Jan. 19, 1937. W. R. HENION 2,068,177

ANESTHETIZING APPARATUS

Filed April 13, 1933 3 Sheets-Sheet 1

FIG. 1

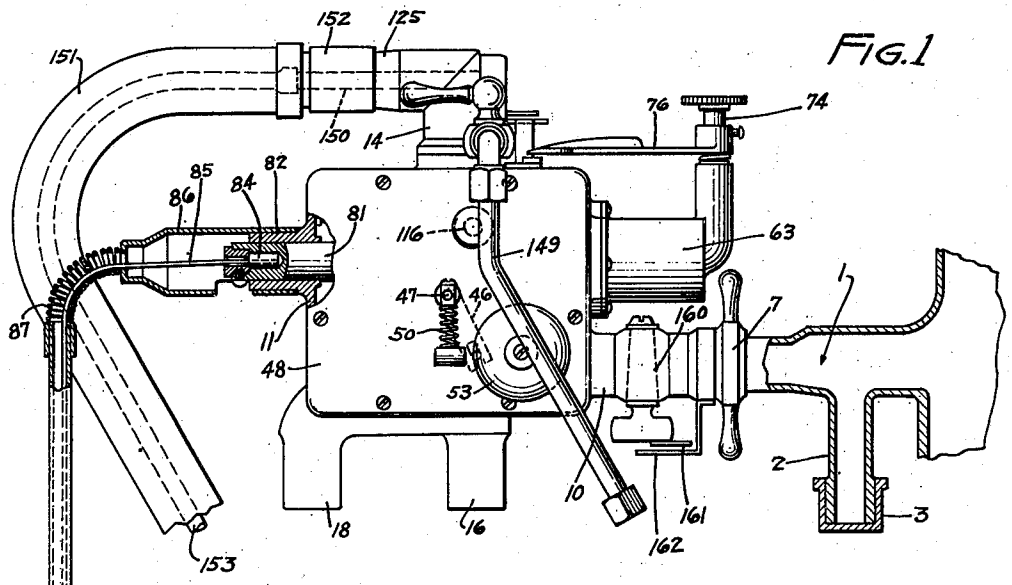
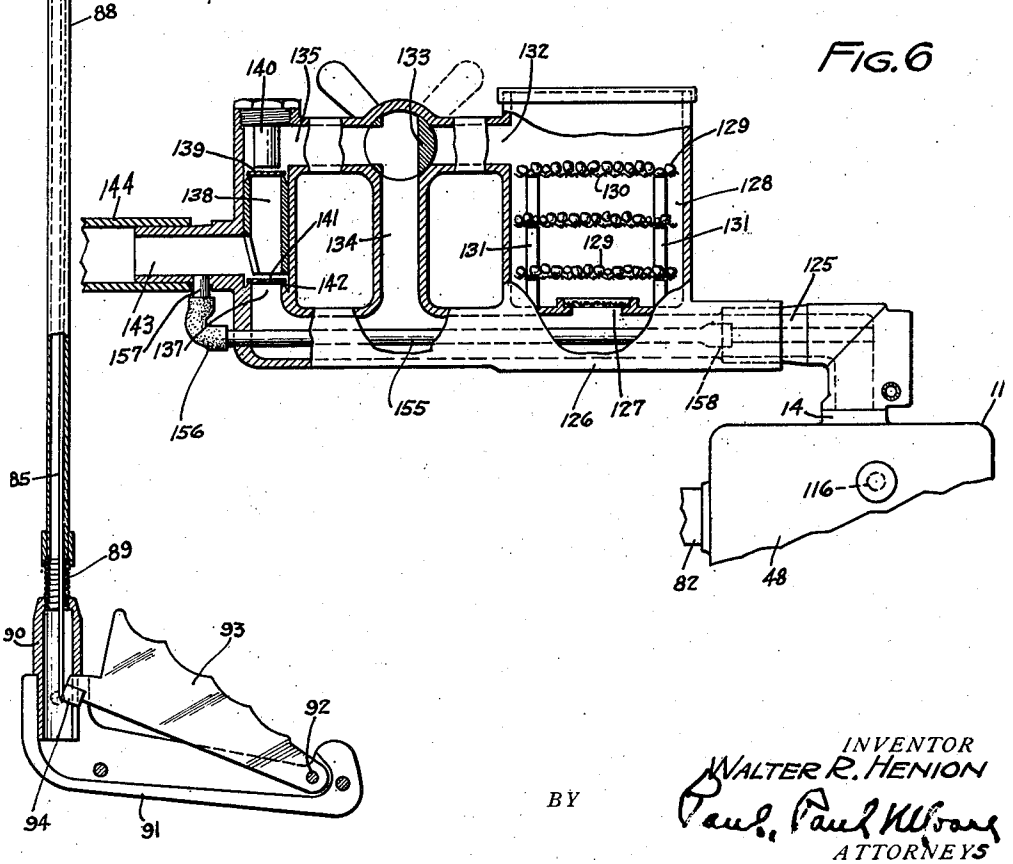


