Feb. 18, 1936. A. ALSAKER ET AL 2,031,296

DISCONNECT PLUG AND RECEPTACLE

Filed July 19, 1933 2 Sheets-Sheet 1

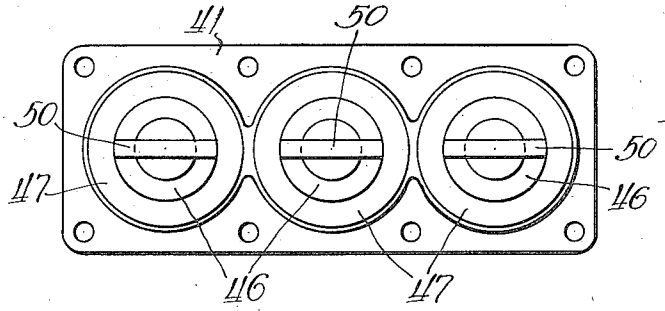


Fig. 2.

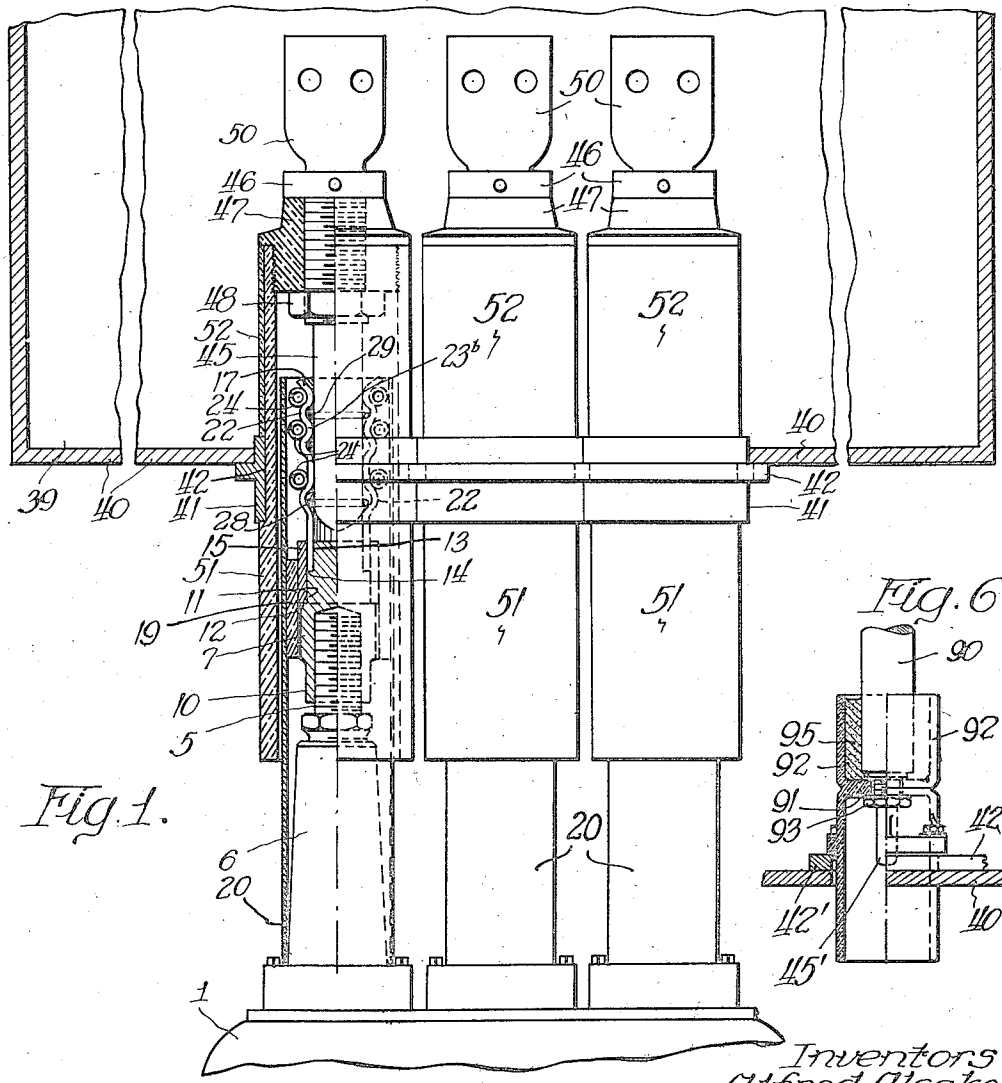


Fig. 1.

