Nov. 10, 1964 L. C. MINOR 3,156,516

ELECTRICAL CONNECTOR

Filed July 23, 1962

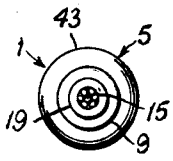


FIG. 2.

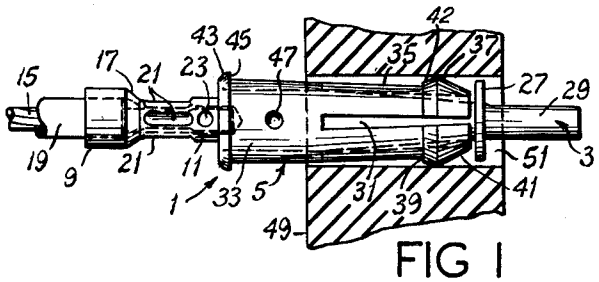


FIG 1

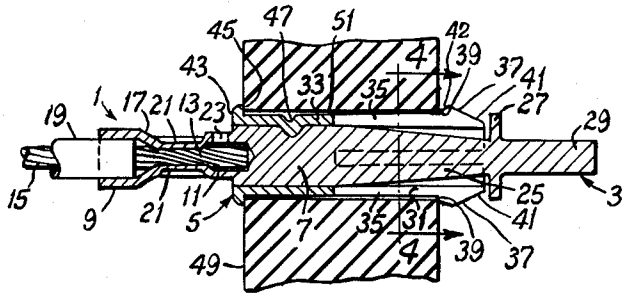


FIG.3.

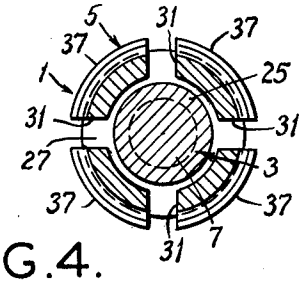


FIG.4.

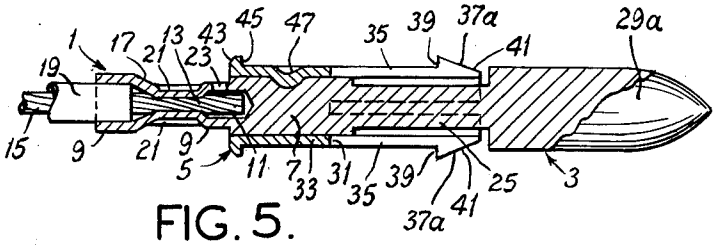


FIG. 5.

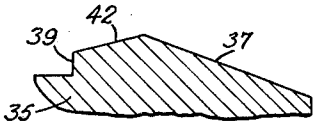


FIG.6.

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ELECTRICAL CONNECTOR

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This invention relates to electrical connectors, and more particularly to jack plug connectors or so-called "patch cord pins" which are used in plugboards (also referred to as patch boards) of electronic computers, sorters, printers, telemetering apparatus and the like.

Electronic equipment such as above mentioned may include an insulation board having a multiplicity of holes therein each adapted to have an electrical connector plugged therein. This board may be referred to as a plugboard or patch board. Electrical connectors, which may be referred to as jack plug connectors or patch cord pins, are plugged into various holes, depending upon the programming of the equipment. Such pins usually have wires connected to one end, and, when the pins are plugged into the holes in the board, electrical interconnections are made with their other ends for establishing the programmed circuits. The pins are removable from and re-insertable in the holes in the board.

It is important that such pins, while being readily plugged into the holes in the board, be positively and tightly locked in the board, particularly when the electronic equipment is used where it is subjected to vibration, while being readily removable when desired without damaging the board at the ends of the holes. With certain prior types of pins, the board is apt to become dented or chipped at the ends of the holes upon repeated plugging in and removal of the pins. This is sometimes referred to as "cratering," and leads to loose fitting of the pins, with the possibility of the pins shaking out of the holes when subjected to vibration.

Accordingly, among the several objects of the invention may be noted the provision of an improved electrical connector of the class described which, while being readily plugged into a hole in a board, is tightly locked in the hole after plugging, while being readily removable from the hole whenever desired without damaging the board at the ends of the hole; and the provision of such a connector which is of economical, shake-proof construction, consisting of two pieces firmly secured together, adapted in use to insure electrical conduction between an electrical conductor attached to one end thereof on one side of the board and a part of circuitry on the other side of the board; and the provision of such a connector providing for easy connection to said one end of the conductor, with a firm grip on the conductor. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claims.

