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(71) Applicant
Drägerwerk Aktiengesellschaft
Moislinger Allee 53–55
2400 Lübeck
Germany (Fed Rep)
(72) Inventor
Peter Jurgen Schreiber
(74) Agents
Haseltine Lake & Co
28 Southampton Buildings
Chancery Lane
London WC2A 1AT

(54) **Interlock for anaesthesia vaporizers**

(57) In an anaesthesia apparatus, equipment is provided comprising an interlock device (20) and a pair of vaporizers (22 and 24). Each vaporizer includes a rotatable metering means (30) for opening and closing that vaporizer and for metering the rate of introduction of an evaporated anaesthetic into a flowing gas. The interlock (20) ensures that one vaporizer is closed whenever the other is open and comprises a pair of reciprocable pins (54) and a cooperating pivotable lever (52). Each pin (54) is arranged to be capable of extending into a cam recess (44) by pivoting action of the lever. Rotation of one metering means (30) automatically causes the pin (54) to move out of the cam recess (44) and into contact with the lever. This action pivots the lever (52) and causes it to contact the other pin to urge the other pin into the recess (44) in the other rotatable metering means (30), thereby locking it closed.

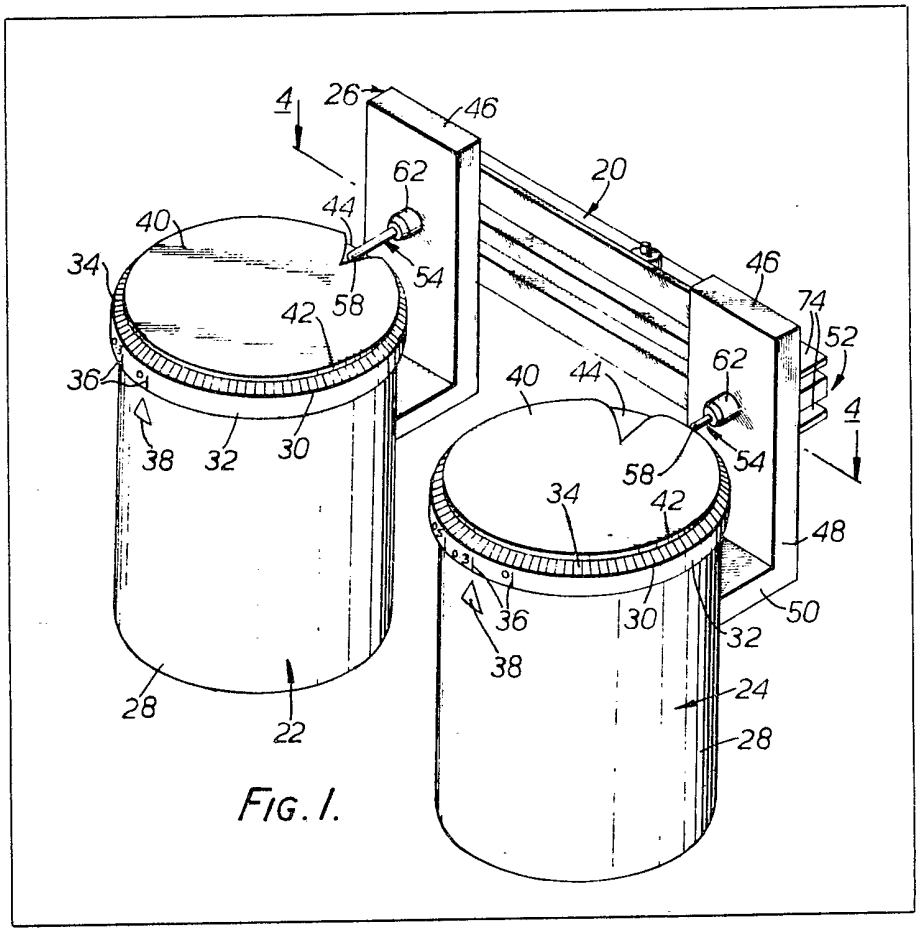

FIG. 1.

