MODEL TRAIN CONTROLLER

By A. ANTHONY

MODEL train controllers of conventional design, using a rheostat, suffer poor performance under variable load conditions. Ideally, an electronic stabilised controller with overload protection must be used for best performance.

The unit described in this article is simple to operate, has smooth control of output, and also has some degree of overload protection.

The circuit (Fig. 1) follows the usual pattern for stabilised power supplies, but has a polarity reversing switch and thyristor overload cut-out circuit.

STABILISER

The mains transformer T1 must be an isolated double wound type for safety reasons. The secondary winding should supply 9V a.c. to the bridge rectifier D1–4 to convert the a.c. to d.c. Smoothing is carried out by C1 before passing to the regulation circuit.

This section consists mainly of a voltage stabiliser TR1–2 and the overload detector TR3. Stabiliser transistors TR1 and TR2 operate as a super-alpha or Darlington pair to reduce the output impedance of the circuit. The base current is supplied by the voltage divider chain R1, VR1, and R2 and is set by the control VR1.

Since this current is to be varied to supply variable output voltage, a Zener diode should not be used. Instead a thyristor SCR1 is inserted to cut off the stabiliser transistors when the line is overloaded or accidentally short-circuited.

OVERLOAD DETECTOR

A heavy increase in current on the line causes the voltage across resistor R5 to increase to such an extent that TR3 will switch on. Collector current will then flow, part of which is picked off to trigger the thyristor.

In the prototype, the voltage across R5 was in excess of 0·6V for triggering. The resistance of R5 will be determined by the normal running load current, using Ohm's Law: $R_5 = 0{\cdot}6/I_L$. This current can be measured by using the high range of a multimeter, under normal working conditions, in series with the output positive line (S3b wiper).

To keep thermal drift and leakage current to a minimum for reliable operation, TR3 should be a silicon transistor; a *pnp* type is used for convenience in this circuit.

Visual warning of overload is given by the indicator lamp LP2 which should be rated at 12V or more. If a lower voltage bulb is used a series resistor must be

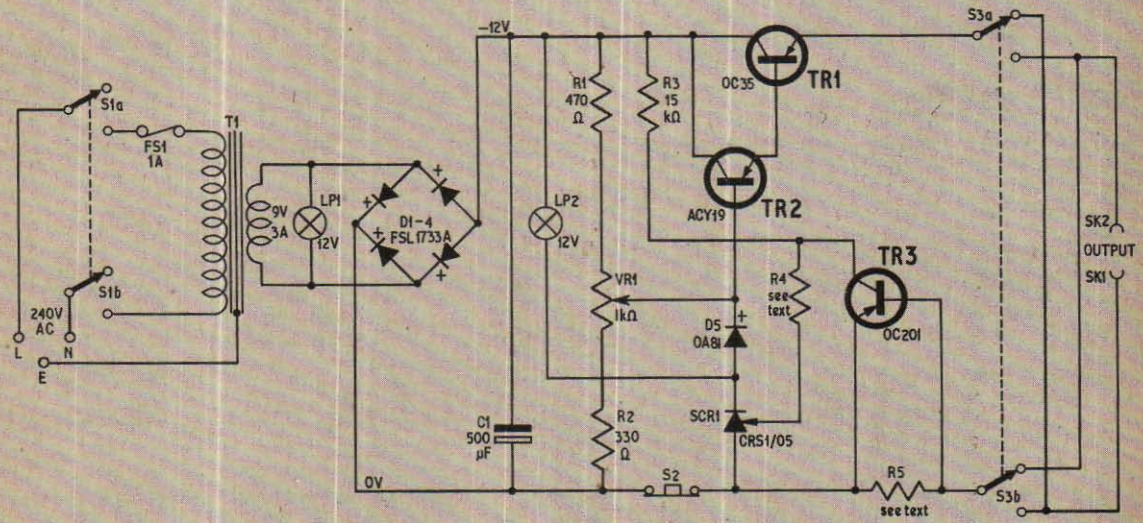
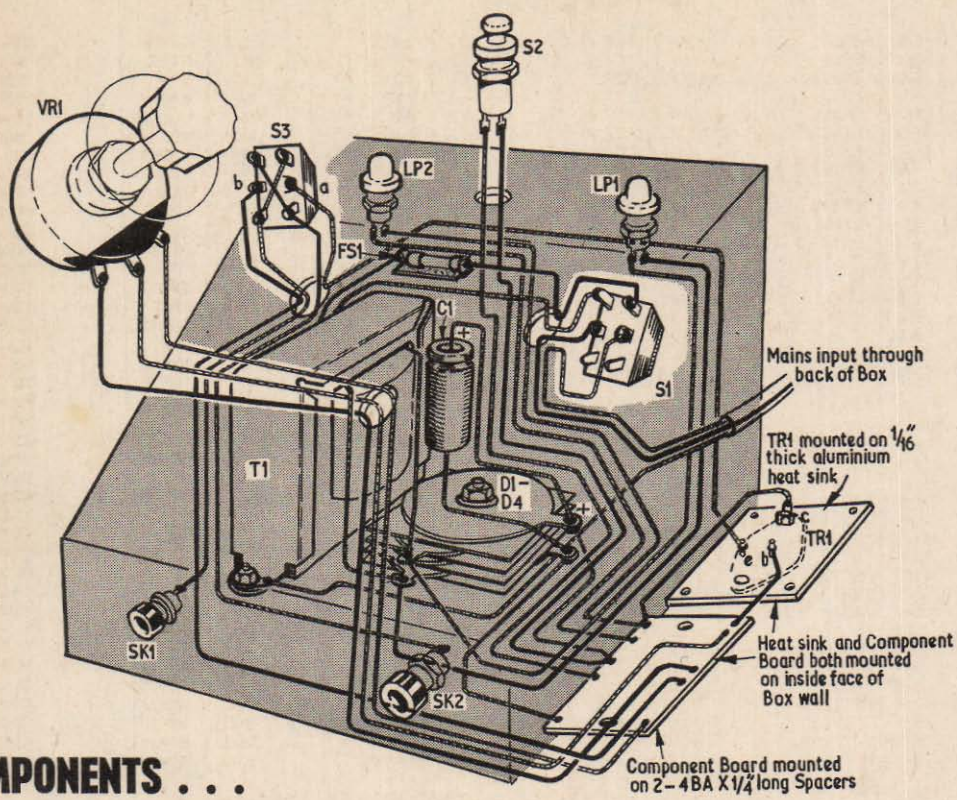


