

March 19, 1935.

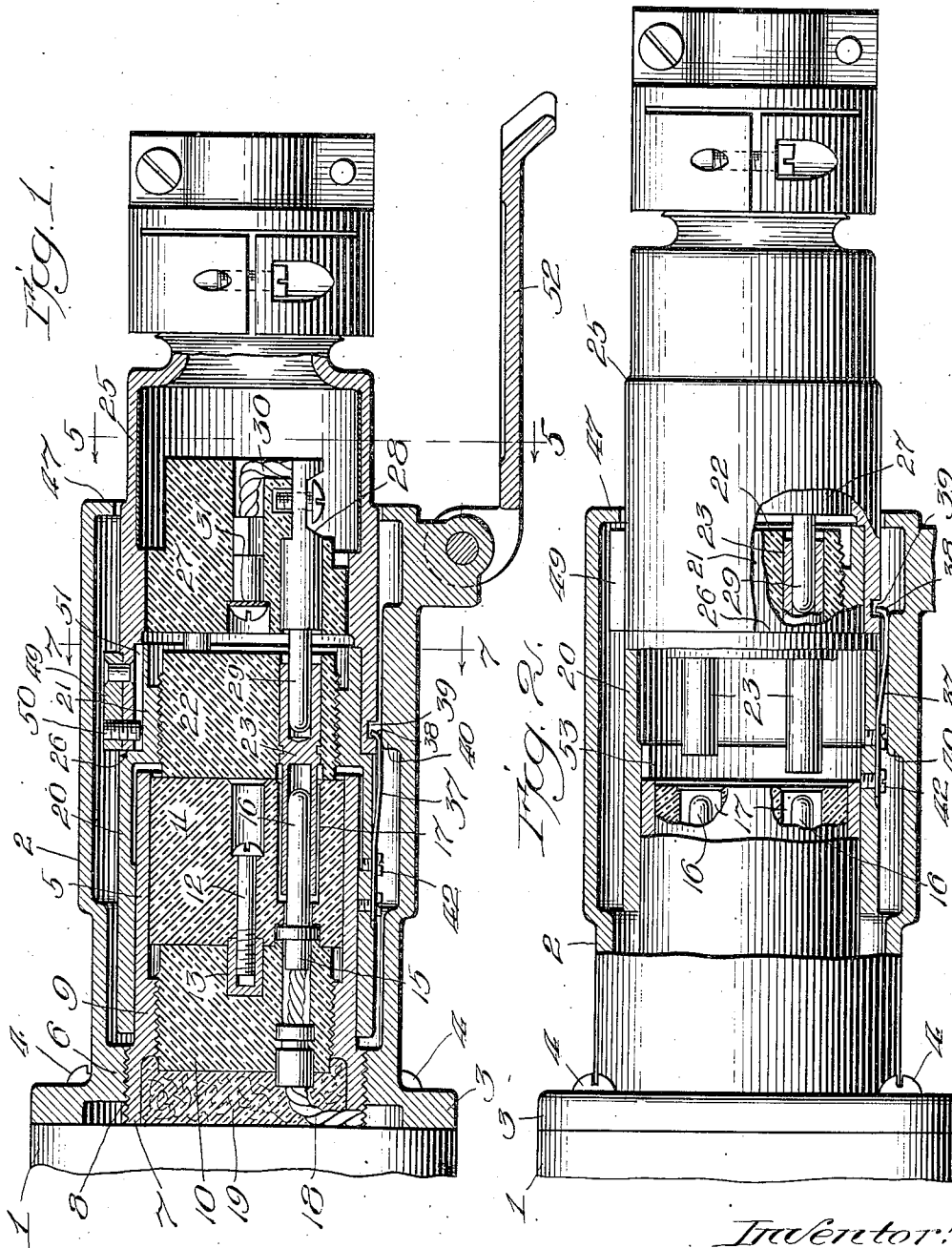
N. A. TORNBLOM

1,995,195

EXPLOSIONPROOF SOCKET AND PLUG

Filed July 3, 1933

3 Sheets-Sheet 1



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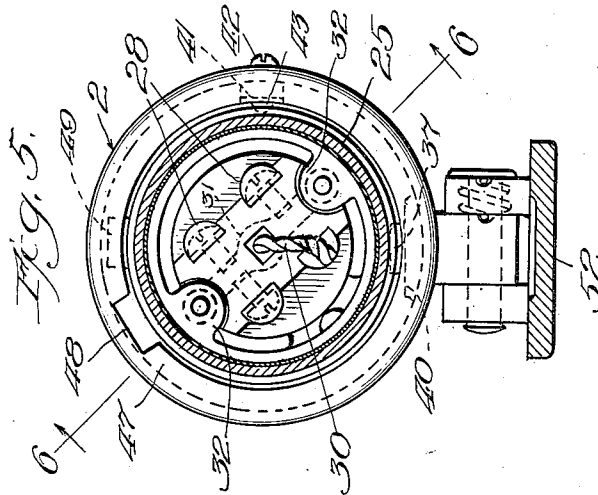
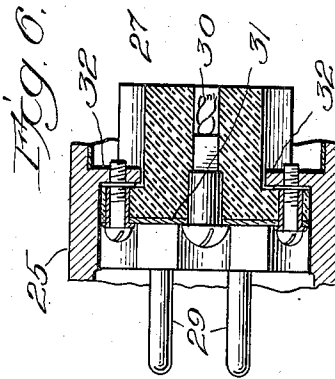
