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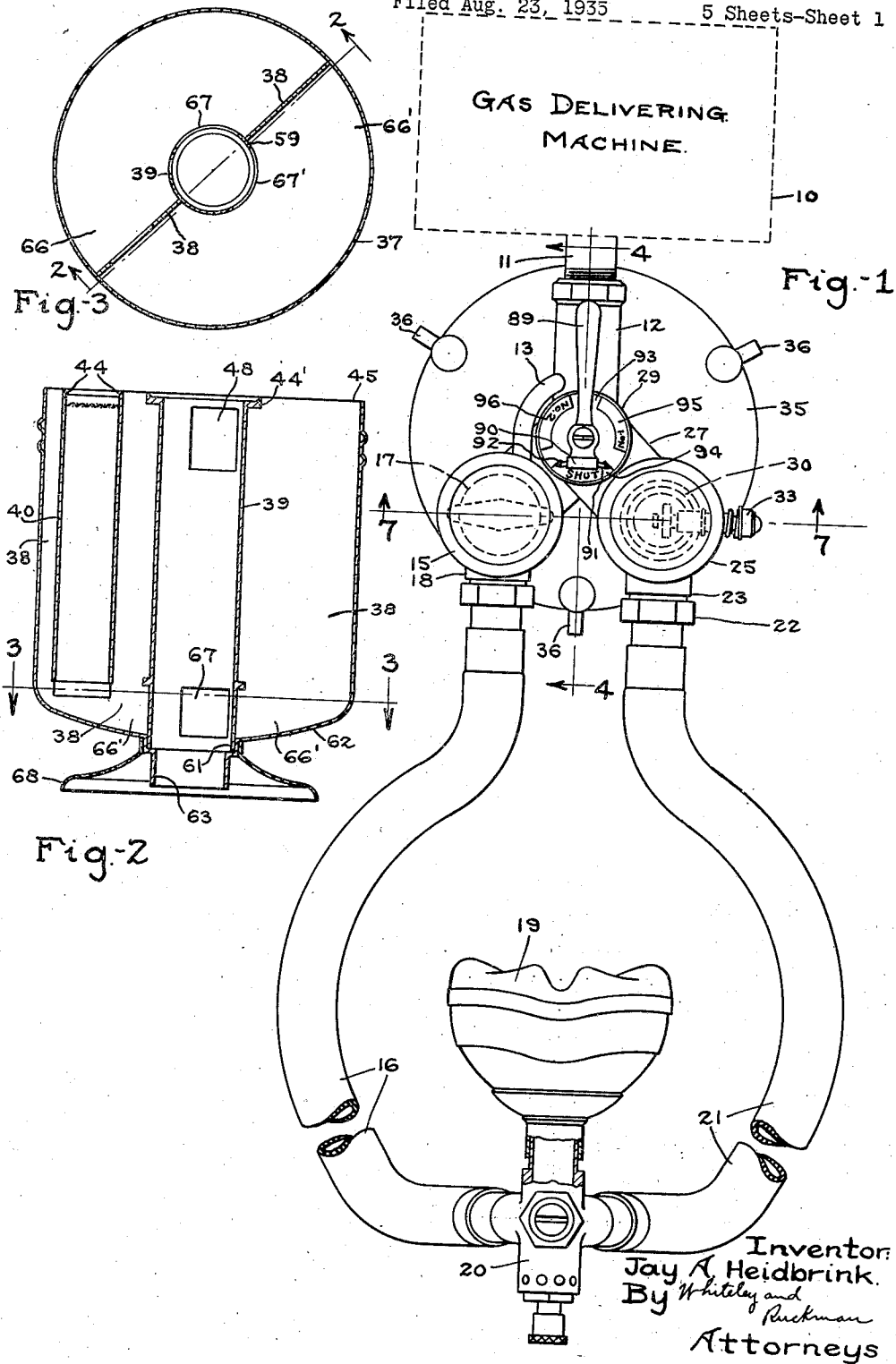
J. A. HEIDBRINK

