Sept. 4, 1956 J. H. EMERSON 2,761,442

THERAPEUTIC APPARATUS AND COLLAR THEREFOR

Filed Oct. 10, 1950 3 Sheets-Sheet 1

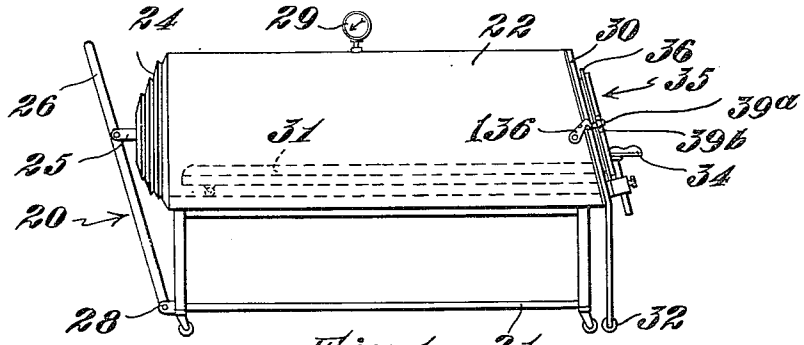


Fig. 1

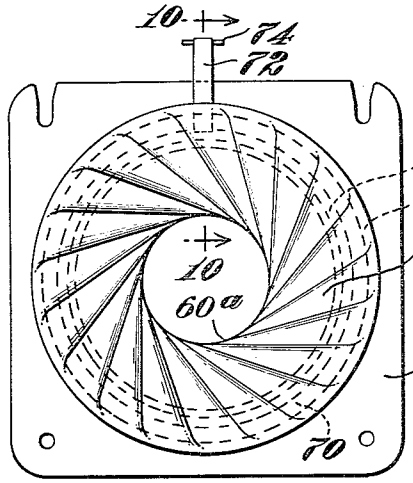


Fig. 7

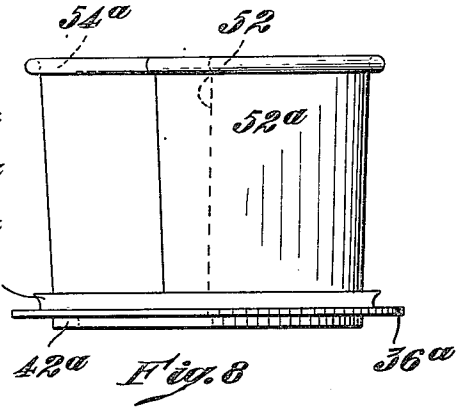


Fig. 8

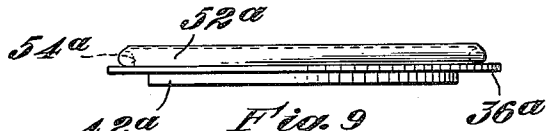


Fig. 9

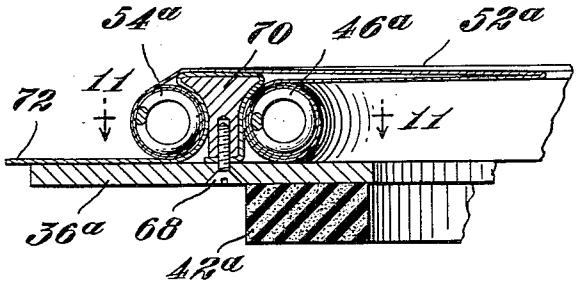


Fig. 10

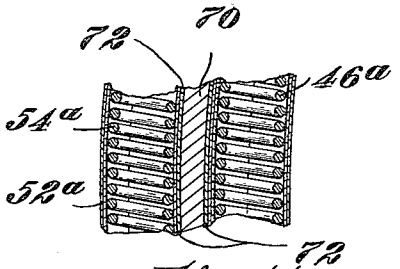


Fig. 11

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THERAPEUTIC APPARATUS AND COLLAR THEREFOR

