June 25, 1968 M. G. ZAVERTNIK ETAL 3,390,369

ELECTRIC PLUG OR RECEPTACLE ASSEMBLY
WITH INTERCHANGEABLE PARTS

Filed Jan. 5, 1966 5 Sheets-Sheet 1

Fig. 1.

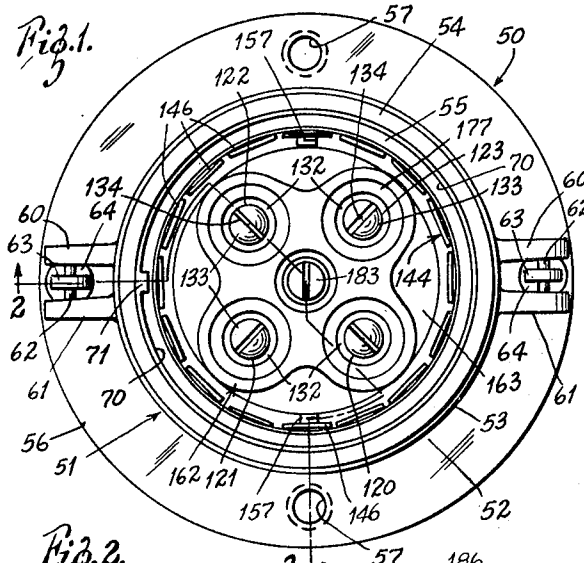


Fig. 4.

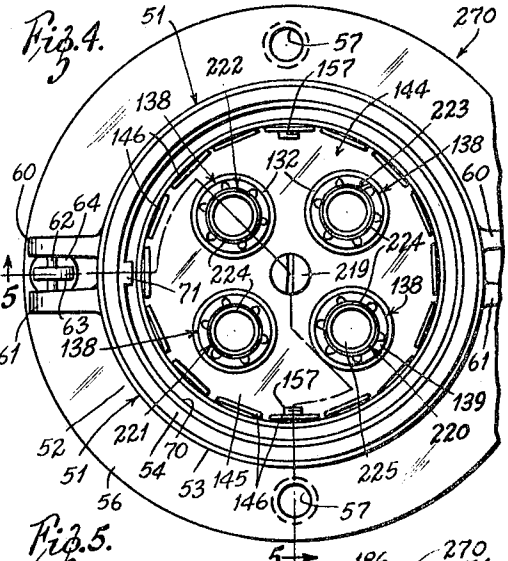


Fig. 2.

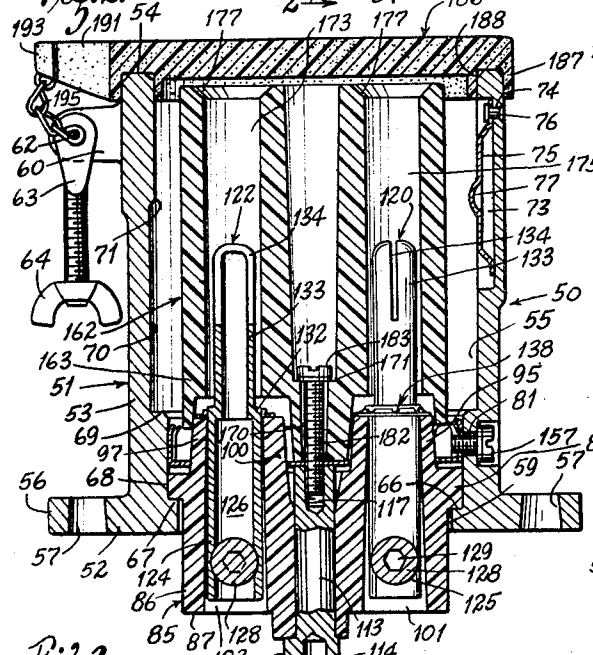


Fig. 5.

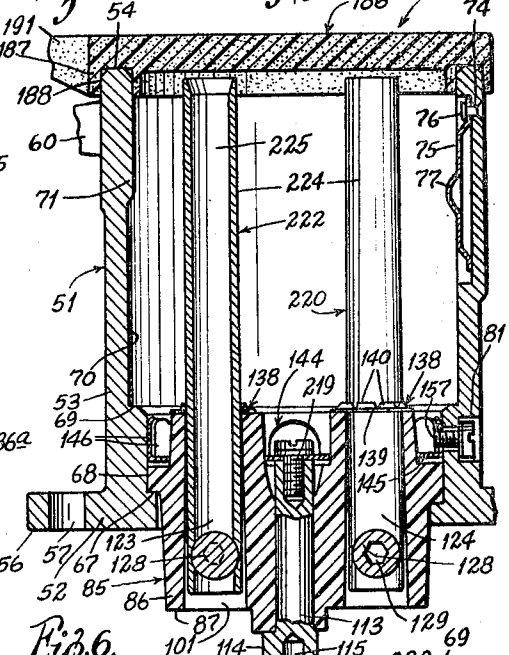


Fig. 3.

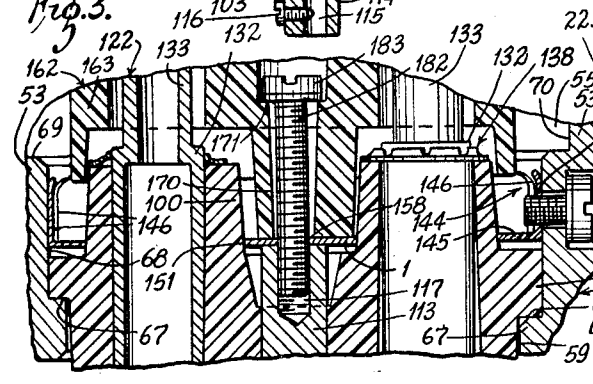
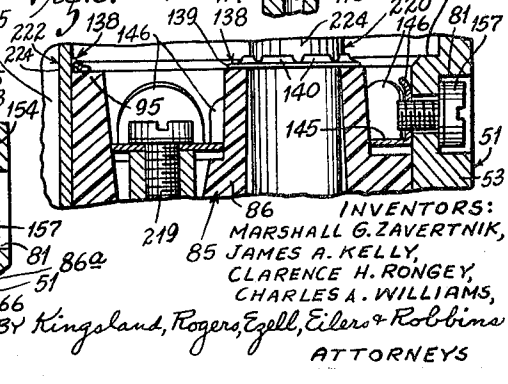


Fig. 6.



INVENTORS:
MARSHALL G. ZAVERTNIK,
JAMES A. KELLY,
CLARENCE H. RONGEY,
CHARLES A. WILLIAMS,
BY Kingsland, Rogers, Ezell, Eilers & Robbins
ATTORNEYS

June 25, 1968 M. G. ZAVERTNIK ETAL 3,390,369

ELECTRIC PLUG OR RECEPTACLE ASSEMBLY
WITH INTERCHANGEABLE PARTS

Filed Jan. 5, 1966 5 Sheets-Sheet 2

Fig. 7.

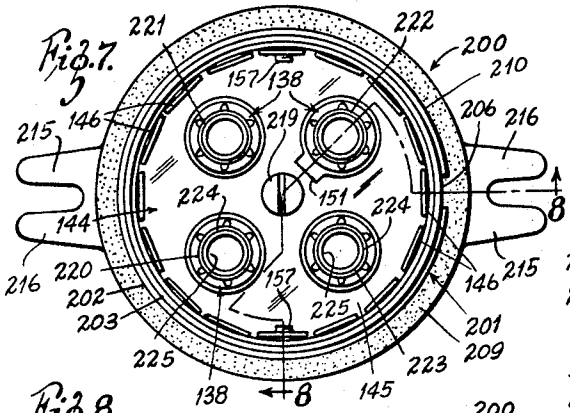


Fig. 9.