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ABSORBER AND REBREATHING MECHANISM FOR ANESTHETIZING MACHINES

Filed Aug. 23, 1935

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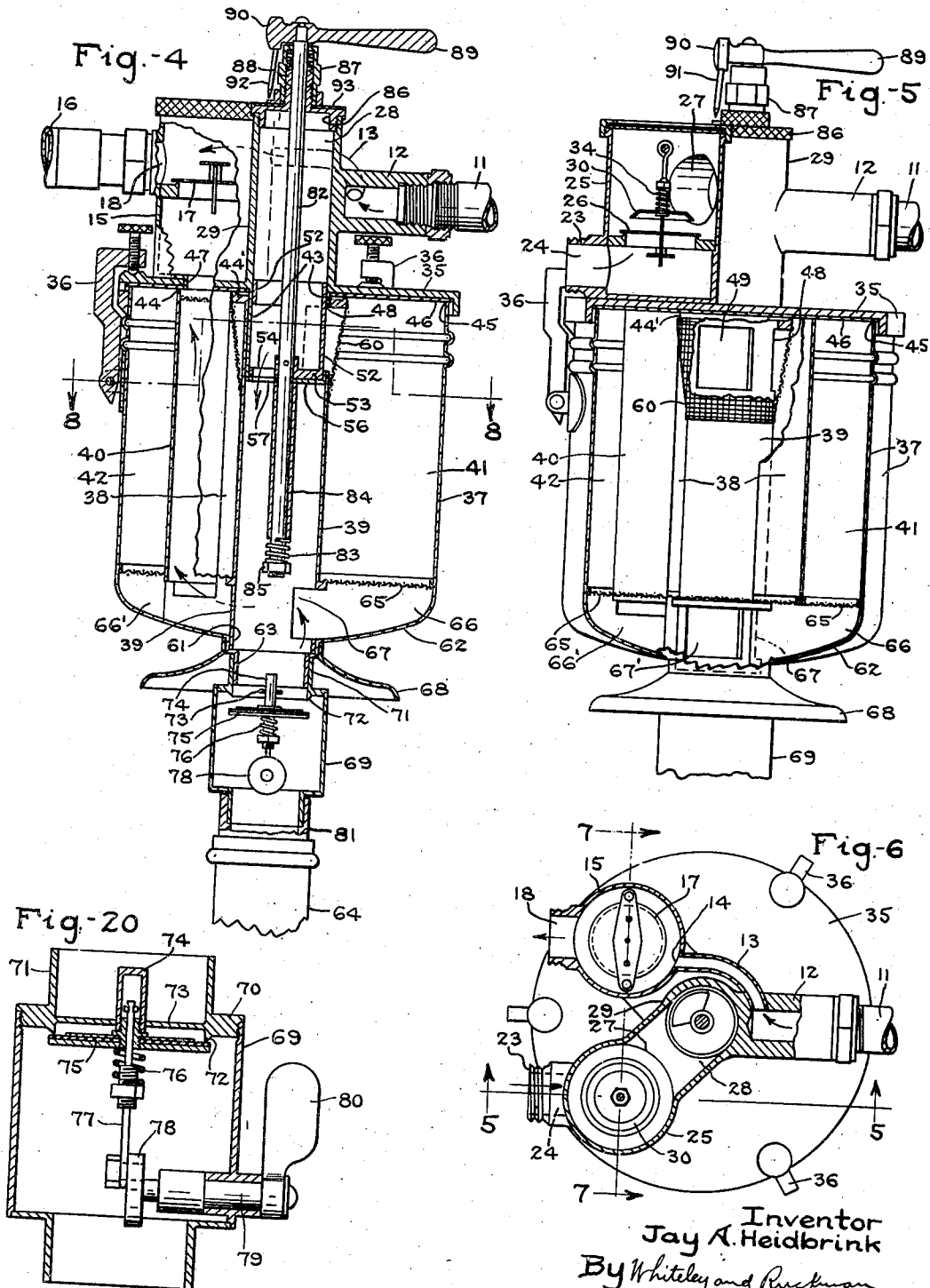
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5 Sheets-Sheet 2



