \ No. of a rod	65	86	88	93	102	123	141			
U_p [V]	870	800	800	855	740	880	870			
E_p [J]	4.24	3.58	3.58	4.09	3.07	4.34	4.24			
T_w [%]	34.6	20.6	22.7	23.8	16.4	16.8	27.2			
E_{out} [mJ]	5.0	4.6	7.7	5.6	5.1	8.5	5.0			
Parameters \ No. of a rod	**72**	**78**	**82**	**87**	**89**	**90**	**92**	**104**	**105**	**108**
U_p [V]	870	890	840	830	820	720	840	730	740	840
E_p [J]	4.24	4.44	3.95	3.86	3.77	2.90	3.95	2.98	3.07	3.95
T_w [%]	27.0	28.1	21.9	21.2	23.4	24.7	24.0	15.2	17.0	27.8
E_{out} [mJ]	5.1	5.0	7.0	4.6	4.6	5.0	4.4	4.5	4.2	4.0
Parameters \ No. of a rod	**63**	**98**	**101**	**103**	**124**	**126**	**131**	**135**		
U_p [V]	870	760	810	780	840	880	870	840		
E_p [J]	4.24	3.24	3.67	3.41	3.95	4.34	4.24	3.95		
T_w [%]	21.6	36.3	29.2	23.2	17.3	22.8	24.0	22.7		
E_{out} [mJ]	4.2	4.5	5.6	7.7	7.0	6.7	7.0	7.9		

in Fig. 9. It is seen that for r 0.03 and 0.06 threshold voltage which increases with the FNA transmission is greater for the smaller ρ. For $\rho \approx 0.09$ threshold voltage decreases with the increasing T_f {C = 11.2 pF). It is also seen that with the increasing mirror transmission T_s (i.e. (T_w) generation threshold decreases.

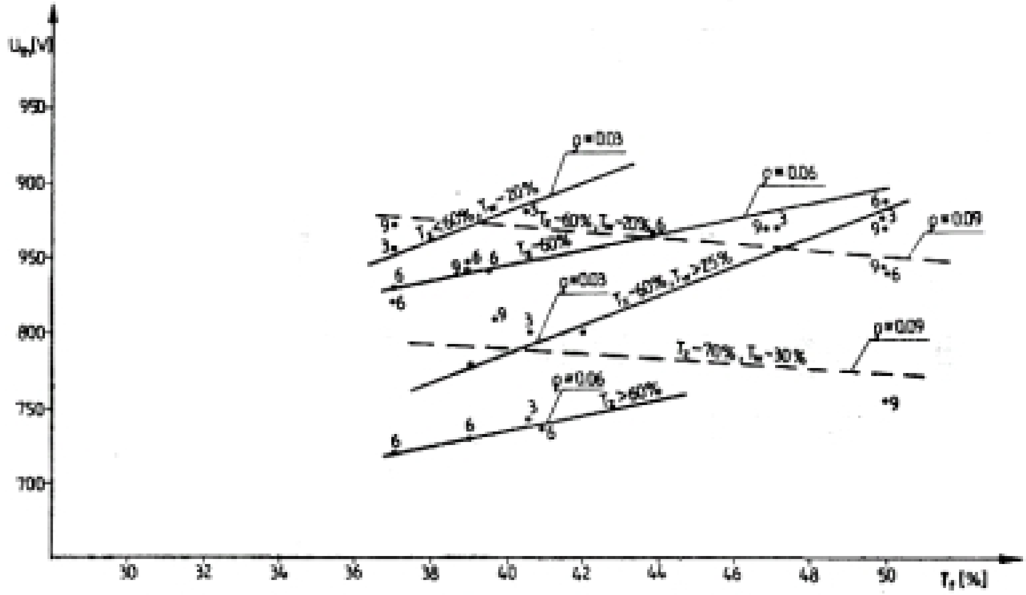

Fig. 9. The dependence of the threshold generation voltage for giant pulse generation on the transmission of FNA for an arbitrary transmissions of mirrors

