

March 10, 1953

E. C. NICKLES

2,630,799

ADJUSTABLE HEAD-END COLLAR FOR RESPIRATORS

Filed Dec. 29, 1951

2 SHEETS—SHEET 1

Fig. 1.

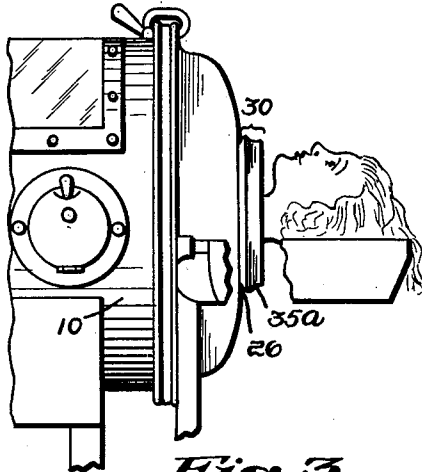


Fig. 2.

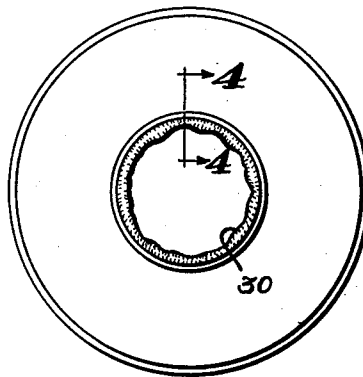


Fig. 3.

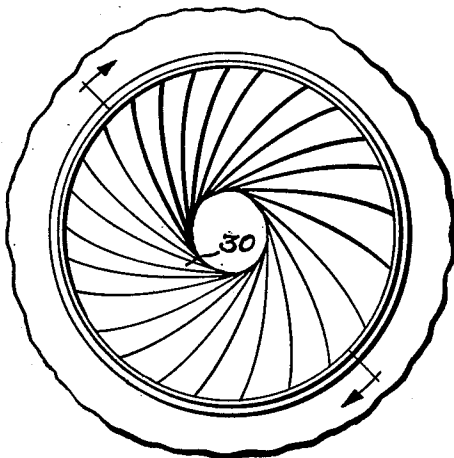


Fig. 4.

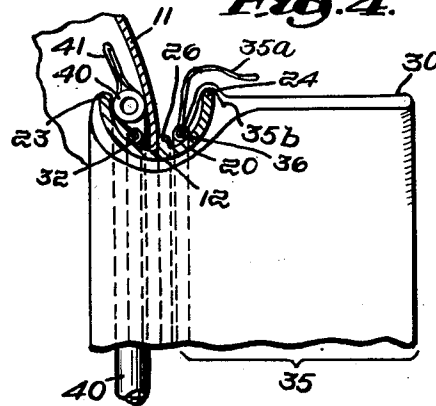


Fig. 5.

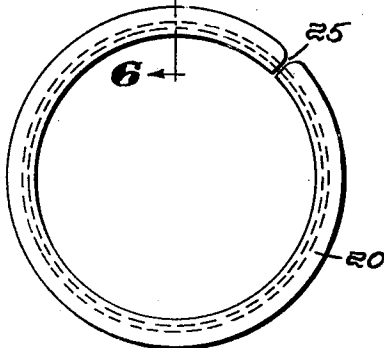
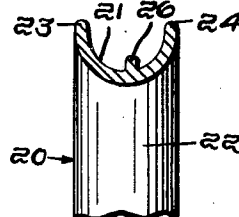


Fig. 6.



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2 SHEETS—SHEET 2

Fig. 7.

