Jan. 25, 1955 C. E. GILBERT 2,700,206

METHOD OF FABRICATING ELECTRIC PLUGS

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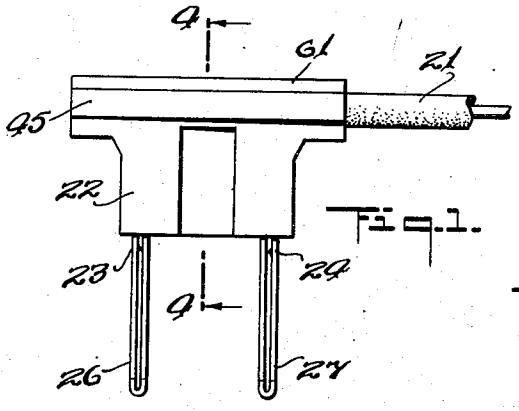


Fig. 1.

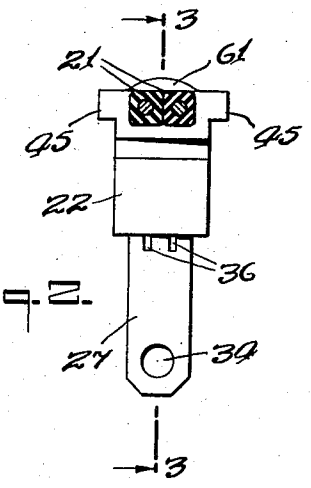


Fig. 2.

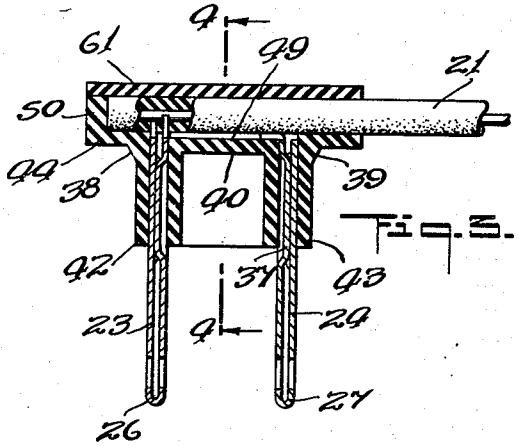


Fig. 3.

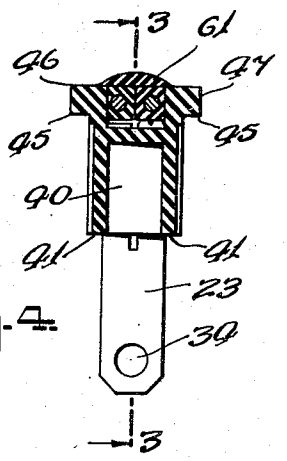


Fig. 4.

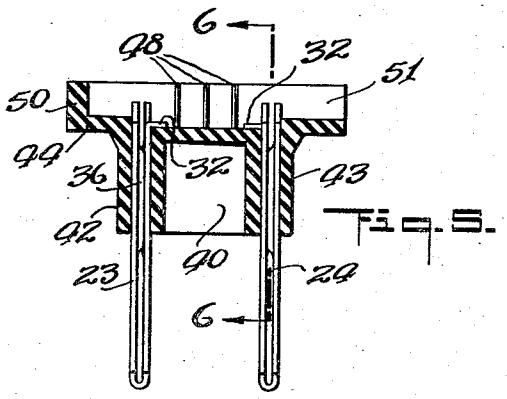


Fig. 5.

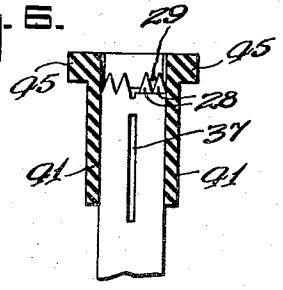


Fig. 6.

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Fig. 7.

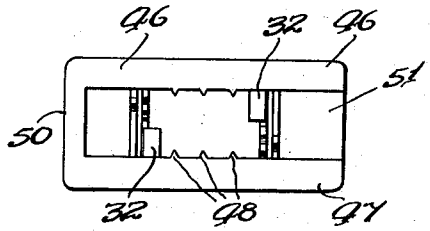


Fig. 8.

