

Feb. 19, 1952

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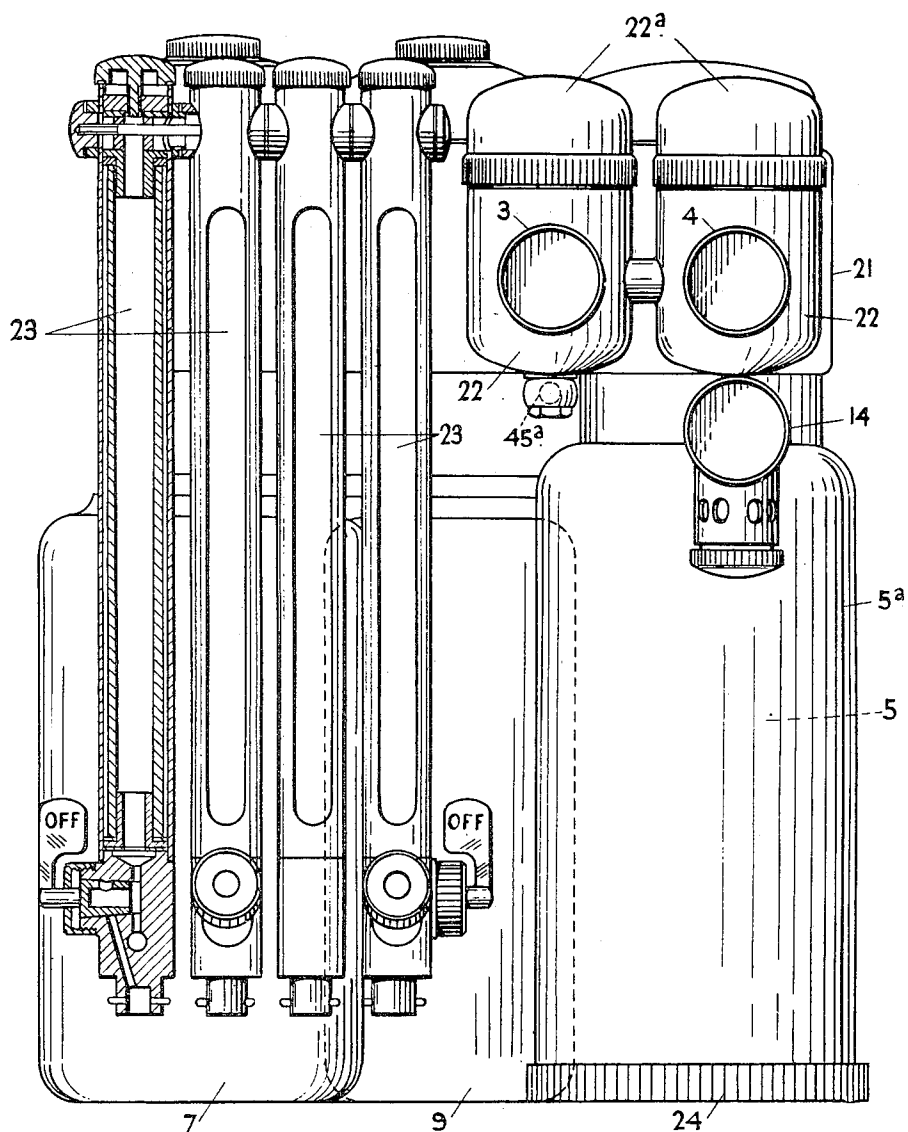
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APPARATUS FOR THE ADMINISTRATION OF INHALANT GAS MIXTURES

