United States Patent

Turner

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[54] METHOD OF MANUFACTURING DOUBLE INSULATED PLUGS

[72] Inventor: **Prescott K. Turner,** Fairfield, Conn.

[73] Assignee: **General Electric Company**

[22] Filed: **April 2, 1969**

[21] Appl. No.: **812,624**

[52] **U.S. Cl.** ..... **29/629,** 18/5 E, 18/36, 264/263, 264/272, 339/218, 339/220

[51] **Int. Cl.** **H02g 15/00**

[58] **Field of Search** ..... 29/624–630; 264/272, 263, 527; 18/5 E, 36

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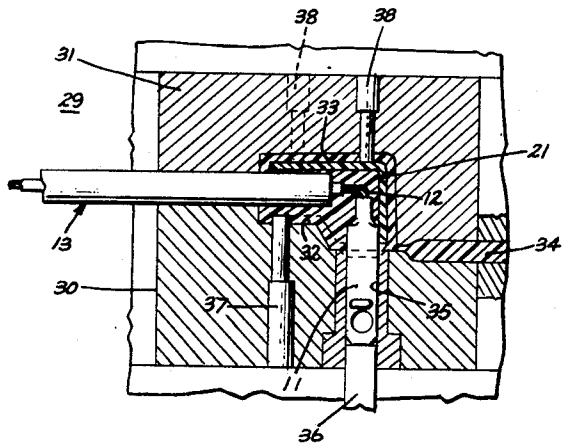
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Primary Examiner—John F. Campbell
Assistant Examiner—Robert W. Church
Attorney—John M. Stoudt, Radford M. Reams, Jon C. Gealow, Frank L. Neuhauser and Oscar B. Waddell

[57] **ABSTRACT**

A method of manufacturing an electrical wiring device in which the electrical connections of the wiring device are positioned within double insulation. The contacts are electrically and mechanically connected to the conductors of a cord to form connections. A portion of each contact is inserted in a mating recess in a mold and a preformed insert of insulating material is positioned overlying the connections. The insert is held in its position overlying the connections and the contacts are maintained in the recesses while a body of insulating material is molded around the insert and connections.