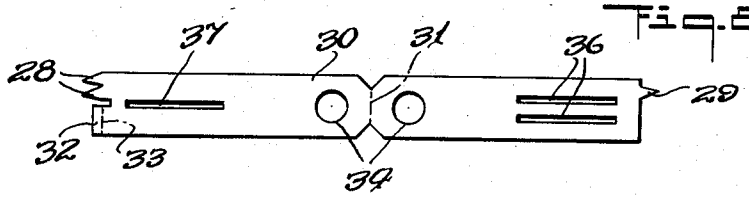


Fig. 10.

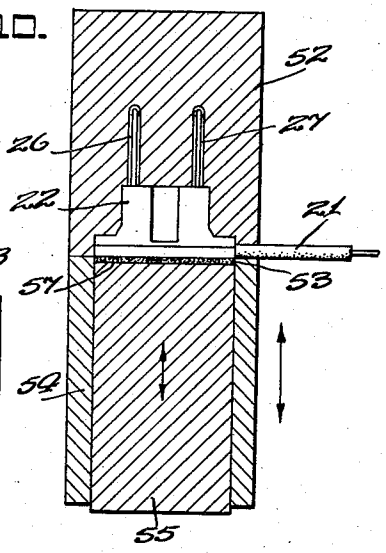
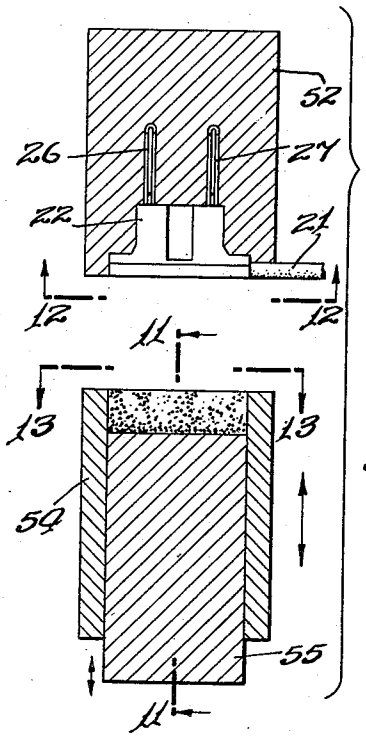


Fig. 9.



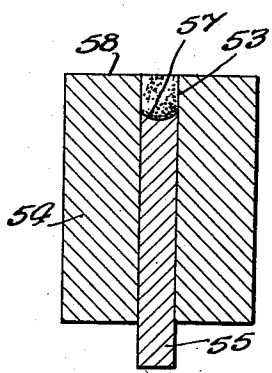


Fig. 11.

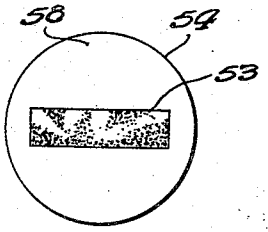


Fig. 13.

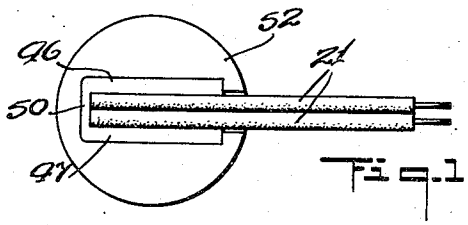


Fig. 12.

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2,700,206

METHOD OF FABRICATING ELECTRIC PLUGS

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Application April 7, 1950, Serial No. 154,500

3 Claims. (Cl. 29—155.55)

The present invention is related to the art concerning electric connector plugs such as of the type used for connecting various electrical appliances to a plug receptacle or outlet, and is more particularly concerned with improvements in the structure and method of constructing such plugs and apparatus for performing such improved methods. The improved plug structure is claimed in copending divisional application Serial No. 430,463, filed May 17, 1954.

The conventional plug receptacle or outlet is adapted to cooperate with a plug having a pair of flat parallel prongs extending perpendicularly with respect to the wall or other mounting of the receptacle. In conventional plugs, the conductor cord is connected to the plug in alignment with its prongs, and extends perpendicularly from the wall on which the receptacle is mounted. This creates an unsightly appearance and an inconvenient arrangement, since in an exposed location the projecting conductor cord may be subject to physical contact with movable objects.

According to one aspect of the present invention, this disadvantage is overcome by having the conductor cord extending perpendicularly to the prongs of the plug, so that upon inserting the plug in the receptacle the conductor cord will extend generally parallel to and only slightly spaced from the wall supporting such receptacle.

