No. 660,382. Patented Oct. 23, 1900.

F. LAMBERT.

SAFETY DEVICE FOR HYDRAULIC APPARATUS.

(Application filed Apr. 5, 1899.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

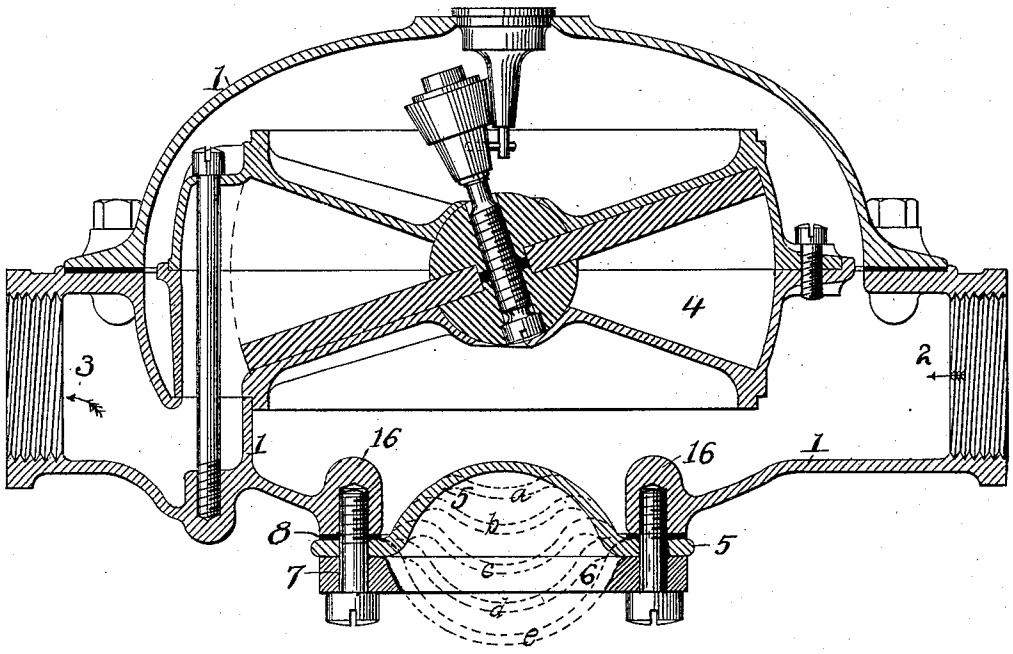
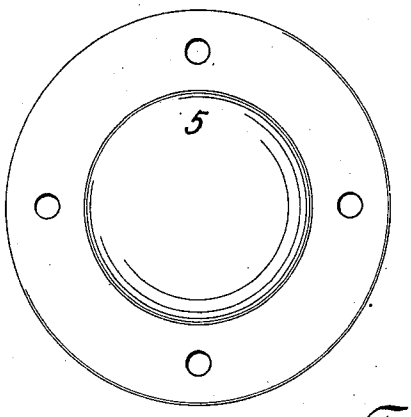


Fig. 2.



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Fig. 3.

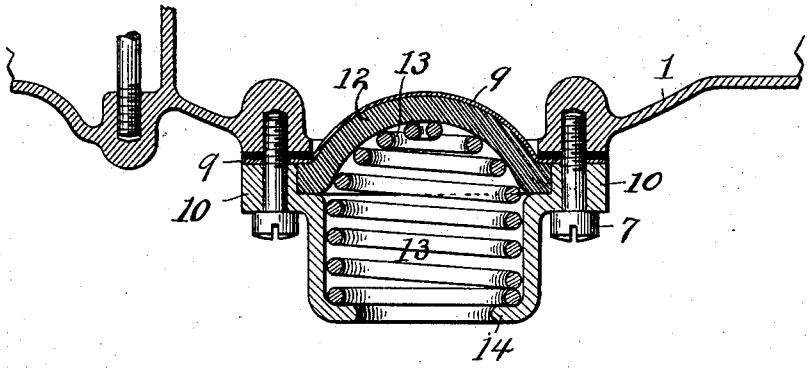
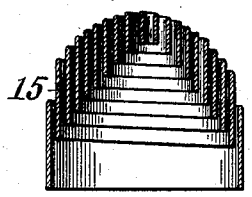


Fig. 4.



