

June 30, 1970

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3,517,451

DISPLAY DEVICE AND CONNECTOR THEREFOR

Original Filed May 27, 1964

2 Sheets-Sheet 1

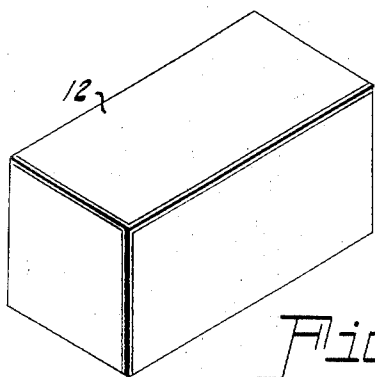


Fig. 1

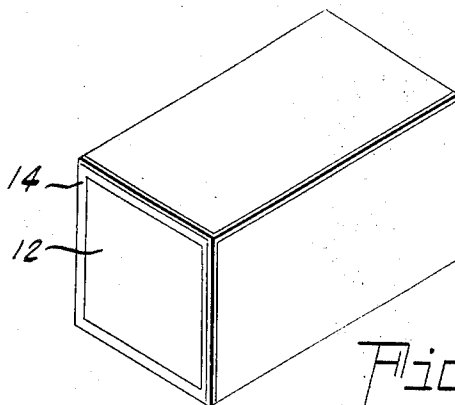


Fig. 2

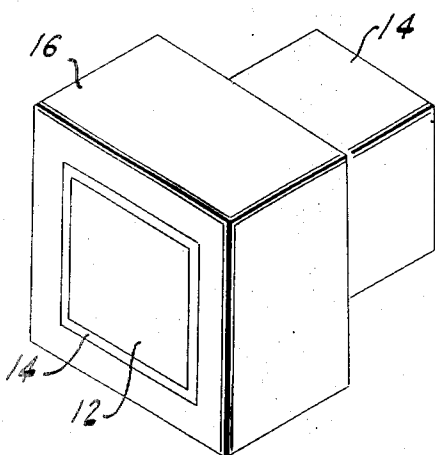


Fig. 3

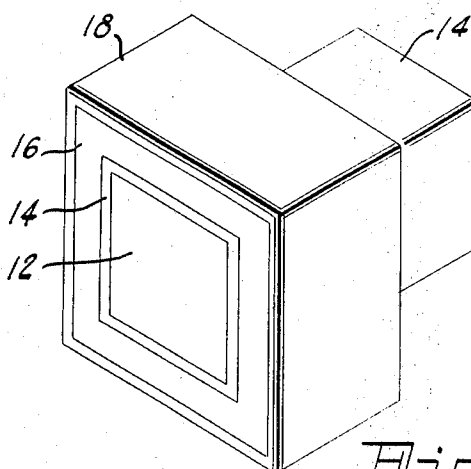


Fig. 4

