June 30, 1942. C. A. HARDAGE 2,288,525

ELECTRICAL PLUG AND RECEPTACLE

Filed May 21, 1940 3 Sheets-Sheet 1

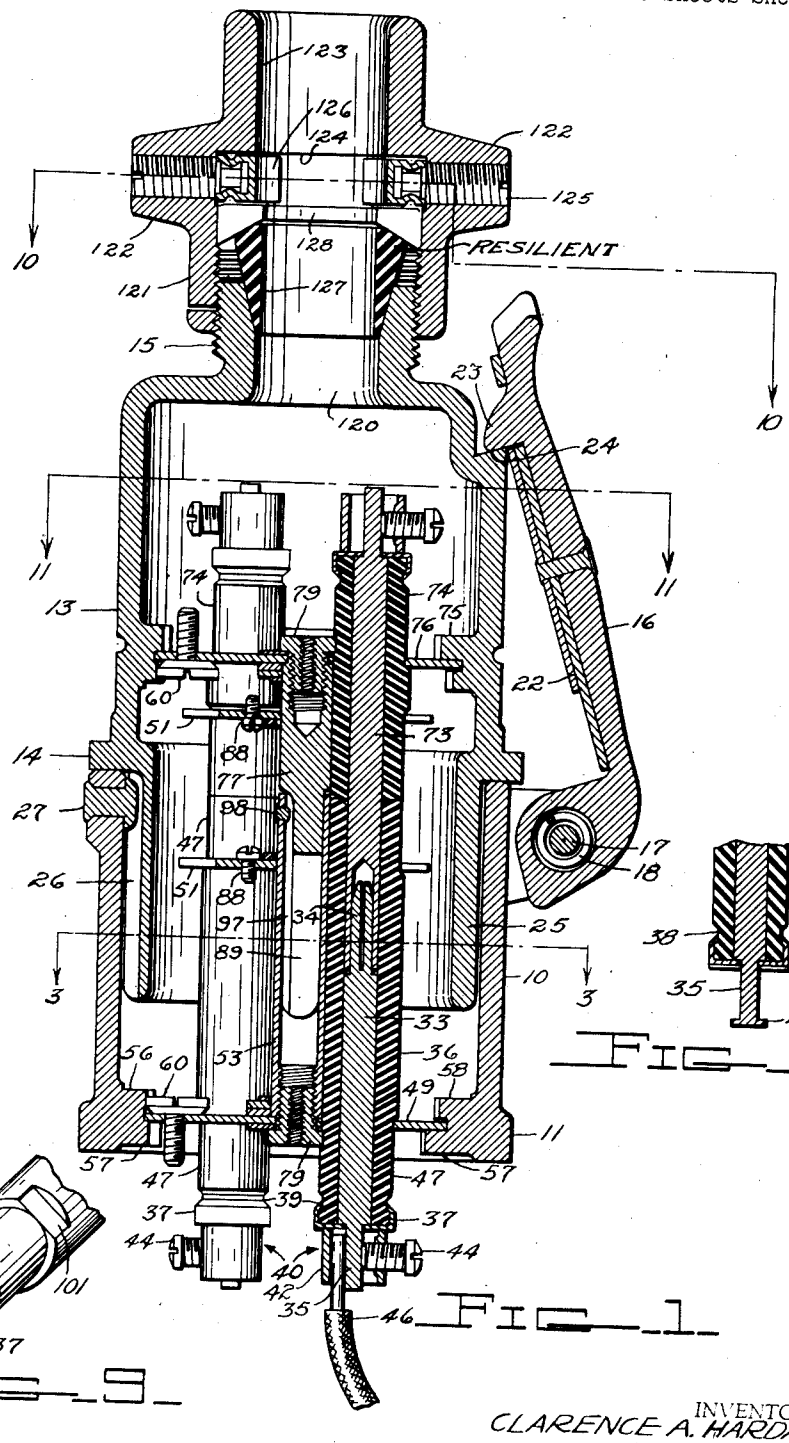


FIG. 8

FIG. 1

FIG. 9

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ELECTRICAL PLUG AND RECEPTACLE

