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(54) Title: BLADDER SYSTEM FOR EXPANSION TANKS

(57) Abstract: The invention relates to an expansion tank with corresponding bladder. The bladder is flexible and pouch-like, is connected to a closing member for an air¬ tight sealing to the expansion tank, and comprises inside a pipe, connected to at least one end of the bladder and the closing member. The expansion tank is made out of plastic. The compressed gas is in the bladder and the liquid is in the spacing between the bladder and the inside of the expansion tank. The expansion tank has an opening at its upper side, sealed by a closing member, that is sufficiently large to remove and reinstall the bladder and corresponding pipe easily in, resp. out of the expansion tank.

Title : Bladder system for expansion tanks

Field of the invention :

The present invention relates to a bladder system for use in expansion tanks.
More in particular the invention relates to a system consisting of a bladder, a rigid tubular body installed inside the bladder and a closing element, for example a cover to which both said elements, the bladder and the tubular body are linked.
Thanks to this bladder system, in case of inspection or replacement of a defective bladder, this bladder can be replaced in a very simple manner so that the expansion tank is ready for use again.
The invention also relates to expansion tanks wherein such bladder systems are installed, as well as a method for the replacement of said inventive bladder system in an expansion tank.

Background of the invention :

Expansion tanks in general :

An expansion tank is a pressure vessel that serves to limit variations in pressure in systems filled with a liquid. An expansion tank comprises two parts, separated by means of a diaphragm or a bladder. One part is filled with the same liquid as the system, whereas the other part is filled with a compressed gas, usually air.

The working principle of an expansion tank is based on the principle that a gas, contrary to a liquid, is compressible. As soon as the pressure in the system goes up, the diaphragm will move in the direction of the gas, or the bladder filled with gas will decrease in volume, whereby the volume in the liquid system increases. In this manner the pressure will be reduced herein.
Expansion tanks are applied amongst others in central heating systems.

One can distinguish various types of expansion tanks.

First, there are expansion tanks characterised by a fixed bladder, for households or small utility houses.

Further there are expansion tanks characterised by a replaceable bladder or bellow, for use in medium-sized houses such as schools, offices, hospitals or smaller production entities.

A third type of expansion tanks can be found in automatic expansion systems, steered by a compressor or a pump, for use in larger entities.

Also important are installations for water (drilling) wells for delivery of water to houses, gardens, cattle as well as agriculture.

An example of an expansion tank with bellow or diaphragm is described in EP 1 918 627 A2 published 2008 05 07, applicant Young Eng. & Manuf., San Dimas, CA, USA.

The problem posed in this patent application is as follows :

Expansion tanks known in the prior art exhibit the problem that in a number of circumstances the bladder, in view of the uncontrollability of its form, closes the inlet/outlet of the tank during a flow of a liquid. (Column 1, line 43).

A second problem is that in case of a sudden flow of liquid in an expansion tank with a bladder the liquid column and its related force, directed to that part of the bladder that is situated directly above said liquid column, can damage the bladder (column 2, lines 52-58).

According to the inventors of this patent application there remains a need for an expansion tank whereby the probability of blocking the tank inlet/outlet opening by the bladder is eliminated (column 2, lines 1-3) and whereby also the possibility of damage to the bladder is diminished (column 2, line 7).

These problems arise not only when the expansion tank is intended to be used for liquids, but also for mixtures of liquids/solids.

The solution proposed in this patent application comprises expansion tanks characterised by a special design of the pipe or duct. These are designed in such a way that a uniform transit of the liquid/solid mixture is enabled, whereby the problems described supra do not arise (column 1, lines 6-9).

In the paragraphs 45 to 56 of this application, this pipe-construction is described for use in an expansion tank that is positioned vertically, whereby the liquid/solid mixture is added, resp. discharged at the bottom by means of an inlet/outlet opening (fig. 5).

In the embodiment of the expansion tank described in this patent application, the bladder is situated between the liquid and the compression gas in such a way that the compression gas is situated between the bladder and the inner side of the expansion tank. This compression gas is set up according to a pressure set in advance; the liquid is at the inner side of the bladder (column 9, lines 34-36). At the outside of the expansion tank there is a pressure meter and a valve for filling the gas (Fig. 5, elements 96 and 92).

The latter implies that the pressure gas is indeed at the outer side of the bladder, and the liquid is at the inner side of the bladder.

At the inside of the bladder a pipe is placed with perforations that are positioned in said pipe and that have dimensions such that the liquid that flows through said perforations form said pipe inside the bladder is uniformly distributed over a large surface. In this way the risk of damage to the bladder is reduced (column 10, lines 46-49).

The disadvantage however of this construction is that, as is set forth hereinafter in more detail, a replacement of the bladder in this type of expansion tanks is quite difficult and time-consuming.

Expansion tanks are equally described in the following patent applications, resp. patents:

- Dutch patent NL 8 100 723 A, published on September 1, 1982;
- US Patent 3,406,722 published October 22, 1968, by A.P. Ruth, Texas, USA;
- US Patent 3,209,785 published October 5, 1965 by Jean Mercier, New York, USA.

In each of these patents, resp. patent applications, the pressure gas in the expansion tank is situated between the bladder or the diaphragm and the inner side of the

expansion tank.

The liquid is situated inside the bladder.

When the bladder is removed, for instance at the occasion of its replacement following a rupture, the whole expansion tank need to be dismantled and thereafter to be mounted again.

This implies that all of these constructions are characterized by a very cumbersome, difficult and time-consuming operation in case of the replacement of a broken or damaged bladder.