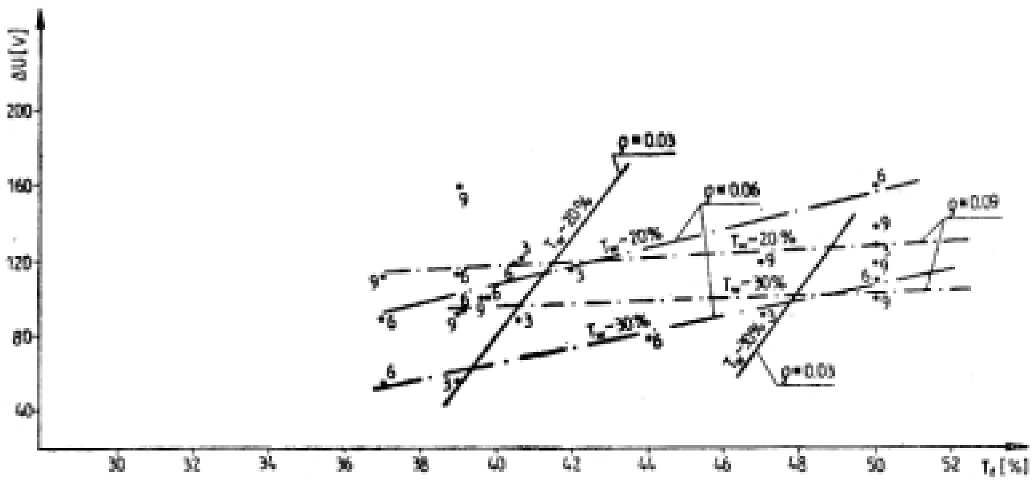

Fig. 10. The dependence of the width of the region of monomode generation on the FNA transmission

Figure 10 presents the dependence of the width of the region of monomode generation on the T_f. It is seen, that for all presented values of ρ the width increases with the increasing T_f and it is greater for smaller ρ.

Thus, generally, with the increasing FNA transmission the threshold generation energy for the giant pulse generation and the width of the monomode generation region increase while the value of output generation energy decreases. For larger absorption coefficient r ≈ 0.09 the value of the threshold generation energy decreases with the increasing T_f.

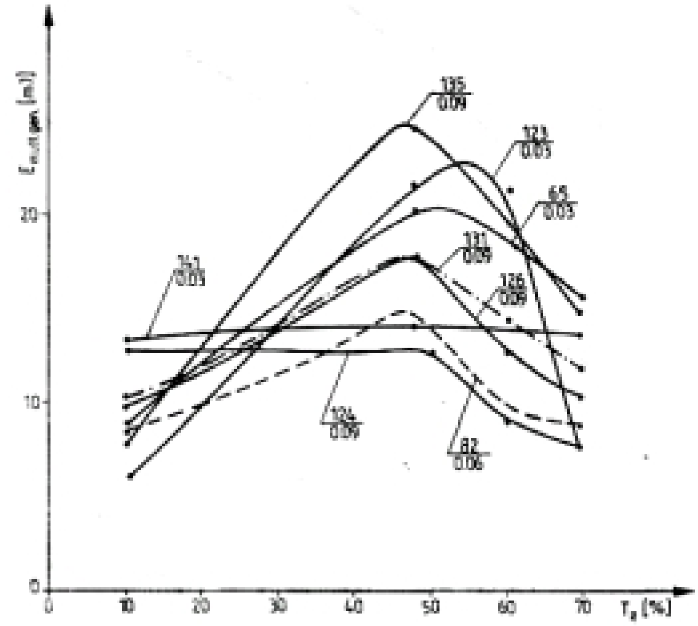

Fig.11 The dependence of multimode generation energy on the transmission of output mirror

Figure 11 shows the dependence of the multimode generation energy on the transmission of output mirror. It is seen, that it is possible to select the Q-switch for a rod of an arbitrary ρ. The greatest multimode generation energy cannot correspond (for a given rod) to the greatest output generation energy for the giant pulse generation. For example, from the laser head with the rod No. 124 we have obtained E_{out} = 7 mJ and with the rod No. 135 E_{out} == 7.9 mJ in spite of their just the same ρ and the maximum of the multimode generation energy differing by 100°/o. In this figure one can see the two rods of similar characteristics (after selecting Q-switch) and physical properties (131 and 126) and the two rods of the same as previous value of ρ but of completely different properties of generation (135 and 124). This means that the rods of the same values of ρ must still differ in one physical parameter at least [3].

