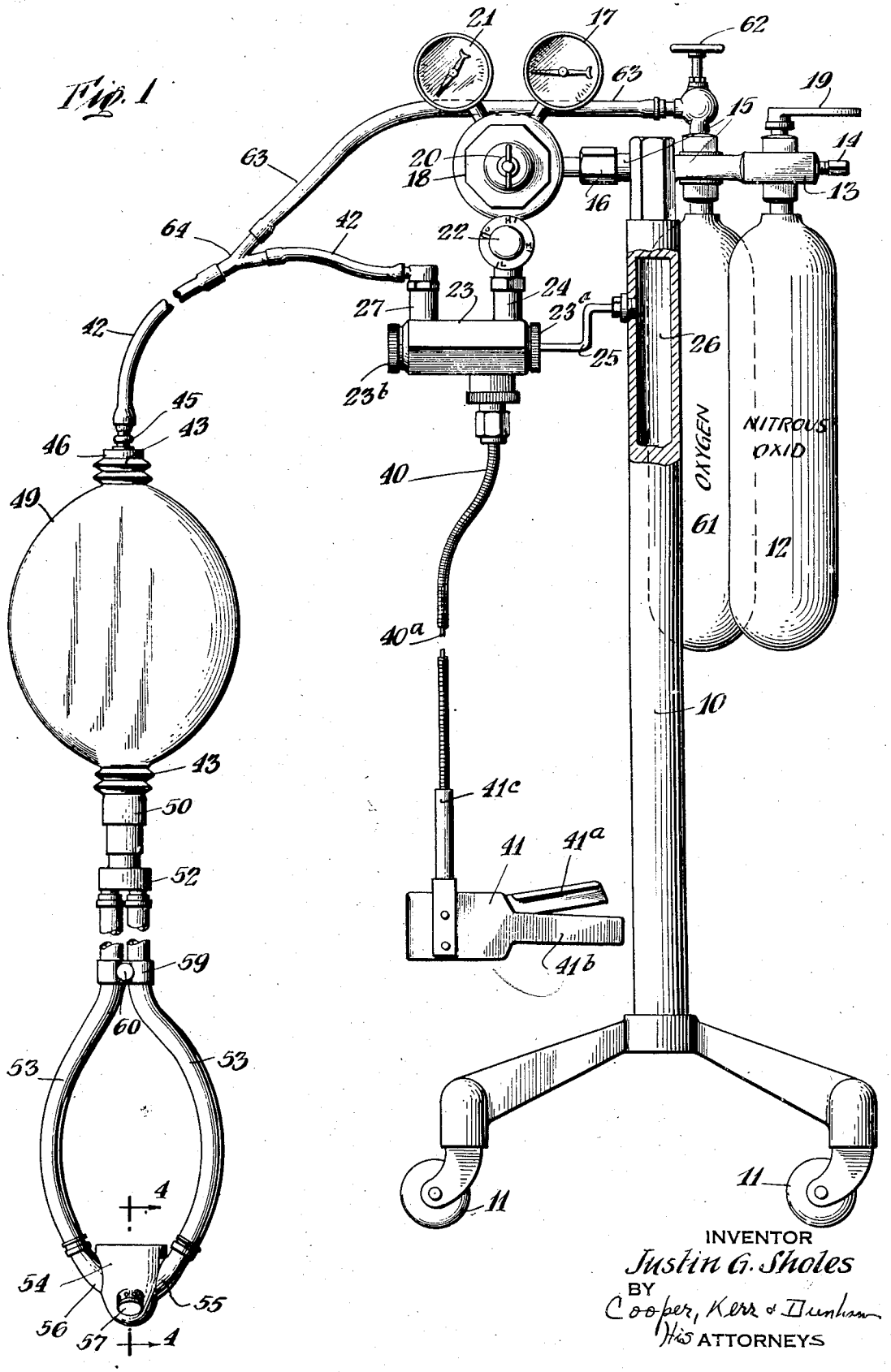
Dec. 26, 1939. J. G. SHOLES 2,185,067

APPARATUS FOR SELF-ADMINISTRATION OF ANESTHETICS

Filed July 2, 1937 4 Sheets-Sheet 1

Fig. 1



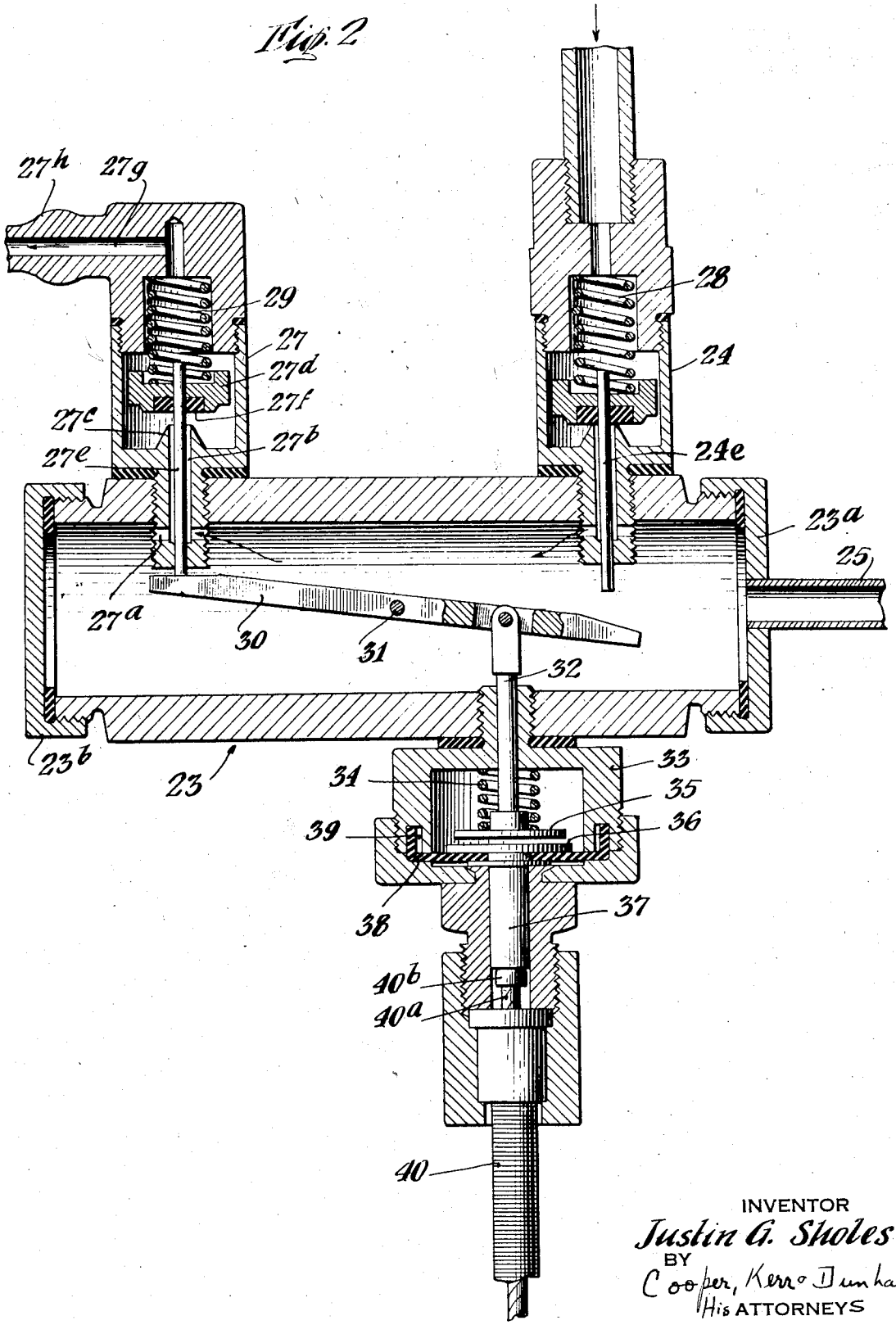

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APPARATUS FOR SELF-ADMINISTRATION OF ANESTHETICS

