

- [54] **HAND ASSIST BREATHER** 2,071,215 2/1937 Petersen 128/28
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- [51] Int. Cl. **A61h 31/00**
- [58] Field of Search 128/24, 25, 28, 60, 128/96

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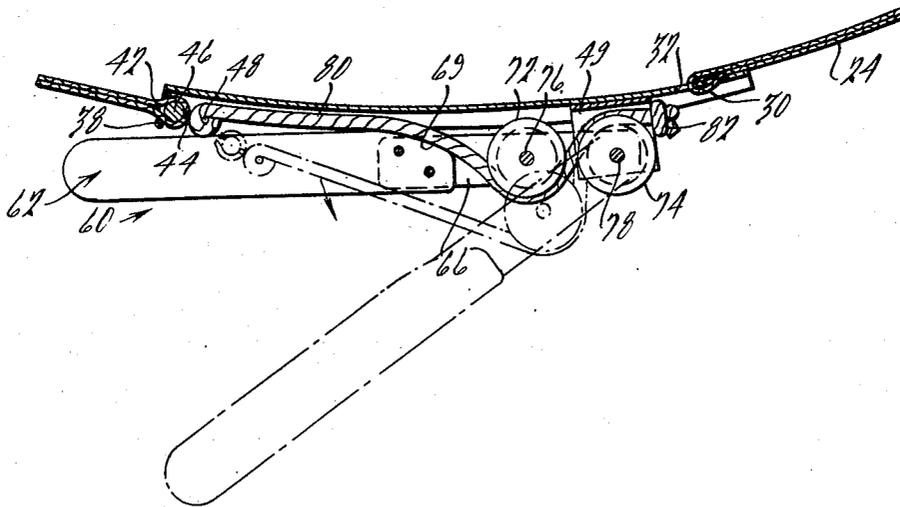
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[57] **ABSTRACT**

A medical appliance of a belt-like structure which is hand operable to improve and sustain respiration, and more specifically can be used by a patient for assisting exhalation of breath from the patient afflicted with obstructive lung disease which is operative by compressing the upper abdomen forcing the diaphragm against the distended lungs.

- [56] **References Cited**
- UNITED STATES PATENTS**
- 2,754,817 7/1956 Nemeth 128/60

20 Claims, 3 Drawing Figures



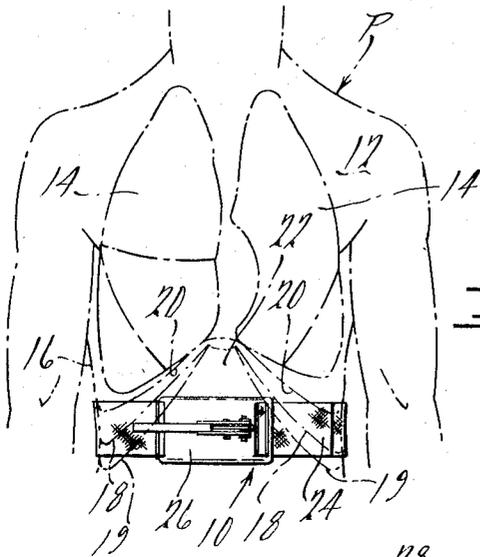


FIG. 1.