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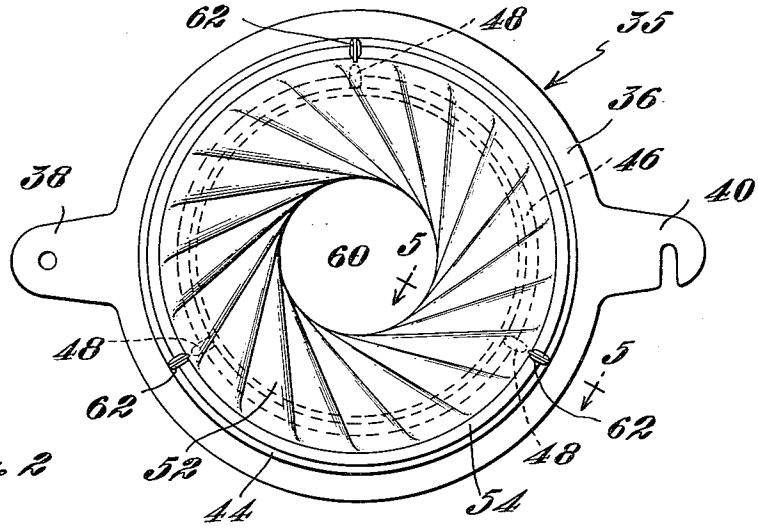


Fig. 2

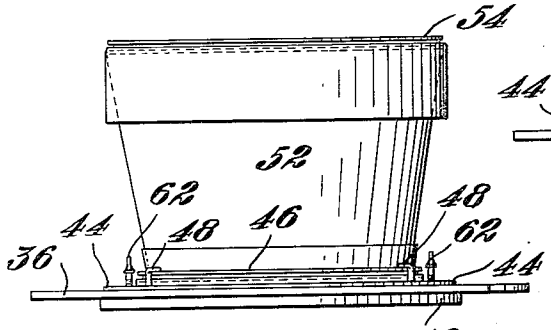


Fig. 3

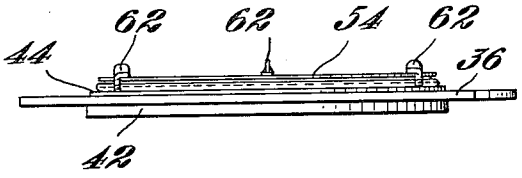


Fig. 4

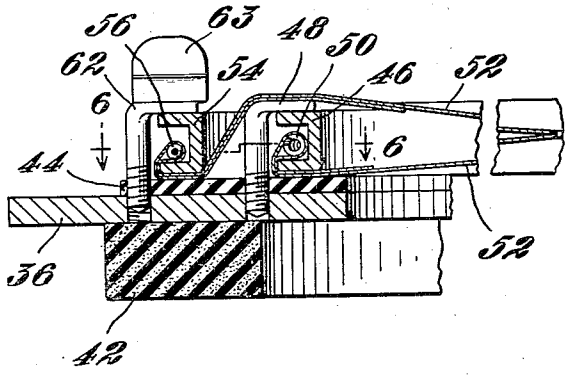


Fig. 5

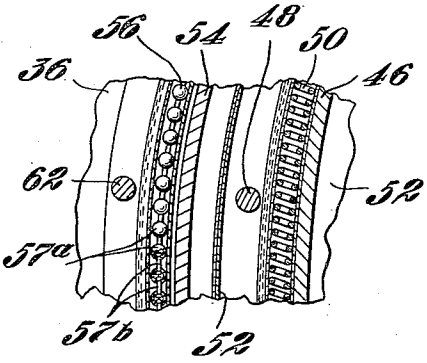


Fig. 6

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THERAPEUTIC APPARATUS AND COLLAR THEREFOR

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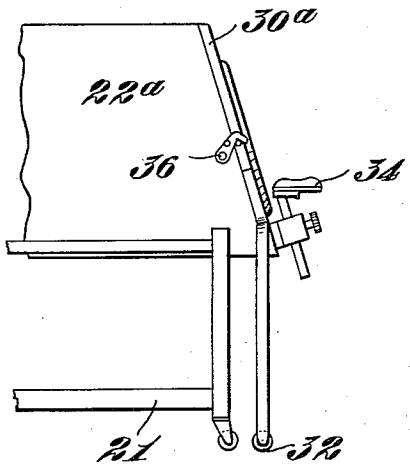