Problem to be solved :

As is apparent from the above described state of the art, for expansion tanks with replaceable diaphragms or bladders, the inspection or replacement of a damaged diaphragm or bladder usually is a difficult and time-consuming issue.

Depending upon the use, for instance depending upon the quality of the water to be handled, and in particular in case of treatment of underground water or dirty water, such a replacement can imply a quite dirty handling operation.

The replacement implies two handlings : on the one hand the bladder to be inspected or to be replaced has to be removed from the expansion tank through a usually narrow opening at the upper or lower side of the tank.

This implies a dismantling or disengagement of the expansion tank from the connected pipes, removal of the air valve and removal of the damaged bladder.

Hereafter a new bladder or diaphragm should be inserted into the same narrow opening in the rigid expansion tank, whereby the diaphragm or bladder should not be damaged during this handling.

(in the text that follows we will always refer to a bladder instead of a diaphragm. This does not limit the field of application of this invention.)

Aim of the invention :

The aim of the invention is the construction of an expansion tank with related bladder system, whereby the replacement of the bladder in an existing expansion tank is simplified.

The aim of the invention is also the construction of an expansion tank, manufactured in a plastic material, with construction features such that the bladder system according to the invention can be easily placed inside and removed from the expansion tank.

By ease of installation according to the present invention, one should understand the following :

- On the one hand a quicker removal of a bladder to be replaced and installation of a new bladder, so gain of time when replacing a bladder;
- On the other hand, a reduction of the risk of damaging the new bladder when installed in an existing expansion tank;
- Without the need to dismantle or disconnect the expansion tank from the connected piping system at the occasion of such replacement.

Short description of the invention :

After many experiments and trials the present inventors have developed an expansion tank comprising a part filled with a compression gas and a part filled with liquid, a flexible pouch like bladder that separates both parts from each other, and a closing member connected to the bladder for an airtight sealing of the bladder to the expansion tank, whereby the bladder comprises a rigid tubular body, connected at at least one end to the bladder and the closing member, characterised in that the expansion tank is made of plastic and after commissioning the pressure gas is inside the bladder and the liquid is in the spacing between the bladder and the inside of the expansion tank.

In conformity herewith, according to a preferred embodiment, the expansion tank comprises an opening that is sufficiently large so that the closing member and the

bladder connected thereto and the rigid tubular body can be installed, respectively can be removed through said opening in, resp. from said expansion tank.

In conformity herewith the inventors have designed a new concept of a bladder system, comprising such a flexible pouch like bladder and a rigid tubular body, for use in the expansion tank as described above.

Further, in conformity with the above, the inventors have designed a new concept for the inspection, respectively for the replacement of a bladder in an expansion tank.

The method according to the invention for the replacement of a bladder in an expansion tank, comprises the following steps :

- Shutting-off of the water inlet to the expansion tank;
- Releasing the pressure from the bladder by means of an air valve;
- Optionally, removal of the air valve from the closing member that connects the bladder to the expansion tank;
- Disconnecting the closing member to which the bladder is connected, from the expansion tank;
- Removal of the closing member to which the bladder and the rigid tubular body are connected from the expansion tank;
- Disconnecting the closing member from the bladder and the rigid tubular body;
- Connecting a new bladder and rigid tubular body to the closing member;
- Re-installing the closing member to which the new bladder is connected and the rigid tubular body in the expansion tank;
- Connecting the closing member to the expansion tank;
- Re-installing the air valve, and bringing up to pressure the new bladder;
- Re-opening the water inlet to the expansion tank.

Preferred embodiments of the invention :

According to a preferred embodiment of the present invention, the bladder system comprises a flexible bladder, characterised in that the flexible bladder is foldable or compressible and, optionally, that the bladder is made of a flexible material, preferably an elastic material, more preferably thermoplastic polyurethane. As an alternative, the bladder can be made out of rubber, preferably butyl rubber, or it can comprise rubber, preferably butyl rubber. Thermoplastic polyurethane is a class of polyurethane plastics with very useful properties including elasticity and durability against oil, grease and wear and tear. Technically these plastics belong to the class of thermoplastic elastomers. Thermoplastic polyurethane is relatively cheap, easy to process, and shows a long operating life, is elastic and less sensitive to bacteria in comparison to alternative elastomers.

According to a further preferred embodiment of the invention, the bladder is manufactured such that it follows the form, inclusive of the curves of the expansion tank with a small excess in dimensions as compared to the dimensions of the expansion tank. As a result hereof the bladder will press at its entire surface against the inner wall of the expansion tank, without the bladder itself being under pressure, even in the absence of water in the expansion tank, also in case the bladder of the air cell takes all of the available space in the expansion tank. This aspect has a beneficial influence on the life time of the bladder.

According to a further preferred embodiment of the invention the bladder system comprises a rigid tubular body made of a light metal or a plastic. Aluminium is particularly suited as light metal. A rigid or stiff thermoplastic material is an example of a material that can be selected as plastic material. Aluminium is a particularly preferred material in view of its easy process ability and it is also less vulnerable to deformation caused by temperature. The term thermoplastic material should be understood according to the present invention as a plastic material that can be elastically deformed at a high temperature above its material specific softening temperature. In principle the rigid tubular body can also be made in a thermosetting plastic material.

The rigid tubular body can for instance be made from a thermoplastic rigid plastic material selected from the following list : polyolefins, polyesters, pvc, polystyrene, thermoplastic polyurethanes, butyl-butadiene rubbers, elastomers, etc.

According to a further preferred embodiment this rigid tubular body comprises apertures. This results in an even pressure in this body, as well as in the remaining places of the bladder. Also the air is blown in the bladder from the air valve through these apertures.

According to a further preferred embodiment the bladder system is characterized by the fact that the bladder at both ends is connected to the rigid tubular body.

