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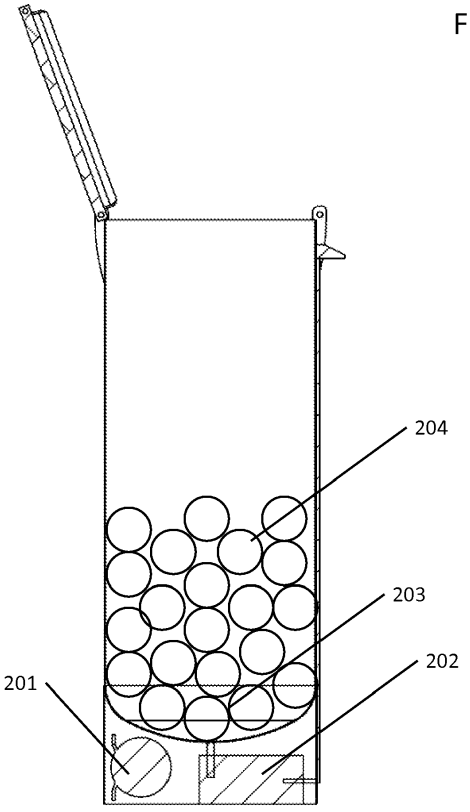
(54) Sports ball pressurizing container

(57) The present invention relates to a sports ball pressurizing container comprising a sealable opening and a pressure control system that comprises means to pressurize the container and a time-controlled pressure release means. The invention also relates to a method of pressurizing at least partially deflated sports ball in a container and releasing the pressure with a time controlled pressure release valve. The invention further relates to a pressure control system comprising an electronic control unit, pressurization means, a pressure gauge, an automatic time keeping device and a time-controlled pressure release means. The invention furthermore relates to the use of a sealable container for pressurizing sports balls.

FIG 2



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Description

Technical field

[0001] The present invention relates to a sports ball pressurizing container, and to a method of pressurizing sports balls.

Prior art

[0002] The present invention relates to pressurized sports balls. Sports balls are generally made of rubber and pressurized with air or nitrogen to about 2 bar. After manufacture sports ball may be placed in a pressurized plastic can to prevent air loss from the balls as the rubber is permeable to gas. Prior to usage, this can is opened. From that moment, the sports balls lose gas and pressure. Balls can generally be used for 1 month of play when stored at ambient pressure. Already during this period, the bounciness of these balls decreases. This becomes especially noticeable when playing with a mix of old and new balls, which results in a large difference of bounce.

[0003] New balls with proper pressure may be hit many meters farther with the same hit as a "dead" ball that may have an internal pressure of only 1 to 1.5 bar that end up in the net. This leads to frustration during an otherwise great game. Mixing of old and new balls is especially a problem for tennis trainers, who usually teach with a cart and a crate with larger numbers of balls, for instance 150 balls. Frequent ball replacement to avoid this pressure problem is costly and may be challenging to the environment. Balls may be stored at 2 bar pressure to prevent pressure loss but since trainer tennis balls are used daily for many hours, during which they are exposed to ambient pressure, they still lose pressure quickly. US 3888347 discloses a ball container with an integrated pump. US 4046491 discloses an apparatus for preserving the ball pressure during storage. US 4101029 discloses a container with gas supply, a pressure gauge, and a pressure release valve. US 4729472 relates to a monitoring device for recording and displaying the times the tennis balls have been used. US 5002196 discloses a container with a compressor, a pressure sensor switch and optionally a manually operable pressure release valve. US 5083415 describes pressurizing a container with a piercing probe and subsequently heat-sealing the piercing. US 5397018 discloses a storage container with a pressure compensation device for controlling a compressor as well as a player's container that can be provided with a hand pump, a pressure control valve and a pressure meter. US 7658211 discloses a container that can be pressurized with CO2.

[0004] There remains a need for proper maintenance of sports ball repressurization without the requirement of complicated procedures or expensive equipment.

Summary of the invention

[0005] Surprisingly, we have found a way to improve sports ball pressurization and overcome one or more of the above or other problems of the prior art.

[0006] Accordingly, the present invention relates to sports ball pressurizing container comprising a sealable opening and a pressure control system that comprises means to pressurize the container and a time-controlled pressure release means. None of these above mentioned prior art documents provides for a inflation system with a time controlled pressure release valve. Preferably, the container comprises a pressure control system that comprises an electronic control unit, a gas supply to pressurize the container, a time keeping device, a time-controlled pressure release valve, a pressure gauge, and a user interface. Preferably, the time-controlled pressure release means is connected via an electronic control to an electronic time keeping device. Preferably, the electronic control unit has electronic connections for data receiving of the time keeping device, the pressure gauge, and the user interface, and wherein the electronic control unit has electronic connections for data providing with the means to pressurize, the time-controlled pressure release means and the user interface; and wherein the container has a gas inflow connection with the means to pressurize and a gas outflow connection with the pressure gauge, the time-controlled pressure release means and the safety release valve; and wherein the container has closure means that provides for a physical closure connection between the container and the lid to seal the container interior. Preferably, the electronic control unit has electronic connections for data receiving with the means to pressurize, the time keeping device, the pressure gauge, the user interface and the closing sensor, and wherein the electronic control unit has electronic connections for data providing with the means to pressurize, the time-controlled pressure release means and the user interface; and wherein the container has a gas inflow connection with the means to pressurize and a gas outflow connection with the pressure gauge, the time-controlled pressure release means and the safety release valve; and wherein the container has closure means that provides for a physical closure connection between the container and the lid to seal the container interior. Preferably, the opening is sealed with a door and a rubber seal and wherein the rubber seal is bonded to the door and/or to the container.

