

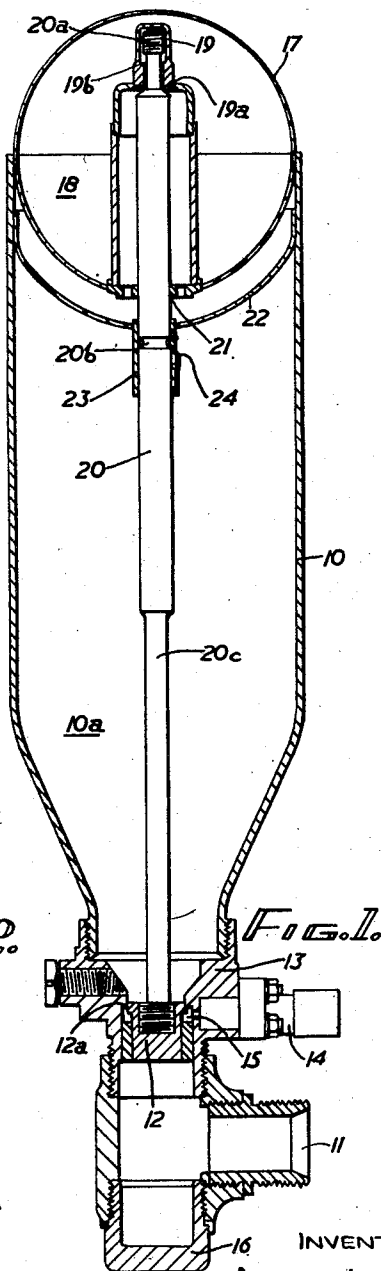
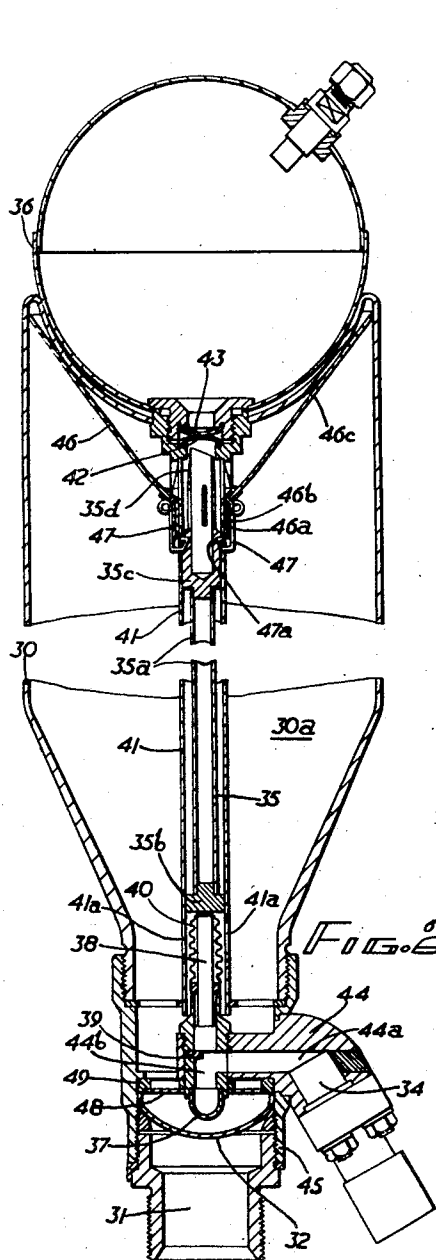
June 11, 1957