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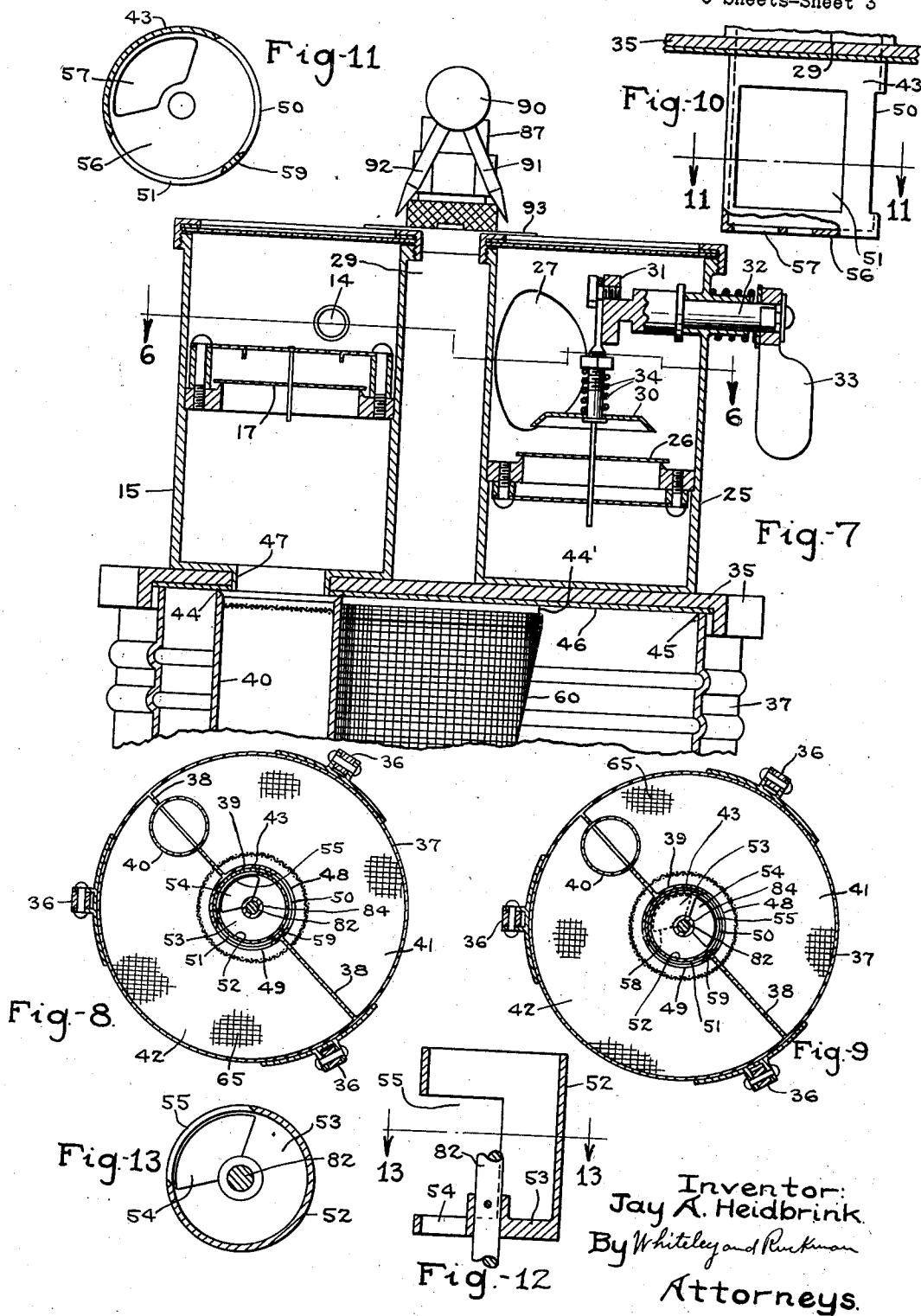
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5 Sheets-Sheet 3



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ABSORBER AND REBREATHING MECHANISM FOR ANESTHETIZING MACHINES

Filed Aug. 23, 1935

5 Sheets-Sheet 4

GAS DELIVERING
MACHINE
17

Fig-14

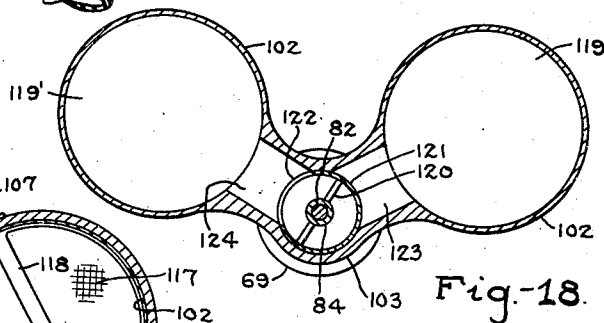
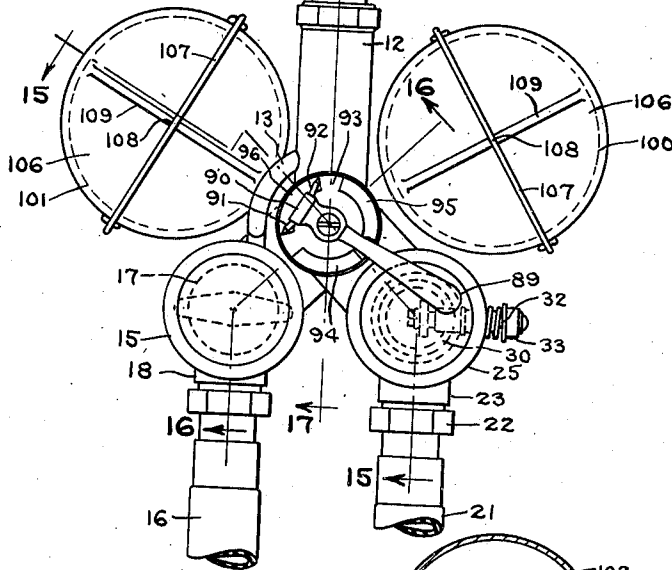


Fig-18.