Fig. 12

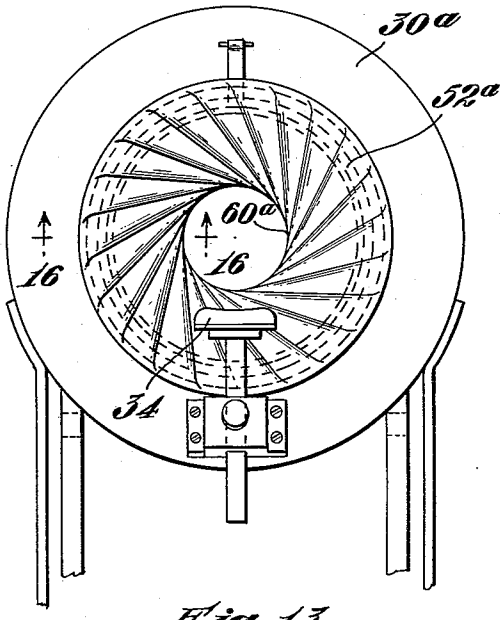


Fig. 13

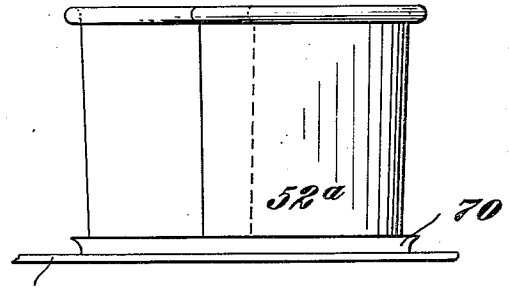


Fig. 14

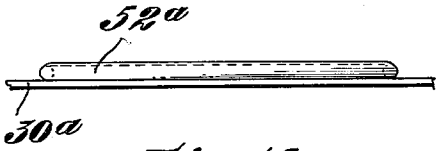


Fig. 15

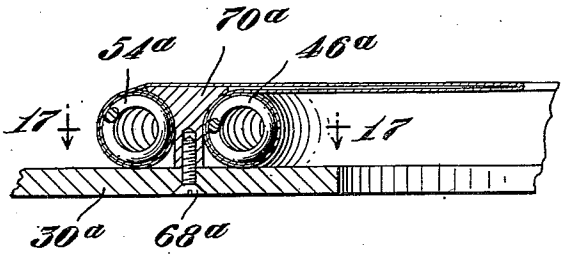


Fig. 16

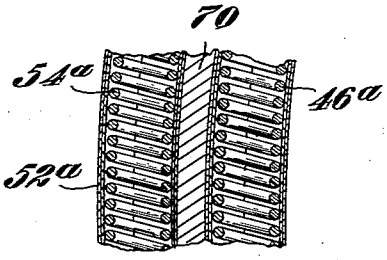


Fig. 17

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THERAPEUTIC APPARATUS AND COLLAR THEREFOR

John H. Emerson, Cambridge, Mass.

Application October 10, 1950, Serial No. 189,439

4 Claims. (Cl. 128—30)

This invention relates to a collar for controlling the size of an opening in a wall of a therapeutic apparatus and more particularly to a novel and efficient collar 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 variations in pressure.

My adjustable collar is adapted for use with artificial respirators of the type shown and described in United States Patent No. 2,060,706 for stimulating breathing in patients suffering from drowning, suffocation, infantile paralysis and the like, with apparatus for stimulating blood circulation of the type shown and described in United States Patent No. 2,142,689, and with other therapeutic devices.

Objects of this invention are to provide a collar for controlling the size of an opening in a respirator or similar therapeutic device which completes the seal between the body of the patient and the device, which is adjustable to accommodate patients of different sizes, which can be quickly and easily adjusted to the required size by one feminine attendant, which is safe to operate and does not injure either the patient or attendant, which is simple in design, which is strong and durable in construction, the tube or sleeve of which may be easily replaced by an attendant, which may be economically manufactured and which advances the respirator collar art generally.

