Electrical stimulation is one of the most effective means of combating such menacing postoperative complications as paralytic ileus of the gastrointestinal tract. Electrical stimulation is being successfully used in malfunctions of gastrointestinal peristalsis resulting from injuries of the spinal cord and brain, pain syndromes, colitis, pancreatitis, chronic constipation, and general lack of mobility in severely ill patients [1-3]. In latter years many writers have reported a good therapeutic effect of electrical stimulation in atonic states of the urinary bladder and urinary and fecal incontinence [4-6].

Recently the All-Union Scientific-Research Institute of Medical Instrumentation in collaboration with the A. V. Vishnevskii Institute of Surgery, the Kaunas Medical Institute, and the Laboratory of Proctology of the RSFSR Ministry of Health have developed for the first time in the Soviet Union an electromedical apparatus for electrostimulation of the gastrointestinal tract, model ESG-35-1 Endoton-1 (Fig. 1) and have put it into multiple production at the Moscow Electromedical Instruments Works.

The electrostimulator consists of a generator of unipolar rectangular pulses and trains of bipolar rectangular electrical pulses.

The repetition rate of unipolar pulses and of trains of bipolar pulses was 12.5, 25, 50 and 100 Hz, and the repetition rate of bipolar pulses in a train was 1000 Hz. The duration of the unipolar pulses and trains of bipolar pulses was 5 msec.

The stimulation rhythm was continuous and periodic, with a 4-sec period of emission repetition (2-sec emission, 2-sec pause).

The maximal amplitude of the output current was 35 mA. The power required by the apparatus did not exceed 10 W. The weight of the apparatus without the kit was 3.5 kg, and in its case with the kit was 9 kg.

The apparatus is made up of six transistors and seven integrated microcircuits. As regards protection from injury by electric current the electrostimulator falls in class II, and during operation does not require protective grounding. There is a cutoff which prevents the current from being fed into the circuit of the patient, if the apparatus is connected to the mains with the current regulator not set to the zero position.

A block diagram of the apparatus is presented in Fig. 2. The electrical part consists of the following functional units: reference frequency generator 1, pulse shaper 2, power amplifier 3, measuring unit 4, and power pack 5.
Fig. 1. General appearance of gastrointestinal tract electrostimulator Endoton-1

Fig. 2. Block diagram of electrostimulator

The generator of the reference frequency produces an alternating voltage with a frequency of 2 kHz, reaching the pulse shaper in which, by means of successive division, pulses having a frequency of 1 kHz, pulses with a frequency of 100, 50, 25, and 12.5 Hz, and pulses with a frequency of 0.25 Hz, are emitted. Depending on the position of the push-button switches located on the front panel of the instrument, these pulses are turned into unipolar or trains of bipolar pulses and are modulated in the form of pulses and pauses. The method of successive division makes it possible to greatly simplify the factory adjustment of the temporal parameters, reducing it to an adjustment of the generator of the reference frequency.

The reference frequency generator and the pulse shaper are made up from integrated microcircuits.

Pulses from the output of the pulse shaper reach the power amplifier which is constructed as a transformerless circuit with transistors of diverse types of conductivity. The amplifier works on a switch system which allows considerable simplification of the thermal operating conditions of the transistors, and a decrease in the size of heat sinks and consequently in the size and weight of the amplifier as a whole.

After the amplifier the current pulses are fed to the circuit of the patient via an amplitude meter. The meter consists of a peak value milliammeter, to the output of which is attached an electromagnetic device calibrated in current amplitude values.

The power unit consists of a rectifier with a voltage doubling circuit for feeding the power amplifier and the bridge rectifier with a parametric voltage stabilizer, and supplies the integrated circuits.

The construction of the instrument makes it convenient to carry. The casing is in two parts held together with screws and is made by casting from colored shockproof polystyrene.

On the frontal aspect of the casing there are a needle device, indicator lights, push-button switches of operating regimes and form of current, a knob controlling the output current intensity, and a main cutoff. All controls and adjusters are located flush with the panel, which rules out the possibility of damaging them while being carried and of accidentally switching them on during operation.

Under the carrying handle there is a compartment covered over by a lid, in which are housed a mains lead and the cable to the patient.

The Endoton-1 instrument is equipped with a set of electrodes. The electrode probe is made of transparent polyvinyl chloride tubing at one end of which there is a metal polar tip in the shape of an olive, and at the other end there is a union for connecting to a standard syringe and a single-pole plug for connecting the patient cable. The lateral aspect of the tube is perforated around the olive. This construction of the electrode enables one not only to perform stimulation of the stomach and duodenum but also where necessary to aspirate the contents or to introduce therapeutic preparations and nutrient mixtures.

The rectal electrodes have a semielastic hermetic construction. At the distal end there is a cylindrical terminal with a spherical end. A second annular terminal is located at a distance of about 10 mm from the first one. On the other side the electrode terminates in a two-prong plug for connection to the instrument.