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SWITCHING DEVICES

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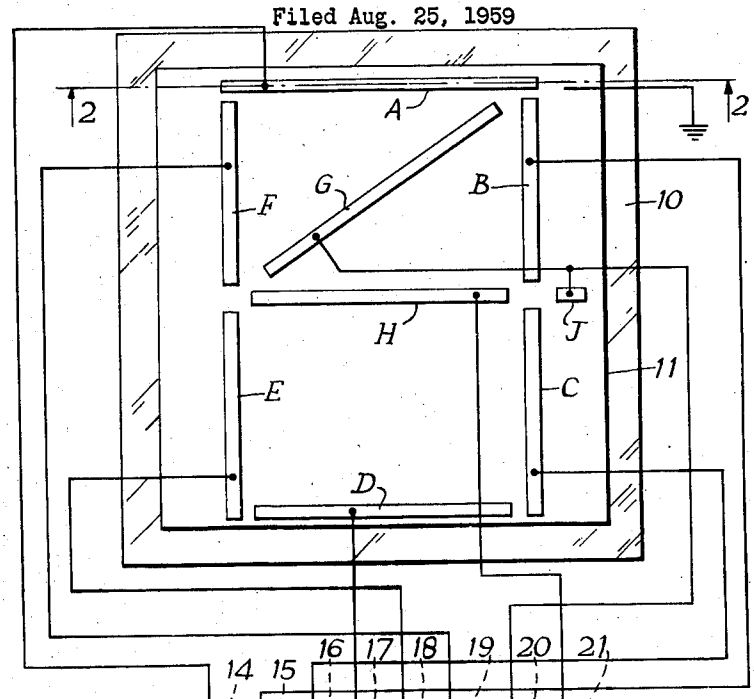


Fig. 1.

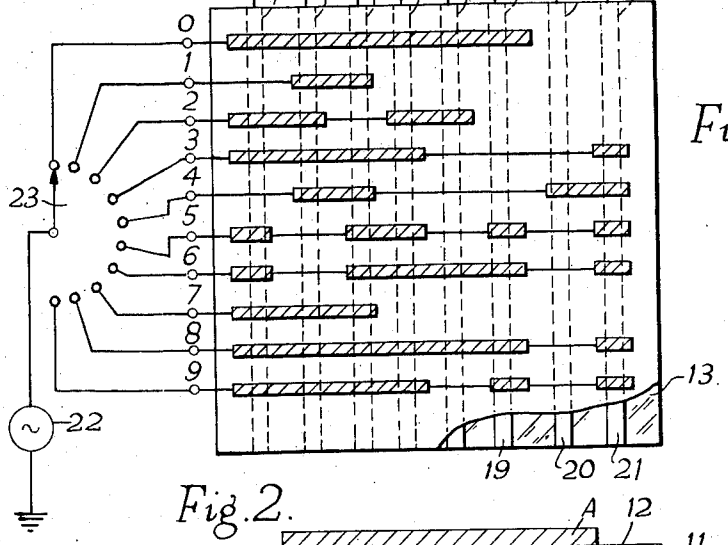
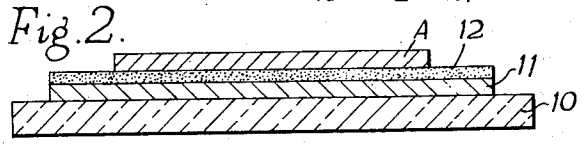


Fig. 2.



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SWITCHING DEVICES

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The present invention relates to switching devices and is concerned with switching devices suitable for enabling different combinations of lamps to be selected for illumination.

In providing an indicator for displaying characters such as numbers it has been proposed to use an electroluminescent device comprising a transparent, conductive front electrode, a layer of electroluminescent material and a back electrode in the form of say the ten digits 0 and 1 to 9 superimposed on one another but electrically insulated from one another. Any desired one of the digits can be illuminated by selecting the appropriate back electrode and applying operating voltage between selected back electrode and the front electrode.

Thus a simple ten-position selector switch is adequate for operating the indicator.

Two disadvantages of such an arrangement are, however, that the number of crossovers in the back electrode is inconveniently large for a satisfactory display, and manufacture is made difficult by the large number of crossovers to be provided.

It has further been proposed to overcome these disadvantages by providing an electroluminescent device in which the back electrode is in the form of a number of strips separated from one another.

The strips are arranged in such a manner that by selecting different combinations of strips and applying operating voltage between the selected strips and the front electrode, different characters can be displayed.

This arrangement has the disadvantage that the selector switch has to be relatively complex if conventional switching apparatus is used.

It is an object of the present invention to provide an improved switching device suitable for operating the last said proposed electroluminescent device.

In one form of the present invention a switching device comprises an insulating support carrying a plurality of spaced, electrically-conducting strips covered with a layer of dielectric or resistance material, and a plurality of sets of electrically-conducting input electrodes lying on the said layer and crossing the conducting strips, the electrodes in different sets crossing different combinations of the strips. Where the layer is of dielectric material the device is suitable solely for use with alternating current, whereas both alternating and direct current can be switched by the device when the layer is of resistance material. It is preferred to make the layer of superlinear resistance material for the reasons explained hereinafter.

The invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a schematic diagram of a unit including a plurality of electroluminescent lamps connected to a switching device, and

Fig. 2 is a cross-section taken along the line 2—2 of Fig. 1.

