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(54) **CHEST COMPRESSION VEST WITH CONNECTING BELT**

BRUSTKOMPRESSIONSWESTE MIT VERBINDUNGSGÜRTEL

GILET DE COMPRESSION THORACIQUE POURVU D'UNE CEINTURE DE CONNEXION

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to chest compression devices and in particular to a high frequency chest wall oscillator device.

[0002] Manual percussion techniques of chest physiotherapy have been used for a variety of diseases such as cystic fibrosis, emphysema, asthma, and chronic bronchitis, to remove the excess mucus that collects in the lungs. To bypass dependency on a care giver to provide this therapy, chest compression devices have been developed to produce high frequency chest wall oscillation (HFCWO), the most successful method of airway clearance. In addition, these devices can be utilized for induction of high quality sputum samples for screening and diagnosing a number of pulmonary disorders such as lung cancer, asthma, chronic obstructive pulmonary disease (COPD), tuberculosis, *Pneumocystis carinii* pneumonia (PCP), inflammation, and infection.

[0003] The device most widely used to produce HFCWO is the ABI Vest Airway Clearance System by American Biosystems, the assignee of the present application. A description of the pneumatically driven system can be found in the Van Brunt et al. patent, U.S. Patent No. 5,769,797, which is assigned to American Biosystems, Inc. Other pneumatic chest compression devices have been described by Warwick et al., U.S. Patent No. 4,838,263 and Hansen, U.S. Patent No 5,569,170.

[0004] Pneumatically driven HFCWO produces substantial transient increases in the airflow velocity with a small displacement of the chest cavity volume. This action produces a cough-like shear force and reduction in mucus viscosity that results in an upward motion of the mucus.

[0005] A shortcoming of the design of the vests used by these devices is that the compressions are not concentrated on the region of the chest which directly surrounds the lungs. An inflatable air bladder that provides the compressive force extends all the way around the patient including the back. The bladder has a rather large volume which renders it inadequate to create the magnitude of force necessary on regions encompassing the lungs to clear the lungs of mucus or induce deep sputum that, for example, provides optimal samples for lung cancer screening. In addition, since the vests close in the front, the air bladder is not continuous over the chest. The air bladder's design does not allow it to reach to the highest lobes of the lung, and it extends too low resulting in compression on the stomach, a particular problem for short adults and children. This results in inefficient and insufficient mucus induction and mobilization. Thus, there remains a need to design a vest which focuses the force in the proper regions to give optimal results.

[0006] Prior art vests, when fastened to the patient and not inflated, take on the shape of the torso. When inflated they bow outward. The outer material is not rigid enough to maintain its shape, and so the vest takes on a more circular shape. The outward force, which causes the bowing, increases the volume of the air bladder, but it is more desirable to have the increase in volume result from a change in the shape of the chest. Therefore, a vest which maintained its shape would be more efficient, because the outward force that causes the vest to change shape would not cancel out the inward compressive force.

[0007] The previous vests were designed for one person to use multiple times. The durable material that is used makes the vest too expensive to be utilized for a single use and cannot be easily and cleanly burned for disposal. For analysis of sputum samples, though, generally the patient only needs the vest one time. The vests, however, cannot be used by multiple patients, because mucus is expelled onto the vest by each patient, and the vests cannot be sterilized between uses. Therefore, there is also a need for a vest which is cost effective for single-use.

BRIEF SUMMARY OF THE INVENTION

[0008] The present invention is a pneumatic chest compression vest according to claim 1 which loosens and helps remove mucus from a person's lungs or induces production of sputum samples for further diagnostic analysis. The vest is designed to focus the compressive force on the region of the chest which encompasses the lungs.

[0009] The vest includes a front panel having a central bib portion and side portions. An air bladder is mounted to the inner surface of the front panel. Air ports and removable air couplings on the front panel are in communication with the air bladder. When inflated, the air bladder applies a compressive force focused on the region of the chest which encases the lungs.

[0010] The vest also includes a belt that connects to the front panel and extends around the person and across the outer surface of the front panel. The belt contains a plurality of longitudinally spaced holes which align with the air ports on the front panel. The air couplings extend through the holes in the belt and the air ports to secure the vest and connect the air bladder to a source of oscillating pneumatic pressure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Figure 1 shows a person wearing a pneumatic chest compression vest.

Figure 2 is a front view of a pneumatic chest compression vest.

Figure 3 is a back view of a pneumatic chest compression vest.

Figure 4 is a side view of an air coupling connected

to a hose.

Figure 5 is a top view of a suspender.

Figure 6 shows where a person's lungs are located relative to a pneumatic chest compression vest.

Figure 7 is a graph illustrating the enhanced performance of a pneumatic chest compression vest in the preferred position.

DETAILED DESCRIPTION

[0012] Figure 1 shows pneumatic chest compression vest 10 of the present invention fitted onto patient P. Pneumatic chest compression vest 10 is shown with front panel 12, belt 14 with belt holes 16, air couplings 18, suspenders 20, hoses 22, and pneumatic pressure generator 24. Front panel 12 of pneumatic chest compression vest 10 covers from approximately the bottom of the patient's rib cage to near the patient's collar bone and extends over the front of the patient's chest to under the patient's arms. Belt 14, which is attached to one side of front panel 12, wraps around the patient's back and across front panel 12. Pneumatic chest compression vest 10 is secured by aligning belt holes 16 with air ports (not shown) on front panel 12 so that air couplings 18 can insert through belt holes 16 and the air ports. Suspenders 20 are also attached to secure pneumatic chest compression vest 10 in place. One end of hoses 22 attaches to air couplings 18 and the other end attaches to pneumatic pressure generator 24. Pneumatic pressure generator 24 provides the oscillating pressure to vest 10 to apply compressive force to the patient's chest. Pneumatic chest compression vest 10 and its operation will be described in more detail in subsequent figures.

[0013] Figure 2 is a front view of pneumatic chest compression vest 10 laid flat. Front panel 12 is comprised of central bib portion 12a, side portions 12b and 12c, tab 34, tab seams 36, air ports 38, and liner seam 40. Belt 14, which attaches to front panel 12 at belt seam 30, contains belt holes 16 with slits 32.

