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FIRE EXTINGUISHER AND CONTAINER FOR FIRE
EXTINGUISHING LIQUIDS AND OTHER FLUIDS

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INVENTOR

[Diagram of fire extinguisher and container for fire extinguishing liquids and other fluids]
This invention relates to fire extinguishers and containers for fire extinguishing liquids and other fluids and has for an object to provide a simple reliable fire extinguisher containing a fire extinguishing liquid which is maintained always under pressure, so that it may be projected upon a fire by the mere opening of a valve.

In accordance with the invention, a body of fire extinguishing liquid, which is preferably carbon tetrachloride, or a liquid containing carbon tetrachloride, is contained in a closed receptacle having resilient walls which by their inherent resiliency retain the liquid constantly under pressure.

An important feature of the invention consists in providing the container with opposite resilient walls which are pressed together by their inherent resiliency when the container is empty, and which are so formed that one of them is continuously expanded when moved from its normal form to the form which it has when the container is filled, while the other is continuously contracted when moved from its normal form to the form which it has when the container is filled. As the result of so constructing the container the tendency of each of the walls to resume its normal size adds to and increases the tendency of each wall to reassume its normal form. Consequently, a body of fluid forced into the container between its walls is maintained under a strong pressure by the inherent resiliency of the walls which tends to cause each of them to reassume its normal size and form, and pressure is maintained throughout the discharge of the fluid from the container.

While the container is an important element in the new fire extinguisher, it may be used, also, for many other purposes.

In order that the invention may clearly be understood, I will describe in detail the embodiments of it which are illustrated in the accompanying drawings, in which

Figs. 1, 2 and 3 are diagrammatic views illustrating the construction of a form of extinguisher embodying the invention, Fig. 1 being a plan view, and Figs. 2 and 3 being sectional views taken on the plane A—B of Fig. 1, and illustrating, respectively, the making and the filling of the container;

Figs. 4, 5, 6, 7, 8 and 9 are detailed views of another embodiment of the invention, Figs. 4, 5 and 6 being, respectively, sectional views taken upon the plane D—E of Fig. 7 and illustrating, respectively, successive stages in the making of the extinguisher, and Fig. 7 being a top view and Fig. 8 a side view of the extinguisher, and Fig. 9 a fragmentary sectional view upon a larger scale showing the construction of the valve; and

Figs. 10 and 11 show an extinguisher embodying the invention arranged for automatic operation, Fig. 10 being a side view of the extinguisher, and Fig. 11 a fragmentary sectional view upon a larger scale, showing the construction of the valve.

The container is formed from two plates 10, 20, one of which, 10, is shown in the plan view, Fig. 1. The other plate 20 is similar to the plate 10 in configuration, and differs from it only in normal curvature as herein-after explained. The material of which the plates are made is flexible so that it may be bent, and resilient so that when bent it tends to return to its normal form. Each plate is also extensible and contractable along lines radiating from its central portion. The directions in which the plates are extensible and contractable are indicated by the dotted lines C in Fig. 1. The plates may be constructed of material which is extensible, contractable and elastic, as well as flexible and resilient, or they may be made of flexible and resilient sheet material which is substantially inextensible and uncontractable.

In the latter case, each plate is made extensible and contractable along the lines C by forming corrugations in it. It should be understood that in referring to the form of the plates or the surface in which the plates lie, reference is made to the median surface of the corrugations, in case the plates are corrugated.

The normal form of the plates is indicated by the dotted lines 10", 20", Fig. 2. It will be noted that the plate 10, hereinafter called the inner plate, is normally more deeply curved than the plate 20, which is referred to as the outer plate. The plate 10 may be given any desired normal curvature, while the plate 20 may be given any normal curvature less than that of the plate 10 including a curvature of infinite radius, that is to say, a substantially flat form.

In making the container, the plates 10 and 20 are placed together with the convex surface of the plate 10 and the concave surface
of the plate 20 inward, that is, in the position indicated by the dotted lines 10\textsuperscript{th}, 20\textsuperscript{th}, in Fig. 2. It will be understood that in case the plate 20 is normally flat, either side of it may be placed inward. Sufficient external pressure is then applied to each of the plates, by means of a press, to overcome the inherent resiliency of the plates and force their inner surfaces into contact with each other.

