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 [21] Appl. No. **781,787**
 [22] Filed **Dec. 6, 1968**
 [45] Patented **Dec. 22, 1970**
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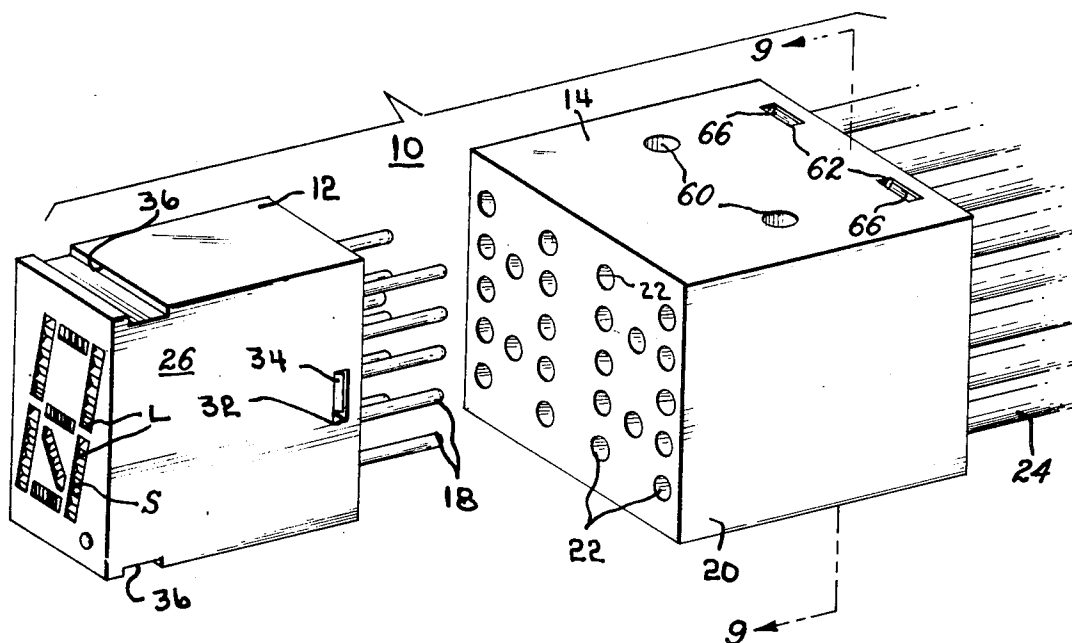
[54] **MODULAR COMPONENT ASSEMBLY
 FACILITATING HEAT DISSIPATION**
3 Claims, 12 Drawing Figs.

