

Aug. 19, 1958

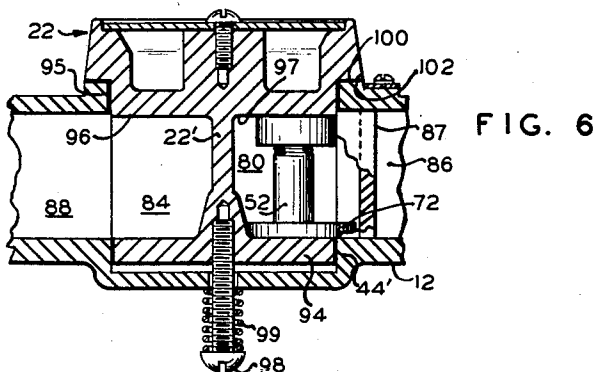
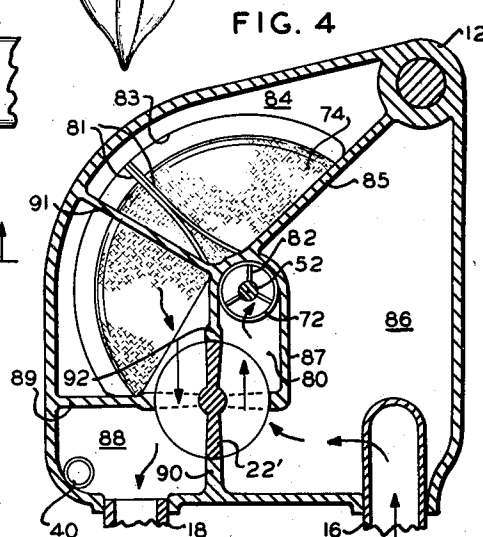
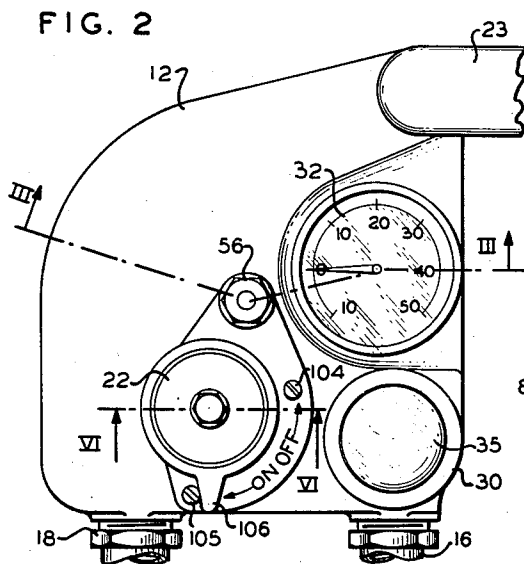
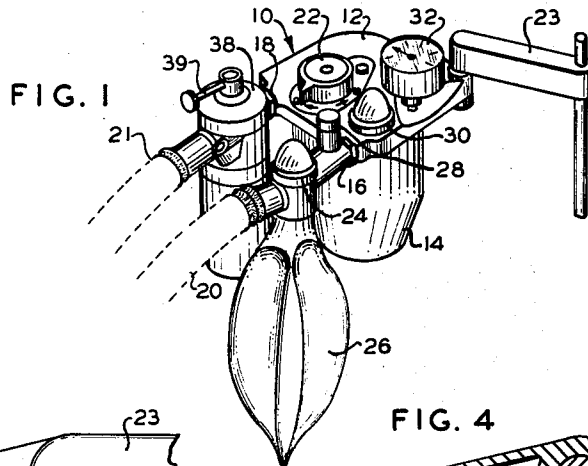
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2,848,309

