

April 1, 1969

M. J. McGOFF ET AL

3,436,191

OXYGEN GENERATOR

Filed June 30, 1966

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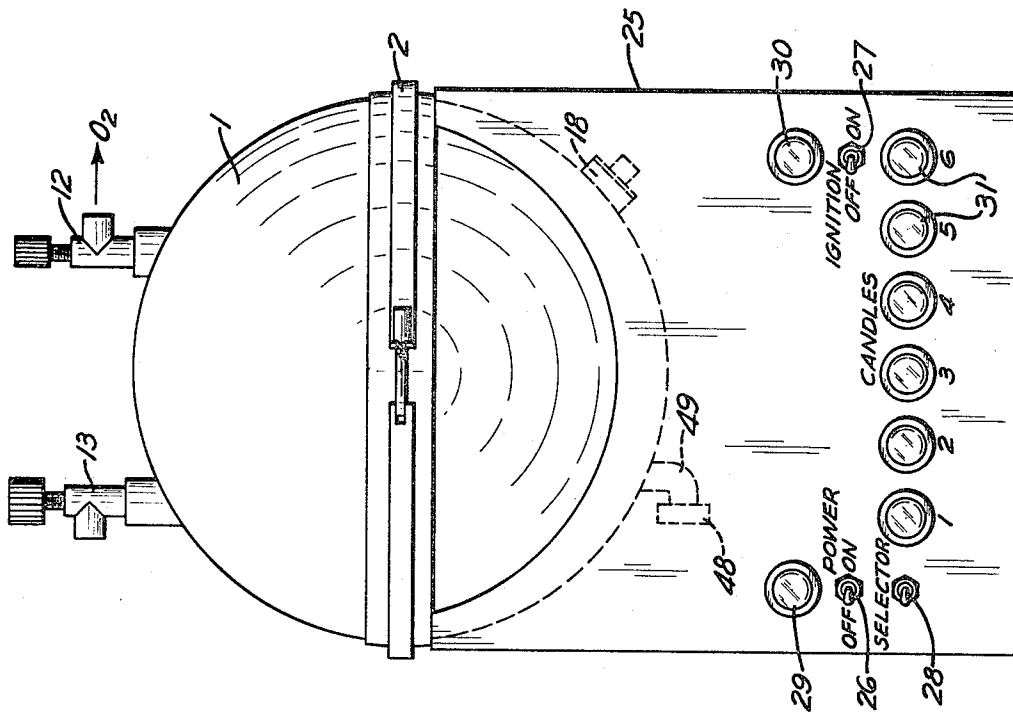