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SAFETY DEVICE FOR HYDRAULIC APPARATUS.

SPECIFICATION forming part of Letters Patent No. 660,382, dated October 23, 1900.

Application filed April 5, 1899. Serial No. 711,775. (No model.)

To all whom it may concern:

Be it known that I, FRANK LAMBERT, a citizen of the United States, and a resident of New York, (Brooklyn,) Kings county, State of New York, have invented Safety Devices for Hydraulic Apparatus, of which the following is a specification.

My invention relates to apparatus such as water-meters or the like, which, through excessive internal pressure developed by expansion when the contents freeze, will burst, or the parts will become so distorted that leakage occurs.

The object of my invention is to provide means whereby the apparatus will not be injuriously affected by accidental excessive pressure, and leakage will be prevented at the time of or after this excessive pressure has been relieved. I accomplish this object by so constructing the apparatus that before the internal pressure becomes great enough to break or permanently deform the water-receptacle its cubic liquid content may increase enough to provide ample room for the expansion into ice of the liquid confined in the apparatus. This is done by means of the safety devices herein shown and described as applied to a well-known form of hydraulic apparatus.

In the accompanying drawings, Figure 1 is a cross-section through the center of a water-meter, showing my improved safety device applied thereto. Fig. 2 is a plan view of a detail of the safety device. Fig. 3 is a sectional view of a modified form of safety device, and Fig. 4 is a detail view of another modification.

Referring to Fig. 1, the meter here shown comprises a pressure casing or shell 1, provided with water-inlet 2 and outlet 3, a measuring-chamber 4, and suitable indicating and registering mechanism forming no part of the present invention.

The measuring-chamber 4 is secured within the pressure-shell 1 in such a manner that water entering the inlet 2 may pass around, above, and below the measuring-chamber, through which the water must pass before it reaches the outlet 3, this latter leading directly from the measuring-chamber. When the water in such a meter comes to or near to the freezing-point, the coldest particles have a tendency to rise to the top, and the water near the upper part of the receptacle or shell becomes generally frozen first, the ice gradually thickening downward. As long as the openings of the pipe connections are not frozen the expansion due to the water freezing does no damage, there simply being back pressure in the inlet-pipe or increased pressure in the outlet-pipe, (if there is no leakage in the various fittings,) or both. However, when the ice is thick enough to reach a point below or at the lowest level of the inlet 2 and outlet 3, or, in other words, these have been clogged up by ice and the water confined in the lower part of the shell freezes, there is no place for the increased volume to force itself, and the shell will either burst or become so distorted that it will be put out of joint and leak, rendering the apparatus inoperative.

It is a known fact that ice submitted to pressure will partly melt and conform itself to the shape of the receptacle in which it is compressed. This occurs in water-meters such as shown in Fig. 1 from the moment the pipes are frozen or the ice is thick enough to reach the lower edge of the ports. Up to this point the ice has freely formed, molding itself to the interior free space of the casing without any pressure other than the normal internal water-pressure; but from this moment until the water in the apparatus is entirely frozen considerable internal pressure is developed and the portion of ice above the lowest level of the ports will be compressed upward, carrying with it the measuring-chamber 4, which will be found afterward to have been distorted. This is due to the fact that the great force applied between the lower face of the chamber 4 and the lower interior face of the shell, which must be very rigid, acts against the chamber with a tendency to lift it upward with the same pressure that it acts on the bottom of shell to force it outward.