Fig. 6.

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Fig. 4.

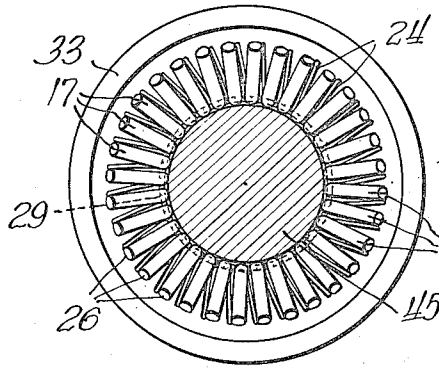


Fig. 3.

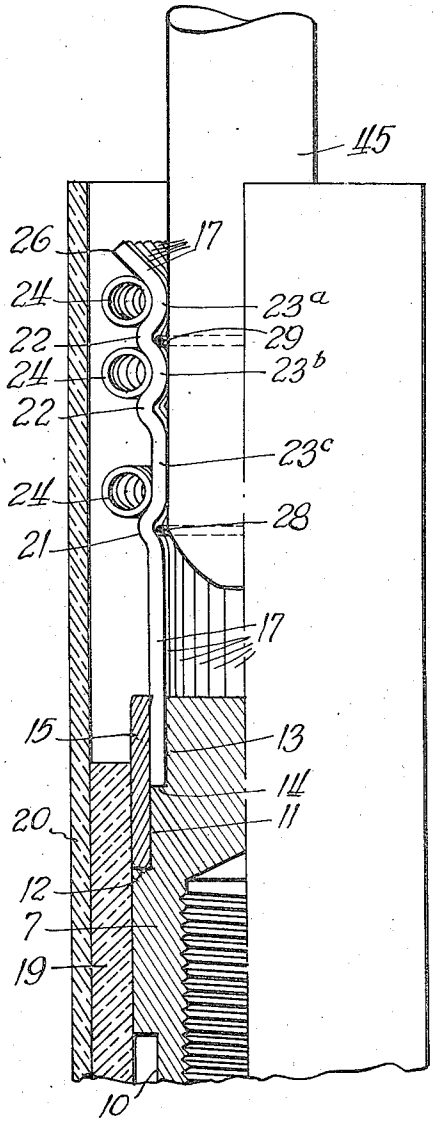
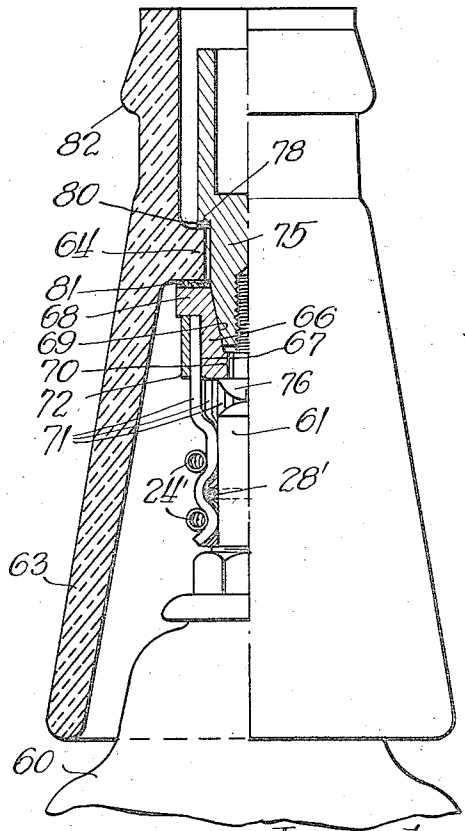


Fig. 5.



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UNITED STATES PATENT OFFICE

2,031,296

DISCONNECT PLUG AND RECEPTACLE

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Application July 19, 1933, Serial No. 681,158

17 Claims. (Cl. 173—332)

This invention relates to electric switches of the plug and socket type, and more particularly to such switches as are used in power work on medium or high voltages and/or currents.

The principal object of this invention is to provide a switch of the above type which will afford a maximum degree of safety and which will be simple in construction and mechanically and electrically efficient in operation when used as a disconnect switch with a circuit breaker of the type wherein the disconnect function is obtained by lowering the breaker from an elevated position.

