C. H. FRINK.

APPARATUS FOR THE ADMINISTRATION OF GENERAL ANESTHETICS.

APPLICATION FILED MAY 25, 1909.

978,728.

Patented Dec. 13, 1910.

3 SHEETS—SHEET 1

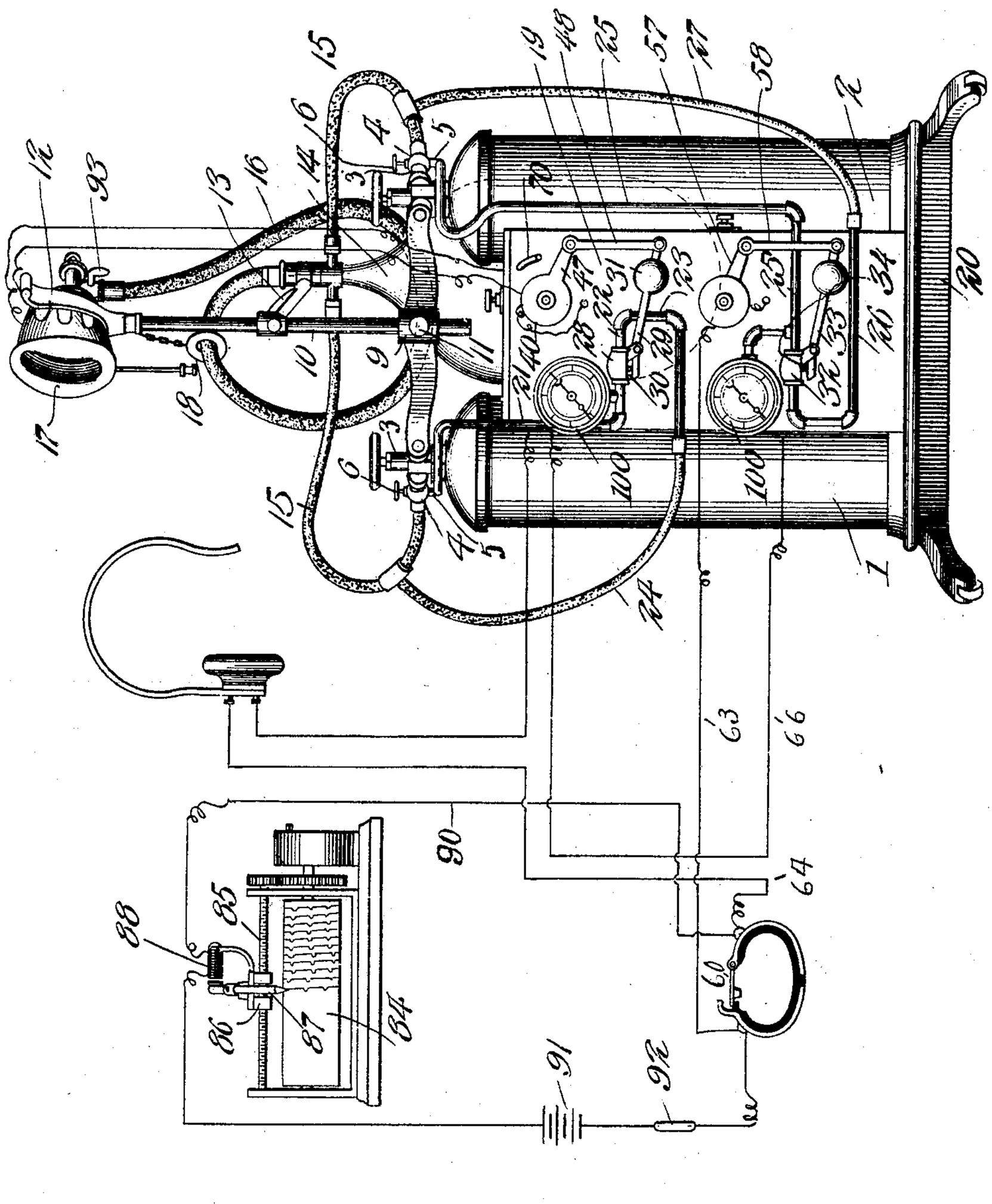

Fig. 1.

Witnesses

Thil E. Barnes

Jos. Ackman Jr.

Inventor

Carroll H. Frink

By Victor J. Evans

Attorney

C. H. FRINK.

APPARATUS FOR THE ADMINISTRATION OF GENERAL ANESTHETICS.

APPLICATION FILED MAY 25, 1909.

978,728.

Patented Dec. 13, 1910.

