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BREATHING APPARATUS

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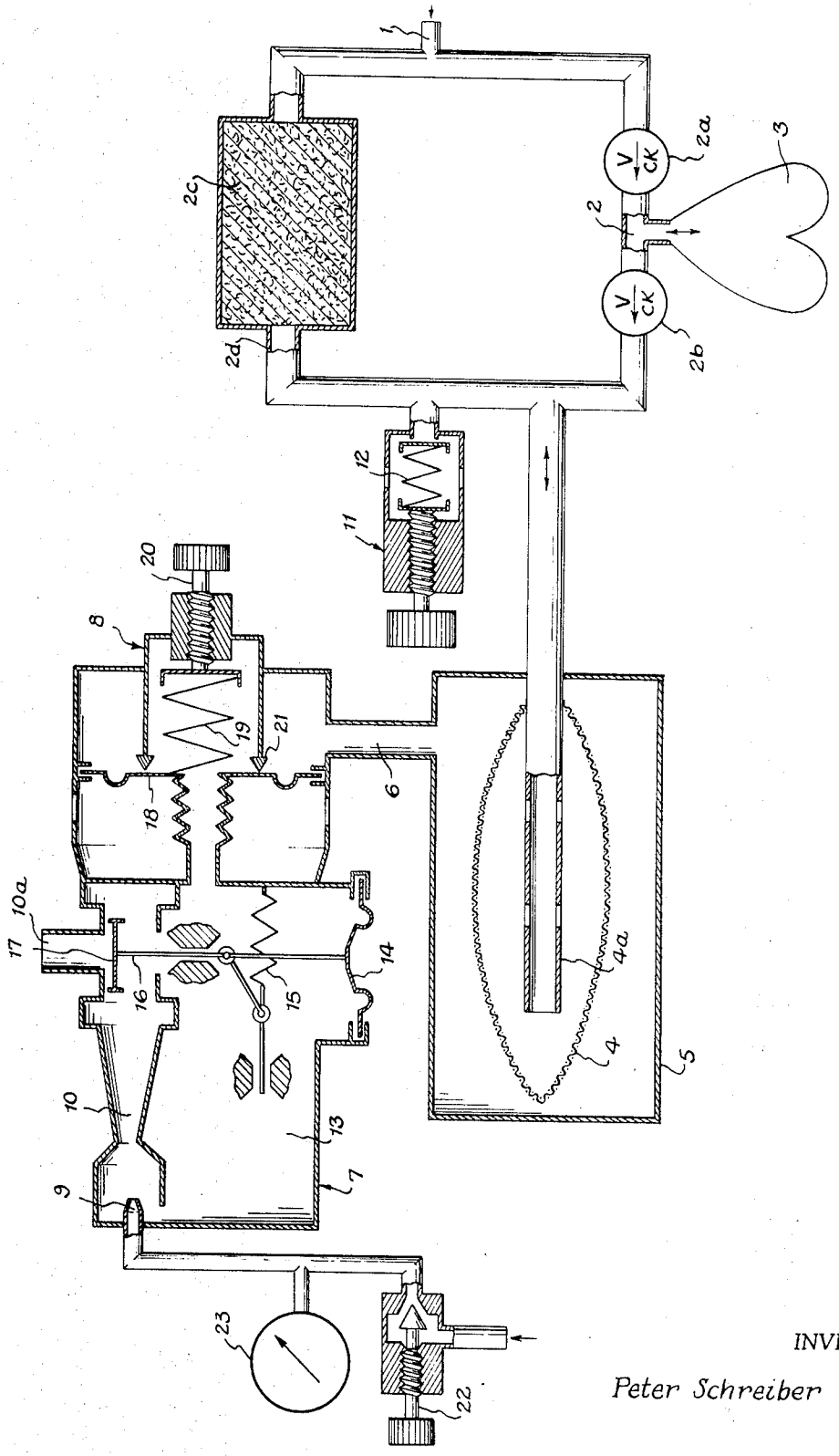

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BREATHING APPARATUS

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U.S. Cl. 128—145.8 4 Claims

ABSTRACT OF THE DISCLOSURE

In a closed breathing system using a breathing bag and gas pressure supply means for producing alternately greater than and less than atmospheric pressures on the bag, a gas pressure adjusting valve is used for blocking the flow of gas between the supply means and the bag until a predetermined pressure has been reached.

