

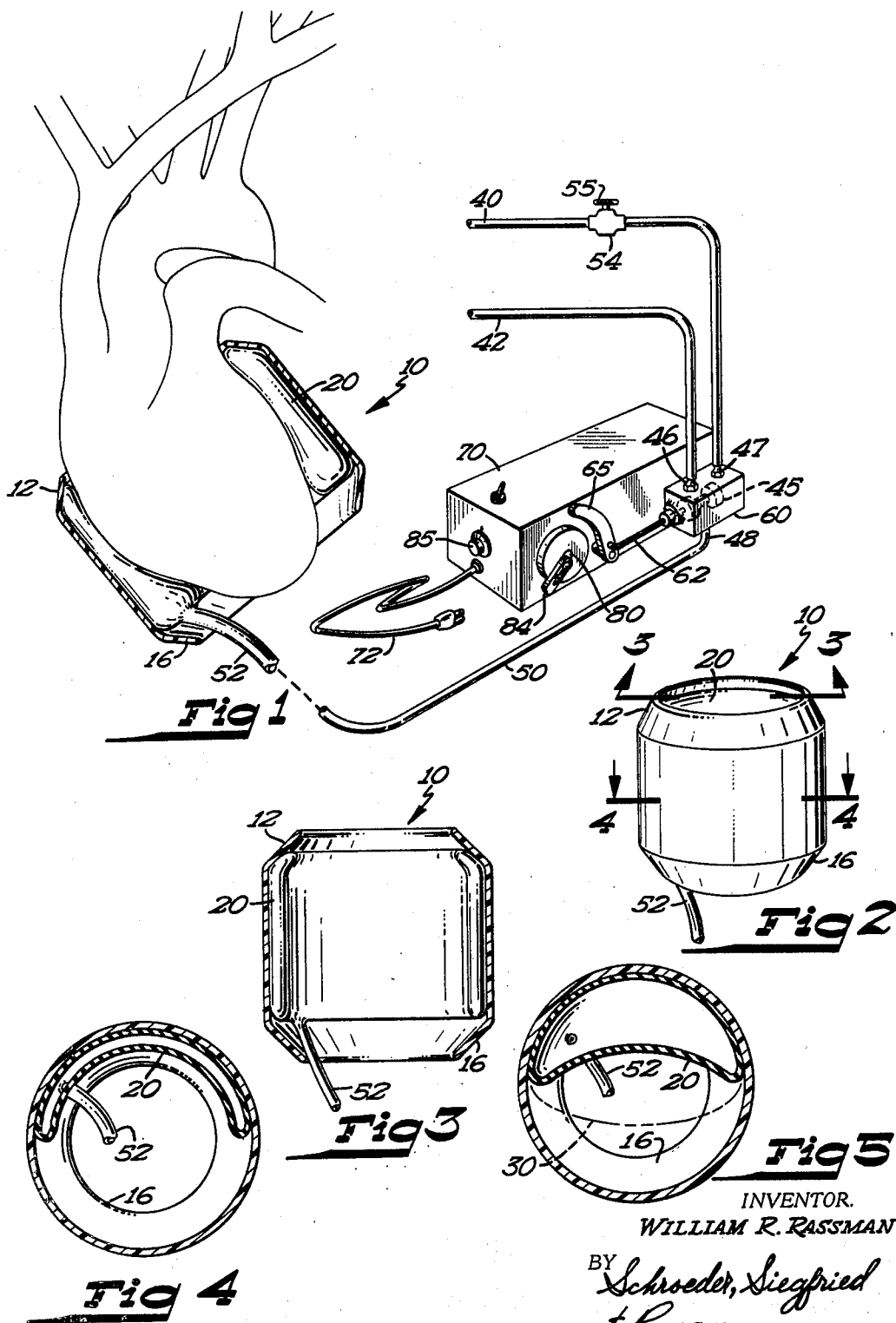
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HEART MASSAGER

