

[54] OXYGEN GENERATOR CELL

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[58] Field of Search. 23/281, 282; 128/191 R;
102/39 R, 99; 44/7.5

[56] References Cited

UNITED STATES PATENTS

3,385,672	5/1968	McGoff et al.	23/281
3,573,001	4/1971	Bovard	23/281
3,736,104	5/1973	Churchill et al.	23/281

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[57]

ABSTRACT

A chemical oxygen generator in the form of a can having a puncturable sealed outlet orifice in one end and housing a chlorate candle in the form of a rigid self-sustaining briquette or body with a reduced volume recessed starting end or top, a main intermediate portion and a reduced volume finishing end or bottom, sized for lessened heat radiation on starting and controlled rate delivery of oxygen and shaped to cooperate with the can and a baffle in the can to define an oxygen flow path to the orifice. The recess in the starting end of the candle is filled with ignition cone material, the candle is firmly held in the can by the baffle and can side wall between shock absorbing end pads and a cone igniter surrounded by the top pads which also serve as filters, depends from the orificed end of the can and is actuated from outside of the can to activate the ignition material for starting the generation of oxygen. When the seal is punctured and the igniter is activated, catalytic decomposition of the candle will generate copious quantities of medically pure oxygen which will flow from the candle under the baffle and upwardly between the baffle and tin can through the filter mats to the orifice.