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Fig. 2




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APPARATUS FOR SELF-ADMINISTRATION OF ANESTHETICS

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Fig. 3

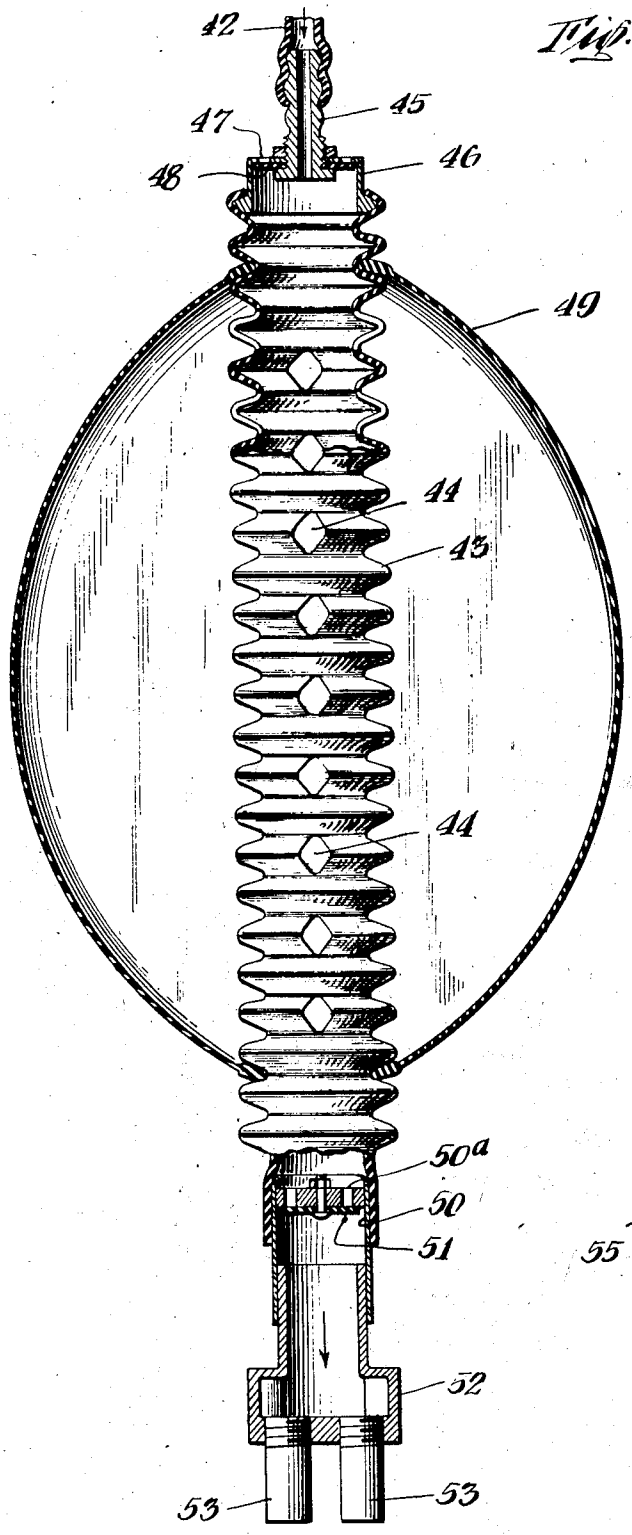
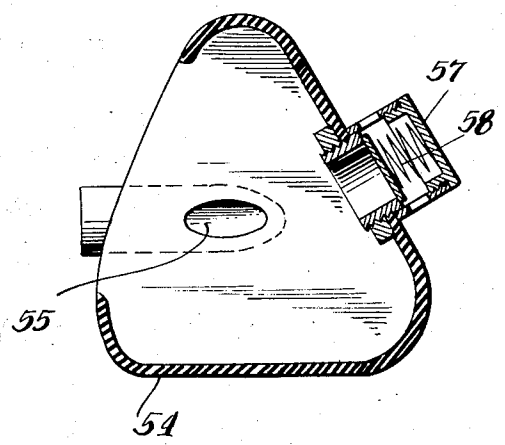



