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C. A. VINAL

2,060,706

VARIABLE PRESSURE THERAPEUTIC APPARATUS

Filed March 23, 1936

2 Sheets-Sheet 1

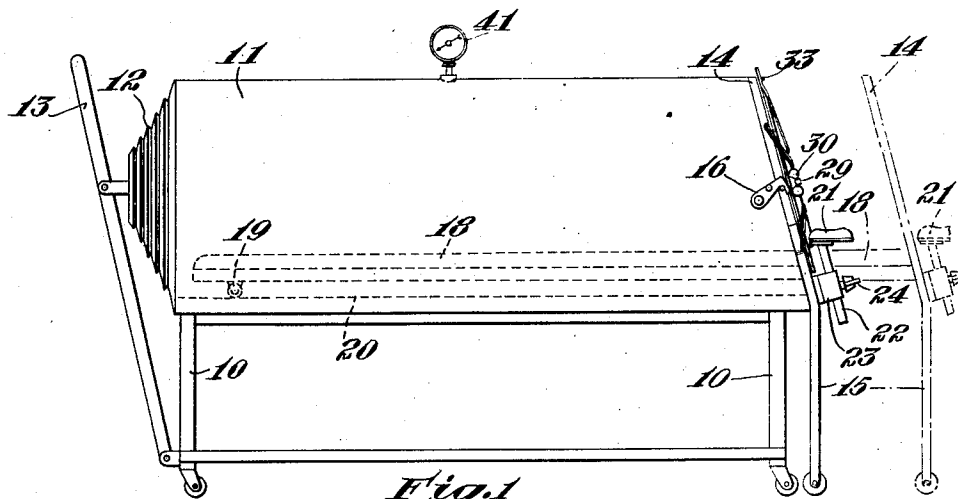


Fig. 1

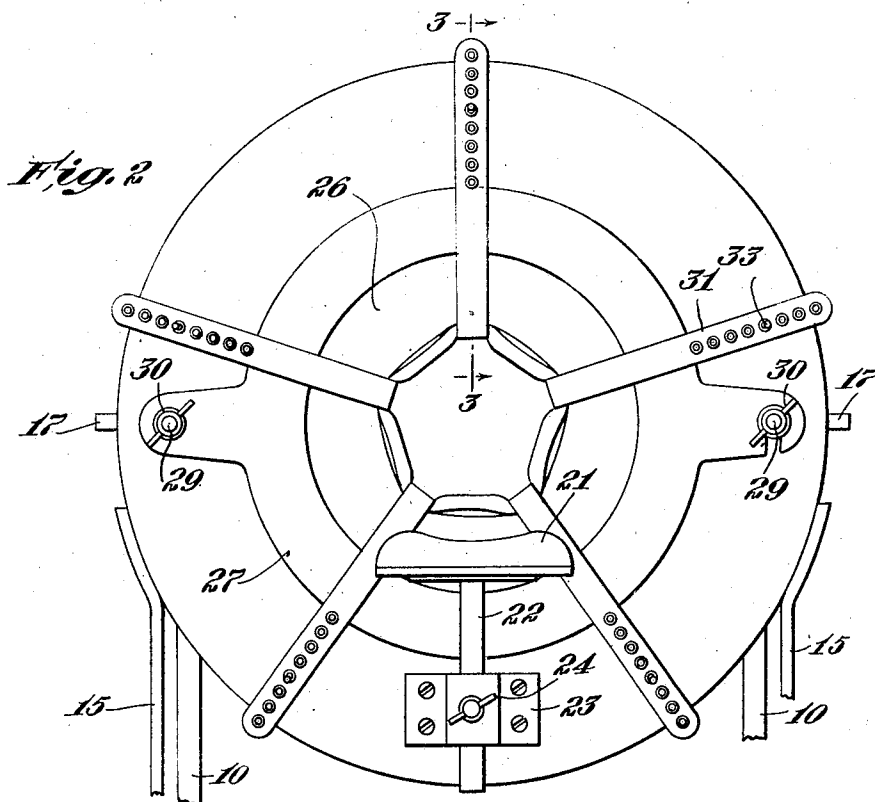


Fig. 2

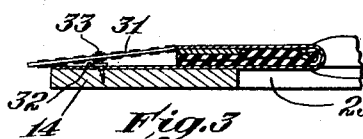


Fig. 3

Inventor
Charles A. Vinal
by Robert Cushman Woodbury.
Attys.