FIG. 6



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ANESTHETIZING APPARATUS

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FIG. 2

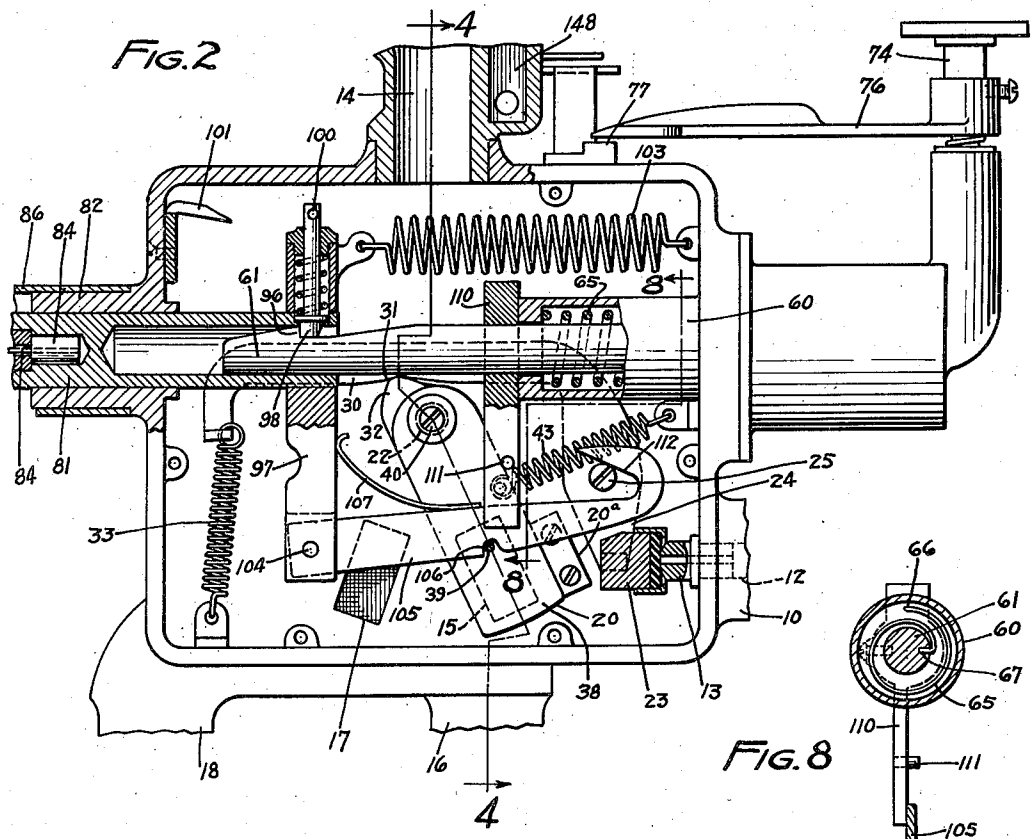


FIG. 8

FIG. 4

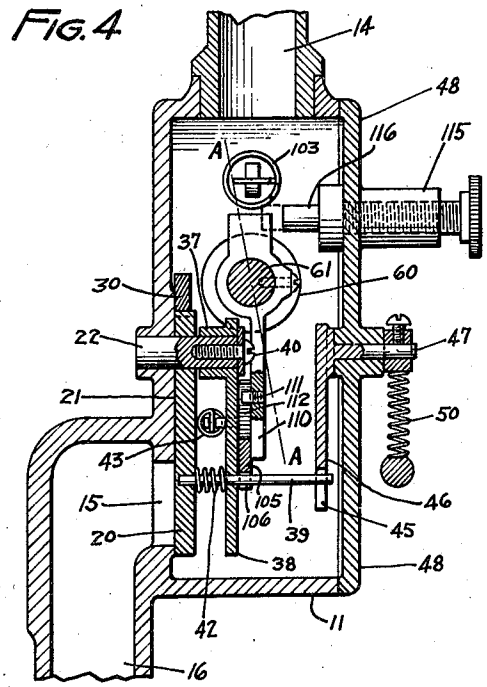
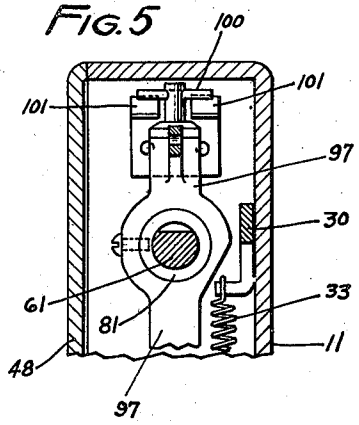


FIG. 5



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Jan. 19, 1937. W. R. HENION 2,068,177

ANESTHETIZING APPARATUS

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FIG. 3

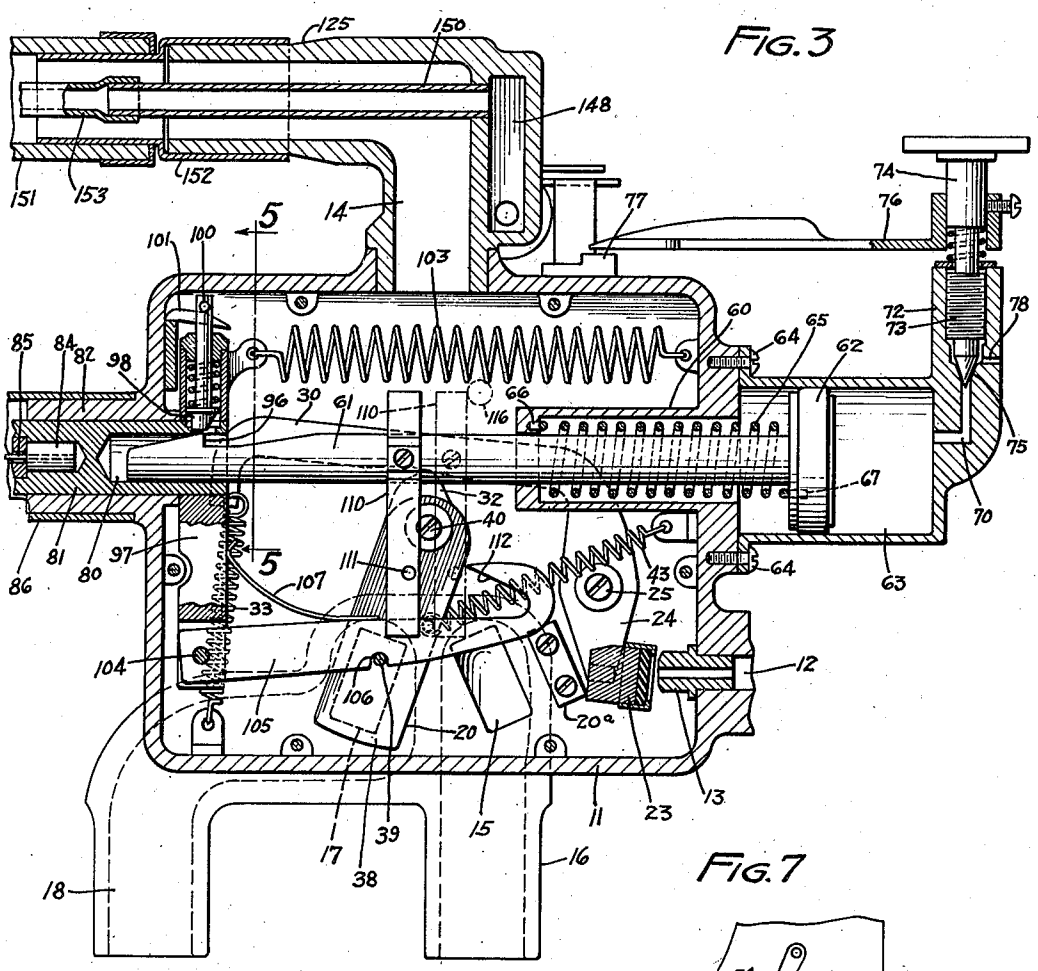
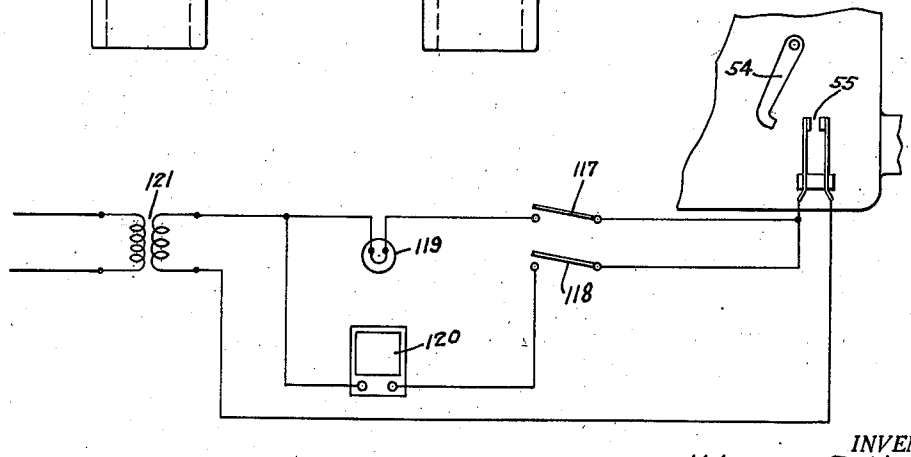