While the plates are held together by external pressure they are joined together about their peripheries. The external pressure is then released and the plates have the form illustrated in full lines 10, 20, Figs. 2 and 3. In this position the portions of the plates within their peripheries are compressed together by the resiliency of the plates which gives each of them a tendency to resume its normal form indicated in dotted lines 10\textsuperscript{th}, 20\textsuperscript{th}, Fig. 2. The two plates will in consequence contact with each other in a surface which is less curved than the normal form 10\textsuperscript{th} of the inner plate and more curved than the normal form 20\textsuperscript{th} of the outer plate. It should be noted that in making the inner plate 10 less deeply curved than its normal form, the plate has been forced to contract so that it is smaller than its normal form and in the same way in making the outer plate 20 more curved than in its normal form this plate has been forced to expand so as to be larger than when in its normal form. The tendency of each plate to reassume its normal size assists the tendency of each plate to reassume its normal form, and the additive effect of these two tendencies maintains the liquid in the container under heavy pressure throughout the emptying of the container.

The embodiment of the invention illustrated in detail in Figs. 4 to 9 is one specific example of the general form which has been described in connection with Figs. 1 to 3. In the form shown in Figs. 4 to 9, the two plates 10, 20, from which the container is made, consist of flexible and resilient sheet material which is substantially inextensible and uncontractable. The most desirable material for the purpose is spring steel. Each plate is made extensible and contractable along lines radiating from its central portion by the provision of concentric corrugations 1, 21. The size of these corrugations is exaggerated in Figs. 4 to 8 for the sake of clearness. The corrugations 11, 21 are made to correspond in form so that they fit together when the plates are brought into contact with each other in the manner hereinafter described. The outermost of the corrugations 11 of the plate 10 is spaced inwardly from the edge of the plate so as to leave an uncorrugated peripheral flange 12. The plate 20 has a similar peripheral flange 22.

The normal form of the two plates is illustrated in Fig. 4. It will be noted that in this embodiment the normally more deeply curved inner plate 10 is normally substantially spherically curved, while the normally less deeply curved outer plate 20 has a normal curvature of infinite radius, that is to say, it is normally flat. After the plates have been given the form illustrated in Fig. 4, they are tempered so that they each have a high degree of resiliency which tends to make each of them reassume its normal form. The resiliency of the corrugated portions of the plates tends also to cause each plate to reassume its normal size. It is unnecessary to make the portions of the plates forming the peripheral flange 11 and 21 resilient and the tempering is most desirably effected in such manner as to leave these flanges comparatively soft.

Before the plates are secured together, and, if desired, before the tempering is effected, a valve 30 is inserted in one of the plates.

While it should be understood that the invention is by no means limited to the use of any particular type of valve or to the insertion of the valve in any particular part of either plate, the valve illustrated in the drawings and the method of inserting this valve will be described for the purpose of illustration. As best seen in Fig. 9, the valve 30 has an outer or body portion 31 which is provided with a central bore, the
inner portion of which forms a conical valve seat 32, while the outer portion 33 is threaded. The inner member 34 of the valve includes a hollow outer stem portion 35 and a solid inner portion 36 which has a conical valve surface corresponding to the conical valve seat 32. The inner portion of the valve stem 35 is externally threaded and screwed into the threaded portion 33 of the bore of the body 31. Lateral openings 37 are provided near the inner end of the valve stem 34. The bore in the valve stem is formed to provide a nozzle 38 at its outer end. The outer surface of the outer end of the valve stem 35 is most desirably provided with an external screw thread 39, this thread being formed in the opposite direction from the thread at the inner end of the valve stem. A handle 40 is applied to the valve stem between its two threaded portions.

In order to provide for the insertion of a valve of the type illustrated, one of the plates, for example, the plate 10', is provided at its center with a hole 13, and the portion of the plate surrounding the hole 13 is pressed outwardly to form a boss 14 as illustrated in Fig. 4. The hole 13 and the boss 14 may conveniently be formed at the time that the plate 10' is given its normal form.

After the valve 30, with the exception of the handle 40, which is applied later, has been assembled, by screwing the inner portion 34 into the valve body from the bottom, the valve is inserted in the hole 13. The inner portion of the valve body 31 substantially fills the space provided inside the boss 14 and fits closely against the inner surface of the boss. The valve body is then secured to the boss by brazing, or in other known manner.

After the valve has been secured in position, the plates 10', 20', are placed together with the convex side of the normally more deeply curved plate 10' inward. As the plate 20' is in this instance flat, either side of it may be regarded as its concave side and turned inward. It should, however, be turned in such manner that its corrugations 11 of the plate 10' when the two are forced together. The relative position in which the plates should be placed is illustrated in Fig. 4. The plates are then forced together by a press applying sufficient pressure to overcome the inherent resiliency of the plates. This pressing is done while the plates are cold. While the plates are held together by the pressure applied by the press, the peripheral corrugations 11, 21 are secured together. This may be accomplished by turning the flanges over and crimping them together so that they are given the form illustrated in Figs. 5 and 6. Or, if desired, the flanges may be secured together by electric welding, or in other known manner. After the flanges have been secured together, the force of the press is released, and the container has the form shown in Fig. 5.