A. MATHISEN
FLUID CONTAINERS

2,795,282

Filed Aug. 24, 1955

2 Sheets-Sheet 1



INVENTOR
ANDERS MATHISEN
BY *John M. Napp*
ATTORNEY

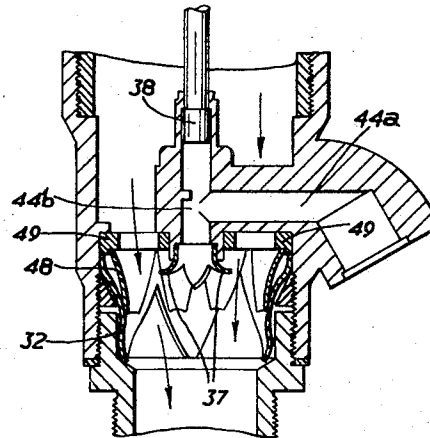
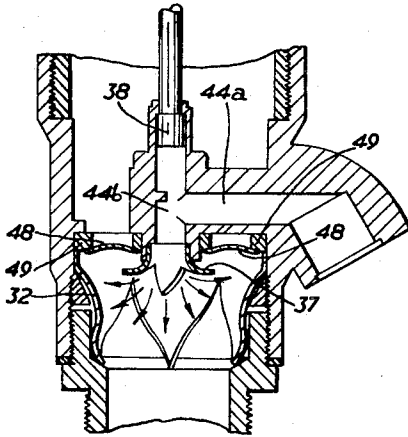
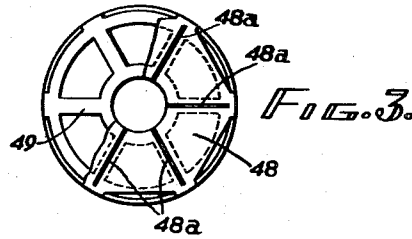
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2 Sheets-Sheet 2



INVENTOR

ANDERS MATHISEN

BY

John H. Mason
ATTORNEY

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FLUID CONTAINERS

Anders Mathisen, London, England, assignor of one-half to Grovner Manufacturing Company Limited, and one-half to Wilkinson Sword Limited, London, England, both British companies

Application August 24, 1955, Serial No. 530,226

Claims priority, application Great Britain
September 3, 1954

13 Claims. (Cl. 169-9)

This application is in part a continuation of my prior application Serial No. 456,719, filed September 17, 1954.

This invention relates to fluid containers, and particularly, though not exclusively, relates to devices for containing liquids adapted to extinguish fires or suppress explosions, the devices being of the kind in which a pressurised gas is used to effect ejection of the liquid.

According to the present invention there is provided a liquid container of the kind in which a pressurised gas is used to effect ejection of the liquid through a normally-sealed discharge outlet, comprising electrically operated means for unsealing said outlet, means for retaining the pressurised gas out of contact with the liquid prior to the time when discharge is required, and means operated substantially simultaneously with said orifice unsealing means for allowing the pressurised gas to act upon the liquid to effect discharge.

The invention also provides a liquid container of the kind in which a pressurised gas is used to effect ejection of the liquid, comprising a reservoir for the liquid having a sealed discharge outlet, a reservoir for the gas, a normally-sealed interconnection being provided between said gas reservoir and said liquid reservoir, electrically operated means for unsealing said discharge outlet and further means for substantially simultaneously unsealing said interconnection whereby said pressurised gas is freed to effect ejection of liquid in said liquid reservoir through said discharge outlet.

There is further provided in accordance with the invention a liquid container comprising a liquid reservoir, a discharge outlet from said reservoir, frangible means sealing said discharge outlet, an electrically ignitable explosive charge for fracturing said frangible means to unseal said discharge outlet, a reservoir for pressurised gas used to effect ejection of liquid from said reservoir through said discharge outlet, an outlet for gas from said gas reservoir through which gas can pass into said liquid reservoir, further frangible means sealing the outlet from the gas reservoir, said further frangible means being fractured upon ignition of said explosive charge, and a piston movable within said liquid reservoir, the arrangement being such that when the gas reservoir outlet is unsealed by ignition of said explosive charge the pressurised gas acts on one side of the piston whose other side is in contact with the liquid to move the piston along the reservoir and thereby eject liquid through the liquid discharge outlet.

Two constructions of fluid containers in accordance with the present invention and designed to contain extinguishing liquid will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a sectional side elevation of the first construction;

Figure 2 is a similar view of the second construction, whilst

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Figure 3 is a detail view of the discharge end of the construction shown in Figure 2, and

Figures 4 and 5 are two views of the discharge end of the Figure 2 construction illustrating operation of the container.