Figure 12 provides one more proof for the above. There, the dependence of the pumping voltage $U_p(V)$ on the multimode generation energy is shown, for the r ≈ 0.03. It is seen, that for the rods of the same values of ρ one can obtain the different multimode generation energies in the laser rod.

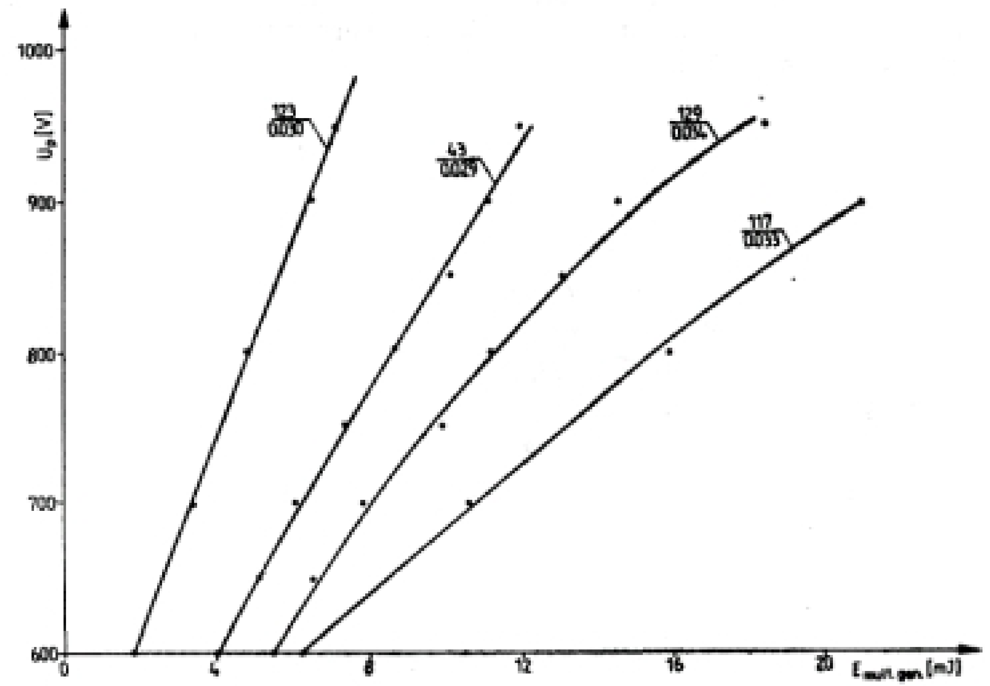

Fig. 12. The dependence of the pumping voltage *Up(V)* on the multimode generation energy

6. Influence of absorption coefficient on generation characteristics of laser heads

Figure 13 shows how (after selecting Q-switch) the T_f, T_s and T_w change with the absorption coefficient (ρ for the selected rods. It is seen that the conduction of Q-switch (T_w) is determined by the value of T_s independently of $\rho(T_S^* — T_w^*, T_s^* — T_w^*)$. The characteristic maxima may be seen for ρ = 0.03, 0.048, 0.06, 0.08 and 0.096. The maxima may be also observed in the next figures.

Figure 14 shows the dependence of the threshold generation voltage for the giant pulse generation for the laser heads with different rods (different ρ). The maximal values of threshold voltage appear at the places just between those mentioned above, namely ρ = 0.040, 0.056, 0.070 and 0.092. Thus, a good laser head (a good rod) must have the small value of threshold voltage of giant pulse generation.

In Figure 15 the dependence of width of the appearing monomode generation on the *r* is shown. Here, we have obtained the confirmation of the preceding result: the better the laser head - the narrower *DU*.