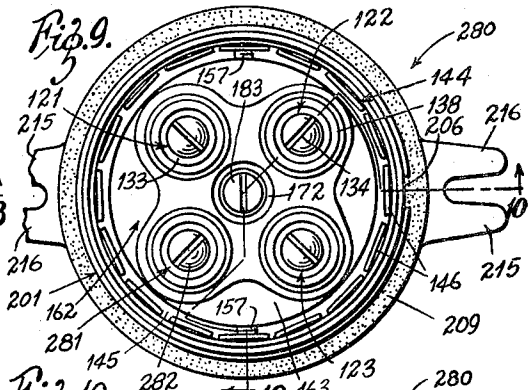


Fig. 8.

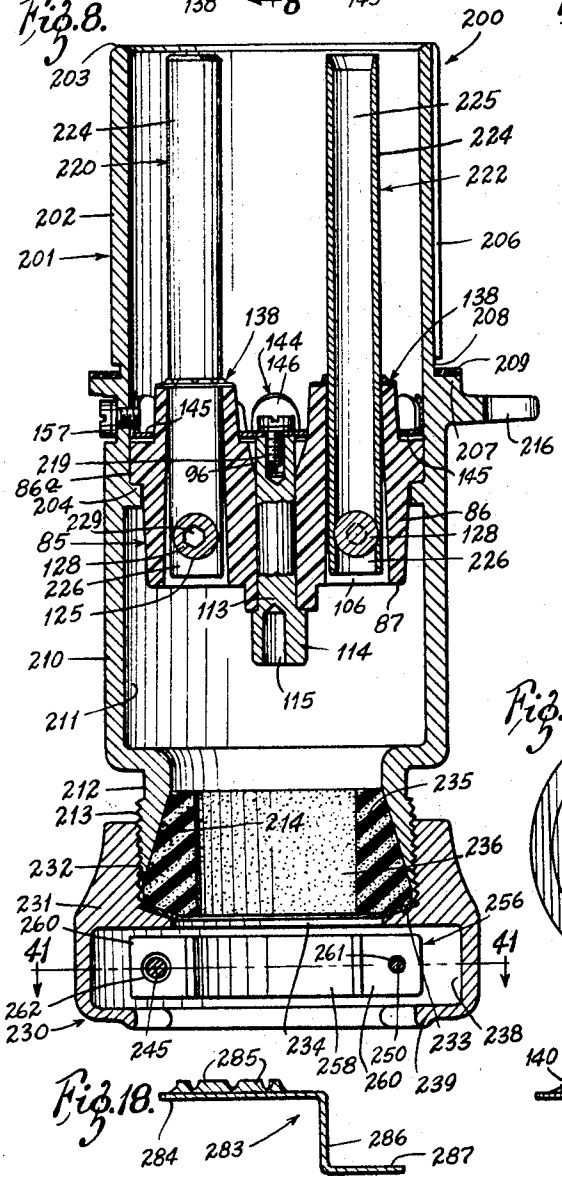


Fig. 10.

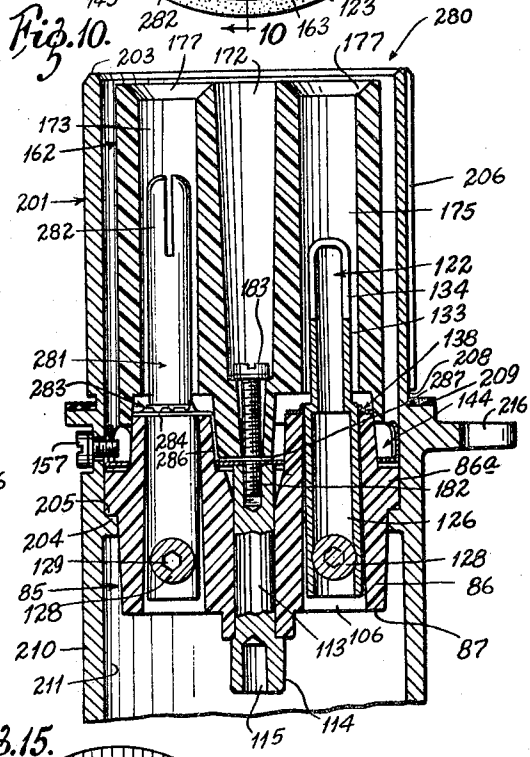


Fig. 15.

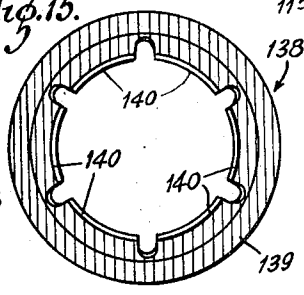


Fig. 17.

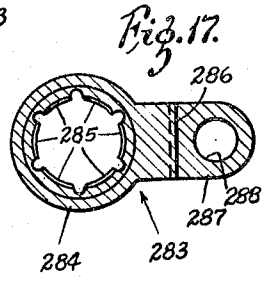


Fig. 16.

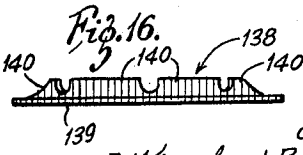


Fig. 18.

INVENTORS:
MARSHALL G. ZAVERTNIK,
JAMES A. KELLY,
CLARENCE H. RONGEY,
CHARLES A. WILLIAMS,
BY Kingsland, Rogers, Ezell, Eilers & Robbins
ATTORNEYS

June 25, 1968 M. G. ZAVERTNIK ET AL 3,390,369

ELECTRIC PLUG OR RECEPTACLE ASSEMBLY
WITH INTERCHANGEABLE PARTS

Filed Jan. 5, 1966 5 Sheets-Sheet 3

Fig. 11.

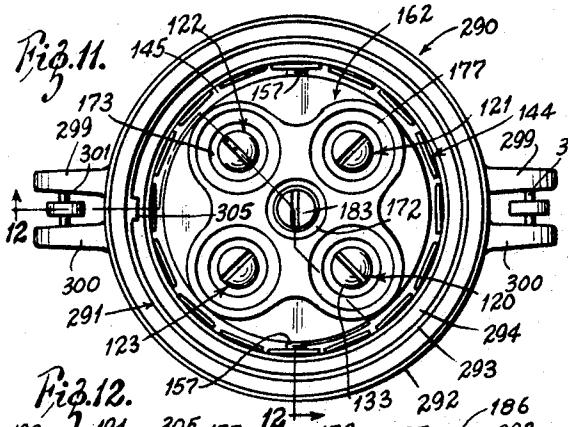


Fig. 13.

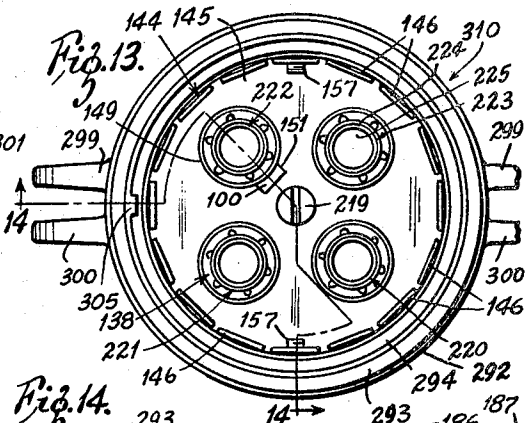


Fig. 12.