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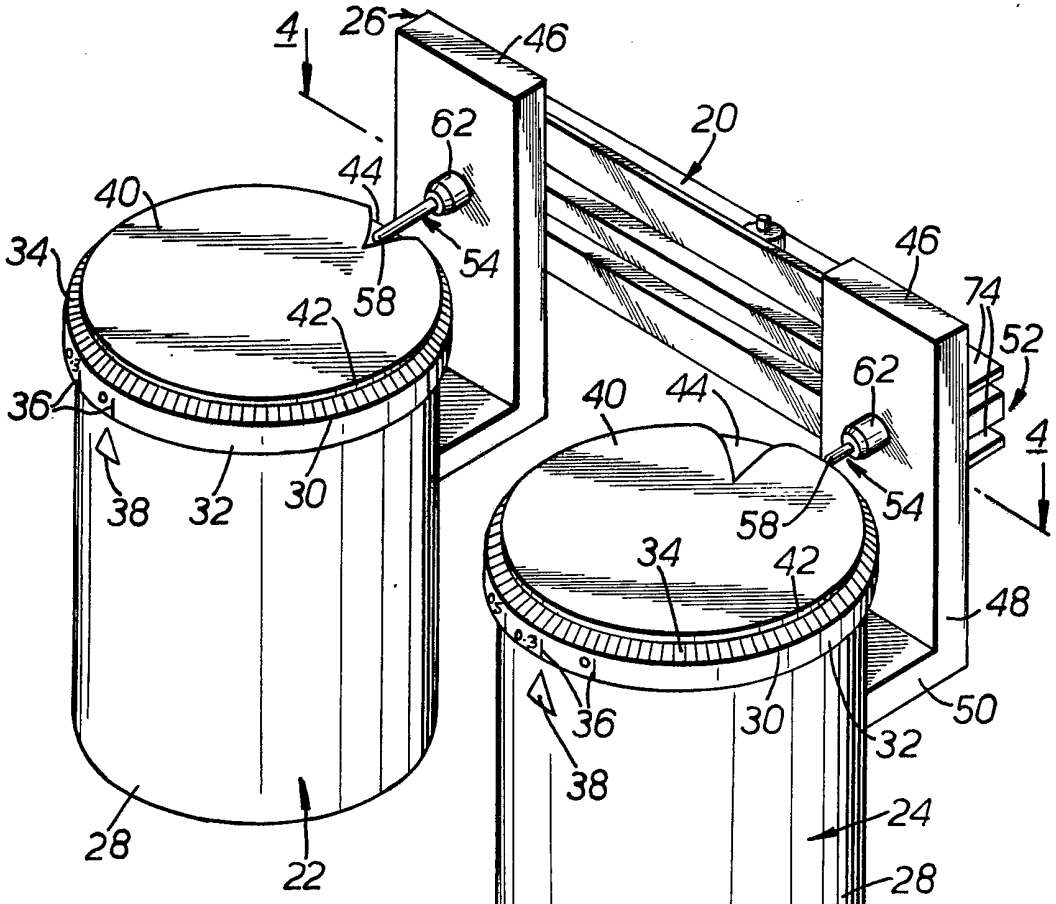
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FIG. 1.

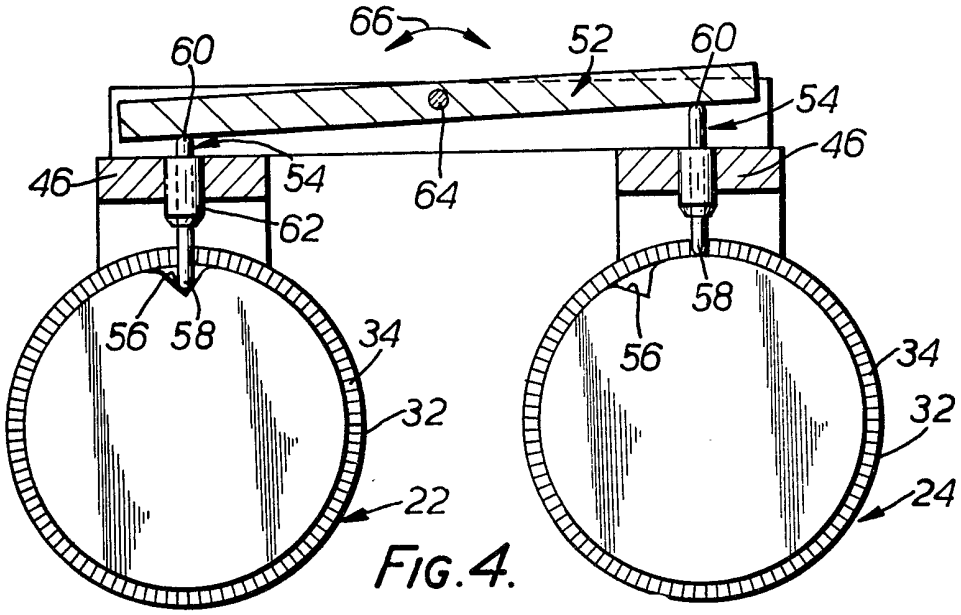
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FIG. 4.

