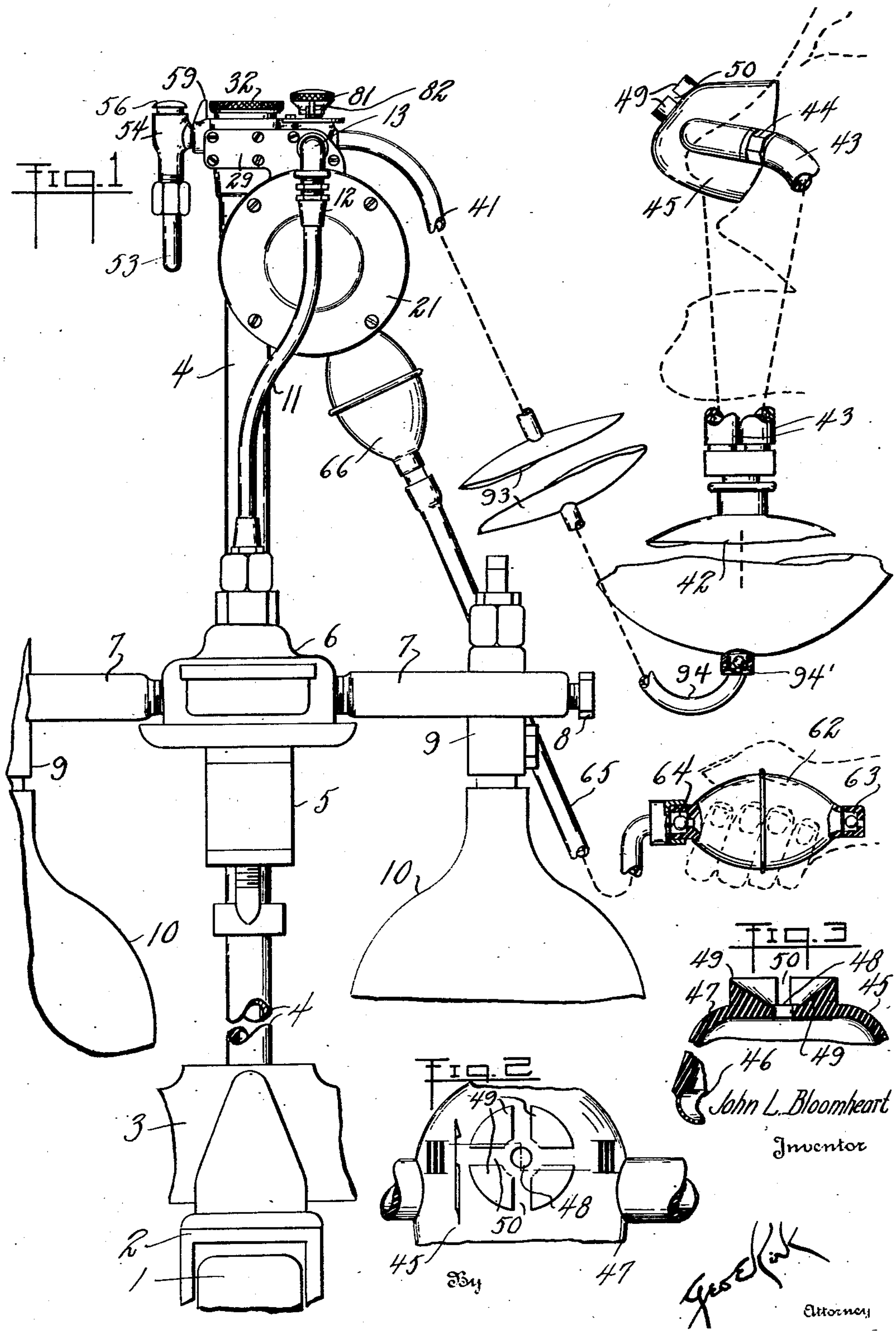
March 5, 1940. J. L. BLOOMHEART 2,192,429