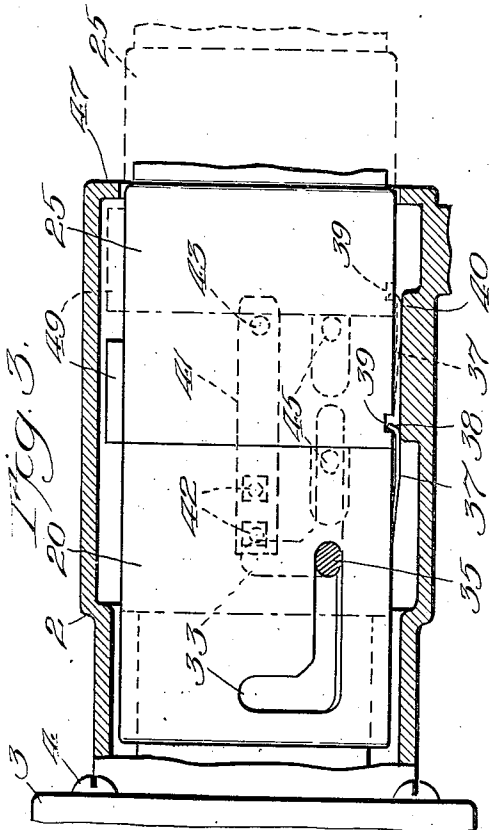
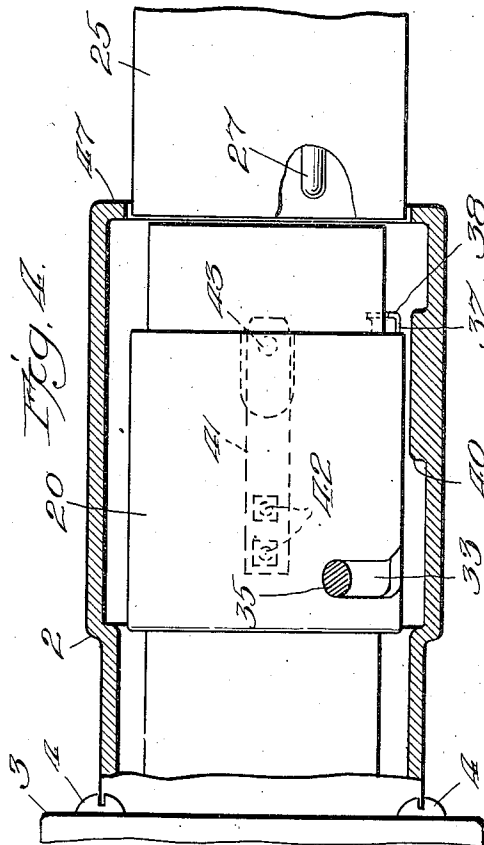
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EXPLOSIONPROOF SOCKET AND PLUG

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3 Sheets-Sheet 2



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Fig. 9.