[0014] Pneumatic chest compression vest 10 wraps around the torso of patient P. Belt 14 of pneumatic chest compression vest 10 extends around the back of patient P and across the outer surface of front panel 12. Belt 14 contains longitudinally positioned belt holes 16 each of which includes a slit 32. Tab 34 is welded onto front panel 12 at tab seams 36 and inserts into one of the belt holes 16.

[0015] Pneumatic chest compression vest 10 is secured in place by overlapping belt holes 16 with air ports 38 on front panel 12. The distance between air ports 38 corresponds to a multiple of the distance between each belt hole 16. In a preferred embodiment, the diameterof belt holes 16 and air ports 38 is about 1.4 inches with belt holes 16 centered about 2 inches apart, and air ports 38 are centered about 6 inches apart. Tab 34 is welded to front panel 12 at tab seams 36 so that it aligns with air ports 38 on front panel 12 in such a way that as belt 14 wraps around patient P and extends across the outer surface of front panel 12, tab 34 can insert into a belt hole 16. When tab 34 is inserted into a belt hole 16, corresponding belt holes 16 will align with air ports 38. Once aligned, air couplings 18 can easily be snapped into belt holes 16 and air ports 38 (see Figure 1). Depending on the circumference of the patient's torso, different belt holes 16 will align with tab 34 and air ports 38. This allows adjustment of pneumatic chest compression vest 10 so that it fits securely around patient P.

[0016] Slits 32 are preferably about 0,5 cm long. Slits 32 allow ease of insertion of suspenders 20 into belt holes 16 (see Figure 1).

[0017] Liner seam 40 extends along the perimeter of front panel 12 encompassing central bib portion 12a, which has a preferred height of about 29,38 cm but can be from about 22,5 to about 32,5 cm, and side portions 12b and 12c, which have a preferred height of about 19,38 cm but can be from about 15 to about 22,5 cm.

[0018] Figure 3 is a back view of pneumatic chest compression vest 10 laid flat. Front panel 12 includes central bib portion 12a, side portions 12b and 12c, air ports 38 (in phantom), and liner seam 40. A liner 50 is shown welded to the inner surface of front panel 12 along liner seam 40. Belt 14, belt holes 16 with slits 32, belt seam 30, and tab 34 (in phantom) are shown and were described in Figure 2.

[0019] Liner 50 is preferably made of an elastic material such as 406,4 μm polyethylene, and the remaining parts, except air couplings 18, are made of an inelastic material such as 203,2 μm polycarbonate. These materials are relatively inexpensive and can be easily incinerated, producing no toxic emissions and little particulate matter for disposal. Liner 50 mounted onto front panel 12 defines an air bladder which is preferably about 52,5 cm wide.

[0020] In operation, the air bladder is inflated via air ports 38 against the chest of patient P to apply a compressive force to the patient's lungs. Side portions 12b and 12c allow the air bladder to extend under the arms of patient P. Thus, the air bladder also compresses the sides of the torso which cover the patient's lungs. Since the air bladder does not extend along belt 14, the compressive force is focused on the proper region for optimal treatment. The combination of a generally rigid outer surface and flexible bladder prevents the vest from taking on a circular shape when the air bladder is inflated. Instead, inflating the air bladder forces the chest to change shape so that most of the motion during compression is inward, and the outward force is minimized. This increases the efficiency of the system. The volume of the air bladder is also reduced over the prior art vests, which makes the system more efficient in terms of applying the same volume of air over a smaller surface area so that the magnitude of force necessary for deep sputum induction is achieved.

[0021] Pneumatic chest compression vest 10 is suitable for typical pressure requirements of about 3447,4 to about 6894,757 Pa., and can operate for about 30 to

about 45 minutes during an oscillatory chest compression treatment. It may last longer for other less stringent applications.

[0022] Figure 4 shows a side view of air coupling 18 connected to hose 22. Air coupling 18 includes head 18a, neck 18b, and body 18c (shown partially in phantom). A portion of hose 22 is shown partially enclosing body 18c of air coupling 18.

[0023] In a preferred embodiment, air coupling 18 is made of aluminum with a height of about 8,13 cm. The height of head 18a is about 2,13 cm, neck 18b is about 2,13 cm, and body 18c is about 4,13 cm and is removably attached to neck 18b. Also, hose 22 is angled about 90° at the end that connects to air coupling 18.

[0024] Head 18a is beveled with the diameter increasing from about 3,25 cm to about 3,5 cm. The inside diameter of head 18a is about 2,88 cm. Neck 18b has a diameter of about 3,4 cm . Body 18c has a diameter of about 3,75 cm with an inside diameter of about 3,0 cm. The inside diameter of air coupling 18 increases from head 18a to body 18c.

[0025] The operation of air coupling 18 is discussed in reference to parts of pneumatic chest compression vest 10 that are not shown. Head 18a snaps through belt holes 16 and air ports 38 into the air bladder. Neck 18b remains within front panel 12 and belt 14 to secure pneumatic chest compression vest 10 around patient P. Hose 22 connects to and partially overlaps body 18c, which is not connected to neck 18b at this point. Body 18c, when connected to neck 18b, remains on the external side of pneumatic chest compression vest 10. Thus, air coupling 18 has dual functions-to secure pneumatic chest compression vest 10 and provide a coupling to attach hose 22. With hose 22 essentially hanging parallel to front panel 12, hose 22 hangs in a manner which keeps air coupling 18 from pulling outward on pneumatic chest compression vest 10. This type of system reduces the parts needed to operate the vest, which makes it less expensive to manufacture and, therefore, ideal for a disposable vest system.

[0026] Figure 5 shows suspender 20 laid flat. Suspender 20 is comprised of strap 20a and serrated ends 20b which include serrations 20c.

[0027] In a preferred embodiment, the length of suspender 20 is about 87,5 cm. Serrated ends 20b are about 17,5 cm long, and each includes about 6 approximately 2,5 cm long serrations 20c. Strap 20a has a width of about 2,75 cm. Serrations 20c extend out to about 4 cm.

[0028] In operation, suspenders 20 extend from the front to the back of pneumatic chest compression vest 10 and insert into two of the belt holes 16 on the front and another pair of belt holes 16 in the back. Serrations 20c allow suspenders 20 to be adjusted to the proper length for a secure fit. In a preferred embodiment, suspenders 20 are crossed in front of patient P to minimize movement or slippage of pneumatic chest compression vest 10 during treatment (see Figure 1).