GAS ADMINISTRATION

Filed Nov. 3, 1937 3 Sheets-Sheet 1



John L. Bloomheart

Inventor

By

Attorney

March 5, 1940. J. L. BLOOMHEART 2,192,429

GAS ADMINISTRATION

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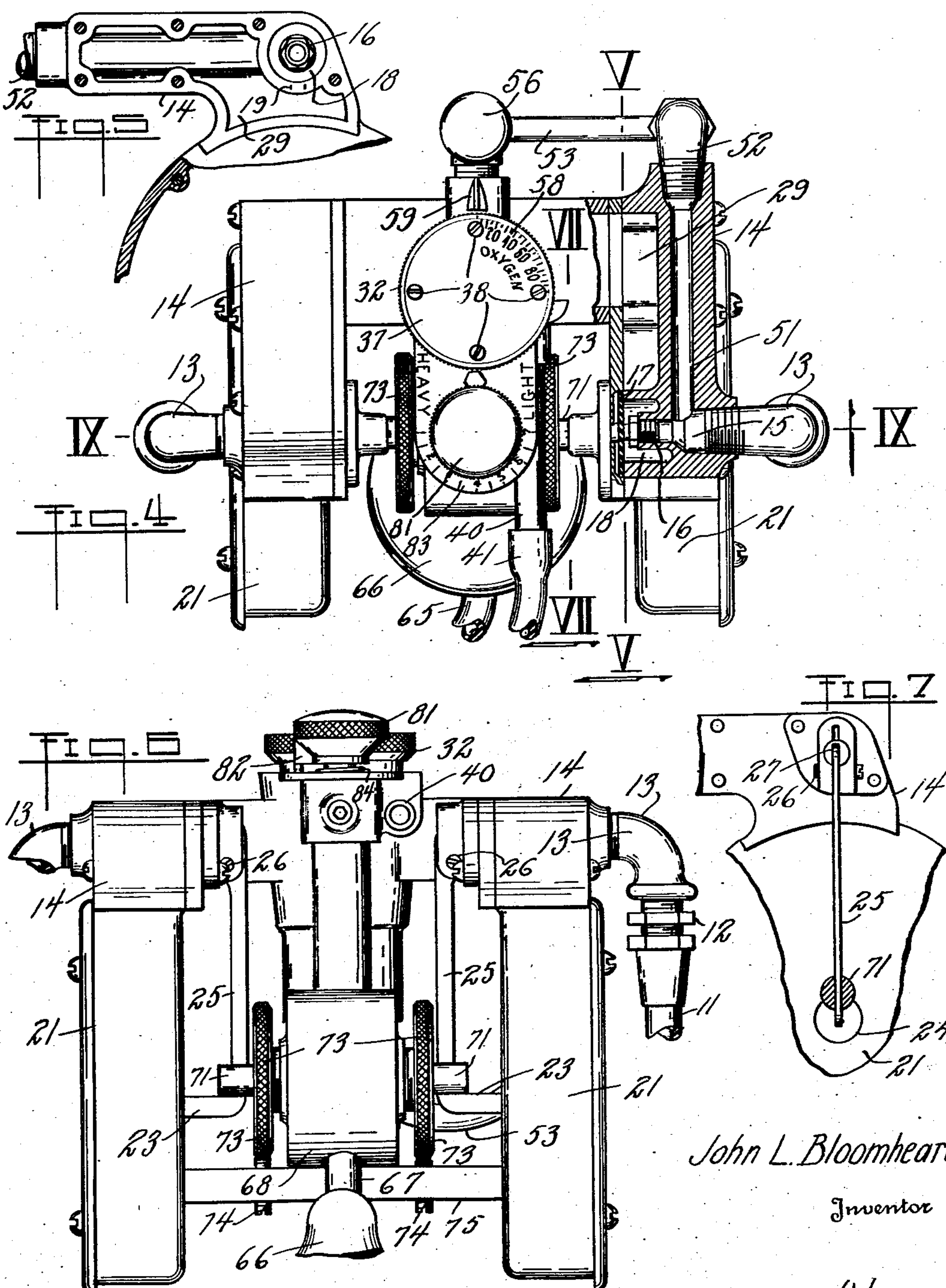

