

May 2, 1933.

P. DRINKER ET AL

1,906,453

RESPIRATOR

Filed Nov. 25, 1931

2 Sheets-Sheet 1

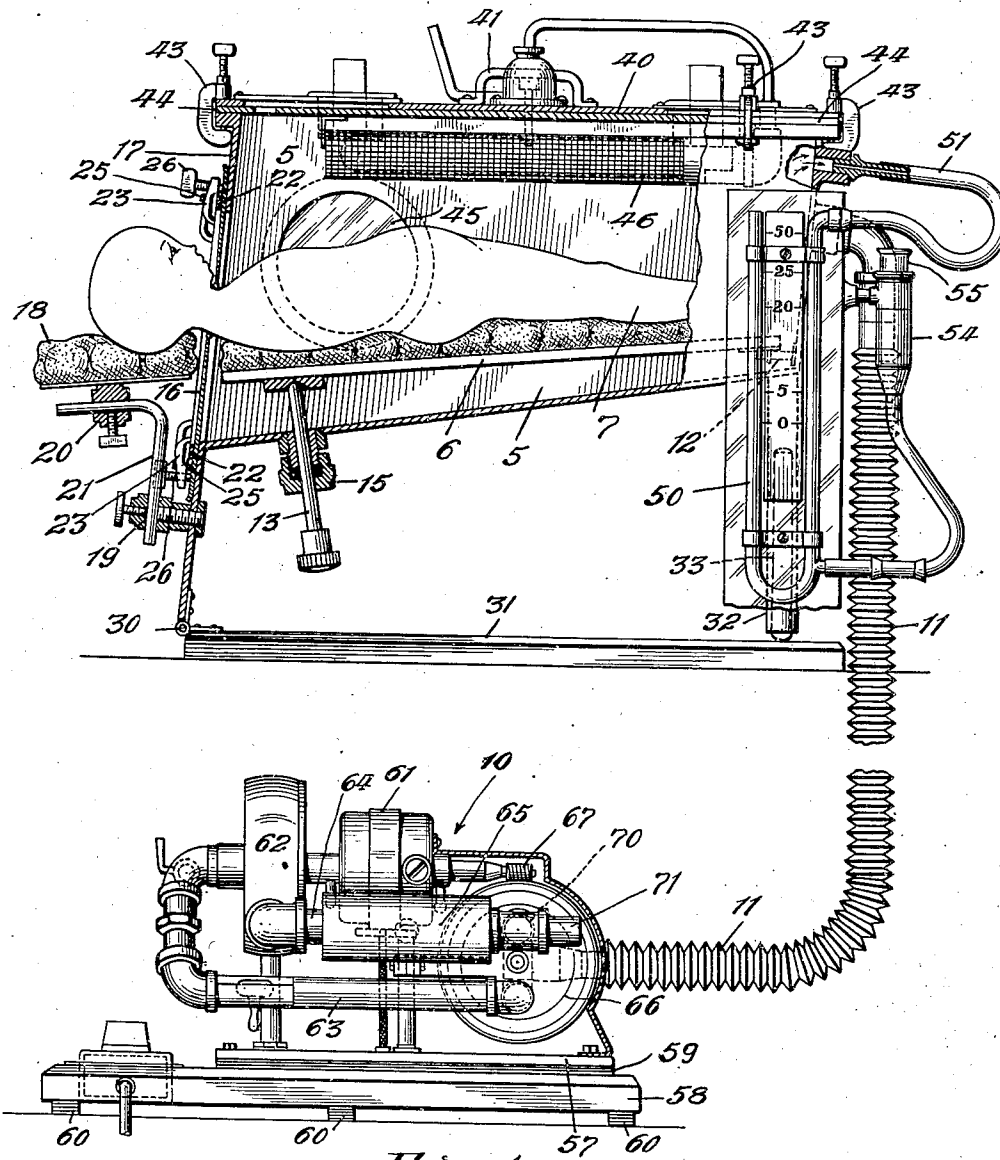


Fig. 1.

INVENTOR
PHILIP DRINKER AND
LOUIS AGASSIZ SHAW
BY
Hammond & Little
ATTORNEYS

May 2, 1933.

P. DRINKER ET AL

1,906,453

RESPIRATOR

Filed Nov. 25, 1931

2 Sheets-Sheet 2

Fig. 2.