[0029] Figure 6 illustrates how pneumatic chest compression vest 10 is positioned with respect to the patient's lungs and skeletal structure. An outline of front panel 12 with top edge 60 and bottom edge 62 of pneumatic chest compression vest 10 indicates the region of the patient's chest that is covered.

[0030] In operation, front panel 12 preferably covers the region of the torso which encases the lungs of patient P. Top edge 60 is positioned near the patient's collar bone, and bottom edge 62 is positioned near the bottom of the patient's rib cage. This provides a focused compressive force on the lungs with the necessary magnitude to induce deep sputum. Compression on the stomach is minimized, and top edge 60 reaches up to the upper lobes of the lungs to facilitate mucus removal in the upper lobes. Thus, the improved design increases the efficiency of the system to obtain sufficient sputum induction and mucus mobilization.

[0031] Figure 7 shows the results of a comparison done between the present invention (new vest), the present invention without the bib section of central bib portion 12a (new vest w/o bib), the present invention positioned backwards (new vest backwards), and a prior art vest (old vest). Figures 2 and 3 provide a good view of the bib section of central bib portion 12a. The bib section is the part of front panel 12 that compresses the upper lobes of the lungs. Peak expiratory volume (peak volume) was measured on a single subject with each variation over an oscillatory frequency range between 5 and 20 Hertz. The subject was fitted with a vest and given a mouthpiece with. a hose attached to a volume chamber. The volume chamber was equipped with a sensor that measured changes in oscillatory volume. Expiratory volumes were measured with each vest variation tested at 5,10,15, and 20 Hertz. The graph illustrates that the present invention in the preferred position (with the front panel over the patient's chest and the bib portion extending to about the collar bone) produces the highest peak volume of airflow. The high peak volume of airflow corresponds to an increased force asserted on the mucus which results in increased mobilization. This data supports the conclusion that the new vest is superior over prior art.

[0032] Pneumatic chest compression vest 10 is designed more efficiently to provide effective sputum induction fordiagnostic evaluation and mucus mobilization for therapeutic lung clearance. The compressions are focused on all lobes of the patient's lungs with a force that induces deep sputum production and facilitates better lung clearance. The combination of a rigid outer surface and flexible bladder results in more efficiency in that outward forces that change the shape of the vest and cancel inward compressive forces on the chest are minimized. Pneumatic chest compression vest 10 can be composed of materials that satisfy this need and are also relatively inexpensive, and make the vest easy and safe to dispose of. The resulting vest is efficient and cost-effective for single-use.

[0033] Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail within the scope of the claims.

Claims

1. A pneumatic chest compression vest (10) **characterized by** :

   - a generally rigid, front panel (12) having an outer surface and an inner surface and a central portion (12a) and side portions (12b and 12c);
   - a flexible air bladder mounted on an inner surface of the front panel;
   - a plurality of air ports (38) through which the air bladder is connectable to a source of oscillating pneumatic pressure (24); **characterized by**
   - a belt (14) connected to the front panel (12) for extending around the patient's (P) back to position the front panel (12) and the flexible air bladder over a patient's chest so that the front panel (12) approximately covers a lung containing region of a patient's chest with a top edge of the front panel at the patient's collar bone and a bottom edge at a bottom of a patient's rib cage.

2. The vest (10) of claim 1 wherein the air bladder engages the front and sides of the patient's chest.

3. The vest (10) of claim 1 wherein the air bladder engages the region of the chest which encompasses the lungs.

4. The vest (10) of claim 1 wherein the front panel (12) has a bib section at its central portion (12a).

5. The vest (10) of claim 1 wherein the central portion (12a) has a height between about 22.5 cm and about 32.5 cm.

6. The vest (10) of claim 1 wherein the side portions (12b) and (12c) have a height between about 15 cm and about 22.5 cm.

7. The vest (10) of claim 1 wherein the vest does not change its general shape during treatment.

8. The vest (10) of claim 1 wherein the compressive force causes the patient's chest to change shape.

9. The vest (10) of claim 1 wherein the vest (10) is constructed from material that when incinerated produces no toxic gas and leaves little particulate matter.

10. The vest (10) of claim 1 wherein the air bladder produces compressive forces of a magnitude to induce deep sputum from the patient's lungs or clear the patient's lungs of mucus.

11. The vest (10) of claim 1 wherein the width of the air bladder is about 52.5 cm.

12. The vest (10) of claim 1 wherein the belt (14) is attached to one side of the front panel (12).

13. The vest (10) of claim 12 wherein the vest (10) is secured to a patient by wrapping the belt (14) around the patient's back and over the outer surface of the front panel (12).

14. The vest (10) of claim 1 wherein the front panel (12) is further secured into position with suspenders (20) that extend over the patient's shoulders and attach to the belt (14) that is wrapped around the patient's back.

15. The vest (10) of claim 1 wherein the supply of oscillating pneumatic pressure (24) is coupled to the air bladder via an air coupling (18) that is inserted through the air ports (38) on the front panel (12).

16. The vest (10) of claim 1 wherein the air bladder is made of 406.4 μm polyethylene.

17. The vest (10) of claim 1 wherein the side portions (12b) and (12c) have a height of between about 15 cm and about 22.5 cm.

18. The vest (10) of claim 14 wherein the suspenders (20) are crossed in front of the patient to hold the vest (10) more securely in place.

19. The vest (10) of claim 1 wherein the side portions (12b) and (12c) extend under the patient's arms.

20. The vest (10) of claim 1 wherein the belt (14) has a plurality of longitudinally spaced belt holes (16).

21. The vest (10) of claim 20 wherein the belt (14) comprises:

   - a first air port (38) on the front panel (12) in communication with the air bladder; and
   - a first air coupling (18) which extends through one of the belt holes (16) and the first air port (38) to hold the belt (14) in position and to connect the air bladder to the source of oscillating pneumatic pressure (24);
   - a second air port (38) on the front panel (12) in communication with the air bladder; and
   - a second air coupling (18) which extends through another one of the belt holes (16) and

the second air port (38) to hold the belt (14) in position and to connect the air bladder to the source of oscillating pneumatic pressure (24).

22. The vest (10) of claim 21 and further comprising:

a tab (34) on the front panel that is insertable into one of the belt holes (16) to assist in aligning one of the belt holes (16) with the first air port (38).

