May 4, 1954 M. A. LOREDO SERRA 2,677,371

APPARATUS FOR INHALATION ANESTHESIA

Filed Aug. 31, 1950

Fig. 1.

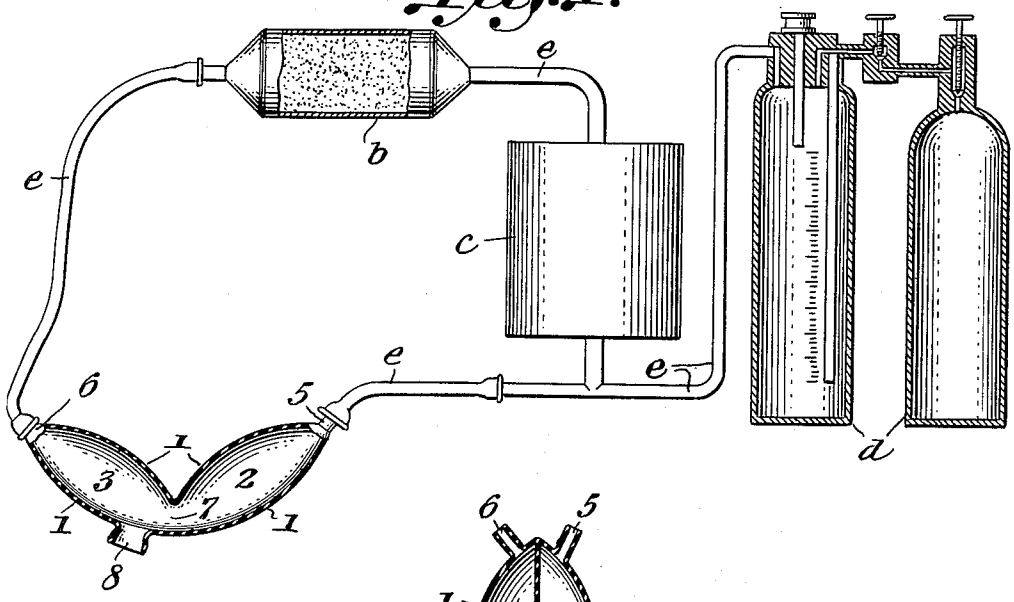
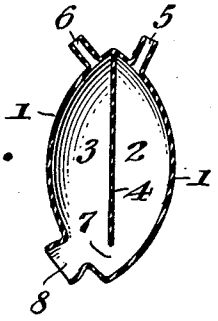


Fig. 2.



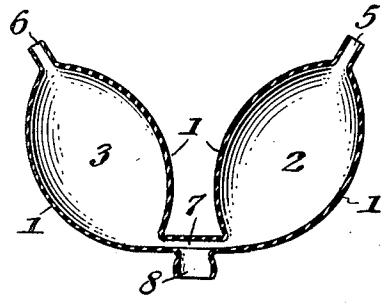


Fig. 3.

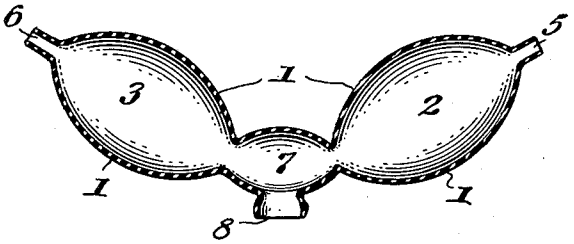


Fig. 4.

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APPARATUS FOR INHALATION ANESTHESIA

Miguel Angel Loredo Serra, Havana, Cuba

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Claims priority, application Cuba October 5, 1949

5 Claims. (Cl. 128—203)

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The present invention relates to an improvement in apparatus for the administration of inhalation anesthesia comprising a closed circuit from which the atmosphere is excluded and within which the gases are positively forced to circulate continuously in one direction by the action of mechanical means included in the circuit.

