March 23, 1965 J. S. LAWRENCE 3,174,294

OXYGEN DISPENSING

Filed Dec. 19, 1958 3 Sheets-Sheet 1

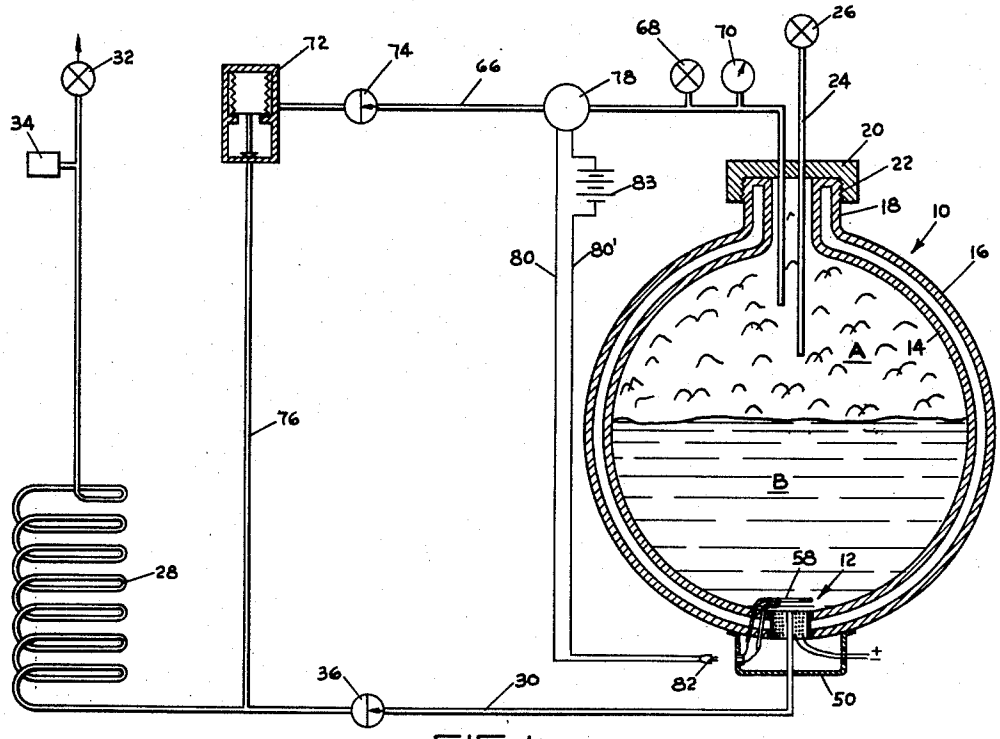


FIG. 1

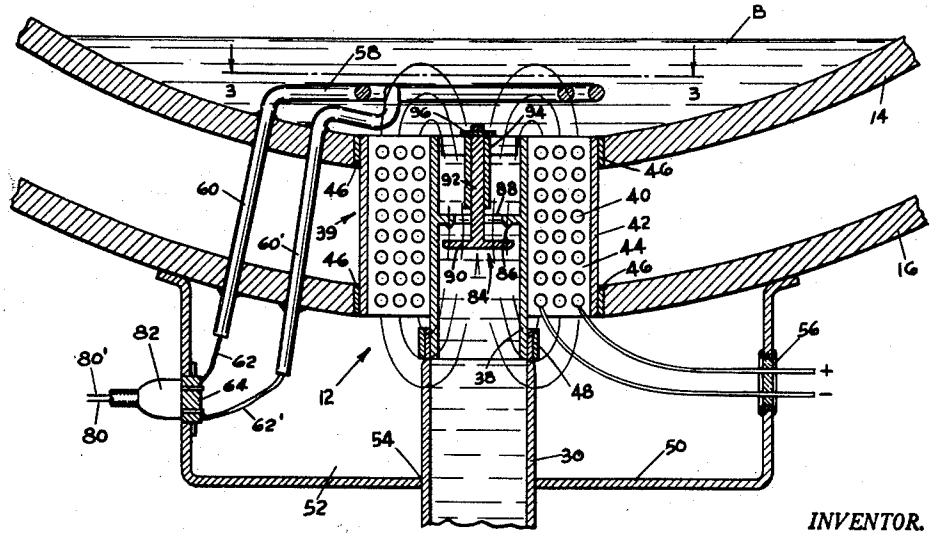


FIG. 2

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OXYGEN DISPENSING

Filed Dec. 19, 1958 3 Sheets-Sheet 2

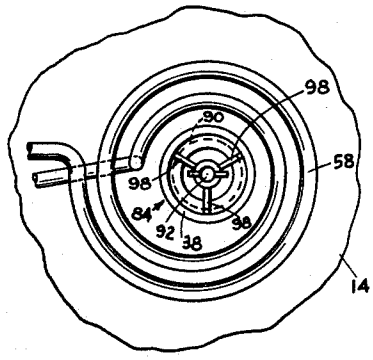


FIG. 3

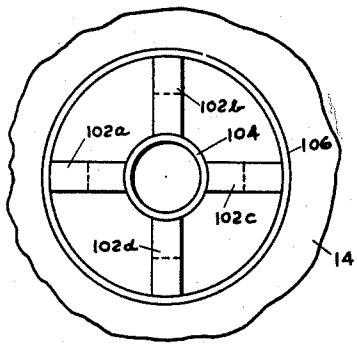


FIG. 5

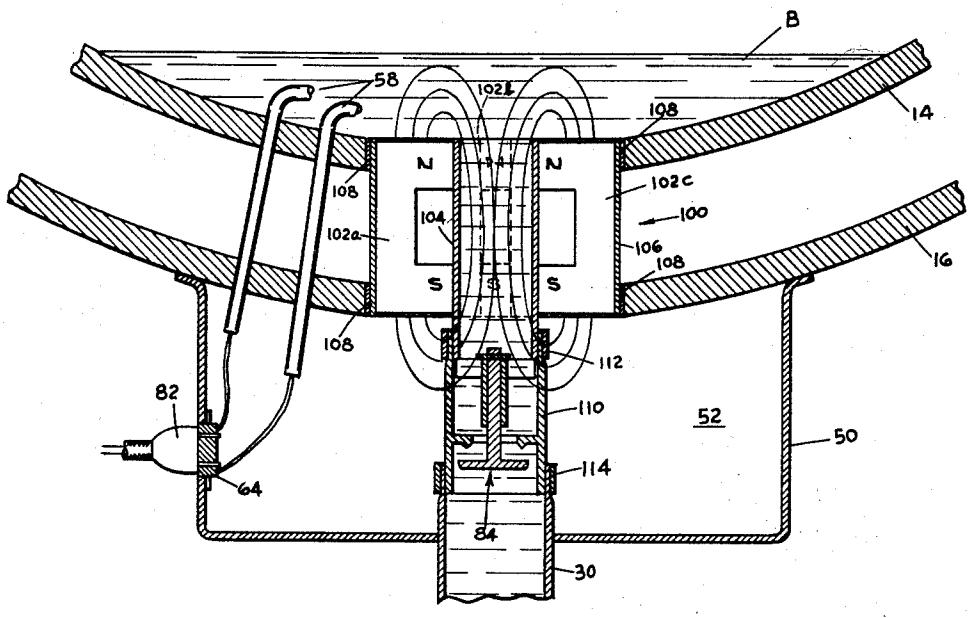


FIG. 4

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OXYGEN DISPENSING

Filed Dec. 19, 1958 3 Sheets-Sheet 3

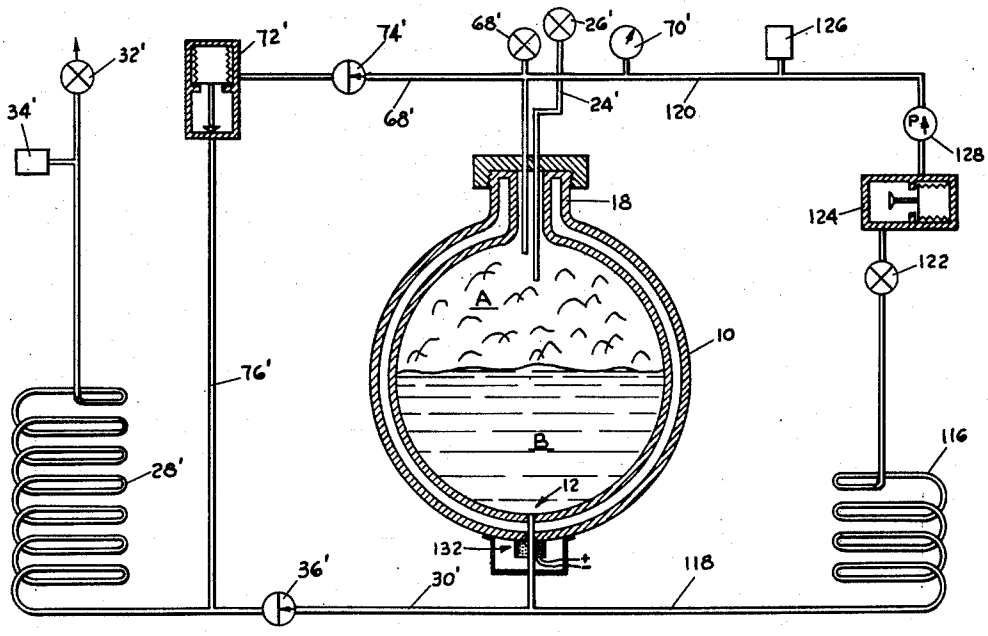


FIG. 6

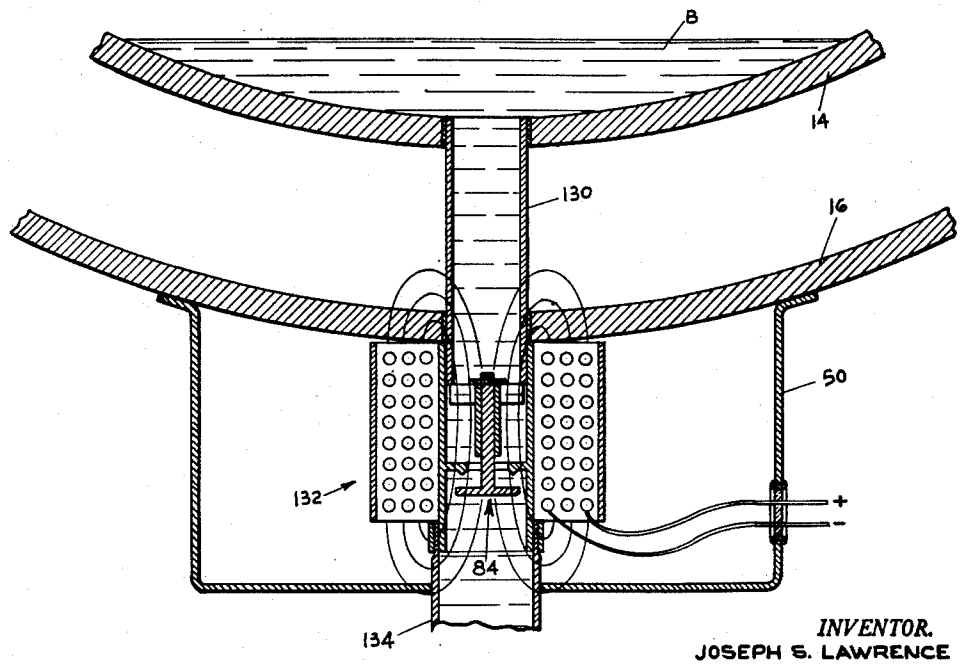


FIG. 7

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United States Patent Office 3,174,294
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3,174,294

OXYGEN DISPENSING

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Filed Dec. 19, 1958, Ser. No. 781,609
13 Claims. (Cl. 62—51)

The invention relates to systems for dispensing or supplying gaseous oxygen, and is more particularly directed to novel methods and means for enabling a liquid oxygen converter system to operate reliably and effectively when the system is subjected to an adverse gravitational environment, or an environment where the force of gravity is non-existent or insufficient to establish the desired separation of the liquid and gaseous phases of the oxygen. The expression "in the absence of the full force of gravity." as hereinafter used, refers to such environmental conditions.

The development of equipment designed to travel at extremely high altitudes or in outer space imposes on such equipment, by virtue of the flight paths, an environment where the force of gravity may be adverse or non-existent. It has already been accomplished that man has been placed in such environments, and by further extension and development of such equipment the sustenance of man for prolonged periods under such conditions and under varying circumstances is becoming of greater significance. In any event, the proper functioning of