The advantage hereof is that the bladder is positioned more accurately and steadily in the expansion tank, which has a beneficial effect on the life time of the bladder.

According to a further preferred embodiment the bladder system is characterized in that the bladder is made from welded pre-cut film materials.

Often according to the state of the art, the elastic bladder material is manufactured using blow-moulding. According to a preferred embodiment of the invention, the bladder is not manufactured by using such blow-moulding technique, but on the basis of welded pre-cut film materials. The advantage hereof is that this technique enables a uniform thickness and the possibility to reinforce the bladder at such places that are in need hereof.

(in case of blow moulding, the thickness usually is not uniform)

A further preferred embodiment of the invention is characterized by the fact that at the end of the bladder system opposite the closing member an adapter is present enabling this end of the bladder system to be accurately positioned relative to a collar of the expansion tank matching with such adapter.

The advantage hereof is, as set forth supra, a better positioning of the bladder system according to the invention in the expansion tank, and hence a longer life time of the bladder.

Indeed, as the bladder at its upper and lower ends is secured to the rigid tubular body, for example the aluminium pipe, and as these parts are introduced as a whole in the expansion tank, the effect is obtained as if the bladder itself at its upper and lower ends is secured to the expansion tank. This effect substantially enhances the life time of the bladder.

The advantage hereof is also that this enables an easy installation and airtight connection of the bladder system to the expansion tank, as well as an easy removal of the bladder system out of the expansion tank.

According to a preferred embodiment the bladder is secured at both ends of the plastic cover to the upper and lower end of the rigid tubular body.

The closing member that connects the rigid tubular body and the flexible bladder can in principle be manufactured in any material, but preferably in a stiff thermoplastic material.

As stiff thermoplastic material any of the following materials can be selected : polyolefins, polyesters, pvc, polystyrene, thermoplastic polyurethanes, butyl-, butadiene rubbers, elastomeric materials, etc.

The bladder and its pipe should be secured as a whole to this closing member, for example by means of a hollow screwed connection. The air valve is positioned in this hollow spacing.

The bladder is designed to be used in combination with an expansion tank that is specifically designed to this end; differently phrased, the bladder is not suitable to be used with existing expansion tanks that are already in use; in principle such tanks are not suited for this purpose.

Replacement of the bladder according to the invention can be effected either in case of breakdown of an existing bladder, or for instance at the occasion of a (yearly) preventive maintenance.

According to a preferred embodiment of the expansion tank, the tank is characterised by the fact that it comprises at at least one end an aperture that is sufficiently large such that the bladder and the rigid tubular body of the bladder system can be installed in, resp. removed from the expansion tank through this end.

The closing member abovementioned to which the bladder and the rigid tubular body are connected fits into this sufficiently large aperture of the expansion tank.

According to a further preferred embodiment of the expansion tank, at its end opposite the abovementioned closing member a collar is provided with which the adapter of the bladder system as described above, fits.

According to a preferred embodiment of the method according to the invention, the step of disconnecting, respectively re-connecting the closing member of the bladder system to the expansion tank is effected by unscrewing, resp. screwing of a V-connection or a bolt/nut connection.

According to a further preferred embodiment the disconnection, resp. the re-connection of the closing member of the bladder system to the rigid tubular body is effected by the unscrewing, resp. the screwing of a nut connection.

Figures :

Figure 1 shows a schematic presentation of an exemplary embodiment of a bladder system according to the invention, positioned in an expansion tank.

Figure 2 shows a more detailed representation of the positioning of a bladder system according to the invention in an expansion tank.

Figure 3 shows a schematic representation of a bladder system according to the invention when positioned in an expansion tank.

Figure 4 shows the various steps to be followed when a preferred embodiment of a bladder system according to the invention has to be replaced in an expansion tank.

Figure 5 shows a detailed representation of a preferred embodiment of a bladder system according to the invention.

Figure 6 shows a cross-section of a preferred embodiment of an expansion tank in working condition according to the invention.

Figure 7 shows a cross-section of an alternate preferred embodiment of a bladder as installed for use in an expansion tank according to the invention.

Figure 8 shows a cross-section of an alternate preferred embodiment of a bladder as

disassembled for use in an expansion tank according to the invention. (in both figures the bladder is shown in blown-up or expanded position for the clarity of the figure.)

Detailed description of the invention :

The term 'flexible' as used in the description and the claims of the present invention should be interpreted as follows.

The bladder should be able to adapt in a flexible manner to the compressibility of the air as opposite to the non-compressible characteristic of the water, such that the bladder can exercise its buffering capacity.

To this end, the material of the bladder should be flexible, but not necessarily elastic. For example, the bladder can be foldable, or compressible. It suffices that the design of the bladder is such that it can exercise its buffering capacity in an expansion tank under practical circumstances.

Preferably the material of the bladder comprises an elastic material such as rubber, but this is not necessary; the bladder can also be manufactured entirely from such elastic material.

Bladder systems according to the invention preferably are positioned in expansion tanks made out of plastic.

Expansion tanks made out of plastic or composite material constitute a preferred embodiment, amongst others in view of their lower weight and resistance to corrosion or rust, and consequently their more easy maintenance.

According to a more preferred embodiment the plastic material comprises thermoplastic materials. These are – as opposite to thermosetting materials – completely recyclable. On top hereof they are characterized by a high impact resistance.

In principle the bladder according to the invention can be used in combination with expansion tanks made out of steel, on condition there is a sufficiently large inlet-aperture for the bladder with the pipe.