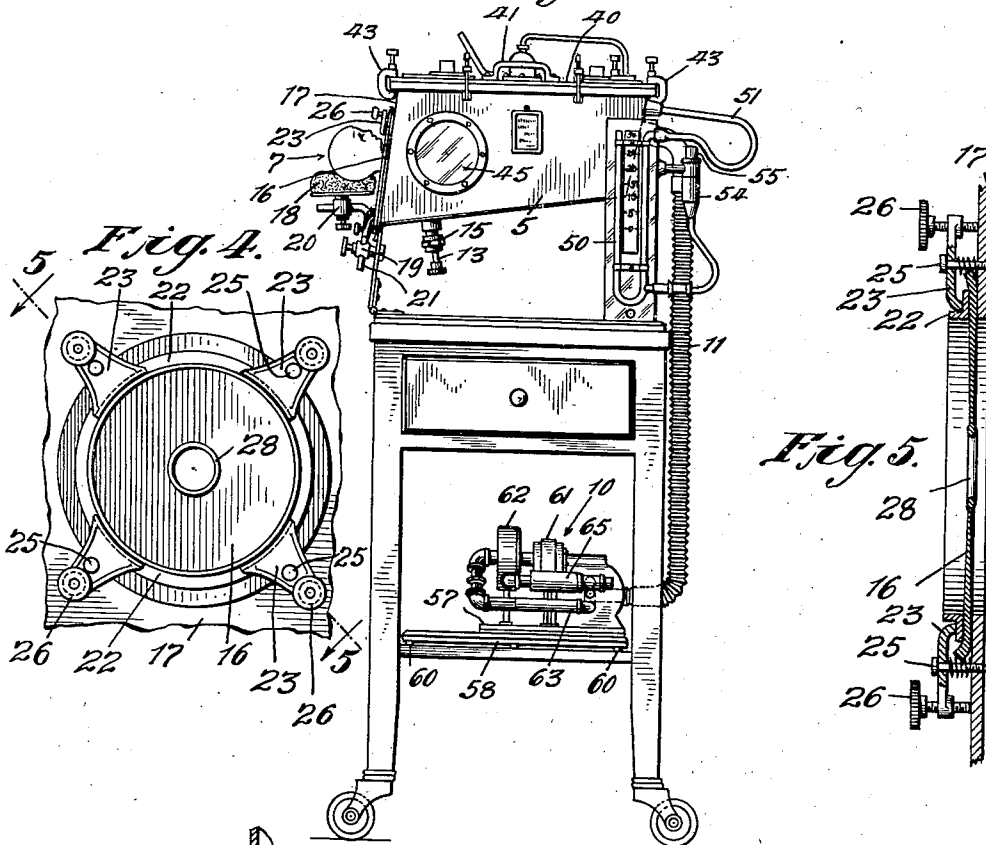


Fig. 4.

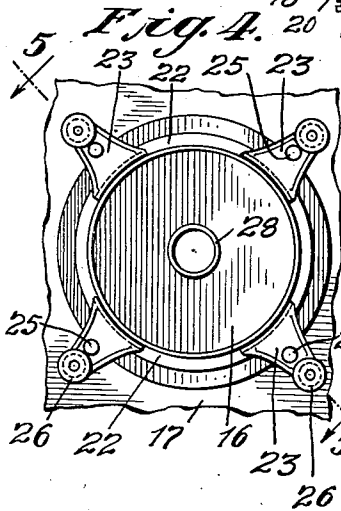


Fig. 5.

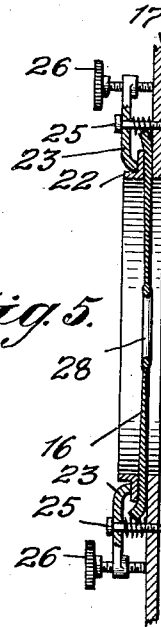
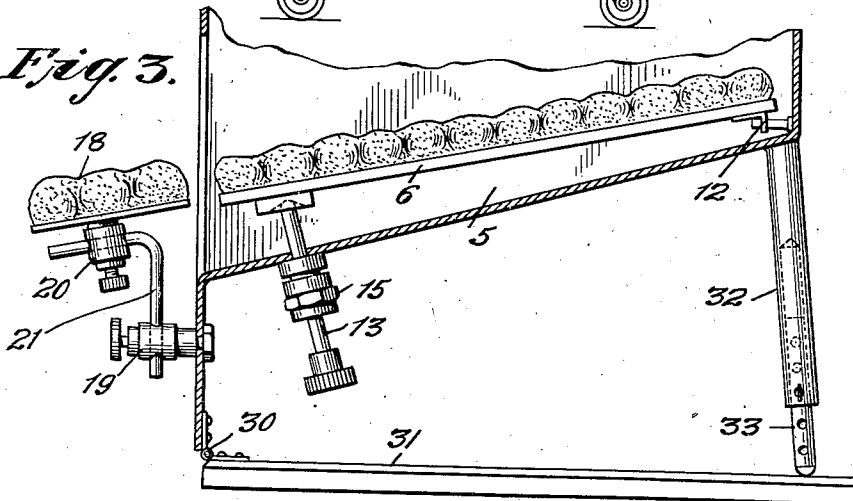


