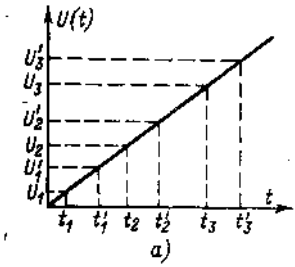
Initial reference standard of small currents of VNIIFTRI

In VNIIFTRI initial reference standard of small currents is capacitive the source on currents 10^{-15}—10^{-8} A (see § 3-4). Its certification is made by a semi-complete method: are defined the steepness *of dU/dt* of tension of the GLIN ramp generator and C the differentiating capacitor. Current at the output is defined as *CdU/dt.*

Measurement of the steepness of saw tooth voltage is taken by method of discrete differentiation (fig. 12-30, a). The Impulse-digital system (fig. 12-30.б) measures time Δt, required for strain measurement at GLIN output on ΔU. The steepness is measured for the sites first, second, etc. At the beginning of an operating cycle tension from an output of a source of reference voltages *the REF* exceeds tension from an output *of GLIN* and zero detector ZD is in an initial state. At the time of t_1 tension from an output *of GLIN* becomes equal U_1, ZD works and starts a digital stop watch DS. After this tension REF changes on ΔU_1, accepting value U'_1. Zero detector reverts to the original state and the key K which was in situation *Start-up* is thrown in the provision *Stop*. At the moment there is a new operation ZD, the stop watch stops, and according to its indications Δt_1 and to value ΔU_1, controlled by a potentiometer *P*, the steepness of tension of $v_1=\Delta U_1/\Delta t_1$ on the site is defined. Similarly the steepness on the subsequent sites is defined.



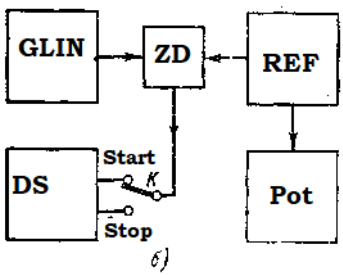


Fig. 12-30. The schedule of voltage variation at the outlet of the ramp generator (a) and the block diagram of the measuring instrument of the steepness *(b).*

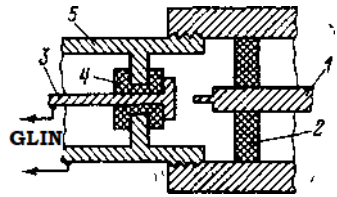


Fig. 12-31. Design of the non-stationary capacitor.

This method allows to measure the steepness with a margin error less than 0.05% that has allowed to investigate in details long stability *of GLIN* and its nonlinearity during a cycle. Researches have shown that the error of a source does not exceed 0.5% in the range of 10^{-14}...10^{-8} A and 1% in the range of 10^{-15}...10^{-14} A (at measurement of the differentiating capacity with a margin error less than 0.1%). Increase in an error is explained the most sensitive range by instability of stray currents of the differentiating capacitor and the calibrated measuring instrument.

Performance verification on currents less than 10^{-15}A

For receiving currents smaller 10^{-15}A differentiating capacitor should be 1 pF and less. The main obstacle to receiving such small currents is the stray current of a base insulator of an output facing of the differentiating capacitor. In order to avoid it the non-stationary design of the differentiating capacitor is used [L. 12-13]. One plate of the capacitor is (fig. 12-31) the entrance electrode *of 1* calibrated device with a high-quality base insulator. *2.* The second plate is formed by an electrode *3* with the base insulator *4* strengthened in metal plug 5, screwed-on on an input block of the device. The design forms the three-tightening capacitor which connection does not enter the additional insulator at the device inlet, and the stray current remains at the same level, as before connection of the device with a source. Changing distance between plates of the capacitor and a form of an electrode *3*, it is possible to receive capacity within 0.01 — 1 pF. For a support of an electrode *3* the normal insulator is used, its stray current becomes isolated through a low-impedance output *of GLIN* and does not influence source accuracy. Capacity of the non-stationary capacitor is defined by an indirect method [L. 12-13].

Chapter thirteenth

CHARGE ELECTROMETRIC MEASURING INSTRUMENTS

13-1. PRINCIPLES of CONSTRUCTION and PROPERTY

a) Principles of construction

In electrometric measuring instruments of electric charges the measured charge by means of the high-quality capacitor or constructive capacity will be transformed to tension which then is defined by the electrometric measuring instrument of tension. Such measuring instruments are close to measuring instruments of small currents to the capacitor and differ from them in the fact that not the speed of voltage variation on the capacitor, and tension is measured. For measurement of tension any of the known methods is applicable (see § 11-1). In modern practice only EMUS with parallel are applied to measurement of charges. OOS via the capacitor. At the same time the continuity of measurements, small influence of an input capacitance of the EMU on results of measurements, stable coefficient of transfer and some other positive properties are provided. The simplest methods applied earlier, for example with use electrostatic or about