Examples of such plastic expansion tanks are those marketed under the brand Wellmate by the company Pentair Residential Filtration, LLC, USA.
These are manufactured on the basis of a glassfiber reinforced epoxy-resin impregnated outer coating.
Still more preferred are the expansion tanks produced by Covess N.V., Belgium, on the basis of pure thermoplastic materials.
The water – or more generally the liquid the pressure whereof should be controlled – resides in these apparatus in the spacing between the outer plastic shell of the expansion tank and the diaphragm or bladder. The latter is usually made of thermoplastic polyurethane.
As set forth above, the gas, usually air, resides in the diaphragm or bladder.

Expansion tanks produced in steel are usually characterized by the inverse situation : in this case the water or the liquid usually resides in the bladder; the air then resides in the spacing between the bladder and the steel cover. This is the situation in each of the expansion tanks described in the prior art set forth above.
The latter construction has the advantage that the bladder is connected at its upper- and lower ends at the steel cover and this generally enhances the life time of the bladder.
The disadvantage of expansion tanks made out of steel is the possible formation of corrosion, as well as their higher weight; this feature renders the initial instalment and the handlings in case of replacement of the bladder more difficult compared to expansion tanks made out of plastic.

Figure 5 shows a drawing of a preferred embodiment of a bladder system according to the invention.
The various elements herein represent the following :
1 represents a central nut / clamping bolt;
2 represents the pipe itself;
3 represents a clamping bolt;
4 represents a clamping part / clamping bolt;
5 represents a spacer (to keep distance between various parts);

6 represents the bladder;

7 equally represents a spacer;

8 represents a nut;

9 represents the air valve;

10 represents a closing plate for the closing member.

Hereinafter we describe by means of illustration and practical embodiment the working of a bladder system according to the invention under practical circumstances.

(The working of the bladder system as described hereinafter applies to an expansion tank made out of plastic, whereby the air is situated in the bladder. In case a metal expansion tank is used, the situation is different, as described supra.)

The air is pressed in the bladder by opening the air valve situated on top of the tank, up until a pressure of for example 3 bar is reached. Hereupon the air valve is locked; water is introduced in the expansion tank at its lower end, until a pressure of for example 6 bar is reached. Once this pressure is reached, the filling pump is stopped. In this way the bladder is compressed until a pressure of 6 bar is equally reached. Water can then be consumed; in case of water consumption, the bladder will expand as a function of the amount of water consumed; the pressure in the bladder and the expansion tank will gradually decrease until the level of 3 bar has been reached. At that point the tank need to be refilled. A signal is sent to the filling pump indicating water should be added through an opening consisting for example of a T-valve or a C-bend at the lower end of the tank. This illustrates the function of the tank : a buffering function to avoid that the filling pump frequently should be started, resp. stopped each time water is consumed.

The bladder systems and expansion tanks according to the invention can be offered in a wide range of applications.

The capacity can vary from quite compact tanks for limited use in households, up until tanks of a larger volume for larger industrial users. The capacity, expressed in litres of liquid, can vary from 5 until 5 000 litre. Preferably between 100 (25.8 Gallons) up to 500 (129 gallons), which represent quite usual values.

The working range in terms of temperature of the liquids to be handled can equally well vary between broad ranges. For most applications the temperature of the liquid to be treated is situated between 1° and 90 ° Celsius.

The working pressure inside the expansion tank can equally vary between broad ranges, depending upon the application. Working pressures up until 10 bar are quite usual.

The weight of a thermoplastic expansion tank with a nominal capacity of 150 Litre is around 18. Kg, and its dimensions are 18 inch as regards its diameter and 101 cm high.

To create a pressure in the bladder according to the invention, the closing member, to which the bladder and the rigid tubular body enclosed therein are connected at one end, comprise an air valve.

This valve enables the bladder to be put under pressure according to a technique known to the person skilled in the art, namely through the introduction of air that is distributed inside the entire flexible bladder through this air valve and through the pipe and its apertures. In case an new expansion tank with bladder according to the invention is delivered to a customer, in most cases the manufacturer takes care that this tank already shows an air pressure in the bladder. This air pressure in a large number of applications amounts to 3 bar.

In case of delivery of such new expansion tank according to the invention, the commissioning is very easy : the expansion tank simply is connected to the system, the water inlet is opened and the operation starts. The expansion tank is then ready for use.

The connection to the system of the customer can take place for instance by means of the in/outlet of the expansion tank, that may comprise a screw thread connection to this end. In many cases a 5/4 inch connection is provided, that can be reduced to a lower value by means of a reduction element, if required.

Hereinafter we describe the method in case of inspection, respectively in case of replacement of a bladder according to the invention in an expansion tank.

Figure 4 as attached shows the various steps to be followed in such method. This method in total comprises 10 steps, as described hereinafter.

Step 1 :

This first step consists in locking the water inlet from the system of the customer to the expansion tank. To this end, the expansion tank need not to be disconnected from the system of the customer.

Step 2 :

The air inside the bladder is allowed to escape by pressing the air valve on the closing member of the tank.

Step 3 :

Optionally residual air pressure in the bladder is allowed to escape by screwing the air valve out of the closing member. For the sake of safety one should take care that as a result of still remaining air pressure, the valve does not fly away.

Step 4 :

The V-connection (clamp) – or alternately the bolt/nut connection – by means whereof the closing member is connected to the expansion tank, is screwed off.

Step 5 :

The closing member, to which the bladder with pipe is connected at at least one end, is removed from the expansion tank. In this way the bladder and the pipe connected thereto are easily removed from the expansion tank.

Step 6 :

By unscrewing a connecting nut in the closing member, the closing member on the one side and the assembly of the bladder and the pipe connected thereto, are separated from each other.

