# United States Patent [19]

**Cooper, Jr. et al.**

[11] **3,813,635**

[45] **May 28, 1974**


[54] **TERMINAL CONNECTOR**


[75] Inventors: **James Joseph Cooper, Jr.; Gary Lee Schurter,** both of St. Louis, Mo.

[73] Assignee: **International Telephone and Telegraph Corporation,** New York, N.Y.



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**Related U.S. Application Data**

[62] Division of Ser. No. 80,339, Oct. 13, 1970, Pat. No. 3,699,497.

[52] **U.S. Cl.** ..... **339/22 B,** 339/242, 339/263 R

[51] **Int. Cl.** ..... **H01r 13/60**

[58] **Field of Search** ..... 339/242, 22 B, 19, 263 R, 339/263 B, 263 E, 263 L, 263 S, 267, 268 R, 268 S, 213, 270



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*Attorney, Agent, or Firm*—James B. Radon; Marvin M. Chaban



[57] **ABSTRACT**

To provide a large contact area and rigid high pressure connection between a heavy power carrying terminal and a power distribution bus, capable of being thoroughly insulated with water-impervious material, a tapered or inverted frusto-conic socket is suitably machined or incised into the bus and a terminal having a similarly tapered shank is press-fitted into the socket. A clearance bore through the shank receives a bolt for connection through a receiver in the bus located beneath the conic socket. An arched washer may be used under the head of the bolt to maintain a high pressure engagement between the terminal shank and the bus during changing thermal or vibratory conditions. The entire connection area may then be jacketed with a double jacket, the jacket serving to insulate the bus and connection in a water-impervious, sealing fashion.


**3 Claims, 8 Drawing Figures**

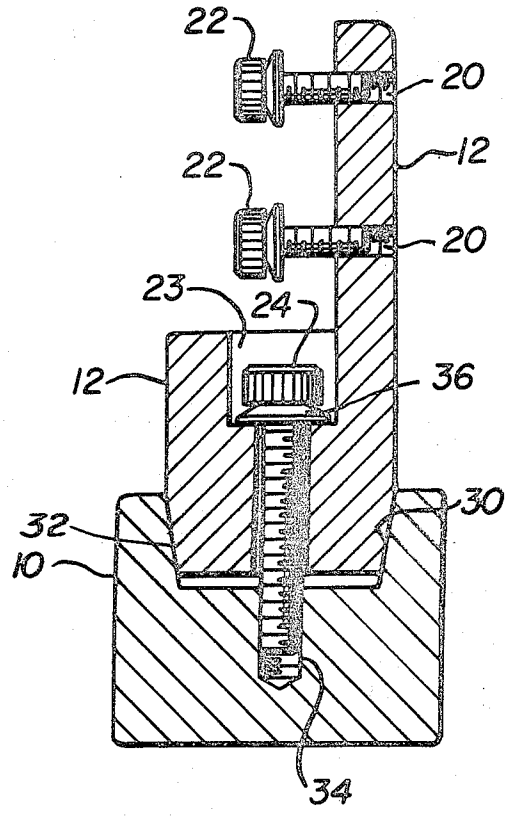
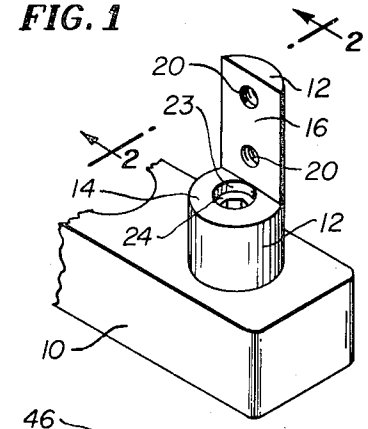


