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HEART RESUSCITATOR APPARATUS

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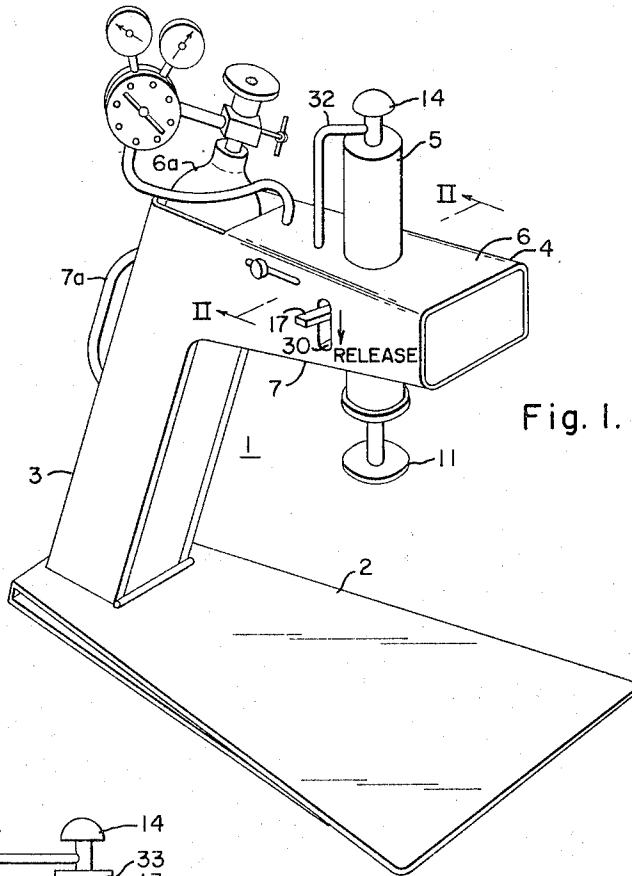


Fig. 1.

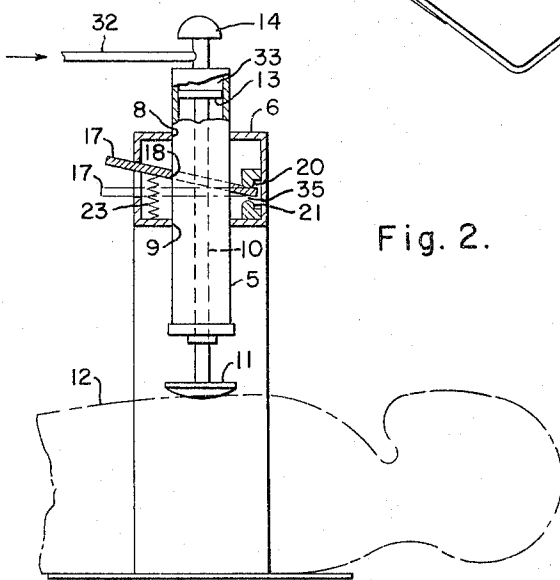


Fig. 2.

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1

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HEART RESUSCITATOR APPARATUS

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The present invention relates to heart resuscitator apparatus and more particularly to heart resuscitator apparatus of the fluid pressure cylinder type for exerting a rhythmic force downwardly on the breastbone of a heart arrest victim to alternately compress and release the victim's heart and thereby cause it to pump blood.

It has been the practice heretofore to employ a piston for the chest-compressor member which has a stroke adequate to accommodate all sizes of heart arrest victims, but to limit the length of the cylinder for such piston to substantially that required to accommodate the effective piston stroke, and make its vertical position adjustable to suit the size of the victim. In such type of apparatus the initial adjustment is made by moving the cylinder downwardly while the chest-compressor member rests on the victim's chest, until the cylinder end abuts the piston to which such member is connected via a piston rod. The cylinder is then raised slightly to provide a small amount of clearance between the piston and upper cylinder end in order to assure freedom for chest expansion during operation of the apparatus. The cylinder is then locked in this final position and brought into operation by alternating supply and release of fluid under pressure thereto and therefrom.

Since the time required for setup of the apparatus interferes with performing closed-chest heart resuscitation manually and permanent damage to the victim's central nervous system will result from loss of blood circulation for more than three or four minutes, it becomes of prime importance to minimize the setup time required. It therefore becomes an object of the present invention to provide, in such heart resuscitation apparatus, a mounting construction and arrangement which enables the initial vertical adjustment of the cylinder, including the final vertical-clearance adjustment for chest-expansion freedom, to be made with maximum facility and in minimal time.

It is another object of the present invention to provide a mounting construction and arrangement which enables the initial vertical adjustment of the cylinder with maximum facility and minimal time while automatically assuring the realization of the aforementioned final vertical-clearance adjustment for chest-expansion freedom.