10 Claims, 10 Drawing Figures

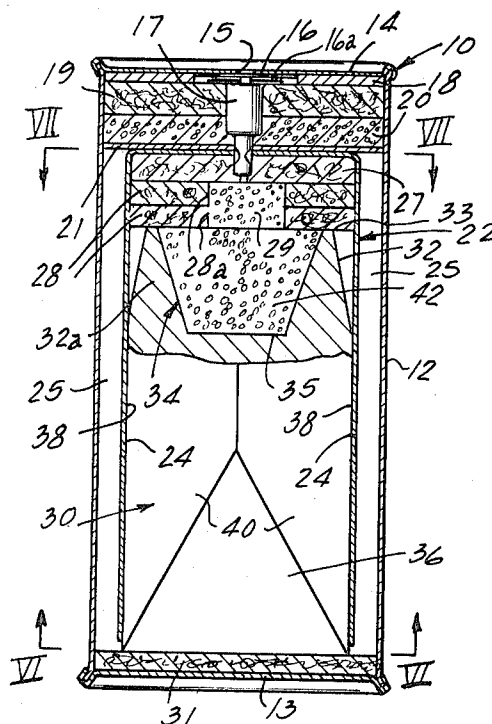


Fig. 1

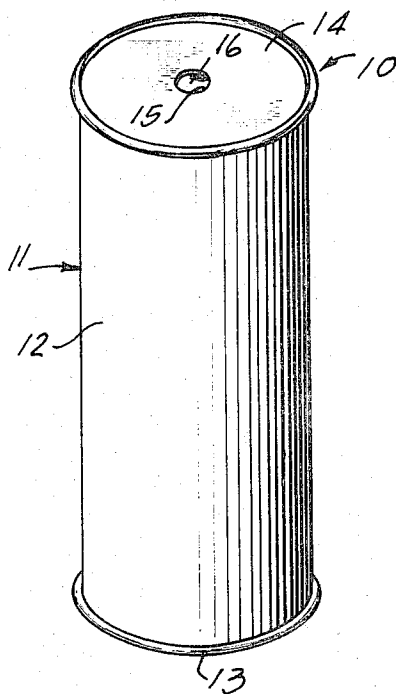


Fig. 2

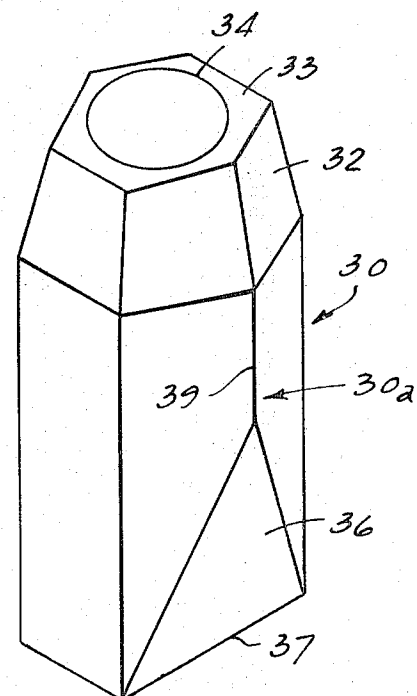
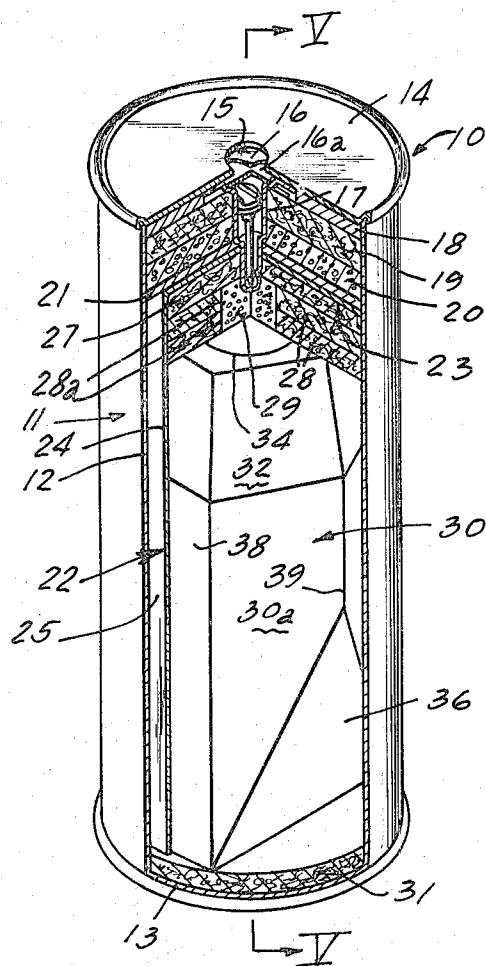