According to another aspect of the present invention a simplified method of constructing such plugs and of connecting them to conductor cords is provided. According to this feature of the invention, the plug is formed of only three parts, two of which are identical. These parts are a shell or housing molded of suitable insulating material, and a pair of contact members terminating at one end in suitable prongs adapted for cooperation with a receptacle. The shell is provided with a pair of slots into which the contact members slidably fit. The conductor cord is then placed over the projecting ends of the contact members opposite their prong ends without having its conductors in any way separated or the insulation stripped therefrom. The apparatus as thus assembled is then placed in a molding machine where simultaneously the conductor cord wires are placed in electrical contact with the respective contact members, and the conductor cord is molded into the shell. This is done by the use of thermosetting insulating material rather than thermoplastic material, which up to now has been exlusively used in this art, providing increased simplicity of apparatus, as well as a shorter cycle of operation, permitting greatly increased production from a given machine. This shorter cycle of operation stems from two features of the present invention. First, the shell is prefabricated and only a slight amount of molding is necessary during the assembly operation, and, second, the use of thermosetting material eliminates the former period of curing and cooling necessary for the conventional thermoplastic material previously used in this art.

The present invention also provides a simplified apparatus for carrying out the method and producing the structure briefly described above.

Further objects and advantages of the present invention will be more clearly apparent from the following specification taken in conjunction with the appended drawings, in which,

Figure 1 is a side elevation view of a preferred form of completed plug arrangement connected to a conductor cord;

Figure 2 is an end elevation view of the structure of Figure 1 viewed from the conductor end thereof;

Figure 3 is a side elevation cross sectional view of the device of Figures 1 and 2 taken along line **3—3** of Figures 2 and 4;

Figure 4 is a transverse cross sectional view taken along line **4—4** of Figures 1 and 3;

Figure 5 is a side elevation cross sectional view of the shell and contact members forming a sub-assembly of the structure of Figures 1–4 before the conductor cord is assembled therewith;

Figure 6 is a fragmentary transverse cross sectional view of the structure of Figure 5 along line **6—6** thereof;

Figure 7 is a top view of the structures of Figures 5 and 6;

Figure 8 is a developed view of the contact element of the previous figures;

Figure 9 shows in simplified form apparatus for assembling the plug and conductor cord, in open position;

Figure 10 shows the apparatus of Figure 9 in closed position during which the molding operation is effected;

Figure 11 is a transverse cross sectional view of the lower member of the apparatus of Figures 9 and 10 taken along line **11—11** of Figure 9;

Figure 12 is a bottom view of the upper member of Figure 9 viewed along the line **12—12** thereof; and

Figure 13 is a top view of the lower member of Figure 9 viewed along the line **13—13** thereof.

Referring to Figures 1 to 4, there is shown the completed and assembled connector plug and conductor cord arrangement forming the present invention. As shown, the conductor cord **21** is assembled in the plug body **22** with the wires of the conductor cord **21** in respective electrical contact with the contact members **23, 24** terminating in respective prongs **26, 27** adapted to make electrical contact with the contact members of any conventional plug receptacle or outlet.

As is clear from these figures, the entire assembly consists of but three parts in addition to the conductor cord **21**, namely the plug body **22** and the two identical contact members **23, 24**. The structure of each of these contact members is shown more clearly in Figure 8. Each contact member **23, 24** is formed from a single strip **30** of conductive material such as brass, having a pair of sharp points **28** at one end and a single point **29** at the other end, the strip **30** being folded about line **31** to form a doubled prong end **26** or **27**. When so folded, the point **29** registers just between the points **28** as shown most clearly in Figure 6. In addition, adjacent the points **28** is a tab portion which is bent at right angles to the strip **30** about a line **33** to form a locating ear or lug **32**, such as shown in Figures 3 or 5. A pair of apertures **34** are formed symmetrically about the folding line **31** so as to be in register, after the contact member is doubled over as shown on Figures 2 and 4. These apertures **34** form a type of detent for the prongs **26, 27** when seated in the plug receptacle.