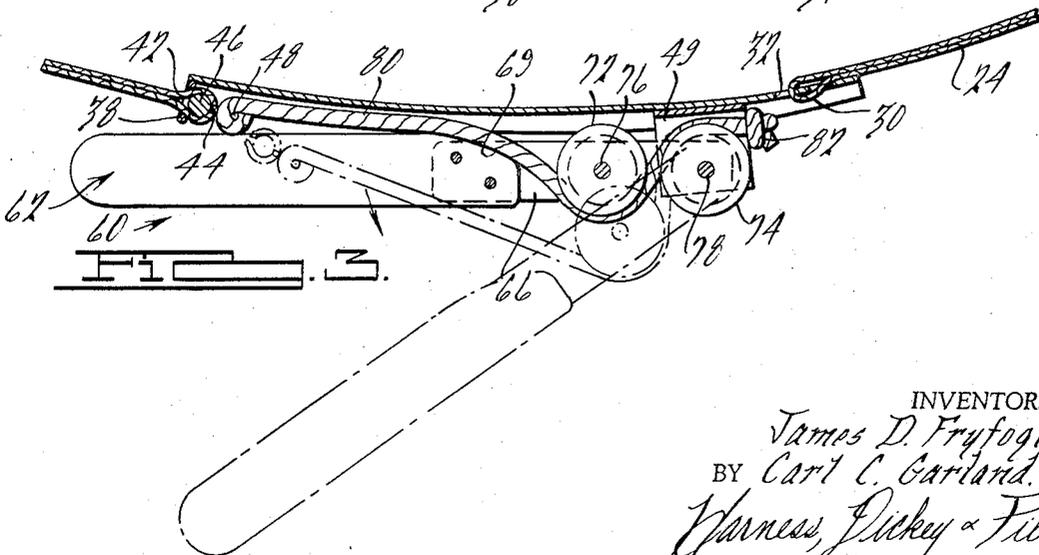
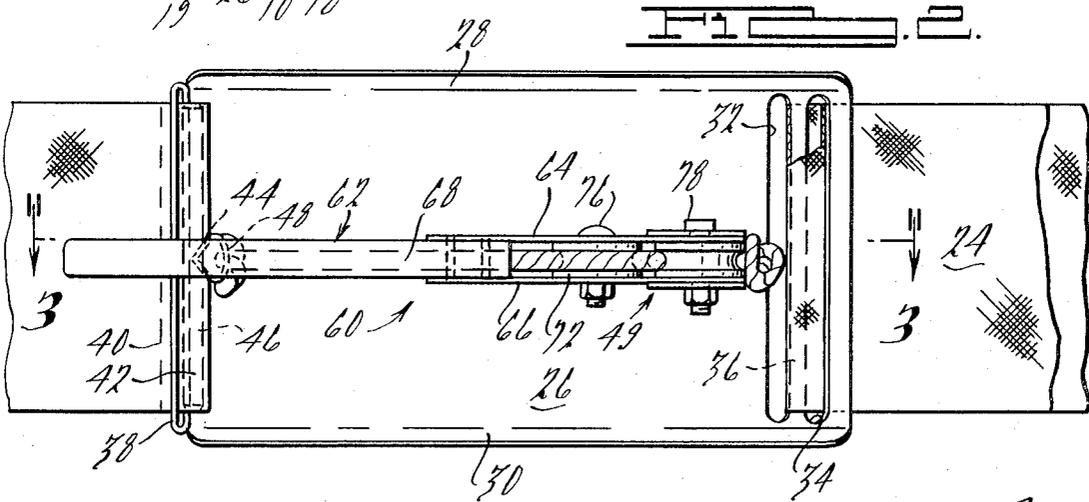


FIG. 3.

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HAND ASSIST BREATHER**SUMMARY AND BACKGROUND OF THE INVENTION**

This invention relates generally to medical appliances and more particularly to a belt-like device for use as a respiratory aid.

In the normal respiration process of the human body, inspiration of air is accomplished by increase and decrease in the size of the thorax. Breathing normally takes place at an intrathoracic pressure slightly below that of the atmosphere and provides a partial vacuum between parietal and visceral pleural surfaces. As the thoracic muscles of inspiration contract to enlarge the chest cage, the lungs passively follow the diaphragm and chest wall due to the increased pressure which exists.

The greatest amount of air that can be expired after a maximum inspiration is termed the vital capacity, the vital capacity normally being a function of the size and vitality of the individual person. In this regard, however, it has been found that a person with a normal respiratory function retains a residual air volume after expiration of approximately 20 percent.

