Sept. 14, 1948. J. A. HEIDBRINK 2,449,165

AIRBORNE ANESTHETIZING APPARATUS

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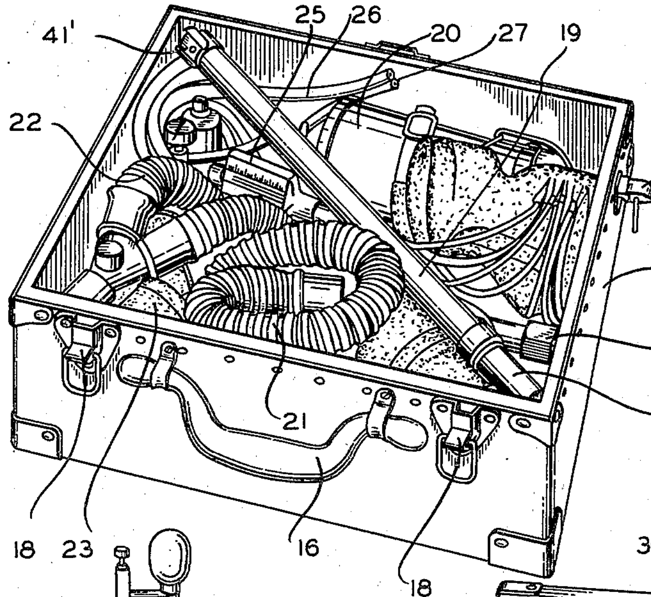

FIG. 1.

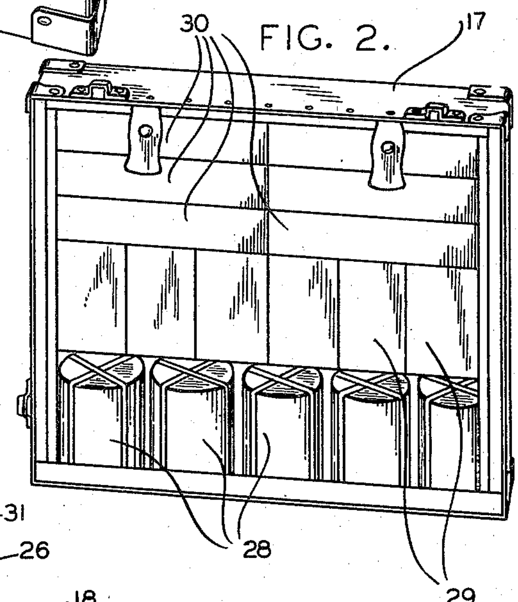

FIG. 2.

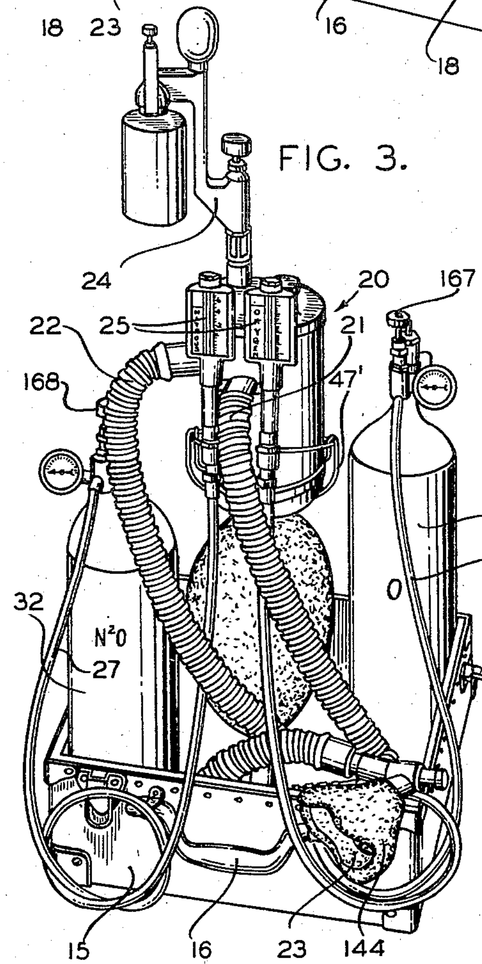

FIG. 3.

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AIRBORNE ANESTHETIZING APPARATUS

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FIG. 4.