FIG. 1



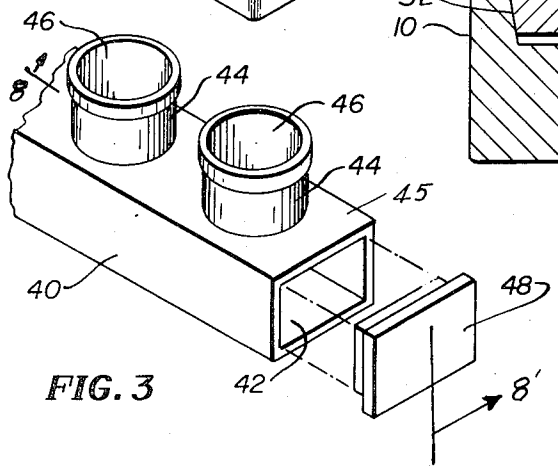
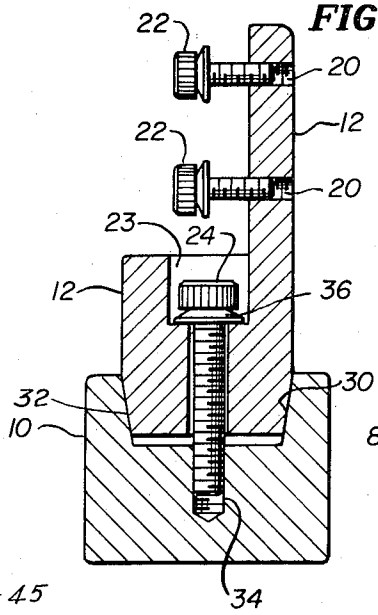




FIG. 3

FIG. 2



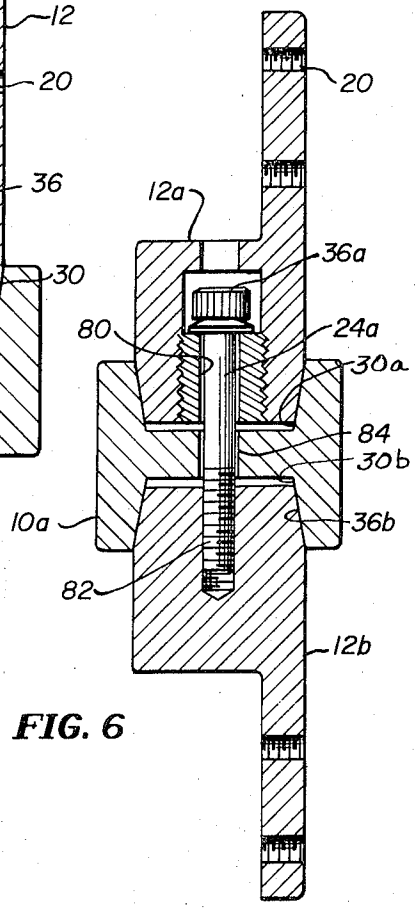




FIG. 6

FIG. 4

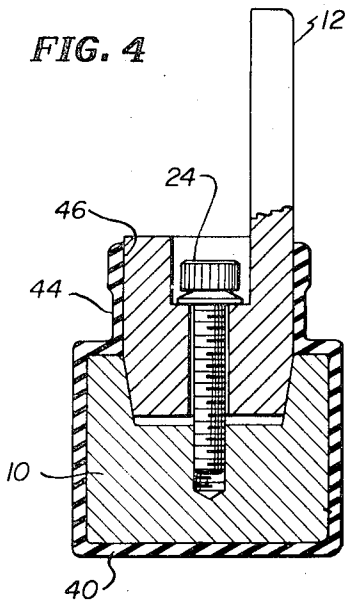
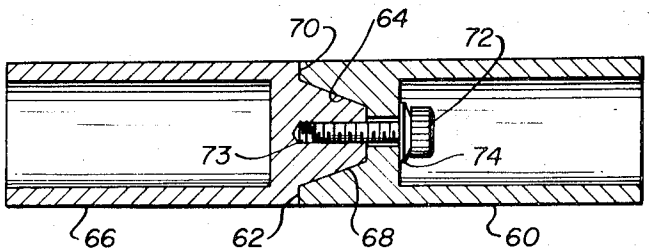