Any condition which interferes with the normally negative intrapleural pressure or which increases the residual air volume generally has a serious effect on the respiratory function. Medical patients afflicted with obstructive lung diseases, such as emphysema, experience difficulty in breathing because they are unable to adequately empty their lungs, i.e., 40 percent or more residual air remains therein after expiration. Thus, essentially two mechanical problems are present:

1. The lung substance is stretched, loses its elastic recoil and physiologically obstructs air flow at the terminal bronchial levels; and

2. The distended lung pushes the diaphragm down and fixes the chest wall in the inspiratory position, i.e., the "barrel" chest. Consequently, the patient's inspiratory and expiratory efforts are thwarted, he relies on the accessory muscles of respiration, namely those of the shoulder girdle, in an attempt to move air in and out of his inefficient thorax.

The most effective muscle of respiration, however, is the diaphragm, which as indicated above, is held on stretch by the expanded rib cage and therefore its active use is minimal.

Various methods or techniques are presently employed to treat a patient afflicted with an obstructive lung disease. Initially, the patient can be taught to blow against a mild obstruction, such as pursed lips or a retard valve, etc., to increase intrabronchial pressure during expiration. This has been found to maintain bronchial patency, which allows better emptying of the alveolar spaces. Concurrently, the patient can be taught to breath using abdominal muscles, increasing diaphragmatic usefulness.

The hand assist breather device of the subject invention has great use in augmenting both of these courses of instruction. With respect to the latter technique, the subject invention directs the patient's attention to breathing with the lower chest and abdominal muscles. Additionally, it has been found that functional activity is increased for those patients not confined to beds.

Thus the hand assist breather device, for assisting a patient to expel excessive residual air, includes an adjustable belt for encircling the lower thoracic cage and

a contoured pressure plate confronting the upper abdomen therebetween the lower edge of the frontal rib cage. One end of the belt is adjustably connected to the pressure plate, whereas the opposite end is connected to an actuating means disposed on the outer surface of the pressure plate. The actuating means includes an operating lever having a pair of pulley members rotatably supported at one end thereof, and a cable connected therebetween the pulleys and the opposite end of the belt. Pivotal manipulation of the operating lever is adapted to force the pressure plate against the upper abdomen and compress the lower rib cage; this compression forces the diaphragm upwardly against the distended lung to assist exhalation. The device is of a lightweight, simple construction and of a compact design. In its non-operative position, the operating lever assumes a position generally parallel with the pressure plate which allows the device to be worn under conventional street clothing or otherwise continuously worn by the patient with no discomfort and without hindering his mobility.

Accordingly, it is an object of the present invention to provide a simple compact device to assist a patient to expel excessive residual air.

It is another object of the present invention to provide a device useful in instructing a patient to breathing with the lower chest and abdominal muscles.

It is another object of the present invention to provide a device to improve and sustain respiration.

It is still another object of the present invention to provide a simple compact device which assists exhalation by applying an inward force on the upper abdomen to compress the lower rib cage and force the diaphragm upwardly against the distended lungs.

It is still a further object of the present invention to provide a respiratory aid which is portable, compact, inexpensive and manually operated.

It is another object of the present invention to provide a medical appliance which is compact and may be comfortably worn under conventional clothing or otherwise continuously worn without discomfort and without hindering mobility of the wearer.

It is yet another object of the present invention to provide a respiratory aid that is easy to manipulate, rugged in construction, and decoratively attractive.

Other advantages of the present invention will become apparent from a consideration of the following detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the present invention as applied to a schematic depicting the neck-waist human anatomy;

FIG. 2 is a frontal elevation of the pressure plate buckle of the present invention in association with a fragmentary belt portion; and

FIG. 3 is a cross-sectional elevation of the pressure plate and fragmentary belt portion taken along the line 3-3 of FIG. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to FIG. 1 of the drawing, a hand assist breather device is indicated generally at 10 in operative relationship to a neck-waist representation 12 of the anatomy of a patient P. The anatomy is not intended to

be inclusive of all organs but various pertinent portions are illustrated for providing a cursory understanding of the operation of the device 10.

With reference then to the anatomy, a pair of lungs are indicated at 14 disposed inwardly of a rib cage 16. The lower edge of the frontal rib cage is illustrated at 18 with the rearward portion at 19, and superimposed thereabove is a diaphragm portion 20. Interposed between the lower adjacent frontal edges 18 of the rib cage 16 is the upper abdomen 22.

