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HEART STIMULATOR UTILIZING A PRESSURE-SENSITIVE SEMICONDUCTOR

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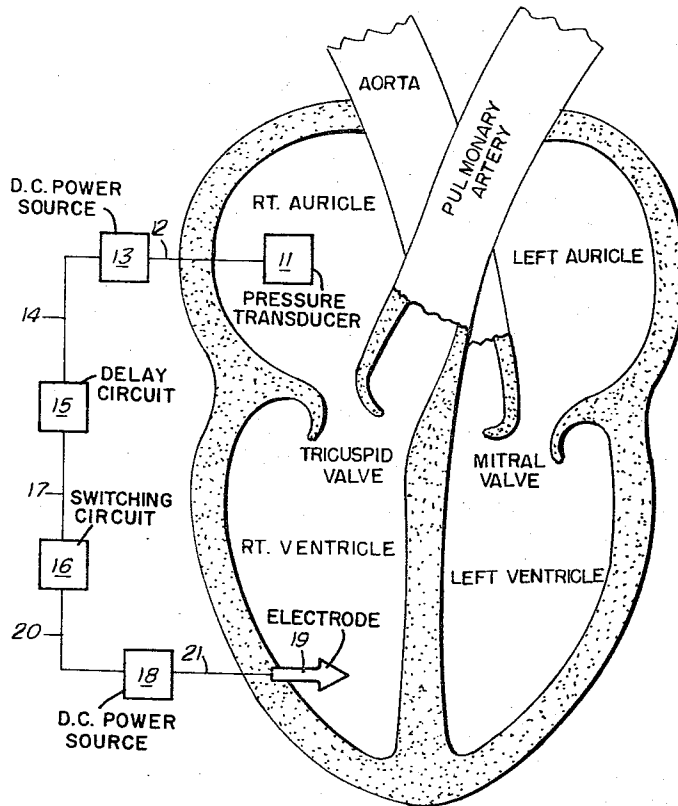


FIG. 1

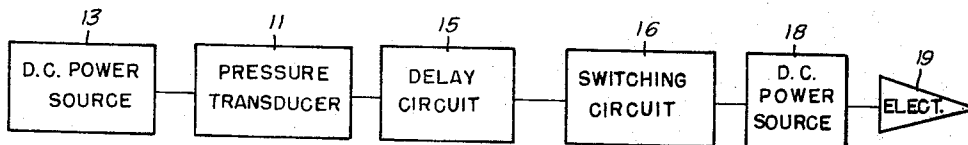


FIG. 2

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HEART STIMULATOR UTILIZING A PRESSURE-SENSITIVE SEMICONDUCTOR

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ABSTRACT OF THE DISCLOSURE

A heart stimulator in which a pressure-sensitive transducer, such as a tunnel diode is placed within the walls of an auricle in the heart. When a high pressure condition is reached, a switching signal is transmitted to a switching circuit, after being delayed, and a D.C. power source is activated thereby activating an electrode placed in the ventricle.

This invention relates to a heart stimulator. More particularly, this invention relates to an ingenious electronic system for stimulating the heart in order to effect pumping of blood in tune to the need put on the circulatory system.

Of fairly recent vintage are electronic systems for heart stimulation, known as "Pacemakers." The known Pacemakers work in an ingenious manner to stimulate the ventricle, either the right or left ventricle, or both, in order to provide necessary stimuli in the event that heart blockage has atrophied normal nerve ends in the muscle walls of the heart.

It is well known that nodes of nerve endings are situated on the atrium portion of the heart, being located on the right auricle and left auricle. In effect, these nodes act as pressure transducers, continuously telemetering pressure changes in the auricles so that as the pressure increases, the tricuspid valve between the right auricle and right ventricle, and the mitral valve between the left auricle and left ventricle, are opened and the appropriate ventricles suck in the blood from their respective auricles and pulse out the blood through their respective pulmonary artery and aorta. In other words, as pressure is built up in the atrium, nerve endings and nerve networks in the wall of the heart lead to suitable nodes in the ventricle portion of the heart to dispose of the blood in suitable pressurized fashion. Even though the heart reacts to the pressure change as telemetered from the atrium to the ventricle, the ventricle itself has a natural beat.

Some congenital heart defects are of a type resulting in what is known as a blockage. In such instances the naturally performing telemetering operation mentioned in the preceding paragraph is in malfunction so that the heart operates inefficiently. The newly developed Pacemakers take over the telemetering function to an extent by providing the ventricle with suitably spaced pulses of electrical energy as if, in fact, the nerve networks of the heart were delivering such pulses. Unfortunately, the prior art Pacemakers leave much to be desired inasmuch as they produce a constant pulse frequency, not variable to the requirements of the individual. In other words, the Pacemaker, in delivering its electrical pulses does so at a beat ordinarily prevalent when the individual is at repose. In the event the individual is engaged in strenuous activity requiring a greater quantity of blood, the Pacemaker does not operate on a faster rate, but actually fights the individual in his additional requirements for blood flow. On the other hand, when the individual is asleep, the Pacemaker does not decrease its frequency, but maintains a constant rate, thereby producing a greater flow of blood than is necessary and oftentimes prevents the individual from obtaining restful sleep.