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HEART MASSAGER

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8 Claims

ABSTRACT OF THE DISCLOSURE

A cardiac massage device having a cylindrically shaped sleeve member of nonexpansible and pliable material which is tapered at its extremities and with a diametrical dimension slightly less than the size of a mammal's heart on which it is to be used at its tapered extremities and with a length dimension of substantially the same length as the ventricular surface of the heart. The sleeve member has an inflatable bladder positioned on the inner peripheral surface of the same with suitable contact means to cause the inner surface to adhere to the interior of the sleeve member. The bladder is positioned on substantially one-half of the inner cylindrical surface of the sleeve member and extends from a point adjacent the taper at one extremity of the sleeve member to a point approximately two-thirds to three-quarters of the length of the sleeve member and spaced from the taper at the other end of the sleeve member. This bladder has a single conduit or pipe of flexible material connected thereto by means of which fluid may be inserted into the bladder to expand the same and withdrawn therefrom to collapse the same in the massaging operation. The sleeve member with the bladder is readily inserted as a prosthetic device through a thoracotomy insertion and manipulation to slide around the heart without requiring further means for retaining the same on the heart. Rhythmic pulsations caused by sequential inflation and deflation of the bladder will provide systolic support to a partially or totally inactive myocardium through massage of the ventricular area of the heart.

This invention relates to myocardial prosthetic devices and more particularly to an improved cardiac massage apparatus for mechanically massaging a mammalian heart to effect ventricular contraction artificially to produce a steady flow of blood to and from the heart.

Prosthetic devices and appliances of this type are known and have been used with varying degrees of success. Such devices are not artificial hearts but are designed to produce mechanical stimulation to eliminate the problem of mechanical massaging of the heart which is beating weakly or has stopped during an operation or for any other reason. Such prior structures have had the disadvantage of difficulty in installation or positioning of the appliance around the heart, difficulty in removal of the same, difficulty in retaining the structure enveloping the heart during the massaging operation, and in simulating a massaging pressure and rhythm to produce blood flow and pressure in a system which closely approximates normal conditions.

The improved cardiac massage apparatus of the present invention provides a prosthetic appliance which is readily inserted on the heart through a thoracotomy insertion and one which will retain itself on the heart during the massaging operation. Similarly, the improved prosthetic appliance may be simply removed with a minimum of surgery and requires only a single inlet or communicating conduit with the massage device to permit operation of the same. In addition, the improved cardiac massage device includes a control structure in which the parameters of pressure, rate of pulsation, and phase of

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pulsation may be separately and accurately adjusted to closely simulate the mammalian heart function and operation.

Therefore, it is the principal object of this invention to provide an improved cardiac massage apparatus.

Another object of this invention is to provide in an improved cardiac massage apparatus, a sleeve member which is shaped to fit around a heart and retain itself thereon with an inflatable bladder therein to massage a heart in the manner so that the sleeve member will be retained on the heart during the massaging operation.

Another object of this invention is to provide in an improved cardiac massage device a simplified structure requiring only a single conduit connection to be connected to the pumping apparatus.

A still further object of this invention is to provide in an improved cardiac massage apparatus, a control structure for selectively and accurately adjusting massaging pressure, pulsation rate, and phase or the time interval between which the heart is pressed and released.

These and other objects of this invention will become apparent from a reading of the attached description together with the drawings wherein:

FIGURE 1 is a sectional view of the improved cardiac massage apparatus shown installed on a mammalian heart with the improved control apparatus connected thereto.

FIGURE 2 is a perspective view of the sleeve member of the improved cardiac massage apparatus.

FIGURE 3 is a sectional view of the sleeve member of FIGURE 2 taken along the lines 3-3 therein.

FIGURE 4 is a sectional view of the sleeve member of FIGURE 2 taken along the lines 4-4 therein, and

FIGURE 5 is a sectional view similar to FIGURE 4 showing varying degrees of extension of the bladder in the sleeve member.

My invention in an improved cardiac massage device or myocardial prosthetic apparatus may be applied to mammalian hearts, human or otherwise. It is designed to give full or partial support to the heart over prolonged periods eliminating the need for manual massage with the maintaining of uniform and rhythmic pulsations to provide normal heart function. This improved cardiac massage device is comprised of a sleeve member 10 which is generally cylindrical in form. The sleeve member can be made of varying types of materials so as to be non-expansible with respect to its diametrical dimension and may be deformable or semi-rigid in construction. This sleeve member has a tapered extremity indicated at 12 which will be slid over a heart and the other extremity may or may not be tapered. In the drawings, it is shown as tapered as at 16. The sleeve member may be made of a heavy cloth material or a semi-plastic material that preferably will have a soft outer covering so as not to bruise or injure tissue contacted by the same. The physical dimensions of the sleeve member are such that the maximum diameter or diametrical dimension of the same will be substantially the same as the broadest dimension of the mammalian heart with which it is to be associated and with the peripheral extremities at the narrowest end of the taper point being less than the maximum dimension of the heart over which it will be slid. The length dimension of the sleeve member may vary and will normally be slightly shorter than the length of the ventricular surface of the heart from its position of installation, as will be hereinafter identified. Positioned on the interior surface of the cylindrical sleeve member is a bladder 20 which extends substantially half way around the interior of the sleeve member and from a position adjacent the tapered extremity of the sleeve at one end of the same to a point slightly removed from the tapered portion at the other extremity of the sleeve. This covers approximately two-thirds to three-quarters of the length

