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SEALING MATERIAL FOR GAS HOLDERS AND METHOD OF USING THE SAME

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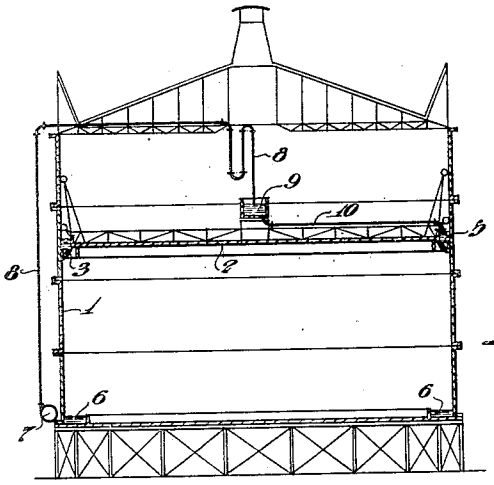


Fig. 1

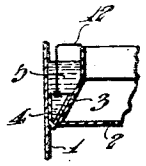


Fig. 2

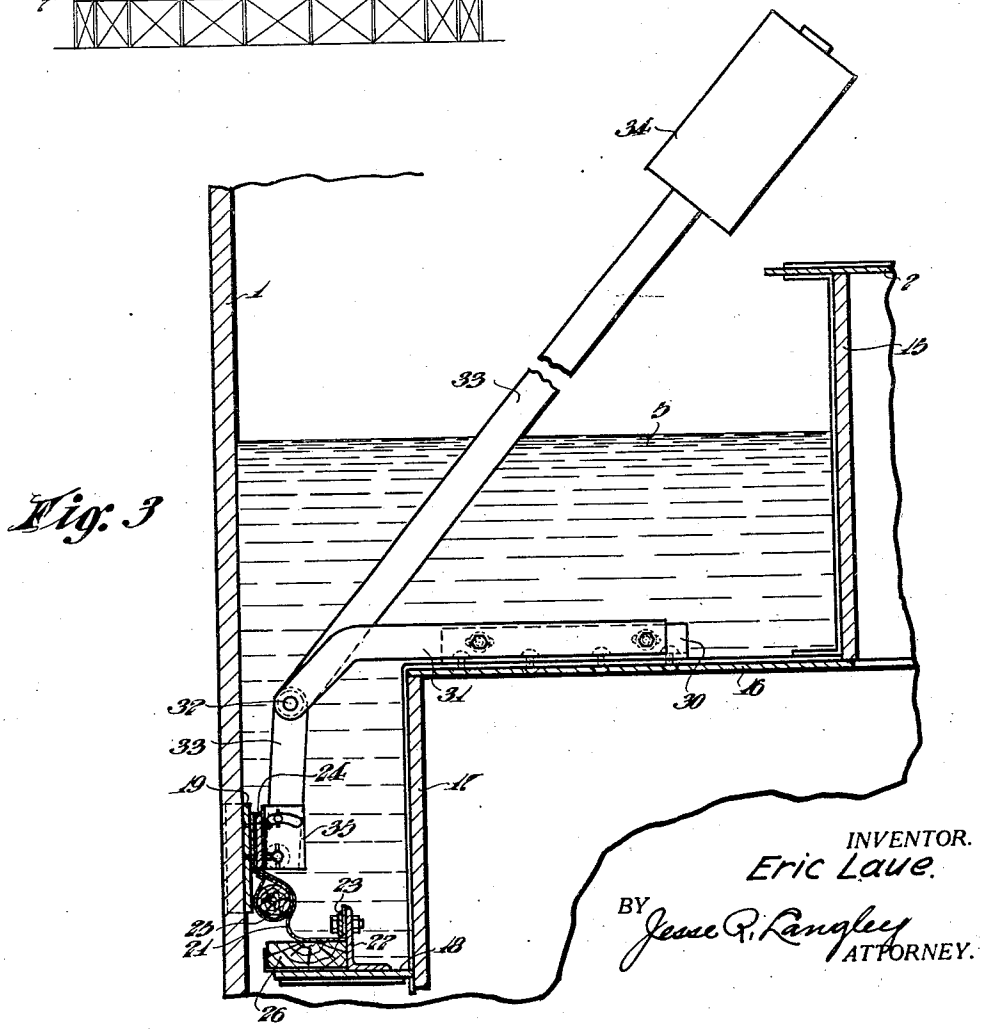


Fig. 3

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SEALING MATERIAL FOR GAS HOLDERS AND METHOD OF USING THE SAME

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6 Claims. (Cl. 48—174)