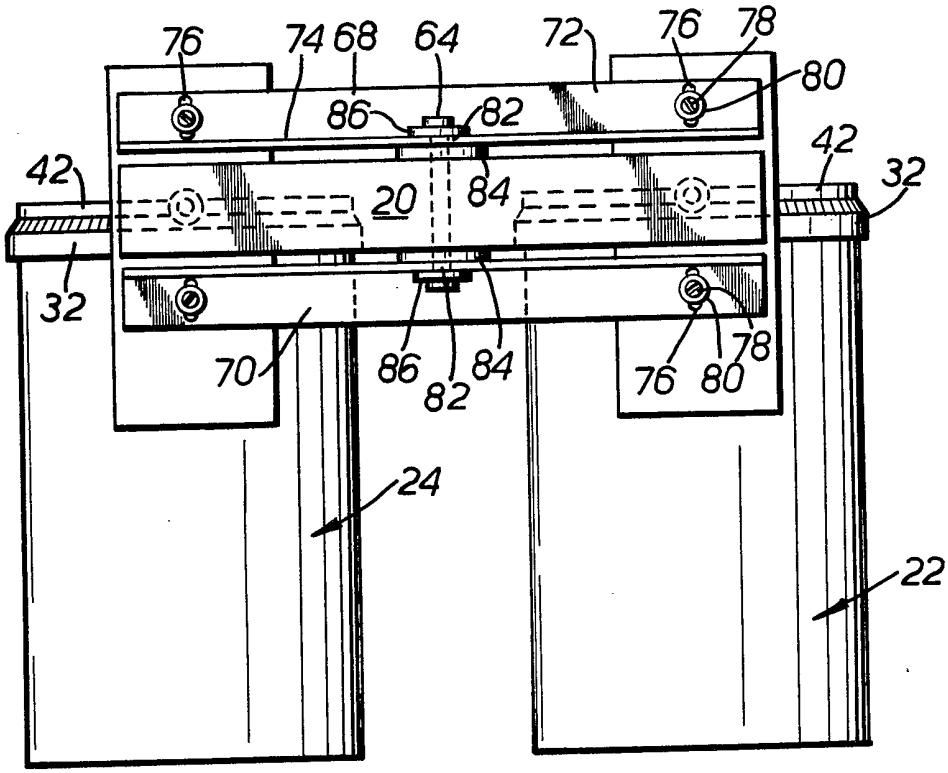
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FIG. 2.

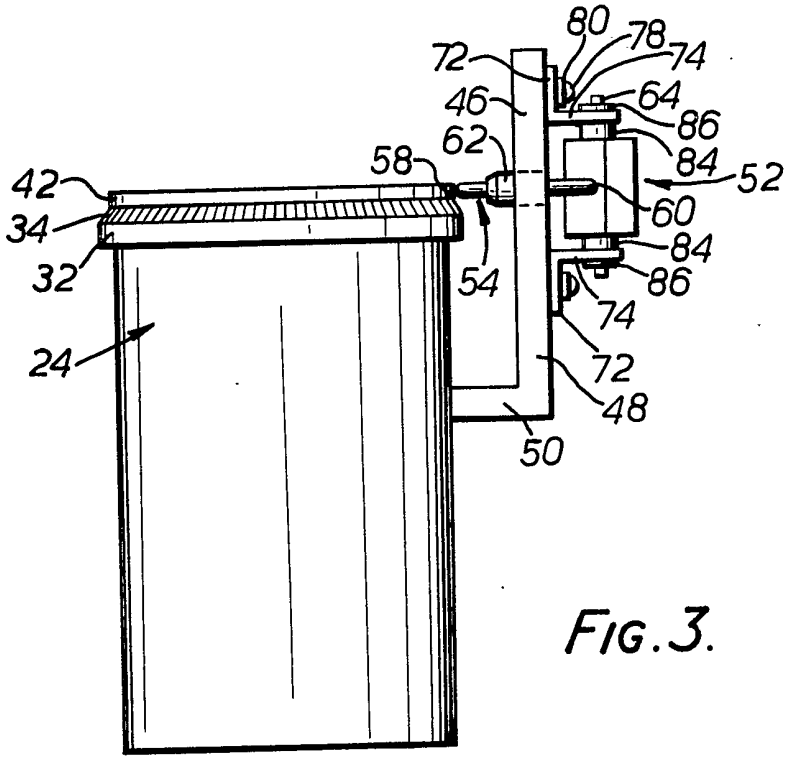
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FIG. 3.

