Jan. 7, 1941. T. J. SHOOLMAN 2,227,847

RESPIRATOR

Filed Sept. 24, 1937 3 Sheets-Sheet 1

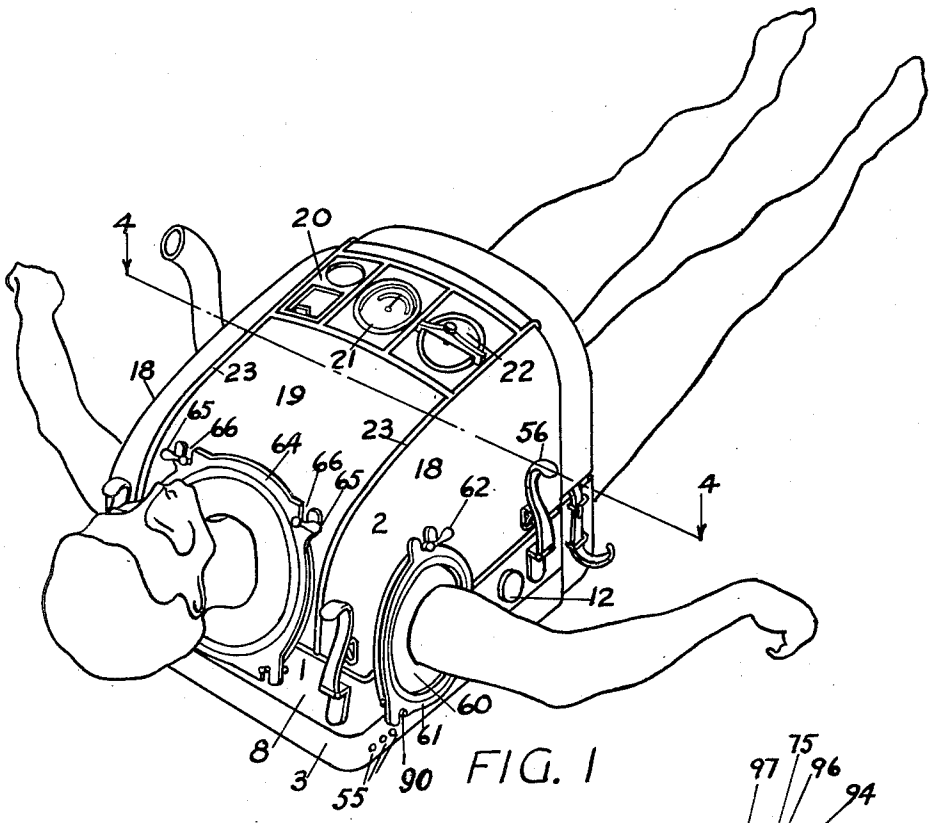


FIG. 1

FIG. 13

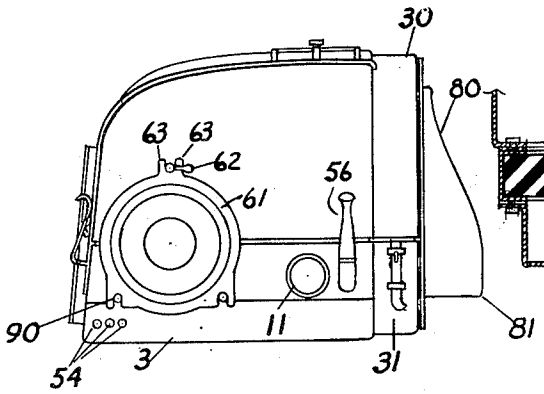


FIG. 2

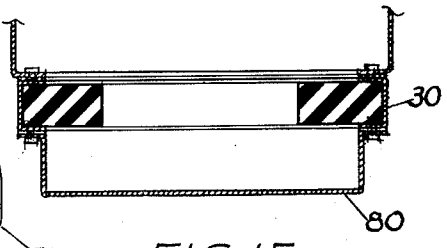


FIG. 15

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RESPIRATOR

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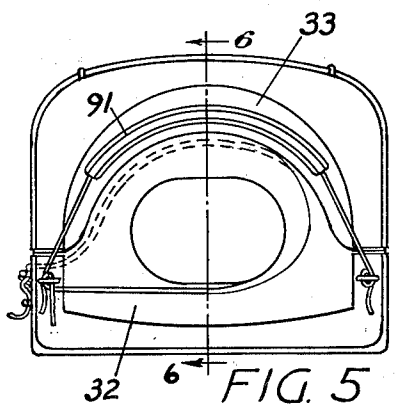