[0007] The present invention further relates to a method of pressurizing at least partially deflated sports balls by:

(i) loading the balls into the interior of a container with a sealable opening;

(ii) pressurizing the container interior using a pressurizing means;
(iii) monitoring the time period of pressurization with a time keeping device; and
(iv) lowering the pressure of the container interior with a time controlled pressure release valve.

[0008] Preferably, the time keeping device measures the time period $t_{ambient}$ during which the balls with original internal ball pressure $p_{original}$ are exposed to ambient pressure $p_{ambient}$. Preferably, during step (iii), the means to pressurize the container subject the balls to an inflation pressure $p_{inflation}$ that is higher than the original internal ball pressure $p_{original}$ of the balls for an inflation time period $t_{inflation}$ such that:

$$t_{inflation}*(p_{inflation} - p_{original}) = k*t_{ambient} * (p_{original} - p_{ambient})$$

and wherein k represents a factor of between 0.1 and 10.0.

[0009] Preferably, the inflation pressure differential ($p_{inflation} - p_{original}$) corresponds to the deflation pressure differential ($p_{original} - p_{ambient}$). Preferably, the inflation time period $t_{inflation}$ corresponds to the deflation time period $t_{ambient}$. Preferably, following above step (iv), the pressure is lowered to the original internal ball pressure $p_{original}$. Preferably, after above step (ii), the pressure supply is temporarily interrupted, the pressure in the container is monitored with the pressure gauge and the electronic control unit triggers an alarm when the pressure drops at a rate of at least 0.01 bar/min. According to a preferred method, the sports balls are pressurized by the following steps:

(ia) determining the original pressure $p_{original}$ of the sports balls;
(ib) exposing the balls to ambient pressure $p_{ambient}$;
(ic) loading the balls into the container;
(iia) determining the ambient time period $t_{ambient}$ that the balls were exposed to ambient pressure $p_{ambient}$;
(iia) determining the inflation pressure $p_{inflation}$;
(iib) pressurizing the container with the balls to the inflation pressure $p_{inflation}$;
(iic) determining the inflation time period t inflation;
(iiia) releasing pressure after reaching the inflation period time $t_{inflation}$;
(iiib) keeping container at original ball pressure $p_{original}$ for storage; and
(iiic) opening container and optionally repeat step (ia) as above.

[0010] Surprisingly, we have found that containers according to the present invention allow for proper pressurization of sports balls, even mixtures of old and new balls. The invention provides a convenient and flexible way of repressurization of sports balls. Sports players will benefit in that they will less frequently be confronted with "dead" balls amongst the sports balls that they are playing with. The invention allows sports balls to be pressurized in batches and to similar internal pressures even mixed batches of old and new balls. The present invention further allows for maintenance of relatively constant pressurization of sports balls over time, each ball individually but also the sports balls as a batch, contributing to enjoyable play over longer periods.

Brief description of the figures

[0011] Figure 1 is a schematic representation of a preferred embodiment of the container of the present invention. Figure 2 is a schematic representation of a preferred embodiment of the container according to the present invention. Figure 3 is a schematic representation of a preferred electronic control scheme that may be used in the present invention. Figure 4 is a schematic representation of a preferred flow chart that may be used in the present invention.

Detailed description of the invention

[0012] For the purpose of the invention, the unit of pressure is bar absolute which may also be referred to as bara or according to this invention bar. Bar absolute is zero-referenced to complete vacuum. 1 bar is equal to 100 kPa and to 0.987atm. Another unit of pressure is gauge bar or barg, which is zero referenced to the atmospheric pressure and thus represents the atmospheric overpressure. Thus, a barg value is about 1 unit lower than the corresponding bar (= bara) value. Another unit of pressure are pound-force per square inch or psi. 1 bar is equal to approximately 14.5psi.

[0013] In one aspect, the invention relates to a sports balls pressurizing container. Examples of such balls without inflation valve are tennis balls, squash balls, and racketball balls. Preferably, the present invention relates to tennis balls.

It is preferred that the sports balls are made of rubber, more preferably the sports balls have a fabric coating. The container pressurizes one or more sports balls in its interior. Preferably, a batch of multiple balls is pressurized at the same time in the container interior, preferably at least 3, more preferably at least 10, and preferably at most 10000, for instance between 10 and 500, or around 150 sports balls. Preferably, the balls are put in a bag to contain dirt, gravel and ball fibers inside the bag. Preferably, the bag is open to allow for pressure adjustment inside the bag.

[0014] Preferably, the sports ball container of the invention comprises a closing means which is preferably a lid or a door. Preferably, the closing means comprise a hinge. Preferably, the container comprises a closure sensor (interlock safety sensor).

[0015] In another aspect, the invention relates to a container, and particularly a sports ball container, comprising a sealable opening which is preferably sealed with a closing means. Pressure containers of the prior art use O-ring seals or clamped seals, but we have found that usage of such seals may lead to pressure leakage leading to frequent seal replacement. We have found that pressure leakage may be reduced by bonding the seal to the door and/or to the container. It reduces the number of mechanical contact interfaces to just one interface, and allows for much easier cleaning prior to closing the container. Without wishing to be bound by any theory, we believe that by bonding the seal to the door and/or to the container allows for better removal of contaminations such as dirt, gravel and ball fibers from the seal. Such contamination may be introduced by the sports balls loading in and unloading from the container interior. In fact, we have found that the invention may prevent such contamination in the first place. The invention may lead to a cleaner seal, resulting in less leakage, a better functioning container and better pressurized sports balls.

