VOLUME INDICATOR FOR ANESTHESIA MACHINE SYSTEM

James O. Elam, Elma, N.Y., assignor to Air-Shields, Inc., Hatboro, Pa., a corporation of Delaware

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3 Claims. (Cl. 128-29)

The present application is a continuation of the application filed by me on August 21, 1958, Serial No. 756,418, now abandoned.

This invention relates to equipment for use with anesthesia machines and is more particularly concerned with improvements in devices for indicating the volume of ventilation being provided.

In the administration of anesthesia the patient at times may be assisted in the breathing process by the anesthetist. For this purpose the anesthesia machine usually incorporates a flexible bag member to which manual pressure is applied to assist in the inhalation phase of the breathing cycle, the flexible bag being connected to the anesthesia gas system. When pressure is relieved on the system by removing the manual pressure to the bag the exhalation phase of the cycle occurs. When the patient is breathing spontaneously the bag expands and retracts in response to the exhalation and inhalation phases. It is an object of the present invention to provide improved equipment to indicate the ventilation being supplied while retaining the customary breathing bag having the "feel" to which the operator is accustomed.

Another object is to accomplish the foregoing without commingling air from the breathing bag with the anesthesia gas being supplied to the patient.

The volume of breathing gas being supplied to the patient is an indication whether adequate ventilation is being accomplished. Being able to observe the ventilation action at all times provides an important check on the functioning of the apparatus and the breathing of the patient. An important object of the invention is the provision of a bellows or similar expansible unit having an easily read scale to show the amount of movement of the bellows at each inhalation. This volume indicator is preferably located in a prominent position where it is readily visible to the anesthetist as to the surgeon and other personnel to permit checking.

A further object of the invention is the provision of a special relief valve construction actuated by the indicator device to automatically bleed off excess gas from the anesthesia system when the indicator unit becomes overstressed. This valve is also constructed to permit inlet of air should the supply of anesthesia gas be insufficient to permit the indicator unit to become collapsed.

Another object of the invention is the provision of an arrangement of indicator bellows and valve which prevents the accumulation of condensed moisture which might affect the operating characteristics.

How the foregoing and other objects and advantages of the invention are accomplished will be clear by reference to the drawings in which:

FIGURE 1 shows a volume indicator device according to the present invention and its relationship to the anesthesia machine system.

FIGURE 2 shows the special valve device of the indicator unit in greater detail to a larger scale.

Referring to the figures it will be seen that an anesthesia mask 5 is illustrated in FIGURE 1 having an inhalation gas connection 6 leading from the supply to the mask and tube 7 which carries the exhalation gas back to the system. Suitable valves permit flow only in the direction of the arrows in tubes 6 and 7. The exhalation gases pass through the carbon dioxide absorber unit 8 before being returned to the system. The system pipe 9 has a connector 10 through which the lung ventilating gas is supplied. The ventilating gas contains the oxygen supply and the anesthesia gas supplied from tanks 10a and 10b.

Connected to the anesthesia system is the indicator unit 11 which incorporates a closed chamber 12 having transparent sides. Inside the chamber 12 is a collapsible container or bellows device 13 having its lower end provided with a neck outlet 14 attached to the upright channel or pipe 15 which in turn is connected to the anesthesia system pipe 9 by means of pipe 16 and connector 17. A pressure indicator 18 is attached to the pipe 16 to show the pressure being developed in the anesthesia machine system.

To assist in the inhalation phase the flexible squeeze bag 19 is connected by a channel 20 to the interior of chamber 12. Thus, manual pressure applied to bag 19 develops an internal pressure which is transferred to the interior of the chamber 12 where it is again transferred through the medium of the bellows unit 13 to the anesthesia gas circuit. There is no communication, however, between the air in the chamber and the anesthesia gases in the bellows and conduit system.

A valve unit 21 is located at the lower end of pipe 15. The constructional details are shown in FIGURE 2. A valve closure member 22 rests on a lower fixed plate 23 to normally close an opening 24 in plate 23. Stop rods 25 are provided to limit the amount of opening of the valve 22. A flexible tension member 26, such as a string or light chain, is attached to the valve 22 by means of a lug 27 and extends upwardly where it is connected to another lug 27a on the inside of the upper surface 28 of the bellows unit 13. The length of the tension member 26 is selected so as to be tight when the upper surface 28 reaches its almost fully extended position, just before contacting the stop 29a on the upper surface 29 of the chamber 12.

