Oct. 21, 1958

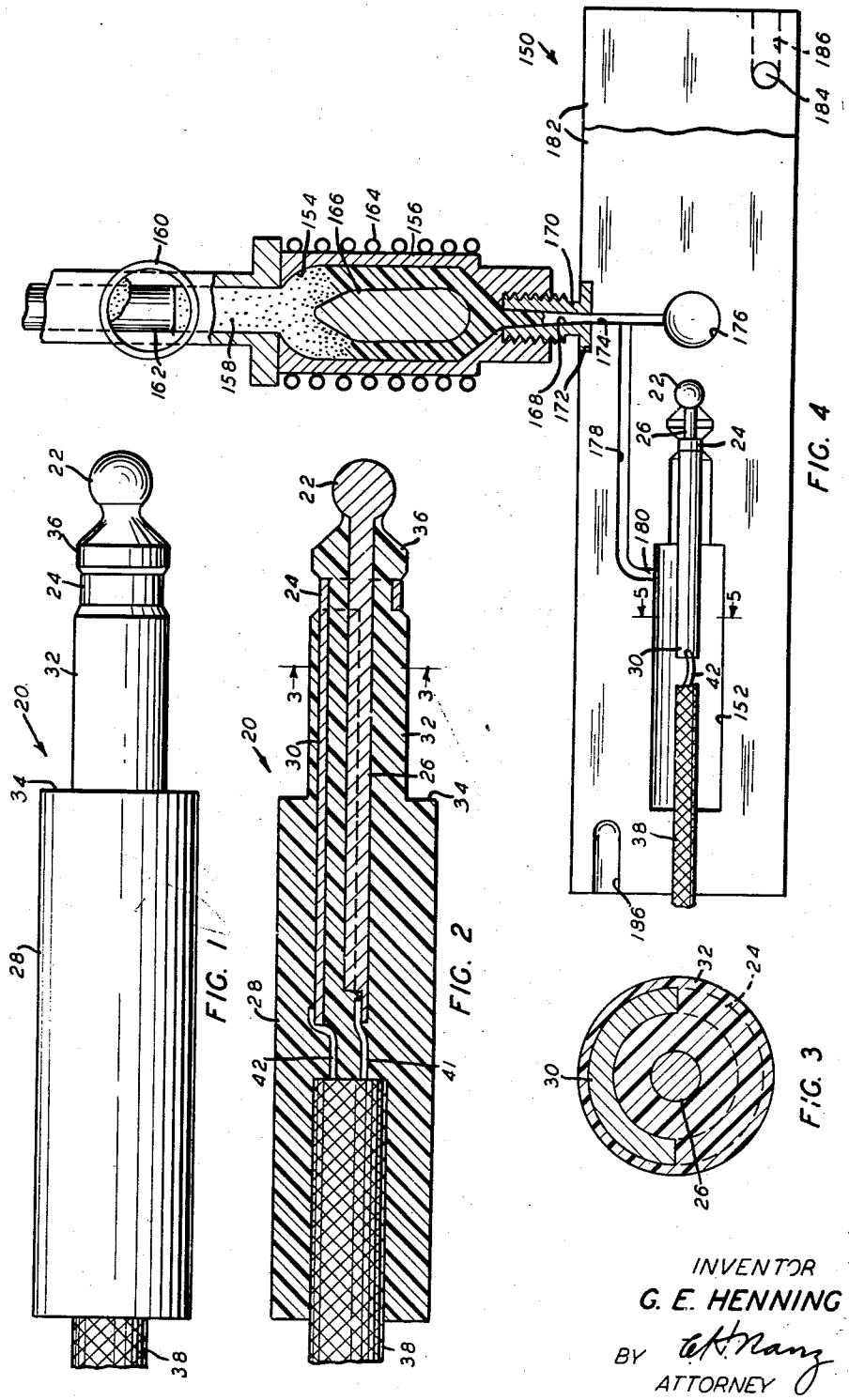
G. E. HENNING

2,857,581

PLUGS FOR COMMUNICATIONS CORDS AND METHODS OF MAKING THE SAME

Filed May 7, 1953

2 Sheets-Sheet 1




INVENTOR
G. E. HENNING
BY
ATTORNEY

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G. E. HENNING

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PLUGS FOR COMMUNICATIONS CORDS AND METHODS OF MAKING THE SAME

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2 Sheets-Sheet 2

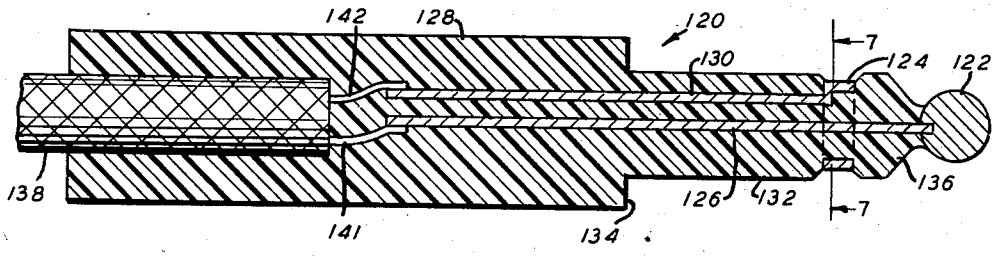



FIG. 6

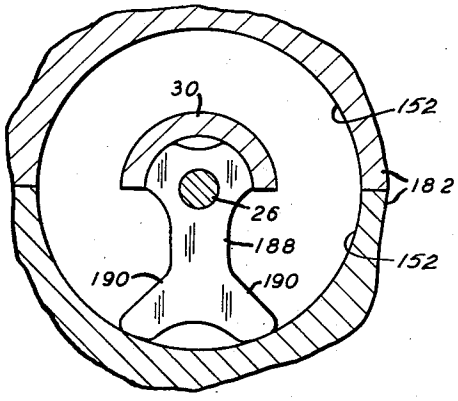



FIG. 5

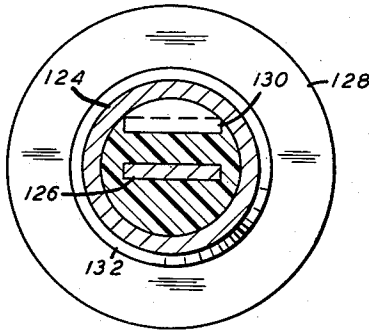



FIG. 7

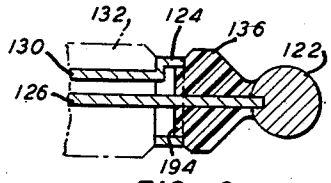



FIG. 8

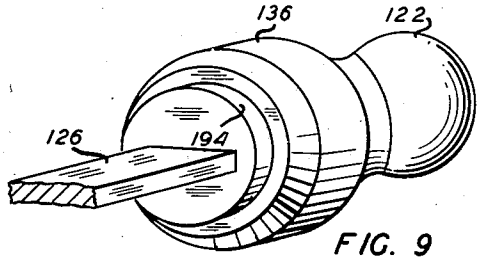



FIG. 9

INVENTOR
G. E. HENNING
BY
ATTORNEY

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2,857,581

# PLUGS FOR COMMUNICATIONS CORDS AND METHODS OF MAKING THE SAME

George E. Henning, Baltimore, Md., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

Application May 7, 1953, Serial No. 353,547

6 Claims. (Cl. 339—183)

This invention relates to comunications cords and methods of manufacturing such cords, and more particularly to cords having plugs thereon used to make connections in telephone switchboards, and the like, and methods of manufacturing such cords.