Step 7 :

In case of replacement of the bladder and the pipe connected thereto, the new bladder and the pipe combination need to be connected to the closing member by tightly screwing again this connection nut.

By means of control, one can assure that the hexagon of the nut fits into the sealing of the closing member.

Step 8 :

(in case of replacement) The new combination of bladder and pipe, connected to the closing member by means of the connecting nut that is tightly screwed, is allowed to come down in the expansion tank.

In this operation, one need to assure that on the one hand the O-ring sealing between the closing member and the expansion tank is placed at its correct position, and remains undamaged.

On the other hand, one needs to assure that the combination of bladder and pipe is accurately placed at the lower end of the tank at the position of, and matching with, the collar of the expansion tank.

Step 9 :

The V-connection or bolt/nut connection is placed again and screwed tightly.

Step 10 :

Finally the air valve is installed again and the bladder is again put up to pressure at the level indicated by the manufacturer.

Hereupon the expansion tank is ready for being used again, and consequently the inlet/outlet openings can be re-opened, and the system of the customer can anew be put in use.

As a further illustration of the dimensions of the expansion tank according to the invention, hereinafter the dimensions (length) of the bladder are set forth, of the expansion tank itself, and the pipe, all of the above for expansion tanks of different volumes :

For 230 Litre : bladder 870 mm, tank 973 mm, pipe 857 mm;

For 300 Litre : bladder 1120 mm, tank 1213 mm, pipe 1097 mm;

For 450 Litre : bladder 1620 mm, tank 1723 mm, pipe 1607 mm.

For an expansion tank of 150 litre a pipe of for instance 1003 mm can be used. This is relatively high, since the diameter of a tank of 150 litre sometimes is chosen less than for instance for a tank of for instance 230 litre.

Figure 6 shows how in a preferred embodiment of an expansion tank according to the invention, the bladder at the lower side of the expansion tank is pressed against the rigid tubular body, and the spacing between the bladder and the inner side of the plastic expansion tank is filled with liquid, in this case water.

The water is pumped inside the tank at its lower end, and the upper part of the bladder remains pressed against the inner side of the expansion tank.

For an expansion tank with a total volume of 150 Litre, and a bladder or air cel that is under an initial pressure of for example 2 bar, water is pressed in the tank with an upper limit of 4 bar. As soon as the compressed pressure gas (usually air) in the bladder or air cel reaches also 4 bar, approximately 50 litre is present in the expansion tank.

According to the preferred embodiment of the bladder as set forth supra, the bladder is designed such that its dimensions slightly exceed the dimensions of the expansion tank.

The unexpected result or advantage hereof is that even in the absence of liquid in the expansion tank (when the tank is completely drained), the bladder is not under any residual strain as all strains are completely amortized by the expansion tank itself. Such a construction surely enhances the life time of the bladder.

The situation whereby all the water is drained from the expansion tank arises in a number of applications quite often.

In Scandinavia – but also in other countries – the water is completely drained in weekend houses. In Scandinavia in view of freezing conditions, in other countries often for hygienic reasons.

During the entire period that the water is completely drained, the bladder presses against the inner side of the expansion tank over the entire surface of the tank. In such a case however, the bladder is not subjected to any tension, in view of its dimensions and form that is designed slightly larger in comparison with the dimensions and form of the corresponding surrounding expansion tank.

Figure 7 shows in cross-section an alternate preferred embodiment of a bladder as installed for use in an expansion tank according to the invention.

This figure clearly shows the total bladder or air cel comprising in its centre the rigid tubular body, in this case a pipe comprising apertures, made in aluminium.

Around this pipe the flexible pouch-like diaphragm or bladder is shown, in this case manufactured in thermoplastic polyurethane (TPU). At the upper and lower end these parts are visible that serve to keep the TPU bladder or pouch around the aluminium pipe.

At the lower end of the combination of the aluminium pipe and the TPU bladder a coupling piece is visible that ends up sharply so as to fit at the lower end of the expansion tank in a collar or fitting, and to keep the pipe and bladder at its position.

At the upper side a connection piece is visible that fits in a cover or closing member to seal the pipe and bladder to the expansion tank in a air-tight manner. This piece also comprises an air valve to blow air into the bladder, and in case of removal of the bladder, to have the air escape therefrom.

Figure 8 shows in cross-section an alternate preferred embodiment of a bladder in dis-assembled state for use in an expansion tank according to the invention.

Various parts are clearly visible in this figure.

At the lower end, as from the pipe/bladder to the expansion tank is shown :

- A bottom screw for connection to the (aluminium) pipe (7);
- A bottom catch plate (5);
- A bottom bolt (17) for connection to the (aluminium) pipe;
- An O-ring (12) for sealing;

At the upper end, as from the pipe/bladder to the cover or closing means :

- An upper screw for connection to the (aluminium) pipe (8);
- An upper catch plate (6);
- An O-ring for air-tight sealing of the bladder;
- An air-bolt (13) that forms the connection between on the one hand the pipe/bladder and the cover/closing means to be positioned on top hereof;
- An O-ring (12);
- The cover or closing member (13) for air-tight sealing of the bladder/pipe with its parts to the expansion tank;
- An air valve (1) to blow air into the bladder and to remove same in case of disassembling;
- A top nut (9).

