METHOD FOR MANUFACTURING MOLDED CONNECTOR PLUGS

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The present invention relates to molded wiring devices such as connectors, and more particularly to a method for manufacturing electrical connector plugs.

The present application is a division of my application Serial No. 265, filed January 4, 1960, and assigned to the same assignee as the instant application.

Prior art wiring devices, such as electrical connector plugs, have been economically and expeditiously manufactured by molding a single insulating body around the connections formed between terminal portions of the contact blade members and the bared conductor ends, and the area adjacent thereto. The body is made of a molded insulating material like rubber or some other suitable thermoplastic or thermosetting material, such as for example, one of the vinyl molding compounds. The physical and electrical proportions and characteristics of such an insulating body vary widely in accordance with the application for which it is designed. Such body should invariably, however, have good insulating qualities, be physically strong, and have a neat and compact overall appearance.

In molded cordset plugs of the prior art, standard multiple wire conductor has been widely used. This type of conductor, as is well known in the art, is rugged and durable, due to the improved flexibility of the stranded conductor wires, and it therefore conveniently lends itself to numerous applications. When the bared end of a stranded conductor has been attached to the terminal portion of a plug contact blade, a problem sometimes occurs when the insulating body is molded about the terminal connections and the adjacent terminal and conductor portions to form the finished plug. More particularly, the high pressure which evolve during the molding operation sometimes cause the exposure of one or more strands of the conductor on the surface of the molded plug or result in their being in dangerous proximity thereto. These strands may be forced to the surface or dangerously near to the surface during the molding process and some of them may be electrically energized when the plug is placed in service. In addition, the high molding pressures may also cause the loose strands of one stranded conductor to be forced laterally toward the loose strands of another conductor, or toward the terminal portion of the contact blade of this other conductor. Such disarrangement of strands may, of course, cause the possibility of short circuiting within the plug body. There are numerous precautionary steps that may be taken during the manufacture of a molded electrical plug to eliminate the loose strand problem, such as using inserts which serve as separators and containers for each connection and its associated bare conductor end. However, no approach has been utilized, heretofore, which lends itself to the economical manufacture of a molded plug, while at the same time enhancing its physical strength and overall appearance.

Accordingly, it is a general object of this invention to provide an improved method for manufacturing a molded wiring device.

A further object of my invention is to provide an improved method for making a molded electrical connector plug which has very good insulating characteristics, is physically strong, and has a neat and compact over-all appearance.

A still further object of my invention is to provide an expedient method for manufacturing a wiring device by using a two-step molding process.

In carrying out the present invention, I have provided an improved method for making an electrical connector plug of the type having a plurality of spaced contact blades. In one form of the plug, each of these contact blades has a contact portion and a terminal portion, and a conductor is mechanically and electrically connected to the terminal portion of each of the blades to form a plurality of spaced connections. For manufacturing the connector plug in accordance with the present invention, I have first premolded an inner insulating body around the spaced connections and portions of the conductors and blades which are contiguous thereto. A subsequent molding operation is then utilized to provide an outer insulating body which surrounds the inner body and additionally insulates the connections to form an improved connector plug. By using a two-step or double-shot molding process for manufacturing the connector plug, the contact blades may be very rigidly supported within the plug housing. Furthermore, since two molding operations are substituted for one, each of these molding operations may therefore be conducted more rapidly than the one large molding operation which has been heretofore followed. Also, by using two separate molded insulating bodies, a very sturdy plug structure is obtained and any loose conductor strands or disarranged conductor is prevented from coming too close to the outer surface of the plug or tending to short circuit within the plug. In addition, such a plug structure facilitates flexibility in the selection of molding materials. As an example of this flexibility, a relatively inexpensive molding material may be used for the inner body and a more expensive and attractive colored molding material might be used for the outer body.

