July 13, 1954 E. LEMMERS 2,683,836

ELECTRIC DISCHARGE DEVICE CONSTRUCTION

Original Filed March 10, 1947

Fig. 1.

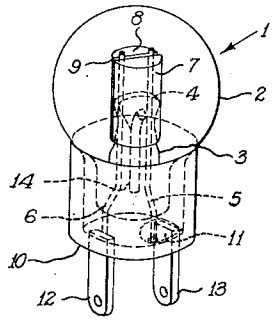


Fig. 2.

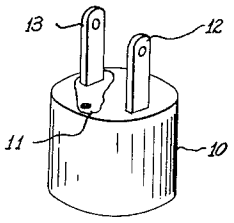


Fig. 3.

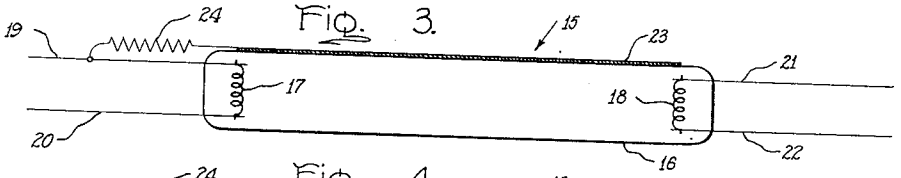


Fig. 4.

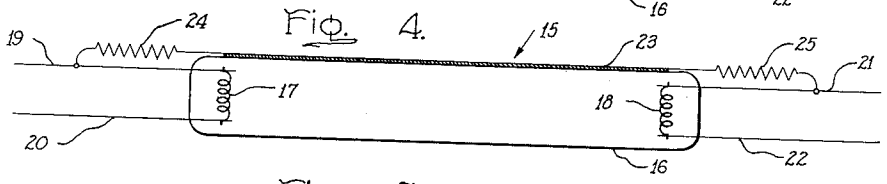


Fig. 5.

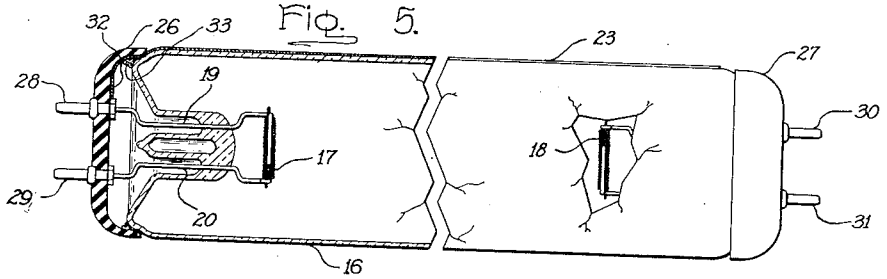


Fig. 6.

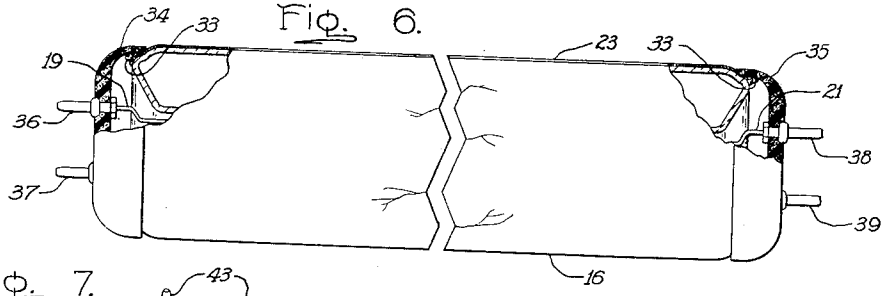
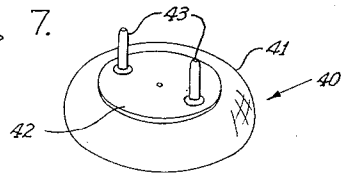


Fig. 7.



