March 28, 1944. K. CONNELL 2,345,530

BREATHING-SYSTEM CANISTER-ARRANGEMENT

Filed Jan. 22, 1941

Fig. 1.

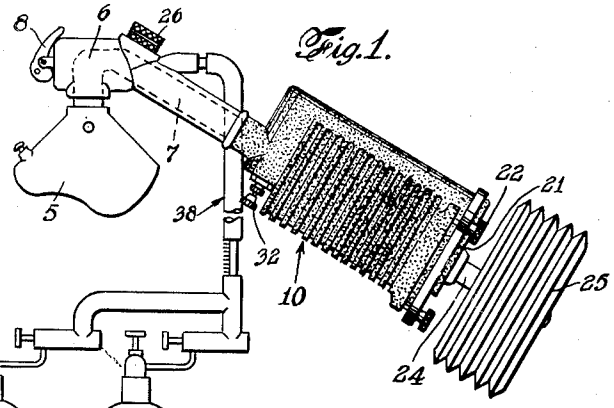


Fig. 2.

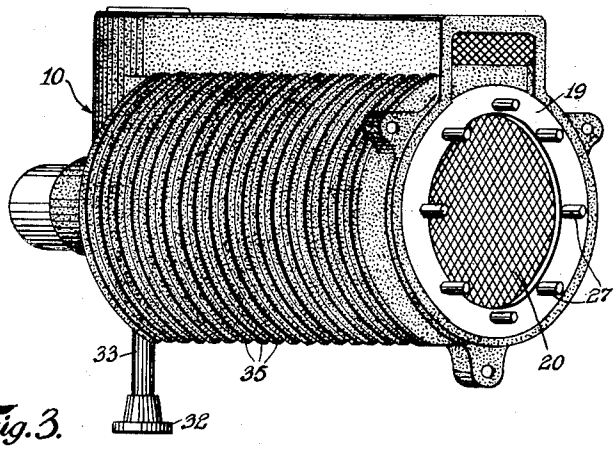


Fig. 4.

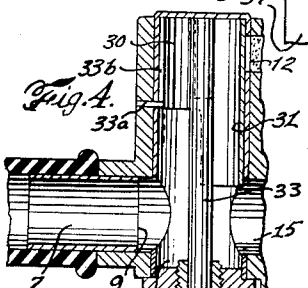
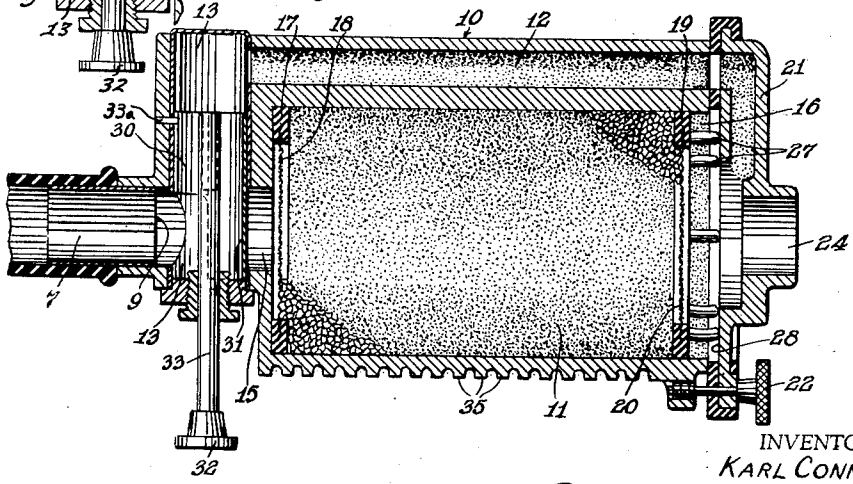


Fig. 3.



INVENTOR.
KARL CONNELL

BY Robert Irving Williams

ATTORNEY.

Patented Mar. 28, 1944 2,345,530

UNITED STATES PATENT OFFICE

2,345,530

BREATHING SYSTEM CANISTER ARRANGEMENT

Karl Connell, Branch, N. Y., assignor to Air Reduction Company, Incorporated, New York, N. Y., a corporation of New York

Application January 22, 1941, Serial No. 375,402

7 Claims. (Cl. 183—40)

This invention relates to breathing systems and more particularly to canisters for use in treating gaseous fluid therein and forming a part of such systems.