The breather device 10 comprises a flexible belt portion 24, preferably constructed of a durable, strong two-ply fabric, and a pressure plate 26. The belted portion 24 is adapted to encircle the lower thorax or rib cage 16 with its ends operatively secured to the pressure plate 26, as shall hereinafter become apparent. The pressure plate 26 is suitably arcuately contoured to comfortably fit the upper abdomen 22 and is dimensioned to have its vertical edges disposed between the lower edge of the ribs 18.

Turning now to FIGS. 2 and 3, the pressure plate 26 is generally rectangular in shape and suitably arcuately contoured to generally conformingly contact an area of the upper abdomen to afford maximum comfort. If required, additional backing could be added to the rearward surface thereof, to further facilitate contact with various forms of anatomy. Preferably, the plate 26 is constructed of stainless steel, which affords good rigidity and is not subject to oxidation. Dimensionally, the plate 26, to most effectively accommodate an average adult, encompasses a surface area of approximately 25 to 30 square inches in order to provide for an area of maximum operational effectiveness; of course, this area could be varied to accommodate different anatomical requirements. As illustrated in FIG. 1, the horizontal dimension of the plate 26 is slightly smaller than the distance between the lower rib edge 18 to have the capability of depressing the upper abdomen 22 without touching the frontal rib structure. For additional comfort, the upper and lower edges 28 and 30 are inclined outwardly so that the edge surfaces themselves do not contact the abdominal portion 22 to be depressed.

With reference now to FIGS. 2 and 3, the right hand portion of the pressure plate 26 can be seen to include a pair of elongated openings or slots 32 and 34, disposed adjacent one to the other. The dual openings 32 and 34 are adapted to receive the belt 24 whereby one end of the belt 24 is fed from the lower surface of the plate 26 through the opening 32 and under the immediate surface portion 36 of the plate 26 and thence out through the opening 34. The extreme right end of the plate 26 will compress the double layer of belt 24 and will assist in holding the belt from slipping. Further, the above described engagement affords a convenient and comfortable adjusting means for properly encircling and positioning the belt 24 around the rib cage 16.

At the extreme left end of the pressure plate 26 an elongated belt loop 38 extends upwardly from the face surface thereof, and is connected thereto preferably by means of suitably spaced spot welds. The elongated aperture defined by the belt loop 38 functions as a guide for the belt 24 during tensioning thereof, and is further adapted to prevent disengagement of the left end of the belt 24 from the pressure plate 26 as shall now be explained.

The left end of the belt is looped and stitched as at 40 to define a loop portion 42, and an opening 44 is

centrally located in the edge of the folded end. To assemble the belt 24 to the pressure plate 26, the loop portion 42 of the belt 24 is guided through the belt loop 38, and a pin member 46, which has an eyelet 48 secured centrally thereto, is inserted into the loop portion 42 with the eyelet 48 extending through the opening 44. With the pin member 46 located in the loop portion 42 of belt 24 that end of the belt 24 cannot now slip through the aperture of the belt loop 38. Completing the description of the pressure plate 26, a U-shaped bracket 49 is located on plate 26 near the elongated slot 32 and adapted for use in pivotably connecting an actuating assembly 60.

The actuating assembly 60 includes a handle 62 which has a pair of leg portions 64 and 66 connected to a solid plastic bar portion 68. The handle 62 is pivotally supported to bracket 49 via a fastener assembly 78. A pair of pulleys 72 and 74 are located between the leg portions 64 and 66 and rotatably secured thereto with pulley 74 supported on fastener assembly 76 and with pulley 72 rotatably supported on fastener assembly 78.

One end of a cord 80 is connected to the eyelet 48 and the other end is guided over the pulley 72, and thence under the pulley 74. The end of the cord 80 is retained under the pulley 74 by means of a knot indicated at 82. In this manner, the one end of the belt 24 is connected to the actuating assembly 60.

To utilize the breather device 10, the pressure plate is positioned over the upper abdomen 22, between the lower edges 18 of the rib cage 16 of a patient P, and the belt 24 is encircled around the lower rib cage 16 and comfortably and firmly buckled to the right end of the plate 26 in the manner previously described. The width of the belt 24, which is preferably just slightly less than the width of the pressure plate 26, by providing a large surface contact area, provides for a structure which is not uncomfortable to the patient while at the same time working over a large effective area.

