INSERTION OF MICROELECTRODES BY A SIMPLIFIED SCHEME OF STEP-MOTOR CONTROL

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Complicated and unreliable systems are at present used to control step motors. Controlled diodes were used for simplicity and to increase the reliability of step-motor control. The system includes two triggers and eight diode rectifiers. A single source of power is used.

Step motors are widely used at the present time in electrophysiological experiments, in particular for the insertion of microelectrodes. However, existing systems for the automatic control of step motors [2, 4, 6] are complicated and not always reliable in operation.

In the step-motor control system suggested below a powerful trigger is used in conjunction with controlled diodes. In this way the circuit could be simplified most and the freedom from interference and the reliability of the apparatus could be increased.

A block diagram of the step-motor control is given in Fig. 1 and the theoretical electrical circuit in Fig. 2. Switching on the power supply activates a positive pulse generator, consisting of a symmetrical multivibrator with pulse former (duration 0.05 μsec) and with a frequency of 10 or 80 Hz, set by switch P_1.

To bring the triggers Tr_1 and Tr_2 into the initial working state the "Start" button is pressed. As a result a pulse from the generator activates the controlled diodes D_6 and D_8. A current then flows through the coils III and IV and the axle of the step motor will be fixed. The position of the "Reverse" switch determines the direction of rotation of the step motor. In position I, when the "Work" button is pressed the pulse passes through the rectifier $D_{19}C_{11}$ to the diode D_5. Tr_1 is thrown and activates winding I of the motor. The next pulse passes through the rectifier $D_{13}C_5$ to the diode D_7, throws Tr_2 and activates winding II [1, 7], and so on. Tr_1 and Tr_2, working in that order, switch over windings III-IV, I-IV, I-II, and III-II of the motor, thus producing rotation in one direction. In position 2 windings III-IV, III-II, I-II, and I-IV are activated, resulting in rotation of the step motor in the other direction. The windings of the step motor are shunted by diodes which serve to suppress oscillatory processes. The shaft of the step motor is connected through

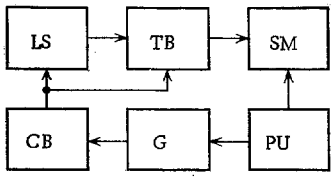

Fig. 1. Block diagram of step-motor control ShDR-711: SM) step motor; TB) trigger block; LS) logical system (consisting of eight pulse-potential rectifier diodes; CB) switching unit; G) positive square pulse generator; PU) power unit.

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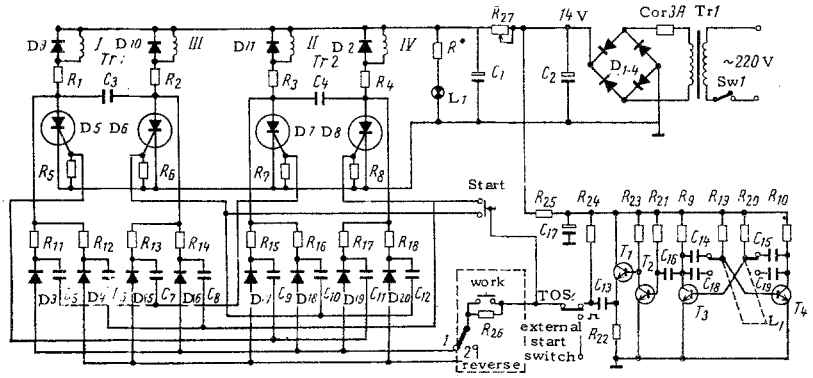

Fig. 2. Theoretical electrical circuit of step motor control ShDR-711: D_{1-4}, D245; D_{5-8}, D235V; D_{9-12}, D226, D_{13-20}, D9D; T_{1-4}, MP11; R_{1-4}, PEV 10 Ω; R_{5-10}, 2 kΩ; R_{11-18}, 5.6 kΩ; R_{19-20}, 75 kΩ; R_{21}, 13 kΩ; R_{22}, 9.1 kΩ; R_{23}, 10 kΩ; R_{24}, 120 kΩ; R_{25}, 47 Ω; R_{26}, 15 kΩ; R_{27}, PPG, 156 Ω; $C_{1,2}$, 4000 μF, 25 V; $C_{3,4}$, 2 μF; C_{5-15}, 0.1 μF; C_1, 1500 pF; C_{17}, 50 μF; $C_{18,19}$, 1.5 μF (broken line denotes extension switchboard). D – diode; Sw – switch; T – tube; TOS – throw-over switch; Con – converter; Tr – transformer. Remainder of explanation in text.

a universal joint to the mechanical reducing gear of the micromanipulator [3] which is fixed to the experimental animal's head. Displacement of the microelectrode by one step of the step motor amounts to 4 μ.

The system is simple in use and contains two triggers and eight diode rectifiers. A single power supply is used. In the writer's laboratory a step motor has operated reliably with this control system for two years.

LITERATURE CITED

1. L. F. Auén, Contactless Switches and Scaling Circuits on Controlled Diodes [in Russian], Leningrad (1968).
2. Sh. Yu. Ismailov, Automatic Systems and Instruments with Step Motors [in Russian], Moscow (1968).
3. V. A. Konstantinov, O. V. Ivanov, K. P. Ivanov, et al., Fiziol. Zh. SSSR, 55, 517 (1969).
4. V. I. Lapchenko, Yu. P. Kachalov, and A. D. Nozdrachev, Fiziol. Zh. SSSR, No. 8, 1177 (1970).
5. V. A. Ratmirov and B. A. Ivobotenko, Step Motors for Automatic Control Systems [in Russian], Moscow (1962).
6. V. A. Ratmirov, B. A. Ivobotenko, V. K. Tsatsenkin, et al., Electrical Instruments with Semiconductor Controls. Systems with Step Motors [in Russian], Moscow (1964).
7. V. A. Labuntsov, S. G. Obukhov, and A. F. Sviridov (editors), Controlled Diodes (Technical Reference Book) [in Russian], Moscow (1971).