

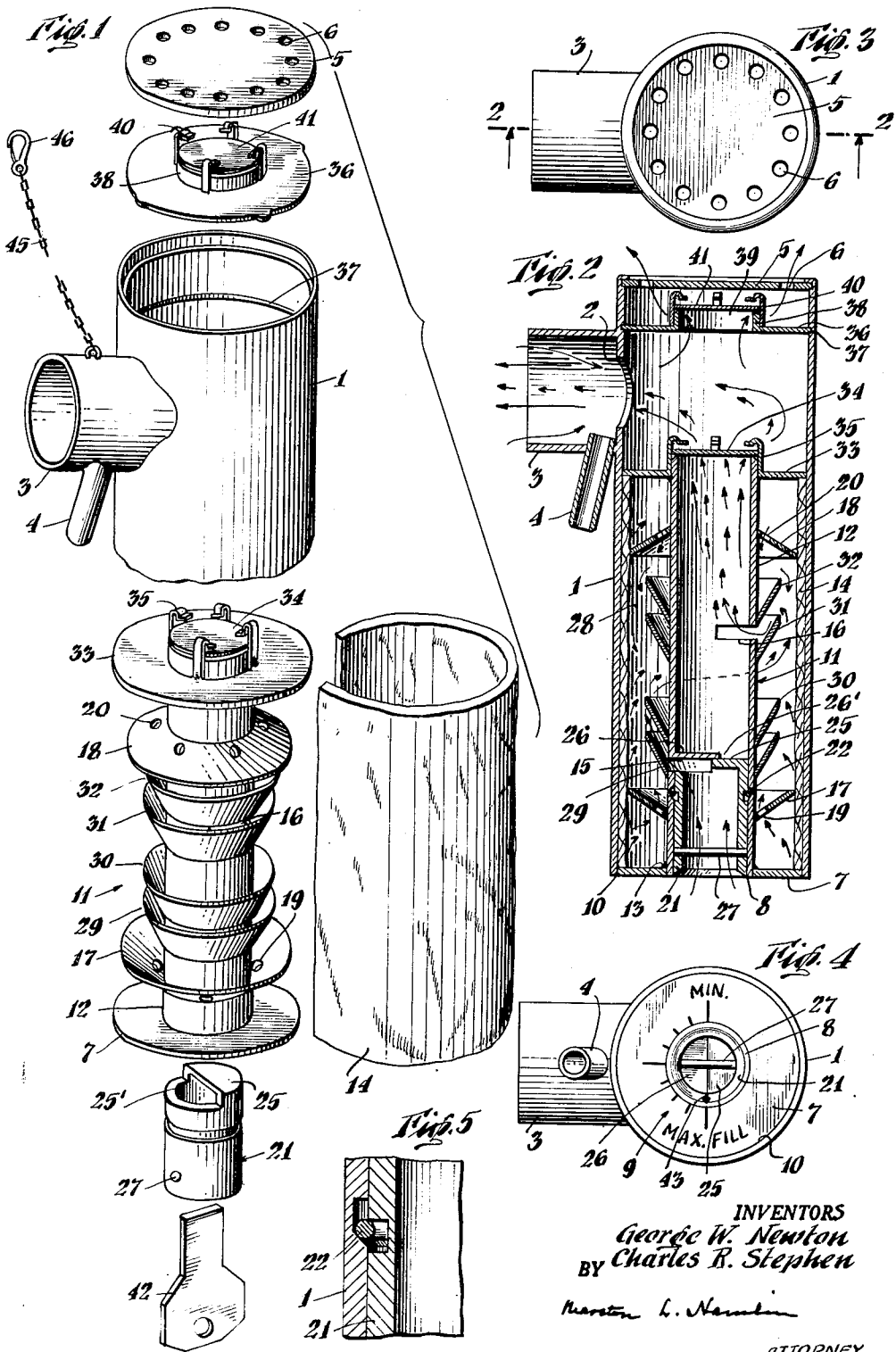
May 4, 1954

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THERAPEUTIC INHALER

2,677,370

Filed May 11, 1953

2 Sheets-Sheet 1



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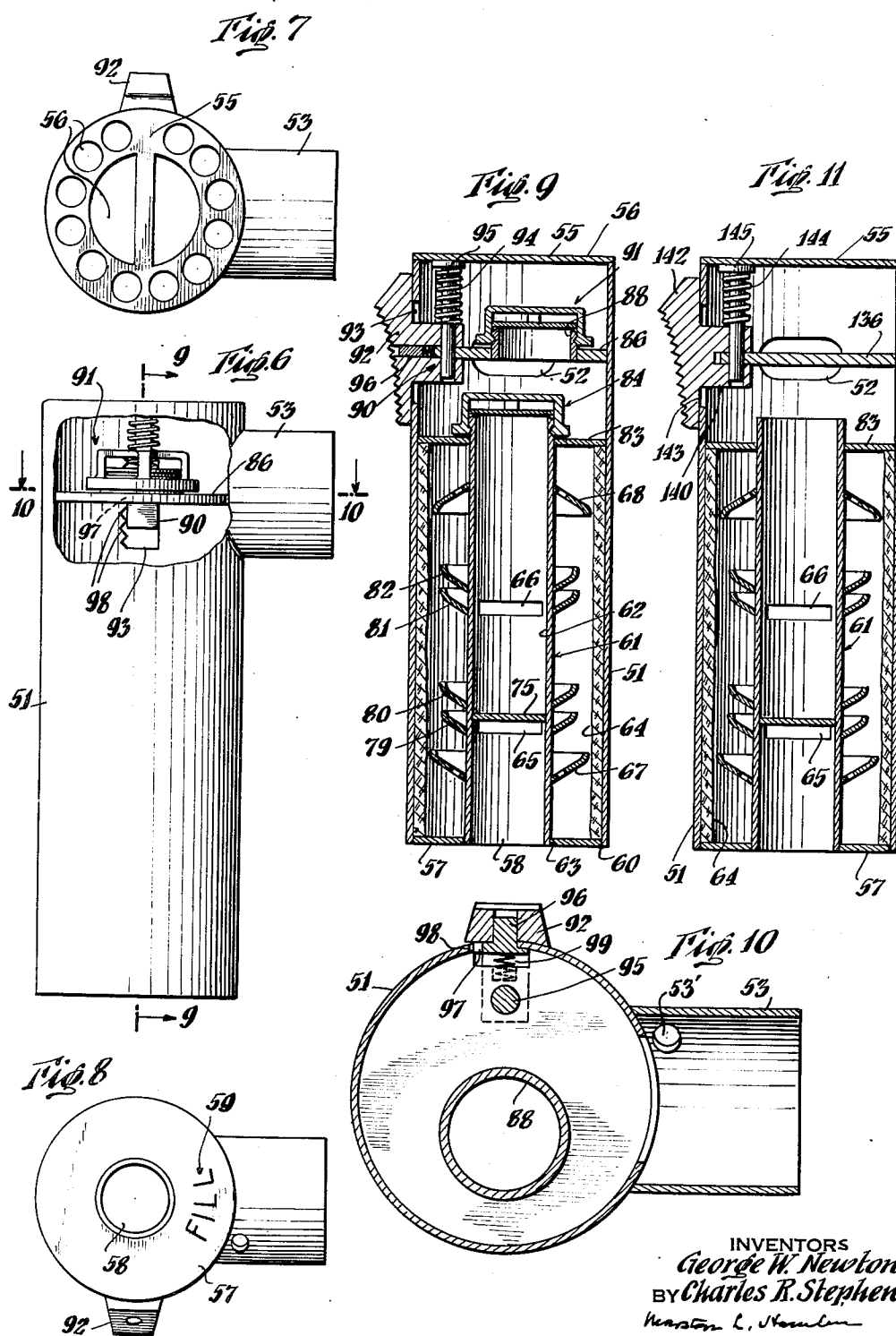
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UNITED STATES PATENT OFFICE

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THERAPEUTIC INHALER

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Application May 11, 1953, Serial No. 354,150

10 Claims. (Cl. 128—195)

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This application is a continuation in part of application Serial No. 295,764, now abandoned, for Inhaler, filed June 26, 1952, by George W. Newton and Charles R. Stephen.