Fig. 3

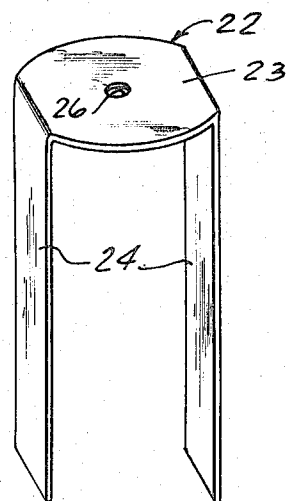
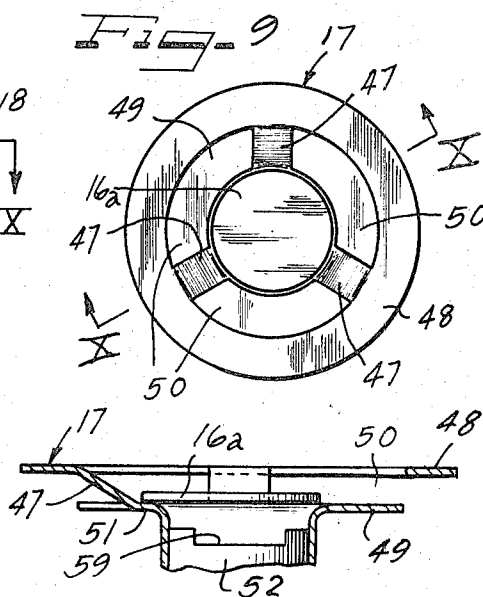
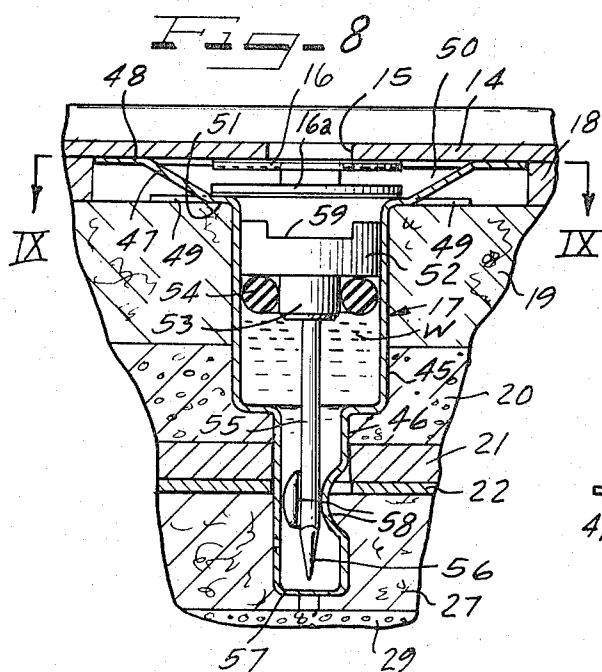
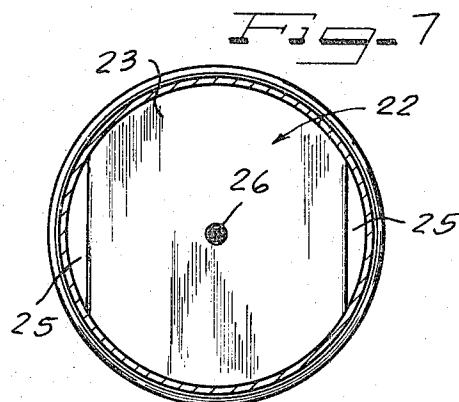
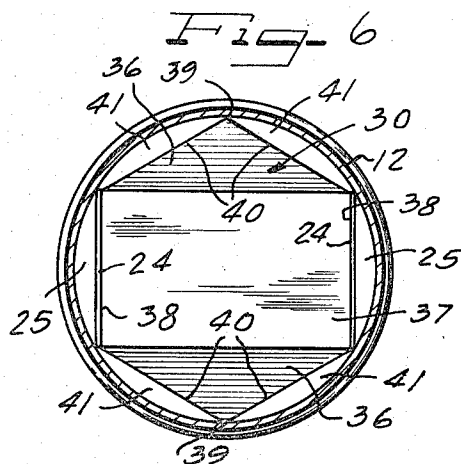
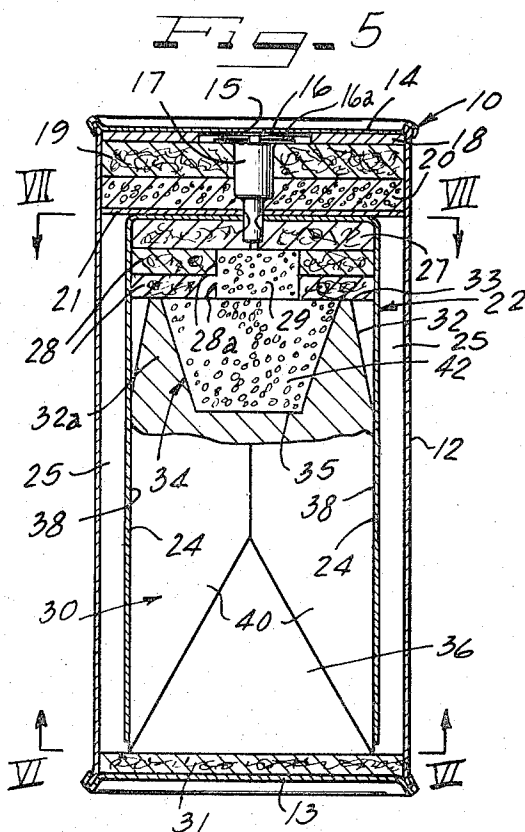


Fig. 4



OXYGEN GENERATOR CELL RELATED APPLICATION

This application is directed to improvements in chemical oxygen generator cells of the general type disclosed in the John P. Churchill and Tommy Lewis Thompson U.S. Patent application entitled "Oxygen Generator Cell," Ser. No. 143,853, filed May 17, 1971, now U.S. Pat. No. 3,736,104 issued May 29, 1973, the disclosure of which is incorporated herein by reference.

1. Field of the Invention

This invention relates to the art of lightweight, disposable can chemical oxygen generators containing a chlorate candle for delivering copious quantities of oxygen at a controlled rate and a low enough temperature so that the can is not damaged. The can is a conventional tin-plated steel can of light gauge used for canned foods and juices. The oxygen produced by the generator is medically pure and its controlled delivery rate may be regulated to be suitable for direct human inhalation. The cell has a prolonged, safe shelf life, remains completely inert until activated and is instantly activated with ease.

