

[54] INFLATED CONTAINERS FOR FLUID PRESSURIZED BALLS

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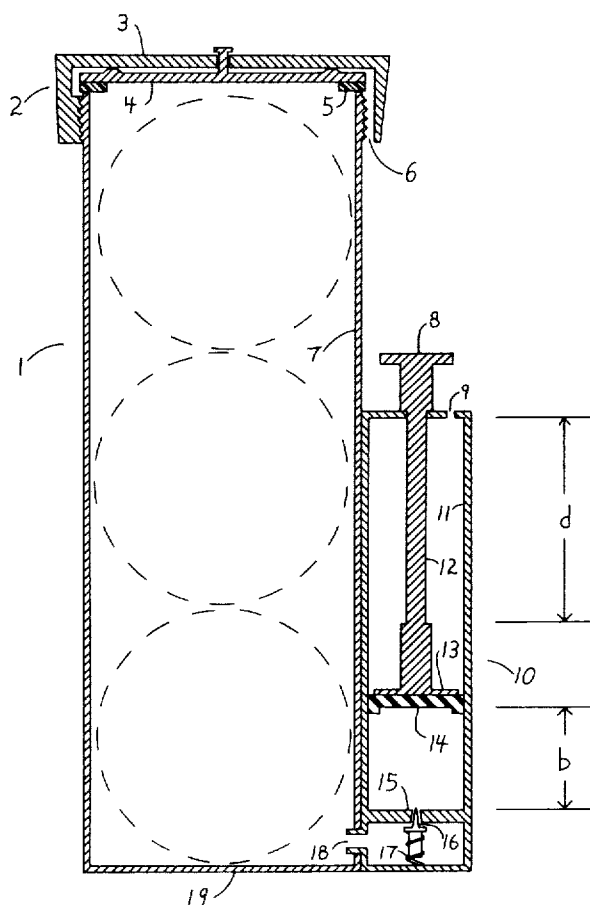
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[57] ABSTRACT

The invention is a reusable pressuretight container for fluid pressurized balls having an open end which has a cap to close it, with a hand operated pump attached to the body of the container, which serves to pressurize the container up to a fixed maximum pressure.