Anesthesia breathing apparatus are known in which a valve system connects the breathing bag to the lungs of the patient.

This valve system can, on one hand, be used to lead the exhaled air from the patient through a carbonic acid absorber as in a closed breathing system and/or to exhaust the exhaled air into the atmosphere as in an open breathing system. In both cases, the valve system is usually connected to an anesthetic gas supply and/or fresh gas as well as to an adjustable excess pressure valve to set the maximum positive breathing pressure.

In one form of such apparatus, the breathing gas is enclosed in an airtight container while being in communication with the patient's lungs. By adding or removing gas to the container and applying it to the exterior of the gas, the expansion and collapsing of the bag alternately causes the patient to exhale or inhale. In one type of such apparatus, the adding and/or removing of the gas to the container for the breathing bag is controlled by pneumatic reversing valves which, when a greater than or less than atmospheric pressure is reached within the container, reverses the flow of gas in the container from adding to removing, and vice versa. The removal of gas from the container in creating a less than atmospheric pressure is usually done by using an injector. The positive and negative pressures of the control valve are thus initially fixed and cannot be adjusted during the operation of the breathing apparatus. The positive reversing pressure in a normally operating apparatus is reached when the bag is completely collapsed and the reversing pressure builds up by the further addition of gas flowing into the container. The maximum pressure in the patient's lungs therefor does not correspond to the reversing pressure of the control valve, that is the maximum pressure in the container, but to the adjusted pressure at the excess pressure valve of the valve system since the gas is flowing from the breathing bag to the lungs of the patient only for so long a time until the opening pressure of this valve occurs.

Such apparatuses are provided with an adjustable stop for the breathing bag in the container.

If by means of an injector the gas is drawn out of the container, as above described, then the breathing bag expands until stopped by the stop. However, the injector continues to remove the gas from the container until it reaches the negative reversing pressure. The negative pressure in the lungs of the patient is dependent upon the volume of exhaled air which was received by the breathing bag during its expansion as well as by the amount of

fresh gas which has been added during this time through the fresh gas valve. The negative pressure in the patient's lungs is, just as in the case with the positive pressure, independent of the reversing pressure for the control valve.

These apparatuses have the disadvantage that, during a change in the fresh gas supply and/or during a change in the expansion of the bag or the frequency, the pressure rising in the lungs of the patient changes. In an extreme case, it can also happen that no negative pressures at all occur and the apparatus already switches to the positive pressure range. However, the negative pressure in the patient's lungs are supposed to be at a certain fixed relationship to the positive pressure as well as to the time relationship for the inhaling and exhaling phases. Despite the care supposed to be afforded the patient in the known apparatus, the solution to these situations can only be achieved by trial and are dependent upon the severity of the circumstances.

The object of this invention is to avoid the disadvantages of the heretofore used apparatuses. Another object is to produce a breathing apparatus in which an exact adjustment can be made of the negative pressure. In this invention, the apparatus for breathing with anesthetics comprises a breathing bag housed in a container and which is alternately placed under greater than and less than atmospheric pressure and with a control apparatus for controlling the greater than or less than atmospheric pressure. In this invention, between the control apparatus and the container for the breathing bag, means is inserted for adjusting the pressure which blocks the flow of gas from the container to the control apparatus when a predetermined pressure has not been reached. In this invention, the breathing bag container is alternately supplied with gas and gas removed by means of a reversing device having one or two injectors. In this invention, a valve is provided between the container and reversing device which, when a certain predetermined less than atmospheric pressure is not reached during the removal of gas from the container, will close the passageway between the container and the reversing device. The injector in the reversing device can then only withdraw gas from the pipe line leading from the reversing device until the reversing pressure has been reached. The negative pressure in the blocking valve does not go below the adjusted norm. This negative pressure rising in the container corresponds to the pressure rising in the bag and thus the pressure in the patient's lungs.

This invention has the advantage that the neagtive pressure occurring in the patient's lungs can be adjusted directly and is not dependent upon a change in the volume of breathing per minute and/or by a change in the supply of fresh gas within a normally occurring range. This invention has the further advantage in that no complicated apparatus is required for the adjusting and limiting of the expansion of the bag.

The means by which the objects of this invention are obtained are described more fully with reference to the accompanying diagrammatic drawing showing a cross-section through the apparatus.

