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3,367,339

IMPLANTABLE NERVE STIMULATING ELECTRODE AND LEAD

Filed Oct. 9, 1964

FIG. 1

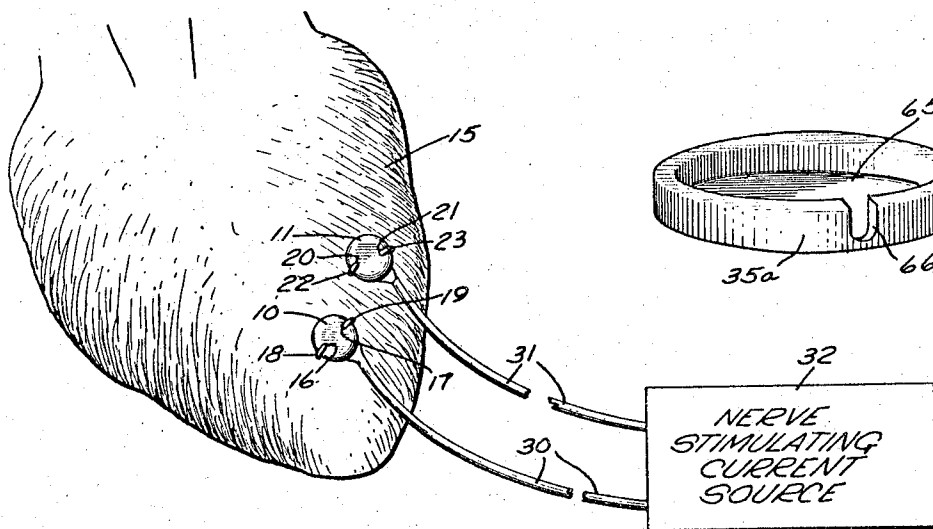


FIG. 4

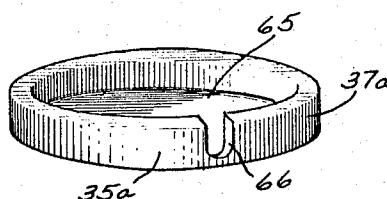


FIG. 2

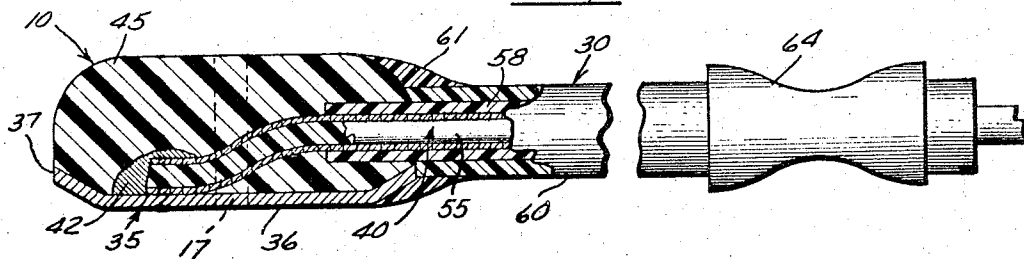


FIG. 3

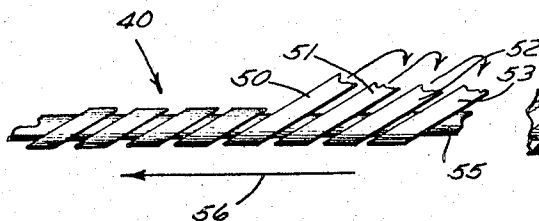
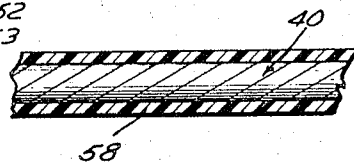


FIG. 5



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ABSTRACT OF THE DISCLOSURE

A nerve stimulating circuit means including an electrode and a flexible conductor connected thereto and extending therefrom. The electrode and the conductor being constructed of material suitable for implantation in a living body. The electrode and conductor means of the present invention can be used in various parts of the body for stimulation of various nerves, however, it has particular utility when secured to myocardium for heart stimulation.

This invention relates to nerve stimulating circuit means and more particularly to a nerve stimulating electrode and flexible conductor connected thereto.

An object of this invention is to provide a nerve stimulating electrode and conductive lead therefor which may be safely and effectively used within the human body.

Another object of the present invention is to provide a nerve stimulating electrode which can be fastened to the heart myocardium without puncturing the tissue surface while also providing proper electrical contact thereto.

Still another object of the present invention is to provide a nerve stimulating electrode which is small in size and light in weight and is safe and effective for use within the human body.

Yet another object of the present invention is to provide a nerve stimulating electrode having a contact surface which can be placed firmly against human body tissue for electrical coupling with nerve cells therein.

Still another object of the present invention is to provide a nerve stimulating electrode and flexible conductor which can be connected between nerve tissue to be stimulated and a stimulating source.

Further objects of this invention as well as a better understanding thereof, may be had from the following description when considered in conjunction with the accompanying drawings, in which:

FIGURE 1 is a somewhat diagrammatic representation of a pair of electrodes and conductors connected between a heart and a nerve stimulating source;

FIGURE 2 is a side elevated sectional view of one electrode and conductor of FIGURE 1;

FIGURE 3 is a somewhat diagrammatic representation showing four rectangular conductors being wrapped about a moving flexible core;

FIGURE 4 shows an alternate embodiment of electrode contractor construction which can be used in FIGURE 2; and

FIGURE 5 is a somewhat diagrammatic view showing the conductors of FIGURE 3 tamped together to form a helically wound flexible conductor.