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UNITED STATES PATENT OFFICE

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ELECTRIC DISCHARGE DEVICE CONSTRUCTION

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Original application March 10, 1947, Serial No. 733,595. Divided and this application June 19, 1948, Serial No. 34,067

21 Claims. (Cl. 315—46)

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This invention relates to electric discharge devices of the type employing ionizable mediums such as gases or vapors, and more particularly to base and starting strip constructions for such devices.

This application is a division of my co-pending application Serial No. 733,595, filed March 10, 1947 (now Patent No. 2,512,280, issued June 20, 1950), which, in turn, is a continuation-in-part of my application Serial No. 671,189, filed May 21, 1946 (now abandoned).

One object of my invention relates to a unitary base and circuit-controlling element for an electric device and which comprises at least one terminal for connection to a source of power and in which an integrally formed portion in electrical contact with the terminal affords a predetermined electrical resistance.

Another object of my invention is to provide a new and improved base construction for electric discharge lamps and similar devices wherein the base, consisting of a composite substance of a predetermined resistance value, serves as a current-limiting device or as a constituent part of the electrical circuit of the electric discharge lamp or part of an associated circuit.

Another object of my invention is to provide a new and improved starting arrangement for electric discharge lamps and similar devices wherein a starting strip electrode is utilized to facilitate starting.

A further object of my invention is to provide a starting arrangement for electric discharge lamps and similar devices of the type employing an external starting strip or stripe electrode to facilitate starting, and means for minimizing shock hazards attending operation of the device.

A still further object of my invention is to provide a starting arrangement for electric discharge lamps and similar devices wherein a starting strip electrode is utilized to facilitate starting, and wherein at least one of the bases of said device functions as a current-limiting means for the starting strip.

Still another object of my invention is to provide a starting arrangement for electric discharge lamps and similar devices wherein a starting strip electrode is utilized to facilitate starting, and wherein at least one of the bases serving as a current-limiting element consists of a composite substance of a predetermined resistance value.

Further features and advantages of my invention will appear from the following detailed description of species thereof. For a better understanding of my invention reference may be had to the following description taken in connection with the accompanying drawings and its scope will be pointed out in the appended claims.

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Fig. 1 is a side elevation of a glow discharge device incorporating my invention. Fig. 2 is a perspective view of the bottom of the base of the glow discharge device shown in Fig. 1 and shows more clearly the construction features of the base incorporating my invention. Fig. 3 is a diagrammatic view of an electric discharge device and means to facilitate starting thereof incorporating my invention. Fig. 4 is a similar diagrammatic view illustrating a modification of my invention. Figs. 5 and 6 show a partially sectionalized electric discharge device and means to facilitate starting thereof incorporating arrangements of Figs. 3 and 4, respectively. Fig. 7 is a perspective view of a base for an electric discharge device illustrating a modification of my invention.

Referring to Fig. 1, I have there illustrated one embodiment of my invention as applied to an electric discharge device or glow lamp 1. The lamp 1 comprises a vitreous envelope 2 having sealed into the end thereof a stem 3, which may comprise a stem press or squeeze 4 employed to furnish a mechanical support for lead-in wires 5 and 6 and to fuse and secure these wires through stem 3. Lead-in wires 5 and 6 serve as supports for electrode structure including a pair of spaced electrodes 7 and 8, defining therebetween a gap 9. Electrodes 7 and 8 may be constructed of preformed sheet material such as nickel, having a substantial concavity into which the upper part of the stem assembly, or particularly the stem squeeze extends, thereby reducing the axial length of the electrode structure and providing mechanical features adaptable for supporting the electrodes. A unitary base structure is provided comprising a non-conductive composition including a resistive element integral therewith of predetermined value, or a predetermined conductive composition or material of a relatively high specific resistivity. In Figs. 1 and 2, a cup-shaped base 10 may embody a resistor 11 therein of a relatively low specific resistivity, for example 3500 ohms, which is electrically connected to one end of lead-in wire 5 and forms with lead-in wire 5 a conductive member of predetermined resistance for connection to an external source, and serves as a ballast for limiting the arc discharge current of glow lamp 1. Base 10 serves conjointly as an insulator for contact terminals or pins 12 and 13 and as a conductive

path by virtue of resistor 11 of predetermined resistive value for ballasting glow lamp 1.

