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3,219,031

EXTERNAL CARDIAC MASSAGE APPARATUS

Filed Dec. 27, 1962

2 Sheets-Sheet 1

FIG. 1

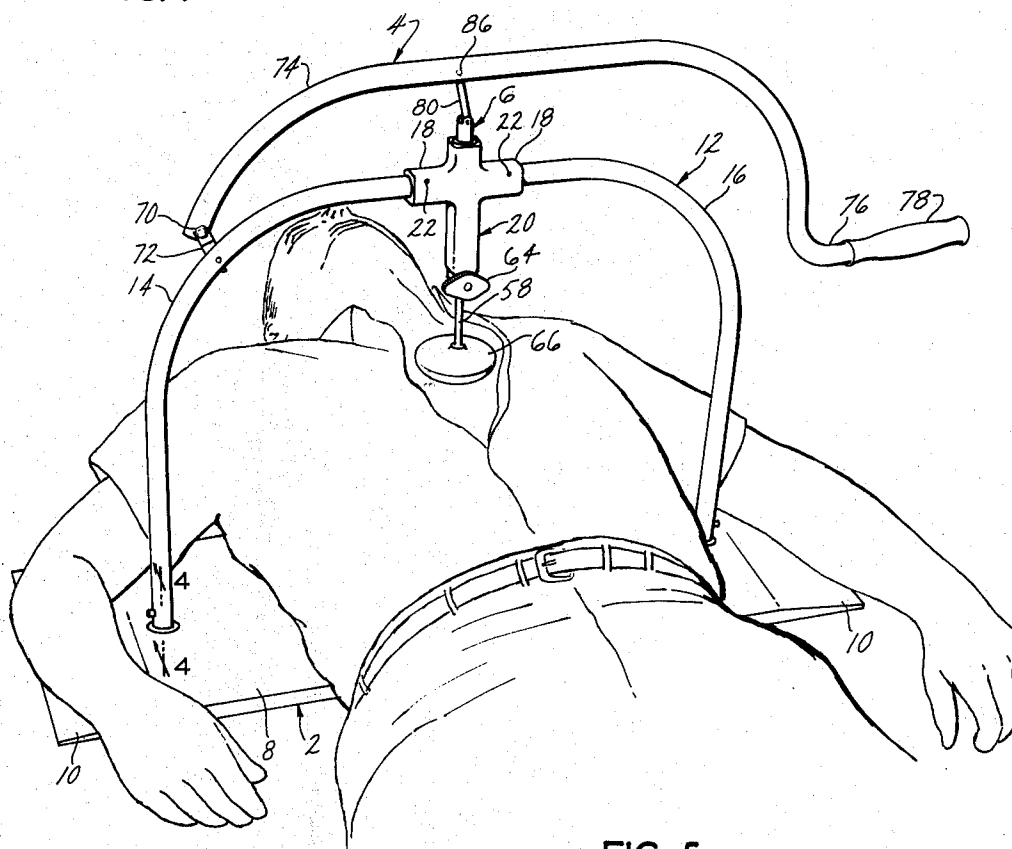


FIG. 5

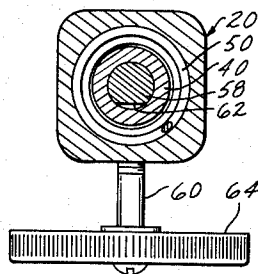
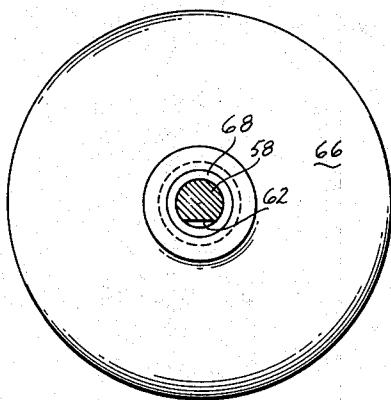


