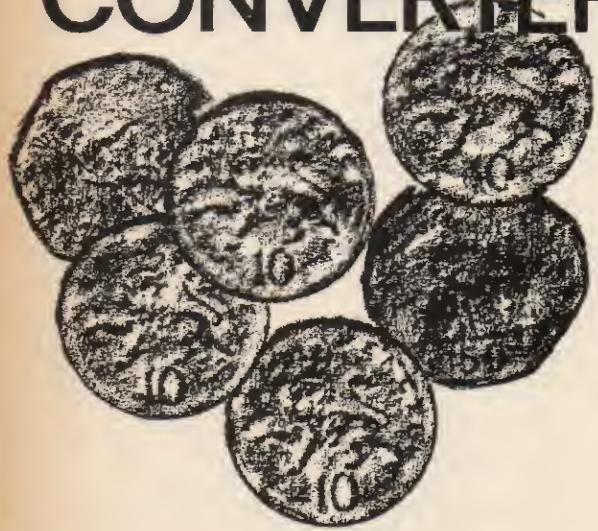
DECIMAL CURRENCY CONVERTER



By G. A. Cozens

THE change to decimal currency in the U.K. on February 15, 1971 draws nearer as the series of new coins is introduced. But the fact remains that we have undertaken a very difficult operation by maintaining the pound as the major unit of currency, and created the task of relating 24 old pennies to 10 new pence.

Electronic methods of conversion to cope with all the 199 values under £1 fall into two categories: analogue or digital computer techniques.

The analogue method using a simple Wheatstone bridge type of balance was tried, but it was difficult to obtain a sufficient degree of accuracy, it being necessary to be within 0·5 per cent. It is difficult to achieve this, even with quite sophisticated circuits and impossible with simple electronics using dials or meters, so this method was abandoned.

DIGITAL CONVERSION

When one tries the digital method it is then that the problems which our planners have imposed become apparent. The instrument finally devised uses switches to select the shilling and pence values, while lamps show the new pence equivalents. Some way of combining the switches and reducing the number of lamps had to be found to reduce the cost of the instrument. It is emphasised at this stage that this instrument carries out conversion only and is not suitable for use as an adding machine. The circuit diagram of the Decimal Currency Converter is shown in Fig. 1.

DIODE LOGIC

This conversion unit uses diode logic. Following the front panel layout in Fig. 2, the selector switches are divided into three rows, one for the even values of shillings (two to eighteen), one row for the odd values of shillings (one to nineteen) and one row for the old pence values—1d, 2d and 3d, 4d, 5d, 6d, 7d, 8d, 9d and 10d, and 11d, thus giving a total of 28 switches. Notice that 2d and 3d are combined on one switch, so are 9d and 10d.

The lamps are arranged in two vertical columns, the left-hand column of nine lamps representing 10p at the bottom of the column, 20p, 30p and so on up to 90p at the top. There is a single lamp to the right of these columns which correspond to ½p.

In this way any of the 199 values of shillings and old pence can be selected using two switches. The equivalent value in new pence will appear in the columns of lamps, one lamp in each column lighting up.

The lamps can be 6 volt 0·1A m.e.s. bulbs or 6V 0·75W l.e.s. bulbs. The relay coil must also be rated for 6 volts operation. Of course, other lamp and relay voltages can be used, but care must be taken not to use current ratings which are too heavy for the diodes to handle.

These diodes are small silicon types such as OA200 or OA202. Some suitable types of diodes are available at very low cost and it may be possible to economise considerably by selecting from these. They are germanium types and are obtainable for as little as 2·5p (6d) each when purchased in bulk quantities.

SWITCH WIRING

Starting with the 1d value, this switch S28 is wired directly in series with the ½p lamp LP19, and S29. See Fig. 3. The 2d and 3d values are combined in the next switch, which is in series with the 1p lamp.

The 4d switch is also in series with this lamp, but there is a diode D1 between the switches and the lamp, which will conduct when either switch is closed.