In the drawings an assembly of nine electroluminescent lamps includes a base plate **10** of glass one surface of

which is substantially completely covered with an electrically-conducting layer, this layer being transparent and conveniently in the form of stannic chloride deposited on the glass plate **10** from the vapor state.

Superimposed over the layer **11** is a layer **12** of electroluminescent material and nine conducting strips A, B, C, D, E, F, G, H and J respectively are arranged over the electroluminescent layer and in contact therewith.

By illuminating different combinations of the nine electroluminescent lamps so formed different ones of the digits 0, and 1 to 9 can be displayed. The following table shows the selections of lamps to be made in displaying the different digits:

Table I

0—	A B C D E F
1—	B C
2—	A B H E D
3—	A B H C D
4—	B G H J C
5—	A F H C D
6—	A F E D C H
7—	A B C
8—	A B C D E F H
9—	A B H F C D

A switching device suitable for use in selecting these different combinations of lamps comprises a rectangular glass plate **13** with eight strips **14** to **21**, of conducting material lying on and affixed to the glass plate **13** parallel to one another.

Over these conducting strips is formed a layer (not shown) of resistance material having a superlinear characteristic, that is the characteristic of a rapid fall in resistance with increase of voltage across the material. A suitable material is silicon carbide used in the present embodiment.

Lying over and in contact with the silicon carbide layer are 10 sets of electrodes in the form of further conducting strips connected to terminals 0 and 1 to 9 respectively. The conductors shown interconnecting the electrodes of each set are arranged to be out of direct contact with the silicon carbide lying beneath them.

Different sets of the electrodes cross different combinations of the conducting strips **14** to **21** in accordance with the following table:

Table II

Set No.:	Conducting strips crossed
0	14, 15, 16, 17, 18, 19
1	15, 16
2	14, 15, 17, 18, 21
3	14, 15, 16, 17, 21
4	15, 16, 20, 21
5	14, 16, 17, 19, 21
6	14, 16, 17, 18, 19, 21
7	14, 15, 16
8	14, 15, 16, 17, 18, 19, 21
9	14, 15, 16, 17, 19, 21

The portions of the sets of electrodes and of the conducting strips at the crossings are closely adjacent one another.

The electroluminescent lamps are connected to the terminals **14** to **21** as follows:

Table III

A—	14
B—	15
C—	16
D—	17
E—	18
F—	19
G and J—	20
H—	21

A source **22** of alternating current at a suitable voltage and frequency for operating the electroluminescent lamps A to J has one terminal earthed and the other connected to the wiper of a 10-position selector switch **23**. The conducting layer **11** of the electroluminescent lamp assembly is also earthed.

In operation the selector switch **23** is adjusted to select the set of electrodes corresponding to the digit to be displayed. For example if the digit 5 is to be displayed the selector switch **23** is set to apply A.C. from the source **22** to the terminal **5**. From the drawing and Table II it will be seen that set No. 5 of electrodes crosses the conducting strips **14**, **16**, **17**, **19** and **21**.

From Table III and the drawing it will be seen that these conducting strips are connected to the lamps A, C, D, F and H respectively which will be seen from Table I to be the lamps for displaying the digit 5.

Although all the conducting strips **14** to **21** are interconnected by the layer of silicon carbide the resistances of the paths between the electrodes of a selected set and the conducting strips crossed by them is always considerably smaller than the resistances of the paths between the selected electrodes and the other conducting strips. It can readily be arranged that the voltage drops in the paths to the unselected lamps is such that they do not luminesce.

Although a switching device utilising a layer of resistance material has been described it will be understood that as the frequency required for exciting some electroluminescent materials is high—say 20 mc./s.—dielectric material can sometimes be used in place of the resistance material.

It is preferred however to use a layer of material such as silicon carbide having a superlinear characteristic relating voltage and resistance since design is facilitated. This is so because the resistance, the electrodes of the selected set and the conducting strips crossed by them is reduced on application of a potential to the selected strip to a greater extent than is the resistance of the longer paths to the other strips.

It will also be understood that although the invention has been described in connection with a digital indicator it may be used with an assembly of lamps for selectively displaying other characters and symbols.

I claim:

1. A switching device comprising an insulating support, a plurality of spaced electrically-conducting strips carried by said support, a plurality of sets of electrically-conducting input electrodes each set having portions thereof cooperatively adjacent corresponding portions of a combination of the strips individual to that set and a layer of dielectric or resistance material in contact with the strips and sets of electrodes at least at the said adjacent portions thereof, whereby the electrical impedance with respect to a predetermined operating signal between any selected set of input electrodes and the strips of the combination individual to that set of electrodes is substantially smaller than the impedance between the selected set of electrodes and the strips not in the combination individual to that set.

2. A switching device, comprising an insulating support carrying a plurality of spaced, electrically-conducting strips covered with a layer of dielectric or resistance material, and a plurality of sets of electrically-conducting input electrodes lying on the said layer and crossing the conducting strips, the electrodes in different sets crossing different combinations of the strips.

3. A switching device according to claim 2, wherein the said layer is of resistance material having a superlinear characteristic relating its resistance to the voltage across it.

4. A display device comprising a plurality of lamps and a switching device connected thereto for selectively energising different combinations of the lamps, the switching device being in accordance with claim 2, separate connections being provided between the said electrically-conducting strips and the different lamps, and a selector switch being connected in series between a source of electric current and the sets of input electrodes.

5. A display device according to claim 4, wherein the lamps are electroluminescent lamps.

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