FIGURE 1 illustrates the apparatus in full line position ready for an inhalation phase. To assist the patient in the inhalation phase the anesthetist squeezes the bag 19 which displaces the gas therein and causes a pressure to develop in chamber 12. This application of pressure to the bellows 13 causes it to transmit the pressure to the anesthesia system pipe 9 thereby forcing anesthesia gas under slight pressure through the inhalation tube 6 to the mask unit 5 where it is delivered to the patient's lungs. Because a standard "breathing" bag 19 is used as the squeeze bag, the feel of the system is very similar to a normal system. Thus the operator can maintain the proper pressure and deliver the desired volume of gas to the patient's lungs. The volume being delivered is directly indicated by the extent that the bellows 13 collapses and is read by the position of the upper surface 28c with
3 respect to a scale 30 marked on the surface of the transparent chamber wall. Preferably several scales are provided so that the reading may be observed from only after inhalation. The scale may be conveniently calibrated in units of 100 cc. When the inhalation phase has been completed the operator relaxes the pressure on the bag 19 so that the pressure in chamber 12 immediately falls to atmospheric and thus permits the patient to exhale through the mask 5 and the tube 7. During the exhalation phase additional ventilating gas is provided to the system through the connector 10 and this together with the gas returned to the system from the absorber unit 8 causes the bellows device 13 to again expand to its original position. This expansion of bellows 13 displaces the gas in chamber 12 into the bag 19 which expands during this phase from its collapsed position 19a to the extended position 19.

In order to assure that an adequate volume of ventilating gas is supplied to the system it is usually customary to supply an amount slightly in excess of the required volume. Under these conditions at the end of each exhalation phase the upper surface 28 of the bellows device will be slightly higher than after the previous cycle.

Eventually the bellows surface 28 reaches its fully extended position and at this point the tension member 26 tightens and lifts the valve member 22 off its seat 23. This opens the anesthesia system to atmosphere and permits the excess gas supplied during the exhalation phase to be bled off to the outside. As soon as the pressure is applied for the inhalation phase the bellows device again is moved toward collapsing position and the valve 22 is closed resulting in application of pressure to the system to provide the inhalation phase as previously described.

The valve 21 may also function as a safety device to prevent a negative pressure being developed in the anesthesia system. Should for some reason the supply of anesthesia gas into the system be inadequate to supply the full ventilating volume required, the bellows device 13 would collapse more at each succeeding cycle until eventually a completely collapsed position such as indicated by the position of the upper surface 28 would occur. At this position natural inhalation by the patient would create a slight negative pressure in the anesthesia system. If this condition were not noted and corrected an inadequate supply of ventilating gas would be available in the system to supply the patient. In this event the valve 22 would open under the negative pressure developed and permit air to enter the anesthesia system to supplement the supply of gas being provided through the connector 10. It will be evident that unassisted or spontaneous breathing also causes expansion and contraction of the bellows 13 so that the volume is directly indicated under these conditions as well. When flow of anesthesia gas is greater than required, distention of the expandable container causes the relief valve to bleed off the excess gas.

From the foregoing it will be evident that I have provided an improved device for lung ventilation of a patient during anesthesia. By means of this equipment it is easy to take readings of the volume of ventilation continuously throughout the period when anesthesia is being administered. The visibility of the apparatus from all positions provides increased safety for the patient and assures that adequate ventilation will be supplied. More accurate adjustment of supply may be used, since any inadequate flow is shown by the gradual lowering of the position of the indicator member 26. Correction of the flow may be made long before the condition becomes urgent.

The combined safety valve and indicator bellows unit provides automatically for overflow of excess anesthesia gas without requiring attention on the part of the anesthetist. Also the construction of the valve device assures an emergency source of air for the patient should the system in the event the anesthesia system should provide an inadequate supply of ventilating gas. All of these advantages permit the anesthetist to maintain a more constant check on the patient because less time and attention is required to maintain proper operation of the equipment.