The present invention is particularly related to an improvement in the apparatus described and claimed in my previous application, Serial No. 71,697, filed January 10, 1949, entitled "Apparatus for No-Effort Inhalation Anesthesia," now Patent No. 2,593,774, the improvement consisting in the incorporation or inclusion in the closed circuit of said apparatus, as a constituent element of said circuit, of a flexible valveless breathing bag comprising two compartments connected in series with each other and with the other elements of said circuit and so constructed that, when it is included in the circuit and the apparatus is in use, the gases in the circuit must circulate continuously through the bag, first through one of the compartments and then through the other, without loitering within the bag or forming eddies in any portion of said bag.

As set forth in said application Serial No. 71,697, the aforementioned closed circuit also comprises a carbon dioxide absorber to the inlet of which is connected the outlet of the breathing bag by suitable tubing, the outlet of said absorber being connected by a tube to the inlet of a suitable pumping device which forces the gases to circulate continuously in the circuit, the outlet or discharge end of said pump being connected to a suitable tube to which is also connected a suitable source of anesthetic gas supply, the other end of said tube being connected to the inlet of the breathing bag, thus completing the circuit through the bag.

From the above it is seen that any breathing bag used in the circuit just described will, of necessity, have a continuous current of gases flowing through it when the circuit is in operation and therefore any breathing bag through which the gases in the circuit can not flow in the form of a continuous stream or current, can not be included in the circuit.

In my previous application it was also pointed out that what is designated as a "breathing passage" or "breathing opening," has no counterpart in any of the known breathing bags but is an opening placed directly in the wall of the breathing bag itself. That opening is applicable directly to the face of the user or by the use of a face mask, for example, thereby allowing the user to

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breathe (inhale and exhale) within the bag the gases flowing through it. Obviously the breathing bag must also have an inlet for the admission of the gases and an outlet to allow the gases to pass out of the bag, said inlet and outlet being connected to the rest of the circuit in the manner described above.

As already pointed out the principal object of the present invention is to prevent the gases flowing in the circuit from loitering or forming eddies within the breathing bag.

Application, Serial Number 71,697, describes and claims a breathing bag featured by having three independent passages located on its periphery; one of said passages being the inlet through which the gases enter the bag, another being the outlet through which said gases flow from the bag into the portion of the circuit where the carbon dioxide absorber is located, the third being a breathing passage, located between the two previously named and of such size that through it the user can breathe, within the bag, the gases passing through the latter. To this last passage is attached a face mask which acts merely as a means for adapting the bag to the face of the user in such a manner that it prevents the gases from escaping to the outer atmosphere or the latter from penetrating the circuit.

As indicated in the pending application, the breathing bag constitutes one of the most essential elements of the apparatus for the administration of inhalation anesthesia without effort and is there described as an elastic covering or bag enclosing a single inner compartment, and having on its periphery the three passages already named, it being also stated that the inlet and outlet passages are located on opposite sides of the bag, with the breathing passage between them so that, when the bag is connected to the circuit of the apparatus, the user will have to breathe directly in the current of gases flowing through the bag from the inlet to the outlet passage.

However, different trials and experiments, performed by me at a later date, showed that in order to obtain a perfect result something else besides the mere fact of locating the three passages on the periphery of the bag in the manner described had to be done, because the bag described in said pending application had the serious drawback that, at certain points in the inner compartment, the gases instead of flowing more or less directly from the inlet passage to the outlet, showed a tendency to form eddies and whirl around in circles instead of advancing towards the outlet passage, and thus the carbon dioxide exhaled by the user

tended to accumulate there with the result that, on occasions, instead of inhaling the gases mixed in the predetermined proportions, he inhales a mixture containing an excess of carbon dioxide and, as a consequence, his breathing becomes unduly laborious.