Claims :

1. Expansion tank comprising a part filled with a compression gas and a part filled with liquid, a flexible pouch like bladder that separates both parts from each other, and a closing member connected to the bladder for an airtight sealing of the bladder to the expansion tank, whereby the bladder comprises a rigid tubular body, connected at at least one end to the bladder and the closing member, characterised in that the expansion tank is made of plastic and after commissioning the pressure gas is inside the bladder and the liquid is in the spacing between the bladder and the inside of the expansion tank.
2. Expansion tank according to claim 1, comprising an opening that is sufficiently large so that the closing member and the bladder and the rigid tubular body connected thereto can be installed in, respectively can be removed from said expansion tank through said opening.
3. Expansion tank according to claim 2, wherein said opening is situated at the upper side of a vertically positioned expansion tank.
4. Expansion tank according to any of the preceding claims, wherein the flexible pouch-like bladder is foldable or compressible and, optionally, that the bladder is made of or comprises an elastic material, more preferably a thermoplastic polyurethane.
5. Expansion tank according to any of the preceding claims, wherein the rigid tubular body is made out of or comprises aluminium or a thermoplastic material , and/or wherein said body comprises apertures.
6. Expansion tank according to any of the preceding claims, wherein the bladder at both ends is connected to the rigid tubular body.
7. Expansion tank according to any of the preceding claims, wherein the bladder is made out of welded pre-cut film materials.
8. Expansion tank according to any of the preceding claims, wherein at the end of the bladder opposite the closing member an adapter is present enabling this end of the bladder to be accurately positioned relative to a collar of the expansion tank matching with such adapter.

9. Expansion tank according to any of the preceding claims, wherein the dimensions and form of the bladder slightly exceed the corresponding dimensions and form of the expansion tank.
10. Use of a flexible pouch-like bladder in an expansion tank according to any of the preceding claims.
11. Method for the replacement of a flexible pouch-like bladder in a plastic expansion tank, comprises the following steps :
    - Shutting-off the water inlet to the expansion tank;
    - Releasing the pressure from the bladder by means of an air valve;
    - Optionally, removal of the air valve from the closing member that connects the bladder to the expansion tank;
    - Disconnecting the closing member to which the bladder is connected;
    - Removal of the closing member to which the bladder and the rigid tubular body are connected from the expansion tank;
    - Disconnecting the closing member from the bladder and the rigid tubular body;
    - Connecting a new bladder and rigid tubular body to the closing member;
    - Re-installing the closing member to which the new bladder and the rigid tubular body are connected in the expansion tank;
    - Connecting the closing member to the expansion tank;
    - Re-installing the air valve, and bringing up to pressure the new bladder;
    - Re-opening the water inlet to the expansion tank.
12. Method according to claim 11, wherein the disconnection, resp. the connection of the closing member of the bladder with the expansion tank is effected by unscrewing, resp. screwing a V-clamp connection or a bolt/nut connection.
13. Method according to claim 11 or 12, wherein the disconnection, resp. the connection of the closing member of the bladder with the rigid tubular body is effected by unscrewing, resp. screwing a nut-connection.