[0016] Preferably, the seal according to this aspect of the invention is bonded to the door, to the container, or to both. In case of two seals that for instance contact, connect or intertwine, one seal may be bonded to the door while the other seal may be bonded to the container. Preferably, the seal is made of rubber. Preferably, the bonded seal is used for sports ball containers. We have found that such a bonded seal is surprisingly effective for pressurizing balls in a container. Preferably, the bond is created by using an adhesive that bonds the seal and the underlying surface of the door, the container, or both (in case of two seals). To bond a rubber seal to the door and/or container surface, preferably an adhesive is applied or in the alternative, first a primer is applied, then a non-vulcanized rubber is applied and subsequently the rubber seal is vulcanized.

[0017] In a further aspect, the invention relates to a container comprising a pressure control system that comprises means to pressurize the container and a time-controlled pressure release means. Preferably, the pressure control system comprises an electronic control unit, also called an ecu. Preferably, the pressure control system comprises a time keeping device. Preferably, the pressure control system comprises a pressure gauge. Preferably, the pressure control system comprises a safety release valve. Preferably, the pressure control system comprises a user interface. The pressure control system may further comprise tubing, cables for electronic data exchange, and a closure sensor.

[0018] Preferably, the means to pressurize the container is by reduction of the interior space of the container, by increase of the gas content of the container, or by a combination thereof. The interior space may be reduced by moving one or more of the walls of the containers inwards, for instance by screwing a cap on a container. Preferably, the means to pressurize the container is a gas supply, using a pressurized gas tank, or more preferably a compressor or hand pump, most preferably a compressor. Preferably, the gas used in the present invention is Nitrogen or air, more preferably air.

[0019] Preferably, the time-controlled pressure release means increases the interior space of the container, decreases the gas content of the container, or a mixture thereof. The interior space may be increased by moving one or more of the walls of the containers outwards, for instance by unscrewing a cap from a container. Preferably, the time-controlled pressure release means is a valve. Preferably, the means is electronic. Preferably, the means is automatic. Preferably, the pressure is reduced by opening the valve and releasing the gas until a programmed pressure has been measured with the pressure gauge.

[0020] Preferably, the ecu comprises one or more microcontrollers with embedded software (i.e. a programmed microcontrollers), preferably including stored algorithms for use in the present invention. Preferably, the ecu provides the central processing and control unit of the electronic data for receiving and sending data in order to manage the pressurization of the container interior, for instance by recording, setting, maintaining, adjusting and/or terminating the pressurization of the container interior. Power supply may contain universal line (110V/220V) power adaptor, or may be a battery.

[0021] Preferably, the time keeping device is electronic and preferably automatic. Preferably, the time keeping device measures the time for instance in units of seconds, minutes or hours. A preferred time keeping device is a clock. According to the invention, the clock may be analogue, digital, mechanic and/or electronic and is preferably electronic. Preferably, the time keeping device is driven by a quartz crystal, a source of a time base.

[0022] Preferably, the pressure gauge is an electronic gauge, allowing for convenient interfacing with the ecu. Preferably, the safety release valve prevents pressure of the container interior to exceed a maximum pressure value. At higher pressures, the safety release valve will open and release the pressure. Preferably, the closure sensor is located in the sealing device and/or hinge bracket and registers whether the container is physically closed and/or sealed. Pref-

erably, the tubing allows for passage of gas for pressurizing and/or pressure release of the container interior. Preferably, cable wiring connects the various elements of the container and the pressure control system to allow for electronic data exchange between the elements. Preferably, the user interface comprises a display and control buttons. Preferably, the control buttons include a start button. Preferably, the control buttons include a button for setting factor k as indicated below.

[0023] Preferably, the container of the invention has the following electronic connections, physical connections and/or flow connections. Preferably, the ecu is electronically connected to the means to pressurize to provide input on supplying pressure to the container and to the time-controlled pressure release means to provide input on releasing pressure from the container. Preferably, the ecu is electronically connected to the time keeping device to receive input on the time. Preferably, the ecu is electronically connected to the pressure gauge to receive input on the pressure in the container. Preferably, the ecu is electronically connected to the user interface to receive input from the control buttons and to provide input to the display on the status of the container for instance on pressure and time. Preferably, the ecu is electronically connected to the closing sensor to receive input on the physical closure of the container. Preferably, the ecu is electronically connected with a power supply.

[0024] Preferably, the means to pressurize the container is electronically connected to the ecu and has a flow connection, preferably through tubing, with the container to provide pressurization, preferably by providing a gas flow. Preferably, the time controlled pressure release means is electronically connected to the ecu and has a flow connection, preferably through tubing, with the container to release pressurization from the container. Preferably, the pressure gauge is electronically connected to the ecu and has a flow connection, preferably through tubing, with the container to measure the pressure in the container interior. Preferably, the safety release has a flow connection with the container and is able to autonomously release overpressure from the container interior. Preferably, the closure means provides for a physical closure connection between the container and the door to close off the container interior and an electronic connection with the ecu to provide input to the ecu on the closure status of the door.

[0025] According to the invention, the container comprises a time controlled pressure release means. Based on the time input from the time keeping device, on the container pressure input from the pressure gauge, the ecu provides electronic input to the time controlled pressure release means and controls the release of pressure from the container. The invention allows for precise pressurization of sports balls based on precise timing of pressure release as determined by the ecu based on various input including the time keeping device, the pressure gauge, the closing means, and the user interface.

[0026] In a further aspect, the invention relates to a method of pressurizing at least partially deflated sports balls by:

(i) loading the balls into the interior of a container with a sealable opening;
(ii) using means for pressurizing the container interior;
(iii) monitoring the time period of pressurization with a time keeping device; and
(iv) lowering the pressure of the container interior with a time controlled pressure release valve.

[0027] Sports balls in step (i) may for instance be retrieved from a pressured new ball can or for instance from the pressurization container after inflation.