FIG. 7



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Patented Jan. 19, 1937 2,068,177

UNITED STATES PATENT OFFICE

2,068,177

ANESTHETIZING APPARATUS

Walter R. Henion, Minneapolis, Minn.

Application April 13, 1933, Serial No. 665,897

24 Claims. (Cl. 128—203)

This invention relates to improvements in anesthetizing apparatus, and is an improvement over certain portions of an apparatus disclosed in my copending application for Anesthetizing apparatus, Serial Number 644,219, filed November 25, 1932. The present invention is, as in my previous invention, concerned with means operable by the patient to keep the patient in a state known as analgesia, in which consciousness and motor ability is maintained, but in which no substantial pain is felt. The device finds valuable use for controlling dental and obstetrical analgesia.

An important feature of the present invention is the provision of means so controllable by the patient, that the gas can be shut off and air obtained while the timer is operative, with the arrangement such that if the patient is, for any reason, unable to operate the control to stop gas and get air, this will be accomplished automatically by the timer at the end of the time period. Thus the gas delivery period may be lengthened or shortened by the patient.

In no machine known to me can the patient shut off the gas at any time, whether the timer is operative or not. In none can the gas be shut off by the patient without waiting for the cut-off or timer to do it automatically.

Other features of this invention relate to means operable by the patient for directly controlling the air and bag valves including a latching mechanism which is operable by the timer to control the valves independently of the patient-control; the operation of one valve by the other; the synchronous operation of the main valve by means of the air and bag valve; the use of a carbon dioxide absorbing means directly in the breathing line; the use of carbon dioxide absorbing means with means for by-passing analgesic or anesthetizing substance; the use of this absorber with valve means for stopping all or permitting a part or all of the exhalations to pass through the absorber; the arrangement whereby the anesthetizing by-pass tube by-passes an in-breathing valve of the carbon dioxide absorber; the inter-position of the carbon dioxide absorber in the breathing line; the ability to give oxygen to the patient while other gas is or is not flowing; the detachable interposition of said absorber in the breathing line; the use of an audible or visible signal or both for indicating to the doctor and/or patient that the supply of anesthetizing substance is cut off; the use of an electrically controlled audible signal; the operation of the signal by a valve; the utilization of part of a valve latching means to operate the signal; the arrangement whereby a valve latching means moves with a timer stem independently of the timer stem; the arrangement whereby the latch tripping means is directly attached to the stem and moves independently of the patient-controlled device; the arrangement whereby a portion of the valve latching means is directly attached to a patient-controlled member which cooperates with the stem of the timer means; and all details of construction shown.

Objects, features, and advantages of the invention will be set forth in the description of the drawings forming a part of this application, and in said drawings

Figure 1 is a side elevation showing the present device attached to the delivery tube of a machine for mixing and delivering anesthetizing or analgesic substance;

Figure 2 is an elevation partly in section showing the parts in their initial position corresponding to Figure 1;

Figure 3 is a view similar to Figure 2 showing the parts position as at the beginning of a timing period, and when the patient is strongly gripping the control lever;

Figure 4 is a vertical transverse section on line 4—4 of Figure 2, showing, among other things, how the valve operates the signal means;

Figure 5 is a detail vertical transverse section on line 5—5 of Figure 3 showing the relation of the timer latch to the trip;

Figure 6 is a longitudinal sectional elevation illustrating the carbon dioxide removing means;

Figure 7 is a diagram of the electrically controlled signaling means; and

Figure 8 is a diagrammatic section taken approximately on line 8—8 of Figure 2 illustrating the manner of winding the timer operating spring during assembly.

The present device may be attached to or form an integral part of any type of standard or specially constructed apparatus for delivering either oxygen or an anesthetizing gas, or a mixture of the two, and it is attachable to and usable with machines of either the continuous or the intermittent flow type. It can also be used with or without a re-breathing bag.

Referring to Figure 1: Numeral 1 indicates the outer terminal portion of the delivery passage of a machine of the bag type. This tube 1 has leading downwardly therefrom a tube 2 to which a re-breathing bag (not shown) can be attached. A cap 3 closes the end of the tube when the bag is used at some other location on

the machine. The device of this invention may be attached to the delivery pipe 1 by a union nut 7 which is rotatable upon a tubular extension 10 of casing 11, which provides a chamber within which most of the operating mechanism is contained and through which the anesthetizing or other substances are delivered and re-breathed.

This extension 10 is provided with a passage 12, see Figure 3, which is continuous with the passage of the tube 1, and in the passage 12 is fixed a nipple 13 against the outer end of which a valve seats to control delivery of the substances into the chamber. The casing 11 is provided in the top with a passage formed by tube 14 through which the gases are delivered to the patient. This tube is suitably secured to the casing 11 as shown. In a vertical side wall of the casing is a passage 15 communicating with the passage of the tube 16, which latter passage delivers into the re-breathing bag. The bag may be attached either at 2 or 16. The cap fits either 2 or 16. There is also in this side wall a second passage 17 which communicates with the passage of the tube 18, these latter passages providing means for intake of air.

Referring to Figures 2 and 4, a plate valve 20 slides against the inner surface of the vertical wall 21 of the casing, and this valve is pivoted on a stub shaft 22 of the casing. The valve is adapted, when there is no delivery of anesthetizing substance to close only the bag passage 15, as shown in Figure 2. During flow of gas this valve closes only the air passage 17, as in Figure 3.