An exhaust tube 14 as shown in Fig. 1 is provided for exhaustion and sealing of envelope 2. A suitable atmosphere, such as a gas or a vapor, is provided within the sealed envelope 2. This atmosphere, for example, may consist of argon containing 5 to 20 per cent of nitrogen at a pressure of 6 to 20 millimeters of mercury. A preferable mixture giving exceptionally good results has been found to be neon containing about 0.8 of a per cent of argon at a pressure of 35 millimeters of mercury.

Fig. 2 is a perspective view of the bottom of the base 10 of the glow discharge device shown in Fig. 1, and shows more clearly the construction features of the base incorporating my invention. As one example with respect to the construction of base 10 shown in Fig. 2, my invention may be carried out by using any suitable plastic moulding compound to which may be added an ingredient such as a powdered electrically conductive ingredient to afford to the resulting form or base a predetermined resistance. More specifically, by the addition of a suitable conductive ingredient the resulting composition or body portion is given a predetermined specific electrical resistivity, and the exact value of the resistance afforded by base construction is determined by the base configuration, thickness, length of path, etc. The range of resistances which may be used for ballasting a glow lamp in this manner and which may be obtained by practicing my invention range from about 1000 ohms to 1 megohm. These values of resistance vary with the characteristics of the lamp, the type of plastic used and the amount of conductive ingredient used therein.

In making a base having a predetermined resistance, I may employ plastic moulding compounds such as those comprising phenol-furfural resins or phenolic resins. Furthermore, I may employ a plastic moulding compound comprising a phenol-furfural and formaldehyde to which may be added a plasticizer such as dibutyl phthalate, a lubricant such as hexamethylene tetramine, an accelerator such as benzoyl peroxide, and a filler such as wood flour.

In order to modify the characteristics of the moulding compound employed in producing the base for glow lamp 1 and to produce therein a path forming a resistor 11 having a predetermined electrical conductivity commensurate with the above-described requirements, I provide a conductive ingredient in the moulding compound to produce the desired resistive characteristics thereof. For example, this conductive ingredient may be a powdered conductive material such as carbon or powdered metals. The percentage by weight of the powdered ingredient employed in moulding compounds is determined by the degree of electrical conductivity desired. In forming the base, conductive moulding compound of a relatively high specific resistivity may be inserted into the mould and an added conductive moulding compound of a relatively low specific resistivity, embodying resistive material such as powdered conductive material as mentioned hereinabove, may be added to form the conductive path 11 serving as the ballast or resistor 11 for glow lamp 1.

In Fig. 3, the discharge device 15 therein comprises an elongated tubular or cylindrical envelope 16 having sealed into the ends thereof the thermionic electrodes 17 and 18 which may be of the filamentary type, each herein illustrated

as comprising a coil, preferably in the form of a coiled coil of tungsten wire activated with the usual mixture of barium and strontium oxides. Sealed into the ends of device 15, lead-in wires 19, 20 and 21, 22 electrically connect thermionic electrodes 17 and 18, respectively. Suitable provision may be made (not shown) for connecting these lead-in wires to a source of electrical supply for heating the electrodes whereby they are brought to a glowing and emitting temperature, and for starting and maintaining the gaseous discharge between the two electrodes. The envelope 16 contains an ionizable medium. This ionizable medium may comprise a rare gas like krypton, neon, argon or mixtures thereof at a pressure of a few millimeters and a small quantity of mercury which, during operation of the lamp, has a low pressure of the order of ten microns. The device 15 may be a low pressure positive column lamp of the fluorescent type with a suitable phosphor or fluorescent coating. This fluorescent coating, upon excitation by the radiation produced by an electric discharge between the electrodes, transforms the shorter-wave radiation due to the discharge into longer-wave radiation, such as radiation within the visible range. For ease of starting, a strip electrode or stripe 23 of conductive material is applied to the surface of device 15.