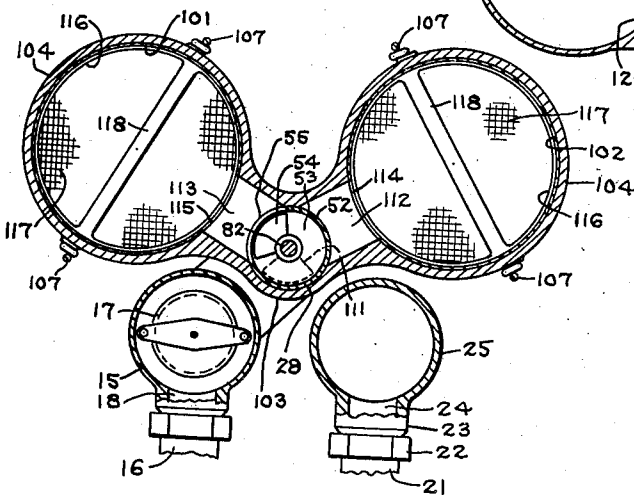


Fig-19

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UNITED STATES PATENT OFFICE

2,136,244

ABSORBER AND REBREATHING MECHANISM FOR ANESTHETIZING MACHINES

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Application August 23, 1935, Serial No. 37,497

11 Claims. (Cl. 128—203)

My invention relates to absorber and rebreathing mechanism for anesthetizing machines, and has for its object to provide novel and effective means for controlling the gas to pass it through the absorber mechanism and for controlling the inhalations so as conveniently to rebreath gas from the rebreathing bag which on exhalation has gone through the absorber material.

In the technique of administering gases for anesthesia or analgesia improved results both in economy and in the character of anesthesia obtained follow the use of material for taking carbon dioxide from the patient's exhalation whereby rebreathing may be effected in something of a closed cycle, there being added only sufficient gas or gas mixture to replace what is absorbed in the patient's lungs and tissues. From careful experimentation I have determined that better results are attained by passing the gas directly from the rebreathing bag to the patient on inhalation, but causing the gas to pass through the absorber material on exhalation only. It is, therefore, one object of my invention to provide means conveniently located and effective for causing the exhaled gases to pass through absorber material to the rebreathing bag and the inhalation to come directly from the rebreathing bag without being exposed to absorber material.

Another object of my invention is to provide double receptacles for absorber material with means for employing either receptacle at will so that when the absorber material in one receptacle may become exhausted another is available for use.

Another object of my invention is to provide valve means whereby exhaled gas may be caused to pass through absorber material entirely through one or the other of the receptacles containing it, or may be made to pass in varying proportions as desired through the absorber material in both receptacles.

A further object of my invention is to pass exhaled gases either directly to the rebreathing bag or directly through absorber material in either container, and also to pass exhaled gases at the same time directly to the rebreathing bag in part and in part through the absorber material in one or the other of the containers in relative proportions to be fixed by the operator.

It is a fact, as I have learned by experience, that the soda lime used for removing carbon dioxide from the exhalations of the patient, will, after a certain amount of use become semi-saturated, or at least on the surfaces thereof,

so that it will lose its effectiveness. But if this so charged soda lime be allowed to rest for a period of time without use the adsorbed carbon dioxide will penetrate deeper into the crystals and the surfaces exposed to exhalations will become self-regenerated so that further use of the same material may be had without external regeneration. It is, therefore, an object of my invention to provide means such that while absorber material in one container is being used in connection with the gas administering machine, the absorber material in another container may be allowed to rest so as to become regenerated or reactivated.

The full objects and advantages of my invention will appear in connection with the detailed description thereof and their advantageous features are particularly pointed out in the claims.

In the drawings, illustrating an application of my invention in one form,

Fig. 1 is a part diagrammatic plan view of a construction embodying my invention. Fig. 2 is a sectional vertical view of one form of absorber with associated mechanism taken on line 2—2 of Fig. 3. Fig. 3 is a transverse view of the same form of absorber mechanism taken on line 3—3 of Fig. 2. Fig. 4 is a vertical section taken on line 4—4 of Fig. 1. Fig. 5 is a vertical section taken on line 5—5 of Fig. 6 with some parts broken away. Fig. 6 is a transverse sectional view taken on line 6—6 of Fig. 7 but on the same scale as Fig. 5. Fig. 7 is an enlarged vertical section taken on line 7—7 of Figs. 1 and 6 and showing only the top part of the mechanism. Fig. 8 is a transverse sectional view taken on line 8—8 of Fig. 4. Fig. 9 is a view similar to Fig. 8 with the parts in modified position. Fig. 10 is a view partly in section of some of the valve mechanism. Fig. 11 is a horizontal section taken on line 11—11 of Fig. 10. Fig. 12 is a longitudinal central section through part of the valve mechanism. Fig. 13 is a transverse section on line 13—13 of Fig. 12. Fig. 14 is a plan view of a modified form of the construction showing two containers for absorber material. Fig. 15 is a sectional elevation view on line 15—15 of Fig. 14. Fig. 16 is a sectional elevational view of some of the parts shown in Fig. 15 on the line 16—16 of Fig. 14, with valve members in a different position. Fig. 17 is a sectional elevation view on line 17—17 of Fig. 14, with parts of the valve mechanism broken away. Fig. 18 is a sectional plan view on line 18—18 of Fig. 15. Fig. 19 is a sectional plan view taken on line 19—19 of Fig. 15. Fig. 20 is an enlarged

sectional view of shut-off mechanism for the rebreathing bag.