John L. Bloomheart
Inventor

By Geo E. Kirk
Attorney

March 5, 1940. J. L. BLOOMHEART 2,192,429

GAS ADMINISTRATION

Filed Nov. 3, 1937 3 Sheets-Sheet 3

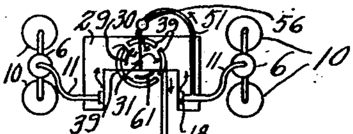

Fig. 8

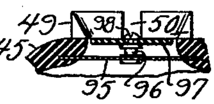

Fig. 15

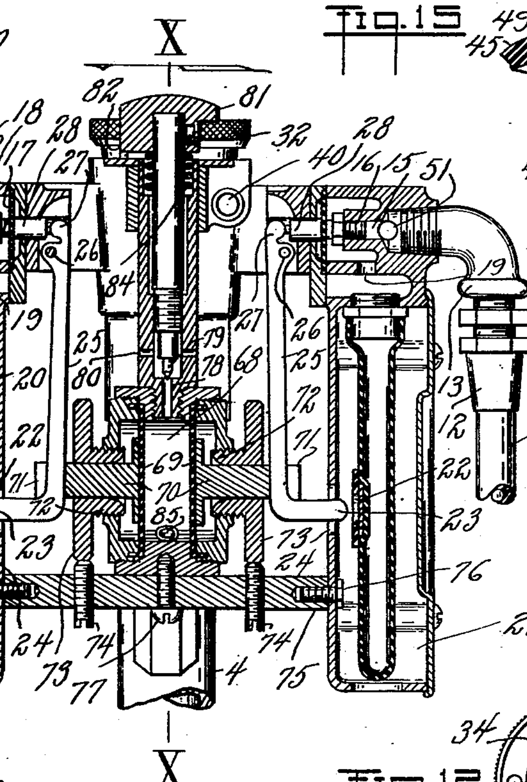

Fig. 9

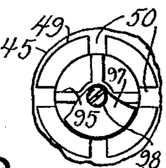

Fig. 16

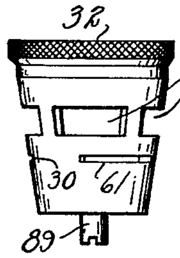

Fig. 11

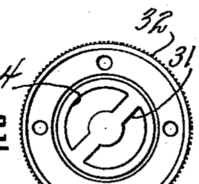

Fig. 12

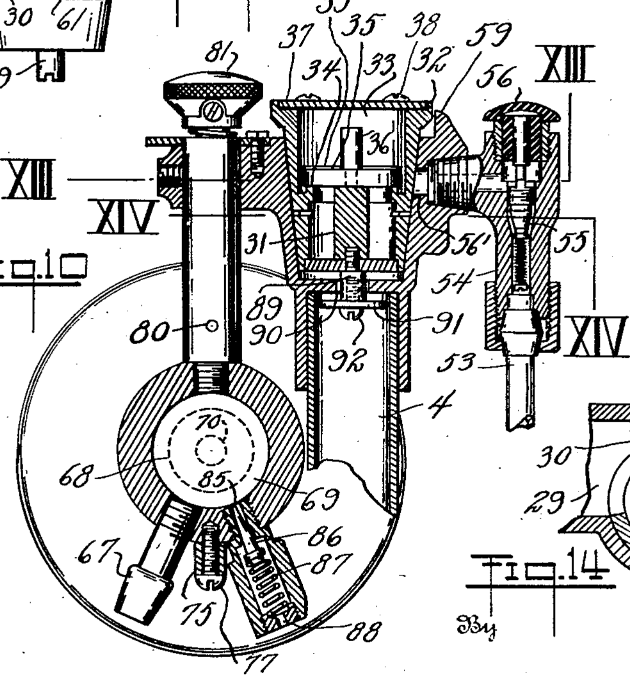

Fig. 10

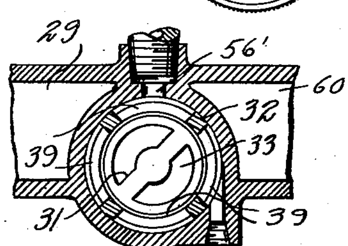

Fig. 13

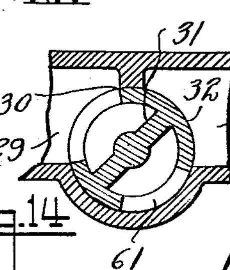

Fig. 14

John L. Bloomheart
Inventor

By

Attorney

Patented Mar. 5, 1940

2,192,429

UNITED STATES PATENT OFFICE

2,192,429

GAS ADMINISTRATION

John L. Bloomheart, Toledo, Ohio, assignor to Martha F. McKesson, Toledo, Ohio

Application November 3, 1937, Serial No. 172,500

17 Claims. (Cl. 128—203)

This invention relates to prescribing and controlling gases for a patient.

This invention has utility for resuscitation, anaesthesia, and analgesia. The latter may be effective under the control of the patient to modify the functioning of the apparatus.

