March 31, 1959 H. J. CYPHERS 2,879,764

SEALING DEVICE FOR MECHANICAL RESPIRATOR

Filed Nov. 15, 1957 3 Sheets-Sheet 1

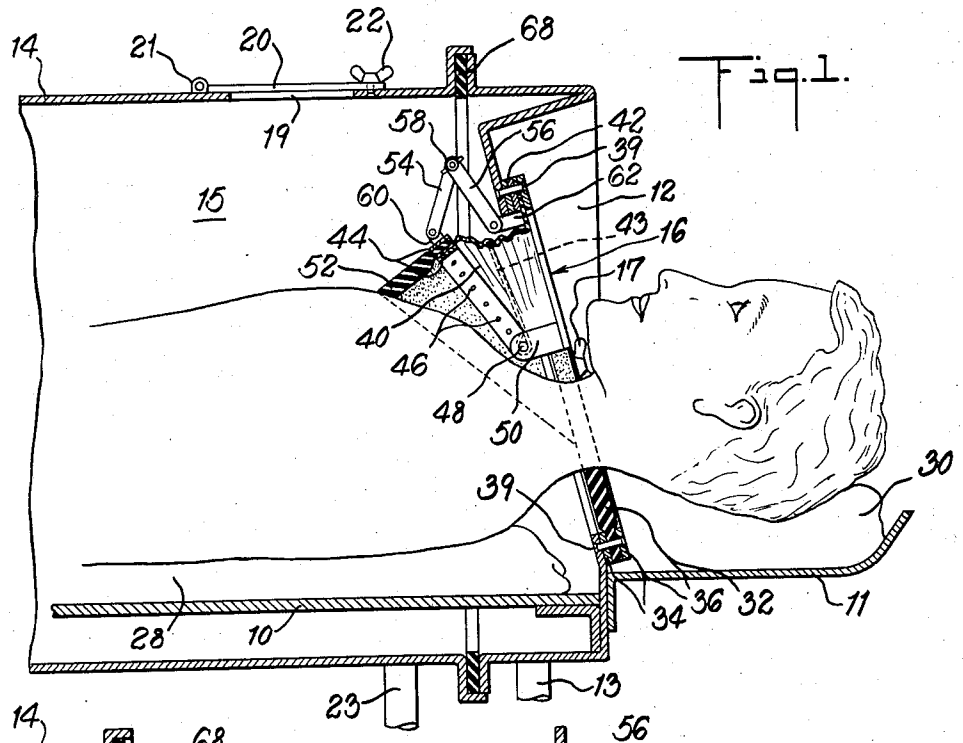


Fig. 1.