Fig. 1

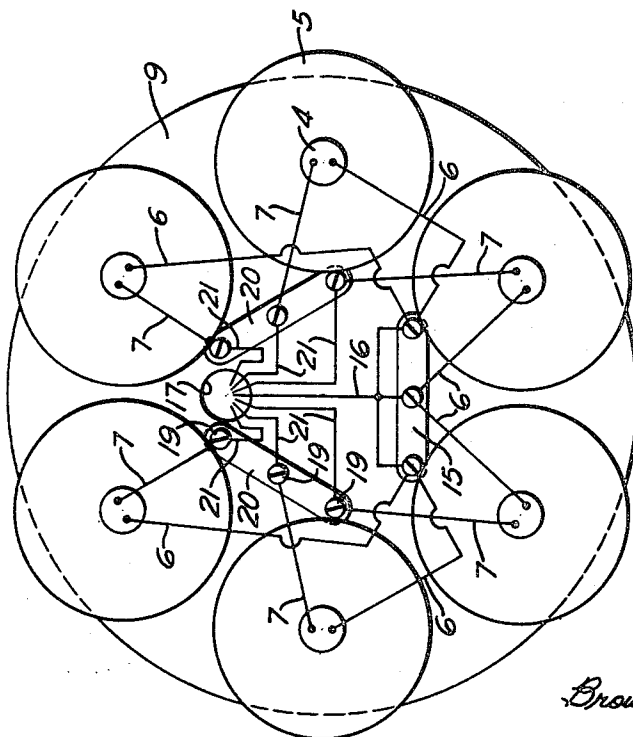


Fig. 3

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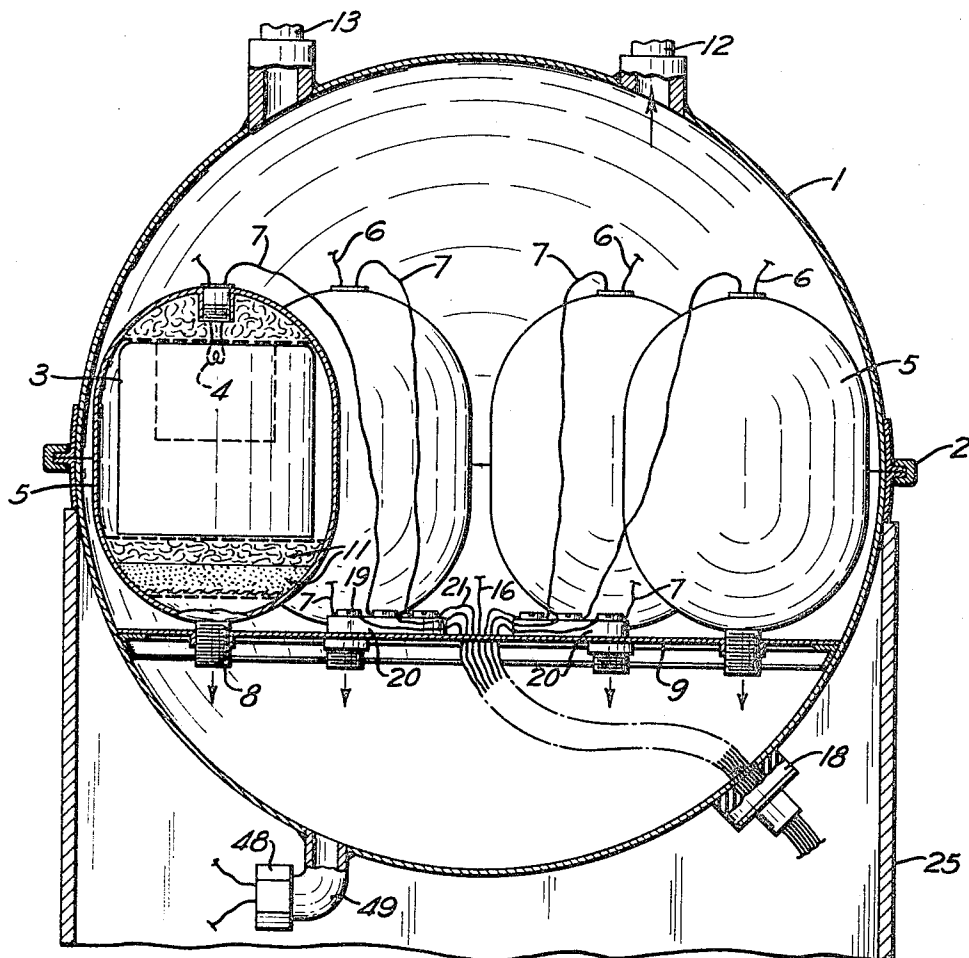


