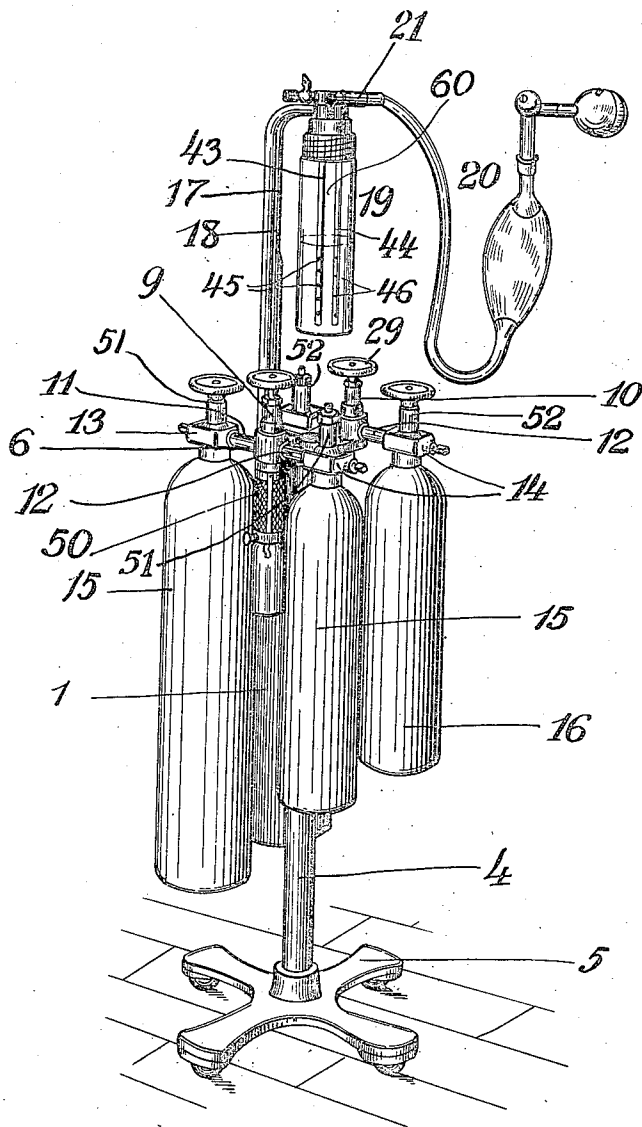


1,433,104.

Patented Oct. 24, 1922.  
 2 SHEETS—SHEET 1.

