May 9, 1961 S. PASIK 2,983,895

COAXIAL JACK PLUG

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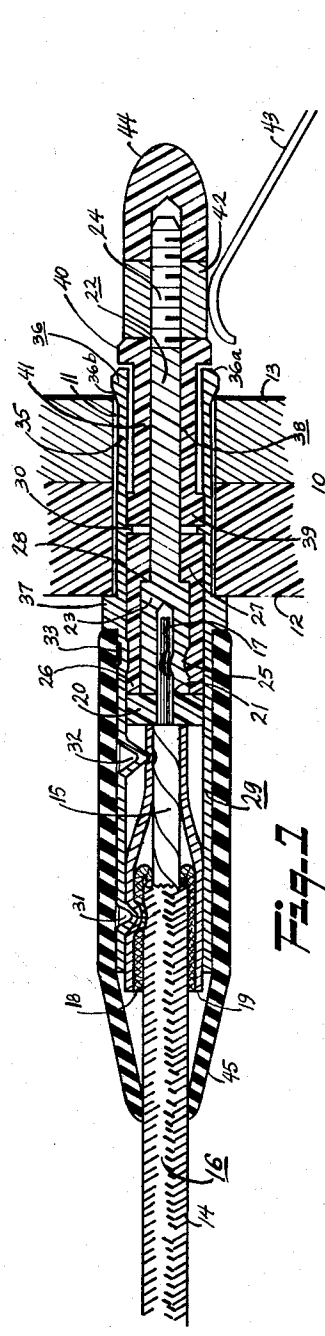

Fig-1

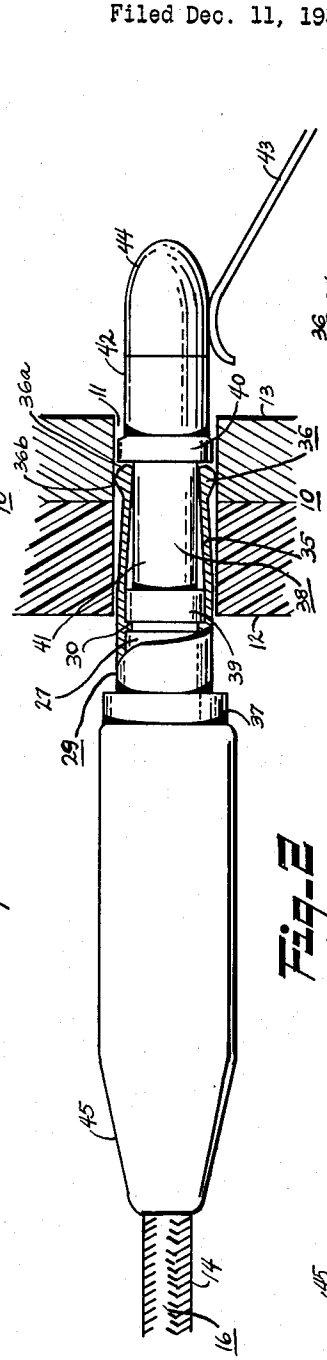

Fig-2

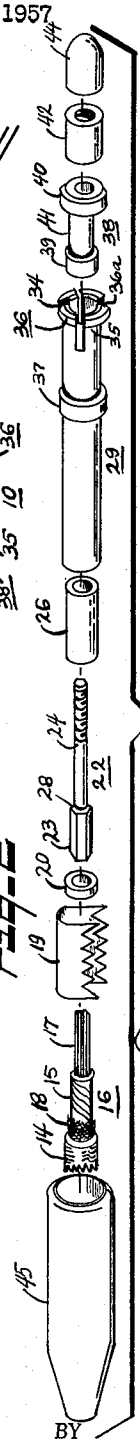

Fig-3

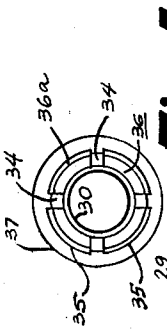

Fig-5

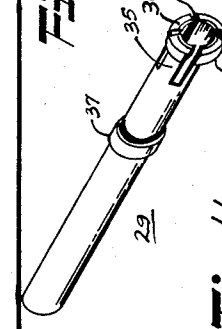

Fig-4

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COAXIAL JACK PLUG

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9 Claims. (Cl. 339—183)

This invention relates to coaxial connectors, and in particular to an improved coaxial jack plug of the type used in the plugboards of electronic computing machines.