At the same time the feel of the system is retained so that the anesthetist does not need to learn new techniques of operation. Furthermore, the precise proportions of gases used in the anesthesia mixture is preserved because air from the squeeze bag is not able to enter the gas system and commingle with the anesthetic mixture. This also prevents the accumulation of condensate in the squeeze bag.

I claim:

1. In a lung ventilating system having conduit means for conveying lung ventilating gases to and from a patient, a bellows unit arranged to collapse and expand generally vertically and with a surrounding transparent chamber wall cooperating to provide internal and external pressure chambers, the conduit means being connected with one of said chambers to receive gases therefrom during inhalation and to deliver gases thereto during exhalation, a bag adapted to be manually squeezed in a hand of the operator and connected to the interior of said chamber to effect and controlling stroke of the bellows and to expand under the influence of expansion of the bellows, the bag thereby being free to transmit the "feel" of the patient's breathing to the hand of the operator, and breathing volume indicator scale means for reading the bellows collapsing and expansion strokes as visible through the transparent chamber wall concurrently with "feeling" the patient's breathing in the collapsing and expansion of the bag.

2. In a lung ventilating system having conduit means for conveying lung ventilating gases to and from a patient, a bellows unit arranged to collapse and expand generally vertically and with a surrounding transparent chamber wall cooperating to provide internal and external pressure chambers, the conduit means being connected with one of said chambers to receive gases therefrom during inhalation and to deliver gases thereto during exhalation, a bag adapted to be manually squeezed in a hand of the operator and connected to the interior of said chamber to effect and controlling stroke of the bellows and to expand under the influence of expansion of the bellows, the bag thereby being free to transmit the "feel" of the patient's breathing to the hand of the operator, and breathing volume indicator scale means for reading the bellows collapsing and expansion strokes as visible through the transparent chamber wall concurrently with "feeling" the patient's breathing in the collapsing and expansion of the bag.

3. In a lung ventilating system having conduit means for conveying lung ventilating gases to and from a patient, a bellows unit arranged to collapse and expand generally vertically and with a surrounding transparent chamber wall cooperating to provide internal and external pressure chambers, the conduit means being connected with one of said chambers to receive gases therefrom during inhalation and to deliver gases thereto during exhalation, a bag adapted to be manually squeezed in a hand of the operator and connected to the interior of said chamber to effect and controlling stroke of the bellows and to expand under the influence of expansion of the bellows, the bag thereby being free to transmit the "feel" of the patient's breathing to the hand of the operator, and breathing volume indicator scale means for reading the bellows collapsing and expansion strokes as visible through the transparent chamber wall concurrently with "feeling" the patient's breathing in the collapsing and expansion of the bag.

4. In a lung ventilating system having conduit means for conveying lung ventilating gases to and from a patient, a bellows unit arranged to collapse and expand generally vertically and with a surrounding transparent chamber wall cooperating to provide internal and external pressure chambers, the conduit means being connected with one of said chambers to receive gases therefrom during inhalation and to deliver gases thereto during exhalation, a bag adapted to be manually squeezed in a hand of the operator and connected to the interior of said chamber to effect and controlling stroke of the bellows and to expand under the influence of expansion of the bellows, the bag thereby being free to transmit the "feel" of the patient's breathing to the hand of the operator, and breathing volume indicator scale means for reading the bellows collapsing and expansion strokes as visible through the transparent chamber wall concurrently with "feeling" the patient's breathing in the collapsing and expansion of the bag.
tient through the conduit means into said one chamber, the bag thereby being free to transmit the “feel” of the patient’s breathing to the hand of the operator, said chambers being pneumatically isolated from each other during operation of the bag to develop pressure in said other chamber, overflow valve means for discharging excess exhalation gas from said one chamber, and breathing volume indicator scale means for reading bellows movement during inhalation and during exhalation as visible through the transparent chamber wall concurrently with “feeling” the patient’s breathing in the collapsing and expansion of the bag.

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RICHARD A. GAUDET, Primary Examiner.