23. The vest (10) of claim 20 and further comprising:

a pair of suspenders (20) extend from belt holes (16) positioned in front of the front panel (12) to belt holes (16) positioned by the patient's back.

24. The vest (10) of claim 14 wherein the suspenders (20) are crossed in the front.

25. The vest (10) of claim 20 wherein the belt holes have slits so the suspenders (20) can easily be inserted into the belt holes (16).

26. The vest (10) of claim 1 wherein the belt (14) is made of an inelastic material.

27. The vest (10) of claim 1 wherein the belt (14) is made of a material which produces no toxic emissions when burned and little particulate matter.

28. The vest (10) of claim 1 wherein the height of the belt (14) is between about 15.0 cm to 22,5 cm.

29. The vest (10) of claim 1 wherein the length of the belt (14) is about 90 cm.

30. The vest (10) of claim 1 wherein the front panel (12) and belt (14) are made of 203.2 μm polycarbonate.

Patentansprüche

1. Pneumatische Brustkompressionsweste (10) **gekennzeichnet durch**:

- eine im Allgemeinen starre Frontplatte (12), die eine Außenfläche und eine Innenfläche und einen Mittelteil (12a) und Seitenteile (12b und 12c) aufweist;
- eine flexible Luftblase, die auf einer Innenfläche der Frontplatte angebracht ist;
- eine Vielzahl von Luftports (38), **durch** die die Luftblase mit einer Quelle oszillierenden Luftdrucks (24) verknüpfbar ist, **gekennzeichnet durch**
- einen mit der Frontplatte (12) verbundenen Gürtel (14) zur Erstreckung um den Rücken des Patienten (P), um die Frontplatte (12) und die flexible Luftblase über der Brust eines Patienten zu positionieren, so dass die Frontplatte (12) ungefähr eine Lunge abdeckt und den Bereich der Brust eines Patienten mit einem oberen Rand der Frontplatte am Schlirsselbein des Patienten und einen unteren Rand am unteren Ende des Brustkorbs eines Patienten enthält.

2. Weste (10) des Anspruchs 1, worin die Luftblase die Vorderseite und Seiten der Brust des Patienten belegt.

3. Weste (10) des Anspruchs 1, worin die Luftblase den Bereich der Brust belegt, der die Lungen umfasst.

4. Weste (10) des Anspruchs 1, worin die Frontplatte (12) ein Latzteil in ihrem Mittelteil aufweist.

5. Weste (10) des Anspruchs 1, worin das Mittelteil (12a) eine Höhe zwischen ungefähr 22,5 cm und ungefähr 32,5 cm ausweist.

6. Weste (10) des Anspruchs 1, worin die Seitenteile (12b) und (12c) eine Höhe zwischen ungefähr 15 cm und ungefähr 22,5 cm aufweisen.

7. Weste (10) des Anspruchs 1, worin die Weste ihre allgemeine Form während der Behandlung nicht ändert.

8. Weste (10) des Anspruchs 1, worin die Druckkraft verursacht, dass die Brust des Patienten ihre Form ändert.

9. Weste (10) des Anspruchs 1, worin die Weste (10) aus einem Material konstruiert ist, das, wenn verbrannt, kein giftiges Gas produziert und wenig Feststoffe zurücklässt.

10. Weste (10) des Anspruchs 1, worin die Luftblase Druckkräfte in einer Größenordnung erzeugt, um ein tiefes Sputum aus den Lungen des Patienten hervorzurufen oder die Lungen des Patienten von Schleim frei zu machen.

11. Weste (10) des Anspruchs 1, worin die Breite der Luftblase ungefähr 52,5 cm beträgt.

12. Weste (10) des Anspruchs 1, worin der Gürtel (14) an einer Seite der Frontplatte (12) befestigt ist.

13. Weste (10) des Anspruchs 12, worin die Weste (10) an einem Patienten befestigt wird, indem der Gürtel (14) um den Rücken des Patienten und über die Außenfläche der Frontplatte (12) gewickelt wird.

14. Weste (10) des Anspruchs 1, worin die Frontplatte (12) ferner mit Trägem (20) in Position gehalten wird, die sich über die Schultern des Patienten erstrecken und am Gürtel (14), der um den Rücken des Patienten gewickelt ist, befestigt werden.

15. Weste (10) des Anspruchs 1, worin die Bereitstellung des oszillierenden Luftdrucks (24) mit der Luftblase über eine Luftkupplung (18) gekoppelt wird, die durch die Luftports (38) auf der Frontplatte (12) eingeführt wird.

16. Weste (10) des Anspruchs 1, worin die Luftblase aus ungefähr 406,4 μm dicken Polyethylen besteht.

17. Weste (10) des Anspruchs 1, worin die Seitenteile (12b) und (12c) eine Höhe zwischen ungefähr 15 cm und ungefähr 22,5 cm aufweisen.

18. Weste (10) des Anspruchs 14, worin die Träger (20) vor dem Patienten gekreuzt werden, um die Weste (10) sicherer an der Stelle zu halten.

19. Weste (10) des Anspruchs 1, worin sich die Seitenteile (12b) und (12c) unter den Armen des Patienten erstrecken.

20. Weste (10) des Anspruchs 1, worin der Gürtel (14) eine Vielzahl von der Länge nach beabstandeten Gürtellöchern (16) aufweist.

21. Weste (10) des Anspruchs 20, worin der Gürtel (14) umfasst:

- einen ersten Luftport (38) auf der Frontplatte (12) in Verbindung mit der Luftblase, und
- eine erste Luftkupplung (18), die sich durch eines der Gürtellöcher (16) und den ersten Luftport (38) erstreckt, um den Gürtel (14) in Position zu halten und die Luftblase mit der Quelle des oszillierenden Luftdrucks (24) zu verbinden;
- einen zweiten Luftport (38) auf der Frontplatte (12) in Verbindung mit der Luftblase, und
- eine zweite Luftkupplung (18), die sich durch ein anderes der Gürtellöcher (16) und den zweiten Luftport (38) erstreckt, um den Gürtel (14) in Position zu halten und die Luftblase mit der Quelle des oszillierenden Luftdrucks (24) zu verbinden.

22. Weste (10) des Anspruchs 21 und ferner umfassend:

einen Lappen (34) auf der Frontplatte, der in eines der Gürtellöcher (16) einführbar ist, um dabei zu helfen, eines der Gürtellöcher (16) auf den ersten Luftport (38) auszurichten.