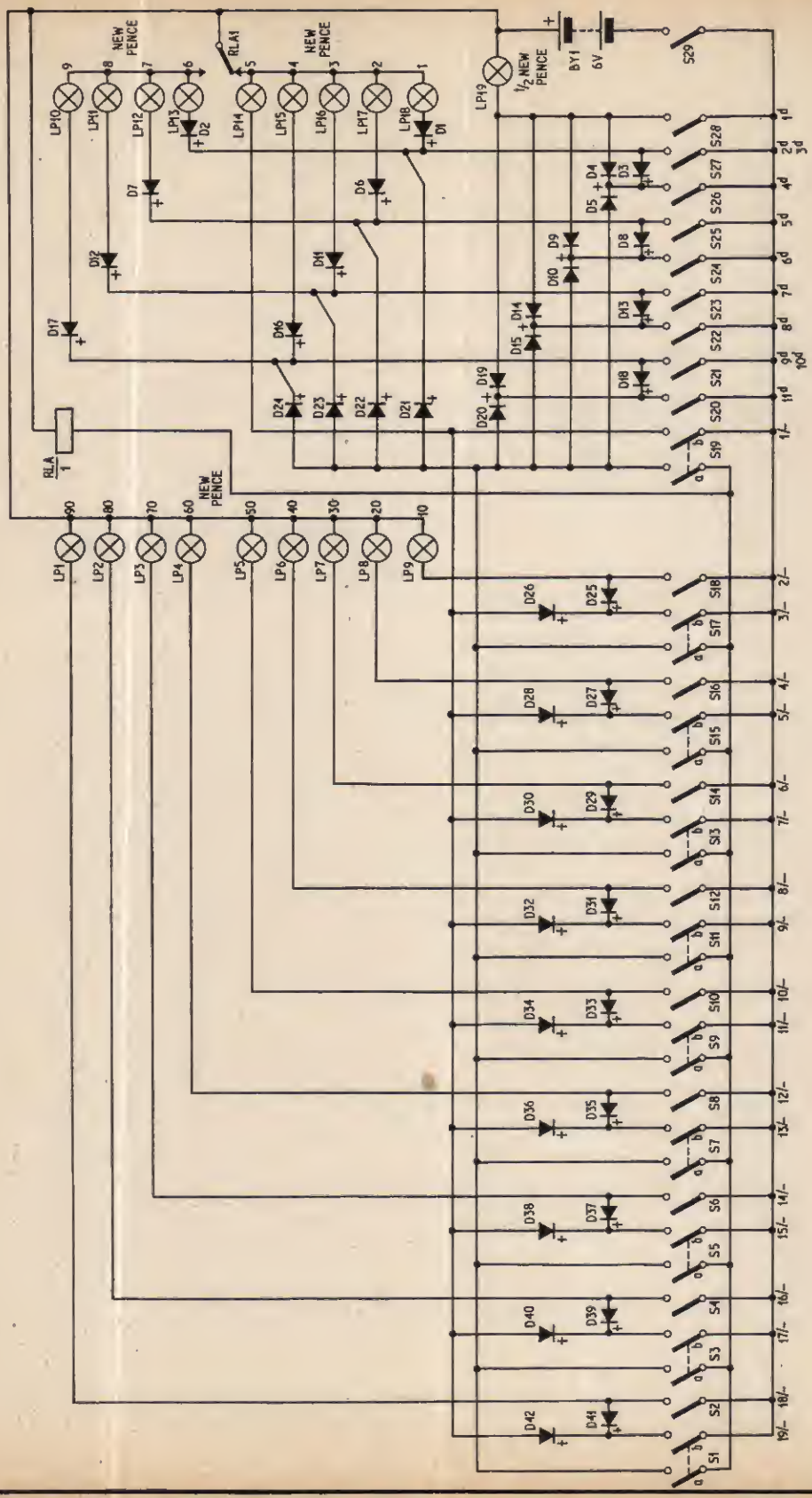
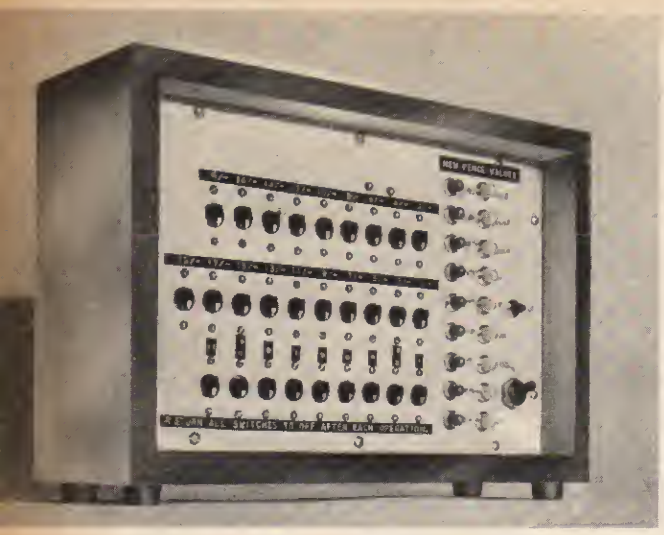


Fig. 1. Complete circuit diagram of the decimal currency converter



Front view of the converter giving layout positioning of components. All switches must be returned to the off position after each calculation

COMPONENTS . . .