Fig. 1. Circuit diagram of the complete controller

FIG. 2. CONSTRUCTIONAL DETAILS



COMPONENTS . . .

Resistors
R1 470Ω
R2 330Ω
R3 15kΩ
R4 See text
R5 Wirewound (see text)

Potentiometer
VR1 1kΩ wirewound

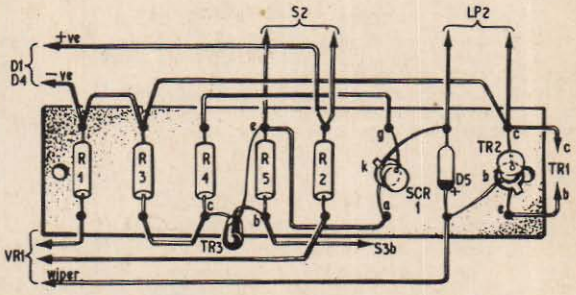
Capacitor
C1 500μF elect. 25V

Transistors
TR1 OC35
TR2 ACY19
TR3 OC201

Diodes and Thyristors
D1–4 18V 2A (S.T.C. type FSL 1733A bridge selenium rectifier)
D5 OA81
SCR1 CRS1/05 (S.T.C.)

Transformer
T1 Mains primary winding, 9V 3A secondary (S.T.C.)

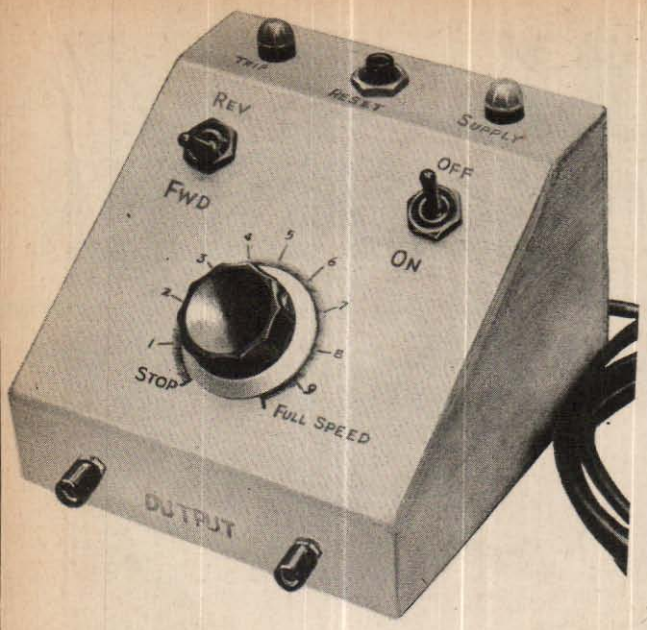
Lamps
LP1, LP2 12V 0·75W l.e.s. (2 off)



Switches
S1 Double pole, on/off, toggle
S2 Push to break, press button
S3 Double pole, changeover toggle

Miscellaneous
FS1 Fuseholder and 2A fuse
Component tag board
Wood for case
Aluminium or copper sheet 1/16 in. or 18 s.w.g. for heat sink

S.T.C. components available from Electroniques (S.T.C.) Ltd.



inserted to prevent the lamp from blowing. The current rating of the lamp should be as low as possible so as not to interfere with the stabiliser cut-off function.

Once the overload is indicated, the offending load should be removed before resetting the circuit again for normal operation. Switch S2 is a push button "break" switch for resetting, and temporarily cuts the supply to TR3 and SCR1.

POLARITY REVERSAL

The output is taken from TR1 emitter (negative) and TR3 base (positive) to a double-pole changeover switch S3a and S3b. This provides simple polarity changeover facilities for train reversing. The switch and output terminals should be clearly labelled to show the polarity for forward and reverse, but it is not good practice to change direction at full speed. Speed reduction should be arranged first by careful use of control VR1.

CONSTRUCTION

Constructional details (Fig. 2) are given here for guidance but there is no reason why this cannot be altered to the constructor's choice.

Since R5 is likely to be a very low value (about 0·5 ohm), it is best to make this component from eureka or nickel chrome wire and trim the length of wire used according to the results of the voltage measurement described earlier. The thickness of the wire is determined by the absolute maximum load current likely to be encountered under normal conditions. Details of this and the length of wire required can be found in standard wire tables in many reference books. (As an approximate guide, 20in of 24 s.w.g. Eureka wire will be one ohm); 15 yards of 24 s.w.g. copper wire will about 1 ohm).) If the wire is insulated it can be wound on a plastics or cardboard former.

Resistor R4 is selected to limit the current required to trigger the thyristor within the maker's recommendations; this current should be at least 10mA.

All components can be mounted on perforated s.r.b.p. or printed circuit board except TR1, which should be mounted on a heat sink. ★