3 Claims, 12 Drawing Figures



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FIG. 1

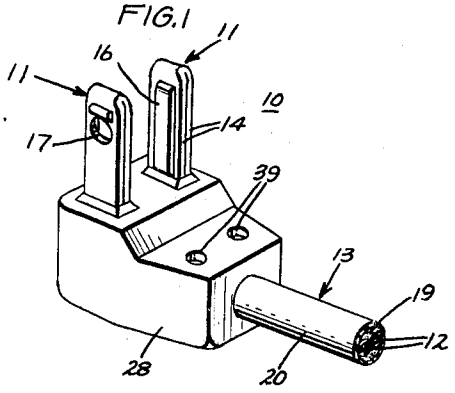


FIG. 2

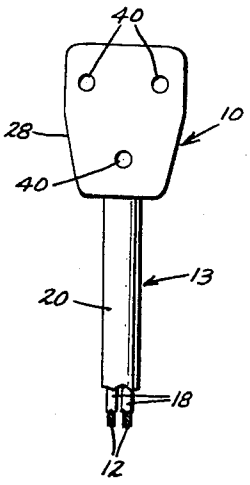


FIG. 3

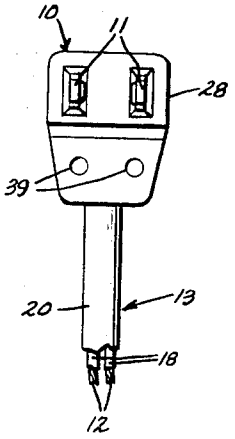


FIG. 4

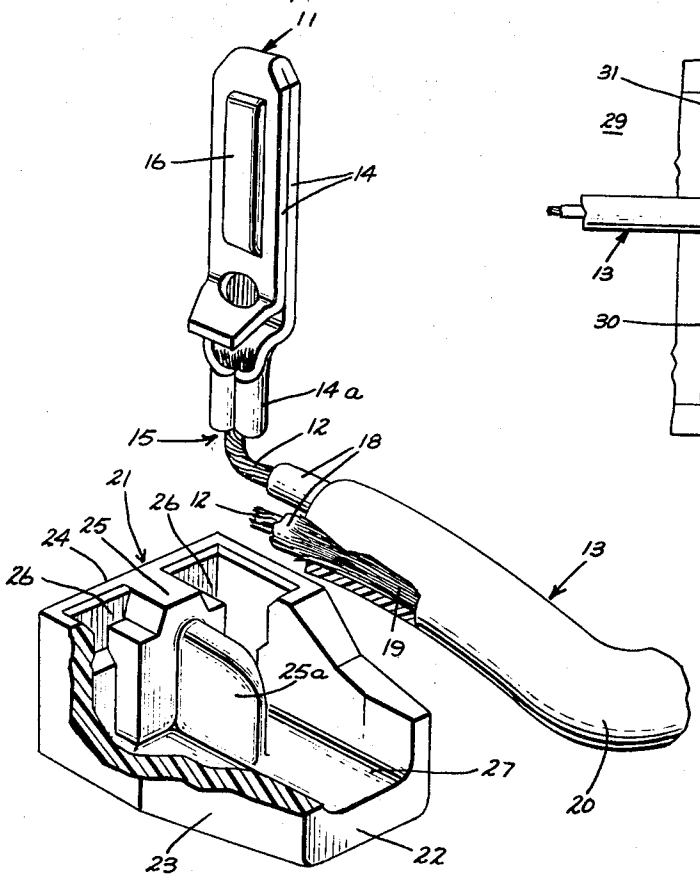
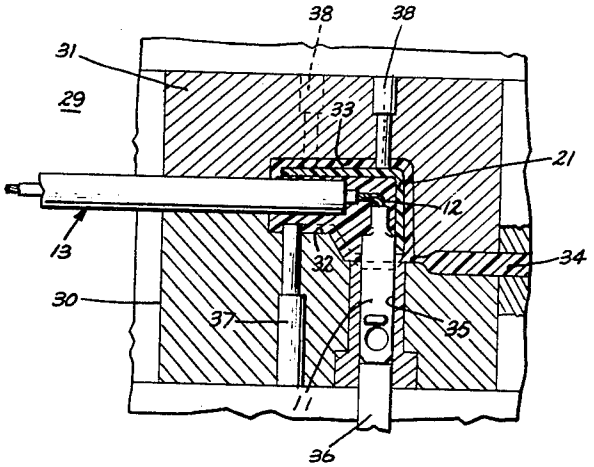


FIG. 5



Inventor:
Prescott K. Turner,
By Radford M. Keama
Attorney.