Diodes
D1–D42 Any type that will carry 100mA or more (42 off)

Lamps
LP1–LP19 6 volt 0·1A or less; with panel lamp-holders (19 off)

Relay
RLA Any 6V type with at least one set of change-over contacts

Switches
S1 to S28 Double-pole changeover slide or toggle switches (28 off)
S29 Single-pole, on/off, toggle switch (S2, S4, S6, S8, S10, S12, S14, S16, S18, S20 to S28 can be single pole)

Battery
BY1 6V type 996 or 2 × 3V type 800

Miscellaneous
Single row tag strips, $\frac{1}{4}$in pitch, 7in long (2 off)
Wood for case, p.v.c. covered wire, lettering

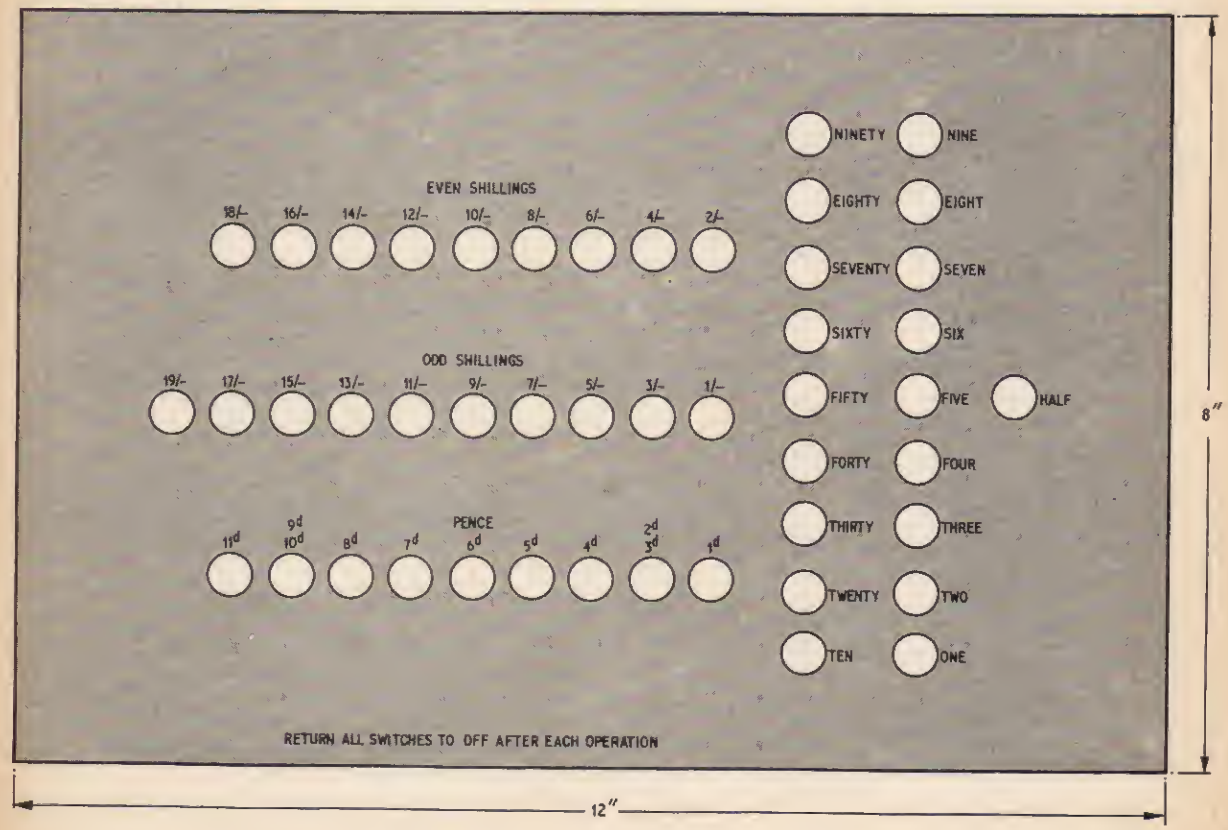


Fig. 2. Front panel layout of lamps and switches

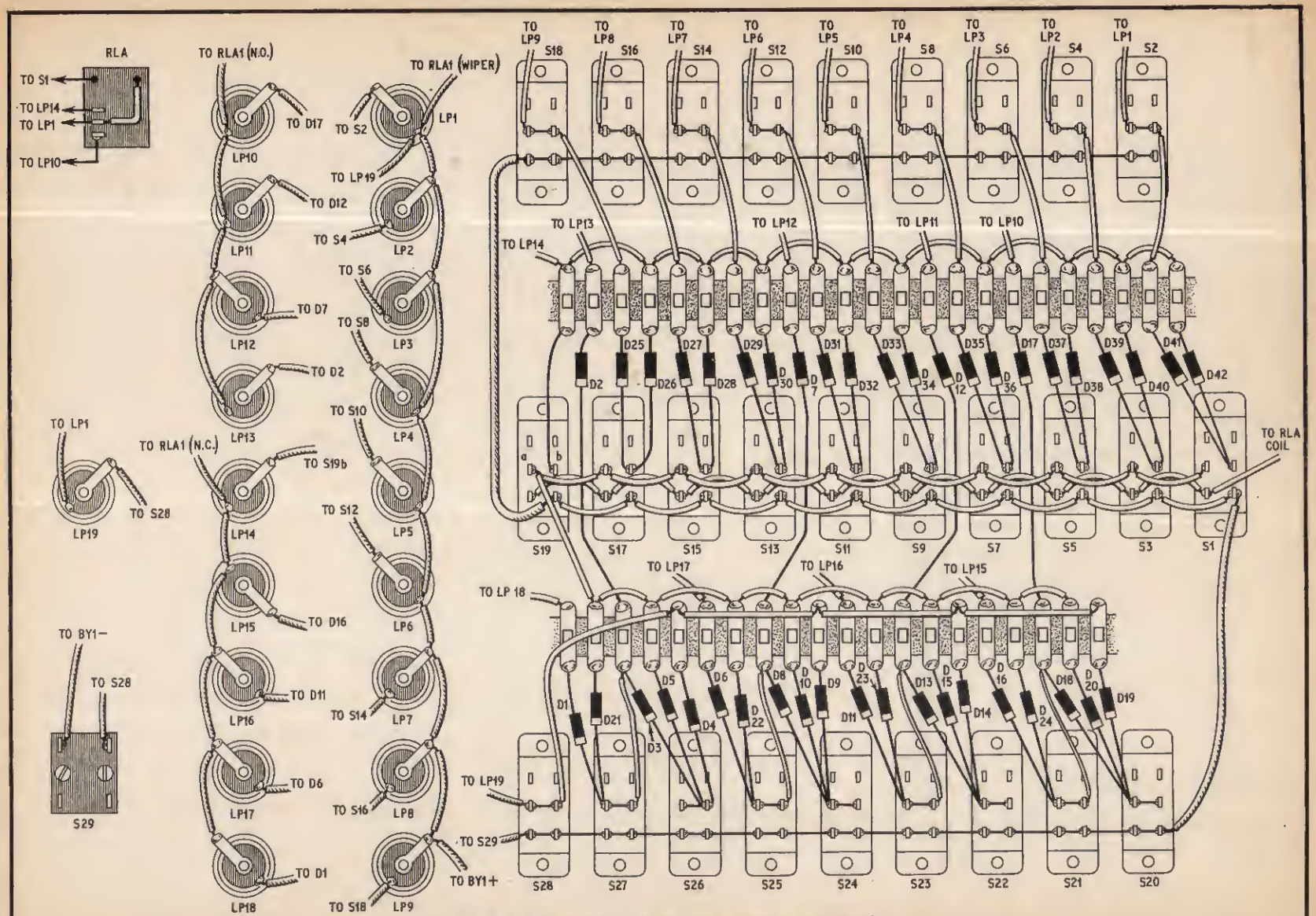
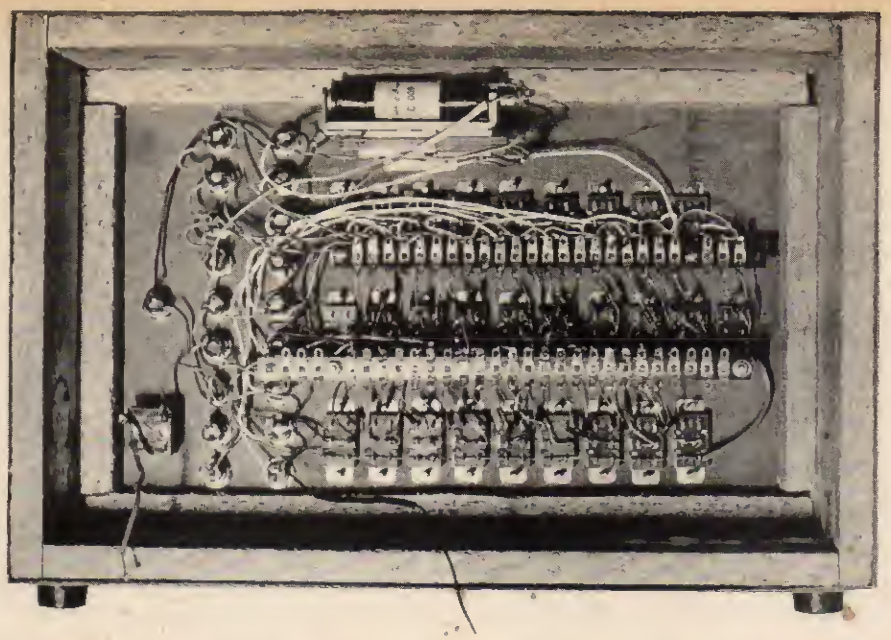