FIG. 5

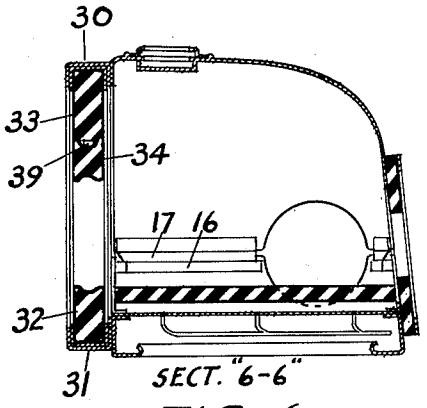


FIG. 6

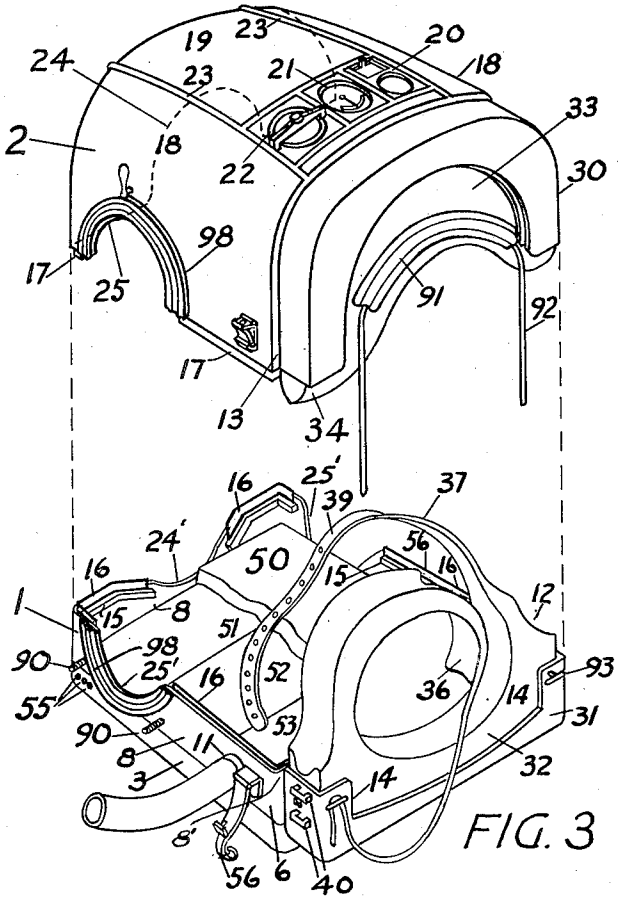


FIG. 3

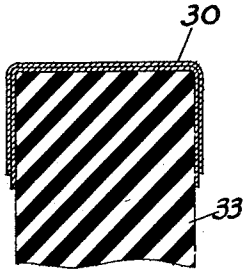


FIG. 11

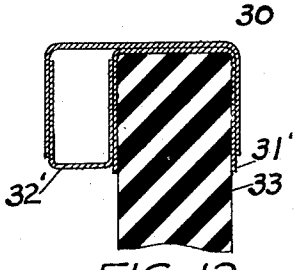


FIG. 12

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RESPIRATOR

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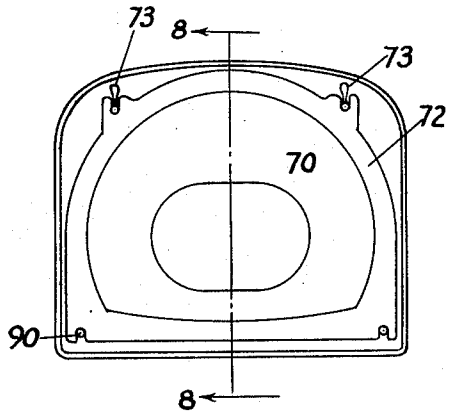