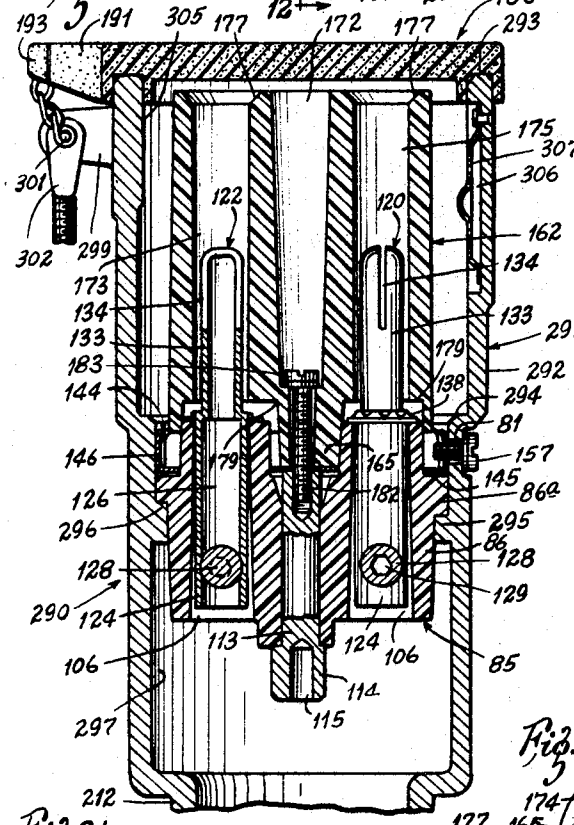


Fig. 14.

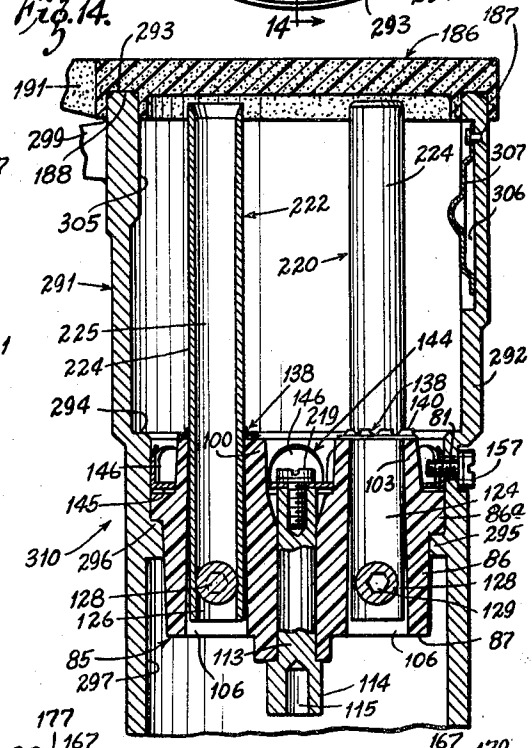


Fig. 20.

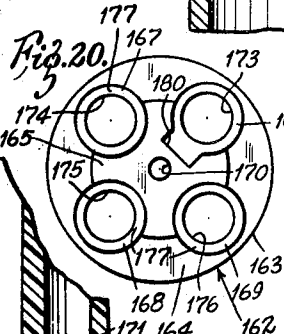


Fig. 19.

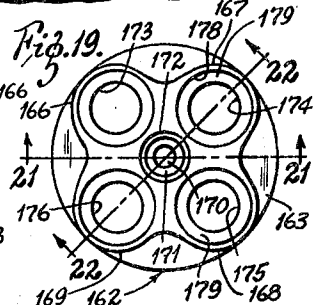


Fig. 21.

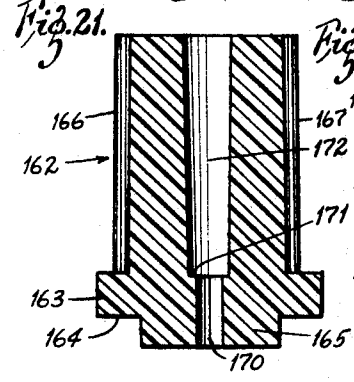
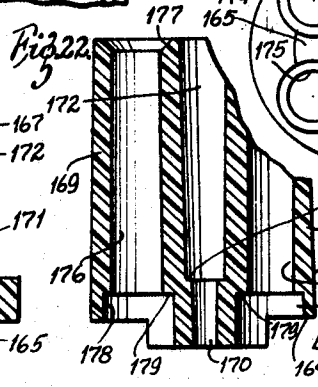


Fig. 22.



INVENTORS:
MARSHALL G. ZAVERTNIK,
JAMES A. KELLY,
CLARENCE H. ROWEY,
CHARLES A. WILLIAMS,
BY Kingsland, Rogers, Ezell, Eilers & Robbins
ATTORNEYS

June 25, 1968 M. G. ZAVERTNIK ETAL 3,390,369

ELECTRIC PLUG OR RECEPTACLE ASSEMBLY
WITH INTERCHANGEABLE PARTS

Filed Jan. 5, 1966 5 Sheets-Sheet 4

Fig. 23.

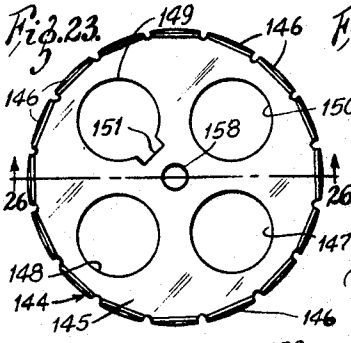


Fig. 24.

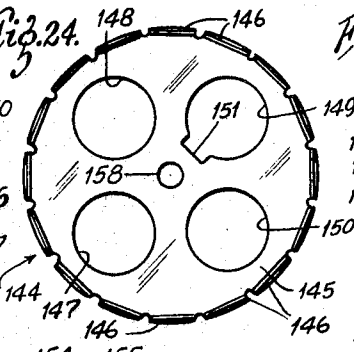


Fig. 33.

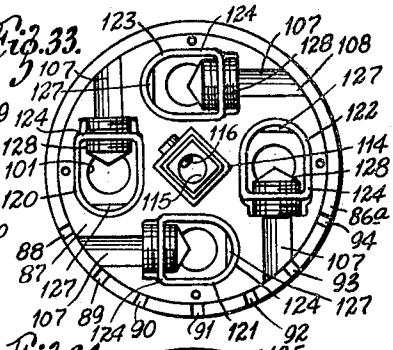


Fig. 25.

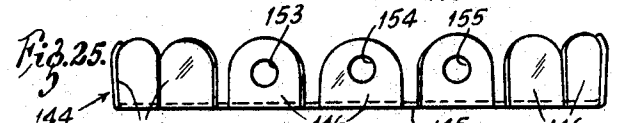


Fig. 26.

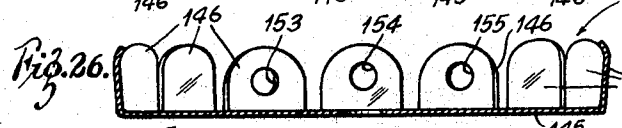


Fig. 34.

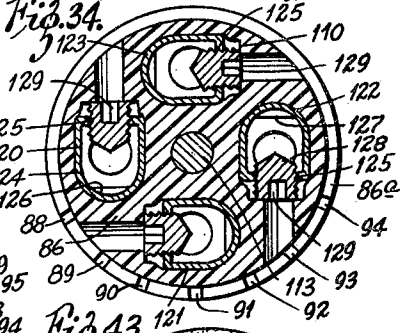


Fig. 27.

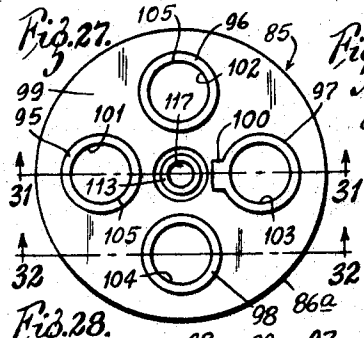


Fig. 30.

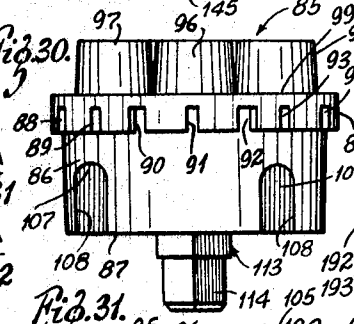


Fig. 43.