Filed May 21, 1940 3 Sheets-Sheet 2

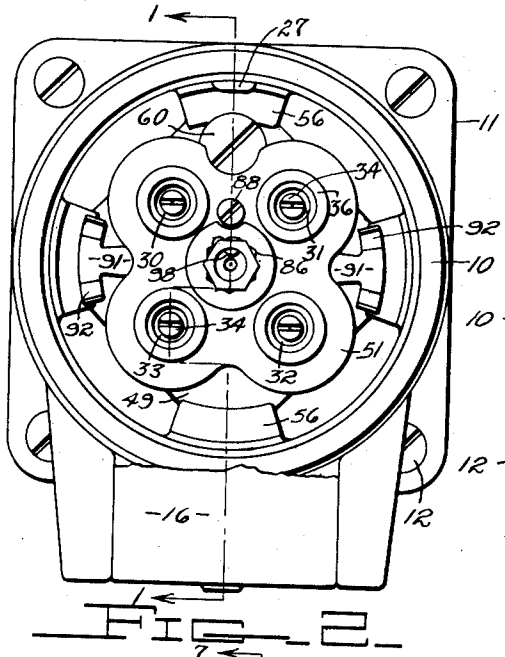


FIG. 2.

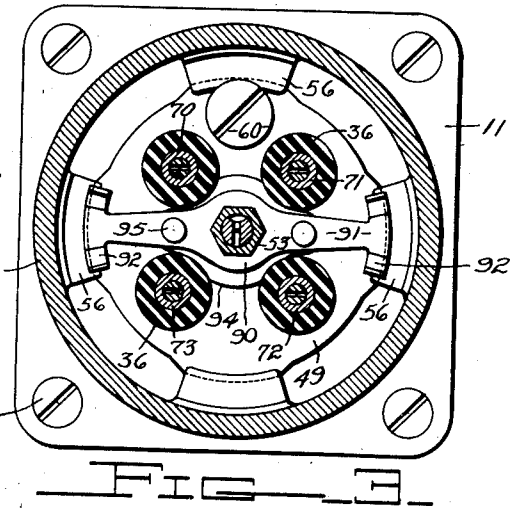


FIG. 3.

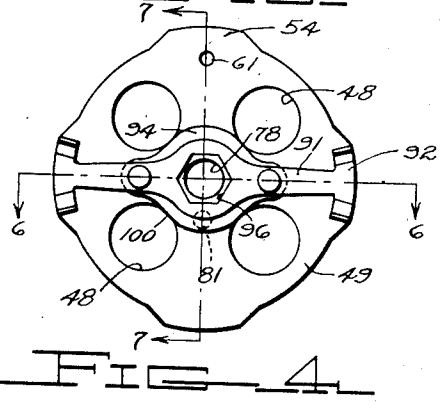


FIG. 4.

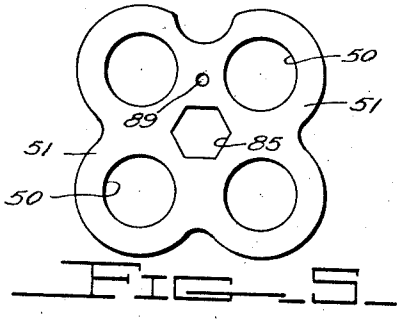


FIG. 5.

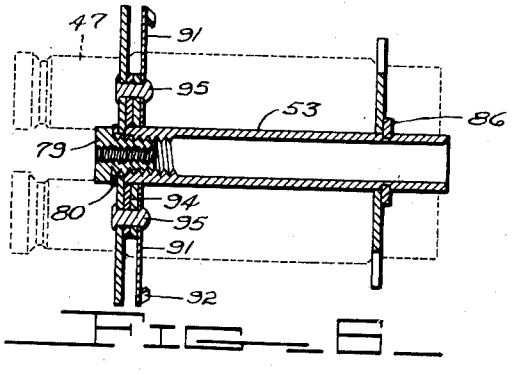


FIG. 6.

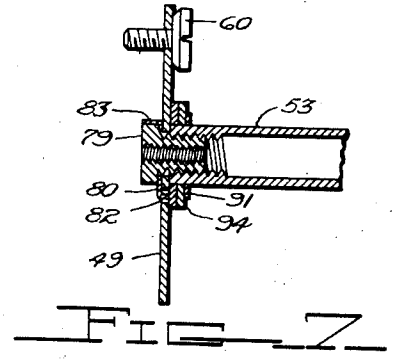


FIG. 7.