3 SHEETS—SHEET 2.

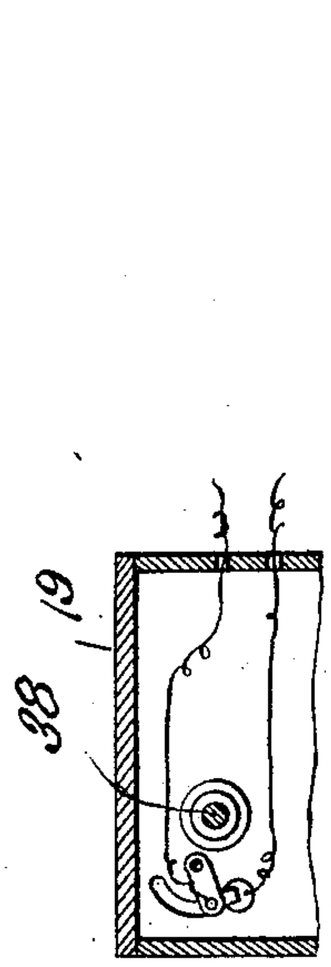

Fig. 4.

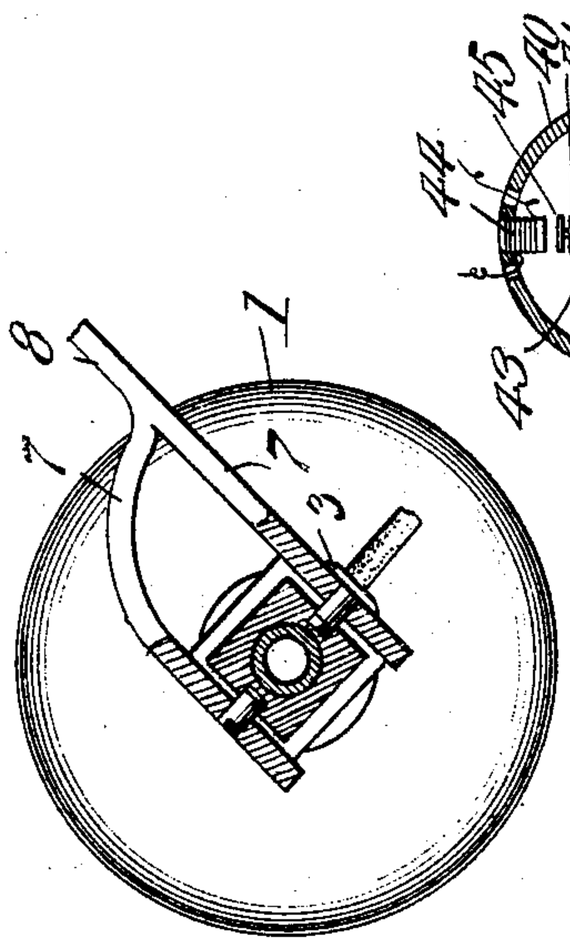

Fig. 5.

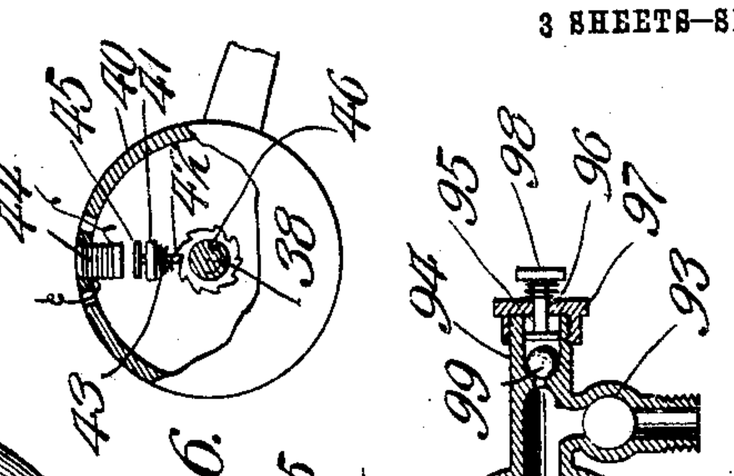

Fig. 6.

Fig. 7.

Fig. 3.

Fig. 1.