Referring now to Figure 1, this shows an extinguisher 10 having a liquid reservoir 10a and a discharge orifice 11 which is normally sealed by a stopper member 12 formed integrally with the extinguisher head 13, the stopper member 12 being connected thereto by a thin frangible web 12a. A removable electrically-fired explosive charge 14 is secured in the head 13 and the explosive force resulting from ignition of the charge 14 enters the space 15 and acts upon the stopper member 12 urging it downwards towards the discharge orifice 11 and severing the frangible web 12a. The stopper member 12 is driven into the cup portion 16 below the discharge orifice 11 thereby allowing a free discharge of fluid through the neck of the extinguisher and out through the discharge orifice 11. The discharge orifice end of the extinguisher as thus described is similar to earlier constructions of the applicant's but the other end of the bottle is entirely different and is modified to provide a closed spherical reservoir 17 for the pressurised gas. A central aperture is provided in the side of the gas reservoir 17 which faces into the interior of the reservoir 10a, and in this aperture is sealed a tube 18 which extends into the gas reservoir 17 and is coaxial with the longitudinal axis of the extinguisher 10. The end of the tube 18 which lies within the reservoir 17 is closed by a sealing member 19 which includes a thin frangible web 19a and which is provided with a re-entrant shoulder 19b. The stopper member 12 is united to one end of a tie rod 20 which extends through the extinguisher and through the tube 18 and has its other end 20a lying within the reservoir sealing member 19 and trapped behind the re-entrant shoulder 19b. An apertured annular member 21 is secured in the tube 18 adjacent the wall of the gas reservoir 17 and forms a guide for the tie rod 20. A cup-shaped sheet metal piston 22, which may be of beryllium copper, is formed with a thin skirt split at numerous points around the circumference to permit flexible engagement of the skirt with the interior of the side wall of the extinguisher. The piston 22 is formed with a central aperture in which a guide tube 23 is secured, the guide tube 23 being a sliding fit on the tie rod 20. The piston 22 is normally positioned adjacent the gas reservoir 17 with its concave surface facing the reservoir 17, and may be positively located in this position by a simple spring catch 24 provided on the piston guide tube 23 and engaging a locating groove 20b on the tie rod 20.

By this construction the pressurising gas and the liquid suppressant are kept separate until the explosive charge 14 is fired to sever the stopper member 12 sealing the discharge orifice. The only added restraint to initial movement of the stopper member 12 is due to the inertia of the tie rod 20, as the construction is such that the trapped end 20a of the tie rod 20 is free to move for a short distance before coming into engagement with the re-entrant shoulder 19b. However, this engagement occurs after a short movement of the stopper member 12, and further movement of the tie rod 20 fractures the frangible web 19a of the reservoir sealing member 19. The pressurising gas is thus freed to act upon the piston 22 and thereby force the suppressant out of the extinguisher through the orifice 11. The piston 22 serves to maintain the separation between the gas and liquid and will move down the extinguisher as the suppressant is ejected, the piston 22 being guided in its passage by engagement of the piston guide tube 23 with the tie rod 20. As the piston 22 nears the end of its travel the

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piston guide tube 23 reaches a portion of the tie rod 20c which is of reduced cross-section, and the gas can then by-pass the piston 22 and maintain the discharge of the suppressant not only until the extinguisher is empty but also through any pipe line which may be connected to the discharge orifice 11.

A similar construction is also possible where the extinguisher has dual discharge orifices which commence together at the neck of the bottle and are inclined outwardly to one another. It is not readily possible to provide a rigid connection between both stopper member and the tie rod, in view of the fact that with outward movement of the stopper member they move further apart from one another. However, this difficulty can be overcome by arranging that the connection between the bottom of the tie rod and each stopper member is a flexible one or is a linkage which is automatically disconnected, after the orifice sealing the gas reservoir has been opened, as a result of further outward movement of the stopper member.

With the majority of existing extinguishers used in aircraft, the positions in which the extinguisher can be mounted are very limited due to the fact that in other positions it is possible for the pressurising gas to escape before some or all of the liquid suppressant, with the result that the latter is not ejected. Thus, in general in order to ensure effective discharge it is necessary for the discharge orifice to be lowermost at the time of discharge. However, even if any extinguisher is mounted so that its discharge opening is lowermost when the aircraft is in its normal flight or ground attitude, the orientation of the aircraft as the result of a crash may be such that at the time of discharge the discharge opening is not lowermost and effective discharge may not occur.

This limitation regarding mounting of the extinguisher does not apply to the construction described above, for the reason that the gas is kept separate from the liquid until the great majority of the liquid has been ejected, and this means that whatever the attitude of the extinguisher at the time of discharge the gas cannot escape past the liquid, at least to any significant extent. Extinguishers according to the invention are therefore suitable for use in aircraft crash protection installations where vertical mounting of the extinguisher is not possible, or at least not desirable, for example in aircraft wings of thin section where such extinguishers may be mounted horizontally or in some other attitude inclined to the vertical.