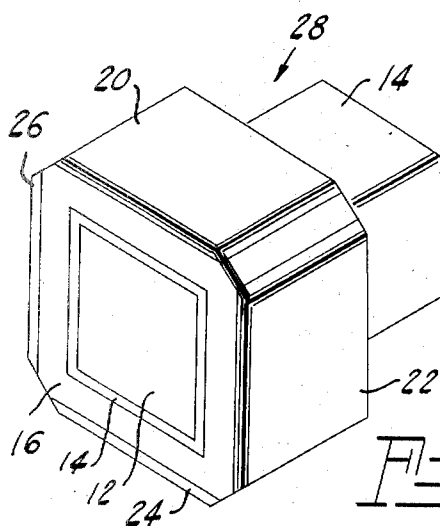


Fig. 5

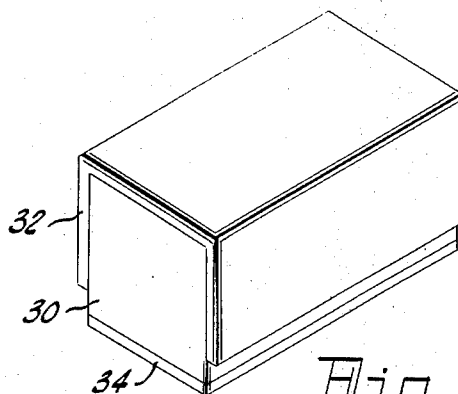


Fig. 6

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2 Sheets-Sheet 2

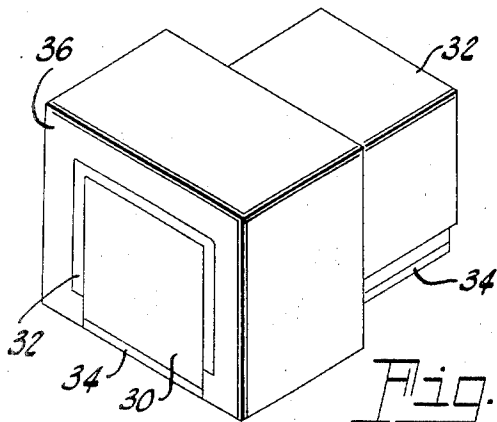


Fig. 7

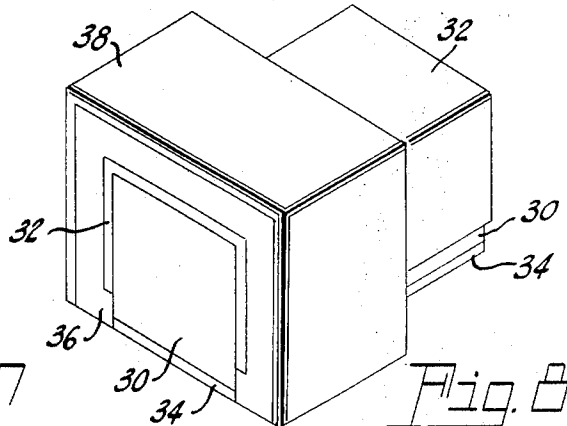


Fig. 8

Fig. 9

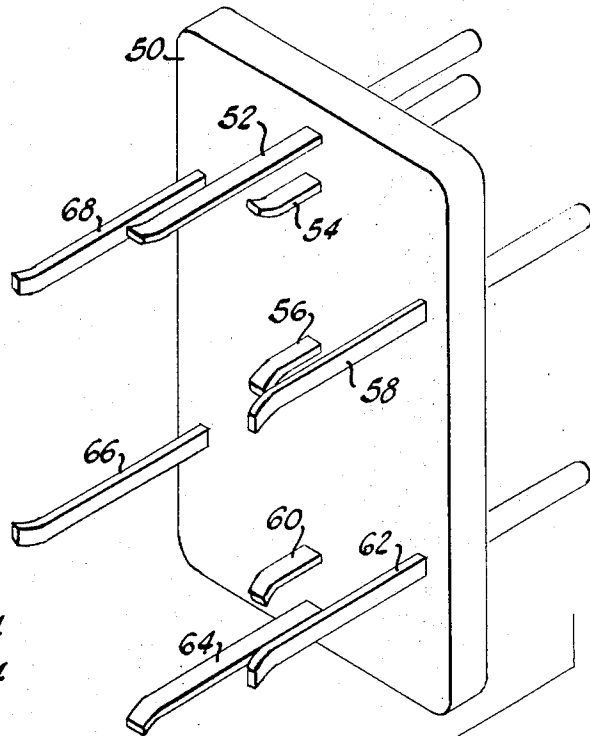
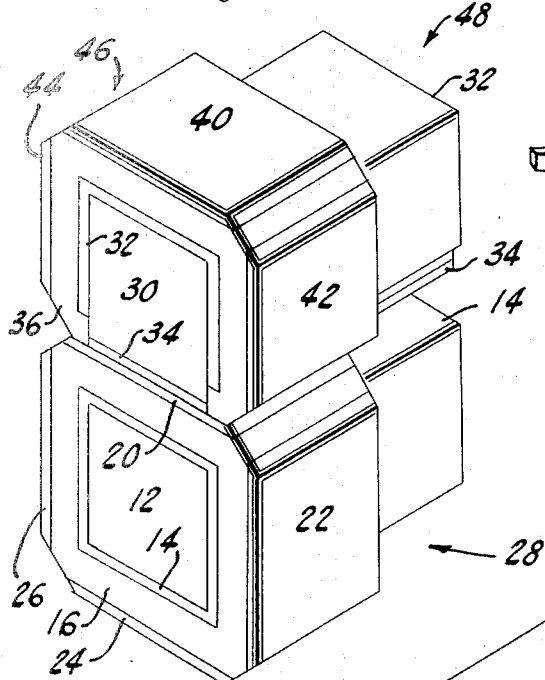
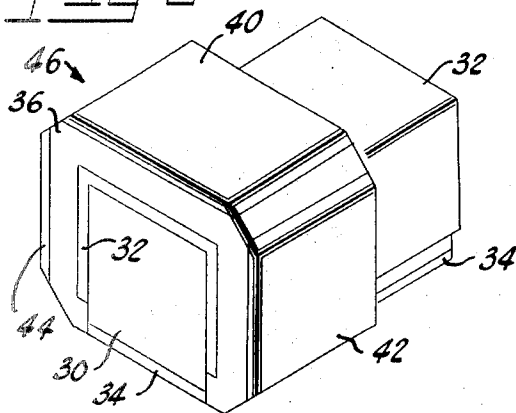