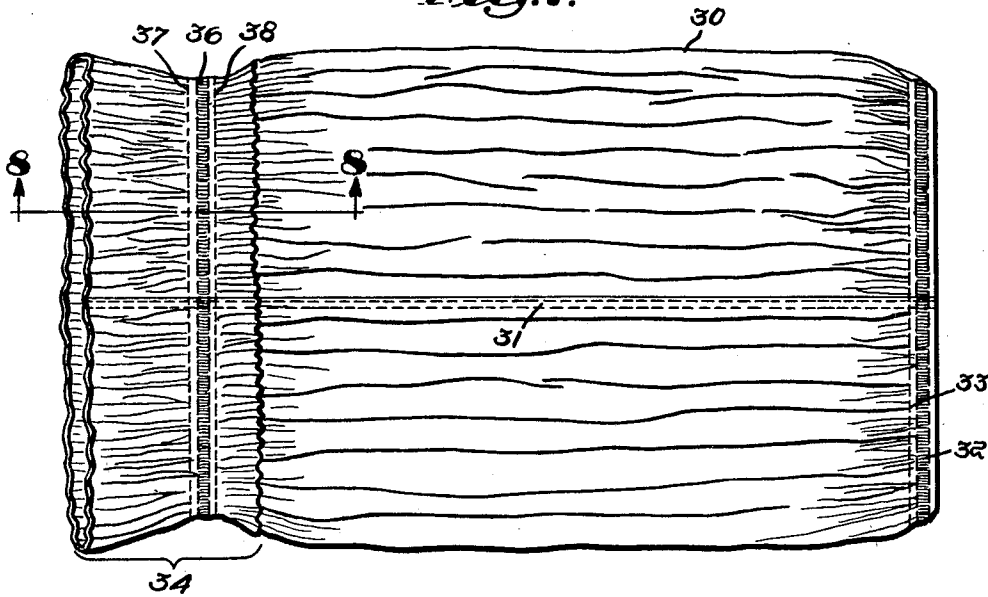


Fig. 8.

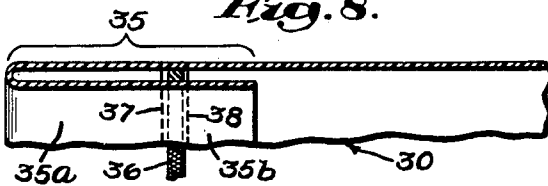


Fig. 10.

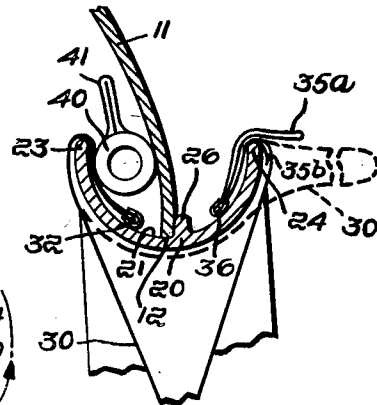
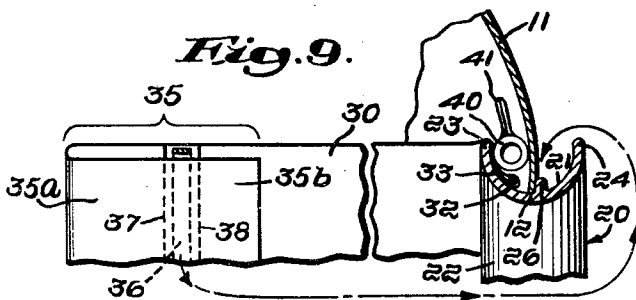


Fig. 9.



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UNITED STATES PATENT OFFICE

2,630,799

ADJUSTABLE HEAD-END COLLAR FOR
RESPIRATORS

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8 Claims. (Cl. 128—30)

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My present invention relates generally to respiration apparatus of the type providing a chamber and associated pressure regulating means for aiding or artificially producing respiration in a patient received therein, and more particularly to a new and improved collar assembly for sealing the head openings of such respirator chambers.

The numerous collar types and forms heretofore employed for the purpose have been found variously complex, cumbersome, and incapable of rapid, accurate adjustment to and from the operative or neck-sealing position, with the patient's head projected outwardly through the collar. Due in part to the unsatisfactory mode and manner of their adjustment and in part to the bulky materials of which they have been fabricated, prior collars have been a source of discomfort to the patient under usual conditions of prolonged use. Such prior collars also have generally required special and relatively expensive respirator-attached fittings.

These and other prior art difficulties and disadvantages are avoided and overcome by the present invention, which provides a simple and efficient respirator collar of inexpensive manufacture and rugged construction. The collar of the invention is characterized further by a minimum number of parts, a capacity for sensitive and accurate adjustment, and a singular ease of attachment to and removal from the respirator without the use of elaborate fittings. My novel respirator collar provides still further an adequate and lasting seal without discomfort or injury to the patient.