FIG. 7

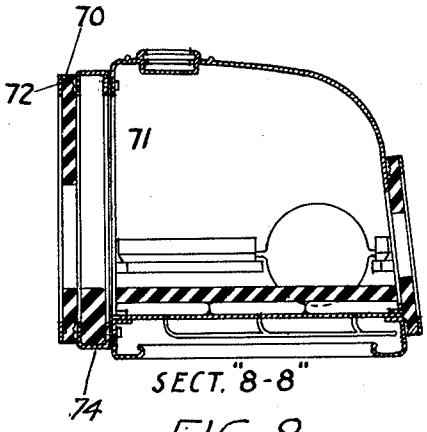


FIG. 8

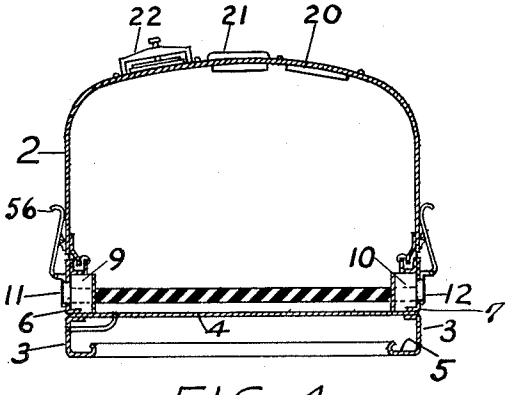


FIG. 4

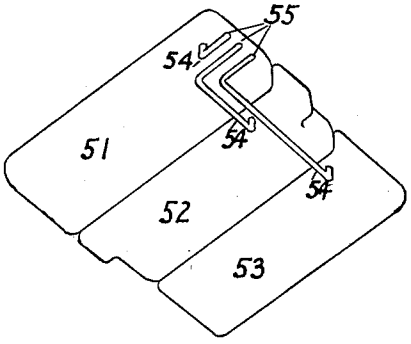


FIG. 10

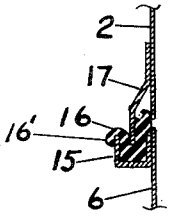


FIG. 9

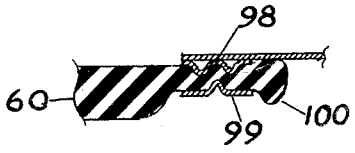


FIG. 14

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UNITED STATES PATENT OFFICE

2,227,847

RESPIRATOR

Theodore J. Shoolman, Brookline, Mass.

Application September 24, 1937, Serial No. 165,557

4 Claims. (Cl. 128—29)

The present invention relates to a respirator of the type which may be used in medical science for aiding in breathing artificially, as for instance in cases where respiratory muscles have been paralyzed by sickness, such as infantile paralysis or in any other cases as for instance, shocks, drowning, suffocation or the like.

Devices of this nature are well known in the art and are of two general types, those in which the body of the patient, except the head, is placed in the respirator, and those in which a smaller part of the body is enclosed in the device. The machine used for enclosing only the upper part of the human body has a number of advantages over the machine in which practically the whole body is placed. It not only allows a certain amount of freedom of the arms and legs, but it also is possible to construct a much lighter device and one which can more easily be handled on a bed or table without great difficulty. The chief difficulty with the devices enclosing only a portion of the body is that a small volume of air is contained in the respirator itself and therefore greater care must be exercised to prevent air leaks from the respirator itself. These air leaks occur not only around the abdomen, arms and neck of the patient, but also around the joints between the parts of the respirator itself. Various methods have been attempted to construct a so called half-size respirator that will provide a device that will hold its air pressure sufficiently during the breathing in and breathing out process, but these for the most part have not been particularly successful.