Referring to the drawings:

Fig. 1 is a side elevation, with parts broken away, of an embodiment of the invention, more particularly as adapted for patient control in analgesia administration;

Fig. 2 is a fragmentary view looking into a form of mask from the back in which the spill port is open constantly to the atmosphere;

Fig. 3 is a section on the line III—III, Fig. 2, showing the port of the mask;

Fig. 4 is a plan view of the head of the gas administering machine of Fig. 1, parts being broken away;

Fig. 5 is a view of the gas supply fitting to the head on the line V—V, Fig. 4;

Fig. 6 is a view of the head from the front or right of Fig. 1, parts being broken away;

Fig. 7 is a view of the lever control for the gas supply to the head on the line VII—VII, Fig. 4;

Fig. 8 is a diagram in plan of ducts to and at the head, showing the gas flow passages from the support to and past the proportioning valve;

Fig. 9 is a section through the head on the line IX—IX, Fig. 4;

Fig. 10 is a view of the proportioning valve and patient control relief features on the line X—X, Fig. 9;

Fig. 11 is a detail view of the proportioning valve plug;

Fig. 12 is a plan view of the plug valve of Fig. 11 with the cover plate removed;

Fig. 13 is a section through the proportioning valve on the line XIII—XIII, Fig. 10, showing the gas flow ports therefrom;

Fig. 14 is a section on the line XIV—XIV, Fig. 10, showing the supply ports to the proportioning valve;

Fig. 15 is a view similar to Fig. 3 of a mask having an automatically variable spill or intake port; and

Fig. 16 is a view looking into the mask port of Fig. 15.

Rollers 1 (Fig. 1) on casters 2 at base 3 mount standard 4 as a tube carrying clamp bracket sleeve portion 5 mounting on opposite sides of the support tube 4 reducing valves 6 having oppositely extending yokes or arms 7 provided with clamping screws 8 mounting valve heads 9 of fluid supply cylinders 10, which may in practice hereunder be nitrous oxid cylinders in showing at the left side of the machine as in Fig. 1, while at the opposite side of the machine as facing to the right of Fig. 1 may be disposed the oxygen supply cylinders. These pressure gases may be under pressure of a plurality of atmospheres.

From the reducing valve 6 duct 11 rises to fitting 12 at elbow 13 entering head piece 14 (Fig. 9). This elbow 13 in head piece 14 is in communication with passage 15 having ported plug 16 therein normally thrust by gas pressure against flexible diaphragm 17 as a closed valve. At the opening of this valve, flow of the supply gas is into chamber 18 in the head with bypass therefrom through port 19 into flat disk-like rubber bag 20 in disk chamber providing housing 21. This rubber bag 20 has seat 22 thereon in position to be contacted by projection 23 through port 24 in the housing 21. This projection 23 is offset from lever arm 25 having fulcrum 26 and short arm 27 acting on plunger 28 to be thrust against the diaphragm 17 and hold such in closure position against the plug 16 as the bag 20 is expanded by gas supply therein.

From this chamber 18 in the head 14 the supply gas past the valve 17 normally flows by way of passage 29 (Figs. 8, 14) to port 30 at one side of the partition 31 in taper plug valve 32 of the proportioning valve. This plug valve 32 is tubular or has chamber 33 (Fig. 10). This chamber adjacent the top of the partition 31 has annular ledge 34 therein clear of the inner walls of the chamber. Resting on this ledge is valve disk 35 having selectively attachable weight or load 36 thereon, thereby adjustable as to its mass for holding this disk or check valve normally in closure position against flow of gas from the supply port 30 over the partition 31 or out from under the valve disk 35. However, as the unbalanced pressure lifts this valve disk, whether suction in the chamber 33 below closure cap 37 as mounted thereon by screws 38 or whether it be pressure from the supply lifting such valve disk 35, there is flow of this supply gas herein, thus far taken as nitrous oxid, not only into this chamber portion of the tubular plug valve 32 but therefrom by way of port or ports 39 thereabout into passage 40 to which is connected delivery duct 41 (Fig. 1), herein shown as extending to rebreathing bag or flexible reservoir 42, from which extends a pair of flexible ducts 43 to fittings 44 on opposite sides of nozzle or mask 45 say as adapted to fit over the nose of the patient. This mask 45 is shown as having soft flexible rim 46 (Fig. 3) engaging the flesh of the patient's face surrounding the nose.

From this flexible portion 46 there is conformable body portion 47 rising therefrom, say of heavier rubber.