FIG.6

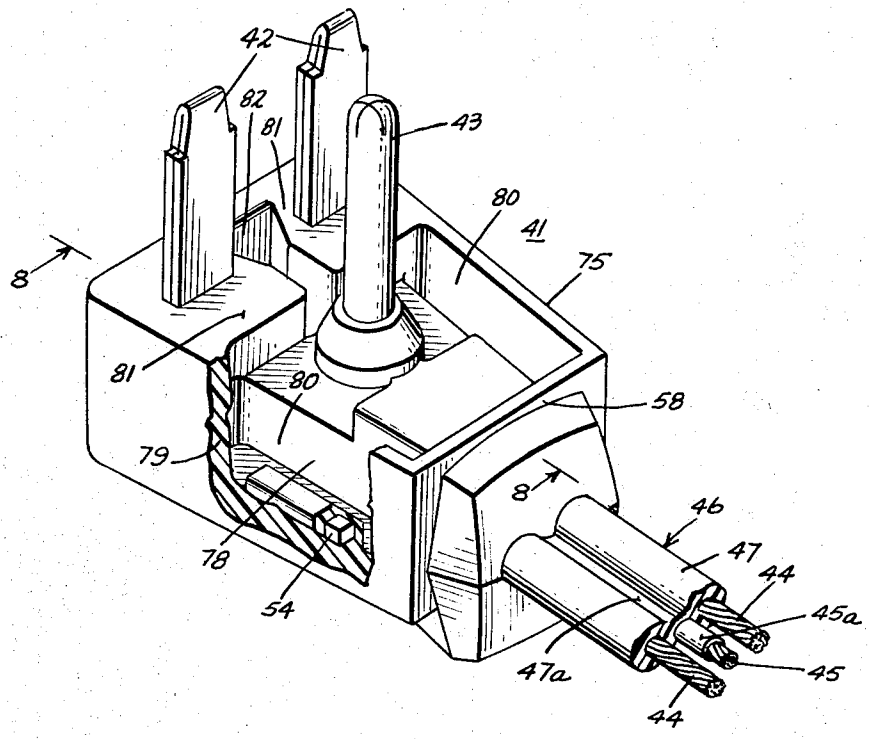


FIG.8

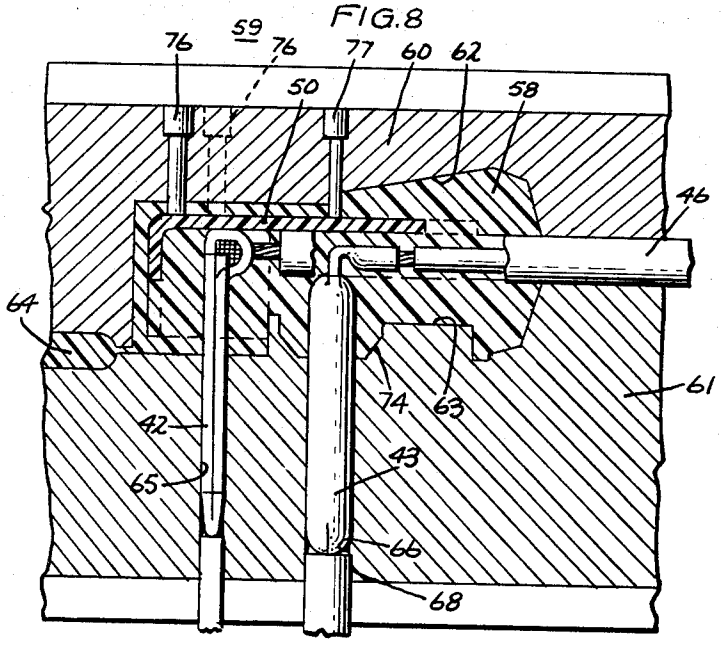
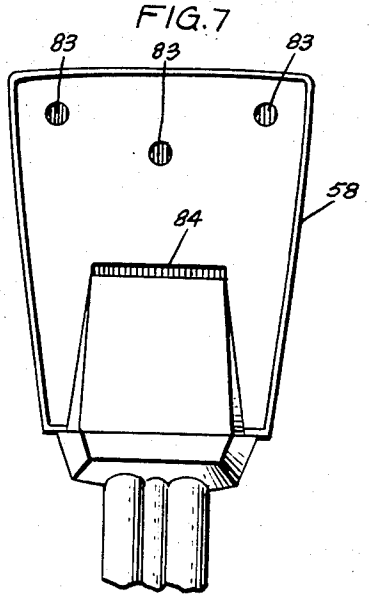


FIG.7



INVENTOR.
Prescott K. Turner,
BY Radford N. Leamo
Attorney.

