

[54] EXTRA-CORPOREAL MEDICAL INSTRUMENT ELECTRICAL CONNECTOR

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[58] Field of Search..... 339/268, 270, 214, 217 R, 339/126, 130

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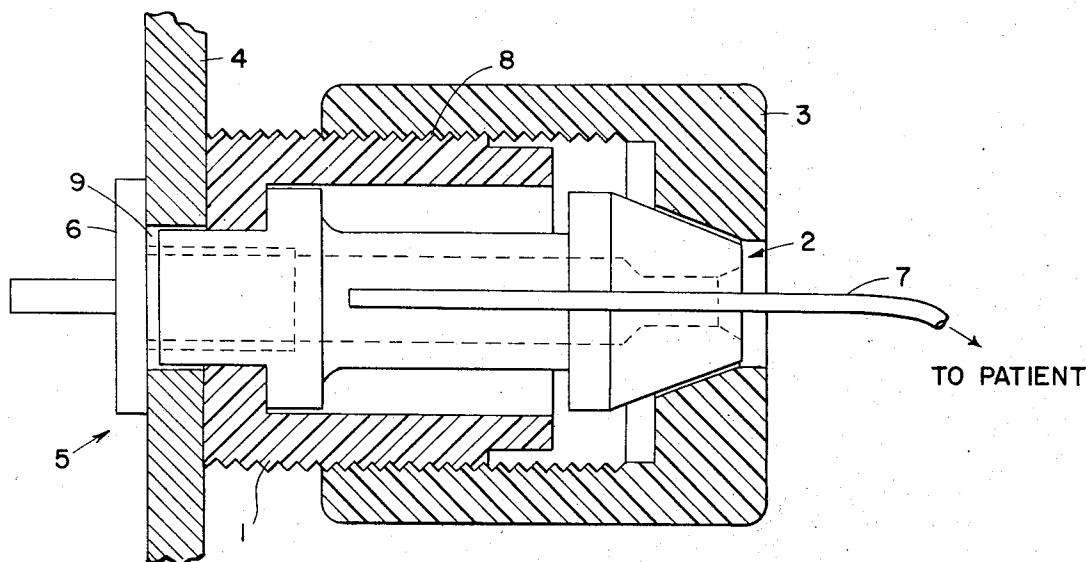
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[57]

ABSTRACT

An electrical connector for attaching wires extending from a patient to an extra-corporeal medical instrument — resilient electrically conductive jaws grip an axially inserted wire leading from the patient. A collet peripherally mounted on the jaws adjustably deforms them exerting a compressive clamping force on the wire. The collet and jaw assembly is appropriately keyed to a complementary aperture in the instrument panel and affixed thereto by a threaded locking member. The locking member is electrically conductive thereby forming a feed through of the instrument panel. As the locking member engages a complementary threaded portion on the distal end of the jaws a bearing force is applied thereby affixing the entire assembly to the panel.