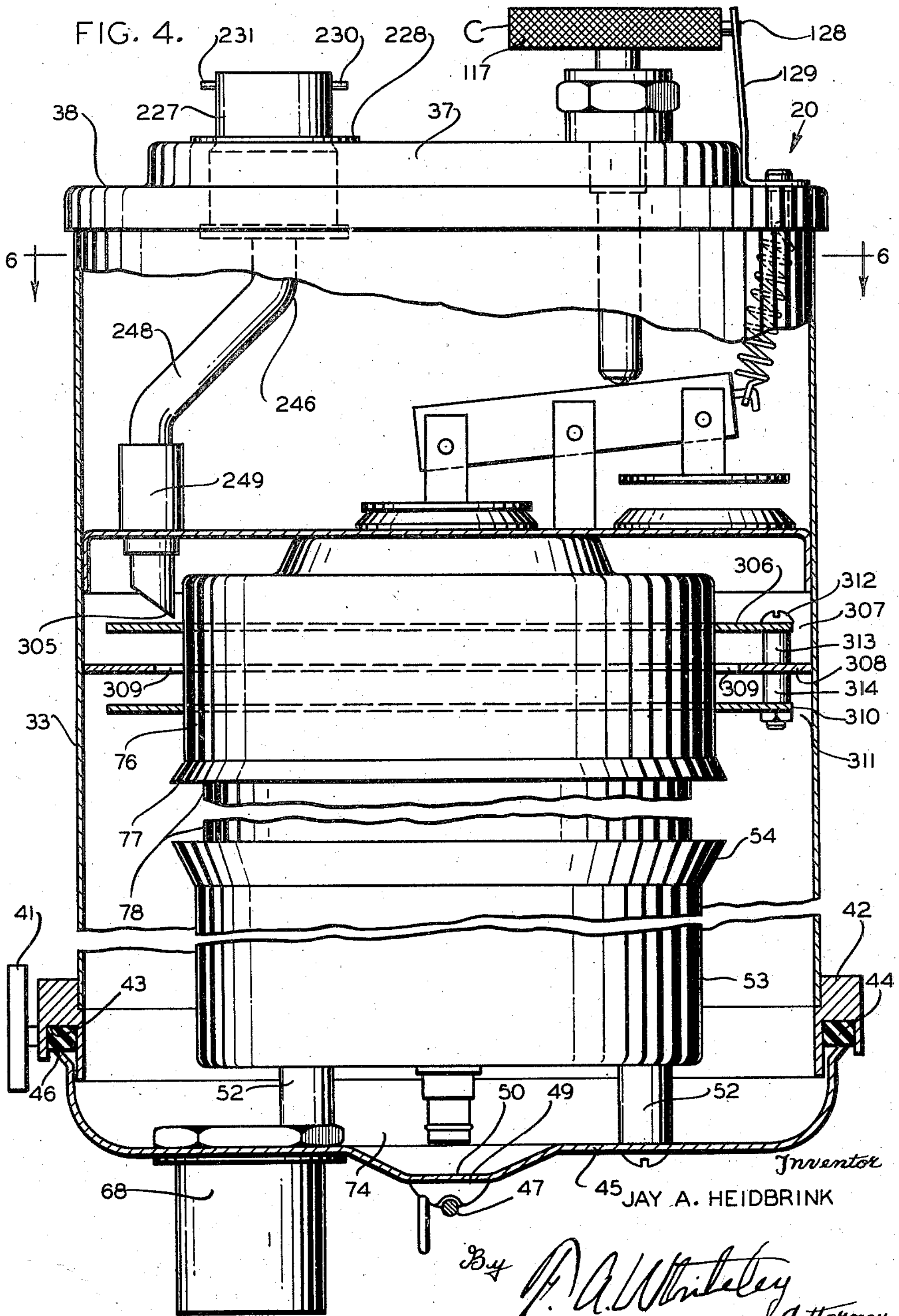

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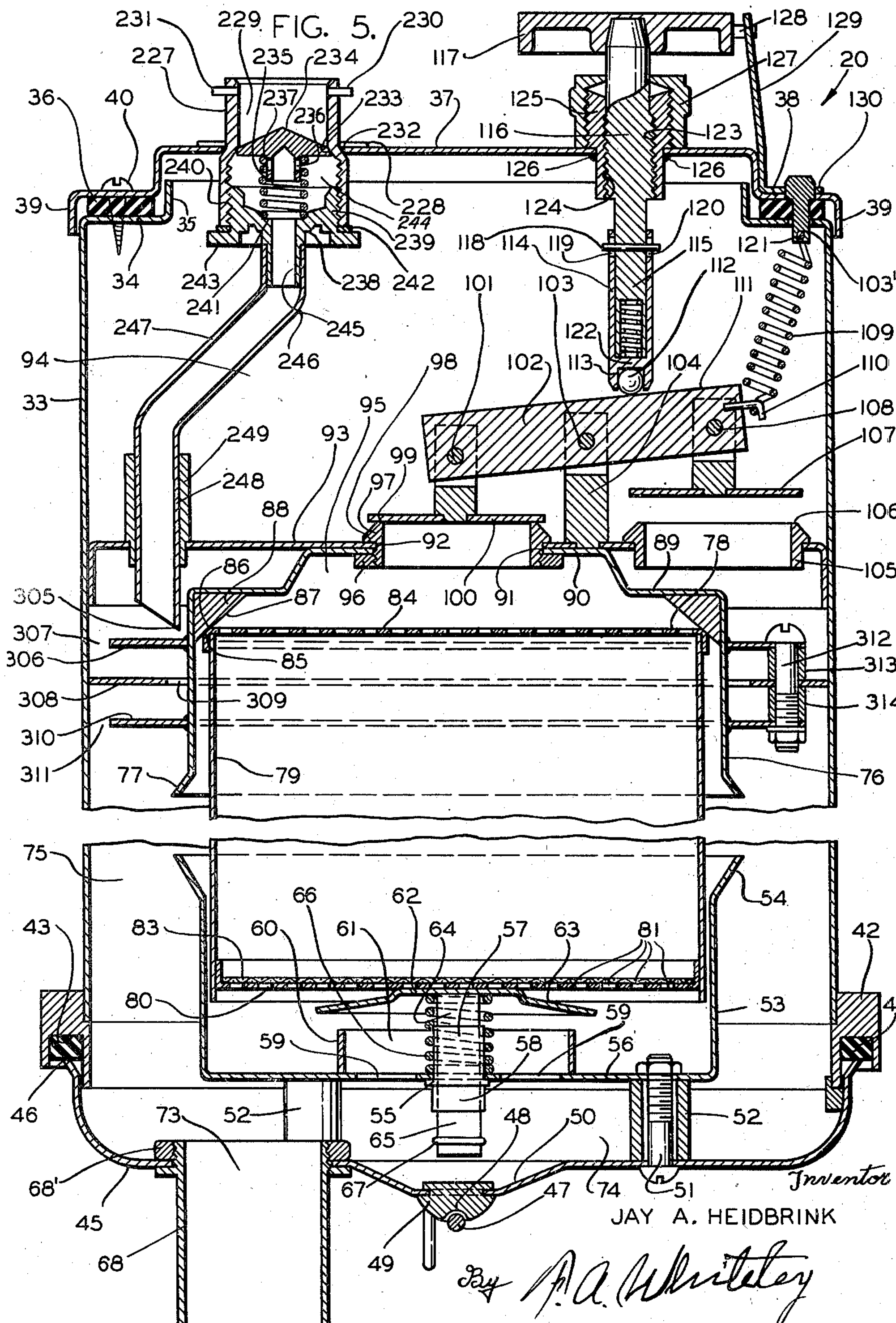
FIG. 5.



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AIRBORNE ANESTHETIZING APPARATUS

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FIG. 6.

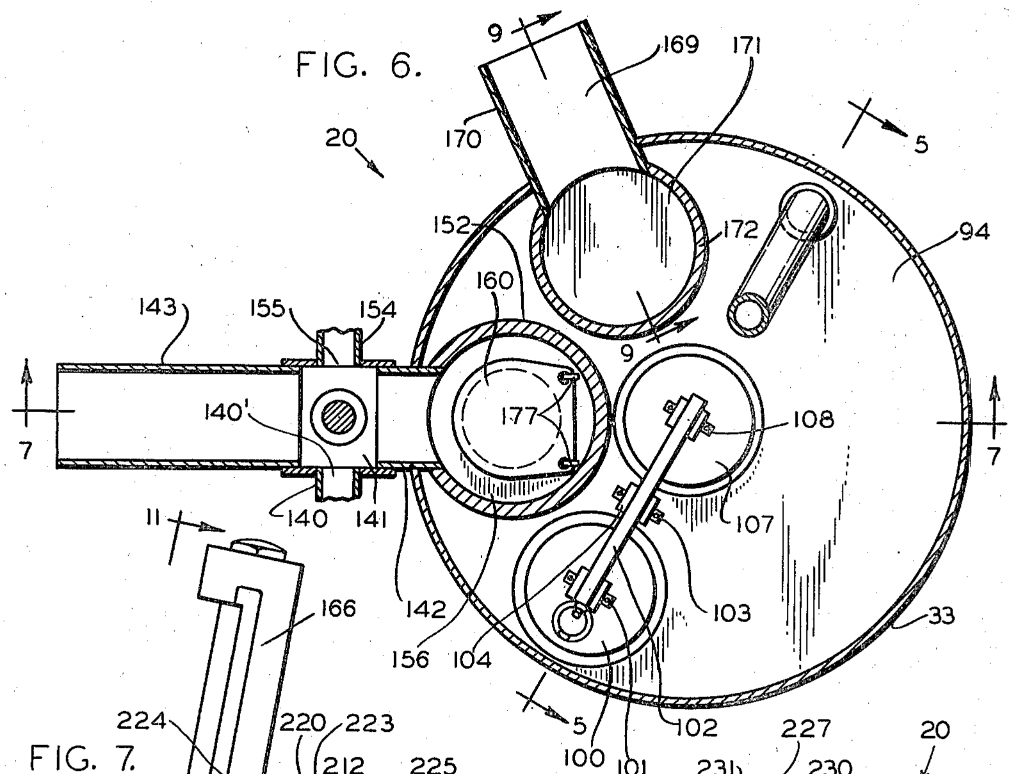

FIG. 7.