As illustrated, a gas-delivering apparatus 10, of usual construction is provided with a passageway extension support 11 to which is secured a passageway support 12 of the absorber and breathing control mechanism hereinafter described. From the interior of passageway 12 a conduit 13 leads through a port 14 to inlet valve mechanism housed in a casing 15 from which extends the inlet tube 16 of the breathing line. As shown in Figs. 4 and 7, the port 14 is above valve disc 17, as also is the outlet 18 leading to the inlet side tubing 16, so that the flow of gas determined by the gas-delivering machine will go constantly to the inhale side of the breathing line.

A respirator 19 is located in the breathing line and is provided with controllable valve mechanism of known construction indicated at 20. The outlet or exhale side of the breathing line comprises tubing 21 which is united by a connector 22 with a nipple 23 which provides an inlet 24 to a valve chamber 25 through which exhaled gases must pass. Within the valve chamber 25 is a valve disc 26 above which is a port or passageway 27 leading into main center channel 28 in casing 29, as clearly shown in Fig. 5. A plunger 30 controlled by crank 31 on stem 32 and handle 33 is adapted to engage valve disc 26 to hold it under pressure of spring 34 for restraining exhalation under pressures lower than that determined by spring 34, as best shown in Fig. 7.

Secured to the lower end of casing 29 (in the form of the invention of Figs. 4 to 13 inclusive) is a supporting disc 35 to which is removably secured by means of thumb screw hasps 36 an absorber container 37. A central partition 38 formed in conjunction with a central valve chamber conduit 39 and a second conduit 40 divides the interior of absorber container into two similar compartments 41 and 42, as clearly indicated in Figs. 2, 8, and 9. The central conduit 39 formed in the double absorber container 37 is adapted to slip over a sleeve extension 43, Figs. 4, 8 and 9, formed as a continuation of the central valve conduit 29 and valve passageway 28. Also conduit 40, Fig. 7, is provided with a lip 44 and conduit 39, Fig. 4, has an annular extension and lip 44', both of which, in common with the upper edge 45 of the walls of container 37, engage a packing sheet 46 on the lower side of disc 35 to make sealing contact therewith. Also the edge of partition 38 similarly engages and seals fast the packing sheet 46. The conduit 40 in position registers around an opening 47 leading into the chamber in valve casing 15 below valve disc 17, whereby gas passing from the absorber to the rebreathing bag as hereinafter described may be drawn past valve 17 into the inhale tube 16 of the breathing line. When, therefore, absorber container 37 is clamped in position on the disc 35, it will be held in air-tight relation thereto with the conduit 40 registering with the opening 47 and the central conduit 39 surrounding the extension 43, as clearly shown in Fig. 4.

At its upper portion, Figs. 8 and 9, the conduit tube 39 is provided with ports 48 and 49, which in assembled position register with corresponding ports 50 and 51 of the extension tube 43. The ports 48, 50 thus open into chamber 41 and the ports 49, 51 open into chamber 42. A drum valve 52 has its circular bottom 53 provided with a segment port 54, and has its cylindrical wall

provided with a correspondingly-positioned laterally disposed port 55, see Figs. 12 and 13. The bottom 53 of valve 52 rests on a partition 56 forming a bottom closure of the extension 43 except for a segment port 57 corresponding to segment port 54 of drum valve 52, but, as indicated in dotted lines at 58 of Fig. 9, located opposite the dividing strip 59 between ports 50 and 51. It follows, therefore, that when the drum valve 52 is in position so that segment port 54 in bottom wall 53 thereof registers with the segment port 57 in bottom wall 52—the position of the parts shown in Fig. 8—the lateral ports 48, 50, and 49, 51 will be closed. When, however, the drum valve is rotated to a position where its lateral port 55 registers with either of the sets of ports 48, 50 or 49, 51, as in Fig. 9, opening between bottom segment ports 54 and 57 will be closed. There are, therefore, three principal operating positions of the drum valve 52. That of Fig. 8, in which exhaled gas is excluded from the absorber material and goes directly through the central conduit 39, that of Fig. 9 in which the exhaled gas must pass through the absorber material in chamber 41, and a third position wherein the valve is shifted to register port 55 with ports 49, 51 and the exhaled gas will be delivered to the chamber 42 in the absorber container 37. A semi-conical strip 60 of reticulate material holds the absorber material away from the ports to prevent its entrance into the drum valve 52 or conduit 39, and also to facilitate ready distribution of exhaled gases to move through the whole body of the absorber material in either of the respective chambers 41 and 42.

There are also a large number of intermediate operating positions of the drum valve 52 of three sorts. In one of these, the valve is positioned so that exhaled gas may go in part directly and in part through the first absorber container. In a second set of positions of the valve, gas may go in part directly through the conduit 39 and in part through the second container of absorber material. In the third set of positions, the exhaled gas may at the same time pass in part through one and in part through the other of the absorber material in the two absorber containers. In each of these three sets of positions, there may be many variations to vary the relative portions of exhaled gas passing through the two channels thus opened by the valve 52.