United States Patent 3,209,747 issued October 5, 1965, titled Heart Resuscitator Apparatus by Robert L. Guentner and assigned to the assignee of the present application, discloses an arrangement which greatly facilitates such initial vertical adjustment of the chest-compressor cylinder during setup, but which does not automatically assure the final vertical-clearance chest-expansion-freedom adjustment. It is yet another object of the present invention to provide an improved arrangement of the type disclosed in the identified patent whereby such improved arrangement provides for such vertical-clearance chest-expansion-freedom adjustment automatically.

In keeping with the foregoing objects, the illustrative embodiment of the invention comprises in general a mounting for the chest-compressor cylinder which permits of downward movement thereof by exertion of manual effort on its upper end, together with a locking construction which automatically returns the cylinder upwardly a certain vertical-clearance chest-expansion-freedom distance following full downward displacement of

2

the cylinder, while also automatically locking the cylinder in this final position against further upward movement.

Other features, objects, and advantages of the invention will become apparent from the following detailed description when taken in connection with the accompanying drawing, in which:

FIGURE 1 is a three-dimensional view of a heart resuscitator apparatus embodying the invention; and

FIGURE 2 is an elevation view in cross-section, illustrating schematically details of the heart-compressor member, the heart-compressor cylinder, and the mounting and locking arrangements, constructed in accord with an illustrative embodiment of the invention.

Referring to the drawing, as aforedescribed in the identified copending patent application, the heart resuscitation apparatus for external closed-chest heart compressing may be as exemplified in FIG. 1 which comprises: a C-shaped frame 1 having a bottom plate 2 adapted to be slid under the back of the heart arrest victim while lying horizontally on his back; a hollow vertical column 3 extending upwardly from the base 2; and a hollow arm 4 secured to the upper end of the column 3 and extending horizontally therefrom above the bottom plate 2. The arm 4 carries the heart-compressor cylinder 5. The hollow column 3 serves as a pocket for storing a bottle of compressed gas for operation of the cylinder 5, and a handle 7a on the column 6 facilitates carrying of the unit.

Also as previously disclosed in the identified copending patent application, referring to FIG. 2, the hollow horizontally-extending arm 4 of the frame 1 comprises top and bottom wall members 6 and 7 having vertically-aligned openings 8 and 9 therein, respectively, through which the cylinder 5 extends and which, in slidable contact with the cylinder, acts as a radial constraint holding the cylinder aligned in a vertical attitude coaxial with such openings, while permitting adjustable movement of the cylinder vertically in its axialwise direction, as downward, for example, for bringing the chest-compressor member 11 initially into contact with the chest of the victim 12 while the operating piston 13 attached via rod 10 is in its uppermost position preparatory to operation of the apparatus, and subsequently upward for release of the heart-resuscitated patient following such operation. A knob 14 attached to the upper end of the cylinder 5 facilitates manual orientation movement of such cylinder during such initial adjustment and final release.

Still further as described in the identified copending patent application, to automatically lock the cylinder 5 against upward vertical movement while permitting it to be shoved downward for initial setup adjustment relative to the victim, a plate-like one-way self-locking tab 17 is included which has a square-edged opening 18 therein in encirclement of the cylinder 5. The tab 17 has a slidable pivotal association with vertically spaced-apart stops 20 and 21 secured to the interior of the arm 4 and is biased upward by a compression spring 23 toward an upward-locking position in which it is shown in the drawing. The edges of the opening 18 contact the outer surface of the cylinder 5 in a tilted manner which forces against such surface and tends to lock with same and further tilt such tab 17 about the stop 20 upwardly when effort is applied to move the cylinder 5 upwardly, which is prevented by the radial constraint of the cylinder so that its upward movement is thus normally locked. Downward movement of the cylinder 5 through the tab 17 is permitted by virtue of pivotal movement thereof downwardly about the lower stop 21 during such cylinder movement, resulting in a tendency for increase in clearance or unlocking action between the tab opening 18 and the outer surface of such cylinder. Thus the arrangement is self-unlocking with respect to downward cylin-

der movement. Raising of the cylinder is permitted, for such as release of the patient following use of the equipment, by manually depressing the tab 17 against the bias of the spring 23 to cause same to assume its unlocked position by pivotal movement about the lower stop 21.