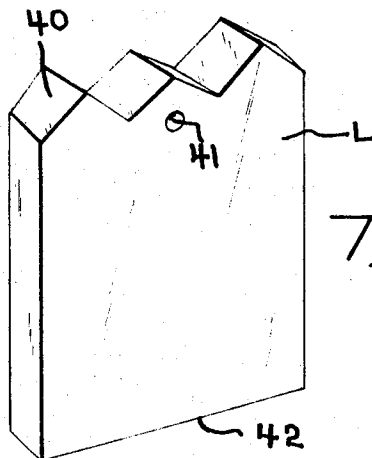
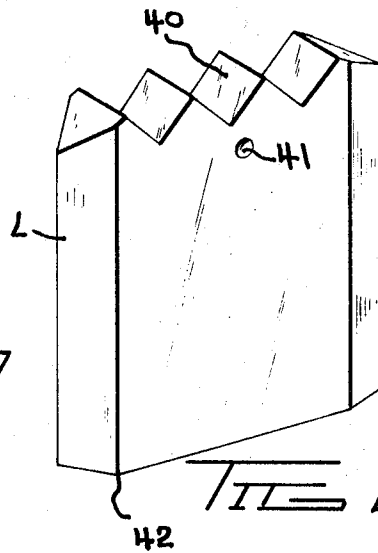
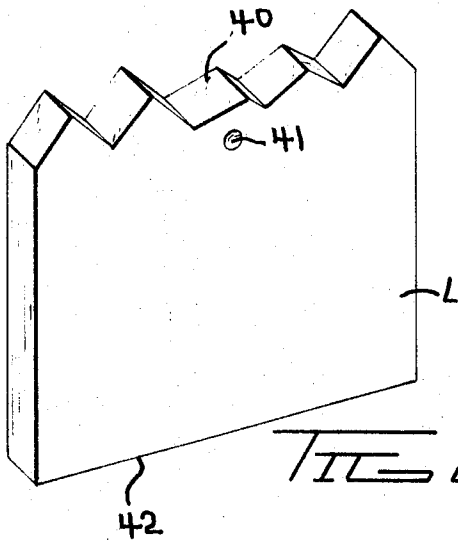
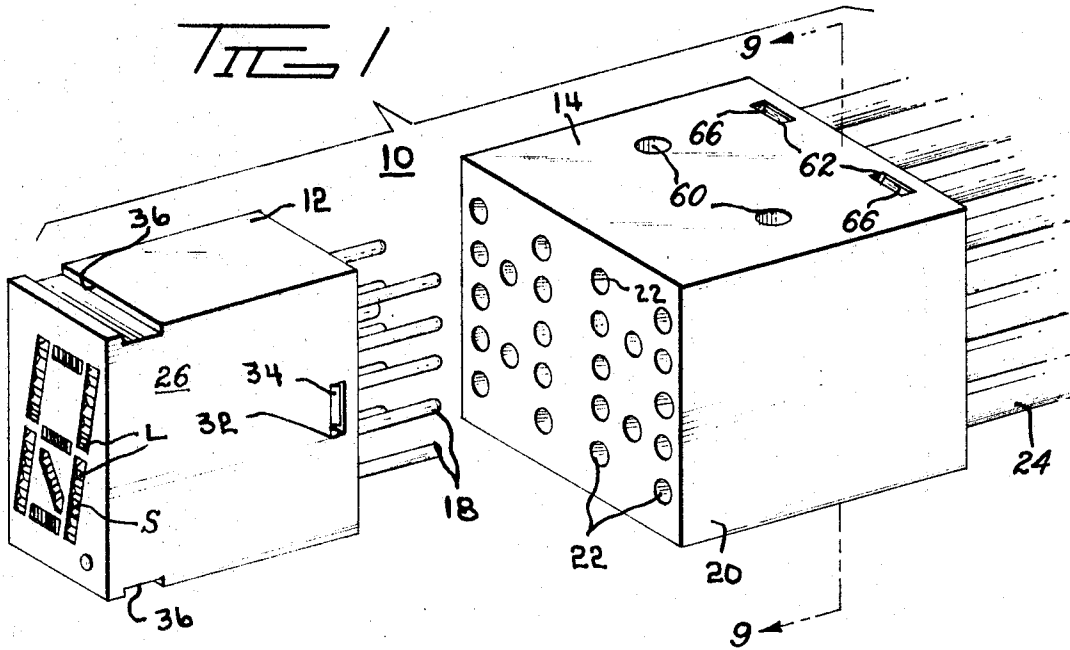
[52] U.S. Cl. **174/59,**
 317/100, 317/101, 339/63, 340/380
 [51] Int. Cl. **H05k 7/10,**
 H01r 13/46
 [50] Field of Search 340/336,
 381; 240/2.1, 8.16; 317/101CB, 100; 174/52.6;
 339/39, 75—79, 59—63

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ABSTRACT: An assembly of modules and connectors is taught which features a construction enabling miniaturization and facilitating assembly and disassembly for field replacement of parts. A display module including segments capable of being selectively illuminated by incandescent lamps is housed in a block of thermally conductive, but electrically insulating, material made of plastic loaded with conductive particles. The incandescent lamps are held on a printed circuit board by a panel which can be snapped into the rear of the module and replaced if necessary. Connector blocks capable of accommodating a number of display modules are provided which include contact receptacles crimped to lead wires and fitted within such block to receive pins from the display module connected to lamps through the printed circuit board. The contact receptacles are held in apertures in the connector block by a plate snapped into the rear of the block.