CARBON DIOXIDE ABSORBER

Filed Oct. 23, 1956

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

FIG. 3

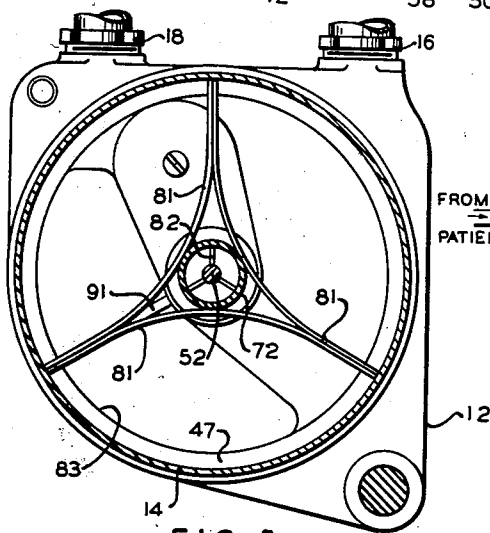
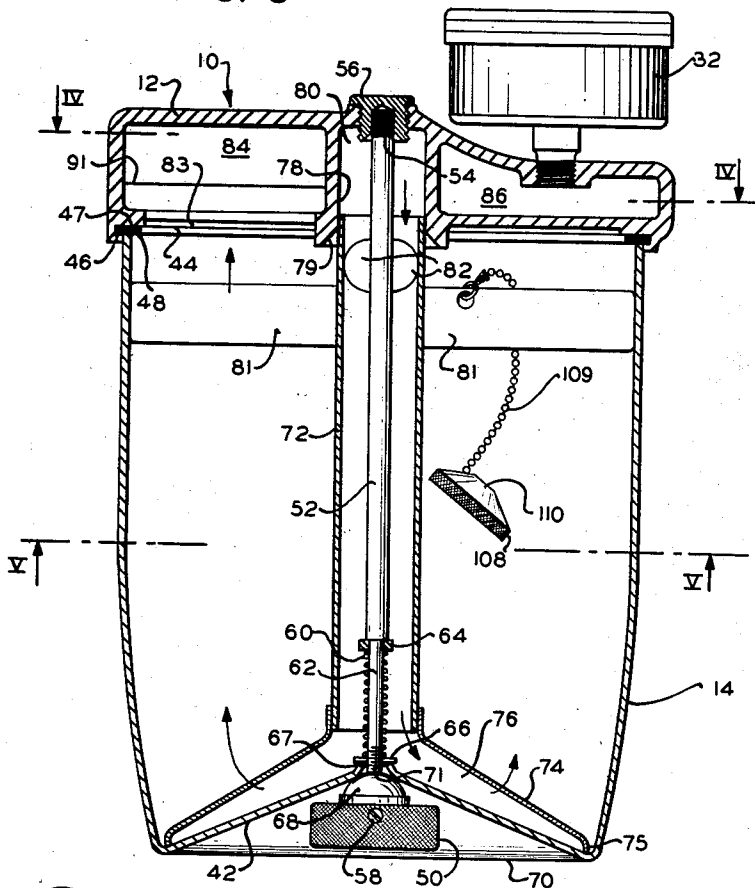
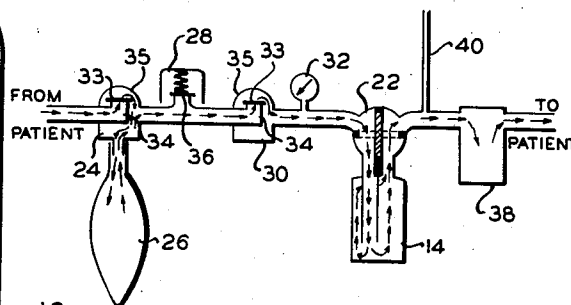


FIG. 5

FIG. 7



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2,848,309

CARBON DIOXIDE ABSORBER

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Application October 23, 1956, Serial No. 617,875

12 Claims. (Cl. 23—284)

This invention relates to absorbers employed in anesthetic administering apparatus for the removal of carbon dioxide and, more particularly, concerns improvements therein. In such absorber devices a canister, or container, generally is provided for holding a supply of a carbon dioxide absorbing agent, such as soda lime, with which the gases in the anesthetic circuit are contacted. The carbon dioxide in the patient's exhalation is selectively removed, for example, by soda lime, through chemical action; the carbon dioxide reacting with the soda lime and the remaining gases being recovered and recycled to the patient. The process may be carried out continuously until the charge becomes exhausted whereupon it is replenished with a fresh absorbent.

It is extremely important when administering anesthetic agents to patients by conventional administering apparatus that the carbon dioxide absorber function properly at all times. Otherwise, the carbon dioxide content of the gases in the breathing circuit may rapidly increase above a safe level, such that adequate ventilation and oxygenation of the patient cannot be maintained. Accordingly, extreme diligence is exercised by the anesthetist or other personnel responsible for the proper functioning of the administering apparatus in examining the equipment before and during administration. In conventional types of absorbers that have been employed heretofore, various unsatisfactory features have been observed. It has been found that many presently available absorbers are cumbersome and of such intricate construction that the inspection or replacement of the absorbent charge, frequently, is quite involved. The time consuming operations for such servicing are not only a hindrance to the normal care and maintenance of the apparatus but are seriously objectionable where it may become necessary to inspect or replace the charge during anesthesia.

The inconvenience involved in the use of present absorbers is further emphasized by the fact that many of these devices, necessarily, have a relatively small capacity for the charge of absorbent. Thus, the procedure of replenishing the charge where its absorbing power is exhausted must be repeated at more frequent intervals. In addition, many of the absorbers currently in use are of such design that the depletion of the absorbent occurs non-uniformly leaving a portion of the charge substantially unchanged while other portions have been substantially exhausted. Although a considerable portion of the charge may still be fresh, its replacement is necessary to insure proper functioning of the absorber and a safe margin of absorptive capacity. Consequently, considerable waste and inefficient use of the absorbent material is incurred. A further source of objection has been encountered in the difficulty of cleaning the absorber devices of conventional construction, and particularly of removing the caked deposits of exhausted charge material which accumulate therein during use. In many absorbers, the points at which these deposits accumulate are not accessible and considerable difficulty and inconven-

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ience is encountered in properly cleaning the apparatus.

It is, therefore, an object of the present invention to provide a carbon dioxide absorber for anesthetic administering apparatus which is of compact construction and which has a removable canister for holding a supply of carbon dioxide absorbent material, wherein the removal and replacement of the canister for replenishing the absorbent and servicing the absorber is greatly simplified.

It is a further object of the invention to provide such an absorber having a housing on which the canister is removably supported, in which a more uniform distribution of the gas mixture through the absorbent material and a more efficient utilization of the absorbent is afforded.

It is a further object of this invention to provide a carbon dioxide absorber having a housing including inlet and outlet connections adapted to be placed in a closed anesthetic administering circuit, which is arranged to receive at a bottom portion thereof an open-top canister registering with openings in said housing for circulating the anesthetic gases therethrough.