of the sleeve and may vary in accord with the overall length of the same. The primary requirement is that the bladder will cover effectively the ventricular surface of the heart on one side of the same when the heart is inserted into the sleeve member and will push the heart against the opposite surface of the sleeve member remote from the bladder and against the edge of the tapered portion to retain the heart within the sleeve member as the bladder is inflated and deflated. Further, this semi-cylindrical shaped bladder, which is attached to the inner peripheral surface of the sleeve member through suitable means (not shown), will act against the ventricular surface of the heart to push the same against the sleeve member in collapsing the heart and will not urge the heart out of the sleeve member.

This sleeve member is inserted on the heart through a thoracotomy type insertion which generally requires a reflection of the rib cage or a portion thereof, and the heart is inserted into the sleeve member through a manipulation by means of which the heart is manually collapsed or manipulated and inserted in its collapsed position into the sleeve member with the upper tapered edge of the same being positioned approximately at the atrio-ventricular groove so as to encompass basically the skeleton portion of the heart. The half bladder design and the physical size of the sleeve member insures that the pulsing pressure in the bladder will act against the heart to collapse the same rather than reject the heart from the sleeve member, and the heart will be retained therein for massage to partially or wholly support the function of the same. As indicated in FIGURES 3 and 4, the one wall of the bladder adjacent the sleeve member would be non-expandable and hence the bladder when inflated would expand into the interior of the sleeve member substantially or partially filling the same as indicated in phantom at 30 in FIGURE 5.

The pulsation fluid pressure applied to the bladder to support pulsations of the same and manipulation of the heart or massage of the same is preferably air. In FIGURE 1, the drawing shows an air pressure source indicated by the conduit 40 and a vacuum pressure source indicated by the conduit 42. These sources are connected to a valve, shown in block at 45, of the three-way type and at the inlet ports 46-47 thereof with the outlet port 48 being connected through a single conduit 50 to the rubber or tubular conduit 52 connected to the interior of the bladder 20. This structure thus requires only a single pipe or conduit to be directed out of the body of the mammal upon which the prosthetic device is being used. The pressure conduit 40 includes a pressure regulating valve 54 with an adjusting handle 55 thereon by means of which the pressure at the inlet port 47 of the valve may be regulated, thus regulating the pressure in the outlet conduit whenever the valve is switched to a point of communication between the inlet port 47 and the outlet port 48. The vacuum line 42 is similarly connected to the inlet port 46 and will communicate with the outlet port 48 and the bladder to evacuate the same whenever the valve is switched to an opposite position. The valve element, shown in phantom at 60, is connected through a lever 62 to a pivoted lever member 65 mounted on the casing of a variable speed drive structure 70. This drive structure is shown only as a box which would normally include an electric motor and a control by means of which current flow from a source such as indicated by the plug 72 would be varied to vary the speed of rotation of the drive. The output of the drive is evidenced by an output shaft 80 having connected thereto an adjustable lever 84 which will cooperate with the pivoted lever 65 to urge the lever 62 connected to the movable valve element 60 for the purpose of switching the position of the same to switch the valve between its operative positions. This will selectively and alternately connect the air pressure and vacuum sources to the bladder for the purpose of inflating and deflating the same. When