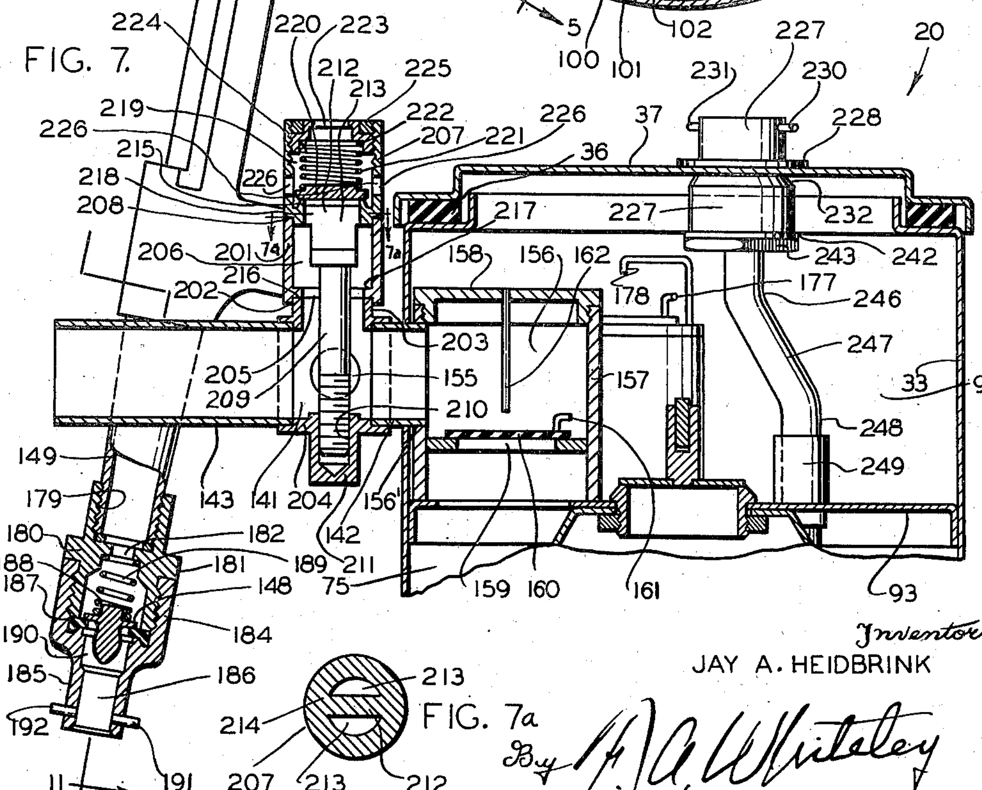

FIG. 7a

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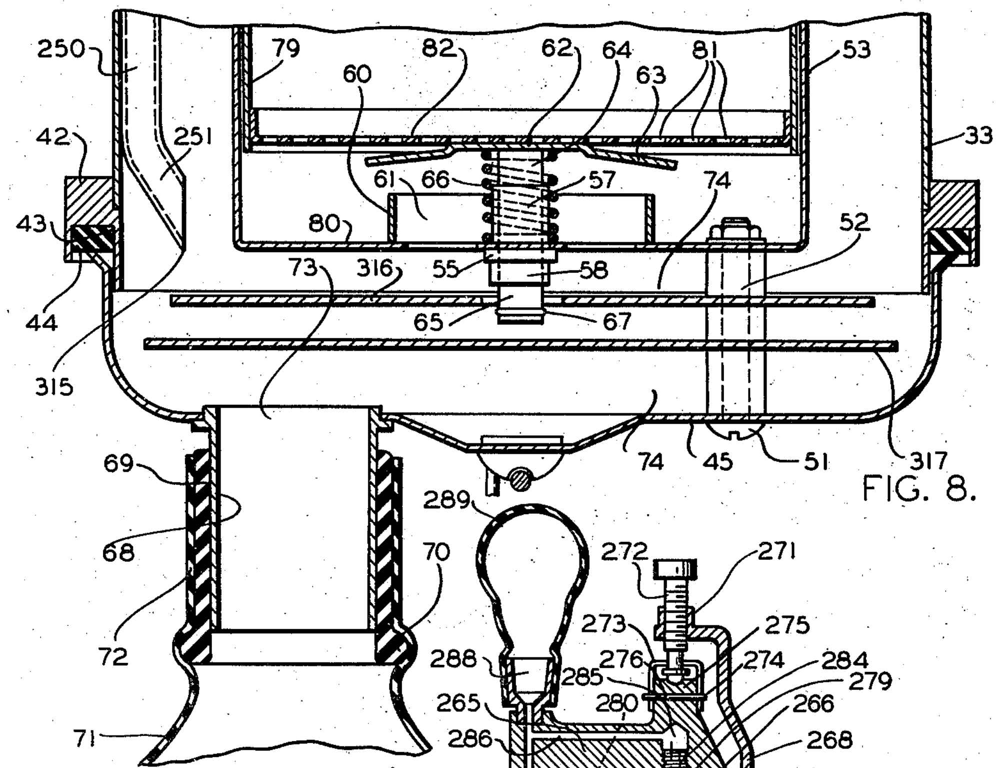

FIG. 8.

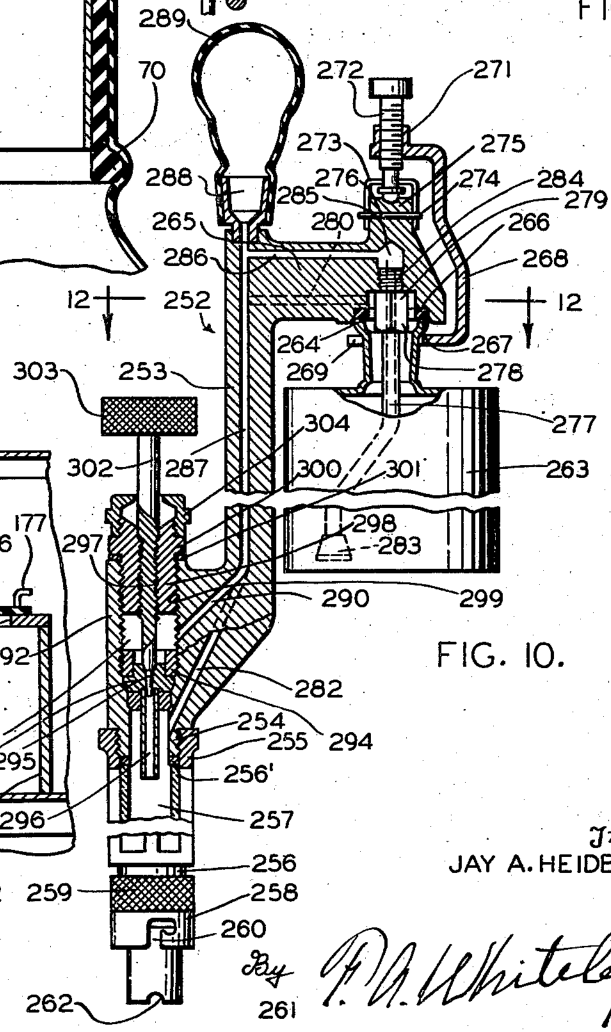

FIG. 10.

FIG. 9.

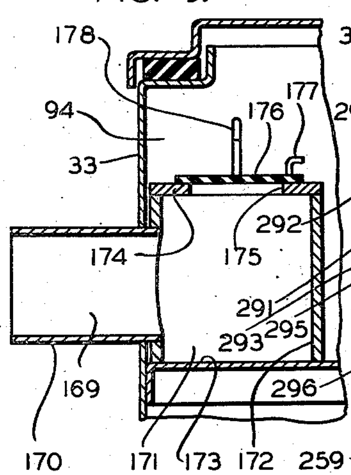

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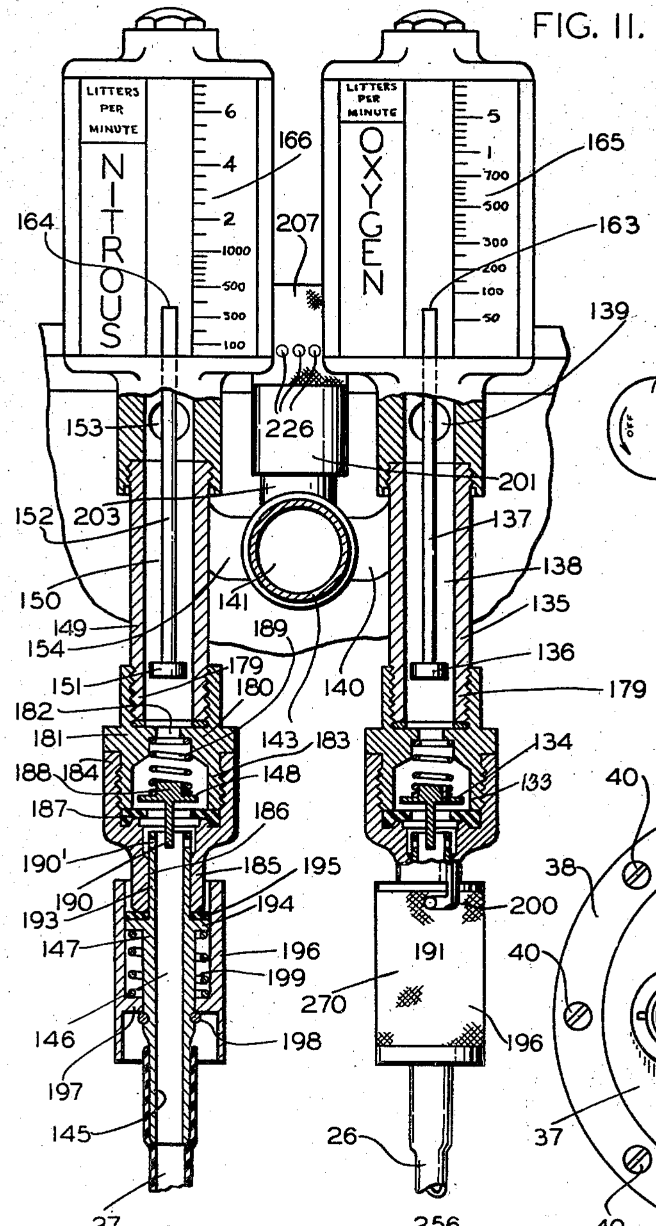
FIG. 11.



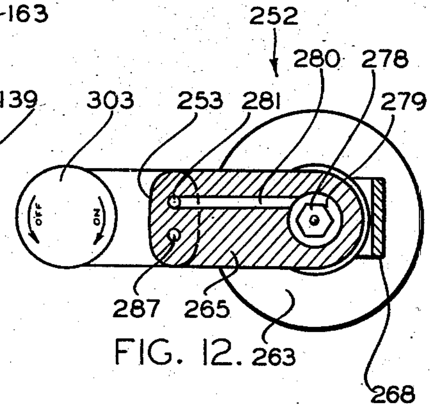


FIG. 12.

FIG. 13.

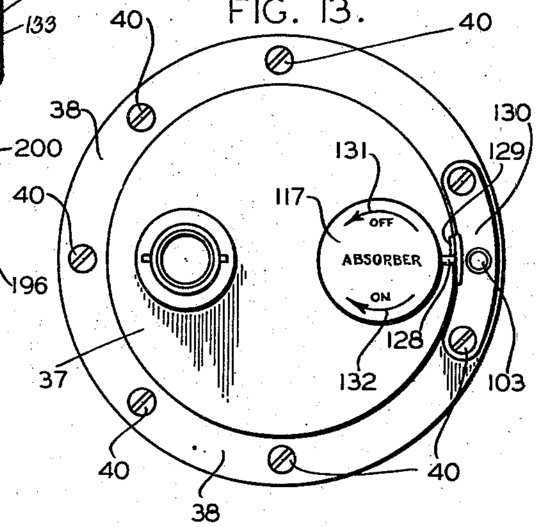
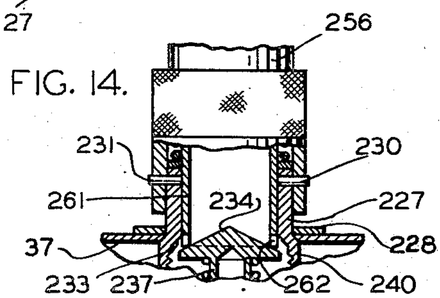


FIG. 14.