Filed Feb. 26, 1948

6 Sheets-Sheet 1

FIG. 1



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6 Sheets-Sheet 2

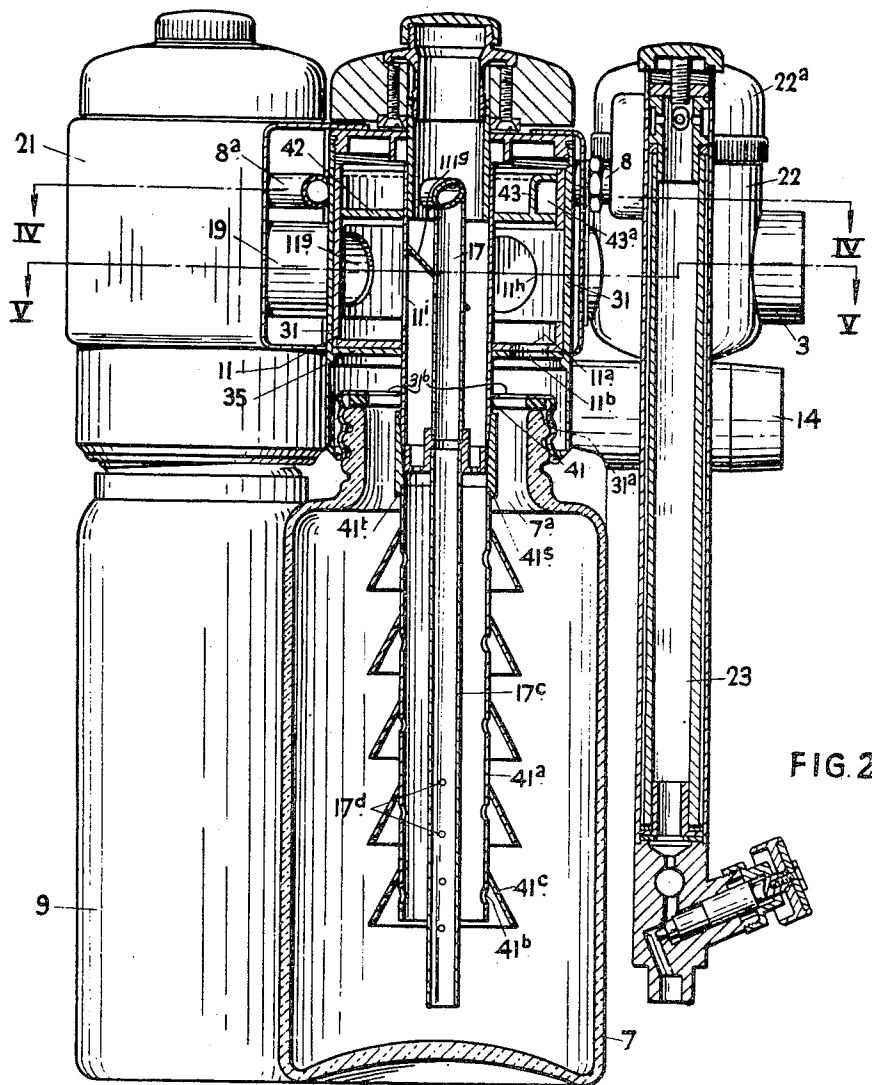


FIG. 2

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6 Sheets-Sheet 3

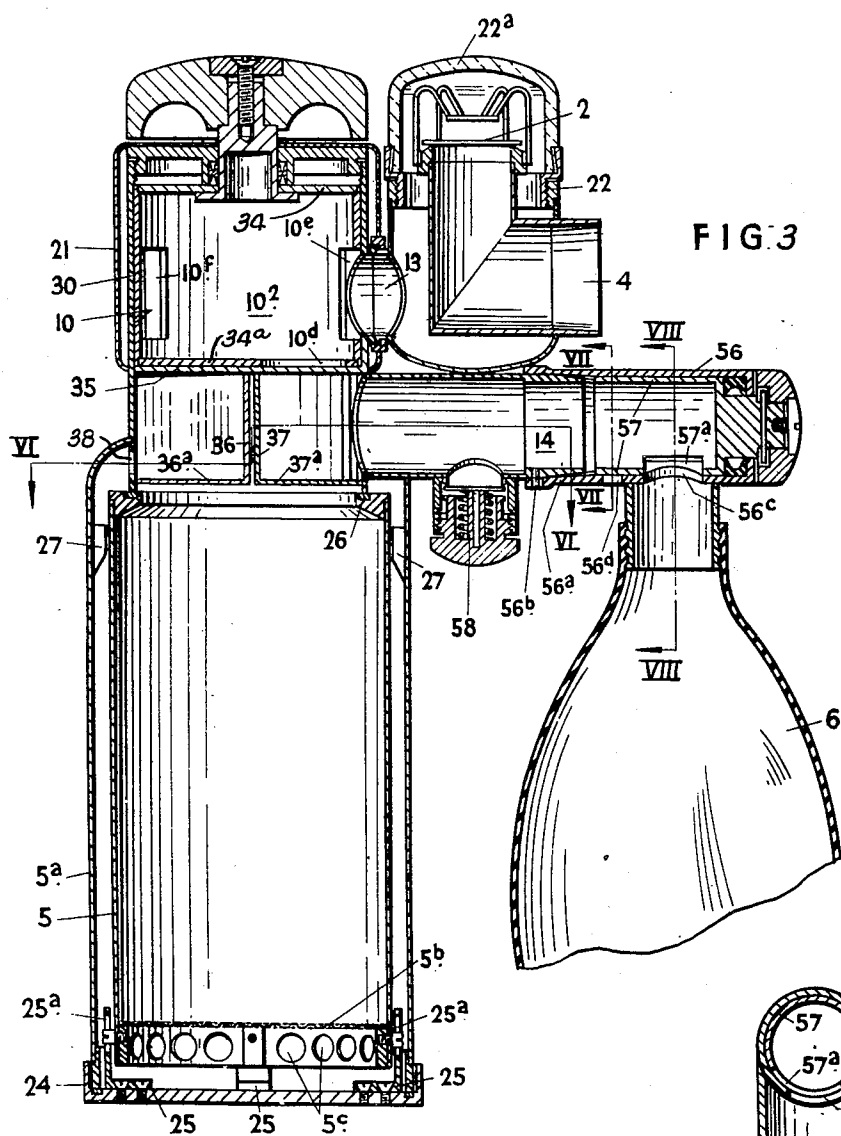


FIG. 3

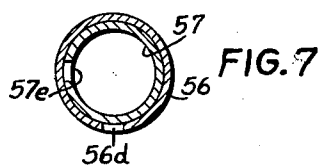


FIG. 7

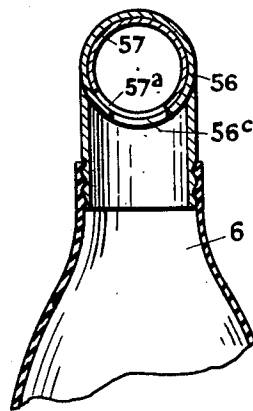


FIG. 8

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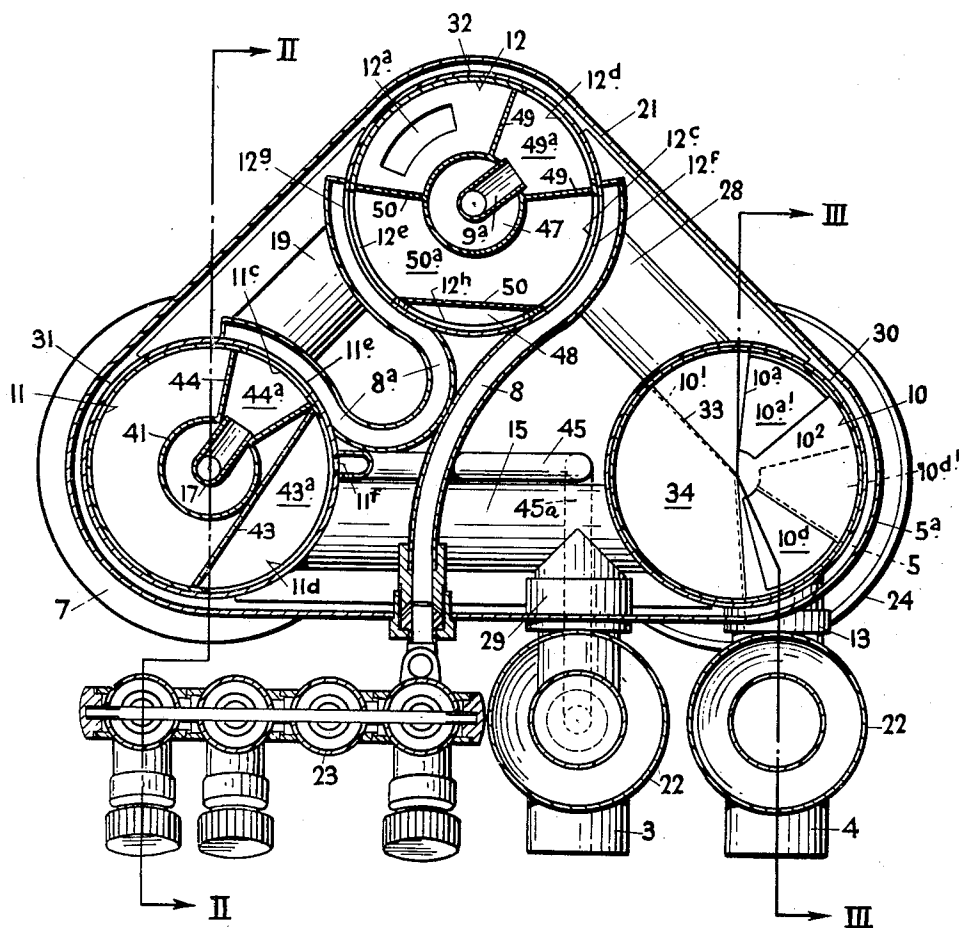


