June 21, 1932. R. G. WULFF ET AL 1,863,958

CONTAINER FOR COMPRESSED OR LIQUEFIED GAS

Filed April 24, 1929

Fig. 1.

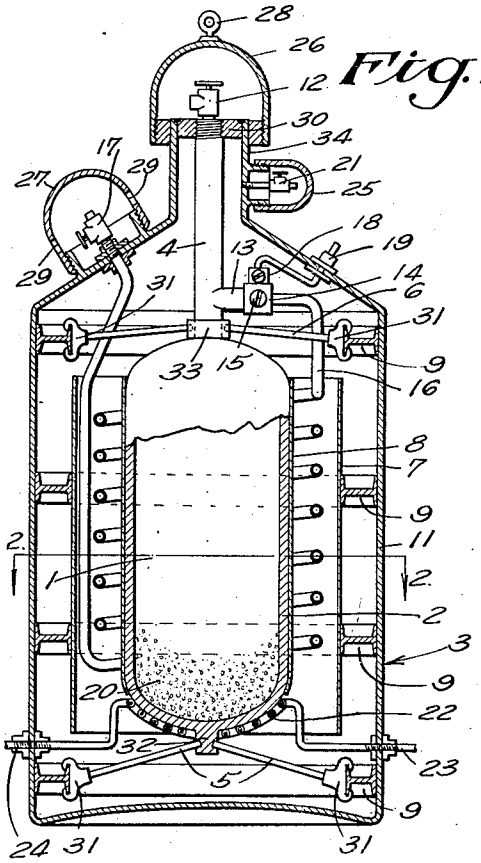


Fig. 3.

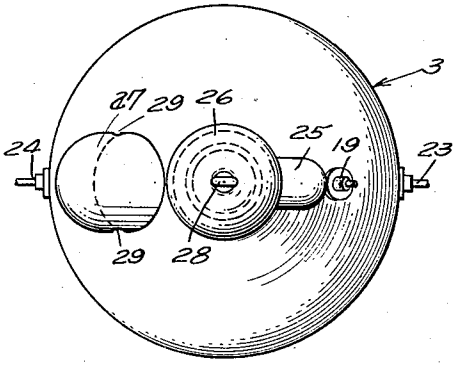
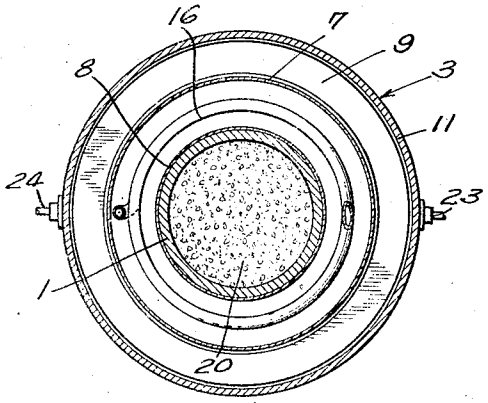


Fig. 2.



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UNITED STATES PATENT OFFICE

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CONTAINER FOR COMPRESSED OR LIQUEFIED GAS

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This invention relates to a container adapted to hold compressed or liquefied gas, or liquefied gas under pressure, in particular, oxygen.

It is the purpose of this invention to provide a container or "cylinder" which may be built in large sizes and when so built is safe, thermally efficient and economical in use and transportation.

Another object of the invention is to provide a container which may, with little difficulty, be mounted upon a pair of wheels and an axle so that it may easily be drawn by an automobile.

The accompanying drawing illustrates the preferred form of our invention.

Fig. 1 is a sectional elevation taken through the longitudinal axis of the container.

Fig. 2 is a plan view of the container upon the section line 2—2 of Fig. 1.

Fig. 3 is a plan view of the top of the container.

In the drawing, 1 is a high pressure chamber in which the gas or liquid is to be held. The wall of this chamber is indicated by 2 and is to be made of the best steel which can be obtained for the purpose. The high pressure chamber is located co-axially within a bottle-shaped outer shell or casing 3 which may be made of about ⅛″ boiler plate steel. The chamber 2 is held by its neck 4 within the shell 3, the extreme end of the neck being threaded into an annular disc 30 which may be pressed or welded into the end of the neck 34 of the shell 3.