My invention relates to sealing fluids for gas holders and, more particularly, to gas holders of the hitherto so-called "dry" or "waterless" type in which gas is confined below a disc piston mounted for free vertical movement in a hollow vertical cylinder.

Such a gas holder is illustrated, for example, in U. S. Patent No. 1,275,696 to K. Jagschitz and numerous holders of this type have been built in this country in recent years.

In all of these holders, some suitable sealing fluid must be employed to seal the sliding joint between the edges of the piston or disc of the sides of the cylinder.

While in the aforesaid patent the use of water as sealing fluid was mentioned, so far as I am aware water has never actually been employed in this type of holder by reason of the fact that the sealing fluid, as also pointed out in the aforesaid patent, should be of a thick and viscous nature. So far as is known, the only sealing fluids which have been used in this country are tars or mixtures of oils normally immiscible with water.

The use of such materials is attended with numerous difficulties. These tars and oils frequently form emulsions with the water which is deposited in the gas holder either by infiltration of rain or snow, by condensation from the atmosphere, or even by condensation from the gas itself. These emulsions greatly diminish the efficiency of the sealing fluid which must be re-distilled or otherwise treated to break up the emulsion and regain the oil or tar. Moreover, the tars themselves are subject to pronounced viscosity changes over comparatively narrow ranges of temperature variation and it is generally extremely difficult to compensate for these temperature changes without discarding the old sealing fluid and introducing new material.

These tars and oils are also subject to considerable viscosity changes due to absorption of light oils from the gas itself and sometimes, also, from the natural tendency possessed by most tars to thicken and deteriorate on standing.

An even more serious difficulty, however, is the fact that in cold weather the water which is deposited along the inward sides of the gas holder cylinder often freezes, forming either a thick and heavy sludge or even masses of ice. Such freezing greatly impairs the freedom with which the piston moves up and down within the cylinder and may even make the operation of the holder dangerous unless some effective means can be employed for its removal.

In the copending application of F. W. Sperr, Jr., Serial No. 396,945, filed October 2, 1929, there is described and claimed the use of various water-miscible substances for this purpose whereby most of the disadvantages inherent in the use of tars and oils may be avoided.

It is, however, somewhat difficult to obtain materials having proper characteristics for use as sealing fluids for gas holders. Solutions of inorganic salts alone, for example, must be highly concentrated and suitable inorganic salts are often of a relatively expensive nature.

An object of the present invention is to provide a sealing fluid for gas holders which is water-miscible and relatively cheap and which has such other advantages over the prior art as will be found to obtain hereinbelow.

A further object of my invention is to provide a use for waste material which is produced in large quantities but for which very little use has hitherto been found in the industries.

A still further object of my invention is to provide a method of maintaining a sealing fluid within a gas holder throughout a period of seasonal temperature fluctuations.

My invention contemplates the use as sealing fluids for gas holders the waste product obtained in the cellulose industry when spruce and similar woods, such as fir and hemlock, are digested with solutions of calcium sulphite or similarly acting substances. These solutions are employed to leach away organic impurities from the wood being treated, leaving only cellulose in the form of "chemical pulp". After the leaching operation, the digesting liquors are discharged. They are known as "waste sulphite liquors", contain much organic matter such as gum, resin and tannin and are either viscous in themselves or capable of being reduced by evaporation to a state of high viscosity.