The connection plugs on switchboard cords used in telephone exchanges must be ruggedly constructed to withstand being rapidly and repeatedly inserted into the jacks in the switchboards by telephone operators. In making connections the plugs are subjected to wear, stress and strain, which tend to make it necessary to replace them periodically. Heretofore, commercial telephone plugs have been manufactured by assembling a plurality of contact and connection members, and housing these members within a tubular metallic body. This assembly was then subjected to a profiling machine in which the final shape and dimensions of the plug were attained. A tubular shell composed of hard rubber, or the like, was attached to the profiled assembly to serve as a hand grip for telephone operators at the switchboard. The metallic body portion of this plug was made of hard brass, in order to impart strength, corrosion resistance and good electrical conductivity to the plug. These plug structures and manufacturing procedures of the prior art were complicated and expensive.

An object of this invention is to provide new and improved communications cords and methods of making such cords.

Another object of this invention is to provide new and improved cords having telephone plugs thereon, and the like, and methods of making such cords.

A cord illustrating certain features of the invention may include a conductive center pin having a contact ball secured to one end thereof and mounted concentrically within a conductive sleeve of a plug body having a contact ring secured to one end thereof so that the contact ball is positioned adjacent to the contact ring, said center pin and sleeve being electrically connected to a plurality of insulated conductors at one end of a length of cordage, and a plastic shell constituting the entire remainder of the plug body molded around the conductors at the end of the cordage and around the adjacent portions of the cordage and of the sleeve.

A method illustrating certain features of the invention may include the steps of mounting within a conductive sleeve having a contact ring secured to one end thereof a conductive center pin having a contact ball secured to one end thereof so that the contact ball is positioned adjacent to the contact ring thereby partially assembling a plug, electrically connecting the center pin and the sleeve to a plurality of insulated conductors at one end of a cord, and molding a plastic shell around the conductors at the end of the cord and around the adjacent portions of the cord and of the sleeve to form the entire remainder of the plug and to encase the end of the cord.

A complete understanding of the invention may be obtained from the following detailed description of cords embodying the invention and methods of making such



cords, when considered in conjunction with the appended drawings, in which:

Fig. 1 is a fragmentary elevation of a completed communications cord embodying the invention;

Fig. 2 is a longitudinal section of the cord shown in Fig. 1;

Fig. 3 is an enlarged, transverse section taken along line 3—3 of Fig. 2;

Fig. 4 is a fragmentary, horizontal section of apparatus suitable for performing one method embodying the invention to manufacture the cord illustrated in Figs. 1, 2 and 3;

Fig. 5 is an enlarged, fragmentary, vertical section taken along line 5—5 of Fig. 4 as it would appear with the upper half of the mold in place;

Fig. 6 is a longitudinal section of a completed cord embodying the invention having a modified structure;

Fig. 7 is an enlarged transverse section taken along line 7—7 of Fig. 6 as it would appear if the embodiment in Fig. 6 were unsectioned;

Fig. 8 is a longitudinal section of a portion of the article shown in Fig. 6, at an intermediate stage of its manufacture according to one method embodying the invention, and

Fig. 9 is an enlarged perspective view of the same portion of the article illustrated in Fig. 8, at another stage of its manufacture.

Referring to Fig. 1, a plug designated generally by the number **20**, is provided in the usual manner with a contact ball **22** and a contact ring **24**, which are designed to complete a two conductor type of electrical circuit when the plug **20** is inserted into a jack on a telephone switchboard (not shown). The contact ball **22** is mounted on one end of a center pin **26** (Figs. 2 and 3) which extends axially through the contact ring **24** and into a cylindrical body portion **28** of the plug **20**. The contact ring **24** is mounted on one end of a semicircular web **30** which is centered on and extends along one side of the center pin **26**. The web **30** and the center pin **26** extend approximately equal distances into the cylindrical body portion **28** of the plug **20**. A shank portion **32** of the plug **20** extends from the contact ring **24** to the cylindrical body portion **28**. The shank portion **32** is also cylindrical in shape, but is of smaller diameter than the body portion **28**, resulting in the formation of an annular shoulder **34** at the juncture of these portions. The shoulder **34** serves as a stop when the right hand end of the plug **20**, as viewed in Fig. 1, is inserted into the jack on a telephone switchboard.