The invention will be better understood from the following description taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a side view of the head end of the main chamber of a respirator provided with the collar of the invention;

Fig. 2 is an end view of the respirator of Fig. 1;

Fig. 3 is an end elevation like that of Fig. 2, but on a larger scale, and with the collar sleeve rotated to neck-sealing position;

Fig. 4 is a section as on the line 4—4 of Fig. 2, illustrating the novel aperture seal of the invention;

Fig. 5 shows separately the collar retainer ring;

Fig. 6 is a section as on the line 6—6 of Fig. 5;

Fig. 7 is an elevation of the collar sleeve;

Fig. 8 is a section as on the line 8—8 of Fig. 7;

Fig. 9 is a section like that of Fig. 4 but with the sleeve in an intermediate stage of assembly, and

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Fig. 10 is a section like that of Fig. 4, but on a larger scale, and with the collar sleeve rotated to neck sealing position, as in Fig. 3.

In Fig. 1 the collar of the invention is shown operatively positioned on the head opening of the end wall of a conventional respirator having a patient-receiving chamber within a cylindrical wall 10 and a separable rounded end wall 11 with a central aperture defined by a rim 12, Figs. 4 and 9. The patient rests on a cot which is slideable lengthwise into and from the chamber 10 along with the head-end wall 11. The latter is supported by wheeled legs (not shown) and is adapted to be sealingly clamped to the chamber 10, all as well known to the art. The patient's head projected through the end wall aperture defined by the rim 12 is received on a rest, as shown. In accordance with the invention, and as will be readily apparent from the several views, this usual respirator construction itself utilized to anchor and support my novel collar in a manner to be described.

Referring now more particularly to Fig. 4, the collar of the invention is there shown to be constituted by but three unitary elements. Annular means 20 is provided for concentrically positioning and rigidly anchoring the assembly on the rim 12 of the head opening. The neck engaging element proper 30 is held on and by said annular means and in accordance with the invention is guided thereby for the unique rotary collar adjusting movement. The means 20, 30 are clamped and sealed together and to the respirator wall by the third or assembly completing element 40.

The annular attaching and guiding means 20, noting particularly Figs. 4 to 6 and 9, comprises an annular hoop-like element or ring of U or substantially half-round cross-sectional form, with the concave side outward. In other words, it is formed exteriorly with an annular trough, channel or groove 21 and has a convex or half-round radially infacing side 22, providing left and right hand, or inner and outer peripheral flanges 23, 24. This ring 20 may be formed of a plastic, wood, metal or other material of suitably resilient character, and is transversely divided as at 25, Fig. 5, whereby it may be removably sprung into place. It will be understood that the wall thickness and contour of the ring 20 may vary substantially with the materials used consistent with the stiffness and resiliency contemplated by the invention, the configuration herein illustrated being appropriate to a presently preferred molded plastic embodiment. In such preferred embodiment the groove

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21 may have a relatively narrow or U-form whereby closely to overlie or straddle the rim 12 in desired manner, or it may have the relatively wide and shallow configuration illustrated herein, wherein it is desirably provided at the base of the trough with an annular stop-forming rib or bead 26 positioned at the right or outer side of the center line, as clearly shown in Fig. 6.

In further accordance with the invention, the aperture-varying neck-sealing element 30 comprises a unitary tube or sleeve of a flexible sheet material which is non-porous or impermeable to a degree supporting a substantially air-tight seal. It will be understood that numerous resinous and other flexible impermeable materials, both inelastisic and elastic, are contemplated for the sleeve 30, but I prefer to employ the plastic commercially identified as Vinylite and known to have the desired flexibility and durability, and to be characterized further by a non-reactive, non-wettable surface rendering it compatible with the skin under the mentioned condition of prolonged use.

Referring now more particularly to Figs. 7 to 9 the collar sleeve 30 may be integrally formed from a tube, or it may be fashioned from lay-flat material rolled and axially stitched as at 31. It has a normal or overall circumferential dimension at the respective end portions predeterminedly such as to fit closely and tightly over the flanges 23, 24, when the ring 20 is snapped into place on the rim 12; see also Figs. 4 and 10. In accordance with the invention this collar sleeve 30 has at one end, that to go at the inner face of the respirator end wall 11, a circumferential elastic band 32 of an overall diameter, in its unstressed state, substantially less than that of the flanges aforesaid. The band 32 may be applied about the marginal edge of the sleeve 30 in the manner of a binding or facing, or the sleeve edge may be turned over the band and circumferentially stitched, as at 33, Figs. 7 and 9.

In further accordance with the invention the other or outer end of the sleeve 30 is folded over, herein inwardly, as seen in Figs. 8 and 9, against the sleeve body to provide a relatively deep doubled-over portion designated generally at 35. This outer end portion 35 of the sleeve is further provided intermediately with a circumferential elastic band 36 which is proportioned like the band 32, and which may be applied at either face of the sleeve or it may be pocketed between parallel lines of stitching 37, 38. The band 36 may be said for convenience to divide this terminal folded-over portion 35 into outer and inner, herein greater and lesser, sections 35a, 35b. The outer section 35a will be referred to as the manipulating portion or flap.