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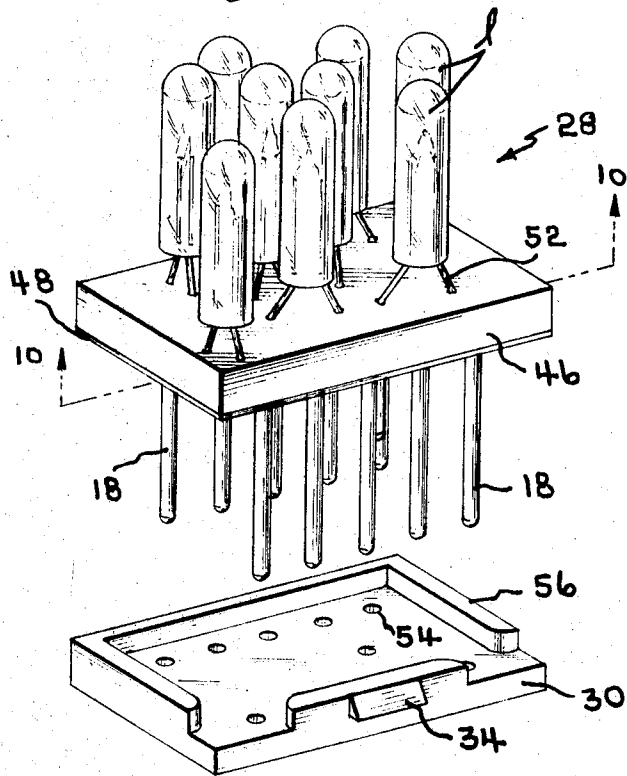
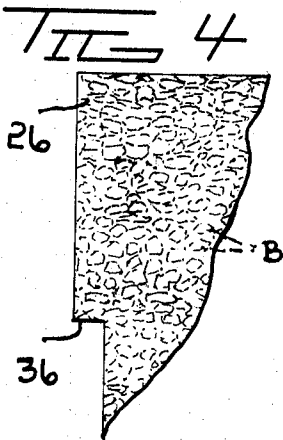
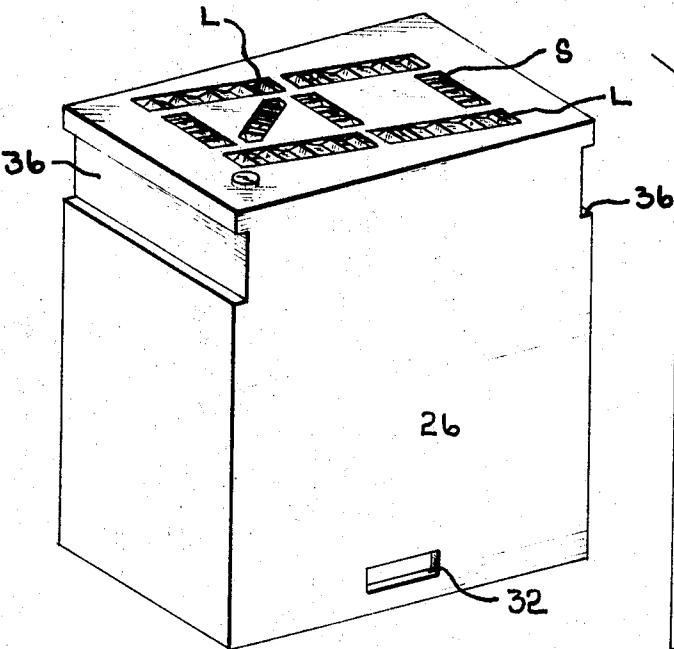