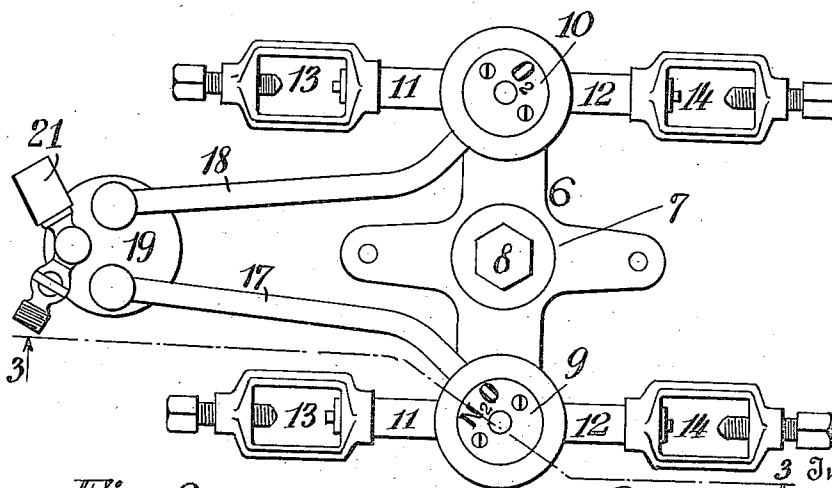
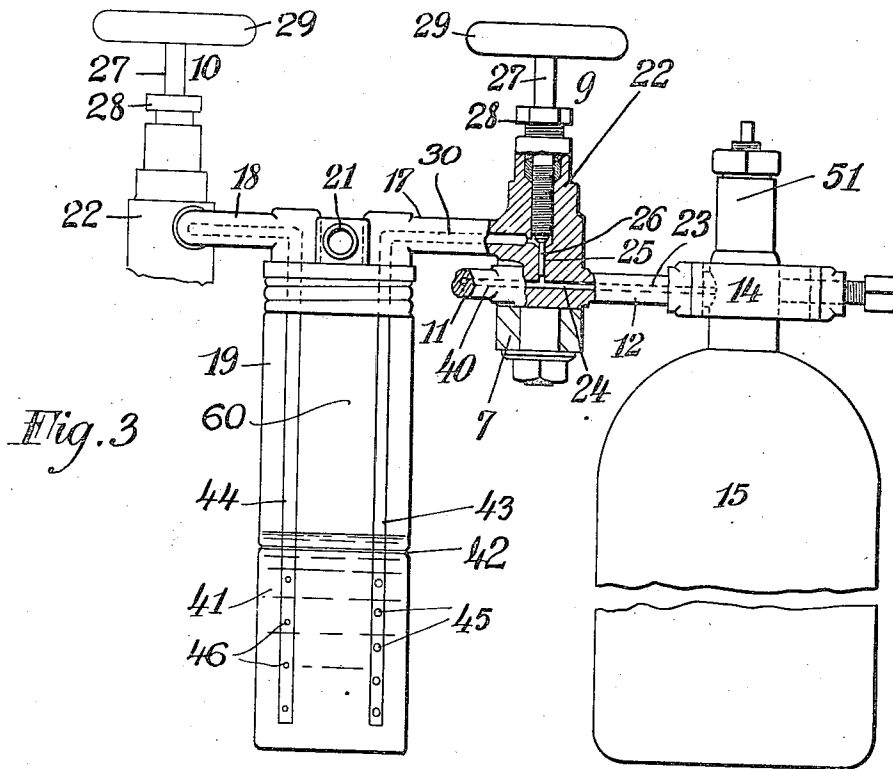
*Fig. 1*



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1,433,104.

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 2 SHEETS—SHEET 2.



By his Attorney  
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## UNITED STATES PATENT OFFICE.

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## APPARATUS FOR ADMINISTERING ANÆSTHETIC GASES.

Application filed September 27, 1917. Serial No. 193,593.

*To all whom it may concern:*

Be it known that I, RICHARD VON FOREGGER, a citizen of the United States of America, residing at Roslyn, Nassau County, State of New York, have invented a new and useful Apparatus for Administering Anæsthetic Gases, of which the following is a specification.

The invention relates to improvements in apparatus for administering anæsthetic gases and especially apparatus for the simultaneous regulated administration of a number of gases such as nitrous oxide and oxygen. Its primary objects are to simplify such apparatus and its management by eliminating the usual diaphragm type of pressure-regulating and reducing valve, and to render it more reliable in use by practically eliminating the tendency of the gas passages to become stopped by freezing, which often occurs from the sudden expansion of the gases in diaphragm valves. These and other results I secure by the substitution of a particular type of control valve, hereinafter described, in place of the usual control valve and the diaphragm reducing valve; this single valve performing the duties of both.

The invention is shown herein as embodied in a nitrous-oxide-oxygen apparatus comprising suitable means for supporting tanks of the gases under pressure and a sight feed device, and means for conducting the gas or gases to the patient. Fig. 1 is a perspective of the apparatus. Fig. 2 is a plan view of the head of the machine with the control valves, and Fig. 3 is an enlarged diagrammatic section on line 3—3 of Fig. 2.

Referring first to Figure 1, the reference numeral 4 denotes a stand or support provided with a suitable foot 5 to support it. At the upper end of the stand a bracket 6, comprising a central portion 7 secured to the stand by a bolt 8, see Fig. 2, supports the control valves 9 and 10 and the tubes 11 and 12 leading therefrom to the yokes 13 and 14 which are arranged to receive the nitrous oxide tanks 15, 15 and the oxygen tanks 16, 16 in the usual manner. From each of the control valves 9 and 10 tubes 17 and 18 lead to the sight feed 19 in which the gases bubble up through water and which is provided with a connection 21 for attachment to a suitable inhalation device 20.

