

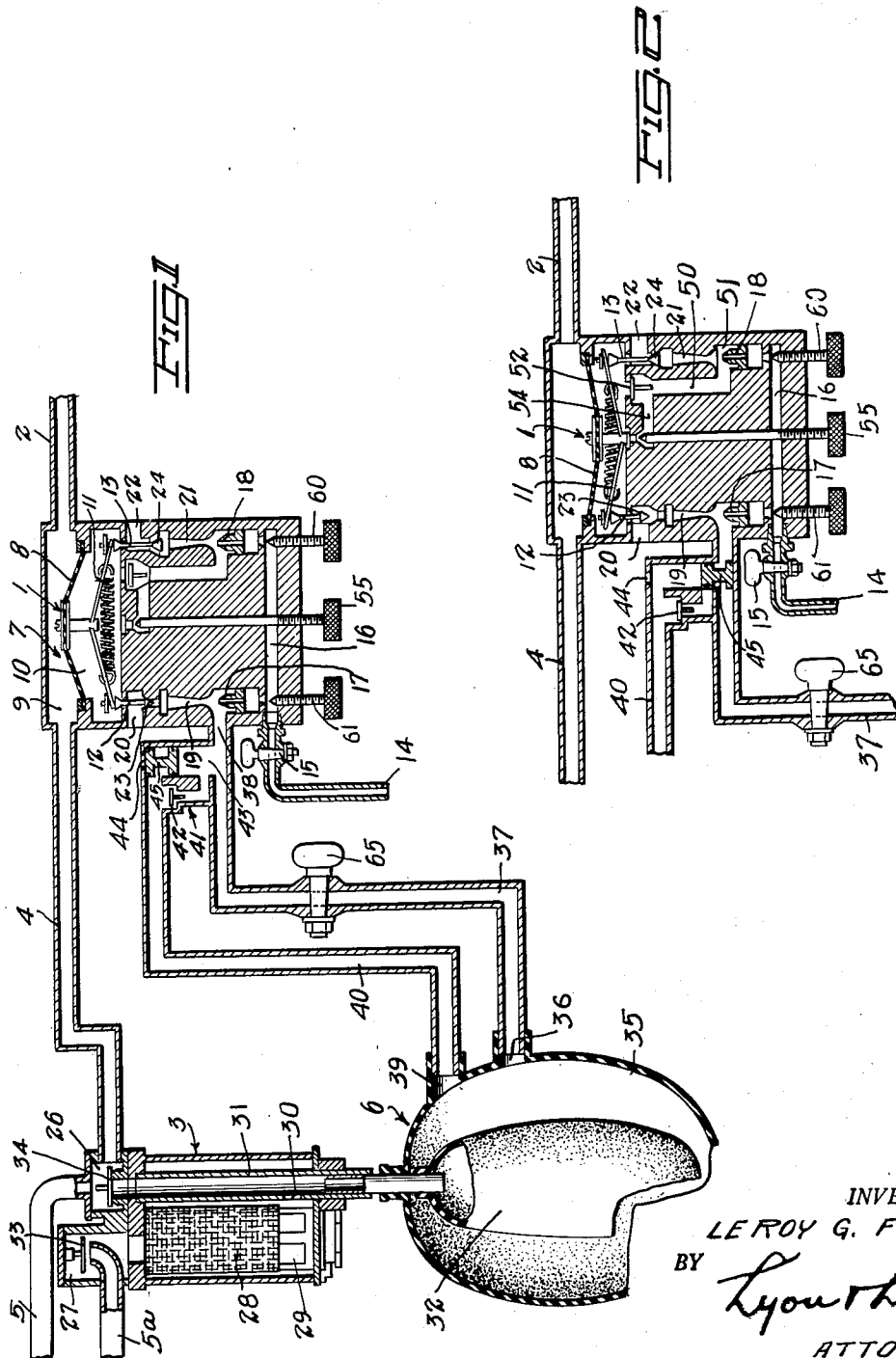
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LE ROY G. FOX

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BREATHING MACHINE

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INVENTOR.
LE ROY G. FOX
BY *Lyon & Lyon*
ATTORNEYS

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BREATHING MACHINE

Le Roy G. Fox, Glendale, Calif., assignor to E & J Manufacturing Co., Burbank, Calif., a corporation of California

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1 Claim. (Cl. 128—29)

My invention relates to a breathing machine and, more specifically, to an improvement over my invention disclosed in my prior application Serial No. 218,656, filed March 31, 1951, entitled Breathing Machine.

The purpose of this invention is to supply a controlled respiration to patients under anaesthesia.