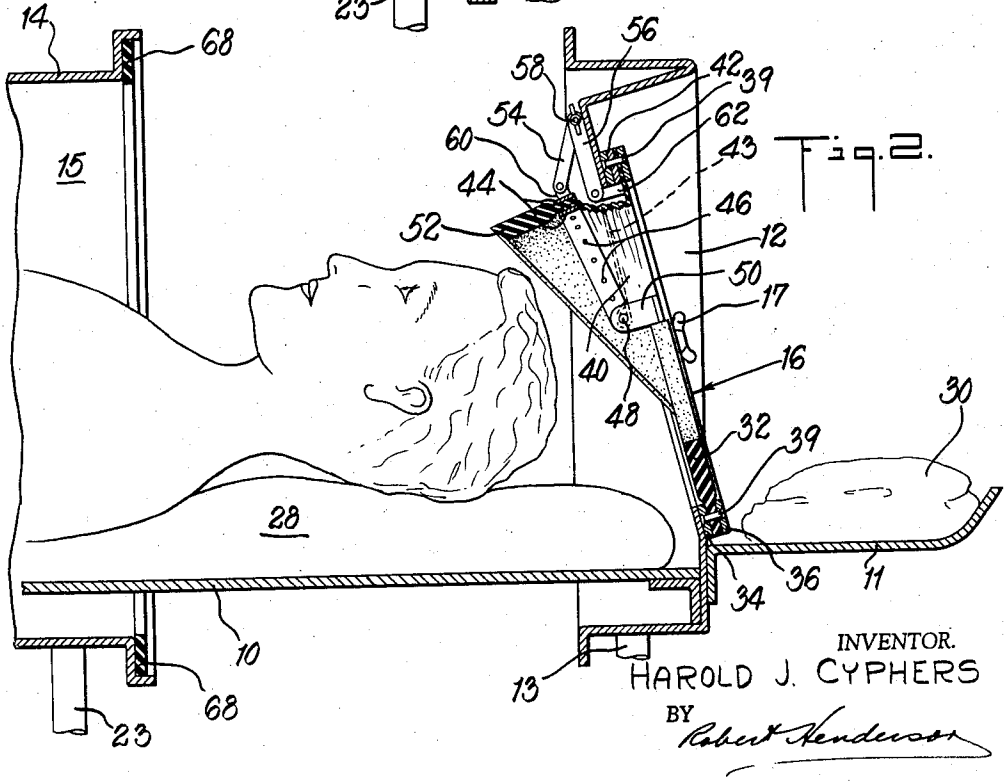


Fig. 2.

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SEALING DEVICE FOR MECHANICAL RESPIRATOR

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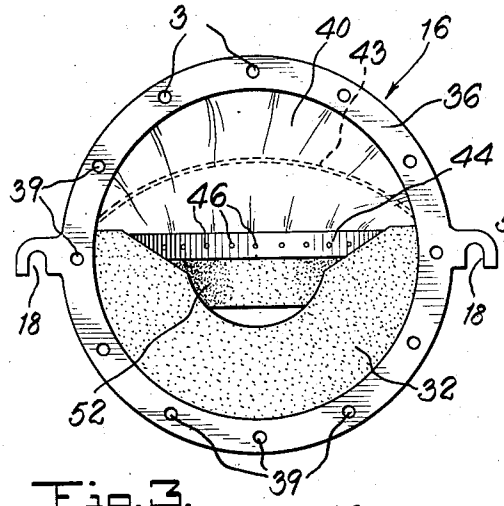


Fig. 3.

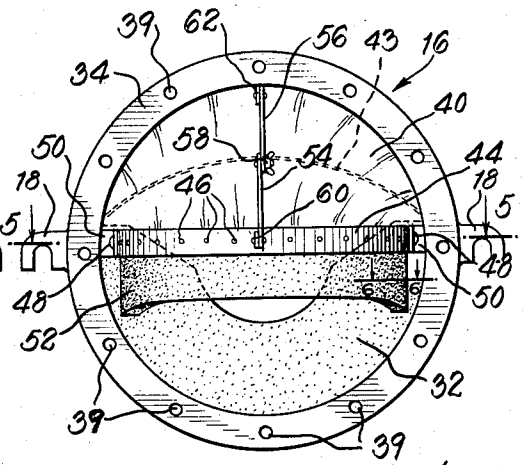


Fig. 4.

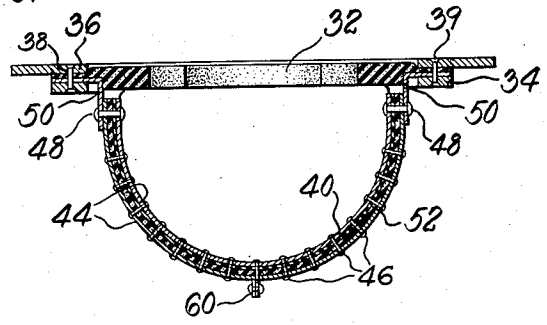


Fig. 5.

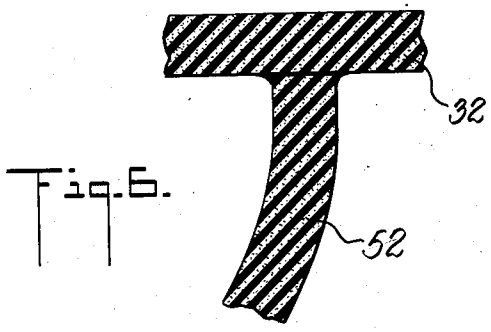


Fig. 6.

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Fig. 7.