It will be understood that these materials vary considerably, according to the nature of the wood treated and the nature of the digesting solution. They may also vary considerably according to the degree of evaporation to which they are subjected after the leaching operation. One such substance which I have found to be suitable is known to the trade as "glutrin" and is a solution of somewhat high viscosity. The same material, upon being evaporated to dryness, yields a substance known in the trade as "goulac", which, in a proper solution, is also suitable for my purpose. A still further substance which can be employed is known to the trade as "super-spruce". It is also a solid and capable of being dissolved to form a viscous solution.

It is extremely difficult to determine the precise nature of these and similar materials, or the details of their manufacture. However, the following average analyses of the aforesaid materials are available:

Average analysis of goulac

	Percent
Total solids	93.47
Moisture	6.53
Mineral ash	11.55
Silica and insoluble	.16
Iron and Alumina (X_2O_3)	.33
Lime (CaO)	4.15
Magnesia (MgO)	3.31
Total alkalies	.35
Total sulphur (S)	5.60
Phosphoric acid (P_2O_5)	.06
Nitrogen (N)	.066
= (NH_3)	.08
Potash (K_2O)	.02
Total organic and volatile	81.92

Average analysis of glutrin

Specific gravity at 60° F	30.5° Baumé
Total solids	51.20%
Moisture	48.80%
Mineral ash	6 to 7%
Silica and insoluble	.10%
Iron and alumina (X_2O_3)	.19%
Lime (CaO)	1.50%
Magnesia (MgO)	1.70%
Total alkalies	.20%
Total sulphur (S)	3.10%
Phosphoric acid (P_2O_5)	.04%
Nitrogen (N)	.033%
= Ammonia (NH_3)	.04%
Potash (K_2O)	.02%
Total organic and volatile	44.20%

Powdered super-spruce

	Percent
Ash	6.20
Iron (Fe.)	.017
Lime (CaO)	0.14
Magnesium (MgO)	2.95
Total solids	96.86
Moisture	3.14
Insolubles	0.00
Non-tan	45.89
Tannin	50.97
Purity	52.62
Acidity	5.20

The viscosity requirements for gas holder sealing fluids vary considerably in accordance with the temperature changes in the locality in which it is to be used but in the Eastern central portion of the United States it is ordinarily required that 50 cc. of the solution flow from the Engler viscosimeter at 80° F. in approximately 135 seconds. This viscosity can readily be obtained with the aforesaid materials. For example, I have found that a solution containing approximately 1100 grams of the aforesaid material known as goulac per thousand grams of water has this viscosity.

While these solutions may often be employed without admixture of other materials, I prefer to add to them soluble salts and especially salts of a hygroscopic nature. The addition of such salts, for example, sodium thiocyanate and calcium chloride, results in numerous advantages. The vapor pressure of the solution can thereby be reduced to such a point that the solution will have a vapor pressure in equilibrium with the atmosphere normally in contact with it or even, when so desired, a lower vapor pressure.

For example, when the gas stored in the holder has been dehydrated, or in case it is important for any other reason to prevent the gas from picking up additional moisture, the vapor pressure of the sealing fluid should be kept at a point sufficiently low to insure that there will be no loss of water therefrom into the gas.

The addition of salts also ordinarily tends to increase the viscosity of the solution, thereby enabling their use under a wide range of temperature conditions, and also tends to decrease the viscosity change which such solutions may undergo upon long standing.

An even more important advantage of the addition of such salts is the fact that the solidifying points of the solutions are thereby very greatly reduced. For example, a solution made from glutrin and water alone having an outflow of approximately 130 seconds (50 cc. at 25° C. in the Engler viscosimeter) was found to commence to solidify at −9° C. and it becomes practically solid at −15° C., whereas a material having the same viscosity but prepared by dissolving sodium thiocyanate in glutrin commenced to solidify at approximately −25° C. and becomes practically solid at −29° C. and a material prepared from glutrin and calcium chloride and having the same viscosity commenced to solidify at −25° C. and was practically solid at −30° C.

When even lower solidifying points are desired, the addition of less hydroscopic or non-hydroscopic salts, such as, for example, sodium chloride, is preferred.

