

Nov. 24, 1964

R. J. VANDERBILT

3,158,702

PATCHCORD CONNECTOR

Filed Nov. 15, 1961

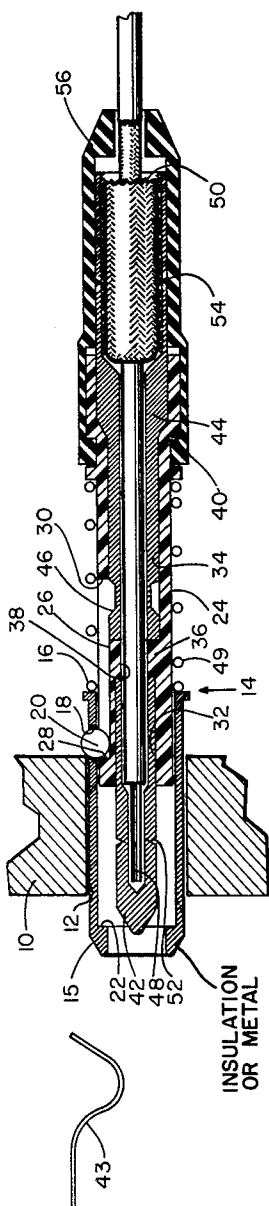


FIG. 1.

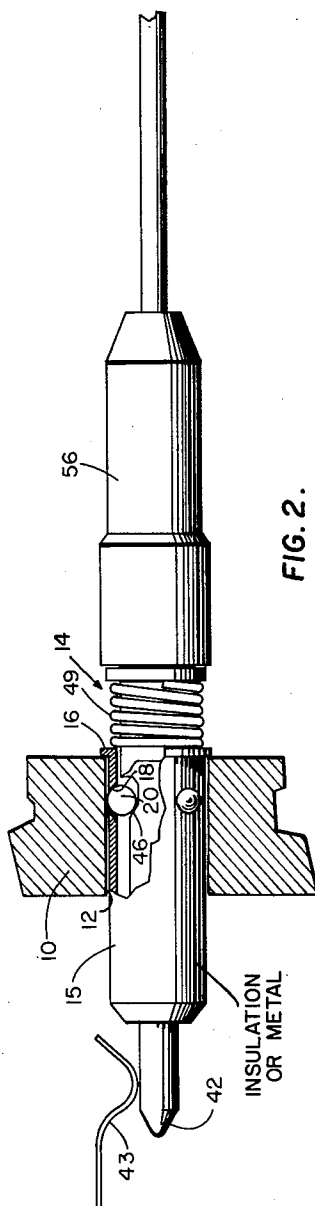


FIG. 2.

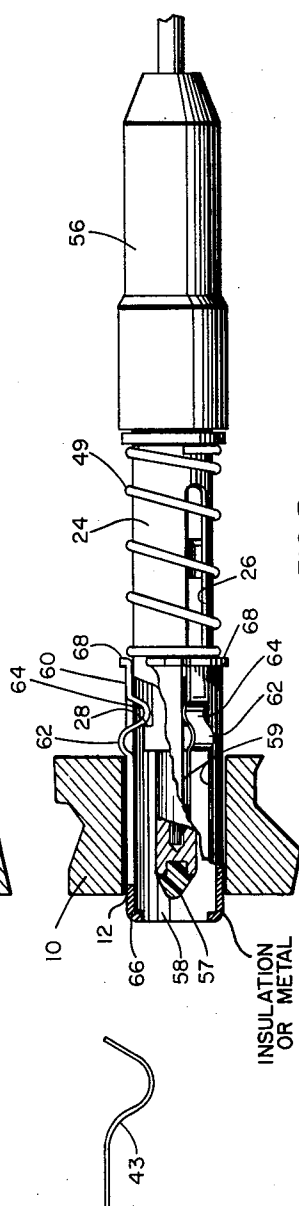


FIG. 3.

INVENTOR.
RICHARD J. VANDERBILT
BY *E. A. Petter*
ATTORNEY

1

3,158,702

PATCHCORD CONNECTOR

Richard J. Vanderbilt, Rumson, N.J., assignor to Electronic Associates Inc., Long Branch, N.J., a corporation of New Jersey

Filed Nov. 15, 1961, Ser. No. 152,439

11 Claims. (Cl. 200—51)

This invention relates generally to patchcord connectors and, in particular, to a plug connector of the type used in patchboards for computers and the like for completing electrical circuits to control the operation of the computer as desired.