In addition, reinforcing ribs are formed into the strip **27** in the form of a pair of parallel ribs **36** at one side of the fold line **31** and a single rib **37** on the other side. These ribs extend symmetrically for equal distances on opposite sides of the fold line **31** and the rib **37** seats between the ribs **36**. As shown in Figures 2 and 6, these ribs **36, 37** extend partially within the plug body **22** and partially outside the plug body **22** to stiffen the prongs **26, 27** and prevent them from readily bending relative to the plug body **22**. This arrangement of ribs provides greatly improved strength for the prongs without substantially increasing the thickness of the finished prong, and permits the use of thinner conductive material for the fabrication of the prongs where desired.

The plug body **22** is shown more clearly in Figures 5 and 7, and comprises a generally rectangular body undercut at its ends as shown at **38** and **39** and also cut away at its center as shown at **40**. These cut away portions **38, 39** and **40** leave the plug body with a pair of thin lower side walls **41** and lower end walls **42, 43** of greater thickness, all of these walls extending from the upper portion **44** of the plug body which is formed with upper side walls **46** and **47** constituting extensions of the side walls **41** and each having a lip **45** forming a finger

hold for grasping the plug body when removing it from a plug receptacle.

The upper end wall 50 joins the upper side walls 46 and 47 at one end, the other end wall being omitted. The upper part 44 of the plug body 22 therefore forms a conductor-cord-receiving channel 51 with a depressed center 49, and the inner surfaces of the side walls 46 and 47 are provided with a plurality of projections shown at 48 which serve to engage the sides of the conductor cord to inhibit movement of the conductor cord relative to the plug body.

The thicker lower end walls 42, 43 of the plug body 22 are provided with respective slots extending completely therethrough from top to bottom, in each of which one of the folded contact members 23, 24 is adapted to be inserted from the upper end into the position shown most clearly in Figure 5, with the tabs 32 facing one another and seated against the depressed center 49 of the channel 50 in the upper portion of the plug body. When this is done the respective points 28, 29 of the two contact members 23, 24 lie in opposite sides of the channel 50. The tabs 32 prevent the contact members 23, 24 from moving downwardly and, as will be shown, further means are provided for preventing upward movement of these contact members so that they are then rigidly secured to the remainder of the structure.

The assembling apparatus shown in Figure 9 has an upper mold portion 52 with a recess closely conforming to the shape of this sub-assembly. The lower mold portion is formed in two portions, one portion 54 having a rectangular channel 53 extending therethrough of a width substantially equal to the width of the channel 50 and a length substantially equal to the length of the plug body 22, as shown in Figure 13. Slidably mounted in this channel 53 is a rectangular insert 55 having a cross section closely conforming to the channel 53 and terminating at its upper end in a concave cylindrical surface 57. The rectangular insert 55 is normally below the upper edge 58 of the lower molded portion 53 by an amount so selected that a proper volume of thermosetting molding powder will be retained in the recess formed by the channel 53 and the rectangular insert 55.

In assembly, the combination of plug body and control members is placed in the upper mold recess, and the recess in the lower mold portion is filled with thermosetting molding powder. Then a conductor cord end is held in channel 50 of the plug body while the mold members 54 and 55 are moved upwardly together until the upper surface 58 of the lower mold portion 54 seats firmly against the lower surface 59 of the upper mold portion 52. During this time heat is applied to both mold members in any suitable manner. For example, one such suitable manner is shown in my copending application Serial No. 641,519, filed January 16, 1946, for Machine for Making Molded Plug Bodies for Electrical Connectors. The heat is applied simultaneously with pressure, which forces the rectangular insert 55 of the lower mold portion upwardly against the plug body 22 in the upper mold portion 52.

Normally a temperature of approximately 300° F. exists at the location of the plug body 22 and a pressure of approximately 2000 pounds per square inch is applied by the rectangular insert 55. These values are not highly critical, since temperatures from 300 to 350° F. may be used and pressures from 850 pounds per square inch and up may be used, the sole criterion being that at the pressure and temperature used, the thermosetting powder will fuse and join with the plug body 22 to provide an integrally molded cap for the plug body such as shown at 61 in Figures 1 to 4.

It will be understood that the pressure applied by the rectangular insert 55 also forces the conductor cord 21 against the points 28 and 29 of the respective contact members 23, 24, which points thereupon pierce the insulation of the conductor cord 21 and make permanent electrical contact with the respective wires of the conductor cord 21. Also the molding temperature is sufficiently low so that no harmful effects are produced on the insulation of the conductor cord 21.

It will be understood, however, that where desired, an intermediate step might be utilized whereby the conductor cord 21 is forced on to the points 28 and 29 either before the plug and contact assembly is placed in the upper molded portion 52 or after such placement but before the lower molded portion closes upon the upper molded portion 52.

