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3,430,188
**ELECTRICAL CONNECTOR WITH A
LOCKING WEDGE**

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4 Claims

ABSTRACT OF THE DISCLOSURE

An electrical connector for fastening in a mounting opening provided in a supporting structure, the connector comprising a main body portion having an integral, flexible arm portion provided on at least one side thereof and extending in a direction substantially parallel to the plane of the side. The connector further includes a wedge means for locking the main body portion in place in the mounting opening. The wedge is dimensioned to seat in the space formed by the side of the main body and flexible arm portions and may be of a contrasting color with the main body portion of the connector for identifying the connector's position in a mating receptacle.

A method of making an electrical connector using a thermoplastic material. The method comprises the steps of molding a sleeve and base plate about a terminal pin and connecting lead assembly to form a center piece having a plurality of semicircular sections in the edges of the base plate. A lead wire, connected to a terminal pin, is next disposed in each of the semicircular sections so that a plurality of outer leads are formed about the lead in the base plate. The center piece with the leads and pins is then disposed in a final mold or die. A thermoplastic material is injected into the mold, and the flow of material into the mold is shutoff about the outer leads.

Background of the invention

The present invention relates generally to an electrical plug fastener construction, and particularly to an improved plug fastening arrangement for a multispeed motor such as shown in U.S. Patent 3,210,578 issued to G. H. Sherer on Oct. 5, 1965 and assigned to the present assignee, though the invention is not limited thereto. The invention further includes a method of making the improved plug.

In U.S. Patent 3,193,226 issued to A. B. Showalter on July 6, 1965, there is shown a one piece phenolic speed selector plug and a method of inserting the plug into mounting opening provided in a motor end bell. This type of plug has several disadvantages. First of all, the phenolic material is brittle and thus subject to breakage. This is particularly troublesome in the assembly process of the plug and motor where breakage can run as high as 75%.

The breakage problem is further attributable to stresses set up in the plug material during assembly and disassembly. Since the plug is a one-piece structure, the material has to be relatively rigid to remain intact when bumped, but it must also deform slightly during assembly when it is forced into the mounting opening. When a rigid material is forced to give or deform even a modest amount, the induced stress therein increases to a point approximating the elastic limit of the material and frequently exceeds it with resulting breakage.

Another disadvantage with a one piece plug is the close tolerances required for both the plug and the mounting opening in order to obtain an adequate snug fit. This requirement is inherent with a one-piece structure.

A further disadvantage with the phenolic plug is the slower and more costly compression molding method of

making the plug as compared to the injection molding process. Also, the tools required for molding a thermosetting (phenolic) material are significantly more expensive than those needed for other molding processes.

Previously, a plug part of this type would have been very difficult and expensive, if not impossible, to mold by the injection process. The main reason for this is the difficulty of shutting off the mold around the leads, and particularly the center lead which is all but inaccessible because of the closely disposed, surrounding outer leads.

Brief summary of the invention

Briefly, the present invention includes a two piece, multi-speed motor connector or plug capable of being injection molded and capable of being inserted in a mounting opening without undue stress imposed upon the plug. The plug comprises a main body portion having integral shoulder portions, an integral parallel extending arm or leg portion on at least one side thereof, and a separate wedge piece for disposition between the arm portion and the side of the main body portion. The arm portion is attached to the main body portion adjacent the motor end thereof to form a generally U-shaped gap or slot. When the plug is disposed in the mounting opening, the open end of the gap faces outwardly from the motor housing and is accessible for insertion of the wedge piece which spreads the arm and main body portion against the sides of the opening to lock the plug in place. Very little force and a minimum of stress is needed to mount the plug since the arm portion is flexible.

The material of the plug is chosen from a thermoplastic material group capable of being injection molded. Thermoplastic materials are more resilient than thermosetting materials, and the injection molding process is significantly less costly than the compression process required for the plug of the Showalter patent.

The invention includes further a method of making the novel plug in which the thermoplastic material is first injection molded around the center pin and lead assembly to form a center piece comprising a plastic sleeve and base plate fixed about the pin and leads. The center piece is then positioned in a final mold cavity or die with the outside leads and pins (usually four). The remainder of the plug is then formed by a second injection molding step. During this molding period, the plastic material is prevented from escaping from the die by pressing the sides of the die against the base plate of the center piece and the outside leads.

By molding the novel plug in two operations as briefly described above, the shutting off problem around the substantially inaccessible center lead is avoided. Further, with the novel plug made in two operations as disclosed herein, there is no chance of an electrical short between the center and outside pins.

The drawings

The objects and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawing, in which:

FIGURE 1 is a perspective view of a male connector plug constructed in accordance with the principles of the invention with a wedge means shown separated from the main body portion of the plug;

FIG. 2 is an elevation view of a molded center piece of the plug shown in FIG. 1;

FIG. 3 is a top view of the center piece of FIG. 2; and
FIG. 4 is an elevation view of the center piece of FIG. 2 disposed in a mold.