It is a principal object of this invention to provide an improved and relatively inexpensive coaxial jack plug which permits maximum utilization of plugboard space.

Another object is to provide a coaxial jack plug which grounds the conductive shield of the coaxial cable through a grounding plate forming part of the plugboard.

Still another object is to provide a coaxial jack plug which is self-latching when fully inserted in a plugboard aperture.

Yet another object is to provide a coaxial jack plug which may be easily inserted and withdrawn from the plugboard without grounding the inner conductor of the coaxial cable to the plugboard grounding plate.

A further object of the invention is to provide an improved coaxial plug of reduced size for use with small diameter coaxial cable.

Shielded coaxial cables having jack plugs at each end are often used in making interconnections on the circuit connecting panels, or plugboards, of electronic apparatus. The outer conductor, or metallic shield, of the coaxial cable is grounded by connecting it through a first conductive element of the jack plug to a grounding plate forming part of the plugboard while the inner conductor is coupled through a second conductive element of the jack plug to a mating contactor.

The coaxial jack plug of this invention comprises an elongated hollow sleeve which is conductively attached at its rearward end to the metallic shield of the coaxial cable. The forward end of the sleeve consists of a plurality of longitudinal resilient fingers having lateral projections extending outwardly beyond the outer surface of the body of the sleeve. The inner conductor of the coaxial cable is conductively attached to a stud which is centered within the hollow sleeve. Tubular insulators separate the stud from the sleeve thereby electrically insulating one conductive element from the other. The outer diameter of the portion of the insulator located adjacent to the resilient fingers of the sleeve is made slightly less than the inner diameter of the sleeve in order to permit the fingers to be deflected inwardly when the jack plug is inserted or removed from the plugboard. The forward end of the stud is provided with a conductive member which is protected by an insulating tip to prevent shorting of the member to the plugboard grounding plate.

The above objects of and the brief introduction to the present invention will be more fully understood and further objects and advantages will become apparent from a study of the following detailed description in connection with the drawings, wherein,

Fig. 1 is a longitudinal sectional view of the jack plug inserted in a plugboard aperture,

Fig. 2 is a view similar to Fig. 1 which shows the jack plug being inserted or removed from the plugboard,

Fig. 3 is an exploded view showing the components which comprise the jack plug,

Fig. 4 is a perspective view of the jack plug sleeve, and

Fig. 5 is an end view of the sleeve.

The jack plug of the present invention is most useful when used in connection with electronic computing machines of the type provided with either fixed or removable plugboards containing rows and columns of apertures. When a removable board is used, it is arranged so that it may be placed into engagement with a fixed panel having rows and columns of mating spring contactors thereby effecting electrical contact between jack plugs inserted in the apertures of the removable board and the oppositely located contactors.

Referring to Figs. 1 and 2 of the drawing, 10 represents a removable laminated plugboard having rows and columns of circular holes of which 11 is a single example. The plugboard 10 includes a panel 12 of insulating material and a conductive plate 13 bonded thereto. Plate 13 is grounded by an external connection not shown in the drawing.

As depicted in Figs. 1 and 3, portions of the insulating jacket 14 and primary insulation 15 of coaxial cable 16 are removed thereby exposing the ends of the inner conductor 17 and metallic shield 18. Shield 18 is folded back over the jacket 14 of cable 16 and a ferrule 19, made of a soft, conductive metal such as brass, is secured around shield 18 and a part of primary insulation 15. Ferrule 19, as shown in Fig. 3, is initially formed in the shape of an inverted U having serrated edges which overlap when the ferrule is crimped about coaxial cable 16.

An insulating washer 20 is placed over the inner conductor 17 and positioned against the ends of primary insulation 15 and ferrule 19. The inner conductor 17 is then inserted in axial opening 21 in conductive stud 22, stud 22 having a receiving portion 23 of hexagonal cross section and a cylindrical forward threaded portion 24. Stud 22 which may, for example, consist of silver plated brass is crimped at 25 to secure it to inner conductor 17.