Fig. 4



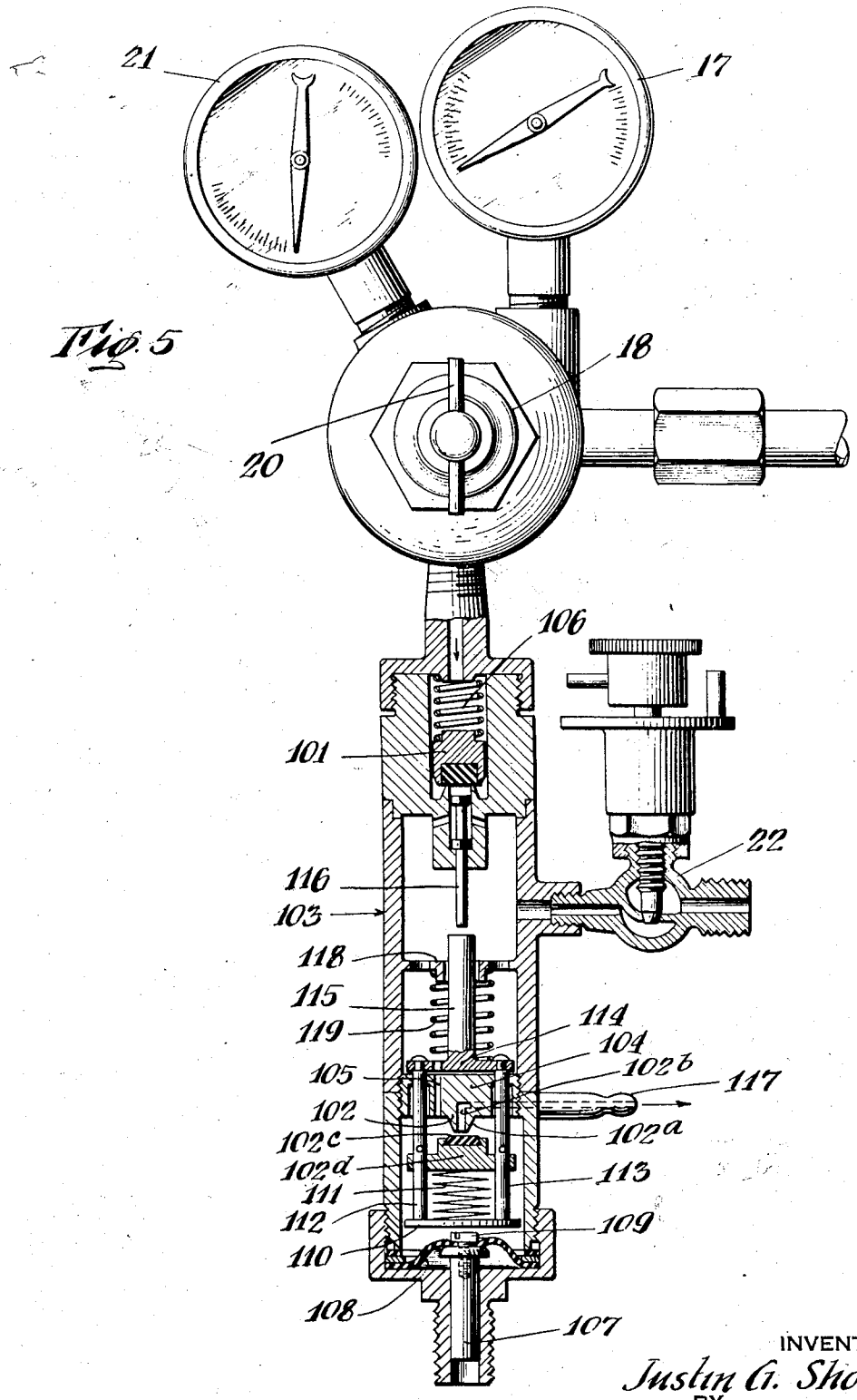

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APPARATUS FOR SELF-ADMINISTRATION OF ANESTHETICS

Filed July 2, 1937 4 Sheets-Sheet 4

Fig. 5




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# UNITED STATES PATENT OFFICE

2,185,067

## APPARATUS FOR SELF-ADMINISTRATION OF ANESTHETICS

Justin G. Sholes, Cleveland, Ohio, assignor to The Ohio Chemical and Manufacturing Company, Cleveland, Ohio, a corporation of Ohio

Application July 2, 1937, Serial No. 151,569

18 Claims. (Cl. 128—203)

This invention relates to an apparatus adapted for use by a patient in the self-administration of gaseous anesthetics, and more particularly to apparatus of that character for enabling a patient to induce or maintain a condition which is sometimes known as "analgesia",—by which is meant insensibility to pain without loss of consciousness, as distinguished from a state of "anesthesia", in which the patient is entirely unconscious. As a matter of convenience, I shall, at times, designate and refer to apparatus of this character as an "analgesor".

The apparatus is also useful in the administration of anesthetics by a physician, in cases in which a complete anesthesia is required, and, more particularly, when a brief but complete unconsciousness is desired.

An anesthetic commonly used in such apparatus is nitrous oxid, ordinarily mixed in suitable proportions with air or oxygen. Although other suitable anesthetics may also be used in apparatus according to my invention, under certain conditions,—for example cyclopropane under proper circumstances,—the following description will be made with reference to nitrous oxid by way of example. The terms "gas" or "anesthetic gas" as used hereafter should be understood to include vapors as well as gases, when the former are employed.

In various situations which arise in the practice of medicine, surgery or dentistry it is desirable that analgesia be induced or maintained by the patient's self-administration of the anesthetic, so that the amount thereof may be controlled by the patient, and regulated according to the time of occurrence and amount of the pain. An example is in dentistry in which the patient may administer anesthetic to himself when drilling or other painful operation occurs, in amount depending upon the severity of the pain. My invention may, however, be used, also, in cases of childbirth, in setting fractures, in a variety of instances of minor surgery such as dressing wounds, and under other suitable circumstances.

An object of the present invention is to provide an apparatus for use in the self-induction of analgesia by a patient, which is at once safe and simple, and more particularly by the use of which a patient cannot administer to himself an overdose or any dangerous quantity of anesthetic.

It is also an object of the present invention to produce such an apparatus in which flow of the anesthetic will automatically cease if the patient lapses into unconsciousness, and more particularly in which such cessation of the flow of anesthetic is not in any way dependent upon a relaxation by the patient, but will occur even should the patient convulsively grip the control handle during unconsciousness.