SPECIFICATION

Equipment with an interlock device for anaesthesia apparatus

This invention relates generally to equipment with an interlock device for anaesthesia apparatus. This invention more particularly relates to such equipment with an interlock device for vaporizers.

Conventional anaesthesia apparatus or machines commonly incorporate two separate vaporizers. Each vaporizer is arranged to dispense a metered amount of anaesthesia vapour, e.g., Halothane, Enflurane, Methoxyflurane, etc., into the patient breathing circuit or fresh gas line.

While the construction of commercially available vaporizers varies from manufacturer to manufacturer, the most common type of vaporizer comprises a canister including a reservoir of the anaesthetic fluid or gas, valve means and a rotatable dial coupled to the valve means for adjusting the valve means to adjust and set the vapour concentration levels provided by the vaporizer. For example, the VAPOR vaporizer used in anaesthesia machines sold by North American Dräger, includes a rotary dial for adjusting the opening of a valve in the vaporizer to divide the gas flow in the vaporizer in accordance with the dial setting. Part of the gas flow passes through a by-pass duct, without entering the vaporizer chamber (where the anaesthetic fluid or gas is located), while the remaining portion of the gas flow passes through the vaporizer chamber for saturation by anaesthesia vapour. The gas flow which is saturated with the vapour is then combined with the by-pass flow so that the whole amount of gas leaves the vaporizer at the set concentration. In the VAPOR vaporizer, the introduction of the gas with the anaesthesia vapour into the fresh gas line is effected by an outlet valve under the control of a separate on/off switch. A pair of rotary cams and a pivoting lever are provided to serve as an interlock to ensure that the outlet of the vaporizer is opened when the rotary dial is adjusted to any particular setting and to prevent the adjustment or metering dial from being rotated to any setting when the on/off switch is closed, thereby precluding any gas from passing into the varporization chamber when the outlet of the vaporizer is closed.

Irrespective of the type and construction of the vaporizers used in dual vaporizer anaesthesia machines, it is desirable to provide means for preventing both vaporizers from being opened at the same time. Such action prevents an uptake of the vaporizing agent from one vaporizer into the other, which occurrence may have a detrimental effect on the patient.

Ohio Medical Products of Madison, Wisconsin, has recently offered a dual vaporizer anaesthesia machine which incorporates a vaporizer interlock system to prevent simultaneous use of the two vaporizers. To that end, the interlock used in the Ohio Medical Products machine comprises a lever mounted behind the vaporizers which lever is pivotable about its mid-point. The lever includes an engaging projection at one end adapted to engage a stop on the rotary dial of one vaporizer and a projection on the other end adapted to alternatively engage a similar stop on the other vaporizer dial. In operation, the lever is pivoted manually by the operator so that its projection engages the stop of the closed vaporizer to prevent the rotation of its concentration adjustment dial. This frees the projection at the other end of the lever from the associated stop of the other vaporizer dial, thereby enabling that vaporizer dial to be adjusted to any particular setting. In order to close the opened vaporizer and open the closed vaporizer to a particular setting, it is necessary to rotate the dial of the opened vaporizer until it is closed and thereafter pivot the lever so that its stop engages the stop of the now closed vaporizer, whereupon the other vaporizer, which had been locked closed, is unlocked and can be adjusted by the rotation of its dial.

While the Ohio Medical Products interlock device appears effective for ensuring that both vaporizers are not opened at the same time, its mode of operation is not readily apparent from examination of the device and is, in fact, somewhat complex. In this regard, as noted heretofore, the operation of the device requires the manual rotation of the vaporizer adjustment dial coupled with the manual pivoting of the interlock lever.