FIG. 6



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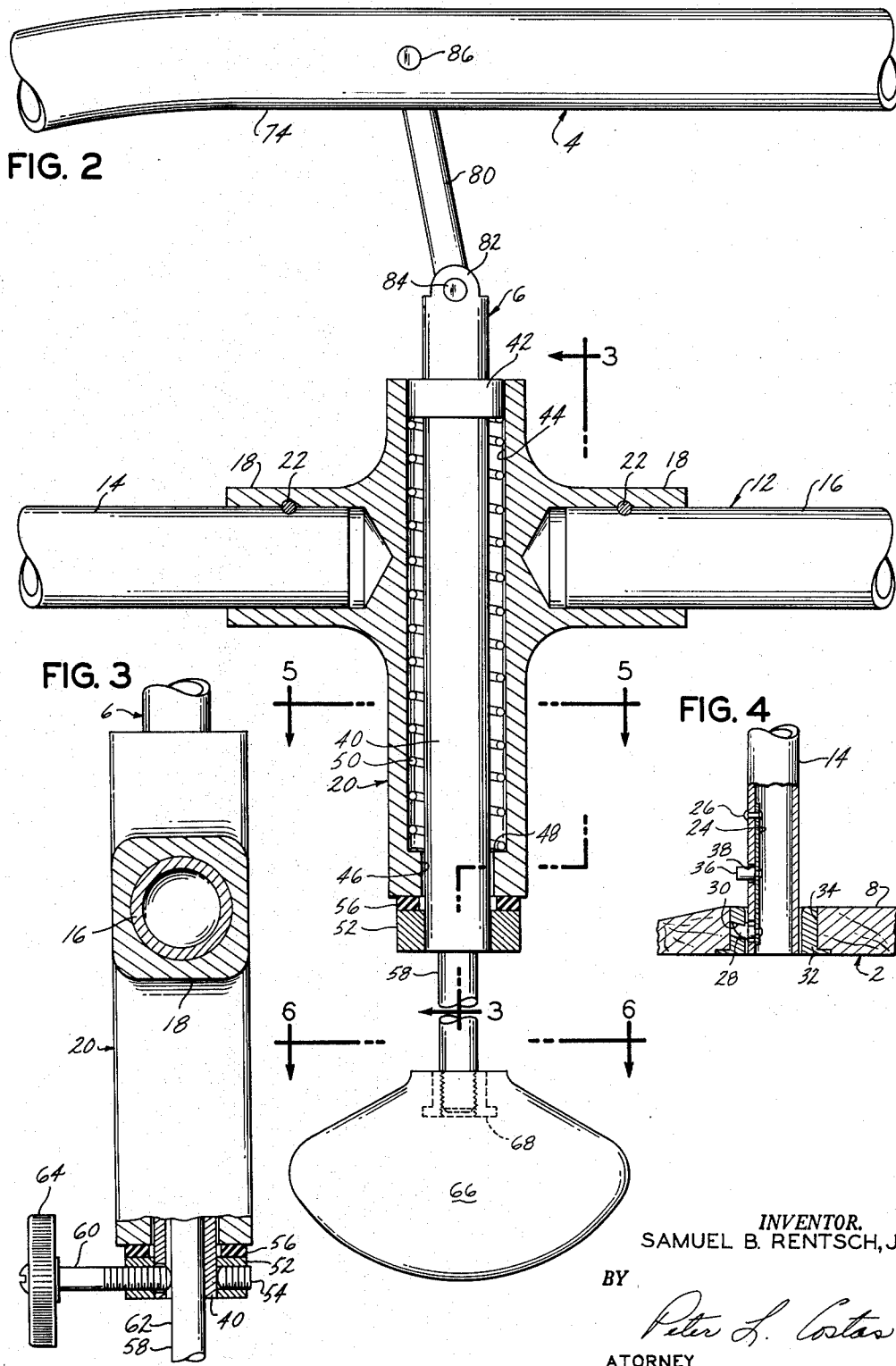
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EXTERNAL CARDIAC MASSAGE APPARATUS

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1

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EXTERNAL CARDIAC MASSAGE APPARATUS
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10 Claims. (Cl. 128—51)

The present invention relates to resuscitators, and more particularly, to external cardiac massage apparatus.