Preferred embodiment

Specifically, there is shown in FIG. 1 a male connector 10 having generally a rectangularly shaped main body portion 12 and an integral, flexible arm portion 14

attached to one side of the main body by an angular extending projection 16. The arm 14 with the projection 16 and the associated side of the main body 12 form generally a U-shaped and outwardly (upwardly) facing slot or opening 18.

The main body portion 12 of the connector 10 includes further integral raised portions 20 provided on opposed sides of the main body, only one of which is shown in FIG. 1. The upper edges of the raised portions are designed to limit movement of connector within a mounting opening (occupied by the connector body in FIG. 1) formed in a wall structure 24 (in section) by abutting against the inside surface thereof. In a similar manner, and for a similar purpose, the side of the main body portion opposite to the side supporting the flexible arm portion 14, and the distant end of the flexible arm, are respectively provided with enlarged inclined portions 25 and 26 which form wide bottom edge or ledge portions 27 and 28 respectively. The inclined portion 26 further provides the flexible arm 14 with a narrow leading edge portion 29 pointing in a generally upward direction in FIG. 1. The ledges 27 and 28 are shown engaging the outside surface of the wall 24 in FIG. 1.

The connector 10 includes further a plurality of terminal elements or pins 30 and 32 and a corresponding number of leads 31 and 33 as best seen in FIG. 1. In a four speed motor, five leads are required for energizing a booster winding and a primary or main stator winding so, that the selector plug, as shown in the above cited patents, includes five leads connected to five terminal pins fixed in the plug body. As further shown, the pins are grouped in the plug to form a center (common) pin and four parallel extending outer pins. In like manner, for purposes of illustration, the present invention shows in FIG. 1, the pin 30 and the connecting lead 31 as a center pin and lead disposed in the plug body 12 in the midst of the four (outer) pins 32 and the corresponding leads 33.

To mount the connector 10 in the opening provided in the wall 24, the connector is directed therethrough from the inside of a housing (not shown) formed by the wall. The terminal pins 30 and 32 are directed through first so that the inclined portions 25 and 26 of the connector body 12 engage the corresponding edges of the opening. (In FIG. 1 the inserting motion of the connector would be in an upward direction.) The connector is then tilted in such a manner that the inclined portion 25 is pushed through to engage the outside surface of the wall as shown in FIG. 1. A force is then applied to the bottom (connecting lead) end of the connector 10 and a simultaneous sidewise force is applied to the top of the flexible arm 14 which protrudes from the opening in the wall 24. This sidewise force is applied along the very top of the arm and is directed towards the main body portion 12. This causes the flexible arm to easily bend inwardly which allows the enlarged portion 26 to pass through, and the connector to right itself within the opening. The flexible arm 14 springs back to engage the edge of the wall opening, and the ledge 28 formed by the enlarged portion 26 seats against the outside surface of the wall 24 as shown in FIG. 1.

The connector 10 is prevented from completely passing through the opening in the wall 24 by virtue of the upper edges of the raised portions 20 which abut against the inside surface of the wall as mentioned earlier.

Thus, it is readily seen that the flexible arm 14 allows easy insertion of the connector 10 in a mounting opening. To secure the connector in the opening, a wedge means 35, shown immediately above the edge portion 29 in FIG. 1, is simply directed into the outwardly facing U-shaped slot 18 formed by the arm 14 and the adjacent side of the connector body 12. The inserted wedge functions to tighten the connector body 12 within the opening provided in the wall 24.

The wedge means 35 has dimensions substantially equal to or in slight excess of the slot 18 to provide the necessary wedging or tightening action. As can be readily seen, the dimension tolerances of the connector body 12 and wall opening are not critical since the wedge 35 will compensate for any variations.

The wedge means 35 may be further provided with a shallow raised or ledge portion 36 adapted to seat in a corresponding indentation or notch 37 provided in the side of the connector body 12 as shown in FIG. 1. When the wedge is properly disposed in the slot 18, the ledge portion 36 of the wedge engages the notch 37 to lock itself in place.

The wedge 35 is preferably colored to provide a means for identifying the particular speed selection made. This is easily accomplished by making or molding the wedge from a material having a color contrasting with that of the body portion 12 and arm 14 so that when the wedge is disposed in place it is clearly seen by the user. The sides of the mating connector (not shown) for the connector 10 are usually provided with motor speed designations as shown in the Sherer patent. With the proper relationship existing between the wedge receiving portion (slot 18) of the connector 10 and the terminal connections and pins, the user of the connector can make speed selection by simply aligning the side of the mating connector containing the desired speed designation with the wedge.