The contact ball **22** is separated from the contact ring **24** by an insulating collar **36**. This collar, known in the art as a "dead collar," approaches the size of the shank portion **32** in outside diameter, being larger than the contact ball **22** and the contact ring **24**. The collar **36** functions as a guide and a bearing surface when the plug **20** is being inserted into the jack on a switchboard.

In accordance with the invention, the body portion **28** and the shank portion **32** of the plug **20**, as well as the collar **36**, are all composed of a molded plastic, such as nylon. The annular shoulder **34** formed at the juncture of the body portion **28** with the shank portion **32** is made of the same molded plastic. It is not necessary to reinforce this shoulder, even though it is subjected to repeated impacts in service. Certain plastics, of which nylon is particularly outstanding, have sufficient strength and impact resistance to serve as efficiently as hard brass in this capacity. In the completed plug **20**, these plastic portions of the plug are all united into one integral unit.

The left hand end of the plug **20**, as viewed in Figs. 1 and 2, is joined to a length of flexible, braided cordage **38** having a pair of filamentary, individually insulated, electrical conductors **41** and **42** therein. The body por-

tion 28 of the plug 20 encases the adjacent portion of the cordage 38. In the interior of the body portion 28, conductor 41 is soldered to the adjacent end of the center pin 26, and the conductor 42 is soldered to the adjacent end of the semicircular web 30, preferably on the outer rim thereof. The conductors 41 and 42 as well as their soldered connections to the pin 26 and the web 30 are completely enveloped by the molded plastic which makes up the body portion 28 of the plug 20. Thus, the plug 20 is joined permanently to the length of cordage 38, and approximately one half the length of the body portion 28 of the plug encases the adjacent end of the cordage 38. By means of the center pin 26 and the web 30, the conductors 41 and 42 of the cordage 38 are connected electrically to the contact ball 22 and the contact ring 24, respectively.

The contact ball 22 may be an integral part of the center pin 26, as shown in Fig. 2, or these members may be made separately and then be threaded or otherwise joined together. In any event, the contact ball 22 may be profiled to its final shape and dimensions prior to the time the rest of the plug 20 is assembled, unlike the procedure used in the prior art. The contact ring 24 may also be machined to its final shape and dimensions during the preliminary operations. This ring is joined integrally to the semicircular web 30, at one end thereof. The ring 24 and the web 30 may be formed simultaneously by machining a brass tube to cut away half of the tube beyond the ring along the axis of the tube.

By modifying the internal structure of the plug 20, the metallic portions thereof may be formed principally by stamping operations instead of machining operations. As shown in Fig. 6, a modified plug 120 is provided with a contact ball 122 and contact ring 124, in the usual manner. As in the case of the plug 20, the contact ball 122 of the plug 120 is secured at one end of a centerpin 126 which protrudes axially through the contact ring 124 and into the interior of a body portion 128 thereof. The contact ring 124 is mounted at one end of an outer pin 130 which is shorter than the center pin 126 but protrudes into the body portion 128 the same distance as the center pin. A shank portion 132 of the plug 120 extends from the contact ring 124 to the body portion 128, and both of these portions of the plug are composed of molded plastic. The body portion 128 and the shank portion 132 are cylindrical in shape, but the shank portion has a smaller diameter, thereby forming an annular shoulder 134 at the junction of these portions of the plug 120. However, the plug 120 differs in structure from the plug 20, in that the center pin 126 and the outer pin 130 have the appearance of flat plates spaced equidistantly throughout the length of the shorter plate.