23. Weste (10) des Anspruchs 20 und ferner umfassend:

ein Paar von Trägem (20), die sich von den Gürtellöchem (16). die vor der Frontplatte (12) positioniert sind, zu den Gürtellöchem (16), die am Rücken des Patienten positioniert sind, erstrecken.

24. Weste (10) des Anspruchs 14, worin die Träger (20) vorne gekreuzt werden.

25. Weste (10) des Anspruchs 20, worin die Gürtellöcher Schlitze aufweisen, so dass die Träger (20) leicht in die Gürtellöcher (16) eingeführt werden können.

26. Weste (10) des Anspruchs 1, worin der Gürtel (14) aus einem unelastischen Material besteht.

27. Weste (10) des Anspruchs 1, worin der Gürtel (14) aus einem Material besteht, das, wenn verbrannt, keine giftigen Emissionen und wenig Feststoffe produziert.

28. Weste (10) des Anspruchs 1, worin die Höhe des Gürtels (14) zwischen ungefähr 15,0 cm bis 22,5 cm beträgt.

29. Weste (10) des Anspruchs 1, worin die Länge des Gürtels (14) ungefähr 90 cm beträgt.

30. Weste (10) des Anspruchs 1, worin die Frontplatte (12) und der Gürtel (14) aus 203,2 μm dicken Polycarbonat bestehen.

Revendications

1. Gilet pneumatique de compression thoracique (10), **caractérisé par** ;

- un panneau avant globalement rigide (12) présentant une surface extérieure et une surface intérieure ainsi qu'une partie centrale (12a) et des parties latérales (12b et 12c) ;
- une poche d'air flexible montée sur une surface intérieure du panneau avant ;
- une pluralité de ports d'air (38) à travers lesquels la poche d'air peut être connectée à une source de pression pneumatique oscillante (24) ; **caractérisé par** :

- une ceinture (14) connectée au panneau avant (12) pour s'étendre autour du dos du patient (P) afin de positionner le panneau avant (12) et la poche d'air flexible sur la poitrine du patient de telle sorte que le panneau avant (12) recouvre

approximativement une région contenant les poumons de la poitrine du patient avec un bord supérieur du panneau avant situé au niveau de la davicule du patient et un bord inférieur situé au bas de la cage thoracique du patient.

2. Gilet (10) selon la revendication 1, dans lequel la poche d'air s'engage à l'avant et sur les côtés de la poitrine du patient.

3. Gilet (10) selon la revendication 1, dans lequel la poche d'air s'engage dans la région de la poitrine qui contient les poumons.

4. Gilet (10) selon la revendication 1, dans lequel le panneau avant (12) présente une section de bavoir au niveau de sa partie centrale (12a).

5. Gilet (10) selon la revendication 1, dans lequel la partie centrale (12a) a une hauteur comprise entre environ 22,5 cm et 32,5 cm.

6. Gilet (10) selon la revendication 1, dans lequel les parties latérales (12b) et (12c) ont une hauteur comprise entre environ 15 cm et environ 22,5 cm.

7. Gilet (10) selon la revendication 1, dans lequel la forme générale du gilet ne change pas durant le traitement.

8. Gilet (10) selon la revendication 1, dans lequel la force de compression entraîne un changement de la forme de la poitrine du patient.

9. Gilet (10) selon la revendication 1, dans lequel le gilet (10) est fabriqué dans un matériau qui, lorsqu'il est incinéré, ne produit aucun gaz toxique et laisse peu de matière particulaire.

10. Gilet (10) selon la revendication 1, dans lequel la poche d'air produit des forces de compression dont la grandeur provoque une profonde expectoration hors des poumons du patient ou un dégagement de mucus hors des poumons du patient.

11. Gilet (10) selon la revendication 1, dans lequel la largeur de la poche d'air est d'environ 52,5 cm.

12. Gilet (10) selon la revendication 1, dans lequel la ceinture (14) est attachée à un côté du panneau avant (12).

13. Gilet (10) selon la revendication 12, dans lequel le gilet (10) est attaché à un patient en enroulant la ceinture (14) autour du dos du patient et sur la surface extérieure du panneau avant (12).

14. Gilet (10) selon la revendication 1, dans lequel le panneau avant (12) est en outre attaché en position à l'aide de brides de suspension (20) qui s'étendent sur les épaules du patient et qui se fixent à la ceinture (14) qui est enroulée autour du dos du patient.

15. Gilet (10) selon la revendication 1, dans lequel la source de pression pneumatique oscillante (24) est couplée à la poche d'air via un raccord d'air (18) qui est inséré à travers les ports d'air (38) prévus sur le panneau avant (12).

16. Gilet (10) selon la revendication 1, dans lequel la poche d'air est constituée de polyéthylène de 406,4 µm.

17. Gilet (10) selon la revendication 1, dans lequel les parties latérales (12b) et (12c) ont une hauteur comprise entre environ 15 cm et environ 22,5 cm.

18. Gilet (10) selon la revendication 14, dans lequel les brides de suspension (20) se croisent à l'avant du patient afin de maintenir le gilet (10) en place d'une façon plus sûre.

19. Gilet (10) selon la revendication 1, dans lequel les parties latérales (12b) et (12c) s'étendent sous les bras du patient.

20. Gilet (10) selon la revendication 1, dans lequel la ceinture (14) comporte une pluralité de trous de ceinture (16) espacés de façon longitudinale.

21. Gilet (10) selon la revendication 20, dans lequel la ceinture (14) comprend :

- un premier port d'air (38) prévu sur le panneau avant (12) et en communication avec la poche d'air ; et
- un premier raccord d'air (18) qui s'étend à travers un premier des trous de ceinture (16) et le premier port d'air (38) afin de maintenir la ceinture (14) en position et de connecter la poche d'air à la source de pression pneumatique oscillante (24) ;
- un deuxième port d'air (38) prévu sur le panneau avant (12) et en communication avec la poche d'air ; et
- un deuxième raccord d'air (18) qui s'étend à travers un autre des trous de ceinture (16) et le deuxième port d'air (38) afin de maintenir la ceinture (14) en position et de connecter la poche d'air à la source de pression pneumatique oscillante (24).