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ELECTRICAL PLUG AND RECEPTACLE

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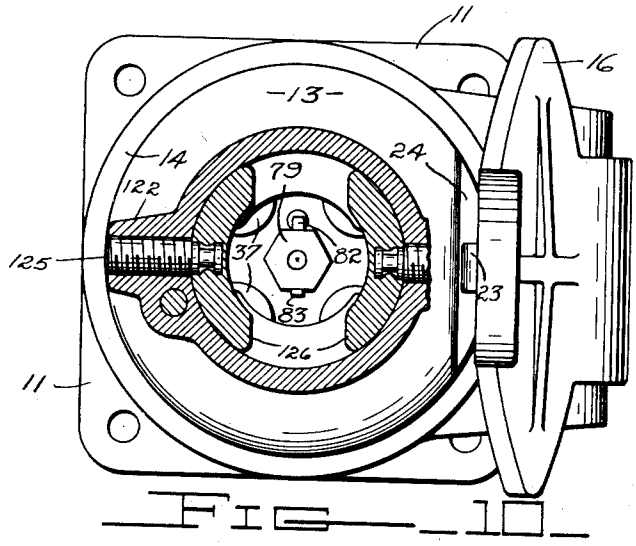


FIG. 10

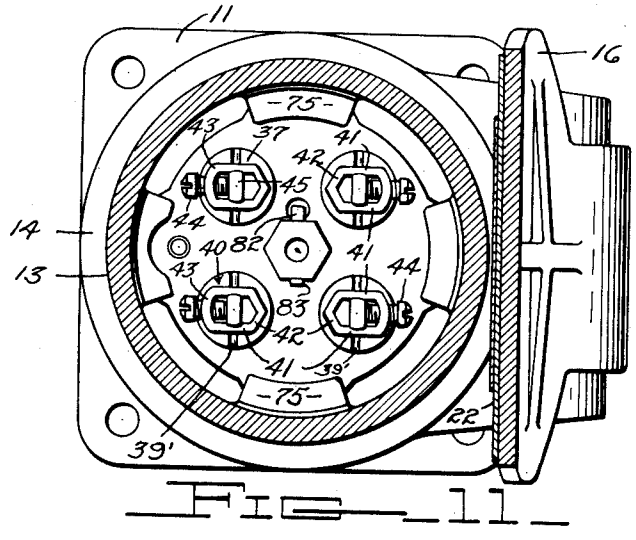


FIG. 11

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UNITED STATES PATENT OFFICE

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ELECTRICAL PLUG AND RECEPTACLE

Clarence A. Hardage, Syracuse, N. Y., assignor to Crouse-Hinds Company, Syracuse, N. Y., a corporation of New York

Application May 21, 1940, Serial No. 336,477

8 Claims. (Cl. 173—328)

This invention relates to electrical plugs and receptacles commonly employed as a convenient means for connecting and disconnecting one portion of an electrical circuit to and from another.

Heretofore, it has been conventional practice to arrange the contacts of the plug in a block of insulating material, and the complemental contacts of the receptacle in another block of such material. The respective blocks of insulating material with the contacts arranged therein are mounted in a suitable protective housing usually formed of metal. It is customary to have one set of contacts terminate within the holes or apertures in the block of insulating material in order that the ends of the contacts when separated, or moved out of engagement, will be positioned in the holes to confine the arc resulting from the separation of the contacts on overload.

This conventional structure has several disadvantages, some of which are that the insulating blocks must be molded out of moldable material which excludes the use of other more satisfactory materials. Also, it is difficult to mold the insulating material with the plurality of apertures for the contacts and maintain these apertures in parallel relationship. This is due to the fact that the material tends to warp or shrink during and after the molding process, with the result that when the contacts are mounted in the block, there is a condition of misalinement of the contacts making it difficult to properly move the contacts of the plug and receptacle into and out of engagement. Also, the confronting faces of the insulating blocks tend to carbonize over a period of extensive use, and this carbonization forms a ready path for the arc to travel from one contact to an adjacent contact, with the result that such plugs and receptacles become short-circuited and burn up. Further, the confronting faces of the single block of insulating material collect moisture and dirt, which also forms a path for the arc to travel from one contact to another. When the block of insulating material has become damaged about one contact, it is necessary to renew the entire block including a new set of contacts, inasmuch as the contacts are often molded into the block of insulating material. For the same reason, it is impractical, and in most instances impossible, to change the polarity of the plug and receptacle after the same has been completed by the manufacturer.