In the computer art, it is common practice to provide a plugboard or patchpanel at which the various computing components may be selectively interconnected by the use of patchcords. In the analog computer art, the distributed capacitance of the patchcords, as well as the stray currents which may be picked up by the patchcords, contribute significantly to the accuracy with which computations are performed and, therefore, it has become a common practice to use shielded patchcords and provide means such as the patchboard itself for effectively grounding the shields of the patchcord. In order to achieve this end, the customary analog computer patchcord connector is adapted for completing a circuit connection to a computing component while also completing a circuit between the braid or shield of a coaxial patchcord and the patchboard.

Prior art connectors of this type have been deficient in several material respects. The most noticeable and significant of the deficiencies has been that with continued use the connectors tend to become worn, fit somewhat loosely in the patchpanel, and fail to provide an adequate circuit to ground for the shielded conductor of the patchcord. Also, being subject to continuous handling by the computer operators, the connectors tend to accumulate the usual body oils found on the human hand and other non-conductive dirt or foreign substances which contribute significantly to the condition of poor electrical contact between the shield connector and the patchpanel. In order to eliminate these conditions, it is frequently necessary to replace defective connectors and to provide for the periodic cleaning of the connectors by the use of carbon tetrachloride or other suitable cleansing solvents.

Prior art connectors further employ an uninsulated projecting terminal. Since it is quite common for computer operators to reconnect the patchboard while the computer and patchcords are energized electrically, the uninsulated terminal is an ever-present hazard of shock to the operators. Moreover, should the energized terminal be accidentally touched to the grounded patchpanel, damage to circuit components or blown fuses will result.

The present invention is directed to a plug connector of the type described which largely eliminates the deficiencies of prior art connectors while also providing means to reduce the hazards associated with the handling of electrically energized terminals. In its preferred form, the present connector comprises an elongated hollow insulating sleeve member which is provided with plural longitudinal grooves or openings. An electrical terminal extends outwardly of one end of the sleeve and is connected to a current-conducting wire of a coaxial conductor which is disposed within the sleeve. Another electrical terminal

2

may extend outwardly of the other end of the sleeve and provide a connection to the wire braid or shield which is associated with the coaxial conductor. An elongated sleeve member, which in the present embodiment may be made of an electrical conducting material, is disposed coaxially of the insulating sleeve, and the sleeves are biased for relative movement in a direction to have the metallic sleeve normally cover or coaxially surround the current-conducting electrical terminal. Contact means, which may take the form of a current-conducting ball, are disposed in each of the longitudinal openings in the insulating sleeve and are movable therein along their length upon movement of the sleeve member to complete an electrical circuit with the terminal which is connected to the coaxial braid.

When the connector is removed from the patchboard, the metallic sleeve is moved in a direction to cover the current-conducting electrical terminal and prevent its being touched and thereby reduce the hazard of electrical shock to the operator. The hazard of touching the terminal to the patchpanel is minimized by this arrangement and can be almost entirely eliminated by providing the terminal with an insulated tip. Upon the application of the slight pressure which is required to insert the connector into a patchboard, the metallic sleeve is retracted to uncover the current-conducting electrical terminal and make it available for completing an electrical circuit. When the connector is seated in an opening in the patchboard, the contact means are driven into engagement with the wall portion of the patchboard opening by the means biasing the normal relative movement of the sleeves in order to complete a circuit between the coaxial braid of the patchcord and the patchboard.

It is among the objects of this invention to provide a cover for a connector terminal while it is disengaged and to permit the connecting of the terminal without having to employ additional means for uncovering the terminal while making it available.

Another object of this invention is to provide a cover for a connector terminal while it is disengaged and to utilize the cover member for purposes of completing a circuit between the coaxial braid of a conductor and a grounded patchboard when the connector terminal is uncovered and engaged.

A further object of the invention is to provide a patchcord connector which is rugged enough to withstand rough handling and which has a long and useful life.