22. Gilet (10) selon la revendication 21, et comprenant en outre :

- une patte (34) sur le panneau avant qui peut

être insérée dans l'un des trous de ceinture (16) afin d'aider à aligner un des trous de ceinture (16) avec le premier port d'air (38).

23. Gilet (10) selon la revendication 20, et comprenant en outre :

- une paire de brides de suspension (20) qui s'étendent à partir de trous de ceinture (16) qui se trouvent en face du panneau avant (12) jusqu'à des trous de ceinture (16) qui se trouvent dans le dos du patient.

24. Gilet (10) selon la revendication 14, dans lequel les brides de suspension (20) se croisent à l'avant.

25. Gilet (10) selon la revendication 20, dans lequel les trous de ceinture comportent des entailles de telle sorte que les brides de suspension puissent être insérées facilement dans les trous de ceinture (16).

26. Gilet (10) selon la revendication 1 dans lequel la ceinture (14) est constituée d'un matériau inélastique.

27. Gilet (10) selon la revendication 1, dans lequel la ceinture (14) est constituée d'une matériau qui ne produit aucune émission toxique lorsqu'il est brûlé, et qui laisse peu de matière particulaire.

28. Gilet (10) selon la revendication 1, dans lequel la hauteur de la ceinture (14) est comprise entre environ 15,0 cm et 22,5 cm.

29. Gilet (10) selon la revendication 1, dans lequel la longueur de la ceinture (14) est d'environ 90 cm.

30. Gilet (10) selon la revendication 1, dans lequel le panneau avant (12) et la ceinture (14) sont constituées de polycarbonate de 203,2 μm.