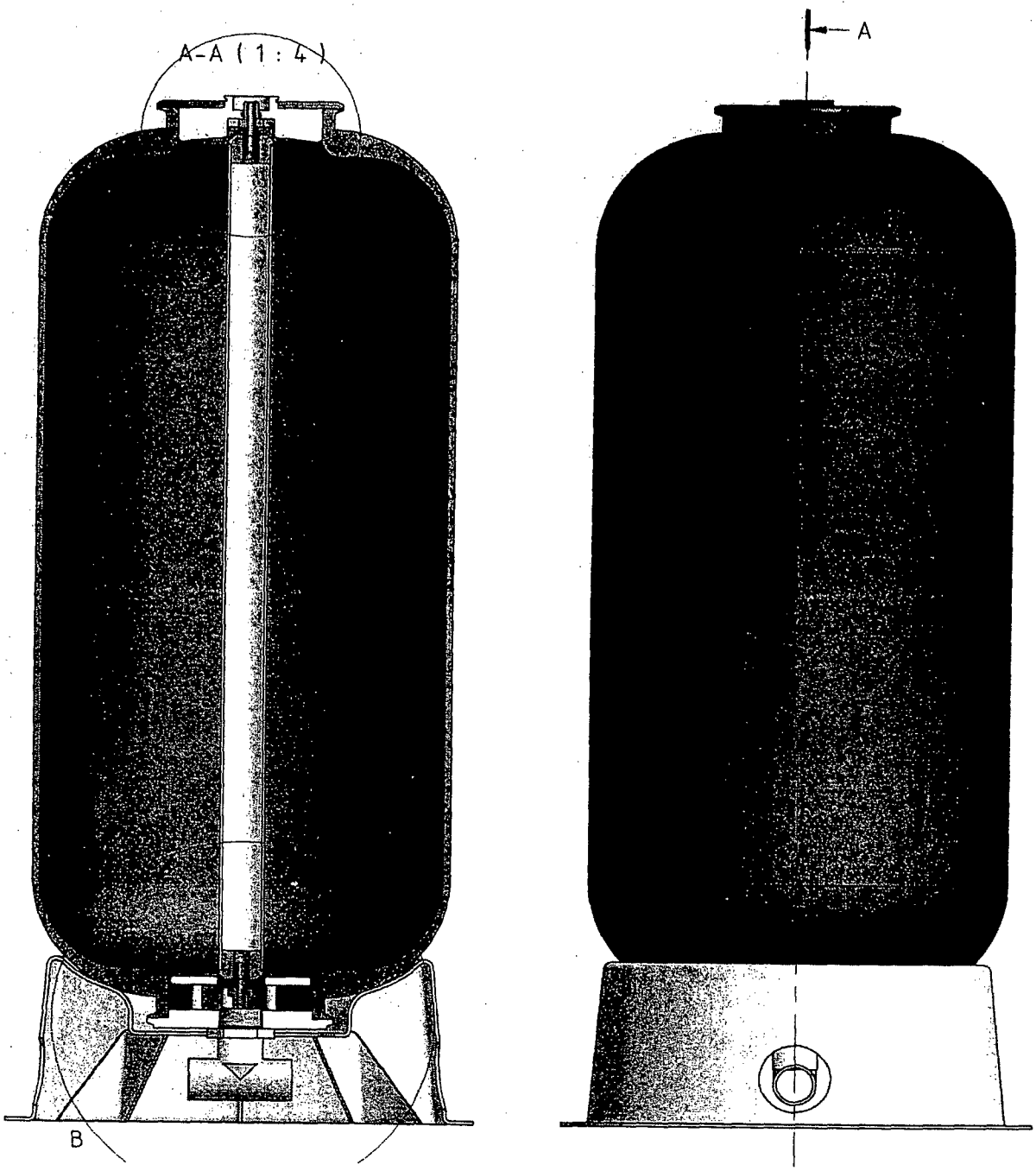


FIG. 1

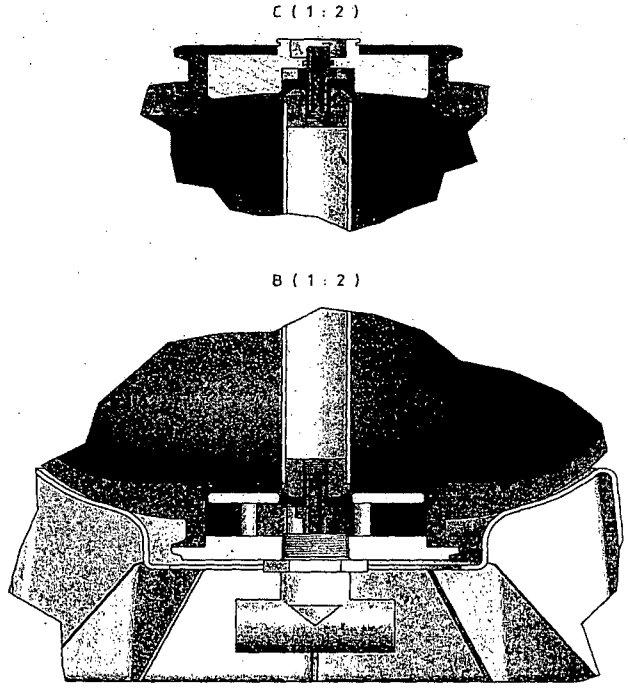


FIG. 2

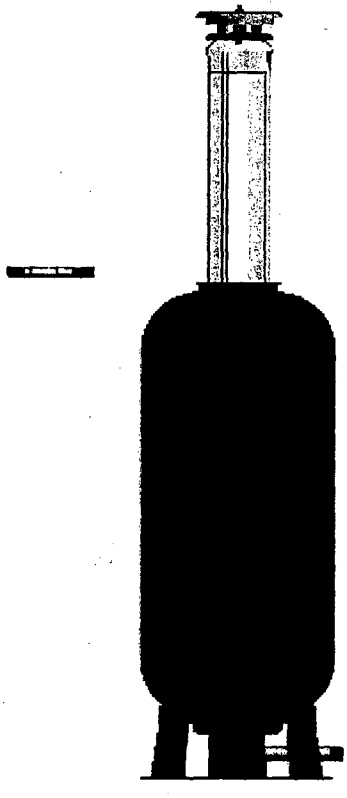
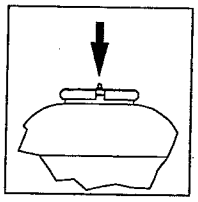
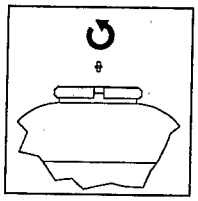


FIG. 3


Stap 2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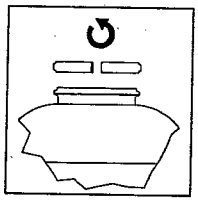
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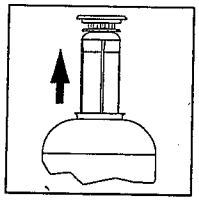
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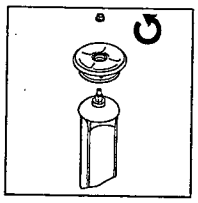
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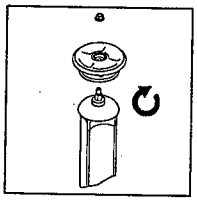
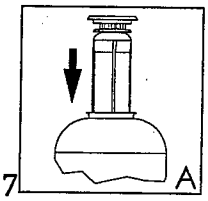
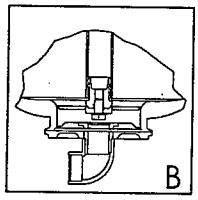

