

[54] **CONTROLLABLE BARBED INTRACARDIAL ELECTRODE**

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[51] Int. Cl. **A61n 1/04**

[58] Field of Search **128/2 A, 2 R, 2.05 D, 128/2.05 F, 2.05 R, 2.06 E, 2.1 E, 404, 418, 419 P, 419 R**

[56]

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Primary Examiner—William E. Kamm

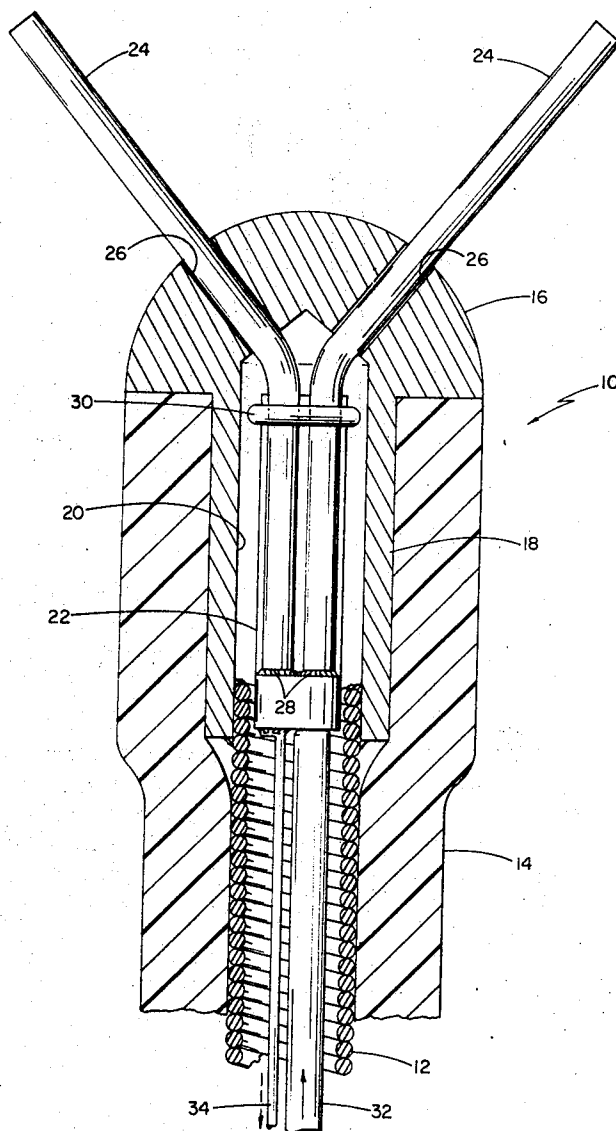
Attorney—Martin Kirkpatrick

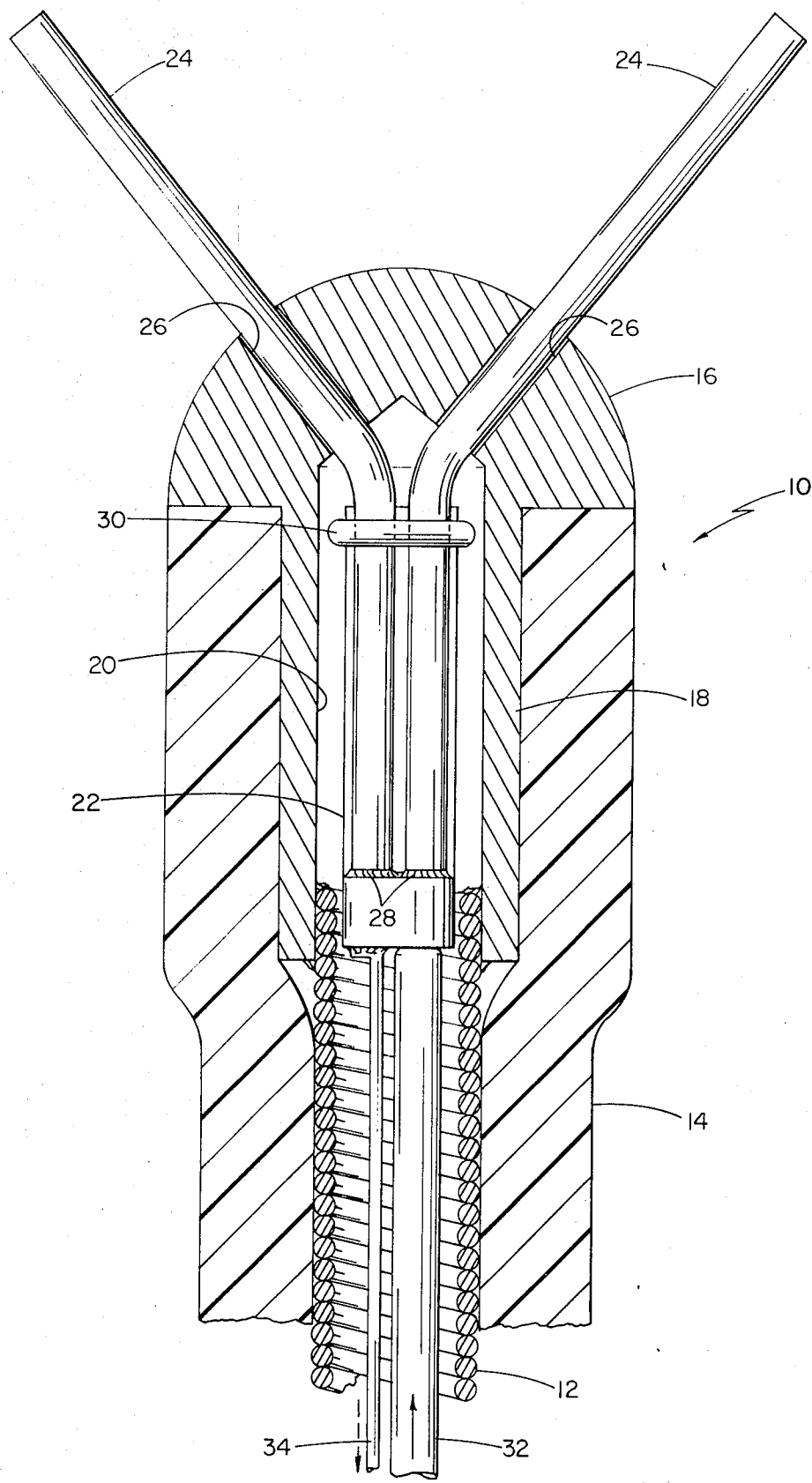
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ABSTRACT

A repeatably implantable intracardial electrode for use with a heart stimulation device provides a piston movable axially within a cavity in the electrode body. The piston carries resilient prongs which move through channels in the electrode body to engage the heart tissue for implantation of the electrode. The prongs are retracted when tension is exerted on the piston, and are advanced by force on the piston.

2 Claims, 1 Drawing Figure





CONTROLLABLE BARBED INTRACARDIAL ELECTRODE

This invention relates to an intracardial electrode for use with heart stimulation devices. In particular, it relates to an implantable electrode having an insulated helical conductor, and provided with a metallic head, which can be placed against the inner surface of the wall of the heart.

An electrode of this sort is introduced into the heart through a vein; generally a jugular vein is used, particularly the *jugularis externa*. To accomplish this, the jugular is opened, and the electrode is then pushed through the vein, metal head foremost, until it reaches the auricle of the heart.

Depending on the clinical situation of the patient, stimulation of either the auricle or the ventricle may be desired. In the case of stimulation of the auricle, the head of the electrode is pressed against the auricle wall; in the case of stimulation of the ventricle, the electrode is fed through the heart valve and is pressed against the wall of the ventricle. It is desirable to dispose the helical conductor in a bowed position, so that the head is pressed against the wall of the heart by the resilience of the conductor.

After the electrode has reached the desired position, measuring and testing apparatus is connected to the end of the conductor that remains outside the patient's body, in order to measure the stimulation threshold of the heart.

After these measurements have been completed, the conductor is connected to a cardiac stimulation device (heart pacer), which may be either external to the body or implanted within the patient.