A first tubular insulator 26, having an inwardly extending flange 27 at one end is pressed over the hexagonal receiving portion 23 of stud 22 with flange 27 positioned against step 28 of stud 22. The tubular insulator 26 is preferably formed of a tetrafluoroethylene resin identified by the trademark "Teflon." This material is characterized by the property that it tends to return to its original shape if it is expanded and then released. By making the inner diameter of insulator 26 slightly less than the diagonal distance across the corners of the hexagonal portion of stud 22, insulator 26 will tend to contract to its original diameter after being forced over the stud thereby gripping the stud and preventing relative rotation between the two parts.

An elongated hollow sleeve 29, which may be extruded from hardened Phosphor bronze, is next slid over the components thus far assembled with its inside shoulder 30 butted against flange 27 of insulator 26 and with its inside surface contacting the outer surfaces of ferrule 19, washer 20, and tubular insulator 26. The sleeve is affixed to the assembly by crimping at 31, 32, and 33, the crimps at 31 and 32 resulting not only in an excellent electrical connection between the metallic shield 18 and ferrule 19 but also in preventing rotation of the elements of the coaxial cable relative to one another. Crimps 31 and 32 also produce a connection of sufficient mechanical strength to withstand the tensile stresses normally imposed on the coaxial cable and jack plug. A shallow crimp is used at 33 to avoid piercing insulator 26 and possibly shorting sleeve 29 to stud 22.

As shown in detail in Figs. 4 and 5, four longitudinal slots **34** are cut in the forward end of hollow sleeve **29** thereby forming four resilient fingers **35**. The forward end of each finger is provided with a latch **36** which extends radially outward from the body of the sleeve, the leading and trailing edges, **36***a* and **36***b* of latch **36** being inclined with respect to the outer surface of finger **35**. The outer diameter of the body of the sleeve is selected so that it may be slideably inserted in the plugboard aperture **11**, and a shoulder **37**, having an outer diameter greater than that of aperture **11**, is provided to prevent insertion of the jack plug past its fully engaged position.

A second tubular insulator **38**, having a rearward flange **39** with an outer diameter equal to the inner diameter of sleeve **29**, is placed over the forward portion **24** of stud **22**. Forward flange **40** of tubular insulator **38** extends beyond the forward edge of sleeve **29** and has a diameter substantially equal to the outer diameter of the body of sleeve **29**. The central section **41** of tubular insulator **38** has an outer diameter less than the inner diameter of reslient fingers **35** permitting the fingers to be deflected inwardly by a radial force on latch **36**.

An internally threaded conductive contacting member **42**, suitably of silver-plated brass, is screwed on to the threaded end of stud **22**. The position, diameter and length of member **42** are selected to insure a good electrical connection with spring contactor **43** and at the same time make it impossible to short member **42** to conductive plate **13** when the jack plug is normally inserted or withdrawn from the plugboard. Thus, the outer diameter of conductive member **42** is less than the outer diameter of the forward flange **40** of tubular insulator **38** and its length with respect to the thickness of the plugboard is short enough to prevent accidental contact with plate **13**. An insulating tip **44** having a rounded forward end and a threaded axial opening at the other end is screwed on to the end of stud **22** to prevent shorting conductive member **42** to plate **13**.

An insulating sheath **45**, preferably of rubber, is placed over the rearward end of the jack plug assembly with its forward end positioned against shoulder **37** and its rearward end surrounding the insulating jacket of coaxial cable **16**. Sheath **45** electrically insulates sleeve **29** while supporting cable **16** adjacent to the plug, thereby increasing its resistance to bending fatigue. Sheath **45** also provides a convenient grip for grasping the plug while inserting and withdrawing it from the plugboard.

