April 4, 1961 A. RILINGER ET AL 2,978,144

SELF-EMPTYING PRESSURE VESSELS

Filed March 15, 1957 2 Sheets-Sheet 1

Fig. 1

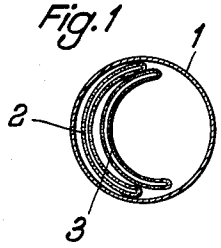


Fig. 2

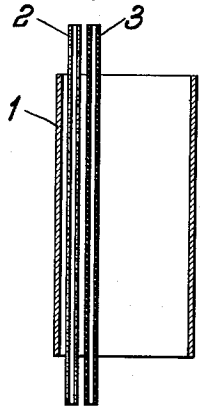


Fig. 3

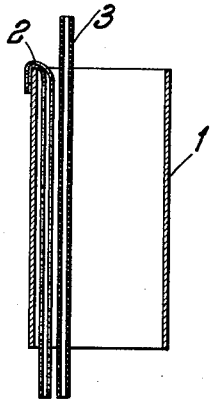


Fig. 4

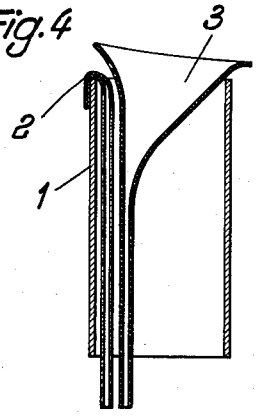


Fig. 5

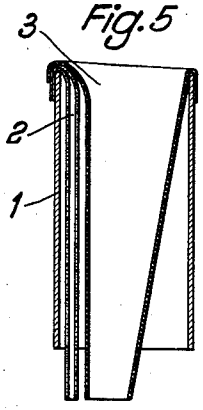


Fig. 6

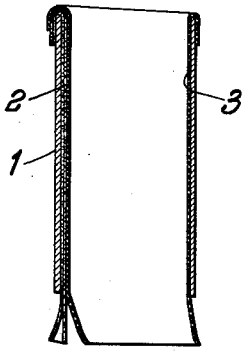


Fig. 7

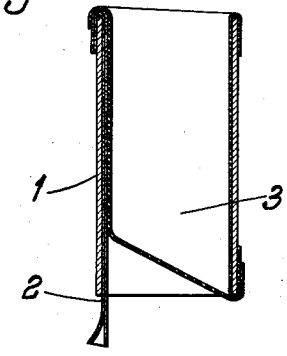


Fig. 8

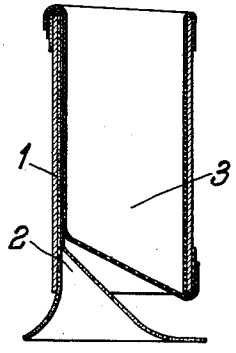
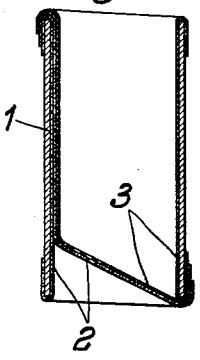


Fig. 9



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SELF-EMPTYING PRESSURE VESSELS