3 Claims, 2 Drawing Figures



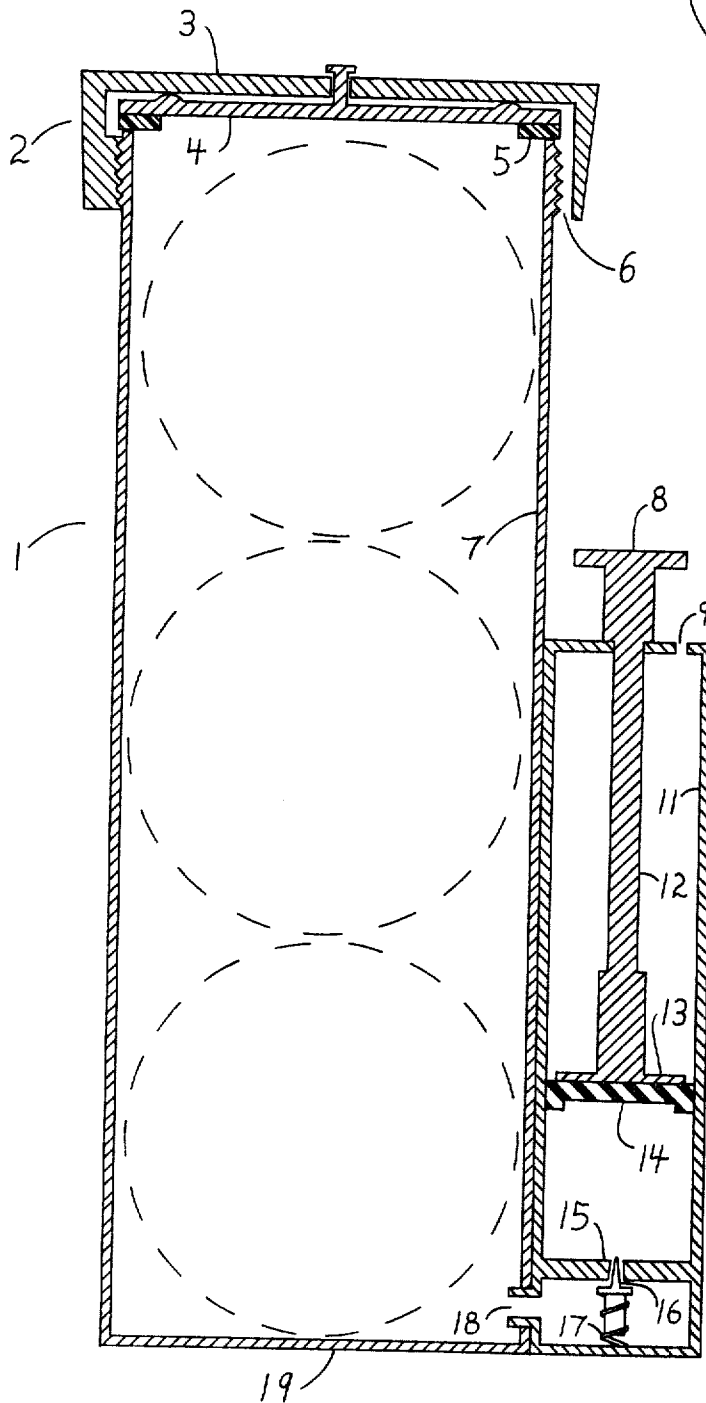


FIGURE 1

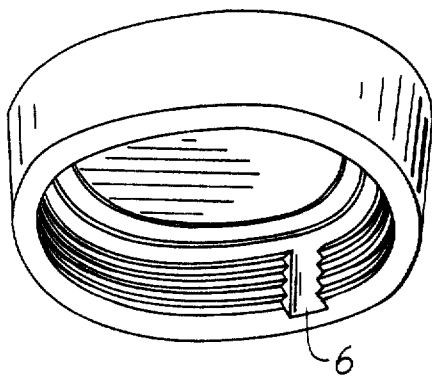
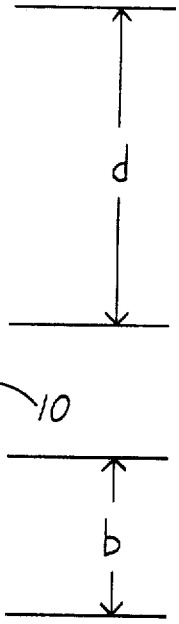


FIGURE 2



INFLATED CONTAINERS FOR FLUID PRESSURIZED BALLS

BACKGROUND

Tennis balls are manufactured to close specifications of size, weight, bounce, and deformability, in order that one tennis ball will behave in play pretty much like any other tennis ball. Most tennis balls are made filled with gas under pressure and originally packaged in groups of three in pressurized cans. These cans are made so that once opened they cannot be repressurized.

When a new tennis ball is taken out of its pressurized can, it immediately begins a slow deterioration caused by the interior pressure. This deterioration does not become obvious for several days and is usually obscured by the wear produced by normal use. Nevertheless, it remains true that after a number of weeks out of the can, even an unused tennis ball loses so much bounce it becomes useless to competent tennis players.

In order to preserve tennis balls when they are not in use, it is therefore desirable to return them to a pressurized container. A number of different types of containers have been devised for this purpose over the last fifty years. None, however, has come into widespread use. The container described here is proposed as an effective, easily used alternative.

DESCRIPTION OF THE INVENTION

With the object of preserving tennis balls from deterioration due to the difference between interior and exterior pressures, the invention is a new combination of parts for a re-useable pressure-tight container for fluid pressurized balls. The invention has an open end to admit balls with a cap to close it, and has a hand-operated pump attached to the body of the container which serves to pressurize the container up to a fixed maximum pressure.

One embodiment of the invention is depicted in the attached drawing.

FIG. 1 is a side cross-sectional view of the invention.

FIG. 2 is a perspective view of the cap.

The assembly consists of a cylindrical can, 1, closed at the bottom but open at the upper end. The open end of the can is provided with a removable cap, 2, which will close pressure-tight. Bonded parallel to the side of the can is a maximum pressure pump, 10, with its outlet, 18, opening into the can.