FIG. 5



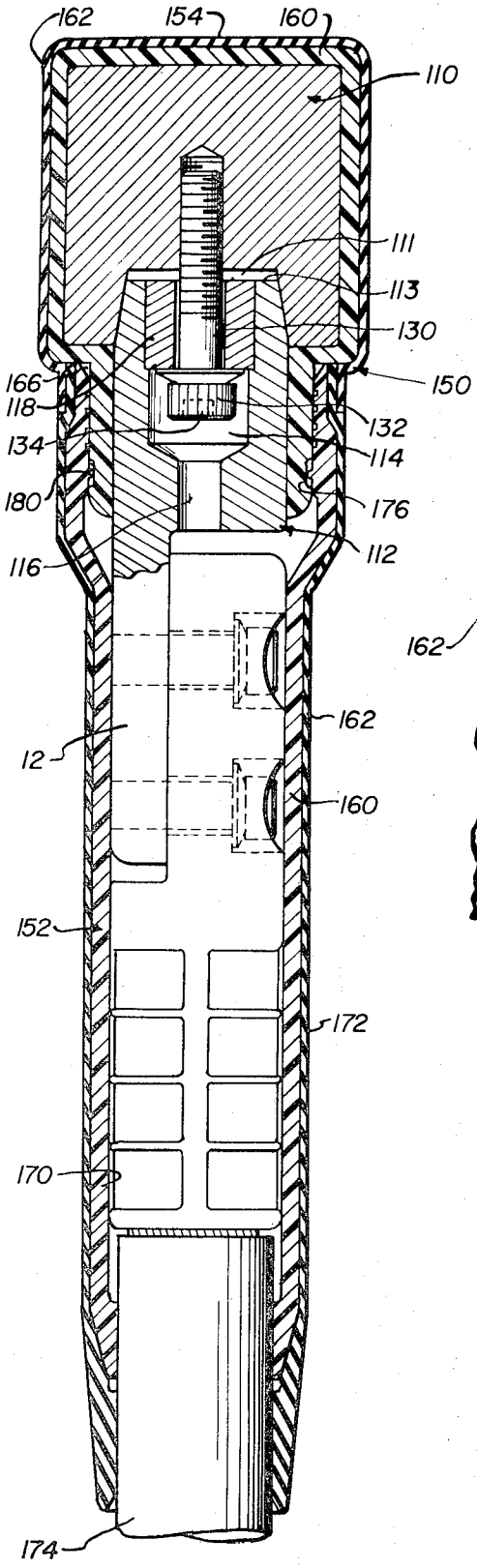

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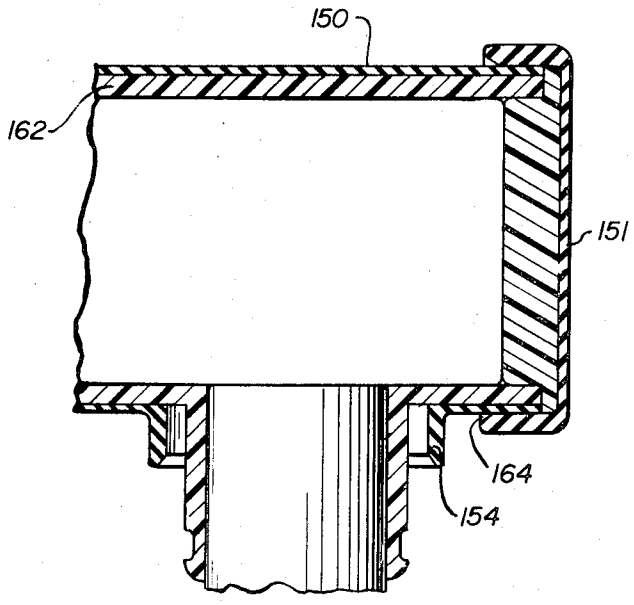
FIG. 7

FIG.8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# TERMINAL CONNECTOR

This is a division of application Ser. No. 80,339 filed October 13, 1970, now U.S. Pat. No. 3,699,497.

## BACKGROUND OF THE INVENTION

Where a terminal or plurality of terminals are to be connected to a heavy power carrier such as a central bus, the general practice has been to drill or otherwise produce a cylindrical socket in the bus surface and thread or tap the socket to receive a shoulder stud terminal. The shoulder on the stud contacts the bus surface to produce a surface to surface contact while further contact is made through the mating contacts. In these devices, the contact surface is limited primarily to that of the shoulder-to-bus contact while the contact through the threads is minimal. The amount of contact surface limits the current carrying capacity of the connection, and the contact may be diminished even further due to mechanical vibration or thermal changes.