Fig. 3.



INVENTOR
PHILIP DRINKER AND
LOUIS AGASSIZ SHAW
BY
Hammond & Little
ATTORNEYS

UNITED STATES PATENT OFFICE

PHILIP DRINKER AND LOUIS AGASSIZ SHAW, OF BOSTON, MASSACHUSETTS, ASSIGN-
ORS, BY MESNE ASSIGNMENTS, TO WARREN E. COLLINS, WARREN E. COLLINS, JR.,
AND WALTER G. CHICK, ALL OF BOSTON, MASSACHUSETTS

RESPIRATOR

Application filed November 25, 1931. Serial No. 577,178.

The present invention relates to apparatus for use in aiding or artificially producing respiration. Emergency cases of drowning, gas poisoning, electric shock and the like have long been treated by artificially inducing respiration to ventilate the lungs until the patient recovers sufficiently to breathe naturally. By the use of the invention described in our copending application, Serial Number 380,271 filed July 23, 1929, it has been possible within the last two years to use artificial respiration successful in pathological cases of poliomyelitis, diphtheritic paralysis, drug poisoning, and asphyxia neonatorum, where artificial respiration complete or in part, for prolonged periods has been necessary. Such extension of artificial respiration has brought comfort to and has saved the lives of many patients otherwise doomed to immediate painful death by suffocation, all of which has been rendered possible through the invention described in the above-noted application.

The present invention has for an object to provide an improved apparatus for producing artificial respiration of a type designed more particularly for treating newborn infants and very small children, although certain features of the apparatus are applicable likewise to the adult forms of respirator as will be apparent as this description proceeds.

For the purposes of disclosure of the principles of the invention an infant model respirator designed more particularly for treating asphyxia neonatorum and having readily controlled effective means for producing and maintaining respiration while supporting the infant in position to facilitate draining of mucous from the air passages is described herein.

The invention aims, for example, to provide arrangements for facilitating the draining of the air passage during the first few minutes after birth, and to provide an air-tight seal around the neck of the patient which will be suitably adjustable and comfortable and will not restrict the neck.

Asphyxia neonatorum occurs in about 5%

of all births and is a major obstetrical problem. If these deeply asphyxiated new-born babies whose hearts are beating but whose respiratory mechanisms are inactive can be kept alive by artificially ventilating the lungs without injury to the delicate tissue thereof long enough they will develop, in a majority of cases, normal respiratory activity.

The present invention provides an apparatus which makes possible and convenient the treatment of such infants by a method which applies no undue strain on either the lung tissues or the muscles of the body. Infants weighing from four to ten pounds at birth have been successfully treated in the apparatus, it having been necessary in some cases to continue the artificial respiration for more than half an hour before natural rhythmic breathing occurred.

The method of treatment in the apparatus of the present invention involves causing respiration by subjecting the chest, exteriorly, to a partial vacuum and causing expiration by releasing such vacuum or, if necessary because of lack of tone of the muscles, by applying a positive pressure to the chest. The apparatus herein described for the purposes of illustration is so designed that the body and legs of the patient are enclosed in a practically air-tight casing while the head and neck project through one end wall to expose the mouth and nose to air at atmospheric pressure.

The nature and objects of the invention will be better understood from a description of a particular illustrative apparatus for the purpose of which description reference should be had to the accompanying drawings forming a part hereof and in which—

Figure 1 is a central sectional and somewhat diagrammatic view of an apparatus embodying the invention,

Fig. 2 is a side view of the complete apparatus,

Fig. 3 is a sectional detail view showing the arrangement for adjusting the inclination of the body support within the casing and of the casing relative to the base,

Fig. 4 is a detail view of the collar clamping means, and

Fig. 5 is a cross-sectional view of the collar, the thickness being relatively exaggerated for clearness of illustration.