Switches of the type used on circuit breakers are necessarily made quite compact. This raises the problem of providing adequate insulation. For the sake of safety, the switch of each pole of the breaker is surrounded by a shield of insulation. In a compact switch, surrounded by solid insulation, the heat generated by the current flow is confined to a restricted region, hence a high temperature might ensue. This is objectionable, since an increase in temperature means an increase in resistance, resulting in an increase in the rate of heat generation and a further increase in the temperature. Therefore, it is quite essential to prevent an undue temperature rise. It is one of the objects of the present invention to provide an arrangement which will have a low contact resistance and which will facilitate the conduction of heat from the region of engagement between the two cooperating members. We accomplish both of these results by making the socket member in the form of a large number of contact wires arranged to define a cylindrical opening for receiving the plug member, and bent so that each of the contact wires engages the plug at a plurality of points, rather than along the entire length of the wire. The points of contact of each individual contact wire are in alignment, and in line with the direction of travel of the switch in its closing direction. As a result, the first point to engage the plug scrapes foreign material, oxides or the like, from the plug, along a narrow line which is the line of engagement with the next point on the wire. Adequate cleaning of the contact plug where it is engaged by the contact wires is thus obtained. This is one of the important objects of the present invention.

A predetermined contact pressure is maintained by coiled springs surrounding the contact assembly. It is one of the objects of the present invention to provide a simple and expedient arrangement for holding the coiled pressure maintaining springs in place. This is accomplished by forming outwardly extending bends in the respective wires to define one or more grooves on the outside of the cylinder formed by the assembled contact wires. The springs are located in these grooves and tend to force the respective contact wires radially inward. The respective wires are additionally bent to define a groove within the periphery of the cylinder formed by the assembled wires. In this latter groove we locate a ring which serves to limit the extent of collapse or inward movement of the assembled contact wires under the action of the external springs.

The contact wires comprising the socket assembly of the present invention may be of any desired cross section. The simplest arrangement is, of course, a circular wire. If desired, we may use wires of a triangular or other polygonal section, thereby increasing the heat radiating surface area in a proportion to the cross-sectional area of the wire. Also, a triangular or other polygonal wire may be used and arranged to contact along one of its corners, so that a sharp line or point of contact with the male plug is obtained, thus increasing the contact pressure.

The contact resistance between the socket and the plug may be reduced by silver plating the respective contact wires and the male plug so that contact is established between surfaces which will not corrode to form high resistance compounds.

It is a further object of the present invention to provide an improved arrangement for mounting the contact wires in place. The wires are carried by a copper stud which is turned down adjacent one end and carries a copper ring adjacent the turned down end, the arrangement being such as to provide a cylindrical groove between the collar and the turned down end of the stud. The contact wires are die pressed into this groove and then swaged in place. This provides a firm electrical contact between the wires and their supporting stud, and constitutes a simple, convenient and economical method of mounting the wires in place.

The attainment of the above and further objects of the present invention will be apparent from the following specification taken in conjunction with the accompanying drawings forming a part thereof.

In the drawings:

Figure 1 is a front view, in partial section, of one embodiment of our invention;

Figure 2 is a top view thereof;

Figure 3 is an enlarged fragmentary view of a

portion of the switching mechanism shown in Figure 1;

Figure 4 is a top plan view of the apparatus shown in Figure 3;

Figure 5 is a fragmentary view, in partial section, illustrating another embodiment of the present invention; and

Figure 6 shows a modified form of male contact plug.

In Figure 1 we have shown our present invention applied to a circuit breaker forming a part of an outdoor electric switching station such as is shown, for instance, in the United States Patents to Allen M. Rossman, No. 1,787,053, dated December 30, 1930 and No. 1,830,409, dated November 3, 1931, or in connection with a switching station such as is shown in the United States patent to Randall, No. 1,818,160, dated August 11, 1931. In such a station the circuit breaker is provided with exteriorly extending disconnecting switch contacts for engaging stationary disconnecting switch contacts that are connected to insulated busses, the disconnecting function being obtained by raising or lowering the circuit breaker.

