United States Patent

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[54] **RESERVE LIQUID STORAGE AND DISPENSING DEVICE**

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[73] Assignee: **ESB Incorporated**

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[52] **U.S. Cl.** **222/389**

[51] **Int. Cl.** **B67d 5/42**

[58] **Field of Search** 222/389, 1

[56] **References Cited**

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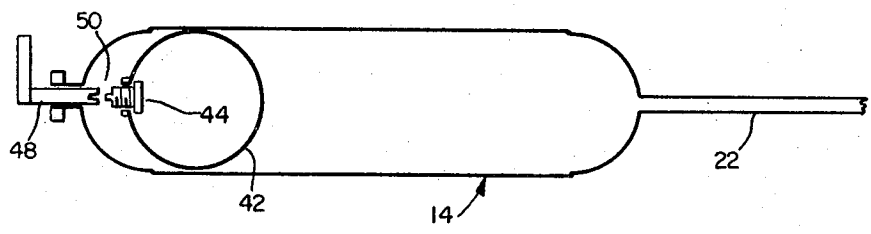
[57] **ABSTRACT**

A reserve liquid storage and dispensing device is described in which liquid stored in a container is dispensed by the motion of a piston. The piston is a tank containing high pressure gas, the gas supplying the energy required to cause the piston to move.

