

Nov. 22, 1960

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2,960,985

ANESTHETIC INHALER APPARATUS

Filed April 9, 1956

2 Sheets-Sheet 1

FIG. 1

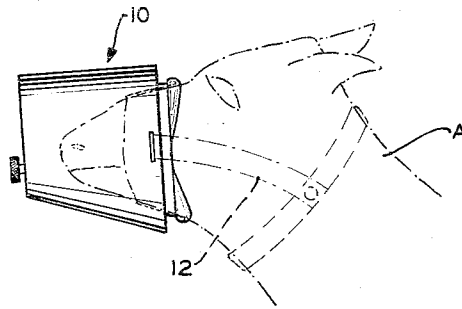
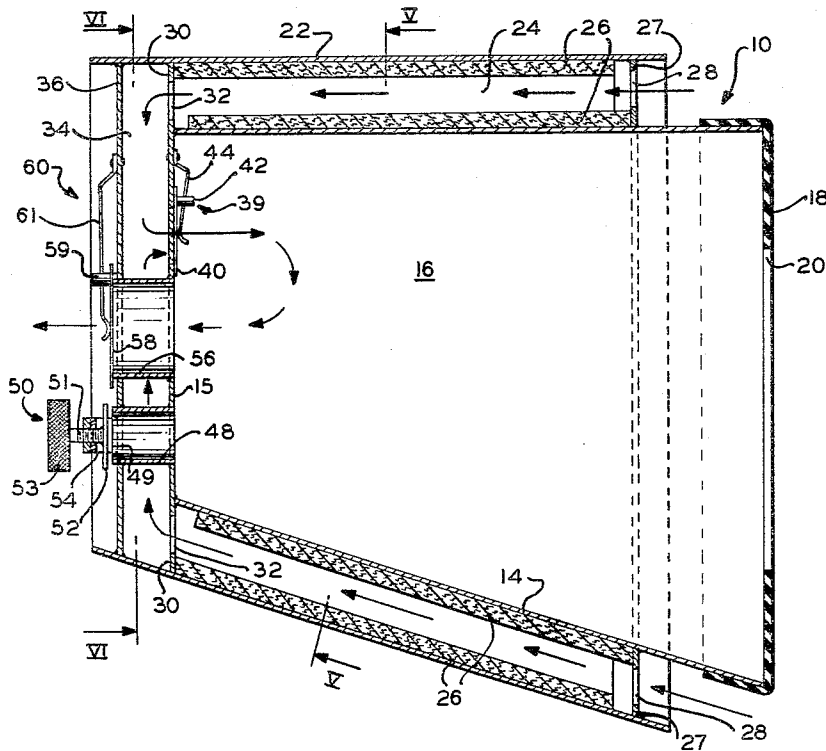