2. Description of the Prior Art

Chemical oxygen generators have heretofore required expensive heavy insulated containers with elaborate starting mechanisms as shown, for example, in the U.S. Pat. Nos. 2,507,450 (Millikan et al), 3,276,846 (Moni et al) and 3,580,250 (Oroza). Such generators were not suited for carrying as a personal accessory, were too expensive to merchandise as an off-the-shelf commodity, were hazardous because of their high temperature operation, and were incapable of delivering pure oxygen at a constant rate.

SUMMARY OF THE INVENTION

According to this invention there is now provided lightweight, disposable tin can chemical oxygen generators capable of being instantly actuated from a completely inert condition to delivery U.S.P. oxygen at a rate suitable for breathing and for a desired period of time. Small, lightweight cells according to this invention will deliver a minimum of sixty standard liters of U.S.P. oxygen with a desired amount of water vapor up to 15 mg. per liter at a delivery rate of 4 standard liters per minute for a minimum of 15 minutes. The cell contains a compressed chlorate candle briquette, preferably of the chemical formulation disclosed and claimed in my U.S. Pat. No. 3,702,305, granted Nov. 7, 1972, the disclosure of which is also incorporated herein by reference. The briquette has a shape and a size which will deliver oxygen at a constant rate without interruption from actuation until completion. The preferred shape is an elongated block of hexagonal cross section with a tapered leading end and a rectangular bottom end. The leading end has a recess for receiving ignition cone material which is water activated and preferably has the formulation disclosed and claimed in my U.S. patent application Ser. No. 138,326, filed Apr. 28, 1971, now U.S. Pat. No. 3,725,156 issued Apr. 3, 1973, the disclosure of which is also incorporated herein by reference.

One end of the tin can has a sealed orifice which is easily punctured to expose a plunger slidable in a sealed water-filled chamber or vial which is punctured by a pin depending from the plunger when the plunger

is depressed. The liberated water immediately moistens the ignition cone material which ignites to activate the candle.

The cell contains a metal baffle with a top or end wall fitting snugly in the can in spaced relation from the orificed end of the can and providing a compartment in the top wall of the can. Two legs from the baffle grip diametrically opposed side walls of the candle and provide an oxygen flow path between the side wall of the can and the legs from the candle to the compartment in the can above the baffle. This compartment is filled with filter material effected to absorb any odors in the oxygen en route to the orifice. Additional mats are positioned between the top end of the candle and the end wall of the baffle and a bottom mat is provided between the bottom end of the candle and the bottom of the can so that the candle in effect is clamped between shock absorbing mats and is embraced by the baffle to be centered in the can with ample oxygen flow paths between the candle and can. No insulation surrounds the candle and heat radiation is uninhibited.

The mats between the candle and end wall of the baffle have central apertures overlying the ignition cone of the candle and these apertures are filled with a loose powder first fire material which may be of the same formulation as the ignition cone material.

The reduced leading end of the candle surrounding the ignition cone is desired to prevent a sudden outpouring of oxygen at the start of the reaction since this portion of the candle surrounds the ignition cone and is rapidly heated. Further, a wider gap is provided between the side wall of the can and the candle to retain some of the heat of reaction at the start and preclude burn-outs in very cold weather. As the reaction proceeds, the temperature tends to rise and accelerate the reaction but the reduced size of the trailing end of the candle provides less cross sectional burning area thereby reducing the available oxygen source even though the burning rate may increase and thus maintaining a constant delivery rate of oxygen.

It is then an object of this invention to provide an improved chemical oxygen generator cell which is inexpensive, light in weight, and produces copious quantities of medically pure oxygen without interruption for a predetermined time period.

Another object of the invention is to provide a chemical oxygen generator in the form of a tin-plated steel can of light gauge containing a chlorate candle with reduced leading and trailing ends to supply copious quantities of medically pure oxygen at a constant rate when activated from one end.

Another object of the invention is to provide improvements in the oxygen generator cell of the John P. Churchill and Tommy Lewis Thompson U.S. Pat. No. 3,736,104 issued May 29, 1973 which better support the chlorate candle, reduce the heat loss from the ignition cone area at low operating temperatures, reduce "hot spots" on the can and maintain a hermetic seal without the use of valves and without requiring a blow-out disk.