Other objects will be apparent from the following description of several specific embodiments of the invention and by reference to the drawings in which:

Fig. 1 is a side elevation of a respirator incorporating one embodiment of the invention;

Fig. 2 is a front view of the closure for the respirator shown in Fig. 1;

Fig. 3 is a side view of the closure of Fig. 1 with the sleeve in an extended position;

Fig. 4 is a side view of the closure with the sleeve in the pleated position;

Fig. 5 is an enlarged fragmentary sectional view on line 5—5 of Fig. 2;

Fig. 6 is a fragmentary sectional view on line 6—6 of Fig. 5;

Fig. 7 is a front view of a second embodiment of a closure embodying the invention;

Fig. 8 is a side view of the embodiment shown in Fig. 7 with the sleeve extended;

Fig. 9 is a side view of the closure shown in Fig. 7 with the sleeve in pleated position;

Fig. 10 is an enlarged fragmentary sectional view on line 10—10 of Fig. 7;

Fig. 11 is a fragmentary sectional view on line 11—11 of Fig. 10;

Fig. 12 is a fragmentary side view of a respirator incorporating a third embodiment of the invention;

Fig. 13 is an end view of the respirator and closure shown in Fig. 12;

Fig. 14 is a side view of the closure shown in Fig. 13 with the sleeve extended;

Fig. 15 is a side view of the closure shown in Fig. 13 with the sleeve in pleated position;

Fig. 16 is an enlarged fragmentary sectional view on line 16—16 of Fig. 13; and

Fig. 17 is a fragmentary sectional view on line 17—17 of Fig. 16.

In Fig. 1, the number 20 designates a respirator similar to that shown in said United States Patent No. 2,060,706 which comprises cylindrical hollow casing 22 supported upon a wheeled carriage 21. One end of the casing 22 is closed by a flexible bellows or diaphragm 24. The diaphragm 24 may be manually expanded and contracted by means of a link 25 which extends between the center of the diaphragm and a lever 26 whose lower end is pivotally connected to the end of the carriage 21 as at 28, although it is to be understood that suitable power operated actuating means may be and in commercial use generally is substituted therefor. The opposite end of the casing 22 is partially closed by means of an end piece or wall 30 and a closure or collar 35 which will be described in detail hereinafter, so that with a patient reclining on the bed 31 with his head supported on the head rest 34 periodic movement of the diaphragm 24 results in periodic variations in the air pressure within the casing, and such variations are indicated upon the pressure gauge 29. The pressures normally used for artificial respiration are from 15 to 25 cm. of mercury.

The end wall 30 is a round metal plate which is clamped to the casing 22 by two oppositely disposed clamps 136. Attached to the inner surface of the end wall 30 is one end of the body support or bed 31 upon which the patient lies with his neck protruding through a centrally disposed opening in the end wall 30 so that his head is supported upon an adjustable head rest 34. To prevent excessive leakage through the space between the neck of the patient and the adjacent edge of the opening in the end wall 30 such space is substantially sealed by means of the closure 35 which, as is shown in Fig. 2, comprises a plate member 36 having two diametrically disposed ears 38 and 40 which are provided respectively with an aperture and a slot for receiving two bolts 39*a*, upon which the plate is detachably held adjacent to the end wall 30 by means of the clamping nuts 39*b* (Fig. 1). The plate 36 is provided with a centrally disposed opening of approximately the same diameter as the opening in the end wall 30 so that when the plate is clamped to the wall the two openings substantially coincide. A gasket 42 of sponge rubber or other resilient material is cemented about the central opening in the plate 36 so that with the plate in place on the end wall it is interposed between the plate member 36 and the outer surface of the end wall 30 thereby to prevent air leakage therebetween. A second gasket 44 of sponge rubber or other resilient material is cemented to the outer surface of the plate 36 so that it lies circumjacent the opening therein.

One end of the flexible sleeve 52 is arranged concentrically of the annular helical spring member 50 and passed about it (see Fig. 5). This annular spring 50 is then expanded slightly in a radial direction and placed in the channel or groove formed in the annular metal member 46 (see Figs. 5 and 6) where it is retained by its longitudinal resilience. The member 46 is detachably secured to the plate 36 by three L-shaped clamps whose threaded ends are respectively received by equally spaced threaded apertures in the plate and one end of the sleeve 52 is thus detachably secured between the member 46 and the gasket 44.