Further aspects of my invention will become apparent hereinafter, and the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which I regard as my invention. The invention, however, as to organization and method of utilization, together with further objects and advantages thereof, may best be understood by reference to the following description when taken in conjunction with the accompanying drawing in which:

FIG. 1 is an elevational view of a pair of contact blades with the bared conductor ends of a two-conductor rip cord attached thereto;

FIG. 2 is an elevational view of the contact blades and bared conductor ends of FIG. 1 after a premolded inner body of molded insulating material has been formed around portions thereof, in accordance with my invention;

FIG. 3 is an elevational view, partially in section and partially broken away to show the external and internal construction of an improved connector plug which may be manufactured in accordance with the present invention;

FIG. 4 is an elevational view, partially in section, showing the relationship between the inner and outer insulating bodies;

FIG. 5 is a perspective view of the improved electrical connector plug made in accordance with my invention;
FIG. 6 is an elevational view, partially in section of an improved angle plug which may be manufactured in accordance with the invention; FIG. 7 is a bottom view of the angle plug of FIG. 6, partially in section; and FIG. 8 is a perspective view of the improved angle plug of FIG. 6.

Referring now to FIG. 1 of the drawing, there is illustrated an improved plug contact blades 1. Each of these contact blades 1 is of one-piece spring strip construction and includes a flat metal strip which is folded upon itself at the outer end to provide a spring acting outer contact portion 3 and a relatively fixed terminal portion 5. (See also FIG. 2.) The outer contact portion 3 of each blade has a pair of aligned holes 7 for engaging the usual projections of a mating female receptacle. Terminal portion 5 of each contact blade 1 includes an integral means such as tab extensions formed thereon, for securing the bared end of a conductor thereto. As shown in FIG. 1, I have chosen conductors 10 to illustrate this aspect of my invention, and these conductors are part of a two-conductor rip cord 11. Each conductor 10 includes a number of stranded wires 12 which are surrounded by the tab extensions of the contact blades 1 to physically and electrically attach them thereto at connections 6 in the well-known manner. A review of my invention in examining FIGS. 2-4, it will be noted that a single molded insulating body 13 is formed around connections 6 as is the conventional custom. In making the illustrated connector plug, I have formed an intermediate or inner body 13 around these connections, before forming my final plug 15 therefrom. (See FIGS. 3 and 4.) Body 13 individually surrounds each connection 6 and its associated bared conductor end with molded insulating material. Aperture 16 is also formed in the inner body between each connection. (See FIG. 2.) This aperture may be of any suitable configuration, such as a mating hole or a slot, but for purposes of illustrating my invention, the configuration of the aperture is in the form of an isoceles triangle. Base 17 of this triangular aperture is spaced slightly from and generally parallel to front wall 19 of body 13, as shown in FIG. 2. This leaves strengthening rib 20 extending parallel to and adjacent to outer wall 19. The apex 18 of aperture 16 is adjacent to and disposed between the ends of the integral insulation of each conductor. Triangular aperture 16 thus physically separates connections 6 and their associated bared conductor ends. It will also be noted that I have formed a recess 21 on the outer face of front wall 19. The purpose of this recess shall hereinafter become apparent. Body 13 may consist of a relatively hard plastic material which is of low cost, such as polystyrene. Of course, any other suitable molding material could be also used, such as, for example, polyvinyl chloride. The type or color of insulating material which is used in this premolded body 13 may vary widely depending upon the application for which the connector plug 15 is to be used.

For parting conductors 9 of the rip cord 11 in the direction of their respective attached contact blades 1, I have molded angular surfaces 23 into body 13. These angular surfaces 23 are disposed so as to provide an accurate angle from outwardly projecting edge 24, for securely and rigidly supporting the parted conductors of the rip cord within molded body 15.

Body 13 may be formed by a suitable premolding operation as injection molding. Any loose strands of bared conductor 10 which are forced to the surface of inner body 13 during the premolding operation would of necessity be adjacent to or contiguos with the outer surface of body 13. To illustrate this, in FIG. 2, loose conductor strands a and b have been indicated in the vicinity of the outer surface of inner body 13. The premolding operation contains such loose strands as these within the limits of the premolded body 13. Any laterally extending loose conductor strands, such as indicated by c and d of FIG. 2, which might otherwise be forced together and touch or short out within the plug, are also physically separated by aspects of my invention. Aperture 16, therefore, performs an important function in the plug, by eliminating the possibility of short circuiting therein.