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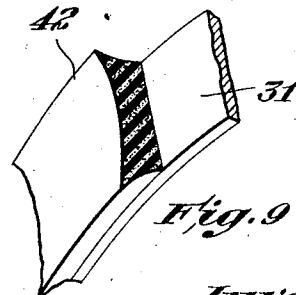
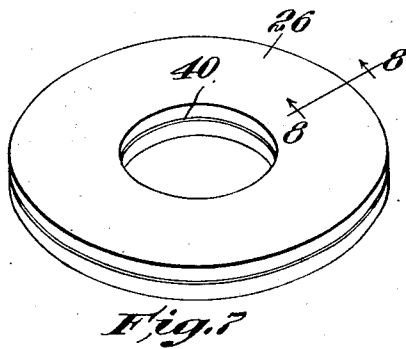
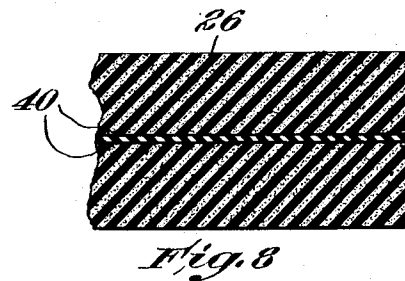
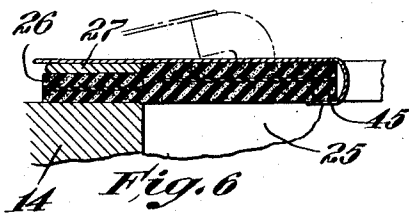
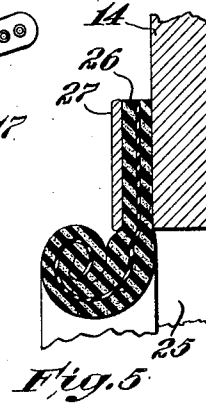
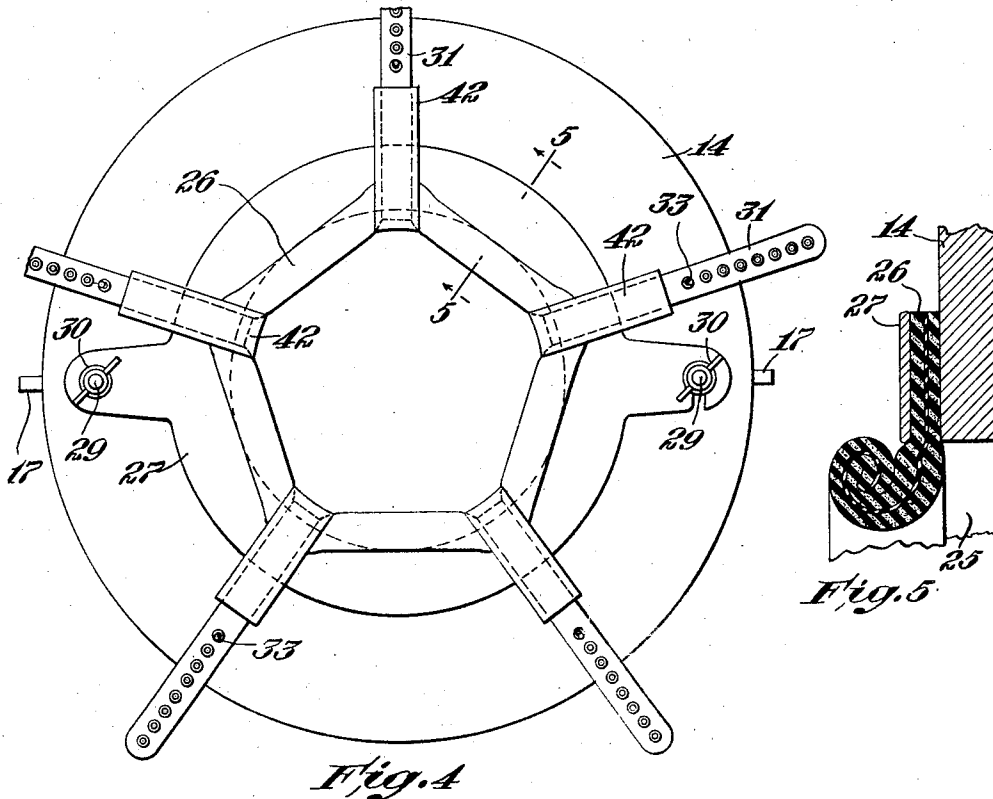
C. A. VINAL