The other end of the sleeve 52 is detachably secured to the annular member 54 by means of a fastening device such as the annular bead chain 56 which is carried in the groove or channel in the ring 54 formed by two flanges which extend normally from the opposite ends

of its web. To thus detachably secure the sleeve to the annular member 54 the end of the sleeve is arranged concentrically of the annular bead chain member 56, passed about it (see Figs. 5 and 6) and the bead chain is then slightly expanded and inserted in the groove of the member 56 where it is retained by the slight longitudinal resilience of the bead chain, the selected portion of the sleeve being interposed between the chain 56 and the inner flange (as shown in Figs. 5 and 6).

It is to be understood that the fastening devices which may be used to secure the sleeve 52 to the annular members 46 and 54 are not necessarily limited to a helical spring 50 or a bead chain 56 described above, but that a wire, a tie cord such as twine or string or other restraining means may be substituted therefor. However, the fastening device associated with the adjustable flange 54 is preferably a bead chain such as 56 as the individual beads 57*a* rotate easily about the bead connectors 57*b* as the sleeve 52 is pulled transversely of the groove in the ring 54, to thus change the operative length of the sleeve extending between the rings 46 and 54, as described in detail hereinafter. The inside diameter of extended ring formed by the chain 56 is made slightly greater than the outer diameter of the annular member 54 so that by extending the chain manually it may be slipped over the periphery of the ring and it then contracts slightly longitudinally so as to be retained in the groove until it is again slightly extended manually when it is desired to remove it from the groove to replace the sleeve. An annular helical spring like the spring 50 has also been found to be very satisfactory for use in the groove of the ring 54 for accommodating such transverse movement of the sleeve during adjustment of its length.

The sleeve 52 is made of any flexible material which is substantially impervious to air at pressures of from 15 to 25 centimeters of mercury. Preferably materials are used which are not resilient, for example, a sheet of polymerized vinyl compound such as the copolymer of vinyl chloride and vinyl acetate plasticized with dioctyl phthalate (sold under the trade-mark "Vinylite"), a textile fabric such as oiled or rubberized silk, linen or cotton, or a textile fabric impregnated with said polymerized vinyl compound are suitable. It is also possible however to use a resilient material such as a sheet of rubber which may be either of the natural or synthetic type.

The sleeve 52 shown in Fig. 3 is in the form of a united tube having a longitudinal seam (not shown) which is made, for example, by stitching, fusing or cementing the longitudinal edges of a sheet together, the process used depending upon the material of which the sleeve is made. However, it is not necessary that the sleeve have a seam if the adjoining longitudinal edges are provided with a generous overlap as is shown in sleeve 52*a* of Figs. 8 and 14. When the term "sleeve" is used in the claims I intend to include both of these arrangements.

To form the neck aperture 60 (Fig. 2) the annular member 54 is manually rotated concentrically of the opening in the plate 36 while the annular member 46 is held stationary by the clamps 48, thus causing the sleeve 52 to be folded into a series of overlapping pleats such as are shown in Fig. 2 which define the aperture in the collar for the patient's neck. The annular member 54 is then placed upon the gasket 44 outside the annular member 46 and clamped in that position by the clamps 62.

In the use of a sleeve of non-resilient material the diameter of the neck aperture 60 is inversely proportional to the length of sleeve 52 which extends between the annular members 46 and 54 and by pulling the sleeve 52 past the bead chain 56 transversely of the groove of the annular member 54, a position can be selected longitudinally of the sleeve which causes the pleated sleeve to fit snugly about the patient's neck thereby minimizing air leakage without discomfort to the patient. When a bead chain 56 is used as a fastening device, it is possible to make the final adjustment to accommodate the patient's neck by further reduction of the diameter of the neck aperture without the necessity of fully extending the sleeve 52 to the position shown in Fig. 3. This may be done by releasing the clamps 62, grasping the ring 54 in the hands, moving it outwardly away from the gasket 44 to a position where the sleeve material extending from the ring 54 towards the aperture 60 slightly clears the heads of the clamps 48 and then rotating the ring in a direction which would normally reduce the diameter of the neck opening. During such rotation, when sufficient tension is built up in the sleeve, it slips between the chain and the side of the groove in the annular member 54 increasing the operative length of the sleeve between the rings 46 and 54. During such operation the beads 57*a* may rotate upon the connecting members 57*b*. After such adjustment has been made in the size of the neck aperture 60, the annular member 54 is again secured in its rotated position by means of the clamps 62 (Fig. 5). The threaded ends of the clamps 62 engage equally spaced threaded apertures in the ring 36, the clamps being provided with vanes 63 which act as handles to facilitate their operation.

