CATHETER FOR THE ELECTRICAL STIMULATION OF THE HEART

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ABSTRACT

Electrical plugs are attached to the electrical conductors of a catheter for the electrical stimulation of the heart by exposing a conductor by removal of a portion of the insulation from the catheter and firmly positioning a connecting member against the exposed conductor.

6 Claims, 9 Drawing Figures
BACKGROUND OF THE INVENTION

This invention relates to a catheter for the electrical stimulation of the heart, comprising a cord of plastic, through which there passes two substantially diametrically oppositely positioned electric conductors. The conductors lead to electrodes positioned at one end of the plastic cord. The other ends of the conductors are connected to electric plugs.

In German patent application OS 1,919,246 there is illustrated a catheter for the electrical stimulation of the heart, which consists of a cord of plastic through which there passes two electric conductors positioned diametrically opposite one another, and leading to electrodes positioned at one end of the cord. This catheter, as used in actual practice, has at the other end, plugs for connection to pacers. The plugs are not directly soldered to the electric conductors leading through the cord, because these wires have insufficient strength to absorb mechanical loads imposed on the plugs. Rather, the plugs are soldered to short pieces of strong, insulated strands, which, are inserted alternately through holes of a strip of insulating material. Small spots of solderable foil are applied to the insulating material. The ends of the conductors of the catheter and the connecting strands are soldered to one another on the solderable foil. The whole structure is then embedded in a shrinkage tube.

This form of construction is faultless mechanically and electrically, but its production requires an appreciable expenditure in material and working time.

SUMMARY OF THE INVENTION

Underlying the invention is the problem of avoiding the disadvantages associated with producing the prior art catheters and to provide a catheter for the electrical stimulation of the heart in which the electric conductors embedded in the cord of plastic are, in a simple manner, mechanically and electrically dependably connected with plugs.

This problem of connecting plugs to conductors is solved by baring portions of the conductor by removal of the insulation from the cord in two places remote from one another. In each case, in the region of the bared conductor, there is thrust a connecting member serving to connect the plugs with the conductors and clamped against the bared conductor.

The solution according to the present invention utilizes the very favorable compact construction of the catheter cross section, which makes possible contact by pressure. To connect a plug to the catheter it is merely necessary to pull out the electric conductor somewhat or expose it by cutting away plastic material to slide the connecting portion over the exposed area and to clamp the connecting member fast. The clamping can be achieved by a screw. Simpler and just as secure, however, is to squeeze the connecting member against the conductor.

The baring or exposure of the electric conductor can be done at places arbitrarily remote from one another. Since the catheter is flexible, the distance between the plugs can be adapted to arbitrary spacings of most diverse pacemaker units.

Another advantage of the present invention lies in that the electric conductors within the catheter lie substantially diametrically opposite from each other and impress upon the catheter a preferential bending direction, namely, in a plane which lies perpendicular to the plane determined by the electric conductors. This means that when the catheter is bent and emplaced, for example, on a flat underlayer the electric conductors always lie one over another. This makes possible the sure determination of places longitudinally remote from one another on the circumference of the catheter which are adjacent to the electric conductors. In practice this means that in the case of a catheter lying bent on a table the baring or exposing operation has to be done once above and once underneath when the two electric conductors are to be exposed.

In a further embodiment of this invention, the connecting member is a sleeve that can be squeezed together when placed on the catheter. In this embodiment the squeezing takes place over a large area, so that there cannot occur any destruction in the electric conductors or of the plastic material. It is especially advantageous if the sleeve extends beyond the exposed part, and therefore embraces and holds the unbared and unweakened part closely.

In another embodiment of this invention, the connecting member is securely joined to a plug. Preferably, the plug and connecting member consist of one piece. This has the advantage of a rigid connection between the plug and connecting member and the plug can be simply handled.

In a particularly preferred embodiment, the cord is folded in the area of the exposed conductor and the connecting member is slipped onto the resulting folded end. The advantage of this embodiment lies in that the cord of the catheter is in the same direction as the plug, and the plug, therefore, can be readily handled.

The bend arising due to the spacing, between the two plugs makes possible an adaptation of the plug to any plug spacings. The danger of sharp bending of the cord in the plug zone are excluded, especially if the cord and plug are connected to one another by a common plastic part, for example, a piece of shrinkage tubing or insulating tubing.

In another embodiment, the bared or exposed portion of the conductor is located, in each case, on only one side of the fold. As a result, the exposed conductor cannot slip back when the sleeve is attached.

Preferably, the fold in the catheter lies in a plane vertical to the plane determined by the two conductors. This type of fold is produced naturally because of the diametrically oppositely arranged conductors. Thus, the position of the conductor to be bared can be determined exactly.