The passage in the nipple 13 is closed by a suitable valve 23 carried by a lever 24 pivoted as at 25 to the wall 21. This lever has a right-angular extension 30, which has in its lower edge a depression 31, which is engaged by a radial extension or cam 32 of the valve 20. To the outer end of the extension 30 is attached a spring 33, in turn suitably attached to the casing, and which acts to hold the extension 30 against the projection 32, and also to move the lever in a direction to close the valve 23. The arrangement is such that when the parts are positioned as shown in Figure 2, the valve 23 is positioned to prevent delivery of anesthetizing or other substance from the passage 12 into the casing or into the passage 14 which leads to the patient. However, when the valve 20 assumes the position shown in Figure 3, to close the air passage 17, cam 32 moves the lever 24 and opens the valve 23. The valve 23 is thus controlled in a predetermined manner by valve 20.

In order that the plate valve 20 may be held sealingly against the wall 21, see Figure 4, the stub shaft 22 has rotatable thereon a sleeve 37 having a plate extension 38 which is opposed to and spaced from the plate valve 20. This valve has attached thereto a pin 39 which passes through an opening in the plate 38, and a washer and screw fastening means generally indicated at 40 secures the sleeve 37 against outward motion, but the sleeve is capable of inward motion. Between the plates 20, 38 is interposed a spring 42 which, re-acting against the plate 38, presses the valve 20 sealingly against the inner face of wall 21 of the casing. A spring 43 is connected to the plate 38 and to the wall of the casing 11, as shown, to normally hold the valve 20 in the position shown in Figure 2, and of course the valve is opened against the action of this spring.

The pin 39 acts to operate a signaling device for notifying the doctor or patient that the supply of anesthetizing or other substance is shut off, and that air is obtainable through the breathing tube. For this purpose, the outer end of the pin is slidably engaged in a slot 45, at the end of an arm 46, having stub shaft 47 journaled in the cover 48 of the casing 11. To the shaft 47 is suitably attached a bell clapper having flexible portion 50. This clapper rings bell 53, see Figure 1, mounted on the outer side of cover 48. When the valve 20 moves to the position shown in Figures 1 and 2, the clapper 52 rings the bell.

I contemplate the use of another kind of signaling means in which an arm 54, see Figure 7, is substituted for the clapper, and operates a switch indicated at 55 to close a circuit or circuits for operating a visual or an audible or both. Description of this feature is completed below.

In the present invention, as in the invention previously referred to, timing means is provided to control the valve or valves. In the previous case the arrangement was such as to prevent patient control to stop delivery of the analgesic substance during a time period. A feature of the present device relates to the means by which the patient can control the valves to stop gas delivery independently of the timer, and while the timer is operative. Moreover, the patient can, as in my first application, reset the timer to increase the gas dosage at any time during the time period. Referring first to Figure 3: The casing 11 which is cast, is provided with an inwardly extending tubular element 60 in which is slidably operable a stem 61 of a piston 62 which piston operates in a cylinder 63 suitably detachably secured as at 64 at the outer side of the casing 11. A spring 65 surrounds the stem 61 and is secured at one end as at 66 to the tube 60, and at the other end as at 67 to the piston. In assembling this spring it is first attached at the point 66 and is then wound in a clockwise direction, see diagram Figure 8. After winding its end is attached at 67, so that the spring is under tension tending to rotate the stem 61 in anti-clockwise direction, as viewed from the right of Figures 2 and 3, for a purpose described below.

To control the out-flow of air from the piston, when moving to the right under the action of the compression spring 65, to obtain the proper timing period, there is provided an outlet passage 70 passing upwardly through an extension 72. Threadingly engaged with the bore of this extension as at 73 is a needle valve 74 seating at 75. The valve has attached thereto a pointer arm 76 which rides over a suitable timer scale (not shown) on a plate 77 attached to the top of casing 11. A fine valve adjustment in accordance with the scale may be made to accurately obtain the desired time period for delivery of the analgesic substance. The passage 70 communicates, when the valve is open, with passage 78 at the opposite side of the valve seat 75, which passage leads to the atmosphere.

The stem 61 has a sliding fit in the end wall of the tubular extension 60, and is also supported by piston 62 and by the end which slides in the bore 80 of a plunger 81 translatable in an extension 82 of casing 11. This plunger is controlled by the patient and has suitably attached thereto as at 84, a wire 85 (also see Figure 1), which passes outwardly through a sleeve 86 rotatable

upon the tubular extension 82. This wire passes through a flexible connection 87 attached to tube 88, and through another flexible connection 89 and tube 90. To the tube 90 is attached a handle or grip element 91 to which is pivoted, as at 92, an operating lever 93, to the outer end of which lever the wire 85 is attached as at 94. The element 91 may be the arm of a dental chair or the rail of a bed and provides something which can be utilized as a basis for whole-hand gripping by the patient. There is no intention to be limited to this particular type of control, because in conjunction with some features herein, the type of control is unimportant, provided it is a patient control.

The lever 93 is controlled by the patient, and when pulled inwardly from the position shown in Figure 1, the delivery and bag valves are opened and the air passage closed, and when in use, the timer is set. In this case, therefore, a sufficient movement of the lever 93 as the result of gripping results in opening the delivery and bag valves and the initiation of a timing operation.

To set the timer as the result of movement of the element 93 by gripping action of the hand of the patient, the stem 61 is notched as at 96. Mounted on the plunger 81 is a cross-arm 97 in the tubular upper part of which is mounted a spring-controlled latch 98 adapted to engage the shoulder in a manner to couple with the rod 61 and pull it to the left from its position in Figure 2 against the action of the spring 65, to the release position, substantially shown in Figure 3.

Figure 2 shows the latch 98 in its initial position against the shoulder 96, and Figure 3 shows the parts as immediately after release of the latch. The latch assumes the position of Figure 2, whenever the patient allows grip lever 93 to assume the position of Figure 1. The latch carries a cross pin 100 which engages a pair of cam arms 101 acting to raise the latch to the position shown in Figure 3, which figure shows the position of the parts just after the patient has gripped and moved the grip element 93 inwardly to its limit position. In this figure, the timer is therefore operating.

It is evident that if the patient releases the grip, the plunger 81 will assume the position shown in Figure 2 and then if full gripping again takes place, before the stem has completed the timing movement, the latch will again engage the shoulder and move the stem 61 again to the position shown in Figure 3. The plunger 81 is pulled to the position shown in Figure 3, also against the action of spring 103.

To control one valve by the other, in this instance the valve 20, and through it the valve 23, as the result of motion of the timer rod 61, the cross arm 97 has pivoted thereto at its lower end as at 104 a latch arm 105 having in its lower edge a notch 106 engageable with pin 39. A spring 107 is provided to cause the lower edge to be constantly engaged with the pin, so that latching will take place automatically.