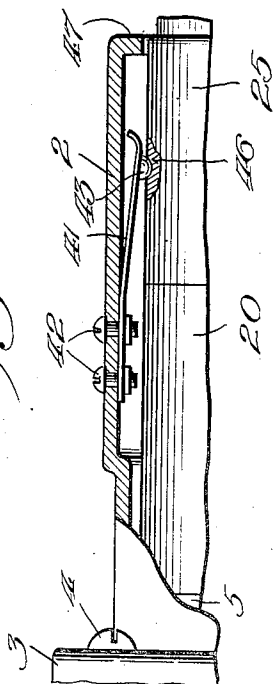


Fig. 8.

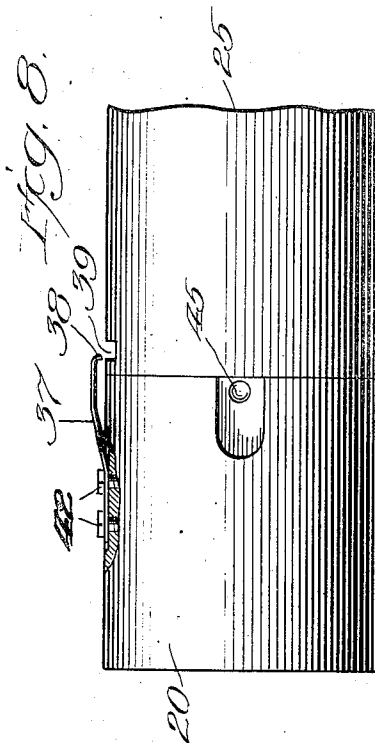
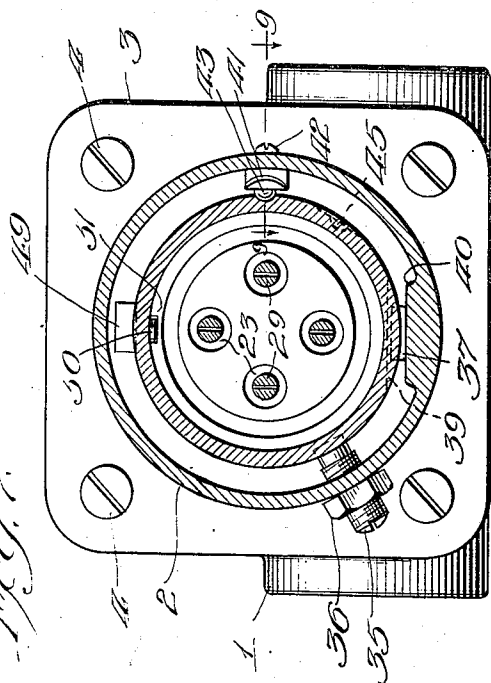


Fig. 7.



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UNITED STATES PATENT OFFICE

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EXPLOSIONPROOF SOCKET AND PLUG

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Application July 3, 1933, Serial No. 678,784

4 Claims. (Cl. 173—328)

The present invention relates to detachable couplings of the type embodying a plug and a socket or receptacle, for the purpose of connecting a conductor or cable to a line or circuit; and it has for one of its objects to produce a coupling which will prevent explosions in the event that the plug is withdrawn while surrounded by an inflammable or explosive atmosphere. A further object of the present invention is to produce a coupling in which the terminals or contact pieces that are left exposed upon the separation of the plug from the socket or receptacle will have been rendered dead and harmless before the contacts or terminals on the plug that cooperate therewith can be separated therefrom.

In carrying out my invention I cause the circuit or circuits to be interrupted within a closed chamber, in the process of withdrawing the plug from the socket or receptacle, whereby no arc or combustion of inflammable gas within the chamber can cause ignition of outside inflammable or explosive gas. I furthermore provide between the terminals or contacts on the plug and those within the receptacle a floating member carrying elements of conducting material adapted to cooperate with both the terminals in the socket and those on the plug; this floating member forming a movable outer wall for the chamber to which I have just referred. Means are provided so that the floating member and the plug are locked together as long as the conducting elements on the floating member are engaged with the contact pieces or terminals in the socket; whereby the floating member is compelled to move outwardly with the plug as the latter is being withdrawn, and cause the connection or connections to be interrupted between the floating member and the terminals in the socket. After the interrupting of the connection or connections within the chamber behind the floating member, whereby the conducting elements on the floating member are deenergized, the plug may be separated from the floating member and be completely withdrawn from the socket. The floating member remains in the socket in its outer, idle position, and with its conducting elements or terminals deenergized or dead, until the plug is again inserted. Consequently, it is impossible to produce a short circuit, while the plug is out, through touching a screw driver or other metal member against the exposed contact pieces or terminals of the socket member.