It is a further object of the invention to provide a carbon dioxide absorber having a detachable canister including a removable down-tube unit carried therein, having a screen on which the bed of absorbent material is supported and which is completely accessible for cleaning.

It is a further object of this invention to provide such an absorber having a housing with a delivery and a discharge port in the bottom thereof and an open-top canister seated thereon encompassing said ports, wherein said canister contains a removable down-tube unit having a screen at its lower end for supporting an absorbent bed, and registering at its upper end with one of said ports whereby respiration gases may be circulated through said canister and said absorbent bed.

It is a further object of the invention to provide such an absorber having a detachable, open-top canister, and an integral down-tube and screen assembly that is removable from the canister, in which the upper end of the down-tube is arranged to be inserted in one of the port openings in the absorber housing and wherein said tube is automatically aligned with said opening when the canister is placed in seated position.

A still further object of the present invention is to provide an open-top canister for an absorber having fastening means for securing the canister in seated position against the bottom of an absorber housing, including an adjusting member disposed at the bottom side of said canister and means projecting upwardly through the canister for detachably engaging the absorber housing.

A still further object of the invention is to provide an absorber having such a detachable canister unit wherein the fastening means is carried by the canister, and the bottom of the canister is provided with a recess for accommodating the adjusting portion of the fastening means, so as to permit the canister to stand on its base in an upright position when detached from the absorber.

A still further object of the invention is to provide in such a canister for carbon dioxide absorbers, a resilient biasing means interposed between the canister and said fastening means effective to urge said fastening means in an upward direction and means for automatically disposing said fastening means in position for engagement in the absorber housing, when the canister is seated.

A still further object of the invention is to provide such a detachable, open-top canister for a carbon dioxide absorber housing, wherein the removable down-tube and screen assembly are axially disposed in the canister; and said fastening means extends co-axially upwardly inside of said down-tube and is threadedly engaged in the absorber housing.

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A still further object of the invention is to provide such a detachable canister for absorber apparatus having a concave bottom in which the absorbent-bed-supporting screen member rests on the bottom of the canister and is shaped relative thereto to form a chamber between the screen and the bottom of the canister of a gradually diminishing cross-sectional area in an outward radial direction, and in which the depth of the bed increases progressively, toward the outer strata thereof, thereby to distribute the flow of gas uniformly through the absorbent charge.

Other objects and advantages of the present invention may be more fully understood by referring to the following description of a preferred embodiment thereof in which reference is made to the accompanying drawings in which:

Fig. 1 is a perspective view illustrating a carbon dioxide absorber including an absorber housing and an open-top detachable canister mounted on the bottom thereof, embodying the features of the present invention;

Fig. 2 is a top plan view of the absorber housing seen in Fig. 1;

Fig. 3 is a full vertical section showing the absorber housing and canister taken along the line 3—3 in Fig. 2, looking in the direction of the arrows;

Fig. 4 is a sectional plan view of the absorber housing taken along the line 4—4 in Fig. 3, looking in the direction of the arrows;

Fig. 5 is a sectional plan view taken through the canister along the line 5—5 in Fig. 3, looking in the direction of the arrows;

Fig. 6 is a partial vertical section taken through the axis of the canister by-pass valve, mounted on the absorber for adjusting the flow of gases through the canister, taken along the line 6—6 in Fig. 2; and,

Fig. 7 is a schematic drawing illustrating the gas circuit formed by the absorber and canister.

A carbon dioxide absorber is designated generally at 10 in Figure 1 of the drawings, having a housing 12 and a canister 14 detachably mounted at the underside thereof. The canister holds a supply of a carbon dioxide absorbent, such as soda lime. Inlet fitting 16 and outlet fitting 18 are adapted to be connected by means of conduits 20 and 21 to the usual anesthetic administering apparatus, as will be more fully described hereinafter, to form a closed anesthetic administering circuit as illustrated for example by the J. A. Heidbrink, United States Patent No. 2,121,196. In such a circuit, an anesthetic gas mixture, upon exhalation by a patient, is delivered to the absorber and circulated through the canister 14, and thence recycled to the patient. A canister by-pass valve 22 is provided in the absorber to control the proportion of gas that is circulated through the canister so that, in this way, the concentration of carbon dioxide in the respiration gases may be maintained at any desired level. This manner of operating absorber devices for closed anesthetic circuits is well known and is effective particularly when it is desired to stimulate the patient's voluntary respiration, by maintaining, temporarily, higher than normal carbon dioxide concentrations. The absorber is equipped with a fixture 23 for supporting the absorber, which may be attached, for example, to a conventional anesthetic machine, not shown.

The inlet fitting 16 carries the customary exhalation check-valve 24 as well as a rebreathing bag 26 and an adjustable pressure relief valve 28. An inhalation check-valve 30 is mounted in the absorber housing and a pressure gage 32 also is fixed thereon to indicate the pressure in the absorber circuit. The check-valves 24 and 30 are of well known construction and are of the type, as illustrated schematically in Figure 7 having a gravity-loaded valve disc 33, and an annular knife-edge seat 34. Each of the valves has a transparent cap 35 through which the fluctuations of the valve disc produced

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by the patient's breathing may be seen. The relief valve 28 is also of conventional design and is illustrated schematically in Figure 7 by the spring loaded valve disc 36, which vents the absorber circuit to the atmosphere when the pressure exceeds the valve setting. A vaporizer 38 of any suitable design is attached to the absorber outlet 18. The vaporizer contains a supply of a volatile liquid anesthetic agent, such as ether, which is vaporized and administered to the anesthetic circuit in controlled amounts by adjustment of the control knob 39. The construction and operation of such vaporizing means is well known to those skilled in the art and forms no part of the present invention.