In breathing systems wherein all or part of the gas exhaled by a patient is rebreathed, it is important that there be provided means for preventing an undesired excess of carbon dioxide in the gas to be rebreathed. To this end there is customarily inserted in the breathing system a canister containing a suitable treating agent such, for example, as soda lime. Since, however, carbon dioxide is a stimulant to breathing, the amount of carbon dioxide desirably contained in gas to be inhaled will depend on the condition of the patient, the type of treatment, and other factors; and to this end it has been found desirable that the utilization of soda lime, or other carbon dioxide absorbent, be controlled. Similar problems occur in the use of other treating agents in breathing systems. Since chemical absorption of carbon dioxide generates heat and at times renders the canister and gases undesirably warm, especially when the canister is used proximal to the patient in the to-and-fro breathing method, it has been found desirable to increase the rate of heat dissipation through the canister. With the foregoing and other considerations in view, the present invention contemplates the provision of a by-passed canister arrangement which, in its more specific aspects, includes valve means for directing the gas either through or around the container for the treating agent. In accordance with the present invention, there is provided a by-passed canister arrangement wherein the container portion and the by-pass channel are formed as an integral unit, preferably an integrally cast metallic unit; whereby there is provided an exceedingly simple and compact device which can be transported and utilized with extreme ease and efficiency. In certain of its more specific aspects, moreover, the invention provides means for the efficient dissipation of heat generated in the canister, as by the absorption of carbon dioxide by soda lime. It is desirable to shape the canister, as by integrally cast fins, so as to provide increased radiation capacity, and to roughen the surface both internally and externally to provide more efficient thermal convection.

Another desideratum in soda-lime canisters is the provision of means whereby the granules of soda lime are maintained compact so as to prevent the formation of large gas passages wherein the gas will not come into intimate contact with the soda lime, and a further desideratum is that the means to this end shall be such as to operate with ease and certainty. With the foregoing and other considerations in view, the invention in certain of its aspects contemplates the provision of a retaining element for the treating agent, and a cover member for the canister so constructed and arranged as to exert compression on the granules of a treating agent when the cover member is in place. It has been found that rubber feet provide a simple and highly effective compression means, such feet being provided on either the cover means or the retainer element, preferably on the latter, in accordance with the invention.

Desirably, the cover element is so formed as to provide communication therethrough with the exterior thereof from the container portion and from the by-pass channel and at the same time to exert when closed a compressing action against the retaining member and thence against the granules in the container portion. Desirably also, there is provided a control valve which permits the flow to be suitably divided between the by-pass channel and the container portion or to be directed entirely through one or the other of these members as desired. Other objects and features of the invention will appear hereinafter.

The invention accordingly comprises the features of construction, combinations of elements, and arrangement of parts, each of which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawing in which:

Figure 1 is a somewhat diagrammatic view of a breathing system embodying the invention;

Fig. 2 is a perspective view of the canister arrangement with the cover removed;

Fig. 3 is a longitudinal sectional view of the canister arrangement showing the valve in its lowermost position; and

Fig. 4 is a fragmentary view showing the valve in its uppermost position.

The invention is exemplified as embodied in a breathing system of the to-and-fro type. It comprises a breathing member, which as illustrated is in the form of a mask 5, and a chimney

piece 6 providing a conduit 7 extending from the mask and having therein an operating valve means 8. The conduit 7 leads to a port 9 on a unitary canister element 10 which in the present instance provides a container portion 11 for soda lime or other treating agent, a by-pass channel 12, and preferably also a connector channel 13. The unit is preferably integrally molded and desirably is a metallic casting. Desirably, this is formed of a light-weight metallic alloy which has a high heat conductivity and which is readily surface-etched, as by acid or anodizing. One alloy suitable for this purpose is a magnesium alloy consisting of 88¾% magnesium, 11% aluminum, and ¼ of 1% manganese. By etching to a fine granular or irregular surface of .001 to .003 inch depth of irregularity (as indicated by the stippling) the rate of heat exchange between internal fluid contents and external atmosphere is increased to about double that of a canister with a polished surface. Both the internal and external surfaces are so etched.