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Patented Sept. 14, 1948 2,449,165

UNITED STATES PATENT OFFICE

2,449,165

AIRBORNE ANESTHETIZING APPARATUS

Jay A. Heidbrink, Minneapolis, Minn., assignor to Air Reduction Company, Incorporated, New York, N. Y., a corporation of New York

Application May 8, 1944, Serial No. 534,642

8 Claims. (Cl. 128—191)

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My invention relates to an airborne anesthetizing apparatus and has for its object to provide a complete anesthesia apparatus which can be housed in a small compact case and which can be assembled with very great dispatch, and which when assembled, in conjunction with portable tanks of oxygen and nitrous oxide and with available cans of ether, provides an efficient gas administering device in which oxygen nitrous oxide anesthesia or other gas anesthesia may be supplemented by ether anesthesia.

In combat areas of war and from emergency accidents in ordinary civilian life cases frequently arise which call for speedy operative treatment before the patient can be removed to hospital operating rooms. The remedial treatment of such cases is very greatly facilitated by the ability to give, with the utmost promptness, a suitable anesthetic. In combat areas and in connection with accident emergencies of the civil population, it is particularly desirable to have anesthetizing apparatus which is capable of giving a desirable anesthesia and which is compact enough and light enough so that it may be carried by hand. Tanks of oxygen and nitrous oxide are made small enough so that such tanks with a suitable handle may be carried by hand, and my apparatus when completely housed in its case with everything therein for the giving of anesthetic, excepting the tanks of oxygen, also can be carried very readily by hand.

Also the apparatus is of such a nature that not only can it be transported by airplane readily and satisfactorily, but it can be with equal readiness dropped by parachute to areas which might be otherwise inaccessible.

It is also important that it be capable of very quick assembly, but such quick assembly must be of a nature which will assure sealing of all connections or joints, as otherwise there might be leakage of the limited supply of gases such as oxygen and nitrous oxide which are available, and the proportions of gases being delivered by the machine might be interfered with. For such emergency anesthetizing outfits it is also essential that use of the gases be conserved not only from the possible danger of leakage, but in the actual use in inhalation, for which reason the apparatus must include means for rebreathing the gases, including means such as soda lime for taking from the gases the carbon dioxide developed in the lungs of a user.

And since the apparatus necessarily must be compact and of small size, it is essential that the last-named means, that is the soda lime and

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its container where that is used, shall be relatively small, for which reason it is desirable to have ready means of changing the canisters of soda lime and for carrying a sufficient number of them with the apparatus so that fresh canisters will be quickly available. Hence the means for holding the soda lime must be such that quick and easy entrance for replacement of the soda lime canisters will be available.

It is a principal object of my invention, therefore, to provide an anesthetizing apparatus made up of numerous parts which, with canisters of soda lime and standard cans of ether, will be conveniently packaged in knocked-down condition in a small case analogous to a suitcase, and which may thus be transported by plane and carried by hand into inaccessible places and which may be very rigidly assembled and put together and connected with suitable tanks of anesthetizing gases, all connections being quick-actuated sealing connections.

It is a further object of my invention to provide an absorber head having a chamber and passages, and a rebreathing bag connected with the passages and an inhalation tube connected with the passages, and to provide in the chamber quick-operating valve means of an oscillating type such that the exhalation gases may go to the rebreathing bag through a container of absorber material such as soda lime and through the material therein or be caused to go to the rebreathing bag outside of said container, or may in part go through the absorber material and in part go around it.

It is a further object of my invention to provide an oscillatible valve structure with two valve closures cooperating with two valve members such that when one is opened the other is closed, and to provide in conjunction therewith a valve operator, which with a single turn may shift the valves to an "on" position or an "off" position for controlling the flow of gas through the absorber or around the absorber, or may be positioned to permit a divided stream of the gas mixture to go in selected proportions both through and around the absorber.

It is a further object of my invention to removably support a container of absorber material within the absorber casing by a spring member adapted to close the bottom of the casing, whereby sealing contact of the upper part of the container is effected whenever the bottom of the casing carrying a container therewith is clamped upon the casing.

It is a further object of my invention to provide a holding chamber for a canister of soda lime or other absorber material which consists of two separated parts, the upper part being fixed and embodying an annular contact member and the lower part being removable and embodying a spring held supporting member and guide, whereby when the canister is positioned within the upper part of said chamber and the lower part is applied thereto, the canister will be held in operative position in the apparatus.

It is a further object of my invention to form openings through the lower part of the canister-holding chamber and to provide an overlying shield above said openings so that dust from the absorber material will be prevented from going with the exhalation gases out of the absorber holding chamber and into the rebreathing bag.

It is a further object of my invention to provide a receiving and delivery chamber above the absorber chamber having sealed therein passageways or chambers with valved openings from the top of one and the bottom of the other chamber and with check valves operative therein, such that one opens and the other closes upon inhalation and that said valves open and close reversely upon exhalation.

It is a further object of my invention to provide a casing having connected therewith a rebreathing bag and embodying an exhalation chamber and an inhalation chamber and an absorber chamber between the two, together with means for controlling flow of exhalation gas to go through the absorber chamber, around it, or partly through and partly around it, and with an exhalation tube and an inhalation tube having valved connection to the respective exhalation and inhalation chambers, whereby a closed breathing line through or around or partly through and partly around the absorber is established.

It is a further object of my invention to provide a mixing chamber in the inhalation part of the closed breathing line outside of the casing and to deliver nitrous oxide and oxygen in predetermined proportions to the mixing chamber, whereby the gas mixture will go to the patient upon inhalation of the gases ahead of the gases from the rebreathing bag.

It is a further object of my invention to provide in communication with the mixing chamber a safety valve adjusted to relieve pressure in the inhalation line whenever the delivery of oxygen and nitrous oxide thereto brings the pressure above a predetermined point.

It is a further object of my invention to provide means adapted to be removably connected with the casing for delivering ether to an evaporator located in the inhalation chamber within the casing.

It is a further object of my invention to provide in the ether supplying apparatus means for detachably supporting a standard can of ether in erect position and sealed into the ether delivery line.

It is a further object of my invention to provide means in conjunction with the ether delivery mechanism for establishing a syphon delivery of ether from the can of ether supported thereon and to cause it to produce automatic continuation of drop feed upon a series of porous evaporator plates located within the path of travel of the gases from the rebreathing bag and to the inhaler.

Other objects and advantages of my invention will appear in connection with the detailed description thereof and the novel means and combinations of elements by which the aforesaid advantageous results are secured will be particularly pointed out in the claims.

In the drawings illustrating my invention in one of its forms:

Fig. 1 illustrates in part perspective the different elements of the anesthetizing apparatus in the base section of the container case.

Fig. 2 is a view in part perspective of the cover part of the case showing the manner of packing therein canisters of absorber material, cans of ether, and the like.

Fig. 3 illustrates the machine set up for use with the addition of tanks of oxygen and nitrous oxide which are transported separately from the other material.

Fig. 4 is an elevation view with some parts broken away and in section showing the arrangement of parts for controlling gas passing on exhalation and inhalation through the apparatus to and from the rebreathing bag.

Fig. 5 is a complete sectional elevation view taken on line 5—5 of Fig. 6.

Fig. 6 is a sectional plan view taken on line 6—6 of Fig. 4.

Fig. 7 is a sectional elevation view of a portion of the upper part of the apparatus taken on line 7—7 of Fig. 6.

Fig. 7a is a section on line 7a—7a of Fig. 7.

Fig. 8 is a sectional view of the lower part of what is shown in Fig. 5 showing a modified form of ether vaporizer.

Fig. 9 is a sectional elevation view of a portion of the apparatus taken on line 9—9 of Fig. 6.

Fig. 10 is a part sectional elevation view of the automatic ether dropper member adapted to be removably connected with the main breathing head.

Fig. 11 is a transverse part sectional view taken substantially on line 11—11 of Fig. 7.

Fig. 12 is a sectional view taken on line 12—12 of Fig. 10.

Fig. 13 is a top plan view of the main casing head.

Fig. 14 is a part sectional view of the connection of the ether member to the top of the main casing.