In accord with novel structural features of the invention as embodied in the chosen exemplification described herein, automatic upward movement of the cylinder 5 a vertical-clearance chest-expansion-freedom distance following initial downward adjustment is realized by provision of a vertical separation distance between the stops 20 and 21 greater than the thickness of the tab 17 as extends therebetween. This normally gives a clearance 35 between the under side of the tab 17 and the lower stop 21, as shown in FIG. 2. During the downward movement of the cylinder 5 to initially adjust same with respect to the chest of a heart arrest victim, the first stage of such movement will carry the tab 17 downwardly along with cylinder movement until such tab travels through the clearance distance 35 and comes into contact with the lower stop 21. Thereafter, continued downward movement of the cylinder 5 will occur relative to tab 17 which becomes detached from the cylinder as aforescribed by slight downward pivotal movement about lower stop 21. With the chest-compressor member resting on the chest of the victim 12 during such downward cylinder movement, the piston 13 will eventually be contacted by the upper end of the cylinder 5 as the rod 10 slides through the lower end of the cylinder. At this time, resistance to further downward movement of the cylinder will be sensed by the operator exerting manual effort on the knob 14, and he will then relax his effort in exertion downwardly thereon. Automatically thereupon, the compression spring 23 acting upwardly against the tab 17 will cause it to lock onto the cylinder 5 by virtue of the off-center application of spring force and the edge of the opening 18 which locks against the surface of such cylinder. The spring then moves the cylinder 5 upwardly a chosen distance, one-half inch, for example, through the medium of the locked-on tab 17 until such tab comes into contact with the upper stop 20. Thereafter the cylinder is thus locked against upward movement during piston-produced chest-depressing operation of the member 11.

From the foregoing description it will be apparent that in the broader aspects of my invention, I have provided an arrangement which permits facile initial adjustment of a heart-compressor cylinder, including automatic final adjustment for chest-expansion-freedom, and in the narrower aspects of my invention I have provided an improved chest-compressor cylinder adjustment-facilitating arrangement of the specific type exemplified herein.

While there has been shown and described what is at present considered to be a preferred embodiment of the invention, modifications thereto will readily occur to those skilled in the art. It is not desired, therefore, that the invention necessarily be limited to the specific arrangements shown, except as falls within the spirit and scope of the appended claims.

I claim as my invention:

1. In a closed-chest fluid-pressure-actuated heart resuscitator unit, a frame, a reciprocable-chest compressing member constructed for engagement with the chest of a heart arrest victim to alternately force compression and release thereof for causing pumping of the victim's heart, a reciprocable fluid pressure actuator including an elongated actuator housing and a movable abutment therein operatively connected to said chest-compressing member having a stroke sufficient for chest-deflection movement but less than that required for initial orienta-

tion movement to suit various sizes of victims, means secured to said frame for guiding constraint of said actuator housing, locking means carried by said frame to permit rapid victim-direction-advancing manual movement of said housing within said guiding constraint to bring said chest compressing member into initial contact with the victim's chest and to retract said housing automatically a selected short distance to a locked position permissive of unconstrained expansion of the victim's chest.

2. The combination as set forth in claim 1, wherein said locking means comprises an elongated tab extending transversely of said actuator housing and having an opening therein fitting loosely therearound, spaced-apart stop members secured to the aforesaid frame for pivotal cooperation with said tab, and bias spring means urging said tab toward a cocked attitude in which the edges of said opening lock with the surface of said actuator housing when urged in the one direction and said tab engages one of said stop members to define a reaction stop position for said housing, the separation of said stop members being such that initial movement of said housing in the patient advancing direction carries said tab with it away from said one stop member a patient-clearance distance against bias of said spring means until said tab contacts the other stop member to unlock said housing for continued movement therebeyond, followed by return of said tab and housing to said reaction stop position by said spring means upon relaxation of manual effort on said housing.

3. In a closed-chest fluid-pressure-actuated heart resuscitator unit, a frame, a vertically-moved chest-compressing member for engagement with the chest of a heart arrest victim to alternately force compression and release thereof for causing pumping of the victim's heart, a fluid pressure actuator including a vertically-extending cylinder and a piston connected to said chest compressing member disposed therebeneath, an elongated tab extending transversely of said cylinder and having an opening fitting around such cylinder, vertically-spaced-apart stop members secured to said frame for pivotal cooperation with an end of said tab extending therebetween, said stop members being separated by a significant distance greater than the thickness of said tab end, and bias spring means urging said tab toward a cocked attitude in which the edges of said tab about said opening lock with the outer surface of said cylinder which is thereby urged upwardly to a reaction stop position defined by contact of said tab with the upper stop member, the vertical separation of said stop members being such that manual effort exerted downwardly on said cylinder first will displace it together with the tab downwardly against said bias spring means a select distance until said tab contacts the lower stop member whereupon the cylinder becomes unlocked for continued movement until the cylinder engages the piston end while the attached chest compressing member rests on the victim's chest, whereupon, relaxation of such manual effort results in the bias spring means returning the cylinder and tab upwardly to the aforesaid reaction stop position to afford sufficient axialwise clearance between cylinder and piston to assure freedom for expansion of the victim's chest.

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