The apparatus shown for the purpose of illustration comprises a wheeled carriage on which is mounted a respirator casing supported at a height to be convenient in use.

As shown, the casing 5 is provided with a body support 6 to receive the patient 7 with his body and legs within the casing and the head projecting through the front wall, means being provided for forming an air-tight seal around the neck.

A power plant 10 conveniently mounted on a shelf of the wheeled carriage is arranged to produce the desired fluctuations of air pressure within the casing to which it is connected by a flexible air conduit 11.

The body support is shown as a bed, provision being made for varying the inclination of the bed in order to facilitate draining of the air passages as is desirable in treating new-born infants. As shown, the foot end of the body support is hingedly supported at 12 and the head end is secured in adjusted position by means of a push rod 13 passing through a stuffing box 15 which can be tightened to hold the rod in adjusted position. A flexible collar 16 forms an air-tight seal around the face of the end wall 17 of the casing for accommodation to the position of the patient. Exteriorly of the casing the head is supported on an adjustable head support 18 which is secured in adjusted position by clamps 19 and 20 and the rod 21. The collar 16 is shown as made in the form of a thin flexible sheet which can be drawn taut and held in position by means of a ring 22 and four clamps 23. The clamps may be of any suitable form. As shown, they are supported on headed pins 25 about which they pivot and they are tightened by means of thrust screws 26. A collar of preferred form made of rubber of good quality is shown in cross-section in Fig. 5. The central aperture may be only an inch or two in diameter when the collar is contracted but when it is applied about the neck of the patient it is stretched radially until it fits comfortably but tightly around the neck of the patient and then it is clamped by the ring 22 and clamps 23 in the desired position. By the use of four clamps 23 operating on the ring 22, it is possible to adjust the clamps to hold about three-fourths of the diameter of the collar while still permitting adjustment of the other one-fourth. As shown, the central portion of the collar is relatively thin but not so thin as to be easily torn during the necessary manipulations and the outer portions which are engaged by the clamping ring 22 are somewhat thicker the better to

resist damage by the clamping. Immediately around the edge of the central aperture a slight bead 28 is formed to resist tearing. The same type of collar and adjustment thereof is used on adult as well as infant respirators.

The rubber collar is made large enough so that it can be clamped in eccentric position relative to the aperture in the end wall thereby providing for adjustment along the face of the end wall of the casing to a position corresponding to the position of the body support and head rest.

The arrangement of the adjustable body support with the adjustable head rest and adjustable air seal fitting around the neck make it convenient to tilt the body of the patient the desired amount in order to satisfactorily drain the nasal passages. Ordinarily a relatively slight inclination is sufficient and the casing is designed on this basis, but in order to permit further inclination of the patient in exceptional cases or to permit variation of the inclination without disturbing the patient, the casing as a whole is made tiltable on its support. To this end the casing is hinged as indicated at 30 to a base which is mounted on or forms the top of the wheeled carriage or stand. The casing at its other end is adjustably supported in position by a pair of extensible legs 32. These legs are shown as formed with the telescoping rod 33 which can be adjustably positioned in its sleeve and secured in adjusted position as by means of suitable set screws. The cover 40 of the casing may conveniently be hinged at one edge so that it may be lifted by the handle 41 for placing or removing the patient and for attention, if necessary. The hinged cover is secured in closed position by a number of clamps 43 or any other desired clamping means and a rubber gasket 44 insures an air-tight seal when the cover is closed.

Observation of the patient is facilitated by air-tight glass or celluloid observation windows 45 and lights 46 within the casing. Aluminum can be substituted in these windows for the purpose of taking X-ray photographs if desired.

The manometer 50 mounted on the exterior of the casing is connected to the interior of the casing by means of a hose 51 in order that the pressure within the casing whether positive or negative may be observed by the attendant as the pressure fluctuates. The manometer also automatically serves as a safety device to prevent excessive pressure, since in case of excessive pressure or vacuum the liquid in the manometer will be discharged and provide an opening for admission or exit of air. In order to facilitate the adjustment of the liquid level in the manometer a small level-

ling device 54 of usual construction is connected therewith.