The clamping and sealing element 40 previously mentioned is fashioned preferably of a round sectioned elastic band or ring, as seen in Figs. 4, 9 and 10, which predeterminedly is capable of exerting, when tensioned, a substantially greater compressive force than the bands 32, 36. This clamp ring 40 may be of a solid rubber or other elastic material, or it may be fashioned from a length of tubing as in the embodiment illustrated. The ring 40 is conveniently provided further with a manipulating tab 41, Figs. 4, 9 and 10, as for facilitating assembly and disassembly of the collar. It will be apparent that numerous other clamping ring shapes, forms and compositions lie within the scope of the invention, that herein shown merely being one which is demonstrably characterized by the simplicity, efficiency and durability contemplated therefor.

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In the assembly of the collar, the mounting ring 20 is first spring-seated on and straddling the rim 12 of the head opening with the bead 26 lying against the outer face of the respirator head-end wall 11, as clearly shown in Figs. 4, 9 and 10. The inner end of the collar sleeve 30 is then expanded over the inner flange 23 of the ring 20, at the inside face of the respirator wall 11. The band 32 when released then serves to contract and position this inner end of the sleeve in the base of the trough 21; Figs. 4, 9 and 10. The annular clamping and sealing ring 40 is next expanded over the ring 20 and sleeve 30 and positioned against the inner face of the respirator wall 11. When released, this clamp ring 40 contracts and sealingly compresses the sleeve 30 within the groove 21, wedging itself between said inner face of the respirator end wall 11 and the inner flange 23 of the mounting ring 20, with the sleeve 30 interposed between it and said mounting ring. This action also serves to draw the mounting ring 20 inward, urging its positioning bead 26 against the outer face of said end wall 11; see particularly the fully seated position of Fig. 4 as compared with the precedent assembly stage of Fig. 9. The assembly as a whole is thus firmly fixed to the respirator, with the mounting ring 20 aligned and concentric with the rim 12 and under radial and also lateral compression thereat, and with the inner end of the collar 30 anchored on the respirator wall and adequately sealed thereat against air pressure differentials occurring across the respirator opening. While the bead 26 within the trough of the mounting ring 20 aids positive positioning thereof satisfactory results have been had with rings omitting such auxiliary positioner.

Having thus secured the inner end of the collar sleeve 30 at the inside of the respirator end wall, the collar as a whole in introverted and passed outwardly through said anchored inner end portion and through the mounting ring 20. The now outer or free end portion 35 of the sleeve at the zone of the band 36 is then turned reversely back toward and over toward the exterior of the end wall 11. The band 36 is at the same time stretched over the external flange 24 of the mounting ring 20. It is then released and allowed to snap down into the annular channel within the mounting ring 20 between the external flange 24 thereof and the respirator end wall 11, externally of the locating rib 26 when the latter is employed. Thus as seen in Fig. 4 and on a larger scale in Fig. 10 the shorter two-walled section 35b of the end portion 35 is inturned and in effect tucked under the also two-walled manipulating or hand-grip section 35a. Aided by the contractive action of the band 36 said hand-grip section 35a tends to stand out, projecting circumferentially in a generally axial direction with respect to the end-wall aperture, where it may readily be grasped for collar manipulation.

The collar 30 is thus completely installed on the respirator end wall 11, in readiness to close variably and to open the head and neck aperture therein. The inner end of the collar is firmly anchored internally of the end wall 11, by means of the relatively heavy and strongly resilient clamp ring 40, while the outer end is operatively positioned at the outer face of the end wall, subject to rotative adjustment thereat to decrease or enlarge the neck aperture as now to be described.

As an important feature of the invention, the outer end portion 35 of the collar, including the

guiding and positioning section 35b and the manipulating or hand-grip section 35a have capacity for rotary sliding movement on and around the mounting ring 20 in either direction and through any appropriate angle up to the maximum, so as to give it the desired orientation with respect to the respirator and the fixed inner end of the collar sleeve 30 for sizing the neck aperture accordingly.