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VARIABLE PRESSURE THERAPEUTIC APPARATUS

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2 Sheets-Sheet 2



Inventor
Charles A. Vinal
by Roberts, Cushman & Woodbury
Attys.

UNITED STATES PATENT OFFICE

2,060,706

VARIABLE PRESSURE THERAPEUTIC
APPARATUSCharles A. Vinal, South Weymouth, Mass., as-
signor to John H. Emerson, Cambridge, Mass.

Application March 23, 1936, Serial No. 70,299

6 Claims. (Cl. 128—30)

This invention relates to therapeutic apparatus for treatment of a portion of a patient's body by subjecting it to periodic variations in pressure, and more particularly to a novel and efficient means for forming a comfortable and adjustable seal between the patient's body and the enclosure in which the portion of the body under treatment is subjected to the variations in pressure.

Artificial respirators for stimulating breathing in patients suffering from drowning, suffocation, infantile paralysis, etc. and devices for stimulating blood circulation in localized portions of the human body for treatment of arteriosclerosis, embolic occlusion, falling hair, etc., are examples of devices in which my adjustable sealing means may be used. Reference may be had to the Drinker and Shaw United States Patents Nos. 1,834,580, 1,906,453 and 1,906,844 for constructions of artificial respirators and to application of Letters Patent of the United States, Serial No. 12,316, filed June 13, 1935, by John H. Emerson for a construction of an apparatus for stimulating blood circulation.

These devices all utilize the broad principle of placing the portion of the body to be treated in an air-tight enclosure and then causing alternative negative and positive or atmospheric pressures to be created within the enclosure upon the surface of the enclosed portion of the patient's body.

The most common means which has been utilized for forming a seal between the enclosure and the portion of the patient's body which is exterior thereof has been a flexible rubber collar clamped against the outer wall of the enclosure. This collar has a central opening which fits snugly around the adjacent portion of the patient's body and which is in alignment with a corresponding opening through the wall of the enclosure. In use it has been found that the edges of the opening in the collar exert excessive pressure upon the adjacent portion of the patient's body thereby causing discomfort to the patient. It has also been found that in inserting the adjacent portion of the patient's body through the opening in the collar before and after treatment great discomfort results to the patient because of the difficulty of holding the opening in stretched position and in preventing it from frictionally contacting the portion of the body which is being inserted there-through.

It has been suggested that by use of a metal ring arranged to clamp the collar against the outside wall of the enclosure near the periphery of the collar and by use of releasable means asso-

ciated with the clamping ring so that the pressure of the ring against the collar may be reduced or eliminated entirely the collar may be pulled outwardly at its edges, thereby stretching the entire collar and enlarging the central opening therein, the collar being thereafter again clamped in stretched position. Dr. Binger and Dr. Davis used such a clamping ring in a body plethysmograph at the hospital of the Rockefeller Institute in New York in 1927. The Drinker and Shaw United States respirator Patent No. 1,906,453 also discloses the use of such a clamping ring with associated adjustable means for temporarily relieving its pressure against localized portions of the outer surface of the rubber collar.

These structures have been found to be unsatisfactory in two respects: first, no provision is made for stretching the central opening wide enough for convenient insertion and removal of the patient and, second, the releasable means can not be conveniently operated by a single attendant to relieve pressure of the edge of the opening in the collar upon a portion of the patient's neck.

The principal object of this invention is to provide novel means for adjusting the size of the central opening in the collar of a variable pressure therapeutic device.