It should be noted that when in this condition portions of the plates within their peripheries are constantly pressed together by the resiliency of the plates which gives each of them a tendency to reassume its original form and its original size. As the resiliency of the two plates is substantially equal the resultant effect is to retain the plates in contact with each other in a curved surface about halfway between the original or normal forms of the two plates.

The container thus constructed is in condition to be filled. Before this is done, however, the handle 40 should be applied to the valve stem 35. The filling is effected by connecting the valve stem 35 with a supply of liquid under pressure and opening the valve 30 by screwing the valve stem inwardly in the valve body 31. The liquid may be supplied through a pipe having an internal thread on its outer end and the thread 39 of the valve stem may be screwed into this pipe by turning the handle 40 which at the same time screws the valve stem inwardly in the valve body opening the valve. The liquid under pressure passes through the bore of the valve stem 35, through the lateral openings 37, between the seat 32 and the conical portion 36, and enters between the plates 10', 20'. When the desired quantity of liquid has been introduced, the supply of liquid is shut off and the valve stem 35 is screwed outwardly closing the valve and disconnecting the valve stem from the liquid supply pipe.

In order to secure the most efficient operation of the container the supply of liquid should be cut off when the container has been swelled to the form illustrated in Figs. 6 and 8. When the container is filled to this extent the normally curved plate 10' has been forced into a substantially flat position while the normally flat plate 20' has been forced into a curved position. It should be noted that throughout the bending of the plate 10' from its normal position shown in Fig. 4 to its filled position shown in Fig. 6, including both the bending which is necessary to bring the peripheries of the plates together in forming the container and the bending which occurs in filling the container, the plate 10' is continuously contracted so that its corrugations 11 become continuously narrower during the bending. The tendency of the corrugations 11 to expand and reassume their normal size, therefore, aids the tendency of the plate 10' to reassume its normal form illustrated in Fig. 4. In the same way throughout the bending of the plate 20', including both the stages of making the container and filling the container, the plate 20' is continuously stretched causing its cor-
rulations 21 to become continuously wider. The tendency of the corrugations 21 to contract and reassemble their normal size thus aids the tendency of the plate 20' to reassemble its normal form illustrated in Fig. 4. It is thus apparent that the tendency of the corrugations of each plate to reassemble their normal size adds to and increases the tendency of each plate to reassemble its normal form. The additive effect of the two tendencies results in maintaining the liquid in the container under a high pressure, and pressure is continued throughout the discharge of the liquid when the valve 30 is opened.

To use the extinguisher which has been described it is merely necessary to turn the handle 40 so as to open the valve 30, and direct the nozzle 44 towards the fire. The extinguisher is dependable and remains ready for use over long periods.

If desired, the extinguisher may be made to operate automatically. An arrangement for this purpose which in itself constitutes a part of my invention is illustrated in Figs. 10 and 11. The extinguisher illustrated in these figures is similar to that shown in Figs. 4 to 9. It is secured with its plate 10' against a ceiling by means of hooks 41. The valve 30' is in general similar to the valve 30 shown in Fig. 9. The valve stem 35' of the valve 30', however, differs somewhat from the valve stem 35 of the valve 30. The bore of the valve stem 35' is of uniform cross-section. The outer surface of the valve stem 35' is continuously threaded and contains two flattened portions 40', 40' formed for the engagement of a detachable handle which may have the form of an ordinary spanner.

The filling of the extinguisher shown in Figs. 10 and 11 is effected in the same manner as the filling of the extinguisher shown in Figs. 4 to 9 except that the pipe through which the liquid under pressure is supplied is, in this instance, provided with a rotatable coupling member. After the extinguisher has been filled, the valve 30' is closed by screwing the valve stem 35' outwards in the body 31' by means of a spanner applied to the flattened portion 40'. A cap 42 is then applied to the valve stem. The cap 42 contains a bore, the inner portion 43 of which is threadable while the outer portion of the bore forms a nozzle 44. Between the nozzle 44 and the threaded portion 43 is an inwardly tapering portion 45 in which is a plug 46 of fusible metal. The cap 42 is applied to the valve stem 35' after the valve stem has been screwed outwards to close the valve. A packing ring 47 is first placed on the valve stem and the cap 42 is then screwed upon the valve stem while the stem is retained against rotation by a spanner applied to the flattened portion 40'. In this way the fusible plug 46 is brought tightly against the end of the valve stem. The spanner is then removed from the flattened portion 40' and the valve stem 35' is screwed inwards in the body 31' by means of a wrench applied to the cap 42. The turning is continued until the packing ring 47 is clamped between the inner end of the cap 42 and the outer end of the body 31' of the valve, leaving the parts in the position shown in Fig. 11. The liquid under pressure in the container is thus brought directly against the fusible plug 46. Consequently, when the temperature of the room in which the extinguisher is placed rises sufficiently to melt the plug 46 the liquid is forcibly projected downward through the nozzle 44. A few of the extinguishers of the type shown in Figs. 10 and 11 secured to the ceiling of a room containing valuable merchandise will give a fire protection equivalent to that provided by the automatic sprinkler systems now in use, while the cost of the extinguishers is insignificant compared with the cost of installing the usual form of automatic sprinkler system.