certain apparatus involved in such travel, or for the sustenance of man therein, requires the delivery of gaseous oxygen under controlled conditions. A liquid oxygen converter system, because of its low weight and minimal space requirements per unit of oxygen gas delivered, is particularly useful in environments of the kind under consideration.

The proper operation of the usual or conventional liquid oxygen converter system requires that the fluid discharged into the system from the container, which holds the supply of liquid oxygen and contains both the liquid and gas phases, shall be of uniform density. Except where the rate of consumption of gas is small, practical considerations require that the liquid form of the oxygen be delivered to the system for vaporization externally of the container. In the event of intermittent discharge of oxygen from the liquid and gaseous phases, the delivery fluid is of non-uniform density, which detrimentally affects the maintenance of the desired operating conditions of the system. In conventional types of liquid oxygen converters, the delivery from the container of oxygen of uniform density depends upon the force of gravity to separate the liquid from the gas.

An object of the invention is to provide a method and means wherein, despite the absence of the full force of gravity, the liquid phase of oxygen may be maintained separately from the gaseous phase, thereby allowing delivery of oxygen of uniform density under controlled conditions.

Another object of the invention is to provide a method and means wherein, despite the absence of the full force of gravity, a liquid seal may be provided at the container outlet of a liquid oxygen converter system, thereby enabling the maintenance of the desired operating pressure in the container, and the delivery of oxygen of uniform density to the system.

A further object of the invention is to provide a method and means wherein, despite the absence of the full force of gravity, the liquid phase of oxygen may be maintained separately from the gaseous phase so that liquid oxygen may be made available for delivery from the