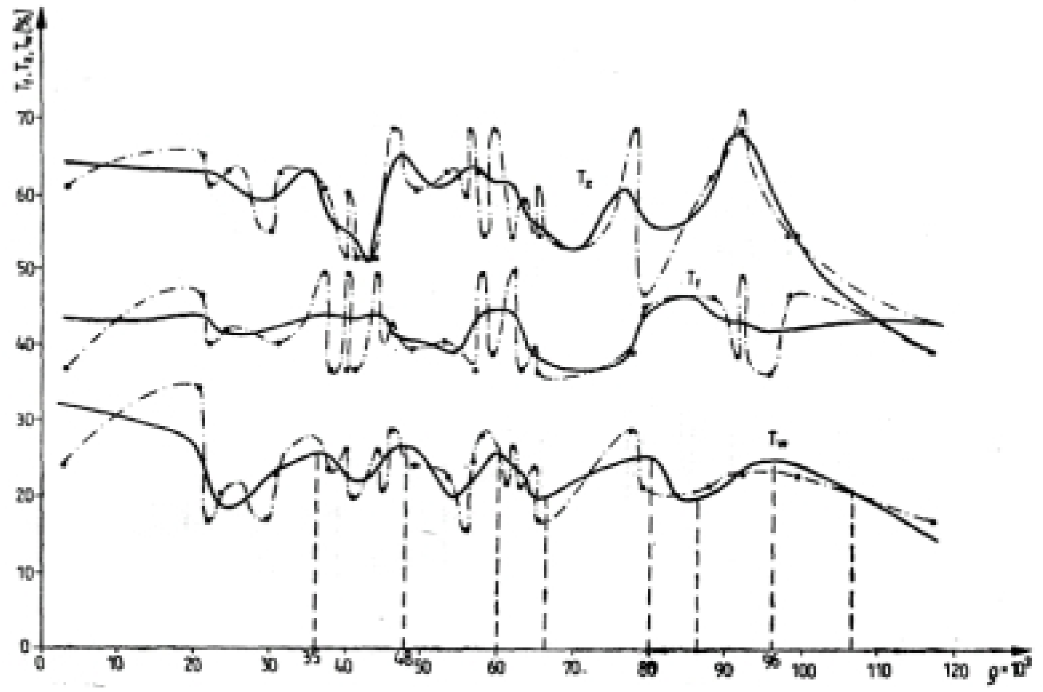

Fig. 13. The dependence of T_f, T_s and T_w on the absorption coefficient ρ for the selected rods

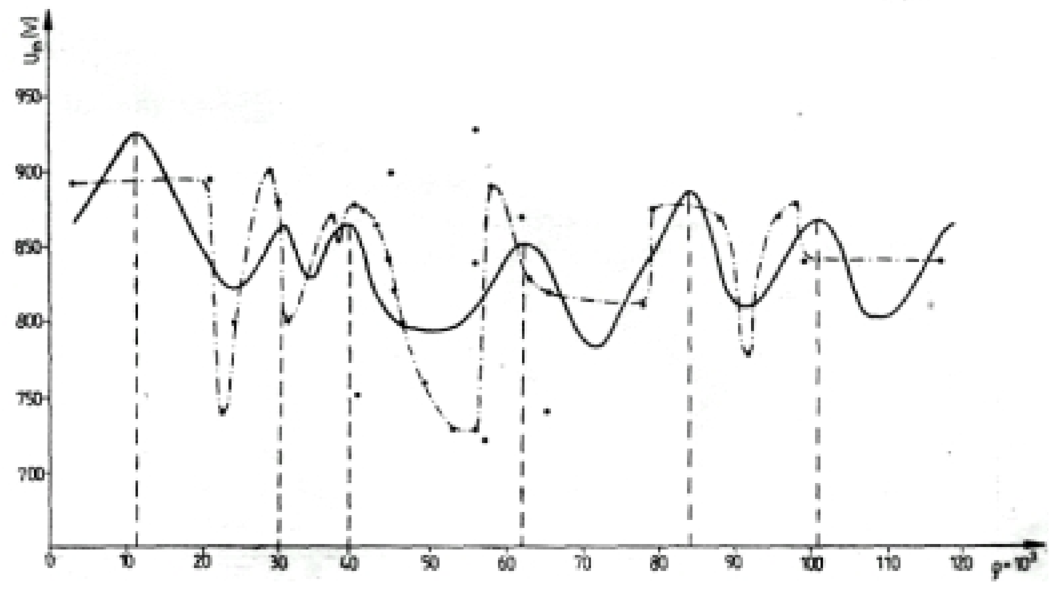

Fig. 14. The dependence of the threshold generation voltage for the giant pulse generation for the laser heads with different rods -