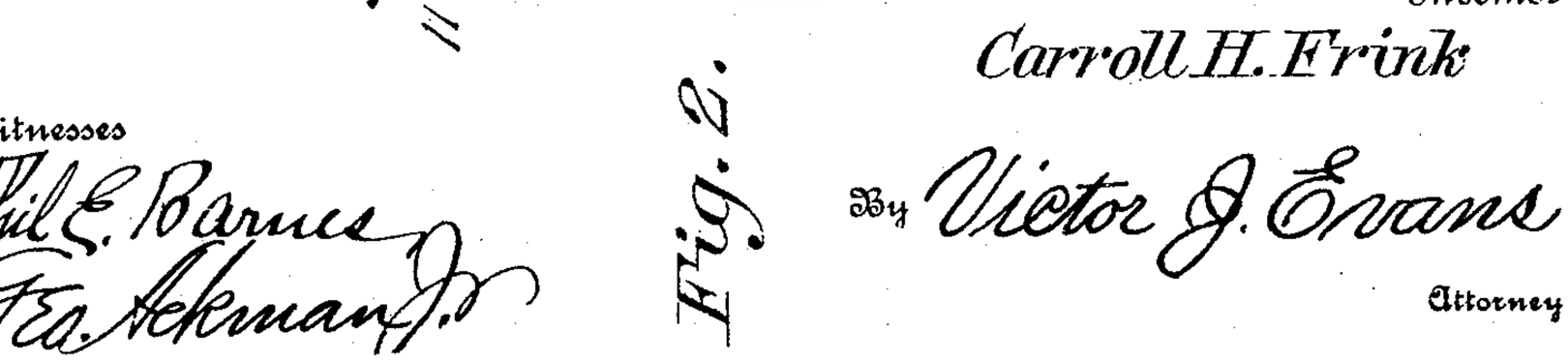

Fig. 2.

Witnesses

Phil E. Barnes

F. A. Ackerman Jr.

Inventor

Carroll H. Frink

By Victor J. Evans

Attorney

C. H. FRINK.

APPARATUS FOR THE ADMINISTRATION OF GENERAL ANESTHETICS.

APPLICATION FILED MAY 25, 1909.

978,728. Patented Dec. 13, 1910.