container and the controlled vaporization thereof externally of the container.

In accordance with the invention generally, these, and other objects, advantages and improved results are obtained by imposing a magnetic field upon liquid oxygen. A magnetic field or flux is effective to attract, sustain or maintain the liquid phase of oxygen in preference to the gaseous phase. The preferential effect of a magnetic field upon liquid oxygen is utilized to separate the liquid from the gaseous phase to insure the delivery of oxygen having a uniform density, as distinguished from an intermittent discharge of the liquid and the gas. In a liquid oxygen converter system, such preferential effect of a magnetic field upon the liquid phase of oxygen serves to effectively separate the liquid from the gas to permit oxygen of uniform density to be delivered to the system under controlled conditions, though the system is located in an environment where the force of gravity normally acting to separate the liquid and gaseous phases is either non-existent or adverse.

Preferably, the preferential effect of a magnetic field for the liquid phase of oxygen is utilized to provide a mass or quantity of liquid oxygen at the outlet of the oxygen container for the converter system. The container, which holds the oxygen in both the liquid and gaseous phases, is thereby provided with a liquid seal at or over the outlet. By providing such liquid seal, the container pressure may be maintained at a desired value, and oxygen of uniform density may be circulated in the system. More particularly, an operative quantity of liquid oxygen is made available for delivery from the container to an evaporating coil, where the liquid may be controllably vaporized, and the resultant gas delivered to the point of use at the desired temperature and pressure. Any known or suitable means may be used to furnish the desired container pressure to deliver the operative quantity of liquid oxygen sustained at the outlet to the external evaporating coil.

