CONTROL SYSTEM FOR STARTING UP THE D.C. MOTORS WITH SEPARATE FIEL

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Abstract: This work is presenting a control system for starting up the D.C. motors with separate excitation, built in both wired and programmed logic. The electrical control diagram in programmed logic was performed by means of a programmable logical controller (PLC), TWIDO type, produced by Schneider. Through the usage of the TWIDO PLC a control system with better functioning performances is obtained, compared to the wired logic control system.

Keywords: D. C. motor, programmable logic controller (PLC), automated start-up.

1. INTRODUCTION

In practice, the following methods are used for starting up the D.C. motors: Start-up through direct connection to main supply, start-up through controllers (rheostats) series connected to the armature and start-up through variable voltage supply, by using special groups of machines or special equipment (controlled rectifiers).

2. CONTROL SYSTEMS FOR STARTING UP THE D.C. MOTORS

2.1 Electrical Diagram for D.C. Motor Control, Built in Wired Logic

The control system is composed of the following: Q_1 - Automatic fuse with thermal relay for the armature circuit; Q_2 - Automatic fuse with thermal relay for the field circuit; Q_3 - Automatic fuse with thermal relay for the field circuit R_1, R_2, R_3 - Start-up resistors; M - D.C. motor; C - Contactor for coupling the motor armature; C_1, C_2, C_3 - Contactors for short-circuiting the resistors R_1, R_2, R_3; d_1, d_2, d_3 - Time relays with adjustable cut-in delay $(0{,}3 \div 3)$ s ; T - transformer $220/110$ V. A.C. for supplying the control circuitry; F_1, F_2 - Fuses for the 110 V. A.C. circuit; S_1 - Start-up push button; S_2 - Stop button. The electrical diagram for controlling the D.C. motors with separate field, for automated start-up in function of time, is shown in Fig.1. Switching on the circuit breakers Q_1, Q_2 and Q_3 prepares the equipment for start-up. Pushing the button S_1 energizes the armature of the D.C. motor M through closing the contacts of the contactor C in the circuit 1. The motor M will start with the whole resistor $R_1 + R_2 + R_3$ connected to the rotor circuit. Through closing the auxiliary contact of the contactor C in the circuit 9, its solenoid will be self-retained. Through closing the auxiliary contact of the contactor C in the circuit 5, the time relay d_1 starts timing the closing of its normally open contacts with cut-in delay. Once timing completed, the relay d_1 will close the contact in the circuit 10, the contactor C_1 cuts in and short-circuits the first step R_1 of the controller. At the same time, the contact of the relay d_1 in the circuit 6 will close and the time relay d_2 starts timing the closing of its normally open contacts with cut-in delay.