After premolded body 13 has been formed around connections 6 and their associated bared conductor ends, my invention includes the benefit of providing a subsequent or final molding operation. A suitable molding operation may again be used, such as injection molding. After the premolded body 13 has been formed, to provide a further insulating support for the connections and their adjacent portions of associated blades and conductors 10, then form molded outer insulating body 25 around body 13. This outer molded body 25 is of one-piece construction and provides additional insulation for my premolded assembly while at the same time enhancing the flexibility of the process for manufacturing a connector plug. Body 25 may be of polyvinyl chloride material, polystyrene, or any other suitable plastic material. In addition, this outer insulating body 25 may be either a soft, supple material, thereby providing a surface which is readily grippeable and pleasant to the touch, or it may be a hard and brittle type of plastic material, thus facilitating a convenient plug structure. For my invention, the outer molded body 25 consist of a colored plastic substance which provides an attractive appearance to the eye. A luminous substance could also be used for this outer body.

Body 25 surrounds the inner body 13 and is interlocked therewith. More particularly, bridge portion 27 of outer body 25 extends transversely through aperture 16 of the premolded body 13 to provide a secure interlocking relationship between the mated insulating bodies. Rib or bump 29 of the outer body extends inwardly to engage shallow recess 21 of the inner body 13, and thus provides an additional interlocking relationship between the two. The interlocking or interdigitating cooperation between the two molded insulating bodies 13 and 25 thus provides a sturdy integrated housing for the connector plug.

It will be apparent that the formation of a subsequent or outer molded insulating body 25 around the premolded body 13 eliminates any possibility of electrically energized loose conductor strands being present in the area adjacent the outer surface of my improved electrical connector plug. Any loosened conductor strands or disarranged conductors are effectively contained by the formation of the molded outer body 25 effect which insulates them. In addition, by forming the aperture 16 in the premolded body 13 between connections 6 and their associated bared conductor ends, and then finally molding body 25 with bridge 27 extending through aperture 16, a physical wall of insulating material is formed, to eliminate any possibility of short circuiting within the plug.

By forming my improved electrical connector plug 15 by a two-step or double-shot molding operation, numerous significant advantages have thus been achieved. A relatively low cost insulating material, such as polystyrene, may be used for the premolded body, since this body is covered by the finally molded body 25. In addition, any combination of relatively soft and relatively hard molding compounds, or relatively expensive and relatively inexpensive molding compounds may be utilized for the respective premolded and subsequently molded bodies 13 and 25. If the application calls for it, for instance, a very thin layer of more expensive colored insulating material may be used for the outer insulating body 25, thus economizing on the over-all cost of plug insulating material. It will also be understood that the two-step molding process lends itself to the production of more rigidly held contact blades. In addition, body 13. The interlocking or interdigitating cooperation operations are involved makes each individual molding step easier than the use of one molding operation, as prescribed by the prior art. For instance, in using a machine which
3,141,054 5 is designed to carry the contacts from a loading station to a first molding station, then to a second molding station, and then to an ejection station, it is possible to obtain a very high output per hour. The reason for this high output is because the first and second individual molding steps are now easier and quicker than the single large molding step which was formerly used.

Figure 6 illustrates an angle-type plug 30 which may also be manufactured by my double-shot molding process. Plug 30 has two contact blades 32 which are functionally similar to blades 1 of plug 15. (See FIG. 8.) As best seen in FIG. 7, blades 32 are crimped to the bare ends 34 of the outermost conductors 36 of a three-conductor ribbon cord 40, to form connections 38. The conductors of the ribbon cord 40 are, of course, disposed perpendicularly with respect to blades 32, to provide the angular plug configuration. Interposed between conductors 36 is a central grounding conductor 42, which is connected to a cylindrical hollow grounding contact 44 at connection 46, by crimping the hollow contact thereto. (See FIG. 6.) This grounding contact could also, of course, be solid in construction and may also be soldered or welded to the grounding conductor. To incorporate the same salient advantages in angle plug 30 as have been achieved in my aforementioned plug 15, two molded insulating bodies have been formed, with connections of said stranded conductors in housing having improved insulating qualities. More particularly, premolded inner body 48 is first molded around connections 38 and 46 and the area adjacent thereto. (See FIG. 7.) Body 48 thus contains any loose strands or disarranged conductors within itself. Slot 50 is formed in inner body 48 between connections 38. As best seen in FIG. 7, the length of this slot also provides a gap between each bare conductor 34 and the bare end of conductor 42. Slot 50 thus serves to provide the advantages of preventing any short circuiting between the strands or disarranged portions of the adjacent bare conductors ends and of also providing an interlocking relationship between body 48 and outer insulating body 52.