The magnetic field may be furnished by an electro-magnet or by a permanent magnet.

In greater detail, reference is made to the following detailed description, together with the accompanying drawings illustrating several preferred embodiments of the invention, wherein:

FIG. 1 is a schematic view of one type of liquid oxygen converter system which may be provided wtih a magnetic separating means of the invention;

FIG. 2 is an enlarged, vertical cross-sectional view of the outlet area of the container shown in FIG. 1;

FIG. 3 is a top plan view taken in the direction of line 3—3 of FIG. 2;

FIG. 4 illustrates a permanent magnet assembly which may be used in lieu of the electro-magnet shown in FIG. 2;

FIG. 5 is a top plan view of the permanent magnet assembly shown in FIG. 4;

FIG. 6 is a schematic view of another type of liquid oxygen converter system which may be provided with a magnetic separating means of the invention; and

FIG. 7 is a view similar to FIG. 2, but showing another form of the invention insofar as the positional relationship of the magnetic means with respect to the container outlet.

As shown in FIGS. 1 and 2, an insulated container or chamber **10** is provided for supplying oxygen to a converter system, the container having a discharge outlet, generally designated **12**, on the bottom side thereof. The container comprises an inner shell **14** and an outer shell **16** spaced therefrom. The shells may be made of copper, aluminum or stainless steel. The space between the shells is evacuated and/or filled with a suitable insulating mate-

rial to provide the desired insulating characteristics. The top side of the container is provided with a neck **18** closed by a cap **20** connected to the neck, as by mating threads **22**. A filling line **24** extends through the cap **20** and into the container. The filling line is provided with a filler valve **26** so that a liquid oxygen source or tank may be connected to the valve to fill the container when empty.

In order to enable the delivery of oxygen having a uniform density to the converter system and to allow the desired operating pressure within the container to be maintained, despite the absence of the full force of gravity, a magnetic field is provided at, or in the vicinity of, the outlet **12**. By magnetically maintaining a mass of liquid oxygen at or over the outlet, the outlet is provided with a liquid seal. In the form of the converter system illustrated, which is of the type in which liquid oxygen is intended for delivery to a supply circuit externally of the container, the magnetic field maintains an operative quantity of liquid oxygen at the outlet to insure that the liquid phase, designated B, will be available for delivery to the supply circuit under the influence of the pressure provided by the gaseous phase, designated A, within the container.

The supply circuit includes an evaporating and superheating coil **28**, one side of which is in communication with the outlet **12** through a conduit or line **30**, the other side of the coil being in communication with a supply valve **32**. The supply valve is adapted for connection to a line to furnish the gas evaporated and warmed by the coil **28** to the point of use. A high-pressure relief valve **34** is disposed between the coil and the supply valve. A spring loaded liquid check valve **36** is located in the line **30** between the supply circuit and a gas pressurizing circuit which will be subsequently described.

As shown in greater detail in FIG. 2, the outlet **12** is in the form of a tube **38**, which may be made a part of an electro-magnet assembly, generally designated **39**. The tube, which is formed of a non-magnetic material, such as aluminum, is suitably wound with a wire in a plurality of adjacent or helical turns to provide a coil **40**. The wire wound tube may be enclosed in a second tube **42**, also of a non-magnetic material. The coil is encased or potted in a suitable insulating material **44**, such as an epoxy resin compound.

The electro-magnet is preferably positioned to extend between the inner and outer shells **14** and **16**, and is secured in place, as by welding portions of the tube **42** to adjacent portions of the shells at the areas **46**. As shown, the outlet tube **38** is of sufficient length so that the lower end thereof may be secured to the line **30** outside the shell **16**. The connection may be accomplished by a clamp **48**, as shown, or the tube and the line may be matingly threaded. The exterior of the container outlet area, including the described surrounding electro-magnet, is provided with an insulating wall **50** to minimize heat leakage. The insulating wall is connected or secured to the outer shell **16**, and is of a contour to furnish a chamber **52**. The insulating wall is provided with an aperture **54** to allow the line **30** to extend therethrough. The ends of the coil **40** are brought out through a hermetically sealed plug **56** secured in the insulating wall so that the coil may be connected to a suitable source of power.

Gas pressurizing means is provided to maintain the desired container pressure so that the operative quantity of liquid oxygen magnetically maintained at the container outlet may be delivered to the supply circuit and the evaporating coil **28**. In the form of the invention illustrated in FIGS. 1 and 2, the pressurizing means includes heating means in the form of an electrical resistance heating element or coil **58**. As shown, the coil is positioned within the container and over the container outlet; also, the coil is located within or adjacent to the magnetic field provided by the magnet. The straight portions **60**, **60'** of the coil extend through, and are supported by, the inner and outer shells **14** and **16**. The extremities of the coil are connected to conductors or wires **62**, **62'** which terminate in a socket **64** secured to extend through the insulation wall **50**.

