March 6, 1956 R. C. ULM 2,737,310

FLOATING ROOF

Filed Jan. 15, 1953 2 Sheets-Sheet 1

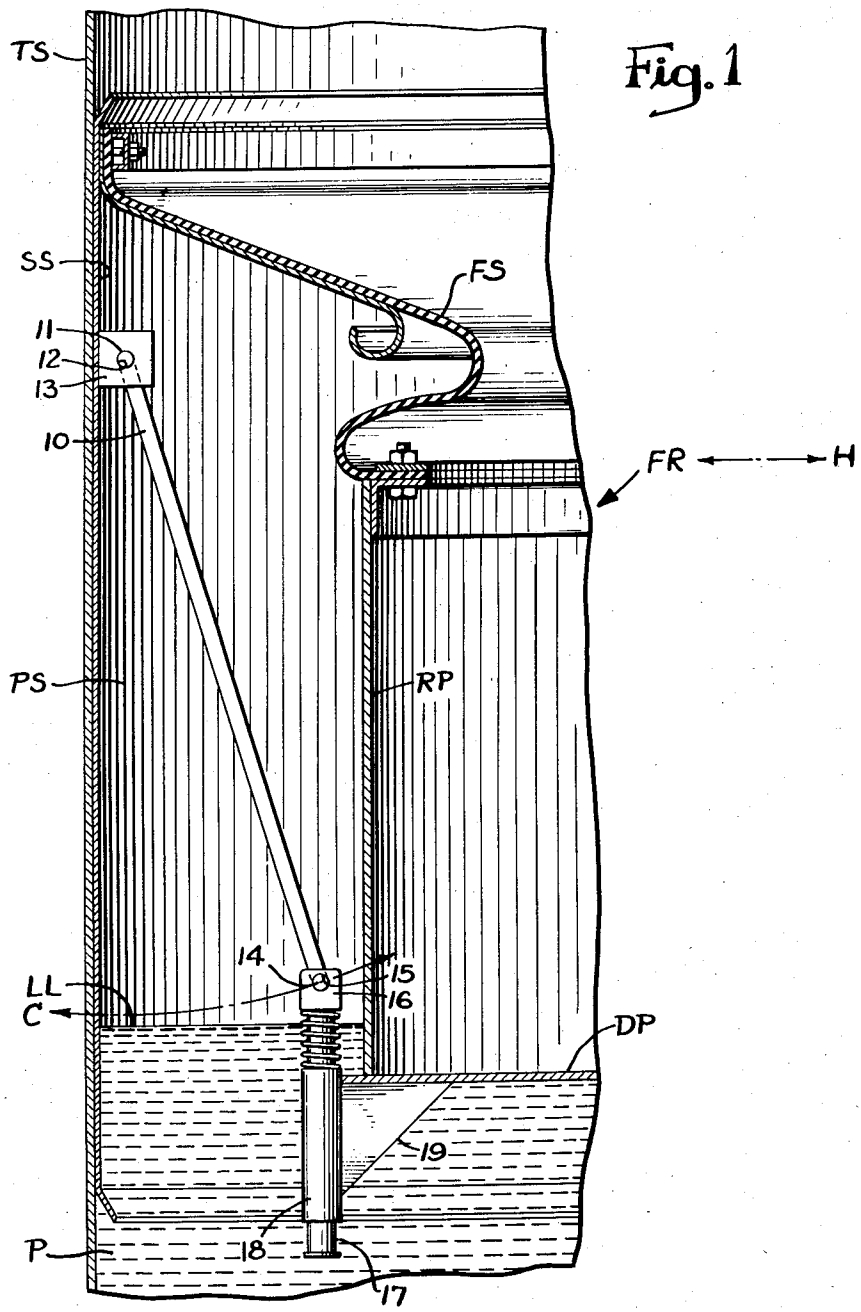


Fig. 1

Inventor
Reign C. Ulm
by: F. D. Praytor Atty.

March 6, 1956 R. C. ULM 2,737,310

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Filed Jan. 15, 1953 2 Sheets-Sheet 2