FIG. 9

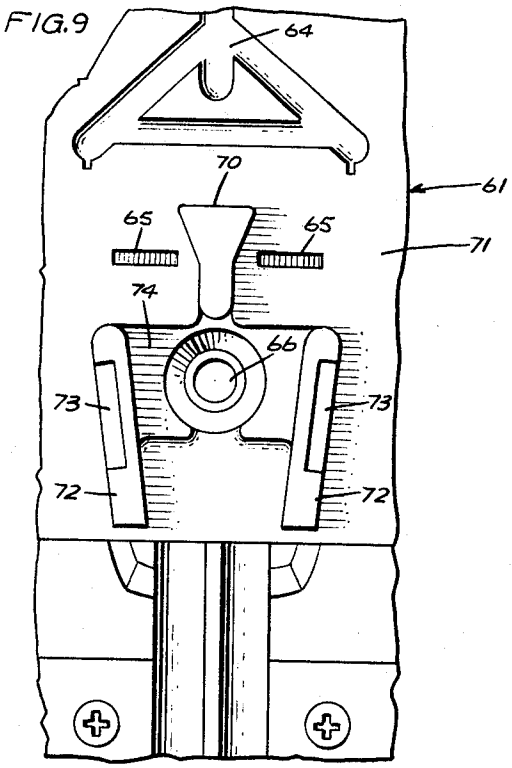


FIG. 10

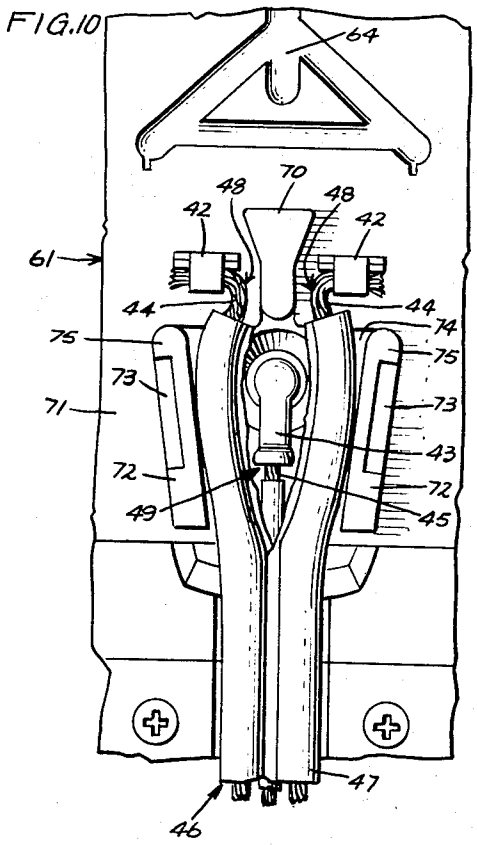


FIG. 11

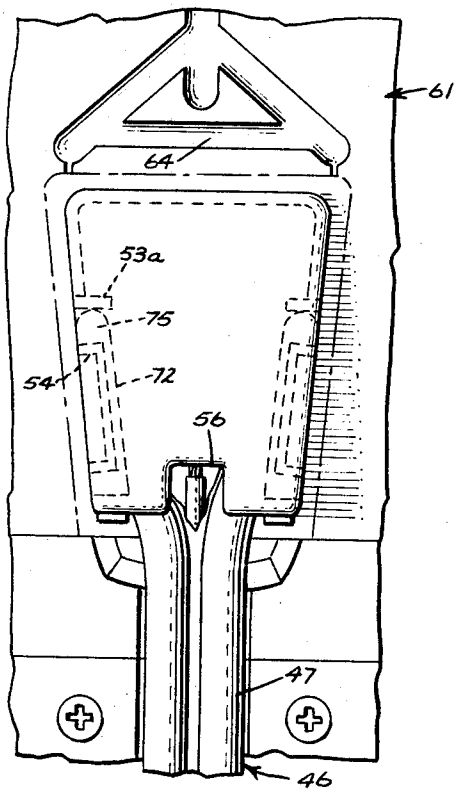
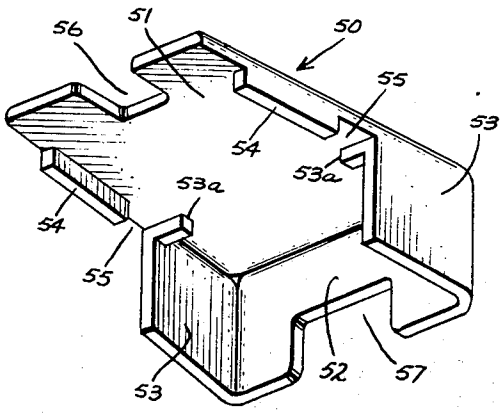


FIG. 12



INVENTOR.
Prescott K. Turner,
BY Radford M. Reams
Attorney.

METHOD OF MANUFACTURING DOUBLE INSULATED PLUGS

BACKGROUND OF THE INVENTION

This invention relates to a method of manufacturing wiring devices, such as electric plugs, and more particularly to an improved method of manufacturing wiring devices of the double insulated type.

It is highly desirable to make wiring devices such as, for instance, electrical plugs with double insulation, that is with two separate layers overlying the connections between the contacts and associated conductors. Such constructions assure that stray wires from the conductors will not crossover to cause internal electrical shorts and will not come to or close to the external surface of the device. U.S. Pat. No. 3,141,054, issued on July 14, 1964 to Wallace R. Francis, and assigned to General Electric Company, assignee of the present invention, discloses a method of forming double insulated plugs in which two separate bodies of insulating material are molded about the connections. That method provides the desired separation and has been commercially very successful. That method requires a double molding process; that is, the connected wires and contacts are placed in a first mold and a first body of insulating material is molded about them. This subassembly is then placed in another mold, and an outer body of insulating material is molded about the first one. This makes it a relatively tedious and time consuming job to mount the contacts in the mold, and having a double molding operation multiplies the number of times this must be done.

It is possible to reduce the process of manufacturing the wiring device to a single molding step by using a preformed insert which overlies the connections. Then a single molding operation can be employed to form the outer body of insulating material. Both for appearance and functional reasons it is desirable that the outer body of insulation be uniform in consistency and without voids. Therefore it is best to form such bodies by injection molding in which the insulating material, in a liquid state, is applied under high pressure and then allowed to solidify. Such molding pressures tend to move the contacts and inserts within the mold, which can result in unsatisfactory final products.

SUMMARY OF THE INVENTION

Accordingly it is an object of the present invention to provide a new and improved method of manufacturing wiring devices of the double insulated type.

It is another object of this invention to provide such an improved method of manufacture which utilizes preformed inserts.

It is a further object of this invention to provide such an improved method which assures proper positioning of the components of the wiring device.

The invention, in accordance with one embodiment thereof, provides a method for manufacturing a wiring device having a plurality of contacts connected to a plurality of associated conductors. The method comprises the steps of assembling the connected contacts and conductors into a preformed insert of insulating material, with the insert substantially encasing the connections between the contacts and the conductors, and restraining the connections and insert substantially in their assembled relationship while molding a body of insulating material around the insert and connections.