In the accompanying drawings, in which several of various possible embodiments of the invention are illustrated,

FIG. 1 is a side elevation of one form of connector of this invention, showing the connector in the process of being plugged into a hole in a board;

FIG. 2 is a left-end view of the FIG. 1 connector;

FIG. 3 is a vertical longitudinal section of the FIG. 1 connector, showing it fully plugged into the hole;

FIG. 4 is an enlarged transverse section of the connector, taken on line 4—4 of FIG. 1; and

FIG. 5 is a vertical longitudinal section like FIG. 3, showing a modification; and

FIG. 6 is an enlarged partial cross section detail of a latch projection component of the connector of FIGS. 1–4.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Referring to the drawings, an electrical connector of this invention, designated in its entirety by reference numeral **1**, is shown to comprise an electrically conductive pin **3** and a sleeve **5** on the pin. The pin **3**, which may be made of any metal or alloy suitable for the purpose, such as commercial leaded bronze, has a solid cylindric sleeve-seating portion **7** intermediate its ends, and a rearward end portion **9** of reduced diameter relative to portion **7** which is tubular so as to provide a socket **11** extending inward from its rearward end for reception of the bared end **13** of an electric conductor **15**. The socket **11** (which may be serrated if desired) extends partly into the intermediate sleeve-seating portion **7** of the pin. The rearward end of portion **9** is flared out as indicated at **17** so that the outer or rearward end of the socket is somewhat enlarged for reception of the end of insulation **19** of the conductor **15**. After insertion of the end of the conductor in socket **11**, the tubular rearward end portion **9** of the pin is crimped as indicated at **21** firmly to grip the conductor. An inspection hole **23** is provided in portion **9** closely adjacent the rearward end of sleeve-seating portion **7** to enable inspection as to proper insertion of the end of the conductor in the socket.

Forward of the cylindric sleeve-seating portion **7**, the pin **3** has a portion **25** of reduced diameter relative to the diameter of portion **7**. As shown, this is provided by forming the pin with a taper converging in forward direction from portion **7**. At the forward (narrow) end of taper portion **25**, pin **3** has a flat annular flange or collar **27**, and, forward of this flange, a forward end extension **29** having a diameter corresponding to that of the narrow end of taper portion **25**.

The sleeve **5** is formed of a suitable resilient metal or alloy, such as a beryllium-copper alloy having a nominal composition of 1.90–2.15% beryllium, 0.20–0.35% cobalt, and the balance copper. It has a plurality of slits **31** extending inward from one end (its forward end) and terminating short of its other end (its rearward end) so that it has a cylindric rearward end portion **33** and a plurality of spring fingers **35** extending forward from portion **33**. Each of these fingers has a latch projection **37** extending laterally outward at its forward end, each of these latch projections having a flat rearward end face **39**, a forward tapered nose formation **41**, and a portion **42** extending rearwardly from the forward end or nose formation portion **41** and tapered inwardly toward the flat rearward face **39**. The sleeve has an outwardly extending annular flange **43** at its rearward end (i.e., at the rearward end of portion **33**), this flange having a flat forward face **45**.

The internal diameter of sleeve **5** corresponds to the diameter of sleeve-seating portion **7** of pin **3** so that portion **33** of the sleeve may be telescoped on portion **7** of the pin. The sleeve is located on the pin with the cylindric rearward end portion **33** of the sleeve on the sleeve-seating portion **7** of the pin, with the rearward end of portion **33** at the rearward end of portion **7**, and with spring fingers **35** extending forward over taper portion **25** of the pin (which allows for bending inward of the spring fingers). Fingers **35** reach nearly to the flange **27**, the diameter of which is slightly less than the external diameter of portion **33** of the sleeve. The sleeve, after assembly with the pin, is securely fastened to the pin, as by staking portion **33** of the sleeve on to portion **7** of the pin as indicated at **47**. This staking is carried out at a num-

ber of places (three, for example) spaced around the sleeve.