The high pressure chamber 1 is also supported within the shell 3 by rods 5 and 6, of which there may be any desired number, preferably three of each. These rods are comparatively long and slender to lessen heat conduction, and may be insulated at one end by a poor heat conductor. The outer ends of all of them terminate in clamps 31 which fit I or H beams 9 as shown in Fig. 1. The rods 5 support the pressure chamber 1 at its lower part on which there is a boss 32 of substantial size. The rods 5 may extend into blind holes tapped in this boss or may otherwise engage it. The rods 6 extend from the I beams 9 to a ring disc 33 encircling the neck 4 of the chamber 1 and may extend into blind holes threaded in the edge of said disc. All of the rods 5 and 6 may be provided with turnbuckles (not shown) for tightening.

The wall of the chamber 1 is provided on its exterior surface with a highly polished metallic cover 8 preferably a sheet of aluminum or copper polished on its outer surface, but permissibly nickel-plated or aluminum painted steel. A second sheet 7 likewise prepared on its inner surface is attached to the circularly bent I or H beams 9. The space between the two metal sheets contains a cooling coil 16. The entire space between the shell 3 and the chamber 1 is highly evacuated of gas and is preferably filled with some heat-insulating incombustible substance (not shown) such as asbestos or kieselguhr, which preferably has first been efficiently denuded of adsorbed gases.

The interior of the chamber 1 may contain silica gel 20 or other incombustible adsorbent capable of occluding large volumes of gas. This material is preferably coarsely granular and lightly set with a binder to prevent its moving within the chamber 1. Besides reducing the effective pressure required to accommodate a given quantity of gas within the chamber 1, said filler 20 performs another function. It prevents stirring of the liquefied gas, saturating it, and so tends to lessen the rate of heat admission, and therefore the rate of evaporation of the contained liquid. Screens should be adapted to the valves to prevent entrance of dust from the filler 20.

Circular I or H beams 9 are arranged to act as reinforcements for the shell 3 and are each fastened to that shell in spaced relation from each other. Braces may be arranged between pairs of beams to maintain the spaced relation and add to the general strength if desired.

At the base of the chamber 1 there is a cooling or heating coil 22 so arranged as to have a maximum cooling or heating effect on the bottom of the chamber. An inlet 23 to this coil is arranged on one side of the shell 3 and an outlet 24 on the opposite side. By this means the coil may be connected to

an outside source of cooling or heating fluid and a battery of our containers may be arranged in series or parallel to receive such fluid through their coils 22. This member, if desired for heating purposes only, may be an electric resistor.

The neck 4 of the chamber 1 carries a side connection 13 with which relief valves 14 and 18 independently connect. The valve 14 is adjustable to actuation at different pressures, by means of the screw 15. Ordinarily it is set for opening at 2000 pounds per square inch pressure. It discharges into the cooling coil 16, expansion and consequent cooling taking place therein and thereabout. Said coil therefore tends to reduce the temperature about the chamber 1 and to lessen the rate of evaporation of the liquid therein, or the further heating of the contents thereof. Discharged gas then reaches a valve 17, and exhausts to the air through this valve. In case of distant transporation or storage for considerable time of liquefied gas or gas under pressure in our container, it may be of advantage to connect the valve 17 with a bank of empty cylinders capable of receiving all the gas initially in the container, and so holding it instead of letting it be lost to the air. For extra safeguard the relief valve 18 is provided, this valve being set to open at a pressure slightly higher than that at which the valve 14 opens. The valve 18 communicates to the atmosphere at 19.

The valve 14 is of the diaphragm type so that it will function substantially independently at the pressure for which it is set to open regardless of the pressure in the coil 16. It will also prevent a bank of tanks connected to the valve 17 from emptying out through the valve 18 after the tank or container 1 is empty or no longer carries the full pressure.

The neck of the chamber 1 is comparatively long so that heat conductivity is diminished. It terminates in an outlet valve 12 which is an ordinary valve and also carries a pressure-reducing valve if desired. At the side of the neck 34 of the shell 3 a valve 21 is provided through which the air may be evacuated. The valves 17, 12, and 21 are each provided with heavy steel protecting caps or bells 27, 26, and 25 respectively. The cap 27 has holes 29, of substantial size, provided in its sides so that connection of its interior with the atmosphere is established. The cap 26 may be provided with a ring 28 for hoisting the entire container.