FIG. 4

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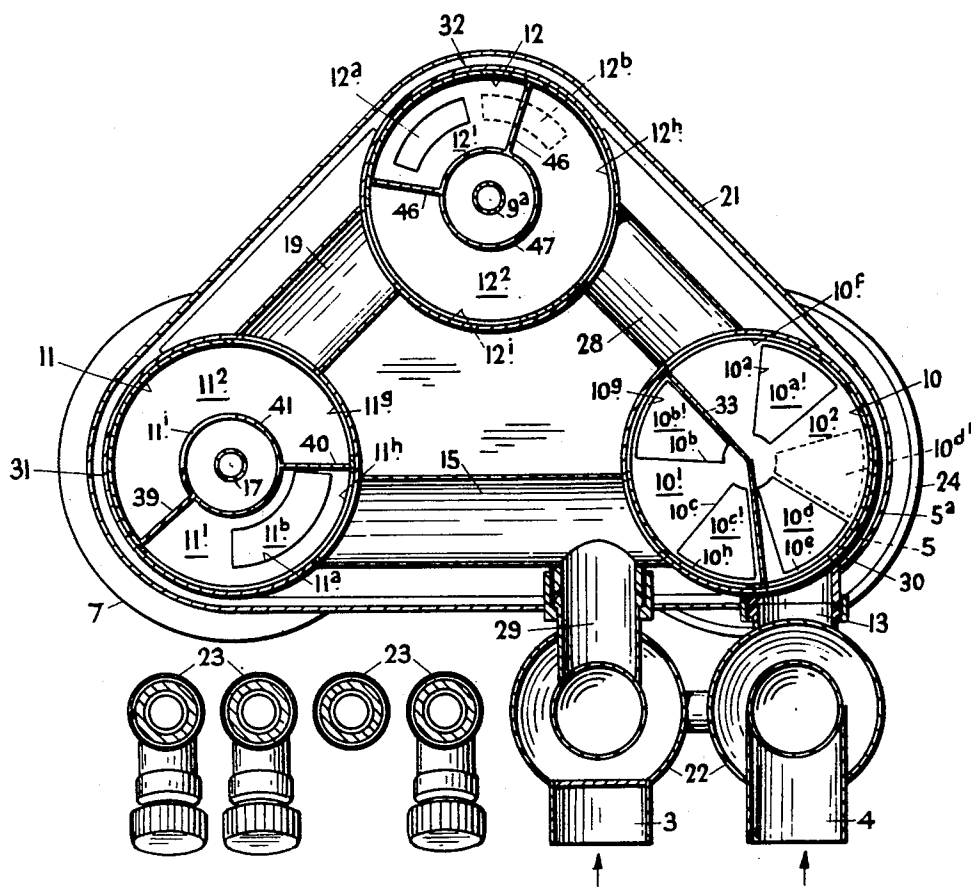
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APPARATUS FOR THE ADMINISTRATION OF INHALANT GAS MIXTURES

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6 Sheets-Sheet 5

FIG. 5



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UNITED STATES PATENT OFFICE

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APPARATUS FOR THE ADMINISTRATION OF
INHALANT GAS MIXTURESHenry Rex Marrett, Coventry, England, assignor
to Airmed Limited, Harecourt House, London
County, EnglandApplication February 26, 1948, Serial No. 11,124
In Great Britain November 6, 1946

13 Claims. (Cl. 128—188)

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This invention relates to improvements in connection with apparatus for the administration of inhalant gas mixtures, such as anesthetics.

In the standard type of closed circuit apparatus used for administering anesthetics there are two main circuits which are interconnected, viz: the patient's circuit, incorporating a carbon dioxide absorber and ether vaporizer, and the basal gas circuit. The patient's circuit includes inlet and outlet valves for the patient's breath, a soda lime container for the removal of carbon-dioxide, a vaporizer containing liquid ether or other volatile liquid, a re-breathing reservoir or rubber bag, and metering valves for varying the amount of gas which it is desired to pass through the soda lime container and/or the vaporizer. The basal gas circuit includes a number of metering valves for the admission of a controlled quantity of one or more basal gases such as nitrous oxide, carbon dioxide, cyclo-propane or oxygen and one or more vaporizers containing volatile liquids such as ether, trichlorethylene or chloroform, and valves permitting the flow of basal gases to contact the vapor or volatile liquids in the vaporizers before the basal gas flow joins the patient's circuit.

In apparatus of this type, there is always the danger that, when brought into use, the operator may erroneously place both the soda lime container and the trichlorethylene vaporizer in circuit together, which would of course result in the decomposition of the trichlorethylene.

It is an object of the present invention to provide an improved form or combinational construction of apparatus for the administration of inhalant gases which, in addition to being portable, will withstand rough usage without developing leaks and in which all controls are arranged in a compact and easily accessible relationship.

It is a further object of the invention to provide an automatic "locking device," whereby, when the gases are being passed through the soda lime container it is rendered impossible to introduce trichlorethylene into the circuit and, similarly, when the gases are being passed through the trichlorethylene vaporizer it is rendered impossible to divert the gases through the soda lime container.

A still further object of the invention is to provide a construction of apparatus of the designated character which incorporates a plurality of valves by means of which complete control may be obtained of the concentration of the anesthetic vapors admixed with gases to be administered to the patient.

A preferred embodiment of the invention will

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now be described with reference to the accompanying drawings in which:

Fig. 1 is a front elevation of the compacted apparatus unit;

5 Fig. 2 is a side elevation thereof partly in section on the line II—II of Fig. 4;

Fig. 3 is a section on the line III—III of Fig. 4; Figs. 4 and 5 are different cross-sectional plan views taken respectively on the lines IV—IV and V—V of Fig. 2;

10 Fig. 6 is a part section on the line VI—VI of Fig. 3;

Figs. 7 and 8 are cross-sections taken respectively on the lines VII—VII and VIII—VIII of Fig. 3; and

15 Fig. 9 is a cross-section of the valve drum "locking device" included in the improved structure of the invention.

Referring now to the structural embodiment of the invention illustrated in Figs. 1 to 9 of the drawings, the apparatus assembly includes a unitary head 21 in the general form of a casing. This head is provided, at the front end of the assembly, with an inlet connection 4 and an outlet connection 3 (see Figs. 1 and 4) for connection to the tubes of the patient's face mask (not shown), said inlet connection 4 and outlet connection 3 being each provided with a non-return valve. One of these valves, namely valve 2 of inlet 4, is shown in Fig. 3, a similar valve being located in the outlet 3. Non-return valves are enclosed in duplicative housings 22 having transparent covers 22a so that the functioning of said valves may be readily observed.