From the above it will be seen that one of the principal objects of the present invention is to provide a breathing bag unit in which all tendency to the formation of eddies (by the gases) is completely eliminated, so that the aforementioned pump or mechanical device maintains a current of gases flowing continuously through the interior of the breathing bag unit so that the user will at every instant breathe the pure gases mixed in the predetermined proportions.

I wish to explain that the expression "breathing bag unit" as used in this specification and in the annexed claims, includes the complete device used as a breathing bag, whether it consist of a single bag divided interiorly into two compartments, or a two-lobed bag, or two bags connected to each other by a suitable element like a tube, for example. It also includes the three passages already mentioned and a fourth passage which communicates the two inner compartments. However, said expression does not include the face mask, catheters or other devices that may be attached to the "breathing passage" to facilitate the user's breathing.

In some of the known apparatus used in the administration of inhalation anesthesia two valves of the "one way" type have been employed in an attempt to solve the problem of preventing the user from inhaling some of the carbon dioxide that he had previously exhaled. Said valves are so installed that, when the user inhales, one of them opens to admit the anesthetic gases to the face mask and closes as soon as inhalation ceases, while the other is maintained closed during inhalation, but, as soon as the user begins to exhale, it opens to allow the exhaled gases to pass out from the face mask. Now, without considering whether said valves really prevent the user from inhaling part of the carbon dioxide previously exhaled by him, it is evident that they are not an acceptable solution because both are operated by the user's breathing efforts and thus, instead of facilitating his breathing, they make it more difficult by introducing two new obstacles in the circuit.

The breathing bag unit of the present invention solves the problem, without using any valves whatever, by the simple expedient of employing two inner compartments connected by a relatively narrow passage, this being sufficient to prevent the formation of eddies within said compartments. Logically, the speed of the gases flowing through the relatively narrow communication passage is greater than those flowing through said compartments through the action of the pump in the circuit, so that any gas (carbon dioxide) exhaled in said communication passage or at any point near to either of its two ends, will be immediately carried away. It is for this reason that, in spite of the fact that excellent results are obtained when the breathing passage opens unto any part of either of the two compartments, I prefer to locate it so as to open directly on said communication passage or at a point on the periphery of either compartment that is located relatively near to one of the ends of said communication passage. I have found that, when this is done, the result obtained is similar to the one produced when the user exhales in one place and then inhales at another.

In the drawings:

Figure 1 is a diagram illustrating the position occupied by the breathing bag unit of the present invention when it is attached to the circuit of the apparatus of my pending application Serial Number 71,697 of January 19, 1949. In said diagram *a* there is a breathing bag unit; *b* is the carbon dioxide absorber; *c* is the pump or mechanical device that circulates the gas in the circuit; *d* is the gas supply source; *e* are the tubes connecting said parts.

Figure 2 is the vertical section of a breathing bag unit consisting of a single bag divided interiorly into two compartments by a partition wall.

Figure 3 is the vertical section of a breathing bag unit that is similar in most of the details to that of Figure 1, from which it differs only in the fact that the two lobes instead of being united directly to each other are attached to the ends of a hollow member that acts as the communication passage.

Figure 4 is the vertical section of a breathing bag unit that is only a modification of the one illustrated in Figure 3, from which it only differs in the fact that the hollow member connecting the two lobes is expanded so as to form a small compartment or chamber.

A simple inspection of the drawings shows that the breathing bag unit of the present invention comprises two inner compartments, two of the ends of which communicate with each other through a passage the cross-sectional area of which is smaller than that of either of the compartments that it communicates, each of the other ends of said two compartments being furnished with a passage that in one is an inlet and in the other an outlet, said breathing bag unit being also furnished with a breathing passage that may be located at any point on the periphery of the unit, though preferably located on said communication passage or at any point near to one of the ends of said passage. All of the units (breathing bag units) illustrated function alike. The gases from the circuit, impelled by said pump, enter the breathing bag unit through the inlet passage and flowing through the first compartment enter the communication passage to issue in the second compartment, then flowing through said second compartment they pass through the outlet passage into that portion of the gas circulation circuit in which the carbon dioxide absorber is located. In passing through the breathing bag unit, the gases must flow past the breathing passage so that the user will breath directly in said current of gases.