Another object of the invention is to provide an improved ignition cup assembly for chemical oxygen generators.

Another object of the invention is to provide an oxygen generator cell which supports the top of a chlorate candle in spaced relation from metal surfaces to reduce heat loss.

A further object of the invention is to provide a hexagon-rectangle combination shape for a chlorate candle to allow free oxygen flow in a tin can housing while providing good support for the candle in the tin can. Other and further objects and features of this invention will become apparent to those skilled in this art from the following detailed description of the annexed sheets of drawings which by way of a preferred example show one embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an isometric view of a chemical oxygen generator cell of this invention;

FIG. 2 is a view similar to FIG. 1 but having a quadrant cut therefrom to show internal parts;

FIG. 3 is an isometric view of the chlorate candle in the cell of FIGS. 1 and 2;

FIG. 4 is an isometric view of the baffle in the cell of FIGS. 1 and 2;

FIG. 5 is a longitudinal cross sectional view of the cell taken along the line V—V of FIG. 2;

FIG. 6 is a transverse sectional view from the bottom upwardly taken along the line VI—VI of FIG. 5;

FIG. 7 is a transverse sectional view from the top downwardly along the line VII—VII of FIG. 5;

FIG. 8 is an enlarged longitudinal sectional view of the valve cup of the cell;

FIG. 9 is a plan view along the line IX—IX of FIG. 8; and

FIG. 10 is a side view of the valve cup along the line X—X of FIG. 9.

BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIGS. 1, 2 and 5 the oxygen generator cell 10 of this invention is illustrated in the form of a cylindrical tin can 11 with a cylindrical side wall 12, a flat circular bottom 13 and a flat circular top 14 crimp-rolled onto the ends of the cylindrical wall 12 and soldered in sealed relation therewith. The top wall 14 has a central circular aperture 15 sealed by an underlying puncturable foil 16. An ignition actuator cup 17 depends from the top wall 14 surrounding the aperture 15 and underlying the puncturable seal 16. The details of the cup will be hereinafter described.

A disk 18 of ceramic fiber material underlies the top wall 14 and surrounds the upper end of the cup 17 to serve as a final dust filter. A ceramic fiber mat 19 underlies the fiber disk 18 and also surrounds the cup 17. This disk and mat are composed of material which will not burn or give off toxic gases. A fibrous ceramic insulating material sold under the trademark "Fiberfrax" by the Carborundum Company is a suitable material.

Underlying the mat 19 is provided a layer 20 of granular sodium peroxide (Na_2O_2), activated alumina or the like to serve as an odor-absorbing layer. Next a "Fiberfrax" or the like disk 21 underlies the layer 20.

A tin-plated steel baffle 22 also shown in FIG. 4, has a circular top end wall 23 underlying the disk 21 and a pair of diametrically opposed flat legs 24 depend from this end wall 23 to a level in the bottom half of the can 11 and preferably extending at least close to the bottom of the can. These legs 24 are spaced inwardly from the side wall 12 of the can to provide flow passages 25 from the bottom portion of the can to the space above the end wall 23 of the baffle. This end wall

23 has a central aperture 26 receiving the nose of the cup 17 therethrough.

Immediately underlying the end wall 23 of the baffle there is provided another "Fiberfrax" mat 27 also with an aperture therethrough receiving the nose of the cup 17 snugly therein. Next, a pair of superimposed "Fiberfrax" mats 28 underlie the mat 27 and have aligned larger diameter apertures 28a filled with a first fire material 29 such as an iodate ignition cone composition disclosed and claimed in my aforesaid U.S. Pat. No. 3,725,156. These two mats 28, of course, could be combined in a single thick mat. It will be noted that the mats 27 and 28 are confined under the top end wall 23 of the baffle and are within the side legs 24 thereof so as not to block the flow paths 25.

A chlorate candle 30, shown in FIGS. 2, 3, 5 and 6, of hexagonal-rectangular configuration is clamped in the can 11 between the mats 28, a bottom "Fiberfrax" mat 31 and the side legs 24 of the baffle 22. This candle is a compressed briquette of a major proportion of an alkali metal chlorate, preferably sodium chlorate, and a sufficient amount of a sodium or potassium oxide catalyst to maintain a self-sustaining catalytic decomposition reaction which will liberate oxygen from the chlorate without any additional heat or added fuel. A preferred chlorate candle formulation is disclosed in my aforesaid U.S. Pat. No. 3,702,305.