In some of the prior art arrangements it has been the practice to allow the starting strip to "float," that is, the starting strip is projected along the length of the discharge devices and in close proximity to the ends thereof. Resulting lamp breakdown voltages were around the values of 220 volts for a 40 watt fluorescent lamp embodying heated thermionic electrodes. By connecting one end of the starting strip directly to one heated thermionic electrode of the discharge device a breakdown voltage around the value of 165 volts is obtained. Reduction in breakdown voltages are also obtained with lamps of varying sizes by a similar connection. This added advantage was not practical, however, due to the shock hazard present during lamp operation.

In accordance with one aspect of my invention, I provide means for connecting the starting strip electrode to one or more of the main electrodes in order to reduce the starting voltage required to initiate an arc discharge between the main electrodes. In addition, I provide arrangements and connections by virtue of which the above-described low-starting voltage is obtained and which also affords a highly desirable feature of reducing or completely eliminating personnel shock hazard incident to the presence of the starting strip electrode 23 on the exterior surface of the envelope.

Generally speaking, I effect the desired connection between the starting strip 23 and one of the electrodes by the use of means affording a predetermined resistance of relatively high value.

For example, in accordance with one aspect of my invention I may employ separate or individual impedance means 24, such as resistances, inductors, or capacitances having relatively large predetermined values of the order of megohms. I have found that for application of the 40 watt size fluorescent lamps resistive values ranging from one to ten megohms, and preferably from 2 to 8 megohms, are satisfactory for the stated purposes of reducing starting voltages and at the same time serving as current-limiting means to reduce personnel shock hazard.

It is possible that the heating of one of the

electrodes may be dispensed with. In that event, it is feasible to dispense with the supplying of heating current to electrode 17, i. e., the electrode connected through impedance 24, to the starting strip 23.

Fig. 4 incorporates the same above-described corresponding parts of Fig. 3 with the addition of an impedance 25, which, as in Fig. 3, may be a resistance, inductance, or capacitance having a relatively large predetermined ohmic value of the order of megohms, and connected to the starting strip 23 in such a manner as to form a series connection between thermionic electrode 18 and the starting strip 23. Thus, a voltage divider is provided across the thermionic electrodes 17 and 18 and includes the starting strip 23 as one element thereof. By utilizing two resistors 24 and 25, it is possible, by selecting the proper resistance ratio between the two resistors, to vary the breakdown voltage between given limits. This reduction in breakdown or starting voltage is particularly evident where this arrangement is used with lamps employing cathode heating or cathode preheating by means of separate cathode heating circuits or auxiliary means. For example, a 40 watt fluorescent lamp with the resistors 24 and 25 both 5 megohms in value, the breakdown voltage of the ionizable medium would be 240 volts; if the megohm resistance ratio was 5 to 2 the breakdown voltage would be 170 volts; and if the megohm ratio was 5 to 1 the breakdown voltage would be 150 volts. Thus, a means is available to either aid or resist the breakdown of the discharge device.

Fig. 5 incorporates the same above-described corresponding parts of Fig. 3 except the resistor 24 is replaced by a cup-shaped base 26 which functions as the current-limiting or impedance means and a base 27 of the type commonly used in the discharge lamp industry. Contact terminals or pins 28, 29 and 30, 31 are connected to the associated lead-in wires. Base 26 may be one of the plastic type presently used in the discharge lamp industry with an associated high resistance conductive path in the form of a layer 32 of conductive material applied to the inner side of the base and forming an electrical connection between the starting strip 23 and the associated electrode 17. Aquadag, India ink, or some similar conductive material may be painted or sprayed on the entire inner surface of the plastic base to form the conductive path of a predetermined resistive value. Thus, by extending the starting strip 23 to the base line of the discharge device on that end of the envelope 16 to which the resistive coated base is to be applied, electrical contact may be made between the resistive coated base and the starting strip 23. To prevent any possibility of a basing cement 33 breaking this electrical connection, it becomes practical to substitute a given per cent of carbon for the usual filler in the basing cement formula. One example of a conductive basing cement incorporating these characteristics is a mixture containing 15 to 17 per cent of a resin consisting of one part of a commercial plastic moulding compound, 4 parts rosin, and 6½ parts shellac, and 33 to 85 per cent marble flour filler of which 8 to 20 per cent of the filler would be graphite flakes. The layer 32 of conductive material applied to the inner side of the base may be in the form of a thin, narrow conductive path sprayed or painted on the base to form a conductor integral therewith of given dimensions and predetermined resistivity.