Another object is to provide novel means for adjusting the size of the opening in such a collar, which means may be operated by a single attendant.

A further object is to provide a novel adjustable closure for a variable pressure therapeutic apparatus.

Other objects relate to the construction and mode of operation and will be apparent from the following description and the accompanying drawings which exemplify one embodiment of my invention chosen for the purposes of illustration.

In the drawings:

Fig. 1 is a view in side elevation of an apparatus embodying my invention;

Fig. 2 is an enlarged end view of the apparatus shown in Fig. 1;

Fig. 3 is a section, with parts broken away on the line 3—3 of Fig. 2;

Fig. 4 is an end view, similar to Fig. 2, but showing the collar opening in full open position;

Fig. 5 is an enlarged section, with parts broken away, on the line 5—5 of Fig. 4;

Fig. 6 is a sectional view similar to Fig. 3,

but showing a modified form of adjusting means for the collar opening;

Fig. 7 is a perspective view of the collar;

Fig. 8 is an enlarged section, with parts broken away, on the lines 8—8 of Fig. 7; and

Fig. 9 is a perspective view, with parts broken away, of a modified form of adjusting means for the collar opening.

The apparatus disclosed in the drawings will be referred to in this specification as an artificial respirator, although as shall be hereinafter pointed out, it may also be used as a device for stimulating blood circulation.

The apparatus illustrated comprises a wheeled carriage 10 on which is mounted a rigid casing 11 which forms the enclosure for the portion of the patient's body to be treated; in the case of an artificial respirator it receives the patient's body up to his neck.

A collapsible diaphragm or bellows 12 secured in one end of the casing may be operated by the attached lever or handle 13, the lower end of which is pivotally secured to the end of the carriage 10.

A rigid end piece 14 supported by a wheeled standard 15 forms a removable closure for the open end of the casing. The removable end piece is held in closed position against the open end of the casing by means of the pivoted clamps 16 mounted on the casing which clamps engage the pins 17 on the end piece to hold it against a suitable rubber gasket provided around the open end of the casing, thus providing an air-tight seal between the end piece and the casing.

A body support or bed 18 is connected at one end to the inner face of the end piece 14 and is provided with rollers 19 adjacent its other end. The rollers 19 ride upon the upper edges of the corresponding tracks 20. Thus when the end piece 14 is slid outwardly away from the open end of the casing the bed moves with it and the rollers 19 traverse the upper edges of the tracks 20.

A head rest 21 is supported on the end piece 14 by means of the bracket 23 through which the substantially vertical arm 22 passes. The height of the head rest may be adjusted by loosening the set screw 24, raising or lowering the arm 22 and then tightening the set screw, the inner end of which abuts the adjacent surface of the arm.

An opening 25 is provided in the center of the end piece large enough to permit the patient's head to readily pass therethrough. A rubber collar 26 having a central neck opening is clamped against the inner face of the end piece by means of the metal clamp 27, the threaded bolts 29 and the interiorly threaded nuts 30. The collar is clamped against the end piece so that the center of its neck opening substantially coincides with the center of the head opening 25 in the end piece. I prefer that this collar be constructed of a relatively thick body portion of sheet sponge rubber with an integral rubber pellicle 40 extending parallel to the surfaces of the collar (see Figs. 7 and 8). It will be readily understood that collars formed of a non-porous rubber sheet may be substituted for such a sponge rubber collar without departing from the scope of this invention.

A plurality of flexible straps 31, preferably made of leather, are provided, each having one end 32 secured to the end piece by means of an eyelet which is large enough to receive the head of a pin 33. The straps extend inwardly from

the corresponding pins 33 between the collar and the end piece, to and through the neck opening in the collar and thence back outwardly substantially parallel to the outer surface of the collar. The free end of each strap is provided with a series of eyelets each capable of receiving the head of the respective adjacent pins 33. These straps 31 thus extend radially of the collar from the edges of the collar neck opening and each strap contacts the adjacent portion of the edge of said opening.

As shown in Fig. 6, the straps may have one end 45 attached to the collar near the central opening rather than extending entirely around the collar as in my preferred embodiment hereinabove described.