This invention has as a general object a particularly simple and economical structure which overcomes all of the disadvantages referred to and others not alluded to. The structure is exceedingly simple and economical to manufacture and has proven to be exceptionally durable in use.

The invention has as a further object a plug and receptacle structure embodying means permitting the plug and receptacle to be conveniently connected to the electrical circuits, and the polarity of either the plug, or the receptacle, or both, to be conveniently changed in the field.

The invention has as a further object a structure by which each line circuit contact is insulated by an individual insulating member and which does not permit the accumulation of moisture or dirt on the confronting surfaces of the insulating members to an extent possible to permit the passage of an arc from one contact to another.

The invention has as a further object a structure by which any contact of either the plug or the receptacle can be quickly and conveniently renewed without necessitating the renewal of any of the other contacts or parts of the plug or receptacle.

In addition to the particular objects set forth, the invention includes certain combinations and constructions which result in other advantages as will be apparent as the description proceeds. For example, with my invention the contact unit of the receptacle is interchangeable with the contact unit of the plug and vice-versa. Like other of the features referred to, this is of great importance particularly in view of the fact that this interchangeability may be conveniently accomplished in the field by any electrician without the use of special tools.

The invention consists in the novel features and in the combinations and constructions hereinafter set forth and claimed.

In describing this invention, reference is had to the accompanying drawings in which like characters designate corresponding parts in all the views.

Figure 1 is a longitudinal, sectional view of the plug and receptacle taken on a line corresponding to line 1—1, Figure 2.

Figure 2 is a front elevational view of the receptacle element of the connector.

Figure 3 is a transverse, sectional view taken on line 3—3, Figure 1.

Figure 4 is a plan view of the contact supporting plate.

Figure 5 is a plan view of the contact guide plate.

Figure 6 is a lengthwise, sectional view of the plates shown in Figures 4 and 5, the plates being mounted in operative position on the grounding contact, the view being taken on a line corresponding to line 6—6, Figure 4.

Figure 7 is a fragmentary, sectional view of the contact supporting plate and contiguous portion of the grounding contact taken on a line corresponding to line 7—7, Figure 4.

Figure 8 is a fragmentary sectional view of the terminal end of a contact.

Figure 9 is a view showing the terminal end of a contact insulating member in perspective.

Figure 10 is a view taken on line 10—10, Figure 1.

Figure 11 is a view taken on line 11—11, Figure 1.

The invention consists generally of a tubular receptacle body and a tubular plug body. In cross section, these bodies may be cylindrical, square, rectangular, or of any other desired form. The invention further includes a supporting plate detachably mounted in the body member and a plurality of tubular insulating members detachably secured to the supporting plate and extending parallel with the axis of the body member. A line circuit contact is arranged in each of the tubular members, and a metallic uninsulated grounding circuit contact is also carried by the supporting plate and preferably is cooperable therewith to detachably secure the tubular members to the plate. The metallic grounding contacts of the plug and receptacle are provided with means cooperable to guide the line circuit contacts of the plug and receptacle into engagement in a predetermined relation.

The receptacle body is indicated at 10 and is here shown as substantially cylindrical in cross section and provided with a base flange 11 of rectangular formation and having apertures in the corners thereof to receive screws 12 by which the receptacle body may be secured to an outlet box or other desired fitting. The plug body 13 is preferably formed with an external annular flange 14 intermediate its ends to engage the front edge of the receptacle body 10, and is formed with an externally threaded neck portion 15 through which the conductors extend to the terminals of the plug contacts. The receptacle housing 10 is preferably provided with a door 16 hinged on a pin 17 and urged toward closed position by spring 18 encircling the hinge pin 17. The inner side of the door is provided with a suitable gasket 22 to form a weather tight closure for the receptacle body, and the door is provided with a boss 23 which engages a ledge 24 formed on the plug body 13, the door acting as a stop member to prevent accidental withdrawal of the plug from the receptacle body.

The forward portion 25 of the plug is arranged to slide within the body 10 and is provided with an axially extending groove 26 cooperable with a rivet 27 having a head arranged on the inner surface of the receptacle body 10, whereby the plug body is guided into the receptacle body 10 in a predetermined relation thereto.