By thus bodily revolving the hand-grip section 35a and the associated guide or bearing section 35b about the collar axis the collar body is caused to twist with respect to the stationarily anchored inner end thereof. Simultaneously the collar assumes an angularly pleated annular diaphragm-like form of gradually increasing radially inward extent, as indicated in Figs. 3 and 10. A multiplicity of pleats automatically form themselves, along lines tangential to the decreasing collar aperture and chordal with reference to the rim of the aperture of the respirator end-wall 11, approaching the true radial of the latter as the collar aperture closes. The width of the plural-walled diaphragm closure thus formed is proportionate to the circumferential extent through which the hand-grip section 35a is rotated. The collar may thus be closed down to whatever size of neck opening is appropriate for the given patient. It is as readily opened by reverse axial turning of the hand-grip section 35a, up to the full dimension of head aperture defined by the mounting ring 20. This closing and opening action of the collar may be demonstrated in principle by holding a paper bag at the bottom while relatively rotatively twisting the open end about the bag axis.

It should be noted that the described contractive and snug fitting support of the collar outer end portion 35 around the ring 20 effects a frictional resistance to rotation of the collar operating band which may be predeterminedly sufficient to fix and maintain it in any desired adjusted or operative position. Further in said connection the section 35b of the outer end portion of the collar, the part which has direct bearing and sliding engagement on the external flange 24 of the mounting rim 20, presents a double thickness of strengthening and wear-resisting material over this guiding and bearing flange 24. The latter as well as the inner flange 23 are formed with rounded edges whereby any wear in these regions is minimized. It is also appropriate to note here that the troughed annular mounting element, herein illustrated by the demountable ring 20 may when provided as initial equipment of the respirator be formed integrally with or otherwise attached to the margin of the head-opening of the respirator end wall.

Thus in operation my novel collar assembly is strikingly simple and efficient. The patient having been placed in the respirator with head and neck projecting through the aperture of the end wall 11, with the collar in the open position of Figs. 1 and 2, the axially extending hand-grip or manipulating band 35a is grasped at diametrically opposed points. Then upon moving the hands rotatively about the opening in one direction or the other there is caused a twisting of the collar sleeve portion which lies intermediate the inner and the outer bands 32 and 36, and which when open, as shown in Fig. 2 and in dotted line, Fig. 10, assumes a loosely furled position in and around the margin of the head opening. This sleeve twisting is characterized by the formation of angular pleats tangential to

and spiraling from the central opening in the collar, as indicated in Fig. 3, in a manner having some similarity in appearance to that of an iris-type camera shutter. The central collar opening, concentric with the wall rim 12, is infinitely variable with and by rotation of the manipulating band formed by the flap section 35a. In further accordance with the invention, and as a consequence of the highly flexible and non-re-

active nature of the plastic sheeting sleeve 10, the collar opening readily and sealingly adapts itself to the particular contour or configuration of the patient's neck without discomfort or irritation thereto.

With further reference to the concentrically rotating, twist-pleating action of the collar sleeve 30, the internal sleeve stresses which are reflected in the chordal or spiraling pleats are seen to be largely transverse to the opening, and therefore not such as to overcome the mentioned frictional engagement of the band 36 in groove 21 and of the flap 35 on the flange 24 by which the sleeve is releasably held fast in any adjusted position. In other words, as the ends of the collar sleeve 30 are relatively rotated in the manner described, the intermediate sleeve body is first drawn inwardly from the position indicated in Figs. 2 and 4 to the substantially planar condition suggested by Fig. 3, see also the dotted and the full-line positions in Fig. 10, and is then subjected to predominantly radial pleat-forming stresses which progressively shrink the opening and enhance the frictional engagement over the mounting ring flange 24 sufficiently to nullify whatever unwinding torque set up by the rotative manipulation of the operating band may be experienced thereat. The variation in sleeve stresses in the adjustment through the relatively small range of neck sizes is seen not to be excessive or such as to prevent ready conformation to the contour of large and small necks with equal facility.

Adjustment of the sleeve to and from the closed position is performed in the identical swift sure manner, by the grasping and rotating of the manipulating band as already described. Shifting the collar to the open position therefore requires no troublesome and time-consuming preliminary manipulation of screws and the like clamping or locking devices, as characteristic of the prior art, and involves only the single manipulating action referred to.