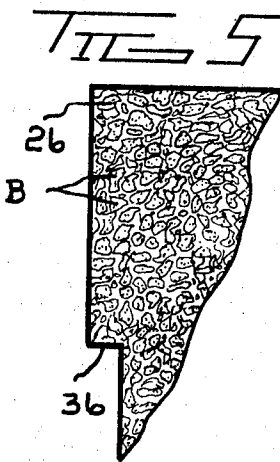
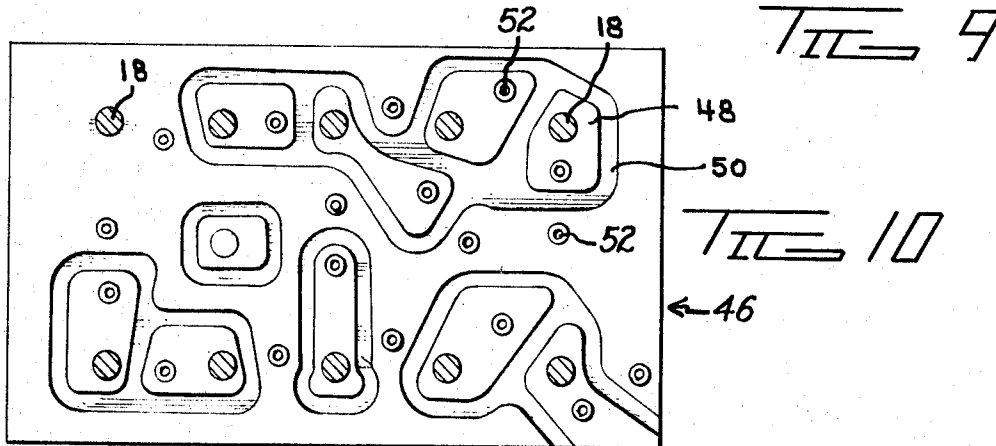
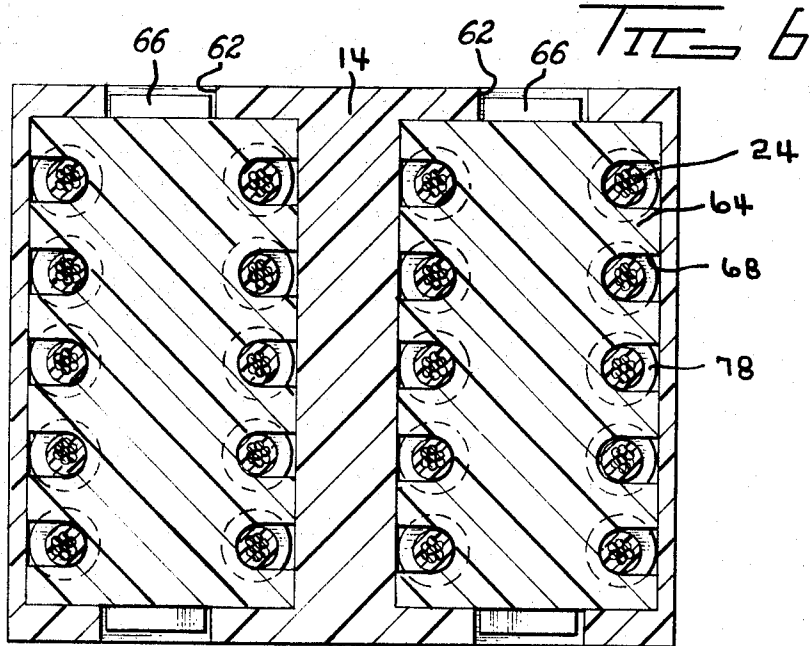
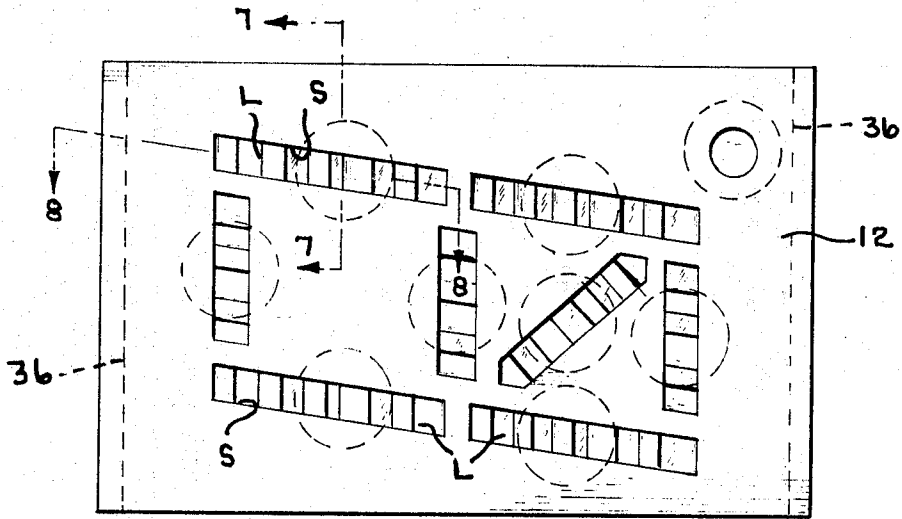
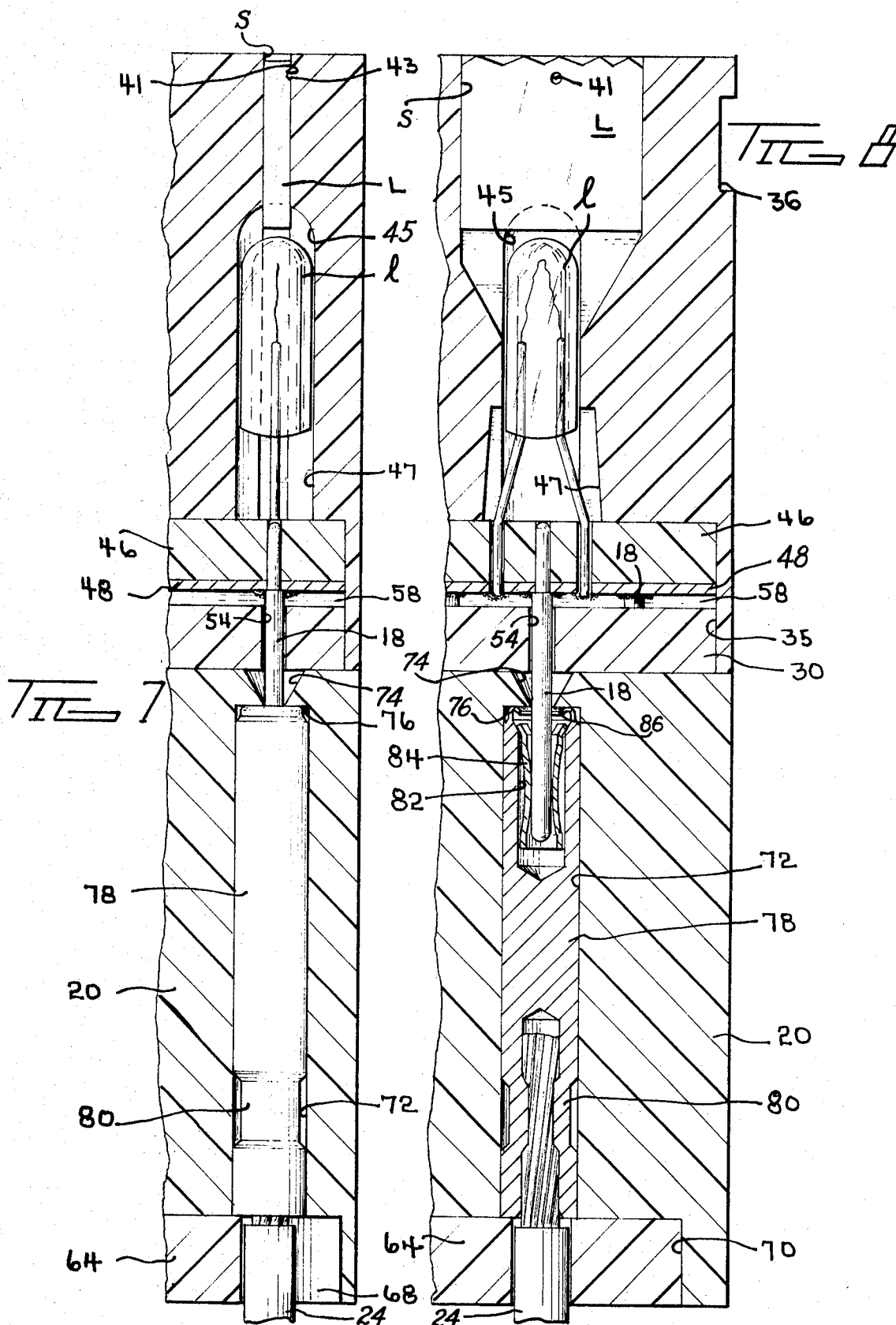