In various forms of apparatus previously proposed for permitting self-administration of anesthetic, a fundamental objection has been that the cutting off of the flow of anesthetic, should the patient administer an overdose and lapse into unconsciousness, is dependent upon the patient's relaxation of his grip, or of his pressure upon some button or valve, or releasing a cord or handle, or some other relaxation intended to be produced by the patient's unconsciousness. A serious difficulty with such apparatus, however, has been that at least some patients do not relax when they become unconscious, but maintain a convulsive grip, pressure or pull upon the apparatus, as the case may be, so that the flow of anesthetic does not automatically cease, and there is the possibility that a dangerous or even fatal overdose of anesthetic may be administered before the patient's condition is noticed by the physician.

It has heretofore been proposed to provide apparatus in which the continued delivery of anesthetic to the patient requires some purposeful effort on the part of the latter, but in most such apparatus there has been an undesirable time relation involved in the shutting off of the flow of anesthetic, after the patient became unconscious, according to which some predetermined quantity of anesthetic could nevertheless be delivered to the patient after that time, or the flow of anesthetic could be continued for a given time after the patient became unconscious.

In my copending application Serial Number 115,327, filed December 11, 1936, now patent No. 2,119,446, for Self-administration of gaseous anesthetics, I described an apparatus designed to overcome this difficulty, and, in certain of its aspects, the invention of the present application is an improvement thereon.

A further object of the present invention is to provide a safe and simple apparatus which overcomes both the foregoing and other difficulties encountered with previous types of apparatus; which has relatively few and simple working parts to get out of order; and which is so arranged that there can be no continued delivery of gas from the storage cylinder or receptacle to the patient after the patient becomes unconscious.

A still further object of the invention is to

provide such an apparatus in which a master control by the doctor, dentist or other operator may be provided, so that the administration of the anesthetic may be supervised by him, and may, if desired, be discontinued, and pure air or oxygen be administered by him, at his discretion, without control by the patient. Such control by the physician or other attendant is desirable because the effect of gas upon different patients cannot always be predicted, and cases may arise in which the patient would be inclined to administer an overdose to himself. According to the present invention, this is under the control of the physician or attendant, and the gas may be shut off and air or oxygen substituted by the latter, should he consider it advisable to do so.

My apparatus is also valuable and efficient for inducing brief anesthesia such as is required for lancing abscesses, removing skin blemishes or in an emergency, as for reducing or setting fractures and performing other brief operations lasting only a few minutes. The method employed requires the physician or his assistant to compress and release the control handle or grip to a point at which the patient sinks into deep anesthesia for a sufficient length of time to permit the brief operation.

The use of my apparatus with anesthetic gas gives greater safety to the patient than administering chloroform, ether or ethyl chloride, which are commonly used in case of an emergency, but which place the patient in a state of anesthesia for an indefinite or uncontrolled length of time. With my apparatus the patient revives promptly, as soon as the physician or his assistant ceases to compress and release the control handle or grip, but recovery may be made even more prompt by administering pure oxygen in the manner hereafter to be described.

Other features and objects of the invention will appear from the following description.

I shall now describe, by way of illustration, the principle of my apparatus, and the best mode in which I have contemplated applying that principle, constituting what is at present the preferred form of the apparatus now known to me, in greater detail in connection with the accompanying drawings, in which:

Figure 1 is an elevational view, partly broken away, of the preferred form of the complete apparatus assembled ready for use;

Fig. 2 is an elevational view, mostly in cross-section, of the valve and gas control chamber assembly;

Fig. 3 is a detailed view, largely in section, of the reservoir portion of the apparatus employed for the admixture of air with the gas and for equalizing or stabilizing the flow of the thus-mixed anesthetic to the mask;

Fig. 4 is a detailed sectional view of the mask, on the line 4—4 of Figure 1; and

Fig. 5 is an elevation, partly in cross-section, of a different form of apparatus, which may also be used, under certain conditions, instead of the apparatus shown in Figure 2, and which also forms a part of my invention.

Referring now to the drawings in greater detail, the apparatus comprises a suitable stand or support 10 which may be conveniently mounted on the casters 11, for ready portability. At one side of the stand there is removably mounted a flask or cylinder 12 of compressed anesthetic gas,—nitrous oxid in the case illustrated. This cylinder may be mounted, as shown, in the yoke or frame 13 where it is secured by the set-screw 14, and connects (through a wire gauze or filter, not shown) with a pipe passing directly through the crosshead 15, which communicates through the coupling 16 with the high-pressure gauge 17 and reducing valve 18. By opening the valve 19 on the gas cylinder, gas is admitted to the reducing valve 18, which may be adjusted by the physician, by means of the handle 20, to give any desired reduced pressure on the low-pressure side thereof, which reduced pressure is indicated by the low-pressure gauge 21. Thus, for example, if gas from the cylinder 12 be admitted to the high-pressure side of the reducing valve 18, by means of the valve 19, until the pressure builds up to say 1000 or 1500 pounds, then by suitable adjustment of the valve handle 20 the physician may regulate the reduced pressure to, say, 10 to 15 pounds, as shown on the low-pressure gauge 21.

A still further adjustment under the control of the physician or operator is furnished by the additional valve 22, located on the outlet side of the reducing valve 18. For example, this valve 22 may be a needle valve for controlling the rate of flow of the gas, and may be provided with an "off" position, after which it progressively opens to permit more rapid flow of the gas, and is conveniently marked "light", "medium" and "heavy" on its dial, which designations signify respectively the strength of the analgesia which the physician desires to have produced by the respective rates of flow permitted by such respective settings of the needle valve.

Connected to the needle valve 22 is what I shall hereafter at times refer to, for convenience, as the "control-valve-and-gas-chamber-assembly", or a "gas control device", generically designated as 23. This comprises several parts, including a check valve 24 arranged at the inlet end of the chamber 23. Also at the inlet end of the chamber 23 is a connection 25 to a reservoir and equalizing chamber 26. The latter may be conveniently housed, as shown, in the vertical portion of the stand 10, and may, for example, have a capacity of about 280 c. c. at one atmosphere pressure. The reservoir and equalizing chamber 26 is not connected to the pipe passing through the cross-head 15, but has its sole connection through the tube 25 to the valve and gas chamber 23. The ends of the chamber may be closed by screw caps 23*a* and 23*b*, or in other suitable manner permitting access if necessary.