Centrally, this mask or nozzle has port 48 normally at all times communicable with the atmosphere. In normal practice, this port may be say 3/32 inch in diameter. There is importance in certain ranges of operation hereunder that this port be protected against casual closure, say by a physician or patient getting the hand or some object thereagainst, tending to throttle this port 48. Accordingly, to obviate such as an unintentional practice, annular series of lugs 49 about this port have spacings 50 therebetween insuring air spillway from the port 48, except as the physician may intentionally insert a finger directly between these lugs to close the port 48.

Supply duct 11 to fitting 12 and elbow 13 (right Fig. 9) may be for dissimilar gas as oxygen to be supplied past ported plug 16 to flexible diaphragm 17 for spill into chamber 18 and a bypass by port 19 to the lever control device as to the valve 17. This supply gas from fitting 13 in advance of the ported plug 16 may pass by duct 51 (Figs. 4, 8, 9) to fitting 52, thence by U-duct 53 (Figs. 4, 10) to fitting 54 in which is located check valve 55, which may be unseated by pressure at button 56 to allow this pressure gas flow from this minor supply duct 53 by way of duct 56' not only into the chamber 33 of the plug valve above the check disk 35, but by way of ports 39 therefrom and passage 40 into supply duct 41 as emergency oxygen delivery controllable by the anaesthetist, attendant, or physician directly to the mask or nozzle as a resuscitating supply for the patient. Pulsing of this plunger 56 is effected by successive depressions timed for promoting inhalation. To this end there may be intermittent closure of the port 48 at the mask. This is a desirable factor for supplying oxygen-enriched respiration gas to the patient. The attendant may shut off the plunger 56 at the time of exhalation and remove the digit from closing the port 48. This practice permits exhalation gas to spill to the atmosphere.

When effecting anaesthesia for the patient, the control may be by the plug valve 32. The extent or ratio of the gases in proportion may be indicated by locating graduation 58 (Fig. 4) as to the pointer 59, which scale may be for the per cent of oxygen. With the nitrous oxid reduced or eliminated by the shifting of the port 30 out of register with the duct 29, there is greater exposure to oxygen supply passage 60 (Figs. 8, 14) for oxygen gas supply by way of port 61 into the plug valve 32 on the opposite side of the partition 31 from the port 30. This oxygen supply as in-flow gas lifts the check valve disk 35, enters the chamber 33 and passes therefrom through the passage 40 and duct 41. This is a gas to dilute the anaesthetizing gas to the mask. In this control there may be manipulation of the port 48 in the event the rebreathing bag 42 be not of sufficient lung capacity desired for the patient in economical gas functioning of the machine. This exhalation gas may have its back pressure at exhalation built up as the check disk 35 is seated to distend the bags 20 and thereby be effective through the levers to close the respective supply valves 17.

Hereunder there is supplemental patient control especially adaptable in analgesia. To this end, the hand of the patient may grip bulb 62 (Fig. 1). This bulb 62 is provided with check valve 63 for free entrance of air thereinto as this bulb 62 expands upon release. As this bulb 62 is compressed by grip of the patient, the valve 63 closes and check valve 64 from this bulb 62 is opened by this air pressure for a pumped quantity of air from the bulb 62 to pass by duct 65 through expansion chamber or bulb 66. In practice, this bulb 66 may not be equipped with valves. The bulb 66 is connected by fitting 67 (Fig. 10) with chamber 68 (Fig. 9) herein shown as having opposing side walls 69 of flexible disks and each directly acting upon plunger 70.

This plunger 70 as protruding has forked end 71 embracing lever arm 25. Surrounding this plug 70 is a sleeve forming an adjustable stop 72 threaded into this housing for the chamber 68. Adjustment of this stop 72 is effective to vary the clearance for movement of the plug 70 as to the sleeve 72. This means a positive limit for movement of the flexible disk 69. At the adjusted position for throw flexing of this diaphragm 69, this plug 72 is a stop and as such is determined from rotation of knurled disk 73 such disk may be engaged by set screw 74 in bar 75 assembled by screws 76 with the housings 21 and screw 77 with the housing for the chamber 68. It is thus seen that as the patient grips the bulb 62 the diaphragm 69 responds to throw the plungers 70 and thereby rock the lever arms 25 against whatever pressure may be in the bag 20 and thereby pneumatically effect, as patient controlled independent of respiration of the patient, an opening of the valve 17 for supply gas.

Were this set up gas tight, the check valve 64 might tend to hold the gas supply as a continuous flow during a period of respiration of the patient, whether or not there were subsequent gripping action. However, in the control herein, it is contemplated that the patient may manipulate for pain release. While the patient is conscious the patient may exert sufficient effort to promote anaesthesia gas flow in lieu of suffering pain from dental operation or in connection with labor.