Fig. 3. Layout and wiring of the components on the panel



Rear view of the converter showing components and wiring. The relay can be mounted in any convenient position on an aluminium bracket screwed to the case

Diode D3 separates the 4d switch from the 2d/3d switch and D4 connects the 4d switch to the ½p lamp.

This pattern is repeated for all the values up to 1s, so that the 5d switch turns on the 2p lamp, and the 6d switch the 2½p lamp, the 7d switch the 3p lamp, and the 8d switch the 3½p lamp. The values 9d and 10d and combined in one switch which operates the 4p lamp and the 11d switch operates the 4½p lamp. The 1s switch operates the 5p lamp.

The 2s switch at the start of the row of even shillings switches is in series with the 10p lamp at the bottom of the left hand column of lamps. The even shillings switches are each in series with a corresponding lamp up to the 18s switch, which operates the 90p lamp at the top of the column.

The line of switches corresponding to the odd numbers of shillings calls for comment since these switches are double-pole, single-throw types. One side is in series with the coil of a relay and a diode. When any one of the odd value paths is completed through another diode, and the "pence" switch and back to the battery, the relay operates.

RELAY CONTACTS

The relay contacts are single-pole changeover, changing the battery return lead for the 1p, 2p, 3p, 4p and 5p lamps, so that the 6p, 7p, 8p, and 9p lamps are operated. In this way 5p are added to the value each time an odd number of shillings is selected.

For example, suppose we select the value 2s 11d. The 2s switch operates the 10p lamp, and the 11d switch operates the 4p lamp via diodes D18 and D16, and the ½p lamp via diode D19.

Now try the value 15s 6d. The 15s switch operates the 70p lamp via D37. When the 6d switch is made the circuit through the relay coil is completed via the second contact on the 15s switch and diode D10. The relay contacts change over and the 7p lamp is lit by the circuit through D8 and D7. The ½p lamp is lit through D9.

Thus the 70p lamp, and 7p lamp and the ½p lamp give a complete reading of 77½p.

The fact that the 15s switch and the 6d switch must both operate to bring on the 7p lamp make this an example of the classic AND gate.

COMPONENTS

The bulb holders used in this model are instrument panel indicators. If a protruding lamp is used, it is sometimes difficult to see when the lamp is on in conditions of bright sunlight; the front panel can be set back so that the sides of the case shield the lamps.

The whole instrument can incorporate a small power pack for mains operation; a 6 volt mains transformer and rectifier only is necessary. These should be capable of handling the total current consumption from the relay and the maximum number of lamps in operation at any time. The model shown here used two 3 volt batteries in series; a high capacity 6 volt battery would be equally suitable, for example type 996.

The relay can be almost any type that will operate at 6 volts and has a set of changeover contacts. Examples are Post Office type 600 or Omron type MH2. It is recommended that the coil resistance is as high as is practical to conserve battery power.

TAG STRIPS

This instrument does not lend itself to any of the modern wiring methods; that shown in the diagram uses long tag strips between the switches.

It is important to make sure that the diodes are connected correctly. The end with the coloured spot or band corresponds to the cathode and is shown on the circuit diagram with a + sign. Relay contacts RLA1 are shown in the non-operative position.

The layout of the instrument with component positions is shown in Fig. 3. It is not essential to follow this rigidly. The drilling details of the front panel will depend on the sizes of the lamps and switches; it should not be beyond the ingenuity of the constructor to arrange these as he chooses. ★