At the end of the timing period the latch 105 is tripped to release the valve 20 which then moves under the action of the spring 43 resulting in closure of both valves 20 and 23. To accomplish this tripping there is non-rotatably mounted on the stem 61, a trip arm 110 having a trip pin 111 engageable with a cam surface 112 of the latch arm 105 to raise the latch against the action of the spring 107 to disengage the notch 106 from the pin 39. Tripping takes place when arm 110 arrives at the position shown in Figure 2. The transverse relation of the arm 110 to the latch arm 105 is shown in Figure 8, in which the spring acts to keep the lower end of 110 against the vertical face of 105. Figure 8 is a somewhat diagrammatic section, meant principally to illustrate the manner of winding spring 65. It will be noted that, in this figure, the outer end of the spring is shown attached to the stem 61 but in practice it is attached at the point 67 to the piston 62, as shown in Figure 3.

Another feature of the invention is a safety feature whereby tripping of the latch 105 to release valve 20 can be prevented. This is used to prevent opening of the air port and shutting off of gas, when it is desired to administer anesthesia, with the device still attached to the machine. It is used in conjunction with a lock-out feature, which latter feature is described in my first case, Ser. No. 644,219, in which the element 86 is pulled outwardly so that its inner end abuts the outer end of the tubular element 82. This moves element 81 to and holds it in the position shown in Figure 3, so that the latch can no longer be engaged with the shoulder 96 of the stem, and thus the timer cannot be operated. This locking of the valves in open position is possible because of the arrangement and relation of the elements as shown in Figure 1, that is the relation of the parts 86, 87, 88, 89, 90, 91, 93, 85 and 81.

For this purpose, see Figure 4, the cover 48 is provided with a tubular extension 115, and in threaded engagement with the bore of this extension is a stop 116 which can be adjusted by rotation, inwardly and outwardly from the full line to the dot-and-dash line positions shown. This pin, when in the dot-and-dash line position of Figure 4 (see also dot-and-dash line position of Figure 3) is adapted to be engaged by arm 110 to keep rod 61 from completing its motion to the right. Its motion is arrested in such manner as to prevent the trip pin 111 from engaging the camming surface 112 of the latch 105. Because of this, the latch cannot be tripped and therefore the valves 20, 23 are held in open position. It will be noted that it is still possible for the patient to operate the plunger 81, to bring it to the position shown in Figure 3 and release it, but the stem cannot take its full motion under the action of the spring 65. All that is necessary then when it is desired to administer anesthesia is to move 116 to act as a stop for 110, and then pull 86 outwardly to its locked position. It is noted that 116 can be screwed to stop position at any time either before or after pulling 86 out to its locked position. It is desirable to use 116 because even when the timer valve is closed to prevent timer action, there might be a leak which would allow the stem to move a sufficient distance to the right, to cause tripping of the latch 105 by pin 111 carried by arm 110 of the stem 61.

Because the stem 61 can be rotated against the action of spring 65 in the manner previously mentioned, the stop 116 can be screwed to the dot-and-dash line position shown in Figure 4, against the upper part of the trip arm 110, while it is in the position shown in Figure 2. When this is done, the arm 110 and the shaft are slightly rotated to a position indicated by the dot-and-dash line A of Figure 4. However, as the stem 61 is pulled to the left, the upper part of the arm 110 is disengaged from the stop 116

and then the spring acts to rotate the stem and piston in anti-clockwise direction to bring the lower end of the arm 110 to its normal position against the latch arm 105, as shown in Figure 8. In this normal position, the upper part of the arm 110 is so positioned as to engage the stop 116 during travel of the piston in timing direction, to prevent sufficient motion of the piston and arm to trip valve latch 105.

Continuing the description of the electrically controlled signaling means, operated by means of arm 54 and switch 55, see Figure 7: Either a buzzer of a lamp may be used, or both; and they may be operated separately or independently. The lamp can be placed on the dentist's instrument tray in front of the patient where it can be seen by both, to be lighted when the flow of analgesic substance is shut off.

Switch 55 controls, through manually operable switches 117—118, circuits respectively for a light bulb 119, and for a buzzer 120. The source of electrical power is indicated at 121. When switches 55 and 117 only are closed the lamp 119 only is energized. When only switches 55 and 118 are closed, the buzzer 120 only is energized. When switches 55, 117, and 118 are closed, both the light and the buzzer are energized.

Another feature of this invention relates to means for removing carbon dioxide from the gases exhaled by the patient. This device, shown in Figure 6, is arranged as a detachable unit, in the breathing line. This unit is attached in any suitable manner to a right-angularly related horizontal extension 125 of the tube 14, and includes a tubular member 126 having a friction fit with the element 125. The passage provided by tube 126 communicates through screened opening 127 with chamber 128, having a removable top. In this chamber is arranged, in any suitable form, fused caustic soda or other suitable carbon dioxide absorbing material. In this instance, the soda has the form of pellets 129 and is arranged on shelves formed of screening 130, so that the exhaled fluids are freed from carbon dioxide during movement toward the bag. A number of these shelves are provided and are held on suitable supports 131. Passage 132 leads from the upper part of chamber 128 and has a three-way valve 133 therein which controls passages 134 opening into tube 126 forwardly of the opening 127 in direction of the patient. The valve also controls passage 135 which, when the valve is properly positioned, is in a continuation of passage 132. Passage 135 leads into passage 137 which communicates with the passage of tube 126. The passage 137 is partly formed by the removable bushing 138, which has resting upon its upper end a check valve 139 closing by gravity. The upward movement of the valve is limited by stop 140. Operating against the lower end of the sleeve 138 as a stop is a second check valve 141 seating by gravity as at 142. Passage 137 leads into tube 143 to which is attached the flexible hose or breathing line 144 leading to the mask, not shown.

The valve 133 is for the purpose of controlling the flow of exhaled gases so that they may or may not be forced to pass through the carbon dioxide absorbing substance 129.

In this case, as in my application previously mentioned, means is provided for by-passing gas directly into the breathing tube independently of patient-control and while the main supply control valve 23 is closed. Either N_2O or oxygen or both may be by-passed and for this purpose, suitable pipe connections are made with the machine as in the first mentioned case. Referring to Figure 3 a common by-pass chamber 148 receives gases or vapors mixed or not mixed, through suitable plural pipe connections and unions generally indicated at 149. Although only one of the pipe connections is shown, it will be understood that there is a pipe connection like that shown at 149 in Figure 1, at the opposite side of the device delivering into the common by-pass chamber 148 through an opening shown in both Figures 2 and 3. This passage in turn delivers into a short pipe 150 of small diameter arranged within and extending slightly outwardly beyond the extension 125. The breathing tube 151 is suitably attached to a sleeve 152 which has a friction fit on the end of the extension 125, as shown. To the end of the pipe 150 is attached a flexible piece of tubing 153 which extends a relatively short distance into the breathing tube 151.