5 Claims, 4 Drawing Figures



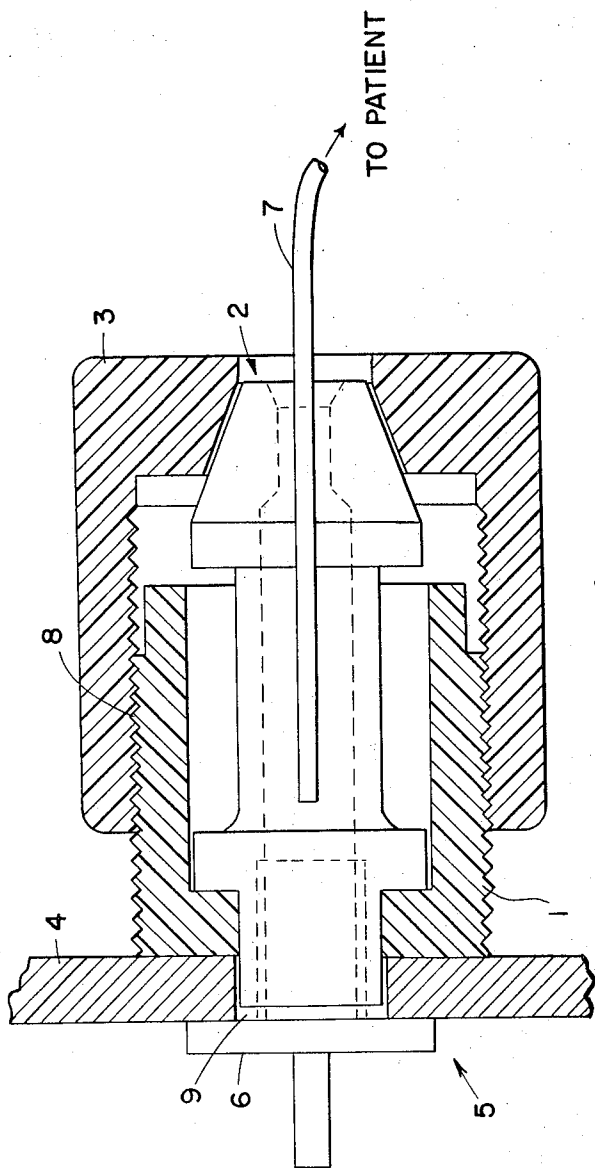


FIG. 1

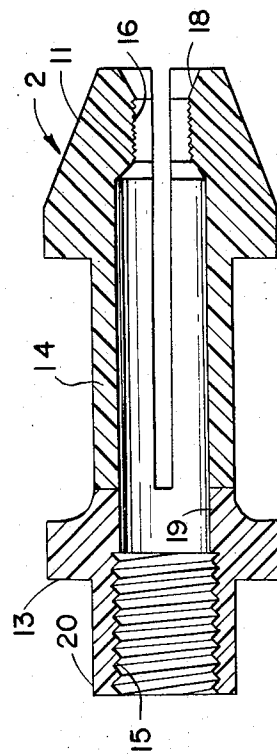


FIG. 2

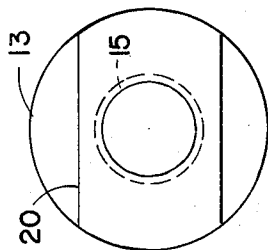


FIG. 3

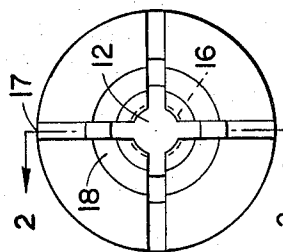


FIG. 4

EXTRA-CORPOREAL MEDICAL INSTRUMENT ELECTRICAL CONNECTOR

BACKGROUND OF THE INVENTION

This invention relates generally to electrical connectors used to attach wires extending from a patient undergoing examination or treatment to a remote extra-corporeal medical instrument. It more particularly relates to a feed through electrical connector used in conjunction with an extra-corporeal heart stimulation device.

In the use of electrical medical instrumentation it is frequently essential that any disconnection of the patient from the device be avoided. In the instance of a heart stimulation instrument such disconnection can often lead to catastrophic results. The applicant's invention is directed to minimizing this problem while still affording ease of use and convenience for hospital personnel.

Electrical terminations used in existing commercial equipment consist of a shaft and a threaded collar. The wire is inserted through a transverse hole in the shaft and the threaded collar is used to compress the wire in the hole thereby providing a locking of the wire as well as an intimate electrical connection. Another means of electrical connection utilizes what is known as "banana plugs". These terminations comprise shafts, to which the wire is affixed, having resilient members axially aligned along the length of the shaft. The shaft is then inserted into a complementary channel or opening which compresses the resilient members thereby providing a biased or spring loaded electrical connection. Anyone at all knowledgeable of instrumentation or the electrical fields of practice are unavoidably aware of the shortcomings of these methods of electrical connection. Their unreliability and inconvenience of use cannot be tolerated in the medical instrumentation field. The former means of termination not only lacks convenience but does not in all instances adequately secure the wire so as to avoid accidental disconnect and in addition imposes severe stresses on the wire which might result in its eventual breakage.

Another shortcoming of existing equipment is its inability to adapt to the varying wire sizes used for connection to patients. Generally, these may vary from .040 inches to .125 inches in diameter. This greatly adds to the inconvenience of use as well as the potential unreliability of the connection. Thus, an acceptable electrical termination should grasp the wires as firmly as possible against accidental disconnect, particularly in hospital environments where the wires are subject to the movements of patients, nurses, physicians, etc. In addition, it should be capable of accepting different wire diameters and impose as little stress as possible on the wires to avoid eventual breakage. The Applicant's electrical connector meets these requirements and overcomes the problems associated with prior art terminations.

It is therefore an object of this invention to provide an improved extra-corporeal medical instrument electrical connector. It is another object of this invention to provide an electrical connector for positively gripping a wire without inducing undue stress. Yet, another object of the invention is to provide a highly reliable conveniently used electrical connector.

SUMMARY OF THE INVENTION

The Applicant's invention contemplates an extra-corporeal medical instrument connector for attaching electrical wires extending from a patient to the instrument. The connector has a resilient electrically conductive multi-jawed member defining an axially aligned channel into which the wire is inserted. A collet is peripherally mounted on the multi-jaw member and adjustably deforms the jaws to exert a compressive clamping force on the inserted wire. The multi-jawed member is then inserted through a properly keyed hole in a panel of the instrument and is affixed thereto by means assembled to its distal end. Thus, there is provided a positive reliable clamping or attachment of the wire from the patient to the instrumentation.