From the foregoing description it will be understood that my present invention provides a respirator collar which is uniquely simple in construction and in operation of closing and opening, and which is quickly and easily applied to and removed from the end-wall head opening without the use of fittings specially adapting a respirator for use therewith. The diaphragm-like closure provided by my collar when adjusted to operative position about the patient's neck is sufficiently close fitting to avoid objectionable air leakage or "whistle" under pressure cycling within the respirator and is generally adequately resistant to in-and-out flutter under pressure changes across the aperture. If desired depressor means such as one or more removable bars disposed chordally across the opening may be employed as customary to define in and out limits for the diaphragm element; obviously also the flexible closure or collar device of the invention is not confined to use at the particular location shown and for which it is especially suited

but is generally useful at access and utility openings of respirators and the like where a passage adjustable to fit a through-extending object is desired.

My invention is not limited to the particular embodiments thereof illustrated and described herein, and I set forth its scope in my following claims.

I claim:

1. Apparatus for sealing the neck receiving opening of an artificial respirator comprising, in combination, an exteriorly grooved snap ring spring seated on the rim of said opening, a generally cylindrical flexible imporous sleeve through said opening and having terminal portions brought reversely over said ring and elastically contracted in said groove, a clamping and sealing ring wedged in said groove between the inner of said portions and the respirator wall, and manually manipulable means integrally projecting at the outer end of said sleeve whereby said terminal portions may be relatively rotated and the intermediate sleeve body varyingly twist-pleated to adjust the size of said opening.

2. Apparatus for operatively sealing the neck receiving aperture of an artificial respirator, comprising, in combination with the rim of such aperture, an annulus removably straddling said rim, a thin-walled flexible seal-forming sleeve passing through said aperture, said sleeve having one end anchored about said annulus inside said rim and having spaced from its other end a circumferential portion slidably seated on said annulus outside said rim, said other sleeve end forming a manipulating flap whereby to rotate said slidably seated portion relative to said anchored end for aperture-varying twist-pleating of the intermediate sleeve body, and means for sealing said anchored end to said annulus and to said rim.

3. A new and improved collar for the head opening of an artificial respirator comprising a mounting ring straddling the rim of said opening and a flexible sleeve passing through said opening and having one end fixedly and the other end rotatably received directly on said ring at opposite sides of said rim, said sleeve having the intermediate body portion doubled on itself and twist-pleated by relative rotative displacement of the sleeve ends about the head opening axis whereby a radially adjustable closure for the head opening is formed.

4. An adjustable collar for the head opening of artificial respirators comprising a ring straddling the rim of said opening, a flexible sleeve having its one end fixedly and its other end rotatably received on said ring at opposite sides of said rim, and having an annular manipulating portion integrally projecting at said other end and rotatable therewith to position the intermediate sleeve body for sealing engagement about the neck of a patient in said respirator.

5. A new and improved collar for the head opening of an artificial respirator comprising in combination a peripherally grooved ring for straddling the rim of such opening, a flexible sleeve dimensioned to pass through said opening and to have its one end fixedly and its other end rotatably received on said ring at opposite sides of such rim, and ring means for removably clamping about said one end and sealing said sleeve to such rim.

6. A new and improved collar for the head opening of an artificial respirator comprising means on the rim of said opening providing infacing and outfacing flanges, a sleeve of flexible web material passing through said opening and having one end fixedly received on the infacing flange and the other end rotatably received on the outfacing flange, the intermediate body portion of the sleeve forming multiple twist-pleats adapted on relative rotation of the ends in one and the opposite direction to reduce and to enlarge the head opening in iris shutter fashion.

7. A collar device for sealing the head opening of an artificial respirator comprising an exteriorly grooved ring straddling said opening, and a relatively thin walled flexible sleeve having an inner end sealingly clamped in said groove inside said opening, a twist-pleatable intermediate body portion passed through said opening, and an outer end doubled over to present a relatively stiff annular manipulating portion and including an elastic band slidable in said groove outside said opening and anchoring and supporting said portion for rotation about said ring, said sleeve and said resilient means proportioned respectively to fit tightly over said ring and to contract in said groove whereby frictionally to resist rotary sliding movement of said manipulating portion from its adjusted position.

8. A collar assembly for the head opening of an artificial respirator comprising in combination a split ring formed with an annular groove in its outer face and with an annular bead at the base of said groove, said ring spring seatable on the rim of said opening with the bead against the outer face of said rim, a flexible plastic sleeve for passing through said opening, elastic bands about one end and about an annular portion in the region of the other end of said sleeve and adapted to be brought reversely over said ring and to contract in said groove, and an elastic clamping and sealing ring for wedging said trough between said one sleeve end and the respirator wall and urging said bead against said outer rim face, said other sleeve end adapted to project outwardly of said ring and to form a rotatable manipulating flap.

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No references cited.