In operation the cap is removed and the tennis balls (shown in FIG. 1 by broken line circles) put in. The cap is then replaced and the pump handle, 8, worked up and down to pressurize the can. Because of the pump's design, the can cannot be overpressurized. The can remains pressurized until the balls are wanted. To get the balls out, the cap is simply removed and the balls dumped out.

Can

The can, 1, is cylindrical. Its sidewall, 7, and bottom, 19, are made from sheet metal or other suitable material. The bottom may be flat or domed, but should be made so the can will stand upright on a level surface. The can should be constructed so as to hold the maximum pressure provided by the pump with good safety.

Cap

The cap, 2, need not be of a particular type, as long as it holds pressure, but the type described here and shown in FIG. 1 will work well.

The cap consists of a top plate, 3, a downwardly extending annular flange with threads on the inside thereof, and an inner seal, 4, made of metal or other suitable material. The inner seal is provided with an annular layer of sealant material, 5, on the outside edge of its lower side. The inner seal and the outer portion of the cap are free to rotate with respect to one another. The outside of the top of the can is threaded to fit the cap. On the inside of the outer cap, a groove perpendicular to the threads, 6, cuts through the threads.

In operation, the cap is put on by simply screwing it on until tight. As the cap tightens, the sealant on the inner seal contacts the top of the can and the inner seal stops rotating. The outer cap continues to rotate until the sealant is compressed between the inner seal and the top of the can. In this method of sealing there is no rubbing between the sealant and the can, so the sealant is not worn away by frequent usage. The cap is removed by simply unscrewing the outer cap. As the outer cap is unscrewed, pressure from the can escapes out through the groove. If the groove were not there, the cap might be dangerously blown off as it was unscrewed.

Pump

The pump, 10, is similar to a small ordinary bicycle pump. It consists of a hollow cylinder, 11, of sheet metal or other suitable material with endwalls. The cylinder is divided by a false bottom, 15, into two portions, a smaller chamber or lower section containing a check valve, 16, and a larger piston chamber housing a piston, 13, inside to compress air. The piston is shown in FIG. 1 at the bottom of its downstroke. The piston is faced with rubber or other flexible material, 14, which will allow air to pass by it on the upstroke but will hold air on the downstroke. The piston is connected by a rod, 12, to the handle, 8, used to work the pump. A hole, 9, at the top of the pump admits air. The valve, 16, near the bottom of the pump lets pressurized air pass on the downstroke of the pump and prevents pressurized air from escaping from the can. A needle valve held by a spring, 17, is shown in FIG. 1, but any type of valve performing the same functions may be used.

The special feature of the pump is that it will only pressurize the can to a fixed maximum pressure. This is so because of the design of the pump.

Operation of the pump is as follows. Suppose the can has just been capped so that the interior pressure is atmospheric pressure and suppose the pump handle is down. When the pump handle is pulled up a partial vacuum is formed in the middle section of the pump (the section between the piston face, 14, and the false bottom, 15), so air at atmospheric pressure rushes from the top of the pump, past the flexible piston face, and into the middle section of the pump. At the top of the piston's stroke, the middle section of the pump is filled with air at atmospheric pressure. When the handle is pushed down, the flexible piston face, 14, acting as a one-way valve, traps the air in the middle section of the pump and compresses it. On the down stroke the needle valve, 16, is blown open immediately because the pressure is now higher between the false bottom and

the piston. The spring, 17, on the needle valve is very light and does not resist pressure appreciably. Air rushes past the needle valve, through the lower section of the pump, through the hole, 18, and into the can. At the end of the downstroke the air in the can and in the lower and middle sections of the pump is at a new pressure, P_1 , which is higher than atmospheric pressure. During the downstroke, air at atmospheric pressure has rushed through the hole, 9, to fill the section above the piston of the pump.

On the next upstroke and subsequent strokes, the situation is somewhat different. First, the spring closes the needle valve because the pressure is no longer higher in the middle section of the piston chamber. (the valve is held closed thereafter primarily by the pressure differential). As the piston rises, the air in the middle section of the pump expands and loses pressure until it reaches atmospheric pressure, at which point air begins to rush from the top of the pump, past the piston face, and into the middle of the pump. At the top of the upstroke, the middle section is again filled with air at atmospheric pressure.