The container portion is formed with an opening 15 through which gas may flow thereto from the connector channel, and is open at its opposite end 16. The interior of the container portion is of uniform cross-sectional area throughout at least a portion thereof adjacent the end 16, and, in the present instance, throughout its length. There is provided in proximity to the opening 15, a wire mesh screen having molded thereon, in the present instance, a soft rubber rim 17 to provide a unit 18 fitting across the opening 15. The unit 18 thus provided corresponds in shape to the internal cross-section of the container portion and serves as a bottom for the container portion when the same is filled with granules of soda lime or other suitable treating agent. It can be removed for cleaning or replacement when desired. At the end 16 is a wire mesh screen having molded thereon a soft rubber rim 19 to provide a retaining element 20 conforming to the internal cross-section of the container portion. It is adapted to be moved axially in the end portion of the container and to serve as a retaining means for the soda lime granules and to be slid out of the end 16 when the container portion is to be emptied or filled.

The canister arrangement is provided with a cover 21 which is formed, in the present instance, of the same material as the unit 10, and which is removably secured thereto by means of screw lugs 22 and is formed to connect the open end 16 of the container portion 11 and the corresponding end of the by-pass channel 12 with a conduit portion 24 leading to an expansible reservoir member in the form of a rubber bag 25. A relief valve 26 is provided in the chimney piece, in the present instance. The surfaces of the walls of the cover member are roughened similarly to those of the unit 10.

In accordance with the invention there are provided either on the cover member or preferably, and as exemplified, on the retaining element 20, resilient rubber feet 27, which in the present instance are molded integrally with the rubber rim 19 of the wire screen retaining element 20 and are adapted to be pressed upon by a surface 28 of the cover member so that the putting in place of the cover member will exert pressure upon the rubber feet which will in turn tend to urge the retaining element inwardly and to compress the granules of the treating agent in the container portion.

In order to control the flow through the integral unit, the connector channel 13 is shaped to provide a housing for an open-ended cylindrical slide valve 30 having a semi-cylindrical portion 31 adapted to close the opening 15 when the valve is drawn to a lowermost position by the operation of a handle 32 on the end of a stem 33. The longitudinal sliding movement of the valve is guided by a pin 33*a* fitting into a slot 33*b*. As will be observed, when the valve is in an uppermost position it will close the by-pass channel 12, whereas when it is either in a partially or fully lowered position it will permit gas to flow therethrough into the channel 12. By partially lowering the valve 30, the opening 15 may be closed to any desired extent so as to permit a partial flow through the container portion 11 and a partial flow through the by-pass channel 12.

In order to obtain a maximum cooling of the container portion due to the heating up of the contents thereof as for example during the absorption of carbon dioxide by soda lime, the container portion is provided with substantially annular fins 35 which merge with the exterior of the by-pass channel 12. The fins 35 are preferably cast integrally with the intgeral unit and formed of the same high heat conductive alloy. Additionally the entire surface of the unit and of the cover is roughened as in the manner indicated above.

In the use of the apparatus in the administration of oxygen, or anaesthetic or other therapeutic gas, such gas from one or more suitably valve-controlled tanks 37 is conducted by means of conduit means 38 to the conduit 7. The patient or other user inhales, and, upon exhalation, forces gas through the conduit 7 into the port 9 and thence to 13; the exhaled gas then is conducted through the container portion 11, or through the by-pass channel 12, or through both, depending upon the position of the valve 30, to the cover portion 21 and thence through the conduit 24 to the bag 25, excess gas being discharged through the relief valve 26. On inhalation, gas which has been delivered or is being delivered to the conduit 7 from the conduit 38 is inhaled; as is also gas drawn through the container 11, or through the by-pass channel 12, or through both, depending upon the position of the valve 30, from the bag 25.

The rubber feet 27 which are under compression when the cover member is in place tend to press the retaining member 20 against the granules of soda lime or other treating agent and to keep them compressed and to minimize the formation of air spaces if the individual granules break down as they perform their treating action. Heat generated by the absorptive action of the soda lime granules is effectively dissipated through the highly conductive walls of the canister, the dissipating action of which is augmented by the etched convection surface as well as by the fins. The entire apparatus, and particularly the by-pass canister unit is exceedingly compact, simple and effective for use under widely varying conditions.