The body 10 has been designated as the receptacle body, and the body member 13 as the plug body. These parts are thus referred to on the theory that the stationary member of connectors of this type is usually termed the receptacle, and the movable member the plug. However, as the description proceeds, it will be apparent that the male and female contacts are interchangeable in both the receptacle and plug bodies.

The line circuit contacts 30, 31, 32 and 33 of the receptacle are formed of suitable conducting material such as brass or bronze. These contacts are formed at one end with a slotted prong 34 of reduced diameter. The opposite ends of the contacts are formed with a flattened portion 35. Each of the contacts is arranged in a tubular member 36 formed of suitable insulating material. The tubes 36 may be molded, or may be machined, or formed from rod or tubular material.

As here shown, the tubular members are provided with a straight bore of uniform cross section in which the contacts are arranged with the prong ends 34 terminating short of one end of the tubes, and the flattened end portion 35 projecting outwardly beyond the opposite end of the tube. The contacts are held from inward axial movement relative to the tubes by a sheet metal cap 37 formed with a central rectangular aperture to receive the flattened end portion 35, and the flange of the cap is spun or crimped into an annular recess 38 formed in the outer surface of the tubular member, as illustrated at 39, Figure 1. The inner end of the tubular members 36 are formed with radially extending grooves 39', and the bottom of the cap is depressed into these grooves to prevent rotation of the caps and contacts relative to the tubular members. The contacts are held from outward axial movement by a terminal clip 40. The clip 40 is of substantially annular formation having opposite parallel side walls 41 and converging end walls 42. The opposite end wall 43 is formed with a threaded aperture to receive a binding screw 44. The narrow side edges of the flattened portion 35 of each contact are recessed from their base outwardly to within a short distance of the outer end, whereby the outer end portion forms shoulders 45 which engage the outer edges of the sides 41 of the terminal clip 40. This arrangement permits the terminal clip to move transversely across the flattened portion 35.

The ends of the conductors 46 are inserted between the side of the flattened portion 35 and the converging end walls 42, and the binding screw 44 tightened. The end of the screw engages the opposite side of the flattened portion thereby clamping the end of the conductor rigidly against the opposite side of the flattened portion 35.

Referring to the receptacle, the tubular members 36 are formed with reduced end portions 47. The reduced end portion 47, adjacent the terminals 40, is inserted through an aperture 48 formed in a supporting plate 49. As here shown, the plug and receptacle is provided with four line circuit contacts. Accordingly, there are four apertures 48 in the supporting plate 49, the plate being here shown as of substantially circular formation for mounting in the circular receptacle body 10. The opposite ends of the tubular members 36 are arranged in similar apertures 50 formed in a guide plate 51. The supporting plate 49 and the outer guide plate 51 are mounted in axially spaced apart relationship and with the apertures 48, 50 in alinement by a centrally arranged post 53. The spacing between the supporting plate 49 and the guide plate 51 is such as to receive the enlarged central portion of the tubular members 36 between the plates and accordingly, the tubular members are thus retained against axial movement relative to the supporting plate 49.

In reference to Figure 4, the supporting plate

is formed with four peripheral projections 54. The housing 10, adjacent its inner end, is formed with an inwardly extending flange consisting of four projections 56 extending inwardly and being equally spaced apart circumferentially. The lower portion 57 of each of the projections 56 extends inwardly a greater distance than the upper portion 58, and the upper and lower portions are separated by a circumferentially extending groove of sufficient width to receive the peripheral edge of the plate 49. The upper portions 58 of the bosses 56 are formed on a radius to receive the peripheral edge of the plate 49 intermediate the projections 54, and the lower portions 57 extend inwardly a sufficient distance to engage the intermediate portions of the plate and support the same. The annular groove is formed on a radius sufficient to permit rotation of the plate 49 to position the projections 54 in the groove between the lower and upper portions 57, 58 of the bosses. Accordingly, the plate 49 is mounted in the body 10 by inserting the same through the front end of the body until the plate 49 engages the lower flanges 57 and then rotating the plate to bring the projections 54 in the grooves in the bosses 56.

After insertion, the plate is held from rotation by a screw 60 threading into an aperture 61 formed in the plate 49, the screw having an enlarged head portion, and one of the bosses 56 being formed with a circular recess on its inner face to receive the head of the screw, see Figures 1, 2 and 3. In this manner, the contact unit is mounted in the receptacle body 10.

