

Aug. 24, 1965

S. BOSWORTH ET AL

3,202,953

ELECTRICAL CONNECTOR

Filed Jan. 7, 1963

2 Sheets-Sheet 1

FIG. 1

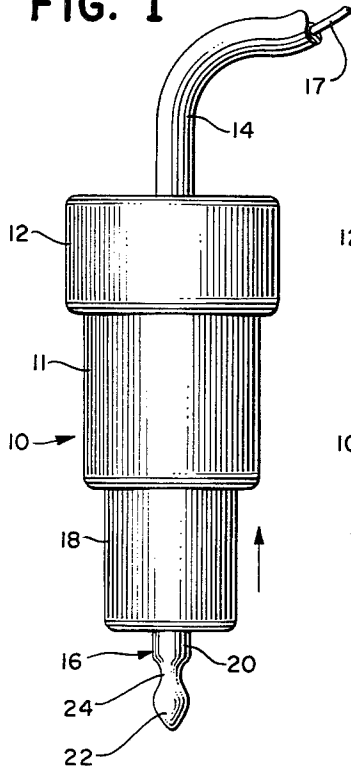


FIG. 3

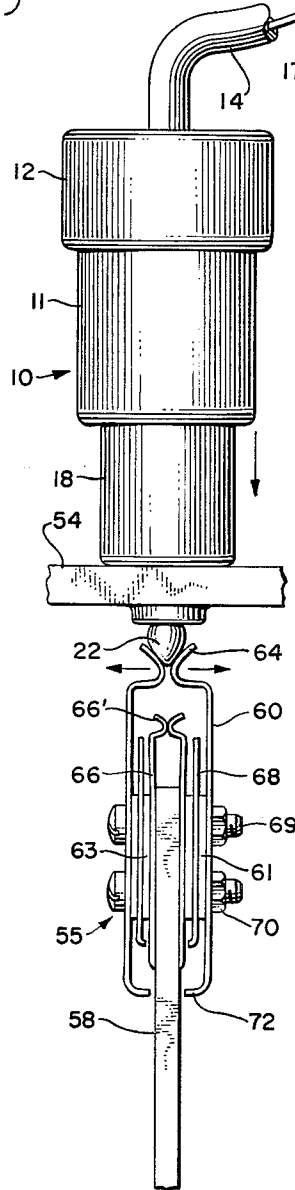


FIG. 4

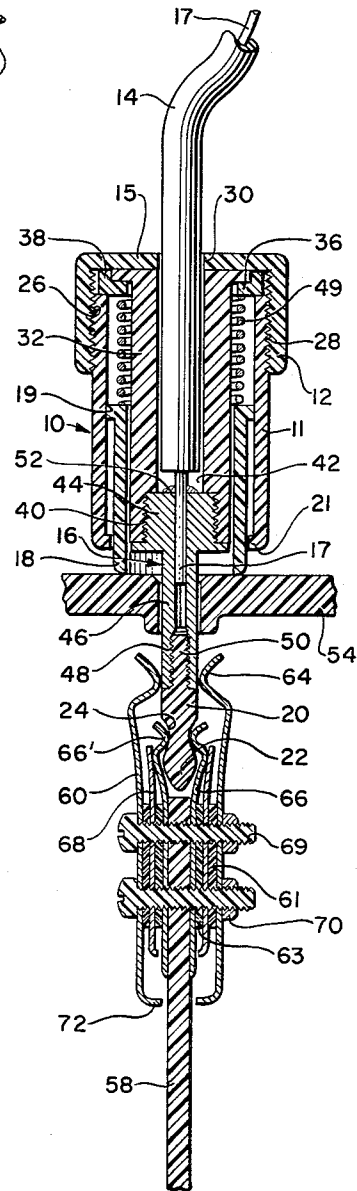
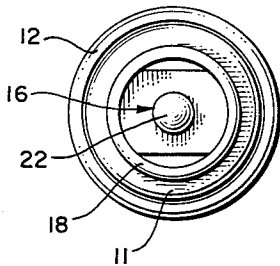