The various features of novelty whereby my invention is characterized will hereinafter be pointed out with particularity in the claims; but,

for a full understanding of my invention and of its objects and advantages, reference may be had to the following detailed description taken in connection with the accompanying drawings, wherein:

Figure 1 is a central longitudinal section through a coupling embodying the present invention, the socket member forming part of a connection box; Fig. 2 is a view partly in side elevation and partly in section, showing the plug member partly withdrawn from the socket; Fig. 3 is a view in which the casing or shell of the socket member is shown in section and the plug member in elevation, with the parts in the relative positions illustrated in Fig. 1, showing in dotted lines the position of the plug member corresponding to that in Fig. 2; Fig. 4 is a view similar to Fig. 3, showing the parts in their relative positions just as the plug is being finally withdrawn from the socket; Fig. 5 is a section on line 5—5 of Fig. 1; Fig. 6 is a section on line 6—6 of Fig. 5; Fig. 7 is a section on line 7—7 of Fig. 1; Fig. 8 is a side view of the floating member in the socket, removed from the socket, together with a fragment of the cooperating end of the plug; and Fig. 9 is a view partly in side elevation and partly in section, showing a fragment of the socket and the plug in coupled relation, the part that is in section being on the plane of line 9—9 of Fig. 7.

In the drawings I have illustrated the invention as embodied in a coupling or connector associated with a box, which may be an outlet box, and, for the sake of brevity, the detailed description will be confined to this embodiment, although the invention is not confined to this particular use.

Referring to the drawings, 1 represents a box having a detachable side or end wall consisting of a long tubular hub or sleeve 2, flanged outwardly at one end, as indicated at 3; the flange being fastened to the body of the box by screws 4 or other suitable means. The actual socket or receptacle is housed within the hub or sleeve and is preferably made separable therefrom. In the arrangement shown, the socket or receptacle has a body member or casing in the form of an open-ended tube 5, considerably smaller in diameter than the internal diameter of the member 2. The member 2 is provided at its inner end with a thickened part 6 whose internal diameter is only slightly larger than the external diameter of the member 5; and the corresponding end of the member 5 is enlarged in diameter, as indicated at 7. The parts 6 and 7 are provided with complementary screw threads

8, whereby the socket or receptacle may be detachably fixed within the member 2 by screwing it into the same. The member 5 has a short section 9 whose internal diameter is somewhat less than that of the body portion thereof, lying just inwardly from the enlarged part 7. A block 10 of insulating material is screwed into this part of reduced diameter. A second block 11 of insulating material lies within the member 5 outwardly from and in contact with the block 10 and is secured thereto by a screw 12 and a nut 13.

The socket or receptacle is provided with any desired number of stationary contact pieces or terminals, of any usual or suitable construction, each being indicated as a whole by the reference number 15. As best shown in Fig. 1, these contact pieces or terminals are mounted in and extend entirely through the block 10, parallel with the axis of the socket; the outer end of each being in the form of a pin 16 housed within a deep well or chamber 17 in the block 11 and capable of wobbling slightly to register it with a meeting contact or terminal. The diameters of the holes 17 are greater than the diameters of the pins. The opposite or inner ends of the terminals or contact pieces are connected to the proper wires of which only one, a grounding wire 18, is shown in the drawings. The block 10 lies wholly within the tubular body member 5 so as to leave in the inner end of the latter the chamber that may be filled with a sealing compound 19 after the connections have been made.