The bottom of the shell 3 is preferably dished and the sides may be provided with suitable lugs, stirrups, trunnions, or rings whereby the entire container may be carried in an automobile trailer, that is to say, be mounted on wheels. Since this presents no difficulty, means for accomplishing the result are not shown.

The procedure to be observed in filling the container with liquid oxygen is preferably as follows:

A number of the containers are connected in series by their inlets and outlets 23 and 24 of their cooling coils 22. Ammonia, brine, oxygen, or other refrigerant is expanded through or allowed to flow through the coil 22, cooling the chamber 1. At the same time, the inside of the shell 3 is evacuated of air through the valve 21 if this has not already been done. Liquid oxygen is then allowed to flow into the chamber 1 through the valve 12 until a proper amount has entered. The valve 12 is then closed and the cap 26 replaced. The container is disconnected from the other cylinders at the cooling outlets.

In a modified form of the invention our container may carry in the space between the shell 3 and the pressure chamber 1 beside the optional filler of heat insulating properties, an easily liquefiable or condensable gas, preferably of high density. The advantage of this is that there need not then be a vacuum drawn on the said space for the purpose of heat insulation. Said space would initially be filled at one atmosphere absolute pressure with said dense gas when the container is substantially at room temperature throughout. Afterwards, when cooling is applied to the coil 22, said gas condenses substantially to liquid or a solid of negligible vapor pressure, a high vacuum automatically resulting without mechanical agencies. This makes it possible to dispense with the vacuum when the container is not cold and is not in use. The time available for air to leak in is so lessened, since a vacuum exists only when the container is cold.

Further, since cooling will condense the dense gas filler, any residual air may be easily drawn out with a vacuum pump through the valve 21 and so separated from the dense gas, thus avoiding rejection of the latter until filled with a new charge of gas. Carbon dioxide, sulphur hexafluoride, sulphur dioxide and hydrocarbon gases such as butane are suitable for the use indicated.

Ordinarily the container alone will be delivered into a customer's hands. It will then be connected to a reducing valve at the valve 12 and the contained gas used, or it can be connected to a bank of cylinders of ordinary design at the valve 12, and said cylinders filled with gaseous contents evaporating from the chamber 1. If it is desired in either case to accelerate the evaporation or efflux of gas from the chamber 1, the heating coil or resistor 22 may be used. Ordinarily said coil will be used on account of the fact that the normal influx of heat through the walls of the container is much too small to yield much gas by evaporation. If preferred, the bank of cylinders may be connected to the valve 17 instead of the valve 12. The safety valve 18

assures that the cylinders will not receive an excessive pressure in any case, whether the heating means 22 is used or not. More than one container may be connected to the same bank of cylinders, and these containers may have their heating coils 22 connected in series or parallel to the same source of heating fluid.

Our container as above described has large capacity, due to the fact that, for instance in the case of oxygen, a pressure of 2,000 pounds per square inch is used, as is standard practice, and at the same time it is highly refrigerated. It is also different from the usual atmospheric pressure liquid oxygen containers, in that it need not be kept upright to prevent spilling. Also, it carries a higher temperature within, due to the higher pressure at which the safety valve is set to open. This is an advantage in lessening the problem of heat insulation, and consequent loss of gas on storage or transportation.

We claim as our invention:

1. In a container of the class described: a chamber adapted to retain a fluid against high internal pressure; a protective casing surrounding said chamber so as to leave a substantial space about the latter; a safety valve communicating with the chamber; a cooling coil about the chamber within the space enclosed by the casing, said coil being adapted to receive the discharge from the safety valve; and an exit valve in the casing adapted to discharge to the outside of the casing fluid which has traversed the cooling coil.

2. A container according to claim 1 in which the space traversed by the cooling coil lies between a pair of reflecting surfaces which face each other.

3. A container according to claim 1 having in addition a second safety valve adapted to discharge at a higher pressure than the first one, directly into the atmosphere.