Figure 7 shows the absorber 10 schematically and illustrates its flow circuit and the manner in which a patient's gases are circulated through the absorber housing and canister. The control of the gases passed through the canister is illustrated in the circuit by the alternate positions of the canister by-pass valve 22 shown in solid and dotted lines, which will be more clearly understood hereinafter. Also shown in the absorber circuit is an inlet 40 such as is conventionally provided in a closed anesthetic circuit, through which fresh gas such as oxygen is added to replenish the oxygen consumed by the patient, or through which gaseous anesthetics such as cyclopropane or nitrous oxide may be supplied. It will be understood to those skilled in the art that the apparatus comprising the closed breathing circuit may be arranged in various ways and, as will become evident in the following description, the present invention is not limited to the specific breathing circuit in which the absorber is employed.

Referring now to Figure 3, it will be seen that the absorber canister 14 comprises an enlarged cylindrical container having an inverted, cone-shaped bottom 42 and an open-top 44 seated within a cylindrical recess 46 on the bottom of the absorber housing. The recess 46 forms a shoulder 47 having a gasket 48 against which the upper edge of the canister is pressed to form a gas-tight seal. A retaining screw for securing the canister has an enlarged knob 50 bearing upwardly against the bottom of the canister and an elongated shaft 52, the upper end 54 of which is threadedly received in a bushing 56 carried in the absorber housing. The knob 50 is threaded on the shaft 52 and locked thereon by means of a set screw 58. The retaining screw is mounted in the canister by means of a spring 60 carried on a reduced portion 62 of the shaft. The spring is compressed between a washer 64 forced against the shoulder formed by the reduced portion of the shaft and a washer 66 which seats on the bottom 42 of the canister against the opening 67 through which the screw shaft projects. The pressure of the spring 60 thus urges the canister retaining screw upwardly, maintaining the head 50 in resilient engagement with the bottom of the canister. The spherical head portion 68 of the retaining screw provides a bearing surface against the bottom of the canister and facilitates adjustment of the retaining screw to engage the threads 54.

It will be noted that the bushing 56 has a chamfered opening which is adapted to facilitate the insertion of the threaded end of the retaining screw. In placing the canister in position on the absorber housing, this construction is highly advantageous since it will be seen that as the canister is raised towards the seating gasket 48 the upper end of the retaining screw comes into abutment with the bushing 56 before the canister is seated. As further upward movement of the canister is continued, the spring 60 is compressed and produces an upward thrust on the retaining screw. This thrust, assisted by the chamfered opening of the bushing is sufficient, automatically, to center the retaining screw against the bushing so that, when the canister is fully seated, the retain-

ing screw may be tightened without the necessity of "hunting" to thread it into the bushing.

It will be noted as a further significant feature of the above construction that the canister retaining screw is at all times carried by the canister and that the external adjusting knob 50 is recessed in the inverted bottom of the canister so as not to protrude beyond the base formed by the bottom edge 70 thereof, as seen in Figure 3. Consequently, when the canister is removed from the absorber, it may be placed on any flat surface and will be entirely self-supporting. In addition, when the canister is picked up and returned to position for attachment to the absorber housing the retaining screw is always immediately accessible for tightening. Should it be necessary to dismantle the canister and the retaining screw, the set screw 58 is released and the knob 50 threaded off of the lower threaded end 71 of the screw shaft 53. This permits the shaft of the retaining screw to be withdrawn through the top of the canister. To reassemble, the washers 64 and 66 and spring 60 are placed on the lower end of the shaft, as shown, which is again inserted through the canister and the knob 50 reattached to the protruding, lower end.

Disposed within the canister 14 is a down-tube 72 which is rigidly attached at its lower end to a perforated plate or screen 74 of a substantially conical shape and which is provided with an in-turned rim 75 on which the screen and down tube assembly are supported on the bottom 42 of the canister. The screen is relatively rigid and is adapted to support thereon a bed of the carbon dioxide absorbent placed in the canister. The apex angle of the cone-shaped screen, it will be seen, is slightly smaller than that of the conical bottom 42 of the canister so as to create therebetween a chamber 76 of gradually diminishing cross-section. At its upper end, the tube 72 is received in an opening 78 which, it will be seen, has a chamfer 79 to facilitate the entrance of the upper portion of the tube 72 therein. The down-tube thus positioned communicates with a delivery chamber 80 within the absorber which, as will later be described, communicates with the absorber inlet 16.

The tube 72 carries at a point toward its upper end a plurality of radially extending ribs 81 whose construction may best be seen by reference to Figure 5. As shown therein, the ribs are formed by a group of three arcuate segments secured at their center points to the tube 72, such as by soldering or riveting, and joined together at their outer ends. Thus, each of the outer ends extends an equal radial distance from the tube 72 and corresponds substantially to the spacing of the inside of the canister 14, so that the ribs formed by the segments act as guides to center the down-tube within the canister.

The lower screen member 74 also assists in centering the down tube by the engagement of its rim 75 with the bottom 48 of the canister, which engagement it will be seen urges the screen into axial alignment within the canister as the weight of the down-tube assembly and absorbent charge supported thereon bear on the bottom of the canister. The retaining screw 52 is also provided with a plurality of radial ribs 82, also seen in Figure 5, which co-act with the interior of the tube 72 to center the shaft 48 therein and assist in its proper engagement with the bushing 56 for securing the canister.