The plug is provided with complemental contacts 70, 71, 72, 73, each being recessed at its outer end to receive the prong portion 34 of the contacts arranged in the receptacle. The inner or terminal ends of the contacts 70, 71, 72, 73 are of identical formation with the inner ends of the contacts 30, 31, 32, 33. The contacts 70, 71, 72 and 73 are arranged in tubular insulating members 74 which are also of identical formation with the tubular members 36 except that the tubular members 74 are of shorter length to permit the contacts arranged therein to extend outwardly therefrom in order that they may engage and disengage the prong portion 34 of the receptacle contacts within the bore of the tubular members 36. The plug body 13 is formed with internal bosses 75 being of duplicate formation with the bosses 56 in the receptacle housing to receive a duplicate supporting plate 76. Preferably, the contact unit of the plug is a duplicate of that of the receptacle, with the exception of the length of the tubular members 74 and the formation of the contacts 70, 71, 72, 73 and the bosses 56, 75, and the contact units are so proportioned that the contact unit shown as mounted in the receptacle may be mounted in the plug, and the plug unit mounted in the receptacle body. Either unit is readily detachable from its body by backing out the screw 60 to permit the unit to be rotated relative to the body to bring the projections 54 of the plates 49, 76, out from in under the upper portions 58 of the bosses 56, 75.

It is often desirable to mount the stationary portion of the connector upon a machine, or other device, as for example the arrangement shown in Figure 1, in which instance the contacts of the plug are hot at all times. This would mean that the bare exposed ends of the contacts 70 to 73 might become short circuited upon contact with metal, or might cause injury if they should be contacted by a workman.

With the structure of my invention, the contact units may be readily reversed, and the contact unit shown mounted in the receptacle Figure 1 may be mounted in the plug body 13, in which instance the live contacts will be protected by the extending ends of the tubular members 36.

In order to permit convenient disassembly of the contact unit in the event it should be necessary to renew any one of them, the supporting plates 49, 76 and the outer guide plates 51 are preferably detachably secured together by the central post 53, in the case of the receptacle unit Figure 1, or the post 77 in the case of the plug unit. As here shown, both the supporting plates and the guide plates are detachably secured to the posts 53, 77. The plates 49, 76 are provided with a centrally arranged aperture 78 to receive a screw 79 having an enlarged head overlying the inner side of the plate and threading into the inner end of the posts 53, 77. A washer 80 may be inserted under the head of the screw 79, the washer being provided with two or more radially extending projections, one of which is bent into an aperture 81 formed in the plate 49, as indicated at 82, Figure 7, and the other projection bent over the flat surface of the nut as indicated at 83, Figure 7, to lock the screw to the plate.

The posts 53, 77 are preferably polygonal in cross section and the outer guide plates 51 are formed with complemental apertures 85, whereby the plates are slidable axially on the posts 53, 77, until they engage the enlarged central portions of the tubular members 36, 74. At this point, the posts are formed with a groove extending through the corners of the polygonal formation. The securing member, in the nature of a washer 86 having a central aperture complemental to the posts, is sleeved over the outer end of the posts until it engages with the plate 51, at which time it may be rotated because of the groove referred to, and upon relative rotation the flat sides of the recess in the washer 86 engage the corners of the posts and accordingly, the plate 51 is then held from outward axial movement. The washer 86 is locked against rotation by a screw 88 threading into an aperture 89 formed in the plates 51 and having an enlarged head arranged in a peripheral notch formed in the washer, see Figure 2.

In the structure shown, the posts 53, 74 also serve the function of an additional pair of contacts. As previously stated, the posts 53, 77 are formed of metal and inasmuch as they are directly attached to the plates 49 which, in turn, are mounted in the bodies of the connector, the posts 53, 77 serve as convenient grounding circuit contacts, the posts 53 being formed with an axially extending aperture to receive the pronged end 89 of the post 77.

In order that a good electrical contact will be made between the posts 53, 77 and the bodies 10 or 13, the plates 49, 76 are preferably provided with a brush 90 having laterally extending arms 91 terminating in contacts 92 which are arranged to frictionally engage the surfaces of the outer bosses 56, 75 when the plates 49, 76 are mounted in the bodies 10, 13. The brush 90 is mounted upon a yoke member 94, the brush and the yoke being secured to the plate as by rivets 95. The brush and yoke are provided with a central aperture 96 complemental to the polygonal shape of the posts 53, 77, and serve to pre-

vent relative rotation between the posts and the plates.