Separation of the gas and liquid means that only the gas reservoir need be sufficiently strong to resist the high gas pressure which may be as much as 350 pounds per square inch or even more. The strength of the liquid compartment is determined by the fact that prior to operation its walls are only required to resist the much lower liquid vapour pressure (which increases with rising temperature), although subsequently they will have to resist the pressure existing when the gas is first released. Clearly for the same weight as an extinguisher having the liquid and gas in communication, the initial pressure or the maximum safe operating temperature may be increased. It should be noted that in a space occupied by a mixture of vapour and a gas which do not react chemically, each exerts the pressure which it would produce if it alone occupied the space. The total pressure when the gas and liquid are not separated is therefore equal to the sum of the vapour pressure and the gas pressure. However, by separating the gas and liquid in the manner described the maximum pressure on the gas reservoir is that due to the gas alone, whilst the maximum pressure on the remainder of the container is that due to the vapour pressure of the liquid alone.

It will now be apparent that even in cases where there is no advantage in separating the gas and liquid from the viewpoint of the mounting position of the extinguisher,

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such separation may still be desirable in order to obtain the above described advantages regarding pressures. The piston used in the above described construction may be omitted where separation is not required after the commencement of discharge.

Whilst in the above described construction there are obvious advantages in the use of a single cartridge to effect opening of both gas and liquid orifices, it will be apparent that separate cartridges may be used to open each orifice, the cartridges being fired substantially simultaneously.

Referring now to Figures 2 and 3, these show the second construction in which the extinguisher is of broadly similar form to that shown in Figure 1, however, in this construction the discharge orifice 31 is closed by a diaphragm sealing member or closure cap 32 which is opened by ignition of an electrically ignited explosive charge 34, and the force of the explosion used to burst open the closure cap 32 is also used to effect movement of a member 35 which will in turn release the gas from the gas reservoir 36 to act upon the liquid contents of the liquid reservoir 30a.

The explosive charge 34 is carried by a cartridge holder 44 mounted in the head 45. The cartridge holder 44 extends into the middle of the neck of the extinguisher 30 and is designed to afford the minimum of obstruction to discharging liquid. The cartridge holder 44 has a bore 44a which at one end communicates with the explosive charge and at the other end terminates in a transverse portion 44b one end of which is closed by a frangible housing 37 of thimble-shape. The thimble 37 is positioned facing the closure cap 32 and is designed to resist the pressure resulting from ignition of the explosive charge 34 until burning of the charge is substantially complete whereupon the thimble 37 shatters to release the pent-up force of the explosion for bursting the closure cap 32. The other end of the transverse bore 44b forms a cylinder in which a piston-like member 38 is slidably mounted. Movement of the piston member 38 towards the thimble 37 is limited by a stop-pin 39. The end of the transverse bore 44b is sealed against the entry of liquid by a bellows 40 which encloses the projecting end of the piston member 38. The end of the piston member 38 bears through the end of the bellows 40 against the member 35. The latter comprises a tube 35a provided with a bearer 35b at one end which is a sliding fit in a guide tube 41. The other end of the tube is carried by a member 35c which is also a sliding fit in the guide tube 41 and is formed with a sharp punch or piercing portion 35d located opposite two abutting diaphragms 42 and 43. The diaphragm 42 seals the end of the liquid reservoir 30a whilst the diaphragm 43 seals the spherical gas reservoir 36.

When the explosive charge 34 is fired, the resultant explosive force is transmitted through the bores 44a and 44b to burst the thimble 37 and cap 32 in the manner described above, and as shown in Figure 4. At the same time the piston 38 is driven forward extending the bellows 40 and driving the punch 35d through the two diaphragms 42 and 43.

Because the cutting edge of the punch 35d lies in a plane which is not normal to the longitudinal axis of the member 35, the two diaphragms 42, 43 do not have a portion cut out completely but a circular flap is formed in each which hinges about the uncut edge. The end of the punch 35d is somewhat tapered so that it wedges in the diaphragms 42, 43 and renders it unlikely that the flaps will be bent back and effect partial re-closure of the opening formed. The gas passes through slots in the wall of the punch 35d and the guide tube 41 to act upon a piston 46 which serves a similar purpose to that in the previous construction. The piston 46 comprises an inner cone 46a and an outer cone 46b from which extend a number, for example twelve, of flexible

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metal vanes 46c adjacent ones of which partially overlap. By this construction the vanes 46c can be sprung together sufficiently to pass the piston through the discharge orifice end of the liquid reservoir 30 during assembly. The inner cone 46a is a sliding fit on the outside of the guide tube 41. The piston 46 carries a plurality of spring clips 47 which prior to operation of the extinguisher engage slots formed in the member 35c, the end 47a of each clip 47 passing through a slot in the guide tube 41. Prior to operation of the extinguisher the clips 47 serve to retain the piston 46 at the end of the liquid reservoir and also serve to retain the member 35 in correct position within the guide tube 41. When the member 35 is moved by firing the cartridge, the end 47a of each clip 47 is driven out of engagement with the slot in the member 35c and the piston is then free to move down the guide tube 41. When the piston 46 reaches the other end of the guide tube 41 the gas can escape through slots 41a.