Referring to Fig. 1, a carrying case is provided comprising a bottom or base portion 15 having a handle 16 with a top portion 17 adapted to be locked together by means of side hasps 18, as indicated in Figs. 1 and 2. Within the bottom casing 15 are positioned when not in use a supporting standard 19, a gas delivery head 20, breathing tubes 21 and 22 connected with a mask structure 23, an ether dropper attachment 24, a flow valve tank connector 25 attached to the head 20, and tank tubes 26 and 27.

In Fig. 2 is shown the cover part of the case with storage therein of a series of soda lime containers 28, of ether cans 29 and of packages 30, containing ampules of pentothal sodium or other anesthetic supplies.

Fig. 3 shows these several elements connected together in operative position, wherein the standard 19 is held by a centrally disposed socket (not shown) in the bottom member 15 which thus becomes the supporting base for the erected organization and all of the parts supported from the standard 19. This is shown in combination with an oxygen tank 31 and a nitrous oxide tank 32 which will be transported independently of the parts contained in the case 15—17.

The gas delivery head 20 comprises an outer casing having a cylindrical wall 33, inwardly turned annular horizontal flange 34, and a concentric cylindrical wall 35, Fig. 5. Upon the horizontal annular flange 34 is an annular gasket 36. A cap piece 37 has an annular horizontal wall 38 with an annular skirt 39. The wall 38 engages the annular gasket 36 and is held in gas tight relation thereon by a multiplicity of sheet metal screws 40, Figs. 5 and 13.

The cylindrical wall 33 has secured to the bottom thereof an annular ring 42, Figs. 4, 5, and 8, which embodies at its bottom part an annular groove 43 wherein is situated an annular gasket 44. A lower cap piece 45 has an annular bevelled rim 46 which is held in engagement with the gasket 44 by means of a hasp 47. This hasp is operated by a well known bail-snap lever arrangement generally shown in Fig. 3 and designated as 47'. This operates to lock it in a socket 48 in a support member 49 united with a depressed part 50 of the bottom cap 45, as clearly shown in Figs. 4 and 5.

At the center of the bottom part 15 of the case is an upstanding socket, not shown, which receives the shank end portion 19*a*, Fig. 1, of standard 19. An internally threaded clamp member 19*b* is screwed upon the upper threaded end of the socket member which holds the standard 19 rigidly erected in position, with the bottom case section 15 as its supporting and stabilizing base. Upon a side of the annular ring 42 is a connector piece 41, Fig. 4, which is keystone-shaped and which enters a correspondingly shaped slot 41' on the standard 19, Fig. 1. Thus to mount the head 20 in operative position it is only necessary to slip the shank 19 into the socket member (not shown), screwing down the internally threaded nut 19*b*, and then to insert the member 41 on ring 42 in the slot 41' and the assembly is complete. This can be done with very great dispatch and gives a rigidly effective support for the head 20 and the parts carried thereby and to be connected therewith.

Secured to the bottom cap 45 by means of screw bolts 51, Fig. 5, which extend through tubular spacers 52, is a cup 53. This cup is provided with a flaring flange portion 54, as clearly indicated in Figs. 4 and 5. At the center of the cup a tubular guide member 55 is provided which is secured to the center of the bottom 56 of the cup 53, and which has a portion 57 above said bottom and a second portion 58 below said bottom. A series of apertures 59, preferably round, are formed about the guide member 57, and surrounding the apertures 59 is an upstanding annular wall 60.

Overlying the chamber 61 formed inside of the annular wall 60 and leading to the apertures 59 is a plate 62 preferably formed with a sloping annular extension 63, as fully shown in Fig. 5. This plate carries a plunger member 64 which is slidably positioned within the guide 55 and which extends below the bottom portion 58 of said guide, as indicated at 65. A compression spring 66 tends to push the plate 62 upwardly so as to bring a stop ring 67 toward engagement with the lower edge of the portion 58 of guide 55. The entire assemblage of the bottom cap 45, the cup 53, and the parts carried thereby is thus readily removable by simply releasing the hasp 47.

The bottom cap 45 has secured thereon by means of a nut 68', as clearly indicated in Figs. 4, 5, and 8, a nipple 68 on which is a rubber bushing 69 having thereon an annular head 70, Fig. 8, positioned about the neck 72 of a rebreathing

bag 71, Fig. 8. This is adapted to be drawn over the nipple 68 and in that manner the bag is removably connected with the bottom cap 45 and opens at 73 into the chamber 74. This chamber 74, when the parts are assembled as in Fig. 5, is in direct communication with the openings 59 from the chamber 61 inside the annular wall 60, and also is in communication with an annular chamber 75 which surrounds the walls of cup 53 and extends upwardly about a second cup 76 with a flaring annular bottom portion 77, which faces but is spaced from the annular flaring upper portion 54 of cup 53.

This arrangement provides a simple and efficient means for introducing into the head 20 a container 78 of absorber material such as soda lime. This is an ordinary can-like container having a cylindrical wall 79 formed with top and bottom members through which the gases of exhalation may be caused to move when that is indicated. The bottom member 80 may be of sheet metal provided with a series of round holes 81, as indicated in Fig. 5, or provided with a reticulate bottom, as indicated at 82 in Fig. 8, or, if desired, the reticulate bottom 82 may be laid upon the sheet metal plate 80, as indicated schematically at 83 of Fig. 5.

The top member 84 of absorber container 78 is, as shown, formed of sheet metal with a multiplicity of small perforations through it where it overlies the soda lime in the container. It is, however, provided with an annular rim 85 formed with an annular bevelled face 86 which is adapted to engage a bevelled face 87 preferably formed with a solid backing 88, as indicated in Fig. 5.

From the above it will be apparent that for inserting an absorber container such as a can of soda lime, it is only necessary to take off the bottom cap 45 and the parts carried thereby, to set the can of soda lime with its bottom 80 adjacent its center in contact with the bottom plate 62 and to return the cap 45 and parts connected thereto together with the can of soda lime into closing position. This will cause the annular bevelled face 86 at the top of the can 79 to engage the annular bevelled face 87 fast on the cup 76. The spring 66 will then be compressed and when the hasp 47 latches the arrangement in position the soda lime container 78 will be removably held by the pressure of said spring through plate 62 against bottom 80 in sealing contact through bevelled face 86 with bevelled face 87.

The cup 76 is provided with a top 89 having a raised portion 90. The solid part 88 for forming the walls 87 is contained in the angle between the cylindrical wall of the cup 76 and the top wall 89. At the center of the upper portion 90 of top wall 89 is a circular opening 91 which coincides with a similar opening 92 in a horizontal wall 93 which forms a partition separating an upper chamber 94 formed within cylindrical wall 93 from the annular chamber 75 heretofore described and from a lower chamber 95 opening directly to the top of soda lime container 78.

Secured by means of a nut 96 is a valve ring 97 which has a part 98 that effects a clamping of the upper part 90 of the top 89 of cup 76 upon the wall 93. The upper edge of the part 98 forms an annular valve seat 99, which is adapted to be engaged by rocking valve member 100 pivoted at 101 to an oscillatible valve carrier 102, which in turn is pivoted at 103 to a stand 104 supported by the partition 93.

Opening into the annular chamber 75 which surrounds the soda lime holders 53 and 76 is a cylindrical member 105 supported upon the partition 93 and which is provided with an annular valve seat 106. The valve seat 106 is adapted to be engaged by a valve member 107 pivoted at 108 to the oscillatible or rocking bar 102. A spring 109 is connected at one end with a hook member 110 fast on the rocking member 102 and at the other end with a peg 103' which extends through the horizontal annular portion 38 on the cap piece 37.

The upper edge 111 of the rocking arm 102 is engaged by a ball 112 supported in a socket 113 at the end of a tubular piece 114 which surrounds a stem 115 having an enlarged screw threaded portion 116 secured to a hand wheel 117. The piece 114 is secured to the stem 115 by means of a pin 118 which extends through slots 119 and 120 in the sides of the tubular member 13 and also extends through the stem 115. A spring 121 is housed within a bore in the lower end of stem 115 and engages a bottom wall 122 which closes the lower end of the tubular member 114 above socket 113 and permits the contact of ball 112 with surface 111 to adjust itself as the screw member 116 is turned. The threads 123 of the threaded portion 116 of stem 115 engage interior threads 124 in a member 125 which is rigidly secured upon the cap piece 37 by brazing indicated at 126. A packing nut 127 is threaded upon member 125 and makes the union of the valve operating members in the cap piece 37 gas tight.

The threads 116 and 124 are of a comparatively steep pitch so that a single full turn of the hand wheel 117 will rock the bar 102 and cause the valves 100 and 107 to shift position. The hand wheel, as shown in Fig. 13, is designated as "absorber" and has two arrows respectively designated as "off" and "on." It also carries a stop 128 which is adapted to engage a side of a finger 129 which rises from plate 130, Fig. 13, resting upon the horizontal annular wall 38 and secured by a pair of screws 40.