FIG. 2



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2 Sheets-Sheet 2

FIG. 3

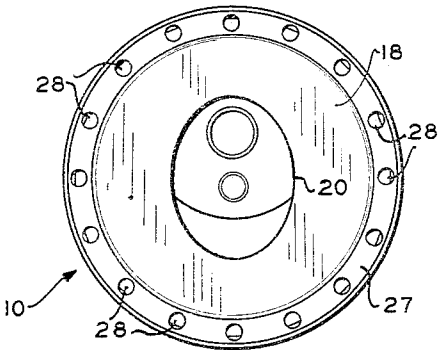


FIG. 4

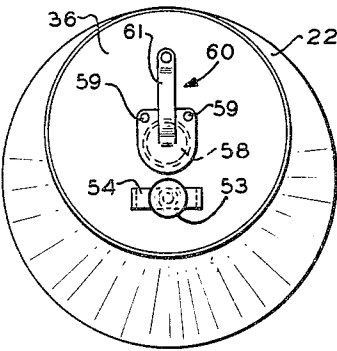


FIG. 6

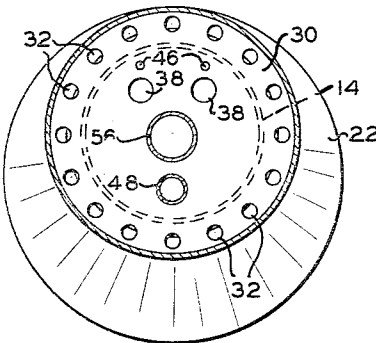


FIG. 5

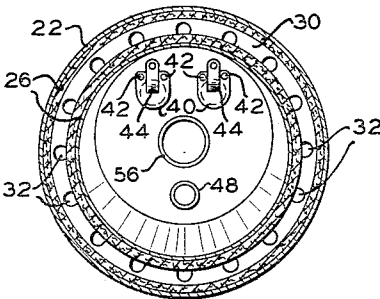
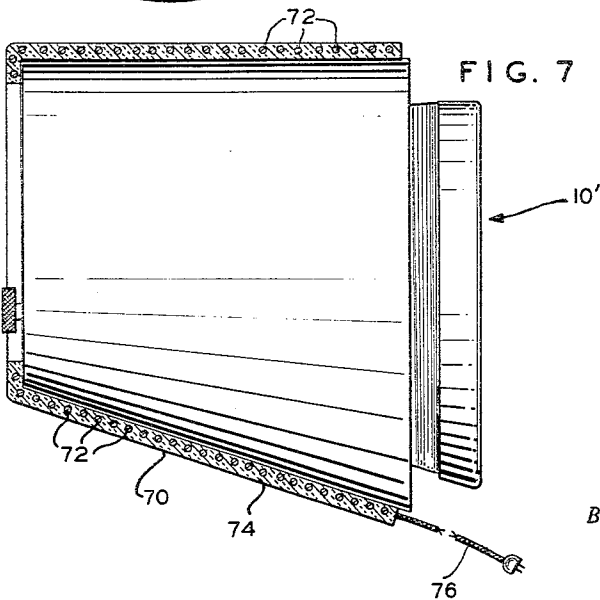


FIG. 7



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1

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ANESTHETIC INHALER APPARATUS

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9 Claims. (Cl. 128—188)

This invention relates to anesthetic inhaler apparatus for volatilizing liquid anesthetic agents and administering the vapors thereof in admixture with air or oxygen. More particularly, the invention relates to such inhaler apparatus adapted for the anesthetization of animals, especially animals having elongated snouts, such as is characteristic of many domesticated animals, for example, sheep, cattle, dogs, etc.

Although in recent years, a growing demand has been evident for more effective means of anesthetization of domesticated animals, resulting both from advancements in veterinarian surgical practices and from the growing public demand for more humane treatment of animals subjected to certain types of surgical treatment, there has been up to the present time no entirely satisfactory method or apparatus, for performing such anesthetizations. The mode of treatment having many desirable aspects which lends itself to the efficient treatment of animals, is the administration of inhalant anesthetic mixtures and particularly mixtures formed from the volatilization of liquid anesthetic agents. However, there are certain inherent difficulties that up to now have detracted from this mode of anesthetization. One such difficulty, for example, has been in the apparatus available for this purpose which must be capable of handling relatively large volumes of respiratory gases characteristic of the larger domestic animals. In existing apparatus not specifically constructed for this purpose, excessive restrictions to breathing are encountered; devices correctively modified by conventional methods to overcome such restrictions become cumbersome and are of little practical value. Furthermore, these devices must not only accommodate large volumes of respiration gases with a minimum restriction; they must also be highly efficient vaporizers such as to adequately enrich these large respiratory gas volumes with sufficient concentrations of anesthetic vapors to induce anesthesia and maintain the anesthesia, with suitable control, at the desired depth. The compactness, ruggedness and simplicity of operation of apparatus of this type are of vital importance since in many instances the animals undergoing treatment do not willingly submit to the application of the apparatus or to the administration of the anesthetic vapors, so that it is desirable for the entire operation to be carried out with the greatest dispatch. In addition, treatment may take place in the open, remote from the usual shelter and other facilities, and in extremes of hot or cold weather; present inhaler devices are incapable of such wide versatility.

Accordingly, it is an object of the present invention to provide an improved inhaler apparatus for volatilizing and administering the vapors of liquid anesthetic agents which is of compact and rugged construction and simple to apply and operate for the purposes of administration under a wide variety of operating conditions.