This invention relates to an inhaler for administering volatile analgesics and anesthetics and more particularly to an inhaler adapted to self-administration by a patient.

Our inhaler is especially useful in the administration of trichlorethylene, one of the more versatile analgesics in the pharmacological armamentarium. However, our inhaler may be used for the administration of other therapeutic agents which vaporize in a manner similar to trichlorethylene.

Trichlorethylene is used in controlled concentrations with air or with air and oxygen for alleviating pain of any type. It has been found particularly useful during obstetrical labor, for minor surgical procedures, for dental treatments, and for the intractable pain of carcinoma.

In many such cases it is an advantage to permit the patient to administer the analgesic himself. The psychological advantages of self-administration of safe yet effective concentrations of an analgesic by means of a reliable apparatus are obvious. When the patient realizes that he himself can take steps to relieve his pain when it occurs, the fear of pain itself is usually eliminated. Several inhalers for the self-administration of trichlorethylene and similar analgesics and anesthetics have been developed, but none of them is believed to be entirely satisfactory from the viewpoint of portability, ease of adjustment, variation of concentration of the administered agent, facility in handling by the patient and complete safety in use.

Prior inhalers have had one or more desirable characteristics but none to our knowledge combines them all to the degree found in the inhaler of the present invention. Our inhaler possesses several advantages over those now available in the market:

1. It is much lighter in weight and thus easier to transport and easier for the patient to handle.

2. It is smaller in diameter and hence easier for the patient to grasp.

3. It offers less resistance to inspiration and expiration, and accordingly does not tire out the patient so easily.

4. The filling device is simple and involves no extra parts or screw devices.

5. Variation of concentrations inhaled can be readily and simply accomplished.

6. The mechanism is simple and yet protected

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in such a way that dropping the inhaler is not likely to cause damage.

7. In one embodiment of our invention a special inlet is provided whereby oxygen can be administered to the patient along with the trichlorethylene-air vapor mixture. This oxygen is mixed with the analgesic vapor just as it enters the mask which the patient holds on his face.

Perhaps the most common use to which these inhalers are put today is for the relief of pain during obstetrical labor. When labor pains are well-established, the inhaler is given to the prospective mother with appropriate explanations of its value. She is told that when she feels a pain coming on, several breaths through the inhaler will relieve the pain of contractions. As labor pains become more severe, the attending doctor or nurse may increase the concentration of trichlorethylene by adjusting the intake mechanism in such a way that more air per inhalation passes over the trichlorethylene surface. The patient holds the inhaler herself and places the mask over her face from time to time as the need for pain relief occurs. Should the patient believe that many inhalations at a time will be of more benefit than a few, she may inhale sufficient vapor to lapse into unconsciousness. When this occurs, her muscles relax, her hand falls away from her face and the mask with it, and in a few seconds she is conscious again. In this feature lies the safety of self-administration in such a manner.

Other conditions in which our inhaler is especially useful are:

1. Changing of painful dressings, especially burn dressings.

2. Testicular biopsies.

3. Cystoscopies.

4. Incision and drainage of abscesses.

5. Dressing and suture of minor lacerations.

6. Manipulation and reduction of simple fractures.

7. Dental treatments and operations.

8. Relief of pain in industrial accidents prior to and during transport to hospital.

9. Relief of pain in wounded personnel prior to definitive care. Such a possibility could arise in a national catastrophe where casualties were too numerous for all to receive immediate treatment.