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 operation, together with further objects and advantages thereof, may best be understood by reference to the following description when taken in conjunction with the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an electrical plug manufactured in accordance with one embodiment of the present invention;

FIG. 2 is a top plan view of the plug of FIG. 1;

FIG. 3 is a bottom plan view of the plug of FIG. 1;

FIG. 4 is an exploded, perspective view illustrating details of the preformed insert, the contacts and the conductors of the plug of FIG. 1, the view being partly broken away and partly in section for purposes of illustration;

FIG. 5 is a somewhat schematic sectional view of a mold utilized in carrying out my invention, in one form thereof, showing details of the preformed insert, contacts and outer body of insulating material of the plug of FIG. 1;

FIG. 6 is a perspective view of another electrical plug manufactured in accordance with an embodiment of the present invention, the view being partly broken away and partly in section for purposes of illustration;

FIG. 7 is a top plan view of the plug of FIG. 6;

FIG. 8 is a somewhat schematic sectional view of a mold utilized in carrying out my invention, in one form thereof, showing details of the preformed insert, contacts and outer body of insulating material of the plug of FIG. 6;

FIG. 9 is a plan view of one member of the mold of FIG. 8;

FIG. 10 is a plan view similar to FIG. 9, showing the contacts and cord in place;

FIG. 11 is a plan view similar to FIGS. 9 and 10, showing the preformed insert in place overlying the connections; and

FIG. 12 is a perspective view of the preformed insert used in the plug of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, particularly FIGS. 1–4, there is shown electrical wiring device, more particularly a male plug 10, manufactured in accordance with one embodiment of the present invention. The plug 10 includes a pair of contacts 11 which are connected to the conductors 12 of an electrical cord 13. Each of the contacts 11 is formed from a single strip of electrically conductive material which is folded upon itself to provide a pair of parallel extending, sandwiched together legs 14. At the free end, an extended portion 14*a* of one of the legs of each contact is crimped around the exposed or bare end of an associated conductor 12 to form an electrical connection 15. The contacts 11 are formed with a suitable shape, such as longitudinally extending ribs 16 and recesses 17, to firmly but releasably engage in a mating female receptacle or socket.

The exemplification cord 13 is a two conductor cord in which each of the conductors 12 is received in an individual jacket 18 of insulating material. The two insulated conductors 12 then are wound together with suitable filler material 19 and received in an outer insulation jacket 20 to form an electrical cord having a generally circular cross-sectional configuration. Each of the conductors 12 is formed from a number of individual strands or wires which are spirally wound together to form the conductor.

The plug 10 also includes a preformed insert 21 of suitable insulating material such as, for example, polystyrene or polyvinyl chloride. The insert 21 includes a base or cover section 22 with a pair of side walls 23 and an end wall 24 extending outwardly therefrom. Intermediate walls or barriers 25 and 25*a* extend outwardly from the cover 22 and longitudinally thereof from the end wall 24. Thus a pair of recesses 26 are formed in the insert 21 and separated from each other by the barriers 25 and 25*a*. Extending from these recesses 26, the base 22 and side walls 23 form a generally rectangular recess 27.

A relatively short length of the individual strands or wires of each conductor 12 are exposed for connection to the contacts 11. Adjacent the exposed ends of the conductors a portion of the individual jackets 18 around the conductors 12 is exposed by removing the filler 19 and outer jacket 20.

When the contacts and cord are assembled in the insert, one of the connections 15 is received in a corresponding one of the recesses 26 with the associated contact 11 extending outwardly between the walls 23, 24, 25 and 25a. The associated conductor 12 and its jacket 18 is also received in that recess 26, adjacent the wall 25a. Both of the conductors 12, with their individual jackets 18, extend from the corresponding recesses 26 into the recess 27. The outer insulation jacket 20 and filler 19 are removed for a length sufficient that the edge of the outer jacket will be well within the recess 27. The cord 13 will exit from the insert 21 through the end of recess 27 opposite end wall 24.

Once the contacts, cord and insert have been assembled an outer body 28 of insulating material is molded around the insert and connections to complete the plug. Referring now particularly to FIG. 5 there is shown, in somewhat schematic form, a mold of the injection type for carrying out this molding step. The mold 29 includes a pair of mating mold members 30 and 31 which are provided with chamber portions 32 and 33 that fit together to form a chamber defining the external shape of the body 28. The mold members also define a channel 34 for admitting liquid insulation material such as, for instance, polyvinyl chloride to the chamber for forming the body 28. The mold member 30 includes two recesses 35 which receive the appropriate portions of contacts 11 so that the contacts may be removably mounted in the mold member 30 in spaced apart relationship. A stop 36 is provided in each of the recesses 35 to engage the end of the contact 11 and thus limit the distance to which the contact is received in the recess. The recesses are shaped complimentarily to the external shape of the contacts 11 so as to closely overlie the contacts and prevent any of the insulating material forming the body 28 from flowing downwardly around the contacts.