With reference to FIG. 3, it will be observed that when the actuating assembly 60 is in its non-operative position, the breather device 10 provides an extremely compact, low profile with respect to the upper abdominal surface; this enables the breather device 10 to be worn under conventional street clothing with no discomfort or impediment to the wearer. This feature allows the device 10 to be continuously worn, so as to increase the functional activity of the patient P suffering from an obstructive lung disease.

To actuate the breather 10, the handle 62 is gripped by the patient P and pivoted counterclockwise as viewed in FIG. 3 around the pivotal axis defined by the fastener assembly 78. In pivoting the handle 62, it will be noted that significant mechanical advantage is afforded the patient P due to the effective moment arm of the handle 62 and also due to the effect of the pulleys 72 and 74; the pulleys 72 and 74 also provide an advantage for effecting travel of the belt 24 whereby the belt 24 will actually travel a distance substantially greater than the distance traveled by the pivot axis defined by fastener 76. These features facilitate the compactness of the device 10. Note that in pivoting the handle 62 about the axis of fastener 78 to its upright position, a component of the tensile force applied to the rope 80 is transmitted in a direction normal to the pressure plate 26 whereby the plate 26 is moved inwardly against the upper abdomen whereby the compression of the abdomen is enhanced; of course, the

plate 26 is also moved against the abdomen by the tensioning of the belt 24. By virtue of the compression of the upper abdomen, the diaphragm 20 is urged upwardly into contact with the distended lungs and increased exhalation is accomplished. Thus it can be seen that the device 10 is of a compact and inexpensive construction which is readily portable and can be literally worn at all times by the patient with no discomfort and without impeding the patient's mobility.

While it will be apparent that the preferred embodiment illustrated herein is well calculated to fulfill the objects above stated, it will be appreciated that the present invention is susceptible to modification, variation and change without departing from the scope of the invention.

What is claimed is:

1. A portable, hand operated, medical appliance for assisting exhalation of breath from a patient by compressing the lower rib cage and upper abdomen to force the diaphragm against the lungs, the appliance comprising: a pressure plate having an inner surface adapted to contact the upper abdomen and dimensioned to be located in between the frontal lower edges of the rib cage; a belt member having an end portion detachably connected to said plate and adapted to encircle the lower rib cage; and means supported by said plate and operative on an opposite end of said belt for selectively constricting said belt from a first condition in which said belt member is relatively untensioned to a second condition in which said belt member is tensioned to compress the lower rib cage while simultaneously forcing said pressure plate compressively against the upper abdomen, said means including an actuating lever lying closely adjacent a confronting outer surface of said pressure plate when in said first condition, to define a low profile whereby said medical appliance can be continuously worn by the patient with no impediment to his mobility.

2. The medical appliance, as recited in claim 1, with said pressure plate having an arcuately contoured inner surface to facilitate conformation to the contour of the upper abdomen.

3. The medical appliance, as recited in claim 1, with said pressure plate having an area, for an average adult, of 25 to 30 square inches.

4. The medical appliance, as recited in claim 1, with said pressure plate having a pair of elongated slots located adjacent to one outer edge, and wherein said one end of said belt member is adjustably connected to said pressure plate by engagement through each of said pair of elongated slots.

5. The medical appliance, as recited in claim 1, wherein said pressure plate includes a pair of edges inclined outwardly from the inner surface whereby the contacting inner surface is substantially smooth.

6. The medical appliance, as recited in claim 1, with said belt member having a width for an average adult of approximately 4 inches.

7. The medical appliance, as recited in claim 1, wherein the width of said belt substantially conforms to the width of said pressure plate.

8. The medical appliance, as recited in claim 1, wherein said pressure plate includes an elongated belt loop connected to an outer surface of said pressure plate, and wherein said opposite end of said belt member is slidably received through said loop.