Closely surrounding the stationary cylindrical body member 5 and having a sliding fit thereon, is a long sleeve 20 reduced abruptly in diameter at its outer end to provide a short section 21 whose internal diameter is preferably less than the internal diameter of the outer end of the member 5. Screwed into the part 21 is a block 22 of insulating material having fixed therein a number of double-ended contact pieces or terminals equal in number and spaced similarly to those in the socket. These contact pieces or terminals may be tubes 23 of a size adapted to enter the wells 17 in the socket and to fit snugly around the contact pins 16 in the latter; these tubes projecting far enough from the block 22 to permit them to reach almost to the bottoms of the wells before the block 22 comes in contact with the stationary block 11. The opposite ends of the tubes 23 need not project from the opposite or outer face of the block 22, but may lie wholly behind said face.

The plug member of the coupling or connector has a cylindrical body member or shell 25 which is a close fit upon the part 21 and which may be telescoped upon the latter until coming in contact with the annular shoulder 26 formed at the juncture of the part 21 with the body portion of the tubular member or sleeve 20. Fixed within the member 25 is a block 27 of insulating material provided with contact pieces or terminals equal in number, similar in spacing, and complementary to those in the block 22. Since the contact pieces or terminals 23 in the block 22 are shown as being tubular, the cooperating parts of the contact pieces or terminals 28 in the block 27 must take the form of pins 29 adapted to enter the tubular terminals 23. The particular contact piece or terminal 28 that appears in Fig. 1 of the drawings is grounded to the shell 25 through a wire 30 connected to a metal bar 31 that extends diametrically across the interior of the member 25 through the block 27 and is fixed at its ends to bosses 32 integral with the member 25.

It will thus be seen that before the conductors

in a cable (not shown) connected to the plug can be coupled to conductors within the box, the terminals 23 in the floating member within the socket must be engaged with the stationary terminals 16, and the terminals or contact pieces in the plug must be engaged with the terminals in the floating member. If means are provided to lock the floating member and the plug together upon the making of a connection, and maintain this relation as long as the terminals in the floating member are engaged with the stationary terminals in the socket, the plug cannot be disconnected from the floating member until the terminals of the latter are separated from those in the socket. The actual breaking or interrupting of the circuits, upon pulling out the plug, must then always occur within the chamber enclosed between the socket member and the floating member, which latter may be regarded as a deep cup-shaped cap having on the socket member a sliding fit sufficiently close to prevent the escape of flame from such chamber. Consequently by properly proportioning the parts, all arcing will be confined to a chamber which, for all practical purposes, may be regarded as being sealed; the sealing being sufficient to prevent the exposure of an actual arc or the escape of a flame that may be caused by the combustion of any small amount of combustible gas that may have become pocketed within the chamber enclosed between the floating member and the socket. Furthermore, by permitting the separation of the plug from the floating member, only after the circuit has been interrupted, the contact pieces or terminals that are left exposed at or toward the outer end of the tubular hub are always deenergized and dead and no short circuit can be caused by the insertion of a screw driver or other metal tool or implement.

I have provided means to accomplish the results just mentioned and, further, to insure that the arcs between the cooperating terminals in the socket and the floating member be effectively extinguished before the plug can be completely withdrawn.

What may be termed the tubular skirt of the floating member, namely, the portion of the tubular part 20 that telescopes over the socket member, has in the periphery an L-shaped slot 33. The short arm of this slot extends circumferentially of the member 20 and the long arm extends lengthwise of the latter. The tubular hub is provided with a pin projecting inwardly from the same into this L-shaped slot. This pin may conveniently take the form of a screw 35 that may be held stationary, in any position into which it may be adjusted, by means of a lock nut 36. The movements of the floating member within the socket are therefore limited to lengthwise movements through a distance equal to the length of the long arm of the slot and to rotary or turning movements no greater than the angular length of the short arm of the slot. The lengthwise movement of the floating member permits the contacts carried thereby to be disengaged from the stationary contacts in the socket, and causes any arcs that may have been formed to be extinguished. I utilize the rotary movements of the floating member to effect the locking together and unlocking of the plug and floating member, the locked relation being maintained during the lengthwise movements of the floating member. To this end I provide the floating member with an external spring finger 37 projecting somewhat beyond the end that is adapted to be engaged with the plug, and having its free end bent laterally to form a hook 38. The shell 25 of the plug has