The shape of the candle or briquette 30 is best shown in FIG. 3. As there shown the briquette has an elongated main body portion 30a of hexagonal cross section with a tapered hexagonal top portion 32 converging to a flat top wall 33 having a central recess or well 34. As shown in FIG. 5 this well 34 converges from the top 33 to a flat bottom 35 level with the bottom extremity of the tapered portion 32 so that the material constituting the upper tapered portion of the briquette 32 increases in radial width from a narrow top rim portion to a wide portion entering the main body 30a.

The full hexagonal body portion 30a as shown in FIG. 3 extends from the base of the tapered portion 32 to a level which is about midway between the top and bottom ends of the briquette and from this level two adjoining sides on diagonal opposite sides of the hexagon are cut back in triangular flats 36 to terminate in a rectangular base 37 which rests on the mat 31.

As shown in FIGS. 2, 5 and 6 the legs 24 of the baffle 22 embrace diagonally opposite sides 38 of the hexagonal body portion 30a from the base of the tapered portion 32 to adjacent the bottom of the candle 30, preferably terminating about $\frac{1}{8}$ inch above the candle bottom. This provides the free flow paths 25 in the can 11 behind the baffle legs 24. In addition, the apices 39 of the remaining sides 40 of the hexagonal portion 30a engage the cylindrical wall 12 of the can providing additional flow passages 41 between the candle and the side wall of the can. In this manner the candle 30 is not only clamped in the can between the mats 28 and 31 but is also centered in the can by the apices 39 and the embracing legs 24 of the baffle. The candle, therefore, cannot shift either axially or laterally in the can and at the same time free flow oxygen paths are insured.

The frusto conical recess 34 of the candle or briquette is filled with ignition cone material 42 of the same type as 29 filling the apertures 28a of the mats 28 but this material 42 is compacted in the candle body in a much more dense relationship than the relatively loose powder 29. The loose powder 29 is more easily

ignited than the compacted material 42 but after the first fire is initiated at 29 the compacted material 42 will readily release heat of such intensity to immediately activate the candle body. The shape of the body 30 and the relative sizes of the various portions thereof are carefully controlled so that a constant delivery rate of oxygen will be maintained from the start to the finish of the catalytic decomposition of the chlorate material. The burning cross sectional area of the candle generally widens through an annular zone 32a from the relatively narrow rim top edge 33 to the full hexagonal body 30a. Since this zone 32a surrounds the ignition cone material 42 the ignition is very rapid and the gradually increasing burning front through zone 32a prevents an excessive out-pouring of oxygen at the start of the ignition. Further, it will be noted that the periphery of the tapered section 32 does not contact either the baffle legs 24 or the tin can side wall 12 so that an unimpeded gap of considerable radial dimension is provided. This gap is desired to conserve heat at the start of the ignition especially during cold weather starts where free radiation from the tin can is not desired. This gap decreases in radial width as the burning front advances and by the time the burning front reaches the full hexagonal body 30a the rate of burning has been accelerated to the desired rate. As the burning front advances through the main body 30a it tends to accelerate and for this purpose the burning area is cut back at 36 to decrease the burning front area and thus maintain a constant rate of oxygen delivery.

The illustrated hexagonal-rectangular configuration is one example of control of the oxygen delivery rate by providing a reduced starting burning front surrounding the ignition material, a main body burning front and a reduced terminal burning front. Dimensions can be widely varied but by way of illustration, a chlorate candle capable of delivering a minimum of 60 liters of oxygen for 15 minutes at the rate of 4 liters per minute will have an overall height of about 3.37 inches, a base length of about 1.73 inches, a base width of 1 inch, tapered sections 36 starting at 1.75 inches above the base and a tapered portion 32 about equal in height to the full hexagonal main portion 30a.

As shown in FIGS. 8 to 10 the ignition cup assembly 17 includes a stamped metal thimble 45 with a reduced diameter leading nose 46 and an outwardly flared collar portion 47 terminating in a flat outturned flange 48. The collar portion 47 is lanced at three arcuate areas 49 thereof providing three arcuate slots 50 equally spaced around the collar.