Although heart massage is a well-known practice among the medical profession and others highly familiar with resuscitation techniques, its use has been generally limited because it requires a relatively high degree of skill to avoid injury to the patient and to achieve optimum effectiveness and also because of the fatigue produced by the operation when conducted manually. Various devices have been designed to apply external pressure to the xiphoid process including both manually and mechanically operated units, but generally such devices are costly and are confined to medical facilities.

Often emergency heart massage is urgently needed at the scenes of drownings, fires, electrocutions and asphyxiations in order to effect resuscitation in conjunction with other therapy, and neither apparatus nor personnel skilled in the technique are immediately available. Moreover, since direct manual massage requires both skill and experience to be effective and to avoid injuring the patient and since it is extremely fatiguing even to the skilled practitioner so as to make effective treatment over extensive time periods a difficult task, it is most desirable that there be readily available simple and relatively fool-proof apparatus which can be effectively used by the novice or by the skilled practitioner for extended periods of time.

It is an object of the present invention to provide a manually operated external heart massage apparatus which can be operated effectively by the unskilled person without substantial risk of injury to the patient.

Another object is to provide such an apparatus which may be effectively operated over extended time periods without unduly fatiguing the operator.

It is also an object to provide such apparatus which is easily transported and assembled and which is relatively simple and inexpensive to manufacture.

Other objects and advantages will be readily apparent from the following detailed description and claims and the attached drawings wherein:

FIGURE 1 is a perspective view of a manually operated external heart massage apparatus embodying the present invention in operative position with a patient;

FIGURE 2 is a fragmentary elevational view to an enlarged scale of the drive portion of the apparatus in FIGURE 1 with the plunger guide housing in section to reveal internal construction;

FIGURE 3 is a cross-sectional view along the line 3—3 of FIGURE 2;

FIGURE 4 is a cross-sectional view to an enlarged scale of the yoke mounting along the line 4—4 of FIGURE 1;

FIGURE 5 is a cross-sectional view along the line 5—5 of FIGURE 2; and

FIGURE 6 is a cross-sectional view along the line 6—6 of FIGURE 2.

It has been found that the foregoing and related objects can be readily attained by an external heart massage apparatus generally comprising a frame having a base portion adapted to extend under the body of a supine patient, a lever arm pivotally mounted on the frame and extending above the base portion for limited reciprocal movement in a substantially vertical plane, and a plunger

2

assembly depending from and drivingly associated with the lever arm for limited vertical movement in response to reciprocation of the lever arm to depress the chest of a supine patient without injury during operation of the apparatus. The vertical movement of the plunger assembly is limited to a predetermined distance to reduce the risk of injury to the patient by preventing the inexperienced operator from excessively depressing the chest. The mechanical advantage gained by using a lever arm to actuate the lever arm is configured and dimensioned to provide a mechanical advantage for reciprocating the plunger assembly and the plunger assembly enables manual operation of the apparatus for relatively extended time periods without undue fatigue.

In operation of the apparatus, the supine patient is located therein with the base extending under the back to stabilize the unit and the plunger assembly in substantial vertical alignment with his xiphoid process. The lever arm is then reciprocated in a vertical plane to reciprocate the plunger assembly to alternately depress and release the chest of the patient with the chest depression produced by the plunger assembly being about 2 inches. Generally, the lever arm is reciprocated about sixty to eighty cycles per minute with pauses of short duration after about ten to fifteen cycles to permit inflation of the lungs.