Only the contact ball 122 need be formed by a machining operation. The center pin 126 may be stamped from a flat strip of metal, and then be joined to the ball 122 by soldering, welding or in any other suitable manner. Likewise, a stamping operation may be used to form the contact ring 124 and the outer pin 130. The formation of these members may be accomplished by stamping a T-shaped section from a flat strip of metal, then rolling the arms of the T-shaped section to bend them arcuately and make their ends meet. Thus, the arcuately bent arms of the T-shaped section become the contact ring 124, while the stem of the T-shaped section becomes the outer pin 130. In order to prevent the arcuately bent halves of such a contact ring from springing outwardly, it may be advisable to bond their ends together, as by soldering. As shown in Figs. 6 and 7, the outer pin 130 may be offset inwardly from the periphery of the ring 124, but this offset is not absolutely necessary, so long as the pin 130 is imbedded deeply enough in the interior of the plastic shank portion 132 of the plug 120 to be insulated adequately.

Between the contact ball 122 and the contact ring 124, the plug 120 is provided with an insulating collar 136, which corresponds in structure and in function with the collar 36 on the plug 20. The left hand end of the plug 120, as viewed in Fig. 6, is attached to a length of flexible cordage 138 having a pair of filamentary, individually insulated conductors 141 and 142 therein. In the interior of the body portion 128 of the plug 120, the conductor 141 is soldered to the adjacent end of the center pin 126, and the conductor 142 is soldered to the adjacent end of the outer pin 130. The molded plastic which makes up the body portion 128 of the plug 120 envelops completely the conductors 141 and 142, their soldered connections to the pins 126 and 130, and the adjacent portion of the cordage 138.

The plug 120 is joined permanently to the adjacent end of the cordage 138, with the conductors 141 and 142 thereof electrically connected to the contact ball 122 and the contact ring 124, respectively. The cylindrical body portion 128 thereof serves conveniently as an insulated handgrip for telephone operators at the switchboard. Approximately one half the length of the body portion 128 encases the adjacent end of the cordage 138, and the other half of the body portion 128 encases the portions of the pins 126 and 130 which project into the body portion from the shank portion 132 of the plug 120.

In the case of both the plug 20 and the plug 120, the molded plastic portions thereof may all be formed simultaneously in a single molding operation, or separate molding operations may be used to form different portions of the plugs successively. However, as a matter of convenience, said single molding operation will be described in relation to a method of manufacturing the plug 20, while a method involving successive molding operations will be described in relation to the manufacture of the plug 120.

In the manufacture of the plug 20, the contact ball 22 and the contact ring 24 along with the center pin 26 and the semicircular web 30 to which the ball and ring are attached, respectively, are first preformed to their final shapes and dimensions. This preliminary operation may be performed by machining suitable brass rods and tubes. Next the center pin 26 is placed axially through the contact ring 24 with the contact ball 22 located near the ring at one end of this assembly. The other end of this assembly is joined to the conductors 41 and 42 of the length of flexible, braided cordage 38. The conductors 41 and 42 are exposed at one end of the cordage 38, and the exposed conductors are arranged to project towards the pin 26 and the web 30. The conductor 41 is then soldered to the adjacent end of the center pin 26, and the conductor 42 is soldered to the outer rim of the semicircular web 30.

The body portion 28 and the shank portion 30 of the plug 20, as well as the collar 36, are now formed simultaneously about this assembly by a single injection molding operation. The pin 26 and the web 30 together with the adjacent end of the cordage 38 to which these members are attached, are placed in a mold 150 (Fig. 4) having a mold cavity 152 therein. The mold cavity 152 is made accurately to very close tolerances in order to fit tightly about the ball 22 and the ring 24, so that none of the plastic injected into the mold 150 can creep around the ball and ring and form insulating layers on the outside of these members. One end of the mold cavity 152 is blocked completely by the contact ball 22. The other end of the mold cavity is closed by the length of cordage 38, but the cordage is permitted to project through the mold to the outside atmosphere. The rest of the mold cavity 152 possesses the proper contours to form the body portion 28, the shank portion 32 and the collar 36 of the plug 20, when molten plastic is injected into the mold 150.