Our inhaler consists essentially of a tubular body having a side outlet near the top for connection with a conventional face mask, a single central tube provided with circular frusto-conical exterior baffles and an air inlet and vapor outlet, a wick surrounding the central tube and baffles, an air inlet near the top of the casing commu-

nicating with the face mask or other inhaling device for supplying vapor-free air, and a bottom closure of the casing containing an air inlet port which also serves as a fill-hole and supplies air to the wick chamber. The inhaler has no loose parts which can be readily lost, such as screw caps, Allen wrenches and the like. While in one modification a key is provided for regulating the air intake and proportioning valve, this is of a simple form and is provided merely as a matter of convenience since the inlet valve may be readily adjusted by a screwdriver, pen knife blade, hemostatic forceps, scissors or other readily available tool of this type. In spite of this ease of adjustment, the inlet valve is not accessible to the patient and accordingly when the proper ratio of analgesic to air or oxygen has been set by the attending physician or nurse, there is little risk of unauthorized change of the setting by the patient.

Three embodiments of our invention are described below and illustrated in the drawings, but the description and drawings are intended to be illustrative only and not to limit our invention, the scope of which is defined in the appended claims.

In the drawings:

Fig. 1 is an exploded view showing the essential parts of one form of our inhaler disassembled;

Fig. 2 is a vertical axial section on line 2—2 of Fig. 3 in which the course of air and vapor currents is indicated by arrows;

Fig. 3 is a top and Fig. 4 a bottom view of the device;

Fig. 5 is an enlarged sectional detail of the retaining ring grooves of the regulating valve;

Fig. 6 is a side view of a modified form of inhaler;

Figs. 7 and 8 are respectively top and bottom views of this modification;

Fig. 9 is a vertical section on the line 9—9 of Fig. 6;

Fig. 10 is a horizontal section on an enlarged scale on the line 10—10 of Fig. 6; and

Fig. 11 is a vertical section of a further modification of our inhalers.

The body 1 is a light-gauge sheet-metal tube having an orifice 2 near the top. This orifice opens into a side arm 3, which is adapted to be connected with a conventional rubber face mask. The side arm is brazed or soldered to the body 1, and a small auxiliary tube 4, which may be used for the administration of oxygen passes through the bottom of and is soldered or brazed to side arm 3.

A perforated top 5, having respiration holes 6, is crimped to the top of body tube 1.

A bottom piece 7 is provided, having a central orifice 8 and bearing indicia 9. This bottom piece is lightly soldered at 10 to body 1 to permit removal for servicing.

A central tube assembly 11 consists of a single light-gauge cylindrical tube 12, provided with fixed exterior frusto-conical baffles. This tube is brazed or soldered at 13 to bottom piece 7. A wick 14 surrounds the tube assembly 11 and lies close to the inner wall of body 1. Tube 12 is provided with two air and vapor ports 15 and 16 in the form of transverse slots, and with two frusto-conical baffles 17 and 18 each provided with a ring of perforations 19 and 20.

In the lower end of tube 12 a valve plug 21 is rotatably mounted, retained by spring 22 seated in grooves 23 in the valve and 24 in tube 12.

The sloping lower face of groove 24 tends to urge the half-end 25 of the valve against the half-partition 26 in tube 12 and also permits removal of valve 21 with retaining spring 22 by a strong outward pull on the rod 27 seated in the sides of valve plug 21. The half-partition 26 in tube 12 and the half-end 25 of valve plug 21 are wide enough to overlap slightly in the position shown in Fig. 2. In this position, passage through the valve plug directly into the tube is shut off, but passage is provided from the valve through cut away portion 25' of the valve plug and port 15 into the wick chamber 28, the annular space between tube 12 and body 1. When valve plug 21 is rotated 180°, it will be seen that access to wick chamber 28 through port 15 is shut off, but access is provided directly from the valve plug to the interior of tube 12.