It is a further object of the present invention to provide such an improved anesthetic inhaler device which

2

is especially suited for handling relatively large tidal exchange volumes of respiration gases with minimum restriction, and which is effective for enriching such gases with adequate anesthetic concentrations of the anesthetic vapors, particularly for the anesthetization of animals.

It is a further object of this invention to provide such an inhaler device, and particularly one adapted for the anesthetization of animals, wherein the vaporizer means for volatilizing liquid anesthetic agents and the means for conducting and applying such vapors to the subject are incorporated in an integral, compact housing structure.

It is a further object of the invention to provide an animal inhaler apparatus for administering vapors of liquid anesthetic agents having an integral arrangement of a vaporizing chamber and a breathing chamber, in which a substantially large vaporizing surface and relatively long, effective path over which the incoming air passes in contact with said surface is provided, without detracting from the compactness of the unitary inhaler construction.

It is a still further object of the invention to provide an integral and compact unitary anesthetic inhaler structure having a breathing chamber therein in which a portion of the subject's head is received and in which said vaporizing means is arranged in said inhaler in outer relation thereto such as to conserve the heat given off by the portion of the subject's body in said breathing chamber and to assist thereby the volatilization of the liquid anesthetic agent.

A further object of the invention is to provide an anesthetic inhaler apparatus for animals having a breathing chamber into which the animal's snout is inserted and resilient means forming an inwardly acting sealing engagement therewith, and in which adjustable valve means permit controlled concentrations of anesthetic vapors to be delivered to said confined breathing chamber.

Apparatus such as the apparatus described herein may be used advantageously in connection with volatile liquid agents such as trichloroethylene. This agent has already exhibited in numerous administrations in animals, that it is capable of producing varying degrees of surgical anesthesia with a minimum of objectionable residual effects. It also works swiftly and has been found to permit rapid recovery of the subject following treatment. Anesthetization by the use of this agent administered in apparatus such as hereinafter more fully described has been found to be extremely helpful, for example, in the dehorning of cattle which heretofore has been considerably painful to the cattle and the subject of difficulty to cattle breeders, veterinarians and the like. A further advantage of the present invention is in facilitating the use of this desirable agent which is relatively difficult to volatilize adequately in conventional apparatus.

The invention and other of its objects and advantages may be more fully understood by reference to the following description and accompanying drawings in which:

Fig. 1 is a pictorial view illustrating an anesthetic inhaler representing a preferred embodiment of the present invention and showing the manner in which it is worn or applied to an animal during use;

Fig. 2 is a longitudinal section view taken through the anesthetic inhaler apparatus illustrated in Fig. 1;

Fig. 3 is an end view of the anesthetic inhaler shown in Fig. 2, in reduced scale, looking into the open end thereof and illustrating the portion of the interior of the breathing chamber;

Fig. 4 is a reduced scale end view showing the bottom end of the anesthetic inhaler device;

Fig. 5 is a sectional view, reduced in scale, taken along the line 5—5 in Fig. 2, looking in the direction of the arrows;

Fig. 6 is a sectional view, reduced in scale, taken along the line 6—6 in Fig. 2, looking in the direction of the arrows; and,

Fig. 7 illustrates a further modification of the anesthetic inhaler shown in Fig. 2 wherein heating means are arranged around the anesthetic vaporizer housing to further facilitate the volatilization of the liquid agent therein.

An inhaler, comprising a preferred embodiment of the present invention, is shown at 10 in Fig. 1 of the drawings wherein it is illustrated, in operative position, as it would be worn by an animal, for example, the animal shown at A, which may be a horse, a cow, a sheep, etc. The inhaler assembly may be held in place manually or if preferred may be secured by means of any suitable strap or other device, such as the head harness 12. Referring to Fig. 2, it will be seen that an inner, substantially cone-shaped member 14 of the inhaler, which is preferably of light weight sheet metal and having a bottom closure plate 15, defines a breathing chamber 16. At the outer end of the shell member 14, an elastic diaphragm 18, which may be made out of any suitable material such as rubber, has an opening 20 which, upon placement over the snout of the animal as shown in Fig. 1, stretches to accommodate this portion of the animal's head. When in place the elastic diaphragm 18 comfortably encircles the inserted portion of the animal's head and affords an effective sealing engagement therewith to prevent escape of gases from the breathing chamber to the surrounding atmosphere regardless of the degree to which the animal's snout is inserted or of the size of the animal's head. It will readily be apparent that the elastic member 18 renders the inhaler applicable to a number of different animals of greatly different sizes.