FIG. 3







MODULAR COMPONENT ASSEMBLY FACILITATING HEAT DISSIPATION

BACKGROUND OF THE INVENTION

Symbolic readout devices are well-known and typically include a block or housing containing a plurality of incandescent or neon lamps which are lighted in patterns to illuminate lens structures formed in segments in the front of the housing. These segments are arranged so as to be capable of representing digits or letters or other symbols, a typical seven segment display being capable of rendering the digits zero and 1 through 9 and several letters of the alphabet. One of the problems heretofore faced with display units using incandescent lamps has been heat dissipation, the lamps employed generating considerable heat which is trapped within the housing. Heat shortens the life of incandescent lamps drastically. Another problem has been with very small symbolic display units, so called miniaturized displays, where the amount of material employed is reduced relatively to the amount of heat generated by incandescent lamps. Put another way, while lamps employed in miniaturized displays are somewhat smaller, the amount of material forming the housing is relatively reduced to a much greater extent and the ability of the surrounding material to conduct heat away from the lamps is appreciably reduced. A further problem is that with very small symbolic display units the typical constructions heretofore employed do not permit field disassembly for replacement of parts such as lamps which have burned out or of leads which need to be changed to accommodate changes in the circuits for symbols employed in a given application.

SUMMARY OF THE INVENTION

The present invention relates to a symbolic display assembly which can be made in very small dimensions and yet can be readily assembled and disassembled for part replacement and/or circuit changes.

It is an object of the invention to provide a symbolic display unit which is pluggable, modular and readily disassembled for part replacement. It is a further object to provide a miniaturized display unit having improved heat dissipation to enhance lamp longevity. It is yet a further object of the invention to provide a connector for pluggable electrical and/or electronic modules which is simpler in terms of design than connectors heretofore available. It is yet another object of the invention to provide an electrical and/or electronic assembly of small multiple pin and pluggable modules which is readily disassembled for part replacement and/or circuit changes.

