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Translated from *Zavodskaya Laboratoriya*, Vol. 26, No. 2, pp. 217-219, February, 1960

Electrolysis at a controlled potential is an effective method of analyzing solution processes at the anode. The regulation of the potential of electrode processes [1] has definite advantages as compared with phase analysis in which the electrochemical conditions for the identification of dispersed phases are often obtained in a purely empirical manner. At the same time the polarization and the "potential versus time" curves do not provide a single-valued solution of the kinetic problems in the electrode processes involved in anode diffusion of steel. Hence, in analyzing metallic phases in various alloys it is necessary to maintain a constant potential, and it is advisable to use for this purpose a potentiostat. However, phase analysis requirements with respect to the potentiostat circuit do not completely correspond with the operational parameters of potentiostats suggested by various authors.

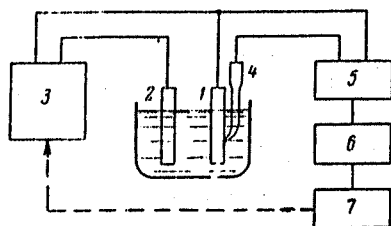


Fig. 1. Theoretical schematic of the potentiostat.

Theoretically the potentiostat consists of three parts: the electrolytic cell, a dc supply source and a device for measuring and automatically controlling the potential of the electrode under test. The tested 1 and auxiliary 2 electrodes (Fig. 1) are polarized from a controlled source of direct current 3. The potential of the electrode under test with respect to the comparison electrode 4 is adjusted by means of potentiometer 5, which is connected through a balance indicator 6 to the controlling device 7. The arrangement makes it possible to change the current which polarizes the cell when the potential between the tested electrode 1 and the comparison electrode 4 changes.

The majority of the potentiostats described in the literature are complicated and difficult to adjust or unstable in operation and in controlling the fixed potential. In order to avoid these defects we selected a circuit which included a chopper and ac amplifier in combination with a controlling motor.

The block schematic of the potentiostat is shown in Fig. 2. The required potential of electrode 1 under test, in this instance the anode, is supplied by a potentiometer with a calibrated slide wire 2. If the potential of the electrode under test deviates from the set value, an unbalance of a definite polarity is produced in the potentiometer circuit. The unbalance (a dc signal) is converted by the chopper stage 3 into an ac signal, whose phase will correspond to the unbalance polarity. This stage consists of a polarized chopper and an input transformer. In this circuit the signal is not only converted, but its voltage is raised considerably. The converted signal is amplified by a three-stage ac amplifier 4. The first two are voltage amplifying RC coupled stages, using pentodes 6Zh4. The third stage consists of a power amplifier which uses double triodes 6N7. The anodes of the output stage are fed from the secondary winding of a power transformer whose midpoint is connected to the control winding of a synchronous capacitor motor D-32 of the control mechanism 5. The control winding of the motor serves as the anode load to the output stage tubes. Since the anodes are connected to the extreme points of the output power transformer, they are in phase opposition. Whereas the grids of the two tubes are connected in parallel and fed by an ac voltage from the second stage. Thus, the phase of the grids coincides with one of the anodes and is in phase opposition with the other, i.e., the admittances of each half of the tube are different. When the polarity of the dc signal changes (unbalance) the phase of the grid voltage changes which produces a phase change in the control winding of the motor. The motor is rigidly connected to the moving arm of the autotransformer, which changes the voltage at the input of the selenium rectifier 6, connected in a bridge circuit. This, in turn, produces a change in the dc current fed to the electrodes of the electrolytic cell 7, thus, returning the potential of the electrode under test to its set value. Tube voltmeter 8 is connected in parallel with the potentiometer input; it consists of a cathode follower circuit and serves as a visual indication of the fixed potential. Units 3, 4, 5, and the voltmeter 8 are supplied through device 9, which consists of a power transformer and crystal diodes DGTs-27.

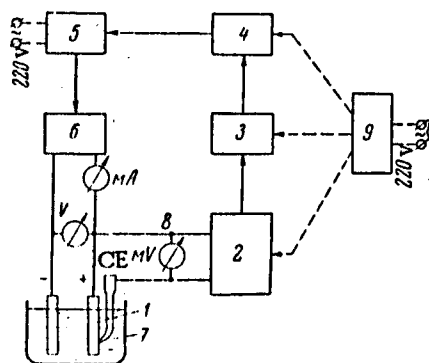


Fig. 2. Block schematic of the potentiostat.

input is ± 2 mv. The potentiostat is constructed in the form of separate units mounted in a metal case of $300 \times 450 \times 670$ mm with all the control and measuring instrument mounted on the front panel.

In addition to its basic purpose, the potentiostat can be used for obtaining polarization curves semiautomatically. In this case the given potential is changed and the corresponding current kept constant. The instrument can also be used for stabilizing dc current in a circuit. For this purpose a shunt is connected in the circuit and the voltage drop across the shunt fed to the potentiostat.

This circuit comprising an ac amplifier and a balancing motor provides maximum simplicity of design and adjustment, makes precision voltage and zero-drift stabilization unnecessary and attains high sensitivity and stability of operation for the potentiostat. The potentiostat model produced provides electrochemical diffusion at a constant potential for samples with a total anode surface up to 8 cm^2 .

LITERATURE CITED

[1] Yu. A. Klyachko and O. D. Larina, *Zavodskaya Lab.* **22**, 12, 1409 (1956); Yu. A. Klyachko, M. M. Shapiro, V. S. Mal'tseva and V. A. Mil'chev, *Zavodskaya Lab.* **24**, 11, 1308 (1958).

AN ELECTRONIC POTENTIOSTAT AND ITS APPLICATION FOR EXPOSING STRUCTURAL CORROSION OF STAINLESS STEEL

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Translated from *Zavodskaya Laboratoriya*, Vol. 26, No. 2, pp. 219-223, February, 1960

Until recently the galvanostatic method of polarization measurements was mainly used for investigating the anode behavior of stainless steel in electrolyte solutions. This method, however, does not provide the possibility of establishing the relationship between the speed of dissolving and the potential over a wide range of polarization which corresponds to a passive condition of steel.