At the other end of the control valve chamber 23 is another check valve 27, constituting the outlet valve. Both the inlet and outlet valves 24 and 27 are provided with springs, 28 and 29 respectively, tending to keep the valves closed, but both valves are capable of actuation, although never simultaneously, by the intermediately pivoted rocker arm 30 carried by the transverse shaft 31, journaled in the walls of the chamber 23. Actuation of the rocker arm 30 permits the alternate, but never simultaneous, opening and closing of the inlet and outlet check valves 24 and 27.

Since the valves 24 and 27 may be similar in construction, I shall describe only valve 27 by way of example. It comprises the gas ducts 27*a* and 27*b*, valve seat 27*c* and valve head 27*d*, which is guided for vertical motion by the loosely-fitting valve-stem 27*e*. The valve head may also be provided with a soft-rubber insert or seal 27*f*, for making a tight closure against the valve seat. Both the weight of the valve head 27*d* and

the pressure of the spring 29 keep the valve normally closed, and it can only be opened by a positive actuation of the rocker arm 30, to exert pressure upon the lower end of the valve stem 27e. Gas outlet is through the duct 27g in the corrugated nipple 27h.

Referring to Figure 2, it will be seen that the openings of the valves 24 and 27, and arrangement of the rocker arm 30, is such that one of the valves is always closed before the other one can be opened.

Actuation of the rocker arm 30 may be effected by the patient by means of the plunger or rod 32 (see Fig. 2) housed in the supplemental casing 33 threaded to the lower side of the chamber 23. The plunger rod 32 is normally maintained and biased in its downwardly extended position, as shown, by means of the spring 34. In this normal position of the rod 32, and consequently of the rocker arm 30, the inlet check valve 24 is maintained normally closed by its spring 28 and the weight of its valve head, as well as by the pressure of gas above the valve. The outlet check valve 27 is held normally open by the pressure of the rocker arm 30, urged by the spring 34. Thus gas flowing through the needle valve 22 can not enter the chamber 23, in the absence of the actuation now to be described.

The rocker arm 30 is actuated by means of the plunger rod 32 through the intermediary of an enlarged plunger head or disc 35, bearing upon a similar cooperating plunger head or disc 36 attached to the shaft 37, which passes through a flexible seal 38 of rubber, leather or other suitable gas-proof material, seated in the annular groove 39 contained in the periphery of the casing 33. A seal preventing the escape of gas is thus provided, while motion may nevertheless be transmitted to the plunger rod 33 through the coacting plunger faces 35 and 36. The shaft 37 is, in turn, actuated by the Bowden cable 40 provided with the plunger 40a terminating in the button 40b bearing against the lower end of the shaft 37. The plunger of the Bowden cable may be extended longitudinally by the patient, by means of the handle-grip or patient control device 41, in such manner that squeezing together the two parts 41a and 41b of the handle grip 41 actuates the cable plunger 40a to force the rod 32 back against the pressure of the spring 34, and thus operate the rocker arm 30 to close the check valve 27 and thereafter open the check valve 24 against the spring 28 and against the gas pressure above it. Upon releasing the grip upon the handle grip 41, a suitable spring (not shown) located in barrel portion 41c of the handle grip 41, returns the handle grip to its normal position and retracts the plunger 40a and its button 40b, of the Bowden cable 40.

Thus in the normal position of the handle 41, the chamber 23 and its associated reservoir 26 are not allowed to fill with gas; flow of gas passing through the needle valve 22, previously adjusted by the doctor, being cut off by valve 24. When the patient grips the handle 41, its movement actuates the Bowden cable 40 and moves the rocker arm 30 against the spring 34 to first permit closing of the outlet valve 27, by means of its spring 29 and the weight of its head 27d, and then to open the inlet valve 24, by pressure of the right end of rocker arm 30 upon the valve stem 24e. Still the patient does not receive gas; but upon releasing the handle grip 41 the setting of the valves 24 and 27 is again reversed, and gas is allowed to flow to the patient, but only such amount as has been previously admitted to the chamber 23, and its associated reservoir 26, by the opposite setting of the valves. Thus the patient receives no gas until he releases the handle grip 41; when the apparatus is in its normal or rest position, the double action of gripping and releasing the handle 41 is necessary before gas is received by the patient. In this way there can never be any continuous or steady flow of gas to the patient, whether the handle 41 is left normally open, or is continuously gripped, or is stationary in some intermediate position. Gas can only be made to flow by alternately gripping and releasing the handle 41, and even then the gas flows only in measured doses equal to the contents of chamber 23 and its associated reservoir 26, and under the pressure previously set by the physician by the reducing valve 18, and further governed by the flow permitted by the needle valve 22, also set by the physician. The chamber 23 and its valves thus constitutes what might be called a gas "lock" or metering device, which permits only a predetermined volume of gas to pass through to the patient, for each cycle of gripping and releasing the handle 41, and whenever the handle 41 is kept stationary in any position,—open, closed or intermediate,—the flow of gas automatically ceases at once.

Flow of gas to the patient is through the further apparatus now to be described (see Figs. 1, 3 and 4). The portion of this apparatus more particularly shown in Figure 3 (but also in Fig. 1) I shall sometimes refer to, for convenience, as a reservoir, or mixing chamber, since it serves to admit air to and mix it with the gas, and also serves to store the resulting mixture, generally under slight pressure.

Gas passes from the outlet check valve 27 through the rubber tube 42, attached to the corrugated nozzle 27h of the check valve 27, into the non-collapsible perforated rubber tube 43 (Fig. 3). This is suitably a corrugated tube of rubber of such thickness as to be non-collapsible under the pressure to which it is subjected, and is provided with a series of holes 44 in its peripheral wall. The inlet thereto is formed by the corrugated nipple 45, which permits inflow of gas, while in the casing 46 surrounding the nipple there is also arranged a series of perforations 47, covered on the inside by a light and flexible rubber disc or washer 48, thus forming a check valve from the parts 46, 47 and 48. The perforations 47 are open to the atmosphere on the outside, so that any suction on the non-collapsible rubber tube 43 draws air in through the check valve past the washer 48 and through the perforations 47.