To determine the interval which may be gaged for an inhalation or several inhalations, there is from the chamber 68 port 78 in which is located needle valve 79, which as clearing the port allows spill by port 80 to the atmosphere. This needle valve is adjusted by manipulating cap 81 (Figs. 4, 9) to bring pointer 82 thereon in position along scale 83. This adjustment may be in practice say at the reading "light" at the right at the number 7 to a quantity as say 200 cc. of anaesthesia gas, say straight nitrous oxid as against say 1000 cc. of straight nitrous oxid gas at the left or "heavy" and proportionate inhalation as may be in order to exhaust such flow from the supply duct 41 as normally free and flowing into the mask 45 to be more readily inhaled through the nostrils than as spilled through the port 48 as open to the atmosphere. Spring 84 at this needle valve device adjacent the cap 81 offers frictional means against ready disturbance of this proportioning as determined by the attendant or anaesthetist independent of the patient.

Should the patient respond to an acute pain by several successive squeezes of the bulb 62 as in quick succession, the result is not one materially to disturb the control adjustment as set by the physician or attendant in the control at the gage 83, for this chamber 68 has therefrom port 85 (Fig. 10) controlled by relief valve 86 having its spring 87 adjusted by ported nut 88. In practice, it is desirable to adjust this relief valve so that there is less than two capacities of the bulb 62 in the chamber 69 at any time. This means that a succession of compressions of the bulb 62 would only carry on slightly beyond the inhalation supply of anaesthetizing gas for which the administration is set. Should the patient be sufficiently conscious to grip as the pressure in the chamber 68 has approached the condition for the valve disk 17 approximately in closing, then there is an elongation of the period for supply. This character of control is to be effective for the patient when conscious. Accordingly, as the conscious condition of the patient departs, the valve should be free for closing to cut off anaesthesia gas supply. In the event the patient may have maintained grip, the relief valve coacts so there may not be a continuation of the supply.

Under the disclosure herein there is a simplified mechanical set-up for wide range of gas administration as anaesthetist, physician, or attendant controlled, whether for resuscitation, for anaesthesia administration, for analgesia by physician, anaesthetist, or attendant, or as to the analgesia as patient controlled. The patient control is subordinate to the proportioning spill to limit patient control and the manipulations incident thereto. Accordingly, there is reliability in this set-up acceptable to meet wide ranges of operating conditions, not only in the dental field but in physician's and surgical fields as well.

The proportioning valve plug 32 is not displaced to disturb its port relation axially, for screw extension 89 (Fig. 10) is through port 90 to carry disk 91 mounted thereon by screw 92. The plug 32 is accordingly locked against removal upwardly without taking off the support tube 4.

Disk 73 may be set for predetermined flow rate control of the respective valves 17.

In practice there may be satisfactory operation hereunder with the single reservoir or expansible rebreathing bag 42. Factors toward disturbance may arise when the patient takes a deep quick heavy breath to inhale, deliberately takes a long inhalation, or when breathing may be quick and shallow or deep and variable. With the mask port 48 of Fig. 3 there may be depletion of the bag 42 or filling thereof with the spill and intake at port 48 of such extent that the patient so reduces the control of the anaesthetic as to detract from the efficiency of the functionings hereunder.

To offset these factors there may be instead of the single reservoir 42 an intermediate reservoir 93 in the line 41 connected to the reservoir 42 by duct 94 with check valve 94' effective to hold the contents of the bag 93 against exhalation contamination. Under this mode of control, say with the bag or reservoir 93 of 1,000 cc. capacity for the nitrous oxid, oxygen, or other anaesthetizing gas, its composition as determined by the valve 32 is against disturbance. The exhalation after the bag 42 has been collapsed may be to distend such back, say for 200 cc. capacity, thereby having the carbon dioxid therein to promote respiration of the patient at the next inhalation.