Anesthesia gas, as, for example, laughing gas and oxygen, is supplied through pipe **1** to the valve system **2** containing the inhaling valve **2***a*, the exhaling valve **2***b* and the carbon dioxide absorber **2***c*.

Valve **2** furnishes communication between the patient's lungs **3** and the breathing bag **4**. This bag **4** is housed in an airtight container **5**. Pipe **6** leads from the interior of the container to a reversing valve **7** by way of a gas pressure adjusting valve **8**. If in the valve position shown in the drawing, gas is supplied to reversing valve **7** through injector nozzle **9** and mixing tube **10**, then this compressed gas flows through valve **8**, pipe **6** into container **5**.

The exterior of the bag **4** is under this gas pressure and collapses so that the breathing gas plus the anesthesia gas in bag **4** is forced through valve **2** into the patient's lungs.

An excess pressure valve **11** communicates with the line **2***d* extending between the valve **2***b* and the filter **2***c*. Valve **11** contains an adjustable spring **12** for setting the valve opening pressure. When the adjusted pressure in valve **11** is reached in the patient's lungs **3**, then valve **11** opens and the gas coming from bag **4** is exhausted into the atmosphere. The pressure set in valve **11** does not exceed that for the patient's lungs.

By means of the gas flowing from reversing valve **7** into container **5**, the bag **4** is completely compressed and is empty. The bag then lies against the perforated end **4***a* of the pipe leading to valve **2**. After bag **4** is completely empty, then the pressure in container **5** rises relatively fast. The pressure in pipe **6** also rises at the same rate as well as in valve **8** and chamber **13** in reversing valve **7**. The membrane **14** in valve **7** becomes subject to this rise in pressure. When this pressure exceeds the counter force of spring **15**, then rod **16** is moved and reverses valve **17**.

The tube **10** now removes gas from chamber **13** as well as from valve **8**, pipe **6** and container **5** and forces this gas through the opening **10***a* into the atmosphere. This results in that bag **4** expands whereby gas is exhaled from lungs **3** into the bag **4**.

A membrane **18** is mounted in valve **8**, which membrane on one side communicates with pipe **6** and container **5** and on the other side is exposed to the atmospheric pressure.

On the side which is exposed to the gas pressure in container **5**, the membrane is engaged by a spring **19** which is adjustable to more or less pressure by means of the threaded shaft **20**. If, because of the neagtive pressure in tube **10**, the pressure drops in valve **8**, then membrane **18** seats against the valve seat **21** in valve **8**. During this movement, membrane **18** must overcome the counter force of spring **19**. When a certain less than atmospheric pressure previously set by means of shaft **20** and spring **19** occurs, then membrane **18** seats against valve seat **21** and thus blocks the flow of gas between container **5** and reversing valve **7**.

Now the pressure in chamber **13** drops rapidly because of the injection exhaust effect of nozzle **9** and tube **10**. Membrane **14**, because of this dropping pressure, is pulled into chamber **13** until the force on the membrane exceeds the counter acting force of spring **15** and thus reverses valve **17**.

It is possible to meter the gas flowing to the nozzle **9** by means of a control valve **22** and a pressure meter **23**. Since the gas which is flowing, as well as the volume of gas removed by nozzle **9** and tube **10**, has a certain relationship with the pressure in front of nozzle **9**, it is possible to recalibrate meter **23** so that with its aid it becomes possible to predetermine the volume of breathing per minute.

Having now described the means by which the objects of the invention are obtained,

I claim:

1. A breathing apparatus for giving anesthesia to a patient comprising a breathing bag, a container enclosing said bag, tube means joined to said bag for communication between the interior of said bag and a patient, compressed gas supply means, reversing valve means joining said supply means and said container for producing alternately greater than and less than atmospheric pressure in said container and on the exterior of said bag, and gas pressure adjusting valve means joined between said reversing valve means and said container for blocking the flow of gas between said reversing valve and said container until a predetermined pressure has been reached.

2. A breathing apparatus as in claim **1**, said gas pressure adjusting valve means comprising a spring-loaded membrane valve having one side open to atmospheric pressure and the other side subject to the gas pressure in said container.

3. A breathing apparatus as in claim **2**, further comprising means for adjusting the spring pressure in said spring-loaded membrane valve.

4. A breathing apparatus as in claim **3**, said membrane valve having a membrane movably engageable with a valve seat for opening and closing said membrane valve.

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