For a better understanding of the present invention together with other and further objects thereof references is had to the following description taken in connection with accompanying drawings. Its scope is pointed out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial cross sectional view showing the connector attached to and through the panel of a medical instrument.

FIG. 2 is a partial cross sectional view of the multi-jawed member of the connector.

FIG. 3 is a side elevational view of the multi-jaw member of FIG. 2 looking at the wire receiving end of the member.

FIG. 4 is a side elevational view of the distal or opposite end of the multi-jawed member from that of FIG. 3.

Like symbols are used to identify the same parts in the different drawings and views. It is intended that these drawings display the preferred embodiment of the Applicant's invention but in no way delimit its scope.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to FIG. 1 there is shown an electrical connector having a resilient multi-jawed member 2 composed of an electrically conductive material, for example, a material such as phosphor bronze or beryllium copper. Multi-jawed member 2 is of generally cylindrical geometry with the jaws forming or defining an axially aligned channel for accepting or receiving a wire 7 inserted therein. The portion of multi-jawed member 2 located at the end into which the wire 7 is inserted has an outer surface inclined at a desired angle. The inclined surfaces are achieved by forming this end of member 2 to a generally frusto-conical geometry. The inclined plane permits the application of inwardly deforming forces upon the jaws, thereby exerting compressive clamping forces on the inserted wire 7. The apex of this frusto-conical portion of member 2 is located forwardly of the jaw openings.

The jaws themselves of member 2 are formed by orthogonal centrally aligned sawcuts extending axially a predetermined distance of the member 2. The axial extension of the sawcuts is selected so as to provide the necessary resiliency for the jaws as well as required integrity or strength of member 2 itself.

Member 2 may be more fully described with reference to FIGS. 2, 3, and 4. FIG. 2 shows a member fabri-

cated most conveniently from a piece of bar or rod stock. The inclined surfaces at the jaw end of the member are formed by a frusto-conical shaping. The jaws themselves are produced by orthogonal centrally located sawcuts 17 extending a predetermined distance along the axis of the member 2. The opening 12 for wire 7 is formed by a drilled hole normally coextensive with the sawcuts. For ease of wire 7 insertion a relieved or counter sunk area 18 is formed at the opening 12. The depth of the sawcuts, the selection of the material and the undercut area 14 of member 2 provides the jaws with the necessary resiliency and strength to produce the desired clamping action. The diameter of the opening or channel 12 is determined by the maximum diameter of the wire 7 to be inserted. An interior chamber 19 is formed or bored within member 2 extending from the distal end a predetermined distance. Chamber 19 provides adequate clearance for insertion of wire 7 as well as providing a channel along which surfaces engaging threads 15 may be formed at the distal end of member 2.

FIG. 4 shows an end view of the wire 7 receiving end of member 2. The orthogonal cross sawcuts 17 are shown forming the jaws, in this instance four jaws, and the channel or wire receiving opening 12 is clearly shown as a drill or otherwise formed opening. The undercut or relieved portion of the jaws about the channel 12 is indicated by surface 18. A threaded or serrated internal portion 16 of the jaws defining the channel 12 is provided to assure intimate contact with wire 7 and positive clamping or gripping thereof.

In describing the distal end of member 2, reference can best be made to FIG. 3. FIG. 4 shows bearing surfaces 13 located on each side of member 2 and formed by relief cuts axially extending from the distal end of member 2 to the bearing surface 13. The bearing surfaces 13 comprise shoulders extending outwardly from the side walls 20 of the distal end or portion of member 2. The internal threaded portion 15 formed on the distal side walls of chamber 19 is provided to permit mounting of the device, to the panel 4.

Again, returning to FIG. 1 there is shown a collet member comprising a first member 1 and a second member 3 peripherally mounted about member 2. Second member 3 is threaded to member 1 thereby movably engaging it. Preferably, the collet is made of electrically insulative material such as nylon or other suitable plastic. However, in instances where such insulation is not required, the collet may be suitably fabricated from a metal or conductive material. Collet member 3 is of generally cylindrical shape having an internal portion generally complimentary with the inclined surfaces 11 of member 2. The angle of these inclined complimentary surfaces is suitably selected in the area of approximately 15° with respect to the axis of the wire receiving channel 12. This angle of course may be varied to provide for variations in desired travel or adjustment provided by collet member 3. Obviously, as the angle of the inclined surfaces are altered the force derived from a given movement of collet member 3 will proportionally vary. Of course, binding or self locking bearing angles must be avoided. The relative movement of collet member 3 with respect to member 2 is provided by its threaded engagement with collet member 1. A forward disengagement of collet member 3 from collet member 1 produces a relief of the compressive forces and an opening of channel 12, while the

inverse is true upon increased engagement of mating threaded portion 8.