As already mentioned one of the advantages accruing from separation of the gas and liquid prior to discharge is that discharge will still occur satisfactorily irrespective of the orientation of the extinguisher at the time of discharge. However, when the discharge orifice is sealed with a diaphragm such as the cap 32 the explosive force is transmitted more effectively to the cap if liquid is present between the thimble 37 and the cap 32. But, in the absence of special provision mounting of the extinguisher in certain attitudes will mean that liquid is not present in this space, or only part of the space contains liquid.

The possible reduction in effectiveness of the explosive charge in the absence of liquid between the thimble 37 and the cap 32 may be offset by closing the annular area which surrounds the thimble 37 behind the cap 32 and through which the liquid passes during discharge. Clearly, this area must only be closed prior to bursting of the cap 32 so that free discharge of the liquid contents of the extinguisher is possible thereafter.

Numerous ways of achieving this are possible, but in the construction shown in Figures 2 and 3 the closure means takes the form of an annular disc 48. This disc 48 is provided with radial slits 48a (Figure 3) to form a number of petals, for example six, the slits 48a terminating before the periphery of the disc so that the petals are attached to one another adjacent the periphery.

The disc 48 is reinforced by a supporting grid 49 positioned on the side of the disc 48 remote from the cap 32. When the thimble 37 is burst the grid 49 supports the petals against the force of the explosion as shown in Figure 4, the explosion being confined within the space between the cap 32 and the disc 48 so that virtually the full force of the explosion acts on the cap 32. When the cap 32 bursts the petals are exposed to the full force of the pressurised liquid, and are thus bent back as shown in Figure 5 allowing free discharge of the liquid.

I claim:

1. A liquid container comprising a liquid reservoir, said liquid reservoir having a sealed discharge outlet, a gas reservoir for containing pressurised gas used to effect ejection of the liquid, said gas reservoir and said liquid reservoir having a normally sealed intercommunicating orifice, electrically operated unsealing means for unsealing said liquid reservoir discharge outlet, and further unsealing means for unsealing said intercommunicating orifice between said gas and liquid reservoirs, and means actuated by said first mentioned unsealing means for operating said further unsealing means substantially simultaneously with the unsealing of said liquid reservoir discharge outlet whereby said pressurised gas is freed to effect ejection of the liquid in said liquid reservoir through said discharge outlet.

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2. A liquid container comprising a liquid reservoir, said liquid reservoir having a discharge outlet, a frangible member sealing said discharge outlet, a gas reservoir for containing pressurised gas used to effect ejection of the liquid, a further frangible member sealing said gas reservoir from said liquid reservoir, an explosive charge, said explosive charge having electrical igniting means and being mounted in proximity to said frangible member for fracturing said frangible member by the explosive force generated upon ignition of said charge to unseal said liquid reservoir discharge outlet, and a movable member for fracturing said further frangible member, when said movable member moves by a predetermined amount, said movable member being movable by said predetermined amount by the force generated upon ignition of said explosive charge whereby said pressurised gas is freed to effect ejection of the liquid from said liquid reservoir through said discharge outlet.

3. A fire extinguisher comprising a reservoir for extinguishing liquid, said extinguishing liquid reservoir having a discharge outlet, a frangible member sealing said discharge outlet, a gas reservoir, a further frangible member sealing said gas reservoir from said liquid reservoir, an explosive charge, said explosive charge having electrical igniting means for igniting said explosive charge to produce an explosive force, means for utilizing part of said explosive force to fracture said frangible member, further means for utilizing part of said explosive force to fracture said further frangible member substantially simultaneously with the fracturing of said first-mentioned frangible member, and a movable piston mounted in said liquid reservoir adjacent said further frangible member whereby when said further frangible member is fractured the gas released from said gas reservoir moves said piston along said liquid reservoir to eject the extinguishing liquid through said discharge outlet.