Fig. 10

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**DISPLAY DEVICE AND CONNECTOR THEREFOR**  
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Application Jan. 4, 1968, Ser. No. 695,758, now Patent  
No. 3,484,975, dated Dec. 23, 1969, which is a division  
of application Ser. No. 370,655, May 27, 1964, now  
Patent No. 3,370,976, dated Feb. 27, 1968, Divided and  
this application Jan. 4, 1968, Ser. No. 695,690  
Int. Cl. G09f 13/22

U.S. Cl. 40—130

3 Claims

## ABSTRACT OF THE DISCLOSURE

A numeric readout device and a process of making the same which utilizes the edge illumination of excited electroluminescent material. The device is fabricated by applying the electrodes and EL material to the periphery of a substrate rather than to the planar surface thereof. This procedure allows the use of thin line figures while maintaining large electrical contact areas for ease of electrical connection. The device produced thereby has a polygonal central core with separate outermost connectors and is mounted for use on an insulating connector board having connector pins formed therein to hold the display in position and provide electrical connection thereto.

## CROSS REFERENCE TO RELATED APPLICATIONS

This application is a divisional application of Ser. No. 370,655, filed May 27, 1964, now U.S. Pat. No. 3,370,976, granted Feb. 27, 1968, which is assigned to the assignee of the present invention and it contains matter disclosed but not claimed in Ser. No. 695,758, now U.S. Pat. No. 3,484,975, granted Dec. 23, 1969, filed Jan. 4, 1968, concurrently herewith, which application is also a division of Ser. No. 370,655.

## BACKGROUND OF THE INVENTION

This invention generally relates to display devices and to a method of making the same. More particularly, it relates to illuminable symbolic and numeric readout displays and a method of making them.

The tremendous increase in the number of electronic computing and testing devices has created a need for visible display units which may be utilized in visually portraying the information derived therefrom. There have been many types of these units, all of which have been more or less successful. These include mechanical counters, gas glow tubes, projection devices, and segmented electroluminescent displays. This invention pertains to the latter type of device.

The usual type of segmented electroluminescent display is comprised of an electrically insulating planar substrate having a particular, electrically conductive, segmented pattern affixed thereto. Overlying this pattern is a layer of an electroluminescent phosphor which may or may not be dispersed in a dielectric medium such as plastic or glass frit. A common transparent, electrically conductive electrode overlies the electroluminescent layer. When a potential is applied between the common transparent electrode and any one or several of the conductive segments, the electroluminescent phosphor therebetween will be excited to luminescence. These devices are quite superior to many of the types in common usage today in that they are not subject to catastrophic failure. They have, however, several disadvantages. Among these are the problems of constructing small displays and the

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difficulty of providing electrical connection to the various segments.

## OBJECTS AND SUMMARY OF THE INVENTION

It is, therefore, an object of this invention to provide a small symbolic readout display having improved manufacturability.

It is another object of this invention to provide an improved electroluminescent readout device.

Another object of this invention is to provide improved means for making electrical connections to readout devices.

Still another object of the invention is to provide a readout device having an improved structure adapted to the economic fabrication thereof.

The above objects are carried out in one aspect of the invention by the provision of a method of making illuminable symbolic readout displays which comprises coating the peripheral surface area of a rod having a given geometrical configuration, and at least the peripheral surface of which is electrically conducting, with an electroluminescent phosphor. Next, an electrically conductive coating is applied over the phosphor, and the discrete areas of the conductive coating are removed whereby a plurality of individually illuminable electroluminescent segments is provided.

It will be seen that, by the use of this method, relatively small and rugged electroluminescent symbolic displays may be fabricated since the size will be controlled by the dimensions of the rod. By making the rod longer than the phosphor layer, electrical connection may be easily accomplished to the inner electrode. By forming several symbolic displays and assembling them together, numeric segmented displays may be provided.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 through 5 illustrate the sequence of operations for fabricating one type of symbolic display device;

FIGS. 6 through 9 illustrate the sequence of operations for fabricating another type of symbolic display device; and

FIG. 10 is an exploded perspective view illustrating a type of numeric readout display which may be assembled from the two symbolic display devices.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

For a better understanding of the present invention, together with other and further objects, advantages, and capabilities thereof, reference is made to the following disclosure and appended claims in connection with the above-described drawings.

