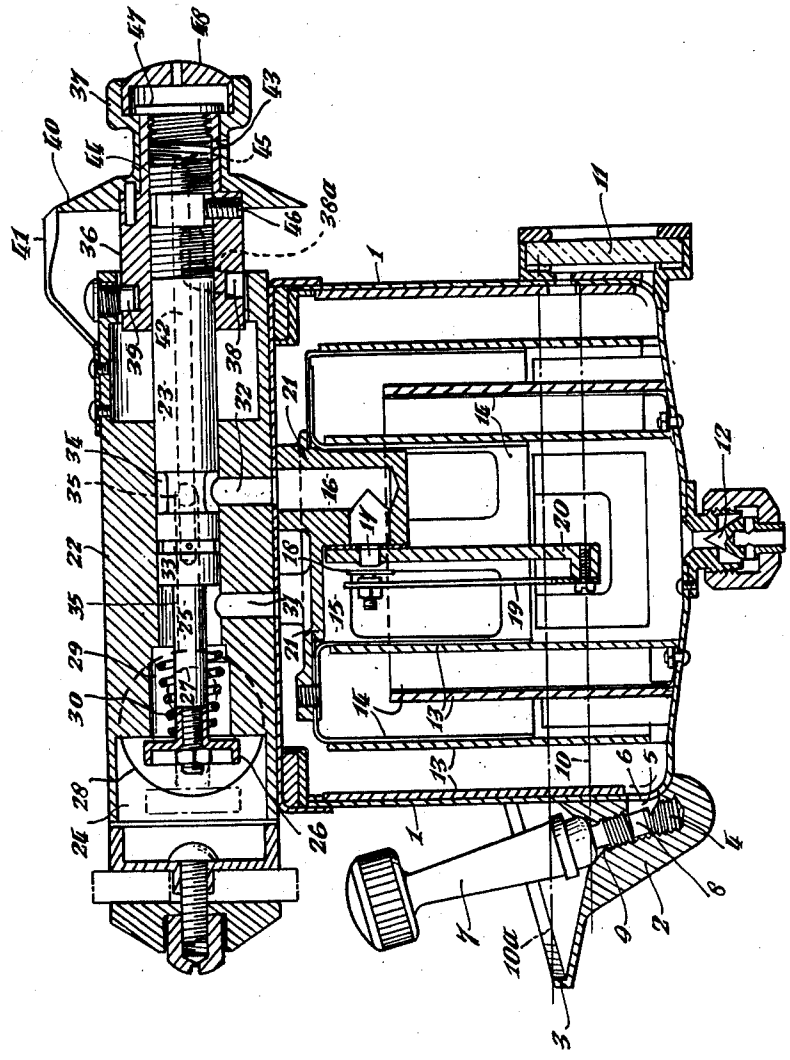
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VOLATILE ANAESTHETIC VAPORISING APPARATUS

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VOLATILE ANAESTHETIC VAPORISING APPARATUS

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This invention relates to apparatus for mixing the vapour of a volatile anaesthetic with a gaseous fluid such as air, oxygen or nitrous oxide, or a combination thereof, all of which for convenience are hereafter included in the term "gas."

Various types of apparatus of the above kind have been produced and this invention is concerned with apparatus wherein gas can be passed straight through to an outlet or a portion of the gas passed through the vaporizer so that a percentage of the volatile anaesthetic is added to the out-flowing gas. Hitherto difficulties have been experienced in providing said apparatus with efficient and simple control means for regulating the flow of a gas and vapour mixture and the main object of this invention is to provide means for solving this problem.

According to the present invention there is provided vaporizing apparatus for a volatile anaesthetic, including a valve housing having a main gas inlet and a main gas-vapour outlet with a valve controlled by-pass passageway therebetween, a gas inlet from the housing to a volatile anaesthetic vaporizing chamber with a temperature controlled vapour outlet from chamber to housing, the latter inlet and outlet being normally closed when the by-pass valve is fully opened and automatically opened by partial closure of said valve by manual control means to an adjustable gas-vapour regulating position, said control means being adapted to provide further adjustment of the valve towards the fully closed position for reducing the amount of by-pass gas and increasing the percentage of vaporised anaesthetic.