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Fig. 10

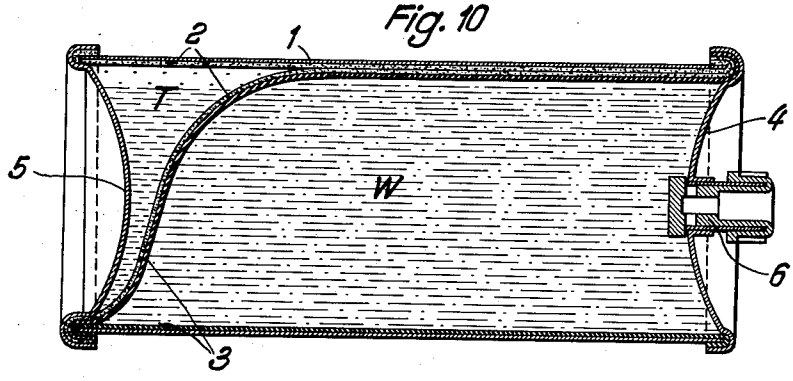


Fig. 11

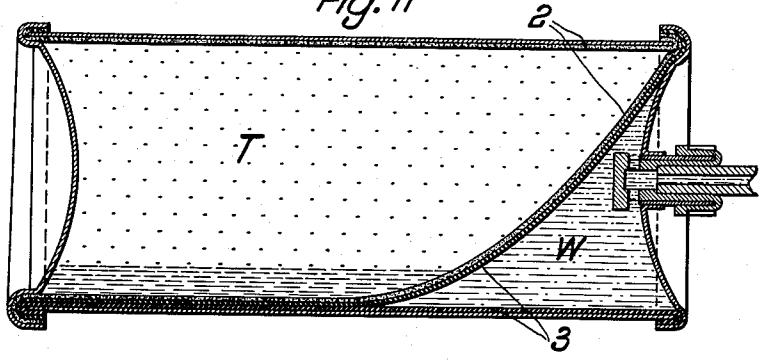
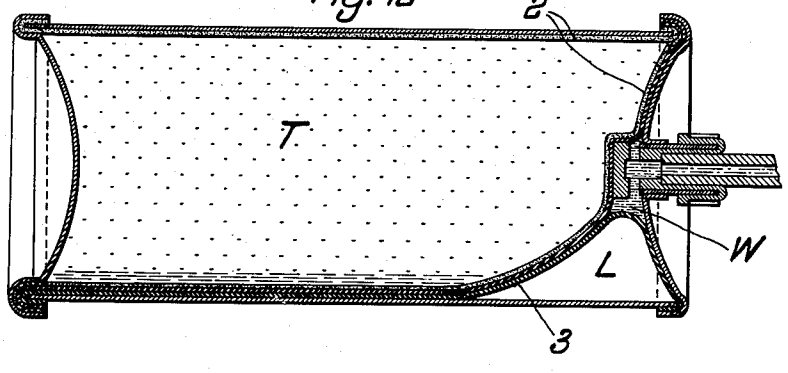


Fig. 12



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SELF-EMPTYING PRESSURE VESSELS

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4 Claims. (Cl. 222—95)

This invention relates to self-emptying pressure vessels.

It is known to use, for a variety of purposes, self-emptying pressure vessels containing liquid or paste-like active substances, wherein the active substances are constantly acted upon by driving media. Hence, when a valve or nozzle on the vessel is opened, the active substance is urged, for instance as a spray, out of the tank without any need for mechanical or manual pressure. The driving or urging medium conventionally takes the form of liquefied gases such as, for instance, chloromethyl, propane, butane, Freon (difluordichloromethane) or the like which evaporate at room temperature of for example 20°–30° C.

For instance, there are vessels known as aerosol regulating vessels wherein a liquid driving medium is mixed with the active substance and expels or entrains it when the vessel closure means are opened. In this case, therefore, a mixture of driving medium and active substance issues from the vessel.

It has also been proposed to ink printing presses by urging the ink, by means of such a driving medium, from the vessel or recipient towards the inking station, the ink having to be mixed with the driving medium as in the case of the aerosol regulating vessels. However, this principle can be applied with advantage only where an ink film of very reduced thickness is required, since only highly fluid ink can be used. The admixed driving liquid helps to produce an ink film of very reduced thickness by flowing in spray form and thereafter volatilizing. On the other hand, this principle cannot be used, for instance, on presses which rotate at high speed and in which thickly viscous ink is applied in relatively large quantities and spread by rubbing. In these cases it has been proposed that the printing ink should be kept separate from the driving liquid in the vessel, for instance, through the agency of a piston surrounded by a sleeve in intimate engagement with the cylinder inner wall. This arrangement has the advantage that, since the driving medium and active substance are separated from one another, any desired active substance can be used in its pure form and with its consistency unimpaired. Also, since the same quantity of driving medium is retained until all the active substance has been removed from the vessel, much less driving medium is needed than with the aerosol principle, which entails a continuous reduction in the quantity of driving medium as it issues with the active substance. A great disadvantage of the piston arrangement is that the vessels must be completely cylindrical and free from all seams or bulges. Piston-type vessels are therefore, costly and complicated, and all the more so since the vessels also serve as dispatch vessels and slight dents or the like are unavoidable. Since dented vessels cannot be used, relatively large losses are incurred.

To obviate this disadvantage, according to another proposal the piston was replaced by a bag of rubber, plastic or other flexible substance, the base of the bag being adapted to move freely and the other and open end thereof being clamped between the end face of the cylindrical vessel and the cover or base. Hence the bag is secured at one end only, bears against the vessel inner wall and is so pushed in at its base that two separate chambers are produced. The reduced volume chamber adjacent the base of the vessel receives the driving medium, while the other and larger-volume chamber near the vessel closure means received the active substance. When the said closure means are removed or opened, the evaporating driving medium acts upon the pushed-over bag base and urges the active substance towards the closure means until the same are reclosed and the density by volume determined by the kind and quantity of driving medium and by the room temperature is reattained.

In itself this process is ideal but it was often found in practice that the active substance issued very sluggishly, if at all, from vessels which were half-full or less. The reason is that, after slight emptying of the vessel, the evolved gas expanded the bag along the vessel inner wall to the vessel closure means and finally squeezed the bag over the exit aperture, thus completely preventing the active substance from issuing from the vessel. Also, the driving gas, which acted upon the bag at constant pressure, could diffuse to some extent, and all the more so since defects in the texture of the flexible bag are not initially perceptible and such defects readily occur, due to decomposition of the substances or disturbances to the structure, when the plastic tubes preferably employed are welded together. As a result, the driving medium mixes with the active substance, which is thus altered and there is a reduction in the quantity of the driving medium. Since this quantity has previously been adapted to the required pressure there is an unexpected pressure drop.