Fig. 2

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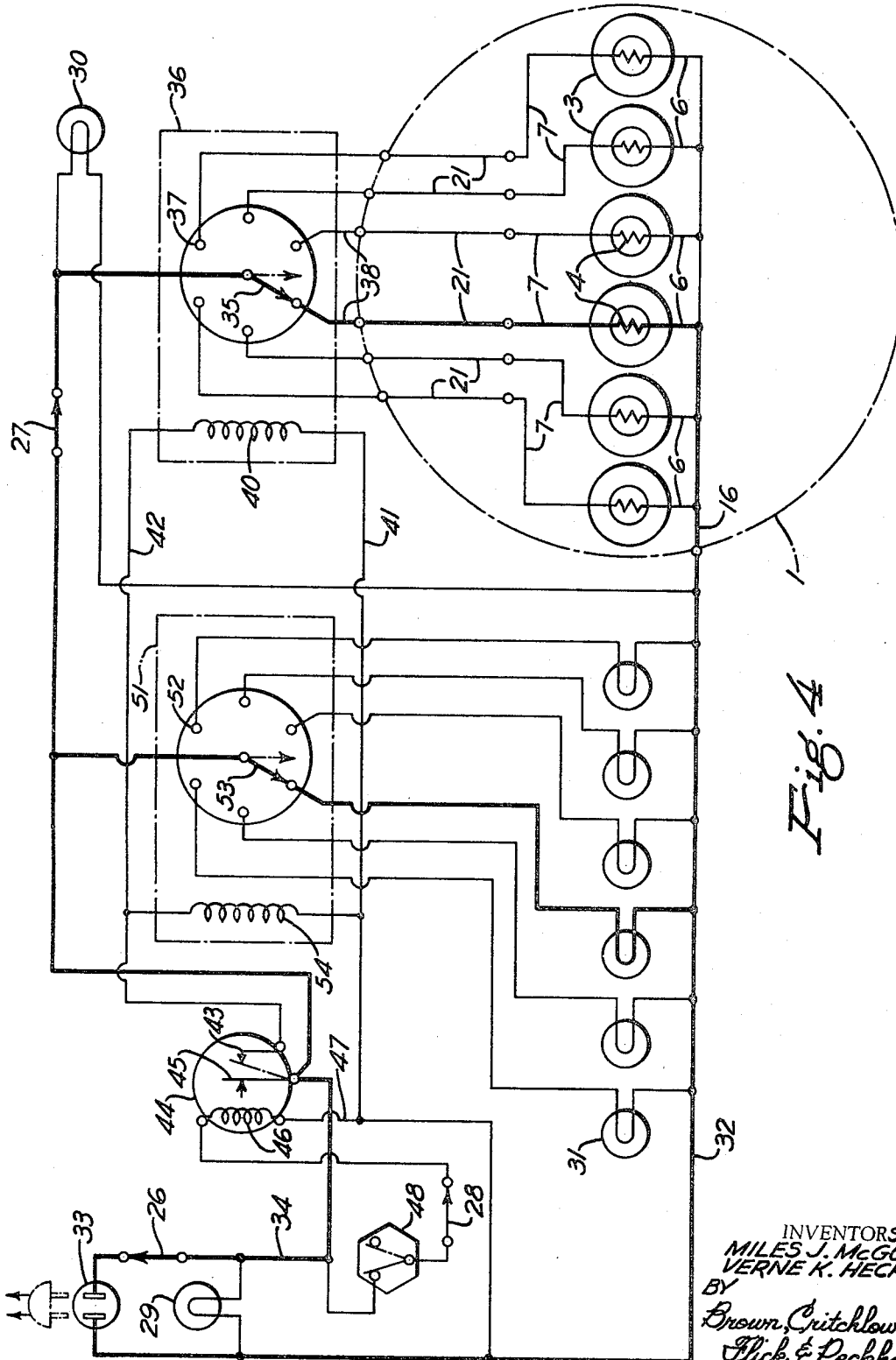


Fig. 4

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OXYGEN GENERATOR

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10 Claims

This invention relates to generators for producing oxygen, and more particularly to those which burn candles that give off oxygen.

A common way of producing oxygen for relatively short periods of time is by burning sodium chlorate candles. Heretofore, in order to provide oxygen for a longer period of time it has been necessary to manually ignite successive candles, or to burn enough candles simultaneously to produce a sufficient supply of oxygen under pressure in a pressure vessel to supply the demand over the desired length of time. Waiting until a candle has been nearly consumed and then igniting a second one is not satisfactory because if the second one is ignited too soon the oxygen pressure becomes too great, while if it is not ignited soon enough there may be a deficiency of oxygen. On the other hand, if several candles are burned at the same time, a large and heavy pressure vessel must be provided to contain the oxygen under high pressure.

It is among the objects of this invention to provide an oxygen generator which operates entirely automatically, which is relatively light in weight and small in size, which operates at a reasonable pressure and temperature, and which consumes an extremely small amount of electric current.

In accordance with this invention, a plurality of oxygen generating candles are mounted inside of a pressure vessel that is provided with an oxygen outlet. There is a separate igniter for each candle. Means are provided which are responsive to oxygen pressure inside the pressure vessel for activating a different igniter every time that pressure drops below a predetermined minimum. Consequently, the candles are burned in succession as needed. Preferably, the pressure-responsive means include an electric circuit that is closed every time the pressure drops below the desired minimum.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which:

FIG. 1 is a front view of the generator;

FIG. 2 is an enlarged fragmentary vertical section;

FIG. 3 is a smaller plan view of the candles mounted on the base plate inside the sphere; and

FIG. 4 is a circuit diagram of the generator.