The pressure in water-supply pipes in general is normally less than two hundred pounds per square inch; but the pressure may rise to three hundred, and sometimes much more, depending upon the rapidity with which the water-flow is shut off, causing water-hammer. Consequently the shell or casing of the meter is designed to withstand a pressure consider-

ably more than the normal—say eight hundred to one thousand pounds—without being permanently deformed.

Referring to Patent No. 375,023, granted to John Thomson and myself on December 20, 1887, it will be seen that the bottom of the meter-casing is formed slightly curved inward. This concave portion tends to flatten or be pushed outward under excessive internal pressure; but the distortion of this portion will act on the entire shell, or at least on the joints and the bolts that unite the lower portion with the upper portion, to permanently deform the parts, causing leakage at the joints. The present invention is an improvement on this construction. Instead of making the entire lower portion of the meter of material capable of withstanding the maximum pressure, as in the above-mentioned patent, I form a safety portion, preferably below the lowest level of the opening of the pipe connections, of material that will yield before the predetermined maximum pressure of the rest of the shell is reached.

As shown in Fig. 1, the shell 1 may be formed with an aperture which is closed by a safety-piece 5, of lead, tin, copper, metal alloys, or other suitable material and of such thickness that it will be pliable under a pressure less than that necessary to permanently deform the rest of the shell. For instance, in meters capable of safely standing one thousand pounds of pressure the safety device may be made capable of yielding under two hundred and fifty or three hundred pounds of pressure.

The safety-piece 5 is secured to the shell 1 by the ring 6 and bolts 7, screwed into the blind threaded holes in the lugs 16 of the shell. Preferably I make this piece with a bowl-shaped portion protruding inwardly and normally lessening the capacity of the shell. This inwardly-bulging portion preferably decreases in thickness toward its center, whereby when from expansion or otherwise the pressure in the meter exceeds the resisting-power of the safety-piece its central portion will yield first and gradually be forced outward, assuming, approximately, a shape such as indicated by dotted lines *a*, *b*, *c*, *d*, or *e*, Fig. 1, according to the pressure exerted, thus increasing the normal cubic water content of the meter sufficient to prevent damage. In other words, the capacity of the meter is increased, while the shell is maintained water-tight.

If after one or more partial or total freezings the bowl-shaped portion of the safety-piece 5 has been forced outward considerably—say, for instance, as represented in dotted lines *c*, *d*, or *e*—the ring 6 may be removed and the safety-piece reversed, so that the central portion again protrudes into the meter.

By making the opening in the ring 6 slightly smaller than the aperture in the shell 1, if the bowl-shaped portion of the safety-piece has been forced by internal pressure to the extreme outer shape shown at *e* this inverted bowl will be small enough in diameter to be easily inserted into the aperture in the shell when the safety-piece is reversed.

The inner circumferential edge of the ring 6, next to the safety-piece 5, is preferably well rounded to prevent the safety-piece from bending at a sharp angle, and thereby increasing the tendency to cut or break. To insure a good joint, a packing-ring or gasket 8 is preferably placed between the faces of the safety-piece and the shell 1, although this gasket may be dispensed with when the safety-piece is made of very soft material, such as lead.

To provide for expansion of water into ice, the safety-piece may be calculated for the limit of safety, to increase by its deformation the cubic water content of the apparatus one-eleventh of its normal capacity, which is the approximate maximum limit of expansion of water when solidified into ice. By means of this construction the water in the meter is always confined—that is, the meter remains water-tight—thus preventing leakage in case the water is only partially frozen or a thaw occurs. This is a very important factor in an apparatus of this kind, which in winter will often freeze and even thaw out unexpectedly and without attracting any one's attention, thus often causing considerable damage by the water before it is known and the water shut off. It will thus be seen that the safety device forms a protection to the rest of the apparatus against damage from any undue internal pressure from any cause, as the safety-piece will give way before the predetermined safety pressure of the apparatus is reached.

Fig. 3 represents a modification whereby when the safety-piece has been forced outward by accidental extra pressure it will be automatically returned to its normal position when the normal pressure in the meter is resumed. In this modification the safety-piece may be of uniform thickness, and a thin sheet of copper will suffice to keep a tight joint and prevent leakage; but I do not limit myself in any case to any particular material or form.