[0028] To facilitate the pressurization method, the ecu preferably receives input from the closure sensor on container closure, from the control buttons on the user interface, and from the pressure gauge on the pressure in the container interior and provides input to the means to pressurize the container to provide gas supply to the container interior through the tubing. Preferably, the ecu receives input from the time keeping device on the time and from the pressure gauge on the container interior pressure and provides input to the time controlled pressure release means to lower the pressure in the container interior. Meanwhile, the ecu provides electronic data on the status of the method to the display on the user interface.

[0029] Preferably, the time keeping device and ecu monitor the ambient time period $t_{ambient}$ during which the sports balls are exposed to ambient pressure $p_{ambient}$. This occurs during step (iii). Preferably, the time keeping device provides the ecu with the time - time a - when the pressure gauge provides electronic data to the ecu that the pressure in the container has dropped below 1.5 bar which occurs shortly after the user has instructed the container to vent. Preferably, the time keeping device provides the ecu with the time - time b - when the pressure gauge provides electronic data to the ecu that the container pressure has reached above 1.5 bar which occurs shortly after the user presses the start button on the control buttons of the user interface. From the difference in time (b-a), the ecu determines the ambient period time $t_{ambient}$.

[0030] The ambient pressure $p_{ambient}$ may be measured using a pressure gauge or estimated, for instance at 1 bar. Usually, $p_{ambient}$ is around 1 bar, at atmospheric pressure.

[0031] Preferably, the balls of a batch have similar or equivalent original internal ball pressure $p_{original}$, although this is not essential for the invention. Preferably, the original internal ball pressure $p_{original}$ is known, from ball factory settings, but it may also be measured or estimated. For instance, the $p_{original}$ of tennis balls is generally between 1.5 and 2.2 bar, for instance around 2 bar.

[0032] Preferably, the means to pressurize the container subjects the balls to a inflation pressure $p_{inflation}$ that is higher than the original internal ball pressure $p_{original}$ of the balls. Preferably, inflation pressure $p_{inflation}$ is preferably applied during above steps (ii) and (iii). Preferably, the inflation pressure $p_{inflation}$ is monitored with the pressure gauge.

[0033] Preferably, the time keeping device and ecu monitor and determine the inflation time period $t_{inflation}$, starting from the time that the container has reached $p_{inflation}$ at the beginning of step (iii) and until the time-controlled pressure release means starts lowering the pressure at the end of step ii). The pressure gauge provides electronic data to the ecu that the inflation pressure p inflation has been reached. The ecu registers the time - time c - as provided by the time keeping device. The ecu determines, preferably with any of its algorithms (and more preferably using the algorithm as provided below) the inflation time period $t_{inflation}$. With time input from the time keeping device, the ecu registers the time period of time c + $t_{inflation}$ and instructs the time-controlled pressure release means to release the pressure from the container interior.

[0034] The present invention relates to a time-controlled pressure release means which, by monitoring the pressurization time, allows for precise pressurization of sports balls. Preferably, sports balls are pressurized to their original internal pressure $p_{original}$ or sometimes - but less preferred - close to their original internal pressure. The time controlled pressure release means is preferably controlled by the ecu and releases the pressure based on the instructions from the ecu which works in conjunction with the other devices as indicated.

[0035] After inflation, the pressure in the container is preferably lowered to the original internal ball pressure $p_{original}$ for storage of the sports balls. This occurs in above step (iv).

[0036] When inflating, the sports balls are preferably subjected to an inflation pressure $p_{inflation}$ for an inflation time period $t_{inflation}$ such that (algorithm):

$$t_{inflation} * (p_{inflation} - p_{original}) = k * t_{ambient} * (p_{original} - p_{ambient})$$

wherein factor k represents a factor that is preferably larger than 0.1, more preferably larger than 0.5 and preferably lower than 10.0, more preferably lower than 2.

[0037] Preferably, factor k can may determined by the user with the buttons on the user interface to customize the internal pressure of the sports ball. This factor can be determined empirically. If the user chooses factor k equals 1, then the sports balls will be inflated to the previous original ball pressure $p_{original}$, a lower value for k leads to softer balls while a higher value for factor k leads to harder balls. By choosing k, the user can take other aspects such as court type, personal preference, weather and altitude into account when deciding on the ball pressure. For instance, on hardcourt, tennis balls often lose felt and become faster. Under such circumstances, factor k may be set to a value less than 1. If a trainer finds after several weeks of play that the balls become too fast, he can decrease the setting of factor k on the user interface. On the other hand, on other types of courts the tennis ball felt may become fluffy, slowing down the ball due to excess wind resistance. Under such circumstances, factor k may be set larger than 1.

[0038] A sports ball or a set of sports balls is generally exposed to $p_{ambient}$ for less than 24 hours, therefore allowing for repressurization during the remainder of the day, during the night, or even in the subsequent days.

[0039] Preferably, the inflation pressure $p_{inflation}$ in the container is at least 2.3 bar, more preferably at least 2.5 bar and preferably at most 5 bar and more preferably at most 4 bar.

[0040] To prevent effects of non-linearity in the permeability, it is preferred that inflation pressure differential ($p_{inflation}$ - $p_{original}$) is equal to the deflation pressure differential ($p_{original}$ - $p_{ambient}$). Preferably, the inflation time period $t_{inflation}$ is set such to correspond to the deflation time period $t_{ambient}$.

[0041] In addition, $p_{inflation}$ is preferably kept low to allow for a lower cost pressure tank and compressor and to prevent collapse of the sports ball under inflation pressure. An important aspect of this invention is that the balls are reinflated preferably every night so that the ball has sufficient remaining pressure to prevent collapse under inflation pressure. Preferably, the inflation time period $t_{inflation}$ is at least 1 hours, more preferably at least 3 hours, and preferably at most 24 hours and more preferably at most 12 hours.