Referring to FIGS. 1, 2 and 3 of the drawings, a pressure vessel 1 is provided which can be formed with the thinnest side wall if it is made spherical. The vessel preferably is made in two halves that are clamped together by a suitable clamping band 2. Inside of this vessel there is a plurality of oxygen generating candles, each of which may be made from a body 3 of sodium chlorate, in one end of which an electrical igniter 4 is imbedded. The chemical and igniter preferably are enclosed in a metal cylinder 5, from one end of which a pair of wires 6 and 7 from the igniter extend. The other end of the cylinder has a central opening, from which a threaded neck 8 projects so that the candle can be screwed into an opening in a base plate 9 rigidly mounted in the lower part of the pressure vessel. The base plate that is shown is provided with six such openings for receiving six candles in a circle, as shown in FIG. 3. The chemical in each candle cylinder may be separated from the opening in the bottom by suitable filtering material 11, which will remove smoke and any contaminant gas from the oxygen leaving the candle through its neck. The upper

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part of the pressure vessel is provided with an oxygen outlet, to which an oxygen flow control valve 12 is connected. The vessel may also be provided with another outlet having a pressure relief valve 13 connected to it.

As shown in FIG. 3, the wires extending out of the tops of the candles are connected to terminal strips mounted on the base plate. One wire 6 from each candle goes to a common terminal strip 15, which also is connected to a single wire 16 that extends down through an opening 17 in the base plate and out of the pressure vessel through an electrical connector 18 that is sealed around an opening in the wall of the vessel. The other wires 7 from the candles each lead to a separate binding post 19 on terminal strips 20. From each binding post a separate wire 21 extends down through plate opening 17 and out to the electrical connector 18. It will be seen that if the common wire 16 is connected in an electrical circuit that is connected to each of the wires 21 in succession, each igniter will be energized in succession. This switching from one igniter to another is brought about in a manner to be described presently.

The pressure vessel is mounted on a housing 25, in which most of the electrical equipment for operating the generator is located. The front wall of the housing serves as a control panel, as shown in FIG. 1. On it are mounted three electric switches 26, 27 and 28 with indicator lights 29 and 30 for two of them. There also is a row of indicating lamps 31 corresponding in number to the oxygen candles. As shown in FIG. 4, the common wire 16 from inside the pressure vessel is connected through electrical connector 18 with a wire 32 leading to a suitable electrical receptacle 33 in the back of the case, by which the generator is connected with a battery. The other terminal of the battery is connected through receptacle 33 with a wire 34 containing power switch 26 and ignition switch 27 and leading to the movable contact 35 of a conventional stepping switch 36, which in this case has six positions. The six fixed contacts 37 of this switch are each connected by a different wire 38 with wires 21 leading to wires 7 and the igniters.

It will therefore be seen that as the movable contact of the stepping switch moves from one fixed contact to the next, it will be electrically connected with each igniter in succession. To cause this movement, one end of the actuating coil 40 of the switch is connected by a wire 41 with wire 32 of the circuit, and the other end of the coil is connected by a wire 42 with a fixed contact 43 of a normally closed relay 44. The movable contact 45 of this relay is connected to wire 34 between the ignition switch and the power switch. The actuating coil 46 of the relay has one end connected by a wire 47 to wire 41, while its other end is connected through selector switch 28 to a normally closed pressure switch 48 that is connected with the power switch. The pressure switch is exposed to the gas pressure inside the pressure vessel, as indicated in FIG. 2. For this purpose it may be connected to the outer end of a short nipple 49 projecting from a hole in the wall of the vessel.

The pressure switch may be adjustable and is set to close when the oxygen pressure in the pressure vessel starts to fall below a predetermined minimum, such as 30 pounds per square inch, for example. It also is set to open when the pressure in the vessel increases a few pounds, for example at 35 pounds per square inch. When all four switches are closed as shown in FIG. 4, the relay coil 46 will be energized, which will open the relay. This causes the movable contact 35 of the stepping switch 36 to engage one of its fixed contacts and thereby place one of the igniters in circuit to ignite the corresponding candle. When the oxygen thus produced increases the pressure in the pressure vessel sufficiently to open pressure switch 48, the relay deenergized and therefore it

closes the circuit to stepping switch coil 40, which causes movable contact 35 to move forward to a position, as indicated in dotted lines, intermediate two fixed contacts. As soon as the oxygen pressure in the vessel starts to fall below the minimum again, the pressure switch will close and thereby open relay 44 and the circuit to the coil of the stepping switch, so the movable contact of the latter will move to the next fixed contact and thereby cause the next candle to be ignited in order to increase the oxygen pressure in the pressure vessel again. This successive ignition of candles proceeds until all candles have burned or until the power switch 26 is open. The opening 17 in base plate 9 places the areas above and below the plate in communication with each other.