Disposed in outer relation to the shell 14 is a second, similar, substantially cone-shaped member 22 which defines between itself and the inner shell 14, a substantially annular vaporizing chamber 24. Linings 26, on the confronting walls of the inner and outer shells 14 and 22 are provided in the vaporizing chamber which are of an absorbent material, such, for example, as wool felt, capable of absorbing a supply of a volatile liquid anesthetic agent which is then evaporated therefrom. The inner and outer shells are spaced by means of an upper plate 27 having a series of openings 28, best seen in Fig. 3, which form inlet passages for conducting atmospheric gas downward through the chamber 24 where volatilized vapors are admixed therewith. At its lower end the bottom closure plate 15 of the inner shell 14 is provided with an outwardly projecting rim portion 30 which engages the outer shell 22. The shell may be connected thereto in any suitable manner such, for example, as by soldering, as shown in the present case, or by means of metal screws. The projecting portion 30 is provided with a series of openings 32 arranged circumferentially to coincide with the substantially annular vaporizing chamber 24 thus forming openings from the lower extremity of the vaporizing chamber to the bottom chamber 34, formed between the plate 15 and an outer closure 36 of the shell 22. The bottom chamber 34, which, it will be seen, also constitutes a part of the vaporizing chamber by warrant of the directly connecting openings 32, communicates with the breathing chamber through a pair of openings 38 in the bottom plate 15. These inlet openings are governed by inhalation check-valves 39 having valve elements 40 which are adapted to move toward or away from the respective openings 38, the valve elements each being slidably supported for this purpose on a pair of projecting guide pins 42, which guide the valve elements during opening and closing movements and maintain them in registry with the respective inhalation openings 38. Light, leaf springs 44, anchored to the bottom plate 15 of the breathing chamber such as by means of screws 46, engage the inner sides of each of the inhalation check valve elements to urge them lightly into closing position thereby requiring a slight

reduction in pressure in the breathing chamber in order to open inhalation valves.

Also forming an inhalation delivery conduit to the breathing chamber is a tube 48 which extends from the bottom plate 15 outwardly through the outer plate 36 and terminates in an atmospheric intake opening 49. An air dilution valve 50 is arranged to cooperate with the inhalation opening 49 to permit controlled amounts of air to be admitted to the breathing chamber together with the anesthetic vapor enriched atmosphere admitted through the inhalation openings 38. The air dilution valve comprises a threaded shaft 51 having a valve seating element 52 at its inner end, disposed to cooperate with opening 49, and an adjusting knob 53 at its outer end. The shaft is threadedly received in a supporting yoke 54 such that by rotation thereof the valve element 52 is adjusted toward or away from opening 49, thereby controlling the amount of air drawn into the breathing chamber during each inhalation.

An enlarged tubular duct 56 extends from the bottom plate 15 through the outer plate 36 forming an exhalation discharge outlet from the breathing chamber 16. The outer end 57 of the exhalation duct is engaged by a check-valve element 58 of exhalation valve 60 which effectively shuts the duct except upon exhalation of the subject. The exhalation valve is substantially the same as inhalation valves 39, having guide pins 59, seen also in Fig. 4, over which openings in the valve element are placed such that the element is maintained in alignment with the end of the duct 56 during opening and closing displacement, and a light leaf spring 61 biasing the valve element slightly toward closed position.

It will be seen as a feature of the construction of the inhaler 10 above described that the breathing chamber 16, having its opening 20 to receive the head of the subject to be anesthetized, is surrounded on each of its other sides by an outer chamber, comprising the chamber compartments 24 and 34, in which the liquid agent is volatilized and admixed with air before entering the breathing chamber. This construction is further characterized by the arrangement of the intake openings 28 at the outer end of the substantially annular vaporizing chamber 24 and the openings 32 at the inner end of this chamber whereby the atmospheric gases are translated downwardly across the evaporating surfaces of the confronting wicks 26 through the entire length of the chamber. This novel construction not only conserves the heat available within the breathing chamber from the subject's body and the exhalation gases, and provides a long contacting path for the evaporating surface, which are vital to the significantly increased volatilizing capacity of this inhaler device, but accomplishes this result in a minimum structural embodiment which is both simple and rugged. The heat conductive metal of the inner shell facilitates the heating of the volatilizing chamber wherein the outer wick element 26 helps to insulate the outer wall surfaces of the inhaler.