In order that the contacts of one unit may engage the complemental contacts of the other unit in a predetermined order, the prong portion 89 of post 77 is formed with an axially extending groove 97, and a rivet 98 is arranged adjacent the outer end of the post 53, whereby the groove must be in alinement with the rivet 98 in order to permit engagement of the contacts by axial movement of one unit toward the other.

It is preferable that the binding screws 44 extend radially outwardly and the structure embodies means to maintain the binding screws in this position by preventing rotation of the tubular members 36, 74 in the supporting plates 49, 76. The yokes 94 are formed with a flat surface 100 extending over a portion of each of the apertures 48, see Figure 4. The inner reduced ends 47 of the tubular members 36, 74 are formed with a flattened surface 101 engaging the surface 100 of the yoke and thereby preventing rotation of the tubular member.

The cable connected to the plug extends through an aperture 120 in the neck or hub portion 15. The cable is secured to the plug body 13 in order to relieve any strain on the individual conductors of the cable and the terminals 35 to which the cable conductors are attached by the structure hereinbefore described.

This cable grip consists of a cylindrical sleeve member 121 threaded internally for engagement with the hub 15 and provided with radially extending bosses 122. The upper or outer portion of the cylindrical member 121 is formed with a reduced bore 123 to receive the cable and which forms an annular shoulder 124. The bosses 122 are formed with internally threaded apertures to receive the screws 125. An arcuate shaped jaw or cable engaging member 126 is secured to the inner end of each of the screws 125. The arrangement is such that the screws may be rotated relative to the cable grips 126, however, axial movement between the cable grips and the screws is prevented. The jaws 126 are arranged immediately below the ledge or shoulder 124, and in order to provide a water tight connection between the cable and the plug body 13, a conical bushing 127, formed of rubber or other yieldable material, encircles the cable and is arranged in the outer portion of the aperture 120 in the hub 15. A metallic or fiber washer 128 is positioned between the outer or base end of the bushing 127 and the washer 128. The confronting surfaces of the bushing 127 and the passage 120, and the confronting surfaces of the base of the bushing 127 and the washer 128 are formed with complemental cam surfaces. The arrangement is such that when the cylindrical member 121 is threaded upon the hub 15, the bushing is contracted throughout its length in order to tightly encircle the cable. The cable is secured to the member 121 by screwing the screws 125 inwardly causing the cable engaging members 126 to securely grip the cable.

This structure forms a particularly efficient and strong cable grip which functions to securely grip the cable and attach the same to the plug body.

It will be observed that any outward strain on the cable is opposed by engagement of the cable gripping members 126 with the shoulder 124. The projections 122 also form a convenient handle, or grip, for inserting and removing the plug body into and out of the receptacle body 10.

What I claim is:

1. An electrical plug and receptacle comprising a plug body and a receptacle body, a supporting plate detachably secured in one of said bodies, a plurality of tubular insulating members carried by said plate, a metallic grounding circuit contact carried by said plate and cooperable to detachably secure said tubular members to said plate, a line circuit contact arranged in each of said tubular members, a plurality of complemental contacts carried by the other body, and means cooperable with said bodies upon axial movement of one toward the other to guide said contacts into engagement in a predetermined relation.

2. An electrical plug and receptacle comprising a plug body and a receptacle body, a contact unit arranged within each of said bodies, each contact unit comprising a supporting plate, a metallic grounding contact detachably secured at one end to said plate, a guide plate arranged on the opposite end of said contact, means cooperable with said contact and guide plate to detachably secure the plate to said contact, both of said plates being formed with alined apertures, a tubular insulating member extending through each pair of alined apertures in said plates and having means cooperable with said plates to prevent axial movement of said members relative to the plate, a line circuit contact arranged in each of said tubular members, means carried by said supporting plate and cooperable with the body member to detachably secure the contact unit in said body member, and means operable to guide the contacts of the unit arranged in one body member into engagement with the contacts arranged in the other body member in a predetermined relation upon axial movement of one body member into the other.