When the jack plug is introduced into aperture **11** of plugboard **10**, the leading edges **36***a* of latches **36** engage the edge of circular opening **11** in panel **12**. The force applied to each latch **36** has a radial component which deflects resilient fingers **35** inwardly so that, as the plug is forced into the aperture, the latches lie within the circumference of the opening, as shown in Fig. 2. Fingers **35**, since they are maintained under tension, exert a radial outward force against the side of aperture **11** thereby tending to hold the plug correctly centered in the opening.

The jack plug is inserted until shoulder **37** of sleeve **29** strikes against the outer surface of panel **12**, as illustrated in Fig. 1. In this position, the forward portions of latches **36** extend beyond conductive plate **13** with the trailing edges **36***b* pressed against the forward edge of aperture **11** by the spring action of partially deflected resilient fingers **35**. The outward pressure exerted by fingers **35** on the edge of the opening securely hold the plug in position while at the same time providing an excellent electrical connection between sleeve **29** and plate **13**. A path for the ground current is provided through metallic shield **18**, ferrule **19**, and sleeve **29**, to grounding plate **13**. The distance between the forward edge of shoulder **37** and a median point on trailing edge **36***b* of latch **36** is made equal to the thickness of plugboard **10**.

With the jack plug fully inserted as shown in Fig. 1, member **42** is conductively engaged with spring contactor **43**. When a pulling force is applied to the fully inserted plug the trailing edges **36***b* of latches **36** engage the edge of opening **11** in plate **13** thereby applying a radial inward force which deflects fingers **35**, until latches **36** lie within the circumference of the opening permitting the plug to be withdrawn from the plugboard.

A significant feature of this invention is that a coaxial jack plug is provided having a conductive sleeve which aids in accurately guiding and positioning the plug when it is inserted or removed from the plugboard. The sleeve also retains the plug securely in position when it has been fully inserted in the plugboard and simultaneously provides a grounding connection for the coaxial cable shield. Furthermore, no springs or other holding devices are required as part of the plugboard thereby simplifying both the design and manufacture of the board.

As many changes could be made in the above construction and many different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A coaxial plug comprising an elongated hollow sleeve adapted for conductive attachment at its rearward end to the outer conductor of a coaxial cable, said sleeve including a forward end comprising a plurality of longitudinal fingers having lateral projections at the ends thereof extending radially outward from the outer surface of said fingers, said fingers being resiliently flexible to permit said lateral projections to be depressed to an inner position substantially flush with the outer surface of said sleeve, a conductive stud coaxially positioned within said hollow sleeve, said stud having its rearward end adapted for conductive attachment to the inner conductor of said coaxial cable and its forward end extending outside the forward end of said sleeve, tubular insulating means having a first portion coaxially positioned between said hollow sleeve and said stud and having a flange portion situated outside the forward edge of the fingers of said sleeve, the outer diameter of the first portion of said insulating means being less than the inner diameter of the longitudinal fingers of said sleeve to permit inward deflection of said longitudinal fingers, the diameter of the flange portion of said tubular insulating means being substantially equal to the outer diameter of said sleeve, and conductor means attached to the forward end of said stud adjacent to said flange portion.

2. The coaxial plug as defined by claim 1, wherein said conductor means comprises a tubular member coaxially disposed upon said stud to form an electrical connector, the outer diameter of said tubular member being less than the outer diameter of the flange portion of said insulating means.

3. The coaxial plug as defined by claim 2, wherein the forward end of said stud extends beyond the forward end of said tubular member, and an insulating tip attached to the forward end of said stud.

4. The coaxial plug as defined by claim 3, wherein the outer diameter of said insulating tip substantially equals the outer diameter of said tubular member.

5. The coaxial plug as defined by claim 1, further including an insulating sheath surrounding the rearward end of said hollow conductive sleeve, said sheath extending beyond the rearward end of said sleeve and being adapted to support said coaxial cable at a point spaced from the end of said sleeve.