Among the plastics which may be used in the manufacture of cords embodying the invention are thermoplastics, such as nylon, polystyrene, polyethylene, and polymerized methyl methacrylate. In view of the brittle

nature of pure polystyrene, it may be advisable to incorporate plasticizers or to employ copolymers of styrene with other synthetic resins. These thermoplastics exhibit toughness, impact resistance, light weight, ease of molding, good insulating properties, and dimensional stability over a wide range of temperatures, which properties make them outstandingly valuable in the manufacture of telephone plugs. They are readily available in the form of molding powders in the commercial chemical market, and in this form they may be injected into molds in accordance with established procedures. Specific details of these procedures are readily obtainable from suppliers of such molding powders.

The preferred thermoplastic is nylon. In the nylon family of compounds, the high molecular weight copolymers derived from hexamethylenediamine and adipic acid have been found to be particularly useful. Nylon is microcrystalline in character, as may be determined from its X-ray diffraction patterns. Due to its crystalline character, unlike most other thermoplastic compounds, it exhibits a sharp melting point. In its molten condition, the viscosity of nylon resembles that of a light lubricating oil.

Molten nylon is injected into the cavity **152** from a heated chamber **154** of an injector **156** to which nylon powder **158** is fed from a hopper **160** by a reciprocable plunger **162**. The injector **156** is surrounded by a heating coil **164** and the center of the heated chamber **154** is occupied by a torpedo **166** which forces the advancing powder **158** into contact with the heated wall of the chamber **154** to convert the nylon into a molten form. During successive strokes of the plunger **162** the nylon powder **158** in the chamber **154** is moved forward by the powder entering the chamber, and heated gradually to fluidity.

The molten nylon progresses from the chamber **154** through a central orifice **168** formed in a nozzle **170** which fits accurately into a recess **172** formed in the outer surface of the mold **150**. The orifice **168** is aligned with a sprue **174** which leads directly into the interior of the mold **150** from the recess **172**. Since the first material ejected through the nozzle **170** may be relatively cold and hard, a cold-slug well **176** is provided at the interior end of the sprue **174**. It may not be necessary to have a cold-slug well when plugs are being molded one at a time, but the provision of a cold-slug well is advisable when several plugs are being molded simultaneously.

A passageway **178**, known as a runner, extends from the mold cavity **152** to about the midpoint of the sprue **174**. After the cold-slug well **176** is filled up, molten material is advanced through the runner **178** to an entrance **180**, known as a gate, provided on one side of the mold cavity **152**. The mold **150** is composed of two mated sections **182—182**, best shown in Fig. 5, which are substantially identical in appearance, and are held together by a pair of guide pins **184—184** located at opposide ends of the mold. After a molding operation has been completed, the two sections **182—182** may be pried apart by inserting any convenient tool (not shown) into a pair of tapered apertures **186—186** which lead from the outside of the mold to the guide pins **184—184**.

It is advisable to provide means for keeping the center pin **26** in the exact center of the contact ring **24** during the injecting molding operation, so that these members will be concentric in the finished telephone plug **20**. Although the contact ball **22** is engaged positively at one end of the mold cavity **152** by the two mold sections **182—182**, it is not advisable to rely entirely upon the tight fit within the mold cavity to keep the pin **26** properly positioned with respect to the ring **24** until the plastic injected into the mold has hardened. Hence, a prop **188** (Fig. 5) is placed in the center of the mold cavity **152** to keep the pin **26** spaced properly from the web **30**. The prop **188** is provided with a pair of spaced feet **190—190** which rest on the interior wall of one of the mold sections **182—182**. The feet **190—190** are contoured properly to fit smoothly against this wall and at the same time to permit plastic injected at one end of the mold cavity **152** to flow past the feet to the other end of the mold cavity. The top of the prop **188** is apertured to fit over the pin **26** and between the pin and the web **30**.

Although the prop **188** functions only as a temporary support while the mold **150** is closed and molten plastic is being injected into the mold, the prop remains permanently in the completed telephone plug **20**. The prop **188** is preformed from the same plastic that is injected into the mold. During the molding operation the prop **188** merges with the body portion **28** of the plug **20**, so that when the plug is removed from the mold the presence of the prop is no longer apparent. The prop **188** may be fitted onto the center pin **26** just prior to the time this pin is soldered to the conductor **41**.