According to the invention, to obviate the disadvantages of the known constructions, in a pressure vessel of the kind specified in which a bag of rubber, plastic or other flexible material is introduced to separate the active substance from the driving liquid, a flexible tube is used having one open end secured to that end of the vessel containing the exit aperture for the active substance, for instance, by clamping between the cover and the preferably cylindrical body, while the other end of the flexible tube is closed by being pressed flat and is secured at the opposite end of the vessel to a side wall thereof, for instance, by clamping between the base and the wall of the vessel, the driving liquid being received in a chamber inside the vessel body at the apex of the flexible tube, the same being formed into a pointed bag.

Preferably, a second flexible tube closed at one end is provided for the driving liquid, the open and closed ends of the second tube being secured to the vessel in the same way, but in inverted relation to the flexible tube containing the active substance, an open chamber being provided near the bottom end of the flexible tube for the active substance inside the vessel, the last-mentioned open chamber serving to receive that part of the second flexible tube which contains the driving liquid.

An embodiment of the invention will be described by way of example with reference to the accompanying drawings in which:

Figures 1 to 9 diagrammatically illustrate how the two flexible tubes are introduced into and secured to the vessel, and

Figures 10 to 12 illustrate a finished vessel and show how operations proceed therein when the closure means have been opened.

Figure 1 is a plan view of the hollow cylindrical body of a liquid vessel 1 without cover and base. As can be seen in Figure 2, which is a sectional view taken through Figure 1, two plastic flexible tubes 2 and 3 laid flat are introduced adjacent one another into the hollow cylinder.

Figures 2 to 9 are diagrammatic views in which, for the sake of simplicity, only the cut edge is apparent.

Initially, the tubes 2 and 3 extend on both sides of the cylindrical vessel 1 beyond the end faces. First, as can be seen in Figure 3, the top end of the tube 2 is closed and bent around the top edge of the vessel wall outwardly, whereafter, as can be seen in Figure 4, the adjacent second tube 3 is opened wide at the top and stretched right around the top end edge of the cylinder 1, so that it acquires the shape shown in Figure 5 with a top circular aperture. That open part of the tube 3 which extends around the top end edge of the cylinder 1 also engages over the top end of the tube 2.

Thereafter, preferably through the agency of a cylindrical former which has an inclined lower part and which is shown hatched in Figure 7, the flexible tube 3, which is intended to receive the active substance in the embodiment illustrated, is pressed against the cylinder inner wall (Figure 6) and urges the tube 2 in the flat state between the said inner wall and the tube 3, the inclined part of the former producing a space for the tube 2 at the bottom to receive the driving medium. The tube 3, which is kept open at the top is closed only at the bottom (just like the tube 2, which is closed at the top) and bent around the outside of the bottom end edge of the vessel wall in order that this tube may be closed and secured by the subsequent fitting of the base (Figure 7).

The free bottom end of the tube 2 is opened wide to form a shallow bag (Figure 8) and stretched around the bottom end edge of the cylinder 1 (Figure 9), just like the tube 3 was stretched around the top end edge; the open part of the tube 2 now surrounds the bottom end edge of the cylinder 1 and also engages over the bottom end of the tube 3. A shallow bag is thus produced for the relatively small quantity of driving media.

After the active substance has been introduced into the chamber formed by the tube 3, a cover 4 (Figure 10) having a closure means or valve or the like is fitted to the cylinder 1 and secured. This step also secures and seals in non-releasable manner the closed end of the tube 2 and the open end of the tube 3. The vessel is then turned the other way round, the driving liquid is charged into the funnel-shaped space of the tube 2 and the base 5 (Figure 10) is fitted and secured in sealing-tight manner to the cylinder 1, so that the closed end of the tube 3 and the open end of the tube 2 are closed tight. After closure, so much of the driving liquid evaporates at room temperature that the predetermined pressure is attained in the vessel, that is, the same has assumed the shape shown in Figure 10.

Figure 10 illustrates the vessel ready for dispatch. It has been charged with active substance W and driving medium T and fitted with a closed closure means 6. When the same is opened, the pressure produced by the evaporating driving medium urges the active substance out of the vessel. Because of the manner in which the flexible tubing is secured, the driving gas is so deflected that the pressure can be applied only from the vessel base, the tube 2 therefore, gradually assumes the shape shown in Figure 11.

The final phase of operation is illustrated in Figure 12. The driving medium has urged the two tubes fast against the vessel inner wall and thus the air is trapped which may be in the vessel but outside the tubing, at one end in the space L. This air assists operation to the extent that the remainder of the active substance is urged out of the vessel.