By these methods only a slight amount of molding is performed during assembly. The molding material contained in the recess 69 not only provides the cap 61 but fills all the interstices between the conductor cord and the plug body 22 and integrally joins with the material of the plug body 22 to rigidly maintain the conductor cord in operative position relative to the contact members. Both the projections 48 (Figure 7) and the surrounding of the conductor cord by molding material serve to retain the conductor cord within the plug body against even strong pulls which might be encountered in use.

It will be understood that both the prongs and the plug shells can be fabricated readily by adaptations of known automatic machinery and the sub-assembly of the plug body and contacts such as shown in Figure 5 can also be made automatically, thereby facilitating and speeding up production of the completed plug and cord assemblies.

The number of parts of this plug and cord construction are thereby maintained at a minimum including merely the cord, the plug body and the two identical plug contacts. Fabrication is greatly simplified and assembly is accomplished in a minimum number of steps performable by relatively low skilled labor, whereby not only is production speeded up, but the cost of the completed construction is greatly minimized.

While the above plug and cord construction and the methods of and apparatus for fabricating the same have been described in detail with respect to preferred embodiments thereof, it is to be understood that the above description is illustrative only and is not to be taken in a limiting sense, since many apparently widely divergent constructions, methods and apparatus can readily be devised by persons skilled in this art without departing from the spirit of the present invention which is defined solely by the appended claims.

What is claimed is:

1. The method of fabricating a conductor cord and connector plug assembly, comprising the steps of fabricating a shell having a pair of parallel contact-element-receiving channels extending completely therethrough, and a single conductor-cord-receiving channel extending transversely of and interconnecting said first channels, said last channel being adjacent one edge of said shell, fabricating a pair of identical contact elements, each formed of a doubled-over conductive strip providing a receptacle-mating prong at one end and with a plurality of conductor-cord-insulation-piercing points at the other end and only on one side thereof, inserting one of said contact elements in each of said contact-element-receiving channels, with said points protruding into said cord-receiving channel, each element having its points on a side of said cord-receiving channel opposite from the points of the other element, laying a parallel wire insulating conductor cord in said cord-receiving channel with each wire of said cord over the points of a respective contact element, applying molding material in said single transverse channel and simultaneously pressing said cord on said points to cause said points to pierce the insulation of said cord to make contact with the respective wires thereof and molding said material as a cap over said cord and cord-receiving channel and integrally with said shell, to form an integral cord and plug arrangement.

2. The method of fabricating a conductor cord and connector plug assembly, comprising the steps of fabricating an elongated shell having a pair of parallel contact-element-receiving channels extending completely therethrough, and a single conductor-cord-receiving channel extending transversely of said first channels, said last channel being adjacent one edge of said shell, fabricating a pair of identical contact elements, each formed of a conductive strip providing a receptacle-mating prong at one end and with a conductor-cord-insulation-piercing point at the other end and only on one side thereof, inserting one of said contact elements in each of said contact-element-receiving channels, with said point protruding into said cord-receiving channel, each element having its point on a side of said cord-receiving channel opposite from the point of the other element, laying an insulated conductor cord in said cord-receiving channel with each wire of said cord over the point of a respective

contact element, and simultaneously pressing said cord on said points to cause said points to pierce the insulation of said cord and to make contact with the respective wires thereof and molding a cap over said cord and cord-receiving channel and integrally with said shell to form an integral cord and plug arrangement.

3. The method of fabricating a conductor cord and connector plug assembly, comprising the steps of fabricating an elongated shell having a pair of parallel contact-element-receiving channels extending completely therethrough, and a single conductor-cord-receiving channel extending transversely of and interconnecting said first channels, said last channel being adjacent one edge of said shell, inserting in each of said element-receiving channels a contact element having a point at one end lying in said cord-receiving channel and a prong at the other end extending outwardly of said shell and adapted to cooperate with a receptacle, the points of said two contact elements lying on opposite sides of said cord-receiving channel, laying an insulated two wire conductor cord in said cord-receiving channel with each wire thereof over the point of a respective contact element, and simultaneously pressing said cord on said points to

cause said points to pierce the insulation of said cord and to make contact with the wires thereof and molding a cap over said cord and cord-receiving channel and integrally with said shell to form a unitary cord and plug arrangement.

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