The head of a three-phase circuit breaker is indicated diagrammatically at 1. The circuit breaker is provided with suitable disconnect switching contacts, to be described more fully, and is adapted to be raised or lowered in a manner known in the art to bring its disconnect terminals into engagement with cooperating stationary disconnect terminals. Threaded terminal shanks 5 extend upwardly from the top of the circuit breaker through insulating bushings 6. This is the usual circuit breaker arrangement well known in the art. It is to such a circuit breaker that the present invention is applied, although not limited thereto.

The female contact of our improved switch is shown more particularly in Figures 3 and 4. It comprises an integral unit which is adapted to be secured to the shank 5 by threading onto the upper end thereof. The mounting means comprises a circular stud member 7 in the form of a plug of copper or other material of high electrical conductivity. The stud member 7 is internally threaded at its lower end for threading onto the shank 5, the copper being slabbed off at the opposite sides of the bottom of the stud member, as indicated at 10, to facilitate the gripping of the stud member 7 by a wrench or the like for turning it on the shank 5. The upper end is turned down to provide a reduced cylindrical portion 11 and a shoulder 12, and is further turned down to provide another reduced cylindrical portion 13 and a shoulder 14. A copper ring or collar 15 is pressed over the cylindrical portion 11 and rests on the shoulder 12. The upper end of the ring or collar 15 extends above the cylindrical portion 11 and, together with the outer surface of the cylindrical portion 13, defines a circular groove. A large number of copper contact wires 17 are mounted with their ends extending into this groove, so that the contact wires extend axially of the stud 7 and define an open cylinder. The wires are die pressed into position, being secured by soldering and by swaging the end of the collar 15 against the wires to firmly press it against the wires. A spacer tube 19 of suitable insulation is pressed over the ring or collar 15, and over this tube is press fitted a tube 20 which surrounds the bushing 6 and rests at the base thereof. The tube 20 may be of any preferred insulating material.

The contact wires 17 are all of like construction and comprise copper wires bent into the form shown in Figure 3. The wires are bent outwardly at the points 21 and 22 to define outwardly concave and inwardly convex portions 23*a*, 23*b* and 23*c*. A plurality of similar bends are provided throughout the length of the wire, and the ends of each wire are bent back to form a guiding lip, as indicated at 26. The outwardly bent portions 21 and 22 are similarly located on all of the wires and define grooves on the inner and outer peripheries of the cylinder formed by the wires. Close pitched coiled springs 24 urge the contact wires radially inward. Each of the springs 24 comprises a helically coiled wire spring bent into ring formation around the contact wire assembly and resting in a peripheral groove. A plurality of guide rings 28 and 29 are inserted into the grooves in the inner periphery of the cylinder defined by the contact wires. These rings limit the extent of inward collapse of the contact spring wires under the action of the springs 24. The rings 28—29 are of an internal diameter slightly in excess of the diameter of the male plug, whereby interference with the male plug is avoided. They are of an external diameter sufficient to permit their retention within the internal grooves of the contact wire assembly even when the wires are spread by the male contact plug, whereby special retaining devices for the rings 28—29 are not necessary.

The bottom of a bus connecting cabinet 39 is indicated at 40. (See Figure 1). This may represent the usual type of cabinet found in outdoor switching stations of the oil-filled bus type, that is, of the type wherein the busses are immersed in a bath of insulating oil, or it may be a cabinet of the type not filled with oil, wherein the conductors are covered with insulation and separated from one another by air. A rectangular metallic bushing flange 41 is secured to the lower side of the bottom 40 of the cabinet. The flange is provided with three circular flanged openings 42, one for each phase of the system. The respective terminal plugs with their associated insulating sleeves extend through these openings.

The terminal plugs for the respective phases are of identical construction, and a description of one will suffice for the other two. A copper plug, which is a smooth cylinder at its lower end and threaded at its upper end, extends through a support 47, and is locked in position on the support by upper and lower nuts 46 and 48 which also serve to form tight seals between the plug and the support 47. The support 47 comprises high grade insulation. The upper end of the plug 45 is flattened to provide a terminal clip 50, which may be silver plated to insure permanent high conductivity. A tube of insulation 51 is press fitted through the opening in the flange 41 and has another insulating tube 52 press fitted over its upper end. The tube 51 is internally threaded at its upper end, and into this thread the support 47 is threaded. The plug 45 is thus supported from the tubes 51—52 by means of the support 47, the tube 51 being held against downward retraction through the hole in the flange 40 by the tube 52 which bears against the support 47. The plug 45 and the contact wires 17 are preferably silver plated, to provide silver to silver contact surfaces which are not subject to the formation of a high resistance oxide as in the case of copper.