The course taken to insure that this reservoir 42 has the rebreathing capacity charge thereinto is effected by providing in the mask 45 a spider 95 centrally carrying a stem 96 mounting a flexible disk 97 as anchored by screw 98. This disk 97 is normally close to closure position in its coaction with the mask 45. Its degree of flexibility say as a rubber or like flexible disk is such that exhalation when rapid or quick may tend first to inflate the reservoir or bag 42 and then spill by flexing the disk 97 outwardly with the response such that no labor is upon the breathing of the patient. At once this exhalation is discontinued, the disk 97 resumes normal position against spill from the bag 42 therefrom even at inhalation. This means that upon inhalation the draft by the patient upon the mask 42 is first to deplete the bag 42, then to lift the check valve 94' and supplement this inhalation by the anaesthetizing gas from the bag or reservoir 93. Should this intake be excessive beyond the immediate response of these supplies, the disk 97 will flex toward the spider 95 and thereby avoid distress to the patient by insuring full gas supply by intake supplement from the atmosphere. The proportioning may be so nicely controlled that there is conserving of the anesthetic gas with retention of its properties for efficient conducting of the functioning of the machine hereunder. These features of mechanical control are thus in a range undisturbed by the patient control factors hereunder. The mask 45 is thus equipped with a reversibly operable automatically variable effective area flow port.

What is claimed and it is desired to secure by Letters Patent is:

1. A gas administering machine embodying a support, a supply tank mounted on the support, a chambered head, a reducing valve between the support and head, flexible diaphragm valve means at the head controlling flow of supply gas from the reducing valve into the head, flow means to the patient including a mask having a port normally constantly communicable with the atmosphere, and patient control means for the valve means at the head and operable independently of the port at the mask and independently of respiration gas flow.

2. A gas administering machine embodying a head, supply means to the head, a proportioning valve in the head operable to vary the relation between the supplies as flowing from the head, through flow means to the patient from the head including a mask having a normally constantly open spill port to the atmosphere respiration by the patient through the mask tending to effect intermittent gas flow past the proportioning valve, and patient control pneumatic means connected to said supply means for there disturbing said respiration gas intermittent flow.

3. A gas administering machine embodying a support, a supply tank mounted on the support, a chambered head, a reducing valve between the support and head, flexible diaphragm valve means at the head controlling flow of supply gas from the reducing valve into the head, and flow means to the patient including a mask having a port normally constantly communicable with the atmosphere, there being lugs about said mask port exteriorly of the flow means to the patient shielding the port against casual closure.

4. A gas administering machine embodying a support, a supply tank mounted on the support, a chambered head, a reducing valve between the support and head, flexible diaphragm valve means at the head controlling flow of supply gas from the reducing valve into the head, flow means to the patient including a mask having a flow responsive intake and spill port to the atmosphere, there being a control lever for the diaphragm valve means, and an adjustable abutment shiftable against the lever for varying the control operation of the valve means.

5. A gas administering machine embodying a support, a supply tank mounted on the support, a chambered head, a reducing valve between the support and head, flexible diaphragm valve means at the head controlling flow of supply gas from

the reducing valve into the head, flow means to the patient including a mask, patient control means independent of respiration gas flow comprising a chamber in the head, a flexible diaphragm wall for said chamber, a plunger operable by said diaphragm for determining valve means control, and a manually controllable pneumatic device from the patient to the chamber for effecting functioning of said plunger.

6. A gas administering machine embodying a support, a supply tank mounted on the support, a chambered head, a reducing valve between the support and head, flexible diaphragm valve means at the head controlling flow of supply gas from the reducing valve into the head, flow means to the patient including a mask having a normally constantly open spill port to the atmosphere, patient control means independent of respiration gas flow for valve means control, and a predetermined-influence adjustable control extent for said patient control.

7. A gas administering machine embodying a support, a supply tank mounted on the support, a chambered head, a reducing valve between the support and head, flexible diaphragm valve means at the head controlling flow of supply gas from the reducing valve into the head, flow means to the patient including a mask having a variably open spill port to the atmosphere, respiration by the patient through the mask tending to effect intermittent gas flow at the valve means, and patient control means disturbing said respiration intermittent gas flow embodying a manually operable bulb for a pneumatic control of said diaphragm means.

8. A gas administering machine embodying a support, a supply tank mounted on the support, a chambered head, a reducing valve between the support and head, flexible diaphragm valve means at the head controlling flow of supply gas from the reducing valve into the head, flow means to the patient including a mask having a reversibly open flow port to the atmosphere, respiration by the patient through the mask tending to effect intermittent gas flow at the valve means, and patient control means disturbing said respiration intermittent gas flow embodying a manually operable valve bulb for a pneumatic control of said diaphragm means.