The two frusto-conical perforated baffles 17 and 18 have diameters sufficiently great to hold wick 14 against the inside walls of body 1. As viewed in Figs. 1 and 2, baffle 17 is mounted base upwards and baffle 18 base downwards. Two smaller exterior frusto-conical baffles 29 and 30 are mounted base upwards on tube 12 respectively below and above port 15. Two similar baffles 31 and 32 are mounted on tube 12 respectively below and above port 16.

A partition 33 is soldered or brazed to tube 12. This partition is circular and is of a diameter to form a sliding fit in body 1, and to retain wick 14 against endwise movement; the partition also forms an end closure of the wick chamber.

Tube 12 projects a short distance above partition 33 to afford a seat for valve disc 34, which is retained loosely in operative position by bent-over tangs 35. The disc 34 is made of thin brass shim stock or sheet plastic, and cooperates with the end of tube 12 to form a one-way valve to permit withdrawal of air and vapor from tube 12 by the user during inspiration, but to prevent return of expired air into the tube.

Above the orifice 2 is mounted a second partition 36 which is held friction-tight in body 1 by means of small circumferentially spaced lugs sprung into internal annular groove 37 in body 1. Integral with partition 36 is a short nipple 38 surrounding central orifice 39. A valve cage 40 and valve disc 41, similar to valve cage 35 and valve disc 34 are mounted on nipple 38 and cooperate therewith to form a one-way expiration valve.

A light chain 45 suitable for attaching by means of a snap hook 46 to a wrist strap may be fastened in any suitable way to the upper part of the inhaler.

In use, a conventional face mask is connected with side arm 3 and valve plug 21 is turned by means of key 42 or otherwise to make index mark 43 on valve plug align with calibration mark "Fill" on bottom 7 of instrument. In this position, half-end 25 of the plug cooperates with half-partition 26 to shut off direct communication between interior of valve plug 21 and tube 12. Key 42 is merely a flat metal stamping of outline shown in Fig. 1 which fits with some play in the interior of valve plug 21 between rod 27 and the adjacent side walls. Since key 42 works equally well on either side of rod 27, no great care is needed in inserting it. Furthermore, as indicated above, if the key is mislaid, the valve can be adjusted by inserting a screwdriver or knife blade, or scissors blades, or by gripping rod 27 by hemostatic forceps or similar instrument. With the valve adjusted to "Fill" position, the

inhaler is inverted, and the desired charge of trichlorethylene or other volatile liquid medication is poured in through valve plug 27. The liquid flows into wick chamber 11 through port 15 and is distributed on wick 14 by inclining and rotating the device back and forth. It will be seen that at this point even if all the liquid has not been absorbed by the wick, it is practically impossible for any of it to spill out of the inhaler, regardless of its position, because bottom 7 and partition 33 in cooperation with wick 14 effectively seal the ends of wick chamber 11 and the frusto-conical baffles deflect or divert liquid from ports 15 and 16, whether the device is upright or inverted.

The inhaler is now ready for use at maximum dosage. When the user inhales, the reduction in pressure in the upper part of the device causes air to be drawn into wick chamber 23 through valve plug 21 and port 15; here it is mixed with the analgesic or other vapor and is further drawn into tube 12 through port 16, through the one-way valve at the top of tube 12, raising disc 35, and so through side arm 2 into the user's respiratory system. Simultaneously the reduced pressure seats valve disc 41 on nipple 38, thus preventing entrance of air through the top of the instrument. On exhalation valve disc 35 is seated on the top of tube 12, thus preventing reentrance of the breath into the wick chamber, and valve disc 41 is raised, thus permitting the exhalation to be exhausted through perforations 6.

If a more moderate dosage is desired, the valve plug 21 is turned so that the index aligns with another of the calibration marks on bottom 7 (see Fig. 4), thus exposing more or less of passage 26' to the interior of valve plug 21. In this position part of the inhaled air passes directly to the patient through tube 12, by-passing wick chamber 23 and thus picking up no analgesic vapors; the remainder of the inhaled air picks up its quota of vapors in the wick chamber. It will be seen that by adjusting the position of valve plug 21, the inhaled mixture may be made very lean or very rich or of any intermediate concentration in accordance with the user's needs.