If a helical spring of a proper length is used the same method of reducing the size of the aperture may be used.

If the neck aperture is too small and is uncomfortable for the patient the clamps 62 are released, the ring 54 is moved outwardly to the position shown in Fig. 3, the outer end of the sleeve 52 is extended outwardly from the outer face of the ring 54 and the ring is then moved inwardly toward the ring 46 while retaining the end of the sleeve in extended position. This causes the sleeve to move transversely of the groove between the chain or other sleeve retaining means and the side of the groove and the operative length of the sleeve between the rings 46 and 54 is thus reduced so that a neck opening of larger diameter results when the ring 54 is later fully rotated concentrically of the opening in the plate 36. The projecting end of the sleeve 52 preferably is re-folded to the position of Fig. 3 before rotating the ring to re-pleat the sleeve and after such rotation the ring is re-clamped against the gasket 44. This same method may be used to decrease the size of the neck opening, except that to decrease the size the ring 54 is moved outwardly along the sleeve 52 away from the ring 46 when it is in extended position.

In Figs. 7 through 11 another embodiment of the invention is shown comprising a plate member 36*a* which although rectilinear in shape for use with the rectilinear end wall of a respirator (not shown) performs the same function as the ring 36 which has been described in detail with respect to the embodiment shown in Figs. 1 to 6. In this case, however, four bolts 39*a* and nuts 39*b* are provided to secure the plate on the end wall. The plate member 36*a* is provided with a central opening which when the plate is secured to the end wall is aligned with the opening in such wall. Air leakage between the end and the inner surface of the plate member is prevented by a ring gasket 42*a* (Fig. 10) which is cemented to the inner surface of the plate about the opening therein.

Secured by screws 68 (Fig. 10) to the outer surface of the plate 36*a* about the opening therein is a flange 70, two opposing surfaces of which are undercut to form two opposed concave recesses or grooves the walls of which are engaged respectively by two annular members 46*a* and 54*a* of a resilient material. The smaller annular member 46*a* may consist of a helical spring whose ends are joined to form it into an annular member, the respective diameters of the helix turns and of the annular member being such and the resiliency of the annular turns and of the annular member being such that the annular member may be compressed slightly radially and thus held by the wall of the inner groove of the annular flange 70 whereby the annular member is detachably secured to the plate member 36*a*.

One end of a flexible sleeve 52*a*, which is similar to

the sleeve 52 except for the use of a longitudinal overlap 52*b* instead of a seam as described above, is detachably secured to the flange 70 and the plate member 36*a* by first arranging said end of the sleeve concentrically of the annular member 46*a* and passing one or more turns of the sleeve about said annular member 46*a* before it is mounted in the inner groove of the flange 70 as described above. The larger annular member 54*a*, which may consist of a helical spring similar to the smaller annular member 46*a* described in detail above, is wound in the outer end of the sleeve 52*a* as is shown in Fig. 8. The annular member 54*a* is then rotated concentrically of the opening in the plate 36*a* to fold the sleeve into a plurality of overlapping pleats which define the neck aperture 60*a* as shown in Fig. 7. The annular member 54*a* is then extended slightly radially and snapped into the outer groove of the flange 70 where it is detachably retained by the pressure which it exerts against the wall of the groove due to its longitudinal resilience.