According to the present invention there is provided equipment for use in an anaesthesia apparatus, the equipment comprising: first and second vaporizers each capable of introducing an anaesthetic at a metered rate into a flowing gas, the first and second vaporizers including respective first and second rotatable metering means for opening and closing the respective first and second vaporizers and for metering the rate of introduction of evaporated anaesthetic into the flowing gas when the respective first or second vaporizer is open; and an interlock device for locking the metering means of one of the first and second vaporizers in a closed position whenever the metering means of the other vaporizer is in the open position, the interlock device comprising interdependent first and second engagement means, the first engagement means being capable of engaging the first rotatable metering means to lock the first rotatable metering means in a closed position, and the second engagement means being capable of engaging the second rotatable metering means to lock the second rotatable metering means in a closed position; the arrangement

being such that, in use, the first or second rotatable metering means can be disengaged from the respective first or second engagement means and a desired rate of flow of an anaesthetic can be set by mere rotation of the respective first or second rotatable metering means, provided that the respective second or first rotatable metering means is in its closed position.

For a better understanding of the present invention and to show more clearly how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings in which:

Figure 1 shows a front perspective view of a portion of an anaesthesia apparatus including equipment having a vaporizer interlock device;

Figure 2 shows a rear view of the portion of the anaesthesia apparatus and equipment of Fig. 1;

Figure 3 is a side view of the portion of the anaesthesia apparatus and equipment shown in Figs. 1 and 2; and

Figure 4 is a sectional view along the line 4–4 of Fig. 1.

In the drawings, similar components are given the same reference numeral.

Referring to Fig. 1, there is shown an interlock device which is generally indicated by the reference 20 and which is intended for use with a pair of vaporizers 22 and 24 of a conventional anaesthesia apparatus or machine, a portion of which is generally indicated by the reference numeral 26.

Each of the vaporizers 22 and 24 is of conventional internal construction except for the use of a respective camming member, to be described in considerable detail later, coupled to, or integral with, a vapour concentration adjustment dial 30. Each vaporizer 22 or 24 comprises a canister 28 containing the anaesthesia vapour or volatile fluid to be dispensed and a means for metering the same into a gas line of the apparatus 26. The concentration of the anaesthesia vapour provided by each of the vaporizers 22 or 24 is determined by the setting of the vapour concentration adjustment dial 30. As can be seen, each dial 30 is a generally disc-shaped member having a circular, outer surface 32 whose upper edge is tapered and is ribbed to provide a manual gripping surface 34. The outer surfaces 32 include a plurality of indicia 36 engraved thereon corresponding to the vapour concentration provided by the respective vaporizer 22 or 24. The canister 28 includes an arrow or pointer indicium 38 to indicate the particular vapour concentration setting established by the respective vaporizer 22 or 24. When the zero mark of indicia 36 is aligned with the arrow 38, the corresponding vaporizer 22 or 24 is closed. The rotation of the dial 30 counterclockwise opens the vaporizer 22 or 24 to introduce vaporized fluid or gas into a patient breathing circuit (not shown). The concentration level established by the setting of the dial 30 is displayed by the indicium 36 disposed opposite to pointer 38.

As noted heretofore, the dial 30 of each vaporizer 22 or 24 includes a respective camming member. Each camming member is generally denoted by the reference numeral 40 and is in the form of a disc having a circular cam surface 42 which is concentric with the dial surface 32. Each of the camming members 40 includes a respective notch or recess 44 in its circular, peripheral cam surface 42. The notches 44 will be described in considerable detail later. It will suffice now now to say that each notch 44 provides an inclined cam surface which is arranged to cooperate with a portion of the interlock device 20 to preclude the opening of one vaporizer 22 or 24 if the other vaporizer 24 or 22 respectively is in any position other than the fully closed or off position.

Each of the vaporizers 22 or 24 is mounted on a portion of the anaesthesia apparatus, such as the console (not shown) by a respective L-shaped mounting bracket 46. Each bracket 46 includes a downwardly extending section 48 and a horizontal portion 50. The cannister 28 of each vaporizer 22 or 24 is connected to the portion 50 of the respective bracket 46.