The nested shell members 14 and 22 shown in the present drawings are not actually cone segments in the precise meaning of the word. As seen in the sectional view of Fig. 2 the upper sides of the shell containers are substantially parallel to the longitudinal axis of the inhaler and the lower sides are inclined outwardly therefrom. This configuration is thought to be best for accommodating the forward head portion, or snout, of many animals such as cows, horses, etc. The substantially cone-shaped shell members 14 and 22 may, however, be of other modified configurations to better accommodate the heads of other subjects to be treated, while retaining the characteristic structural features herein described.

In using the inhaler apparatus a supply of a liquid anesthetic agent such as trichloroethylene is poured into the vaporizing chamber through the openings 28. Approximately six fluid ounces of this agent may be used, for example, which will be completely absorbed in the

5

wick lining of the vaporizing chamber. This quantity should be sufficient for the total period of most anesthetizations; however, additional amounts may be added when required simply by pouring additional liquid into the vaporizing chamber. The inhaler is applied to an animal's head as shown in Fig. 1; preferably the device is passed over the animal's snout as far as is permitted so that the dead space within the breathing chamber is minimized as much as possible. As the subject's forward head portion passes through the opening of the elastic end closure 18, the opening expands to the necessary extent, always maintaining a substantially effective sealing engagement for isolation of the breathing chamber from the surrounding atmosphere. The inhaler then may be secured in position by means of a harness such as at 12. As the subject breathes, air is drawn downwardly through the vaporizing chamber and thence into the breathing chamber during each inhalation through the inhalation passage means, immediately commencing the induction phase. During induction the air dilution valve, normally, is entirely closed, or open to a very small extent, to allow high anesthetic vapor concentrations in the breathing chamber. During each exhalation the slight positive pressure produced in the breathing chamber urges the exhalation valve element outwardly, allowing the exhaled gases to vent to atmosphere. When the air dilution valve 50 is open, some exhalation discharge occurs through this valve also; however, this does not interfere with the operation of the inhaler. After the subject is anesthetized to the desired level of anesthesia, which may vary depending upon the treatment involved, the air dilution valve is adjusted to dilute the anesthetic vapor-air mixtures to such an extent that the concentrations of anesthetic vapors inspired are just sufficient to maintain the desired degree of anesthetization. The physiological signs characteristic of the degrees of anesthetization are easily recognized by the surgeon or other skilled persons conducting the treatment. By appropriately adjusting the air dilution valve the anesthetic condition of the subject may be readily controlled as desired. While under the influence of the anesthetic, the subject will be limp and normally will be either reclined on the ground or suitable platform, or supported in a sling of some kind; the inhaler will operate in any position and may be easily adjusted for the desired control of the anesthesia. Upon completion of the treatment the inhaler is removed, following which the subject quickly recovers consciousness by the respiration of free air.

Shown in Fig. 5 is a modified anesthetic inhaler 10' which is complete in all respects to the inhaler 10 described in the preceding portion of the specification. In the modified version, the outer shell of the inhaler carries a heating sleeve 70 which contains a series of resistance heating coils 72 imbedded in an electrically insulating material 74. The resistance heating coils are provided with an electrical cord 76 that is adapted to be connected to any conventional source of electrical current such that when electrical current is passed through the coils 72 heat is generated therein which is imparted to the inhaler housing and thus serves to facilitate the evaporation of the liquid agent in the vaporizing chamber. Although, as previously described, the design and construction of the present device is such as to render the evaporation of the liquid agent as efficient as possible under ordinary circumstances and even under many adverse circumstances, it is possible, for example, when the device is used out doors during the winter, that even the present construction may not serve to afford adequate concentrations of the anesthetic vapors for the animal undergoing treatment. It is for circumstances such as these that the modified construction of the apparatus is particularly intended. The heating element may be constructed integrally with the anesthetic inhaler housing or, preferably, is provided as a removable element that can be

6

easily set in place by inserting the inhaler 10 into a heating shell such as the shell 70. It will be evident that the present inhaler construction readily lends itself to the application of such auxiliary heating means, the entire system cooperating to afford maximum efficiency in a most compact structure.