Still another object of the present invention is to provide a patchcord connector of the type described which is relatively invulnerable to the adverse effects of surface contaminants.

These and other objects, features, and advantages will become apparent from the following description of a preferred embodiment of the present invention taken in connection with the accompanying drawings wherein:

FIG. 1 is a sectional view in elevation of a preferred embodiment of a plug connector embodying the features of the present invention as it is partially withdrawn from an opening in the patchboard;

FIG. 2 is a view generally similar to that of FIG. 1 but showing the plug connector as it is fully inserted into an opening in the patchboard; and

FIG. 3 is a view generally similar to FIG. 1 showing another embodiment of the present invention.

In the following description, like reference numerals

will be used to designate like parts. In FIG. 1, the reference numeral 10 represents a patchboard which may be connected to an electrical ground and which contains a plurality of openings such as 12, into which the plug connector 14 is shown inserted. The connector 14 includes an outer sleeve or barrel 15 which is preferably cylindrical in form and adapted to be slidably received in one of the openings 12 as shown in FIGS. 1 and 2. The rear end portion of the sleeve 15 has a shoulder 16 of enlarged diameter to abut the front surface of the patchboard 10 and limit forward movement of the sleeve inwardly of the patchboard. A plurality of radially disposed openings 18 are provided in the sleeve 15 adjacent to the shoulder 16. The openings 18 are of circular form and tapered inwardly of the sleeve 15 in order to captively retain a contact element 20, to be hereinafter described. An inwardly extending shoulder 22 is provided at the front or forward end of the sleeve 15 to limit movement of the remaining elements of the connector, to be hereinafter described, relative to the sleeve. Although in this preferred embodiment of the plug connector, the sleeve 15 is shown to be made of an electrically conducting material such as brass, it can be made of an insulating material such as nylon or the like equally as well.

Disposed within the bore of the sleeve 15 and slidably movable therein is a cylindrical insulating sleeve member 24 which may be made of nylon or the like. The member 24 is formed with a plurality of radially disposed slots or grooves 26 which correspond in number and radial position to the radial sleeve openings 18. Slots 26 extend along the axis of the member 24 for a portion of its length and terminate in a front wall 28 and a rear wall 30. An axial bore 32 of suitable diameter is provided at the forward end of the member 24 and an axial bore 34 of slightly larger diameter is provided at the rear end of member 24. The bores 32 and 34 terminate at and define an insulating flange 36 internally of the member 24 which is provided with an axially disposed cylindrical aperture 38. The diameter of bore 34 is preferably selected to be of the same diameter as the depth of slots 26 so as to permit that portion of the slots which is disposed between a wall 30 and flange 36 to communicate with the bore 34. Member 24 is also provided with an enlarged rear end portion which may have a radial slot 40 adjacent to its forward end.

Inserted within the bore 32 is an elongated metallic terminal 42 which makes contact with a suitable terminal 43 of the patchboard and which has a bullet-nose end extending outwardly of the member 24. Inserted within the bore 34 is another terminal 44 which may be generally in the form of a sleeve and provided with a radial slot in its outer surface adjacent to the end disposed within the bore 34. The radial slot may originate at the corresponding end walls 30 when terminal 44 is fully seated in the bore 34 and may extend in a generally forward direction to define a cam surface 46 within each of the slots or grooves 26. Thus, it will be seen that the terminal 42 and the terminal 44 are insulated one from the other by the flange 36 formed by the insulating member 24. In this manner, terminal 42 inserted in bore 32 and terminal 43 inserted in bore 34 are secured in the cylindrical sleeve member 24 and are disposed in a spaced end-to-end relationship within the insulating sleeve 24.

In this preferred embodiment, contact element 20 is generally in the form of a metallic ball, and one such element is disposed within each of the slots 26 with a portion of its surface normally extending upwardly through the corresponding radial opening 18. A spring 49 is disposed coaxially of the insulating member 24 between its enlarged rear end portion and the shoulder 16 of sleeve 15 to urge movement of the sleeve in a direction to coaxially surround or cover the terminal 42.

The rear end portion of terminal 44 may extend outwardly of the bore 34 and may be there provided with an enlarged diameter bore which may be internally threaded. The portion of terminal 44 which lies within the member 24 may have a bore of the same diameter as the aperture 38.