Surrounding the perforated tube 43 is an expansible rubber bladder or balloon in the form of a bag 49, forming a reservoir and gas mixing and equalizing chamber for maintaining, under slight pressure, the mixture of gas and air which results from the arrangement just described, and for supplying it to the patient. This is done through the outlet check valve 50, provided with a series of perforations 50a, opening into the tube 43, and a light rubber washer 51 arranged on the outside thereof, to permit the gas-air mixture to be inhaled from the reservoir, but to close upon exhalation by the patient. The mixture of air and gas then passes through the coupling 52 into the rubber tubes 53 and thence to the mask 54, which is adapted to fit over the patient's nose, in the form shown, or may be arranged to fit over his mouth, or both nose and

mouth, as desired. For dental work a nasal mask is preferred as shown. In that case, two inlets 55 and 56 into the mask (Figs. 1 and 4) may coincide with the patient's nostrils, for permitting him to inhale the air-gas mixture, and still another check valve 57 is arranged on the outside of the mask to permit the patient to exhale. This valve opens against the spring 58 upon exhalation, but closes immediately the patient begins to inhale, so that all inhalation is of air-gas mixture from the reservoir 49.

An adjustable collar 59 (Fig. 1) fitting over the two rubber tubes 53 and normally held in place by the spring catch and release button 60 permits the tubes 53 to be placed around the patient's head and the mask clamped over his nose by sliding of the collar 59 along the tubes 53, to provide a comfortable adjustment.

A further safety feature of the apparatus is shown in Figure 1, and consists of an oxygen cylinder 61, suitably mounted on the stand 10, and provided with a valve 62 controlled by the physician, and connected to the rubber tube 63 connecting through the Y connection 64 to the tube 42, and thence through the mixing chamber and reservoir 49, to the mask 54. Thus should the physician observe any symptoms of distress or over-excitement in the patient, he has only to open the valve 62 and inject pure oxygen into the reservoir 49, where a slight pressure of oxygen may be thus built up, and oxygen immediately passes to the patient, thus at once bringing the patient out of the anesthetic. The valve 62 is preferably under the exclusive control of the physician.

The operation of the form of apparatus shown in Figures 1 to 4 has been shown in detail by the foregoing description, but may be summarized as follows:

The physician first adjusts the valves 19, 18 and 22 to give the desired pressure and flow of gas, then gives the handle grip 41 to the patient and fits the mask or other suitable inhaling appliance over the patient's nose, or mouth, or both, as desired, by adjusting the tubes 53 and collar 59, which is thereafter held in place by its spring catch 60. Thus if the patient feels pain, he has only to grip and then release the handle 41, thus permitting gas to flow to the reservoir 49. In the meantime, the patient has, of course, been breathing air through the check valves 46, 47 and 48 at the inlet end, and 50 at the outlet end, of the reservoir or mixing chamber 43, 49, thus inhaling from the reservoir 49 and exhaling through the check valve 57. Gripping and releasing the handle 41 injects gas into the air in the reservoir 49 and gives a slight analgesic effect. Continued alternate gripping and releasing of the handle 41 continues to inject gas into the reservoir 49, so that air-gas mixture is breathed, but whenever the patient feels that he has had enough gas, or the pain ceases, he has only to stop working the handle 41 and gas will instantly stop flowing, without any timed flow or metered amount being thereafter permitted to pass. As soon as the gas is shut off, the patient thereafter draws only pure air into the reservoir 49.

An important advantage of this arrangement is that the flow of gas is immediately and automatically shut off when the patient ceases the alternate gripping and releasing of handle 41, whether voluntarily or through lapsing into unconsciousness. Some patients may relax when unconscious, while others are apt to maintain a convulsive grasp of the apparatus, but, in either condition, in the apparatus according to my invention, the flow of gas immediately ceases without timing or other delay.

A different form of apparatus according to my invention is shown in Figure 5. In this construction the inlet and outlet valves 101 and 102 respectively, are arranged at opposite ends of a cylindrical gas-and-valve-control-chamber 103, which is provided with a fixed partition 104 intermediate the ends thereof, having a series of perforations, 105, to permit passage of gas. When the handle grip (as 41; not shown in Fig. 5, but suitably similar to that of Fig. 1) is relaxed, the valve 101 is kept closed, as shown, by the spring 106, and gas cannot enter the chamber 103. If, however, the handle 41 is gripped, its Bowden cable (not shown in Fig. 5 but similar to that of Fig. 1) actuates the rod 107 which, through the flexible rubber or other suitable diaphragm seal 108, and head 109, pushes upon the loosely fitting disc or plate 110, thus compressing the spring 11 and closing the valve 102 to the outlet. This valve may consist of the seat 102*a*, gas passage 102*b*, and soft rubber, leather or other suitable seal 102*c*, set in the valve head 102*d*. The plate 110 is mounted upon rods 112 and 113 which pass through the partition 104 and are attached at their upper ends to the similar loosely fiting plate or disc 114. This in turn carries the rod or plunger 115 rigidly attached thereto. This rod passes through and is guided by the additional perforated partition 118, to abut, when actuated, against the sliding pin 116 for actuation of the check valve 101. Thus valve 102 is always closed if valve 101 is open. The perforations 105 in the partition 104 permit the flow of gas therethrough, and so out through nozzle 117 to the reservoir and mask, but due to the interrelation of valves 101 and 102 there can never be any continuous flow of gas to the mask, whether the handle grip 41 be opened or closed. Only by continuous operation of the handle grip, alternately gripping and releasing it, can gas be made to flow to the mask.

The purpose of the perforated partition 118 is to furnish a support and guideway for the plunger rod 115, while the spring 119 maintains the plunger 115 in normally retracted position, as shown. Valve 102 is normally open, also as shown, and valve 101 is normally closed, as shown. Actuation of the handle grip first closes valve 102, then opens valve 101. Upon relaxation of the handle grip the process and setting of the valves is reversed.

In this construction a reservoir and equalizing chamber may be provided in the stand column, as at 26 in Fig. 1, and, for example, a suitable capacity for this reservoir is approximately 280 c. c. at one atmosphere pressure.