Each stroke of the plunger **162** moves enough of the nylon powder **158** into the heated chamber **154** to equal the amount of molten nylon required by the mold **150** for the formation of a single telephone plug **20**. The chamber **154** has a capacity sufficient to hold several shots of nylon, so that a reservoir of molten material is available constantly for the production of a succession of completed plugs. The powder **158** is heated gradually and converted to fluidity as it is advanced through the chamber **154** by successive strokes of the plunger **162**. The heating coil **164** maintains the chamber **154** at a temperature of about 500° F., which is slightly above the melting point of the nylon molding powder used. It is advisable to heat the mold **150** also in order to prevent the injected nylon from solidifying before the mold is filled completely. A suitable temperature for the mold **150** is about 200° F., which is well below the melting point of nylon and yet is high enough to insure that the molten plastic will penetrate into every accessible portion of the mold cavity **152**. Injection pressures of about 8,000 pounds per square inch have been used successfully.

The same method used to manufacture the plug **20** may be used to manufacture the modified plug **120**. A prop (not shown), somewhat similar to the prop **188** used in the case of the plug **20**, may be used to keep the pins **126** and **130** of the plug **120** spaced properly during the molding operation.

Instead of using such a prop, the collar **136** may be molded beforehand and used in a similar manner. As shown in Figs. 8 and 9, the preformed collar **136** is provided with a hub **194**, which fits into the contact ring **124** and maintains the center pin **126** spaced properly from the ring and from the outer pin **130** which is attached to the ring. After performing the preliminary operations of forming the contact ball **122**, the contact ring **124**, and the pins **126** and **130** to which the ball and ring are respectively attached, these members are assembled by sliding the preformed collar **136** along the center pin **126** up to the ball **122**. The contact ring **124** is then fitted over the hub **194** of the collar **136**. The conductors **141** and **142** are exposed at one end of the length of braided cordage **138**. The conductor **141** is soldered to the center pin **126**, and the conductor **142** is soldered to the outer pin **130**. This assembly is placed in a mold similar to the mold **150**, and the rest of the molding procedure is the same as in the case of the plug **20**.

Still another method of manufacturing cords embodying the invention involves the use of two separate injection molding operations. After assembling the center pin within the contact ring, the collar **36** or **136**, as the case may be, is formed by injecting molten plastic into a mold just large enough to accommodate this portion of a plug. The rest of the plastic portions of the plug and the cord are formed by a second molding operation. By first forming the collar in this manner, the center pin is kept mounted concentrically within the contact ring until the plastic injected to form the rest of the body of the plug

has hardened. In this method the use of preformed props and collars is avoided.

Although the invention has been illustrated and described with reference to the specific construction of cords designed for making connections in a two conductor system, the invention is not limited to such cords. Methods and products embodying the invention are also applicable to other types of cords, such as cords designed for three conductor systems. In such cases, a second contact ring, like the single ring **24** on the plug **20**, might be placed on the shank portion **32** of the plug, and be connected to another pin extending longitudinally through the interior of the plug to another conductor in a length of braided cordage. The construction of other component parts of the cord may be varied without departing from the spirit and scope of the invention.

What is claimed is:

1. The method of making electrical connection plugs and attaching them to an end of cords having a plurality of insulated conductors therein, which comprises mounting within a conductive sleeve having a contact ring secured to one end thereof a conductive center pin having a contact ball secured to one end thereof so that the contact ball is positioned adjacent to the contact ring thereby partially forming a plug assembly, inserting a prop between the pin and the sleeve to maintain them in concentric spaced relationship, electrically connecting the center pin and the sleeve to the conductors at the end of such a cord, placing this assembly including the attached end of the cord within a mold with said prop contacting a portion of the mold and holding the center pin and sleeve in concentric spaced relationship with respect to each other and with respect to the mold, the mold being designed to fit closely around the ring, the ball and the cord, injecting molten plastic into the mold to encase the adjacent end of the cord and to form the entire remainder of the plug including an insulating collar located between the ball and the ring.