The invention provides vaporizing apparatus for a volatile anaesthetic, including a body casing to contain volatile anaesthetic which can vaporize in at least one chamber in the casing, a gas inlet to and a gas outlet from the casing, temperature controlled valve means for controlling the passage of gas-vapour mixture from said chamber to said outlet, a manual control valve associated with graduated scale means for normally closing said inlet and outlet and having an inner headed part for controlling the by-pass flow of gas from a main inlet to a main outlet, the arrangement being such that initial axial displacement of the manual control valve partially closes the by-pass passage for gas and uncovers the inlet to and outlet from the casing and further infinitely variable axial displacement between predetermined limits controls the relative proportions of by-pass gas and gas flowing to the vaporizing chamber.

The invention includes apparatus wherein the manual control valve comprises a piston-type member mounted to rotate about its own axis and have simultaneous longitudinal displacement when operated manually, said member having annular ports for the inlet of vaporizing gas to the casing and outlet of vapour therefrom. Said valve member may also be formed to act as pressure balancing means between the casing and the atmosphere.

The control valve member is preferably constructed to be axially adjustable in relation to its manual operating means for setting purposes.

The accompanying drawing illustrates an embodiment of the invention in a sectional view which will now be referred to:

The improved apparatus includes a body casing 1 for containing volatile anaesthetic and is furnished in its bottom region with a horizontally projecting hollow inlet body 2 for the introduction of a liquid anaesthetic. Preferably this inlet tube is constructed so that with the body casing 1 in a vertical position only a given quantity of anaesthetic can be introduced into the casing. As shown the inlet body 2 has a funnel-shaped top 3 leading to a screw-threaded passage 4 with a lateral opening 5 in register with a hole 6 in the wall of the casing 1. A removable plug 7 has its partly screw-threaded stem 8 entered into the passage 4 for the plug to make a metal to metal joint with the seating 9. Anaesthetic can be poured into the filler body 2 up to say the level 10 which showing in the mouth of the passage 4 is a ready tell-tale of the liquid level in the casing 1. Too much liquid anaesthetic cannot be poured into the casing 1 as it could not rise above the level 10*a* as it would spill over the lip of the top 3.

The casing is also furnished with a viewing window 11 in its wall to enable the level of the liquid to be seen at will and also a draining plug device 12, cock or valve, is furnished in the bottom of the casing.

The casing 1 contains a plurality of cylindrical wicks 13 of different diameters carried concentrically by the casing wall and perforated or other supporting means 14 and so arranged that liquid can be raised into a series of vaporizing chambers by capillary action. The arrangement is such that in effect vapour from the liquid anaesthetic rises into the upper region of the casing and converges inwardly into a central chamber 15 to pass out through an outlet passage 16 connecting with the top of the casing. The inlet port 17 to this outlet passage is controlled by adjustable valve means 18 carried by a temperature sensitive element 19 mounted within the casing. For example, said element is a bi-metallic strip secured at its lower end to a pendant arm 20 having the aforesaid inlet port 17 formed in the upper part thereof and said arm is carried by a mounting member 21 which carries some of the wick supporting means 14 and has the aforesaid outlet passage 16 formed therein.

The above body casing 1 has a valve body 22 mounted on its top to form a cylinder for a piston-type horizontal valve member 23 which is a neat working fit in the cylinder bore. At one end of the cylinder bore, within the valve body, is a communicating chamber 24 into which the inner stem end 25 of the valve member normally projects for its enlarged valve head 26 to control the flow of gas which enters laterally through a main inlet opening 27 into the valve body through the chamber 24 and then out through an enlarged gas-vapour outlet 28 to which any suitable connection may be made. The gas inlet enters into the open enlarged end 29 of the valve cylinder bore to flow round the said valve stem 25 and into the chamber 24, and a spring 30 bearing against the valve head 26 urges the valve member towards its normal open position. Through the wall of this valve cylinder is provided a gas auxiliary inlet passage 31 into the body casing 1 and parallel therewith is a vapour auxiliary outlet passage 32 in register with the aforesaid outlet passage 16 in the casing. Annular ports 33, 34 are provided in the valve member 23, and the stem 25 in effect forms a port between the member and the head 26, for said ports to register with the said inlet and outlet passages in the valve cylinder. A vapour duct 35 longitudinally in the valve body leads to the outlet 28 from a point adjacent the vapour outlet 32 and said duct is communicated with outlet 32 when annular port 34 is in register therewith as shown.