A wrist strap attached to chain 45 may be fastened around the patient's wrist to prevent accidental dropping of the inhaler.

A modified form of inhaler is illustrated in Figs. 6-10. Its principle of operation is substantially the same as that of the inhaler illustrated in Figs. 1-5, but it is provided with a different type of proportioning valve.

The body 51 is provided with a horizontally elongated orifice 52 near the top, opening into side arm 53, which is adapted to be connected with a conventional rubber face mask or other inhaling device. A small hole 53' in side arm 53 may be provided to receive a bead chain for attaching a wrist strap.

A perforated top 55, having respiration holes 56 of large area is fixed to the top of body 51.

A bottom piece 57 is provided, having a central orifice 58, bearing indicia 59. This bottom piece is lightly soldered at 60 to body 51 to permit removal for servicing as in the previously illustrated inhaler.

A central tube assembly 61 consists of a single cylindrical tube 62, provided with fixed exterior frusto-conical baffles and brazed or soldered at 63 to bottom piece 57. A wick 64 surrounds the tube assembly and lies close to the inner wall of body 51. Tube 62 is provided with an air inlet port 65

and an air-vapor port 66 communicating with the wick chamber, and with frusto-conical baffles projecting into the wick chamber. Baffles 67 and 68 have diameters sufficiently great to hold wick 64 against the inside wall of body 51, and baffles 79, 80, 81 and 82 are of less diameter. A solid partition 75, just above air inlet port 65 separates the lower from the upper portion of the tube.

A top partition 83, soldered or brazed to tube 62, forms an end closure of the wick chamber and retains wick 64 against endwise movement. Tube 62 projects a short distance through and above partition 83 to afford a seat for one-way inhalation valve 84.

So far the construction of this embodiment of our invention has in general followed that shown in Fig. 2, with the exception that in this embodiment no proportioning valve is provided at the bottom of tube 62 analogous to valve 21 in Fig. 2. Unlike partition 25, partition 75 completely separates the upper and lower portions of tube 62.

In the embodiment of Figs. 6-10, regulation of vapor dosage is provided by proportioning valve 90 in the head of the inhaler. This valve comprises a vertically adjustable disc 86 having a range of travel permitting it to be positioned entirely above or entirely below orifice 52 or in any intermediate position. This disc has an upstanding nipple 88 surrounding orifice 89, on which is mounted a one-way exhalation valve 91, similar in construction to valve 84.

Disc 86 is movable by means of thumb piece 92 (which may be of molded plastic), traveling in slot 93 in body 51, against pressure of spring 94 on guide rod 95 which is retained by top 55. Guide rod 95 passes through a hole in the inner portion of thumb piece 92. Valve 90 is retained in a desired position by means of latch 96 having a locking lug 97 which engages notches 98 in the edge of slot 93. Latch 96 is forced outwards by compression latch spring 99, which tends to keep lug 97 engaged with one of notches 98. Since latch 96 is recessed below the surface of thumb piece 92, a small instrument is needed to depress it to permit movement of the proportioning valve, so it is not readily accessible to tampering by a patient using the inhaler. When valve 90 is in its top position with disc 86 above orifice 52, orifice 52 receives only the rich air-vapor from the wick chamber. As valve 90 is moved downward, disc 86 passes across orifice 52, permitting more and more air to be drawn in through holes 56 in top 55 and blended with the air-vapor mixture from the wick chamber. Finally, when the valve is in its bottom position with disc 86 entirely below orifice 52, the latter receives only fresh air drawn in directly through holes 56.

The method of use of this model of the inhaler will be evident from this description and from the description of use of the inhaler of Figs. 1-5.