In another form of connector known to the art, a clearance opening is drilled or otherwise machined or formed through the bus, and a screw receiving socket is threaded into the underside of the terminal. A bolt is passed through the clearance opening and is tightened into the terminal. Again the contact surface is formed by the shoulder abutting against the bus upper surface and minimally through the bolt and its contact with the bus lower surface. Again any loosening of the bolt will lead to decreasing the contact pressure between the terminal and the bus, thereby lessening the current carrying capability of the connection. In addition, the protrusions from opposed sides of the bus increase the problems where the bus and terminal are to be insulated in a water-impervious manner.

It is therefore an object of the invention to provide a new and improved high pressure high current carrying connection between a heavy duty bus and one or more terminals.

It is a further object of the invention to provide an improved connector construction for readily connecting one heavy duty terminal to another.

It is a further object of the invention to provide a heavy duty high pressure terminal construction for connection to a central bus to produce a good conductivity, large surface contact between the bus and terminal, relatively impervious to vibration and thermal effects.

It is a still further object of the invention to provide a superior insulating, water-sealed jacket for a heavy power bus and connector.

To effect these and other objects, features, and advantages of the invention, we provide a central bus with an inverted, truncated conic cavity into which is press-fitted the shank of a complementary shaped terminal. A bolt is connected to a receiver firmly secured within the bus and extending into said concavity. A pressure maintaining washer is fitted under the head of the bolt. In this way the complementary conic surfaces provide a large surface area of contact between the bus and the terminal without using the bolt for any appreciable current transfer.

The entire structure can then be jacketed with an interior insulating jacket liner properly sealed to suitable insulating sleeves and double sealed with an outer sealing jacket which can be mated with sleeves, the inner



jacket liner and sleeves being of elastomeric material having high insulating properties and superior heat aging and setting characteristics while the outer jacket is comprised of elastomeric material with high resistance to degradation by oils and abrasion.

Thus, a rigid high pressure connection capable of high power carrying capability is formed, which connection can be maintained even with vibration and thermal cycling.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a section of bus with terminal mounted thereon according to the invention with the insulation and jacketing removed to show the interior structure;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a perspective view of a section of insulating jacket for the connected bus and terminal;

FIG. 4 is a sectional view as FIG. 2 showing the bus connector with terminals, assembled within the insulating jacket;

FIG. 5 is a sectional view of a varient structure of terminals employing the invention;

FIG. 6 is a sectional view of a further variant terminal and bus structure employing the invention;

FIG. 7 is a section view as FIGS. 2, 4, and 6, of an alternate form of terminal and bus structure bearing a cable connected thereto jacketed and sealed; and

FIG. 8 is a view in section along the line 8—8′ of FIG. 3 showing a portion of the fully jacketed terminal, the view of FIG. 8 being shown inserted.

Shown in FIG. 1 is an assembled terminal, shown without insulation, using one form of our invention. In that figure, we show a large rectangular bus 10 onto which has been mounted a terminal 12. The portion of the terminal 12 above the bus is cylindrical in cross section and terminates in a horizontal wall 14 from which the terminal portion 16 upstands. The terminal portion 16 has a circular segmental cross section and spaced along its height has tapped holes 20 for receiving therein screws 22 (not shown in FIG. 1) for connection to the cable which is to be affixed to the terminal in a conventional manner.

Within the center of wall 14 is a circular recess 23 for receiving a mounting bolt 24, the head of which can be seen in FIG. 1. Bolt 24 serves to hold the terminal 12 in firm contact with the bus 10 as will be explained.