adjusting the speed of the drive structure 70 through manually operated vernier type control handle 85, the rate of switching will be adjusted to correspond with the pulsing rate of expansion and contraction of the bladder 20 of the massage device. By adjustment of the lever arm 84 relative to the shaft 80 which engages the pivoted lever 65 or the cam surface on the same, the point at which the lever 84 will contact the pivoted lever 75 and the period of time at which it will remain in contact with the same to pivot the lever 65 for a single rotation of the shaft will be adjusted. This will vary the period of time for a single rotation of the shaft 80 in which the bladder 20 is connected to the pressure and vacuum sources. In such a massage device, the bladder is inflated for a relatively short portion of the cycle corresponding to normal heart pumping function and the bladder will be collapsed for the remaining portion of a single cycle. This is known as the phase adjustment of the pumping source and with the pressure regulation of the fluid in the bladder 20 through the pressure regulating valve 55 and the speed setting as determined by the speed control 85 on the output speed of rotation of the shaft or cam 80, pulse rate, blood pressure and phase may be adjusted to permit the massage device to simulate actual heart conditions and more closely permit massage or manipulation of the heart for extended periods to wholly or partially support the heart pumping function. Thus, the inflation and deflation of the bladder 80 in the sleeve member 10 may be readily adjusted and accurately adjusted to closely simulate the normal heart beat of a patient. Removal of the sleeve member is effected by manipulation of the heart to slide the sleeve off of the heart.

The particular materials making up the bladder and sleeve member and the control apparatus for adjusting rate and phase of the pulsing pressure to the bladder may vary within the scope of the present invention. Therefore, I wish to be limited only by the appended claims.

What is claimed is:

1. A cardiac massage apparatus comprising, a sleeve member generally cylindrical in form with at least one extremity tapered inwardly, said sleeve member being slightly larger than the largest dimension of a heart with which it is to be associated at its largest dimension and smaller than the heart at its tapered extremity being formed of a substantially nonexpandable material, a bladder fixed to the inner peripheral wall of the sleeve member over approximately one-half of the inner circumferential surface of the sleeve member and from said one tapered extremity to approximately two-thirds the height of the sleeve member, conduit means connected to said bladder, and means connected to the conduit means and the bladder to direct fluid under pressure into and out of the bladder.

2. The cardiac massage apparatus of claim 1 in which the sleeve member has an exterior surface of soft pliant material with a rigid form so as not to be expandable and in which the bladder is fixed at its surface adjacent to the interior wall of the sleeve member so as to adhere thereto being free at its other surfaces so as to expand into and partially fill the interior of the sleeve member with varying degrees of bladder inflation.

3. A cardiac massage apparatus comprising, a sleeve member generally cylindrical in form with inwardly tapered extremities, said sleeve member being slightly larger than the largest dimension of a heart with which it is to be associated at its largest dimension and smaller than the heart at its tapered extremities being formed of a substantially nonexpandable material, a bladder fixed to the inner peripheral wall of the sleeve member over approximately one-half of the inner circumferential surface of the sleeve member, conduit means connected to said bladder, and means connected to the conduit means and the bladder to direct fluid under pressure into and out of the bladder, said bladder extending circumferen-

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tially along the inner wall of the sleeve member over approximately one-half of the extent of the same and from one of its tapered extremities to approximately two-thirds of the height of the sleeve member toward the other tapered extremity.

4. The cardiac massage apparatus of claim 3 in which the conduit means is a single air inlet conduit connected to the bladder.

5. The cardiac massage apparatus of claim 3 in which the fluid under pressure is directed into and out of the bladder through the conduit means includes means for varying the rate of pulsation of the fluid into and out of the bladder together with the pressure of the fluid in the bladder and the length of time the pressure in the bladder causes inflation of the same compared with the time the bladder is collapsed.

6. The cardiac massager apparatus of claim 4 in which the means connected to the bladder to direct fluid under pressure into and out of the bladder includes a source of air under pressure and a vacuum source together with a valve means switching between the sources to connect the conduit means selectively to the vacuum and pressure sources.

7. The cardiac massage apparatus of claim 6 in which the valve means is a three-way diverting valve with the vacuum source and pressure source connected to the inlet ports thereof and a single outlet port is connected to the conduit leading to the bladder and with an air pres-

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sure regulator included with the air pressure source to regulate selectively the pressure of the same and with a motor driven switching means having a variable speed control operating the diverting valve.

8. The cardiac massage apparatus of claim 7 in which the motor driven switching means operating the diverting valve includes a variable speed electric motor and control means for varying the speed of operation of the same together with a cam follower having an adjustable arm connected to and driven by said motor and a cam surface connected through a pivoted lever and operating said diverting valve between switching positions in which the adjustment of the cam follower and its engagement with the cam surface will determine the length of time the diverting valve is operated in one position with respect to the other position in its switching operation for each revolution of the cam follower.

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