The arrows which may be designated as 131 and 132, as shown in Fig. 13, are both pointing away from the pointer bar 129. This is the neutral position in which both valves 100 and 107 are held off of their valve seats and the stream of exhalation gases will be equally divided, one part going through the absorber material in container 79 and the other part going around it through chamber 75. When the hand wheel 117 is turned to carry the stop 128 into contact with the pointer bar 129 the "on" arrow will point downwardly toward the stop indicating that the valve members have been shifted, valve 107 to closing position and valve 100 to open position; that is the absorber is on at that time and the absorber is in full use. Upon turning the wheel a substantially full turn the stop 128 will engage the other side of pointer bar 129 and the arrow designated as "off" will then point upwardly to the pointer bar and in this position valve 100 will be fully closed and valve 107 will be fully open and the absorber is "off," that is entirely out of operation so no exhaled gases will pass through the absorber. The positions of the "off" arrow and the "on" arrow other than those above mentioned relative to the pointer bar 129 will inform the operator of the degree of opening of the two valves simultaneously. It follows that, in addition to the equal opening of the two valves, as indicated in Fig. 13, the absorber valve 100 may be opened only a trifle and the free flow valve 107 opened a great deal or variations may be made as the operator may elect.

The principal purpose of this adjustable valve arrangement is to permit the operator to vary the degree of carbon dioxide absorption as the condition of the patient may require. This will insure against over absorption, resulting in complete removal of carbon dioxide, which would have a tendency to prevent needed breathing stimulous and result in shallow breathing. This also enables the operator to use the soda lime in the container to the best advantage. Thus when the container is filled with fresh soda lime, absorption will be relatively complete and a divided stream of air may be necessary. On the other hand, when the soda lime or other absorber material approaches the point of exhaustion, it will be desirable to permit a greater and greater amount of exhalation gas to pass through it up to a full delivery of the entire exhalation gas through the absorber material.

In practical operation a mixture of two gases, namely oxygen and nitrous oxide, will be employed. Referring to Figs. 3, 7, and 11, the means of introducing these gases into the breathing line will now be pointed out. Thus referring to Fig. 11, oxygen from tank 31 passes through tube 26 and through a closure fitting 270, and through a valve casing 133 past a spring operated closure valve 134 into tube 135 of a flow valve of well known construction. This flow valve has a float 136 upon a stem 137, the flow valve and stem operating in an expanding passageway 138. From passageway 138 the gas goes through an opening 139 and a passageway 140 and thence through a port 140', Fig. 6, and into mixing chamber 141 in a fitting which is permanently connected with a tube connection 142. This connection is in effect a nipple brazed into and extending through casing wall 33. From chamber 141 the inhalation gases and oxygen go through a nipple extension 143 connecting with the breathing tube 21 which go to a suitable mask structure 144, Fig. 3.

The nitrous oxide flows from tank 32 through rubber tube 27 into a delivery passage 146 in tube 145 formed in a connector piece 147, Fig. 11. The connector piece 147 is shown in section and it will be understood that this connector piece is identically the same in structure both internally and externally as connector piece 270. The nitrous oxide flows past open valve 148 into a flow gauge tube 149 forming an expanding passageway 150. Within the passageway 150 is a float 151 having stem 152 in all respects like the float 136 and stem 137 in the oxygen float valve structure 135. The nitrous oxide goes from the passageway 150 through a port 153 and a passageway 154 opening into the mixing chamber 141 through an open port 155, as shown in Fig. 7.

Thus the chamber 141 receives the oxygen and nitrous oxide from opposite sides thereof so the chamber 141 becomes in fact the mixing chamber and the mixture is carried through the connector 143 and inhalation breathing tube 21 directly to the breathing passageway of the patient.

The tubular passageway 142 is permanently connected, Figs. 6 and 7, with an inhalation chamber 156 formed within a cylindrical member 157 in the exhalation chamber 94. It has a closed top 158 and a large port 159, Fig. 7, which is adapted to be closed by a flap valve 160, pivoted upon a hook pin 161 and restrained by a stop pin 162. The port 159 opens into inhalation chamber 75 which communicates with rebreathing bag

71 so that inhalation draws gases from the rebreathing bag, and the fresh oxygen and nitrous oxide delivered to the mixing chamber 141 moves as a mixture to the lungs ahead of the rebreathing bag gases.

The ends 163 and 164 of the oxygen flow stem 137 and the nitrous oxide flow stem 152 register with gauges 165 and 166 which give the reading of flow volumes in liters per minute of the respective gases. This flow is controlled by valves 167 and 168 on the tanks 31 and 32, Fig. 3.

Exhalation passes from the mask 144 through the exhalation breathing tube 22 into a passageway 169 formed within a tube 170 with which the breathing tube 22 connects. The tube 170 is fast upon and passes through the cylindrical casing wall 33, Figs. 6 and 9, and into a chamber 171 formed by a cylindrical member 172, and having a closed bottom 173 and a top 174 formed with an opening 175 which is closed by a flap valve 176. The flap valve is mounted upon hook pivots 177, Fig. 6, and is restrained in its upward movement by a hook pin 178. When the flap valve is opened by positive pressure, gases of exhalation flow through the passageway 169, the chamber 171, the port 175, into the chamber 94.

From chamber 94 the gases of exhalation may go either through the soda lime container 79 or about that container or partly through the container and partly about the container, according to the position of the valves 100 and 107. Whichever path or paths of travel is followed, the exhalation gases ultimately go to chamber 74 and thence through opening 73 and tubular connector 68 into the rebreathing bag 71.

There is thus from the mask 144 a closed breathing line which includes for inhalation the inhalation tube 21 connected through the nipple passageways 143 and 142 and mixing chamber 141, through chamber 156 and chambers 75 and 74 connected with the rebreathing bag 71, and a connected exhalation passageway going through exhalation tube 22 connecting with passageway 169, chamber 171, upper chamber 94 and thence, either through the soda lime container 79 or around or in a divided stream through and around it, to the chamber 74 and rebreathing bag 71.

The connector members 270 and 147 are exactly alike so that a description of one corresponds to a description of both. Having reference to Figs. 7 and 11, the details of the connector member and of the parts with which it connects are clearly shown. Thus flow tube 149 (or 135) is provided with a threaded end 179 upon which is screwed a piece 180 having an annular extension 181 with a central aperture 182 therethrough.

On tubular extension 183 of this piece is screwed a cup portion 184 of a member having a tubular extension part 185 formed with a central tubular unthreaded bore 186. The cup member 184 has at its bottom an annular gasket 187 which also forms a seat for the valve member 148.

This valve member is in the form of a disc with a cylindrical projection 188 which is surrounded by a compression spring 189 normally pressing the valve 148 into closing contact with the gasket 187.

The valve 148 is also provided with a plunger head 190 which, as references to the respective Figs. 7 and 11 clearly show, is flat and rather narrow in one of its dimensions and somewhat expanded in the other dimension, so as to substantially engage the walls of passageway 186 and hold the valve in proper position relative to the valve seat on gasket 187 and at the same time to provide gas passages 190′ to the valve 148.

The tubular extension 185 is also provided with oppositely disposed pins 191 and 192 which extend outwardly therefrom but not into the passageway 186, as clearly shown in Fig. 7. The connector member 147 is provided with tubular extension 193 which at its inner end is of less diameter than the width of the pusher head 190. The connector piece 147 is provided with an annular flange-like extension 194 upon which rests a gasket 195.

A second tubular member 196, Fig. 11, is provided with an internally disposed annular flange 197, which surrounds the outer portion of the lower part of the tubular connector piece 147. A lock ring 198 engaging an external groove in the connector member 147 and engaging the annular flange 197 may hold the member 196 upon the assemblage, after a spring 199 has been positioned about the member 147 between the flange 194 on it and the flange 197 on the second tubular member 196 to hold the gasket 195 against the end of tube 185.

In making the connection, which can be done very quickly, the tube extension 193 of connector member 147 is pushed into the tubular bore 186 until its end engages the pusher head 190 which will lift the valve 148 from its seat and through passages 190′ will open communication between passageway 150 in tube 149 and passageway 146 in connector piece 147.

The member 196 is provided with bayonet slots 200, Fig. 11 right, oppositely positioned and opening through the top edge thereof. By pushing up against the pressure of spring 199 the pins 191 and 192 may be caused to move down into the bayonet slot, and then by turning the member 196 (or member 270) it will hold the parts in almost instantly assembled locking relation and simultaneously will cause the valve 148 (or 134) to be held properly opened. In this manner the oxygen and nitrous oxide connections can be made with certainty of prevention of leakage and with the expenditure of very little time, all important where the apparatus is to be given emergency use.

Since the mixing chamber 141 receiving the gases directly from oxygen delivery tube 154, and since nitrous oxide delivery tube 140 is closed against positive pressure therein and in the passageway leading to the mask by reason of the flap valve 160, Fig. 7, holding against internal pressure, I have provided means for relieving pressure should it rise above a desired low point. This means is shown in detail in Fig. 7.