[0042] Generally, the time the sports balls are in play is shorter than 12 hours. In that case, a preferred inflation pressure is around 3 bar, as this provides an inflation pressure differential of 1 bar which is equal to the deflation pressure differential (of about 2 bar $p_{original}$ minus 1 bar $p_{ambient}$) and the inflation time period $t_{inflation}$ can be kept at the same length as the ambient time period $t_{ambient}$ during which the balls were exposed to ambient pressure $p_{ambient}$. Any additional time after $t_{inflation}$ and before opening of the container, the sports balls are preferably stored at p original to optimize internal sports ball pressure. For simplicity 2 bar may be used as an example.

[0043] A preferred method according to the invention relates to a method of pressurizing at least partially deflated sports balls by:

(ia) determining the original pressure $p_{original}$ of the sports balls;
(ib) exposing the balls to ambient pressure $p_{ambient}$;
(ic) loading the balls into the container;
(iia) determining the ambient time period $t_{ambient}$ that the balls were exposed to ambient pressure $p_{ambient}$;
(iia) determining the inflation pressure $p_{inflation}$;
(iib) pressurizing the container with the balls to the inflation pressure $p_{inflation}$;
(iic) determining the inflation time period $t_{inflation}$;
(iiia) releasing pressure after reaching the inflation time period $t_{inflation}$;
(iiib) keeping container at original ball pressure $p_{original}$ for storage; and
(iiic) opening container and optionally repeat step (ia) as above.

[0044] The method of the invention may also provide for the option of opening the container before the inflation time period $t_{inflation}$ has ended, for instance when the sports balls are needed in another unexpected game challenge. In that case, the remaining inflation time may be added to the next inflation time, of course adjusting for any differences in inflation pressures $p_{inflation}$ and using the algorithm provided.

[0045] The present invention provides for proper inflation of sports balls, also covering a mix of old and new balls. Without wishing to be bound by any theory, old balls may generally deflate quicker as gas diffuses faster through the worn-out rubber of the ball as compared to new balls. However, at the same time, old balls may generally inflate more quickly as well because gas diffuses after through the worn-out rubber into the ball as compared to new balls. We have surprisingly found that mixes of old and new balls may be properly inflated with the present invention.

[0046] In another aspect, the present invention relates to a method of monitoring pressure leakage from a container wherein the container is pressurized, the pressure supply is temporarily interrupted, the pressure in the container is monitored with a pressure gauge and an alarm is triggered when the pressure drops at or above a certain rate. Preferably, an ecu triggers the alarm. Preferably, the rate of pressure drop is at least 0.01 bar/min, more preferably at least 0.05 bar/min. Preferably, the pressure supply is interrupted for a period of at least a few seconds, more preferably 30 seconds and preferably at most 5 minutes, more preferably at most 2 minutes, for instance 1 minute.

Detailed description of the figures

[0047]

Figure 1 schematically shows a three dimensional illustration of a container according to the invention wherein the opening of ball container 102 with stand 110 can be sealed with closing means lid 101 to which rubber seal 103 is bonded. Lid 101 connects with hinge pin 106 which is locked with hinge pin interlock 107 and is part of hinge bracket 105. User interface 108 is connected to control cable 109

Figure 2 schematically shows a cross section of a preferred sports ball container according to the invention. Tennis balls 204 rest on bottom 203. Compressor 201 is placed underneath at interior bottom 203 together with pressure control unit 202 which comprises an electronic pressure gauge, an electronic clock as time keeping unit, an electronic time-controlled pressure release valve, tubing, and an ecu.

Figure 3 schematically shows a preferred electronic control scheme of the present invention. Double lines represent gas flow direction, single lines represent electronic information flow with the arrows indicating the flow direction, and the dashed line represents the physical connector between the interlock sensor and the lid hinge pin. Power input from power supply 303 is provided to electronic control unit 301 which is provided with electronic input on lid closure from lid safety lock 310. Electronic input on time is provided to the ecu by electronic time keeping device clock 302 and electronic input on pressure inside container 304 from pressure gauge 307. Electronic control unit 301 exchanges electronic data with user interface 309 which consists of a display and control buttons.
Electronic control unit 301 provides electronic input to compressor pump 305 to control gas supply to container 304. Ecu 301 provides electronic input to time-controlled pressure release valve 306 to control gas release from container 304. Pressure gauge 307 measures the pressure in container 304 and provides electronic data on pressure to electronic control unit 301. Safety release valve 308 opens above 3.2 bar and releases the gas, maintaining the pressure in container 304 at maximum 3.2 bar. Container 304 physically interlocks with lid safety interlock 310 to seal the opening of container 304.

Figure 4 schematically shows an example of a preferred flow diagram wherein a rectangular box represents a user action and an oval box represents an ecu action. Starting at the top, the user opens the lid by pressing. The ecu opens the release valve until pressure gauge indicates the atmospheric release pressure of 1 bar and subsequently

registers the time 1. The user may then remove the sports balls, plays a game, ends the game, places the balls in the container, closes the lid of the container and presses the start control button on the user interface. The ecu registers the time 2. The ecu starts the compressor until the pressure gauge indicates that the inflation pressure of 3 bar has been reached and maintains the pressure in the container at 3 bar for time period (time 2- time 1). Subsequently, the ecu opens the release valve until the pressure gauge indicates pressure of 2 bar as storage pressure for the sports balls. Subsequently, the flow diagram continues at the top.