The interlock device 20 comprises a pivotable lever means 52 (Fig. 1) and an associated pair of engagement means in the form of a pair of cam follower pins 54. Each of the cam followers pins 54 is arranged for reciprocation into or out of a respective cam notch or recess 44 in the dial 30 of an associated vaporizer 22 or 24.

As can be seen in Fig. 1, each of the cam notches or recesses 44 is in the form of a right angle, V-shaped, slot with the sides of the slot inclined to radii of the respective camming member 40. The inclined sides of the slot form inclined cam surfaces 56. Each of the cam follower pins 54 is an elongate rod-shaped member having opposed rounded ends 58 and 60. The rounded end 58 of each pin 54 serves as the cam following surface of that pin 54 and is adapted to ride along the periphery of the respective camming member 40.

Each of the cam follower pins 54 extends horizontally through a sleeve 62 located in the portion 48 of one of the brackets 46. Each pin 54 is freely reciprocable longitudinally within said sleeve. The pivotable lever means 52 is in the form of an elongate bar which is arranged to pivot in a horizontal plane about a vertical pivot pin 64 in either the clockwise or counterclockwise direction (as shown by the double headed arrow 66 in Fig. 4). The lever means or bar 52 is located with respect to the cam follower pins 54 so that when pivoted

clockwise one end of the lever means 52 engages or abuts the rounded end 60 of one pin 54 and when pivoted counter-clockwise the other end of the lever-means 52 engages or abuts the corresponding end of the other pin 54.

The lever means 52 is mounted between a pair of support members 68 and 70 (Fig. 2). Each members 68 and 70 is an elongate L-shaped member which includes a vertically disposed portion 72 and a horizontal flange 74. A pair of vertically oriented elongate slots 76 are located within the portion 72 of the flange adjacent either end thereof. A respective threaded fastener, such as a screw 78 extends through each slot 76 and into an associated threaded opening in the portion 48 of one of the brackets 46. A washer 80 is located under the head of the screw 78. The lower support member 70 is mounted in an identical manner to the upper support member 68. A vertical pivot pin 64 extends through aligned openings 82 in the upper and lower support members 68 and 70 respectively. The pivotable lever means 52 is disposed horizontally between the upper and lower support members 68 and 70 and is centred, via a pair of washers 84. The pivot pin 64 is held in place by a pair of locking C-rings 86 located in respective annular recesses (not shown) in the periphery of the pin 64 adjacent each end.

Each of the cam notches 44 is located on the periphery of the camming member 40 so that it is aligned with its associated cam following pin 54 when the respective vaporizer 22 or 24 is closed (at which time the zero indicium 36 is aligned with the pointer indicium 38).

Each of the cam follower pins 54 is arranged for selective engagement with its associated cam notch or recess 44. The lever means 52 and the cam follower pins 54 cooperate with each other so that when the vapour concentration dial 30 of either vaporizer 22 or 24 is in the closed position, the cam follower pin 54 associated with the other vaporizer 24 or 22 respectively can be moved or displaced out of the cam recess 44 by mere rotation of the dial 30. For example, as the dial 30 of the vaporizer 24 is rotated to establish a desired vapour concentration setting, the end surface 58 of the cam following pin 54 associated therewith rides up one of the inclined surfaces 56 of its cam recess 44 until it is on the circular periphery 42 of the corresponding camming member 40. This action moves the cam follower pin 54 to the rear, i.e., toward the lever means 52, whereupon its rear surface 60 engages the lever means 52 to pivot the lever means 52 in the counter-clockwise direction as seen in Fig. 4. This counter-clockwise pivoting of the lever means 52 causes a portion of its opposite end to engage the end 60 of the other cam follower pin 54, thereby forcing that pin 54 forward, i.e. toward the vaporizer 22 and firmly into the aligned cam recess 44 in its camming member 40. The cam recess 44 thus acts as a stop to lock the vaporizer 22 in the closed position.

