The need for an early and reliable diagnosis of vascular diseases has motivated the search for objective, easily realized, and harmless methods of studying the blood supply in the individual organs. Some methods of bloodlessly studying the blood supply are described in the literature [1-5] and are used in practice: 1) investigating the condition of arteries according to the regularity of their dilatation during a pulse cycle; 2) investigating the variation of the blood content in a particular organ during each pulse stroke. The modern methods employed for these purposes fall into two groups: 1) mechanoelectrical, which record the mechanical vibrations of the arteries by converting them into electric signals with the help of transducers. Various types of sphygmographic recordings fall into this class—piezoelectric recorders, capacitor recorders, photo or strain transducers. 2) Electrical. In this class there are two varieties of rheographs [2, 3]. The electrocapacitive method [5-8] is an unique combination of elements from both groups.

Some of the methods have shortcomings along with the advantages. For the mechanoelectrical they are the following: 1) the pressure exerted on a vessel affects the arterial blood flow; 2) only the condition of a particular artery is investigated; 3) it is only possible to record the pulsations of the accessible portions of the medium and large arteries.

The electrocapacitive method of recording blood supply is employed rather rarely and has been studied hardly at all. First Atzler [5] and later Koizumi and other authors [6, 7] began to use it to investigate the volume vibrations of the heart and vessels. The work of Figar [9] verified the linear relationship between an electroplethysmogram and the blood filled skin. The information from our investigations [8, 10] leads us to believe that by employing new technical facilities this method will have advantages.

In order to register and study the blood supply of the tissues or of each pulse cycle, we have designed equipment that is provided with electrocapacitive transducers. The technical approach differs from that of the equipment used for the same purposes by the authors mentioned above. In our instrument a frequency modulated signal is employed. The transistorized design makes it small and light, as well as economical and convenient to operate with any recording equipment for physiological investigations (electrocardiographs, electroencephalographs, etc.). Other electronic instruments such as rheographs, recording equipment, etc. have no effect on it, and it does not interfere with their operation. The instrument makes it possible to study the pulse cycles of a particular organ or artery by means of a capacitor transducer. The latter is formed by an electrode A, which is electrically connected to the surface of the tissue under study, and by an electrode B which is positioned at some distance d from it (Fig. 1). The capacity of this capacitor is determined from the formula:

$$C = K \frac{S \varepsilon}{d},$$

where $K$ is a constant, $S$ is the area of the electrodes, $d$ is the distance between them, and $\varepsilon$ is the dielectric constant of the substance between the electrodes. Due to the blood filled tissues, the distance $d$ varies periodically by $\Delta d$ with each pulse stroke. This causes a change in the capacity $C$ of the capacitor transducer. The latter is connected to the circuit of a high frequency oscillator in such a way that its frequency...
modulates the oscillator signal. By replacing $V$ in the formula for the oscillation frequency:

$$f = \frac{1}{2\pi \sqrt{LC}}$$

with the condition that $\Delta d/d < 1$ it turns out that the relationship between the change in the frequency $\Delta f$ and $\Delta d$ is linear. This relation is defined by the expression:

$$f = K \Delta d,$$

where $K$ is a constant and $L$ is the oscillator inductance.

The schematic circuit of the instrument is shown in Fig. 2. The high frequency oscillator is the principal unit. The transistor $T_1$ used in it has a grounded base, the oscillator is built around the Klamp circuit, and it has good frequency stability. The most favorable oscillator operating conditions were set up by the selection of resistances $R_1$, $R_3$, and $R_4$. The electrocapacitive transducer is connected in parallel with a variable capacitor $C_4$. A change in the capacity of the transducer changes the oscillator frequency.

The frequency modulated signal thus obtained is fed through the low valued capacitor $C_6$ to a buffer stage. This stage is an emitter follower design and has strong negative feedback for the high frequency voltage. The oscillatory circuit $L_3$, $C_7$, and $C_8$ is at once the load for the buffer stage and an element of the frequency detector, or discriminator. The variations in the oscillator frequency are converted by means of the discriminator into voltage variations which are proportional to them. Following the frequency detector the useful signal is fed to a potentiometer $P_1$ that serves to adjust the output voltage passed on to the recording device—an electrocardiograph, an electroencephalograph, etc. The battery voltage is measured by means of a meter $MA$, and the adjustment of the equipment is checked by means of the pushbutton $K_2$. The fundamental operating frequency of the instrument is set with the variable capacitor $C_4$. The apparatus is supplied from a pocket flashlight battery (4.5 V).

Examinations are made under the optimum physiological conditions for the patient. They are harmless and are not accompanied by painful or unpleasant sensations. Recordings were made with the equipment on pulsations of elastic and muscular type arteries located at the surface or deeper (a. carotis, a. radialis, a. cubitis).