The flange 48 is soldered to the underface of the top can lid 14 surrounding the orifice 15. The foil 16 sealing this orifice 15 is sealed as by soldering to the underface of the lid 14. In addition, a second foil 16a is sealed, as by soldering, to a shoulder 51 between the collar 47 and the top of the thimble portion 45. Both seals 16 and 16a are desirable, the orifice seal 16 being effective to seal the entire can from the atmosphere and the ignition cup seal 16a being effective to seal the interior of the ignition cup from the contents of the can. The seals 16 and 16a may be metal foil soldered to the can lid and shoulder respectively.

A metal plunger 52 is slidable in the thimble 45 and has a boss portion 53 surrounded by a rubber O-ring seal 54. A pin 55 extends from this boss portion 53 into the reduced diameter nose portion 46 and has a pointed end 56 resting on the closed bottom of the nose

portion. Depressed portions 58 in the nose 46 provide guides for the pin 55 to hold it in the center of the nose. The head 52 at the plunger is recessed at 59 so that in the event oxygen pressure forces it against the can lid 14, an ample escape path for the oxygen will be provided.

The thimble 45 and its nose 46 are filled with water W which is trapped therein by the O-ring seal 54 which is preferably composed of silicone rubber, "Viton" or "Teflon." This water W may contain an anti-freeze chemical and is completely sealed in the cup assembly 17 by the second foil seal 16a. A small air gap is provided between the water W and the plunger and seal assembly so that the plunger may be depressed to cause the pin 55 to pierce the closed bottom 57 of the nose 46 whereupon the water will be released and ejected through the pierced hole in the bottom 57 of the nose.

To activate the cell it is only necessary to force a pin or the like through the seals 16 and 16a depressing the plunger head 52 causing the pin point 56 to pierce the bottom wall 57 and moving the O-ring 54 downwardly with the plunger head and boss to eject the water W ahead of it through the pierced opening in this bottom 57. In this manner the water will immediately be fed to the first fire material 29 to start the reaction.

The oxygen flow will be generally downward over the candle body 30a and flats 36 through the passages 41 over and into the mat 31 and then into the flow paths 25. This flow pattern permits preheating of the bottom of the candle at low temperatures. From the paths 25 the oxygen will flow into the compartment above the top wall 23 of the baffle 22 where the oxygen will be deodorized and filtered through the ceramic fiber disks, the layer 20, and the mat 19 to flow through the openings 50 in the thimble 45 to emerge through the orifice 15 in the top can lid. The oxygen flow path is thus between the candle and the side wall of the can where heat can be dissipated from the oxygen to deliver it at substantially room temperatures.

From the above description it will now be understood that this invention provides chemical oxygen generator cells which are inexpensive enough to be disposed after single usage, are light in weight, foolproof in performance, completely safe in operation and have a substantially perpetual shelf life.

I claim as my invention:

1. A chemical oxygen generator cell which comprises a disposable canister having an end wall with an orifice therethrough, a puncturable seal closing the orifice of said end wall, a chlorate candle in said canister having a reduced area starting end, a reduced area finishing end, and a main body portion therebetween, porous mats in the canister clamping the candle against axial shifting in the canister, a baffle overlying the candle in the canister and having side legs embracing the main body portion of the candle centering the candle from the side wall of the canister and providing oxygen flow paths between the candle and side wall of the canister communicating through the porous mats with the orifice in the end wall of the canister, a sealed housing in said canister adjacent said orifice and containing a fluid for activating the candle, ignition material between the candle and said sealed housing, and means accessible through the orifice of the canister for releasing fluid from the sealed housing to activate said ignition material and thereby actuate the candle for delivering oxygen from the canister through said orifice.

2. The cell of claim 1 wherein the baffle is pressed in tight fitting relation in the canister and provides a compartment between the candle and the orificed end of the canister.

3. The cell of claim 1 wherein the candle has an elongated main body portion of hexagonal cross section shape with diametrically opposed apices engaging the canister and with diametrically opposed sides embraced by the legs of the baffle.

