# SOURCE OF PULSED EXCITATION ENERGY FOR LASERS OF LIDARS

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*We discuss here the problem on development of highly efficient pumping systems for pulsed solid lasers used as transmitting devices in lidars. The structure and characteristics of the pumping block BINOM are presented.*

Solid repetitively pulsed Nd:YAG lasers have been shown to be useful for atmospheric studies. These lasers provide high–power output (up to 1 MW) and short pulse duration (about 10 ns). Lidars based on this type of lasers allow large operation range as well as high accuracy and resolution of remote sensing. It is also of great practical importance that the radiation of first harmonic of such lasers (1.06 μm) can be efficiently converted using methods of nonlinear optics to the second and higher–order harmonics.

At the same time, consideration of a number of specific problems being solved by lidars based on Nd:YAG lasers shows that prospects for their development are limited by laser transmitter parameters. Hence, the structure of laser transmitters should necessarily be updated. This conclusion follows from several interrelated reasons.

The first stems from design and application features of lidars and is the necessity of providing high–precision measurements of lidar returns varied over wide dynamic range. It should be pointed out that accuracy of lidar measurements rapidly falls when instability of laser output reaches 10–30% or scatter of peak power exceeds 10% to 80%. Thus, improvement in stability of laser output parameters is necessary.

The second is related to specific features of certain measurement technique based on variation of laser pulse repetition rate according to an arbitrarily selected law. Such a mode of lidar operation requires a new approach to laser excitation system development since the existing units provide only a discrete number of values of pulse repetition rate and demonstrate limited flexibility in operation.

The third factor to be important in practice is reliability and easiness in use under field conditions. To meet this requirement, one should minimize the aspect ratio of the excitation system. It should be noted also that development of a system with a stable laser output and variable pulse repetition rate is a sort of difficult technical problem since these two requirements contradict each other.

Summarizing, we come to a conclusion that in order to widen capabilities of Nd:YAG–laser based lidars it is necessary to develop improved structure of laser transmitter units including new excitation systems for repetitively pulsed solid lasers. Existing systems adapted to meet specific requirements do not provide reliable performance. Thus, potentials of Nd:YAG–laser based lidars are limited.

Theoretical and experimental investigation into auxiliary discharge regime and analysis of capacitive energy storage enable us to develop an excitation system for Nd:YAG lasers with respect to requirements of lidar performance. The structure of excitation system developed is presented in Fig. 1. The specific feature of this system is the presence of auxiliary energy storages (AESs) that control performance of the units responsible for laser operation mode using extra energy from the basic storage.

Basic requirements to excitation system for pulsed solid lasers taken into account in our work were as follows:

– widening of the range of pulse repetition rate and providing of the synchronization of the transmitter operation from an external source;

– improvement in reliability of the system;

– diminution of mass and sizes of the system;

– minimization of the volume of servicing work and shortening of the relaxation time;

– improvement of efficiency of the excitation system.

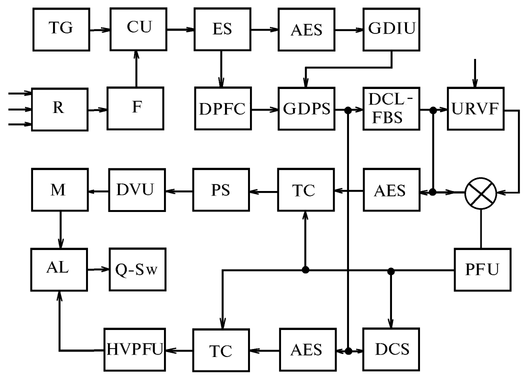


*FIG. 1. Block diagram of the excitation system.*

The system consists of two basic channels, i.e., the channel of electrooptical Q–switch control pulse formation and channel of pulse formation for active element . The latter includes energy storage (ES), gas discharge pumping source (GDPS), discharge current limiter (DCL), discharge current switch (DCS), discharge pulse formation circuit (DPFC), and gas discharge initiation unit (GDIU). A rectifier R converts alternating voltage into direct one. The rectifier is coupled with the charging unit (CU) through a filter F. Discharge pulse repetition rate is determined by a trigger generator (TG). A control system consisting of a feedback sensor (FBS), a comparator and unit of reference voltage formation (URVF) provides variation and stabilization of charging voltage level.

Electro–optical Q–switch operation is controlled by the resonator Q–factor variation according to a certain law and with a necessary delay after the excitation pulse. This is provided by modulator M, artificial line AL, delay variation unit DVU, high voltage pulse formation unit HVPFU, and pulsed stabilizer PS.

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The system developed was tested under both field and bench conditions. The results obtained confirm our theoretical ideas used for the development of the structure of excitation system and for construction individual units and demonstrate improved flexibility of the system operation as compared to the known ones. Based on these data a Nd:YAG–laser compatible power supply BINOM was constructed. It allows laser operation at elevated pulse repetition rate. BINOM is designed as a desk unit including power supply, charging unit, capacitive energy storage, high–voltage rectifier, generator of high–voltage pulses for EOS control, control system for variation and stabilization of pumping power and synchronizing pulse formation. The picture of the device BINOM is presented in Fig.2.

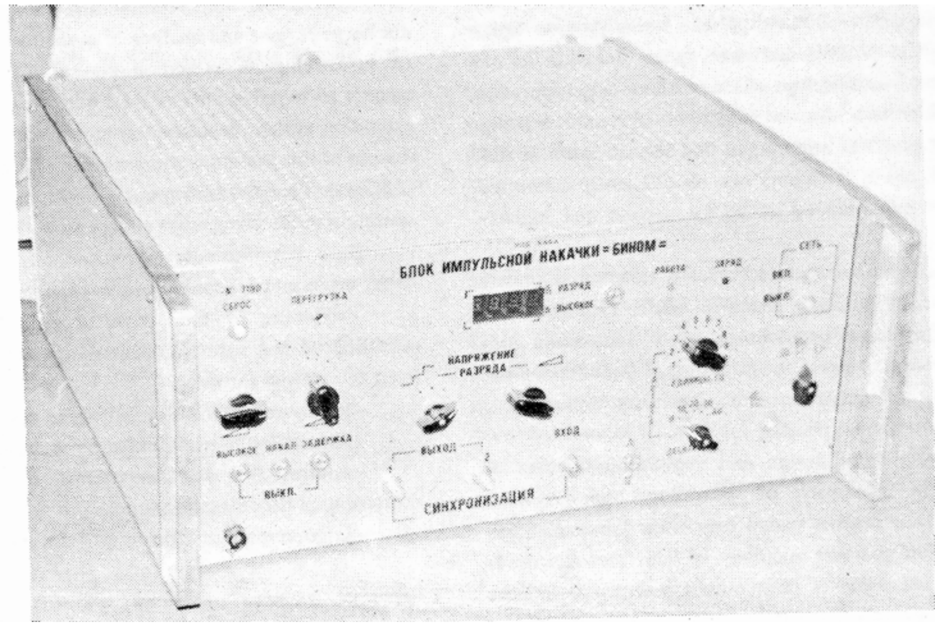


*FIG. 2.*

Basic specifications of the power supply

| | |
|---|---|
| Limits of fine variation of the charging voltage, V | 250–1000 |
| Pulse energy, J | 3–50 |
| Energy instability | 1% |
| Pulse repetition rate, Hz | 0–150 (fine variation) including single–shot operations |
| Type of pumping flash lamp | IFP–800, ISP–2500 and similar ones |
| Maximum power consumed, kW | 8 |
| Mass, kg | 60 |
| Size, mm | 480×350×285 |