Also on the front of the unitary head 21, there is provided a passage 14 for the rebreathing bag 6 (Fig. 3). Adjacent to said passage a bank of flow-meters 23 is mounted upon the unitary head 21, the outlet from the flow-meters for the basal gases leading to an inlet passage 8 (Figs. 4 and 2) in the head for introduction of basal gas or gases to the system. As shown, the inlet and outlet connections 4 and 3, the valve housings 22 for the non-return valves 1 and 2, the passage 14 to the rebreathing bag 6 (Fig. 3) and the flow-meters 23 for the basal gases are all located at the front of the unitary head 21 for ease of observation and control.

Mounted or connectively assembled on the underside of the unitary head 21 are the soda lime container 5, the ether vaporizer 7 and the trichlorethylene vaporizer 9, these being disposed in close relationship to each other.

Inserted concentrically in cylinders 30, 31, 32 (Fig. 4) extending vertically downward from the

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top of the unitary head 21 and forming, in effect, a part of said head, are three vertical drums 10, 11, 12 (Fig. 4) mounted rotatably in said cylinders respectively over the soda lime container 5, the ether vaporizer 7 and the trichlorethylene vaporizer 9 (see also Figs. 2 and 3). These drums are provided with ports and compartments which cooperate with ports and passageways provided in or connected with said cylinders or with parts of the unitary head 21, as is hereinafter more fully explained, and accordingly act as valves.

The rotatable drum 10 (over the soda lime container), hereinafter called the "main drum," has two settings controlling the flow of gases in what is termed and hereinafter described as the "patient's circuit," that is, either (a) through the soda lime container 5 or (b) by by-passing the soda lime container 5. The other two rotatable drums 11 and 12, hereinafter referred to as the "ether drum" and the "trichlorethylene drum," respectively control the admission of the patient's breath or any desired proportion thereof to the ether vaporizer 7, and the flow of basal gases or any desired proportion of such gases through one or both of the vaporizers 7 and 9.

The soda lime container 5 is surrounded by an outer casing 5a (see Figs. 1 and 2) and is supported on the inside of a knurled closure 24, screwed to the outer side of said casing, by means of angle brackets 25. A spring, such as a circular coil spring (not shown), is interposed between said closure 24 and the bottom edge of the soda lime container 5, the brackets 25 being provided with vertical slots 25a to take up the movement of the brackets as the closure 24 is screwed onto the outer casing 5a for securing the soda lime container 5 in position. In the upper edge of the container an inset sealing ring 26 (Fig. 3) is provided to effect a tight closure contact. The outer casing 5a is also provided with guides 27 (Fig. 3) to locate the container 5 centrally when it is inserted in the outer casing 5a.

The container 5 is provided with a gauze layer 5b at its bottom to prevent the soda lime from entering the circuit conduits and, below said gauze level, a row of ports 5c communicating with the annular passage formed around said container between it and the outer casing 5a. This annular passage communicates with the passage 14 to the rebreather bag 6 through openings 38 controlled by a valve as will later appear.

Referring now more particularly to Figures 4 and 5, three passages 15, 19 and 28 interconnect the three cylinders 30, 31 and 32 in the unitary head 21 in which the main drum 10, the ether drum 11 and the trichlorethylene drum 12 rotate. These interconnecting passages 15, 19, 28 have circuit opening to a branch 29 leading from one of the same (in this instance passage 15) to the inspiratory non-return valve in the outlet connection 3 of the apparatus.

The main drum 10 is provided with a vertical partition 33 dividing it depthwise on the lines of a chord or segment into two space portions 10¹ and 10², the portion 10¹ being closed over or capped at its top by a horizontal plate 34 extending from the wall of the drum to said vertical partition 33. The base or bottom cross-plate 34a of the drum 10 is provided with the four ports 10a, 10b, 10c and 10d which are adapted to register, in one or the other of the alternative settings of drum 10, respectively with ports 10a¹, 10b¹, 10c¹ and 10d¹ (see Figs. 3, 5 and 6) formed in the bottom 35 of the unitary head 21. In addition, the circumferential wall of the main drum

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10 is provided with four ports 10e, 10f, 10g and 10h (see Figs. 3 and 5), which can be brought into registration with the passage 13 (Fig. 6) leading to the expiratory non-return valve 2 in the inlet connection 4 of the apparatus and also with the passages 15 and 28 connecting the cylinders 31 and 32 with the cylinder 30. Thus the main drum 10 may be said to be interconnectable with the ether and trichlorethylene vaporizer drums 11 and 12 respectively.

The circumferential wall of cylinder 30 (Fig. 3) extends below the bottom plate 35 of the head 21, down to the open top of the soda lime container 5 in contact with the sealing ring 26 in the latter, and the space thereof between the top of said soda lime container and the bottom plate 35 of the head is subdivided by vertical partitions 36 and 37 (Figs. 3 and 6). These last-named partitions comprise plates bent right-angularly or otherwise formed at their lower ends to provide closure plates 36a and 37a over the soda lime container (Figs. 3 and 6). The outer casing 5a of the soda lime container 5 terminates at or in the downwardly extended wall of cylinder 30 above a row of ports 38 (Fig. 6) previously mentioned. The positionings of the aforementioned ports 10a¹, 10b¹, 10c¹ and 10d¹ in the bottom plate 35 of the head relative to said vertical partitions 36 and 37 within the lower end of cylinder 30 are shown in dotted lines in Fig. 6.

The ether drum 11 in cylinder 31 is provided with vertical partitions 39 and 40 (Fig. 5) dividing the annular space of said drum, between a central filling passage 41 therein and the inner peripheral wall thereof, into two portions 11¹ and 11², said partitions extending through only a portion of the depth of the drum. These divided space portions 11¹ and 11² of the drum are covered over by a horizontal plate 42 (Fig. 2). Supported on this horizontal plate 42 are a right-angular plate member 43 on the line of a chord (Figs. 2 and 4) defining a gas passage 43a and a V-shaped member 44 on the lines of a segment forming a gas passage 44a leading to a tube 17 extending down through the central passage 41 into the ether vaporizer 7. The bottom plate (not numbered) of the drum 11 is provided with a port 11a (Figs. 2 and 5) adapted to register with a port 11b in the bottom plate 35 of the head 21. The cylindrical wall of drum 11 is provided at an upper level with ports 11c and 11d (Fig. 4) adapted to register respectively with ports 11e and 11f in the cylinder 31, so as to lead basal gases from the passage 8a (extending from cylinder 32) into the gas passage 44a of the drum 11 and from the gas passage 43a of the drum to an exit passage 45 extending from the cylinder 31. This last-named passage 45 leads by way of a banjo connection 45a to the valve housing 22 of the inspiratory non-return valve 3. At a lower level in the cylindrical wall of drum 11, further ports 11g and 11h (Fig. 5) are provided to register with ports (not lettered) opening from cylinder 31 to the passages 19 and 15. A port 11i in the central filling passage 41 serves to connect the space 11² with said central filling passage 41.