FIG. 2



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2 Sheets-Sheet 2

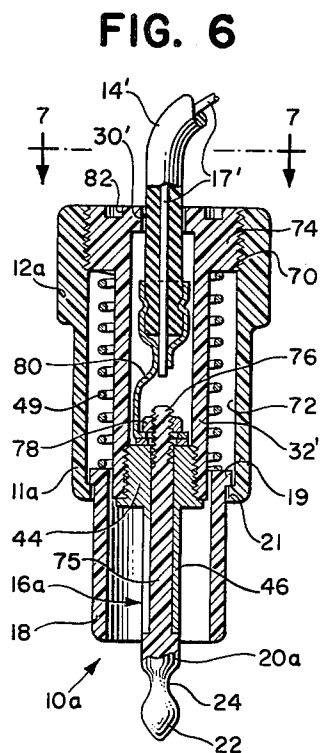
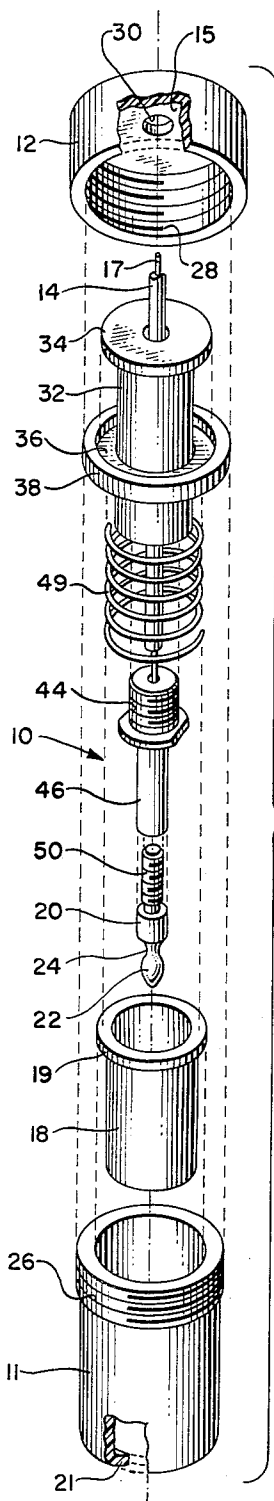


FIG. 5

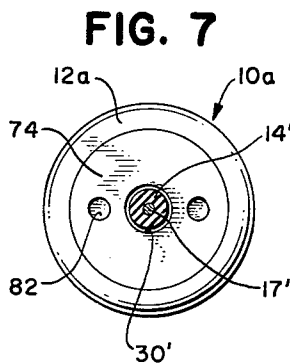


FIG. 7

FIG. 8

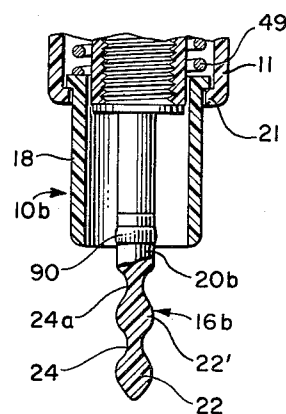
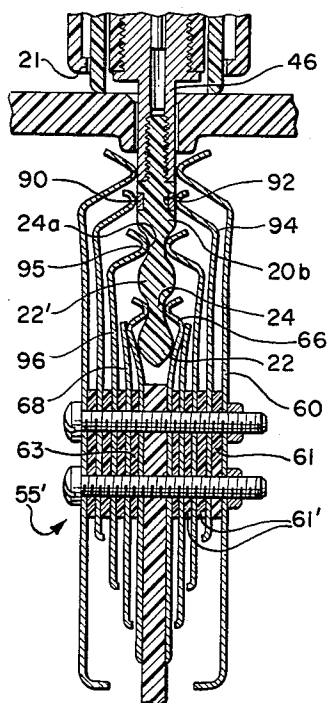


FIG. 9



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ELECTRICAL CONNECTOR

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Filed Jan. 7, 1963, Ser. No. 249,630
3 Claims. (Cl. 339-42)

This invention relates to the art of electrical connectors and more particularly concerns an electric plug for connection of an electric cable to a jack, socket or receptacle.

When electric cables or cords carry high voltage it is desirable that the plugs used to connect them to appropriate electric circuits avoid exposing the high voltage pins or prongs of the plug to contact by operating personnel or to contact with various parts of the circuits. Heretofore substantially all plugs used for test leads in meters and for electric connections of various other types have all had exposed projecting studs, prongs or pins.

The present invention has as a principal object to provide a plug which has a prong, conducting portions of which are always concealed within a housing of the plug.