It will thus be seen that the apparatus is designed symmetrically with the nitrous ox-

ide tanks on the one side and the oxygen tanks on the other side, and the hand wheels 29 of the control valves 9 and 10 for the respective gases are preferably labelled as indicated in Figure 2 so as to avoid confusion. In operation the gases pass from the tanks through their respective control valves into the sight feed and thence to the inhalation appliance.

The design of the control valves adapts them to give absolute control and regulation of the flow of the gases with substantially the same effect as obtained by the use of automatic pressure regulators, but without their inconveniences and uncertainties. These valves serve to reduce the gas pressure from the high pressure of the gas tank, frequently over a thousand pounds, to a pressure of a few inches of water as delivered to the inhaler and they maintain an equivalently uniform flow rate according to their adjustment. Each valve comprises a valve body 22 having a tube 12 connecting with the yoke 14 and a tube 11 connecting with the yoke 13. The bore 23 of the tube 12 and the bore 40 in tube 11 are both connected to a horizontal channel 24 in the body of the valve and this channel opens into the lower end of a cylindrical valve seat 25, in which a cylindrical valve pin 26 of uniform diameter is adapted to be operated, i. e., raised and lowered, by means of the valve stem 27 in threaded engagement with the upper part of the valve body 22. The valve stem passes through a stuffing box 28 and is operated by means of a hand wheel 29. The valve body is provided with an outlet tube 17 for connection with the sight feed 19. The bore 30 of this tube leads from the valve chamber at the upper end of the valve seat 25. When the valve stem is screwed down the valve pin 26 is moved down to the bottom part of the valve seat 25, where it completely cuts off the supply of the gas from the tanks, preventing the gas from passing into the bore 30. When the valve stem is rotated to screw it up, the flow may not start immediately because such rotation produces very little upward movement of the valve proper. At a certain point however, the valve 26 will have ascended sufficiently in its seat to allow some gas to pass through, which at the beginning may appear as only single bubbles in the sight feed, and further turning of the valve stem will increase the

rate of flow. The pressure of the gas is thus reduced and its rate of flow regulated in a fine degree. To secure these results, it will be observed from Fig. 3 of the drawing that the valve member 26 closely fits its cylindrical valve seat 25 and the gas passes axially through the crevice between them. Turning the handle 29 moves the valve axially within its seat to shorten the passage-way through the crevice and thereby increase the flow of gas, or to lengthen the crevice and thereby reduce the flow, according to the direction of turning, but neither movement changes the cross-area of the crevice, since both valve and seat are cylindrical. That is to say, the fine crevice between the valve and its seat, is a passage-way of constant cross-area and the control is exercised by changing the length of the said crevice without changing its cross-area. Such a valve I have found, when the valve proper is snugly fitted in the seat as shown in Fig. 3, is well adapted to control the flow of anæsthetic gaseous materials from their high pressure sources to the low pressure outlet, in that, on the one hand, it is capable of the finest adjustment from a position in which it permits the gas to pass not at all or so slowly that only single bubbles appear in the sight feed, up to a position of maximum flow, and on the other hand in that it is able to make the very great pressure reduction between the source and the outlet with little if any likelihood of freezing in the passage from rapid expansion.