Collet member 1 is again of generally cylindrical geometry having sufficient internal relief to accept insertion of the distal portion of member 2. The complementary geometry of collet member 1 with the geometry of the distal end of member 2 provides both bearing surfaces between these members as well as a locking or keying function. It is, of course, necessary that collet member 1 remain affixed to or stationary with respect to member 2 if the necessary relative travel between collet member 3 and member 2 is to be achieved. Of course, other means of keying these members together may be utilized such as pinning or perhaps even integral construction or fabrication.

A locking member 6 has a complementary threaded portion to that of internal threads 15 and engages the distal end of member 2 when inserted through an opening or aperture 9 in the panel or wall of medical instrument 5. The aperture 9 is of complementary geometry or shape with respect to the distal end of member 2 to provide keying or locking with respect to the panel 4. In the illustrated instance of a feed through electrical connector and where the panel member 4 is of electrically conductive nature a suitable electrically insulative ferrule must be placed about the bearing portions of the assembly to prevent electrical contact with the wall 4. Any suitable electrically insulative material such as nylon or "mylar" may be used to achieve this purpose, and such ferrule are easily fabricated or purchased. In a feed through application the locking member 6 is of course fabricated from a suitable electrically conductive material and in most instances will match the material of the jaw member 2. A post or other electrical junction is provided on the locking member 6 for the purposes of electrical connection internal of the extracorporeal medical instrument 5. If of course electrical contact is desired with wall 4 such as in the instance of a ground connection, the insulative ferrule may not be necessary and likewise in the situation where the panel 4 is non-conductive.

In normal use a wire extending from the body of the patient is inserted through channel 12 internal of member 2. After insertion the collet member 3 is adjusted to greater engagement with collet member 1 thereby bearing the internal frusto-conical surface of collet member 3 against the complementary surface of the jaw member 2. As engagement of the collet members is increased a compressive force is exerted against wire 7 driving the serrations or threads 16 into the wire thereby positively engaging it. The entire assembly is affixed to the medical instrument 5 by extending the distal end of the member 2 through a complementary aperture 9 and engaging it with locking member 6. As the engagement of the threaded portion 15 with locking member 6 is increased a bearing surface on collet member 1 is drawn up against wall 4 as is an appearing bearing surface on locking member 6. The locking member 6 is adjusted until the desired bearing or locking forces exist against the wall member 4, additional locking members such as lock washers or deformable elements may be included in the assembly to assure positive engagement of the wall 4.

The Applicant's invention provides a reliable and versatile electrical connection for wires extending from a patient to a remote medical instrument. It is capable of convenient use and may accept wires or pins of dif-

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ferent diameters without the need of a tool. It provides excellent electrical insulation against accidental connection to adjoining terminals.

The electrical connector herein described is illustrative of the Applicant's invention and it is intended that those modifications obvious to one skilled in the art be included within its scope.

We claim:

1. An electrical connector adapted for high reliability operation in medical electronics usage to couple electrical conductor leads having cylindrical surfaces from instruments sensing bodily conditions to an instrument panel having apertures said connector comprising: a multi-jawed connector member having an internal, axially aligned bore therethrough, said jaws being formed by radial axially aligned slots extending a substantial portion of the axial extent of said connector member, said member having a wire receiving end and a panel terminating end, said member at said wire receiving end having a substantially frusto-conical external surface and said bore having a substantially cylindrical surface, said terminating end including first means for keying said connecting member into one of said apertures of said panel to prevent relative rotatory motion of said connector in said panel or said wire during connection; a collet member adapted to be received over said connector member, said collet member having an axial bore therethrough complementary to said connector member at one end and adapted at said other end with a frusto-conical surface complementary to the

frusto-conical surface of said connector member whereby rotary movement of said collet member causes relative axial movement of said collet member toward said connector member and panel to cause said substantially cylindrical surface of said bore to mate with and close on a length of said cylindrical wire equal to a considerable portion of said axial extent and make a secure electrical and mechanical connection therewith, said collet member including a first member including second keying means adapted to cooperate with said first keying means of said connector member, preventing relative rotary motion of said conductor and said connector member, and a second member threadingly engaged with said first member, said second member including said frusto-conical bore and adapted to be received over said connector and said first member.

2. The connector of claim 1 wherein said frusto-conical surfaces are disposed at an angle of approximately 15° to the axis of said cone.

3. The connector of claim 2 wherein said connector and keying means are of electrically conductive material.

4. The connector of claim 3 wherein said first and second collet members are of electrically insulative material.

5. The connector of claim 4 wherein said channel may receive said wire having a diameter between approximately 0.040 and 0.125 inches.

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