2. The method of making telephone plugs and attaching them to an end of cords having a plurality of insulated conductors therein, which comprises mounting within a conductive sleeve having a contact ring secured to one end thereof a conductive center pin having a contact ball secured to one end thereof so that the contact ball is positioned adjacent to the contact ring thereby partially forming a plug assembly, inserting a preformed prop composed of molded nylon between the pin and the sleeve in contact with the inside surface of a mold to maintain them in concentric spaced relationship with respect to each other and with respect to the inside surface of the mold, electrically connecting the center pin and the sleeve to the conductors at the end of such a cord, placing this assembly including the attached end of the cord within the mold which fits tightly around the ring, the ball and the cord, injecting molten nylon into the mold to encase the adjacent end of the cord and to form the entire remainder of the plug including an insulating collar located between the ball and the ring.

3. In a connection cord for telephone switchboards including a length of cordage having a plurality of insulated conductors therein and having attached at one end thereof a connection plug including a conductive center pin having a contact ball secured to one end thereof and mounted concentrically within a conductive semicircular web having a contact ring secured to one end thereof so that the ball is positioned adjacent to the ring, said center pin and web being electrically connected to the conductors at the end of the length of cordage, the improvement which comprises a shell composed of molded nylon encasing the conductors at the end of the cordage and encasing the adjacent portions of the cordage and of the web, said shell constituting the entire remainder of the plug including a cylindrical body portion encasing the conductors at the end of the cordage, a cylindrical shank portion extending from the body portion to the contact ring, an annular shoulder formed between the body portion and the shank portion, and an insulating collar portion located between the ball and the ring.

4. In a connection cord for telephone switchboards including a length of cordage having a plurality of insulated conductors therein and having attached at one end thereof a connection plug including a conductive center pin having a contact ball secured to one end thereof and mounted equidistantly from a conductive outer pin having a contact ring secured to one end thereof so that the ball is positioned adjacent to the ring, the other ends of the pins being electrically connected to the conductors at the end of the length of cordage, the improvement which comprises a shell composed of molded nylon encasing the conductors at the end of the cordage and encasing the adjacent portions of the cordage and of the pins, said shell constituting the entire remainder of the plug including a cylindrical body portion encasing the conductors at the end of the cordage, a cylindrical shank portion extending from the body portion to the contact ring, an annular shoulder formed between the body portion and the shank portion, and an insulating collar portion located between the ball and the ring.

5. In a connection cord for telephone switchboards including a length of cordage having a plurality of insulated conductors therein and having one end thereof attached to a telephone plug comprising a flat center conductor having a rectangular cross section, a sleeve the center of which corresponds to the longitudinal center line of said flat center conductor and parallel thereto, a contact ball secured to one end of said center conductor, a contact ring secured to the end of said sleeve adjacent to said contact ball, said center conductor and said sleeve being individually electrically connected to separate conductors of said cordage, a plastic mass molded in situ in the space between said center conductor and said sleeve, and an annular shoulder formed on said mass to serve as a stop for said plug when inserted into the switchboard to make electrical contacts between said ball and contact ring and portions of said switchboard, said mass encapsulating a portion of said cordage and said plug to form a unitary assembly.

6. A telephone connecting plug comprising a flat center conductor having a rectangular cross section, a contact ball secured adjacent to one end thereof, a flat outer conductor having a rectangular cross section, the longitudinal axes of said outer conductor and said center conductor being parallel with respect to each other, a contact ring secured adjacent to said contact ball on one end of said outer conductor, a cordage having a plurality of insulated conductors individually secured on the opposite ends of said center conductor and said outer conductor, and a mass of molded plastic in situ in the space between said outer conductor and said center conductor and encapsulating portions thereof and a portion of said cordage to form a unitary assembly.

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