An explanation will now be given of the mode of operation of the apparatus thus far described.

When the circuit breaker is in the lowest position the live plug 45 is protected by the insulating tube 51 against accidental contact, whereas the wire contact assemblies on the circuit breaker are protected by the insulating tubes 20. As the circuit breaker is raised, the tubes 20 telescope within the tubes 51 and, upon continuous elevation of the circuit breaker, the female contacts on the circuit breaker telescope over the plugs 45. As this occurs the contact wires 17 are spread by the respective plugs 45 and are maintained in firm engagement with the plugs by the pressure of the coil springs 24. When the circuit breaker is in its fully elevated position no live parts are exposed, and an operator may safely work around the insulating tubes surrounding the live contacts.

It is to be noted that each contact wire engages its plug 45 at a plurality of points rather than along the full length of the wire. This means that a high pressure per unit contacting area can be maintained to obtain the benefit of a low contact resistance. Also, there is an ample amount of copper between the contact points for carrying away the heat generated at the points of contact and for providing a comparatively large heat radiating surface. Also, there are spaces between the adjacent contact making points of adjacent wires. These spaces permit the natural formation of convection air currents at the very points of heat generation, which currents serve to carry away the heat generated and to prevent formation of localized hot spots at the points of contact between the wires 17 and the plug 45.

There is another distinct advantage obtained by our improved contact structure, an advantage resulting from the fact that the contacting portions 23*a*, 23*b* and 23*c* are in alignment. During the switch closing operation the contact wires 17 first engage the plug 45 at the uppermost bent portions 23*a*. The area of engagement between the plug and the contact wires is very small, practically point contact, hence the unit pressure between the contact wires and the plug under the action of the uppermost spring 24 is very great. As the switch closing action continues, the portion 23*a* moves along the plug and scrapes it along a thin line, thus serving to provide a clean line of contact for the next lower bent portion 23*b*. This portion engages the plug 45 along the very line that was scraped of foreign material, oxide and the like, by the portion 23*a*. The middle portion 23*b* also engages the plug 45 at practically a point contact, thus providing a high contact pressure with the plug. This serves further to clean the line of engagement with the plug 45 as the closing action continues. Later the portion 23*c* engages the plug along the very line that was cleaned by the scraping action of the portions 23*a* and 23*b*. Since the portion 23*c* engages along an already cleaned line it does not have to do any appreciable scraping. The portion 23*c* is therefore made of appreciably greater length than the portions 23*a* and 23*b*, so that it engages the plug 45 along a line rather than at a point. This prevents an undue concentration of the current flowing through the switch. It is also to be noted that during the scraping action of the contact wires on the contact plug there is ample space between contacting points of adjacent wires for receiving the foreign matter that may be scraped from the plug.

Reference may now be had to Figure 5 wherein there is shown the present invention applied to a disconnecting cap which may be used to establish connections wherever desired, as for instance, to a terminal pot head. The upper end of a terminator or pot head is indicated at 60. This terminator may be of any preferred construction, for instance, one such as shown in the United States patent of Joseph C. Rah, No. 1,901,667, issued March 14, 1933. It is, however, to be understood that the present invention is not limited in its application to a terminator. The upper end of the terminator is provided with an outwardly extending cylindrical copper plug 61 for the establishment of electrical connections therewith. The female contact is mounted in a housing 63 of porcelain, pyrex or other suitable insulating material, and comprises a conical skirt portion and an upper cylindrical portion, with an internal peripherally extending shoulder 64 between them. The contact assembly is adapted to be clamped to this shoulder. The contact wires are mounted on a support 66 that is provided with a cylindrical portion 67 and a flange 68 and has an inverted conical bore 69 at one end and a cylindrical counterbore 70 at the other end. Spring contact wires 71 are secured around the cylindrical portion 67 by means of a collar 72, of copper or the like, which is swaged against the wires as in the construction previously described, to jam the wires firmly in place. The wire support 66 is inserted into the skirt portion of the cap and is secured to a connector 75 that is inserted through the opposite end of the cap, a screw 76 serving to secure the two together. The connector 75 has a shoulder 78 that bears against the inner peripheral flange 64. Gaskets 80 and 81, of cork or other suitable material, are interposed between the flange 64 and the shoulder 78 of the connector and the flange 68 of the support. The screw 76 draws the connector 75 firmly against the support 66 and maintains a firm electrical engagement between them. The upper end of the connector is provided with a central bore for receiving a conductor which may be soldered or otherwise secured thereto and in firm electrical engagement with the connector.

