

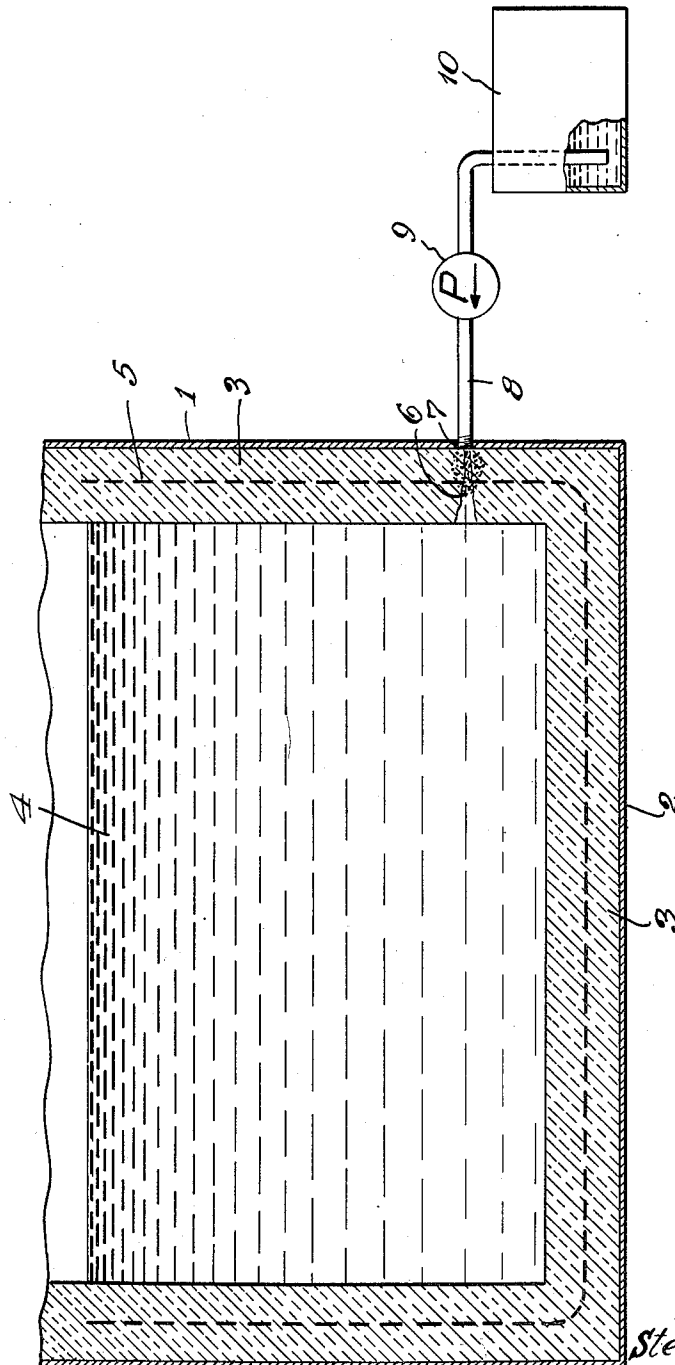
Dec. 24, 1957

S. BECKWITH

2,817,218

METHOD FOR STOPPING LEAKS IN TANKS

Filed Aug. 18, 1954



Inventor
Sterling Beckwith
by Parker & Carter
Attorneys

1

2,817,218

METHOD FOR STOPPING LEAKS IN TANKS

Sterling Beckwith, Lake Forest, Ill., assignor, by mesne assignments, to Constock Liquid Methane Corporation, a corporation of Delaware

Application August 18, 1954, Serial No. 450,776

7 Claims. (Cl. 62—170)

My invention relates to improvements in method of stopping leaks in tanks and has for one object to provide a convenient and reliable method of stopping a leak in a tank wherein the metal outer wall is insulated from the contents of the tank by an insulating lining of such character that a cold boiling liquid contained within the tank is kept by the insulation out of contact with the outer tank wall or shell.

My invention is especially applicable to tanks adapted to contain such cold boiling liquids as liquefied methane at atmospheric pressure which at that pressure boil at approximately -258° F., a temperature which, if the steel tank wall were subjected to it, might have a deleterious effect on the steel tank wall.

The lining being porous, may be penetrated by the cold liquid under the effect of hydrostatic pressure and capillary attraction but under ordinary circumstances ambient heat penetrating through the steel tank wall will heat the capillary streams of the liquid so as to vaporize them and either build up a pressure in the tank lining which will prevent further outward movement of the liquid and will normally expel liquid which has already penetrated the lining. It is even possible that the rate of vaporization in the absence of the building up of sufficient pressure will be sufficient to vaporize the liquid as it approaches the tank wall before it reaches the steel shell so that the tank wall is subjected to ambient temperature on the outside and to the temperature of the gas only on the inside, the gas being of low specific temperature and being heated by the ambient temperature from the steel wall, will be unable to lower the temperature of the steel shell or wall to the danger point.