A further object is to provide a plug which has a fixed axial pin or prong surrounded by a spring loaded retractable non-conductive shell, the shell being movable axially of the pin to permit the pin to be inserted into a jack, socket or receptacle of a circuit.

A further object is to provide a plug of the character described, wherein the pin or prong has a non-conductive tip for separating and engaging spring contacts of a jack, socket or receptacle, while other portions of the pin or prong are electrically conductive for contacting appropriate conductive parts of the jack.

Another object is to provide a plug of the character described, where a plurality of interfitted parts are provided which are so arranged that the prong or pin is disposed and held axially of the surrounding shell.

A still further object is to provide a plug of the character described which is made of parts which can be quickly assembled and disassembled, and which is durable and foolproof in operation.

The invention will be best understood from the following detailed description taken together with the drawing wherein:

FIG. 1 is a side elevational view of a plug embodying the invention.

FIG. 2 is a bottom plan view of the plug.

FIG. 3 is a side elevational view of a plug on an enlarged scale, shown mounted on panel and engaged with an associated jack.

FIG. 4 is a vertical central sectional view through the plug and jack of FIG. 3.

FIG. 5 is an exploded perspective view of a plug embodying the invention.

FIG. 6 is a vertical sectional view similar to part of FIG. 3, of another plug.

FIG. 7 is a transverse sectional view taken on line 7-7 of FIG. 6.

FIG. 8 is a sectional view similar to a part of FIG. 6, showing another plug construction.

FIG. 9 is a vertical sectional view similar to parts of FIG. 4, showing the plug construction of FIG. 8 in association with a panel and jack.

Referring first to FIGS. 1-3, there is shown a plug 10 embodying the invention. This plug has a cylindrical body 11 having a cylindrical head 12 at one end where an electric cord or cable 14 enters the flat top of the head into the plug. The plug has pin 16 fixed axially

therein and extending outwardly of body 11 oppositely to head 12. Surrounding the pin and concentric therewith is a hollow, retractable shell 18 extending outwardly of body 11 and movable partially into the body axially thereof. The pin 16 has a non-conductive cylindrical tip 20 formed with knob 22 defined by a circumferential groove 24. This tip is exposed when the shell is fully extended as shown in FIG. 1.

FIGS. 4 and 5 show details of internal parts and construction of plug 10. Body 11 has an external thread 26 at its upper end which engages with internal thread 28 of head 12. The head is hollow and includes a flange top 15 provided with a hole 30 through which passes electric cord 14. A cylindrical or tubular insulated fitting 32 is provided inside the head and body of the plug. This fitting has an annular flange 34 formed at its upper end. This flange seats on top of an annular internal flange 36 formed in a ring 38. The ring is tightly engaged between the upper end of body 11 and the under side of top 15 when the head is tightened on the body. The fitting 32 extends axially downward through the ring and is coaxial with and inside the body. The fitting has an enlarged internal threaded tubular portion 40 at the lower end of its central bore 42 to receive a threaded head 44 formed at the end of a conductive metal tube 46. Tube 46 forms part of pin or prong 16. The tube has an internal thread 48 at its lower end to receive and engage a threaded stud 50 formed at the upper end of tip 20. The tube has an axial bore in which terminates the wire 17 of cord 14. The wire may be secured to the tube 46 or to its head 44 by solder 52 or by other suitable means to insure electrical continuity between the wire and tube. A coil spring 49 concentric with fitting 32 is located between the top of shell 18 and the under side of flange 36.

All parts of the plug except the metal tube and spring are preferably made of plastic non-conductive, insulation material. The tip 20 of the pin is preferably made of so-called "self-lubricating" plastic, such as nylon, polytetrafluorethylene or the like.

It will be noted that shell 18 has an external annular flange 19 at its upper end which diameter is substantially equal to the internal diameter of body 11. Body 11 has an internal circumferential flange 21 at its bottom end which is aligned with flange 19 to prevent the shell from becoming detached from the body.

The spring 49 tends to expand and bias the shell outwardly of the body. The axial length of the shell is greater than the axial length of the portion of tube 46 which extends outwardly of body 11. Thus the shell conceals the tube when the shell is in its fully extended position shown in FIGS. 1 and 4.