The outer end of the aforesaid valve member has an operating sleeve **36** secured thereon and such sleeve is furnished with a milled or other gripping knob **37** which enables the valve member to be rotated about its axis and given axial displacement. To give initial longitudinal displacement to the valve member **23** and further axial displacement when it is rotated, the sleeve is furnished with an annular cam groove **38** into which there is entered a pin **39** secured in the valve body **22**. The cam groove has a longitudinal straight part **38***a* and continues in a part-helical form. This sleeve is also furnished with a graduated indicator disc **40** which rotates in relation to a fixed pointer **41**, or the like, secured to the valve body.

Conveniently the valve member also serves for controlling the pressure within the body casing **1** and thus acts as pressure balancing means. The port **33** communicates through a hole and an axial passage **42** in the valve member with a space in the aforesaid operating sleeve **36** and from thence through a small orifice **43** in the sleeve to atmosphere. Thus when the valve member is in its inward or "vapour off" position for the through passage of gas, the annular port **33** will be in register with the gas inlet passage **31** to the body casing which will thus be in communication with the atmosphere for balancing the pressure in the casing. It will be appreciated that should there be an increase in temperature which would raise the pressure in the casing due to an increase in the vapour pressure there will be automatic relief to atmosphere through the aforesaid means.

The operation of the above apparatus is as follows: In the first instance the manual control valve is in what may be termed the "off" position with the head **26** of the valve at its furthest open point away from the open end **29** of the valve cylinder bore and the two aforesaid inlet and outlet passages **31**, **32** in the valve cylinder body **22** covered by piston parts of the valve member, i.e. shut off from the inlet **27** and outlet **28**. In this position of the valve the casing **1** will only be connected to atmosphere by means of the port **33** and passage **42** aforesaid. Moreover, the operating knob **37** will be in its innermost position with the fixed guide pin **39** lying at the forward end of the straight part **38***a* of the cam groove **38**. With the valve in this position all gas entering the apparatus by inlet **27** will be by-passed through chamber **24** to the main gas-vapour outlet **28**. To bring the vaporizer into action the operating knob **37** is drawn axially outwards until the pin **39** reaches the start of the spiral portion of the cam groove **38**. At this point the aforesaid inlet and outlet passages **31**, **32** to and from the casing **1** have been completely uncovered so that gas entering the apparatus can either be by-passed to the main outlet **28** or through inlet **31** into the vaporizer casing. In this manner the proportion of gas being by-passed straight to the main outlet **28** is controlled by the valve head **26** and the proportion of gas-vapour leaving the casing **1** through passages **16** and **32** is controlled by the aforesaid temperature controlled valve means **18**. The operating knob **37** can now be rotated and as the fixed pin **39** is in the spiral cam groove **38** there will be corresponding axial displacement of the valve member head **26** towards the open end of the cylinder bore which will gradually reduce the amount of gas being by-passed to the main outlet **28** and increase the amount of gas being passed into the casing **1** for vaporizing volatile anaesthetic and this consequently results in a stronger mixture through the aforesaid main outlet **28**.

Dealing now with the calibrations associated with the valve knob **37**, the marking "off" on the disc **40** can be used to indicate when the valve head **26** is in its extreme open position to show that the gas is not being allowed to flow to the vaporizing chamber **1**. When the knob is pulled out initially it reaches the point when rotary calibration takes place and the disc can have any suitable graduation marking to show that this is the percentage at which vapour mixture will pass from the apparatus. Preferably, the position of the valve member **23** for this start of rotary calibration is made axially adjustable so that the valve head position can be set by a manufacturer or service engineer to give a desired starting percentage of mixture. Conveniently, the end **44** of the valve member is screw-threaded to engage with internal screw-threads in the knob sleeve **36** and have an end slot **45** for the introduction of a screwdriver. By means of such a tool the valve member can be given axial displacement in relation to the knob and its sleeve to set the position of the valve head **26** and the adjustable setting retained by tightening up the grub screw **46**. To prevent interference a flanged ferrule **47**, which also serves to hold the knob on its sleeve, is screwed into the end of the sleeve **36**. A cap or other closure member **48** is used to close the open end of the knob. In this manner the screw setting of the valve member in relation to its operating knob decides the initial low percentage setting and the slope or angle of the spiral groove **38**, which may be of a pitch, or combination of pitches, to suit the calibration required, decides the range above this point. By providing this adjustment the vaporizing apparatus can be made to suit different types of volatile anaesthetic.