A gas or vapor line **66** extends through the cap **20** and is in communication with the neck end **18** of the container. A relief or vent valve **68** and a pressure gauge **70** are disposed in the line. A pressure-opening valve **72** and a gas check valve **74** are positioned between the upper or gas side of the container and the supply circuit, a line **76** being provided between the pressure-opening valve and the liquid supply line **30**.

In order to controllably maintain a predetermined gas pressure within the container, and upon the liquid sustained at the container outlet, pressure control means or a gas pressure responsive switch **78** is provided in the line **66**. The pressure responsive switch senses any drop in container pressure below a desired predetermined value to energize the coil **58**, and to restore the pressure to the desired value. The pressure responsive switch is connected to the heating coil by electrical conductors or leads **80**, **80'**, which terminate in a plug **82** received within the socket **64**. A source **83** of electrical power, for example, a battery, provides the energy for heating the coil **58**. The gas pressure responsive switch may be of any suitable type.

A suitable trap means is provided at or near the juncture of the liquid supply line **30** and the container outlet within a heat insulated zone, such as the area between the container shells or the described chamber **52**. As shown in FIGS. 2 and 3, the trap means may comprise a check valve, generally designated **84**, positioned within the outlet tube **38**. The check valve, made of non-magnetic components, may be of any suitable construction. As shown, the valve may comprise a seat **86** formed integrally with the tube **38** and extending radially inward thereof for a portion of the tube diameter to provide a valve opening **88**. A disk **90** at the end of a stem **92** is adapted for engagement with the seat. The stem extends through a bore provided by a hollow cylinder **94**, the stem being held against separation from the cylinder by a cross-pin **96** therethrough, which also limits the extent of opening movement of the valve disk. The cylinder is supported at the center of a plurality of circumferentially and equidistantly spaced vanes **98** which are secured to and extend radially inward from the tube **38**.

The check valve prevents the back flow of vapor into the container and the continuous feeding of liquid from the container to the supply line **30** when the converter is not in operation. Thus, after filling and under the influence of a normal gravitational environment, liquid will tend to flow by gravity through the outlet into the supply line **30** where heat imparted from the surrounding atmosphere will cause it to become vaporized. Such vaporized liquid will then pass backwardly to the container and be replaced by further gravitational feed of liquid. This cycle normally would proceed continuously with the result that the container pressure would rapidly increase and eventually vent to the atmosphere permitting a loss of some of the oxygen contents. By the provision of a trap or check valve device at the outlet of the container as above described, the initial pressure produced by vaporization of the liquid in the supply line will prevent any further delivery of liquid from the container until the supply valve of the converter is opened, permitting the discharge of the contents of the container under the propelling influence of the differential pressure between the container and the pressure of the supply line. The trap means is similarly effective while the converter is not in operation even under a non-gravitational environment. It may be seen, for example, that under such condition, the liquid oxygen within the container exhibits a tendency to become symmetrically disposed under the influence of the magnetic field of the magnet **39**. Under some circumstances, the liquid or a portion of the liquid mass so influenced may become located in a region which is exposed to a

relatively high input of heat from the surrounding atmosphere, causing such liquid to become vaporized. The check valve then operates in substantially the same manner as under gravity conditions so that such vaporization, if and when it may occur, will cause the valve to close and prevent the passage of liquid oxygen to such region until the supply valve of the delivery circuit is opened. It may be seen, of course, that when the delivery tube from the container is arranged to pass upwardly and through the top of the container, trap means or a check valve device would then not be needed.

With an empty system, a liquid oxygen source is connected to the filler valve **26**, and the vent valve **68** is opened. Liquid oxygen flows into the converter, from which it is boiled off while cooling the internal parts of the system down to the temperature of the liquid oxygen. The resulting gas is vented through the vent valve. When liquid oxygen begins to issue from the vent valve, the filling operation is stopped and the filler and vent valves are closed.

To ready the system for operation in an environment where the force of gravity is adverse or non-existent, the electro-magnet is energized, thereby sustaining a mass of the liquid within its field to provide a liquid seal and maintain an operative quantity of liquid oxygen at the container outlet. The supply valve **32** is then opened. Before the magnetically sustained liquid oxygen is delivered from the container to the supply line **30** and to the coil **28**, a limited quantity of gas accumulated in the container at a pressure exceeding the desired operating pressure is economized and delivered to the supply valve. The pressure-opening valve **72** is set to automatically open at a desired value and permit gas to flow through the check valve **74** and to the supply circuit and supply valve. The gas check valve **74** and the liquid check valve **36** prevent reverse flow. It will be seen also that the pressure loading of the check valve **36** requires a slight differential pressure across the check valve to allow the flow of liquid from the container through the line **30** so that such flow of liquid may not occur as long as the opening valve **72** is open and vapor from the container is being delivered therethrough. The pressure-opening valve **72** closes automatically slightly above the desired operating pressure, and such pressure is maintained by the control afforded by the described pressure responsive switch and heating coil arrangement. The maintenance by the magnetic field of an operative quantity of liquid oxygen to cover the container outlet, and the pressure of the gas upon the liquid, assures that only liquid oxygen will be transferred to the evaporating coil **28** for its controlled vaporization and warming, and delivery to the supply valve.