In carrying out a complete process of manufacturing the plug 10 first the appropriate lengths of insulation jackets 18, filler 19 and insulation jacket 20 are removed. Then the contacts 11 are joined to the conductors 12. Each of the contacts is inserted in one of the recesses 35 to the associated stop 36. Thereafter the preformed insert 21 is placed in juxtaposition over the connections 15, as well as the adjacent portions of both the contacts 11 and the conductors 12. The insert substantially encases the connections with portions of the insert overlying the connections, and adjacent parts of the contacts and bared conductors, on all sides which might be exposed to contact by a person during use. Furthermore barriers 25 and 25a prevent any loose strand from extending out of its associated recess 26 into the other recess 26. That is, all sides are covered which could be touched by a person when the contacts are in a cooperating female receptacle, and electrical interconnection between the conductors 12 is precluded. It will be understood that the connections and insert could be assembled and then the contacts inserted in the recesses.

Then the mold members are brought together to form the chamber defining the exterior size and shape of the plug. It will be noted that mold member 30 has a number of positioning pins 37, and the mold member 31 has a number of similar pins 38. When the mold members are brought together, each of the pins 37 engages a corresponding one of the side walls 23 while the pins 38 engage the cover or base section 22. Thus the pins restrain or hold the insert 21 within the molding chamber in a predetermined position over the contacts 11. Since the insert closely overlies the connections 15, the conductors 12 and the portions of the contacts 11 not received in the recesses 35; the connections, conductors, and contacts are also substantially restrained from movement, with the contacts 11 being maintained in predetermined positions within the recesses 35. By the same token the contacts 11, fitting closely within the recesses 26, help hold the insert in its proper position within the molding chamber.

Then liquid insulating material is forced into the chamber through the conduit 34 to completely fill the chamber and form the outer body 28 of insulating material. The body 28 of insulating material substantially encloses the insert 21, the connections 15, and the adjacent portions of the contacts and conductors. It completely fills the recesses 26 and 27 and extends over and adheres to the end portion of the insulating jacket 20 of cord 13.

It will be understood that in injection molding this liquid insulating material is rapidly forced into the chamber under relatively high pressure to form a homogeneous, void free body 28. Without the pins 37 and 38 this molding pressure could cause the insert 21 to move with respect to the conductors and contacts and could cause the contacts to partially lift out of the recesses 35. Such movement of the internal parts of the plug very well could cause an unsatisfactory plug. For instance, there might be portions of the plug, which could be touched by a person while the plug is "live," which were not doubly insulated. Also the length or portion of the contacts exposed for insertion into a cooperating female receptacle could be shortened sufficiently that proper contact could not be made.

Once the insulating material forming the outer body or jacket 28 has hardened, the mold members are parted and the completed plug is removed.

Viewing now FIGS. 2 and 3 it will be seen that the two pins 37 leave two corresponding small openings 39 in the body 28 while the three pins 38 leave three corresponding small openings 40 in the body 28. The openings 39 are completely surrounded by part of the insulating material forming the body 28 and bottom against the side walls 23 of the insert so that there is effectively no chance that an exposed wire or strand from one of the conductors 12 will be in these openings. The openings 40 are on the opposite side of the cover or base section 22 of the insert so that there is again complete assurance that no live wire or strand from the conductors 12 may be exposed in these openings.

Referring now to FIGS. 6–12, there is shown a somewhat different plug and the mold used in manufacturing this plug in accordance with one embodiment of the present invention. This plug 41 is a heavy duty three prong type used with supply cords for apparatus such as electric ranges. The plug 41 includes a pair of power contacts 42 and a ground contact 43 which are respectively connected to a pair of power conductors 44 and a ground conductor 45 of a cord 46.

The power contacts 42 are flat, elongated members formed by bending over a single strip of contact material while the neutral or ground contact 43 is formed from a single strip of contact material which is bent upon itself to form an elongated contact of generally circular cross-sectional configuration. This configuration of the contacts, as well as their physical spacing, assures that the plug will be inserted in a cooperating female receptacle in a proper orientation so that the contacts 42 do in fact serve as power contacts and the contact 43 serves as a ground contact.

Each of the conductors 44 and 45 is formed by spirally winding together a number of individual wires or strands of conductive material. The neutral or ground conductor 45 is received in individual jacket of insulation 45a and then all three of the conductors are encased in an outer insulating jacket 47. The cord 46 of the exemplification is of the well-known rip cord type in which the jacket 47 is formed with reduced thickness portion 47a which may be easily separated to expose the neutral conductor.