To insert a patient in the apparatus the attendant successively grips each strap 31 near its free end, pulls it outwardly and locks the strap in such extended position by slipping the proper eyelet over the head of the corresponding pin, thus enlarging the neck opening as shown in Fig. 4. This operation both stretches the neck opening and causes the adjacent portions of the edge of the neck opening of the collar to roll up (see Figs. 4 and 5). When the modified construction shown in Fig. 6 is used, enlargement of the neck opening by successively extending the straps is primarily a stretching operation, as shown by the dot and dash position of strap and collar in Fig. 6.

When the neck opening has thus been enlarged and locked in enlarged position, the opening is large enough to permit free passage of the patient's head therethrough. The bed is then slid out of the casing by pulling the end piece outwardly and the patient is placed on the bed. The patient's head is then passed through the neck opening in the collar and placed upon the head rest. The bed is then rolled into the casing and the end piece locked in closed position by means of the clamps 16 and pins 17.

The attendant then releases the straps 31 successively and by means of each strap carefully guides the adjacent edges of the collar inwardly until a comfortable fit is obtained between the patient's neck and the edges of the neck opening in the collar (see position of collar and straps in Fig. 2). Each strap is held in the proper position by means of engagement between the corresponding eyelet and the adjacent pin 33. The patient's body is thus enclosed up to his neck in the air-tight casing 11 and a comfortable seal is provided between his neck and the collar.

Alternate variations in pressure are created upon the patient's chest by operating the bellows 12 which alternately creates negative pressure and positive or atmospheric pressure within the casing. When the negative pressure is created, the patient's lungs are forced to expand, drawing in air through his nose and mouth and when the negative pressure is released to atmospheric pressure or above, the air in the patient's lungs is expelled through his nose and mouth. This operation is repeated in time with the normal rate of breathing. As is well known by persons skilled in the art, the bellows is commonly operated automatically by suitable attachments with an electric motor. The intensity of negative and positive pressures within the casing may be observed upon the pressure gauge 41.

When a patient remains in the apparatus for extended periods of time, it is necessary to change his position on the bed from time to time and his neck frequently becomes out of line with the cen-

ter of the collar opening, resulting in greater pressure by the edge of the collar neck opening on one portion of his neck than on the other portions. To relieve the resulting discomfort the strap associated with the edge of the neck opening adjacent the uncomfortable point is pulled outwardly far enough to relieve the pressure of the neck opening against the patient's neck at that point and the strap adjacent the opposite portion of the neck opening is released enough to eliminate any air leakage at the latter point. This adjustment of the size of the neck opening and of its position relative to the head opening in the end piece can readily be made by a single attendant by thus successively either increasing or reducing the tension in the proper straps and then locking them in the proper adjusted positions.

It will be understood from Fig. 2 that the neck opening is more restricted between the portions of the opening which contact the straps than at the portions of the opening which actually contact the straps. I have found that notwithstanding this fact the collar can be comfortably adjusted to prevent leakage between the patient's neck and the straps because relatively small pressures by the patient's neck against the more restricted portions of the neck opening between straps cause said portions of the opening to move outwardly, thereby conforming to the contour of the patient's neck. Thus if the straps are adjusted so that their inner faces comfortably contact the patient's neck, the portion of the neck opening between straps will conform to the patient's neck without uncomfortably restricting it, and the neck opening as a whole will thus form an air-tight and comfortable seal between the patient's neck and the collar.

To entirely eliminate any contact between the flexible straps and the patient's neck, the inner face of each strap may be provided with a lining of soft rubber, for example sponge rubber, as shown in Figs. 4 and 9. This rubber lining will eliminate any possibility of air leakage between the patient's neck and the straps and will reduce the pressure of the restricted portions of the collar against the patient's neck (see Fig. 4).

In the case of particularly tender necks I have found that by swathing the patient's neck with cotton batting a comfortable and air-tight seal can be maintained without the use of such a rubber lining for the straps.

When the apparatus is used for the stimulation of blood circulation in a portion of the patient's body, for example his leg, his foot and leg are inserted through the opening in the collar and the edges of the opening are then adjusted by means of the straps to form a comfortable and air-tight fit around the adjacent portion of the patient's leg.