A typical coaxial conductor comprising a current-conducting element or wire 48 covered with a suitable dielectric and an external shield or braid 50 is shown to be disposed within the plug connector 14. That portion of the coaxial conductor which lies within the aperture 38 and within the same diameter internal bores of terminals 42 and 44 is stripped of its braid 50. The dielectric and braid are stripped from the wire 48 only for that portion of its length which lies within the reduced diameter bore of terminal 42. For convenience, the braid to be removed from the conductor may be turned back open itself for that portion of its length which lies within the enlarged bore of terminal 44 when the coaxial conductor is fully inserted into the plug connector.

In securing the coaxial conductor to the plug connector, it is convenient to first push the conductor into the connector until the forward edge of the braid 50 engages the internally threaded portion of terminal 44, and then twist or rotate the conductor relative to the connector and thereby screw it inwardly thereof through coaction of the braid and the internal threads to complete the insertion. In order to provide for a rigid assembly and establish electrical contact between the coaxial conductor and the plug connector, the terminal 42 may be suitably crimped at 52 and the terminal 44 may be suitably crimped at 54. A suitable, commercially available plastic or rubberized insulating sleeve 56 may be disposed coaxially of the rear end portion of member 24 and for a short length of the inserted conductor. Sleeve 56 may further be secured to and seated in the radial slot 40.

When the plug connector 14 is withdrawn from an opening 12, the parts thereof assume the condition of FIG. 1, viz., spring 49 biases the sleeve 14, and in turn the ball 20 for movement in a forward direction whereby the sleeve provides a substantially complete cover for the terminal 42. Forward movement of sleeve 14 is limited by engagement of balls 20 with the front walls 28 of slots 26. In this position of the sleeve, the terminal 42 may be energized electrically and yet can be handled somewhat carelessly without presenting a hazard to the computer operator. Moreover, in inserting an energized connector into an opening 12 as shown in FIG. 1, the danger of accidentally touching the terminal 42 against the grounded patchboard is significantly reduced. It is also to be noted that in this position of sleeve 15 the balls 20 do not engage the terminal 44.

When the connector is being inserted into an opening in the patchboard 10 as shown in FIG. 1, the balls 20 extend beyond the cross-section limits of the opening 12 and thereby engage the front surface of the patchboard, adjacent to the opening 12. Continued inserting pressure on the connector causes the balls 20 to roll or slide within the slots 26 and permit limited unrestricted relative movement of sleeve 15 and insulating member 24. When the relative movement of the sleeve 15 and insulating member is such that the balls 20 descend the cam surfaces 46, they no longer extend beyond the cross-sectional limits of openings 12 and the shoulder 16 can then be engaged with the front surface of the patchboard. Forward movement of insulating member 24 and terminal 42 is limited by engagement of the front or forward edge of member 24 with shoulder 22. At this time, the bullet-nose end of terminal 42 is seated firmly and positively with a wiping action against the corresponding contact 43.

When, thereafter, inserting pressure is removed from the plug connector, the bias of spring 49 will cause slight

5

relative movement of sleeve 15 and insulating member 24 and cause the cam surface 46 to press the balls 20 against the side wall portion of the opening 12. In this manner, a very satisfactory low-impedance circuit is established between the braid 50 and patchboard 10 via the terminal 44 and balls 20. Moreover, since only a very small portion of a given ball 20 is exposed to handling and since the balls normally rotate or wipe within the slots 26, the low-impedance path established between the conductor braid and the patchboard can be maintained over an extended period of continued use with minimal maintenance. Since, in this embodiment, the sleeve 15 does not form part of an electrical circuit for the coaxial braid, the accumulation of dirt or other contaminants on its surface does not adversely affect operation or performance of the plug connector.

The modification shown in FIG. 3 is similar to that shown in FIGS. 1 and 2 except that the movable contact means are made as an integral part of the retractable sleeve and the terminal 42 is provided with a bullet-nose tip 57 which is made of an insulating material, such as nylon. The tip 57 may be molded into an appropriate aperture provided in the extending end portion of terminal 42 for this purpose. Alternatively, the aperture in terminal 42 and a portion of the tip 57 may be provided with similar cooperative threads to facilitate their assembly. Although the use of the tips 57 is shown only in conjunction with the embodiment of FIG. 3, it will be understood that it may be used with the embodiment of FIGS. 1 and 2 as well.