In the preferred aspect of the invention, the apparatus has a frame which may be quickly assembled and easily stored including a base portion fabricated with end edges which are bevelled downwardly to facilitate sliding under the back of a supine patient and a lightweight yoke portion. The yoke has vertical leg portions and a top portion dimensioned to straddle or span a supine patient, and is readily anchored to the base after the patient has been located thereon. The lever arm is mounted at one end to the top portion of the yoke portion adjacent one end thereof so that it extends above and generally parallel to the top portion of the yoke and may pivot or reciprocate in a generally vertical plane. The plunger assembly is slidably supported in a plunger guide housing at about the center of the top portion of the yoke and is drivingly coupled to the lever arm to reciprocate in a vertical plane. At the lower end of the plunger assembly is a fist or plunger face piece having a smooth, hard, convexly curved bottom surface and means are provided for adjusting the vertical spacing between the face piece and the base of the frame to accommodate the patient. To facilitate the operation of the apparatus, the plunger guide housing is preferably provided with compressible spring means to bias the plunger assembly upwardly to a raised position and return it at the completion of a downstroke. To compensate for the arcuate movement of the reciprocating lever arm, the plunger assembly is coupled thereto by a linking pin pivotally connected at both ends so as to permit the plunger assembly to reciprocate on a vertical line.

Referring now in detail to the attached drawings, a manually operated external heart massage apparatus embodying the present invention is generally comprised of a frame 2, the lever arm 4 pivotally mounted thereon and a plunger assembly 6 slidably supported in the frame 2 and depending from and drivingly associated with the lever arm 4 for limited reciprocation in a vertical plane. The frame 2 has a base 8 with downwardly bevelled end edges designated by the numeral 10 so that it may be readily slipped under the back of a supine patient and a generally U-shaped yoke 12 formed of a pair of generally opposed, generally L-shaped tubular members 14, 16 having their opposed upper ends seated in the bores of the horizontal arms 18 of the generally cross-shaped plunger guide housing 20 and locked therein by the pins

22. The tubular members 14, 16 are dimensioned to provide a top portion for the yoke 12 of sufficient length to span the body of a patient received in the apparatus and vertical leg or side portions of sufficient height to provide adequate spacing between the base 8 and the top portion and the plunger assembly 6 supported thereon to accommodate the patient and provide spacing for clearance and vertical adjustment of the plunger assembly 6.

As shown in detail in FIGURE 4, the lower ends of the tubular members 14, 16 of the yoke 12 are quickly engageable in or disengageable from the base 8 by a snap-locking mechanism. An elongated leaf spring 24 is located in the bore of the tubular members and is secured to the inner wall at its upper end by a rivet 26 or other suitable means. At the lower end thereof is mounted a cam finger 28 which projects outwardly through an aperture in the tubular member and which has an arcuate lower face adapted to move the finger 28 inwardly of the tubular member against the biasing pressure of the spring 24 as it is pressed downwardly against the metal collar 32 in the mounting aperture 34 of the base 8. After the finger 28 is cammed inwardly and passes the radial wall of the collar 32, the spring 24 again biases the finger outwardly of the tubular member so that it seats in the locking aperture 30 in the collar 32 to firmly anchor the yoke 12 in the base 8. To rapidly disengage the yoke 12 from the base 8, a release pin 36 is mounted on the spring 24 intermediate its length and extends through the aperture 38 in the tubular member so that, when pressed upon, it will deflect the spring 24 and move the cam finger 28 inwardly of the tubular member.

Referring now in detail to the plunger assembly 6, an elongated tubular plunger member 40 having a radial collar 42 spaced inwardly from but adjacent its upper end is slidably seated in the vertical bore 44 through the plunger guide housing 20. The bore 44 has a reduced diameter portion 46 at its lower end providing a radial shoulder 48 therein upon which is seated a helical compression spring 50 acting against the lower face of the collar 42 to bias the plunger member 40 upwardly. An annular stop collar 52 mounted on the bottom end of the tubular plunger member 40 by the set screw 54 limits upward movement of the plunger member and an annular washer 56 of resilient material disposed thereon reduces the impact and wear upon the stop collar 52 as it is driven against the lower end of the plunger guide housing 20 by the helical compression spring 50.

