MODIFIED PHYSIOTHERAPEUTIC INSTALLATION BASED ON A MALAKHIT LASER

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Information is presented on the new therapeutic devices operating in the green (510.6 nm) and yellow (578.2 nm) ranges of the visible spectrum. Block-diagrams and specifications -are described of Malakhit and Malakhit–M physiotherapeutic installations based on compact copper vapor lasers. Also presented are the functional capabilities of these devices and the therapeutic procedures developed at the Tomsk Oncological Center of the Russian Academy of Medical Sciences based on the Malakhit type devices.

During the past several years lasers have become a common tool in medical institutions. Inductially built lasers have found wide applications in surgery and low-intensity therapy.

We are now short of adequate laser facilities to initiate a comprehensive study of interaction of laser radiation with biological objects. Radiation power of the commercial He–Ne lasers operating at 633 nm does not exceed 100 mW. More powerful rare–gas–ion lasers operating in the visible possess high energy intensity, large overall dimensions, require intense water cooling and a three–phase supply line. Such setups cannot be used extensively in practical medicine. To operate high–power lasers the attending personnel must be specially trained, and the operating areas should be organized.

Metal–vapor lasers can close the gap between the high-power (CO_2, Ar^+, YAG) and the low–power (He–Ne, semiconductor) lasers. What is more, metal-vapor lasers overlap most of the visible spectral range.

The present paper reports a Malakhit physiotherapeutic unit, built around a small-size Cu-vapor laser. The Malakhit system is unique in having high efficiency, low energy consumption, small overall dimensions, a single-phase supply line, and lack of water cooling. The ease of control and automatic tuning to operational mode make it accessible for general users.

The Malakhit and Malakhit-M laser physiotherapeutic units are intended for clinical, and preventive use and for research activities. They are used to treat and prevent many conditions in oncology, cardiology, proctology, gastroenterology, pyo–septic pathology, etc.

Their therapeutic effect is based on photobiochemical action of laser radiation on biological objects manifested in regeneration of functional capabilities of those objects when exposed to small doses of radiation and in selective necrosis produced by power densities exceeding 10 W/cm^2. Laser emission is fed through a flexible optical waveguide to focus on pathological area; optical probes are used to form the wavefront in a particular manner. The number and configuration of tip–probes depend on the medical task at hand. Flow–charts of the Malakhit and Malakhit–M setups are given in Figs. 1 and 2.

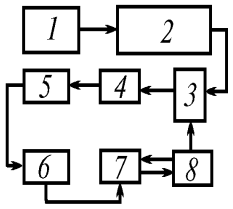

FIG. 1.

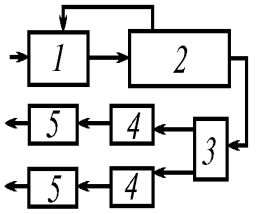

FIG. 2

Laser power supply *1* generates high–voltage pulses at a pulse repetition rate in excess of 10 kHz which are fed to electrodes of the gas–discharge tube inside emitter *2*. The emitter is rigidly coupled to attachment consisting of several elements:

– spectral separation module *3,*
– radiation power attenuator *4,*
– optical waveguide merge *5*.

The Malakhit is actually an attachment to those units, with a two–channel exit for laser radiation, splitting the generated wavelengths (510.6 and 578.2 nm) into different optical channels and mixing it in one of the channels.

The Malakhit–M modified setup differs from Malakhit in having wider functional capabilities. The merge consists of:

– electromechanical shutter *3,*
– spectral splitter *4,*
– ten-step laser radiation attenuator 5,
– optical waveguide joint *6,*
– radiation power meter 7 at the distal end of the optical waveguide,
– remote-control console *8* for the shutter and the power meter.

Specifications of these medical units are listed in the table.

Biostimulating effect of low-intensity laser radiation has found wide applications to practical medicine. Laser therapy is successfully employed to treat many chronic diseases resistant to medicinal treatment. The Cu–vapor laser radiation can be applied to different areas of clinical medicine; it has stimulating and antimicrobic action, and

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displays no tumor-stimulating effects, as supported by experimental and clinical studies at the Scientific–Research Institute of Oncology, Tomsk Scientific Center, Russian Academy of Sciences. Of prime importance is the method of treating precancerous diseases of upper respiratory tracts and of the gastroenteric tract. The principle of the proposed method is that low–intensity laser radiation directly affects pathologically changed tissues. The following therapeutic procedures have been developed and are successfully used at the Scientific–Research Institute of Oncology, using the Malakhit physiotherapeutic units:

1) laser endoscopic therapy of diseases of upper respiratory tracts,

2) laser endoscopic therapy of diseases of the gastroenteric tract,

3) treatment of radiologic complications,

4) treatment of postoperative states in patients operated for carcinoma of stomach and rectum.

Contraindiction to laser endoscopic therapy is an extremely grave general condition of the patient prohibiting endoscopy.

Feature	Malakhit	Malakhit–M
Radiation wavelength, nm	510.6, 578.2	510.6, 578.2
Average waveguide power, mW	50–500	20–1600
Pulse repetition rate, kHz	12–18	12–25
Number of spectral splits	2	3
Number of attenuation steps	5	10
Timer lapses range, s	–	0–9999
Continuous operation, hr	8	8
Mass, kg	48.5	52.6
Overall dimensions:		
power supply, mm	150×280×500	150×280×500
emitter, mm	150×190×900	150×150×850

Laser therapy using the Malakhit setup is a useful tool for treating open ulcers of the stomach and duodenum, inflammations of respiratory tracts. Respective therapeutic procedures are straitforward, they can be used both in hospital and ambulatory and make recovery without surgical intervention possible.