As best seen in FIG. 10, each of the power contacts is crimped around an exposed end of an associated one of the power conductors 44 to form a pair of power connections 48 while the ground conductor 43 is crimped around a bare end of the ground conductor 45 to form a ground connection 49.

The plug 41 also includes a preformed insert 50 of suitable insulating material such as, for example, polystyrene or polyvinyl chloride. As best seen in FIG. 12, the insert 50 includes a base or cover section 51. An end wall 52 extends from the cover at one end thereof while a pair of side walls 53 extend from the cover 51 partially along the side edges thereof and are joined to the end wall 52. A tab 53a extends inwardly along the inside of cover 51 adjacent the lateral edge of each

of the side walls 53. A rib 54 extends from each side edge of the cover 51 and each rib is slightly spaced from the adjacent side wall 53 to form a notch 55 therebetween. The cover portion 51 defines a notch 56 at its end removed from the end wall 52, and the end wall 52 defines a notch 57 extending inwardly from its free distal edge.

The plug 41 also includes an outer body 58 of suitable insulating material such as, for example, polyvinyl chloride.

The body 58 is molded around the connections 48 and 49, the adjacent portions of the contacts 42 and 43, the ends of the conductors 44 and 45, and the insert 50. This outer body 58 of insulation is injection molded in a mold 59. As best seen in FIG. 8, the mold 59 includes a pair of mold members 60 and 61 having chamber portions 62 and 63 which are brought into mating relationship when the mold members are joined to provide a chamber which defines the exterior configuration of the body 58. The mold members also define an inlet conduit 64 for injecting suitable insulating material, in liquid form, into the cavity to thus form the body 58.

Referring now in particular to FIGS. 8–10 it will be seen that the mold member 61 includes a pair of recesses 65 which receive a portion of the power contacts 42 and a recess 66 which receives a portion of the ground contact 43. Stops 67 and 68 are provided in the bottom of the recesses 65 and 66 respectively to limit the extent of insertion of the associated contacts within these recesses. The mold member also includes a barrier 70 which extends outwardly from the base surface 71 of the mold member 61. The barrier 70 is positioned between the recesses 65 and extends in both directions along the base surface 71 substantially beyond these recesses. A barrier 72 extends outwardly from the surface 71 on each side of the recess 66, and a recess 73 is formed in the outer portion of each of the barriers 72. Each of the recesses 73 is slightly larger than the ribs 54 of the insert 50. It will be noted from FIGS. 6 and 8–10 that the recess 66 is formed in and barriers 72 extend outwardly from a platform 74 of the mold member 61.

In making the plug 41 first the insulation jacket 48 of cord 46 is split along reduced width portion 47*a* to expose a portion of the ground conductor 45. Then a portion of the jacket 47 is removed from the end of each of the power conductors 44, and a portion of the jacket 45*a* is removed from the ground conductor 45 so that each of the conductors has an end portion in which the individual wires or strands are exposed. Each of the power contacts 42 is crimped around the exposed end of one of the power conductors 44 to form the power connections 48 and the end of the ground contact 43 is crimped around the exposed end of the ground conductor 45 to form the ground connection 49.

Each of the power contacts 42 and the neutral contacts 43 is inserted in a corresponding one of the recesses 65 and 66. Each of the power contacts 42 is positioned in its recess 65 so that the contact is between the bared portion of the associated power conductor and the adjacent end of the plug 41, and that the distal end of the conductors 44 are turned outwardly toward the nearest side of the plug. Additionally when the insulation is removed from the ground conductor it is also clipped so that it is shorter than the power conductors, and thus the ground connection 49 and the ground contact 43 are positioned between portions of the power conductors 44 which remain covered with the insulating jacket 47.

Next the preformed insert 50 is placed on the mold member 61 in juxtaposition to and overlying the connections 48 and 49 as well as the contacts and the adjacent portions of the conductors. As best seen in FIGS. 8 and 11, stops 67 are positioned so that the insert 50 will rest against, or at least very close to, the top of the power contacts 42, when the power contacts are fully seated in the recesses 65; and the distal edge of the walls 52 and 53 of the insert rest against the base surface 71 of the mold member 61. Stop 68 is placed to similarly position ground contact 43. Also each of the ribs 54 is received in a cooperating one of the recesses 73 of the barriers 72 with the tip 75 of the barrier 72 fitting within the notch 55 between the rib 54 and the adjacent tab 53*a*. Also, as will be seen from FIG. 11, the ribs 54 fit somewhat loosely within the recesses 73, and the outer insulation jacket 47 of the cord is split a sufficient distance so that the terminal portion of the split is in register with the notch 56 in the cover section of the insert.