A conduit 39 at 61 extends beyond the preferably-bulged bottom 62 of the absorber container 37 which is carried over the bottom edge of conduit 39 in a reduced connector member 63 adapted to have applied thereto and supported either directly or through a shut-off valve as hereinafter described, a rebreathing bag 64 of usual construction. At the bottom the absorber material is held spaced from the bottom wall 62 by a reticulate partition 65, there being thus formed a pair of lower chambers 66 and 66', Fig. 3, surrounding the conduit 39 which opens into said chambers through ports 67 and 67', as clearly shown in Figs. 2 and 3. The conduit 40 also opens at its lower end into both chambers 66 and 66' so that exhaled gas, after passing through absorber material in either of chambers 41 and 42 or both or neither thereof, may go to the rebreathing bag and thence back through port 67 or 67' and conduit 40 into valve chamber 15 (Fig. 7) and thence past valve 17 to the inhale tube 16 of the breathing line. A stand 68 is applied to the lower end of the ab-

sorber container to support the same when removed from the disk 35 for filling.

A shut-off valve for the rebreathing bag is shown in detail in Figs. 4 and 20. It comprises a cylindrical valve chamber 69 into which is threaded a top valve seat member 70 embodying a slip tube 71 adapted to take over the reduced extension 63 of conduit 39, and also provided with an annular valve seat 72 and a transverse bar 73 forming a guide for a valve disc plunger 74. A valve disc 75 is supported thereon through a compression spring 76 which is adapted to be actuated by a link 77 on a crank 78, which in turn is mounted on a pin shaft 79 actuated by a handle 80. The rebreathing bag is held in open relation to the valve chamber 69 by means of an extension adapter 81. When, therefore, the handle and crank are in the dropped position of Fig. 4, there is full communication of the interior of conduit 39 and chamber 66 and 66' to and with the rebreathing bag. When the handle and crank are shifted to the up-position of Fig. 20, the rebreathing bag is cut off or put out of operative connection with these passages.

It is to be noted, however, that valve 75 may be moved against the force of spring 76, which is adjusted to correspond with control of valve 26 by spring 34, as a safety device to prevent too great pressure in the lungs of the patient, since both valves 26 and 75 at a certain maximum pressure will yield, permitting the gas to pass to the rebreathing bag. And since the rebreathing bag is composed of light elastic material, it will expand and burst before the pressure of gas in the system reaches a dangerously high degree.

As best shown in Fig. 4, the drum valve 52 is pinned to a stem 82 which extends through its bottom and through an aperture in the partition wall 56 to a point some distance below the same, so that the drum valve bottom 53 may be held firmly against the partition member 56 by means of a compression spring 83 taking against a long washer 84 and properly tensioned by means of a nut 85 threaded on the end of stem 82. The stem 82 passes through a central opening in a closure cap 86 threaded into the top of casing 29. A packing nut 87 and suitable packing 88 renders the connection gas-tight. A handle 89 is fast on stem 82. Opposite the handle 89 is an extension 90 which carries a pair of pointers 91, 92 extending in a substantially vertical plane, as clearly shown in Figs. 1, 5 and 7. These pointers cooperate with a scale member 93 directly overlying the upper end of casing 29. The scale 93 provides three circumferential segments 94, 95 and 96 respectively, each comprising an annular extent on the scale 93 equal to the spread of the ends of the pointers 91 and 92. Scale segment 94 carries the notation "Shut", and when the pointers are at its outer limits, there is an indication that the drum valve 52 is in the position of Fig. 8 with absorber material shut off from the interior of conduit 39. The scale segment 95 carries the notation "No. 1 chamber", and when the pointers are at its limits it indicates that ports 49, 51 and 55 are open to admit exhaled gas to compartment 42 of absorber container 37, and that the bottom ports are closed. Scale segment 96 carries the notation "No. 2 chamber," and when the pointers 91 and 92 are at its limits it indicates that ports 48, 50 and 55 are in register to deliver exhaled gases to chamber 41, as shown in Fig. 9.

In practice, where absorption is employed the valve will generally be set, by means of pointers

91 and 92 so that the exhaled gases will pass through one of the chambers, as chamber No. 1, until the absorber material therein, such as soda lime, begins to lose efficiency because of nearing saturation. The valve will then be shifted to the position of Fig. 9 to pass exhalations through chamber No. 2, and the absorber material in chamber No. 1 will be permitted to rest. While so resting it has been discovered it will gradually reactivate itself so as to be effective for further absorption. Also, when absorption material in one chamber, as in chamber No. 1, is becoming somewhat deficient in absorptive power and the material in the other chamber, as chamber No. 2, is fresh, it frequently is desirable and effects marked economics in the use of absorber material to position the valve so the pointers are both above the indicated chambers No. 1 and No. 2, in which position exhaled gases can pass through the absorber material in both chambers and the weakened material in one chamber can continue to be used to a point much nearer saturation by reason of the fact that dividing the flow reduces the rate of flow through both chambers and the strong material in one of the chambers aids in complete absorption.