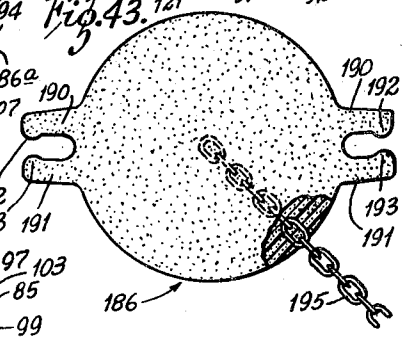


Fig. 28.

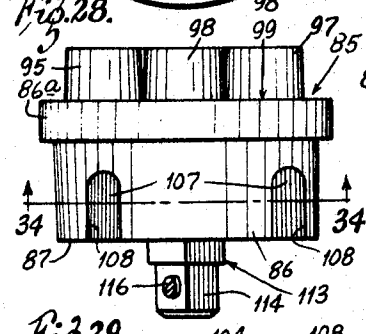


Fig. 31.

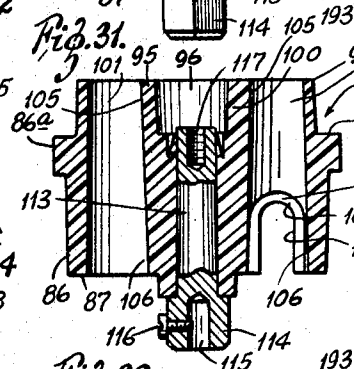


Fig. 44.

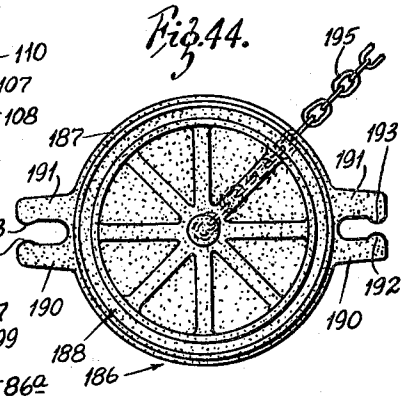


Fig. 29.

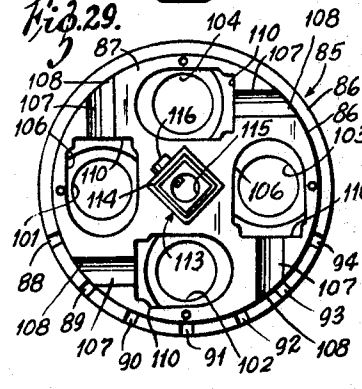
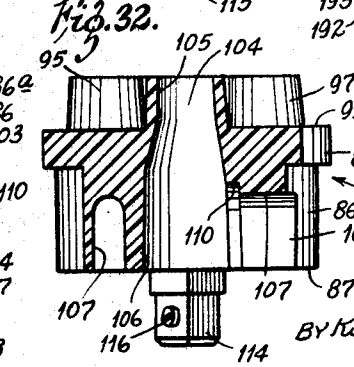


Fig. 32.



INVENTORS:
MARSHALL G. ZAVERTNIK,
JAMES A. KELLY,
CLARENCE H. RONGEY,
CHARLES A. WILLIAMS,
BY Kingsland, Rogers, Ezell, Eilers & Robbins
ATTORNEYS

June 25, 1968 M. G. ZAVERTNIK ETAL 3,390,369

ELECTRIC PLUG OR RECEPTACLE ASSEMBLY
WITH INTERCHANGEABLE PARTS

Filed Jan. 5, 1966 5 Sheets-Sheet 5

Fig. 35.

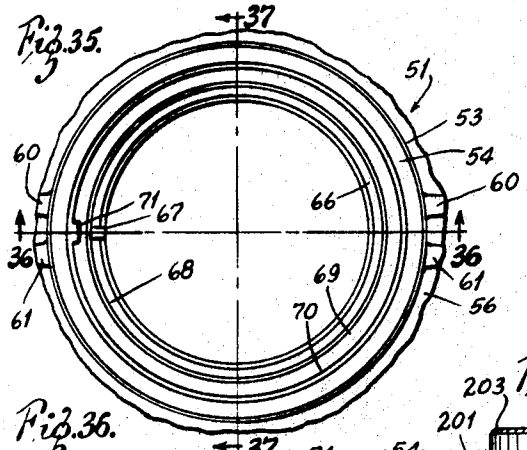


Fig. 36.

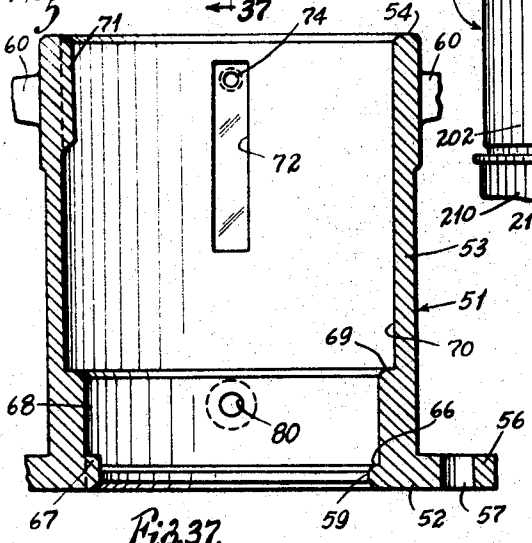


Fig. 37.

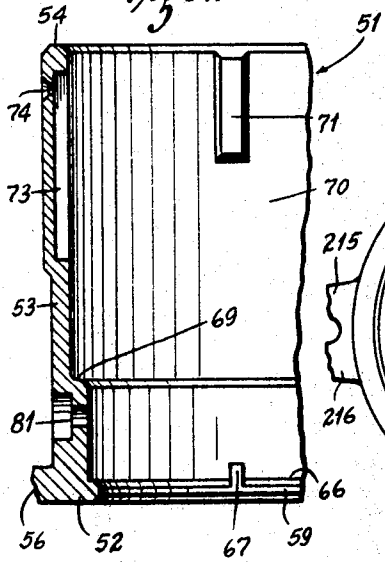


Fig. 38.

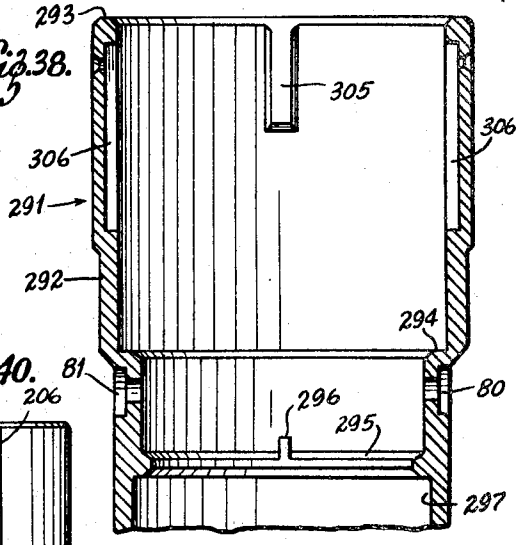


Fig. 40.

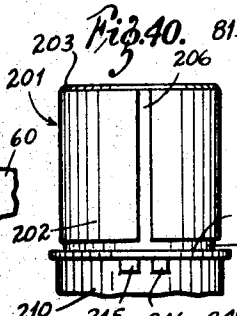


Fig. 41.

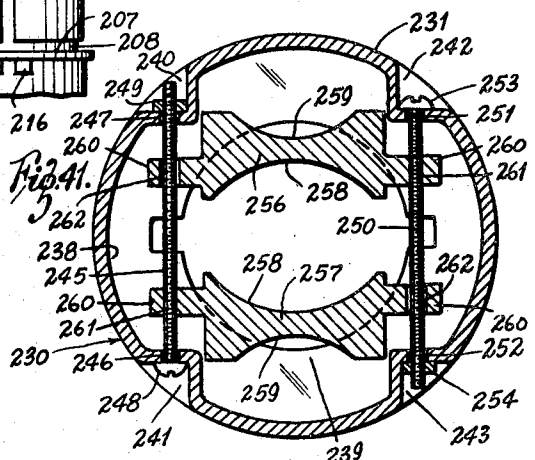


Fig. 39.