Fig. 6 incorporates the above-described corresponding parts of Fig. 4 except resistors 24 and 25 are replaced by cup-shaped bases 34 and 35 which function as the current-limiting or impedance means and also comprise elements of a voltage divider. Bases 34 and 35 are formed with a pair of contact terminals or pins 36, 37 and 38, 39 respectively, to which the lead-in wires 19, 20 and 21, 22 are respectively connected. The base structure consists of a composition metallic or otherwise having a relatively high specific resistivity, thus providing a high resistance conductive path between the starting strip 23 and the associated electrode 17 or 18. In this manner the bases serve conjointly as an insulator for the contact terminals or pins and as conductive paths of predetermined resistive value for connection to the starting strip 23.

As one example, with respect to the construction of bases 34 and 35, my invention may be carried out, as hereinbefore mentioned, by using any suitable plastic moulding compound to which may be added in ingredient such as a powdered electrically conductive ingredient to afford to the resulting or formed bases a predetermined resistance. More specifically, by the addition of a suitable conductive ingredient, the resulting composition is given a predetermined specific electrical resistivity. This conductive ingredient may be a powdered conductive material such as carbon, or powdered metals. The percentage by weight of the powdered ingredient employed in moulding compound is determined by the degree of electrical conductivity desired. I have found that in order to obtain the above-described ohmic values for the conductive path that from 1 to 10 per cent by weight of carbon may be used to produce electrical resistivities of the proper magnitudes.

Fig. 7 is a perspective view of a base 40 for an electric discharge device illustrating a modification of my invention. I have there shown a unitary base having a shape of the type commonly used in the fluorescent lamp industry except the cup-shaped base comprises a metallic shell 41 embodying a flat plastic body portion or disc 42 of a predetermined electrical resistance moulded or formed integral therewith. Disc 42 supports a pair of contact pins or terminals 43 and serves conjointly as an insulator therefor and as a conductive path of predetermined resistive value for connection through shell 41 to a starting strip or stripe on a fluorescent lamp such as that shown in Figs. 5 and 6. Shell 41, for example, may be an aluminum alloy or brass coated steel.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination, an electric discharge device of the type employing an ionizable medium and including a plurality of electrodes at least one of which is of the thermionic type and including an enclosing envelope, starting means comprising a strip extending between said electrodes and terminated in the vicinities thereof, and a base for said envelope comprising a cup-shaped member enclosing an end of said envelope and composed, at least in part, of an insulating moulded plastic material modified by dispersion therein of a conductive ingredient and having a relatively high predetermined ohmic resistance for connecting said strip to said electrode.

2. In an electric discharge lamp of the fluorescent type, the combination comprising a plurality of thermionic electrodes, an enclosing envelope having a fluorescent material on the interior surface, an ionizable medium contained within said

envelope, a metallic conducting strip extending axially between said electrodes and terminating within the vicinities thereof, and a base structure for each of said electrodes comprising a cup-shaped member enclosing an end of said envelope and constituted of a moulded resinous composition having dispersed therein a conductive ingredient so as to have a relatively high specific resistivity providing a high resistance conductive path between said strip and the associated electrode.

3. In combination, an electric discharge device of the type employing an ionizable medium and comprising a plurality of electrodes at least one of which is of the thermionic type and an enclosing envelope, a starting strip on the surface of said envelope extending between said electrodes, and a plurality of bases for said envelope associatel with the respective electrodes at least one of which comprises a cup-shaped member which encloses an end of said envelope and is constituted of a plastic moulded material having dispersed therein a conductive ingredient so as to have a predetermined resistivity to prevent appreciable leakage between terminals connected to the associated electrode and which provides an electrical connection to said strip.