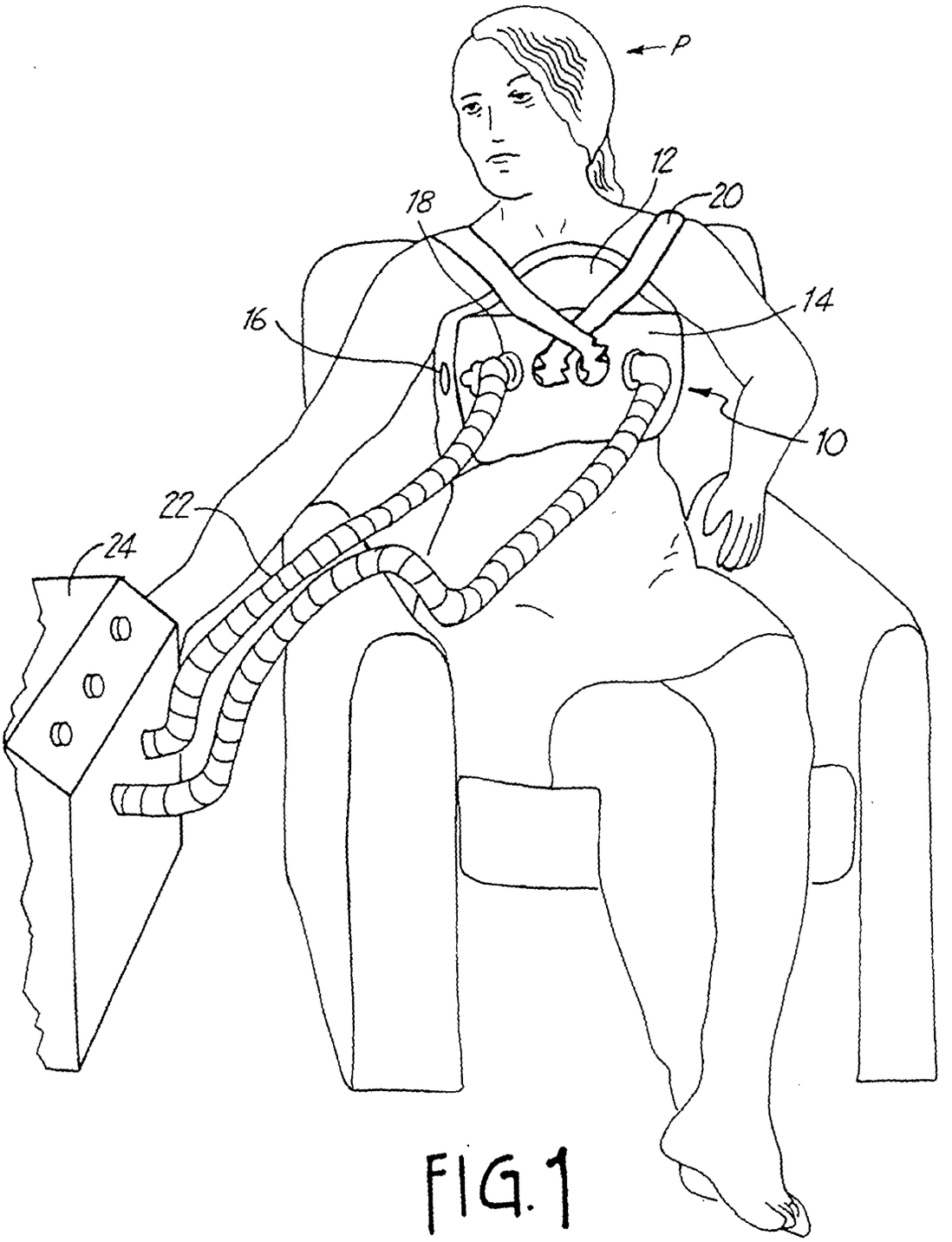


FIG. 1

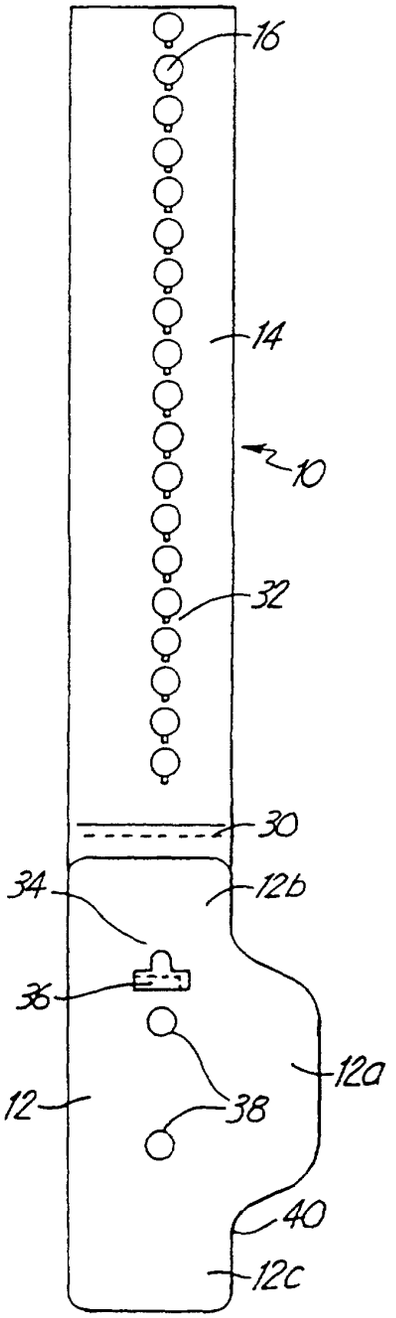


FIG. 2

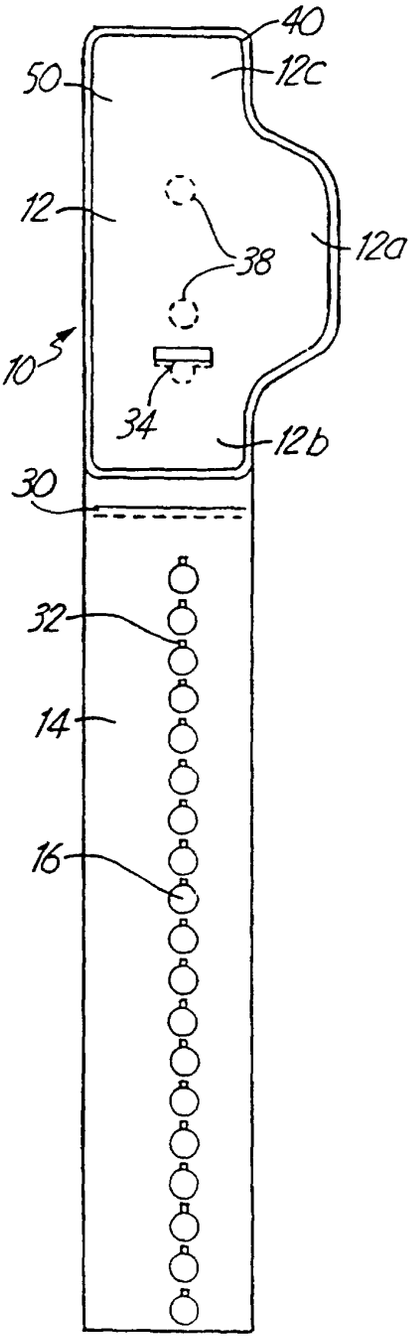


FIG. 3

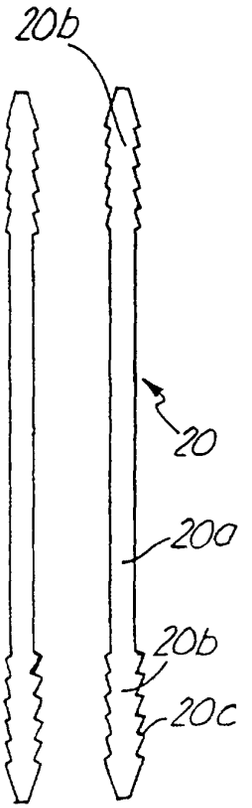


FIG. 5

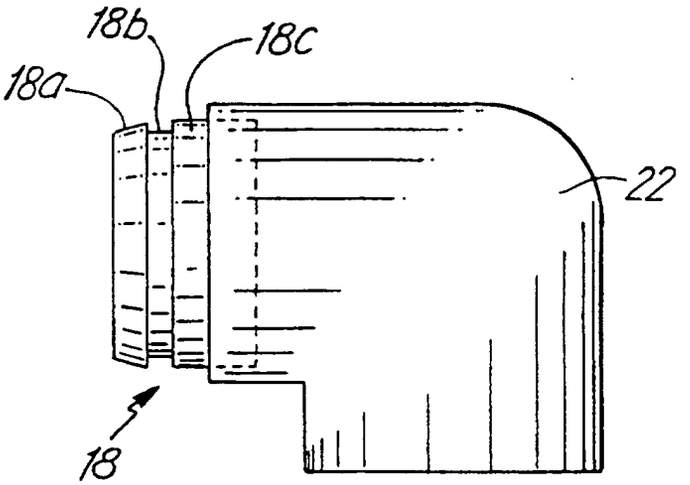
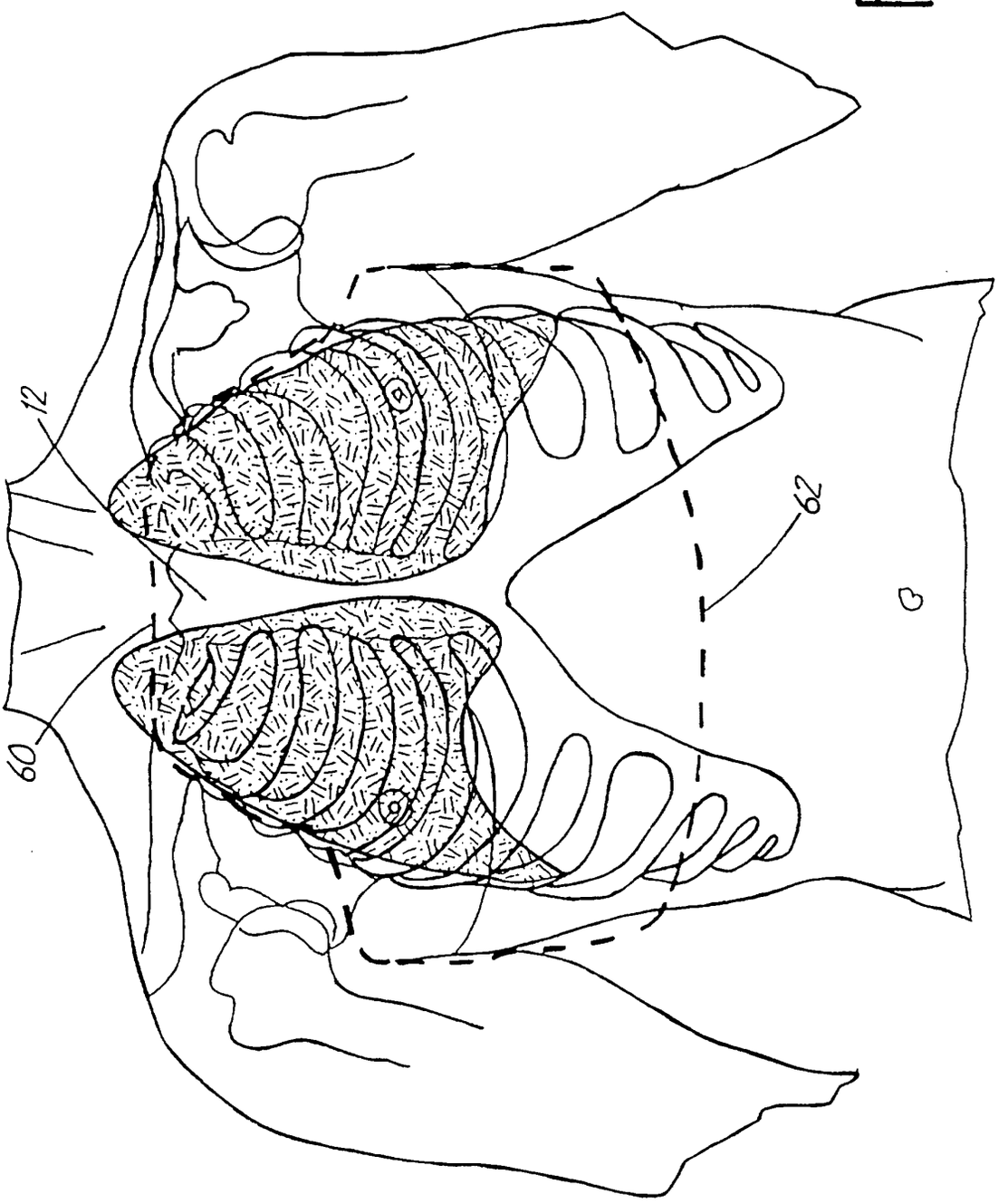