The contact wire arrangement shown in Figure 5 may be substantially the same construction as that shown in Figure 1. This contacting arrangement is of smaller current capacity and therefore is of smaller length and requires fewer coil springs 24′ on the outside thereof and only one internal spacing ring 28′.

To disestablish the electrical connection between the conductor secured within the connector 75 and the terminator plug 61, it is merely necessary to raise and remove the porcelain cap. Due to the insulation afforded by the cap, it is safe to do this by manually gripping the cap and manipulating it. If desired, mechanical means may be provided for accomplishing this. For this purpose the porcelain cap is provided with a curved peripheral bead 82 to which a split clamp may be secured for mechanical connection with the cap in the manner indicated in the above referred to patent to Joseph C. Rah.

In Figure 6 we have shown a modified form of male contact plug, which may be substituted for the male contact plug assembly of Figure 1. The male contact is indicated at 45′, being electrically a part of a conductor 90, which may be covered with suitable insulation. The plug 45′ extends through a central opening in a web 91 of a sleeve of insulation 92, and is secured therein by a nut 93 threaded on the plug 45′. The insulating sleeve 92 is provided with an outwardly extending

flange whereby it may be bolted to the flange plate 42', this plate being, in turn, secured to the upper surface of the bottom 40 of the bus connecting cabinet. The web 91 divides the insulating sleeve 92 into upper and lower portions. After assembly of the contact the upper portion of the sleeve is filled with a suitable insulating compound 95. Electrically this material equals porcelain, and for bushings its dielectric and mechanical characteristics make it more desirable than other types of insulation. The sleeve 92 of Figure 6 and the sleeves 20, 51, 52 and 53 of Figures 1 and 5 may be made of any desired insulating material.

In compliance with the requirements of the patent statutes we have herein shown and described a few preferred embodiments of our invention. It is, however, to be understood that the invention is not limited to the precise constructions herein shown, the same being merely illustrative of the principles of the invention.

What we consider new and desire to secure by Letters Patent is:

1. A contact including a circular support defining a groove with said contact adjacent the edge of said support, and contact wires inserted into said groove and extending therefrom to define a socket, the edge of the support being swaged towards the contact wires to hold them in place.

2. A contact comprising a cylindrical stud having a peripheral recess at one edge thereof, a copper tube pressed over the stud and defining an axially extending annular groove with said recess, contact wires pressed into said groove and extending therefrom, and means for securing said wires in position.

3. A contact comprising a cylindrical stud having a peripheral recess at one edge thereof, a copper tube pressed over the stud and defining a cylindrical groove with said recess, and contact wires held in said groove and extending therefrom, the end of the tube being swaged towards said wires.

4. A contact comprising a cylindrical stud having a peripheral recess at one edge thereof, a copper tube pressed over the stud and defining a cylindrical groove with said recess, contact wires held in said groove and extending therefrom, the end of the tube being swaged towards said wires, a short insulating tube fitted over the copper tube, and a comparatively long tube of insulation fitting over the short tube and surrounding the contact wires in spaced relation.

5. A switch contact comprising a contact stud, a plurality of longitudinally extending wire contact springs defining a hollow cylinder secured to said stud, the outside of the cylinder having a peripheral groove therein formed by similarly located bends in the adjacent wires, a spring member embracing the cylinder at the groove and resiliently pressing the wire contact springs inward, a groove formed in the internal periphery of the cylinder, and a ring within the internal groove and limiting the extent of inward movement of the wires.

6. A switch contact comprising a circular plug, a plurality of wire contact fingers secured thereto to define an open cylinder, springs embracing the wire contact finger assembly and urging the contact fingers inwardly of the cylinder, and a ring within the cylinder for limiting the extent of inward movement of the wire contact fingers.

7. A switch socket for receiving a plug, said socket comprising a plurality of separate and independent contact wires extending longitudinally thereof, each of said wires having a plurality of contact making portions spaced from one another and in longitudinal alignment and having intermediate portions between said contact making portions disposed out of alignment therewith, the outermost contact making portion comprising substantially a point contact, resilient means pressing the same towards its contact making position, whereby upon insertion of a plug into the socket the outermost contact making portion scrapes a narrow line along the plug, the adjacent contact making portion of the wire engaging the plug along the line scraped by the preceding contact making portion, and means including an axially extending annular groove for securing the opposite ends of said wires in predetermined position to define a cylindrical socket.