4. In an electric discharge lamp of the fluorescent type, the combination comprising an enclosing envelope having a fluorescent material on the interior surface thereof, a pair of spaced filamentary electrodes, a starting strip on the exterior surface of said envelope, and a pair of bases for supporting terminals connected to the associated electrode, at least one of said bases comprising a cup-shaped member enclosing an end of said envelope and composed, at least in part, of plastic moulded composition having dispersed therein a conductive ingredient so as to have a relatively high specific resistivity which enables it to serve conjointly as an insulator for said terminals and as a high resistance conductive path for connection to said strip.

5. In an electric discharge device of the type employing an ionizable medium, the combination comprising an enclosing envelope, a pair of thermionic electrodes positioned therein, a conductive strip on the exterior surface of said envelope terminating within the vicinities of said electrodes, and a pair of base structures associated with the respective electrodes at extremities of said envelope and each comprising a cup-shaped member enclosing an end of said envelope and constructed of plastic moulded compositions having dispersed therein a conductive ingredient so as to have relatively high specific resistivities of different values for constituting in conjunction with said strip a voltage divider connected across the electrodes of said device.

6. In combination, an electric discharge device of the type employing an ionizable medium and including a plurality of electrodes at least one of which is of the thermionic type, starting means comprising a strip extending between said electrodes and terminated in the vicinities thereof, a base for said envelope comprising a cup-shaped member enclosing an end of said envelope and composed of plastic moulded material having dispersed therein a conductive ingredient so as to have a relatively high predetermined ohmic resistance for connecting said strip to said electrode, and a conductive sealing cement or compound for securing said base to said envelope.

7. In an electric discharge lamp of the fluorescent type, the combination comprising a plurality of thermionic electrodes, an enclosing envelope having a fluorescent material on the interior surface, an ionizable medium contained within said envelope, a metallic conductive strip extending axially between said electrodes and terminating within the vicinities thereof, a base structure for each of said electrodes comprising a cup-shaped member enclosing an end of said envelope and constituted of a plastic moulded composition having dispersed therein a conductive ingredient so as to have a relatively high specific resistivity providing a high resistance conductive path between said strip and the associated electrode, and a conductive sealing cement or compound for securing said base structure to said envelope.

8. In an electric discharge device of the glow lamp type, the combination comprising a plurality of electrodes, an enclosing envelope, an ionizable medium contained within said envelope, and a base structure for supporting terminals connected to associated electrodes and comprising a cup-shaped member enclosing an end of said envelope and composed of insulating organic plastic material having a relatively high specific resistivity and having a portion thereof modified by added conductive material dispersed therein and providing a relatively low resistance conductive path between one of said electrodes and the associated terminal and serving as a ballast resistance.

9. In an electric discharge device of the glow lamp type, the combination comprising a plurality of electrodes, an enclosing envelope, an ionizable medium contained within said envelope, and a base structure for supporting terminals connected to associated electrodes and including a cup-shaped member enclosing an end of said envelope and composed, at least in part, of an insulating organic plastic material modified by added conductive material dispersed therein and providing a relatively low resistance conductive path between one of said electrodes and the associated terminal and serving as a ballast resistance.

10. A unitary base and circuit-controlling structure for an electric device and comprising a hollow cup-shaped member shaped to enclose an end portion of said electric device and carrying at least one terminal for connection to a source of power and including an integral conductive disc of insulating organic plastic material modified by added conductive material dispersed therein so as to have a predetermined electrical resistance and in electrical contact with said terminal.

11. A unitary base and circuit-controlling structure for an electric device and comprising at least one terminal for connection to a source of power, said base comprising a metallic shell embodying a molded disc integral therewith and which is in electrical contact with said terminal and composed of insulating organic plastic material modified by added conductive material dispersed therein and having an electrical resistance lying within the range from about one to ten megohms.