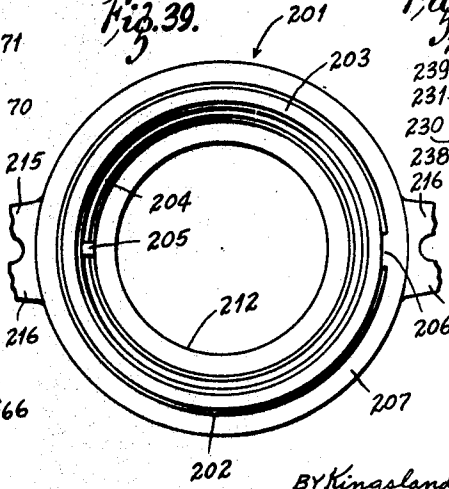
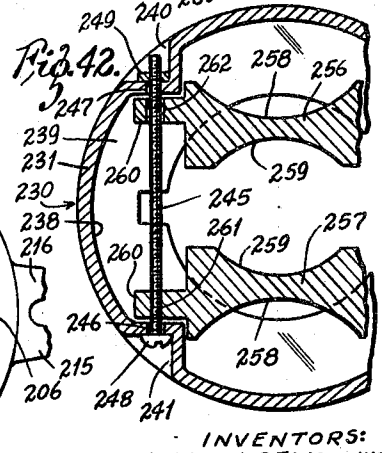


Fig. 42.



INVENTORS:
MARSHALL G. ZAVERTNIK,
JAMES A. KELLY,
CLARENCE H. RONGEY,
CHARLES A. WILLIAMS,

BY Kingsland, Rogers, Ezell, Eilers & Robbins
ATTORNEYS

United States Patent Office 3,390,369 Patented June 25, 1968

3,390,369

ELECTRIC PLUG OR RECEPTACLE ASSEMBLY WITH INTERCHANGEABLE PARTS

Marshall G. Zavertnik, Manchester, and James A. Kelly, St. Louis, Mo., and Clarence A. Rongey, Granite City, Ill., and Chester E. Williams, Rock Hill, Mo., assignors to Killark Electric Manufacturing Company, St. Louis, Mo., a corporation of Missouri

Filed Jan. 5, 1966, Ser. No. 540,423
12 Claims. (Cl. 339—14)

ABSTRACT OF THE DISCLOSURE

An electrical plug and receptacle assembly having readily interchangeable parts including different housing shells for the plug and receptacle assemblies, the housing shells complementing one another with one fitting within the other. The housing shells are interchangeable so that they can alternately contain other parts such as prongs or receptacle elements, arc chutes, and grounding rings for either a plug assembly or a receptacle assembly.

Both the plug and receptacle assemblies include a base insulator which supports either a set of contact prongs or a set of receptacle elements and which also contains a grounding shaft running through its center to which a ground conductor is connected. A grounding ring has openings through it for receiving hubs on the base insulator which surround the contact elements and has a central portion for making electrical contact with the ground shaft. The ground ring also has side flanges for maintaining contact with the housing shell. There is a spring at the upper end of the housing shell for making initial contact with the complementary housing shell to assure a ground before there are contacts between the hot terminals.

As further protection against inadvertent electrical contact, the plug assembly has an arc chute which comprises a plurality of tubular members held together as a unit, the tubular members fitting over the exposed prong portions of the contact elements. The tubular members of the arc chute are large enough in diameter to receive the female contact elements of the receptacle assembly.

In both assemblies, the contact elements ran be oriented for different amperages by rotating the base insulator and the grounding ring connected to it. The grounding ring has different flanges with different holes in them and selected ones of these holes are positioned opposite short screws, depending upon the orientation of the base insulator. The screws lock the grounding ring and base insulator in the selected position. There are also complementary keys and keyways in the housing shells which must be identically oriented before the two assemblies can be fitted together.

A weathertight cap of linear polyethylene fits over the housing shell in a snap-on fashion to provide a weathertight closure. The cap is easily removed when an electrical connection is to be made.

In addition to the foregoing, there are a number of objects of this invention. One object is to provide plug and receptacle assemblies made of interchangeable parts including interchangeable prong and receptacle housing shells, interchangeable insulators, interchangeable grounding elements, interchangeable contact elements, and interchangeable fastening parts. Another object of the invention is to provide plug and receptacle assemblies with means to assure ground contact prior to contact between the hot contact elements.

Another object of the invention is to provide a plug assembly having a base insulator of unitary formation and an arc chute of unitary formation, but wherein the base insulator and the arc chute are separate parts so that each may be made of a material best suited for its purpose of either insulating or providing resistance to arcing.

Another object of the invention is to provide plug and receptacle assemblies with retainer rings for locking the contact elements in place, the retainer rings being color coded for keying wire connections.

Another object of the invention is to provide plug and receptacle assemblies wherein the male and female contact elements are interchangeable and wherein each contact element has a conductor terminal formed integrally with it.

Another object of the invention is to provide such an assembly wherein the conductor terminals include setscrews for locking the conductors in place and wherein the setscrews are held captive in the base insulator.

Another object of the invention is to provide plug and receptacle assemblies wherein the contact elements can be oriented for different amperages and wherein the different plug and receptacle assemblies cannot make electrical contact unless they are identically oriented.

Another object of the invention is to provide plug and receptacle assemblies having a weathertight cap of linear polyethylene which is inexpensive to mold and yet provides a good weathertight seal, and which has an end of a retaining chain cast permanently into it.

Another object of the invention is to provide plug and receptacle assemblies for forming an electrical connector with a clamping assembly to clamp the electrical conductors, the clamping assembly having reversible adjustable jaws.

Other objects and advantages will be apparent to those skilled in the art.

In the drawings:

FIGURE 1 is a top plan view of the plug assembly with the weather protective cap removed;

FIGURE 2 is a view in section taken along the line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged fragmentary view in section of the central lower portion of the plug assembly of FIGURE 2;

FIGURE 4 is a top plan view (with the weather protective cap removed) of a receptacle assembly using interchangeable parts from the plug assembly of FIGURES 1–3;

FIGURE 5 is a view in section taken along the line 5—5 of FIGURE 4;

FIGURE 6 is an enlarged fragmentary view in section of the lower central portion of FIGURE 5;

FIGURE 7 is a top plan view of a receptacle assembly which is complementary to and operative with the plug assembly of FIGURES 1–3;

FIGURE 8 is a view in section taken along the line 8—8 of FIGURE 7;

FIGURE 9 is a top plan view of a plug assembly which is complementary to and operative with the receptacle assembly of FIGURES 4–6;

FIGURE 10 is a view in section taken along the line 10—10 of FIGURE 9;

FIGURE 11 is a top plan view of a plug assembly which is cooperative with and can be used with the receptacle assembly of FIGURE 8 as an unmounted connector, the weather protective cover having been removed;

FIGURE 12 is a view in section taken along the line 12—12 of FIGURE 11;

FIGURE 13 is a top plan view of a receptacle assembly which is cooperative with and can be used with the plug assembly of FIGURES 9 and 10, the weather protective cover having been removed;

FIGURE 14 is a view in section taken along the line 14—14 of FIGURE 13;

FIGURE 15 is an enlarged top plan view of a color coded push nut or retaining ring for retaining a contact in place within the base insulator, the vertical lines that appear, indicating the color red;

FIGURE 16 is a side elevation view of the push nut of FIGURE 15;

FIGURE 17 is a top plan view of another form of push nut having a tab extension for making ground contact, the diagonal lines that appear, indicating the color green;

FIGURE 18 is a side elevation view of the ground contact push nut of FIGURE 17;

FIGURE 19 is a top plan view on a reduced scale of the arc chute;

FIGURE 20 is a bottom plan view on a reduced scale of the arc chute;

FIGURE 21 is a view in section taken along the line **21—21** of FIGURE 19;

FIGURE 22 is a fragmentary view in section taken along the line **22—22** of FIGURE 19;