The foregoing objects are attained by the present invention through the use of blocks containing passages for elements inserted therein with the rear portion of such blocks relieved across the face of the block to receive a plate which can be snapped into place to secure multiple elements in such passages. Display modules are provided formed of blocks of material which is heat conductive, but not electrically conductive. These blocks are, in a preferred embodiment, comprised of nylon, filled with one mill particles or walls of copper with a 50-50 loading of particles in the nylon base material. Injection molding of the 50-50 mix has been found to produce a skin of plastic material which yields an unexpected high voltage breakdown for the blocks. On the other hand, the blocks have been found to readily conduct heat away from sites such as lamps down within the blocks. The blocks forming the modules and the blocks forming connectors for the modules include passageways defining individual positions for lamps and/or contact pins. An insulating plate is fitted within the rear of the blocks to cover over the individual passageways and lock the individual components within the blocks. The plates contain detent elements cooperating with small slots in the blocks to lock the plates in position and thus lock the components within the blocks. The plates may be readily removed to permit part replacement and/or changes in the circuit.

In the drawings:

FIG. 1 is a perspective view of an illustrative display assembly, shown approximately 3 1/2 times actual size;

FIGS. 2A, B and C, depict different lens structures for use with the display modules shown in FIG. 1, shown approximately 10 times actual size;

FIG. 3 is an exploded and perspective view of the symbol display module shown in FIG. 1;

FIG. 4 is an enlarged view of a corner of the housing block of FIG. 3 taken from the left-hand top end of the block;

FIG. 5 is a section of the corner shown in FIG. 4;

FIG. 6 is a front-end view of the display module, somewhat enlarged from that shown in FIG. 1, showing in phantom the position of lamp apertures;

FIG. 7 is a partial, longitudinal and sectional view taken through lines 7-7 of FIG. 6;

FIG. 8 is a partial, longitudinal and sectional view taken through lines 8-8 of FIG. 6;

FIG. 9 is a view from the rear of the connector block shown in FIG. 1 to the right, taken through lines 9-9 of such FIG.; and

FIG. 10 is a bottom plan view of the printed circuit board utilized with the display module as viewed from lines 10-10 of FIG. 3.

DESCRIPTION OF PREFERRED EMBODIMENT OF THE INVENTION

Referring now to FIG. 1, an assembly 10 is shown to be comprised of a display unit module 12 and an associated connector 14. The module 12 includes on the front face an eight-segment display which is capable of displaying zero and 1 through 9 and a number of letters by selectively energizing lamps associated with such segments and buried within the block 12. These lamps are connected to contact pins shown as 18 extended from the rear of the module. The contact pins are plugged into related contact receptacles contained in connector 14. The connector 14 in the illustrative embodiment includes a block or housing 20 which has patterns of apertures 22 contained in the front face thereof arranged to receive pins 18 of a module. Two sets of patterns are shown relative to the connector 14 to accommodate two modules. It is contemplated that a connector 14 may contain as many sets of apertures and contact receptacles as is required. The contact receptacles within 14 are connected individually to leads shown as 24 extending to the right in FIG. 1. These leads power the lamps in the modules and may be selectively energized by auxiliary circuits to provide a display readout on the front face of the module.

It should be apparent from FIG. 1 that the module 12 can be plugged into the connector block 14 and an additional module like 12 could be plugged in there adjacent.

Turning now to the module 12 in greater detail, reference is made to FIG. 3 and to the exploded view there shown. As can be seen, module 12 is comprised of a housing or block 26, a lamp assembly 28 and a locking plate 30. The block 26 is preferably a one-piece molding of plastic material, such as nylon, filled with conductive particles to an extent to make the block thermally conductive but not electrically conductive. FIGS. 4 and 5 depict the left corner edge of the block 26 blown up from the showing of FIG. 3. FIG. 4 shows the surface of the block with small copper particles or balls appearing in phantom beneath the skin of the block. FIG. 5 shows the same view, but sectioned to expose the particles embedded within the plastic material. The particles are shown as B and are only schematically represented. In an actual sample the particular were comprised of copper and were approximately 0.001 of an inch in diameter. The particles were thoroughly mixed into the plastic material prior to molding and the mixture was injected into a cavity mold under appropriate heat and pressure for molding nylon. As can be discerned from FIGS. 4 and 5, the process leaves a thin skin of plastic material extending around and over all surfaces of the particles. A block formed in the foregoing manner was subjected to a voltage breakdown test and withstood an excess of 2,000 volts, placed across leads touched to the surface of the block on either side thereof. A block formed of the process was found to have ex-

cellent heat dissipation, but more than adequate electrical insulation. As can be discerned from FIG. 8, the lamps shown as *l* in FIG. 3 and in FIGS. 7 and 8 are entirely within the block 26 and the lower portion of the lamp, adjacent its leads, is very close to the block material. The block material utilized additionally was rendered opaque reducing the light lost therethrough and providing better definition relative to the blocks segments or slots, shown in FIG. 3 as *S*. Use of the metallic powder, fibers or flakes is also contemplated as a fill for the plastic material. The phenomena which results in the conductive particles residing beneath all of the surfaces of the block when it is injection molding is not altogether understood, but has been found to occur each time using standard molding techniques.