3. An electrical plug and receptacle comprising a tubular receptacle body and a tubular plug body, a supporting plate detachably secured in one of said bodies, a metallic contact fixedly secured to said supporting plate and extending parallel to the axis of the body, a plurality of tubular insulating members mounted at one end in said supporting plate, a guide plate arranged on the opposite ends of said tubular members, and means cooperable with said guide plate and said metallic contact to detachably secure said tubular members to said supporting plate, a contact arranged in each of said tubular members, said other body being provided with a plurality of contacts complemental to the contacts arranged in said tubular members and including a metallic contact complemental to said first mentioned metallic contact, said metallic contacts being cooperable to guide said other contacts into engagement in a predetermined order upon axial movement of one body toward the other.

4. An electrical plug and receptable comprising a tubular plug body and a tubular receptacle body slidable one within the other upon axial movement of one body toward the other, each of said bodies being formed with an internal flange, a contact unit detachably mounted in each of said bodies, each of said contact units comprising a supporting plate arranged upon the flange and detachably secured in each body, a metallic grounding circuit contact fixedly secured in the center of the supporting plate and extending parallel to the axis of the body, said

plate being formed with a plurality of apertures spaced about said metallic contact, a tubular insulating member having one end thereof positioned in each of said apertures, a guide plate formed with a plurality of complemental apertures mounted upon the opposite ends of said metallic contact and said tubular members, and means cooperable with said plate and said metallic contact for detachably securing the guide plate to the metallic contact and securing the tubular members to said supporting plate, a line circuit contact arranged in each of said tubular members, said metallic contacts being cooperable upon movement of one body toward the other to guide said other contacts into engagement in a predetermined order.

5. An electrical plug and receptacle comprising a plug body and a receptacle body, said bodies being arranged to slide one within the other, a contact unit arranged within each body, each contact unit comprising a plate, a post secured at one end to the plate centrally thereof, a second plate, an annular series of tubular insulating members arranged between said plates, means cooperable to detachably secure said second plate to said post, a contact arranged in each tubular member, means operable to detachably secure a contact unit in each of said bodies, and means operable to guide the contacts of one unit into engagement with the contacts of the other unit in a predetermined relation upon movement of one body into the other, the post of one contact unit being formed with an axially extending aperture to slidably receive the end of the post of the other unit during engagement of the line circuit contacts of said units.

6. An electrical plug and receptacle comprising a plug body member and a receptacle body member, a contact unit arranged in each of said body members, each contact unit comprising a plate, a metallic post secured at one end to said plate centrally thereof, a second plate arranged in axial spaced apart relationship to said first plate, and means cooperable to detachably secure said second plate to said post, an annular series of tubular insulating members carried by said plates, a line circuit contact arranged in each of said tubular members, means operable to detachably secure a contact unit in each body member, and means operable to guide the contacts of one unit into engagement with the contacts of the other unit upon axial movement of one body member toward the other, the post of one contact unit being formed with an aperture and the post of said other contact unit extending outwardly beyond said second plate and being arranged to slidably engage the aperture in said other post previous to engagement of the line circuit contacts of said units.

7. An electrical connector comprising a tubular body formed with an internal flange having circumferentially spaced apart slots, a contact unit arranged within the body and comprising a supporting plate, a post fixedly secured in the center of the supporting plate, a guide plate detachably secured to the opposite end of said post, said plates being formed with a plurality of alined apertures spaced about said post, a plurality of tubular insulating members arranged between said plates with their ends positioned in said apertures, means cooperable with said tubular members and said plates to prevent axial movement of the members relative to the plates, said supporting plate being formed with circumferentially spaced radially extending projections adapted to be positioned in the slots of said body flange upon rotation of the contact unit, a screw threading into said plate and engaging the flange of the body to detachably retain the contact unit against rotation, and a contact arranged in each of said tubular members.

8. An electrical connector comprising a tubular body formed with an internal flange having circumferentially spaced apart slots, a contact unit arranged within the body and comprising a supporting plate, a post fixedly secured in the center of the supporting plate, a guide plate detachably secured to the opposite end of said post, said plates being formed with a plurality of alined apertures spaced about said post, a plurality of tubular insulating members arranged between said plates with their ends positioned in said apertures, means cooperable with said tubular members and said plates to prevent axial movement of the members relative to the plates, said supporting plate being formed with circumferentially spaced radially extending projections adapted to be positioned in the slots of said body flange upon rotation of the contact unit, means cooperable with said supporting plate and the body flange to detachably maintain the projections on said plate in the slots of the flange, and with the unit in a predetermined position relative to the body.

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