FIGURE 23 is a top plan view of a grounding ring;

FIGURE 24 is a bottom plan view of the grounding ring of FIGURE 23;

FIGURE 25 is an enlarged side elevation view of the grounding ring;

FIGURE 26 is an enlarged view in section taken along the line **26—26** of FIGURE 23;

FIGURE 27 is a top plan view of the base insulator shown on a reduced scale;

FIGURE 28 is a side elevation view on a reduced scale of the base insulator;

FIGURE 29 is a bottom plan view on a reduced scale of the base insulator;

FIGURE 30 is a side elevation view on a reduced scale showing the reverse side of the base insulator from the shown in FIGURE 28;

FIGURE 31 is a view in section on a reduced scale taken along the line **31—31** of FIGURE 27;

FIGURE 32 is a view in section on a reduced scale taken along the line **32—32** of FIGURE 27;

FIGURE 33 is a bottom plan view of the base insulator showing the terminals and locking setscrews;

FIGURE 34 is a view in section on a reduced scale taken along the line **34—34** of FIGURE 28, with the terminals and locking setscrews added;

FIGURE 35 is a fragmentary top plan view of a plug or receptacle shell;

FIGURE 36 is a view in section taken along the line **36—36** of FIGURE 35;

FIGURE 37 is a view in section taken along the line **37—37** of FIGURE 35;

FIGURE 38 is a fragmentary view in section of another shell corresponding to the shell used for the connector assembly shown in FIGURE 12, being a shell adapted to receive the shell of FIGURES 35–37;

FIGURE 39 is a fragmentary top plan view of another shell;

FIGURE 40 is a fragmentary side elevation view on a reduced scale of the shell of FIGURE 39;

FIGURE 41 is a view in section taken along the line **41—41** of FIGURE 8, and showing the cord grip jaws oriented for clamping relatively large cords;

FIGURE 42 is a fragmentary view in section similar to that of FIGURE 41, but showing the cord grip jaws oriented to grip cords of relatively smaller diameters;

FIGURE 43 is a top plan view of the weather protective cap; and

FIGURE 44 is a bottom plan view of the weather protective cap.

Referring now to FIGURES 1–3, the plug assembly **50** comprises a cast aluminum plug shell **51** having a flat base **52**, a generally cylindrical side wall **53**, and an upper edge **54**, all providing a central cavity **55**. There is an annular flange **56** surrounding the base **52** and having holes **57** through it to permit mounting of the shell **51** at

any desired location. There is a large round opening **59** through the base **52**.

Near the upper edge **54** of the shell **51**, two pairs of spaced ears **60** and **61** project laterally outwardly. A shaft **62** is mounted between each pair of ears **60** and **61**, and the shaft **62** pivotally supports a bolt **63** onto which a wing nut **64** is threaded.

There is an annular shoulder or ledge **66** surrounding the opening **59**, with a lug **67** projecting above the ledge **66** and inwardly of the adjacent inner wall **68**. There is another annular shoulder **69** that joins the wall **68** to the upper inner cylindrical wall **70**. A narrow vertical key **71** projects inwardly from the wall **70**. In addition, with reference also to FIGURES 35–37, there are two vertical recesses **72** and **73** in the side wall **70**, each with a countersunk hole **74** leading from it through the wall **70**. There is a grounding spring **75** held in each recess **72** and **73** by a rivet **76** extending through the hole **74**. The grounding spring **75** has a curved inwardly projecting portion **77** that extends beyond the inner surface of the wall **70**. There are also two counterbored holes **80** and **81** through the lower portion of the shell **51** communicating with the wall **68**.

As shown in FIGURES 27–31, a base insulator **85** has a body **86** that is generally cylindrical, but with a slight taper toward its lower surface **87**. There is an annular shoulder **86***a* at the upper end of the cylindrical portion **86** which rests upon the shoulder **66** of the plug shell **51**, as shown in FIGURES 2 and 3. There is a plurality of notches **88**, **89**, **90**, **91**, **92**, **93**, and **94** in the shoulder **87**, one of which receives the lug **67** adjacent the shoulder **66**.

There is a plurality of upstanding bosses **95**, **96**, **97** and **98** extending above the upper surface **99** of the body portion **86***a*. One of the bosses **97** has a vertical inwardly extending key **100**. The bosses **95–98** surround bores **101**, **102**, **103**, and **104**, respectively, which extend through the base insulator **85**. Each bore **101–104** is generally round near its upper end **105** and maintains a relatively constant width in its dimension parallel to the radius of the base insulator **85**, but gradually spreads laterally toward its lower end **106** as shown in FIGURE 32. There is a lateral extension **107** at a side of each bore **101–104** adjacent the lower end **106** thereof. Each lateral extension **107** opens through the lower wall **86** of the base insulator **85** and has a mouth **108** through a side of the base insulator. However, the height and width of the extension **107** is less than the height and width of the lower portion **106** of each bore **101–104** so that a horseshoe-shaped shoulder **110** is defined, as particularly shown in FIGURES 29, 31, and 32.

The base insulator **85** is made of a suitable insulating material which provides electrical insulation, but there is an electrically conductive shaft **113** molded into the base insulator. The shaft **113** has a head **114** at its lower end with a recess **115** in it for receiving a ground conductor. There is a setscrew **116** threaded through a side of the head **114** to lock a ground conductor in the recess **115**. At the upper end of the grounding shaft, there is a tapped hole **117**.

There are contact prongs **120**, **121**, **122**, and **123** received within the bores **101–104**, respectively. Each prong has a base **124** of gradually increasing width with a flat side having a threaded hole **125** through it (see FIGURES 33 and 34) to its hollow interior **126**. There are vertically spaced inwardly projecting ribs **127** opposite the hole **125**. The hole **125** receives a setscrew **128** having an Allen wrench socket **129** for tightening a wire between the setscrew **128** and the opposing ribs **127**. The diameter of the setscrew **128** being less than the width of the lateral passage **107**, the setscrews **128** are captive in the base insulator.

As seen particularly in FIGURES 1 and 2, each prong **120–123** also has a shoulder **132** positioned above the upper surface of the bosses **95–98**, above which a contact element **133** extends. There is a slot **134** in each contact

element 133 to make it laterally yieldable as is cutomary in the art.

Each contact prong 120–123 is held in place with a retaining ring or push nut 138, shown in FIGURES 15 and 16. Each push nut 138 has a base 139 that rests on top of the boss 95, 96, 97 or 98 and an upwardly inclined group of tabs 140 which are sprung against the base 123 of the prong just below the shoulder 132. The push nuts 138 are color coded to identify different contacts 120–123.

A grounding ring 144 is shown in FIGURES 23–26 as comprising a base 145 with a plurality of vertically upstanding tabs 146 around the periphery of the base 145. There are holes 147, 148, 149 and 150 for receiving the bosses 95–98, respectively. The hole 149 has an adjacent keyway 151 for receiving the key 100 on the boss 97. When the ground ring 144 is pressed into the position shown in FIGURE 2, the keyway 151 cooperates with the key 100 to assure a proper orientation. In addition, there is a plurality of holes 153, 154 and 155 in diametrically opposing ones of the tabs 146. The countersunk holes 81 receive short bolts 157 which can be threaded into selected ones of the holes 153–155 to position the grounding ring 144 in one of a plurality of selected positions. A hole 158 in the center of the base 145 overlies the tapped hole 117 in the conducting shaft 113.

FIGURES 19–22 illustrate an arc chute 162. The arc chute 162, which is made of a material selected for best arc resistance characteristics, has a base 163 having a flat lower side 164 with a central hub 165 projecting below it. There are four tubular members 166, 167, 168 and 169 which may merge together at the center of the arc chute and, in any case, there is a hole 170 through the center of the arc chute countersunk to provide a shoulder 171 with a larger access passage 172 above the shoulder.