Slidably carried within the bore of the tubular plunger member 40 and depending therefrom is the plunger rod 58 which may be adjusted vertically or telescoped therein by the adjusting screw 60 which is threadably engaged in the stop collar 52 and bears against a flat vertically extending face 62 on the plunger rod 58 to maintain it in adjusted position. The outer end of the adjusting screw 60 is desirably provided with an enlarged handle 64 to facilitate adjustment and application of sufficient pressure to ensure firm engagement. At its lower end the plunger rod 58 carries a plunger face piece or "fist" 66 of relatively hard but yieldable material such as hard rubber having a convexly curved lower surface. To provide a firm mounting, an internally threaded metal insert 68 is incorporated in the face piece 66, and the lower end of the plunger rod 58 threadably engages therewith.

The lever arm 4 is of tubular construction and has one end thereof pivotally mounted by the pivot pin 70 in the fork-shaped pivot support member 72 which in turn is secured in the yoke 12 adjacent one of the leg portions 14, thus permitting the lever arm to be reciprocated in a vertical plane. As seen in FIGURE 1, the lever arm 4 has a generally U-shaped body portion 74 extending in generally parallel spaced relationship to the yoke 12 and a horizontal portion 76 at its other end having a hand grip 78 of rubber or other suitable material.

The lever arm 4 and the plunger assembly 6 are drivingly connected by a linking or drive pin 80 which is

pivotally mounted at its lower end in the upstanding ears 82 at the upper end of the tubular plunger member 40 by the pivot pin 84 and at its upper end in the tubular lever arm 4 by the pivot pin 86. In this manner, the arcuate motion of the lever arm 4 relative to the plunger assembly 6 is compensated and the plunger assembly 6 moves in a vertical plane without undue stress. As the lever arm 4 is reciprocated downwardly, it abuts against the upper end of the plunger guide housing 20. The amount of vertical movement imparted to the plunger assembly thus may be positively limited, preferably to about 2 inches.

Referring now to the operation of the apparatus, the base 2 is easily slipped under the back of a supine patient with the downwardly bevelled end edges 10 serving to ease the passage of the base. The yoke 12 is easily and conveniently locked into position astride the patient by the snap-lock fasteners as the tubular members 14, 16 are inserted through the metal collars 32 into the mounting apertures 34 in the base. The patient is positioned within the apparatus with his xiphoid process vertically aligned with the plunger face piece 66 and the plunger rod 58 is extended downwardly until the face piece is in firm contact with the xiphoid process, at which point the adjusting screw 60 is tightened to frictionally lock the plunger rod 58 within the tubular plunger member 40.

As the lever arm 4 is pushed downwardly, it drives the tubular plunger member 40 downwardly and causes the plunger face piece 66 to depress the xiphoid process until the lever arm 4 abuts against the upper surface of the plunger guide housing 20 after permitting the desired depression approximately 2 inches. On release, the lever arm 4 is returned to its raised position by the combined action of the helical compression spring 50 and the resiliency of the patient's chest. This reciprocation of the lever arm and resultant alternate depression and release should be repeated at a rate of about sixty to eighty cycles per minute with a pause after every ten to fifteen cycles to permit inflation of the patient's lungs.

Since a relatively large force is needed to depress the patient's chest the desired 2 inches, the mechanical advantage gained by use of the lever arm 4 permits the operation of the apparatus for extended periods of time without undue fatigue to the operator. To minimize bruises and friction burns to the patient's chest, the face piece 66 is designed to conform approximately to the concave configuration of the xiphoid process region when depressed for minimum slipping, and its surface is smooth for relatively friction-free contact with the patient's skin. In this connection, it is most desirable that the patient's chest be bared to minimize frictional abrasion occurring due to the interposition of clothing and relative movement thereof.