It will be understood that this invention is not limited to the specific and preferred embodiment herein shown and described but may take other forms and may be used in other ways without parting from the spirit of the invention which is defined by the following claims.

I claim:

1. An anesthetic inhaler comprising a housing having a breathing chamber therein open at one end to receive at least a portion of the subject's head to be anesthetized, a vaporizing chamber, separated from said breathing chamber by a common wall member, extending substantially longitudinally adjacent to said breathing chamber and disposed externally thereof in said housing, means for vaporizing a supply of liquid anesthetic in said vaporizing chamber, said vaporizing chamber having an air inlet at one end thereof and an inhalation opening communicating with said breathing chamber at the opposite end thereof, the portion of said vaporizing chamber between said air inlet and said inhalation opening being at least partially coextensive with said breathing chamber means forming an exhalation opening from said breathing chamber to the atmosphere and valve means operatively associated with said inhalation and exhalation openings respectively, operable to admit anesthetic gas mixtures from said vaporizing chamber to said breathing chamber during inhalation and to release expired gases from said breathing chamber during exhalation.

2. An anesthetic inhaler according to claim 1 wherein said breathing chamber is provided with elastic peripheral means defining said open end thereof, said elastic means being effective to press inwardly against the inserted portion of a subject's head and to form a gas sealing engagement.

3. An anesthetic inhaler according to claim 1 having separate adjustable means for admitting air to said breathing chamber during inhalation for controllably diluting said anesthetic gas mixtures.

4. An anesthetic inhaler comprising a substantially cylindrical container forming a breathing chamber open at one end to receive a portion of a subject's head, a second container surrounding said cylindrical container forming a substantially annular vaporizing chamber between the spaced cylindrical side walls of each container, means for volatilizing a supply of a liquid anesthetic agent in said vaporizing chamber, means for conducting air through at least a portion of the length of said vaporizing chamber coextensive with said breathing chamber and delivering anesthetic vapor-air mixtures formed therein to said breathing chamber, and means for controllably diluting said anesthetic mixtures.

5. An anesthetic inhaler according to claim 4 wherein a lining of absorbent material is placed against each of the confronting cylindrical side walls of said annular vaporizing chamber and said air is conducted longitudinally through said chamber between said absorbent linings.

6. An anesthetic inhaler apparatus for animals, comprising a housing having inner and outer nested shell members, said shell members being of substantially cone-shaped cross-section truncated by bottom closure plate members, a breathing chamber in said inner shell member open at one end to receive the snout of an animal therein, elastic means surrounding said opening effective to act inwardly against the inserted portion of an animal's snout to form a sealing closure for said breathing chamber, means joining said shell members in assembled spaced relation forming an outer chamber enclosing the nested portion of said inner shell member, said outer chamber including a generally annular vaporizing chamber formed

7

between the opposing cylindrical side walls of said shell members and a bottom chamber formed between the bottom closure plates of said shell members, wick elements in said annular chamber forming oppositely disposed linings on the confronting cylindrical side walls thereof, means for admitting air into the upper end of said annular chamber, passage means connecting said bottom chamber with said breathing chamber effective to admit gases during inhalation, means for controllably admitting air directly to said breathing chamber and means responsive during exhalation to vent the breathing chamber to the atmosphere.

7. An anesthetic inhaler according to claim 6 wherein said means for controllably admitting air directly to said breathing chamber comprises a passage extending externally of said housing through said bottom closure plate members and adjustable valve means supported at the bottom of said housing for regulating the flow capacity of said passage.

8

8. An anesthetic inhaler according to claim 7 wherein said shell members are made of relatively thin, sheet metal.

9. An anesthetic inhaler according to claim 8 wherein said housing is provided with an outer casing, which conforms to the shape of said housing and contains heating elements effective to promote the volatilization of liquid agent in said annular vaporizing chamber.

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