8. A switch comprising a plug and a socket for receiving the plug, said socket comprising a plurality of contact wires arranged to define a cylinder, means urging the wires radially inward towards the plug, and a spacing ring within said cylindrical socket limiting the extent of inward movement of said wires when the plug is removed.

9. A circuit breaker having a head portion, a bushing extending through the head portion, a line terminal at the end of the bushing, a switch member including a stud at its end, said stud being mounted on said line terminal and having a plurality of contact wires extending axially thereof, and a tube of insulation carried by the stud and surrounding the contact wires assembly and extending over the bushing.

10. A switch contact making member comprising a hollow body of insulation generally circular in cross section and open at its two ends, said body having an internal circumferentially extending web formed integrally therewith and dividing the body into two sections, said web having a centrally located opening therethrough, a switch contacting member including portions in each of the two sections, and means clamping the contacting member to the opposite faces of the web at the opening.

11. In combination, a circuit breaker having an extending successively recessed terminal stud, a cylindrical member engaging about said stud and defining an annular groove with one recessed portion thereof, a plurality of contact fingers seating in said groove and forming a cylindrical outwardly extending socket, a short insulating tube pressed over said terminal stud and cylindrical member beneath said socket, a relatively long insulating tube fitting over said short tube and surrounding said socket, a contact plug adapted to be engaged in said socket, and an insulating tube surrounding said plug and adapted to have telescoping engagement about said relatively long insulating tube carried by said terminal stud upon contacting engagement between said plug and socket.

12. A contact comprising a stud member having a recessed portion, a collar disposed about said recessed portion and defining an annular groove therewith, a plurality of contact wires having frictional seating engagement within said groove, said wires extending outwardlly therefrom to define a cylindrical expansible and contractible socket, means within said socket for limiting contraction thereof, and an insulating tube carried by said stud member and surrounding said wires.

13. A contact comprising a contact stud having a recessed portion, a collar disposed thereabout and defining an annular groove therebetween, and a plurality of spaced wires having frictional seating engagement within said groove and extending

outwardly therefrom, the edge of said collar being swaged inwardly to secure said wires in position, each of said wires having inwardly extending axially spaced offset portions whereby spaced line contact surfaces are provided, the spacing between said wires and between said contact surfaces of each of said wires providing for circulation of air about each of said contact surfaces.

14. Means for effecting connection with a male contact plug comprising a supporting stud having a pair of successively reduced axially extending portions, a cylindrical tube fitting about said first reduced extending portion and extending axially of said stud to define an annular groove with said second reduced portion, and a plurality of separate wire members having frictional engagement at one end thereof in said groove and extending outwardly of said stud to define a cylindrical socket for receiving said plug.

15. Means for effecting connection with a male contact plug comprising a supporting stud having a pair of successively reduced extending portions, a cylindrical tube fitting about said first reduced extending portion and extending axially of said stud to define an annular groove with said second reduced portion, a plurality of separate wire members having frictional engagement at one end thereof in said groove and extending outwardly of said stud to define a cylindrical socket for receiving said plug, and spring means encircling said wires adjacent the opposite ends thereof for urging them into engagement with said plug.

16. Means for effecting connection with a male contact plug comprising a supporting stud having a pair of successively reduced extending portions, a cylindrical tube fitting about said first reduced extending portion and having an external diameter corresponding to the external diameter of said stud, said tube extending axially of said stud to define therewith an annular groove between the interior of said tube and said second reduced portion, a plurality of separate wire members engaging in said groove and extending outwardly of said stud to define a cylindrical socket for receiving said plug, a first tubular member formed of insulating material and press fitted over said stud and a portion of said tube, and a second tubular member extending about the first tubular member and formed of insulating material extending upwardly about said cylindrical socket and spaced from the outer periphery of said socket.

17. A contact comprising a conducting stud and a plurality of separate contact wires having one end of each of said wires rigidly secured about an end of said stud, the wires extending outwardly from said end of said stud to define a cylindrical socket and having their free outwardly extending ends flared outwardly.

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