There are passages 173, 174, 175 and 176 through the tubular members 166–169, respectively. Each passage 173–176 has a beveled upper end 177 and a counterbored lower end 178 which provides an annular shoulder 179. There is a keyway 180 adjacent the lower end 178 of the bore 173 to receive the projection 100 on the upper side of the base insulator 85 (shown in FIGURE 27).

The arc chute 162 fits over the prongs 120–123 as shown in FIGURE 2 with the projecting key 100 received within projecting hub 165 hits the top of the ground ring 144. Then the arc chute is fastened in place by a bolt 182, the head 183 of which bears against the shoulder 171 and the shaft of which extends through the passage 170 and the hole 158 in the grounding ring 144.

FIGURES 43 and 44 show a linear polyethylene cap 186 having an annular downward projection 187 with an annular groove 188 in it for receiving the upper edge 54 of the shell 51. This groove 188 is shaped to cooperate with the rim 54 to provide a snap-on weathertight seal.

At opposite sides of the cap 186, there are two pairs of spaced ears 190 and 191 with inwardly directed beads 192 and 193, respectively. The ears 190 and 191 receive the bolt 63 between them when the bolt is pivoted about the shaft 62. Then, when the wing nuts 64 are tightened, they tighten the cap 186 onto the plug shell 51.

A chain 195 has an end molded onto the cap 186. The other end is fastened to one of the shafts 62 so that the cap 186 cannot be mislaid.

FIGURES 7 and 8 illustrate a receptacle assembly 200 that may be used with the plug assembly 50 which has been described. In the receptacle assembly 200 there are some parts which are interchangeable with those in the plug assembly 50, as will be described. The receptacle shell 201 is different in comprising a cylindrical wall 202 having an upper edge 203 and an internal annular shoulder 204. A notch 205 (FIGURE 39) above the shoulder 204 corresponds to the notch 67 on the assembly 50. There is a vertical groove 206 in the outer wall of the cylinder 202 and an annular shoulder 207 below a peripheral groove 208 which receives a gasket 209.

Below the annular shoulder 205, there is a wall 210 defining a well 211 leading to a neck portion 212 having external threads 213 and an internal beveled wall 214. The shell 201 may also have opposing clamping lugs 215 and 216.

The receptacle assembly 200 uses the base insulator 85 which has been described, including the grounding shaft 113 and the grounding ring 144. The grounding ring 144 is set in a rotatably adjustable position by the two setscrews 157 which also have been described. However, since there is no arc chute in the receptacle assembly, a different length bolt 219 is used to fasten the grounding ring 144 to the ground shaft 113.

The base insulator 85 in the receptacle assembly 200 supports a plurality of female contact elements 220, 221, 222 and 223. Each of the contact elements 220–223 has an upper cylindrical portion 224 with a hollow interior 225 and with a lower portion 226 that may be identical to the lower portion of the contact prongs 120, 121, 122 and 123, including the locking studs 128 and their relationship to the lateral recesses 107 in the base insulator 85. The external diameter of each contact element 220–223 is the same as the diameter of the area of the contact prongs 120–123 just below the shoulder 132. Therefore, the locking nuts 138 are used for holding the contact elements 220–223 in place in the base insulator 85.

A clamping assembly 230 has a housing 231 with internal threads 232, an inwardly beveled seat 233, and an inner passage 234. A rubber grommet 235 is wedged between the seat 233 and the beveled entrance 214 of the receptacle housing 201 when housing 231 is threaded onto the lower threaded end 213. The grommet 235 has a passage 236 through it for accommodating electrical conductors.

There is an annular recess 238 in the clamping housing 231 defined at its lower side by an annular flange 239. As shown in FIGURES 41 and 42, there are opposing recesses 240 and 241 on one side of the clamping housing 231 and recesses 242 and 243 on the other side. A bolt 245 extends through holes 246 and 247 in the housing 231. The head 248 of the bolt 245 bears against the wall of the recess 241 and at the other end of the bolt, a locking nut 249 is threaded onto the bolt 245 and spot welded in place to provide a bearing. Similarly, a bolt 250 extends through holes 251 and 252 in the housing 231, the head 253 being positioned within the recess 242 and the locking nut 254 being positioned within the recess 243. There are two clamping jaws 256 and 257. Each clamping jaw has a relatively large-radius bearing side 258 and a smaller-radius bearing side 259. Each clamping jaw has a pair of opposed flanges 260. One flange of each pair has a tapped hole 261 through it for receiving one of the bolts 245 and 250. The opposite flange of each pair has a circular opening 262 through it, the diameter of the opening being larger than that of the bolts.

When the jaws 256 and 257 are oriented as shown in FIGURE 41, the larger-radius sides 258 oppose one another, and the positions of the flanges 260 permit these walls 258 to be moved relatively far apart when the bolts 245 and 250 are rotated. Still, rotation of these bolts permits adjustment of the spacing between the walls 258. For smaller diameter conductors, the bolts 245 and 250 are removed to permit inversion of the jaws 256 and 257, as shown in FIGURE 42, with the smaller-radius walls 259 opposing one another. Now, the bolts 245 and 250 can be threaded to adjust the relative spacing between the walls 259. Thus, the jaws 256 and 257 accommodate a range of smaller diameter conductors.

It will be noted that the clamping assembly 230 has no sharp protruding parts. The recesses 240, 241, 242 and 243 receive the parts of the screws 245 and 250 which would otherwise project, and the annular flange 239 extends beyond the sharp edges of the clamps 256 and 257.

The plug assembly 50 and the receptacle assembly 200

fit together in a manner that assures proper electrical connection. The key **71** in the inner wall **70** of the plug shell **51** prevents entry of the receptacle shell **201** into the plug shell unless the slot **205** is aligned with the key **71**. If there is proper alignment, the receptacle shell **201** can enter the plug shell **51**, and the female contact elements **220–223** enter the tubular members **166–169**. Before the contact elements **220–223** reach the contact elements **120–123**, the leading edge **203** of the receptacle shell **201** contacts the ground spring **75**, establishing a ground contact because the spring **75** is in contact through the rivet **76** with the aluminum housing of the shell **51**. The shell **51** makes ground contact with the grounding ring **144** through the studs **157**. From the grounding ring **144** contact is made with the grounding shaft **113** in the ground wire which is held in the recess **115** by the setscrew **116**. Thereafter, as the receptacle assembly **200** is pushed further toward the plug assembly **50**, the contact prongs **133** of the male contact elements **120–123** enter the female contact elements **220–223** to make the desired electrical connection until the rim **54** seats against the gasket **209** on the shoulder **207**. Then, the bolts **63** may be swung into the space between the opposed locking lugs **215** and **216** and the wing nuts **64** tightened to hold the plug and receptacle assemblies securely together.

The design of this invention and the various parts make interchangeability and versatility a significant advantage. For example, referring to FIGURES 4 and 5, there is a receptacle assembly **270** different from the plug assembly **50** of FIGURE 2 and the receptacle assembly **200** of FIGURE 8, but employing parts all of which have already been described. The receptacle assembly **270** has a housing shell **51** identical to the shell **51** shown in FIGURE 2. It has a base insulator **85** identical to the base insulator **85** used for the plug assembly **50** and also for the receptacle assembly **200**. The grounding shaft **113** is identical to the grounding shaft **113** used for the plug assembly **50** and the receptacle assembly **200**, with the same bolt **219** as is used for the receptacle assembly **200**. The grounding ring **144** is identical to the grounding ring used for both the plug assembly **50** and the receptacle assembly **200**. The female contact elements **220–223** with their clamping studs **128** are like the contact elements and clamping studs used on the receptacle assembly **200**. The snap rings **138** are the same as already described, and the snap-on weatherproof cap **186** is as described.