Turning now to Figure 2, we see that in the case it illustrates the breathing bag unit consists of an elastic cover or bag 1, preferably made of rubber, divided interiorly into two compartments 2 and 3, by a partition extending from side to side and from the top to a predetermined distance from the bottom of the bag, so that between the lower edge of said partition 4 and the bottom of the bag 1, a free space is left which acts as the communication passage 7 between the two compartments 2 and 3. The ends of compartments 2 and 3 opposite to those where communication passage 7 is located are furnished each with a passage which in compartment 2 is inlet passage 5 while that of compartment 3 is outlet passage 6. Finally, breathing passage 8 is located on the

periphery of compartment 3 near the outlet or discharge end of communication passage 7.

In the breathing bag unit illustrated in Figure 1, cover 1 assumes the form of a two-lobed bag, with ellipsoidal lobes, united at their lower ends, each of said lobes defining a compartment, the one on the right being indicated by 2 and the one on the left by 3. The communication passage 7 being located at the point of union of the two lobes, the inlet passage at the upper end of compartment 2, while the outlet passage is located at the upper end of compartment 3. In this case the breathing passage 8 is also located in compartment 3, close to the discharge end of communication passage 7.

Figure 3 illustrates a breathing bag unit that is nothing more than a variation of the one illustrated in Figure 1, said variation or modification consisting in the fact that the lobes defining compartments 2 and 3, instead of being directly united to each other at their lower ends, have said ends attached to a hollow member that defines the communication 7.

Figure 4 presents another modification that differs from that of Figure 3 only in that said hollow member is expanded so as to form a small compartment communicating with compartments 2 and 3, and to which the breathing passage 8 is attached.

Having thus exposed my invention and described several embodiments of the same, I claim as new:

1. In an apparatus for the administration of inhalation anesthesia comprising a closed circuit from which the atmosphere is excluded and within which the gases are forced to circulate continuously by mechanical means included in the circuit, a carbon dioxide absorber in said circuit, and a source of supply of anesthetic gases, the improvement consisting in the inclusion in said circuit, as a constituent element of the same, of a flexible, valveless breathing bag having two compartments connected in series with each other and with the rest of the circuit, said bag having in one of said compartments an inlet for the admission of the gases, an outlet in the other compartment for the discharge of the gases, and a breathing opening in the wall of the bag and located between said inlet and said outlet.

2. Improvement in apparatus for the administration of inhalation anesthesia as claimed in claim 1, said two compartments consisting of two ellipsoidal hollow elements joined at two of their ends.

3. Improvement in apparatus for the administration of inhalation anesthesia as claimed in claim 2, said two ellipsoidal elements being joined to each other by a tubular element in which said breathing opening is located.

4. Improvement in apparatus for the administration of inhalation anesthesia as claimed in claim 3, the element joining the two ellipsoidal compartments also being of ellipsoidal form.

5. Improvement in apparatus for the administration of inhalation anesthesia comprising a closed circuit from which the atmosphere is excluded and within which the gases are forced to circulate continuously, said circuit including a carbon dioxide absorber, mechanical means for the positive circulation of the gases and a source of supply of anesthetic gases, the improvement consisting in the inclusion in said circuit, as a constituent element of the same, of a flexible, valveless breathing bag divided interiorly into two adjacent compartments connected in series with each other and with the rest of the circuit, said division of the breathing bag into said two compartments being effected by a partition extending substantially vertically from the top of the bag to a point spaced a predetermined distance from the bottom of the bag, one of said compartments being furnished with an inlet for the admission of the gases at its top and the other compartment having an outlet for the gases at its top, and a breathing opening in the outer wall of the bag and located between said inlet and outlet.

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