While it is preferred to utilize the magnetic means of the invention to assure the delivery of liquid oxygen from the container for controlled vaporization of the liquid externally of the container, where the rate of consumption of the gas is relatively small, the magnetic means may be utilized to concentrate a mass of liquid oxygen within an area of the container for the purpose of controllably vaporizing the liquid within the container at such area by suitable heating means, such as the heating coil **58**. The resultant gas delivered from the container then need only be warmed to permit its use. When the gas phase is thus taken from the container, the trap means is unnecessary.

As shown in FIGS. 4 and 5, the magnetic means may be in the form of a permanent magnet, generally designated **100**. The permanent magnet may comprise an assembly of a plurality of magnets, for example, four magnets **102***a*, **102***b*, **102***c* and **102***d* as shown. The permanent magnets are preferably equidistantly spaced from one another and supported between inner and outer tubes **104** and **106**, respectively. Like pole faces are located at the same ends of the assembly, and the assembly may be secured in position between the inner and outer shells at the areas **108**.

As also shown in FIG. 4, where a trap or check valve is included for cooperation with the container outlet, the valve trap **84** may be separately provided for in a tubular element **110**, instead of being made a part of, and located within, the outlet tube of the magnet assembly, as shown in FIG. 2. In such an arrangement, the tube **110** is suitably secured to the lower end of outlet tube **104**, which forms part of the magnet assembly. The connection between the parts may be by means of a clamp **112**, and the valve-containing tube may be suitably secured, as by a clamp **114**, to the conduit or line **30**. The provision of the check valve in a separate element is an alternative arrangement for manufacturing purposes, and may also be used with the electro-magnet of FIG. 2.

The intensity of the magnetic field required to sustain and maintain oxygen in liquid form separately from the gas in the absence of gravity is less than the field intensity required in a condition of adverse gravity, as when the converter is positioned during upside-down flight. Under an adverse gravity condition the electro-magnet will furnish a higher field intensity than the permanent magnet for a given size and weight. Thus, where an adverse gravity condition will be encountered, it is preferred to use an electro-magnet arrangement.

FIG. 6 shows the magnetic separating means of the invention in relation to another type of liquid oxygen converter system. Instead of the previously described heating coil and pressure responsive switch arrangement to provide the container pressure for delivering the operative quantity of magnetically sustained liquid oxygen to the supply circuit, gas pressurizing means in the form of a pressure build-up circuit, including an evaporating coil **116** which also receives liquid oxygen, may be used. One side of the coil is in communication with the container outlet **12** through a line **118** for the delivery of liquid oxygen to the coil. The opposite side of the coil is in communication with the top side or the neck **18** of the container through a line **120**. A build-up valve **122**, a pressure-closing valve **124** and a low-pressure relief valve **126** are disposed within the pressurizing circuit, between the gas side of the coil and top or gas side of the container. To assist in circulating the liquid through the pressure build-up coil, suitable circulating means, such as a pump **128** may be provided.

The elements of the supply circuit are essentially the same as hereinbefore described in connection with FIG. 1, as are the elements for filling the container, for venting gas, for connecting the pressurizing circuit to the supply circuit and to economize gas, and for indicating pressure. Such like elements are indicated by the same numerals primed. The line **68'**, however, is in communication with the line **120** and the pressure build-up coil **116**, as well as with the gas side of the container.

With the container filled with liquid oxygen, the build-up valve **122** is opened to permit liquid oxygen to flow into the build-up coil **116** under the influence of gravity. The liquid oxygen evaporates in the build-up coil causing pressure in the system to increase. When the system pressure reaches the desired value, for example 70 or 300 p.s.i.g., the pressure-closing valve **124** closes automatically to prevent any more liquid oxygen from being evaporated.

A liquid oxygen converter is not perfectly insulated, and therefore some heat leakage may be expected. Heat leakage will cause a further increase in pressure in the system. The low-pressure relief valve **126** prevents excessive pressure build-up in the pressurizing circuit by venting at a predetermined pressure above the desired pressure in the system, for example, above 110 p.s.i. for 70 p.s.i.g. sytem If the pressure in the supply circuit exceeds 180 p.s.i. in such a system, the high-pressure relief valve **34'** will vent excess gas from the supply circuit. A higher pressure may exist in the supply circuit than in the pressurizing circuit. The two check valves **36'** and **74'**, however, prevent reverse flow.

The pressure opening valve **72'** functions substantially identically to the valve **72** described above in connection with FIG. 1. Thus, this valve is open when the pressure within the container is above a predetermined pressure so that upon opening of the delivery valve **32'**, the vapor within the container is first allowed to exhaust to the delivery system. When such vapor has been discharged sufficiently to reduce the container pressure to a value slightly above the desired predetermined operating pressure of the container, the valve **72'** closes. Thereafter, the delivery of gas to the valve **32'** occurs from the liquid phase of the container. It will be seen that when the pressure of the container drops below its desired operating pressure, for example 70 p.s.i.g., the pressure-closing valve **124** of the pressurizing circuit reopens to permit liquid to enter the build-up coil **116**. The resulting vaporization of such liquid will produce a corresponding increase in the pressure of the container so that the desired operating pressure may be maintained.