As shown in Fig. 2, the ether vaporizer 7 screws into a re-entrant portion 31a formed in the lower end of the cylinder 31. The central filling passage 41 tapers externally at its lower end to provide a push fit interconnection with a reversely tapered sleeve 41s, carrying an extension 41a of said passage 41. The sleeve 41s also carries a spider 41t which receives the tube 17 and an

extension 17c of said tube, such extension being provided with a plurality of holes 17a below the level of the liquid ether. The extension 41a is provided with apertures 41b spaced along its length and shielded by baffles 41c. The before-mentioned port 11i in the filling passage 41 is provided with a baffle 11g to prevent the splash of ether into the chamber portions 11² of the drum. The annular space 7a between the neck of the vaporizer 7 and the sleeve 41s provides a passage for the gases, and openings 31b are provided in the horizontal cross-plate part of the re-entrant portion 31a above said space 7a to permit upward egress of gases from the vaporizer therethrough.

The drum 12 controlling the trichlorethylene vaporizer 9 within the cylinder 32 is provided with vertical partitions 46 (Fig. 5), dividing the annular space of the drum on the lines of a segment between a central filling passage 47 and the inner peripheral wall of the drum into two portions 12¹ and 12². The space portion 12² is covered by a horizontal plate 48 (indicated in Fig. 4) which supports two pairs of plate members 49 and 50 (Fig. 4), the first on the lines of a segment and the second on lines of parallel chords, providing respectively passages 49a and 50a for the gases. The gas passage 49a opens into or from a bent tube 9a extending down into the trichlorethylene vaporizer 9 similarly to the tube 17 in the ether vaporizer 7. The horizontal bottom plate of the drum 12 is provided with a port 12a adapted to register with a port 12b (Fig. 5) in the bottom plate of the cylinder 32. The circumferential wall of drum 12 is provided with ports 12c, 12d and 12e (Fig. 4) at an upper level adapted to register with ports 12f and 12g in the walls of the cylinder 32 containing the drum, so as to lead basal gases in to the drum from the inlet passage 8 and to provide for the exit of the basal gases through the passage 8a leading to the ether drum 11, while at a lower level ports 12h and 12i (Fig. 5) are provided to register with the cylinder interconnecting passages 28 and 19.

The attachment 56 by which the rebreathing bag 6 is mounted at the end of the previously described passage 14 is provided with a tapered joint 56a (Fig. 3) and with a bayonet catch 56b to prevent accidental displacement from the passage 14. This attachment 56 is further provided with a control valve in the form of a drum 57 which can be rotated in either direction out of a mid-position. In the mid-position (Figs. 3 and 8) the bag 6 is open to the gas circuit through the port 57a in the drum 57 and a port 56c in the attachment 56. Rotation of the drum 57 in one (counterclockwise) direction closes the port 56c and opens the circuit to the atmosphere for partial rebreathing through a vent 56d in the attachment 56 with which a smaller port 57e in the drum is brought into register (see Fig. 7). Rotation of the drum 57 in the other (clockwise) direction gradually closes both the port 56c and the vent 56d so that both the bag and the vent are closed for insufflation.

Also, in this connection, the usual relief valve 58 is provided (Fig. 3) to prevent undue pressure from building up in the circuit.

As hereinbefore stated, it is intended that when the soda lime container 5 is open in the circuit the trichlorethylene vaporizer 9 shall not be operated; that is, it will be rendered impossible to introduce trichlorethylene into the circuit. Accordingly, a locking device is provided between the drums 10 and 12 in cylinders 30 and 32. This

locking device as shown in Fig. 9 comprises a plunger 51 under tension of a spring 52. It is mounted in a tubular sleeve 53 extending between the two drum cylinders and is held or urged normally in engagement with a recess 54 in the drum 12, thereby keeping said drum from rotating. The drum 10 controlling the soda lime container 5 also is provided with a recess 55 which, when drum 10 is moved to position cutting the soda lime container 5 out of circuit, registers with the end of the tubular sleeve 53. Consequently, if the drum 12 then is rotated, the cam faces 54a thereon will move the plunger 51 against the action of its spring 52 into said recess 55 of the drum 10, so that drum 10 will then be locked against rotation until the trichlorethylene drum 12 is rotated back to the "off" position. Thereupon, the spring 52 moves the plunger 51 back into the recess 54 of the drum 12, thus again locking the drum 12 and again permitting movement of drum 10.

The drum 10 is adapted to be moved anti-clockwise through an angle of 45° from the position shown in Fig. 5. The drum 11 is adapted to be moved anti-clockwise through an angle of 90° from the position shown in Fig. 5, while the drum 12 is adapted to be moved clockwise through an angle of 60°. All three are turned manually by knobs, shown but not lettered, provided at the top of their respective cylinders on stem projected through the head 21.

In operation, with the drums 10, 11 and 12 set as shown in Figs. 4 and 5, that is, with the soda lime container 5 in circuit and the trichlorethylene vaporizer 9 cut out of circuit, the exhaled gases from the patient (i. e., from the gas mask) enter the connection 4 to the expiratory non-return valve 2 in said connection. Past said valve the gases move through passage 13 and the port 10e into the space portion 10² of the drum 10, thence down through the ports 10a and 10a¹ into the space below the drum between the vertical partitions 36 and 37 (Fig. 6). From there they pass down through the soda lime container 5, up through the ports 5c around the annular passage between the soda lime container 5 and its casing 5a, and thence through the ports 38 into the space portion beneath the drum 10 enclosed by the partition 36. From the last named space the gases then pass up through the open ports 10b, 10b¹ and down through the open ports 10c, 10c¹ into and through the passage 14 to the rebreathing bag or reservoir 6.

On inspiration, the gases traverse in reverse the path just described, with the exception that, after emerging upwardly through the ports 10a and 10a¹, they traverse the passage 28 through ports 10f and 12h into the space portion 12² of the drum 12, leave said space by way of port 12i opening into passage 19 and enter the space portion 11² of the drum 11 by way of the port 11g. The gases then pass through port 11i into the central filling passage 41 and down through its extension 41a, out through the apertures 41b around the baffles 41c and upwardly through the exit 7a and openings 31b and through ports 11b, 11a into the space portion 11¹ of the drum 11. From this last named space in drum 11 the gases emerge by way of port 11h into the passage 15 and pass thence by way of branch 29 to the inspiratory non-return valve 1 in connection 3. Thus the gases are caused to take a circulatory flow through the apparatus.