It will be seen that the above construction greatly facilitates the procedure for mounting the canister on the absorber housing, which, in fact may be done entirely by "feel." This may be done, for example, by tilting the canister slightly and raising it toward the bottom of the absorber so that its upper edge is placed against the inside of the recess 46. The canister is then straightened to its upright position, while maintaining its upper edge against the inside of the recess 46, which automatically brings the entire upper rim 44 of the canister into seated position against the annular absorber

gasket 48. At the same time, the aligning means above-described effects the alignment and the insertion of the tube 72 into the port 78 and automatically brings the retaining screw into confronting position for engagement with the bushing 56. The chamfer 79 in the opening 78, it will be seen, should be sufficient to permit the entry of the tube 72 therein when the canister is seated in accordance with the procedure above-described. The opening 78 is slightly larger than the tube 72 to facilitate its insertion and avoid binding, but preferably is as closely fit as otherwise possible to reduce leakage around the tube.

Preferably, the guiding ribs 81 carried by the down-tube are located at a level corresponding to the level with which it is desired to fill the canister. Thus, when the canister is charged with a carbon dioxide absorbing material, such as soda lime, which preferably is in granular form, the material is added to form a bed extending from the supporting screen 74 up to the level of the radial guide ribs. In this manner, a convenient means is provided for indicating the desired amount of charge so that a small space is insured at the top of the canister above the charge bed. This space communicates with an outlet opening 83 through which the gases, after passing through the absorbent bed, are discharged to an outlet chamber 84 in the housing. The chamber 84, as will later be described, connects with the absorber outlet 18.

The internal construction of the absorber housing through which the anesthetic gases are circulated and conducted to and from the canister may best be seen by reference to Figures 2, 4, 5 and 6. Referring to Figure 4, a partition 85 forms one wall of the chamber 84 and separates this chamber from an inlet chamber 86 which receives the respiration gases from the inlet fitting 16. The chamber 86 is also enclosed by a partition 87 which divides this chamber from the delivery chamber 80. The outlet fitting 18 through which the gases are returned to the anesthetic delivery circuit connects with a chamber 88 in the absorber enclosed by partition members 89 and 90. The opening for receiving the fresh-gas inlet 40 is shown in the chamber 88. The canister by-pass valve 22, shown externally in Figure 1, is provided with a web 22' as seen in Figure 4 which when positioned as shown by the dotted lines forms a continuous wall together with the aligned partitions 87 and 89. In this position of the control valve, all of the gas delivered to the absorber through the inlet fitting 16 is passed from the delivery chamber 86 directly to the discharge chamber 88 and thence returned to the circuit through the outlet fitting 18; none of the gases are circulated through the canister. When the valve is rotated 90° such that the web 22' is in the position shown by the solid lines in Figure 4, an opening is created between the chambers 86 and 80. In this case, all of the gases delivered to the absorber pass into the chamber 80 and thence downwardly through the tube 72 of the canister, to the bottom, distributing chamber 76 seen in Figure 3, and upwardly through the absorbent bed supported in the canister on screen 74. The opening 83 through which the treated gases are discharged from the canister and delivered to the absorber chamber 84 is somewhat kidney-shaped, as can be seen in Figure 4. The web 91 extending across the chamber 84 does not form a partition, but is merely a structural rib member for strengthening the absorber housing which, preferably, is a casting. It will be seen that a partition 92 forms an extension of partition 87 and separates the chamber 80 from the chamber 84. Together with the web 22' of the control valve and partition 90, the partition 92 forms a continuous wall, when the valve 22 is in the full line position shown dividing the inlet chamber 86 and chamber 80 from the discharge chambers 84 and 88. It will be readily apparent that, when the control valve 22 is rotated to a position intermediate the two positions illustrated in

Figure 4, the gases delivered to chamber 86 will be divided, a portion thereof being circulated through the canister and a portion thereof passing directly to the discharge outlet of the absorber. In this manner, it is possible to control the level of carbon dioxide concentration in the breathing circuit, since the gases passing directly to the outlet will retain their carbon dioxide content.

The construction of the control valve 22 is more fully shown in the sectional view of Figure 6 wherein it will be seen that the web 22' thereof forms a part of a cylindrical valve stem 94 that is received within an opening 95 in the absorber housing. The valve stem has opposite grooves 96 and 97 on either side of its web, or partition 22', which form openings through which the gases are conducted between the chambers interconnected by the setting of the valve. The valve stem is rotatably seated in the valve housing by means of a retaining screw 98 threaded into the valve stem and resiliently biased by a spring 99 to maintain the valve in frictional seating engagement. A shoulder 100 on the upper side of the valve provides a bearing surface which rests on a corresponding seating surface 102 formed on the top of the valve body. Also seen in this figure and further illustrating the construction of the absorber housing is the vertical elevation of partition 87 dividing the chamber 86 and the chamber 89 of the absorber. The partition is partially broken away in this view to reveal the protruding upper end of the tube 72 extending into the chamber 88, and the upper end of the retaining screw, as seen through the valve opening formed by the groove 97. The chamber 84 is visible through the valve opening formed by groove 96, on the opposite side of valve web 22'.