In the present invention various parts of the respirator are so constructed that they easily fit together in joints which will prevent air leakage. In addition to this the seals at the patient's body are so made that very little leakage will take place. Further than this the present device is constructed so that it can easily be made from practically plain material such as sheet aluminum or the like without a great deal of forming necessary by special dies. The usual apparatus for raising and lowering the pressure in the respirator may be employed and this in itself forms no part of the present invention.

Further advantages and merits of the present invention will be better understood from the description given below when taken in connection with the drawings showing an embodiment of the invention:

Figure 1 shows a perspective view of the respirator as applied to a patient.

Figure 2 shows a side view of the respirator as seen from the side of Figure 1.

Figure 3 shows an exploded view of the respirator in perspective indicating the top and bottom portions.

Figure 4 is a section taken on the line 4—4 of Figure 1.

Figure 5 shows an end view of the respirator looking at the same from the abdomen end.

Figure 6 indicates a section on the line 6—6 of Figure 5.

Figure 7 shows an alternative construction of the end view corresponding to Figure 5, and,

Figure 8 shows a section through Figure 7 on the line 8—8.

Figure 9 shows a detail of construction illustrating the method of sealing the parts of the respirator.

Figure 10 shows a detail of the air cushion shown in Figure 5.

Figure 11 is a detailed modification of the end section of the respirator.

Figure 12 shows a further detail of Figure 11

Figure 13 is a modification of the arm plates of Figures 1 and 2.

Figure 14 indicates a further modification of the disc by which the sponge rubber arm pieces are attached to the respirator, and,

Figure 15 shows a detail of a removable end extension shown in Figure 2.

In the drawings the respirator is shown as constructed of two main portions, a lower portion 1 and an upper portion 2. The lower portion 1 is formed of a base element 3 and a floor 4. The base element 3 as indicated in Figure 4 has a "C" section 5 providing a hollow space in the base which may be used for a set of drawers. The base member 4 is of course sealed to the apron or supporting member 3, either by welding or any other suitable process. Formed with the floor or base 4 are the side walls of the base 6 and 7 and the end wall 8, the side walls 6 and 7 being the walls where the patient's arms come through the device and the end wall 8 where the neck of the patient comes through the device. At the inner side of these walls are provided chambers 9 and 10 communicating with the air or exhaust sources 11 and 12. These chambers spread out or diffuse the air entering or leaving the chamber, thus avoiding the creation of an air draft. The back wall 8' as indicated in Figure 3 is practically cut away and replaced by the abdominal sealing wall 13, which will be more fully described later.

This wall 13 is attached to the inwardly extending flanges 14—14 extending inwardly respectively from the side walls 6 and 7. The wall construction at the joint of the upper and lower elements

of the respirator is indicated in section in Figure 9. Formed on the inside of the lower walls 6, 7, and 8 is an elongated channel element 15 which may be welded to the walls just below the top edge as indicated in Figure 9. This channel 15 is filled with a rubber strip 16 which extends well beyond the top of the channel and laps over the inner edge of the channel as indicated at 16' while it extends above the edge of the wall 6 on the other side. The upper shell 2 of the casing is provided with inwardly and downwardly extending tongue 17 which has its end positioned to lie in the center of the channel 15 when the walls 2 and 6 are aligned with one another. The wall 2 extends downwardly from the place where the tongue 17 is fastened so that the rubber sealing element 16 is forced upward between the tongue 17 and the wall 2 as the wall 2 comes down into line with the edge of the wall 6. A seal is thereby effected not only between the two outer walls 6 and 2 by means of the rubber laying against the inner surface, but mainly of course by means of the edge of the tongue 17 pressing downward into the rubber sealing element 16. The end of the tongue 17 is sealed to the wall 2 at the arm, neck and abdomen opening and so also the channel 15.