It is also possible for the fold to lie in a plane perpendicular to the plane determined by the two conductors, and for the cord to run remote from the bend inside the connecting member or inside the sleeve, in such a way that the inner wall of the sleeve lies essentially on the cord with the exposed conductor. Through a winding configuration the exposed conductor lies with greater security on the inner wall of the sleeve or of the connecting member.

Preferably, the sleeve has an axially running corrugation to facilitate squeezing or compression. The sleeve can also be squeezed in essentially figure-eight form. These types of squeezing to attach the connecting member provide for an especially good placement of the sleeve on the bared conductor.
BRIEF DESCRIPTION OF THE DRAWINGS

With the aid of the attached drawings the invention will be explained in detail.

FIG. 1 illustrates a side view of a typical catheter body for the electrical stimulation of the heart.

FIG. 2 illustrates a cross-section of the catheter of FIG. 1.

FIG. 3 illustrates one embodiment of the present invention wherein the connecting members are slipped onto the unfolded cord of the catheter.

FIGS. 4 and 5 show sections IV—IV and V—V through the cord and connecting members illustrated in FIG. 3.

FIG. 6 shows another embodiment wherein the cord is folded and the fold is attached to the connecting members.

FIGS. 7 and 8 show sections VII—VII and VIII—VIII through the cord and connecting members illustrated in FIG. 6.

FIG. 9 shows a section similar to FIG. 6, wherein the cord turns in winding form within the connection sleeve.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows the construction of a known catheter having a solid cord 1 of plastic, in the center of which there is embedded a thin, pull-proof core 2. In the region between the core 2 and the outer wall of the cord 1 there are embedded two electric conductors 3 and 4.

The core 2 absorbs all the tensile forces, so that the cord 1, despite the stretching properties of the plastic used, cannot stretch and the electrical conductors cannot break.

FIG. 3 shows the plug end of the catheter illustrated in FIG. 1. Sleeves 5 and 6 are slipped onto cord 1 and consist of a thin squeezable material integrally formed with plugs 7 and 8 to provide a single piece as illustrated. The bottom of cord 1 is removed as illustrated in FIG. 4. Therefore, the removal of the bottom of cord 1 adjacent to the conductor 4, in the region of the sleeve 5 results in a bar or exposure of the conductor 4. The sleeve 5 has, in the region of the exposed conductor, a corrugation 9, which establishes a terminal (clamping) contact with the conductor 4. The sleeve 5 extends, on both sides, beyond the portion of cord 1 removed to expose the conductor 4. Thus, sleeve 5 has a firm hold on the cord 1, so that any weakening of the cord 1 caused by the bar or exposure of the conductor 4 has no effect on the overall assembly in case the conductor 4 is bent.

In a corresponding manner the top of cord 1 is bared adjacent to the electric conductor 3 in the region of the sleeve 6, as illustrated in FIG. 5, so that the conductor 3 is exposed. A corrugation 10 in the sleeve 6 establishes a firm mechanical and electrical contact with the conductor 3. Corrugations 9 and 10 in sleeves 5 and 6 simultaneously provide a safeguard against lateral shifting of the sleeves. The whole sleeve 5 or 6 can, of course, be squeezed in such a way that its circumference is reduced. This also establishes a secure electrical contact with the electrical conductors.

The left portion of FIG. 4 illustrates a section IV—IV of FIG. 3, through the sleeve 5 in the region of the corrugation 9. It is to be pointed out that the electric conductor 4 lying beneath core 2 is bared and through the corrugation 9 there is established a sure electrical contact between conductor 4 and sleeve 5.

FIG. 5 also illustrates a section V—V of FIG. 3, through the sleeve 6 in the region of the corrugation 10, which establishes an intimate contact with the conductor 3.

In the cross-sectional drawings of FIGS. 4 and 5 it is to be noted that the sleeves 5 and 6 closely surround the cord 1, and, bridge the removed portions of cord 1 for the exposure of the conductors 3 and 4.

FIG. 6 shows a particularly preferred embodiment of a catheter constructed according to FIGS. 1 and 2. The catheter as illustrated contains electrodes 11 and 12, but the middle portion of the long cord 1 is “cut out” for ease of illustration. The upper horizontal part of the cord 1, as illustrated, turns through 90°, so that the conductor 3 lies in front in the drawing and the conductor 4 behind (see FIG. 6). The cord 1 is provided with sharp bends 13 and 14, so that there are formed folds 15 and 16. The cord 1 is provided in each case on one side of the bends 13 and 14 with removed portions 17 and 18, so that through the removed portion 17 the front conductor 3 is exposed and through the removed portion 18 the rear conductor 4 is exposed.