3 SHEETS—SHEET 3.

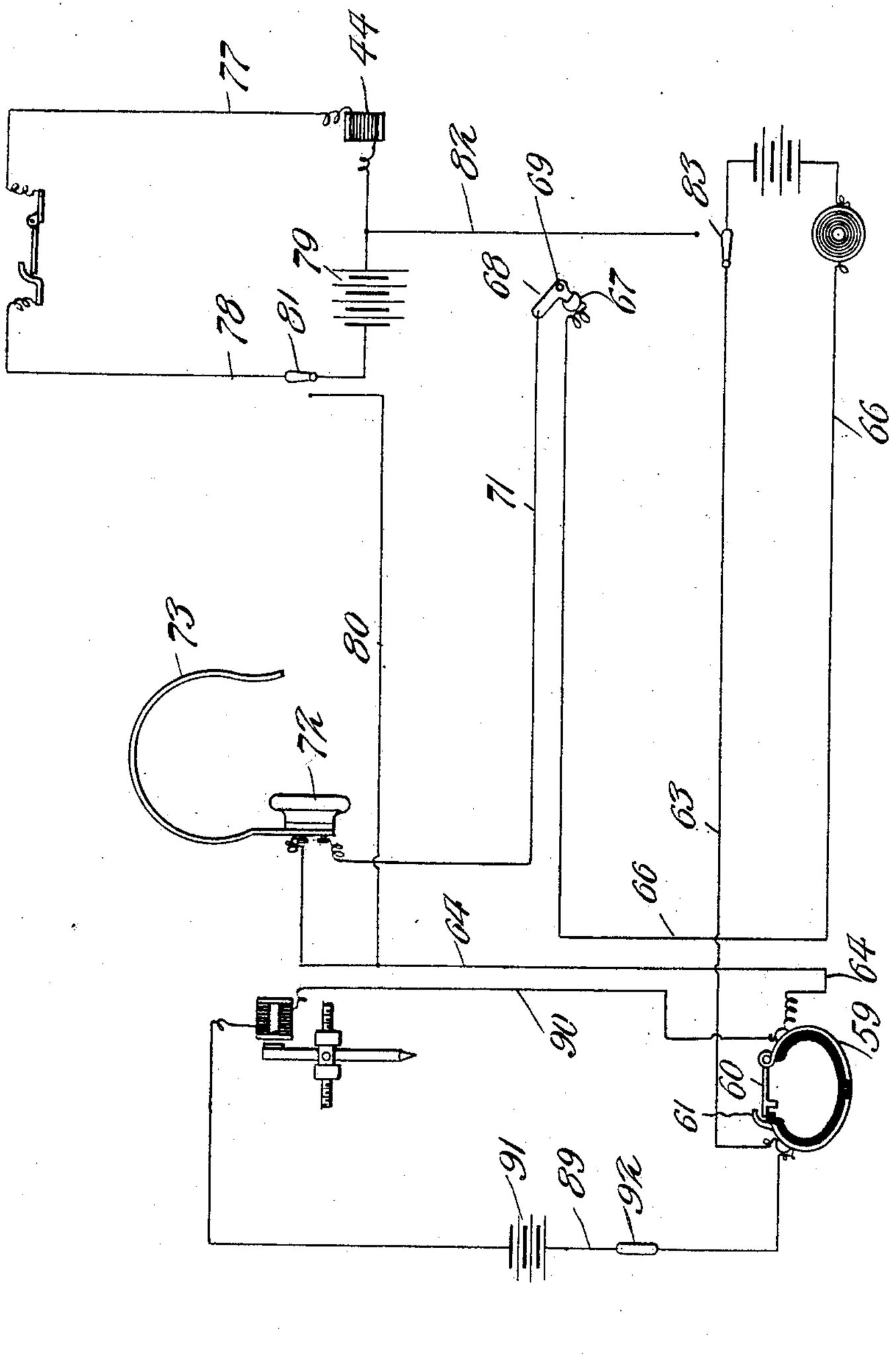

Fig. 8.

Witnesses
Phil. E. Barnes.
Fred. Ackman Jr.

Inventor
Carroll H. Frink
By Victor J. Evans
Attorney

UNITED STATES PATENT OFFICE.

CARROLL H. FRINK, OF JACKSONVILLE, FLORIDA.

APPARATUS FOR THE ADMINISTRATION OF GENERAL ANESTHETICS.

978,728. Specification of Letters Patent. Patented Dec. 13, 1910.

Application filed May 25, 1909. Serial No. 498,187.

To all whom it may concern:

Be it known that I, CARROLL H. FRINK, a citizen of the United States, residing at Jacksonville, in the county of Duval and State of Florida, have invented new and useful Improvements in Apparatus for the Administration of General Anesthetics, of which the following is a specification.

The invention relates to an improvement in apparatus for the administration of general anesthetics, and is particularly directed to a construction by which the condition of the patient may automatically control the apparatus.

The present invention is particularly designed for the administration of nitrous oxid gas and oxygen, and is particularly designed to enable the condition of the patient to directly control the admission of the nitrous oxid gas and oxygen, the construction providing for the immediate cessation of the administration of the nitrous oxid gas in the event of a weakness or stopping of the heart action and the immediate administration of pure oxygen or other similar agent, the construction also including a means whereby the administration of the anesthetic or of the pure oxygen is directly controlled by the exhalation of the patient entirely independent of the heart action.

In the administration of the anesthetics as ordinarily practiced the proper proportion of the gases noted, as well as the proper time to administer one or the other alone has been primarily dependent upon the skill and observance of the operator in noting respiration and circulation of the patient. In connection with the safeguard provided by the skill of the operator the present invention is designed to materially assist the anesthetist by constructing an apparatus which, while directly under the control of the operator, will functionate automatically by the condition of the heart action and the exhalation of the patient.

The invention will be described in the following specification, reference being had particularly to the accompanying drawings, in which:—

Figure 1 is a view in elevation of the improved apparatus. Fig. 2 is a sectional view taken through the casing, the mechanism within the casing being shown in elevation. Fig. 3 is an enlarged broken sectional view of the means for controlling the valve governing the oxygen supply. Fig. 4 is a broken sectional view, partly in elevation, showing the means for releasing the oxygen supply from control by the heart action. Fig. 5 is a section showing the independent free and valved outlets from the gas tanks. Fig. 6 is a broken sectional view illustrating the means for controlling the nitrous oxid supply by the heart action. Fig. 7 is a sectional view of the face mask for the patient. Fig. 8 is a diagrammatic view of the main circuits.

Referring particularly to the accompanying drawings, wherein similar reference numerals indicate like parts throughout the several views, the improved apparatus includes tanks 1 and 2 which may be of any usual or desired form, and which, for the purposes of the present description, may be noted as containing nitrous oxid gas and oxygen respectively. The tanks are practically duplicates, as shown in the accompanying drawings, each having a gas outlet 3 in communication with independent by-passes 4 and 5 controlled by a valve 6, so that the operator may direct the gas through either by-pass at will. The nipple constituting the gas outlet from the tank is supported in one arm 7 of a bracket 8, the other arm of said bracket being provided with a set screw to firmly hold the nipple 3 in place, as is usual in stock gas cylinders. The bracket extends between the tanks as a single arm, the branch ends formed by the arms 7 providing yokes to engage the tanks, all as clearly shown in Figs. 1 and 5. Centrally between the tanks the bracket is formed with a sleeve-like enlargement 9 in which is slidably mounted a rod 10, a set screw 11 coöperating with the sleeve enlargement and engaging the rod to support the latter in adjusted position. The upper end of the rod 10 carries a supporting section including spaced arms 12, and adjustably secured upon the rod intermediate the support 12 and sleeve 9 is a hanger arm 13, designed to engage and support a gas mixing bag 14. The bag is in direct communication with the by-pass nipples 4 of each tank through flexible pipe sections 15, and the outlet from the gas bag is in communication with a pipe section 16 which leads to an inhaling mask 17 designed when not in use to rest in the support 12, the

length of the pipe 16 intermediate the inhaler and gas bag being supported in a ring hanger 18 pendent from the support 12.