It has been found in practice that only a small part of the active substance which adhered to the walls of the conventional vessels used heretofore remained in vessels having the flexible tube arrangement according to the invention. This reliable and substantially complete consumption of the active substance is of itself a considerable technical advance, and another advantage is that the use of flexible tubing instead of bags obviates welding seams on the base. As a result, and more particularly where a number of foil layers are provided to separate the driving medium from the active substance, a diffusion of the driving medium into the active substance is substantially obviated.

In a simplified embodiment, the tube 2 can be omitted and merely the tube 3 can be so secured to the base and cover that the expansion of the driving gas from the vessel base towards the exit aperture acts upon the active substance. For instance, to produce this effect the tube is secured in the manner hereinbefore described. It then forms a bag which is wide open at the vessel cover and which extends right around the end edge of the cylinder 1. The flexible tube thus folded in between the cylinder edge and the cover extends along the cylinder inner wall to the base, where it is closed and, while in the closed state, bent aside outwardly and laid around the cylinder end edge. This closed tube end is also non-releasably folded in on the vessel base. If the tube is secured in this way, it cannot place itself before the exit aperture of the vessel or become so kinked that the active substance in the bag is prevented from issuing. The pressure of the driving medium charged into the open chamber on the vessel base will always take effect where both the active substance and also the tube offer least resistance. In the tube securing arrangement according to the invention, when the tube is full the resistance is greatest near the vessel cover, because of the tension of the tube, the resistance decreasing towards the vessel base. This ensures that the substance is urged uniformly out of the vessel without disturbance. Preferably however, in order to reduce possible diffusion of the driving gas as far as possible, at least two flexible tubes will be provided in the vessel in the manner hereinbefore described.

Another considerable advantage of using two tubes is that the active substance issues until the tube is completely empty, because the air which acts at the termination of operations remains separate from the active substance and from the driving medium and is urged towards the cover to urge out the remaining active substance. If only one flexible tube is used, the air is disposed in the driving gas chamber and cannot assist operations, so that there is bound to be a residue of active substance.

The pressure vessel can of course be constructed in other ways. For instance, other means could be provided for securing the tubes to the vessels. For instance, instead of stretching the tubing around the outside of the cover edge, an internally fitted ring could be used. The tubes might be produced with one end closed or with a special extension for clamping to the vessel.

The pressure vessel need not of course be cylindrical but is with advantage cylindrical or oval to ensure that space is used efficiently, in which case the cylindrical base surface must form a circle, ellipse or other closed curve.

We claim:

1. A self-emptying pressure vessel for active substances, comprising a body, a cover provided with an exit aperture for the active substance, a base, the cover and the base being rigidly secured to said body at its upper and lower end respectively, a flexible tube adapted to receive the active substance, said tube having been widened as much as possible to adapt it to the inner diameter of the vessel and having one open end secured to that end of the vessel containing the exit aperture, the other end of the flexible tube being closed by being pressed flat in such a way that the one side thereof has a somewhat greater length than the opposite side and is secured at the opposite end of the body to the lower edge thereof, and a chamber provided inside the vessel body at the outside of the closed end of the flexible tube, and adapted to receive a driving liquid which evaporates at temperatures of 20–30° C.

2. A self-emptying pressure vessel for active substances, comprising a body, a cover provided with an exit aperture for the active substance, a base, the cover

and the base being rigidly secured to said body at its upper and lower end respectively, a flexible tube adapted to receive the active substance, said tube having been widened as much as possible to adapt it to the inner diameter of the vessel and having one open end secured to that end of the vessel containing the exit aperture, the other end of the flexible tube being closed by being pressed flat in such a way that the one side thereof has a somewhat greater length than the opposite side and is secured at the opposite end of the body to the lower edge thereof, and a second flexible tube having an open end and being closed at the other end and provided for the driving liquid which evaporates at temperatures of 20–30° C., the open and closed ends of the second tube being secured to the vessel in inverted relation to the flexible tube containing the active substance so as to provide an open chamber near the bottom end of the flexible tube for the active substance inside the vessel, and the last-mentioned open chamber serving to receive that part of the second flexible tube which contains the driving liquid.

3. A pressure vessel according to claim 2, wherein both the closed ends of the flexible tubes and the open ends are secured to opposite end edges of the vessel body

by being provided around or pushed over such edges and clamped between the said edges of the vessel body and the cover and the base respectively.

4. A pressure vessel according to claim 2, wherein the open end of one tube is pushed over the closed end of the other tube which is laid around the outside of the end edge of the vessel body, and is retained in position by bent over edges of the cover or the base and clamped between the said edges of the vessel body and the cover and the base respectively said tube ends also sealing the vessel in the regions where they are secured.

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