Although the electrode and conductor means of the present invention can be used in various parts of the body for stimulation of various nerves, it has particular utility when secured to myocardium for heart stimulation. By way of example, FIGURE 1 shows a pair of electrodes 10 and 11 secured to a heart 15 in the region of the left ventricle. The electrode 10 is provided with a pair of holes 16 and 17 through which sutures 18 and 19 are provided for securing the electrode 10 firmly against the

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heart tissue. The electrode 11 is also provided with a pair of holes 20 and 21 through which sutures 22 and 23 are provided to secure the electrode 11 firmly against the heart tissue.

5 Stimulating current is applied to electrodes 10 and 11 through conductors 30 and 31 respectively from a nerve stimulating current source 32, which may be a device similar to my electronic heart stimulator described in my co-pending application Ser. No. 395,079, filed Sept. 8, 1964, entitled, "Electronic Heart Stimulator."

10 Shown in FIGURE 2 is a detailed view of the electrode 10 and conductor 30. An electrode contactor 35 has a flat contact surface 36 and a slight upturned peripheral edge 37. A helically wound flexible conductor 40 is secured to the electrode contactor 35 by solder or other means as indicated at 42.

To provide a smooth contoured surface on the back side of electrode contactor 35, and also to seal the connection 42 and conductor 40 from organisms in the body, 20 a molded cover 45 made of either epoxy or silastic is provided. After the electrode contactor 35, conductor 40 and molded cover 45 have been joined together to form the electrode unit 10, the holes 16 and 17 are then provided.

As shown in FIGURE 3, the conductor 40 is constructed by wrapping four rectangular conductors 50, 51, 52 and 53 about a flexible core 55 moving in the direction as indicated by arrow 56. The flexible core 55 is preferably of nylon material, while the four rectangular conductors are preferably strips of stainless steel. After the conductors 50-53 have been wrapped about the flexible core 55, the conductors are tamped together to form 30 a compact, flexible and springy conductor. A coating of polyethylene is preferably applied over the conductor assembly 40 of FIGURE 5 as indicated at 58 in FIGURE 5 to provide a flexible tubular adherent covering for the conductor assembly.

Referring to FIGURE 2, a flexible sleeve or tubing 60 is placed about the conductor 40 and its coating 58 and secured to the electrode 10 by adhesive as shown at 61. 40 The tubing 60 is preferably a Dow-Corning silastic of pure silicon material. The outer wall of the tubing 60 is preferably two to three millimeters above the contact surface 36 of the electrode 10. This allows the electrode to indent the heart muscle sufficient to cause good electrical 45 contact. The normal saline fluid of the heart also increases the conductivity between the contactor 35 and the heart muscle.

To prevent the helically wound conductors 50-53 from unwinding or stretching in the tubing 60 a terminating crimp terminal 64 is securely crimped at the free end of the conductor assembly.

Shown in FIGURE 4 is an alternate configuration of the contactor 35, FIGURE 2, and is designated by reference numeral 35a. The upturned peripheral edge 37a provides a cavity 65 in which a flexible conductor can be secured, and thereafter the cavity 65 can be filled with insulating material such as epoxy or silastic. A notch 66 is terminated approximately 2 to 3 millimeters from the bottom surface of contactor 35a to allow the contactor 35a to suitably indent the fibrous tissue which it is placed upon.

Although the description of this invention has been given with respect to a particular embodiment, it is not to be construed in a limiting sense.

Therefore, the foregoing description of this invention concerns only the preferred embodiment thereof, and that accordingly, changes and modifications may be made therein by those skilled in the art without departing from the spirit and scope of the novel concepts of this invention.

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I claim as my invention:

1. A nerve stimulating means comprising:

an electrode having a flat circular contact surface with an upturned peripheral edge,

a helically wound flexible conductor connected at one end to said electrode on the side thereof opposite said contact surface and having an opposite end, said flexible conductor having a flexible core, a cover means molded on said electrode on said opposite side thereof for covering the connection between said electrode and said flexible conductor, flexible tubing means surrounding said helically wound flexible conductor and extending the length thereof,

sealing means around said flexible tubing at a point adjacent to said cover means providing a seal therebetween, and an energy source connected at the opposite end of said flexible conductor for delivering stimulating impulses to said electrode.

2. The nerve stimulating means of claim 1 in which said helically wound flexible conductor comprises four stainless steel rectangular conductors wound about a nylon core.

3. The nerve stimulating means of claim 2 in which said four rectangular conductors are wound about said nylon core such that each conductor is in contact with said core and each of said conductors is in close proximity with the conductor immediately adjacent thereto.

4. A nerve stimulating electrode comprising:

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contact means having a flat contact surface with an upturned edge and a connection surface opposite said contact surface;

a flexible core;

a helically wound flexible conductor wrapped about said core;

connection means electrically connecting one end of said conductor to the connection surface of said contact means;

cover means molded on said contact means and overlying the connection surface thereof and surrounding said connection means;

flexible tubing means surrounding said conductor and extending the length thereof; and

sealing means around said flexible tubing at a point adjacent to said cover means providing a seal therebetween.

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