FIGS. 3 and 4 show a non-conductive panel 54 upon which plug 10 is mounted in operative position. The panel may have a hole 56 through which pin 16 may be passed. A jack 55 is shown mounted on another panel 58 rigidly carried on a suitable support not shown. This support may be the panel 54. The jack has a first pair of outer spring contacts 60 opposing each other at flexible ends beyond panel 58. The ends of the contacts have outwardly flared fingers 64. A second pair of conductive spring contacts 66 are disposed respectively between the contacts 60 and panel 56. A third pair of spring contacts 68 are respectively disposed between contacts 60 and 66. Insulation strips 61 are disposed between contacts 60 and 68. Insulation strips 63 are disposed between contacts 66 and 68. Non-conductive, plastic screws 69 are inserted through registering holes in the several contacts, strips and panel 58, and are secured by metal or plastic nuts 70. The several contacts have bent ends 72 to which suitable

electric connections may be made from an electric circuit or circuits carried by panel 53 or some other support.

In operation of the plug, the bottom end of shell 18 will be placed against the outer surface of panel 54 with non-conductive tip 20 extending through hole 56. First plug 20 will engage and separate fingers 64 of contacts 60. As the plug is pushed axially downward toward jack 55, the shell 18 will retract against increasing tension in spring 20 while tip 20 will advance into engagement with contacts 66. The rounded knob of the tip will separate the contacts 66 and the bent ends 66' of the contacts will engage at groove 24 to retain knob 22. At the same time the metal tubular portion 46 of the pin 16 will reach and contact both contact fingers 64 to complete an electric circuit between wire 17 and both fingers 64. When the contacts 66 are separated they bear against the contact elements 68 which serve to back up the contacts 66 and maintain a firmer spring tension and engagement of the knob 22. If contact elements 68 are connected in an electric circuit then there will be established continuity between the circuit of contact elements 66 and 68. However the circuit including wire 17 and contacts 60 will be isolated from the circuits of contacts 66, 68 since tip 20 is a non-conductive member.

Since the shell 18 is under spring tension, the tubular member 46 remains wholly concealed inside the shell outside of panel 54. If the pin 20 is disengaged by a pull exerted axially outward of head 12 or body 11, then the shell 18 will be automatically extended as the pin comes out of hole 56. As a result the electrically conductive tubular member 46 is always concealed and shielded from external contact by an operator or any external circuit.

FIG. 5 shows the several parts in an exploded array. It will be noted these parts can easily be quickly assembled and disassembled for connecting and replacing wire 17 or for any other purpose.

FIGS. 6 and 7 show another plug 10a which in side view is identical to plug 10. This plug may be substituted in place of plug 10 for use with jack 55 of FIGS. 3 and 4.

In plug 10a, the body 11a and head 12a are integrally formed as a unit. Head 12a has an internal thread 70 at the upper end of its central bore 72. An externally threaded annular flange 74 at one end of the tubular portion of insulated fitting 32' engages with thread 70. The tubular portion of the fitting has a diameter less than flange 74 and coil spring 49 is placed concentrically on its portion of the fitting as in plug 10. The spring 49 bears on the upper end of flange 19 of the shell 18. The upper end of the spring bears on the underside of flange 74. Pin 16a has a tubular conductive member 46 supporting non-conductive tip 20a which is integral with a non-conductive axial stem 75. Stem 75 extends through the bore in tube 46 and out of head 44. The upper end 76 of the stem 75 is threaded and engages a nut 78 which holds a lug 80 on the end of the stem. The lug bears on the top of head 44. Cord 14' passes through hole 30' in flange 74. Wire 17 is crimped, soldered or otherwise secured to the lug. Thus electrical continuity is established and maintained between the wire and tubular member 46. Other parts of plug 10a corresponding to those of plug 10 are identically numbered.

A pair of recesses 32 are formed in the outer end of the fitting for engagement by a suitable spanner wrench used to remove and replace the fitting.

When the plug 10a is assembled it operates in the same manner as described for plug 10. Shell 18 will retract when the pin 16a is advanced through a hole in a panel to engage a jack, as illustrated in FIG. 3.

In FIGS. 8 and 9, plug 10b is similar to plug 10 and corresponding parts are identically numbered. Plug 10b has a pin 16b provided with an auxiliary contact ring 90 between knob 22 and tubular contact member 46. The ring 90 can be set into a circumferential groove 92 in the insulated tip 20b. Thus the exterior surface of the ring

will be flush with the surface of non-conductive tip 20b and member 46. A further groove 24a can be provided between knob 22 and member 46 in tip 20b.