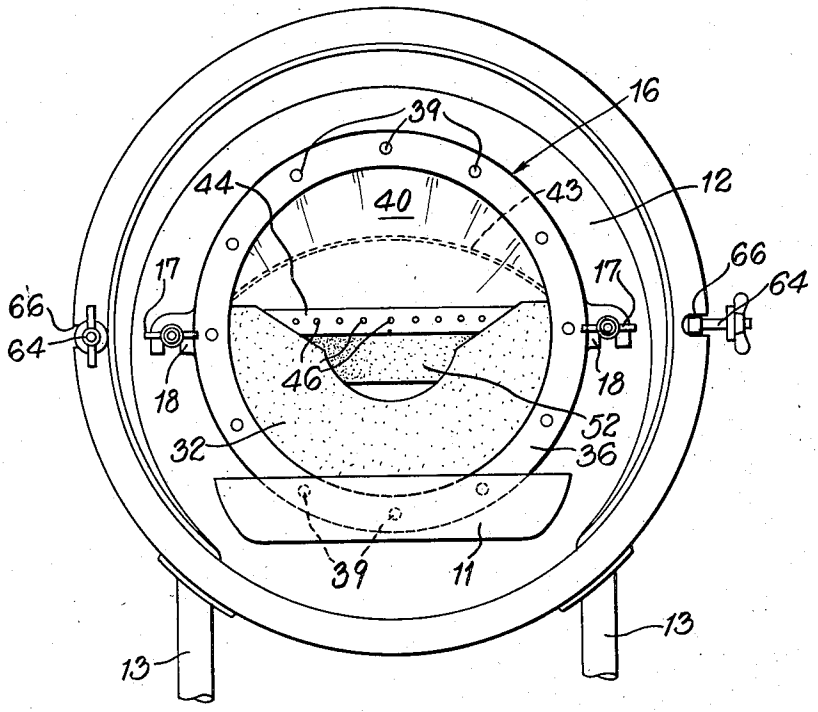
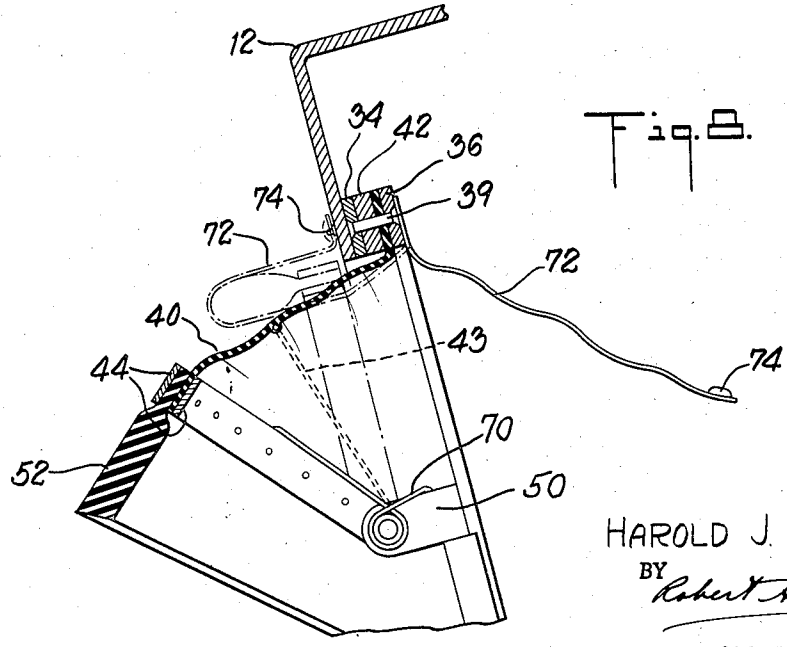


Fig. 8.



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2,879,764

SEALING DEVICE FOR MECHANICAL RESPIRATOR

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Application November 15, 1957, Serial No. 696,648

6 Claims. (Cl. 128—30)

This invention relates to sealing devices such as are used in mechanical respirators wherein pulsating air pressure is established by mechanical means in a portion of the device which encloses a human torso in order to cause expansion and contraction of the patient's chest to sustain breathing of the patient.

The invention relates more particularly to means associated with such a pressure chamber for effecting a seal about the upper part of the torso or, i.e., in the general vicinity of the neck and chest of the patient enabling the patient's chest to be expanded and contracted by the pulsating pressure while enabling the patient's head to be outside of the pressure chamber. Although the device which constitutes the present invention functions in relation to a patient's chest, as well as in relation to his neck, the device will hereinafter sometimes be referred to, for convenience, merely as a "neck seal."

Such neck seals, heretofore provided in mechanical respirators, have usually been in the form of an annulus of sponge or foam rubber which, when the patient is in position in the respirator, extends closely about the patient's neck. The principal disadvantages of such an annular neck seal are: (1) the discomfort of the neck seal to the patient because of the fact that the seal ordinarily fits quite tightly about the patient's neck; (2) the fact that such an annular neck seal must be expanded by a suitable expanding device in order to enable the patient's head to be pushed through the central opening therein in placing the patient properly in the respirator; and (3) such a neck seal, fitting closely about a patient's neck, would prevent the performance of a tracheotomy while the patient is in the respirator and would press against a metal tube inserted in the patient's trachea and cause severe irritation.