Turning again to FIG. 3, the exterior detail of block 26 includes in the rear a pair of small slots shown as 32, another one existing in the block wall opposite to the one shown. These slots accommodate beveled detents shown as 34 on a locking plate 30 when such plate is fitted within the rear of the block. As can be seen in FIG. 8, the rear of the block 26 is recessed as at 35 to receive the body of plate 30 flush with the rear end of the block. Toward the forward face of block 26, top and bottom, is provided a slight recess shown as 36 to enable the module to be pulled outwardly and removed from a connector 14; the recesses providing a gripping surface. In the face of block 26, as shown in FIG. 3, can be seen the plurality of segments or slots *S* which define the symbolic display of the module. The slots are arranged and oriented as best shown in FIG. 6 and have an interior configuration as best shown in FIGS. 7 and 8. As can be seen in FIGS. 7 and 8, the slots *S* extend straight back inwardly and then are beveled inwardly to a circular configuration to receive the insertion of a lamp *l* within slots. The slots then open outwardly to facilitate the insertion of lamps and leads into the position shown in FIG. 8. Each of the slots *S* is filled with a lens shown as *L*; differently dimensioned lenses being shown in FIGS. 2A, 2B and 2C. The forward edges of the lens are serrated as indicated by numeral 40 in the various FIGS. This serration is intended to improve light dispersion. The rear or bottom faces of the lenses are substantially flat as at 42. The lenses are of a cross-sectional configuration to fit within the slots *S* which are, as can be seen in FIG. 6, trapezoidal. As shown in FIGS. 7 and 8, the slots *S* include a center rounded portion shown as 45, which extends forwardly of the end of the lamp *l* to relieve assembly tolerances and any slightly different positioning of the various lamps of a module assembly. The rear portion 47 is dimensioned to permit lamp insertion. The lenses *L* extend slightly past the end of the portion 45 of the slots *S*, as shown in FIG. 7. Lenses *L* are preferably premolded of Lucite or similar material and inserted and bonded with adhesive into position within the slots *S* of the block 26. Alternatively, lenses *L* may be cast into the block, using filler pins shaped like *L* to limit flow. As a further alternative, it is contemplated that the lens may be provided with small detents such as 41 to mate with matching holes 43 or dimples formed or drilled through block 26 to permit the lenses to be snapped into position and removed, if desired.

Returning to FIG. 3, the lamp assembly 28 is comprised of a printed circuit board 46, typically of a phenolic sheet having copper foil bonded thereto and etched to define appropriate circuits. FIG. 10 shows the bottom side of the board 46 with the copper foil being represented as 48 and the etched-away portion as 50. It will be observed that each island of conductive foil is made to contain a contact pin 18 and the end of a lamp lead shown as 52. These conductive elements are soldered to the foil and thereby joined to the P.C. board. As shown in FIG. 3, lamps *l* are positioned above the board with lamp leads 52 extended down through the board and to the foil on the bottom side. Lamps *l* are arranged in a pattern to fit within the apertures in block 26 defined by slots *S* and the rear portions 46 and 47, shown in FIGS. 7 and 8. As previously mentioned, the rear of each block 26 is relieved as at 35, shown in FIGS. 7 and 8. The board 46 is dimensioned to fit

well within such relief in the manner shown in FIGS. 7 and 8 and the relief 35 is deep enough to accommodate the volume and thickness of plate 30. Plate 30 includes holes shown as 54 in a pattern to receive pins 18 of the assembly 28, extended therethrough. Plate 30 also includes a small wall portion 56 which extends substantially around three sides of the plate and serves to push against the bottom of the P.C. board and provide a standoff space between the upper surface of the plate and the foil and circuits on the P.C. board. This space is shown as 58 in FIGS. 7 and 8. As can be appreciated from FIG. 3, the display module can be readily assembled by placing the lamp assembly 28 within block 26 and placing the plate 30 over the back of 28, fitting the apertures 54 over pins 18 and pushing the plate home to latch the detents 34 thereof in slots 32. The module, although formed of very small parts, can be readily disassembled for replacement of lamps which may either be burned out or caused to fail for mechanical reasons.