12. A unitary base and circuit-controlling structure for electrical devices comprising a hollow cup-shaped member shaped to enclose an end portion of said electrical device and carrying at least one contact terminal for connection to a source of power, at least a part of said cup-shaped member being composed of an insulating organic plastic material having at least a portion thereof modified by added conductive material dispersed therein so as to have a predetermined substan-

tial electrical resistance and in electrical contact with said terminal.

13. A unitary base and circuit-controlling structure for electrical devices comprising a hollow cup-shaped member shaped to enclose an end portion of said electrical device and carrying at least one contact terminal for connection to a source of power, said cup-shaped member being composed of an insulating organic plastic material having at least a portion thereof modified by added conductive material dispersed therein so as to have a predetermined substantial electrical resistance and in electrical contact with said terminal.

14. A unitary base and circuit-controlling structure for electrical devices comprising a hollow cup-shaped member shaped to enclose an end portion of said electrical device and carrying at least one contact terminal for connection to a source of power, at least a part of said cup-shaped member being composed of an insulating organic plastic material modified by added conductive material dispersed therein so as to have a predetermined substantial electrical resistance and in electrical contact with said terminal.

15. A unitary base and circuit-controlling structure for electrical devices comprising a hollow cup-shaped member shaped to enclose an end portion of said electrical device and carrying at least one contact terminal for connection to a source of power, said cup-shaped member being composed of an insulating organic plastic material modified by added conductive material dispersed therein so as to have a predetermined substantial electrical resistance and in electrical contact with said terminal.

16. A unitary base and circuit-controlling structure for electrical devices comprising a hollow cup-shaped member shaped to enclose an end portion of said electrical device and carrying at least one contact terminal for connection to a source of power, at least a part of said cup-shaped member being composed of an insulating organic plastic material having at least a portion thereof modified by added conductive material dispersed therein so as to have a predetermined substantial electrical resistance within the range from about one to ten megohms and in electrical contact with said terminal.

17. A unitary base and circuit-controlling structure for electrical devices comprising a hollow cup-shaped member shaped to enclose an end portion of said electrical device and carrying at least one contact terminal for connection to a source of power, at least a part of said cup-shaped member being composed of an insulating organic plastic resin having at least a portion thereof modified by added conductive material dispersed therein so as to have a predetermined substantial electrical resistance and in electrical contact with said terminal.

18. A unitary base and circuit-controlling structure for electrical devices comprising a hollow cup-shaped member shaped to enclose an end portion of said electrical device and carrying at least one contact terminal for connection to a source of power, at least a part of said cup-shaped member being composed of an insulating organic

plastic resin and filler and having at least a portion thereof modified by added conductive material dispersed therein so as to have a predetermined substantial electrical resistance and in electrical contact with said terminal.

19. A unitary base and circuit-controlling structure for electrical devices comprising a hollow cup-shaped member shaped to enclose an end portion of said electrical device and carrying at least one contact terminal for connection to a source of power, at least a part of said cup-shaped member being composed of an insulating organic plastic material comprising a phenol-furfural resin and having at least a portion thereof modified by about 3 to 10 percent by weight of carbon dispersed therein so as to have a predetermined substantial electrical resistance and in electrical contact with said terminal.

20. A unitary base and circuit-controlling structure for electrical devices comprising a hollow cup-shaped member shaped to enclose an end portion of said electrical device and carrying at least one contact terminal for connection to a source of power, at least a part of said cup-shaped member being composed of an insulating organic plastic material comprising a phenolic resin and having at least a portion thereof modified by about 3 to 10 per cent by weight of carbon dispersed therein so as to have a predetermined substantial electrical resistance and in electrical contact with said terminal.

21. An electric discharge device comprising a sealed envelope provided with a plurality of electrodes, and a unitary base structure comprising a hollow cup-shaped member enclosing an end of said envelope and carrying at least one contact terminal, at least a part of said cup-shaped member being composed of an insulating organic plastic material having at least a portion thereof modified by added conductive material dispersed therein so as to have a predetermined substantial electrical resistance, said contact terminal being electrically connected to one of said electrodes through said modified portion of the cup-shaped member.

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