The ring 90 serves to contact an additional pair of spring contacts 94 interposed in jack 55' just inside of contacts 60. The bent fingers 95 of another pair of spring contacts 96 just within contacts 94 engage in groove 24a. Contacts 66 engage in groove 24. The tip 20b thus has a double knob construction with knobs 22 and 22' engaged by two pairs of contacts 66 and 96. The arrangement of plug 10b and jack 55' permits a larger number of circuits to be opened or closed than is possible in jack 55, due to the larger number of contacts. In addition, plug 10b will be held more securely by jack 55' to the double knob engagement of the contacts.

Additional insulation strips or wafers 61' are used to separate the added contacts 94, 96 from the adjacent ones and from each other.

In all forms of the invention, there is provided a plug structure in which a cylindrical body supports a fixed pin or prong in axial disposition therein. An axial movable shell shields electrically conductive parts of the pin in all positions of plug in engagement with and out of engagement with a jack. The structure of plug 10a is somewhat simpler and uses less parts than plug 10. The parts of plug 10a can be separated without use of any tool while plug 10a requires a wrench. The non-conductive pin 20a, with its non-conductive stem 75 employed in plug 10a, can be used in plug 10 in place of non-conductive tip 20 with its short threaded stud 50. Wire 17 will then be attached to the upper threaded end of stem 75 as illustrated in FIG. 6.

It is also possible to employ non-conductive tip 20 in plug 10a in place of pin 20a and stem 75. Wire 17a will then be secured to tube 46 as shown in FIG. 4.

What is claimed and sought to be protected by Letters Patent of the United States is:

1. A plug for connecting an electric wire to an electric circuit having spaced pairs of spring contacts, comprising a generally cylindrical body, a pin supported in said body axially thereof, said pin having a non-conductive tip and a conductive portion adjoining said tip axially of the pin, a cylindrical shell supported by said body in axial alignment therewith, said pin extending axially out of one end of said body, said shell being axially movable in said body and having a portion extending outwardly of said body, said portion of the shell surrounding at least part of said pin in all positions of said shell, spring means biasing said shell outwardly of said body so that said conductive portion of the pin is wholly concealed and shielded by said shell when the shell is fully extended from said body, said conductive portion of the pin being exposed when the shell is fully retracted into said body, a head at the other end of said body, an insulation fitting in said body, said fitting having a tubular portion carrying said spring means and detachably engaged with said conductive portion of the pin, said fitting having a passage therethrough for receiving said electric wire, said conductive portion of the pin having an end exposed in said fitting for connection of said wire thereto, said fitting having a flange at one end, said head being removably secured by threaded means on said body, and a ring engaged between said body and said head, said ring having a flange engaged with the flange of said fitting and holding said fitting and pin rigidly in axial alignment within said body.

2. A plug for connecting an electric wire to an electric circuit having spaced pairs of spring contacts, comprising a generally cylindrical body, a pin supported in said body axially thereof, said pin having a non-conductive tip and a conductive portion adjoining said tip axially of the pin, a cylindrical shell supported by said body in axial alignment therewith, said pin extending axially out of one end of said body, said shell being axially movable in said body and having a portion extending outwardly of said body, said portion surrounding at least part of said pin in all

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positions of said shell, spring means biasing said shell outwardly of said body so that said conductive portion of the pin is wholly concealed and shielded by said shell when the shell is fully extended from said body, said conductive portion of the pin being exposed when the shell is fully retracted into said body, a head at the other end of said body, an insulation fitting in said body, said fitting having a tubular portion carrying said spring means and detachably engaged with said conductive portion of the pin, said fitting having a passage therethrough for receiving said electric wire, said conductive portion of the pin having an end exposed in said tubular portion of the fitting for connection of said wire thereto, said fitting having a flange at one end, and threaded means detachably holding said flange and head together, whereby said fitting and pin are held rigidly in axial alignment within said body.

3. A plug as claimed in claim 2 for connecting an electric wire to an electric circuit having spaced pairs of spring contacts, wherein said non-conductive tip has a pair of knobs at its free end and circumferential grooves at the knobs for separating and engaging two pairs of said contacts while another pair of said contacts engage said con-

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ductive portion of the pin, said pin having a conductive element supported on said tip and spaced from said conductive portion for engaging a further pair of said contacts.

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