The use of the cardiac massage apparatus and method is indicated whenever respiration therapy is necessary and no peripheral pulsations of the heart can be palpated. It can be desirably employed in conjunction with oxygen therapy, artificial respiration or mouth-to-mouth breathing. Such need will frequently arise where the patient has been rescued from drowning, asphyxiation or electrocution or where the patient has had a severe head injury or heart attack or is otherwise suffering from impaired heart and respiratory action due to unknown causes. However, it is imperative that therapy be commenced as quickly as possible following the tragedy so as to increase the likelihood of success and diminish the likelihood of permanent injury. When the patient can complain of the operation of the apparatus, its need no longer exists; periodically during operation, the patient should be checked for palpable pulsation to determine the effectiveness of the operation or of further need therefor.

Various elements of the apparatus may be readily fabricated from metallic tubing of lightweight metal such as aluminum. The plunger guide housing may be readily cast or machined and the base member may conveniently

5

be fabricated from wood. To reduce friction, the helical compression spring may be coated with a synthetic resin of high lubricity such as tetrafluoroethylene, and a resilient buffer member may be provided upon the top of the plunger guide housing to reduce impact stresses and wear.

Thus it can be seen that the external cardiac massage apparatus of the present invention is relatively inexpensive and simple to manufacture and is easy to transport and assemble, thus encouraging its widespread distribution to operating rooms, hospital emergency rooms, doctors' offices, ambulances and other emergency vehicles, swimming areas and other places where cardiac arrest may be encountered. The limited stroke of the plunger assembly and the configuration of the plunger face piece minimize the risk of complications such as fractured ribs, liver lacerations and surface bruising to the patient. Due to the mechanical advantage provided by the lever arm, one person may operate the apparatus for extended periods of time without excessive fatigue as compared to the ten or fifteen minutes of fatiguing direct external manual heart massage which may be administered without resting. The simple, virtually foolproof method of external heart massage provided by the apparatus and method of the present invention provides the novice as well as the highly experienced doctor with the means of administering effective emergency heart massage, thus constituting a significant and useful contribution to the art of heart massage.

Although but one specific embodiment of the invention has been shown and described herein, it will be understood that modifications may be made within the spirit of the invention.

Having thus described the invention, I claim:

1. An external cardiac massage apparatus comprising a frame having a base portion adapted to extend under the body of a supine patient and a top portion spaced above said base portion and extending thereover so as to receive a patient therebetween; a lever arm pivotally mounted on said top portion of said frame and extending above said top portion for limited reciprocal movement in a substantially vertical plane; a plunger assembly having a plunger face piece at its lower end, said plunger assembly being slidably mounted on said top portion of the frame at a point spaced from said pivotal mounting of said lever arm; means pivotally connecting said plunger assembly to said lever arm, said plunger assembly depending from and being drivingly associated with said lever arm for limited vertical movement in response to reciprocation of said lever arm to depress the chest of a supine patient, said lever arm being configured and dimensioned to provide a mechanical advantage for reciprocating said plunger assembly; and means limiting the vertical movement of said plunger assembly to a predetermined distance to prevent injury to the patient during operation of the apparatus.

2. The cardiac massage apparatus of claim 1 wherein said plunger assembly includes means for adjusting the vertical spacing between said plunger face piece and said base portion to move said face piece into firm contact with the chest of the patient.

3. The cardiac massage apparatus of claim 1 wherein said plunger assembly includes resiliently compressible means biasing said plunger face piece upwardly from said base portion.

4. The cardiac massage apparatus of claim 1 wherein said means pivotally mounting said plunger assembly is a drive pin member pivotally connected at its ends to both said lever arm and the upper end of said plunger assembly.