The above description constitutes in general the ordinary and usual form of apparatus for administering nitrous oxid and oxygen, and while I have described and illustrated such form of apparatus, it is to be understood that it is intended as an example only of the details noted, and that I contemplate for use with the improved mechanism to be later described any usual or preferred form of apparatus by which the gases desired to be administered may be mixed and delivered to the patient.

In constructing the improved apparatus for the automatic control of the administration of gases I arrange between the tanks 1 and 2 a casing 19. The casing 19 is preferably in the form of a metallic box-like body and together with the tanks 1 and 2 is supported upon a wheeled base 20 so that the apparatus as a whole may be conveniently removed from place to place. Leading from the by-pass nipple 5 and in communication therewith is a pipe section 21 which depends slightly in advance of the front wall of the casing 19, terminating above the central line of the case and being connected to a laterally projected pipe section 22, which extends partly across the face of the casing and is in turn connected to a pipe section 23, which, through the medium of a flexible pipe section 24, is connected to the supply tube 15 leading from the by-pass nipple 4 of the nitrous oxid tank. The by-pass nipple 5 of the oxygen tank 2 is also connected with a depending pipe section 25 which terminates in advance of and below the center of the casing and is in open communication with a laterally projected pipe section 25′ which extends across the face of the case below and in parallel relation to the pipe section 22 from the nitrous oxid tank. The pipe section 25′ is, through the medium of a pipe section 26 and a flexible tube or pipe 27, in communication with the supply tube 15 from the oxygen tank. It is thus evident that the operator by properly setting the valves 6 of the respective tanks may deliver the gases directly to the gas bag through the supply tubes 15 by means of the by-pass nipples 4, which is the ordinary method of administering the gases now in use, or may deliver the gases to the supply tubes 15 through the by-pass nipples 5 and the respective pipe sections arranged in front of the casing, in which event the passage of the gases will be controlled by the automatic apparatus of the present invention.

Arranged in the pipe section 22 leading from the nitrous oxid tank is a valve casing 28 in which is mounted a spring valve, of any desired form, so arranged as to cause the spring to normally maintain the valve open to permit a free flow of the gas. Mounted on the valve casing is a pivoted lever 29, the shorter or inner branch of which engages the stem 30 of the valve, while the longer or outer branch is provided with a weight 31 arranged to overbalance the spring of the valve so that when the lever is in lowered position under the influence of the weight the valve will be closed to prevent the passage of the gas from the tank to the gas bag, and when the lever is in elevated position, under the influence of the mechanism to be described, the spring of the valve will operate to open the same.

The pipe section 25′ in communication with the oxygen tank is provided with a valve casing 32 in which is mounted a spring pressed valve with the spring arranged to normally close the valve, there being pivotally mounted on the valve casing a lever 33 having the shorter arm underlying the stem 34 of the valve and the longer arm provided with a weight 35 arranged to overbalance the valve spring. In this construction when the lever 33 is in lowered position under the influence of the weight the valve is maintained open against the influence of the spring to permit a free passage of the oxygen from the tank to the gas bag, while when the lever is in elevated position, under the influence of the mechanism to be described, the valve will be closed by a spring to prevent the passage of the oxygen.

Mounted within the casing 19 on the rear wall thereof above the pipe section 22 is a clock work or similar mechanism 36 having a winding or operating key 37 projecting through the rear wall of the case in a conveniently accessible position. The power shaft 38 from the mechanism 36 projects transverse the case and through the forward wall a friction brake element 39 being arranged to engage the power shaft with a handle therefor extending beyond the upper wall of the case to permit the operator to control the speed of the shaft 38 at will. Loosely mounted upon the power shaft 38 beyond the forward wall of the casing is a lever head 40 of hollow construction. Slidably mounted in a guide member 41 secured to one wall of the head is a pawl 42, which, through the medium of a spring 43 is spring pressed in the downward or operative direction. Secured to the annular wall of the head is an electro-magnet 44, the pawl 42 being provided with a disk head 45 arranged to serve as an armature for the electro-magnet. Secured upon the power shaft 38 within the plane of the lever head is a ratchet wheel 46, and the pawl 42 is so arranged that when the electro-magnet is deënergized the spring 43 will operate to cause the pawl to engage one of the teeth of the ratchet, whereby the lever head 40 is locked to the