In the form of invention shown in Figs. 14 to 19 inclusive, the above-defined parts all operate in the same way except that instead of having one absorber container divided into two compartments, there are two independent and separate absorber containers either of which may be emptied and refilled independently of the other. These containers consist of cylinders 100 and 101 each supported upon a base member 102 which is secured to or cast with tubular member 103 formed as a downward extension of casing member 29, as best shown in Fig. 18. There is also formed in conjunction with tubular conduit 103 a double ring casting 104, Fig. 19, and tubular container members 100 and 101 extend through the separated rings thereon, their bottoms resting on a circular ledge 105 formed in the bottom members 102, Figs. 15 and 19, and the top of each being closed by a cap 106 held in position by a spring hasp 107 snapping into a recess 108 in a cam bar 109 on the top of covers 106.

Tubular member 103 is provided, with a partition 110 formed with a segment port 111, Figs. 16, 17, and in dotted lines in Fig. 19. Above the partition 110 the tubular member 103, where it merges with casing 29, opens into a pair of passageways 112, 113, Fig. 19, which open through ports 114, 115 to the interior of cylinders 100 and 101. Drum valve 52, as in the construction of Figs. 1 to 13 inclusive, rests upon partition 110, its segment port 54 through bottom wall 53 being adapted to register with segment port 111 in partition 110 to pass exhaled gases directly through tubular member 103 and shut-off valve 69 to rebreathing bag 64, when that is desired. The lateral port 55 in drum valve 52 is adapted to register either with passageway 112, or, as in Fig. 19, with passageway 113 to pass exhaled gases into container cylinder 100 or 101, and, as can be seen from an inspection of Fig. 19, it is adapted to take an intermediate position to pass gas into both said containers. The means for operating drum valve 52 and indicating its positions for control of the exhaled gases is the same in the modification of Fig. 14 to 20 as in the construction shown in Figs. 1 to 13.

As clearly indicated in Figs. 15 and 19, the absorber material is carried by buckets 116 in the form of cylinders, the lower edges of which rest

upon the ledge 105, said buckets having a reticulate bottom 117 and a crossbar handle 118 by means of which they may conveniently be lifted from container cylinders 100 or 101. From the above description and that of the bottom valve hereinafter given, it will be clear that while the machine is in use passing the exhaled gases through absorber material in bucket 116 in one of the container cylinders, as 101, the other container cylinder may be opened up and the bucket 116 therein containing absorber material be withdrawn and fresh absorber material be substituted for that which may have been subjected to a sufficient amount of use.

The member 102 provides a pair of chambers 119, 119', Figs. 15 and 18, to which will go the exhaled gases passing through cylinder containers 101 or 102 respectively. Pinned to the bottom of valve stem 32 by means of bar 120, Fig. 15, is an open-ended cylinder valve 121 having a port 122 adapted to register with passageways 123 and 124 respectively, Fig. 18, leading from chambers 119 and 119', respectively, whereby exhaled gas passing through either container 101 or 102 may go to the rebreathing bag 64 and thence, or directly, to the inhale side of the breathing line. Thus, as in the construction of Figs. 1 to 13 inclusive, providing communication from one container of absorber material and cutting off communication from the other.

The exhaled gas whether or not it has gone through one of the absorber containers, or whether or not it has gone to the rebreathing bag, passes through the interior of tubular conduit member 103 and through a passageway 125 leading therefrom into valve chamber in valve casing 15 below the flicker valve 17, as clearly shown in Figs. 15, 16 and 17, and thence to the inhale side 16 of the breathing line.

The advantages of my invention will be apparent from the foregoing description. With this apparatus, no matter how long it may be used in producing anesthesia or analgesia, there always is available suitable active absorber material, specifically soda lime, to take care of the requisite absorption of carbon dioxide. Very great economy will result from the use of the apparatus, since absorber material may not only be employed until its capacity is temporarily exhausted, but the rest periods which are permitted by the use of more than one absorber container will give it opportunity to reactivate itself and be available for use. The indicator mechanism associated with the valve is of particularly positive and easily readable nature. By means of that indicator, the operator may instantly set the valve in any of its three primary positions or in any desired one of the great number of positions available of the three secondary sets of positions. The machine is absolutely safe and dependable, and is so constructed as to make very easy refilling the absorber containers.

I claim:

1. In an anesthetizing apparatus, embodying a closed breathing line, a multiplicity of separate containers for absorber material each having a port adapted to open into the breathing line, a valve having a port adapted to register separately with each of said first-named ports or jointly with two of them, a pair of pointers movable with said valve, and an indicator cooperating with the pointers to show when the first-named ports are all closed by the valve, when any of them is fully opened, and when two of them are opened.