The respective extreme positions of the valve illustrated in Figure 4 are determined by the stops 104 and 105 shown in Figure 2 which are engaged by a radial protrusion 106 of the valve. Thus, as seen in this figure, when the valve 22 is rotated such that the protrusion 106 engages the stop 105, as shown, the valve partition 22' is in the orientation seen in Figure 4 in which all of the gases are conducted through the canister. This position of the valve is designated as the "on" position. When the valve is rotated to place the protrusion 106 against the stop 104, the partition 22' is orientated as indicated by the dotted lines in Figure 4 in which all of the gases pass directly to the discharge outlet of the absorber and none are circulated through the canister. This position of the valve 22 is designated as the "off" position.

It will be apparent that the absorber apparatus now described affords an extremely compact and simple mechanism which greatly facilitates the use and maintenance thereof. When, for example, it is desired to inspect the absorbent charge or to replace it, the canister may easily and quickly be removed by a single operation in which the knob 56 of the retaining screw, as shown in Figure 3, is unthreaded, whereupon the entire canister assembly is freed of the absorber housing and may be lowered therefrom and conveniently rested on a table or other flat surface. It is a further significant feature of this construction that when the canister is emptied, the interior thereof and the down-tube assembly and screen may be thoroughly cleaned with ease. Thus, for example, the down-tube and attached screen can be removed from the canister leaving exposed the interior of the canister, which is free of crevices or recesses in which deposits can occur. Similarly, the removable down-tube assembly is entirely accessible for cleaning and particularly for the removal of deposits which tend to form on the screen during use.

A cap 108, seen in Figure 3, supported by a bead chain 109 from one of the radial ribs 81, is placed over the end of the tube 72 when the canister is filled. The upper conical end 110 of the cap has a reduced size opening through which the shaft 52 projects when the cap is placed in the down-tube, so that the absorbent is prevented from

entering the tube during filling. The cap is attached to the down-tube for convenience and may be detached and used separately if desired. It is desirable frequently to keep on hand a filled, spare canister so that the absorber can be recharged without actually having to refill the same canister. If it is desired to replace the charge during anesthesia, the valve 22 is placed in "off" position, isolating the canister from the remainder of the circuit. The canister can then be replaced without interrupting the patient's breathing.

After refilling the canister, it may easily be returned to its original seated position on the absorber following the procedure described above and the retaining screw then tightened to complete its gas tight sealing engagement. As described above, the act of placing the canister in seated position against the bottom of the absorber housing automatically effects the insertion of the down-tube in the opening 78 of the absorber housing, and automatically disposes the retaining screw in aligned, confronting position to the bushing 56 for completion of the threaded engagement of these members. Thus, the entire seating operation may be accomplished without "hunting" or manipulation to effect alignment. After the canister has been seated, the canister bypass valve is set in its desired position causing a predetermined portion of the gas flow to be circulated through the canister. When the canister by-pass valve is fully or partially open, the inlet gases are permitted to pass through the chambers 86 and 89 of the absorber housing, downwardly through the tube 72 to the distributing chamber 76. The gases thence pass upwardly through the screen 74 and the charge bed supported thereon and out of the top of the canister through the opening 83 formed in the bottom of the absorber housing. These gases pass through opening 83 into chamber 84 and thence to outlet chamber 88 which communicates with the absorber outlet 18. When the canister by-pass valve is only partially open, a portion of the gases delivered to the absorber will, of course, be delivered directly to the discharge chamber 88 so as to circumvent the canister. The path of the gases through the absorber is illustrated as previously mentioned in the schematic flow circuit of Figure 7. The apparatus therein, of course, is connected to the usual administering apparatus, such as an inhaler face mask, to complete a closed breathing circuit in which the gases may be continuously administered and recycled to the patient. It will be understood that the various elements comprising the flow circuit such as the check valves, the ether vaporizer, etc., may be rearranged and that an absorber may be constructed in accordance with the present invention in which these parts of the circuit have a different relationship than in the present preferred embodiment. In some instances, for example, it may be desired to locate the various valve elements and the vaporizer apart from the absorber housing. In other instances, it may be preferred, for example, to connect the vaporizer on the inlet side of the absorber and possibly also to rearrange the pressure relief valve and inhalation check valve to correspond to other frequently employed circuit arrangements.

The construction of the absorber as above described, in addition to facilitating the operation and servicing thereof, affords a greatly improved distribution of the gas flow through the absorbent bed. As before described, the distributing chamber 76 gradually diminishes in cross-sectional flow area toward the outer edge of the canister. This produces a manifolding effect in which the gases delivered to the chamber are distributed more uniformly in their flow upwardly through the screen. In addition, the inverted bottom of the canister and the corresponding shape of the supporting screen 82 provide a vertical flow path at the outer strata of the charge bed, immediately adjacent the wall of the canister, of greater relative length from the bottom of the charge to the top thereof, than the corresponding vertical flow path formed in the inner strata immediately adjacent the tube 80.