The carbon dioxide attachment, see Figure 6, has an inflexible tube 155 corresponding in function to the tubes 150, 153, and this passes outwardly and has attached thereto a flexible connection 156 in turn attached to a nipple 157 which leads into the tube 143. This arrangement by-passes the valve 141 so that in an emergency, for example when oxygen is to be delivered, there will be no valve interference with the free supply of oxygen to the patient. The opposite end of the tube 155 is detachably connected with the tube 150 as at 158. The carbon dioxide absorbing unit can be quickly applied or removed.

With the valve 133 positioned as shown in Figure 6, and with delivery valve 23 open, the gases do not pass through the carbon dioxide absorbing chamber, but re-breathing is possible just the same. On inhalation, valve 141 is opened and valve 139 remains closed. On exhalation, valve 139 opens and valve 141 remains closed, the exhaled gas passing through valve 139, passage 135, valve 133 and passage 134 through tubes 126 and 14, and across the chamber formed by casing 11 to the bag, not shown. When the valve 133 is moved to its other position, indicated by the dotted position of the handle, the delivered gas to be inhaled takes the course previously described, but the exhaled gases pass through valve 139, passage 135, valve 133, passage 132, chamber 128, through the caustic soda 129, and passage 127 to tube 14, thence to the bag.

Another feature of the invention which is an important one in this art relates to the provision of a volume control valve 160, see Figure 1, for controlling the volume of the mixed gas before delivery to the patient. The valve is preferably arranged between the gas mixing chamber of the machine and casing 11 for controlling the amount of flow of gases after mixing, all in a manner not to reduce the cross-sectional area in the actual breathing line, but so as to be able to vary the delivery valving to suit requirements for either analgesic or anesthetic dosage. This valve is herein located between the gas machine and the casing 11, and this particular location is also claimed. Any suitable type of valve can be used, and the valve has a pointer 161 operating over a graduated scale 162, so that the volume can be accurately measured and controlled.

Timing operation

Let it be assumed that all the parts are positioned as shown in Figures 1 and 2 and that the patient desires to obtain a timed dose of analgesia. The patient strongly grips lever 93 and pulls it inwardly to its limit position, and plunger 81 is moved to the left, entraining stem 61 against the action of spring 65. Valve 20 is moved to the left to open the bag passage 15 and close the air passage 17 and valve 23 is moved also to the left to open position. Stem and valves all move in the same direction. At the end of the timer-setting movement, pin 100 of the latch engages the trip cam 101, and the latch is tripped to release the stem, see Figure 3. This tripping, of course, takes place while the patient is still strongly gripping and holding the lever 93 in its inward limit position. By this tripping, the timing operation is initiated and the stem starts its motion to the right under the action of springs. When trip bar 110 has nearly reached the position shown in Figure 2, pin 111 engages tripping cam face 112 of the valve latch 105, moving the latch upwardly to disengage the same from pin 39. The valves 20—23 then move quickly from the position shown in Figure 3 to that shown in Figure 2 to open the air passage and close the bag passage, and close the gas delivery passage. After this valve tripping has taken place, and after the patient releases the grip, the lower edge of latch arm 105 rides on pin 39, to latched position. Tripping takes place substantially at the end of the timing period.

By fully opening valve 78, timing action by the piston is stopped, although the stem is moved by the latch as before, whenever the valve controlling means is moved to the left by the patient. Timer action is also stopped by use of stop 116, as previously described.

The absorber can also be used in anesthesia by removing the casing 11 and attaching the absorber structure directly to the gas delivering machine 1. Of course, it is usable for anesthesia when the valves are locked open by 86 and/or 116, during delivery of an anesthetic gas.

The tubular member 18 is for the purpose of attaching a receptacle which acts somewhat as a re-breathing receptacle for the air line. The function of this receptacle is fully described and claimed in my copending application above referred to.

The general procedure for using the device is as follows: Assume the patient to be a woman. She is seated in the chair, and the doctor places the grip in the patient's hand. The nasal inhaler is then put on the patient's face. The doctor instructs the patient, and lets her operate the device before the gas is turned on, so that she may be familiar with her part. He then sets his regulators on the gas machine, and causes the gas to flow. The timer is set, for example, to shut off the gas at the end of a minute. No gas flows to the patient, until the patient squeezes the grip. If, after the gas has taken effect and the doctor has begun his operation, the patient feels herself losing consciousness, she releases the grip, to shut off the gas, close the bag, and open an air port to get air. In this invention, she can do this while the timer is operating, and may thereafter get additional gas at will, by reversing the procedure above mentioned. If the patient, through fear or pain, or inability of any kind, is unable to release the grip to stop gas and get air, the cut-out or timer operates automatically to do this.

It is to be noted that it is not true that all patients, when they feel themselves losing consciousness, release the grip. Some patients continue the gripping action and in this way receive more gas instead of less gas as they should. It appears that some patients are either no longer able to think clearly when they nearly approach the unconscious stage, or if they think clearly they are not, for some reason, able to release their grip. A patient of this kind is as like to do one thing as another, that is hold tightly or let go. The present device provides means whereby if the patient is not able to let go, the gas will, in spite of this fact, be automatically cut off at the end of the timing period. On the other hand, the present device provides means whereby if the patient thinks he has enough gas before the end of the timing period, he can directly control the valves, independently of the timer, to cut off the gas supply and can thus shorten the gas delivery period.

Another feature, which is claimed herein, relates to audible signaling by working those parts of the apparatus which are concerned with starting and stopping the supply of analgesic or anesthetic substance. Two signals are provided, one to indicate when gas flow has started and one to indicate when gas flow has stopped. The signal to show that gas flow is started and that air is no longer available is given as a result of impact engagement of latch 100 with trip 101, and/or of latch arm 97 with the vertical side wall of the casing 11, or other equivalent part. The signal to show that gas flow is stopped and that air is available is given by impact of valve 20 with stop 20^a, see Figure 2. This latter signal is most dependably audible when it results from tripping of the valve latch 105 to cause automatic engagement of valve 20 against the stop 20^a. However, in case the patient releases the grip quickly, the spring brings the valve 20 against stop 20^a with sufficient force to create the proper signal. These audible signals are valuable features and are sufficient for respective purposes independently of any of the signaling means heretofore described. Either or both may be used alone or in combination with the signaling means previously described.