Accordingly, the primary object of the present invention

is to provide a unique telemetering system resulting in heart stimulation accounting for variances in the need for blood supply.

It is another object of the present invention to disclose an electrical system utilizable in a heart stimulation program.

It is yet another object of the present invention to provide a heart stimulator which is extremely compact and is efficient in operation.

Additional objects and advantages of the present invention will become apparent upon a more detailed consideration as set forth below and taken in conjunction with the drawings, wherein:

FIGURE 1 is a diagrammatic cross-section of the heart in the diastole phase; and,

FIGURE 2 is a block diagram of the circuitry involved in carrying out the present invention.

Now, turning our attention to FIGURE 1, it will be noted that the cross-sectional view represents a diagrammatic view of a mammalian heart, and in particular the heart of a human being. It will be assumed that the heart will have undergone a degree of heart blockage, which necessitates the implantation of the present invention. Within the walls of the right auricle and/or the left auricle, a tiny transducer 11 is positioned. This tiny transducer is merely a pressure sensitive element, such as a tunnel diode which, under present day technology, may be constructed to assume an extremely tiny dimension. The pressure transducer 11 is positioned in the walls of the heart near the inner periphery by means of open heart surgery, now nicely perfected by our medical scientists. Tiny leads 12 emerge from the heart and are carried outwardly through the parietal pleura of a power source such as a D.C. battery 13. The D.C. battery provides suitable biasing to the tunnel diode pressure transducer when such is utilized.

The pressure transducer selected is such that it may be sensitive to pressure changes of the type found from low pressure to high pressure conditions in the atrium. When a high pressure condition is achieved in the atrium, the pressure transducer senses it and would ordinarily throw a suitable electronic switch immediately. However, by means of lead line 14, the switching is delayed by means of a conventional delay circuit 15 before it is connected to the conventional switching circuit 16 through lead line 17. When the switching circuit is phased to the "on" side, the power source 18 is put into the line leading to an electrode 19 through leads 20 and 21. The electrode 19 is of the same type as employed in a Pacemaker and is of an extremely small size.

It will be appreciated that as in the same manner or use of a conventional Pacemaker, the electronic circuitry and power source may be positioned outside the body or may be located directly below the skin and outside of the sternum. Such parts of the circuitry would, of course, be the power source 13, the delay circuit 15, the switching circuit 16, and the power source 18.

By positioning the electronic components in this manner and employing tiny leads to the heart, there is practically no discomfort to the individual utilizing this system. The entire arrangement is very small and the power consumption is almost infinitesimal, so that the circuitry of the present system may be removed for the replacement of either the electronic components or the power source, which may be in the form of batteries, by means of a simple operation which may be performed on an annual basis.

In FIGURE 2, a further rendition of the circuitry of the present invention is set forth, showing the D.C. battery source 13, the pressure transducer 11, the delay circuit 15, the switching circuitry 16, the D.C. power source 18, and the electrode 19. Electrode 19 is positioned in the

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ventricle portion of the heart, either right or left, or both.

By means of the present invention, it will be seen that technological advances have been made to take the place of damaged heart conditions and that the circuitry involved is, in fact, analogous to the heart circuitry, at least in the function thereby achieved.

It will be apparent that many changes and modifications of the several features described herein may be made without departing from the spirit and scope of the invention. It is, therefore, apparent that the foregoing description is by way of illustration of the invention rather than limitation of the invention.

What is claimed is:

1. A heart stimulator, comprising:

- (a) a pressure sensitive transducer means adapted to be inserted in the atrium of a heart for sensing a high pressure condition in said atrium;
- (b) electrode means adapted to be inserted in the ventricle of said heart; and
- (c) telemetering means connecting said transducer and said electrode means, said telemetering means comprising a delay circuit, a switching circuit, and a DC power source, said delay circuit being connected to receive the output of said pressure sensitive trans-

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ducer, said switching circuit being connected to receive the output of said delay circuit, and said DC power source being adapted to be connected to said electrode means by said switching circuit when said switching circuit is activated by the delayed signal from said pressure sensitive transducer.

2. The heart stimulator of claim 1 in which said pressure sensitive transducer means is a pressure sensitive semiconductor.

3. The heart stimulator of claim 1 in which said pressure sensitive transducer means is a tunnel diode.

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