power shaft and rotated therewith. Upon the energization of the electro-magnet 44 the pawl is attracted and disengaged from the ratchet, thereby freeing the lever head 40 from the power shaft 38. The lever head 40 is provided with a radially extending arm 47 connected through the medium of a link 48 with the weighted end of the lever 29. From this construction it will be apparent that with the pawl 42 in operative position the power shaft 38, which, of course, is continuously rotated will operate to draw upwardly upon the weighted end of the lever 29 and thereby close the valves within the casing 28, while energization of the electro-magnet 44 will free the lever head from connection with the power shaft and permit said lever to drop to open the valve within the casing 28.

Mounted within the casing 19 against the rear wall thereof below the power mechanism 36 is additional and similar power mechanism 49, wound or set through a key 50 and having a power shaft 51 extending through the forward wall of the case, said power shaft being controlled by a manually adjustable brake element 52 extending through the side of the case. The power mechanism 59 is so arranged that the power shaft thereof projects through the forward wall of the case above the pipe section 25 from the oxygen tank, and on the power shaft, beyond the front wall of the case, is fixed a collar 53. Beyond the collar a disk 54 is keyed for independent longitudinal movement upon the shaft, while loosely mounted on the shaft between the collar and disk is a lever head 55, preferably of hollow construction, in which is arranged an electro-magnet 56, said magnet being so disposed that when energized it will attract the disk 54, binding the head between the disk and collar and thereby fixing the head to and for rotation with the shaft, the deënergization of the electro-magnet releasing the head for independent movement. An arm 57 projects radially from the lever head and is connected through the medium of a link 58 with the weighted end of the lever 33.

By the above described construction it is obvious that upon the energization of the electro-magnet 56 the lever head will be locked to the power shaft 51 with the effect to elevate the weighted end of the lever 33 and thereby close the valve in the casing 34, the deënergization of the electro-magnet freeing the lever head from the shaft and permitting the weighted end of the lever to fall with the effect to open the valve in the casing 34.

In conjunction with the mechanical features described I provide a means for controlling such mechanical features by the condition of the patient. It being desirable to control the administration of the anesthetic by the condition of the circulation and exhalations of the patient, I arrange for the circulatory control of the mechanism a wrist ring 59, having a movable section 60. The ring 59 is arranged to encircle the wrist of the patient with the movable section 50 overlying the radial artery and bearing upon that point at which the wrist pulse is perceptible. The ring, which is of conductive material is insulated from the skin of the patient, and terminates in a contact point 61, which overlies the free end of the movable section 60 of the ring. The contact 61 is so arranged relative to the movable section 60, that when the latter is elevated under the pulse influence it will engage the contact 61 and close the circuit at this point. From the ring on opposite sides of the contact point 61 extend conductors 63 and 64, the first of which leads to the casing 19 to and through one or more batteries 65 supported in the lower portion of the casing and from said batteries to the electro-magnet 56. From the electro-magnet 56 a conductor 66 extends to a point within the case adjacent the nitrous oxid control, terminating in a fixed contact 67. Mounted on the inner side of the case adjacent the fixed contact is a switch arm 68 normally in engagement with the contact 67, and held so by gravity or other suitable means. From the switch 68 there is projected a pin 69 which extends through a slot 70 in the face of the case and rests in the path of the arm 47 of the upper lever head. The parts are so arranged that when the arm 47 reaches a position near its upward limit of movement, it will engage the pin 69, and as the arm continues to rise will operate the pin to move the switch 68 from engagement with the contact 67, thereby breaking the circuit at this point. From the switch 68 a conductor 71 extends to an ordinary telephone receiver ear trumpet 72, to which is secured a head spring 73 for holding the receiver adjacent the ear of the operator. From the receiver 72 the current is led over the conductor 64, previously noted as projecting from the wrist ring. The electro-magnet of the nitrous oxid control is in circuit with the inhaling mask, and for the purpose of controlling this circuit said mask is formed with an outlet 74 normally closed by a section 75, the mask also carrying a contact 76 adapted to be engaged by the valve 75 when said valve is opened under the influence of the exhalations from the patient. The circuit is completed through conductors 77 and 78 leading respectively from the valve section 75 and the contact 76, the conductors leading through one or more batteries 79 supported on a shelf in the upper part of the case and to and through the electro-magnet 44.