For the sake of better representation, plugs 19 and 20 are illustrated with their sleeve parts 21 and 22 removed from the folds 15 and 16. Thus it is clear that the sliding of the sleeve parts 21 and 22 onto the folds 15 and 16 is possible without any difficulty and there is achieved a contact between the inner wall of the sleeve part 21 with the conductor 3 and of the inner wall of the sleeve part 22 with the conductor 4. To mechanically support the folds 15 and 16 in the sleeve parts 21 and 22 the sleeve parts are squeezed together, as illustrated in the sections VII—VII and VIII—VIII of FIGS. 7 and 8. This squeezing together need be carried out only in that portion of the sleeves in which contact with the electrical conductors is to be achieved. Of course, a squeezing over the entire length of the sleeve is also possible, whereby there is achieved a better appearance and a better hold.

The sleeve parts 21 and 22, after sliding onto the folds 15 and 16 extend beyond the removed portions 17 and 18, so that the cord 1 is firmly embraced and also held in its unweakened portion of the sleeves, so that especially high bending strains cannot occur. Since the removed portions 17 and 18 are positioned in each case on only one side of the folds 15 and 16, the conductors 3 and 4 are held at the foremost part of the folds 15 and 16. Therefore, in the region of bends 13 and 14 the removed portions cannot fold when they slide into the sleeve parts 21 and 22. Between the folds 15 and 16 there is formed an arch 23, so that the plugs 19 and 20 are insertable at any desired spacing and in any desired position in the receptacles of a pacemaker unit.

The section VII—VII through FIG. 6 illustrated in FIG. 7, shows a figure-eight squeezing of the sleeve part 21. As a result, the two halves of the fold 15 are closely surrounded and held fast by the sleeve part 21. Simultaneously there is achieved a sure contact between the sleeve 21 and the conductor 3. Section VIII—VIII through FIG. 6 is, in mirror image, substantially the same as section VII—VII, in which, however there is now established a contact between the conductor 4 and the sleeve part 22.

FIG. 9 corresponds substantially to section VIII—VIII in FIG. 6. It is to be perceived, to be sure, that
the lower half of the fold 16 (FIG. 6) is turned from the bend 14 in a winding or twisting manner about the other half, so that the removed portion 18 with the exposed conductor 4 lies flat on the inner wall of the sleeve part 22. Thereby there is assured an especially good contact between the inner wall of the sleeve part and the conductor.

The connection plugs illustrated can be used not only in catheters for the electrical stimulation of the heart, but also in other cables which have the cross-sectional structures similar to catheters.

What I claim is:

1. In a catheter for electrical stimulation of the heart of the type including a plastic cord of substantially circular cross-section, a first and second conductor within said plastic cord, said first and second conductors being substantially diametrically opposed, a pair of electrodes at one end of said plastic cord, and a pair of plugs near the end opposite said electrodes, an improved means for connecting said plugs and said first and second conductors, respectively, comprising, in combination:

a first and second contact area along said plastic cord, said first and second contact areas being substantially diametrically opposed and exposing a portion of said first and second conductors, respectively, said portion of said first and second conductors having a predetermined length;

a first and second electrically conductive sleeve engagingly receiving said plastic cord, said first and second sleeves having a sleeve length greater than said predetermined length and a crimped portion substantially longitudinally and radially aligned with said first and second contact areas, respectively, said crimped portion of said first and second electrically conductive sleeves contacting said exposed portion of said first and second conductor, respectively, said crimped portion and said sleeve length cooperatively defining means for securing said sleeve to said plastic cord to substantially avoid longitudinal and rotational movement thereof; and

means for securing said plugs to said first and second electrically conductive sleeves, respectively.

2. An improved connecting means as claimed in claim 1 wherein said plugs and said first and second electrically conductive sleeves, respectively, are integral.

3. An improved connecting means as claimed in claim 1 wherein said first and second electrically conductive sleeves are corrugated.

4. In a catheter for electrical stimulation of the heart of the type including a plastic cord of substantially circular cross-section, a first and second conductor within said plastic cord, said first and second conductors being substantially diametrically opposed, and a pair of electrodes at one end of said plastic cord, an improvement comprising, in combination:

a first fold end in said plastic cord, a first portion of said plastic cord being folded against a second portion thereof to define said first fold end;

a second fold end in said plastic cord, a third portion of said plastic cord being folded against a fourth portion thereof to define said second fold end;

a first contact area near said first fold end and exposing a first section of said first conductor;

a second contact area near said second fold end and exposing a second section of said second conductor;

a first and second electrically conductive sleeve receiving said first and second fold ends, respectively, said first and second sleeves having a crimped portion substantially aligned with said first and second contact areas, respectively, said crimped portion of said first and second electrically conductive sleeve contacting said first and second sections, respectively; and

a first and second plug engagingly receiving said first and second sleeve, respectively.

5. An improvement as claimed in claim 4 wherein said first and second electrically conductive sleeves are corrugated.

6. An improvement as claimed in claim 4 wherein said first and second sleeves substantially cover said first and second contact areas, respectively.

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