I claim as my invention:

1. In combination with a machine for supplying inhalation fluids, a breathing tube for the patient, an automatically closing valve for controlling delivery of the fluid from the machine to the tube, means manually operable by a patient for controlling the valve to open it and hold it open and timing means adapted at the end of a timing period to annul the controlling action of said manual means and permit the valve to automatically and instantly close, while the valve-hold-open action of said manual means continues.

2. In combination with a machine for supplying inhalation fluids, a breathing tube for the patient, a valve for controlling delivery of the fluid from the machine to the tube and a spring for closing the valve, means manually operable by a patient for positively controlling the valve to open it and hold it open and timing means having a movable element adapted, at the end of a timed period, to annul the controlling action of said manual means and permit the spring to close the valve while valve-hold-open action of said manual means continues.

3. In combination with a machine for supplying inhalation fluids, a breathing line for the patient, an automatically closing valve for controlling delivery of the fluid through the line to the patient, patient-operable means for controlling the valve to open or close the same, including a part positively operable to open the valve, timing means adapted at the end of a timed period to annul the controlling action of said manual means on said valve while said part of said manual means is being positively operated, whereby to permit automatic closure of said valve.

4. In combination with a machine for supplying inhalation fluid, a breathing tube for the patient, an automatically closing valve for controlling delivery of fluid from the machine to the tube, means for timing the closure of the valve, means manually operable by a patient for controlling the timing means for setting the same to begin timing, and means automatically operable thereafter for initiating timing action, means also controlled by said manually operable means for controlling the valve to open and close the same independently of the timing means, and means operable by the timing means for annulling the controlling action of the last mentioned means at the end of the timing period to obtain automatic valve closure.

5. In combination with a machine for supplying inhalation fluid, a breathing tube for the patient, an automatically closing valve for controlling delivery of fluid from the machine to the tube, means for timing closure of the valve, means manually operable by a patient for connecting with the timing means and setting the same to begin timing, and means automatically operable after setting for releasing said connecting means to obtain timing action, means controlled by said manually operable means for connecting with the valve to open and close the same independently of the timing means, and means operable by the timing means for disconnecting said last mentioned means at the end of the timing period to obtain valve closure.

6. In combination with a machine for supplying inhalation fluids, a breathing tube for the patient, an automatically closing valve for controlling delivery of fluid from the machine to the tube, means for timing closure of the valve, means manually operable by a patient for connecting with the timing means and thereafter setting the timing means to begin timing, means automatically operable after such setting and during operation of the manual means for releasing said connecting means to obtain timing action, means controlled by said manually operable means for connecting with the valve to open and close the same independently of the timing means, and means operable by the timing means for disconnecting said last mentioned means at the end of the timing period to obtain independent valve closure.

7. In combination with a machine for supplying inhalation fluids, a breathing tube for the patient, an automatically closing valve for controlling delivery of fluid from the machine to the tube, means for timing the closure of the valve, means manually operable by an ungrasping action of the whole hand of a patient for connecting with the timing means and thereafter operable by a grasping action of the whole hand for setting the timing means to begin timing, means automatically operable after such setting and during grasping action of the manual means for releasing said connecting means to obtain timing action, means controlled by said manually operable means for connecting with the valve to open and close the same independently of the timing means, and means operable by the timing means for disconnecting said last mentioned means at the end of the timing period to obtain valve closure.

8. In combination with a machine for supplying inhalation fluids, a breathing tube for the patient, a valve for controlling delivery of fluid from the machine to the tube, means for timing the closure of the valve, means manually operable by a patient for connecting with the timing means and thereafter setting the timing means to begin timing, and means automatically operable after such setting and during operation of the manual means for releasing said connecting means to obtain timing action, means controlled by said manually operable means for connecting with the valve to open and close the same independently of the timing means, means operable by the timing means for disconnecting said last mentioned means at the end of the timing period, and means operable as a result of valve closure to give a signal that such closure has taken place.

9. In combination with a machine for supplying inhalation fluids either mixed or unmixed, a casing providing a chamber, a breathing and rebreathing tube for the patient, attached by one end to the casing and communicating with the chamber and having a mask at the opposite end, said casing having a fluid inlet passage into which fluids from the machine are delivered either mixed or unmixed and further having a bag passage communicating with the chamber, each passage when open being in free communication across the chamber with the breathing tube and with each other, carbon dioxide extracting means including a carbon dioxide-absorbing substance, said means forming a part of the breathing and rebreathing tube, and including valve means part adjustable to permit or prevent passage of the exhaled fluid through the absorbing substance when on its way to the chamber, valve means controlling the fluid inlet and bag passages, patient-operable means controlling said last mentioned valve means, and means by which unmixed fluid from the machine can be delivered into said breathing tube at a point forwardly of the last mentioned valve means and forwardly of said carbon dioxide extracting means in direction of the patient.

10. In combination with a machine for supplying inhalation fluids either mixed or unmixed, a casing providing a chamber, a breathing and rebreathing tube for the patient, attached to the casing and communicating with the chamber, said casing having a fluid inlet passage into which fluids from the machine are delivered either mixed or unmixed and further having a bag passage communicating with the chamber, each passage when open being in free communication across the chamber with the breathing tube and with each other, carbon dioxide extracting means including a carbon dioxide-absorbing substance, said means forming a part of the breathing tube, and including valve means part adjustable to permit or prevent passage of the exhaled fluid through the absorbing substance when on its way to the chamber, automatically closing valve means controlling the fluid inlet and bag passages, means manually operable by a positive action of the patient for

controlling said last mentioned valve means to open the inlet and bag passage, and after cessation of such positive action to allow closure of said passages by the valve means, and means by which unmixed fluid from the machine can be delivered into said breathing tube at a point forwardly of the last mentioned valve means and forwardly of said carbon dioxide extracting means in direction of the patient.

11. In combination with a machine for supplying inhalation fluids, a casing providing a chamber, a breathing and rebreathing tube for the patient, attached by one end to the casing and communicating with the chamber and having a mask at the opposite end, said casing having a fluid inlet passage into which fluid from the machine is delivered, and further having a bag passage communicating with the chamber, each passage when open being in free communication across the chamber with the breathing tube and with each other, carbon dioxide extracting means including a carbon dioxide-absorbing substance, said means forming a part of the breathing and rebreathing tube, and including valve means part adjustable to permit or prevent passage of the exhaled fluid through the absorbing substance when on its way to the chamber, valve means controlling the fluid inlet and bag passages, and means manually operable by a patient for controlling said last mentioned valve means.