The top half of the respirator comprises the side pieces 18 and the top plate 19 carrying the indicating and regulating valves 20, 21 and 22 which may be of the usual type used in respirators of the present description. The pieces 18 and 19 may be pressed from sheet stock by proper presses and dies and joined along the edges 23, 23 in any suitable fashion. The top half is provided with suitable openings 24, 25, the opening 24 corresponding with the opening 24' in the lower half of the respirator and constructed to allow the neck of the patient to go through it. The openings 25' correspond to the openings 25 to allow the arms of the patient to be extended from the respirator.

At the back portion of the respirator on each half 1 and 2 there are provided casings 30 and 31 in the form of C or U shaped channels which are filled with walls or plates 32 and 33 forming the opening through which the abdomen portion of the patient extends. These elements 32 and 33 are preferably of sponge rubber or some elastic material which yields to the body movement and still provides an air seal to prevent air from leaking into or out of the respirator. The upper portion 33 is arched as indicated by the end view in Figure 5 with a low arch however so that the patient's body forms itself into the sponge rubber, the lower edge of the portion 33 being cut as indicated at 34 with an outwardly curved portion adapted to engage in the correspondingly concave member of the lower portion as will presently be explained. The lower half 32 is also preferably of sponge rubber and is formed with two spiralling ends 36 and 37, the end 37 being tapered to form a band or strap as indicated at 39. The end 36 is made inwardly concave so that the top element 37 and the strap 39 will rest in it and further so that the concave portion of the top part will form a closed seal over the bottom half of the closure. The strap 39 may preferably be brought out to tie at the side eyelets 40, so that when the patient is first put into the respirator, the strap 39 can be clamped down in place. On the upper sponge rubber elements 33 there may be fastened an arced piece 91 through which a cord 92 may pass. This cord 92 will hang downward and may be used to tie the piece 33 to the lower half of the casing by tying the cord 92 around the hooks 93 projecting from the lower half of the casing. After these two ends are properly adjusted the upper section having the piece 33 is clamped down to make a complete seal around the patient's body. It will of course be understood that various size elements can be used in the end channels 30 and 31 and for this reason the rubber elements 32 and 33 are removable from the channels and the correct sizes for the particular patient for which the respirator is to be used may be inserted.

In the view shown in Figures 11 and 12 the end portions 32 and 33 may either occupy the entire space in the channels 30 and 31 or they may be put in special casings as indicated at 31' to fill only a portion of the channel. To fill up the rest of the space, a second channel 32' may be used which may be sprung out at its edges so as to hold the channel 31' in place. In this way the sponge rubber elements 32 and 33 may offset the space of the channel 32 thereby allowing the rubber to be positioned further down on the patient's body.

Within the respirator there is provided a mattress 50 made of some suitable material as shown in Figure 1. Below this cushion there is an air cushion which has three separate chambers 51, 52 and 53 which may be inflated from the valve connections 54, 54, 54. These are preferably brought out through the openings 55 at the base 3 of the lower portion 1 of the respirator. These chambers may be separately inflated so that the proper adjustment against the patient's body may be obtained and this of course may be done after the patient has been placed in the respirator.

When the patient has ben placed in the respirator, the two halves are brought together and clamped in any suitable fashion as indicated by the clamps 56, 56, 56. The clamping will bring together the two edges 2 and 6 as indicated in Figure 9 and cause the tongue 17 to bury itself in the rubber piece 16 forming an air-tight seal about the sides of the respirator. The arm and neck elements may be closed as indicated in Figures 1 and 2. In this case the rubber gasket 60 of sponge rubber or similar material is placed snugly around the arm and a flat plate 61 is placed over it. The plate 61 is put in position by first putting the edge of the plate into engagement with the proper tooth on the ratchet rod 90 and then bringing the top part of the plate to the side of the respirator after which the screw clamp 62 is tightened to tighten the plate to the side of the respirator. This plate seals the rubber against the side of the casing and may be sufficiently wide to exert a pressure against the arms of the patient to make a perfect seal.