FIG. 4

FIG. 6



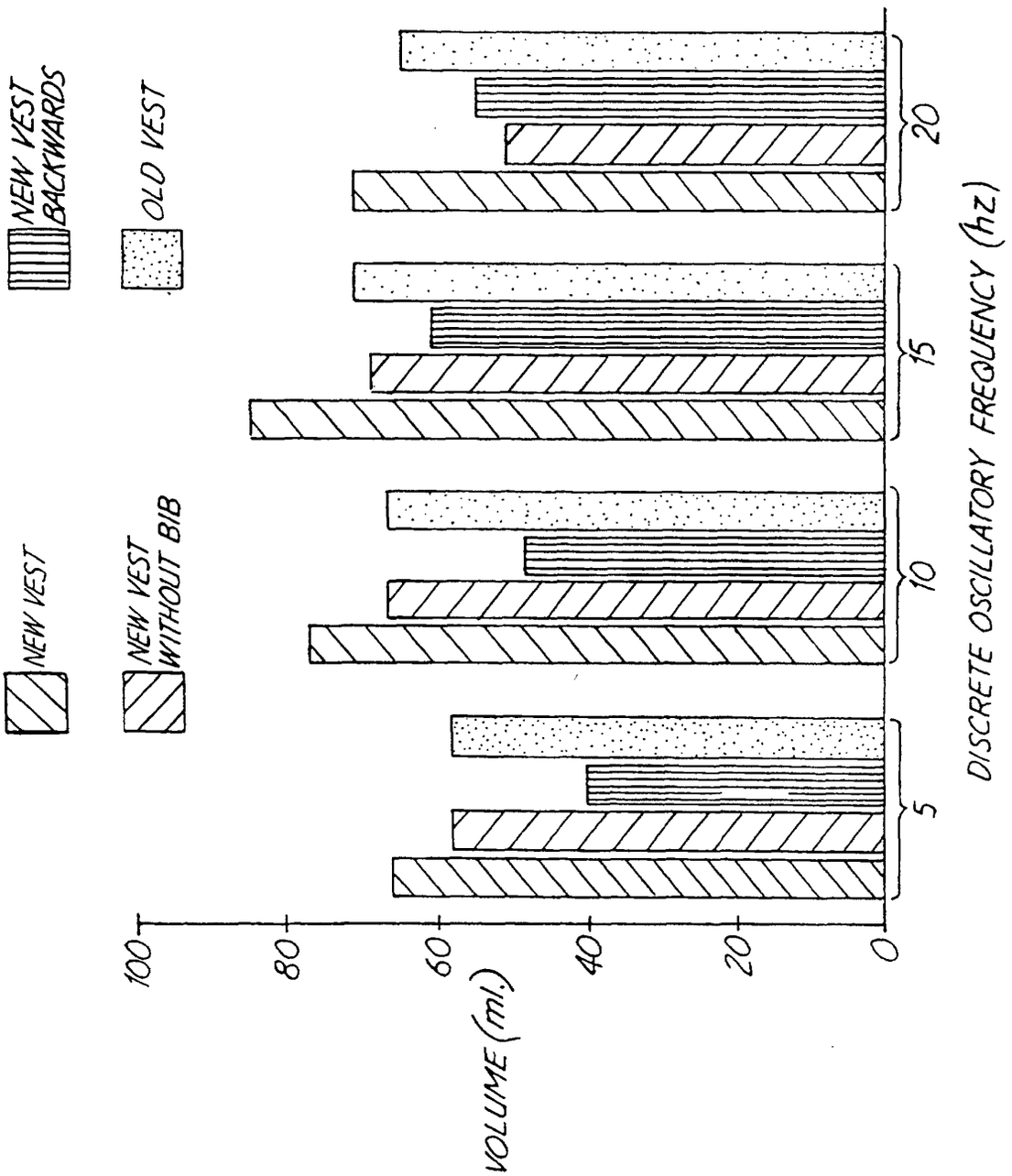

NEW VEST
NEW VEST WITHOUT BIB
NEW VEST BACKWARDS
OLD VEST
VOLUME (ml.)
100
80
60
40
20
0
5
10
15
20
DISCRETE OSCILLATORY FREQUENCY (hz)

FIG. 7