9. The medical appliance, as recited in claim 8, wherein said opposite end of said belt member is folded-over to define a passage therealong; and wherein said appliance includes an elongated pin member located in said passage for restraining said opposite end of said belt member from disengagement with said belt loop.

10. The medical appliance, as recited in claim 9, with said means being connected with said pin member whereby movement of said actuating lever results in constriction of said belt member.

11. The medical appliance, as recited in claim 1, further comprising: a first pulley rotatably connected to said one end of said actuating lever; and wherein said means includes a flexible connector operatively engaging said first pulley and having one end connected to said opposite end of said belt member.

12. The medical appliance, as recited in claim 11, further including a second pulley rotatably connected to said operating lever, said second pulley being spaced inwardly from said first pulley and operatively engaging said cord.

13. The medical appliance, as recited in claim 1, wherein the pivotal movement of said lever transmits a force normal to said pressure plate which is adapted to compress the upper abdomen.

14. A portable, hand operated medical appliance, for assisting exhalation of breath from a patient afflicted with an obstructive lung disease, by compressing the upper abdomen to upwardly urge the diaphragm against the lung, which comprises:

a pressure plate having an inner surface adapted to contact with the upper abdomen and dimensioned to be located in between the frontal lower edges of the rib cage;

a bracket connected to an outer surface of said pressure plate;

an elongated actuating lever having one end pivotably connected to said bracket;

a pulley rotatably supported by said actuating lever and located inwardly along the elongated axis of said actuating lever from the pivotal axis;

a belt having one end adjustably connected to said pressure plate and adapted to encircle the lower rib cage; and

a cord, engaging said pulley, and connecting an opposite end of said belt and said bracket whereby pivotal movement of said actuating lever will simultaneously constrict said belt and urge said pressure plate inwardly against the upper surface of the abdomen.

15. A portable, hand operated medical appliance, for assisting exhalation of breath from a patient afflicted with an obstructive lung disease, by compressing the upper abdomen to upwardly urge the diaphragm against the lung, which comprises:

a pressure plate having an inner surface adapted to contact with the upper abdomen and dimensioned to be located in between the frontal lower edges of the rib cage;

a bracket connected to an outer surface of said pressure plate;

an elongated actuating lever having one end pivotably connected to said bracket, said actuating lever lying closely adjacent the confronting outer surface of said pressure plate in a first condition to define a low profile whereby said medical appliance can

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be continuously worn by the patient with no impediment to his mobility;

a pulley rotatably supported by said actuating lever and located inwardly along the elongated axis of said actuating lever from the pivotal axis;

a belt having one end adjustably connected to said pressure plate and adapted to encircle the lower rib cage; and a cord, engaging said pulley, and connecting an opposite end of said belt and said bracket whereby pivotal movement of said actuating lever from said first condition will simultaneously constrict said belt and urge said pressure plate inwardly against the upper surface of the abdomen.

16. A medical appliance for assisting exhalation of breath comprising: a pressure plate adapted to be located against the upper abdomen between the lower rib cage; a belt having a first end detachably secured to said plate and adapted to encircle the rib cage; an actuating lever pivotably connected to said plate; means including at least one pulley rotatably supported by said lever and operative with an opposite end of said belt for constricting said belt in response to pivotal movement

of said lever, whereby said plate may be selectively urged against the upper abdomen and said belt is compressed around the rib cage to assist exhalation of breath.

5 17. The medical appliance, as recited in claim 16, wherein said means includes first and second pulleys rotatably supported by said lever, and wherein one of said pulleys is coaxially located with the pivotal connection of said lever with said plate.

10 18. The medical appliance, as recited in claim 17, wherein the other of said pulleys is spaced from said one pulley along a longitudinal axis of said lever.

15 19. The medical appliance, as recited in claim 16, wherein one end of said lever is bifurcated, and wherein said at least one pulley is located in a recess formed by said bifurcation.

20 20. The medical appliance, as recited in claim 16, wherein said lever lies closely adjacent a confronting outer surface of said plate when said belt is unconstricted relative to said rib cage to define a low profile whereby said medical appliance can be continuously worn by a patient with no impediment to his mobility.

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