A still further modification of our invention is illustrated in Fig. 11. This is intended particularly for dental use, the requirements of which are somewhat different from those of general medical and surgical use. The dentist prefers an inhaling device in the form of a nose piece which is strapped in place during the treatment or operation; this may be connected with our inhaler by tubes and suitable fittings. Since the patient in this case cannot regulate the dosage he receives by applying and removing a mask as required, another regulating means must be provided. This is done by modifying the proportioning valve; the locking device of Figs. 9 and 10 is omitted and the valve is readily adjusted by the

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patient's thumb. Should the patient become unconscious and so relax, the valve is spring-biased to return automatically to a position admitting only fresh air to the inhaling device.

The construction of the body of the inhaler illustrated in Fig. 11 is the same as that shown in Figs. 6-10. The modified proportioning valve is shown at 140. A solid disc 136 is moved across orifice 52 by means of thumb piece 142, to which it is attached and which slides vertically in slot 143 in body 51. The disc and thumb piece are normally biased by compression spring 144 to take a bottom position with disc 136 below orifice 52, thus admitting only fresh air to the inhaling device. As the patient raises the disc against spring 144 by means of the thumb piece, more and more vapor from the wick chamber is admitted to the inhaling device. If pressure on the thumb piece is relaxed, disc 136 returns to the all-fresh-air position. Spring 144 surrounds guide pin 145 retained by top piece 55 and passing through a hole in the inner extension of the thumb piece.

It will be noted that the inhaler of Fig. 11 lacks one-way valves 84 and 91 of Fig. 9. It is intended that this inhaler be used with an inhaling device incorporating one-way inlet and outlet valves, the outlet valve being preferably in or close to the nose piece and the inlet valve close to our inhaler. This arrangement has the advantage that, with the somewhat long connecting tubes required, there is a minimum of ebb and flow of air and vapor in the tubes and a minimum of rebreathing. However, alternate arrangements are practicable in which either one or both one-way valves are incorporated in the inhaler and one or none respectively in the inhaling device.

The particular form of inhaling device used, whether face mask, nose piece or other device, forms no part of this invention.

We claim:

1. An inhaler adapted to self-administration by the user of a mixture of air with the vapor of an easily volatile liquid medicament, the inhaler comprising: a tubular body closed at both ends and having near the top a side arm communicating through an orifice with the interior of the inhaler and adapted to fit an inhaling device; an air port at the top of the body; a combined intake air port and fill-hole at the bottom of the body; a single longitudinal tube within the body of the inhaler, the lower end of the tube being connected with the inlet port at the bottom of the inhaler and the upper end of the tube terminating below the top of the inhaler; a first partition near the top of and surrounding the longitudinal tube and positioned below the side arm of the inhaler, said partition, the longitudinal tube, and the bottom closure cooperating with the interior walls of the inhaler body to form a wick chamber; a wick in the wick chamber; a first port in the lower portion of the longitudinal tube providing access from the outside air to the wick chamber; a second port in the upper portion of the longitudinal tube providing access from the wick chamber to the space above said first partition; a wall in the longitudinal tube between said ports; and a second partition in the body of the inhaler between said first partition and the air port at the top of the body; said inhaler containing within its body a proportioning valve adapted to regulate the ratio of vapor to air in the mixture inhaled by the user, said valve being accessible for adjustment

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from the outside of the inhaler without disassembly of the inhaler.

2. An inhaler as defined in claim 1 in which the second partition in the top of the inhaler is vertically movable across the side arm orifice, a slot in the side of the inhaler, a slideable thumb piece on the outside of the inhaler having a portion projecting through the slot and attached to the movable partition, said movable partition constituting a proportioning valve regulable by movement of the thumb piece.