In the event that it is desired to close the vaporizer 24 and open vaporizer 22, all that is required is to manually grasp the dial 30 of the vaporizer 24 to rotate it in the clockwise direction until the vaporizer 24 is closed, whereupon its cam recess 44 is aligned with its associated cam follower pin 54. The vapour concentration dial 30 of vaporizer 22 is then manually rotated in the clockwise direction, whereupon the cam follower surface 58 of the associated pin 54 rides up one of the inclined surfaces 56 and onto the circular cam surface 42. This action causes this pin 54 to move to the rear, thus engaging one end of lever means 52 to cause the lever means 52 to pivot in the clockwise direction. The clockwise pivoting of lever means 52 causes its other end to force the other cam follower pin 54 (the right hand pin 54 in Fig. 4), forward, that is, into the aligned cam recess 44 of vaporizer 24. So long as the vaporizer 22 is at any concentration setting other than the zero (closed) setting, the cam follower pin 54 associated therewith will hold the lever means 52 in the clockwise pivoted position so that the associated cam follower pin 54 is locked in the cam recess 44 in the camming member 40 of the vaporizer 24.

As will be appreciated from the foregoing, the interlock device 20 of the present invention is simple in construction and effective in operation. In this regard, all that is required to effect the adjustment of one vaporizer 22 or 24 and the locking of the other vaporizer 24 or 22 respectively in the closed position is the mere rotation of the vaporizer concentration adjusting dials 30. The cam surface 42 of the camming members 40 on the dial 30 of the opened vaporizer 22 or 24 effectuates the pivoting action of the lever means 52 to lock the other vaporizer 24 or 22 respectively in the closed position without requiring the operator to grasp the lever means 52 to pivot it to the locked position. This feature is of considerable importance since it simplifies operating procedure, thereby minimizing the chance of operator error.

CLAIMS

1. Equipment for use in an anaesthesia apparatus, the equipment comprising: first and second vaporizers each capable of introducing an anaesthetic at a metered rate into a flowing gas, the first and second vaporizers including respective first and second rotatable metering means for opening and closing the respective first and second vaporizers and for metering the rate of introduction of evaporated anaesthetic into the flowing gas when

the respective first or second vaporizer is open; and an interlock device for locking the metering means of one of the first and second vaporizers in a closed position whenever the metering means of the other vaporizer is in the open position, the interlock device comprising interdependent first and second engagement means, the first engagement means being capable of engaging the first rotatable metering means to lock the first rotatable metering means in a closed position, and the second engagement means being capable of engaging the second rotatable metering means to lock the second rotatable metering means in a closed position; the arrangement being such that, in use, the first or second rotatable metering means can be disengaged from the respective first or second engagement means and a desired rate of flow of an anaesthetic can be set by mere rotation of the respective first or second rotatable metering means, provided that the respective second or first rotatable metering means is in its closed position.

2. Equipment as claimed in claim 1, wherein each of the first and second rotatable metering means includes a respective first or second stop means with which the respective first or second engagement means can engage to lock the respective first or second rotatable metering means.

3. Equipment as claimed in claim 2, wherein each of the first and second rotatable metering means comprises a dial with a cam surface having a recess therein forming the respective first or second stop means.

4. Equipment as claimed in claim 3, wherein each of the first and second engagement means is capable of reciprocating into and out of its associated recess and sliding along said cam surface as the respective first or second rotatable metering means is rotated.

5. Equipment as claimed in any one of claims 1 to 4, wherein the interlock device also includes a pivotal lever means carrying, or capable of contacting, the first and second engagement means.

6. Equipment as claimed in claim 5 when appendant to claims 3 or 4, wherein each of said recesses includes one or more inclined surface arranged to cooperate with its associated first or second engagement means to move automatically the associated first or second engagement means out of that recess and to pivot the lever means when the respective first or second rotatable metering means is rotated, thereby causing the lever means to move the second or first engagement means respectively into the recess of the second or first rotatable metering means to lock that second or first rotatable metering means in a closed position.

7. Equipment as claimed in claim 5 or 6, wherein each of the first and second engagement means comprises a cam follower pin separate from the lever means, and wherein the lever means comprises an elongate member pivotably mounted about an intermediate point thereof.

8. Equipment as claimed in claim 7, wherein each of the cam follower pins is an elongate member having a first free end formed as a cam follower surface and an opposite second free end for abutting the lever means, with one of the cam follower pins abutting the lever means on one side of said intermediate point and the other of the cam follower pins abutting the lever means on the other side of said point.

9. Equipment as claimed in any one of claims 1 to 4 wherein the interlock device is an element of which opposite end portions serve as the first and second engagement means respectively, the element being mounted for reciprocable movement between the first and second rotatable metering means.

10. Equipment substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

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