It is an object of my invention to provide a breathing machine in which the patient does his own breathing but the machine has incorporated therewith an aspirator assister so that the slightest back pressure in a patient's lungs during the inhalation cycle will reverse the action of the breathing machine into an exhalation cycle and when the pressure in the patient's lungs is at atmospheric pressure the breathing machine will reverse itself to the inhalation cycle.

Other objects and advantages of my invention will be apparent from the following description of the preferred embodiments thereof.

In the drawings:

Figure 1 is a sectional view of my breathing machine showing it in the inhalation cycle.

Figure 2 is a partial section similar to Figure 1 showing my breathing machine in the exhalation cycle.

A breathing machine constructed in accordance with my invention comprises a control mechanism 1 connected by a pipe 2 to a source of anaesthetic gas or oxygen (not shown). A CO₂ absorbing tank 3 is connected to my breathing machine by the pipe 4. A breathing mask is connected to the absorbing tank 3 by the inhalation pipe 5 and the exhalation pipe 5a.

An aspirator assister mechanism 6 is connected, as hereafter described, to the control mechanism 1 and the absorbing tank 3.

The control mechanism 1 comprises a chamber 7 in which is positioned a pressure sensitive diaphragm 8 which divides the chamber 7 into the upper and lower chambers 9 and 10, respectively.

A snapover toggle mechanism 11 is connected to the diaphragm 8 and to the valve stems 12 and 13. A supply of oxygen or other gas under pressure is ported to the control mechanism by the pipe 14, past a control valve 15 into a passage 16. The passage 16 is ported into a pair of venturi nozzles 17 and 18, respectively. The venturi nozzle 17 ports oxygen under pressure through the venturi tube 19 and out through an outlet 20. The venturi nozzle 18 ports the oxygen through the venturi tube 21 and out through an outlet 22.

Positioned between the end of the venturi tube 19 and the outlet 20 is a valve carried by the valve stem 12. A valve 24 is carried by the valve stem 13 and positioned between the venturi tube 21 and the outlet 22.

When the pressure in the upper chamber 9 is less than in the lower chamber 10, the diaphragm 8 will extend upwardly as shown in Figure 1 and the toggle mechanism 11 will maintain the valve 23 closed and the valve 24 open. When, however, the pressure in the chamber 9 exceeds that in the chamber 10, the diaphragm

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8 will move downwardly into the position shown in Figure 2, tripping the toggle mechanism 11, closing the valve 24 and opening the valve 23.

To provide for changes of pressure in the chamber 10 a passage 50 is ported into the chamber 51 between the venturi nozzle 18 and the venturi tube 21, and is closed by a flutter valve 52. A side port 54 connects the passage 50 to the chamber 10, past the needle valve 55.

The pipe 4 connects the chamber 9 with a chamber 26 in the absorbing tank 3, which is directly connected by the inhalation pipe 5 to the breathing mask (not shown), thus permitting the anaesthetic gas or oxygen entering the chamber 9 through the pipe 2 to pass directly to the patient's lungs.

The exhalation pipe 5a returns the gases from the patient's lungs to the chamber 27 in the absorbing tank 3 where it passes downwardly through a canister of soda lime 28 and out through the ports 29 and 30 into a delivery pipe 31. The delivery pipe 31 connects to the chamber 26 and to a bellows 32. Flutter valves 33 and 34 prevent a reversal of either the inflowing gases or the exhaled gases. The bellows 32 is surrounded by a tank 35.

A port 36 is connected by a pipe 37 to a port 38 between the venturi nozzle 17 and the venturi tube 19 in the control mechanism 1. A second port 39 connects the tank 35 by means of a pipe 40 to an assister valve mechanism 41. The assister valve mechanism 41 comprises a flutter valve 42 which connects the pipe 40 to the pipe 37 by means of a port 43. In the assister valve mechanism 41 is a port 44 to the atmosphere.

A float valve 45 is adapted to open and close the port 44.

The assister valve mechanism 41 is operated so as to assure that no negative pressure can be placed in the tank 35 during the exhalation cycle. This is accomplished by the fact that whenever the pressure in passage 38 falls below the atmospheric pressure the valve 45 will seal the port 43, thus porting the tank 35 directly to the atmosphere through the port 44. When the pressure in the port 38 exhausts atmospheric pressure the float valve 45 will rise, closing the port 44 and opening the port 43, allowing the air to lift the flutter valve 42 and port air into the tank 35.