The retractable sleeve 58 in the embodiment of FIG. 3 is preferably made of resilient electrical-conducting material, such as a beryllium copper alloy. Although the sleeve may be formed by any suitable extruding or metal-forming operation, it has been found most desirable to form it from a flat rectangular sheet in a progressive die. While the sleeve 58 is in its flat form, it is provided with one or more pairs of longitudinal slits 59 which define a finger or cantilever element 60. Each finger or cantilever element 60 may be of a suitable length and of a width which is somewhat less than the width of a corresponding opening or groove 26. Through the use of a suitable die, each element or finger 60 is thereafter altered in appearance so as to have a cross-sectional configuration which is generally in the form of the letter S, whereby an arcuate portion 62 extends above the cross-sectional limits of the sheet 58 and an arcuate portion 64 extends below the cross-sectional limits of the sheet. In the present embodiment, the arcuate portion 64 is formed adjacent to the free end portion of the finger or element 60.

The sheet 58 may be thereafter rolled into the form of a slit sleeve and provided with an inwardly extending radial lip portion 66 at the one or forward end and an outwardly extending radial lip portion 68 at its opposite or rear end. The sleeve 58 thus formed is slipped over the terminal 42 end of insulating member 24 with the arcuate portions 64 disposed for sliding movement in corresponding grooves or openings 26.

With the spring 49 biasing the sleeve 58 for movement in a direction to cover terminal 42, cooperation between the portions 64 and the bottom of corresponding openings 26 causes the arcuate portions 62 to extend beyond the cross-sectional limits of the sleeve 58 and abut the front edge portion of an opening 12 upon insertion of the plug connector of this embodiment into the patchboard. Engagement of the portions 64 with the walls 28 limits relative movement of the retractable sleeve 58 and insulating member 24 in one direction. Continued insertion pressure on the plug connector permits movement of the sleeve 58 relative to the insulating member 24 until such time as the portions 64 ride down the cam surface 46 and permit the arcuate portions 62 to be forced inwardly of the cross-sectional limits of sleeve 58. At this time, the lip portion 68 may be moved into engagement with the front surface of the patchpanel 10 to limit inward

6

movement of the sleeve 58. Thereafter, when inserting pressure is removed from the plug connector, the spring 49 will cause slight relative movement of the sleeve 58 and insulating member 24 to cause cam surfaces 46 to press the portions 62 into engagement with the sidewalls of the opening 12. A circuit is thus established between the braid 50 of a patchcord and the patchpanel 10 via the finger or element 60, the arcuate portion 64 engaging the terminal 44 and the arcuate portion 62 engaging the patchpanel.

While in the embodiment of FIG. 3 the sleeve 58 forms part of an electrical circuit between the braid of a coaxial conductor and the patchpanel, the accumulation of dirt or other contaminants on its surface is not significant because of the wiping action of the arcuate portions 62 and 64 on their respective contact surfaces. The advantage of this embodiment of plug connector over that of the embodiment shown in FIGS. 1 and 2 is that the assembly of the components is somewhat simpler. Also, since there are fewer components to the plug connector in the embodiment of FIG. 3, its manufacture is somewhat less costly.

While the connectors and patchboard openings have been described as being of a cylindrical configuration, it will be apparent that the present connectors could be utilized in openings of other configurations merely by altering the external cross-sectional configuration of the sleeves 15 and 58. In addition, although the present connectors have been shown and described for a particular use, it should be apparent that a circuit for a conductor other than the braid of a coaxial patchcord can be made with its use.

While only two embodiments have been shown and described herein, and inasmuch as this invention is subject to many variations, modifications, and reversals of parts, it is intended that all matter contained herein shall be considered as illustrative and not in a limiting sense.