One the other hand, FIGURES 9 and 10 illustrate a plug assembly **280** which is different from the assemblies heretofore described, although it uses parts identical to those already described, the plug assembly **280** being complementary to the receptacle assembly **270** shown in FIGURE 5. The plug assembly **280** uses the housing shell **201** which is used for the receptacle assembly **200**. It also uses the same base insulator **85**, grounding shaft **113**, and ground ring **144** which have been described, and uses the arc chute **162** and the fastening bolt **182** which are used for the plug assembly **50**. The prongs may be identical to the prongs **120–123** as have been described, and the snap rings **138** which hold them in place may also be as described, but FIGURES 9 and 10 illustrate a modification wherein one of the prongs is a grounding prong **281** with its contact elements **282** of extended length. Also, to hold the grounding prong in place, there is a special snap ring **283** (FIGURES 17 and 18) having a base **284** and inner tabs **285** corresponding to the base **139** and the tabs **140** on the ring **138**, but the snap ring **283** also has a downwardly extending arm **286** and a lateral tab **287** having a hole **288** through it. When the snap ring **283** is in place as shown in FIGURE 10, holding the grounding prong **281** in the base insulator **85**, the tab **287** overlies the base **145** of the ground ring **144** and receives the bolt **182**. Therefore, a ground connection is established from the ground prong **281** through the snap ring **283** and its tab **287** to the ground shaft **113**. Because of its extended length, the ground prong **281** makes contact with its appropriate female receptacle before the hot contacts are made so that shorts are grounded. This extended length ground contact **281** may be used with or instead of the ground contact springs **75**.

The plug assembly **50** shown in FIGURE 2 and the receptacle assembly **270** shown in FIGURE 5 have housing shells **51** that are intended to be bolted for generally permanent mounting, but there are times when unmounted electrical connectors are needed. For these, receptacle assembly **200** of FIGURE 8 or the plug assembly **280** of FIGURE 10 may be used.

In FIGURES 11 and 12, a plug assembly **290** is shown having a housing **291** with a cylindrical wall **292** between an upper edge **293** and an inner annular shoulder **294**. The configuration of this part of the housing **291** corresponds to what has been described for the shell **51**.

The housing shell **291** also has another annular ledge **295** with an upstanding lug **296** corresponding to the lugs **67** of the shell **51** (see FIGURES 35 and 36). There is a well **297** below the ledge **295**, and although broken away, a threaded neck portion corresponding to the neck **212** and threaded area **213** on the housing shell **201** as shown in FIGURE 8. This threaded neck portion is sized to receive the clamping assembly **230** as has been described.

The housing shell **291** has the sets of spaced ears **299** and **300** between which a shaft **301** is mounted to support the locking bolt **302** which corresponds to the bolt **63**. On the inner wall of the housing shell **291**, there is a vertical key **305** and a pair of recesses **306** to receive the grounding springs **307** which correspond to the grounding springs **75**.

The other parts of the plug assembly **290** are identical to parts which have already been described. The base insulator **85** which has been described is used, its annular shoulder **87** resting upon the ledge **295** with the key **296** being received in one of the notches **88–94**. The grounding shaft **113**, the arc chute **162**, the ground ring **144**, the bolt **182**, the contact elements **120–123**, and the snap rings **138**, all of which have already been described, are used in the assembly **290**.

The plug assembly **290** fits together with the receptacle assembly **200** as is now apparent.

FIGURES 13 and 14 illustrate another receptacle assembly **310** that complements the plug assembly **280**. The receptacle assembly **310** uses parts which have already been described, including the housing **291** which is used with the plug assembly **290**, and including the base insulator **85**, the ground shaft **113**, the female contact elements **220–223**, and the cap **186**.

Orientation for proper polarity may be explained in connection with the plug assembly **50** as shown in FIGURE 2. As has already been stated, the snap rings **138** are color coded in different colors corresponding to different wire connections, and appropriate wires are clamped by the setscrews **128** to the different contact elements **120–123**, depending upon these color codings. Since different connector assemblies may carry different currents, means are provided for orienting the positions of the contact elements **120–123** so that only receptacle assemblies having the same orientation can be put into electrical contact with the prongs **120–123**. This orientation is accomplished by removing the screws **157** and rotating the base insulator **85** until predetermined ones of the holes **153–155** are opposite the screws **157**, the grounding ring **144** being rotated with the base insulator **85**. When the proper predetermined position of the grounding ring **144** is established, the screws **157** are replaced. The key **67** fits within one of the notches **88–94** because these notches are spaced equally with the spacing between the holes **153**, **154**, and **155**. Since the notches **88–94** are only on one side of the base insulator **85**, it is impossible to inadvertently get the base insulator **85** one hundred eighty degrees out of orientation when attempting to align the proper holes **153–155** with the screws **157**.

The receptacle which is to be used with the plug assembly **50**, such as the assembly **200**, is also oriented as has just been described. The assemblies will fit together if the orientation is identical because only then will the position of the key **71** correspond to the position of the keyway **206**.

Various changes and modifications may be made within the purview of this invention as will be readily apparent to those skilled in the art. Such changes and modifications are within the scope and teaching of this invention as defined by the claims appended hereto.

What is claimed is:

1. An electrical contact assembly for a plug or receptacle comprising a housing shell having an open end, a base insulator supported opposite the said open end, a plurality of contact elements projecting from the base insulator toward the said open end, a grounding ring supported by the base insulator, and means to selectively orient the base insulator upon rotation within the housing shell depending upon the electrical characteristics of the assembly, with electrical contact means for locking the grounding ring to the housing shell in a selected position and thereby lock the base insulator in a selected position.

2. The assembly of claim **1** wherein the shell is complementary and telescopes with another similar shell, and wherein there are identical parts in the last-named shell, except that contact elements in one shell are prongs and contact elements in the other shell are recessed to receive the prongs.

3. The assembly of claim **2** including an arc chute of arc resistant material having tubular members surrounding but spaced from the prongs, the tubular members being sized to receive the recessed contact elements.

4. The assembly of claim **2** wherein the shells are electrically conductive, but each is in electrical contact with its respective grounding ring, a grounding shaft through the base insulator for making contact with a ground conductor, and means to establish electrical contact between the grounding ring and the grounding shaft.

5. The combination of claim **2** wherein the housing shells of the plug and receptacle assemblies are interchangeable.

6. The combination of claim **5** wherein one of the housing shells has means for permanent mounting of the shell to a wall surface, and another unmountable shell interchangeable with the last-named shell for use as an unmountable connector assembly.

7. The combination of claim **4** with interfitting key and keyway elements between the base insulator and the grounding ring to orient the grounding ring relative to the base insulator.

8. The combination of claim **7** with releasable locking means to interlock with different parts of the grounding ring, thereby permitting rotation of the grounding ring and base insulator to different predetermined positions relative to the housing shell corresponding to different electrical characteristics of the assembly.

9. The combination of claim **8** with interfitting key and keyway elements between the telescoping housing shells to prevent contact between contact elements of two assemblies unless their base insulators are identically oriented.

10. The combination of claim **1** including color coded snap rings for locking the contact elements in the base insulator and for identifying which contact elements are to be wired to selected external conductors.

11. The combination of claim **1** including a clamping assembly threaded to the shell and having wholly contained reversible, slidable jaws for clamping conductors between them.

12. The combination of claim **1** including a linear polyethylene cover for the said open end of the shell.

References Cited

UNITED STATES PATENTS

2,032,501	3/1936	Reynolds	339—14
2,091,054	8/7937	Petrie	339—103
2,521,056	9/1950	Frei et al.	339—63
2,563,713	8/1951	Frei et al.	339—63
2,750,571	6/1956	Schmier	339—103
3,065,439	11/1962	Krause	339—18
3,146,054	8/1964	Shearer et al.	339—186
3,177,462	4/1965	Sarnmark	339—186
3,271,726	9/1966	Pfendler	339—49

FOREIGN PATENTS

1,024,602	2/1958	Germany.
831,884	4/1960	Great Britain.
941,593	11/1963	Great Britain.
950,088	6/1964	Great Britain.

MARVIN A. CHAMPION, *Primary Examiner.*

P. A. CLIFFORD, *Examiner.*