12. In combination with a machine for supplying inhalation fluid, a casing providing a chamber, a breathing tube for the patient attached to the casing and communicating with the chamber, said casing having a fluid inlet passage through which fluids from the machine are delivered to the chamber, and further having a bag passage, each passage when open being in free communication across the chamber with a breathing tube and with each other, a first automatically closing valve controlling the intake passage, a second automatically closing valve controlling the bag passage, means by which the second valve controls the first to open or close it when the bag passage is opened or closed, and means manually operable by a patient for controlling the bag valve.

13. In combination with a machine for supplying inhalation fluid, a casing providing a chamber, a breathing tube for the patient attached to the casing and communicating with the chamber, said casing having a fluid inlet passage through which fluids from the machine are delivered to the chamber, and further having a bag passage, each passage when open being in free communication across the chamber with a breathing tube and with each other, a first automatically closing valve controlling the intake passage, a second automatically closing valve controlling the bag passage, means by which the second valve controls the first to open or close it when the bag passage is opened or closed, means manually operable by a patient by release and positive actions respectively for connecting with the bag valve and then opening the same, means for timing a delayed closure of the valves, means operable by release action of said manual means for connecting with the timing means, and thereafter on positive action setting said means to begin timing, means automatically operable after setting for releasing said connecting means to obtain timing action, and means operable by the timing means for disconnecting said patient-operable bag valve control means at the end of the timing period.

14. In combination with a machine for supplying inhalation fluid, a casing providing a chamber, a breathing and rebreathing tube for the patient attached to the casing and communicating with the chamber, said casing having a fluid inlet passage through which fluids from the machine are delivered to the chamber, and further having a bag passage and an air intake passage both communicating with the chamber, each passage when open being in free communication across the chamber with a breathing tube and the bag passage when open being in free communication with both the breathing tube and the intake passage, a first automatically closing valve controlling the intake passage, a second valve adapted for alternately controlling the bag and air passages, and automatically movable to close the bag passage, means by which the second valve controls the first to open or close it when the bag passage is opened or closed, means manually operable by a patient by release and positive actions respectively for connecting with the bag valve and then opening the same, means for timing closure of the valves, means operable by release action of said manual means for connecting with the timing means and thereafter on positive actions setting said means to begin timing, means automatically operable after setting for releasing said connecting means to obtain timing action, and means operable by the timing means for disconnecting said patient-operable bag valve control means at the end of the timing period.

15. In combination with a machine for supplying inhalation fluids, means by which flow of fluid to the organs of respiration is controlled including a self-closing valve, means manually operable by the patient for opening and closing the valve including a latch in releasable relation with the valve, timing means, means by which the manually operable means sets the timer as it opens the valve, and automatically initiates timing actions at the end of the valve-opening operation, said timing means being adapted at the end of the timing period to trip the latch to allow valve closure while said manually operable means is in valve-open position.

16. In combination with a means for supplying inhalation fluids, means by which flow of fluid to the organs of respiration is controlled including a valve, timing means, means manually operable by the patient for controlling the valve to open and close it, including means for setting and automatically releasing the timing means at the end of the valve-opening operation, and means acted on by said timing means at the end of the timing period to cause the valve to close independently of any control action of the manually operable means.

17. In combination with a machine for supplying inhalation fluid, a casing providing a chamber, a breathing line for the patient attached to the casing and communicating with the chamber, said casing having a fluid inlet passage into which fluids from the machine are delivered and further having a bag passage communicating with the chamber, each passage when open being in free communication across the chamber with the breathing tube and with each other, a carbon dioxide extracting means forming part of the breathing line, automatically closing valve means controlling fluid inlet and bag passages and means manually operable by the patient for controlling the same, and means

by which unmixed fluid from the machine can be delivered into the breathing line without passing through said last mentioned valve means and without passing through said carbon dioxide extracting means.

18. In combination with an apparatus for administering inhalation fluids, means by which flow of fluid to the organs of respiration is controlled including a valve, means for timing closure of the valve, and manual means operable by the patient for controlling the valve independently of said timing means while said timing means is operative.

19. In combination with an apparatus for administering inhalation fluids, means by which flow of fluid to the organs of respiration is controlled including a valve, means for timing closure of the valve including a stem, manual means operable by the patient for controlling the valve independently of said timing means while said timing means is operative, including parts operatively associated with said stem for initiating timer action when the valve is opened.

20. In combination with a machine for administering inhalation fluids, means by which the flow of fluid to the organs of respiration is controlled including a breathing line, a patient-operable valve controlling entry of inhalation fluid into said line, a carbon dioxide absorbing means operatively associated with said line, and means by which fluid from the machine can be delivered into said breathing line to reach the patient without passing through said patient-controlled valve nor through said carbon dioxide absorbing means.

21. In combination with a machine for administering inhalation fluids, means by which the flow of fluid to the organs of respiration is controlled including a tube through which the patient breathes and rebreathes, a valve controlling entry of inhalation fluid into said tube, carbon dioxide absorbing means forming part of said tube, and valve means part adjustable to permit or prevent passage of exhaled fluid through said absorber.

22. In combination with a machine for administering inhalation fluids, means by which the flow of fluid to the organs of respiration is controlled including a tube through which the patient breathes and rebreathes, a valve controlling entry of inhalation fluid into said tube, carbon dioxide absorbing means forming part of said tube, valve means part adjustable to permit or prevent passage of exhaled fluid through said absorbing means, and means by which fluid from the machine can be delivered into said breathing tube to reach the patient without passing through said valve nor through said carbon dioxide absorbing means.

23. In combination with a machine for supplying inhalation fluids, first means for controlling flow of fluid to the organs of respiration, and operable for automatically stopping the flow, second means controlling the first means and operable by the grasping action of the hand of a patient for initiating flow and thereafter permitting independent action of the first means to stop the flow while the grasping action of the control continues but requiring release preparatory to another flow-initiating operation, and signal means controlled by the first means and operable to startle the patient when said first means has stopped the flow, whereby the patient's obtunded sensory faculties are stimulated to prompt him to release his grip on the second control means to condition said means for another operation, and whereby the proper response by the patient to the signal is indicative to another person of the proper sensory state of the patient.

24. In combination with a machine for supplying inhalation fluids, first means for controlling flow of fluid to the organs of respiration, and operable for automatically stopping the flow, second means controlling the first means and operable by the grasping action of the hand of a patient for initiating flow and thereafter permitting independent action of the first means to stop the flow while the grasping action of the control continues but requiring release preparatory to another flow-initiating operation, and electrically operable signal means controlled by the first means and operable to startle the patient when said first means has stopped the flow, whereby the patient's obtunded sensory faculties are stimulated to prompt him to release his grip on the second control means to condition said means for another operation, and whereby the proper response by the patient to the signal is indicative to another person of the proper sensory state of the patient.

WALTER R. HENION.