The magnetic field imposed upon a mass of liquid oxygen at the container outlet insures the delivery of liquid oxygen to the coil **116** of the pressurizing circuit, when needed, and to the evaporating coil **28'** of the supply circuit, though the force of gravity normally acting to separate the liquid and gaseous phases in the container and causing flow of the liquid to the circuits is absent. When the supply valve **32'** is opened, the operating pressure of the gas upon the operative quantity of liquid magnetically sustained at the container outlet, forces the liquid through the outlet and into the evaporating and superheating coil **28'**. Here the liquid is converted to gas which is heated to the desired temperature for delivery to the supply valve. It will be understood that either the electro-magnet assembly of FIG. 2, or the permanent magnet assembly shown in FIG. 4, may be used in conjunction with the container outlet for supplying the liquid oxygen to the pressurizing and supply circuits shown in FIG. 6.

The pressure upon the liquid oxygen made available for delivery to the evaporating and superheating coil **28'** by the magnetic means of the invention will tend to drop as the supply of oxygen in the container is used. Such pressure drop will be compensated for to some extent by normal heat leakage into the container; also, there will be a certain amount of additional heat leakage through the build-up circuit portion of the apparatus. For relatively small flow rates, such as for respiration purposes, the converter may function suitably in an adverse gravitational environment for a reasonable length of time. However, where relatively large flow rates are required, and to utilize the full contents of the container, suitable gas circulating means, such as the pump **128**, which is made responsive to pressure drop, may be employed to provide the desired pressure differential so that the magnetically sustained liquid oxygen will be transferred from the container to the coils.

To minimize heat leakage, it is advantageous to have a single, common outlet for both the pressurizing and supply circuits in the converter system shown in FIG. 6. It is within the scope of the invention, however, to provide a system in which there is, in addition to the supply outlet, a separate or second outlet from the container so that each circuit is in communication with an individual container outlet. It may be seen that depending upon whether it is desired to deliver vapor phase or liquid phase to the supply outlet that the supply outlet would be arranged in relation to the magnetic means so as to insure the access to such outlet of fluid of uniform density. Where the fluid is to be delivered to the supply circuit for example from the liquid phase, the supply outlet is disposed in close proximity to the magnetic means as hereinabove illustrated and the second outlet would be disposed near or adjacent to the magnetic means for the first outlet, or suitably related to a second magnetic means.

FIG. 7 shows another embodiment of the invention from the standpoint of the positional relationship of the magnetic means with respect to the liquid line from the container outlet. Though this embodiment of the invention is illustrated with relation to the converter system shown in FIG. 6, it will be understood that the illustrated arrangement may be used with the converter system shown in FIG. 1. In this form of the invention, a tube **130** having a length greater than the distance between the inner and outer shells **14** and **16** extends between the shells, with the lower end of the tube projecting exteriorly of the outer shell. The projecting portion of the tube **130** is received within and secured to the upper end of the inner tube element of the magnet assembly **132**. The magnet assembly may be an electro-magnet as shown, or a permanent magnet assembly. The magnet may be provided with a check valve **84** within its confines and as part of the magnet assembly as shown, or the check valve may be provided in a separate element as shown in FIG. 4. The inner tube of the magnet assembly is secured in communication with a liquid line **134** discharging to the supply circuit, as in the converter system shown in FIG. 1, or in communication with both the supply circuit and the pressurizing circuit, as in the system shown in FIG. 6.

It is believed that the advantages of the invention will be apparent from the foregoing detailed description. The liquid and gaseous phases of oxygen are separately maintained by utilizing the preferential effect of a magnetic field for the liquid phase. By magnetically maintaining a quantity of liquid oxygen separately from the gaseous phase with which it is related in a container for a liquid oxygen converter system, a single phase of oxygen or oxygen of uniform density may be delivered from the container and to the system, despite the absence of the full force of gravity normally acting to separate the liquid from the gas. By locating the magnetic field at a liquid delivery outlet, a liquid seal is provided at such outlet to enable the necessary operating pressure to be maintained in the container and to assure transfer of oxygen uniformly of a single phase to the system. By positioning the magnetic field adjacent the outlet, delivery to a supply coil of an operative quantity of liquid oxygen for controlled vaporization externally of the container is assured; also, delivery of an operative quantity of liquid oxygen to a pressure build-up coil, and the maintenance of a desired operating pressure is assured.

While several preferred forms of the invention have been illustrated and described, it will be apparent that various changes or modifications may be made without departing from the spirit and scope of the invention, as sought to be defined in the following claims.

I claim:

1. A method of dispensing oxygen of uniform density from a container holding a supply consisting essentially of oxygen in the liquid and gaseous phases, said container, the wall of which is impermeable to the passage of liquid and gaseous oxygen, to be subjected to an environment in which the force of gravity normally acting to separate the liquid and gaseous phases is absent, said method comprising subjecting the oxygen to a magnetic field to preferentially maintain a mass of liquid phase oxygen separately from the gaseous phase, and delivering a separate single phase of the oxygen from the container.