2. In an anesthetizing apparatus, embodying a

closed breathing line and a conduit connected with the exhale side thereof, a rebreathing bag into which said conduit opens, a multiplicity of separate containers of absorber material adjacent the conduit, and controllable means for selectively causing exhalation gas to pass through the conduit directly to the rebreathing bag or to pass through the absorber material in either or two of said containers as desired.

3. In an anesthetizing apparatus, embodying a breathing line and a conduit connected with the exhale side thereof, a rebreathing bag into which said conduit opens, a pair of separate containers of absorber material each having a port adapted to lead into the conduit, a partition in the conduit having a port, a drum valve having a bottom wall and bottom port adapted to register with the port in the partition and having a side-wall port adapted to register with the ports to the absorber containers, and controllable means for selectively setting the drum valve.

4. In an anesthetizing apparatus, embodying a breathing line and a conduit connected with the exhale side thereof, a rebreathing bag into which said conduit opens, a pair of separate containers of absorber material each having a port adapted to lead into the conduit, a partition in the conduit having a port, a drum valve having a bottom wall and bottom port adapted to register with the port in the partition and having a side-wall port adapted to register with the ports to the absorber containers, and a handle and spaced pointers movable with said drum valve and cooperating with indicating means for selectively setting the drum valve.

5. An anesthetizing apparatus, embodying a breathing line, a conduit therein connected with the exhale side and the inhale side thereof respectively, a partition in said conduit between said inhale and exhale sides of the rebreathing line, a pair of separate containers for absorber material each having a port adapted to open into the conduit above the partition, and having means above said partition for selectively determining flow of exhalation gas to pass through the absorber material in one or the other of said containers or to pass directly to the inhale side of the rebreathing line.

6. In an anesthetizing apparatus, embodying a closed breathing line and a conduit therein connected with the exhale and the inhale sides respectively thereof, a container for absorber material surrounding said conduit, a partition including said conduit dividing the container into separated compartments each containing absorber material, and ports and valve mechanism in said conduit operative alternatively to open and close either of said compartments to the exhale side of the breathing line.

7. In an anesthetizing apparatus, embodying a closed breathing line and a conduit therein connected at one end with the exhale side of the rebreathing line, a second conduit adjacent the first-named conduit connected with the inhale side of the rebreathing line, a container for absorber material surrounding said conduits, a partition including both said conduits dividing the container into separated compartments each containing absorber material, and ports and valve mechanism in said conduit operative alternately to open and close either of said compartments to the exhale side of the breathing line.

8. An anesthetizing apparatus embodying a closed breathing line, a cylindrical conduit in said line communicating with the inhale and the ex-

hale sides thereof and having a ported transverse partition thereacross, a pair of containers of soda lime located adjacent said conduit and having ports adapted to be opened thereinto, and a cup valve resting upon the partition and having a port in its side for opening the conduit to one or the other of the soda lime containers and having a port in its bottom adapted alternately to open communication directly through the conduit when the port to both soda lime containers is closed.

9. An anesthetizing apparatus embodying a closed breathing line, a cylindrical conduit in said line communicating with the inhale and the exhale sides thereof and having a ported transverse partition thereacross, a pair of containers of soda lime located adjacent said conduit and having ports adapted to be opened thereinto, a cup valve resting upon the partition and having a port in its side for opening the conduit to one or the other of the soda lime containers and having a port in its bottom adapted alternately to open communication directly through the conduit when the port to both soda lime containers is closed, a scaled closure cap on the end of said conduit, and a handle for operating said cup valve provided with two indicator fingers cooperating with said scale to indicate the precise degree of opening and closing of each of the ports of said cup valve.

10. An anesthetizing apparatus embodying a closed breathing line, a cylindrical conduit in said

line communicating with the inhale and exhale sides thereof, and having a ported transverse partition thereacross, a pair of containers of soda lime located adjacent said conduit and having ports adapted to be opened thereinto, a valve in said conduit adapted to open communication directly therethrough, into either of said containers or into both of them, a handle for operating said valve embodying a pair of diverging pointers, and a scale cooperating with said pointers to indicate exactly the condition of opening into said containers or directly through the conduit.

11. An anesthetizing apparatus embodying a closed breathing line, a cylindrical conduit in said line communicating with the inhale and exhale sides thereof, and having a ported transverse partition thereacross, a pair of containers of soda lime located adjacent said conduit and having ports adapted to be opened thereinto, a valve in said conduit adapted to open communication directly therethrough, into either of said containers or into both of them, a handle for operating said valve embodying a pair of diverging pointers, and an indicating plate cooperating with the ends of said pointers and having thereon three sets of indications each corresponding to the spread of said pointers whereby the valve may be instantly and simply set to open into either of said containers, to open directly through the conduit, to open in varying degrees and through the conduit.

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