In using such materials as are disclosed herein for sealing gas holders, the viscosity requirements for the particular locality and the average humidity of the locality must be considered. For example, in the Eastern central portion of the United States, where the average relative humidity is 75°, in order to provide a material which will have a suitable viscosity and be in equilibrium with the atmosphere, I may employ a liquid prepared as follows:

A solution is prepared by dissolving 1120 parts by weight of goulac in 1000 parts by weight of water, and 350 parts by weight of sodium thiocyanate are added thereto. The resulting solution will have a proper viscosity and vapor pressure for the above-recited purpose.

Ordinarily, however, I prefer to keep the salt concentration in the solution such that a small loss of water ordinarily occurs. Under normal conditions, some water would have to be added from time to time, as could be determined from periodic inspection of the sealing liquid. When winter approaches, these water additions should be made somewhat larger or more frequently to maintain a constant viscosity whereas, after the passage of winter and upon the approach of warmer weather, the additions of water should be omitted until the loss of water compensates for the higher temperature. The desired viscosity may thus be maintained throughout the season.

If excessive quantities of water are accidentally added to the sealing fluid, as may happen in winter, the solution may readily be evaporated until a higher viscosity is obtained, but ordinarily this will not be necessary.

If the waste materials to be employed for pre-

paring the sealing fluid are found to be acidic in character, they should be neutralized in order to prevent any corrosive action. This may be done with a suitable alkaline material, such as lime.

Solutions prepared as hereinabove described are stable, have low solidifying points and lower temperature coefficients of viscosity than materials previously used, do not absorb hydrocarbons from gas and principally do not form emulsions nor permit the formation of ice within the gas holder and, consequently, represent a material advance in the art of sealing gas holders of the indicator type.

In the accompanying drawing there are shown for purposes of illustration several forms of disc-closure type gas holders and sealing means therefor. In this drawing,

Figure 1 is a more or less diagrammatic vertical sectional view of a gas holder of the "waterless" or disc-closure type which may be sealed according to the present invention;

Fig. 2 is a similar view on an enlarged scale of a modified form of seal for the device shown in Fig. 1; and

Fig. 3 is a view partly in elevation and partly in vertical section of one form of sealing means which has been employed in gas holders of the disc-closure type.

Similar reference numerals designate similar parts in each of the views of the drawing.

The gas holder and seal shown in Figs. 1 and 2 are substantially those shown in U. S. Patent No. 1,275,696 granted August 13, 1918 to Konrad Jagschitz. As shown in these figures, the gas holder comprises principally a wall or reservoir 1 having a disc-shaped closure 2 which is vertically movable as the volume of gas in the holder increases or decreases. The disc 2 is provided with a peripheral wall 3 arranged obliquely to the reservoir wall 1, and a series of wedge-shaped members 4 are arranged end-to-end to form a complete annular member and are slidable on said peripheral wall 3 in free engagement with the reservoir wall 1. These wedge-shaped members 4 are displaceable or movable relatively to each other and thus automatically adjust themselves to all variations or inequalities to the reservoir wall and thereby reduce the space between the disc 2 and the wall 1 to a minimum at all times.

The sealing fluid 1 which is indicated at 5 in the drawing is supplied to the space between the wall 1 and the peripheral wall 3 of the disc 2 lying above the wedge-shaped member 4 and serves to complete the seal between the disc 2 and the wall 1 so that the space within the reservoir and below the disc 2 is at all times sealed against the atmosphere. Whatever sealing fluid trickles through between the space between the disc 2 and the wall flows downwardly along said wall and may be collected in an annular channel 6 located at the bottom of the reservoir. From this channel 6 this fluid may be pumped back or raised by means of a pump 7 and a conduit 8 into a vessel 9 located above the disc-closure 2 and from which the liquid may be conducted back to the annular sealing ring in any convenient manner, as for example by means of a conduit 10.

In the instance shown in Fig. 2, the wedge-shaped members 4 are provided with resilient supports 12 which exert a pressure on said members 4 in such a direction as to augment the pressure of the sealing fluid 5.

The sealing device shown in Fig. 3 is substantially that disclosed in U. S. Patent No. 1,711,392, granted April 30, 1929 to Paul M. Kuehn, and closely approximates the sealing means actually used in practice with holders of this type.