The following non limiting example is provided

Example

[0048] A tennis teacher starts at 9 am (time a) with the opening of the container that was pressurized at a storage pressure of 2 bar which is equivalent to the original ball pressure $p_{original}$. Before opening, the container first depressurizes using the pressure release valve to ambient pressure $p_{ambient}$ of 1 bar (atmospheric pressure). The ecu in combination with the time keeping device registers a time of 9am when the pressure gauge indicates 1 bar. The teacher removes the sports balls and replaces them in the container at the end of the day at 5pm (time b). He closes the lid and presses the start button on the user interface. Slightly after 5pm, using the time keeping device the ecu registers through the pressure gauge that the pressure in the container has reached 1.5 bar and registers the end of ambient time period $t_{ambient}$. The teacher sets factor k to 1. The ecu instructs the pressurizing means to increase the pressure of the container to an optimal inflation pressure $p_{inflation}$ of 3 bar considering that inflation pressure differentials ($p_{inflation}$ - $p_{original}$) and deflation pressure differential (p original - p ambient) are equal to prevent effects of non-linearity in the permeability. Using the above algorithm (wherein t inflation =1*8*(2-1)/(3-2) = 8 hours), the ecu instructs, under guidance from the time keeping unit, the time controlled release means to release pressure at 1am the next day to the storage pressure $p_{original}$ of 2 bar. The next day, the tennis teacher can again use properly inflated balls for an enjoyable tennis training.

Claims

1. Sports ball pressurizing container comprising a sealable opening and a pressure control system that comprises means to pressurize the container and a time-controlled pressure release means.

2. Container according to claim 1, wherein the container comprises a pressure control system that comprises an electronic control unit, a gas supply to pressurize the container, a time keeping device, a time-controlled pressure release valve, a pressure gauge, and a user interface.

3. Container according to claim 1, wherein the time-controlled pressure release means is connected via an electronic control to an electronic time keeping device.

4. Container according to claims 1-3, wherein the electronic control unit has electronic connections for data receiving of the time keeping device, the pressure gauge, and the user interface, and wherein the electronic control unit has electronic connections for data providing with the means to pressurize, the time-controlled pressure release means and the user interface; and wherein the container has a gas inflow connection with the means to pressurize and a gas outflow connection with the pressure gauge, the time-controlled pressure release means and the safety release valve; and wherein the container has closure means that provides for a physical closure connection between the container and the lid to seal the container interior.

5. Container according to claims 1-4, wherein the opening is sealed with a door and a rubber seal and wherein the rubber seal is bonded to the door and/or to the container.

6. Method of pressurizing at least partially deflated sports balls by:

   (i) loading the balls into the interior of a container with a sealable opening;
   (ii) pressurizing the container interior using a pressurizing means;
   (iii) monitoring the time period of pressurization with an time keeping device; and
   (iv) lowering the pressure of the container interior with a time controlled pressure release valve.

7. Method according to claim 6, wherein the time keeping device measures the time period $t_{ambient}$ during which the balls with original internal ball pressure $p_{original}$ are exposed to ambient pressure $p_{ambient}$.

8. Method according to claims 6-7, wherein, during step (iii), the means to pressurize the container subject the balls to a inflation pressure $p_{inflation}$ that is higher than the original internal ball pressure $p_{original}$ of the balls for an inflation time period of $t_{inflation}$ such that:

$$t_{inflation} * (p_{inflation} - p_{original}) = k * t_{ambient} * (p_{original} - p_{ambient})$$

and wherein k represents a factor of between 0.1 and 10.0.

9. Method according to claim 8, wherein the inflation pressure differential ($p_{inflation} - p_{original}$) corresponds to the deflation pressure differential ($p_{original} - p_{ambient}$).

10. Method according to claim 8, wherein the inflation time period $t_{inflation}$ corresponds to the deflation time period $t_{ambient}$.

11. Method according to claims 6-10, wherein, following step (iv), the pressure is lowered to the original internal ball pressure $p_{original}$.

12. Method according to claims 6-11, wherein after step (ii), the pressure supply is temporarily interrupted, the pressure in the container is monitored with the pressure gauge and the electronic control unit triggers an alarm when the pressure drops at a rate of at least 0.01 bar/min.

13. Method according to claims 6-12, wherein the sports balls are pressurized by the following steps:

(ia) determining the original pressure $p_{original}$ of the sports balls;
(ib) exposing the balls to ambient pressure $p_{ambient}$;
(ic) loading the balls into the container;
(iia) determining the ambient time period $t_{ambient}$ that the balls were exposed to ambient pressure $p_{ambient}$;
(iia) determining the inflation pressure $p_{inflation}$;
(iib) pressurizing the container with the balls to the inflation pressure $p_{inflation}$;
(iic) determining the inflation time period $t_{inflation}$;
(iiia) releasing pressure after reaching the inflation time period $t_{inflation}$;
(iiib) keeping container at original ball pressure $p_{original}$ for storage; and
(iiic) opening container and optionally repeat step (ia) as above.