When the heart pacer is to be implanted, a support or bed for the stimulator is provided in the thorax or abdomen and then connected to the neck by means of tubing that is led through the body. The external end of the helical conductor (remote from the heart) is then led through the tubing to the stimulator support, after which the tube is removed from the body and the conductor is connected to the stimulator.

An electrode that may be attached to the surface of the wall of the heart, rather than within the wall tissue, provides a most important advantage, in that the surgical procedure for implantation is much less extensive. However, such an exterior electrode has previously involved the disadvantage that after a period of use the electrode sometimes becomes dislodged, separating the operative tip of the electrode from the heart wall. Such dislocation is generally the result of movements of the heart wall. As a result, the patient must undergo a further surgical operation in order to replant the electrode, with obvious undesirable stress on the patient.

To prevent such dislocation, it has been attempted to place the tip of the electrode between trabecular muscles; but such muscles are not common in the heart wall. It has also been suggested that a portion of the head of the electrode might be formed as a truncated cone, so that the head can operate as a barb. At present, no useful measurements can be expected using such a device.

It is therefore an object of the invention to provide an improved implantable intracardial electrode, which substantially reduces the likelihood of dislocation of the electrode, and thus increases the safety of the patient using it.

It is also an object to provide an electrode whose position within the heart can be altered by an external control, without the need of additional surgical procedures.

It is a further object to provide such an electrode that is detachable and reimplantable without injury to the patient.

According to the invention, the electrode provides a cavity in which is placed a piston movable coaxial with and connected to the conductor. A number of resilient prongs or barbs are attached to the cylinder. Channels are provided in the tip of the head, at an angle to the cavity axis, and the resilient prongs are extendable through these channels to the outside of the electrode.

Motion of the cylinder towards the heart wall pushes these resilient prongs into the myocardium, securing the electrode in place. To obtain this effect, it is important that the prongs be placed at a suitable angle with respect to the axis of the piston, and that the diameter of the prongs be suitably chosen. Good results may be obtained when the channels in the head of the electrode are placed at an angle of about 40° with respect to the axis of the piston.

The prongs in a preferred embodiment may be advantageously made of nylon of 0.3 mm diameter. Alternatively, one may use metal prongs covered with insulating material. The use of metal prongs has the advantage that the placement of the prongs in the wall of the heart may be observed with the aid of X-rays.

If on the first attempt the electrode is not satisfactorily implanted, the prongs may be freed from the heart wall tissue by means of a thin flexible wire attached to the piston, and led through the inside of the insulating member. Tension on the wire retracts the piston and thereby the prongs.

Forward motion of the piston, to force the prongs into the myocardium, is accomplished by means of a stiff wire, also led through the inside of the insulating member. To obtain good operating contact of this wire with the piston, the end of the piston nearest the conductor may be covered with a metallic cap.

Other objects, features and advantages will appear from the following description of a preferred embodiment of the invention, taken together with the attached drawing thereof, in which:

FIG. 1 is a cross-sectional view of the electrode.

Referring to the drawing, electrode 10 is connected to a helical conductor 12, carried within an insulating member 14, such as a tube of silicone rubber. Conductor 12 may be externally connected at its remote end to a heart stimulation device. Conductor 12 is electrically connected with a head 16, which may be made, for example, of platinum; a narrowed portion 18 of head 16 is inserted into insulating member 14, so that portion 18 lies between conductor 12 and insulating member 14. In the construction of head 16, the end of conductor 12 is pressed into the material of head portion 18, ensuring good electrical contact.

Head 16 contains a cavity 20, within which a hollow cylindrical piston 22 is axially movable. A number (for example four) of resilient prongs 24 are attached to piston 22; such prongs may for example be made of nylon or insulated stainless steel. Each prong 24 extends into a channel 26 through head 16, each channel being disposed at an angle of about 40° with respect to the piston axis. Four prongs are a desirable number.

Prongs 24 are firmly attached at 28, as by welding, to the end of piston 22 nearest conductor 12. At the forward end of the piston the prongs are retained by a ring 30, to prevent their spreading.