4 Claims, 4 Drawing Figures



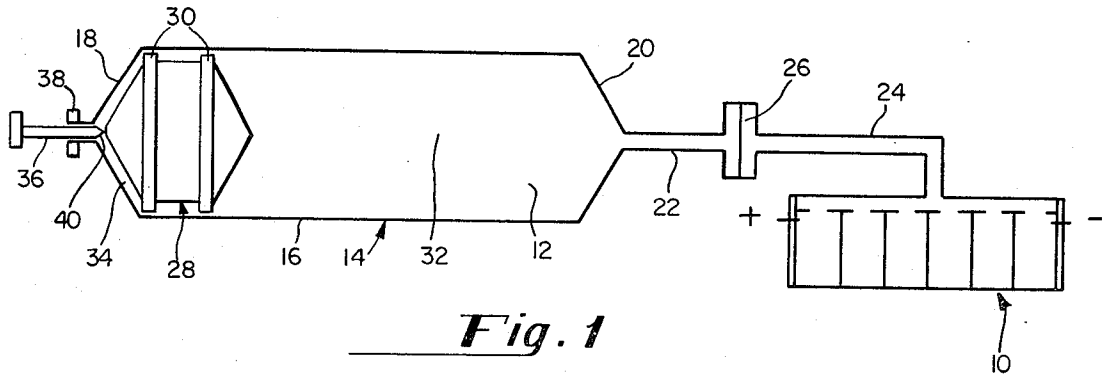


Fig. 1

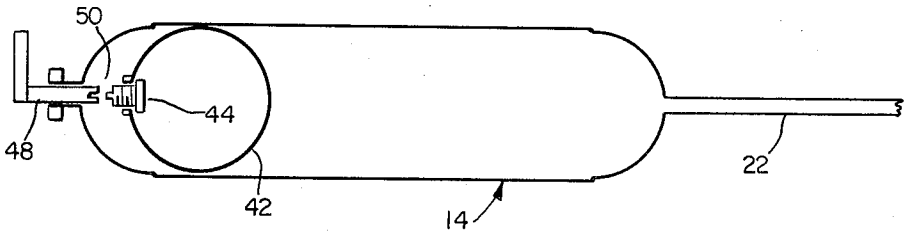


Fig. 2

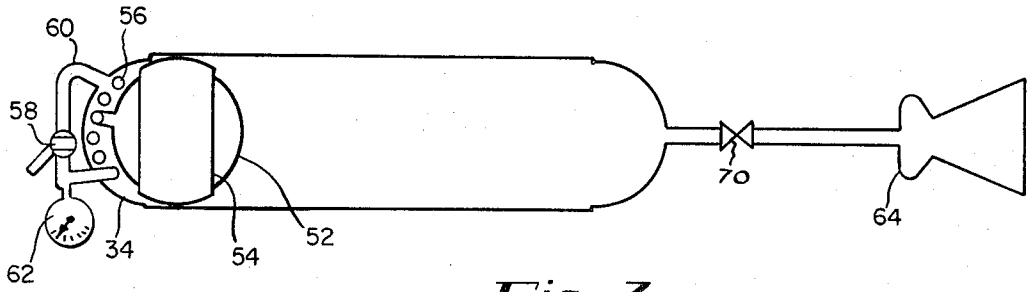


Fig. 3

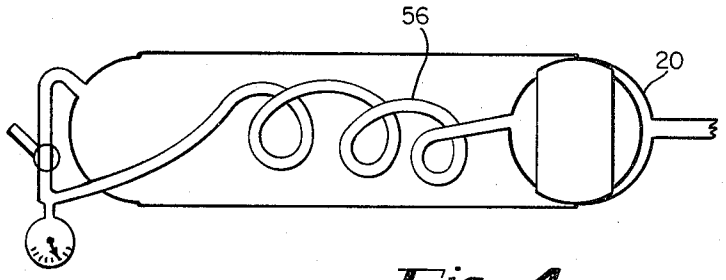


Fig. 4

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RESERVE LIQUID STORAGE AND DISPENSING DEVICE

BACKGROUND OF THE INVENTION

1 Field of the Invention

This device relates to reserve type primary batteries and in particular to remotely operated reserve type primary batteries. In a broader concept, it relates to any device where a remotely operated reserve type liquid dispensing means is used. An example of this would be a dispenser for liquid fuel for a rocket device.

2. Description of the Prior Art

Remotely activated liquid dispensers for reserve type primary batteries have taken two principal forms. In one, a gas generator such as an explosive match or squib has been used to force liquid battery electrolyte out of a container. In some instances, the container is a flexible bag located in a containing vessel, and in some cases, it is a cylinder with or without a piston working within. In the second, the energy of a compressed spring is used to release the liquid from the container to the point of use. Both these systems have faults. In the first system, because the gas generator is self-destroying, the user is never sure that the gas generator will perform as described. In the second system, the amount of power that can be stored per unit weight is low and the spring operated devices tend to be large and clumsy.

SUMMARY OF THE INVENTION

According to this invention, the liquid to be dispensed is contained in a closed container, the container having a piston located therein. The piston itself is a hollow tank containing the activating gas under pressure. Means are provided for directing gas from the gas storage tank to an area confined by the piston and the liquid storage device, forcing the piston to move and dispensing the stored liquid from an outlet on one end of the tank. A pressure sensing device reading the gas pressure within the gas storage tank provides a means for monitoring the energy available in the gas storage tank at any particular moment.

The particular benefits of this construction are: a high volumetric efficiency in terms of total liquid delivered divided by the system volume; high weight efficiency or ratio of liquid weight divided by total weight; and provision for monitoring the available actuating energy at any time.

In a modified embodiment of the invention, the device can be used to dispense fractional parts of the contained liquid at several instants of time.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a cross section of a simplified liquid storage and dispensing device in accordance with the invention.

FIG. 2 shows a cross section of a second embodiment of the invention making use of a valve to release compressed gas from the gas storage tank.

FIG. 3 shows a cross section of a third embodiment of the invention having the gas control valve external to the liquid storage reservoir.

FIG. 4 shows a cross section of the same embodiment as FIG. 3 after operation of the device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Item **10**, FIG. **1**, represents a reserve primary battery. This battery, completely inactive when dry, will provide a desired quantity of electric power when filled with electrolyte **12** contained in liquid storage reservoir **14**. Reservoir **14** has a central section **16** of uniform cross section, a first end wall **18** and a second end wall **20**. An outlet opening **22** connects the inside of reservoir **14** with the dispensing system **24**. In order to prevent liquid from running out of outlet **22** prior to the desired time of use, a pressure operated shut-off device is mounted across outlet **22** or in the dispensing system **24**. This shut-off device can be a spring loaded valve, a plug or other such device. In FIG. **1**, a pressure frangible diaphragm **26** is shown located in an enlargement of system **24**.

A tank **28** is located within the liquid storage reservoir **14** normally at the end of the reservoir away from outlet **22**. This tank contains compressed gas at a high pressure. Sealing rings such as **30** are provided to seal the opening between reservoir **14** and tank **28**, tank **28** thereby becoming a piston within reservoir **14**. The seals **30** effectively separate the liquid storage reservoir into two sections, a liquid containing section **32** and a void section **34**. A shaft **36** passes through the first end wall **18** of the liquid storage reservoir. It is fitted with a sealing gland **38** where it passes through wall **18** and it has a sharpened end **40**.