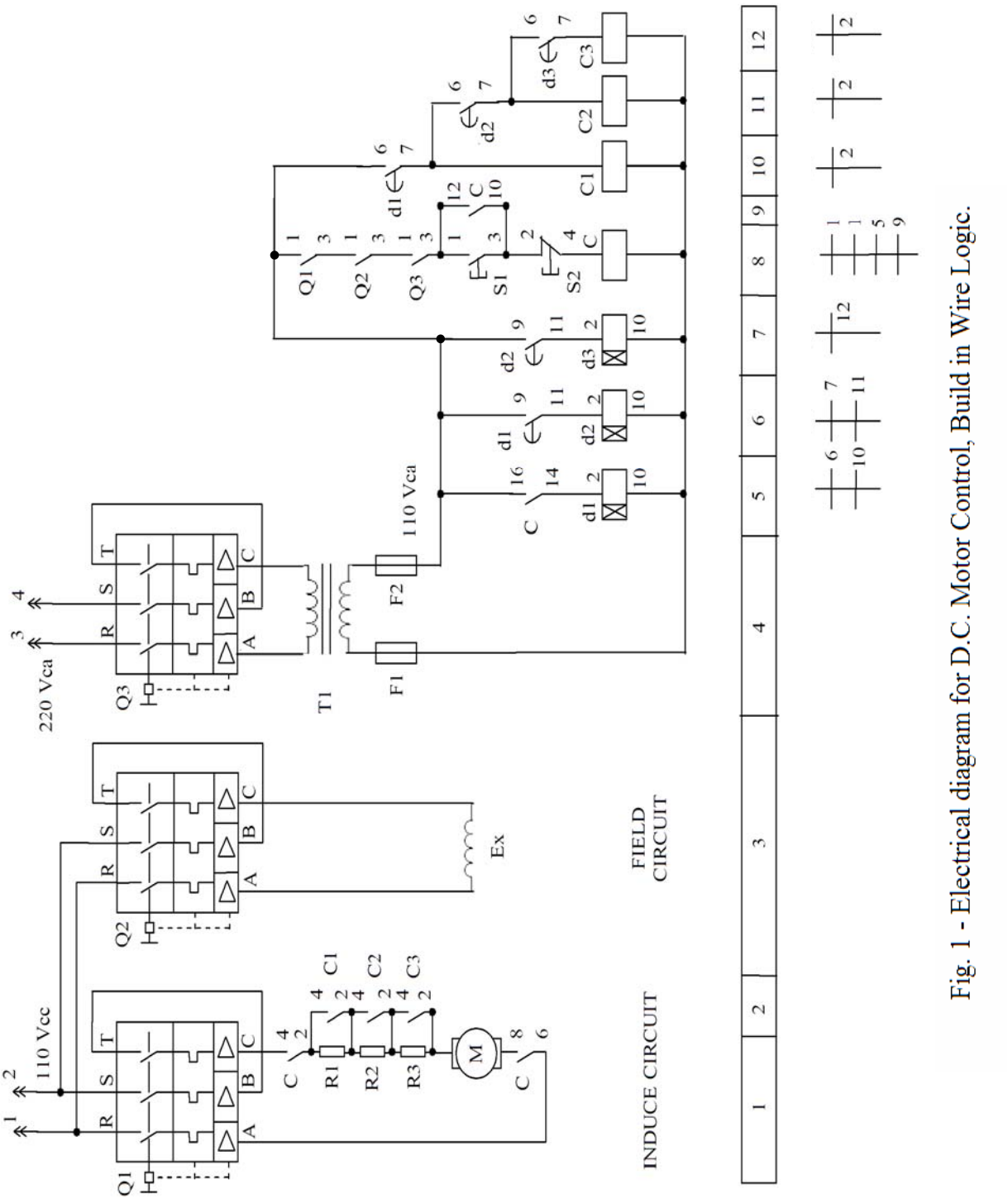

Fig. 1 - Electrical diagram for D.C. Motor Control, Build in Wire Logic.

After timing, the relay d_2 closes its contact in the circuit 11, the contactor C_2 cuts in and short-circuits the second step of the controller, R_2. At the same time, the contact of the relay d_2 in the circuit 7 will close and the time relay d_3 starts timing the closing of its normally open contacts with cut-in delay. Once timing completed, the relay d_3 closes its contact in the circuit 12, the contactor C_3 cuts in and short-circuits the last step of the controller, R_3.

2.2 Electrical Diagram for D.C. Motor Control, Built in Programmed Logic

The block diagram of the control system of the D.C. motor, equipped with the PLC TWIDO is shown in Fig. 2. The PLC TWIDO is manufactured by Scheinder. It is composed of three modules: [4]: Module I includes the central unit and has 12 digital inputs and 8 digital outputs. The extension module II has 8 digital inputs. The extension module III has 8 digital outputs. The electrical control diagram of the D.C. motor using TWIDO is shown in Fig. 3. The power circuit for supplying the D.C. motor with separate field is identical to the one shown in Fig.1.

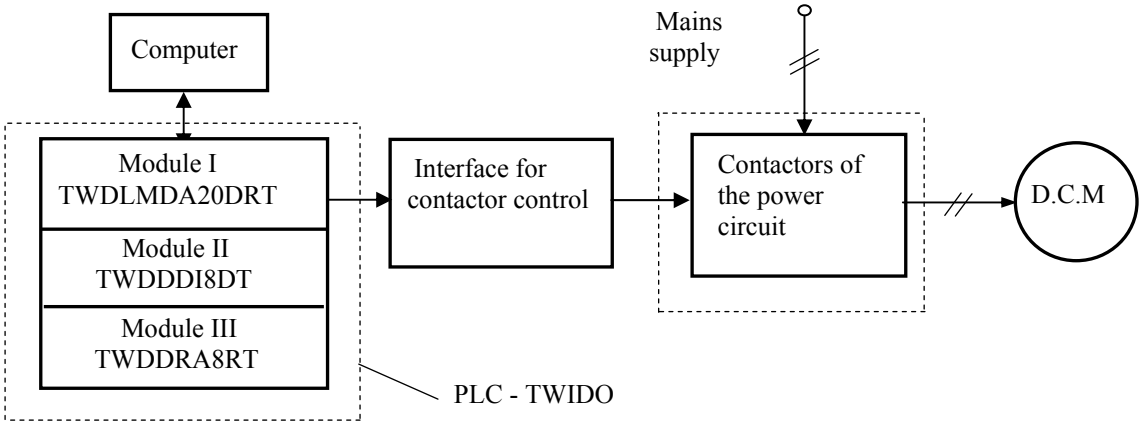

Fig.2. Block diagram of the control system of the D.C. motor equipped with PLC.