With the drum 10 in the position shown and the drum 12 locked against movement as illus-

trated in Fig. 9, the drum 11 may be rotated in an anti-clockwise direction through 90° to its "off" position. As the drum 11 is so rotated, the partition 40 gradually moves across the opening from the passage 19 into cylinder 31 and accordingly, the gases in the patient's circuit following the flow above described will alternatively enter both the space portions 11² and 11¹. Those of the gases which enter the portion 11² are passed down as previously described through port 11i and the filling passage 41 through the vaporizer 7, and return through the but now only partially open ports 11a and 11b into the space portion 11¹. Those of said gases which alternatively now initially enter said space portion 11¹ from the passage 19 pass directly across the top of the vaporizer 7 and join the reduced flow coming up therefrom through the ports 11a and 11b. Together they pass out through port 11h into the passage 15 and thence to the inspiratory non-return valve 1 by way of the branch 29 as already described, but the reunited flows will now contain a lesser volume of ether vapor. With the drum 11 turned finally into the full "off" position, the partitions 39 and 40 are so positioned that all of the gases entering from the passage 19 will then enter only the portion 11¹ of the drum 11 and will directly leave the drum again through the port 11h without traversing or entering down into the ether vaporizer 7.

Further, with the drums 10, 11 and 12 in the positions shown, i. e., with the soda lime drum 10 turned "on," the trichlorethylene drum 12 turned "off" and the ether drum 11 turned "on," the basal gases, if flow of the latter is turned on, will enter through the passage 8 (Fig. 4), pass through the ports 12f, 12c into the gas passage 50a of the drum 12 and leave the last-named passage by way of ports 12e, 12g at the opposite side of said drum. These basal gases are conducted thence by the passage 8a (Figs. 4 and 2) to the drum 11, entering the latter through ports 11c, 11e into the space passage 44a thereof and pass on down through the tube 17 extending therefrom into the vaporizer 7. Emerging through the apertures 17d and bottom of said tube, these gases mingle and rise with the gases in the patient's circuit which are flowing, as previously described, down into the vaporizer through the passage 41. The basal gases thus admixed with the gases in the patient's circuit then enter therewith into the portion 11¹ of the drum 11 through the ports 11a, 11b and leave the drum by way of the port 11h, passing onward through the passage 15 and branch 29 which lead to the inspiratory non-return valve 1 in connection 3.

If the drum 11 now is rotated in anti-clockwise direction from its "on" position towards its "off" position, the basal gas flow entering through port 11e from the passage 8a is divided between the gas passages 44a and 43a of the drum, that portion of such flow which is directed into passage 44a being led through the vaporizer 7 as already described above, while that portion of the flow which is diverted into passage 43a is led straight to the outlet passage 45 by way of the ports 11f and 11d. Hence, the diverted portion is led direct to the inspiratory valve in the connection 3. Naturally, in the full "off" position of said drum, all of the basal gas flow will be diverted across the top of the ether vaporizer 7 into the passage 45 without traversing or passing down into said vaporizer.

If the drum 10 is rotated anti-clockwise through 45° from the "on" position shown in Fig. 5 to its "off" position, the space portion 10² of said drum will no longer be in communication through port 10e with the passage 13 from the expiratory valve in connection 4. Instead, the space portion 10¹ will be brought into communication with said passage and valve through the port 10h. Also, due to the rotation of the drum, the ports 10a, 10b and 10c will no longer be in register with the ports 10a¹, 10b¹ and 10c¹. Instead, the port 10d will now be brought into register with the port 10d¹. Hence, in such "off" position of the drum, with the gases in the patient's circuit now entering space portion 10¹ from the expiratory non-return valve 2, and with the ports 10b and 10c now closed, the only port left open from said space portion 10¹ will be the port 10g which now registers with passage 15. Consequently, on expiration, the gases now will traverse this passage 15 and enter the space portion 11¹ of drum 11, then pass down through the ports 11a, 11b and enter the ether vaporizer 7 through the openings 31b and passage 7a. From the vaporizer the gases pass back upward by way of the central filling passage 41 and port 11i into the space portion 11² of the drum 11. From this space they move then through the port 11g, passage 19 and port 12i into the space portion 12² of the drum 12, thence through port 12h, passage 28 and port 10f into the space portion 10² of the drum 10. Thus circulated back to the drum 10, the gases now pass down through the ports 10d, 10d¹ to the passage 14 and rebreathing bag or reservoir 6. On inspiration, the gases flow back from the rebreathing bag or reservoir 6 in the reverse direction to that just described, with the exception that, when the gases re-enter passage 15, instead of returning to the space portion 10¹ of drum 10, they are withdrawn through branch 29 to the inspiratory non-return valve 1 of connection 3.

When the drum 10 is in "off" position and the soda lime container 5 is out of circuit, as just above described, the drum 12 controlling the trichlorethylene vaporizer 9 may be rotated, thereby locking said drum 10 in the "off" position by engagement of the plunger 51 in the recess 55 as previously described. If the drum 12 is rotated to its "on" position, in which the port 12a registers with the port 12b, the gases in the patient's circuit will still follow the path hereinabove described, since the port 12i will still register with the passage 19 and the port 12h will still register with the passage 28, i. e., said gases do not traverse or enter into the trichlorethylene vaporizer 9. On the other hand, the basal gases, instead of entering passage 50a through ports 12f, 12c as previously described, will now enter passage 49a through ports 12f, 12d. Accordingly, the basal gases are led down through the bent tube 9a into the trichlorethylene vaporizer 9 and out again by way of the ports 12, 12b, passing over the top of the covered passage 50a (formed by the plate members 50) and leaving the drum 12 by way of ports 12h, 12g. Thence, the basal gases traverse the passage 8a to the drum 11 and, depending upon the setting of this last named drum in "off" position, "on" position, or an intermediate position therebetween, the basal gases are passed either through the passage 44a into the ether vaporizer, or through the passage 43a to direct exit through port 11d and passage 45, or partly through both.

Although, throughout the above description, reference is made to a trichlorethylene vaporizer,

it is to be understood that this could be replaced by a chloroform vaporizer.

I claim:

1. Apparatus for the administration of in-
halent gas mixtures for anethetizing purposes,
comprising, for use with a face-mask applicable
to the patient; a patient's circuit including in-
spiratory and expiratory valves having connec-
tions for said mask, a vaporizer for a volatile li-
quid to be administered to the patient in a gaseous
state, a carbon dioxide absorber, passages con-
necting the vaporizer and absorber and each
with said inspiratory and expiratory valves, a re-
breathing bag operatively connected by the pas-
sages connecting said vaporizer with said ab-
sorber and each with the two named valves, and
control valves arranged in the several intercon-
necting passages for controlling the flow of gases
therein between the vaporizer and absorber and
between the respective first-named two valves;
a basal gas circuit connected with said patient's
circuit and including a second vaporizer for a
second volatile liquid to be administered to the
patient in a gaseous state, control valves in said
basal circuit for controlling the flow of basal
gas from its supply source into the patient's cir-
cuit and either through or past the second vapor-
izer, together with a flow meter for determining
the volume of basal gas supply feed from its
source; and means preventing admission of any
of the basal gas into said second vaporizer be-
fore entry into the patient's circuit while the
absorber of said patient's circuit is open there-
in to circulatory flow operation; the component
elements of the two defined circuits being as-
sembled in compacted close relationship to form
a small portable unit in which the flow meter,
the inspiratory and expiratory valves, and the
rebreathing bag are visible together from a
position in which all said valves are also opera-
ble by the administrator.

2. Apparatus for the administration of in-
halent gases as claimed in claim 1, wherein a
single control is provided for the valves control-
ling the flow of gas in the patient's circuit be-
tween the expiratory valve, the carbon dioxide
absorber, the rebreathing bag and the vaporizer
of said circuit.

3. Apparatus for the administration of in-
halent gases as claimed in claim 1, wherein a
valve is provided at the point of the basal gas
circuit's connection with the patient's circuit for
delivering the gas supplied by the former to the
latter to the inspiratory valve of the latter
alternatively either direct or by way of the vapor-
izer of said latter circuit.

4. Apparatus for the administration of in-
halent gases as claimed in claim 1, wherein a
valve is provided at the point of the basal gas
circuit's connection with the patient's circuit
for directing the gas introduced by the former
into the latter to the inspiratory valve of the
latter alternatively either direct or by way of
the vaporizer of said latter circuit, and said di-
rectional control valve also controls the relative
flow of gas within the patient's circuit and gas
from said basal gas circuit to said inspiratory
valve.

5. Apparatus for the administration of in-
halent gases as claimed in claim 1, wherein a
valve is provided at the point of the basal gas
circuit's connection with the patient's circuit for
directing the gas introduced by the former into
the latter to the inspiratory valve of the latter
alternatively either direct or by way of the vapor-
izer of said latter circuit, and said directional

control valve also controls the relative flow of
gas within the patient's circuit and gas from
said basal gas circuit to said inspiratory valve;
said control valve being in the form of a rotary
ported drum the progressive rotation of which
results in progressive increase of flow of patient's
gas and basal gas to said inspiratory valve, the
flow of patient's gas reaching a maximum rate
before the flow of basal gas reaches its maximum
rate.

6. Apparatus for the administration of in-
halent gases as claimed in claim 1, wherein a
single control is provided for the valves control-
ling the flow of gas in the patient's circuit be-
tween the expiratory valve, the carbon dioxide
absorber, the rebreathing bag and the vaporizer
of said circuit, the valves controlling flow to and
from said absorber being capable of cutting the
absorber entirely out of circuit operation.

7. Apparatus for the administration of in-
halent gas mixtures for anethetizing purposes,
comprising, for use with a face mask applicable
to the patient; a patient's circuit including
inspiratory and expiratory valves having connec-
tion for said mask, a vaporizer for a volatile
liquid to be administered to the patient in a
gaseous state, a carbon dioxide absorber, pas-
sages connecting the vaporizer and absorber each
with said inspiratory and expiratory valves and
with each other, a rebreathing bag, operative-
ly connected with the passages connecting said
vaporizer and absorber each with said two named
valves and with each other, and control valve
elements for controlling the flow of gases
through said interconnecting passages between
and to and from the absorber, rebreathing bag
and vaporizer for varying the circulatory path
thereof as desired between the expiratory and
inspiratory valves; a basal gas circuit connected
with said patient's circuit at a point of passage
between the vaporizer and the inspiratory valve
thereof and including a second vaporizer for a
second volatile liquid to be administered to the
patient in a gaseous state, together with a source
of basal gas supply and a flow meter for indicat-
ing the volume of supply thereinto, and control
valve elements for controlling the flow of the
basal gas between its source and point of entry
into the patient's circuit either past or through
or partially past and through the second vapor-
izer; said control valve elements of the patient's
circuit consisting of single rotatable drum mem-
bers mounted one each over the absorber and
the vaporizer of said circuit and having ports
therein arranged respectively to register with the
passages to and from the said members they
overlie and to move out of register or to register
in different relations with said passages as they
are rotated to different positions so as to open
and close or open to alternate permission of flow
the passages between said members, and the said
control valve elements of the basal circuit con-
sisting of a third rotatable drum member
mounted over the vaporizer of the latter circuit
and having ports therein arranged to register
with passages of the circuit to and from the said
member it overlies and to move to register in
different relation with said passages as it is
rotated to different positions so as either to di-
rect the basal gas supply from its source direct
to the point of entry into the patient's circuit
in bypass of said vaporizer or alternately to pass
said gas supply first into and through said vapor-
izer or partially in both paths of flow.

8. Apparatus for the administration of inhalent gas mixtures for anesthetizing purposes, comprising, for use with a face mask applicable to the patient; a patient's circuit including inspiratory and expiratory valves having connection for said mask, a vaporizer for a volatile liquid to be administered to the patient in a gaseous state, a carbon dioxide absorber, passages connecting the vaporizer and absorber each with said inspiratory and expiratory valves and with each other, a rebreathing bag operatively connected with the passages connecting said vaporizer and absorber each with said two named valves and with each other, and control valve elements for controlling the flow of gases through said interconnecting passages between and to and from the absorber, rebreathing bag and vaporizer for varying the circulatory path thereof as desired between the expiratory and inspiratory valves; a basal gas circuit connected with said patient's circuit at a point of passage between the vaporizer and the inspiratory valve thereof and including a second vaporizer for a second volatile liquid to be administered to the patient in a gaseous state, together with a source of basal gas supply and a flow meter for indicating the volume of supply thereinto, and control valve elements for controlling the flow of the basal gas between its source and point of entry into the patient's circuit either past or through or partially past and through the second vaporizer; said control valve elements of the patient's circuit consisting of single rotatable drum members mounted one each over the absorber and the vaporizer of said circuit and having ports therein arranged respectively to register with the passages to and from the said members they overlie and to move out of register or to register in different relations with said passages as they are rotated to different positions so as to open and close or open to alternate permission of flow the passages between said members, and the said control valve elements of the basal circuit consisting of a third rotatable drum member mounted over the vaporizer of the latter circuit and having ports therein arranged to register with passages of the circuit to and from the said member it overlies and to move to register in different relation with said passages as it is rotated to different positions so as either to direct the basal gas supply from its source direct to the point of entry into the patient's circuit in bypass of said vaporizer or alternately to pass said gas supply first into and through said vaporizer or partially in both paths of flow; and means provided between said third rotatable drum member and the rotatable drum member mounted over the absorber of the patient's circuit for locking said third drum member in position by-passing the basal gas flow over the vaporizer of the basal gas circuit while the rotatable drum member over said absorber is in position permitting circulation of gases in the patient's circuit through said absorber.

9. Apparatus for the administration of inhalent gas mixtures for anesthetizing purposes, comprising, for use with a face mask applicable to the patient; a patient's circuit including inspiratory and expiratory valves having connection for said mask, a vaporizer for a volatile liquid to be administered to the patient in a gaseous state, a carbon dioxide absorber, passages connecting the vaporizer and absorber each with said inspiratory and expiratory valves and with each other, a rebreathing bag operatively

connected with the passages connecting said vaporizer and absorber each with said two named valves and with each other, and control valve elements for controlling the flow of gases through said interconnecting passages between and to and from the absorber, rebreathing bag and vaporizer for varying the circulatory path thereof as desired between the expiratory and inspiratory valves; a basal gas circuit connected with said patient's circuit at a point of passage between the vaporizer and the inspiratory valve thereof and including a second vaporizer for a second volatile liquid to be administered to the patient in a gaseous state, together with a source of basal gas supply and a flow meter for indicating the volume of supply thereinto, and control valve elements for controlling the flow of the basal gas between its source and point of entry into the patient's circuit either past or through or partially past and through the second vaporizer; said control valve elements of the patient's circuit consisting of single rotatable drum members mounted one each over the absorber and the vaporizer of said circuit and having ports therein arranged respectively to register with the passages to and from the said members they overlie and to move out of register or to register in different relations with said passages as they are rotated to different positions so as to open and close or open to alternate permission of flow the passages between said members, and the said control valve elements of the basal circuit consisting of a third rotatable drum member mounted over the vaporizer of the latter circuit and having ports therein arranged to register with passages of the circuit to and from the said member it overlies and to move to register in different relation with said passages as it is rotated to different positions so as either to direct the basal gas supply from its source direct to the point of entry into the patient's circuit in by-pass of said vaporizer or alternately to pass said gas supply first into and through said vaporizer or partially in both paths of flow; and means provided between said third rotatable drum member and the rotatable drum member mounted over the absorber of the patient's circuit for locking said third drum member in position by-passing the basal gas flow over the vaporizer of the basal gas circuit while the rotatable drum member over said absorber is in position permitting circulation of gases in the patient's circuit through said absorber; the component elements of the two defined circuits being assembled in close relationship to form a compact unit in which the flow meter, the inspiratory and expiratory valves, and the rebreathing bag are visible together from a position in which the three rotatable drum members providing the control valve elements are also operable by the administrator.

10. Apparatus for the administration of inhalent gas mixtures for anesthetizing purposes, comprising, for use with a face mask applicable to the patient; a patient's circuit including inspiratory and expiratory valves having connection for said mask, a vaporizer for a volatile liquid to be administered to the patient in a gaseous state, a carbon dioxide absorber, passages connecting the vaporizer and absorber each with said inspiratory and expiratory valves and with each other, a rebreathing bag operatively connected with the passages connecting said vaporizer and absorber each with said two named valves and with each other, and control valve

elements for controlling the flow of gases through said interconnecting passages between and to and from the absorber, rebreathing bag and vaporizer for varying the circulatory path thereof as desired between the expiratory and inspiratory valves; a basal gas circuit connected with said patient's circuit by opening into an extra passage between the vaporizer and the inspiratory valve thereof and including a second vaporizer for a second volatile liquid to be administered to the patient in a gaseous state, together with a source of basal gas supply and a flow meter for indicating the volume of supply therein, control valve elements for controlling the flow of the basal gas between its source and the point of entry into the patient's circuit either past or through or partially past and through the second vaporizer, and separate control valve elements at the point of basal gas entry into the patient's circuit for controlling the introductory movement thereof either directly to the inspiratory valve or indirectly thereto through the vaporizer of the patient's circuit or partially along both paths; said control valve elements of the patient's circuit consisting of single rotatable drum members mounted one each over the absorber and the vaporizer of said circuit and having ports therein arranged respectively to register with the passages to and from the said members they overlie and to move out of register or to register in different relations with said passages as they are rotated to different positions so as to open and close or open to alternate flows the passages between said members, the rotatable drum member mounted over the vaporizer of said patient's circuit including also the separate control valve elements for controlling the directional flow of the basal gas introduced into the patient's circuit, and the said control valve elements of the basal circuit consisting of a third rotatable drum member mounted over the vaporizer of the latter circuit and having ports therein arranged to register with passages of the circuit to and from the said member it overlies and to move to register in different relations with said passages as it is rotated to different positions so as to direct the basal gas supply from its source either direct to the point of entry into the patient's circuit in by-pass of said vaporizer or alternately to pass said gas supply first into and through said vaporizer or partially in both such paths of flow.

11. Apparatus for the administration of inhalant gas mixtures, comprising a regulatory gas flow circuit including in combination; a vaporizer for a volatile liquid to be administered to the patient in a gaseous state; patient's inspiratory and expiratory valves having connections for a mask applicable to the patient; a carbon dioxide absorber; passages connecting the inspiratory valve with said absorber and the expiratory valve with said vaporizer and the absorber and vaporizer together; a rebreathing bag

operatively connected by the passages connecting said vaporizer to said absorber and the two stated valves; other valves in the circuit for controlling the flow of gases therein between the respective first-named valves, absorber, rebreathing bag and vaporizer each with the other; a correlated basal gas circuit including a second vaporizer for a second volatile liquid to be administered to the patient in the gaseous state; a metering valve connected to a source of basal gas and to said second vaporizer in the basal circuit; a flow member operatively connected to said metering valve; and a passage connecting both said second vaporizer and said metering valve to the first defined flow circuit; the several elements of the first defined and the basal gas circuits being assembled in close relationship to form a compact portable unit in which the flow meter, the inspiratory and expiratory valves, and the rebreathing bag are visible together from a position in which all said valves are also operable by the administrator.

12. Apparatus for the administration of inhalant gases as claimed in claim 11, wherein the vaporizer of the regulatory flow circuit receiving gases exhaled by the patient through the expiratory valve and delivering gases inhaled by the patient through the inspiratory valve includes tubes arranged one within the other providing passages for gas entry thereinto and withdrawal therefrom; said tubes extending downwardly within the vaporizer to a level below the normal level of the volatile liquid contained therein to be volatilized into enriching admixture with the gases passed therethrough.

13. Apparatus for the administration of inhalant gases as claimed in claim 11, wherein the carbon dioxide absorber of the regulatory flow circuit through which gases exhaled and inhaled by the patient are passed for removal of carbon dioxide contained therein comprises a vessel housed in a fixed casing having a readily detachable closure at its lower end serving as a support for the vessel, resilient means being provided between said casing closure and said vessel to maintain the vessel tight at its upper end against an abutment around its communicative opening to the gas circuit, and a sealing ring between said upper end of the vessel and its said abutment to render it airtight exteriorly around such opening.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,897,378	Hinkle	Feb. 14, 1933
1,971,408	Heidbrink	Aug. 28, 1934
2,407,221	Bloomheart	Sept. 10, 1946