This effect prevails so long as the sole avenue of access of the liquid through the insulating lining toward the shell is the capillaries in the lining. If for any reason whatever, however, there is a breaking down of the insulating lining so that the liquid may progressively penetrate the lining and reach the steel shell, trouble immediately ensues. The metal itself may deteriorate under the effect of the cold and in any event condensation of ambient moisture in the outer air will present difficult problems which must be avoided.

Therefore, it is necessary to provide some method by which in the event of any breakage or deterioration of the inner insulating lining, which permits or would permit the escape of the liquid through the insulating lining to contact the shell will be prevented.

Such treatment must come from the outside in through the shell wall when the tank is in use because the low temperature of the liquid itself and the fact that air must not be allowed to enter the tank because an explosive mixture would result makes it impossible without completely emptying the tank and purging it of gas, to do any repair work on the inside. However, such repair is equally useful during construction as the lining is being built up. Since such repair would avoid the necessity of tearing out the lining for repair during construction.

Because of the intense cold of the liquid, if and when

2

there is any such break down of the lining which permits the liquid as a cold liquid to reach the tank shell, immediately the temperature of the shell will drop far below ambient temperature and moisture condensation and frost formation will occur at the point where the liquid has passed through the lining as a liquid and in liquid phase has contacted the shell. Thus it is easy to determine the place at which the leak through insulating lining has developed. I propose that when such leak is located, a hole is drilled through the steel tank and a liquid be forced through the hole into the lining. Paraffin is a suitable liquid for that purpose. Hot paraffin forced through the hole into the lining will distribute itself throughout that portion of the lining where the leak has occurred, being forced into the lining by high hydraulic pressure, it will congeal or harden and furnish a permanent plug to fill the leak in the lining. The pressure at which the liquid is forced into the lining will, of course, be held below the pressure which the lining can safely support.

Paraffin, of course, is a poor conductor of heat and since paraffin solidifies at ambient temperatures, no temperature on the outside of the tank will cause it to melt and if sufficient pressure is provided and the paraffin either in liquid form or even in solid form is forced into the leak, it will plug the leak and the cold of the liquid where it comes in contact with the paraffin will insure that the paraffin remains in solid condition at the point at which it is forced by the hydraulic pressure on the outside. The hydraulic pressure will be sufficient to cause the paraffin even as it congeals and solidifies to distribute itself through the pores of the lining but when the hydraulic pressure is withdrawn and the paraffin has solidified, the hydrostatic pressure of the liquid in the tank, it being remembered that the liquid is at atmospheric pressure, will be insufficient to disturb the paraffin plug. Experience has taught that the paraffin plug under these conditions will furnish an effective closure and permanent repair for a leak or dangerous weakness in the lining which might ultimately become a leak.

My invention is illustrated more or less diagrammatically in the accompanying drawing wherein the figure shows a section through a tank adapted to contain cold boiling liquid.

Like parts are indicated by like characters throughout the drawings and specification.

1 is a steel tank; 2 a floor; 3, an insulating lining for wall and floor, just porous to the extent that the cold boiling liquid 4, for example methane, may penetrate the lining and move under hydrostatic pressure through the capillary pores in the lining toward the wall and floor of the steel tank.

The dotted lines 5 indicate the zone or area to which the liquid in liquid phase may penetrate in capillary streams toward the outer tank wall. The area between 5 and 3 is the area in which the liquid in liquid phase does not penetrate but this area is filled normally with liquid in gaseous phase and since the gas has been raised at least to boiling temperature by the ambient air at zone 5 and is of relatively low specific heat, the heat penetrating from 1 through the lining toward zone 3 will raise the temperature of the gas to a point at which, where it contacts the steel tank 1, it will be unable to dangerously reduce the temperature of the steel. If for some reason or another a break in the lining takes place so that we have an unobstructed passageway 6 through the insulating lining from the mass 4 to the shell, then that passageway will immediately be filled with the cold liquid and the cold liquid will then directly contact the tank wall in liquid phase and reduce its temperature.

When a small hole 7 is drilled through the tank wall and a pressure member is immediately applied thereto,

3

paraffin or some other suitable material may be introduced through the pipe 8 by pump 9 from reservoir 10 at a pressure sufficient to cause the paraffin to penetrate the insulating lining and fill enough of the opening 6 so that there will be a barrier interposed between the liquid and the tank wall. This paraffin will spread about the opening 6 through the capillaries of the lining and a tight plug will thus be provided which will prevent further access of the liquid to the shell.

Paraffin is a convenient material to be used at the temperatures and under the conditions involved, it will not be appreciably dissolved by the cold liquid; it will be kept in solid form by the cold and having once been forced into position as a plug to fill the leak in the insulating lining, it will remain as a plug and prevent further contact of the cold boiling liquid with the steel shell.