In FIG. 2, there can be seen an inverted truncated conic cavity or socket 30 in the bus. The basal section of the terminal 12 has a complementarily shaped shank section 32 to fit within cavity 30 in tight fitting relationship therein. A suitable degree of taper to comprise the shank section may be that of the Morse taper as used in machine tool work. As an example of the amount of taper used and the relative proportions of components found acceptable, we have found that for a bus of 2-¾ inch height, a terminal shank section which has as its major diameter of 1-¾ inch, a conic section of approximately ½ inch height, and a minor diameter of approximately 1-½ inch provides a suitable contact surface, and easily assembled components. By press fitting the terminal basal section into the bus cavity, a large surface to surface contact area is produced. The contact is enhanced and maintained by the tightening of bolt 24 within a suitably threaded socket 34. A crowned or arched washer 36 of the type sold under the tradename

"Belleville" washer is inserted under the head of the bolt **24** prior to mounting of the bolt to sustain a pressure fit between the terminal base and the bus cavity.

In FIG. **3**, we show a single jacket **40** of suitable insulating, water-impervious material. The jacket **40** as shown has a rectangular through opening **42** sized to receive with a clearance fit the bus **10.** The jacket has spaced tubular risers **44**, extending upwardly from the top jacket wall **45**, there being open communication between the through opening **42** and the tubular bores **46** of risers **44.** The bore spacing would correspond to the spacing between terminals to be mounted on the bus, and the bores must be sufficiently large to encircle a terminal, once assembled in the manner shown in FIG. **4.** Annular shoulders at the rim of the bores serve to receive and mate with a suitable insulating sleeve, if desired. An end plug or cap **48** is fitted into the end of the opening **42** to close the opening and complete the insulation surrounding the bus.

In FIG. **5**, we show how our invention may be used to connect together two tubular crimp sleeves with a rigid high pressure electrical contact between the sleeves. A first of the crimp sleeves **60** has a circular end wall or floor **62** at one end. The outer surface of the end wall **62** has an inverted truncated conical cavity **64** formed therein. The other sleeve **66** has a truncated cone **68** extending outwardly from its circular end wall **70.** The truncated cone **68** and cavity **64** are complementarily sized and shaped in the manner previously described for FIGS. **1** and **2.** Thus, the bolt **72** readily fits within the tubular opening **75** at the center of the crimp sleeve **70.** Cone **68** fits into cavity **64** with a press fit insuring large area surface to surface contact. A suitable bolt **72** in one sleeve end wall fits into a suitably threaded hole **73** in the wall of the other sleeve and a compression maintaining washer **74** is mounted under the bolt head.

In FIG. **6**, we show how two terminals **12*a*** and **12*b*** can be connected to a bus **10**a using a single bolt **24*a*** with the terminals mounted on both sides of the bus opposed cavities of the same shape as previously described, i.e. truncated conic sockets, are formed or machined in the bus **10*a***, the sockets **30*a*** and **30*b*** being of desired size and configuration for the terminal to be attached. Preferably sockets **30*a*** and **30*b*** would have the same size and configuration with a clearance opening coaxial to both sockets. One terminal **30*a*** has a central clearance opening **80**; The other terminal **30*b*** has a threaded receiver opening **82** in its communication with a suitable bus clearance opening **84** to receive a single bolt **24*a*** holding both terminals firmly in contact with the bus. Again a holding crowned washer **36*a*** fits under the head of bolt **34*a***, to tightly hold the terminals together.

The drawings in general have shown a single socket in each bus **10.** Using our principle, we could of course provide and show a plurality of sockets in the bus, as indicated by FIG. **1**, and a like number of terminals mounted therein. The principle, of course, remains the same.

Similarly in describing the insulating jacket of FIG. **3**, it is clear that the jacket would be slid onto the bus prior to the mounting of terminals or terminals on the bus. The jacket bores would then be aligned with the sockets and the terminals affixed. The jacket could require one end plug or two end plugs, dependent on whether the jacket had been fabricated with one solid end wall or with both ends open.