Since certain changes may be made in the above construction and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A by-passed canister arrangement for breathing systems comprising a unitary element providing a container portion having an open end and an opening in its opposite end, said unitary element providing also a channel paralleling said container portion and having a common wall therewith and a channel connecting said opening and the first mentioned channel with an exterior port, a sleeve valve mounted in the second mentioned channel and movable along said channel between a position wherein it permits communication between said port and said opening but prevents communication between said port and the first mentioned channel and a position wherein it permits communication between said port and said first mentioned channel but prevents communication between said port and said opening, said valve being also movable to a position wherein it is adapted to permit proportioned flows from said port to said opening and to said first mentioned channel, and removable cover means providing communication therethrough with the exterior thereof from the open end of said container and from said first mentioned channel.

2. A by-passed canister arrangement for breathing systems comprising a unitary metallic element providing a container portion having an open end and an opening in its opposite end, said unitary element providing also a channel paralleling said container portion and a channel connecting said opening and the first mentioned channel with an exterior port, a sleeve valve mounted in the second mentioned channel and movable along said channel between a position wherein it permits communication between said port and said opening but prevents communication between said port and the first mentioned channel and a position wherein it permits communication between said port and said first mentioned channel but prevents communication between said port and said opening, said valve being also movable to a position wherein it is adapted to permit proportioned flows from said port to said opening and to said first mentioned channel, removable cover means providing communication therethrough with the exterior thereof from the open end of said container and from said first mentioned channel, and cooling fins molded integrally with said unitary element.

3. A by-passed canister arrangement for breathing systems comprising a unitary metallic element formed to provide a container for material adapted for the treatment of gaseous fluid passing therethrough, said container having an open end and an opening in its opposite end, said unitary element being also formed to provide a channel by-passing said container, cover means adapted to extend over said open end of said container and one end of said channel and to permit communication therethrough with the exterior thereof from said container and said channel, flow-controlling valve means for regulating the flow of gas through said container, and cooling fins molded integrally with said metallic element.

4. A canister arrangement for breathing systems, comprising a container member adapted to contain granular material for the treatment of expiration products, an inwardly movable retainer element at one end of said container portion and comprising a foraminate screen with a soft rubber rim, outwardly extending resilient rubber compression feet molded integrally with said rim, and a cover member adapted to exert pressure on said compression feet.

5. A canister arrangement for breathing systems comprising a container member adapted to contain compressible material for the treatment of gaseous fluid passing therethrough and having a uniform cross section throughout at least a portion of its extent on one of its axes, a retaining element in said portion and adapted to permit the passage of gas therethrough and movable on said axis to exert a compressing action on compressible material in said container when pressed against said compressible material, cover means for said container member, and resilient rubber compression feet on said retaining element and arranged to receive pressure from said cover means when the latter is put in place.

6. A by-passed canister arrangement for breathing systems comprising a unitary element providing a container member and a by-pass channel, said container member having an open end and an adjacent end portion of uniform cross section and having an opening at its opposite end, means to direct a gas either through said container member or through said by-pass channel, a retaining element in said end portion and adapted to permit the passage of gas therethrough and movable along said end portion to exert a compressing action on compressible material in said container member when pressed against said compressible material, cover means formed to permit communication therethrough with the exterior thereof from said container member and from said by-pass channel and removable to permit said container to be filled with a gas-treating material, and resilient means on said retaining element arranged to receive pressure from said cover means when the latter is put in place.

7. A canister arrangement for breathing systems comprising a container member adapted to contain compressible material for the treatment of gaseous fluid passing therethrough and having a uniform cross section throughout at least a portion of its extent on one of its axes, a retaining element in said portion and adapted to permit the passage of gas therethrough and movable on said axis to exert a compressing action on compressible material in said container when pressed against said compressible material, cover means for said container member, and resilient rubber compression feet spaced apart and positioned adjacent the periphery of said retaining element and adapted to press said retaining element against the contents of said container member when said cover means is put in place.

KARL CONNELL.