The neck portion is held in the same way by means of the plate 64 held by means of the clamping bolts 65 working in the grooves 66 of the plate 64. In place of using the method of clamping the end piece as indicated in Figures 3, 5 and 6, the method indicated in Figures 7 and 8 may be employed. In this case a wide disc 70 of sponge rubber or similar material is laid flat against the end 71 of the respirator. A large metal disc 72 is used to clamp the rubber firmly against the end of the casing. This may be accomplished similarly as in Figures 1 and 2 by means of the clamp bolts 73 clamping the flanges extending from the disc 72.

If the respirator is not sufficiently long, a section 74 may be added which may be bolted to the end of the respirator in any suitable manner

that will make an air tight joint and then the sponge rubber disc for the patient's abdomen may be added.

In Figure 13 there is shown a modification of the arm openings detachable from the reset of the respirator. In this modification a cupped shaped element **94** is provided with an outwardly extending flange disc **95** and an inwardly extending flange **96** allowing an opening **97** through which the patient's arm projects. A sponge rubber disc **75** may be clamped against the flange **96** to make a seal around the patient's arm in any known manner. This element may be positioned in a direction to extend into the respirator or project outward. In either case it is clamped to the respirator by means of the clamping flange **95**. This modification will allow the respirator to be used for various size patients.

In Figure 14 a modification is shown of a method of clamping the rubber gasket **60** to the respirator. The respirator wall itself may be corrugated as indicated at **98** and a corrugated disc or a disc with a single corrugation **99** may serve to fit in the corrugation portion **98**. The disc **99** is held to the respirator in the same way as previously described and squeezes the rubber in such a manner as to prevent the end **100** from being pulled inward or outward in its clamped position.

In Figure 15 there is shown a detail of the end extension indicated in Figure 2. For this purpose beyond the section **30** there may be attached by any suitable means a hood element **80** which is outwardly curved from the top of the respirator towards the bottom **81** providing effectively at the bottom an extension element for the respirator so that the respirator may be longest at the base where the patient lies. The hood **80** entirely covers the end of the respirator and seals it completely off in this way forming a full size respirator for an infant or small child and thereby eliminating the necessity of applying a sealing element about the patient's body.

Having now described my invention, I claim:

1. An artificial respirator adapted to encase the upper part of the human body comprising top and lower halves formed in separate sections providing open ends when said halves go together, means provided at the edges of said halves for sealing said halves of the respirator at the edges that come together each of said halves having at their abdominal end means forming a U shaped section, removable sponge rubber plates fitting into said end section and having an opening for the abdomen of the patient and means for independently briging said plates in close contact with the patient's body before clamping said halves of the respirator together and means for clamping the halves of the respirator together.

2. An artificial respirator of the type described adapted to encase the upper part of the human body comprising having two sections adapted to fit one another and means providing a seal at the joining edge, said respirator having an opening at the abdomen end and means for sealing said opening, comprising means formed of sponge rubber having a top and bottom section said bottom section having flexible extensions with means for fastening the same around the patient's body and said top section having means formed to fit over the bottom section and means for attaching the same to the respirator.

3. In an artificial respirator of the type described, an abdominal seal end having a pair of sponge rubber elements adapted to fit one in the other, one of said elements having free end straps adapted to be tightened about the patient and the other of said elements having means for tying the same to the respirator.

4. In an artificial respirator of the type described having upper and lower sections and means for sealing said sections together an end sectional element forming an end opening and having two parts applied one to each half of the respirator said sectional element having a U shaped channel, means containing a sponge rubber plate having a form to fit the body of a patient and occupying less than the width of the whole channel and a second element holding said sponge rubber element in the desired position in said channel.

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