I claim:

1. A plug connector comprising an elongated hollow insulating sleeve having at least one longitudinal opening therein, a pair of metallic elements disposed in a spaced end-to-end relationship within said sleeve, an elongated sleeve member disposed coaxially of said insulating sleeve and movable with respect thereto along the longitudinal axis thereof, and a contact element disposed within said longitudinal opening and movable therein along the length thereof upon movement of said sleeve member to limit relative movement of said insulating sleeve and sleeve member in one direction and to establish electrical contact with one of said metallic elements upon relative movement of said insulating sleeve and said sleeve member in an opposite direction.

2. A plug connector comprising a hollow cylindrical insulating sleeve having a plurality of longitudinal openings therein, a pair of metallic elements disposed in a spaced end-to-end relationship within said sleeve, a tubular sleeve member disposed coaxially of said insulating sleeve and movable with respect thereto along the longitudinal axis thereof, and a metallic contact element disposed within each of said plurality of openings and movable therein along the length thereof upon movement of said sleeve member to limit relative movement of said insulating sleeve and sleeve member in one direction and to establish electrical contact with one of said metallic elements upon relative movement of said insulating sleeve and sleeve member in an opposite direction.

3. A plug connector comprising an elongated hollow insulating sleeve member having at least one longitudinal opening therein, a pair of metallic elements disposed in a spaced end-to-end relationship within said sleeve, with at least one of said elements being disposed to extend outwardly of one end of said sleeve, an elongated metallic sleeve member disposed coaxially of said insulating sleeve and movable with respect thereto along the longitudinal axis thereof, and a contact element disposed within said

longitudinal opening and movable therein along the length thereof upon movement of said metallic sleeve to limit relative movement of said sleeves in a first direction wherein said metallic sleeve surrounds said one outwardly extending metallic element and to establish electrical contact with the other of said pair of metallic elements upon relative movement of said sleeves in an opposite direction.

4. A plug connector according to claim 3 wherein said one metallic element has a tip of insulating material on the end thereof which extends outwardly of said insulating sleeve.

5. A plug connector comprising a hollow cylindrical insulating sleeve having a plurality of longitudinal openings therein, a pair of metallic elements disposed in a spaced insulated end-to-end relationship within said sleeve and extending outwardly of the opposite ends thereof, a tubular metallic sleeve disposed coaxially of said insulating sleeve and movable with respect thereto along the longitudinal axis thereof, and a metallic element disposed within each of said plurality of openings and movable therein along the length thereof upon movement of said metallic sleeve to limit relative movement of said sleeves in one direction and to establish electrical contact with one of said metallic elements upon relative movement of said sleeves in an opposite direction.

6. A plug connector comprising a hollow cylindrical insulating sleeve having a plurality of longitudinal openings therein, a pair of metallic elements disposed in an insulated end-to-end relationship within said sleeve and extending outwardly of the opposite ends thereof, a tubular metallic sleeve disposed coaxially of said insulating sleeve and including a plurality of radial openings therein, and a metallic contact disposed within each of said plurality of longitudinal openings and extending into a corresponding one of said radial openings in said metallic sleeve, each said metallic contact being movable along the length of a corresponding longitudinal opening upon movement of said metallic sleeve to limit relative movement of said sleeves in one direction and to establish an electrical contact with one of said metallic elements upon relative movement of said sleeves in an opposite direction.

7. A plug connector comprising an elongated insulating cylinder having a bore open at either end and having a plurality of longitudinal openings therein, said cylinder having an inside shoulder intermediate its ends and an outside shoulder at one end, a metallic sleeve disposed in the bore at said one end of said cylinder and abutting said shoulder, a metallic stud disposed in the bore at the other end of said cylinder and having an end extending outwardly thereof, an elongated metallic barrel having a plurality of radial openings at one end and disposed coaxially of said other end of said cylinder, said elongated metallic barrel having a partially closed end which is adapted to engage said one end of said cylinder to limit movement of said barrel in one direction and having an outer shoulder adjacent said radial openings, a spring disposed between said outside shoulder of said cylinder and said outer shoulder of said metallic barrel for biasing said metallic barrel for movement in a direction to surround said stud, and a metallic ball capactively retained within each of said plural openings in said metallic barrel and a corresponding one of said longitudinal openings, each said ball being movable along the length of said longitudinal opening upon movement of said barrel to limit movement of said barrel in the direction to surround said stud and for establishing electrical contact with said metallic sleeve when said barrel is moved in an opposite direction.