5. An external cardiac massage apparatus comprising a frame having a base portion adapted to extend under the body of a supine patient and a top portion extending above said base portion and extending thereover so as to receive a patient therebetween; a lever arm pivotally mounted on said top portion of said frame and extending above said top portion for limited reciprocal movement in a sub-

6

stantially vertical plane, said lever arm having a handle portion at the end thereof opposite said pivotal mounting; a plunger guide housing mounted on said top portion at a point spaced from said pivotal mounting of said lever arm thereon a drive pin member pivotally connected adjacent one end thereof to said lever arm above said plunger guide housing; and having a vertical aperture extending therethrough; and a plunger assembly pivotally connected to the other end of said drive pin member and having an adjustable telescoping plunger portion slidably seated in said vertical aperture for guided vertical movement therethrough and extending outwardly from the lower end of said plunger guide housing, said plunger assembly having a plunger face piece mounted on the lower end of said telescoping plunger and resiliently compressible means in said plunger guide housing biasing said plunger upwardly, the distance along said lever arm from said handle portion to the point of mounting to said frame being greater than the distance along said lever arm from the point of connection of said plunger assembly to the point of mounting to said frame to provide a mechanical advantage for reciprocating said plunger assembly, said plunger guide housing providing means limiting the vertical movement of said plunger assembly to a predetermined distance to prevent injury to a patient during operation of the apparatus.

6. The cardiac massage apparatus of claim 5 wherein said plunger face piece has a convexly curved lower face of relatively smooth, relatively hard, but yieldable material.

7. The cardiac massage apparatus of claim 5 wherein said plunger guide housing has a reduced diameter portion adjacent the lower end thereof providing a radial shoulder and wherein said telescoping plunger has a radial collar adjacent the upper end thereof, said resiliently compressible means being disposed between said shoulder and collar.

8. An external cardiac massage apparatus comprising a relatively flat base having downwardly bevelled ends for rapid and facile sliding under the body of a supine patient; a yoke member having vertical side portions removably anchored in said base and a top portion extending above said base, said yoke being dimensioned to span the body of a supine patient; a lever arm pivotally mounted for limited movement in a vertical plane at one end thereof on the top portion of said yoke adjacent one of said leg portions, said lever arm extending above and generally parallel to said top portion for limited reciprocal movement in a substantially vertical plane and having a handle portion at the other end thereof; a plunger guide housing on said top portion of the yoke adjacent the midpoint thereof and having a vertical aperture extending therethrough with a reduced diameter portion adjacent the lower end thereof providing a radial shoulder; a tubular plunger member having a radial collar adjacent its upper end slidably seated in said aperture of said guide housing for guided vertical movement therethrough, said plunger member having a stop means mounted thereon below said guide housing and configured and dimensioned to abut against said guide housing to limit upward movement of said plunger member; a plunger rod seated within said tubular plunger member and extending downwardly from said plunger guide housing; means for adjustably positioning said plunger rod in said tubular plunger member to vary the vertical spacing from said base; a plunger face piece mounted on the lower end of said plunger rod and having a convexly curved lower surface of relatively smooth, rigid material; a spiral compression spring seated in said aperture of the plunger guide housing between said radial shoulder thereof and the radial collar and biasing said plunger member upwardly; and a drive pin pivotally connected at one end to the lever arm intermediate the ends thereof and at the other end to the plunger member for vertical movement in response to reciprocation of said lever arm, said lever arm providing a mechanical

7

advantage for reciprocating said plunger member and abutting against said guide housing to limit downward movement of said plunger member.

9. The cardiac massage apparatus of claim 8 wherein said lever arm is vertically spaced above said plunger guide housing at a distance of about 2 inches when said plunger member is biased by said spring member to its uppermost position with said stop means abutting said guide housing.

10. The cardiac massage apparatus of claim 5 wherein said plunger portion has a stop means mounted thereon below said plunger guide housing and configured and dimensioned to abut against said plunger guide housing to limit upward movement of said plunger portion, and wherein said lever arm abuts against said plunger guide

8

housing to limit the downward movement of said plunger portion.

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