Referring to Fig. 3, the safety-piece 9 is secured to the shell 1 by means of the outer flange or ring 10 of the flanged cylinder 11 and bolts 7, and a thick washer or block 12, of soft rubber or the like, is held against the safety-piece 9 by a spring 13, one end of which bears on the inner flange 14 of the cylinder 10, while the other end presses the rubber washer 12 and the safety-piece 9 upward. The force or tension of this spring 13 is calculated to resist a pressure greater than the normal water-pressure in the meter, but to yield under a pressure less than is necessary to deform the shell proper. Therefore when the internal pressure in the meter exceeds the resisting-power of the spring 13 the safety-piece 9 and the washer 12 are forced outward, compressing the spring 13. As soon as the

pressure in the meter diminishes the spring 13 reacts and forces the washer or block 12 and the safety-piece 9 back, so that when the internal pressure again becomes normal the safety-piece has again resumed its normal shape, as shown in Fig. 3. The tension of the spring is calculated to safely overcome the resistance of the normal water-pressure plus the resistance to deformation of the material of the safety-piece and block 12.

The spring 13 may be made of steel wire of variable cross-section, and attention is called to its peculiar form, which gives it an increasing resistance to compression from its center outward—that is, the resistance of the spring is weakest when its central coils are depressed and strongest when the external coils are depressed. This variable resistance is made to compensate for the internal pressure, which presses on the safety-piece with variable effect at its different portions, in accordance with its diameter, whereby the entire system under pressure (if the resiliency of the spring is properly calculated) will tend to depress the safety-piece at the center first and near the periphery last.

Instead of the wire spring 13 I may use a spring 15, Fig. 4, formed by coiling a flat strip of metal varying in width, the narrowest portion being at the center and the widest part at the outer coils, so that the resistance of the spring to compression will be less at the center than near its outer diameter—that is, in accord with the effect of the internal pressure acting on the safety-piece, as before explained.

The washer 12 prevents any corrugations or sharp bends or kinks forming on the safety-piece, as might happen if this latter were resting directly on the coiled spring 13 or 15, the washer following the uneven contour of the top of the spring. This washer also acts to cushion the safety-piece.

The outer edge of the washer 12 enters a recess in the flanged cylinder 11, whereby it is prevented from getting out of place when pressed up or down with the safety-piece. The safety-piece may be formed of a plurality of layers of the same material, or of various materials combined. For instance, if lead is used for the safety-piece proper, a thin sheet or layer of copper may be placed on one or both sides thereof to protect it against corrosion, which might change its strength or flexibility.

I claim as my invention—

1. In a water-meter, a pressure-shell, the said shell being provided with an aperture, a reversible safety-piece closing said aperture and adapted to yield under a water-pressure less than that necessary to deform the shell.

2. In a water-meter, a pressure-shell, the said shell being provided with an aperture, and a reversible safety-piece closing said aperture and provided with a bowl-shaped portion protruding into the interior of the meter and adapted to be inverted by a water-pressure that will not deform the other parts of the meter.

3. In a water apparatus, a shell having an aperture, a reversible safety-piece closing the said aperture and normally protruding into the interior of the apparatus, but capable of having its form reversed by an internal pressure that will not deform the shell, and means to limit the diameter of the outward bend given the said safety-piece by the excessive pressure to a size less than the diameter of the said aperture.

4. In a water apparatus, a shell having an aperture, and a safety-piece closing said aperture and adapted to yield under pressure less than the one required to deform the said shell the said safety-piece decreasing in resistance from the circumference toward the center.

5. In a water apparatus, a shell, having an aperture, and a safety-piece closing said aperture and adapted to yield under a water-pressure less than the one required to deform the said shell, the said safety-piece decreasing in thickness toward the center.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FRANK LAMBERT.

Witnesses:
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