2. A method of dispensing liquid oxygen from a container holding a supply consisting essentially of oxygen in the liquid and gaseous phases, said container, the wall of which is impermeable to the passage of liquid and gaseous oxygen, to be subjected to an environment in which the force of gravity normally acting to separate the liquid and gaseous phases is absent, said method comprising subjecting the oxygen to a magnetic field within the container to preferentially maintain a mass of liquid phase oxygen separately from the gaseous phase, and delivering the separate liquid phase of oxygen from the container.

3. A method of dispensing gaseous oxygen from a container holding a supply consisting essentially of oxygen in the liquid and gaseous phases, said container, the wall of which is impermeable to the passage of liquid and gaseous oxygen, to be subjected to an environment in which the force of gravity normally acting to separate the liquid and gaseous phases is absent, said method comprising subjecting the oxygen to a magnetic field within the container to preferentially maintain a mass of liquid phase oxygen separately from the gaseous phase, vaporizing the liquid mass thus separated, and delivering the resultant gas from the container.

4. A method of dispensing oxygen of uniform density from a container holding a supply of oxygen in the liquid and gaseous phases, said container to be subjected to an environment in which the force of gravity normally acting to separate the liquid and gaseous phases is absent, said method comprising subjecting the oxygen to a magnetic field at an outlet area of the container to preferentially maintain a mass of liquid phase oxygen separately from the gaseous phase, thereby providing a liquid seal at the outlet and enabling the desired operating pressure to be maintained in the container, and delivering a separate single phase of the oxygen from the container.

5. A method of delivering liquid oxygen from a container holding a supply of oxygen in the liquid and gaseous phases to an evaporating coil of a liquid oxygen converter in the absence of the full force of gravity normally acting to deliver the liquid to the coil, said method comprising subjecting the oxygen to a magnetic field at an outlet area of the container to preferentially maintain a mass of liquid phase oxygen separately from the gaseous phase, thereby providing a liquid seal at the outlet and enabling the desired operating pressure to be maintained in the container, and delivering liquid oxygen from the container to the coil.

6. A method of supplying gaseous oxygen from a container holding a supply consisting essentially of oxygen in the liquid and gaseous phases, said container, the wall of which is impermeable to the liquid and gaseous oxygen, to be subjected to an environment in which the full force of gravity normally acting to separate the liquid from the gas is absent, said method comprising imposing a magnetic field upon a mass of liquid oxygen at an outlet area of the container to preferentially maintain the liquid mass separately from the gas and provide a liquid seal at said outlet, and vaporizing the liquid mass within the magnetic field.

7. In a liquid oxygen converter including a container having an outlet for the oxygen, the container, the wall of which is impermeable to the passage of liquid and gaseous oxygen, holding a supply consisting essentially of oxygen in the liquid and gaseous phases, the improvement comprising magnetic means positioned with respect to the outlet to maintain a supply of oxygen in liquid form at the outlet in the absence of the full force of gravity upon the liquid oxygen.

8. A liquid oxygen converter including a container for the oxygen, said container holding a supply consisting essentially of oxygen in the liquid and gaseous phases and comprising spaced inner and outer, oxygen-impermeable shells, an outlet tube extending between said inner and outer shells, and magnetic means positioned in surrounding relationship with respect to the outlet tube to maintain a supply of oxygen in liquid form within said tube.

9. A liquid oxygen converter system including a container having an outlet for the oxygen in communication with an evaporating coil in a supply circuit, said container holding a supply consisting essentially of oxygen in the liquid and gaseous phases, the wall of the container being impermeable to the passage of the liquid and gaseous oxygen, magnetic means positioned with respect to the outlet to maintain a supply of oxygen in liquid form at the outlet for delivery to the coil in the absence of the full force of gravity upon the liquid oxygen, and means for controllably producing vapor pressure in said container.

10. A liquid oxygen converter system including a container having an outlet for the oxygen in communication with an evaporating coil in a supply circuit, magnetic means positioned with respect to the outlet to maintain a supply of oxygen in liquid form at the outlet for delivery to the coil in the absence of the full force of gravity upon the liquid oxygen, and pressurizing means comprising heating means disposed within the container adjacent the field provided by the magnetic means and pressure responsive means to actuate the heating means.

11. A liquid oxygen converter system including a container having an outlet for the oxygen in communication with an evaporating coil in a supply circuit and an evaporating coil in a pressurizing circuit, said container holding a supply consisting essentially of oxygen in the liquid and gaseous phases, the wall of the container being impermeable to the passage of the liquid and gaseous oxygen, and magnetic means positioned with respect to the outlet to maintain a supply of oxygen in liquid form at the outlet for delivery to the coils in the absence of the full force of gravity upon the liquid oxygen.

12. A liquid oxygen converter system including a container having an outlet for the oxygen in communication with an evaporating coil in a supply circuit, magnetic means positioned with respect to the outlet to maintain a supply of oxygen in liquid form at the outlet for delivery to the coil in the absence of the full force of gravity upon the liquid oxygen, trap means to prevent vapor which may form in the supply circuit from entering the container, and means effective to controllably maintain a desired vapor pressure within said container.

13. A liquid oxygen converter system as set forth in claim 12, wherein the container comprises spaced inner and outer shells; wherein the container outlet comprises a tube extending between the shells; wherein the outlet tube is part of the magnetic means; and wherein the trap means comprises a check valve disposed within the outlet tube.

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