On the next downstroke, the air is again trapped by the piston face and compressed. This time, however, the needle valve does not open immediately, but only when the pressure in the middle section exceeds P_1 . When it does, air passes into the can until the end of the downstroke is reached and the air in the can and in the lower and middle sections of the pump is at a higher pressure, P_2 .

As is shown in FIG. 1, at the end of its downstroke, the piston face is a distance b from the false bottom, 15, of the pump. The piston may be pulled upwards a distance d . On the upstroke a column of air of length $d+b$ will be trapped in the middle section of the pump.

It may be seen that the pump will not inflate the can over a fixed maximum pressure (namely $(d+b)/b$ times atmospheric pressure) as follows. The key is that no air will go through the valve from the pump into the can unless the pressure in the middle section of the pump is higher than the pressure in the can.

Let the area of the piston face be A , and let atmospheric pressure be P . Suppose the pressure in the can has reached $(d+b)/b$ times atmospheric pressure. When the handle is pulled out, a volume of air equal to $(d+b)A$ will be inside the middle section of the pump. This air will be at atmospheric pressure. When the handle is pushed down, this air will be compressed into a volume bA . As long as the temperature of the air doesn't change, the ideal gas law implies:

new volume times new pressure = old volume times old pressure or

$$bA \times \text{new pressure} = (d+b)A \times P \text{ so}$$

$$\text{new pressure} = ((d+b)/b)P$$

The new pressure is not larger than the pressure already in the can, so no air will go through the valve from the pump into the can. Hence, the pressure in the can cannot increase beyond $((d+b)/b)P$.

When the handle is released, the air in the middle section of the pump will expand back to its original volume and atmospheric pressure.

Tennis balls are inflated above atmospheric pressure

with about 21 pounds per square inch of gas pressure when new. Atmospheric pressure is about 14 pounds per square inch. Thus the total pressure in tennis balls is about 35 pounds per square inch, or $2\frac{1}{2}$ times atmospheric pressure. To equalize this pressure it is reasonable to have a pump which will create a pressure 3 times atmospheric pressure. This "three atmosphere" pump will have $(d+b)/b = 3$, or $d = 2b$. FIG. 1 shows d to be approximately twice the length of b .

Because pumping is a complex phenomenon, it may be desirable to vary the proportion $d = 2b$ slightly in the commercial product either to make it possible to pressurize the can with fewer strokes or to decrease the maximum pressure attainable in the can.

The use of the maximum pressure pump has two advantages. First, pressure control is good; without special valves or gauges of the sort referred to in the Miller U.S. Pat. No. 1,911,125 and the Anderson Australian Pat. No. 22,852/29, a proper pressure may be attained in the can. The pressure can easily be made as high as the pressure in a tennis ball, an improvement over the device described in the Hobbs U.S. Pat. No. 3,581,881, which is claimed to be pressurizable only to about 12 pounds per square inch above atmospheric pressure by an average adult. Second, the can will be relatively safe from exploding as a result of excessive pressure inside.

I claim:

1. A ball storage container comprising a hollow pressuretight first cylinder provided with a removeable cap, pump means connected to said first cylinder to inflate said first cylinder to a fixed maximum pressure, said pump means comprising a hollow second cylinder having end walls, a false bottom located in said second cylinder a spaced distance from one of said end walls to define a small chamber adjacent one of said end walls and a larger piston chamber adjacent the other of said end walls, a piston located in said piston chamber, a pump handle located outside said second cylinder and connected to the piston by a piston rod extending through the other of said end walls, said piston chamber communicating pressurized air to said first cylinder through said small chamber, a one way check valve located in said small chamber with means to admit the pressurized air from said piston chamber into said first cylinder and prevent the air from escaping from said first cylinder to said piston chamber, said piston having a maximum downstroke wherein it is a spaced distance from said false bottom, said distance determined so that said first cylinder can be inflated only to said fixed maximum pressure when the pump is used at normal atmospheric pressure.

2. The container of claim 1 wherein said cap comprises a top plate having a downwardly extending annular flange having threads on the inner surface of said flange to engage corresponding threads on said first cylinder, a portion of said inner surface of said flange having a groove cut through the threads so that pressurized air can escape slowly from said first cylinder when said cap is being unscrewed therefrom.

3. The container of claim 2 wherein said cap is provided with an inner seal, said seal and said cap being free to rotate relative to one another.

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