After inner body 48 has been premolded around the connections and bare conductors of the angle plug, outer insulating body 52 is molded around body 48. Outer body 52 surrounds inner body 48 and is interlocked therewith by cooperation with slot 50 to efficiently eliminate the problem of the emergence of electrically energized loose strands in the area adjacent the surface of the molded insulating body. In addition, by means of slot 50 of premolded body 48, plug 30 also provides protection against short circuits between the associated strand conductors. Accordingly, all of the aforementioned functional advantages of connector plug 15 have thus been efficiently incorporated in angular connector plug 30.

While I have illustrated the molded outer body as completely encompassing the molded inner body, it will be apparent in some instances that a molded outer body may be formed which only partially, i.e., substantially but not completely, surrounds the inner body and at the same time provides all of the beneficial aspects of my invention. For example, in the molded angle plug, the face of the inner body through which the contacts extend could be left uncovered by insulating material of the outer body. It will therefore be seen that my new and improved method for manufacturing a wiring device, as herein illustrated for an electrical connector plug, provides an efficient and advantageous means for economically eliminating the problem of the emergence of electrically energized loose strands or bare conductors in the area adjacent the surface of a molded insulating body. In addition, my invention affords reliable protection against short circuiting within the plug. This construction may be efficiently utilized for obtaining very rigidly held plug blades. Furthermore, over-all flexibility in the selection of finished molding materials is clearly afforded by use of the two-shot molding process.

While in accordance with the patent statutes I have described what at present is considered to be the preferred embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from my invention, and I, therefore, aim in the following claims to cover all such equivalent variations as fall within the true spirit and scope of this invention.

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

1. A method for manufacturing a wiring device having a plurality of contacts connected to a plurality of associated stranded conductors, said method comprising the steps of premolding a first insulating body around and directly onto the bare connections between said contacts and said stranded conductors and portions of said conductors and contacts contiguous to said connections, and subsequently molding a second insulating body around said first insulating body to further insulate said connections and form a strong wiring device.

2. A method for manufacturing a connector comprising, forming separate bare connections between a plurality of spaced contacts and a plurality of associated stranded conductors, premolding by injection a first insulating body around and directly onto said bare connections and portions of conductors and contacts contiguous to said connections, and subsequently molding by injection a second insulating body around said first insulating body thereby to further insulate said connections and form a strong connector.

3. A method for manufacturing a molded electrical connector plug having a plurality of spaced blade members mechanically and electrically connected to a plurality of associated stranded conductors, said method comprising the steps of attaching a separate stranded conductor end to the terminal portion of each of said blade members to form bare connections therebetween, premolding a first insulating body around and directly onto said bare connections and adjacent portions of said members and conductors with a space formed in said first body between said connections, and subsequently molding a second insulating body around said first insulating body so that said second body extends therefrom to further insulate and protect said first molded body to further insulate said conductors both from each other and from the plug surface and to thereby form a strong plug.

4. A method for manufacturing a molded electrical connector plug having a pair of spaced blade members connected to a pair of associated stranded conductors, said method comprising the steps of attaching a stranded conductor end to the terminal portion of each of said blade members to form bare connections therebetween, premolding a first insulating body around and directly onto said bare connections and adjacent portions of said members and conductors with a space formed in said first body between said connections, said aperture being in the configuration of an isosceles triangle, and subsequently molding a second insulating body around said first insulating body so that said second body extends through said aperture of said first molded body to further insulate said conductors both from each other and from the plug surface and to thereby form a strong plug.

5. A method for manufacturing a wiring device comprising, forming separate bare connections between a plurality of spaced apart contacts and a plurality of associated stranded conductors, premolding a first insulating body around and directly onto said bare connections and portions of said stranded conductors and contacts contiguous to said connections so that each of said connections is embedded in said first insulating body, and subsequently molding a second insulating body around said first insulating body thereby to further insulate said connections and form a strong wiring device.

6. The method of claim 2 wherein said first insulating body is formed so that said contacts extend through one
face thereof, and said second body is formed around said first body so that it overlies at least all of the other exterior surfaces of said first body.

7. The method of claim 3 wherein said first insulating body is formed so that said blade members extend through one face thereof, and said second insulating body is formed around said first body so that it overlies at least all of the other exterior surfaces of said first body.

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