At 49 in FIGS. 1 and 3 is indicated a plugboard or patch board, and at 51 is indicated one of the holes in the board. The external diameter of portion 33 of the sleeve is slightly less than the diameter of the hole 51 and the external diameter of flange 43 is somewhat greater than the diameter of hole 51. Spring fingers 35 normally extend straight forward from portion 33 of the sleeve and, with these fingers in their straight normal condition, the external diameter of rearward faces 39 of latch projections 37 is somewhat greater than the diameter of hole 51. The longitudinal distance along the sleeve from face 45 of flange 43 to rearward faces 39 of the latch projections 37 corresponds to the thickness of the board 49 (i.e., the length of hole 51).

As shown in FIG. 1, the electrical connector 1 is entered in hole 51 from one end thereof, and pushed in until the flat forward face 45 of flange 43 engages the board 49 at the end of the hole (FIG. 3). Spring fingers 35 bend inward into the spaces provided by taper portion 25 on the pin 3 by reason of the camming action on the tapered nose formations 41 on the latch projections 37 at the forward ends of the fingers. When the connector 1 reaches the fully inserted FIG. 3 position, the spring fingers snap out to bring latch projections 37 into latching position with the rearward end faces 39 of the latch projections engaging the board at the end of the hole, tightly locking the connector in the hole. The connector is adapted to be readily removed from the hole, without damaging the board at the ends of the holes, by a tool of a type having a tube retractable against a spring bias into a handle and having an ejector pin fixed to the handle extending lengthwise in the tube, by application of the end of the tube to the nose formations 41 of the latch projections 37 to squeeze them inward, and then pushing in on the handle to cause the ejector pin to push the connector back out of the hole.

It will be noted that the electrical path from the forward end extension 29 to the socket 11 of pin 3 is through a single integral conductive element, thus insuring good electrical continuity and conductance.

FIG. 5 shows a modification which is in all respects the same as that shown in FIGS. 1 and 3 and described above, except that instead of having the reduced-diameter forward end extension 29 on the pin 3, a bullet end 29*a* is provided, and that latch projections 37*a* of a slightly modified shape (relative to projections 37) are provided.

It will be understood that many means may be utilized to secure sleeve 5 to pin 3 other than staking, and that any such equivalent arrangements such as snap-rings, etc., may be conveniently employed for this purpose.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. An electrical connector adapted to be plugged into and unplugged from a hole in a board, comprising an electrically conductive pin and a sleeve on said pin, said sleeve being formed of resilient material and having a plurality of slits extending inward from one end thereof constituting its forward end and terminating short of its other and rearward end so that said sleeve has a cylindric rearward end portion and a forward end portion wholly constituted by a plurality of individual spring fingers separated by said slits extending forward from said cylindric rearward end portion and integral with the latter, said cylindric rearward end portion of the sleeve being circumferentially continuous so as to be radially inexpansible, said sleeve having an outwardly extending integral annular flange at its rearward end, said flange having a flat forward face for engagement with one face of a board at one end of a hole in the board, each of said spring fingers having an outwardly extending latch projection at its forward end having a flat rearward face for latching engagement with the other face of a board at the other end of the hole, each of said latch projections having a nose formation with a forward end portion tapered inwardly toward the forward end of the nose formation for springing said fingers radially inward upon plugging said connector into the hole, and a portion extending rearwardly from said forward end portion tapered inwardly toward the flat rearward face of the nose portion, said pin having a cylindric sleeve-seating portion intermediate its ends received in said cylindric rearward end portion of said sleeve and said cylindric rearward end portion of said sleeve being securely fastened to said sleeve-seating portion of said pin against axial movement relative to the pin, said pin having an integral portion forward of said sleeve-seating portion of reduced diameter relative to the diameter of said sleeve-seating portion to allow for bending inward of said spring fingers as said connector is inserted in a hole, said pin further having an integral rearward end portion extending rearward from said sleeve-seating portion and having a socket extending from its rearward end for reception of one end of an electric conductor to be secured therein, and said pin further having an integral forward end extension reaching beyond the forward ends of said spring fingers.

2. An electrical connector as set forth in claim 1 having a flange at the forward end of said taper portion, said forward end extension of the pin extending forward from this flange.

3. An electrical connector as set forth in claim 1 wherein said rearward end portion of the pin is of smaller diameter than said cylindrical sleeve-seating portion of the pin and is generally coaxial therewith and of relatively thin-walled construction so that it is adapted to be crimped to grip the end of a conductor inserted in said socket, the rearward end of said sleeve being located adjacent the rearward end of said cylindric sleeve-seating portion of the pin.

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