In the construction as illustrated in the form of apparatus shown in Fig. 5 I have shown the needle valve 22 interposed between the chamber 103 and the reservoir 26, where it may be controlled by the physician. As before, a reducing valve 18 is provided between the gas cylinder and the gas chamber 103, with high and low pressure gauges 17 and 21 and a handle 20 under control of the physician, all as before. A copper gauze screen or filter (not shown), between the gas cylinder and the inlet side of the reducing valve, may also be provided if desired.

The detailed operation of the form of apparatus shown in Figure 5 will be clear from the foregoing description, but may be summarized as follows:

When the valves 18 and 22 have been suitably

adjusted by the physician, valve 101 is normally closed, and valve 102, to the mask or other inhaling appliance, is normally open. The patient thus breathes only air. Gripping of the handle 41 actuates the Bowden cable 40 to push the plunger 107 inward, thus first closing valve 102, and then opening valve 101. This admits gas to the chamber 103 and the reservoir 26, but the patient still receives only air. Release of the handle 41 reverses the setting of the valves 101 and 102, and the patient then receives a small quantity of gas admixed with the air. As before, continued and positive alternate gripping and relaxation of the patient's actuating handle is required in order to make a continued administration of gas. Any cessation of the positive operation by the patient causes the flow to cease at once.

The other features of construction and operation of the apparatus of Fig. 5 are apparent from the detailed description already given, as well as from the description of Figures 1 to 4 inclusive.

When either form of the apparatus hereinabove described (that of Figures 1 and 2, or that of Figure 5) is employed for administering anesthesia, as distinguished from inducing analgesia, as for producing brief anesthesia for minor operations or emergency work, as already described, the handle grip 41 is, of course, utilized and controlled by the physician or his assistant, in such manner that the desired anesthesia is produced for only the time during which it is actually required. This is a substantial advantage over earlier practice, as, for example, the administration of ether for an emergency operation, which may produce unconsciousness for an uncontrolled or indefinite length of time.

The apparatus herein specifically illustrated and described are the best embodiments of my invention now known to me, but it is to be understood that the invention is not necessarily or specifically limited thereto, but may be carried out in other ways, without departure from its spirit, within the scope of the following claims.

I claim:

1. In an analgesic apparatus of the class described, adapted for the self-administration of anesthetic gas by a patient, and including a source of anesthetic gas, means for delivering the gas therefrom, and a mask for delivering the gas to the patient, the elements which comprise a gas control chamber provided with inlet and outlet valves so arranged and inter-related that both valves can never be opened at the same time, and operating mechanism under the control of the patient for alternately opening said valves to permit only a limited quantity of gas to flow to the patient, the arrangement and location of said valves and patient control means being such that gas can not flow to the patient while said patient-controlled means is stationary in any position.

2. In an apparatus for use in the administration of an anesthetic, and having a source of anesthetic, an inhaling mask for the patient, and a reservoir connected with the mask and adapted to receive air from the atmosphere and deliver the same to the mask when the patient inhales, the elements which comprise a gas control valve mechanism having a plurality of valves through which gas must pass in series before reaching the patient, positively-acting mechanical means for automatically closing at least one of said valves before another of said valves can be opened, and means for opening said valves alternately and only while another of said valves is closed.

3. In an apparatus for use in the administration of an anesthetic, and having a source of anesthetic, an inhaling appliance for the patient, and a reservoir connected with the inhaling appliance and adapted to receive air from the atmosphere and deliver the same to the patient when he inhales, the elements which comprise a gas control chamber and valve mechanism having at least two valves through which gas must pass in series before reaching the patient, means for maintaining each of said valves normally closed in the absence of actuation thereof, a rocker arm pivoted intermediate its ends and arranged to actuate said valves alternately only, the valves being actuated by the rocker arm from opposite sides of said pivot and the normal position of said rocker arm being such that it holds one valve open against its normal bias, while permitting the other valve to assume its normally closed position, and means for actuating said rocker arm to first close said open valve and then open said initially closed valve only while the initially open valve is maintained closed.

4. In an apparatus for use in the administration of an anesthetic, and having a source of anesthetic, an inhaling mask for the patient, and a reservoir connected with the mask and adapted to receive air from the atmosphere and deliver the same to the mask when the patient inhales, the elements which comprise a gas control chamber and valve mechanism having two valves through which gas must pass in series before reaching the patient, positively-acting mechanical means for automatically closing one of said valves before the other valve can be opened, means for opening said valves alternately, and an additional gas reservoir between said valves.

5. In an apparatus for permitting the self-administration of anesthetic by a patient, and provided with a suitable source of anesthetic gas and an inhaling appliance for the patient, the features of novelty which comprise a master control under the exclusive control of a physician for limiting the maximum possible flow of gas to the patient, and a subsidiary control under the control of the patient for permitting limited flow of gas to the patient, subject to said master control, said subsidiary control comprising at least two valves through which gas must pass in series before it can reach the patient, said valves being so constructed and arranged that at least one of them is always closed and gas can not pass therethrough except upon positive actuation thereof, by the patient, and that passage of gas will be automatically cut off whenever said subsidiary control is in stationary condition.

6. In an apparatus for use in the self-administration of anesthetic gas by a patient, said apparatus being provided with a source of anesthetic gas and an inhaling appliance for the patient, the elements which comprise a mixing chamber interposed between the inhaling appliance and the gas source and constructed and arranged to admit air from the atmosphere and mix the same with anesthetic gas from said source, a gas control device interposed between said gas source and said mixing chamber, means under the control of the patient for permitting gas to pass through said control device only during positive actuation of said patient control means by the patient, and mechanism for shutting off further passage of gas through said gas control device whenever said patient-actuated control device is in stationary condition.

7. In an apparatus for use in the self-adminis-

tration of anesthetic gas by a patient, said apparatus being provided with a source of anesthetic gas and an inhaling appliance for the patient, the elements which comprise a mixing chamber interposed between the inhaling appliance and the gas source and constructed and arranged to admit air from the atmosphere and mix the same with anesthetic gas from said source, a gas control device interposed between said gas source and said mixing chamber, means under the control of the patient for permitting gas to pass through said control device only during positive actuation of said patient control means by the patient, mechanism for shutting off further passage of gas through said gas control device whenever said patient-actuated control device is in stationary condition, and a source of oxygen and connection therefrom for permitting the physician to furnish oxygen to the patient at the discretion of the physican and without control by the patient.