It has been found in cylindrical charge containers that there is a tendency for a greater portion of the gas to flow through the outer strata of the charge bed adjacent to the outer walls of the container, apparently due to a reduced flow resistance in these regions. In the present construction, the elongation of this outer flow path tends to equalize the flow assistance throughout the bed, thus producing a more uniform distribution of flow. This will be seen to afford a more uniform consumption, or depletion, of the absorbent and effect a greater economy in its use. A further significant advantage gained by the employment of the device herein described results from the circulation of the gases to be treated, first downwardly through the centrally located tube 72, and thence upwardly through the absorbent bed which is in surrounding relation thereto. The proximity thus afforded, of the down-tube and delivery gases to the charge bed, enables heating of the incoming gases by the heat evolved in the charge due to the chemical reaction by which absorption of the carbon dioxide occurs. The temperatures, of course, are not intense, but sufficient heating takes place to increase the moisture capacity of the gases, enabling the gases to pick up a considerable portion of the moisture that is also formed as a product of the absorption reaction in the lower strata of the charge bed. Thus, the lower strata is kept relatively dry and is prevented from becoming saturated by this moisture. Under these conditions, the charge has less tendency to cake and form deposits on the screen 74 so that the cleaning of the screen and lower parts of the canister is greatly facilitated. In addition, the moisture picked up by the warmed gases is carried upwardly through the charge bed, the top strata of which normally would be relatively dry. In such a dry state, the finer particles of the charge material can be picked up by the gas and carried into the gas passages, requiring screens or other similar devices to prevent this occurrence. In the present arrangement, the additional moisture afforded in the top strata of the charge bed tends to reduce or prevent the entrainment of fine particles in the gases. Avoidance of this occurrence, of course, is highly desirable, not only because it eliminates the need of screen or baffle devices, but also because it eliminates the undesired, deleterious effects produced by the caustic absorbent when deposited in other parts of the absorber.

The present invention is not limited to the specific embodiment herein described, but may be used in other ways without the departure from its spirit as defined by the following claims:

I claim:

1. A carbon dioxide absorber for anesthetic administering apparatus, comprising a housing having an annular seating surface on the bottom thereof, a detachable, cylindrical canister supported by said housing, adapted to hold a supply of carbon dioxide absorbent, having an open top received in substantially gas-tight engagement against said annular seating surface, first and second openings in the bottom of said housing registering with the open top of said canister and forming a part of a breathing circuit through which gases are adapted to be circulated through said canister, said first opening being concentrically disposed with respect to said annular seating surface, a removable down-tube assembly in said canister, including a vertical tubular member registering at its upper end with said first opening and having a radially extending screen at its lower end which is adapted to support thereon a bed of the carbon dioxide absorbent, said screen being seated on the bottom of said canister and shaped with respect thereto to form a distributing chamber at the bottom of said canister communicating with the lower end of said tube, and means for detachably securing said canister to said absorber, including a threaded socket within said first opening and a retaining screw, said retaining screw having an adjusting knob bearing against the bottom of said canister and an elongated shaft extending upwardly

through said tubular member, threadedly engaged in said socket.

2. An absorber as set forth in claim 1 wherein said threaded socket is concentrically disposed in said first opening and said retaining screw is provided with guide means axially disposing said shaft in said down-tube, such that when said canister is seated against said absorber, said down-tube is automatically placed in registry with said first opening and said screw shaft is automatically aligned for threaded engagement in said socket.

3. An absorber as set forth in claim 1 wherein said retaining screw is mounted in said canister, said screw being longitudinally movable with respect to said canister and having resilient means urging the head thereof upwardly against the bottom of said canister.

4. An absorber as set forth in claim 3 wherein the bottom of said canister is concave and said head portion of said screw mounted therein is completely recessed such that the canister is self-supporting on the bottom thereof when removed from said absorber housing.

5. A carbon dioxide absorber comprising a housing adapted to be connected to an anesthetic circuit, having a canister receiving recess at the bottom thereof and an annular seating surface therein, a cylindrical canister received in said recess having an open-top seated against said seating surface, a vertical down-tube carried in said canister having a funnel-shaped screen surrounding the lower end thereof resting on the bottom of said canister to form a distributing chamber communicating with the lower end of said tube, a first opening in said absorber recess concentrically disposed relative to said annular seating surface and having an outwardly flared entrance, guide means for substantially centering said tube in said canister effective to permit the upper end thereof to be retractably inserted in said first opening when said canister is seated on said absorber, a second opening in said housing recess registering with said canister and forming, together with said first opening, passage means for conducting circuit gases to and from said canister, a threaded socket in said absorber housing concentrically disposed in said first opening, a retaining screw having a head portion engaging the bottom of said canister and an elongated shaft portion extending upwardly through said tube, adapted at its upper end to be threaded into said socket, guide means disposing said elongated shaft member substantially centrally in said down-tube, and means mounting said retaining screw in said canister including resilient means urging said retaining screw upwardly and effective to permit relative longitudinal displacement between said screw and said canister, said canister being adapted to be seated and secured to said absorber by placing, first, one part of its upper edge in said recess and in engagement with said seating surface, and, while maintaining such engagement, adjusting the position of said canister to bring about engagement of the entire upper edge of said seating surface, said tube being automatically inserted in said first opening and said retaining screw being automatically aligned and resiliently 'butted' against said socket, by said act of adjusting the position of said canister to place it in full seated position.