4. In a liquid container of the kind in which a pressurised gas is used to effect ejection of the liquid through a normally-sealed discharge outlet, frangible means for sealing said outlet, an explosive charge, means for igniting said explosive charge, means for applying part of the explosive force resulting from ignition of said charge to fracture said frangible outlet sealing means, a sealed gas reservoir having an orifice communicating with the liquid container, frangible orifice sealing means for retaining the pressurised gas out of contact with the liquid prior to the time when discharge is required, and means for applying part of said explosive force to fracture said frangible orifice sealing means.

5. A liquid container comprising a liquid reservoir, said reservoir having a discharge outlet for liquid, frangible means sealing said discharge outlet, an electrically ignitable explosive charge for fracturing said frangible means to unseal said discharge outlet, a gas reservoir, said gas reservoir having an outlet through which gas can pass into said liquid reservoir to effect ejection of liquid from said reservoir through the discharge outlet of the liquid reservoir, further frangible means sealing the gas reservoir outlet, means operable by said explosive charge for fracturing said further frangible means upon ignition of said explosive charge, and a piston movable within said liquid reservoir, whereby gas released from said gas reservoir as a result of ignition of said explosive charge acts on the piston to move the piston along the reservoir and thereby eject liquid through the liquid discharge outlet.

6. A liquid container according to claim 5, in which the liquid reservoir is of elongated cylindrical shape and the gas reservoir is of spherical shape, the gas reservoir being mounted at one end of said liquid reservoir and the discharge outlet being provided at the opposite end of said liquid reservoir.

7. A liquid container according to claim 5, in which said piston is composed of a number of flexible metal vanes whereby the vanes can be sprung together sufficiently to

pass the piston through the liquid discharge outlet during assembly of the container.

8. A liquid container according to claim 7 in which adjacent vanes overlap.

9. A liquid container comprising a liquid reservoir, said reservoir having a discharge outlet for liquid, a frangible diaphragm sealing said discharge outlet, and explosive charge having electrical igniting means, a holder for said explosive charge, said holder having a bore terminating opposite said diaphragm, a frangible cover closing the end of said bore, a member closing the space around said frangible cover for concentrating onto said frangible diaphragm a predetermined part of the force of the explosion resulting from ignition of said explosive charge, a gas reservoir, said gas reservoir having an outlet through which gas can pass into said liquid reservoir to effect ejection of liquid from said reservoir through the discharge outlet of the liquid reservoir, further frangible means sealing the gas reservoir outlet, means for utilizing the remaining part of the force of the explosion for fracturing said further frangible means upon ignition of said explosive charge, and a piston movable within said liquid reservoir, whereby gas released from said gas reservoir as a result of ignition of said explosive charge acts on the piston to move the piston along the reservoir and thereby eject liquid through the liquid discharge outlet.

10. A liquid container according to claim 9, in which a tube extends through said liquid reservoir, and in which said means for utilizing the remaining part of the force of the explosion for fracturing said further frangible means is a movable member slidably mounted within said tube, said piston having a hub slidable on the outside of said tube.

11. A liquid container according to claim 9, in which said member closing the space around the frangible cover comprises a disc, said disc being weakened along predetermined lines, and in which a grid structure supports said disc on the side opposite of the said facing into said space.

12. A fire extinguisher comprising a reservoir for extinguishing liquid, said extinguishing liquid reservoir having a discharge outlet for liquid, a frangible diaphragm sealing said discharge outlet, an electrically ignitable explosive charge, a holder for said explosive charge, said holder having a bore commencing adjacent said charge and terminating opposite said diaphragm, a frangible cover closing the end of said bore, a member closing the space around said frangible cover for retaining a pre-determined amount of the force of the explosion in the region of said diaphragm prior to opening thereof, a gas reservoir, said gas reservoir having an outlet through which gas can pass into said liquid reservoir, further frangible means sealing the outlet from the gas reservoir, a movable member, a predetermined movement of said movable member fracturing said further frangible means, means for applying part of the force of said explosion to said movable member to effect said predetermined movement, and a movable piston mounted in said liquid reservoir adjacent said further frangible member whereby gas released from said gas reservoir as a result of ignition of said explosive charge acts on the piston to move the piston along the liquid reservoir and thereby eject liquid through the liquid discharge outlet.

13. A fire extinguisher according to claim 12, in which said holder has a further bore communicating with the first bore, and in which said means for applying part of the force of said explosion to said movable member comprises a plunger movable in said bore, said plunger contacting said movable member whereby part of the force of the explosion resulting from ignition of the explosive charge moves said plunger which in turn effects movement of said movable member by said predetermined amount.

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