The power plant for causing the fluctuations of pressure within the casing to induce respiration, is suitably mounted on the carriage. As shown, it is mounted on a base 57 which is insulated from a second base 58 by means of a rubber pad 59 and in turn the base 58 is supported on rubber block 60 to deaden the vibration. The power plant, as shown, comprises a motor 61 driving a suction fan 62 to the inlet of which the conduit 63 is connected and to the outlet of which is connected a conduit 64 and muffler 65. Between the conduit 63 and the muffler 65 is arranged a valve 66 which is rotated by a worm 67 driven by the motor 61. The valve ports are so arranged that during rotation of the valve connection is established alternately, first between the conduit 11 and the conduit 63 to exhaust air from the casing, and then between the conduit 11 and the discharge end of the muffler 65 thru port 70 to permit the intake of air into the casing thru the muffler discharge outlet at 71.

It may be desirable at times to alternately apply suction and pressure in which case the discharge outlet 71 of the muffler may be closed or partially closed whereupon connection of the conduit 11 with the port 70 will cause pressure to be applied within the casing. The speed of the motor may be varied by means of a suitable rheostat. The variation of pressure used in the treatment of infants does not generally exceed 10 cm. of water. In most cases the pressure is alternated between atmospheric pressure and sub-atmospheric pressure but occasionally it is found desirable to apply pressures alternating between positive and negative.

The foregoing particular description is illustrative merely and is not intended as defining the limits of the invention. Obviously many changes may be made without departing from the spirit of the appended claims.

We claim:—

1. 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 for periodically varying the pressure within the casing, a seal for said opening comprising a flexible rubber collar having an opening to fit around the patient's neck and means to clamp the outer edges of said collar to the casing wall, said collar being elastic to permit stretching by pulling on its outer edges to enlarge the opening and provide a comfortable fit around the patient's neck and said clamping means being adjustable to clamp and hold the collar in its stretched position.

2. A rubber collar for forming a seal be-

tween the neck of a patient and the wall of an artificial respirator casing having a relatively thin and elastic central portion with an opening to fit around the patient's neck, the edge of which opening is beaded to resist tearing, the outer portion of the collar being thicker to resist tearing when pulling to adjust the position of the collar and to stretch the opening.

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 projects, means to seal said opening around the patient's neck comprising an adjustable and stretchable collar consisting of a sheet of flexible material having an opening therein to fit around the patient's neck, clamping means around the opening in the casing wall to secure said collar in position, said clamping means permitting bodily adjustment of the opening in the casing wall, said clamping means also permitting stretching of the collar to give a good fit around the patient's neck and providing means to clamp the collar in stretched position and means to periodically produce variations of pressure within said casing.

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 projects, means to produce periodic variations in pressure within said casing and means to provide a seal for said opening comprising a stretchable rubber collar adapted to fit around the patient's neck and be clamped to the wall of said casing, and clamp means at a plurality of points around the opening in said casing wall to clamp said collar in adjusted and stretched position.

5. In an apparatus for producing artificial respiration, a casing to receive the body of the patient, having an opening in one wall thereof through which the head of the patient projects, means to periodically vary the pressure in said casing, and means to provide a seal around the patient's neck comprising a sheet of rubber material having an opening therein and means to clamp said sheet to the casing wall through which the patient's head projects, said clamping means permitting bodily adjustment of the position of said collar and also permitting portions of said collar to be stretched and moved relative to other portions of said collar, and permitting said portions to be clamped in said stretched positions.

6. In apparatus for producing artificial respiration a casing adapted to receive the body of a patient with the head projected therefrom, said casing having a hinged cover and means for forming an air-tight

seal when said cover is closed, a body support within said casing inclined downwardly toward the head end thereof, means for varying the inclination of said body support, a stretchable and adjustably positioned flexible collar arranged to form an air-tight seal around the neck of the patient, means for clamping said collar to the end wall of the casing in stretched and adjusted position to form an air-tight seal therewith, an adjustable head rest exterior to said casing for supporting the head of the patient in alignment with said body support and means for periodically varying the pressure within said casing.

7. In apparatus for producing artificial respiration, a casing adapted to receive the body of a patient with the head projecting therefrom, said casing having an opening for access to the interior, a door closing said opening, means for forming an air-tight seal when said door is closed, a body support within said casing, a stretchable and adjustably positioned flexible collar arranged to form an air-tight seal around the neck of the patient, means for clamping said collar to the end wall of the casing in stretched and adjusted position to form an air-tight seal therewith, and means for periodically varying the pressure within said casing.

In testimony whereof we have affixed our signatures to this specification.

PHILIP DRINKER.
LOUIS AGASSIZ SHAW.