6. A coaxial plug comprising an elongated hollow sleeve adapted for conductive attachment at its rearward end to the outer conductor of a coaxial cable, said sleeve having a forward end comprising a plurality of longitudinal resilient fingers, latching means affixed to the forward end of the outer surface of said longitudinal fingers, a conductive stud coaxially positioned within said hollow

sleeve, said stud having a rearward portion adapted for conductive attachment to the inner conductor of said coaxial cable and a forward portion extending beyond the forward end of said sleeve, a first tubular insulator coaxially positioned between the rearward portion of said stud and said hollow sleeve, a second tubular insulator having its central section positioned between the forward portion of said stud and the longitudinal fingers of said sleeve and having a flange portion situated outside the forward end of said sleeve, said central section having an outer diameter less than the inner diameter of said sleeve to permit said resilient fingers to be deflected to an inner position wherein the outer edge of said latching means is flush with the outer surface of said sleeve, said flange portion having an outer diameter substantially equal to the outer diameter of said sleeve, and conductor means attached to the forward end of said stud adjacent to said flange portion.

7. A jack plug adapted for conductive attachment to a coaxial cable, said cable having an inner conductor and a metallic shield insulated from and surrounding said inner conductor, comprising an elongated hollow conductive sleeve having a forward end comprising a plurality of longitudinal fingers with lateral projections extending outwardly therefrom, said fingers being resiliently flexible to permit said lateral projections to be depressed to an inner position substantially flush with the outer surface of said conductive sleeve, conductive means adapted to couple the rearward end of said hollow conductive sleeve to the metallic shield of said coaxial cable, a conductive stud coaxially positioned within said hollow sleeve, said stud having an axially located aperture in its rearward end adapted to receive the inner conductor of said coaxial cable and having its forward end extending outside the forward end of said sleeve, tubular insulating means having a first portion coaxially positioned between said hollow sleeve and said stud and a flange portion situated outside the forward end of said sleeve, the outer diameter of the first portion of said insulating means being less than the inner diameter of the longitudinal fingers of said sleeve to permit inward deflection of said longitudinal fingers, the diameter of the flange portion of said insulating means being substantially equal to the outer diameter of said sleeve, and conductor means attached to the forward end of said stud adjacent to said flange portion.

8. A coaxial plug for use with a plugboard comprising in combination an elongated hollow conductive sleeve, said sleeve having a forward end consisting of a plurality of longitudinal fingers each including a lateral projection at the end thereof extending radially outward from the outer surface, said fingers being resiliently flexible to permit said lateral projections to be depressed to an inner position substantially flush with the outer surface of said sleeve, a conductive stud positioned within said hollow conductive sleeve and having a threaded forward end extending outside the forward end of said sleeve, a first tubular insulating means surrounding the rear end of said stud and compressed within said sleeve for securing said stud in coaxial alignment within said sleeve, a second tubular insulating means surrounding the forward end of said stud, said second tubular insulating means having a first portion situated between said stud and the fingers of said sleeve and having a flange portion situated outside the forward edge of the fingers of said sleeve, the outer diameter of the first portion of said second insulating means being less than the inner diameter of said sleeve to permit inward deflection of said longitudinal fingers, the diameter of the flange portion of said second tubular insulating means being substantially equal to the outer diameter of said sleeve, a threaded conductor engaging the threaded forward end portion of said stud and adjoining the flange portion of said second tubular insulating means, the diameter of said conductor being less than the outer diameter of the flange portion of said second insulating means, and an insulated tip attached to the forward end of said stud adjacent to said conductor.

9. A coaxial plug comprising an elongated hollow sleeve adapted for conductive attachment at its rearward end to the outer conductor of a coaxial cable, said sleeve including a forward end carrying conductive latching means having lateral projections extending radially outward from the outer surface of said sleeve, said latching means being resiliently flexible to permit said lateral projections to be depressed to an inner position substantially flush with the outer surface of said sleeve, a conductive stud coaxially positioned within said hollow sleeve, said stud having its rearward end adapted for conductive attachment to the inner conductor of said coaxial cable and its forward end extending outside the forward end of said sleeve, tubular insulating means having a first portion coaxially positioned between said hollow sleeve and said stud and having a flange portion situated outside the forward end of said latching means, the outer diameter of the first portion of said insulating means being less than the inner diameter of said sleeve, the diameter of the flange portion of said tubular insulating means being substantially equal to the outer diameter of said sleeve, and conductor means attached to the forward end of said stud adjacent to said flange portion.

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