Other suitable materials might be used. Under some circumstances even water might be forced into the leak or any other liquid may be used which can be introduced and pumped as a liquid, will flow to some extent as it solidifies and will remain a solid under the effect of the low temperature of the cold boiling liquid.

Another material that might be used to plug the leak is carbon dioxide. Carbon dioxide gas freezes to a solid or Dry Ice at temperatures far above the temperature of methane. If carbon dioxide is forced into the lining at the leak, it will penetrate the leak, resist outward flow of the cold boiling liquid, will readily penetrate the pores of the lining about the leak and will congeal to form a plug filling the leak and filling the area in the porous lining around the leak.

In any event, once the plug has been formed, the hole in the lining will be closed and an easy way to close it would be to screw in a plug in place of the threaded pipe through which the plug-forming liquid or fluid entered the lining.

Another suitable way in which to insert the plug is, after a hole has been made in the tank wall at the leak point, to thread the hole and screw into the threaded hole a valve member which when open permits the sealing liquid to be forced into the lining. As the sealing liquid penetrates the lining and congeals or sets, resistance to flow will increase and flow will be stopped when the pressure in the lining approaches the safe pressure which the lining itself can stand without rupture. This pressure, of course, depends on the character of the lining and its resistance to internal pressure which in each case will be determined empirically for any specific type of lining.

A suitable sealing liquid is a mixture of paraffin and turpentine which by control of the relative proportions can be made to congeal at any desired temperature in a wide range, such as from -220° F. to 100° F.

I claim:

1. The method of stopping from the outside a leak in the porous insulating lining of a metal walled tank with a frozen plug of sealing fluid, which consists in making a hole in the metal wall, in line with the leak and forcing into the lining, through the hole under hydraulic pressure, a sealing fluid the freezing point of which is above the temperature of the liquid contents of the tank.

2. The method of stopping from the outside a leak in the porous insulating lining of a metal walled tank with a frozen plug of sealing fluid, which consists in making a hole in the metal wall, in line with the leak and forcing into the lining, through the hole under hydraulic pressure, a sealing fluid the freezing point of which

4

is above the temperature of the liquid contents of the tank, and continuing the introduction of the sealing fluid until it has congealed and formed a plug in the insulation, to close the leak.

3. The method of protecting the outer metallic shell of an interiorly lined tank from contact with a cold boiling liquid escaping through a leak in the lining with a frozen plug of sealing fluid, which consists in making a hole in the shell in line with the leak and forcing into the leak and into the pores of the lining about the leak, through the hole under hydraulic pressure, a sealing fluid, the freezing point of which is above the temperature of the cold boiling liquid in the tank.

4. The method of protecting the outer metallic shell of an interiorly lined tank from contact with a cold boiling liquid escaping through a leak in the lining with a frozen plug of sealing fluid, which consists in making a hole in the shell in line with the leak and forcing into the leak and into the pores of the lining about the leak, through the hole, under hydraulic pressure, a sealing fluid, the freezing point of which is above the temperature of the cold boiling liquid in the tank, and continuing the introduction of the sealing fluid until it has congealed and formed a plug in the insulation, to close the leak.

5. The method of stopping a leak in the porous insulating lining of a metallic walled tank from the outside which tank contains a cold boiling liquid, such for example as methane, which consists in making a hole in the metal wall at the point where the leak has permitted the liquid methane to contact and chill the tank wall, forcing into the lining through the hole under pressure a sealing gas, the freezing point of which is above the temperature of the liquid contents of the tank.

6. The method of stopping a leak in the porous insulating lining of a metallic walled tank from the outside which tank contains a cold boiling liquid, such for example as methane, which consists in making a hole in the metal wall at the point where the leak has permitted the liquid methane to contact and chill the tank wall, forcing into the lining through the hole under pressure a sealing liquid, the freezing point of which is above the temperature of the liquid contents of the tank.

7. The method of stopping a leak in the porous insulating lining of a metallic walled tank from the outside which tank contains a cold boiling liquid, such for example as methane, which consists in making a hole in the metal wall at the point where the leak has permitted the liquid methane to contact and chill the tank wall, forcing into the lining through the hole under pressure carbon dioxide in gaseous phase, the freezing point of which is above the temperature of the liquid contents of the tank, continuing the introduction of the carbon dioxide until it has penetrated the pores of the lining about the leak, has filled the leak and formed a solid, Dry Ice plug closing the leak.

References Cited in the file of this patent

UNITED STATES PATENTS

331,658	Sooysmith	Dec. 1, 1885
908,016	Lake	Dec. 29, 1908
2,190,367	Mead	Feb. 13, 1940
2,476,601	Harper	July 17, 1949
2,646,707	Notz	July 28, 1953

FOREIGN PATENTS

1,006,160	France	Jan. 16, 1952
-----------	--------	---------------