Stap 7



Stap 8



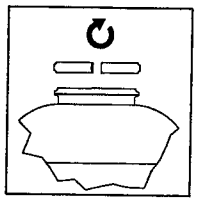

Stap 9

FIG 4

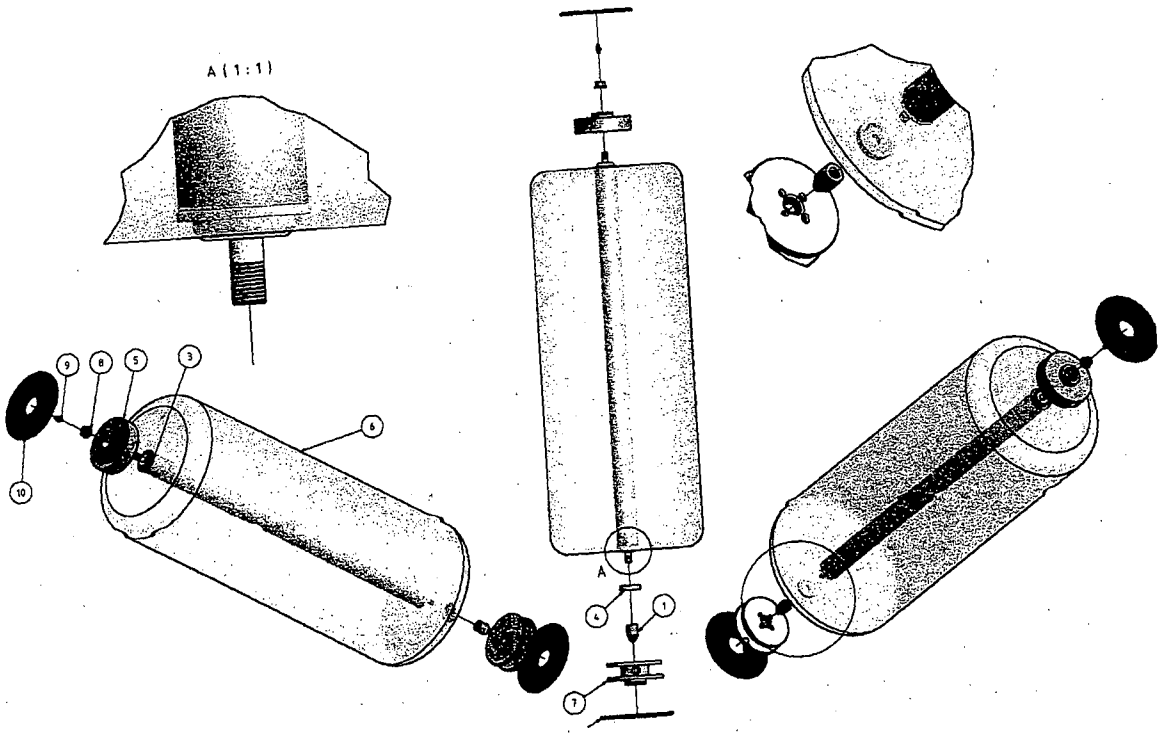


FIG 5

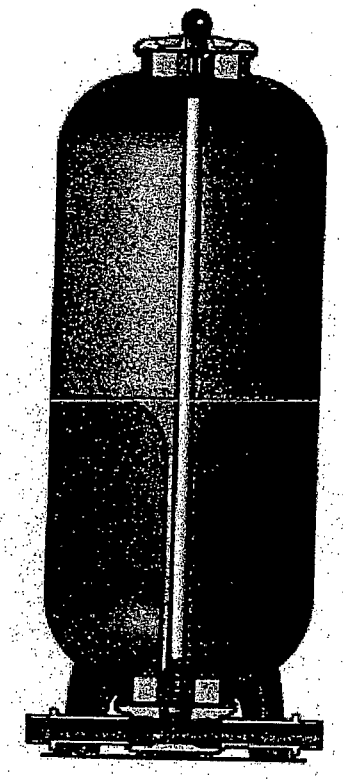


FIG 6

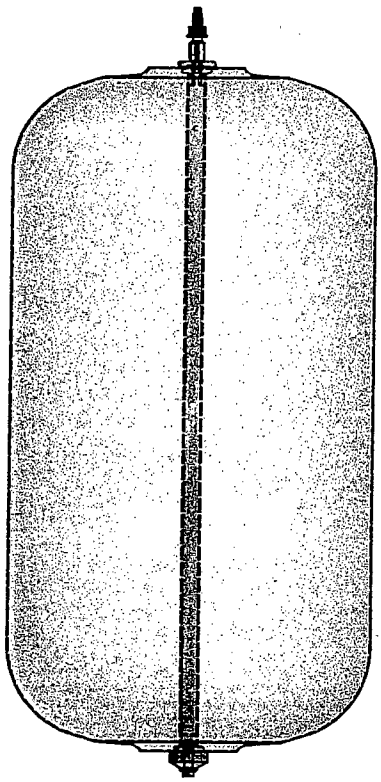


FIG 7

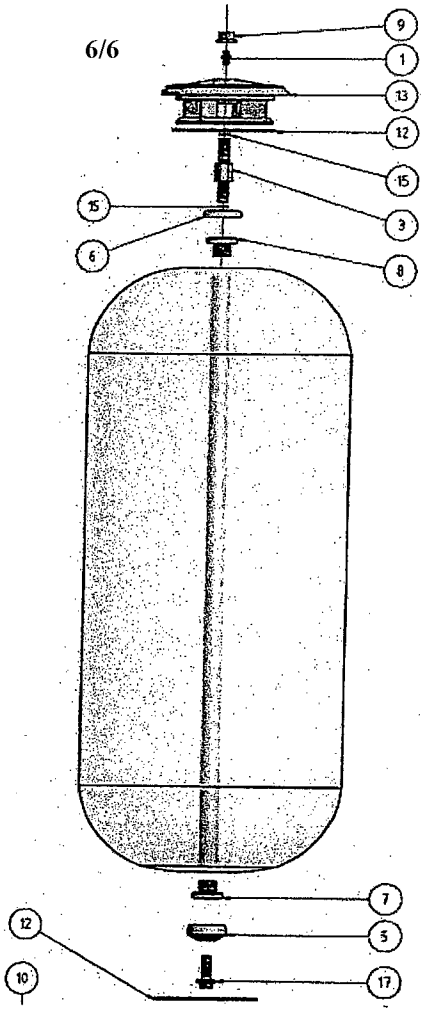


FIG 8