Under certain conditions it will be found desirable to control the oxygen and nitrous

oxid supplies directly by the exhalations of the patient, and to permit such arrangement I lead a branch conductor 80 from the main conductor 64 to a point adjacent the conductor 78, including in the latter conductor a switch 81, whereby the current may be directed over the conductor 80 instead of through the batteries 79. In the conductor beyond the batteries I connect a bridge conductor 82, which extends to a point adjacent the main conductor 63, and also place a switch 83 in the conductor 63, so that the current may be directed over the conductor instead of the conductor 63.

As an auxiliary part of the present apparatus and in order to enable the operator to obtain a permanent record of the heart condition, as evidenced in the circulation of any particular patient, I arrange the recording apparatus including a power driven cylinder 84, adapted to receive a surface sheet and mount beyond the cylinder a revolving threaded shaft 85 on which is threaded a carrier 86. A fountain pen or other marking instrument 87 is secured upon the carrier and adapted to rest upon the surface sheet, the pen being mounted for a limited pivotal movement under the influence of the electro-magnet 88 also mounted upon the carrier. The electro-magnet is in circuit through conductors 89 and 90 with the wrist ring, so that upon each heart beat the electro-magnet is energized with the effect to move the pen and cause the writing end of the latter to indicate such movement upon the lines it is continuously drawing upon the surface sheet. The recording apparatus and circuit include a source of energy 91 and a switch 92 serving their usual functions, the recording circuit and apparatus being designed for use when a permanent record of a particular patient is desired, being otherwise eliminated if desired by operation of the switch 92.

In emergency cases it is at times necessary to use a particular restorative for the resuscitation of a patient, and the present apparatus makes provision for the use of such restorative. For example, as more particularly noted in Fig. 7, I provide the connection between the supply pipe 16 from the gas bag and the inhaling mask 17 with a valve 93, so that the supply of gas to the inhaler may be manually controlled at will. In the connection or in a hollow extension 94 thereof I arrange a plunger 95 having the stem 96 projected through a cap 97 closing the end of the extension, the stem being spring pressed in the outward direction and having a finger disk 98 at the outer terminal. The extension is in communication with the inhaler, and is so arranged that space is provided within the same in advance of the plunger 95 for the reception of a frangible globule, as 99, which may contain nitrite of amyl. In the event such restorative is essential the operator, by turning the valve 93, may cut off the supply of gas and by pressing the plunger may break the globule to permit the patient to directly inhale the restorative.

With the parts constructed and arranged as described the operation is as follows: Upon each heart beat of the patient the circuit, including the electro-magnet 56 and the telephone receiver, is energized. The closing of the circuit momentarily locks the lever head 55 to the power shaft 51, thereby elevating the lever 33 and closing the valve 34, cutting off the supply of oxygen. At intervals between the heart beats the lever head 55 is released from the shaft and the weight 35 on the lever 33 operates to restore the supply of oxygen. The delivery of the oxygen is thus directly controlled by the heart beats of the patient, a strong steady heart action inducing a continuous and proper supply of oxygen. At the same time each exhalation of the patient closes the circuit through the electro-magnet 44 withdrawing the pawl from the ratch 46 and releasing the lever head 40 from the shaft 38, thereby permitting the lever 29 to drop under the influence of the weight and open the valve 28 controlling the nitrous oxid supply. Therefore, as long as the heart beats and exhalations of the patients continue in the proper order the nitrous oxid and oxygen are properly delivered. Assuming, however, a dangerous condition in which the heart beats are so weak as to fail to operate the section 60 of the wrist ring to close the circuit, the electro-magnet 56 will not become energized, and will remain free of engagement with the shaft 51. This permits the lever 33 to drop to its extreme downward limit and thereby fully open the oxygen supply valve, admitting a full and constant supply of oxygen to the patient until the circuit is again closed by the heart beats. If the exhalations of the patient cease or become too weak to close the circuit at the inhaler, the electro-magnet 44 is not energized, and the pawl 42 will lock the lever head 40 to the shaft 38, causing the power mechanism to fully elevate the lever 29 and thereby close or cut off the supply of nitrous oxid. In the event the exhalations are absent for a given length of time the power shaft 38 will so elevate the arm 47 as to engage the pin 69 of the switch 68, and so elevate the switch as to break the circuit at this point. This will immediately cut out the wrist ring as a controlling medium for the oxygen supply circuit, and the oxygen supply valve will remain fully open entirely independent of any heart action until the exhalations are fully restored, when the electro-magnet 44 is again energized to release the lever head 40 and by such release permit the lever 29 to move downward and the

switch 68 to again close the circuit at the point noted.