Referring now in more detail to the connector 14, as shown in FIG. 1, the connector is comprised of a block 20 which is an insulating material. Referring to FIG. 1, the block includes in its front face, apertures 22 in patterns to receive the pins 18, as heretofore mentioned. Extra apertures in the center of the rows shown accommodate alignment pins which may be provided on 12, if desired. Mounting holes shown as 60 are preferably included in the blocks and at the rear a pair of slots 62 are provided top and bottom to receive detents of plates 64 having a configuration shown in FIGS. 8 and 9. Each plate 64 includes detents at the top and bottom, shown as 66, and slots 68 along each side of a width less than that of 22 but sufficient to accommodate the leads 24 for the connector. The plates 64 are of a thickness relative to an internal rear recess 70 shown in FIG. 8 to fit fully within the rear of the blocks. Slots 68 permit termination of the leads 24 to contact elements prior to insertion within the plates. The preferred construction of contact elements 78 is shown in FIGS. 7 and 8 with contact elements fitted within apertures 72. These apertures are of a constant circular configuration along most of the length thereof for ease of manufacture, as by molding. The front end of each aperture contains a thin wall portion externally beveled as at 74 to facilitate insertion of pins 18 and on the interior defining a stop surface 76 limiting forward axial movement of the contact elements relative to the connector block. The contact elements 78 include a rear portion 80 of a wall thickness permitting such portion to be crimped inwardly, as indicated in FIGS. 7 and 8 to terminate the elements to the conductive wires or strands of a lead 24. The elements 78 have a diameter to fit snugly within apertures 72 but still permit hand insertion. Elements 78 are of a length to be fully seated within apertures 72 and to be held therein by the plates 64. The forward end of each contact element is hollowed out as at 82 to contain a resilient contact spring 84, which is preferably of a construction to provide a firm, spring contact with a pin 18 despite manufacturing and/or assembly tolerances in the parts. Springs 84 are electrically and mechanically secured in the elements 78 by an end shown as 86 folded over and swaged down over an end portion of the springs.

Contact elements 78 may be first terminated to leads 24 and then laid into the slots 68 of the plate 64 with the assembly of plate and leads and contacts worked into the apertures 72 of the connector block and seated. The foregoing approach enhances a miniaturization of connector assemblies containing multiple contacts and leads. It also enhances replacement in the event a contact fails or changes in the field are necessary. It is frequently easier to change the relative position of contact elements and leads than it is to change the associated electrical circuit which provides the selective connection of leads and thus the selective energization of lamps for display purposes. In a typical application with an eight segment display, an initial use may call only for digits with a later use calling for alphabetic characters or other symbols to be displayed. The invention structure readily permits appropriate changes. Molded-in contact elements or those which must be potted for mechanical integrity preclude such changes. As

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should now be apparent, the general approach of the invention is to form an assembly of electrical components, such as lamps, in modules which are pluggable and which are of a construction facilitating field assembly and disassembly, in conjunction with connectors which readily facilitate lead changes and/or part replacement. The module containing incandescent lamps is provided with a heat conductive but electrically insulating material for heat dissipation to improve the longevity of the components within the module. As one further point, it will be observed that the volume or mass of metal in and connected to the contact paths is relatively large. This too serves to aid in heat dissipation by conduction. From the foregoing it will be appreciated that certain aspects of the invention are fully applicable to the packaging and interconnection of the other types of electrical components and of electronic components, particularly where miniaturization is a problem and there is a source of heat from an element which must be encased in a housing. The invention thus contemplates that resistors may be packaged in modular form utilizing the invention in its several aspects and that indeed entire microelectronic circuits may be packaged in the modules in a pluggable form which is field serviceable.

The concept of a heat conductive but electrically insulating package is also contemplated as having additional and separate uses in packaging heat generating components.

Having now disclosed what I believe to be discovery and innovation, in my several preferred modes of possible practice, I define what I believe to be inventive through the appended claims.

I claim:

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1. In an assembly having multiple electrical connections and mounting components, a module of electrically insulating material having contact elements thereon, a plurality of recesses within such module which receive said components inserted therewithin, a means for mounting said components and for housing contact elements for said components, further means for locking said means for mounting to said components into said module, said means for mounting being readily removable to facilitate removal and replacement of said components, a connection attached to said module including a connector block having a plurality of apertures in a pattern aligned with said contact elements of said module, a plurality of further contact elements contained within said apertures and attachable to electrical leads for energizing said components and further means for mounting attached to the rear of said connector to lock said further contact elements within said apertures and position said leads as terminated to said elements relative to said connector, said further means for mounting being readily removable to facilitate removal and replacement of said leads.

2. The assembly of claim 1 wherein said module and said connector block each include means to facilitate removal and/or replacement of said components and of said contact elements.

3. The assembly of claim 2 wherein said means is comprised of a plate structure for said module and a plate structure for said connector block, each plate structure being of a dimension and including detents snapped into engagement with mating portions of the module and connector block, respectively.

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