Figure 16 presents the dependence of giant pulse generation energy on the ρ. It is seen that the maximal generation energy appears for the same values of ρ as shown in Fig. 13. Similar situation may be observed in Fig. 17. In this figure

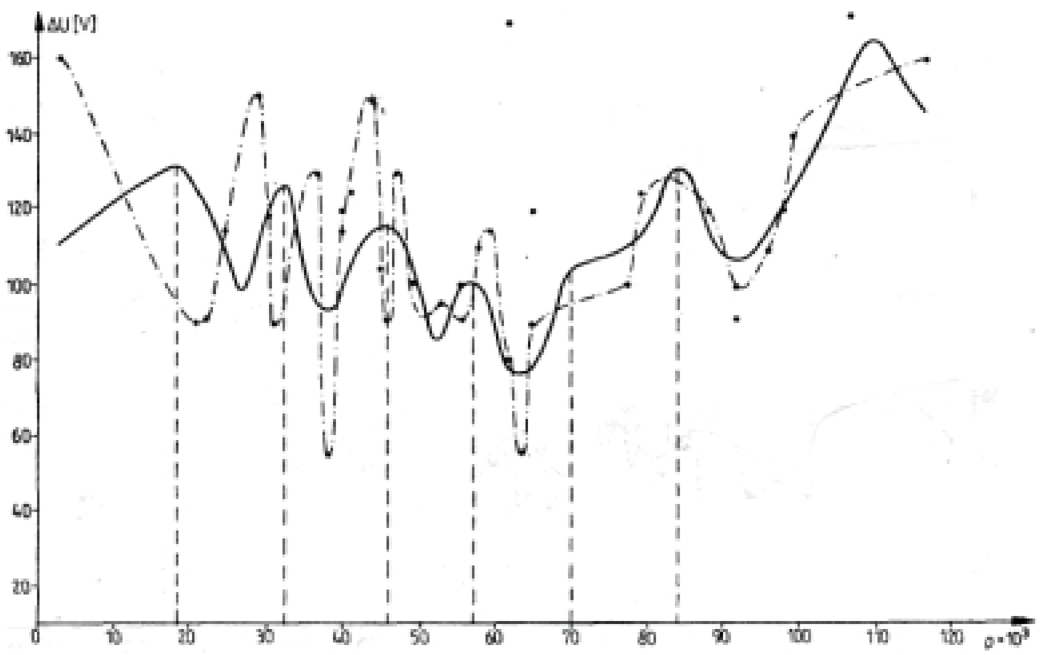

Fig. 15. The dependence of width of the appearing of monomode generation on the absorption coefficient ρ

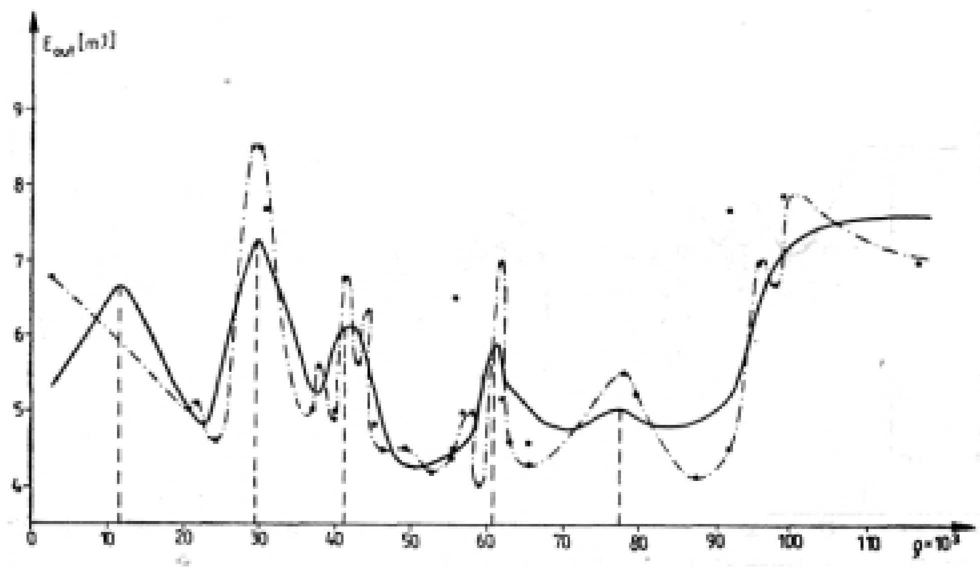

Fig. 16. The dependence of giant pulse generation energy on the absorption coefficient ρ

the dependence of multimode generation energy on-the absorption coefficient ρ for the pumping voltage 850 V and mirror transmission T_z = 60.9% is shown.