An important object of the present invention is the provision of an upper torso or neck seal for a respirator which avoids close confinement of the patient's neck and thereby greatly minimizes possible discomfort on the part of the patient.

Another important object is the provision of such an upper torso or neck seal of such structure that the sealing effect across the front of the patient takes place chiefly across his chest rather than at his neck.

Another important object is the provision of such an upper torso or neck seal which includes means by which the seal may easily be opened up and held open to such a substantial extent that the patient's head may very easily be passed through the seal in placing him in position in the respirator.

Another important object is the provision of such an upper torso or neck seal which affords space for performance of a tracheotomy while the patient is in the respirator and avoids irritation resulting from pressing of some part of the device upon a tube inserted in the patient's trachea.

The foregoing and other more or less obvious objects are accomplished by the present invention of which two illustrative embodiments are shown in the accompanying drawings without, however, limiting the invention to those particular embodiments.

In the drawings:

Figure 1 is a fragmentary, central, vertical, longitudinal sectional view of one end of a pulsating pressure chamber of a mechanical respirator including a preferred form of upper torso seal according to the present invention; this view also showing the upper portion of a patient's body in proper place within the device with the seal in sealing position in relation to the neck and torso of the patient.

Fig. 2 is a view of a character somewhat similar to Fig. 1 but showing the patient in the process of being put into place in the device.

Fig. 3 is an end elevational view of the seal included in Figs. 1 and 2, as viewed from the outer side of the seal or, i.e., from the right side of Fig. 1.

Fig. 4 is an end elevational view of the inner side of the seal.

Fig. 5 is a horizontal sectional view of the seal substantially on the line 5—5 of Fig. 4.

Fig. 6 is an enlarged, fragmentary, sectional view substantially on the line 6—6 of Fig. 4.

Fig. 7 is an outer end view of the seal as applied to a head end closure of the respirator.

Fig. 8 is a central, vertical sectional view of a modified form of seal according to this invention.

Mechanical respirators have been manufactured in various forms; hence, in showing certain parts of a respirator in Figs. 1, 2, 7 and 8, no attempt has been made to show those parts precisely as they appear in any particular type of respirator now in use, but they are shown quite generally or diagrammatically in relation to the upper portion of a patient and to a seal for effecting a substantially airtight seal about the upper part of the torso of the patient while enabling the patient's head to protrude from the device.

Thus, in Figs. 1 and 2, there are shown, as parts of a respirator, a mattress support **10** and a pillow support **11**, both as integral parts of a head end wall **12** which is supported by suitable legs **13**. A fragmentarily shown cylinder **14**, defining therewithin a pulsating-pressure air chamber **15**, and an upper torso or neck seal **16**, are also shown in said figures, said neck seal being circular in shape and held in place on the wall **12** by wing nuts and bolts **17** or equivalent fastening means (Fig. 7) engaging slotted lugs **18** provided at opposite sides of said seal. The cylinder **14** preferably has a suitably located top or side opening **19** covered in any suitable manner by a cover **20** which may be hinged at **21** to the cylinder **14** and may be held in its closed position, as shown, by a hand-operable clamp **22**. The opening **19** should be so located as to enable one servicing or operating the device to have manual access to the interior of the cylinder **14** whereby to adjust the seal **16** properly, as hereinafter explained.

The cylinder **14** is suitably supported on legs **23**, of which only one is fragmentarily shown, and those legs, as well as legs **13** of the end wall **12**, are commonly provided with casters or wheels enabling the cylinder **14** and end wall **12** to be moved endwisely of the cylinder relatively to each other and to enable the entire respirator to be rolled along a floor. The mattress support **10** is suitably supported within the cylinder **14** for endwise movement into and out of said cylinder, and telescoping tubular guides (not shown) may be employed below said cylinder to guide such relative movement of the end wall **12** and the cylinder **14**.

The respirator is provided with a suitable mattress **28** and a pillow **30** for the comfort of the patient. In addition to the showing of Figs. 1 and 2, the details of the upper torso seal **16** are shown in the other figures

of the drawings. The seal **16**, as illustrated, has a generally flat, approximately semi-annular neck rest or seal **32** of soft rubber or rubber-like material, such as sponge or foam rubber, which neck rest or seal is disposed in the lower half of the seal **16**, being held in place by having its semi-circular outer margin clamped securely between two rigid metal rings **34** and **36** having countersunk holes **38** therein within which rivets **39** are provided to hold said two rings securely clamped together.