To the inputs I_1, I_2, I_3, I_4 and I_5 of the PLC, the signals coming from the start-up and stop buttons S_1, S_2 are applied, as well as the normally closed contacts (NC) of the overload protection relays in the power circuit of the D.C. motor supply. To the outputs O_2, O_3, O_4 and O_5 of the PLC the miniature relays k_1, k_2, k_3 and k_4 are connected, that are the interface for the control of the power contactors in the supply circuit of the D.C. motor with separate field. The contacts of these relays are used for controlling the supply of the solenoids of the contactors C, C_1, C_2 and C_3 in Fig. 4.

3. EXPERIMENTAL DETERMINATIONS

The control systems in wired and programmed logic for the start-up of the D.C. motors with separate field have been built at the Electrical Machinery laboratory of the University of Bacau. For the PLC the application program has been issued by using a language oriented on diagrams with contacts, [5]. The functioning program has been edited with the help of the program TWIDO.SOFT.EXE installed on a IBM-PC compatible computer. The program has been transferred from the computer memory to the memory of the TWIDO PLC through a special connection cable. The program has been implemented and validated for D.C. motor having the following characteristics: Rated power, $P_n = 1$ KW, rated rpm $n_n = 1500$ rpm, rated voltage $U_n = 110$ V. D.C.

Through the usage of the TWIDO PLC a control system with better performances and better reliability is obtained.

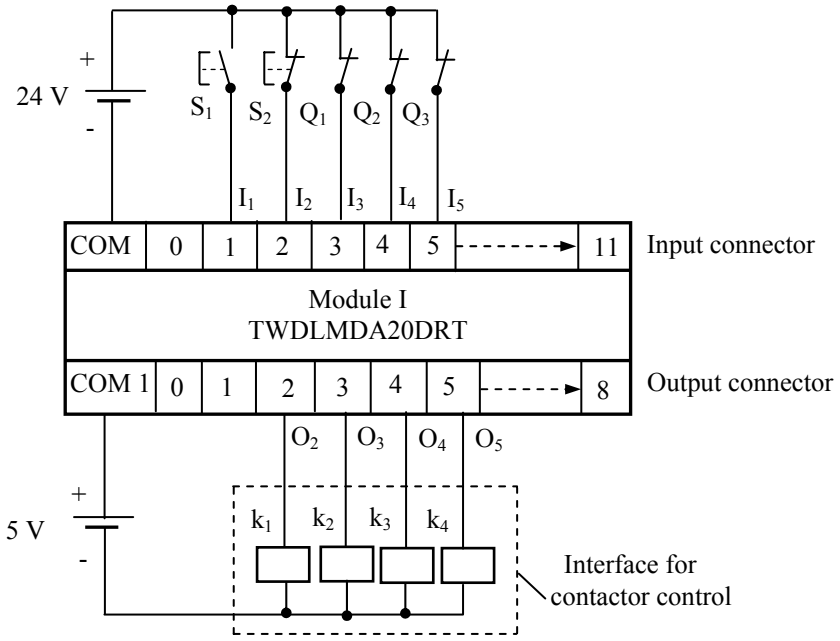

Fig.3. Electrical control diagram of the D.C. motor in programmed logic

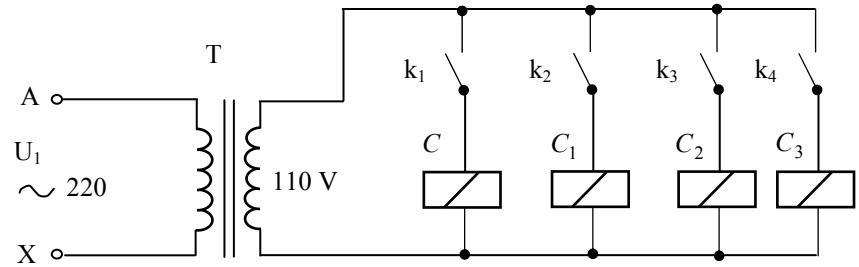

Fig.4. Control diagram of supply of the power circuit contactors

4. CONCLUSIONS

This work was presenting a control system for starting up the D.C. motors with separate excitation, built in both wired and programmed logic. The Electrical control diagram of the D.C. motor in programmed logic was built with the help of a programmable logic controller, TWIDO type, produced by Schneider. Through the usage of the TWIDO PLC, a control system with better performances and higher functioning reliability has been obtained, compared to wired logic control system.

5. REFERENCES

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