From the two control valves the gases pass through the tubes 17 and 18 to the sight feed 19 which is preferably in the form of a glass bottle or vessel about half filled with water 41. An annular groove or ridge may be blown in the vessel to serve as a mark for the water level. The space within the vessel 19 forms a mixing chamber for the gases. For the sake of clearness the tubes 17 and 18 are shown in Figure 3 as extending in opposite directions to their respective control valves 9 and 10. The arrangement of these parts is shown in the preferred form in Figure 2. The gases pass from the tubes 17 and 18 into the two tubes 43 and 44 which extend to near the bottom of the vessel 19. The tube 43 communicates with the tube 17 for the supply of nitrous oxide and the tube 44 communicates with the tube 18 for the supply of oxygen. Below the water level the tube 43 is provided with five spaced holes 45, while the tube 44 has four spaced holes 46. The holes 45 and 46 occupy the same lengths on their respective tubes as shown. The holes 45 are approximately three times the size of the holes 46. By means of this arrangement the actual flow of the gas and oxygen may be observed and the proper proportion ob-

tained conveniently. It is well known that the sudden expansion of nitrous oxide (or carbon dioxide) when entering the chamber of a diaphragm reducing valve causes such lowering of temperature that the gas is apt to freeze whereby the gas passage becomes clogged and the gas flows irregularly or ceases entirely. My control valve excludes expansion that would cause freezing. The gas flows are therefore uniform and continuous without interruption at the required low pressure and a special heating device is not necessary, such as must be used with all apparatus worked with the customary diaphragm reducing valves.

The anæsthetic is administered by opening wide the usual tank valves 51 and 52 on the tanks 15 and 16 and permitting the gases to pass through the tubes 11 and 12 to the control valves by means of which the flows are adjusted as desired, and thence by way of the tubes 17 and 18 to the sight feed and from the latter to the inhalation appliance, it being understood that one tank 15 and one tank 16 is used at a time and two other tanks 15 and 16 are for reserve.

As shown in Fig. 1, the sight feed 19 may be supported above the tanks by simply arranging the tubes 17 and 18 accordingly, and the entire apparatus is preferably arranged symmetrically for ease of operation and accessibility, which features are also clearly apparent from an inspection of Figure 2. It is of course not necessary that there should be four tanks or that they should be of the same size. The number of tanks beyond two, one containing the nitrous oxide and one the oxygen, is immaterial, as is likewise the position of the sight feed.

It will be understood from the foregoing that the fine adjustability of my control valves renders the apparatus very economical in operation. The process of conducting a continuous supply of gases from the two tanks and to the sight feed while regulating and controlling the volume and percentages by the control valves aided by the visible gauging means results in a steady supply of uniform pressure when once the valves are set and renders the apparatus practically automatic in operation.

It will further be understood that I do not wish to limit my invention by the disclosure herein otherwise than required by the scope of the appended claims.

1. In an anæsthetic apparatus, the combination of a source of gas under pressure, an inhalation appliance, and an interposed manually operated control valve comprising two members providing a crevice forming a part of the passage connecting said source and inhalation appliance, said members being relatively movable at will to change the length of the crevice without substantially

changing its cross area, thereby varying the rate of flow in proportion to said change of length.

2. In an anæsthetic apparatus, the combination with a source of gas under pressure, an inhalation appliance, and an interposed manually operated control valve comprising a cylindrical seat and a closely fitting cylindrical valve pin therein providing an annular crevice through which the gas flows axially of the valve pin whereby the pressure of the gas is reduced, the cylindrical pin being movable axially within its enclosing cylindrical seat, to control the rate of flow, at the will of the operator

3. In an anesthetizing apparatus, the combination with a gas tank, a manually operated control valve, means for detachably connecting the tank and valve, and an inhalation appliance for receiving gas from the valve, said valve comprising a cylindrical valve seat and a closely fitting cylindrical valve pin therein through the crevice

between which the gas passes axially, the pin being movable axially by the operator to change the length of the crevice.

4. An anesthetizing apparatus comprising in combination with the source of anæsthetic gas under pressure, the inhalation appliance and the connecting tubing of a manually operated regulating valve comprising two members closely fitted to each other to form between them a minute crevice constituting the connection between the high and low pressure sides of the valve and means for moving one of said members to change the length of the crevice, the width of said crevice being predetermined to cause such member-movement to produce an anæsthetic range of flow variation without other means for pressure reduction or regulation.

In testimony whereof I have signed this specification.

RICHARD VON FOREGGER.