Then the two mold members 60 and 61 are brought together so that the chamber portions 62 and 63 come into register to form the molding cavity which defines the overall outer configuration of the plug. The mold member 60 includes restraining means such as pins 76 and rib 77 which engage the cover section 51 of the insert 50 to hold it firmly against the mold member 61. Thus the insert is firmly locked in position within the molding cavity and the insert in turn maintains the contacts substantially in their predetermined positions within the mating recesses.

Thereafter the desired insulating material is injected into the mold through the inlet conduit 64 under high pressure to form the body 58 of insulating material which surrounds the insert 59, as well as the contacts and the associated portions of the cord. This insulating material completely fills the molding cavity flowing under the insert as well as on top of it so as to intimately surround the connections, the adjacent portion of the contacts and the adjacent portions of the cord. This insulation material also fills the notch 56, and flows around the adjacent split portion of the cord, tying the insert and cord together. It also fills the notch 56 and the recesses 73 around the ribs 54. Thus the insert, the contacts and the cord are all firmly locked together in the outer housing.

It will be noted that there is a separately formed double layer of insulation between the connections, as well as the adjacent portions of the contacts and exposed conductors, and the adjacent exterior surfaces of the plug which might be touched by someone when the plug is "live," that is when the plug is mounted in an associated female receptacle. To this end the cover section 51, side walls 53 and end walls 52 of the insert overlie the power connections 48 on all sides which might be so touched by the user. The ground connection and the adjacent portion of the ground contact and ground conductor are enclosed in a portion 78 of the body 58 which is separated from the lateral walls 79 of the body by recesses 80, which extend into the plug to the insert 50. Also the two power contacts 42 are each enclosed in portions 81 of the body of insulating material, which are separated by a recess 82 that also extends into the plug to the cover section 51 of the insert.

In the event an individual strand or wire was loose from the conductors 44 and 45 and the pressure during molding causes it to move away from the conductor, it either would be trapped within the insulating material forming the body portions 78 and 81 or, at most, it might be exposed to the surface of one of the portions 78 and 81. The recess 82 prevents a strand from crossing over from one power conductor to the other while the recesses 80 prevent a strand of the neutral conductor from getting to the exterior surface of the plug. Since the surfaces of the outer body 58 defined by the portions 78 and 81 are shielded from human contact at all times when the plug is in use, the fact that a stray strand is exposed to the surface of the portions can cause no harm.

The substantial spaced apart relationship between the power contact 42 and the neutral contact 43, when assembled in the mold, assures no crossover of strands between the power and neutral contacts. As seen in FIG. 7, the pins 76 leave small holes 83 in the body 58, and rib 77 leaves an elongated hole 84 in the body 58. Since these holes are on the opposite side of insert 51 than the contacts and conductors, they present no opportunity for exposure of stray strands.

While, in accordance with the Patent Statues, I have described at present what are considered to be the preferred embodiments 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 of manufacturing an electrical plug, the method comprising the steps of: electrically and mechanically attaching a plurality of contacts to a corresponding plurality of conductors to form a plurality of connections; inserting a portion of each of said contacts into a predetermined position in a mating recess in a mold and then placing a preformed insert of insulating material in juxtaposition to and overlying said connections; restraining said insert in juxtaposition to said connections and maintaining said contacts in their predetermined positions in said mating recesses while molding a body of insulating material substantially enclosing said connections and said insert.

2. A method of manufacturing an electrical plug, the method comprising the steps of: electrically and mechanically attaching a plurality of power contacts and a ground contact respectively to a corresponding plurality of power conductors and a ground conductors to form a plurality of power connections and a ground connection; inserting a portion of each of said contacts into a predetermined position in a mating one of a plurality of spaced apart recesses in a mold and placing a preformed insert of insulating material in juxtaposition to and overlying said connections; holding said insert in juxtaposition to said connections and maintaining said contacts in their predetermined positions in said mating recesses while molding a body of insulating material substantially around said connection and said insert, with said body having portions thereof surrounding each of said power connections and with a recess between said body portions.

3. A method of manufacturing an electrical plug, the method comprising the steps of: electrically and mechanically attaching a plurality of power contacts and a ground contact respectively to a corresponding plurality of power conductors and a ground conductor to form a plurality of power connections and a ground connection; inserting a portion of each of said contacts into a predetermined position in a mating one of a plurality of spaced apart recesses in a mold and placing a preformed insert of insulating material in juxtaposition to and overlying said connections, with at least said power connections being received in mating, spaced apart chambers in said insert; restraining said insert in juxtaposition to said connections and restraining said contacts in their predetermined positions in said mating recesses while injection molding a body of insulating material substantially around said connections and said insert, with said body of insulating material substantially filling said chambers about said power connections.

* * * * *