The upper half of the seal includes a canopy **40** of substantially impervious sheet-rubber or equivalent impervious flexible material, the sheet-rubber constituting said canopy having a semi-circular margin which is clamped between the upper halves of the rings **34**, **36**. As the sheet-rubber of the canopy is thinner than the clamped marginal portion of the neck rest or seal **32**, a suitable semi-circular filler piece **42** is clamped with the mentioned sheet-rubber between the upper halves of the rings **34**, **36** in order to impose proper clamping pressure upon the mentioned sheet-rubber. To oppose or minimize collapse of the canopy **40** with pulsations of the air in the cylinder **14**, said canopy may advantageously have one or more semi-circular wire supports **43** or equivalent supporting means embedded therein; one such support being indicated in broken lines in most figures of the drawings.

The sheet-rubber constituting the canopy **40**, if it were unwrinkled and extended as completely as possible, would be approximately in the form of a quarter-sphere. The margin of this quarter-sphere, remote from the previously mentioned semi-circular margin thereof, is clamped between two semi-circular bands **44** which preferably are held together by a series of rivets **46** which pass through adjacent marginal portions of the canopy **40**. At their extremities, the semi-circular bands **44** are pivotally connected by rivets **48** to lugs **50** which are clamped between rings **34**, **36** at opposite side points thereof so that the bands **44** may swing between a fully raised position, as shown in Fig. 2, and a somewhat lowered or sealing position, as shown in Fig. 1.

Also clamped between the bands **44** and held by the rivets **46** is the upper margin of an approximately semi-cylindrical sealing member **52** of sponge or foam rubber, or equivalent material. Toward its opposite ends the sealing member **52** is airtightly bonded suitably to upper side portions of the neck rest or seal **32**, as shown in Fig. 6, and the approximately semi-circular free edge of the sealing member **52** is thereby established in substantial continuity with the neck rest or seal in such manner that the sealing member **52** effects a seal across the patient's chest, as shown in Fig. 1, while the neck rest or seal effects a seal around the back of the patient's neck.

Means are provided for holding the bands **44** and the sealing member **52** in their raised position shown in Fig. 2, which means function also to hold said bands and sealing member in their lowermost or sealing position, as shown in Fig. 1. The mentioned means comprise two rigid arms **54**, **56** pivotally joined by a bolt and wing nut **58**, and the ends of said arms, respectively, are pivotally connected to a lug **60** suitably fixed approximately to the center of the bands **44** and a lug **62** suitably fixed to the metal rings **34**, **36** at the top thereof.

In the use of the device, pivotal wing nut and bolt assemblies **64** on the cylinder **14** are loosened and swung sidewisely from within slots **66** in end wall **12**, whereafter the latter is pulled away from the cylinder **14**, thereby withdrawing the supported mattress **28** from within said cylinder. The operator then sees that the bands **44** are in their uppermost position, as in Fig. 2, and tightens them in that position by tightening the wing nut **58**; the member **52**, in that position, being somewhat stretched, as may be observed from the mentioned figure. Then, the patient is placed upon the mattress and is slid upwardly thereon so that his head passes through the seal **16** between the neck rest or seal **32** and the then-raised cylindrical sealing member **52** and reaches a position in which it may rest upon the pillow **30**.

During the passing of the patient's head through the seal, the neck rest **32** may be held downwardly by the operator either manually or by the use of a suitable spreading device, although, even if this is not done, the patient's head may pass through the seal **16** quite easily and with little or no annoyance to him. The neck seal **32**, of course, is released after the patient has been properly positioned in the device, whereupon the neck rest or seal lightly and comfortably engages the back and side of the patient's neck. After the patient is positioned comfortably with his head upon the pillow **30**, the operator releases the wing nut **58** and then pivots the bands **44** downwardly to bring the bottom or sealing edge of the cylindrical sealing member **52** down lightly upon the patient's chest and in position to extend somewhat across the front of the patient's shoulders. After having achieved this positioning of the sealing member **52**, the operator retightens the wing nut **58** to hold the parts in their positions shown in Fig. 1 of the drawings. Then the end wall **12** is pushed back into engagement with a gasket **68** on the near end of the cylinder **14**, after which the latter and the end wall **12** are locked together by suitable manipulation of wing nuts and bolts **64**. The opening **19** enables further adjustment of the neck seal, if necessary, without again separating the end wall **12** from the cylinder **14**.