in the periphery a notch 39 into which the hooked end of the spring finger on the floating member may be pressed when the plug and the floating member are in the proper angular positions relatively to each other. As best shown in Figs. 1, 2 and 7, the tubular hub has an inwardly-projecting shallow boss 40 of considerable length and width. This boss is so positioned that whenever a coupling has been completed, as shown in Fig. 1, the free end of the spring finger 37 rests on the boss and is held by the latter with its hook engaged in the notch 39 in the plug. Therefore, if the plug is drawn outwardly, namely, toward the right, as viewed in Fig. 1, the floating member must move with the same. The boss in the hub is made long enough so that the contacts carried by the floating member must become completely disengaged from the stationary contacts or terminals in the socket while the spring finger is still riding on the boss; this condition being illustrated in Fig. 2. After the parts have been brought into the relative positions illustrated in Fig. 2, the plug may be unlocked from the floating member by turning it until the spring finger is carried clear of the boss in the hub. When the parts are in the positions shown in Fig. 1, the pin 35 is at the free end of the long arm of the slot 33, as shown in full lines in Fig. 3. When the plug is pulled out to bring the parts into the positions shown in Fig. 2, the slot 33 is carried to the position illustrated in dotted lines in Fig. 3, bringing the pin 35 into registration with the short arm of the slot. The plug and the floating member may now be turned in unison until the pin 35 is at the free end of the short arm of the slot 33, as indicated in Fig. 4.

After the floating member has been brought into the position illustrated in Fig. 4, it will, of course, be held against lengthwise movement by the pin 35, and it should also be locked against accidental turning movements until the plug, which may now be withdrawn completely, is again entered. This locking of the floating member against accidental turning may conveniently be accomplished by a spring finger 41, lying within the tubular hub 2 against the cylindrical wall thereof, and extending lengthwise of the hub. The finger is fixed to the hub at its inner end and, by screws 42 or otherwise, and its free end is bent toward the axis of the hub and has on the side toward said axis a little hemispherical projection 43. The projection 43 is adapted to drop into a little hemispherical recess 45 in the periphery of the casing 20 of the floating member at the instant that the floating member has been turned as far as it will go after having been withdrawn to the position illustrated in Fig. 2. It will be evident from Fig. 7 that upon the turning of the floating member in the counterclockwise direction until the spring finger 37 clears the boss 40, the recess 45 will register with the nose or projection 43, provided that the floating member has been drawn outwardly far enough, namely to the dotted line position indicated in Fig. 3. When the spring finger 41 is not serving to hold the floating member in its outer, idle position, it may be usefully employed to hold the plug yieldingly against withdrawal. Thus, as shown in Fig. 9, when the parts are in the normal coupled positions, the nose or projection 43 on the spring finger 41 seats itself in a little depression 46 in the periphery of the shell 25 of the plug.

It will be seen that the tubular hub has an internal annular flange 47 at its free end. This flange has therein a notch 48, best shown in Fig. 5. On the exterior of the plug is fixed a little

block 49 of the proper width and thickness to permit it to pass through the notch 48 and thus make it necessary that this block be always brought into registration with the notch before the plug can be inserted or withdrawn. Of course, the notch and the plug are so located that the contact pieces or terminals in the plug are in registration with those in the floating member at the time that the block registers with the notch. Therefore the plug need only be brought toward the socket with the block or lug thereon registering with the notch in the hub, and then be pushed in, in order to engage its terminals or contact pieces with those in the floating member. One of the pins 50 that holds the block or lug 49 to the wall of the plug preferably projects entirely through this wall so that the plug cannot be slipped upon the end of reduced diameter of the floating member, namely, the part 21, unless the pin 50 registers with a groove 51 extending lengthwise in the periphery of the part 21, as shown in Fig. 1. The parts are so proportioned that the pin 50 enters the groove or slot 51 before the terminals in the plug reach those in the floating member and, therefore, the pin and groove serve accurately to register the cooperating contacts or terminals in the plug and floating member before these terminals or contacts engage with each other.

The hub 2 may be provided at its free end with a hinged cover member 52 adapted to close that end of the hub after the plug has been withdrawn.