8. In an apparatus of the class described, a gas reservoir and mixing chamber comprising, in combination, a chamber provided with a gas inlet, a check valve for admitting air under the suction of inhalation by a patient, a second check valve for permitting the resulting mixture to be drawn out under the suction of inhalation, but closed by exhalation, to prevent the exhaled breath from mixing with the air-gas mixture in the reservoir, and a flexible reservoir in communication with said chamber between said check valves, for storing the air-gas mixture.

9. In an analgesor of the class described, and provided with an inhaling appliance for a patient, the features which comprise a collapsible reservoir connected with said inhaling appliance and provided with inlet and outlet check valves through which air is normally breathed by the patient, a connection to said reservoir from a gas control chamber, mechanism in said gas control chamber for permitting gas to pass therethrough only upon positive actuation thereof, and a control device adapted for operation by the patient and so connected to said gas control chamber that the patient can, at will, actuate the same, but only by positive mechanical movement of said control device, to inject a limited quantity of gas into said reservoir so that the patient inhales therefrom a mixture of air and gas instead of air only.

10. In an apparatus for use in the administration of an anesthetic, and having a source of anesthetic, an inhaling mask for the patient, and a reservoir connected with the mask and adapted to receive air from the atmosphere and deliver the same to the mask when the patient inhales, the novel elements which comprise a gas control valve mechanism having a plurality of valves through which gas must pass in series before reaching the patient, positively-acting mechanical control means for automatically closing one of said valves before another of said valves can be opened, and means for closing and opening said valves alternately in such manner that at least one of said valves is always closed.

11. In an apparatus for the administration of anesthetic gas, including a suitable source of anesthetic gas and an inhaling appliance for a patient, the features which comprise a master control valve, under the exclusive control of the attending physician, for limiting the possible flow of gas to the patient, and a subsidiary control means, also under the control of a physician, for permitting only a limited quantity of gas to flow to the patient, said subsidiary control means comprising at least two valves in series between the source of anesthetic gas and the inhaling appliance, and so constructed and arranged that gas can only pass therethrough to the patient upon positive actuation of the valves by the physician, and that all further flow of gas to the patient can be immediately cut off by the physician at will, by maintaining said control valve in any stationary condition.

12. In an apparatus for use in the administration of anesthetic gas, and provided with a suitable source of anesthetic gas and an inhaling appliance for a patient, the features which comprise primary means for limiting the flow of gas to the apparatus, and subsidiary means for administering limited quantities of gas to the patient, said subsidiary means comprising a plurality of valves through which gas must pass in series before reaching the patient, and actuating means for opening and closing said valves in such relation that at least one of said valves is always closed in every position of said actuating means.

13. In an apparatus for self-administration of anesthetic gas which comprises the combination with a gas chamber having an outlet for connection with a mask and an inlet for the anesthetic, a self-closing valve for the anesthetic inlet, and a movable member in the chamber, said movable member being normally disengaged from said inlet valve but engageable therewith to open the same, manual means operable from a point outside the gas chamber to actuate said movable member within the chamber to open the anesthetic inlet valve, and a gas-tight flexible diaphragm sealing means interposed between said manual operating means and the movable member within the gas chamber and hermetically sealing the gas chamber against escape of anesthetic gas into the atmosphere, while permitting actuation of the anesthetic valve by said external operating means.

14. A gas-and-air mixing and reservoir device for use in administration of anesthetics, comprising a pair of inter-communicating chambers, of which one is larger than the other, and the larger at least partially surrounds and encloses the smaller, said inner chamber being substantially non-collapsible in character and said outer chamber being flexible and expansible in character and adapted to receive and contain gas or gas-air mixture under moderate pressure; means associated with said inner chamber adapted for connection with a source of anesthetic gas; and means also associated with said inner chamber and adapted, under suction of inhalation by a patient, to admit air to said reservoir, for mixture with the anesthetic gas.

15. A gas-and-air mixing and reservoir apparatus for use in administration of anesthetics, comprising a pair of coaxial and intercommunicating chambers of which the outer encloses and surrounds at least a portion of the inner, said inner chamber comprising a substantially non-collapsible, corrugated and perforated tube and said outer chamber comprising an expansible reservoir enclosing the perforated portion of said inner chamber and forming a substantially gas-tight seal at the ends thereof, means in communication with said inner chamber for the admission to the interior of said reservoir of anesthetic gas from a suitable source, and means also in communication with said inner chamber for the admission to the interior of said reservoir of air from the surrounding atmosphere.

16. A gas control device for an apparatus for administration of anesthetic gas, comprising a gas chamber having inlet and outlet valves, means for maintaining said inlet valve in normally-closed position, means for maintaining said outlet valve in normally open position, and actuating mechanism for operating said valves from outside said gas chamber, said actuating mechanism comprising, in combination, gas-tight sealing means for transmitting the actuating motion from outside to inside said gas chamber, and a reciprocating plunger operable by said transmission means, and interposed between said valves, said plunger being adapted to move along said gas chamber and actuate said valves in sequence; the proportions and dimensions of said plunger with respect to said valves and gas chamber being such that the outlet valve is necessarily closed by motion of the plunger before the inlet valve can be opened and, conversely, upon a reciprocal motion of said plunger, the inlet valve is necessarily closed before the outlet valve can be opened.

17. A gas control device for an apparatus for administration of anesthetic gas, comprising a gas chamber having an inlet valve and an outlet valve through which gas must pass in series in order to pass through said chamber, and operating mechanism for selective operation of said valves, the construction, arrangement and interrelation of said valves and their operating mechanism being such that only one of said valves can be open at a time and that continuous flow of gas through said gas chamber cannot occur at any time or in any position of said operating mechanism.

18. A gas control device for an apparatus for administration of anesthetic gas, comprising a gas chamber through which gas must pass prior to its administration to a patient, and having an inlet valve and means for maintaining the same in normally closed position, and an outlet valve and means for maintaining the same in normally closed position; a movable actuating member mounted for selective and alternative, but not simultaneous, actuation of said valves; biasing means operably associated with said actuating member for normally maintaining it in such position that said outlet valve is held open thereby and said inlet valve remains normally closed; and means operable from outside said gas chamber for moving said actuating member against its bias in such manner that said outlet valve is first closed and said inlet valve is thereafter opened.

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