Referring now to the drawings with greater particularity, in FIG. 1 there is shown a rod 12 of some suitable opaque material such as glass or ceramic or electrically conductive metal. If rod 12 is metal, the electroluminescent phosphor may be applied directly thereto; however, if the rod is glass or ceramic or some other electrically insulating material, then an electrically conductive coating such as 14 in FIG. 2 would have to be applied thereto to provide an inner electrode. Coating 14 may be any suitable and easily applied material such as aluminum or gold.

Phosphor layer 16 is then applied to coating 14 by any conventional means, as by spraying, and may consist of all phosphor or phosphor particles dispersed in a dielectric medium such as glass frit or plastic. Layer 16 does not extend the entire length of rod 12 so that electrical connection can be made to coating 14.

Conductive coating 18 may be applied over layer 16 by suitable means to provide the construction shown in

FIG. 4; and then selected, discrete areas of coating 18 are removed to form a plurality of individual outer electrodes 20, 22, 24, 26 which provide individually illuminable electroluminescent segments in a first symbolic display device 28. While rod 12 is shown in this instance as having a substantially parallelogrammatic configuration, it is to be understood that other polygonal configurations may be used for other purposes with equal success. For example, if rod 12 had a decagonal configuration, a ten-segment decade counter could be produced.

Symbolic display devices constructed according to the method of this invention provide a distinct advance in the art. Small, rugged units of virtually any configuration can be constructed, and electrical connection to the various electrodes can be easily accomplished.

To construct a numeric readout display; that is, a display which portrays the conventional physical characteristics of numbers, the following approach has been tried:

An electrically insulating rod 30, similar in size and configuration to rod 12, has first and second electrically conductive coatings, 32, 34 respectively, applied thereto as is shown in FIG. 6. Coating 32 extends the full length of rod 30 and encompasses substantially three surfaces thereof. Coating 34 is adhered to the previously uncoated surface and is insulated from coating 32 and also extends the full length of rod 30.

Phosphor layer 36 is applied by suitable means to overlie coating 32, and a third electrically conductive coating 38 is applied thereover. Again, layer 36 and coating 38 preferably do not extend the full length of rod 30. Selected, discrete areas of coating 38 are then removed, as by grinding to form a plurality of electrodes 40, 42, 44 which provide individually illuminable electroluminescent segments in a second symbolic display device 46.

While it has been suggested to apply coating 18 and coating 38 in a more or less enveloping manner and then remove selected, discrete areas thereof to form electrodes, it will be obvious to those skilled in the art that the electrodes could be individually applied.

Numeric readout display 48 is formed by combining a first symbolic display device 28 and a second symbolic display device 46 in the stacked manner shown in FIG. 10. Preferably they may be cemented together by a conductive epoxy. This unit is then affixed in connector board 50 by any suitable means, such as by cementing. Board 50 may be any electrically insulating material having good strength characteristics; and it is provided with connector pins 52, 54, 56, 58, 60, 62, 64, 66 which provide

electrical contact with electrodes 40, 32, 34, 42, 14, 22, 24, 26, and 44 respectively. The connector pins project through board 50 so that the entire unit may be connected to suitable electrical potentials.

This device is small and rugged and is relatively economical to manufacture, and it greatly simplifies the job of making electrical connection to the various segments.

While there have been shown and described what are at present considered the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention as defined by the appended claims.

I claim:

1. In combination, a device for illuminatingly displaying selectively variable, intelligence conveying symbols and a connector board therefor, said device comprising: at least one elemental unit having a polygonal central core having a plurality of substantially flat sides and a given length and at least the surface of which is electrically conductive to provide an inner electrode; an electroluminescent phosphor having a length less than said given length substantially surrounding said inner electrode; and a plurality of individual outer electrodes disposed on said phosphor, one outer electrode for each of said sides; said connector board comprising an electrically insulating substrate having a plurality of electrically conductive connector pins formed therein, at least one of said pins being formed to contact said inner electrodes and at least some of the remaining pins being formed to contact said outer electrodes.

2. The invention of claim 1 wherein said device is comprised of two of said elemental units stacked one upon the other.

3. The invention of claim 2 wherein said devices are releasably mounted by said pins.

#### References Cited

##### UNITED STATES PATENTS

|           |        |                  |          |
|-----------|--------|------------------|----------|
| 1,894,380 | 1/1933 | Long             | 40—130   |
| 2,878,418 | 3/1959 | Garfinkel et al. | 40—130 X |
| 2,942,157 | 6/1960 | Davis            | 317—119  |
| 3,133,221 | 5/1964 | Knochel et al.   | 313—108  |

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