It comprises a cup-shaped seat 201 which has a bottom flange 202 surrounding a nipple 203 fast on member 204 forming the breathing chamber 141. An opening 205 connects the breathing chamber 141 with a chamber 206 within the cup member 201. A valve casing 207 has an annular flange 208 which engages the upper wall of the upper annular edge of member 201. A bolt 209 formed as a part of or rigidly united to the valve casing 207, extends across valve chamber 141 and by means of the valve casing, knurled on its outer surface, is screwed at its end into a threaded opening 210 in a boss 211 formed on the mixing chamber member 204.

The bolt 209 connects with an upper portion 212 which is integral with the valve casing 207 and provides openings 213, Fig. 7a, through an annular ring 214 extending inwardly from valve casing 207 and formed with an annular valve seat

215, as shown. By screwing the bolt 209 down tightly, a gas tight union is effected at 208 and also at 216 where the upper edge of nipple 203 engages the face of flange 217, all these contacting members being milled smooth to make sure of metal to metal sealing contact, since ether vapor tends to destroy rubber and like gasket material and hence gaskets cannot be used.

A valve 220 is held upon the valve seat 215 by a spring 221. The spring 221 engages a cap piece 222 which has a socket 223 which enables it to be turned more or less within the threaded inner wall 224 of valve piece 207, by which the tension of the spring 221 may be adjusted. A lock ring 225 holds the cap piece in its adjusted position. Apertures 226 in the valve casing 207 permit ready escape of gas when the valve 220 responding to pressure of the gas in the mixing chamber 141 is forced open.

I provide means for the effective administration of ether. For this purpose I provide a hollow connector piece 227 which is secured upon the cap member 37 by means of a ring 228 brazed to the outside of member 227 and brazed upon the cap piece 37, Figs. 5 and 14. The upper part of connector piece 227 encloses a cylindrical passageway 229, Fig. 5, and embodies outwardly extending pins 230 and 231.

The connector piece 227 which is cylindrical in its upper portion has an outwardly flaring portion 232 which on its inside forms an annular valve seat 233 engaged by the edges of a cone-shaped valve piece 234, the apex or cone extending upwardly. A tubular extension 235 of the valve piece is provided with a series of apertures 236 and is surrounded by a spring 237 which normally holds the valve piece 234 in engagement with the valve seat 233.

A closure member 238 has a cylindrical externally threaded portion 239 which is screwed into an internally threaded extension 240 of connector piece 227. This forms a seat at 241 for the spring 235 and also engages a gasket 242 with an outwardly extending annular flange 243. Hence, by screwing up on the closure member 238, an air tight seal is made for the chamber 244 formed within the member 240.

A hollow nipple 245 extends centrally downward from the closure piece 239 and is connected with a metallic delivery tube 246. The tube 246 has an intermediate downwardly-slanting portion 247 and a vertical portion 248 which is held within a reinforcing collar 249 to pass through the partition 93, as clearly shown in Figs. 4 and 5. As shown in Fig. 8, the vertical part of the tube 248 is extended, as indicated at 250, and is provided with a slanting portion 251 for conducting the ether to a dropper point 315 as will be hereinafter pointed out in detail.

An automatic ether dropper designated generally with the numeral 252 is formed with a main supporting standard 253. This is formed with a bottom hollow threaded boss 254 on which is screwed an internally threaded nut 255 which forces the upper edge of a tubular member 256 against a sealing gasket 256', Fig. 10. The member 256 is thus held rigidly extended from the supporting standard 253 and its interior passageway 257 is held in gas tight relation therewith. The member 256 has fast thereon a tubular coupler 258 which in part is knurled, as indicated at 259, and which has oppositely disposed bayonet slots 260 adapted to be slipped over the pins 230 and 231, see Fig. 14. A tubular portion 261 provided with indented openings 262 is thrust against the valve 234 as the parts are brought together, resulting in pushing the valve 234 from its seat 233, Fig. 14. This opens communication through passageway 257 into passageway 229, and thence past the valve 234 into passageway 238 and into nipple passageway leading to the tubular extension 246. In this manner the ether delivery assembly is readily secured upon the head 20 in operative relation thereto.

Ether is provided in standard cans 263, which, as is customary, are provided with an outwardly flaring neck rim 264, Fig. 10. The standard 253 has formed therewith a unitary offset portion 265 which embodies at its lower part a seat 266 wherein is a gasket 267 adapted to receive the upper edge of the flaring portion 264 of the ether can neck. A clamp member 268 has a fork 269 which embraces the flaring neck 264. The clamp member is provided with a boss 271 in which is threaded a screw bolt 272 held in position by a yoke 273 pivoted upon a pin 274 to an upstanding boss 275 forming a part of extension 265. The end of screw bolt 272 engages a seat 276 on the boss 275. With this arrangement the upper edge of ether can neck 274 can be drawn up in gas tight relation against the gasket 266, and the container of ether 263 can be quickly replaced with other containers taken from the stock 29 thereof carried in the upper part 17 of the case, Fig. 2. Since it can be readily replaced with a fresh gasket, in this relation a gasket can be employed.

A tube 277 is secured by means of a nut 278 in a recess 279 formed in the lower side of the part 265 of standard 253 within the seat 266 holding the gasket 267. This recess connects with a bore 280 in offset part 265, Figs. 10 and 12, which bore in turn connects with a downwardly turned bore or passageway 281 which extends through standard 253 and then obliquely at 282, Fig. 10, to the chamber 257, heretofore described. The tube 277 has at its bottom a screen indicated generally at 283 and it connects as shown in dotted lines at 284 with a chamber 285.

Leading from this chamber is a bore 286 which connects with a bore 287 in the standard 253. The upper part of bore 287 enters a flaring-walled cup 288 at the upper part thereof. To this cup is secured a rubber bulb 289. The lower part of bore 287 connects by an obliquely disposed extension 290 with a valve chamber 291 formed in an offset part 292 of the standard 253.

At the bottom of valve chamber 291 is a needle valve block 293 held in position by a lock nut 294. A needle valve 295 opens communication with a dropper tube 296 which discharges into chamber 257. The needle valve stem is threaded at 297 through an externally threaded member 298 which is screwed upon the internal thread 299 of the walls of valve chamber 291. An annular portion 300 of member 298 engages a gasket 301 which seals said member 298 against leakage from valve chamber 291. The valve stem 297 is provided with an unthreaded part 302 upon which is a thumb screw 303 by means of which the needle valve may be opened more or less. A packing nut 304 seals the stem 302 against leakage.

The object of this arrangement is to provide syphon-action ether-dropping delivery of the ether, the container of which, being suspended with its neck up, can not effect direct gravity dropping. To produce the above action the needle valve 295 is closed. The bulb 289 is then squeezed. This will force air through the tube 277 into the bottom of the ether can from which it will bubble out and pass through annular recess 279, bores 280, 281, and 282 to chamber 257 connected with the breathing line. When the bulb 289 is released it will suck ether through tubular passageway 284 and bore 286 and into cup 288 from which it will gravitate to and fill valve chamber 291 and passages 287 and 286 leading therefrom, including the passage through pipe 277 to the bottom of the ether can.

There will then be a continuous column of ether through the passageways to valve chamber 291. Since the bottom of this chamber is lower than any level of the ether in the container 263, by syphon action the ether will continue to flow into chamber 291, as it drops out of it. By operating the needle valve thumb screw 303 the rate of feed of the ether from the dropper tube 296 may be regulated. It follows that once the syphon action of dropping the ether has been established it will continue as long as there is any ether in the ether container 263. And when that is exhausted a new supply may be quickly and simply provided. The top of thumb screw 303 is provided with an "off" arrow and an "on" arrow, showing the direction to turn the needle valve on or off.

The ether so regulated and continually dropped, goes from the point 305 upon a porous annular plate 306, Fig. 5, which may be, as shown in Fig. 5, located in the upper part of annular air chamber 75. The edge of plate 306 is annularly spaced from the wall 33 as indicated at 307. The ether which drops from the edge of plate 306 will fall upon a similar annular plate 308 which is secured to the inside of the wall 33 with an annular space 309 between its inner edge and the outer surface of cup 76. The ether from plate 308, if any, will drop upon plate 310 which, like plate 306, is secured at its inner edge to the cup 76 with an annular space 311 between its outer edge and the inner surface of wall 33. The plates 306, 308 and 310 are formed of some suitable porous material, preferably a porous metal such as oil filter material. These plates not only permit some passage of air, but through capillary action tend to spread the liquid upon their surface, so no liquid will drop from the edge of one plate to another plate until the entire surface of the first plate is covered by a film of the liquid. By the time any ether has reached plate 310 it will have been substantially vaporized by inhalation of gas passing up through annular chamber 75 and past flap valve 160 and through chamber 156 to the breathing line in tube 143 and inhalation tube 21. There is thus provided a very large and effective evaporation area, which, because the plates 306, 308 and 310 are porous, some or all may be completely covered with a film of liquid and so produces rapid evaporation, making possible the use of the instrument for ether anesthesia alone, which readily can take place when the nitrous oxide is shut off, and oxygen is used with the ether, or when oxygen also is shut off and air is admitted through an air intake valve (not shown) on the inhaler, or with a combination of oxygen and air.