8. A plug connector for insertion within a plugboard opening of predetermined cross-sectional dimension, comprising a hollow cylindrical insulating sleeve having at least one longitudinal opening therein, a metallic element disposed within said sleeve and including an inclined

outer surface within said sleeve juxtaposition said opening, a tubular metallic sleeve disposed coaxially of said insulating sleeve and having at least one radial opening therein, a metallic contact element disposed within said radial opening and movable along the length of said longitudinal opening, and spring means biasing said metallic sleeve and insulating sleeve for relative movement in one direction with respect to their longitudinal axes whereby said metallic contact is caused to extend through said radial opening beyond the cross-sectional limits of said metallic sleeve, said metallic contact element engaging the front surface of the plugboard upon the application of pressure in inserting said metallic sleeve within the opening in the plug to cause relative movement within the opening in the plugboard to cause relative movement of said insulating sleeve and said metallic sleeve in an opposite direction, said contact element being driven into engagement with said inclined surface by said spring means to complete an electrical circuit between said metallic element and the plugboard when the plug connector is fully inserted into the plugboard opening.

9. A plug connector for insertion within a plugboard opening of predetermined cross-sectional dimension comprising a hollow cylindrical insulating sleeve having at least one longitudinal opening therein, a metallic element disposed within one end of said sleeve and including an inclined outer surface within said sleeve juxtaposition said opening, a metallic stud inserted into the other end of said sleeve and having an end extending outwardly therefrom, a tubular metallic sleeve disposed coaxially of said insulating sleeve and having at least one radial opening therein, a metallic contact element disposed within said radial opening and movable along the length of said longitudinal opening, and spring means biasing said metallic sleeve and insulating sleeve for relative movement in one direction with respect to their longitudinal axes, whereby said metallic contact is caused to extend through said radial opening beyond the cross-sectional limits of said metallic sleeve and said metallic sleeve is caused to cover said stud, said metallic contact element engaging the front surface of the plugboard upon the application of pressure in inserting said metallic sleeve within the opening in the plugboard to cause relative movement of said insulating sleeve and said metallic sleeve in an opposite direction, whereby said stud is uncovered and said contact element is engaged with said inclined surface to complete an electrical circuit between said metallic element and the plugboard.

10. A plug connector comprising a hollow cylindrical insulating sleeve having a plurality of longitudinal openings therein, a pair of metallic elements disposed in an insulated end-to-end relationship within said sleeve and extending outwardly of the opposite ends thereof, and a tubular metallic sleeve disposed coaxially of said insulating sleeve and including a plurality of radially disposed fingers, each of said plurality of fingers being disposed within a corresponding one of said plurality of longitudinal openings, said fingers being movable along the length of a corresponding longitudinal opening upon movement of said metallic sleeve to limit relative movement of said sleeves in one direction and to establish an electrical contact with one of said metallic elements upon relative movement of said sleeves in an opposite direction.

11. A plug connector for insertion into a patchboard opening of predetermined cross-sectional dimension, comprising a hollow cylindrical insulating sleeve having a plurality of longitudinal openings therein, a pair of metallic elements disposed in an insulated end-to-end relationship within said sleeve and extending outwardly of the opposite ends thereof, a tubular metallic sleeve disposed coaxially of said insulating sleeve and including a plurality of radially disposed S-shaped contact elements disposed for sliding movement in a corresponding one of

said plurality of longitudinal openings, and means biasing said metallic sleeve for movement in a first direction wherein said contact elements are caused to extend beyond the cross-sectional dimensions of the patchboard opening and limit relative movement of said sleeves, said sleeves being movable in an opposite direction upon engagement of said contact elements with the patchboard adjacent to the opening to establish an electrical circuit between one of said metallic elements and the patchboard.

5

10

References Cited in the file of this patent

UNITED STATES PATENTS

262,301	Mann	Aug. 8, 1882
741,713	Prentiss	Oct. 20, 1903
1,650,779	Williams	Nov. 29, 1927
2,748,229	Block	May 29, 1956

FOREIGN PATENTS

802,930	Germany	Feb. 26, 1951
553,869	Great Britain	June 9, 1943