In FIGS. **7** and **8**, we show an alternate form of assembly fully jacketed and sealed, employing our inventive concept. There we show a section through our bus bar **110** to which there is connected a tapering terminal **112** fitted therein within a truncated conic cavity **111** in bus **110.** The terminal **112** has extending therethrough a central cylindrical bore **114** which extends from one terminal surface **113** concentrically through the terminal for most of the terminal height and leads into a central bore **116** of smaller diameter. The lower end of bore **114** is filled with a core plug **118** having threaded fit into bore **114.** The core plug may also be welded to the terminal **112** if desired. The plug is cylindrical in shape and its lower surface remains coplanar with the bottom surface **113** of the terminal. A central clearance hole **130** in the plug bears a headed bolt **132**, the bolt head resting in bore **114** between plug **118** and the decreased diameter of bore **116.** The socket type bolt head **134** is accessible through the bore **116** for tightening the screw into a suitably threaded hole **140** in the bus bar concentric with the conic cavity **111.**

The terminal and bus connector assembly is insulated and sealed with a composite molded insulating jacket **150** comprised of composite molded end plugs **151** for the jacket; composite, molded, slip-over self-sealing insulating sleeves **152** for the cable and cable connection, and bus cover **154.** All insulating components of this system include a molded inner liner **160** of double thickness fabricated of an elastomeric material having high dielectric strength and good physical properties such as elasticity and resiliency, especially concerning permanent set characteristics in conjunction with heat aging. The outer casing **162** of all the components is also an elastomeric material, this material having high resistance to degradation by oils and excellent resistance to abrasion.

At the junction or sealing area **164** where end plugs **151** are assembled to the bus cover **154,** or at sealing area **166** the insulating sleeves **152** are assembled to the bus coating **154,** the inner lining material **160** of any component always bears sealingly against the inner lining material of the mating component and the outer casing material always bears against seals to the outer casing of the mating component. Further the inner lines **170** of sleeves **152** may have annular sealing ribs adjacent each end and in addition the outer liner **172** annular sealing ribs for sealing to the cable **114.** Further, the bus cover **154** as shown in FIG. **7** has an annular depression **176** for receiving enlarged rib **180** of the sleeve to complete the sealing arrangement. In this manner, a mating U-shaped joint is formed by the outer and inner liners of one member into which joint the outer and inner liners of the other member matingly fit.

In this way, the entire bus connector with sleeves, when installed in service, is compatible with and truly an extension of the presently used and acceptable insulating system used on network underground conductors. This insulating system, which includes the slip-over self-sealing sleeves, thereby eliminating the costly taping operation generally required on network connector design. The use of slip-over sleeves no longer makes the integrity of the sealing areas solely dependent on the ability of the installer to fabricate a seal with tape. The thick, molded-on outer casing would

overcome problems prevalent with dip coated outer jackets where incomplete coating may occur leading to the ever present possibility that the thin coating may be easily damaged during installation, thus exposing the inner electrical insulation and making it susceptible to damage by oil. The sealing arrangement disclosed herein between the bus jacket and the self-sealing insulating sleeve permits a simplification in mold design and reduces the size of the insulating sleeves and end plugs, but permits the "extension of the cable insulation" feature into the bus connector assembly.

While there has been described what is at present thought to be the preferred embodiments of the invention, it is understood that modifications may be made therein, and it is intended to cover in the appended claims all such modifications which fall within the true spirit and scope of the invention.

We claim:

**1.** A power distribution connection for joining two terminal members comprising an inverted, frusto-conic blind socket in one wall of a first conductive terminal member, a shank on a second terminal member, said shank including a frusto-conic section shaped and sized for press-fitting relationship within said frusto-conic socket, said socket being greater in depth than the penetration depth of said shank to allow said shank to be compressively seated within said conic socket to produce a large conic area of surface-to-surface contact between said terminal members to render said contact capable of carrying currents of over 1,000 amps., conductive means extending through said one wall of said first conductive member and the base of said frusto-conic shank for permanently connecting said shank within said socket, and means for maintaining a high compressive force in said surface contact between said terminal members, wherein said permanent connecting means comprises a threaded fastener extending through the base of the frusto-conic shank of said second terminal member and a threaded receiver on the other terminal member, and further includes a biasing member maintaining relatively constant pressure between said shank and said socket.

**2.** The connection of claim **1**, wherein there is a one-piece insulating cover disposed about said first terminal member, said cover being imperforate on the side opposite said second terminal member.

**3.** The connection of claim **1**, wherein said connecting means comprises a bolt passed through said second terminal member, and a threaded member facing said socket for receiving said bolt.

* * * * *