From the above description it will be apparent that a variable pressure therapeutic apparatus constructed in accordance with this invention provides novel means for adjusting the size and position of the collar opening which may be easily and speedily operated by a single attendant both to insert and remove the patient from the casing and also to provide a comfortable fit between the patient's body and the collar opening during treatment.

I claim:

1. Apparatus for treatment of a patient, comprising a casing to receive the portion of the patient's body to be treated, an opening in one wall thereof through which the portion of the

patient's body adjacent the portion to be treated may project, means to produce periodic variations in pressure within said casing, a seal for said opening comprising a flexible rubber collar having an opening to fit around the adjacent portion of the patient's body, means to clamp the outer edges of said collar to the casing wall, a plurality of flexible tension members associated with the edges of the opening in the collar and extending radially of the collar, and a plurality of releasable holding means, each associated with one of said tension members, said tension members and said holding means being constructed and arranged to permit pulling of each tension member outwardly to enlarge the adjacent portion of the opening in the collar and to releasably hold said tension member in such position.

2. In an apparatus for producing artificial respiration, a casing to receive the body of the patient, an opening in one wall thereof through which the head of the patient may project, means to produce periodic variations in pressure within said casing, a seal for said opening comprising a flexible rubber collar having an opening to fit around the patient's neck, means to clamp the outer edges of said collar to the casing wall, a plurality of flexible tension members associated with the edges of the opening in the collar and extending radially of the collar, and a plurality of holding means, each holding means being associated with one of said tension members to releasably hold it in a plurality of extended positions thereby permitting the portion of the opening in the collar associated with each tension member to be held in a plurality of stretched and contracted positions.

3. In an apparatus for producing artificial respiration, a casing to receive the body of the patient, an opening in one wall thereof through which the head of the patient may project, means to produce periodic variations in pressure within said casing, a seal for said opening comprising a flexible rubber collar having an opening to fit around the patient's neck, means to clamp the outer edges of said collar to the casing wall, a plurality of flexible straps extending radially from the opening in the collar toward the outer edges of the collar, each strap being associated with a portion of the edge of the opening in the collar so as to stretch said edge when the strap is pulled outwardly in a radial direction, and a plurality of holding means, each holding means being associated with one of said straps to releasably hold it in a plurality of extended positions thereby permitting the portion of the opening in the collar associated with each strap to be held in a plurality of stretched and contracted positions.

4. In an apparatus for producing artificial respiration, a casing to receive the body of the patient, an opening in one wall thereof through which the head of the patient may project, means to produce periodic variations in pressure within said casing, a seal for said opening comprising a flexible rubber collar having an opening to fit around the patient's neck, means to clamp the outer edges of said collar to the casing wall, a plurality of flexible straps extending radially of the collar from the edges of the opening therein, each strap having one end secured to the casing wall, the strap extending thence inwardly between the casing wall and the collar to and through the neck opening and thence back outwardly substantially parallel to the outer surface of the collar, and a plurality of releasable holding means, each holding means being associated with the

free end of the corresponding strap to releasably hold it in a plurality of extended positions thereby permitting the portion of the opening in the collar associated with each strap to be held in a
5 plurality of stretched and contracted positions.

5. In an apparatus for producing artificial respiration, a casing to receive the body of the patient, an opening in one wall thereof through which the head of the patient may project, means
10 to produce periodic variations in pressure within said casing, a seal for said opening comprising a flexible rubber collar having an opening to fit around the patient's neck, means to clamp the outer edges of said collar to the casing wall, and
15 means for enlarging the collar opening comprising a plurality of flexible straps extending radially of the collar from the edges of the opening therein.

6. In an apparatus for producing artificial respiration, a casing to receive the body of the patient, an opening in one wall thereof through which the head of the patient may project, means to produce periodic variations in pressure within said casing, a seal for said opening comprising a flexible rubber collar having an opening to fit around the patient's neck, means to clamp the outer edges of said collar to the casing wall, and means for enlarging the collar opening comprising a plurality of flexible straps extending radially of the collar from the edges of the opening therein, each strap having one end secured against movement radially of the collar and the
1 other end free for movement radially of the collar.

CHARLES A. VINAL.