It is believed that the operation of the device has been sufficiently explained in connection with the description of the construction. However, it may be noted that, as shown in Fig. 2, the actual circuits are interrupted between the terminals 16 and 23 within the chamber marked 53 in Fig. 2. The only way that there could be communication between this chamber and the outside atmosphere would be between the overlapping portions of the members 5 and 20. However, these members fit closely against each other, and the overlap is a long one, so that there is no danger of any leakage of flame occurring along this path. Any arcs that are formed are sealed within this chamber until they are broken by the outward movement of the floating member with the plug. When the plug is finally separated from the floating member and leaves the socket, it is only after the circuits have already been broken between the terminals in the socket and those of the floating member, and thus no arcing can occur between the terminals of the plug and those on the floating member. Nor can any arcing or shorting take place if a metal element is subsequently laid in contact with a terminal or terminals at the mouth of the socket while the plug is out.

While I have illustrated and described with particularity only a single preferred form of my invention, I do not desire to be limited to the exact structural details thus illustrated and described; but intend to cover all forms and arrangements which come within the definitions of my invention constituting the appended claims.

I claim:

1. In combination, a deep socket having terminals within the inner end, a floating member in the socket outwardly from the aforesaid terminals and forming with the socket a closed chamber within which the aforesaid terminals lie, said floating member having in the periphery an L-shaped groove one arm of which extends in the direction of the length of the socket and the

other arm of which extends circumferentially from the inner end of the first arm, an internal projection in the socket entered in said groove and limiting the lengthwise and turning movements of said floating member, a plug adapted to be entered into the outer end of the socket and having terminals, contact pieces carried by said floating member and adapted to cooperate with the terminals within the socket and also with the terminals in the plug; and means to lock said plug and said floating member together while said projection remains in the longitudinal arm of the groove in the floating member and to unlock the same while the said projection lies in the circumferential arm of said groove, whereby the contact pieces in the floating member must become disengaged from the terminals in the socket and be shifted circumferentially before such contact pieces can become separated from the terminals in the plug.

2. In combination, a deep socket having terminals within the inner end, a floating member in the socket having elements of conducting material adapted to be engaged with the aforesaid terminals by a sliding movement lengthwise of the socket, an interlock between the socket and said floating member to permit the floating member to move lengthwise of the socket and be held against turning movements while said elements and said terminals are in engagement with each other and permitting the floating member to turn while being held against lengthwise movement when the floating member is at the outer limit of its movement, a plug adapted to be entered in the socket and having terminals adapted to be engaged by said floating member by a sliding movement lengthwise of the socket, a catch on the floating member adapted to engage with the plug and lock the plug and the floating member together, and means on the socket member cooperating with the catch to hold the latter in its locking position during the lengthwise movements of the floating member and permitting the catch to release the plug after the plug and the floating member have been drawn to the outer limit of movement of the floating member and turned through a predetermined angle.

3. In combination, a long tubular housing member, a cylindrical socket member fixed in one end of said housing member and extending only part way to the opposite end of the latter, there being

an annular space or chamber between the major portion of the socket member and the housing member, a floating member arranged within the housing member outwardly from the socket member and having a long sleeve portion extending into said annular space or chamber, the socket member and the floating member having cooperating terminals adapted to engage with each other when the floating member is pushed inwardly and to become disengaged from each other when the floating member is drawn outwardly, a plug member adapted to be entered into the outer end of said housing member, terminals on the plug member adapted to engage with the terminals on the floating member, and means to lock the floating member and the plug member together whenever the terminals in the floating member and the socket member are engaged with each other and to release the plug member so as to permit it to be withdrawn after the terminals on the floating member have been disengaged from the terminals in the socket member.

4. In combination, a long tubular housing member, a cylindrical socket member fixed in one end of said housing member and extending only part way to the opposite end of the latter, there being an annular space or chamber between the major portion of the socket member and the housing member, a floating member arranged within the housing member outwardly from the socket member and having a long sleeve portion extending into said annular space or chamber, the socket member and the floating member having cooperating terminals adapted to engage with each other when the floating member is pushed inwardly and to become disengaged from each other when the floating member is drawn outwardly, a plug member adapted to be entered into the outer end of said housing member and having a tubular part adapted to surround the outer end of the floating member, terminals on the plug member adapted to engage with the terminals on the floating member, and means to lock the floating member and the plug member together whenever the terminals in the floating member and the socket member are engaged with each other and to release the plug member so as to permit it to be withdrawn after the terminals on the floating member have been disengaged from the terminals in the socket member.

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