4. In a container of the class described: a chamber adapted to retain a fluid against high internal pressure; a comparatively long neck on said chamber; a protective casing surrounding said chamber and its neck; means for suspending the chamber within the casing by its neck; rod members adapted to hold the chamber in spaced relation to the casing; and means adapted to be used for either heating or cooling the chamber adjacent to the outer surface of the bottom of said chamber.

5. A container according to claim 4 in which the heating or cooling means is a coil having an inlet and an outlet extending through the protective casing.

6. In a container of the class described: a bottle-shaped chamber adapted to retain a fluid against high internal pressure; two safety valves communicating with said chamber, one of said valves being set to open at a higher pressure than the other; a cooling coil encircling the pressure chamber and adapted to receive the discharge of the more easily opened safety valve; and a protective casing surrounding all of the above described elements at a substantial distance therefrom and having outlets to which the cooling coil and the more difficultly opened safety valve are connected by piping.

7. A container according to claim 6 in which the space between the internal elements and the protective casing is packed with a non-combustible heat-insulating substance.

8. In a container of the class described, an internal stress-resisting chamber containing silica gel, said chamber being surrounded by a protective casing at a substantial distance therefrom, the intermediate space being substantially filled with a heat-insulating and incombustible substance.

9. A container according to claim 8 in which a substantial part of the heat-insulating and in combustible substance around the chamber is retained between two highly reflecting metal surfaces.

10. A container according to claim 8 in which the chamber has a safety valve located between the chamber and the protective casing, and a cooling coil encircling the chamber and located between two highly reflecting metal surfaces, said coil being adapted to receive fluid discharged from said safety valve and to void it to the outside of the protective casing.

11. In a container of the class described: a bottle-shaped pressure-retaining vessel having a side neck; a pair of safety valves connecting with said side neck and adapted to open at different pressures; a cooling coil surrounding the vessel; piping allowing the easier opening safety valve to exhaust through the cooling coil and the more difficultly opening one to exhaust into the atmosphere; a heating or cooling coil adjacent the bottom of the pressure-retaining vessel; a protective casing surrounding the above described elements at a substantial distance therefrom; a plurality of I or H beams of annular shape internally reinforcing said casing; a plurality of rod members holding the inner vessel in spaced relation to the casing; an internally facing reflecting metal surface supported on the I or H beams; an externally facing reflecting metal surface supported upon said pressure vessel; ports in the casing permitting the exhaust of the safety valve piping to the atmosphere, the evacuation of gas within the space between the pressure vessel and casing, and the traverse of fluid through the cooling or heating coil; and a valve permitting the ingress or egress of fluid from the inner pressure-retaining vessel.

12. A container according to claim 11 in which the inner pressure-retaining vessel is

substantially filled with granular silica gel.

13. A container according to claim 11 in which the space between the inner vessel and the protective casing contains a substantial quantity of a non-combustible porous heat-insulating substance.

14. A container according to claim 11 in which the space between the inner vessel and the protective casing contains a substantial quantity of a non-combustible heat-insulating substance and a gas capable of easy condensation to a liquid.

15. In a container of the class described: a strong single walled vessel capable of retaining a fluid which can exert a high outward pressure upon said vessel; a protective casing surrounding said inner vessel so as to leave a substantial space between the inner vessel and the casing; a porous filling of poor heat conductivity substantially filling the space between the container and the casing; a safety valve communicating with the inner vessel and set to exhaust at high pressures only, the discharge of said valve being arranged and directed to cool the space occupied by the porous filling; and a pair of large reflecting surfaces enclosing a portion of said filling and being arranged so as to face each other.

16. In a container of the class described: a chamber adapted to retain a fluid against high internal pressure; a protective casing surrounding said chamber so as to leave a substantial space about the latter; a safety valve located between the chamber and the protective casing, communicating with said chamber; and a conduit connecting the safety valve to an exit in the casing, said exit being adapted to discharge to the outside of the casing fluid received from the safety valve.

17. A container according to claim 16 in which a coil is provided to heat or cool the chamber artificially, but is not in communication with said chamber.

In testimony whereof, we have hereunto set our hands at Los Angeles, California, this 19th day of April, 1929.

ROBERT G. WULFF.
CHRISTOPHER V. MOODY.