In order that the user of this apparatus will know which candle is being burned at any given time, another stepping switch 51 is connected with the indicating lamps 31 for the igniters. This switch may have the same general construction as the one just described, with each of its fixed contacts 52 electrically connected to a different lamp. One terminal of each lamp is connected to wire 32. The movable contacts 53 of this switch is connected to the main circuit wire 34 between the ignition switch 27 and the power switch. The actuating coil 54 of this stepping switch is connected to the same wires 41 and 42 as the other stepping switch coil. Consequently, the two stepping switches operate in unison so that the lamps are lit in succession as successive igniters are energized.

This apparatus is connected to a battery while the power switch and ignition switch are open. Then the power switch is closed, after which the selector switch 28 can be opened and closed in order to step the indicating lights and igniters to a desired starting point. This will not ignite the candles because the ignition switch is open. Since the oxygen pressure in the pressure vessel initially is below the desired minimum, the pressure switch 48 will be closed. As soon as the ignition switch 27 is closed, the igniter that happens to be in circuit will be energized in order to light a candle. After that, the stepping switches will open and close periodically in accordance with rising and falling pressure in the pressure vessel to light each candle in succession and thereby maintain the desired oxygen pressure in the vessel.

One of the advantages of this apparatus is that a fairly even, relatively low pressure can be maintained over a long period of time. This means that the size and weight of the pressure vessel can be held at a minimum, this being especially desirable when such apparatus is used in space travel where weight and space savings are particularly important. Although the oxygen candles generate heat, the successive ignition of the candles herein reduces thermal problems because the heat production extends over a longer period of time and therefore is considerably less than if it were produced all at once. This avoids lowering of the stress values of the structural materials, which is another reason why the weight of this apparatus can be reduced. The igniters consume only a minute amount of electricity.

We claim:

1. An oxygen generator comprising a pressure vessel provided with an oxygen outlet, a plurality of oxygen generating candles disposed therein, an igniter for each candle, and means responsive to oxygen pressure inside said vessel for activating a different igniter every time said

pressure drops below a predetermined minimum, whereby said candles are burned in succession as needed.

2. An oxygen generator as recited in claim 1, in which said pressure-responsive means includes an electric circuit that is closed every time said pressure drops below said minimum, and means connecting a different igniter in said circuit every time it is closed.

3. An oxygen generator as recited in claim 1, in which said pressure-responsive means includes an electric switch for closing an electric circuit to each igniter in succession, and means for actuating the switch every time said pressure drops below said minimum.

4. An oxygen generator as recited in claim 1, in which said pressure-responsive means includes a normally closed electric circuit, means opening the circuit every time said pressure exceeds a predetermined maximum, and means connecting a different igniter in said circuit every time it closes.

5. An oxygen generator as recited in claim 1, including electric lamps corresponding to the different candles, and means for lighting the lamps in succession to indicate the candle that is burning.

6. An oxygen generator as recited in claim 5, including means for actuating said lamp lighting means without igniting the candles.

7. An oxygen generator comprising a pressure vessel provided with an oxygen outlet, a plurality of oxygen generating candles disposed therein, an electrically actuated igniter for each candle, an electric circuit, an electric switch for connecting each igniter in succession into said circuit, and means responsive to oxygen pressure inside said vessel for actuating said switch to connect the next igniter into the circuit every time said pressure falls below a predetermined minimum, whereby to burn said candles in succession as needed.

8. An oxygen generator as recited in claim 7, including a lamp corresponding to each candle, and a second electric switch for connecting each lamp in succession in said circuit, said pressure-responsive means being formed to actuate said second switch simultaneously with the first-mentioned switch.

9. An oxygen generator as recited in claim 7, in which said pressure-responsive means includes electrically operated means for actuating said switch, and a pressure switch subject to said oxygen pressure controlling the supply of electric current to said last-mentioned means.

10. An oxygen generator as recited in claim 9, in which said pressure switch is closed while the oxygen pressure is below said minimum, and a relay controlled by the pressure switch makes and breaks the circuit to said electrically operated means.

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