The plates 306 and 310 are brazed to the outer wall of the cup 76 and the plate 308 is brazed to the inside of cylindrical wall 33 and these plates are held in fixed spaced relation by means of screws 312 and spacers 313 and 314.

An alternative ether evaporator is shown in Fig. 8, where the ether drops at 315 upon a circular disc 316 within the chamber 74 below the plate 80. The plate 316 is porous like the plates 306, 308, and 310 and from the edges of plate 316 ether may drop upon a second circular plate 317 of larger diameter than plate 316. The plates 316 and 317 will be subject alternately to the movement of gases both on inhalation and exhalation, while the plates 306, 308 and 310 may be subject to the movement of gases only on inhalation.

The advantages of my invention have been quite fully brought out in connection with the detailed description thereof. Broadly these advantages reside in the fact that, in an anesthetizing apparatus adapted to be quickly assembled and disassembled, its component parts also have combinations of elements which provide a means of administering gas anesthesia or ether anesthesia, or both, actually superior to means for that purpose employed in the larger type, permanently assembled anesthesia devices employed in hospitals. Yet these component parts when disassembled can readily be packed together with surplus cans or containers of absorber materials, of ether, and of other materials, in a compact case as light and easy to handle and to transport by hand as an ordinary suitcase.

As a direct and particular advantage of my invention, the arrangement of chambers, passageways, soda lime container, and ether vaporizers in the breathing head which forms part of the breathing line, in relation to the rebreathing bag and the mask connected with the breathing tubes is such as to produce, not only a highly efficient organization, but one which has exceptional simplicity and efficacy for control by the operator and which also provides a closed breathing line wherein there is little or no restriction and which gives substantially maximum ease of breathing.

A further great advantage of my invention resides in the quick and simple means provided for changing the absorber container and the ether container so that comparatively small containers of both soda lime and of ether may be used effectively and are available to meet emergencies.

A further advantage of my invention resides in the extremely simple valve arrangement whereby exhalation gases may readily be caused to move entirely through the absorber, entirely around the absorber, or, in a divided stream, in part through the absorber and in part around the absorber in relative proportions which may readily be determined by the operator, another feature which makes possible the use of a relatively small soda lime container.

Another great advantage of my invention may be found in the arrangement of the mixing chamber relative to the delivery of gases such as oxygen and nitrous oxide thereto directly in the forward part of the inhalation line so that instant shift from mixture to pure oxygen or changes of proportions of the gases may readily be effected, together with means for safeguarding the patient against other than predetermined possible maximum pressures.

A further very substantial advantage of my invention resides in the fact that an ether administrating device is provided wherein the usual containers of ether are applied in an inverted position and a syphon delivery of the ether may quickly be effected, which is of great advantage in connection with a portable, quickly assembled anesthetizing device.

I claim:

1. In an anesthetizing apparatus, a closed breathing line including a casing having an inhalation part, an evaporator in the inhalation part, a tube extending outside the casing for con-

veying ether to the evaporator, a holder for ether supported in an upright position upon said tube, a chamber closed by a needle valve on a level below the bottom of the container, passages leading respectively from the bottom of the ether holder to the chamber and from the top of the ether holder to the tube, a bulb in communication with said passages, whereby by compressing the same when the needle valve is closed air will be driven through the ether to the tube and by releasing the bulb ether will be drawn from the holder to fill the chamber above the needle valve and the tube leading thereto from the bottom of the holder to give a syphon delivery of the ether controlled by the needle valve to the delivery tube.

2. An anesthetizing apparatus, comprising a casing head having a partition thereacross to form therein an upper and a lower chamber, a cup-like member in the lower chamber having a bevelled annular surface at its upper part, a bottom closing said lower chamber, an annular gasket adapted to be engaged by the upturned edges of said bottom, a spring hasp for forcing said edges against the gasket, a spring member carried by the bottom, and a soda lime container resting upon said spring member and having its upper edges forced into sealing engagement with the bevelled annular member when the bottom member is secured in position by the hasp.

3. An anesthetizing apparatus, comprising a casing head having a partition thereacross to form therein an upper and a lower chamber, a cup-like member in the lower chamber having a bevelled annular surface at its upper part, a bottom closing said chamber, an annular gasket adapted to be engaged by the upturned edges of said bottom, a spring hasp for forcing said edges against the gasket, a spring member carried by the bottom, a soda lime container resting upon said spring member and having its upper edges forced into sealing engagement with the bevelled annular member when the bottom member is secured in position by the hasp, a rebreathing bag opening into said bottom member, means establishing a closed breathing line wherein the exhalation gases may pass directly through the soda lime container toward said bottom member and rebreathing bag, and means associated with said bottom member for deflecting particles of soda lime from passage from the soda lime container into the rebreathing bag and the inhalation side of the breathing line.

4. An anesthetizing apparatus, the component parts of which are adapted to be separated to be conveniently packaged in a casing carried by the hand, said casing formed of two separable interlocking parts, a tubular standard of a length relative to the cross-sectional area of the casing such that the standard can be contained within a section of the casing, a centrally disposed socket formed on the inside of the bottom of one part of the casing for receiving and holding erect the standard, said part of the casing forming the supporting base of the apparatus, an anesthetizer head adapted to be independently positioned within the casing and to be connected with and supported by the standard, flow valves fast on the head adapted to be connected to tanks of oxygen and nitrous oxide, a mask and set of breathing tubes adapted to be packaged in the casing, all said parts being adapted for connection one with the other for quick assembly, said head embodying chambers and passages such that in combination with the flow valve passages a closed breathing line may be quickly established and a complete anesthetizing apparatus be quickly assembled for emergency use.

5. An anesthetizing apparatus comprising a casing having upper and lower chambers formed therein, a soda lime container in the lower chamber spaced a substantial distance from the walls and bottom thereof, said casing and connected parts forming a closed breathing line with the inhalation part thereof extending through said space, staggered plates severally attached to said walls at one of their edges forming baffles having annular portions extended into said space with staggered annular air passages past their unattached edges, a supply of ether, a tube having operative connection with said supply and extending within the space to discharge ether upon said extended portions of the baffles for vaporization therefrom, and manually operable means for causing continuous delivery of ether from said supply to the baffles.

6. An anesthetizing apparatus comprising a casing having therein a soda lime container and an interconnected annular and bottom space about the soda lime container, said casing and connected parts forming a closed breathing line with the inhalation part thereof extending through said space, an ether can supported with its opening up and providing a supply of ether, means for establishing a syphon flow of ether from said ether can consisting of a tube extending to near the bottom of the ether can, a manually operable air bulb and passages therefrom for forcing air through the ether and out of the apparatus, air passages connected therewith and to the bulb whereby release of the bulb will establish continuous syphon-feed flow of ether to the ether dropping means.

7. An anesthetizing apparatus, comprising an anesthetizing head, a transverse partition therein forming an upper chamber and a lower chamber on the head, a soda lime container having perforated ends and being removably supported in the lower chamber so as to leave a space of large cross sectional area about and across the lower end of the same, a re-breathing bag connected with said space, a breathing line having breathing connection of the inhalation side with said space and not said upper chamber and having breathing connection of the exhalation side with the upper chamber, said partition having a port and connecting passageway going to the upper end of the soda lime container and a second port and passageway going to said space, a centrally pivoted bar and a valve on each end thereof, and means including a spring acting upon one end of the bar and a hand operated stem acting on the other end of the bar for swinging the bar on its pivot to open one port and close the other port simultaneously to any degree desired, thereby to control the movement of exhalation gas from the upper chamber so it may wholly or in part pass through said space to the re-breathing bag or may wholly or in part pass through the soda lime container to the re-breathing bag.

8. An anesthetizing apparatus, comprising an anesthetizing head, a transverse partition therein forming an upper chamber and a lower chamber on the head, a soda lime container having perforated ends and being removably supported in the lower chamber so as to leave a space of large cross sectional area about and across the lower end of the same, a re-breathing

bag connected with said space, a breathing line having breathing connection of the inhalation side with said space and not said upper chamber and having breathing connection of the exhalation side with the upper chamber, a cup surrounding a part of the soda lime container and having means connected therewith for supporting the container and positioned to form a chamber below the bottom wall of the container, an opening through the bottom wall of the cup into said last named chamber, an annular wall surrounding said opening, and a baffle member overlying said opening to insure against particles from the soda lime container passing into the space and to the re-breathing bag.

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