In the operation of my breathing machine there are two cycles. In the first of these cycles—the inhalation cycle—the anaesthesia gas or oxygen entering the chamber 9 by means of the pipe 2 passes directly out through the conduit 4 and thence to the breathing mask. In this position the snap toggle 11 is in its upward position maintaining the valve 23 closed and the valve 24 open. The oxygen or gas under pressure entering through the valve 15 will thus flow through the venturi nozzle 18, out through the venturi tube 21 and outlet 22, causing the flutter valve 52 to open and permit the exhaustion of the oxygen from the chamber 10. At the same time this supply of oxygen will pass through the venturi nozzle 17, through the port 38 and the pipe 37, compressing the bellows 32, which thus forces any gases in the bellows 32 to pass up through the conduit or delivery pipe 31 past the flutter valve 34 and into the breathing mask.

Because of the pressure in the pipe 37, there will be a pressure on the underside of the float valve 45, causing it to seal the port 44. When the patient's lungs have been filled to their capacity a back pressure will exist in the inhalation pipe 4, chamber 26, conduit 25 and chamber 9 while there is a decrease in pressure in the chamber 10. This will cause the flutter valve 34 to close and the diaphragm 8 to be depressed, tripping the toggle mechanism 11 and closing the valve 24, opening the valve 23 and thus placing my breathing machine in the exhalation cycle.

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During the exhalation cycle the gas from the patient's lungs passes out through the exhalation pipe 5a, through the absorbing tank 3 into the bellows 32. At the same time the oxygen entering by the valve 15 passes through the venturi nozzle 17, through the venturi tube 19 and out through the outlet 20. This relieves the pressure in the pipe 37, allowing the valve 45 to fall, opening the port 44, removing the pressure on the bellows 32 and allowing the exhalation gases to fill the bellows 32. At the same time the oxygen from the chamber 15 passes through the passage 50 and past a needle valve 55 into the chamber 10 until the pressure in the chamber 10 exceeds that of the chamber 9, whereupon the toggle mechanism 11 will trip and return the machine to the inhalation cycle.

To more effectively assure that my breathing machine will reverse from the inhalation to the exhalation cycle at the exact moment when there is back pressure in the patient's lungs and to prevent the formation of a vacuum or minus pressure therein, I provide a shut-off valve 65 in the line 37. When the valve 65 is closed the float valve 45 closes the port 43 during the exhalation cycle and prevents reduction of pressure in the tank 35 to below atmosphere. Of course this can be achieved by dispensing with the pipe 37 and merely porting oxygen to the tank 35 by way of the port 43 and valve 42 during the inhalation cycle.

The control mechanism 1 is adjusted by means of the needle valve 55 so that when the pressure in the tank 35 is at atmosphere the pressure in the chamber 10 will be sufficiently great to move the diaphragm 8 and trip the toggle mechanism 11 in order to return the inhalation cycle. At this time the pressure in the bellows 32 will be substantially at atmosphere and the gases will have been removed from the patient's lungs.

The control needle valve 60 is used to control the depth of inhalation. When the needle valve 60 is in its most open position, then the greater pressure is placed upon the patient's lungs before the toggle mechanism will reverse my breathing machine. When it is substantially closed, very small pressures will trip the mechanism. By the use of this control valve 60 my breathing machine can be adjusted to fit the size of a patient's lungs.

A rate of respiration control valve is provided by the needle valve 61 which is adapted to close the connection between the passage 16 and the venturi nozzle 17. As

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this valve 61 is closed, the amount of oxygen passing to the tank 35 is controlled, thus the speed with which the oxygen is removed from the tank 35 will increase or decrease the number of cycles per minute that my breathing machine will make and thus, control the respiration cycle.

I claim:

In a breathing machine, the combination of a delivery pipe connecting to a supply of gas at one end and a breathing mask connected to the other end of said delivery pipe, a bellows connected to said delivery pipe, a pressure chamber surrounding said bellows, a control mechanism to control the pressure in said delivery pipe and said pressure chamber comprising a case forming a chamber, a diaphragm dividing said chamber in two, a supply of air under pressure, one side of said chamber being ported to said delivery pipe, a passage porting air from said air supply to said second chamber, a toggle mechanism attached to said diaphragm valves, adapted to close the passages between said chamber and said air supply and connected to be driven by said toggle mechanism, a port in said passage between said valves open to the atmosphere, a pipe connecting said last mentioned passage with said pressure chamber to port air under pressure thereto, a passage from said air supply to the atmosphere, a valve connected to be driven by said toggle mechanism to close said last mentioned passage, said last mentioned valve being closed when said first mentioned valves are opened and open when said first mentioned valves are closed, an exhaust passage from said second passage to said last mentioned passage and a plate valve in said exhaust pipe adapted to open when said last mentioned valve is opened, and a port in said pipe to said atmosphere, and a float valve positioned in said pipe to close said port when there is pressure in said pipe, and to shut off said pipe from the oxygen supply when there is a decrease in pressure in said pipe, and a by-pass around said float valve closed by a float valve in opposite action to said float valve.

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