3. An inhaler as defined in claim 2, having locking means for securing the proportioning valve in a desired position.

4. An inhaler as defined in claim 2 having a spring adapted to bias the proportioning valve to its lowest position.

5. An inhaler as defined in claim 1 in which the proportioning valve is constituted of a rotatable valve plug in the bottom of the longitudinal tube, having a cut-away portion cooperating with the first port and with a cut-away portion of the wall in the longitudinal tube to provide regulable access from the atmosphere through the valve plug to the wick chamber.

6. An inhaler as defined in claim 1 having a one-way inhalation valve at the top of the longitudinal tube and a one-way exhalation valve in the second partition.

7. An inhaler adapted to self-administration by the user of a mixture of air with the vapor of an easily volatile liquid medicament, the inhaler comprising: a cylindrical body closed at both ends and having near the top a side arm communicating through an orifice with the interior of the inhaler and adapted to fit a face mask; an exhalation port at the top of the body; an inhalation port in the bottom closure of the body; a single longitudinal tube within the body of the inhaler, the lower end of the tube being fixedly connected with the inlet port in the bottom closure, the upper end of the longitudinal tube terminating below the top of the inhaler; a first partition near the top of and surrounding the longitudinal tube and positioned below the side arm of the inhaler, said partition, the longitudinal tube, and the bottom closure cooperating with the interior walls of the inhaler body to form an annular wick chamber; a wick in the wick chamber; a second vertical adjustable partition in the body of the inhaler positioned between said first partition and the top closure of the inhaler, said second partition being pierced by an exhalation passage and being adapted to be moved vertically across the side arm orifice; a one-way inhalation valve at the top of the longitudinal tube and a one-way exhalation valve in the exhalation passage of said second adjustable partition; a first port in and near the bottom of the longitudinal tube providing access from the atmosphere to the wick chamber; a wall in the longitudinal tube above said first port; and a second port in the longitudinal tube above said wall and providing access from the wick chamber through the longitudinal tube to the space above said second partition.

8. An inhaler adapted to self-administration by the user of a mixture of air with the vapor of an easily volatile liquid medicament, the inhaler comprising: a cylindrical body closed at both ends and having near the top a side arm adapted to fit a face mask; an exhalation port at the top of the body; an inhalation port in the bottom closure of the body; a single longitudinal tube within the body of the inhaler, the lower end of

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the tube being fixedly connected with the inlet port in the bottom closure and forming a housing for a rotatable proportioning and filling valve plug, the plug being positioned entirely within the body of the inhaler, the upper end of the longitudinal tube terminating below the top of the inhaler; a first partition near the top of and surrounding the longitudinal tube and positioned below the side arm of the inhaler, said partition, the longitudinal tube, and the bottom closure cooperating with the interior walls of the inhaler body to form an annular wick chamber; a wick in the wick chamber; a second partition in the body of the inhaler positioned above said side arm and below said exhalation port, said second partition being pierced by an exhalation passage; a one-way inhalation valve at the top of the longitudinal tube and a one-way exhalation valve in the exhalation passage of said second partition; a first port in and near the bottom of the longitudinal tube cooperating with the valve plug to provide regulable access from the atmosphere through the valve plug to the wick chamber; a passage near the bottom of the longitudinal tube cooperating with the valve plug to provide regulable access from the atmosphere through the

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valve plug to the interior of the longitudinal tube; and a second port in the longitudinal tube spaced above the first port and providing access from the wick chamber to the interior of the longitudinal tube.

9. An inhaler as defined in claim 8 having in the wick chamber two pairs of inverted frusto-conical baffles positioned on the longitudinal tube, the baffles having a diameter substantially less than the interior diameter of the inhaler body, one pair of said baffles being positioned respectively closely above and below said first port in the longitudinal tube and the other pair of said baffles being positioned respectively closely above and below said second port in said longitudinal tube.

10. An inhaler as defined in claim 8 in which the wick is a web positioned against the interior walls of the body of the inhaler and in which two perforated circular baffles are positioned on the longitudinal tube, one near the bottom and one near the top, the baffles having a diameter such as to retain the wick against the inner walls of the inhaler.

No references cited.