It will be understood the apparatus may be modified without departing from the scope of the invention and particularly the body casing **1** and its interior fitments may be constructed to suit requirements. If desirable, instead of using multi-wick means **13** a single cylindrical or other wick may be employed.

What we claim is:

1. Apparatus for vaporizing a volatile anaesthetic comprising a valve body having a main gas inlet, a main gas-vapor outlet, and a by-pass passageway providing communication between said main inlet and said main outlet, said valve body having also in a wall thereof an auxiliary inlet and an auxiliary outlet each in communication at one end with said by-pass passageway, a first valve member movable in said valve body for controlling the passage of fluid through said by-pass passageway and also the openings of said auxiliary inlet and said auxiliary outlet, a casing secured to said valve body, said casing having at least one volatile anaesthetic vaporizing chamber therein and first and second passage means providing communication between said vaporizing chamber and said valve body auxiliary inlet and outlet, respectively, second valve means in one of said casing passages for controlling the passage of fluid therethrough, temperature-responsive means for adjusting the opening of said second valve means as a function of temperature, and manual control means for progressively displacing said valve member with respect to said valve body to simultaneously open said valve body auxiliary inlet and said auxiliary outlet and to progressively close the communication through said by-pass passageway between said main gas inlet and said main gas-vapor outlet whereby the percentage of vaporized anaesthetic delivered from the body main outlet is increased.

2. Vaporizing apparatus as defined in claim 1 wherein said first valve member comprises a piston-type element having longitudinally spaced annular ports therein adapted to cooperate with the openings of said valve body auxiliary inlet and auxiliary outlet, said valve member being mounted for rotation about its longitudinal axis and also for axial movement relative to said housing.

3. Apparatus as defined in claim 2 wherein said first valve member has a reduced stem portion projecting axially at one end thereof, said stem portion terminating in a valve head adapted to cooperate with a valve seat in the valve body for progressively closing the by-pass passageway between said valve body main inlet and said main outlet.

4. Apparatus as defined in claim 3 wherein said valve body by-pass passageway constitutes a cylindrical bore within said valve body, said first valve member stem portion extending through a portion of said cylindrical bore

and said valve head having a diameter larger than the diameter of the cylindrical bore.

5. Apparatus as defined in claim 2 wherein said manual control means is adjustably connected to one end of said first valve member by means of an operating sleeve screw-threadably connected thereto.

6. Apparatus as defined in claim 5 wherein said operating sleeve has a cam-shaped groove in the outer periphery thereof of part-helical and part straight configuration, said valve body having a stationary pin engaging said cam-shaped groove so that the sleeve and the first valve member can be initially displaced axially and then rotated relative to the valve body to achieve controlled axial adjustment.

7. Apparatus as defined in claim 2 and further including spring means normally biasing said first valve member to fully open said by-pass passageway and to close the auxiliary inlet and auxiliary outlet passages.

8. Apparatus as defined in claim 2 wherein said first valve member includes a venting passage for venting to atmosphere said auxiliary inlet opening and thus said volatile anaesthetic vaporizing chamber when said valve member is in its normal fully open position.

9. Apparatus as defined in claim 1 wherein said casing includes a plurality of concentrically-arranged tubular wicks disposed vertically therein, said casing second passage means being centrally located with respect to said tubular wicks.

10. Apparatus as defined in claim 1 and further including filler means mounted in the wall of said casing through which a given quantity of anaesthetic may be introduced into said vaporizing chamber.

11. Apparatus as defined in claim 10 wherein said filler means comprises a filler body connected to the wall of said casing, said filler body having an internally screw-threaded inlet opening providing communication with the interior of said casing, and a plug screwed into said opening to make a joint with a seating, said filler body having a funnel-shaped entry to said opening.

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