6. A carbon dioxide absorber comprising a housing having an inlet and an outlet adapted to be connected in a breathing circuit, first and second openings in the bottom of said housing connected respectively with said inlet and said outlet, an annular seating surface on the bottom of said housing encompassing said first and second openings, a cylindrical canister having an open top secured to said housing in engagement with said annular seat such that gases may be conducted to and from said canister through said first and second openings, said canister having an inverted concave bottom and an aperture substantially centrally disposed therein, a threaded receptacle disposed in said housing in substantially concentric, confronting relation to said canister, a retaining screw having an enlarged head bearing upwardly against the

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bottom of said canister and having an elongated shaft extending upwardly through said aperture adapted to be threadedly received in said receptacle, means carried on said shaft for centering it in said canister, to effect alignment of said shaft with said receptacle when said canister is in seated position, spring means carried on said shaft, compressed against the bottom of said canister and a portion of said shaft, such that said retaining screw is resiliently mounted in said canister to permit relative longitudinal displacement therebetween, means forming a conduit registering at its upper end with said first opening and connecting at its lower end with a distributing chamber at the bottom of said canister, said distributing chamber being separated from the upper charge containing chamber of said canister by a screen adapted to support thereon a bed of granular absorbent material, and valve means interconnecting said inlet and outlet, operable to control the flow of gas through said canister.

7. A carbon dioxide absorber for anesthetic administering apparatus in which a charge of carbon dioxide absorbent material is adapted to be held and contacted with respiratory gases conducted therethrough comprising a cylindrical, open-top shell forming a canister for holding said absorbent charge, a removable down-tube unit disposed in said canister, including a vertically extending tube having radial projecting means arranged to slidably contact the side wall of said canister for positioning said tube therein, and a screen, encircling said tube at the lower end portion thereof and extending outwardly therefrom, said screen at its outer peripheral end portion bearing against a wall portion of said canister and forming in the lower region of said canister a distributing chamber communicating with the lower end of said tube, the space above said screen communicating with said distributing chamber through the perforations of said screen and forming a chamber in which a charge of absorbent material is adapted to be held and supported on said screen, a housing having gas passages through which respiratory gases are adapted to be circulated, means on the underside of said housing for receiving the upper, open end of said canister thereagainst, including at least two separate ports through which the respiratory gases in said gas passages are adapted to be delivered to and from said canister respectively, said canister receiving means being effective to register said ports with the top of said canister and to register one of said openings with the upper end of said vertical tube, and externally accessible retaining means operable to detachably secure said canister against said canister receiving means.

8. A carbon dioxide absorber according to claim 7 wherein said retaining means comprises a rod engageable with the underside of said canister, projecting upwardly therethrough and extending longitudinally through said vertical tube, and being detachably engageable at its upper end with said housing to hold said canister in gas-tight engagement therewith.

9. A carbon dioxide absorber according to claim 8 wherein said retaining means has an externally accessible manually adjustable portion engageable with the underside of said canister and said canister is recessed at the bottom thereof to accommodate said retaining means portion therein and effectively present a self-supporting base permitting said canister to be placed in an upright position on a flat surface when said canister is detached from said housing.

10. An absorber for anesthetic administering apparatus comprising a housing having an inlet and an outlet adapted to be connected in a breathing circuit and communicating respectively with first and second openings in the bottom of said housing, a detachable canister for holding a supply of a carbon dioxide absorbent having an open top received against said housing so as to encompass said first and second bottom openings, a removable down-

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tube assembly carried in said canister including a substantially axially disposed vertical tubular member and a screen member forming an annular skirt extending outwardly and downwardly from the lower portion of said tubular member, said tubular member registering at its upper end with one of said openings and said screen having a cone shape and extending outwardly to the side walls of said canister to form in the space below said screen a distributing chamber communicating with the lower end of said tubular member and effectively separating said chamber from the space thereabove in said canister in which is adapted to be placed a charge of absorbent material, said canister having an inverted, conical bottom face whose axis is substantially concentric with and whose apex angle is relatively greater than that of said conically shaped screen member, such that said distributing chamber has a progressively diminishing cross-sectional flow area at successively greater radial increments, and externally accessible retaining means engageable with the underside of said canister extending upwardly therethrough and detachably engaging with said housing to effectively secure said canister in gastight engagement therewith.

11. An absorber as set forth in claim 10 wherein said retaining means comprises a screw having an elongated shaft co-axially disposed in said tubular member, threadedly engaging said housing at its upper end and having a knob with a spherical bearing surface engaging the conical bottom of said canister.

12. A carbon dioxide absorber for anesthetic administering apparatus comprising a housing adapted to be connected in an anesthetic breathing circuit and having passages therein for conducting said respiratory gases therethrough, including at least two separate gas ports in a bottom face thereof, a cylindrical open-top shell forming a canister for holding a charge of carbon dioxide absorbent material detachably secured to the underside of said housing such that the open top thereof registers with said gas ports formed in the bottom of said housing, a removable down-tube unit carried in said canister including a vertically extending tube positioned longitudinally, substantially centrally relative to the side walls of said canister, registering at its upper end with one of said gas ports, and a rigid screen member surrounding and extending outwardly at the lower end portion thereof from said tube to the cylindrical side walls of said canister, said screen member being of a cone-like configuration extending outwardly and downwardly from said central tube and resting at its outer edge against the bottom of said canister to thereby support said down-tube unit, said screen forming in the bottom of said canister an outwardly extending distributing chamber communicating with the lower end of central tube and forming above said screen a charge chamber, wherein a body of said carbon dioxide absorbent charge is adapted to be supported on said screen, to which gases may pass from said distributing chamber through said screen, said charge chamber having a progressively greater vertical extent in an outward radial direction such that respiratory gases passed downwardly through said tube to said distributing chamber and upwardly through a body of charge material in said charge chamber are substantially uniformly distributed throughout the cross-sectional flow area thereof and wherein the flow path adjacent the outer cylindrical wall of said canister constitutes the maximum length of flow path in said charge bed.

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