The battery **10** may be activated by giving the end of shaft **36** a sharp blow. This will force the sharp end **40** into tank **28**. Gas will then escape under pressure into the void portion **34** of reservoir **14** forcing tank **28** toward the second end wall **20**. When the pressure in section **34** becomes high enough, diaphragm **26** will rupture and electrolyte will be fed rapidly to battery **10**.

In a second embodiment, the gas storage tank **42** shown in FIG. **2** is in the form of a sphere. In this case, the fit of the gas storage tank is sufficiently close that no sealing material is needed between tank **42** and reservoir **14**. Tank **42** is closed by a screw valve **44** having valve stem **46**. A rotatable shaft **48** passing through end wall **18** engages stem **46** by means of a slip coupling shown at **50** in the disengaged condition for clarity, enabling valve **44** to be opened but not hindering motion of tank **42**.

A third embodiment is shown in FIGS. **3** and **4**. In FIG. **3**, hollow spherical piston **52** containing gas under pressure has a coating of low friction material such as teflon around its mid portion to act as sealant. A coil of tubing shown in cross section at **56** connects the interior of piston **52** to valve **58** located outside of reservoir **14**. Return pipe **66** connects the outlet of valve **58** to the void portion **34** of reservoir **14**. A pressure measuring device **62**, such as a bourdon guage, provides a means of monitoring the gas pressure in tank **52** during storage and prior to use. In the case of FIG. **3**, the dispenser is shown feeding a reaction motor **64**.

FIG. **4** depicts the device of FIG. **3** after the piston has discharged its contents into motor **64**. Pipe **56** is now pulled out approximately to its full length and sphere **54** has nested into the second end wall **20**, which in this case is of hemispherical shape to accept sphere **54** thereby eliminating unnecessary retention of electrolyte.

The embodiment of the invention depicted in FIGS. **3** and **4** has the further feature of dispensing the contained liquid in several fractional amounts. The amount of liquid dispensed from the reservoir **14** is dependent upon the movement of the spherical piston **52**. The movement of piston **52** is dependent upon the quantity of gas delivered from the gas supply within piston **52**. The quantity of gas delivered can be controlled by controlled opening and closing of valve **58**. Further control can be provided by the use of stop valve **70**, FIG. **3**.

The materials of construction for this device must be chosen to be compatible with the liquids to be stored. The speed of transfer of liquid will be determined by its viscosity, the gas pressure available and the geometry of the system. By proper choice of these variables it is possible to get complete discharge of liquid in a matter of a second or less as would be desirable for reserve battery priming. For fuel handling, the period of discharge might well take several minutes or even more.

Having thus fully described my invention and described its method of operation, I claim:

1. A reserve liquid storage and dispensing device which comprises:

a. a tubulor liquid storage reservoir;

b. a gas storage tank located within the liquid storage reservoir and adjacent a first end thereof, an external circumference of the gas storage tank mating with and similar and equal in size to the internal cross section of the liquid storage reservoir and slidably mounted therein;

c. a shut-off valve mounted on the gas storage tank and facing the first end wall of the liquid storage reservoir, the

shut-off valve when open providing access for the gas within the gas storage tank to the portion of the liquid storage reservoir bounded by the first end wall of the reservoir and an end portion of the gas storage tank;

d. a valve operating means extending through the first end wall of the liquid storage reservoir and engaging the opening means of the shut-off valve; and,

e. a liquid outlet formed in the second end wall of the liquid storage reservoir.

2. A reserve liquid storage and dispensing device which comprises:

a. a cylindrical liquid storage reservoir having a first and second end wall;

b. a gas storage tank located within the liquid storage reservoir having an external diameter equal to the internal diameter of the liquid storage reservoir and slideably mounted therein;

c. a flexible tube located within the liquid storage reservoir connecting the interior of the gas storage tank to a first opening formed in a first end wall of the liquid storage reservoir;

d. an operating valve external to the liquid storage reservoir tubularly connected between the first opening in the first end wall of the liquid storage reservoir and a second opening formed through the first end wall of the liquid storage reservoir; and

e. an outlet formed in the second end wall of the cylindrical liquid storage reservoir.

3. A device as defined in claim 2 in which the gas storage tank is spherical in shape, and the second end wall of the liquid reservoir is a hemisphere.

4. A device as defined in claim 2 in which a gas pressure sensing device is located on the tubular connection between the first end wall of the liquid reservoir and the operating valve.

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