It will be understood that an uninterrupted sealing effect with the patient's neck and chest is achieved by the neck seal **32** and the semi-cylindrical chest seal **52** and that no part of the seals **32** or **52** is in engagement with the front of the patient's neck where such engagement would cause considerable discomfort to the patient. The present invention, thus, affords a greater degree of comfort than can be had with prior neck seals.

It will also be seen from Fig. 1 that, when the patient is in the respirator, his neck is accessible for the performance of a tracheotomy and a tube extending into his trachea will not be pressed against to any material extent by any part of the neck seal, so that he will suffer no discomfort in that respect.

The embodiment illustrated in Fig. 8 differs from the first-described embodiment chiefly in the omission of adjusting arms **54**, **56** and in the substitution of torque springs **70** so associated with each of lugs **50** and the bands **44** as normally to urge the latter and the semi-circular sealing member **52** toward the patient's chest and to hold said member yieldably against the patient's chest. When the patient's head is being slid through the neck seal in placing him in the respirator, a strap **72**, suitably anchored at one end to rigid ring **36** and having fastening means **74** at its other end, may pass through and about the canopy **40**, bands **44** and sealing member **52** and, by said fastening means, be fastened to rigid ring **34**, as illustrated in broken lines in Fig. 8, to hold the mentioned parts **40**, **44** and **52** up while the patient's head is passing through the seal. After the patient is properly positioned, the strap **72** is unfastened and suitably tucked aside, leaving the springs **70** to hold the sealing member **52** in sealing engagement with the patient's chest.

It should be apparent that the disclosed concepts may be utilized in various other ways without, however, departing from the invention as set forth in the following claims.

I claim:

1. A sealing device for a mechanical respirator comprising a substantially semi-annular neck rest having an outer marginal portion adapted for airtight association with a part of a neck opening of a pulsating-pressure air chamber of a respirator and an inner surface adapted for sealing contact with the back of a patient's neck, an impervious flexible canopy, extending laterally of said neck rest, having a first marginal portion adapted for air-

tight association with another part of said neck opening and complementing said marginal portion of the neck rest to effect a circumferentially continuous seal of the sealing device with said neck opening, and said canopy having a second marginal portion connected to said neck rest and adapted to engage the patient's chest to effect a seal thereacross and to form with said neck rest a seal, with the patient, which extends uninterruptedly about the latter's neck and chest.

2. A sealing device for a mechanical respirator comprising a substantially flat, semi-annular neck rest and a sealing canopy extending laterally of the neck rest; outer marginal portions of the neck rest and canopy being adapted to effect a circumferentially continuous seal with a neck seal opening in a respirator and inner marginal portions of the neck rest and canopy being adapted to effect an uninterrupted seal about the back of the neck and across the front of the chest of a patient in said respirator, said canopy being approximately quarter-spherical and having a substantially semi-cylindrical sealing member at the margin of the canopy which is adapted to face a patient's chest, said semi-cylindrical sealing member being connected, at its ends, to said neck rest and forming with the latter a continuous sealing surface adapted to engage about the back of the neck and the front of the chest of a patient.

3. A sealing device according to claim 2, further including a rigid ring to which said outer marginal portions of the neck rest and canopy are airtightly fixed and a semi-circular band to which adjacent edges of said canopy

and said semi-cylindrical sealing member are fixed; said ring being adapted to be fixed at a neck opening of a mechanical respirator, and the ends of said band being pivotally connected to opposite sides of said ring to permit pivotal shifting of said semi-cylindrical sealing member relatively to a patient's chest.

4. A sealing device according to claim 3, further including an adjustable linkage between said ring and said band to facilitate adjustment of the position of said semi-cylindrical sealing member relatively to a patient's chest.

5. A sealing device according to claim 4, said linkage comprising a pair of pivotally interconnected arms, said pair being pivotally connected to and between a top portion of said ring and an intermediate portion of said band, and further including releasable means at the juncture of the two said arms for holding said band in an adjusted position in relation to said ring.

6. A sealing device according to claim 3, further including spring means connecting with said rigid ring and said band to urge the latter continuously toward the patient's chest.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,879,764 March 31, 1959

Harold J. Cyphers

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 6, line 19, for "connecting" read -- coacting --.

Signed and sealed this 7th day of July 1959.

SEAL)
ttest:
ARL H. AXLINE
ttesting Officer

ROBERT C. WATSON
Commissioner of Patents