By shifting the switches 81 and 83 through the conductors 80 and 82 respectively the entire operation may be controlled by the exhalations of the patient independently of the heart action as indicated at the pulse. Gages 100 are arranged in the respective pipe sections 22 and 25 between the valves therein and the respective tanks, said gages operating to indicate the pressure in the tanks.

As shown in Fig. 7 the gas inlet to the face mask is provided with a disk valve 101, which when the person inhales will permit the ready escape of the gas into the mask, but which closes automatically during the exhalation, the closing being due to the pressure of the exhaled air.

Having thus described the invention what is claimed as new, is:—

1. An apparatus for the administration of anesthetics including an anesthetic receptacle, a valve controlling the delivery from said receptacle to the patient, an electrical circuit for controlling the valve, and a circuit closer to control said circuit, said closer including a movable member influenced by the arterial pulsation of the patient.

2. An apparatus for the administration of anesthetics including an anesethetic receptacle, a valve controlling the delivery from said receptacle to the patient, an electrical circuit for controlling the valve, a ring made up of two sections respectively forming the terminals of the electric circuit, one of said sections including a movable member influenced by the arterial pulsation of the patient, whereby to make and break the circuit by the heart beats of the patient.

3. An apparatus for the administration of anesthetics including an anesthetic receptacle, a valve controlling the flow from said receptacle, an electric circuit adapted upon energization to operate the valve to permit a delivery from the receptacle, means to energize the circuit by the exhalations of the patient, and means for operating the valve to cut off the delivery from the receptacle upon the cessation of such exhalations.

4. An apparatus for the administration of anesthetics including an anesthetic receptacle, a valve controlling the delivery therefrom, means operated by the exhalation of the patient to open the valve, and means operated upon the cessation of such exhalations to close the valve.

5. An apparatus for the administration of anesthetics including a plurality of anesthetic receptacles, means for controlling the delivery from one receptacle, means for controlling the delivery from the other receptacle, and means governed by the exhalations of the patient for operating both of said controlling means.

6. An apparatus for the administration of general anesthetics including a plurality of anesthetic receptacles, means governed by the pulse of the patient for controlling the delivery from one receptacle, and means governed by the exhalation of the patient for controlling the delivery from the other receptacle.

7. An apparatus for the administration of anesthetics including a plurality of receptacles, means governed by the pulse of the patient for controlling the delivery from the first receptacle, means governed by the exhalations of the patient for controlling the delivery from the second receptacle, and means whereby the exhalation governed means may cut out the pulse governed means to control the delivery from the first receptacle independent of the pulse of the patient.

8. An apparatus for the administration of anesthetics including an oxygen receptacle and a nitrous oxid receptacle, a valve controlling the delivery from the oxygen receptacle, a valve controlling the delivery from the nitrous oxid receptacle, means for operating the first mentioned valve to close the same, means for operating the second mentioned valve to close the same, and means controlled by the exhalation of the patient whereby the first mentioned valve is released from its operating means and the second mentioned valve arranged within control of its operating means.

9. An apparatus for the administration of anesthetics including an oxygen receptacle and a nitrous oxid receptacle, means controlled by the pulse of the patient for cutting out the oxygen receptacle when the pulse is active, and means controlled by the exhalations of the patient for cutting out the nitrous oxid receptacle upon the cessation of such exhalations.

10. An apparatus for the administration of anesthetics including an oxygen receptacle and a nitrous oxid receptacle, a valve controlling the delivery from the oxygen receptacle, a valve controlling the delivery from the nitrous oxid receptacle, power means for operating the first valve in one direction, power means for operating the second valve in one direction, means operated by the pulse for releasing the valve of the oxygen receptacle from control of its power means, and means operated by the exhalations of the patient for releasing the valve of the nitrous oxid receptacle from control of its power means.

11. An apparatus for the administration of anesthetics including a plurality of receptacles, a valve for each receptacle, the valve of one receptacle being normally open, and the valve of the other receptacle being normally closed, means operated to close the normally open valve, means operated to open the normally closed valve, and means

controlled by the condition of the patient for releasing the normally open valve from its operating means and for arranging the normally closed valve beyond the control of its operating means.

12. An apparatus for the administration of anesthetics including a plurality of receptacles, a valve for each receptacle, one of said valves being normally open and the other normally closed, independent power means for closing the normally open valve and opening the normally closed valve, means controlled by the pulse of the patient for releasing the normally open valve from the influence of its operating means, and means controlled by the exhalations of the patient to arrange the normally closed valve within the influence of its operating means.

In testimony whereof I affix my signature in presence of two witnesses.

CARROLL H. FRINK.

Witnesses:

LULA J. PRATT,

E. I. BENNETT.