To aid in the removal of the annular member 54*a* from the outer recess of the flange 70, one end of a strip of flexible material 72 (Figs. 7, 10 and 11) is secured between the end of the flange 70 and the plate 36*a* by one of the screws 68 and the strip is then brought forwardly adjacent to the wall of the inner groove, thence over the exposed face of the flange and thence rearwardly adjacent to the wall of the outer groove. The free end of the strip 72 is attached to a handle such as the pin 74 so that the annular member 54*a* may be pulled away from and over the flange by exerting tension in the strip 72, such tension temporarily slightly extending the diameter of the annular member at the locality of its engagement with the strip 72.

As was described with respect to the embodiment of Figs. 1 to 6, the diameter of the neck aperture 60*a* is inversely proportional to the length of the portion of the sleeve 52*a* between the annular members 46*a* and 54*a*. This effective length may be varied by adjusting the longitudinal position of the larger annular member 54*a* on the sleeve 52*a* with respect to the smaller annular member 46*a*. The neck aperture diameter is most conveniently varied by changing the amount of the sleeve 52*a* which is wound upon or passed about the annular member 54*a*, the greater the amount the shorter the effective sleeve length and the greater the aperture diameter; and conversely the smaller the amount the longer the effective sleeve length and the smaller the aperture diameter. To change this sleeve length it is merely necessary to remove the annular member 54*a* from the groove, rotate it concentrically of the neck opening 60*a* so as to remove the pleats and then rotate it concentrically of the axis of its helix turns. The latter rotation increases or decreases the amount of the sleeve which is wound or passed about the annular member and thus controls the effective length of the sleeve.

A third embodiment of the invention is shown in Figs. 12 through 17 wherein the flange 70*a*, which is similar in construction to the flange 70 described above, is attached directly to the end wall 30*a* of a respirator 22*a* rather than to a plate member as was the case in the previously described embodiments. The walls of the grooves of the flange 70*a* engage respectively two annular members 46*a* and 54*a* upon which the sleeve 52*a* is wound, these annular members and sleeve being similar

in construction and operation to the elements bearing the same indicia which were described in detail above in connection with the embodiment shown in Figs. 7 to 11.

From the foregoing it will be apparent to persons skilled in the art that I have provided a collar for controlling the size of an opening in a wall of a respirator or similar therapeutic device which is strong and durable in construction, easy to replace, which can be quickly and easily adjusted to the desired size by one attendant, which is safe to operate and will not injure either the patient or the attendant during operation and which may be economically manufactured.

It should be understood that the present disclosure is for the purpose of illustration only and that this invention includes all modifications and equivalents which fall within the scope of the appended claims.

I claim:

1. A device for constricting an opening in the wall of a closed therapeutic chamber about a body member projecting through said opening comprising an annular helical spring which has a self-sustaining cross sectional shape, a flexible sleeve of material which is substantially impervious to air, one end of said sleeve being arranged concentrically of said annular helical spring and detachably passed about it, and means for detachably securing said annular helical spring concentrically of said opening in said wall.

2. The device of claim 1 wherein said means for detachably securing said annular member concentrically of said opening comprises a ring having a flange on its outer peripheral surface for receiving said annular member and a flange on its inner surface for use in detachably securing the other end of said sleeve concentrically of said opening in said wall.

3. A device for constricting an opening in the wall of a closed therapeutic chamber about a body member projecting through said opening comprising a flexible sleeve of material which is substantially impervious to air, a supporting ring having a groove in its outer peripheral surface for use in detachably securing one end of the sleeve to said wall concentrically of said opening, and an annular helical spring which is capable of being rotated about its longitudinal axis, said one end of said sleeve being arranged concentrically of said annular helical spring and detachably passed about it and said annular helical spring being detachably positioned in said groove.

4. The device of claim 3 wherein said supporting ring also has a groove in its inner surface for use in detachably securing the other end of the sleeve to said wall concentrically of said opening.

References Cited in the file of this patent

UNITED STATES PATENTS

1,431,918	Arthur	Oct. 17, 1922
1,906,844	Drinker	May 2, 1933
1,986,484	Schlueter	Jan. 1, 1935
2,405,682	Bogoslowsky	Aug. 13, 1946
2,478,852	Wallin	Aug. 9, 1949
2,695,608	Gibbon	Nov. 30, 1954

FOREIGN PATENTS

535,489	Great Britain	Apr. 10, 1941
592,388	Great Britain	Sept. 16, 1947