A force-transmitting member is provided in the form of a stiff wire 32, carried within insulating member 14, by which piston 22 can be moved forward, causing prongs 24 to protrude through channels 26 to the exterior of electrode 10, enabling them to engage the tissue of the myocardium.

In addition, a thin wire 34 may be attached to cylinder 22, for instance by welding, to provide a tension-transmitting member by means of which piston 22 together with attached prongs 24 can be retracted if the first attempt at implantation in the myocardium is unsatisfactory.

Prongs 24 may be of varying length, depending on whether the electrode is to be attached to the auricle or the ventricle. The length should be such that when piston 22 is in its extreme forward position (shown in the drawing), a length of about 3 mm protrudes from head 16, if the head is to be attached to the auricle, or a length of 4 to 5 mm if it is to be attached to the ventricle.

The outer diameter of insulating member 14 may be about 2.5 mm, while the helix of the conductor may have an outside diameter of 1 mm and an inside diameter of 0.7 mm. In constructing the electrode, a lubricant, such as one made of silicone, may be provided, ensuring free motion of the prongs through the channels. After inserting the lubricant, piston 22 is moved back and forth several times, after which the superfluous lubricant may be removed.

In use, the electrode is secured in place by pushing on stiff wire 32 to force prongs 24 outwardly into the heart wall tissue. Wire 32 may then be removed through insulating member 14, leaving only the coiled conductor 12 and thin wire 34, which are relatively flexible. The end of insulating member 14 remote from electrode 10, with conductor 12, may then be connected to a suitable heart stimulation device internal or external to the patient. In the event that electrode 10 is unsatisfactorily placed or must be removed, prongs 24 are retracted by tension on thin wire 34, and stiff wire 32 may be reinserted through the remote end of insulating member 14 to exert the desired force on cylinder 22 to cause reimplantation.

What is claimed is:

1. A controllable repeatably implantable electrode comprising
 - a conducting head,
 - a conductor electrically connected to said head,
 - said head having a front portion and elongated body portion defining an axially oriented cavity,
 - a tubular insulating member connected to said body portion and aligned with said cavity, said conductor being carried away from said head within said insulating member,

a plurality of channels extending from said cavity through said front portion to the exterior of said head, and each disposed at an angle to the axis of said cavity,

a rigid cylindrical piston movable axially within said cavity between a forward implantation position and a retracted position, carrying a plurality of resilient prongs each extending into a said channel,

a removable force-transmitting member carried within said insulating member, having one end bearing against said piston and the other end remote from said piston,

a flexible tension-transmitting member carried within said insulating member, having one end attached to said piston and the other end remote from said piston,

said piston being moved within said cavity to said forward implantation position by force applied to said remote end of said force-transmitting member, said prongs being thereby moved through said channels to engage the heart tissue for implantation of said electrode, and said piston being moved to said retracted position by tension exerted on said remote end of said tension-transmitting member, said prongs being thereby retracted and freed from said heart tissue for removal of said electrode.

2. An intracardial electrode for use in artificial stimulation of a patient's heart, suitable for prolonged implantation within a patient's body,

said electrode comprising

an elongated body defining an axially oriented cavity, a tubular flexible insulating member connected to said body and aligned with said cavity,

a flexible electrical conductor connected to said body and carried away therefrom within said flexible insulating member,

said body having at least one channel extending from said cavity to the exterior of said body and disposed at an angle to the axis of said cavity, a rigid piston movable axially within said cavity, and at least one resilient prong longer than a said channel, attached to said piston and extending into a said channel,

a substantially rigid force-transmitting member carried within said insulating member, having one end bearing against said piston and the other end remote from said piston and protruding from said insulating member, and

a generally flexible retracting member attached to said piston and carried away therefrom within said conducting member;

whereby force exerted on said remote end of said force-transmitting member is transmitted by said bearing end to said piston, causing said prong to extend through said channel to engage the tissue of the said patient's heart, and tension exerted on said retracting member is transmitted to said piston and retracts it, freeing said prongs from the heart tissue.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,754,555 Dated August 28, 1973

Inventor(s) German Schmitt

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 20, delete "24" and insert -- in --.

Column 4, line 32, delete "tubular".

Signed and sealed this 4th day of June 1974.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents