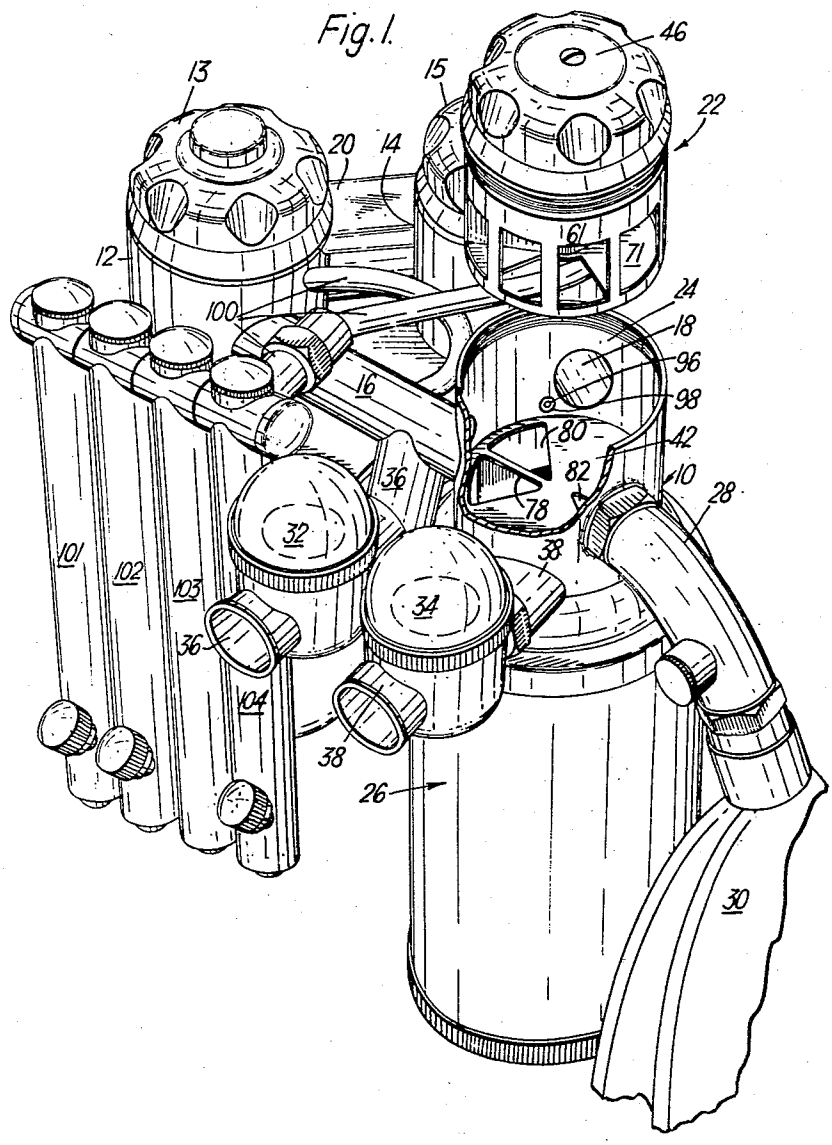
June 17, 1958 H. R. MARRETT 2,839,055

APPARATUS FOR THE ADMINISTRATION OF ANAESTHETICS

Filed July 8, 1955 4 Sheets-Sheet 1

Fig. 1.




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APPARATUS FOR THE ADMINISTRATION OF ANAESTHETICS

Filed July 8, 1955 4 Sheets-Sheet 2

Fig. 2.

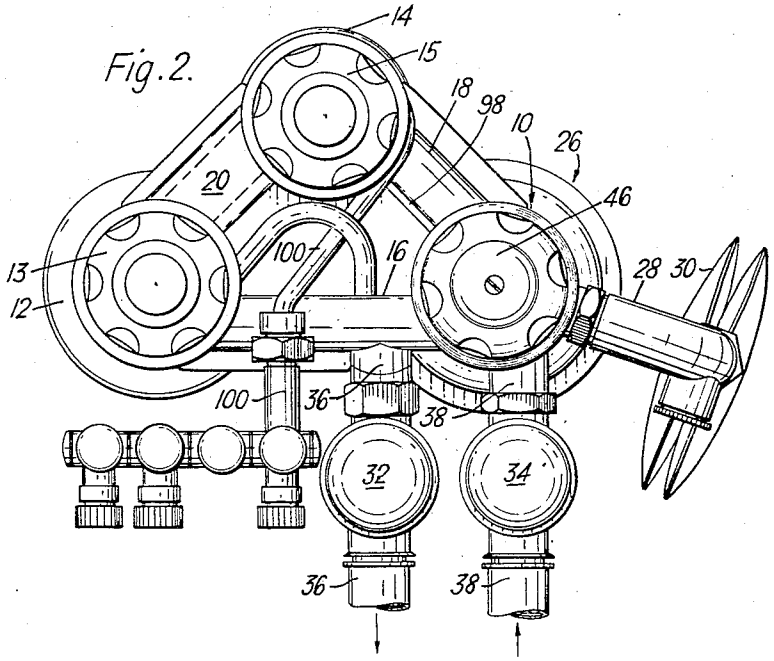
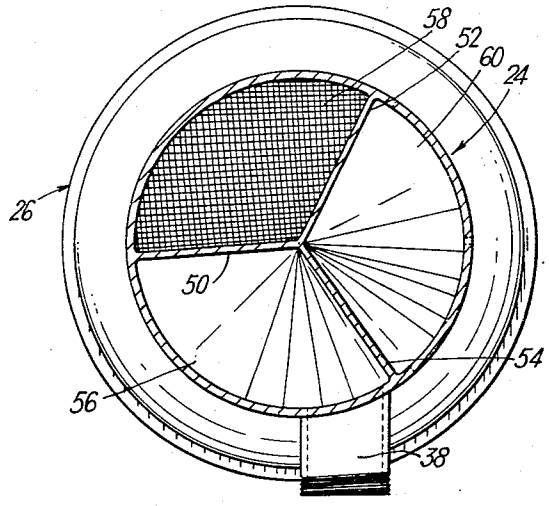



Fig. 6.



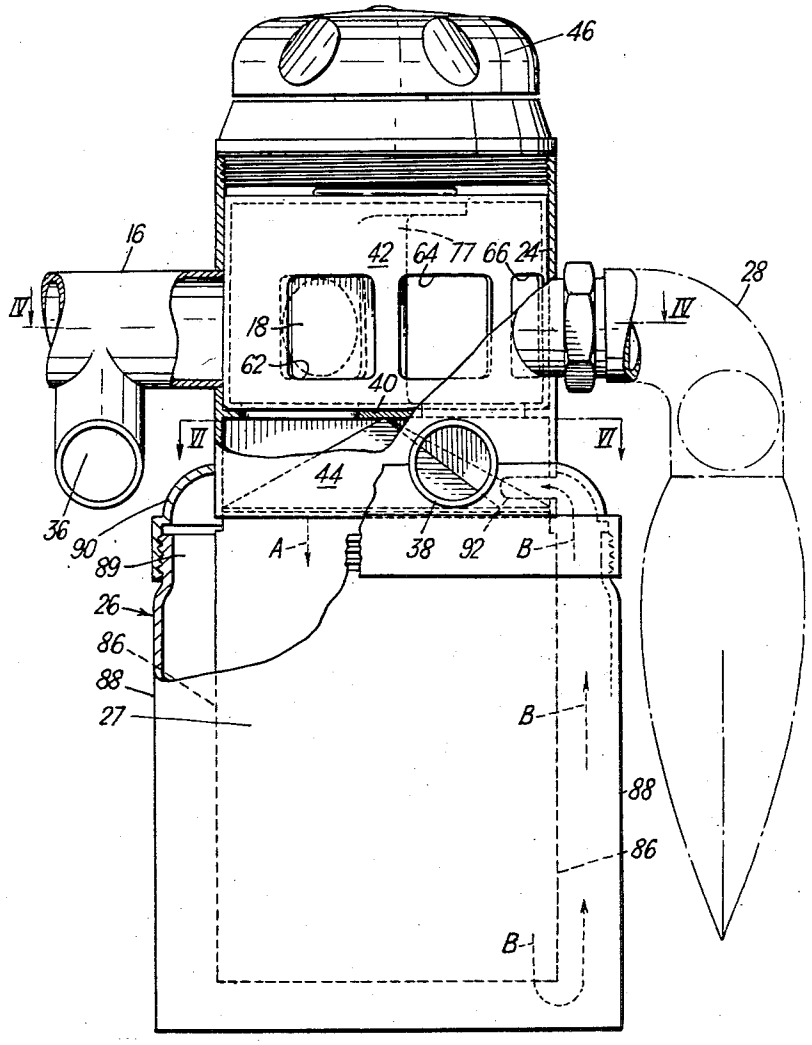

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APPARATUS FOR THE ADMINISTRATION OF ANAESTHETICS

Filed July 8, 195[illegible] 4 Sheets-Sheet 3

Fig. 3.




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June 17, 1958 H. R. MARRETT 2,839,055

APPARATUS FOR THE ADMINISTRATION OF ANAESTHETICS

Filed July 8, 1955 4 Sheets-Sheet 4

Fig. 4.

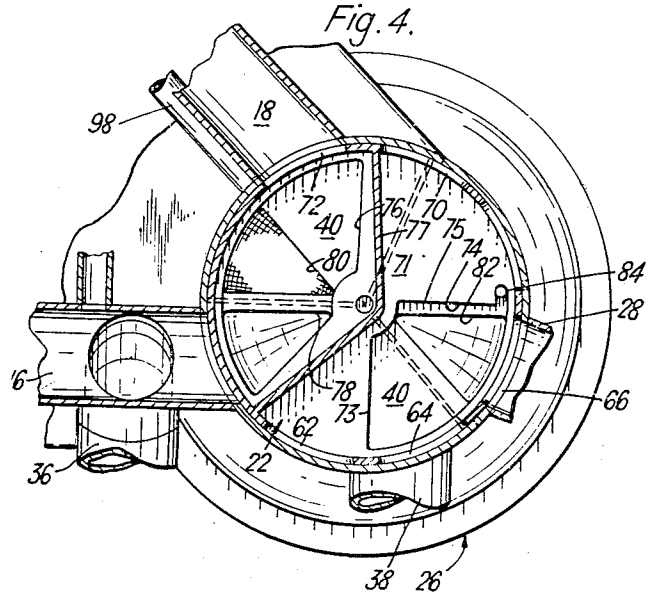
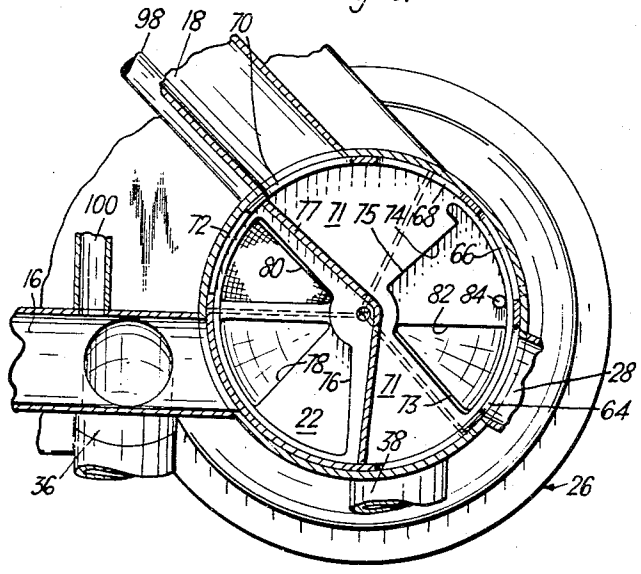



Fig. 5.




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2,839,055

# APPARATUS FOR THE ADMINISTRATION OF ANAESTHETICS

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Application July 8, 1955, Serial No. 520,842

Claims priority, application Great Britain July 16, 1954

13 Claims. (Cl. 128—188)

This invention relates to apparatus for administering inhalent gas mixtures to patients, more particularly for anaesthetic and analgesic purposes.

In standard apparatus of this kind, the patient breathes into and out of a re-breathing bag, the patient's exhalations being passed through an absorber which removes carbon dioxide from them before being fed back to the patient.

There are in use today, two systems of routing the gases, one called the To & Fro system and the other called the Circle system. In the To & Fro system, the gases pass through the absorber both on their way to the re-breathing bag and again on their way back to the patient. In other words, the patient breathes through the absorber both on expiration and on inspiration. In the Circle system, however, the gases pass through the absorber only on their way to the bag, returning to the patient over a circuit which by-passes the absorber. In other words, the patient breathes through the absorber, only on expiration.

The To & Fro system provides for a high degree of carbon dioxide absorption but that is accompanied by a relatively high resistance to breathing. Furthermore, the To & Fro system of operation can result in accumulation of carbon dioxide in the circuit producing what is known as "dead space."

On the other hand, the Circle system of operation provides relatively low resistance to breathing and a reduced risk of dead space but does not provide for a very high degree of carbon dioxide absorption.

In the apparatus in accordance with the invention provision is made for both To & Fro and Circle operation and each kind of operation can be selected at will.

Normally, apparatus for administering anaesthetics is designed either for the To & Fro system or for the Circle system. If, during a surgical operation, it is found desirable to change from one system to the other, for example, where it is found that the patient is too weak to overcome the resistance in the To & Fro circuit, the supply must be switched from one apparatus to another.

According to the invention an apparatus for administering anaesthetics comprising a re-breathing bag and a carbon dioxide absorber, is provided with valve-controlled passages interconnecting the bag, the absorber and the patient's inspiratory and expiratory conduits such that a circuit can be established from the expiratory conduit to the inspiratory conduit through the absorber and the bag for Circle operation or an alternative circuit can be established from one conduit to the other through the absorber, the bag and the absorber for To & Fro operation, the change from one circuit to the other being effected without any interruption in the supply to the patient.

In the preferred form of the invention, a single valve is provided for switching over from one kind of operation to the other. A single valve has important advantages over a number of valves. It avoids cumbersome complications in design of the apparatus but, more important, it simplifies the task of the anaesthetist who, it will be understood, may have to effect the switch as a matter of emergency. A single valve will necessarily be of somewhat complicated structure but that is of no great consequence as long as it lends itself to simple actuation. The simplest form of actuation is rotation and the preferred form of valve in accordance with the invention is therefore a rotary valve.



An example of portable apparatus in accordance with the invention embodying a rotary valve, is shown in the accompanying drawings in which:

Figure 1 is a perspective view of the apparatus;

Figure 2 is a plan of Figure 1;

Figure 3 is an elevation partly in section of the carbon dioxide absorber, the re-breathing bag and the control valve of the apparatus;

Figure 4 is a section taken on the line IV—IV in Figure 3 and showing the control valve in the To & Fro position;

Figure 5 is a view similar to that of Figure 4 showing the valve in the Circle position; and

Figure 6 is a section taken on the line VI—VI in Figure 3.

The anaesthetic administering apparatus shown in Figures 1 and 2 comprises a control unit **10**, a vaporiser **12** for a gas such as ether and a vaporiser **14** for a second gas such as chloroform or trichlorethylene. The control unit is connected to the vaporisers by conduits **16** and **18** and the vaporisers are connected together by a conduit **20**.

The control unit **10** comprises a control valve **22** (see Fig. 1), a housing **24** for the control valve, and a carbon dioxide absorber **26** containing a quantity of soda lime **27**. A conduit **28**, leads from the control valve housing **24** to a re-breathing bag **30**. A patient's inspiratory conduit **36** is branched off the conduit **16** and is adapted to be connected to a face-piece or mask (not shown) worn by the patient during an administration. A patient's expiratory conduit **38** connected to the valve housing **24** is adapted to be connected also to the face-piece or mask. In the said conduits **36** and **38** there are respectively one-way inspiratory and expiratory valves **32** and **34**.

The control unit **10** is shown in greater detail in Figure 3.

The valve housing **24** is divided, by a partition **40**, into two compartments; an upper compartment **42** and a lower compartment **44**. The conduits **16**, **18** and **28** are connected to the compartment **42**, and the carbon dioxide absorber and the conduit **38** are connected to the compartment **44**.

The control valve **22** is adapted to be rotated in the upper compartment **42**, and is provided with a control knob **46** for that purpose.

The lower compartment **44** is divided by three radial walls **50**, **52** and **54** into three chambers **56**, **58** and **60**, as shown in Figure 6. The patient's expiratory conduit **38** leads to the chamber **56** and chambers **58** and **60** are each connected to the soda lime absorber **26** at such points therein that gas can flow from one chamber to the other only by passing through the soda lime in the absorber. The absorber **26** is in the form of a double walled canister, having inner and outer containers **86** and **88**. The inner container **86** carries the soda lime **27** and the two containers are arranged one inside the other with a space **89** between them. An internally threaded flange **90** depends from the outside of the compartment **42** and is adapted to receive the externally threaded mouth of the container **88**. When the absorber has been screwed into position, the mouth of the inner container **86** is in direct communication with the chamber **58** of the compartment **44**, and the space **89** between the containers

86 and 88 is in communication with the chamber 60 of the compartment 44, through a slot 92 in its outer wall.

The control valve 22 has a peripheral wall 61 and a base 71 (see Fig. 1). As can be seen from Figures 4 and 5, there are a number of ports 62—72 in the wall 61 and two ports 74 and 76 in the base 71. The space above the base bounded by the peripheral wall has a dividing wall 77 proceeding across it between the ports 74 and 76.

The partition 40 has in it three ports 78, 80 and 82 and is also provided with a pin 84 which protrudes through the port 74 so that rotational movement of the control valve 22 is limited by the abutment of one of the bounding edges 73 and 75 against the pin.

Thus, rotation of the valve 22 between positions in which the edges 73 and 75 abut against the pin 84 serves to control the various passages interconnecting the bag 30, the absorber 26 and the patient's inspiratory and expiratory conduits 36 and 38 so that a circuit can be established from the conduit 38 to the conduit 36 through the absorber 26 and the bag 30 for Circle operation, or an alternative circuit can be established from the conduit 38 to the conduit 36, through the absorber 26, the bag 30 and again through the absorber 26 for To and Fro operation.

This can be better understood with reference to Figures 3 to 6.

In Figure 4, the valve 22 is shown in the position it occupies for the To and Fro kind of operation.

As the patient exhales, gases pass through the one-way valve 34 and the conduit 38 into the chamber 56 (Fig. 6). Due to the position of the valve 22 the port 78 in the partition 40, is uncovered and the gases pass through that port and through the port 76 in the base 71 of the valve 22 into the space to the left hand side (as viewed in Fig. 4) of the dividing wall 77. The gases, having arrived there, cannot pass round the circuit through the vaporisers, as the one-way valve 32 is closed and thus provides a dead end. Thus, the gases pass again through the port 76, downwards in Figure 3, and through the port 80 in the partition 40 into the chamber 58 of the compartment 44 (see Fig. 6).

As the chamber 58 leads to the soda lime in the absorber 26, the gases pass through the soda lime in the direction of the dotted arrow A, and along the space 89 between the containers 86 and 88 and in the direction of the dotted arrows B, through the slot 92 into the chamber 60 of the compartment 44. The chamber 60 has an outlet in the shape of the port 82 in the partition 40, thus the gases pass through that port, which, due to the position of the valve 22 is uncovered, and through the port 74 in the base 71 of the valve 22 into the space to the right hand side of the dividing wall 77 (as viewed in Fig. 4). The gases then follow the only path open to them from this space, that is through the port 66 and the conduit 28 into the bag 30.

As the patient inhales with the valve 22 in the To and Fro position of Figure 4, the gases take the same path as just described, but in reverse, until they arrive for the second time in the space to the left-hand side of the dividing wall 77. From this space they cannot take their original path through the ports 76 and 78 into the chamber 56, because the one-way valve 34 is closed and thus provides a dead end. Instead, the gases are drawn by the patient out of the compartment 42, through the port 72, along the conduit 18, through the vaporisers 14 and 12 and travel back to the patient by way of conduits 16 and 38 and the one-way valve 32.

In Figure 5, the valve 22 is shown in the position it occupies for the Circle kind of operation.

As the patient exhales, gases pass through the one-way valve 34 and the conduit 38 into the chamber 56 (Fig. 6). Due to the position of the valve 22, the port 78 in the partition 40 is uncovered and the gases pass through that port, and through the port 76 in the base 71 of the valve 22 into the space to the left-hand side (as viewed in Fig. 5) of the dividing wall 77. From this space there is only one path open for the gases and that is back through the port 76 in the valve base 71, through the port 80 in the partition 40 and into the chamber 58 (Fig. 6).

As the chamber 58 leads to the soda lime in the absorber 26, the gases pass through the soda lime in the direction of the dotted arrow A, and along the space 89 between the containers 86 and 88 and in the direction of the dotted arrows B, through the slot 92 into the chamber 60 of the compartment 44. The chamber 60 has an outlet in the shape of the port 82 in the partition 40, thus the gases pass through that port, which due to the position of the valve 22 is uncovered, and through the port 74 in the base 71 of the valve 22 into the space to the right hand side of the dividing wall 77 (as viewed in Fig. 5). The gases then follow the only path open to them from this space, that is through the port 66 and the conduit 28 into the bag 30.

In Figure 5, the valve 22 has been turned anti-clockwise about 45° out of its position in Figure 4 and the conduit 18 is, therefore, in communication with the space to the right of the dividing wall 77 through the port 70. Thus, as the patient inhales in the Circle position, the gases leave the bag 30, pass through the port 66 and the conduit 28 into the space to the right of the wall 77. The gases cannot pass back through the ports 74 and 82 as the one-way valve 34 is closed and thus provides a dead-end, so they are drawn by the patient through the port 70 along the conduit 18, through the vaporisers 14 and 12 and the conduits 20 and 16 and travel back to the patient by way of conduit 38 and the one-way valve 32.

The vaporisers 12 and 14 are in the form of bottles containing "gas" in liquid form. They are provided with control knobs 13 and 15 by means of which vapour inlet valves (not shown) can be operated to allow vapour to find its way into the apparatus through the conduits 16, 18 and 20. With both knobs 13 and 15 in the "off" position, a circuit is established from the conduit 16 to the conduit 18, passing through the vaporisers but by-passing the contents of the bottles.

It is essential that when trichloroethylene is being adminstered, it should not come into contact with the soda lime in the absorber. If this should be allowed to happen, a toxic gas would result, which would be injurious to the patient. The control valve provides the necessary insurance against such a state of affairs occurring.

Thus, by turning the control valve 22 approximately 45° in an anti-clockwise sense out of its position as shown in Figure 5, a circuit is established which enables the patient to breath into and out of the bag 30, through the inspiratory and expiratory conduits 36 and 38, without the gases passing through the absorber 26. Only with the valve 22 in this so-called locking position, can trichloroethylene be introduced into the apparatus at all. In all other positions of the valve 22, a safety locking device is effective to prevent the knob 15, which liberates the trichloroethylene vapour, from being operated.

The locking device comprises a spring loaded pin 96 (see Fig. 1) which is axially movable in a tube 98 lying between the vaporiser 14 and the housing 24 of the control unit 10. With the control knob 15 in the "off" position a cam detent is brought opposite the vaporiser end of the pin 96 which being spring loaded is urged into the detent so that its control unit end lies flush with the inner surface of the housing 24. In this position of the pin 96, the control valve knob 46 can be manipulated into and out of its various positions. However, unless the control valve 22 is in the locking position any attempt to move the knob 15 will not succeed because the pin 96 will be prevented from moving axially by that part of the peripheral wall 61 which is continuous and which lies beneath the ports 62—72.

There is however, an aperture which when the control valve is in the locking position, and only then, lies opposite the pin 96 at the control unit end thereof. Thus,

in that position with the absorber **26** out of circuit, the knob **15** can be turned, the pin riding out of the detent and entering the aperture, to adminster trichloroethylene to the patient.

Having turned the knob **15** and caused the pin **96** to enter the aperture in the wall **61** the valve **22** itself is locked against movement. Thus, while trichloroethylene is being adminstered to the patient it is impossible to bring the absorber into circuit. The risk of toxic gases being generated is thereby eliminated.

Besides the supply of gas in vapour form from the vaporisers, other gases, such as oxygen or nitrous oxide can be supplied by way of a pipe **100** through flow-meters **101, 102, 103** and **104.**

It will be seen that the control valve which forms a part of the apparatus in accordance with the invention, provides a very simple means of control, and in particular enables the anaesthetist to switch over from the To and Fra to the Circle system, or vice versa, by simple turning movement. It also eliminates the danger of trichloroethylene being passed through the absorber.

I claim:

1. In apparatus for administering inhalent gas mixtures, having a carbon dioxide absorber, a re-breathing bag and patient's inspiratory and expiratory conduits, a rotary valve controlling the flow of gas between the patient's inspiratory and expiratory conduits, a housing for said valve, a partition in said housing dividing it into upper and lower compartments, ports in said partition, passages connecting said upper compartment to said patient's inspiratory conduit and to said bag, passages connecting said lower compartment to said patient's expiratory conduit and to said carbon dioxide absorber, said rotary valve having a base and a peripheral wall, ports in said base adapted to be brought into and out of communication with said ports in said partition by rotation of said valve and ports in said peripheral wall adapted to be brought into and out of communication with said passages connecting said upper compartment to said patient's inspiratory conduit and to said bag by rotation of said valve.

2. In apparatus for administering inhalent gas mixtures having a carbon dioxide absorber, a re-breathing bag and patient's inspiratory and expiratory conduits, a rotary valve having two positions and controlling the flow of gas between the patient's said inspiratory and expiratory conduits, a housing for said valve, a partition in said housing dividing it into upper and lower compartments, ports in said partition, passages connecting said upper compartment to said patient's inspiratory conduit and to said bag, passages connecting said lower compartment to said patient's expiratory conduit and to said carbon dioxide absorber, said rotary valve having a base and a peripheral wall, ports in said base adapted to be brought into and out of communication with said ports in said partition, and ports in said peripheral wall, adapted to be brought into and out of communication with said passages connecting said upper compartment to said patient's inspiratory conduit and to said bag by rotating said valve between said two positions, in one of which positions a circuit is established on expiration by the patient from said patient's expiratory conduit through one of said ports in said base, another of said ports in said partition, said absorber, a third port in said partition, another port in said base, a port in said peripheral wall, and a passage leading to said bag, and on inspiration by the patient, from said bag through said passage, said port in said peripheral wall, said other port in said base, said third port in said partition, said absorber, said other port in said partition, said first port in said base and another port in said peripheral wall to a passage leading to said patient's inspiratory conduit and in the other of which positions a circuit is established, on expiration by the patient, from said patient's expiratory conduit through one of said ports in said partition, one



of said ports in said base, another of said ports in said partition, said absorber, another of the ports in said base, one of said ports in said peripheral wall and said passage leading to said bag, and on inspiration by the patient, from said bag through said passage, said port in said peripheral wall, another port in said peripheral wall and a passage leading to said patient's inspiratory conduit.

3. In apparatus for administering inhalent gas mixtures as claimed in claim 2 having at least one vaporiser for a gas to be administered, a passage leading direct from a port in said peripheral wall and constituting part of the circuit established with said rotary control valve in said first position, and another passage leading from a port in said peripheral wall to said patient's inspiratory conduit via said vaporiser and constituting part of the circuit established with said rotary control valve in said other position.

4. Apparatus for administering inhalent gas mixtures comprising an inlet for gas to be administered, a carbon dioxide absorber, a re-breathing bag, a patient's inspiratory conduit, a patient's expiratory conduit, a one-way valve in each of said conduits, passages connecting said gas inlet to said inspiratory conduit and connecting said conduits to said absorber and said bag and a control valve having two positions, in one of which a circuit is established from said expiratory conduit to said inspiratory conduit via said absorber, said bag and said absorber again in that order, and in the other of which a circuit is established from said expiratory conduit to said inspiratory conduit via said absorber and said bag, without a second passage through said absorber.

5. Apparatus as claimed in claim 4 in which the control valve is a rotary valve.

6. Apparatus for administering inhalent gas mixtures, comprising an inlet for gas to be administered, a carbon dioxide absorber, a re-breathing bag, a patient's inspiratory conduit, a patient's expiratory conduit, a one-way valve in each of said conduits, passages connecting said gas inlet to said inspiratory conduit and connecting said conduits to said absorber and said bag and a control valve having two positions, in one of which a circuit is established from said expiratory conduit to said inspiratory conduit via said absorber, said bag and said absorber again in that order, and in the other of which a circuit is established from said expiratory conduit to said inspiratory conduit via said absorber and said bag in that order without a second passage through said absorber.