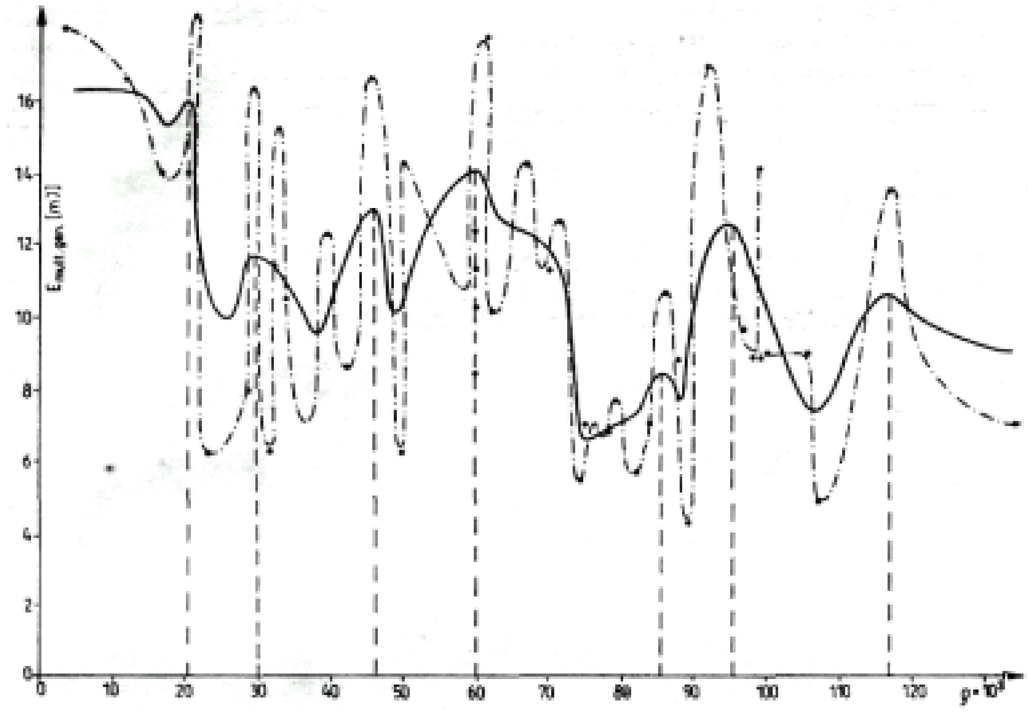

Fig. 17. The dependence of multimode generation energy on the absorption coefficient ρ for the pumping voltage 850 V and mirror transmission T_z = 60.9%

7. Results

The scatter of the multimode generation energy can be explained by the fact that the position of the rod in the laser head with respect to the optical axis is non optimal. In connection with the change of optical properties of a rod on its cross-section, its rotation by an arbitrary angle around the optical axis causes the change of measured $E_{mult\ gen}$ values even by 100°/o.

Hence, for the explanation of the energetic characteristics of laser heads selected here, it is necessary to measure the laser emission cross-section of rods.

From the above text one can select the following important results :

i) The explicit correlation of optical and generational features of rods applied in the laser heads is seen.

ii) E_p of giant pulse generation behaves monotonically with the change of T_w and T_f for an arbitrary ρ. For the rods with ρ = 0.03 and ρ = 0.06 the increase of a threshold energy with T_w and T_f is observed, while for the rods with ρ = 0.09 this energy decreases with T_w and T_f.

iii) The width of monomode generation energy region increases with *the* increasing T_f and the generation energy of giant pulse generation decrease independently of ρ.

iv) For the rods with the same value of ρ one can obtain different multi-mode generation energies in the laser head.

v) The conduction of Q-switch is determined by the value of T_z .

vi) The better the laser head (i.e., rod) the smaller E_p and the narrower ΔU.

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