

It was found that the absolute error in measuring the consumption of titrant in analyzing weak acids in non-aqueous liquids is  $\pm 0.04$  ml. The mean relative error in determining the concentration of a weak acid whose content, in the solution varies from 0.1 to 1%, is 3%.

The minimum percentage of acidity and basicity, which can be determined with a high degree of reliability, is 0.005%. If necessary, the accuracy and sensitivity of the device can be increased still further by the use of the corresponding analyzing cell. For obtaining such results it is necessary that, at the point when the titration is finished, a change in the high-frequency conductivity takes place. In addition, it is necessary that the liquid being analyzed contains no solid particles or gas.

The high-frequency titrating device can be recommended for analyzing a single component in multicomponent (aqueous or nonaqueous) liquids.

#### LITERATURE CITED

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### A HIGH-OHMIC POTENTIOMETER AND pH-METER BASED ON AN LP-58 DEVICE

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The LP-58 pH-meter at present made by Soviet industry is not sufficiently sensitive and accurate; on the other hand, the P-4, R-300, and R-307 potentiometers which have a high accuracy of 1, 0.01, and 0.001 mV (P-4  $R_{in} \approx 400 \Omega$  and for both others 10 k $\Omega$  per 1 V) which precludes their use for measuring emf's of current sources with a high internal resistance.

We describe below two types of pH-meters obtained by combining potentiometers with the electronic amplifiers of the existing pH-meter both of which produce an input resistance to the order of hundreds of M $\Omega$ . The first of these models (Fig. 1) requires only a small modification to the circuit but it must be assembled with a high degree of precision.

The storage battery in the LP-58 is disconnected (handle  $I_2$  turned into position "off"), socket  $S_0$  and the minus of the anode feed ( $-A$ ), which can be taken from the frame of LP-58, are connected to  $d$  of the potentiometer R-300. The 10 k $\Omega$  resistance connected to these sockets must be removed and the pushbutton closed. In order to avoid disturbances, the cable from socket  $S_0$  must be very short and have a screening braiding one end of which is connected to the body of the LP-58 and the other end to the head of one of the screws on the top panel of the R-300. The tip of the glass electrode can be used as a contact for connecting the cable to socket  $S_0$ .

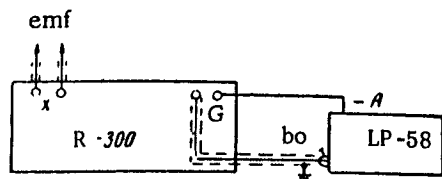


Fig. 1. Schematic diagram of the high-ohmic potentiometer which makes use of R-300 and LP-58 devices.

The body of the LP-58 should be well earthed; the standard cell is connected to terminals  $S_0$  and the emf being measured to terminals X of the R-300 potentiometer. The order of operation for this device is the same as for the R-300; balancing is effected by changing the resistors of R-300 and is indicated by the zero galvanometer of the LP-58 when the pushbutton of the pH-meter is depressed.

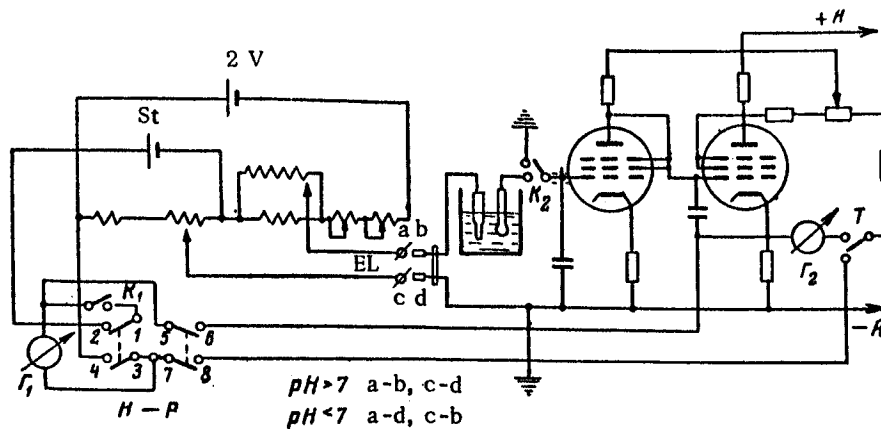


Fig. 2. Schematic diagram of a pH-meter which incorporates P-4 and LP-58 devices. Position of switch H-P: for tuning 1-2, 3-4 switched on; for operation 5-6, 7-8, switched on.

If an LP-58 is used with a two-stage amplifier, its sensitivity can be increased to 0.1 mV by replacing its zero instrument by the zero galvanometer of a P-4

The second model can be successfully used if it is intended to measure pH by means of a glass electrode which, in this case, is connected to the specially provided and screened socket So of the pH-meter LP-58.

In order to make the device more compact, the R-300 can be replaced by a P-4 potentiometer made by the Moskip Plant. As distinct from the first model, the amplifier of this device is not used when tuning against a standard cell, while the galvanometer is connected to a suitable point in the P-4 circuit.

The connection of the zero-galvanometer to the required point in the circuit is effect automatically, depending on the position H or P of the switch of the P-4, provided that the two cables leading from contacts 6 and 8 of the switch are both disconnected and reconnected to each other while, at the same time, the contacts thus made free are connected to the LP-58 device (Fig. 2). In this circuit the galvanometer remains permanently connected through button  $K_1$  and the measurement can only be made when two pushbuttons are operated simultaneously: pushbutton  $K_1$  on the P-4 and pushbutton  $K_2$  on the LP-58. In order to avoid this inconvenience, a small modification should be made to the circuit of the switch of the P-4 so that pushbutton  $K_1$  only works during the tuning of the device against a standard cell, while during the measurement of pH it becomes automatically short-circuited if an R-300 potentiometer is used, no modification is required; it is sufficient to secure the pushbutton in its depressed position.

Switch T, provided in the circuit, can be used to disconnect the insufficiently sensitive device installed in the LP-58 and to bring into use instead the external zero galvanometer  $G_1$  of the P-4. This galvanometer, the standard cell and the storage battery are connected to sockets G, St, and 2V of the P-4 device; switch  $I_2$  of the LP-58 always remains in the "off" position.

In order to eliminate the effect of temperature in measuring pH by means of the glass electrode, this measurement is carried out in a thermostat; the use of temperature pH compensators (the type used in an LP-58) fail to ensure a satisfactory measurement of accuracy [1]. The glass electrode is calibrated (not less than once daily) against 3-4 buffer solutions, each with known pH values; pH of the solution being investigated is found from the  $E=f(\text{pH})$  curve, or from a table. In the conditions described, the device can measure pH with an accuracy to 0.01 pH. A large reserve of sensitivity enables a further increase of accuracy to 0.1 mV, i.e., to about 0.002 pH if a potentiometer of a higher accuracy (e.g., R-300) is used.

#### LITERATURE CITED

1. K. Schwabe, Fortschritte der pH Messtechnik, VEB Technik, p. 125, 134, 201, Berlin (1958).