7. Apparatus for administering inhalent gas mixtures comprising an inlet for gas to be administered, a carbon dioxide absorber, a re-breathing bag, a patient's inspiratory conduit, a patient's expiratory conduit, a one-way valve in each of said conduits, passages connecting said gas inlet to said inspiratory conduit and connecting said conduits to said absorber and said bag, and a control valve having three positions, in one of which a circuit is established from said expiratory conduit to said inspiratory conduit via said absorber, said bag and said absorber again in that order, in another of which a circuit is established from said expiratory conduit to said inspiratory conduit via said absorber and said bag without a second passage through said absorber, and in a third of which a circuit is established from said expiratory conduit to said inspiratory conduit via said bag.

8. Apparatus as claimed in claim 7 in which said second mentioned circuit is established from said expiratory conduit to the said inspiratory conduit via said absorber and said bag in that order.

9. Apparatus as claimed in claim 8 in which said second mentioned circuit is established from said expiratory conduit to said inspiratory conduit via said bag and said absorber in that order.

10. Apparatus for administering inhalent gas mixtures comprising an inlet for gas to be administered, a carbon dioxide absorber, a re-breathing bag, a patient's inspira-

tory conduit, a patient's expiratory conduit, a one-way valve in each of said conduits, passages connecting said gas inlet to said inspiratory conduit and connecting said conduits to said absorber and said bag, a vaporiser and means for establishing a circuit from said vaporiser to the patient's inspiratory conduit, and a control valve having three positions, in one of which a circuit is established from said expiratory conduit to said inspiratory conduit via said absorber, said bag and said absorber again in that order, in another of which a circuit is established from said expiratory conduit to said inspiratory conduit via said absorber and said bag without a second passage through said absorber, and in a third of which a circuit is established from said expiratory conduit to said inspiratory conduit via said bag and means operative to prevent establishment of said circuit from said vaporiser to the patient's inspiratory conduit while the said control valve is out of said third position.

11. Apparatus for administering inhalent gas mixtures comprising a carbon dioxide absorber, a re-breathing bag, a patient's inspiratory conduit, a patient's expiratory conduit, a one-way valve in each of said conduits, a vaporiser for a gas to be administered, passages connecting said vaporiser to said inspiratory conduit and connecting said conduits to said absorber and said bag, a vapour inlet valve in the passage between said vaporiser and said patient's inspiratory conduit, and a control valve having three positions, in one of which a circuit is established from said expiratory conduit to said inspiratory conduit via said absorber, said bag, and said absorber again in that order, in another of which a circuit is established from said expiratory conduit to said inspiratory conduit via said absorber and said bag without a second passage through said absorber, and a third of which a circuit is established from said expiratory conduit to said inspiratory conduit via said bag, a cam movable with said vapour inlet valve, an aperture in said control valve, and a pin to fit said aperture adapted



to be moved by said cam on operation of said vapour inlet valve, so as to pass through said aperture and allow vapour to be admitted to the patient's inspiratory conduit only when said control valve is in the said third position with said aperture in line with said pin.

12. Apparatus as claimed in claim 11 in which the said control and vapour inlet valves are both rotary valves.

13. Apparatus for administering inhalent gas mixtures comprising an inlet for gas from an external source, a carbon dioxide absorber, a re-breathing bag, a patient's inspiratory conduit, a patient's expiratory conduit, a one-way valve in each of said conduits, passages connecting said gas inlet to said inspiratory conduit and connecting said conduits to said absorber and said bag, a pair of vaporisers connected to said inspiratory conduit, a vapour inlet valve between each of the vaporisers and the patient's inspiratory conduit, a rotary control valve having three positions, in one of which a circuit is established from said expiratory conduit to said inspiratory conduit via said absorber, said bag, and said absorber again in that order, in another of which a circuit is established from said expiratory conduit to said inspiratory conduit via said absorber and said bag without a second passage through said absorber, and in a third of which a circuit is established from said expiratory conduit to said inspiratory conduit via said bag, and means associated with the said rotary control valve and one of said vapour inlet valves to prevent a circuit being established, through that vapour inlet valve from the vaporiser which it control to the said patient's inspiratory conduit, while the said control valve is out of the said third position.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 2,407,221 | Bloomheart | Sept. 10, 1946 |
| 2,586,677 | Marrett | Feb. 19, 1952 |