While I believe that the most valuable advantages of the invention are secured in embodying it in fire extinguishers such as have been described, it should be understood that a container constructed in accordance with the invention is susceptible of many other uses.

I wish it clearly understood that the invention is by no means limited to the specific embodiments of it which have been illustrated and described. Thus, it is not essential that peripheries of the two plates be circular although it is advantageous to have the periphery of each plate form a continuous unbroken curve. Furthermore, it is not essential that one of the plates be normally flat or that one of the plates be formed into a substantially flat form when the container is filled. I shall not, however, endeavor to set out all the modifications which may be made in the embodiments described without departing from my invention.

I claim as my invention:

1. A fire extinguisher, comprising a closed container having opposite walls of stiff resilient material, each of said walls being extensible and contractable and one of said walls having a normal inward curvature, and a body of fire extinguishing liquid in said container serving to hold said inwardly curved wall in a form less curved than its normal form and to hold the opposite wall in a form more curved than its normal form and retained under pressure by the resiliency of said walls.

2. An article of manufacture, comprising the combination of a container consisting of two plates of stiff resilient material secured together about their peripheries, both of said plates being contractable and extensible
and one of said plates being normally more deeply curved than the other and having its normally convex surface inward, and a body of fluid in said container serving to hold said plate in a form less curved than its normal form and to hold the other plate in a form more curved than its normal form.

3. An article of manufacture, comprising the combination of a container consisting of two plates of resilient sheet material, both of said plates being extensible and contractable along lines radiating from their central portions and one of said plates being normally more deeply curved than the other and having its normally convex side inward, and a body of fluid in said container serving to hold said plate in substantially flat form and serving to hold the other plate in a form more curved than its normal form.

4. An article of manufacture, comprising the combination of a container consisting of two plates secured together about their peripheries, each of said plates being extensible and contractable along lines radiating from its central portion, one of said plates being normally flat and the other of said plates being normally curved and having its normally convex side inward, and a body of fluid in said container serving to hold said normally flat plate in outwardly curved form and to hold said normally curved plate in a form less curved than its normal form.

5. An article of manufacture, comprising the combination of a container consisting of two plates secured together about their peripheries, each of said plates being extensible and contractable along lines radiating from its central portion, one of said plates being normally flat and the other of said plates being normally curved and having its normally convex side inward, and a body of fluid in said container serving to hold said normally flat plate in outwardly curved form and to hold said normally curved plate in substantially flat form.

6. A container formed from two plates of resilient stiff sheet material corrugated so as to be extensible and contractable along lines radiating from their central portions, said plates being secured together about their peripheries and being so formed that one of them is continuously contracted when moved from its normal position to the position which it occupies when the container is filled, while the other is continuously extended when moved from its normal position to the position which it occupies when the container is filled.

7. A container comprising two extensible and contractable plates of resilient sheet material secured together about their peripheries and contacting with each other in a curved surface when the container is empty, the inner plate having a normal curvature greater than that of said surface of contact, and the outer plate having a normal form less curved than said surface of contact.

8. A container formed of two extensible and contractable plates of resilient sheet material, one of which is normally more deeply curved than the other, said plates being secured together about their peripheries with the convex side of the normally more deeply curved plate and the concave side of the normally less deeply curved plate inward.

9. A container constructed in accordance with claim 7 in which the normally less deeply curved plate has a normal curvature of infinite radius so that it is normally flat.

10. A container formed of two concentrically corrugated spring metal plates, one of which is normally more deeply curved than the other, said plates being secured together about their peripheries with the convex side of the normally more deeply curved plate and the concave side of the normally less deeply curved plate inward.

11. A container formed of two concentrically corrugated spring metal plates, one of which is normally curved and the other of which is normally substantially flat, said plates being secured together about their peripheries with the convex side of the normally curved plate inward.

In testimony whereof I have hereunto set my hand.

ROBERT W. BYERLY.