9. A gas administering machine embodying a support, a supply tank mounted on the support, a chambered head, a reducing valve between the support and head, flexible diaphragm valve means at the head controlling flow of supply gas from the reducing valve into the head, flow means to the patient including a mask having an automatically responsive flow port to the atmosphere, respiration by the patient through the mask tending to effect intermittent gas flow at the valve means, patient control means disturbing said respiration intermittent gas flow, embodying a manually operable bulb, a duct therefrom, and diaphragm control means for the valve means operable from said bulb.

10. A gas administering machine embodying a support, a supply tank mounted on the support, a chambered head, a reducing valve between the support and head, valve means at the head controlling flow of supply gas from the reducing valve into the head, flow means to the patient including a mask having an automatically reversible port to the atmosphere, respiration by the patient through the mask tending to effect intermittent gas flow at the valve means, patient control means disturbing said respiration intermittent gas flow, embodying a manually operable bulb, a duct therefrom, diaphragm control means for the valve means operable from said bulb including a chamber, and an adjustable spill from said chamber.

11. A gas administering machine embodying a support, a supply tank mounted on the support, a chambered head, a reducing valve between the support and head, valve means at the head controlling flow of supply gas from the reducing valve into the head, flow means to the patient including a mask having an automatically variable port to the atmosphere, respiration by the patient through the mask tending to effect intermittent gas flow at the valve means, patient control means disturbing said respiration intermittent gas flow, embodying a manually operable bulb, a duct therefrom, diaphragm control means for the valve means operable from said bulb including a chamber, and an adjustable stop for varying the control of the means.

12. A gas administering machine embodying a support, a supply tank mounted on the support, a chambered head, a reducing valve between the support and head, valve means at the head controlling flow of supply gas from the reducing valve into the head, flow means to the patient including a mask having a reversible automatically variable port to the atmosphere, respiration by the patient through the mask tending to effect intermittent gas flow at the valve means, patient control means disturbing said respiration intermittent gas flow, embodying a manually operable bulb, a duct therefrom, diaphragm control means for the valve means operable from said bulb, including a chamber, and a relief valve from the chamber.

13. A gas administering machine embodying a support, a supply tank mounted on the support, a chambered head, a reducing valve between the support and head, flexible diaphragm valve means at the head controlling flow of supply gas from the reducing valve into the head, flow means to the patient including a mask having a port to the atmosphere, and a flexible disk having clearance of said port at all times and shiftable as disturbed by pressure in the mask for spill or intake response increased clearance at said port.

14. A gas administering machine embodying a support, a supply tank mounted on the support, a chambered head, a reducing valve between the support and head, movable means at the head controlling flow of supply gas from the reducing valve in the head, flow means to the patient including a reservoir, and a mask, and patient control means for the movable means at the head including a bulb to be grasped by the patient and a tube in communication from said bulb to the movable means having a port to the atmosphere, and a flexible disk having clearance of said port at all times and shiftable as disturbed by pressure in the mask for spill or intake response increased clearance at said port subordinate to said reservoir.

15. A gas administering machine embodying a support, a supply tank mounted on the support, a chambered head, a reducing valve between the support and head, flexible diaphragm valve means at the head controlling flow of supply gas from the reducing valve into the head, flow means to the patient including a primary gas reservoir, a secondary rebreathing gas reservoir, a valve precluding flow from the secondary reservoir to the primary reservoir, a mask in communication with the secondary reservoir, said mask having a port

to the atmosphere, and a flexible disk having clearance at said port at all times and shiftable as disturbed by pressure in the mask to increase said clearance for spill subordinate to said secondary reservoir or for intake subordinate to said secondary and primary reservoirs.

16. A gas administering machine embodying a support, a supply tank mounted on the support, a chambered head, a reducing valve between the support and head, flexible diaphragm valve means at the head controlling flow of supply gas from the reducing valve into the head, flow means to the patient including a mask having an automatically responsive flow port to the atmosphere, said valve being adapted to effect intermittent gas flow upon respiration by the patient through the mask, patient control means disturbing said respiration intermittent gas flow, embodying a manually operable bulb, a duct therefrom, and diaphragm control means for the valve means operable from said bulb.

17. A gas administering machine embodying a support, a supply tank mounted on the support, a chambered head, a reducing valve between the support and head, flow means to the patient including a mask having an automatically responsive flow port to the atmosphere flexible diaphragm, valve mechanism tending to effect intermittent gas flow upon respiration by the patient through the mask, patient control means disturbing said respiration intermittent gas flow embodying a manually operable bulb, a duct therefrom, and diaphragm control means for the valve mechanism operable from said bulb.

JOHN L. BLOOMHEART.