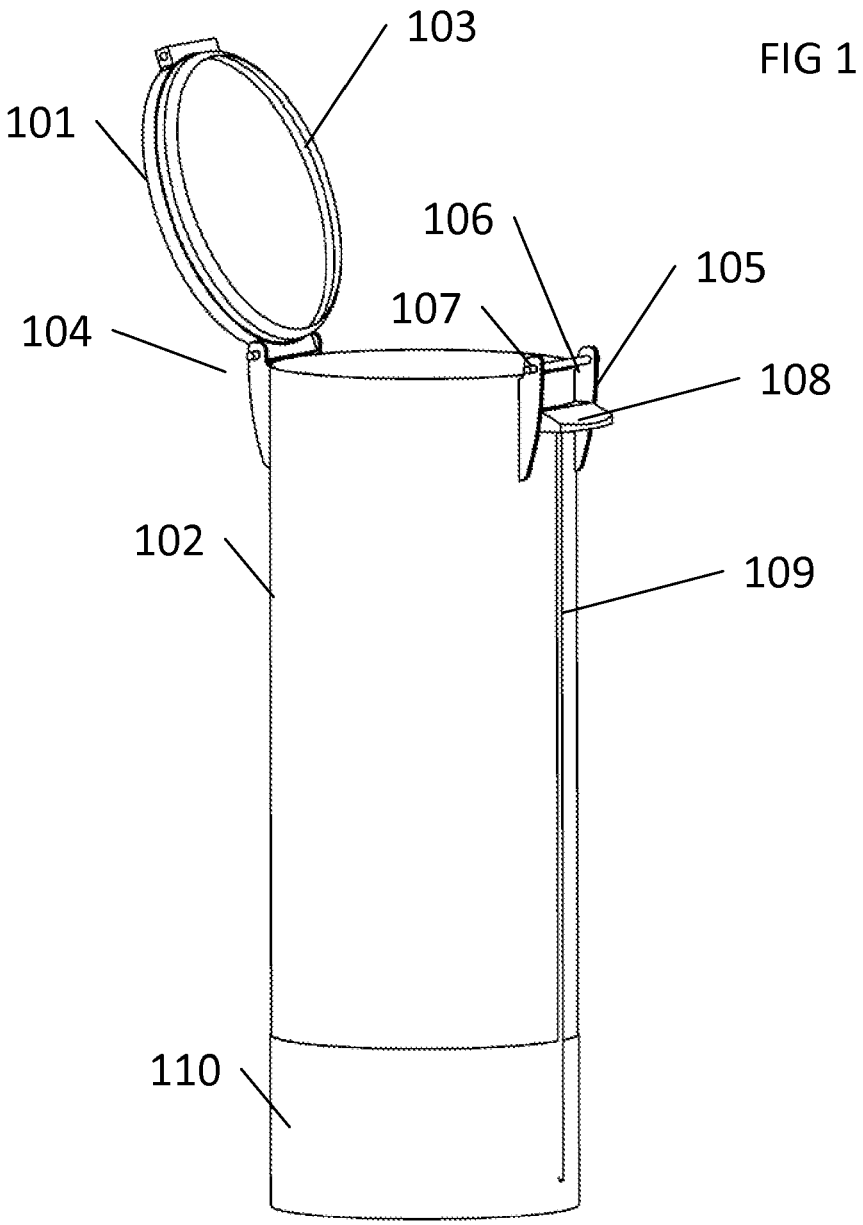


FIG 1

FIG 2

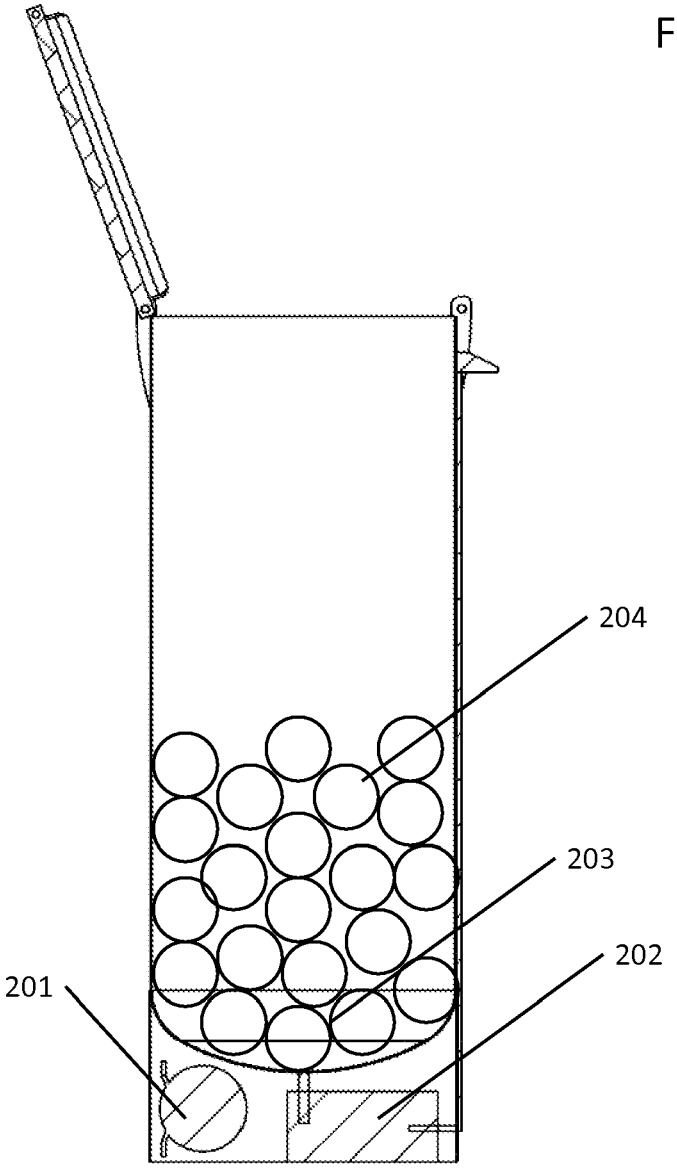


FIG 3

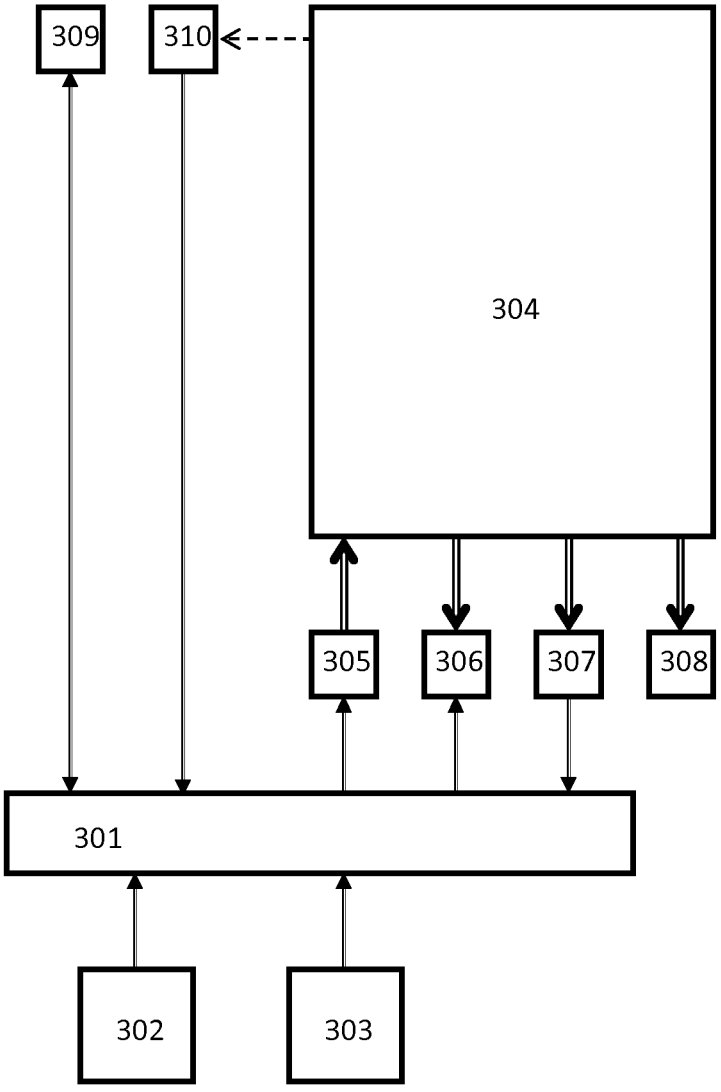
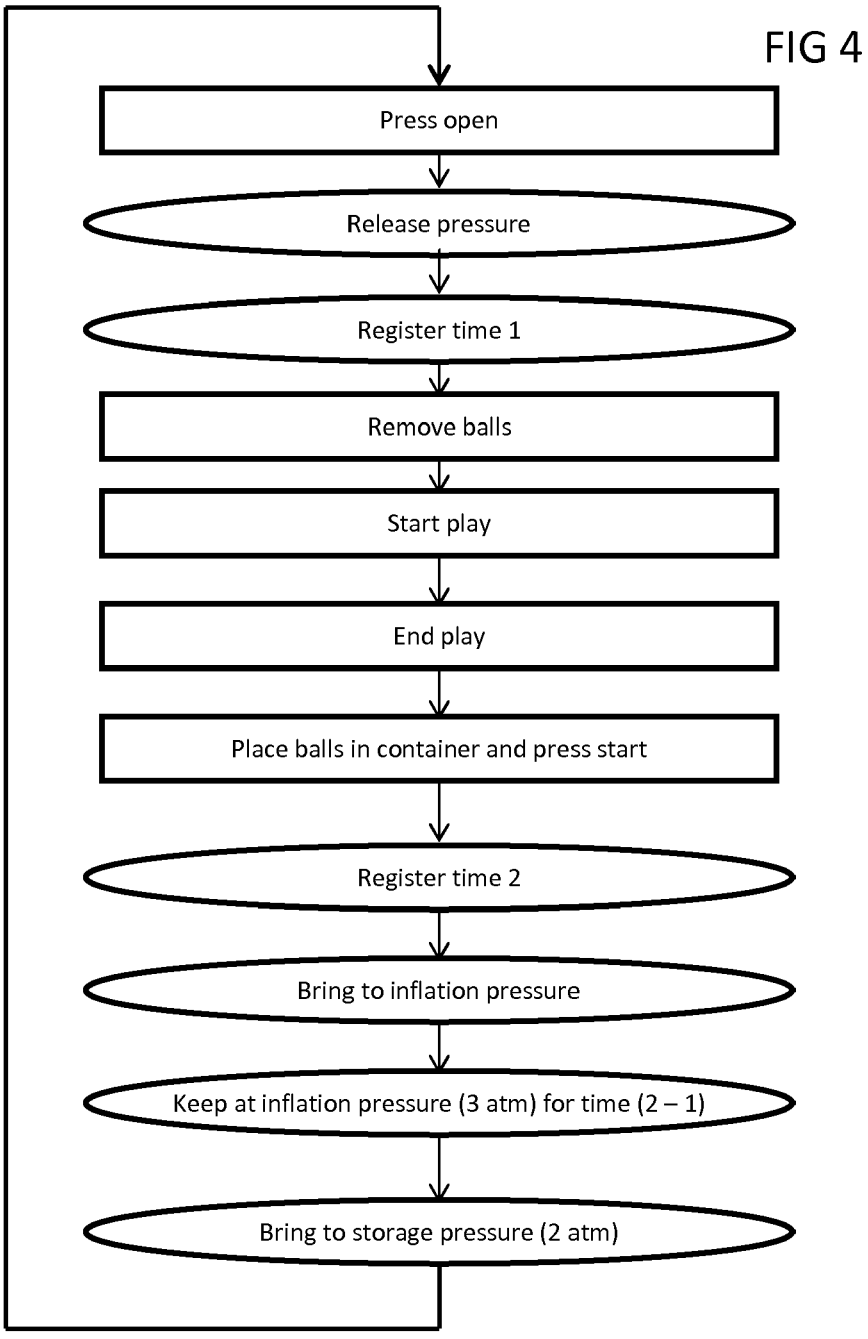


FIG 4


Press open
Release pressure
Register time 1
Remove balls
Start play
End play
Place balls in container and press start
Register time 2
Bring to inflation pressure
Keep at inflation pressure (3 atm) for time (2 – 1)
Bring to storage pressure (2 atm)

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EUROPEAN SEARCH REPORT

Application Number
EP 11 16 3613

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15 November 2011	Jones, Mark

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15-11-2011

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