4. An oxygen generator cell which comprises a disposable tin can having an oxygen dispensing orifice in one end thereof, a puncturable seal closing said orifice, a chlorate candle in said can, means clamping said candle against axial movement in said can, said chlorate candle having reduced area leading and trailing ends tapering to a full main body portion between said ends, ignition cone material in the reduced leading end of the candle, a baffle with a centrally apertured end wall overlying the reduced leading end of the candle having depending side legs embracing the main body portion of the candle and centering the candle from the side wall of the can and providing oxygen flow paths between the legs and side wall of the candle, a sealed fluid filled thimble suspended in the can from the orificed end wall of the can around said orifice and having a nose portion projecting through the central aperture of the baffle end wall into close relation with said ignition cone material in the reduced leading end of the candle, plunger means in the thimble having a depending pin adapted to pierce the nose of the thimble to release fluid to the ignition cone material, and said plunger means adapted to be depressed upon puncturing the sealed orifice in the end wall of the can whereby the ignition material will activate the candle and oxygen will flow to the orifice.

5. The generator of claim 4 wherein the thimble has a cylindrical main body portion, an outturned slotted flange, a reduced diameter nose portion and depressions in the nose portion slidably guiding the pin.

6. The generator of claim 4 wherein the end portion of the metal baffle fits tightly in the cylindrical wall of the can and is spaced downwardly from the orificed end wall of the can to provide a compartment, and filter material fills said compartment.

7. A chemical oxygen generator which comprises a disposable tin can having a cylindrical body, flat circular disk ends, and a central oxygen dispensing orifice in one disk end, a puncturable seal closing said orifice, a metal baffle in said tin can having an end wall tightly fitting the cylindrical body of the can spaced below the orificed disk end of the can and cooperating therewith to provide a compartment in the can, filter means in said compartment, said baffle having opposed side legs extending from the end wall of the baffle inwardly from the cylindrical body of the can providing flow paths between the side legs and cylindrical body connecting with said compartment, a chlorate candle underlying said baffle and embraced by said legs, ignition material

in the end of said candle adjacent said end wall of the baffle, filters in said compartment between the baffle and orificed disk end of the can, a sealed thimble filled with ignition material activating fluid suspended from the orificed disk end of the can around the orifice thereof and extending through the filter means and the end wall of the baffle to the ignition material, plunger means in said thimble having a piercing point for rupturing a portion of the thimble to release fluid to the ignition material, said plunger means being actuated through the orifice in the disk end of the can whereby the ignition material will ignite the candle to release oxygen to the flow paths and through the filter means to the orifice, and resilient pads at the ends of the candle clamping the candle against axial shifting in the can.

8. In a disposable can chemical oxygen generator cell having a can housing with an oxygen outlet orifice in an end wall thereof, a chlorate candle therein, and an actuator for igniting the candle, the improvement of a metal baffle snugly fitting in said can in spaced relation inwardly from the orificed end of the can and overlying one end of the candle to provide a compartment in the can receiving oxygen from the candle as it flows to the orifice, said baffle having opposed integral depending legs embracing the sides of the candle to center the candle from the side wall of the can and provide oxygen flow paths along the length of the candle between the legs and the side walls of the can communicating with said compartment.

9. In a chemical oxygen generator cell, a can, an orificed end wall on said can, a chlorate candle in said can, a thimble suspended from the orificed end wall of the can and extending therefrom into close relation with an end of the candle, said thimble having a tubular portion with a reduced diameter nose and a closed puncturable bottom, a plunger in said tubular portion, a needle extending from the plunger into the reduced diameter nose having a pointed end adapted to puncture the bottom of the nose, a seal underlying the plunger trapping liquid in the thimble and nose, said thimble having an outturned flange secured to the underface of the orificed end wall of the can around the orifice thereof, and radial openings below said flange accommodating flow of oxygen to the orifice in the end wall of the can.

10. In a chemical oxygen generator cell, the improvement of an oxygen generating candle comprising a compressed briquette of oxygen generating chemical material, said briquette having an elongated hexagonal shaped body with apices sized to engage the side wall of the cell and side walls spaced from the side wall of the shell to provide oxygen flow paths therebetween, said hexagonal body having a tapered leading end converging to a reduced cross section end, and said body having a tapered bottom portion converging to a reduced area bottom end, said top end having a central recess, and ignition cone material filling said recess.

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