The wedge 35 is further preferably molded simultaneously with the mating connector at no extra cost or separate fabricating operation.

The connector body 12 is preferably made of thermoplastic materials, for example, nylon or polyvinyl chloride, such materials being more resilient and stronger than thermosetting materials and thus less subject to breakage. The flexible arm 14 is thus able to bend without breaking, yet when disposed in a mounting opening and wedged by the wedge means 35 is sufficiently rigid to properly secure the connector 10 in place.

The connector 10 is further capable of being manufactured by the injection molding process briefly described above.

The process includes a first operation of molding a center piece 40 as shown in FIG. 2. The center piece comprises a plastic sleeve 41 and a rectangular shaped base plate structure 42 respectively molded about the center pin 30 and the center lead 31 as shown. The center piece 40 is molded in a suitably shaped mold or die with the pin 30 and the lead 31 connected together in a suitable manner.

The plate structure 42 is provided with four, substantially semicircular openings 43 adjacent the four corners of the plate as best seen in FIG. 3.

The outer four leads 33 are next disposed in the semicircular openings 43 (FIG. 4) with the outer pins 32 attached thereto in a suitable manner. The center piece 40, with the leads and pins, is then disposed in a final mold or die 46 as shown in FIG. 4. In FIG. 4 only one half of the die shown, the other half being removed to reveal the center piece 40.

The die 46 includes an upper section 47 having a recess 48 therein for accommodating the ends of the pins 30 and 32. The die includes further center section 49 having a center hollow area shaped to form the connector body 12 as shown in FIG. 1. The center section 49 includes further an inlet passageway 51 connecting the center hollow area of the die section 49 to the outside of the die.

The die 46 is closed with a lower section 53 having a recess shaped to accommodate the plate 42 of the center piece 40, and holes to permit the leads 31 and 33 to extend therethrough.

As can be readily seen from viewing the figures, the outer leads 33 obscure the center lead 31 so that it would

be difficult to shut off a molding operation around the center lead at the surface of the base plate 42.

In the present invention, a thermoplastic material, for example nylon, in fluid form is injected into the mold 46 through the inlet 51, and flows around the pins 32 and 33, and around the sleeve 41 until the level of the material reaches the top of the center section 49 at which time the flow of material is shut off. The mold prevents the flow from escaping around the outer leads by pressing against the edges of the plate 42 and the outwardly facing surfaces of the four outer leads 33. Thus, the flow does not have to be shut off around the substantially inaccessible center lead 31.

To prevent the movement of the center sleeve 41 within the final plug body 12, the sleeve can be provided with recesses or holes 44 (only one of which is shown) for accepting the plastic fill as the final plug body is formed in the mold 46.

By virtue of the two step molding process described above, the chance of an electrical short between the center pin 30 and any of the outer pins 32 is eliminated since the insulating sleeve 41 and the base plate 42 are molded about the pin 30 and its lead 31 before the outer leads and pins are assembled for the molding process.

From the foregoing description it should now be apparent that a new and useful connector 10, and a novel method of making same have been disclosed. The main body of the connector is provided with a resilient integral arm 14 attached to one side of the main body and extending in a direction substantially parallel to the one side. By forcing the arm inwardly towards the main body when the connector is being inserted into a mounting opening, the connector is easily and quickly mounted without breaking the connector. A wedge means is then inserted between the resilient arm and the main body to secure the connector in the opening.

The arm 14 has a resilient characteristic by virtue of the connector's thermoplastic composition. This allows the connector 10 to be made by the less costly injection molding process. And by using a two step molding process, the injection molding process is made practical by allowing the mold to be shut off around the outer lead connections and a previously molded base plate, and allows positioning and alignment of the terminal pins before the final molding step.

Though the invention has been described with a certain degree of particularity, it should be noted that changes may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A stationary electrical connector effective to provide running speed selection for a multispeed electric motor, and adapted to fit into a mounting opening provided in a supporting structure, said connector comprising:

a main body portion made from a thermoplastic material capable of being injection molded, and having an integrally formed flexible arm provided on at least one side thereof and extending in a direction substantially parallel to the plane of the one side, said main body portion molded about and supporting a center pin and lead, and a plurality of outer pins and leads,

a space provided between the one side and the flexible arm, and

a wedge for locking the connector in place in the mounting opening, and for providing a marker effective to provide a visible indication of motor speed selection when inserted into said space provided between the flexible arm and the one side of said main body portion.

2. The connector described in claim 1 in which the wedge has a color different from that of the main body portion of the connector.

3. The connector described in claim 1 in which the main body portion of the connector is made of a nylon material.

4. The connector described in claim 1, in which the wedge is provided with a raised or ledge portion, and the one side of the main body of the connector being provided with a corresponding notched portion for receiving said raised portion.

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