In this instance, the moving disc-closure 2 is provided with a depending wall 15, a shelf 16, a second depending wall 17 and an outwardly extending circumferential support or bracket element 8, the edge of which extends somewhat away from the inner face of the wall 1.

As in other types of holders of this general character, this structure together with elements to be described below provides a well or trough adapted to contain a sealing fluid such as that described hereinabove.

Supported by the closure and urged outwardly against the inner wall of the tank is a series of interengaging rubbing shoes or plates 19, and cooperating with the plates 19 is a flexible member 21 formed of canvas or equivalent material. The inner edge of this material is clamped between an upstanding angle 22 secured to the member 18 and a plate 23 attached by bolts or the like to the angle 22. The canvas is doubled upon itself and the bolted portion bears against the rubbing shoes or plates 19, being clamped against the latter by suitable plates 24.

As will be seen upon reference to Fig. 3, the canvas member 21 is carried down and around bars 25, preferably of wood, one fold of the canvas being doubled back around the bars 25 to secure the same. These bars act as spacers and serve to hold the canvas out of contact with the wall of the holder and thus prevent wearing of the canvas against the wall as the closure or piston is moved up and down. Suitable wooden elements 26 form a rest for the lower portion of the canvas and hold such portion out of contact with metal which would have a tendency to chafe it.

By reason of the construction above outlined, there is produced an expansible or dilatable trough or channel, the lower portion whereof is flexible and which extends entirely around the structure between the inner face of the wall and the outer portion of the piston or closure proper. As above indicated and as shown in Fig. 3, this trough is designed to be filled with a liquid sealing medium, such for example as an aqueous viscous solution.

In order to hold the rubbing shoes 19 in close contact at all times with the wall 1, there is provided one or more angle bars 30 attached to the shelf 16. Adjustably secured to said angle bars are one or more arms 31, the outer ends of which extend downwardly. The shaft or bar 32 is mounted in said ends and forms a pivot for one or more lever arms 33. The upper portion of the arms 33 has secured to it a weight 34, while the lower portion of the arms 33 is suitably connected to a bracket or brackets 35 secured to the rubbing bar or shoe 19.

As will be noted, the weighted levers are connected to and coact with the rubbing shoes adjacent the ends thereof. Hence any tendency to spring is obviated and the shoes are held closely to the wall. The liquid of course seals the joints and at the same time reduces friction between the surfaces.

It will be apparent to those skilled in the art that my invention is susceptible of various modifications and, consequently, my invention is not limited to the specific examples given hereinabove by way of explanation but may be va-

riously practiced and embodied within the scope of the claims hereinafter made.

I claim as my invention:

1. The method of preventing the escape of gas confined within a gas holder of the disc-closure type which comprises sealing the disc against the walls of the holder with a viscous aqueous solution of waste sulphite material resulting from the manufacture of cellulose fibers by the sulphite process of treating wood.

2. The method of preventing the escape of gas confined within a gas holder of the disc-closure type which comprises sealing the disc against the walls of the holder with a viscous aqueous solution of waste sulphide material resulting from the manufacture of cellulose fibers by the sulphite process of treating wood and an inorganic salt comprising at least one of the groups consisting of sodium thiocyanate, calcium chloride, and sodium chloride.

3. The method of preventing the escape of gas confined within a gas holder of the disc-closure type which comprises sealing the disc against the walls of the holder with a viscous aqueous solution of waste sulphate material obtained from calcium sulphite process of treating wood.

4. The method of preventing the escape of gas confined within a gas holder of the disc-closure type which comprises sealing the disc against the walls of the holder with a viscous aqueous solution of goulac obtained from calcium sulphite process of treating wood.

5. The method of preventing the escape of gas confined within a gas holder of the disc-closure type which comprises sealing the disc against the walls of the holder with a viscous solution of glutrin obtained from calcium sulphite process of treating wood.

6. The method of preventing the escape of gas confined within a gas holder of the disc-closure type which comprises sealing the disc against the walls of the holder with a viscous aqueous solution containing substantially equal parts by weight of goulac and water obtained from calcium sulphite process of treating wood.

ERIC LAUE.