Fig.2

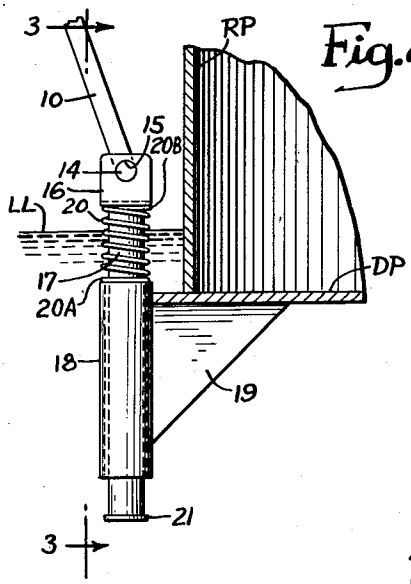


Fig.3

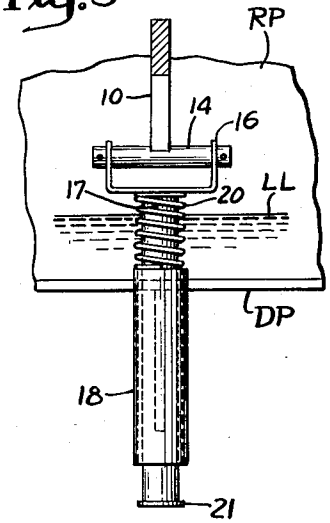


Fig.4

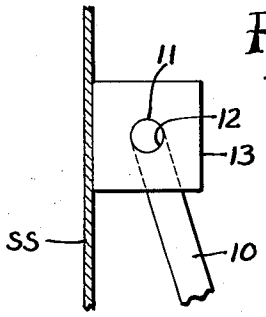
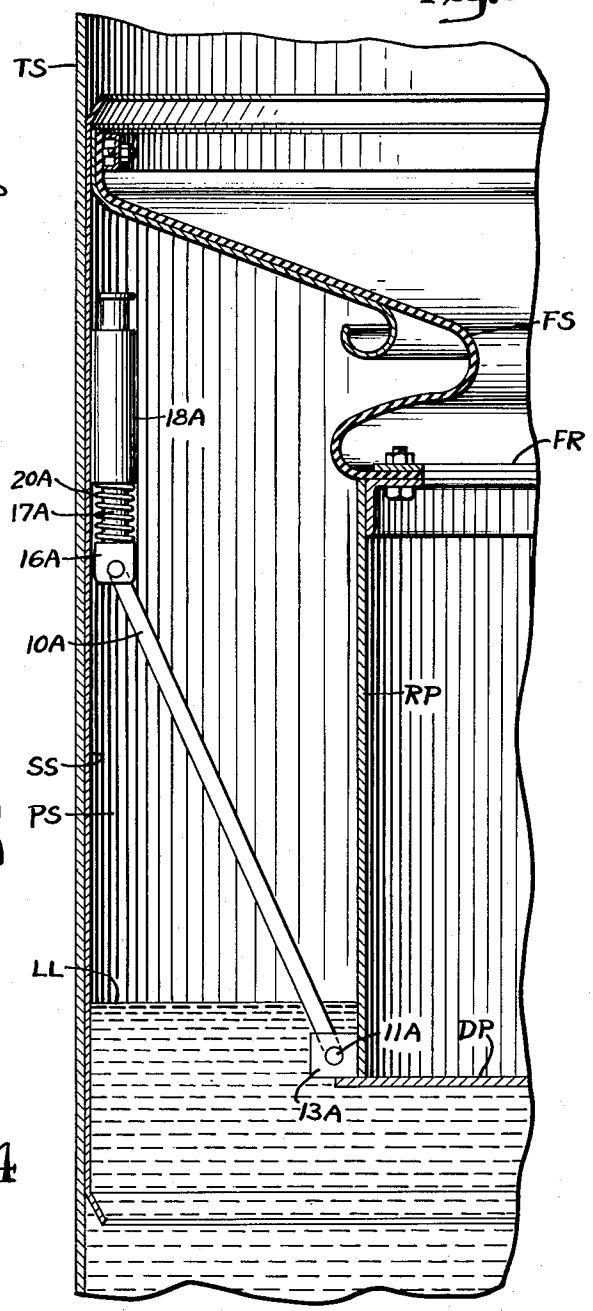


Fig.5



Inventor
Reign C. Ulm

by: F. D. Ray Atty.

United States Patent Office

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FLOATING ROOF

Reign C. Ulm, Schererville, Ind., assignor to Graver Tank & Mfg. Co. Inc., East Chicago, Ind., a corporation of Delaware

Application January 15, 1953, Serial No. 331,413

1 Claim. (Cl. 220—26)

This invention relates to improvements in the seal mechanism for a floating roof, as used for the protection of volatile products such as gasoline. This is a continuation in part of my copending application S. N. 319,806, now Patent No. 2,650,738, issued September 1, 1953.

Said earlier application has disclosed a combined seal shoe supporting and seal action maintaining mechanism, utilizing a resiliently extensible arm which pivotally interconnects a lower part of the floating roof with an upper part of the seal shoe. Such an arm furnishes adequate support for the seal shoe; and since it is resiliently extensible it efficiently and economically avoids certain distortions of the seal shoe, as explained in my earlier application. The arm can be formed very simply by telescoping pipes, resiliently extended by a coaxially arranged compression spring, and terminally pivoted. In said earlier application the arm has been shown in that form.

I have discovered that further improvement is possible by interposing at least one of the required pivots between a resiliently extensible part and the arm itself, rather than vice versa. In this new and preferred arrangement, an angle (of variable magnitude) is formed between the arm and the spring or equivalent device. Theoretically, such an angular arrangement seems unnecessary and odd; however, in practice it has definite advantages. This applies mainly, but not exclusively, if the spring is interposed between the lower, inner end of the arm and the floating roof.

It is a basic object of this application to secure these further advantages.

A particular object and feature is, separation of the rigid arm from the resilient spring or equivalent device, in order that each can be constructed of materials most suitable for its particular functions. Both efficiency and economy are thus enhanced.

Another particular object and feature is, improved lubrication of the extensible or slidable parts. This leads to a longer and more successful life for such parts.

These and other features will be understood more clearly from the description of preferred embodiments, which follows.

In the drawing:

Figure 1 is a partial cross-sectional view of a floating roof utilizing the present invention.

Figure 2 is an enlarged detail from Figure 1.

Figure 3 is another view of the detail of Figure 2, the view being taken along lines 3—3 of Figure 2.

Figure 4 is another enlarged detail from Figure 1; and Figure 5 is a view generally similar to Figure 1, showing a slight modification of the apparatus of that figure.

Referring first to Figures 1 to 4:

The floating roof FR floats on the liquid level LL of the product P stored within the tank shell TS. The rim plate RP of the floating roof FR is separated from the inside of the tank shell TS by a peripheral space PS in order to avoid frictional interference between metallic members TS and RP, while allowing the tank shell TS to be built and operated economically, that is, without

extreme precaution against the occurrence of out-of-roundness, plate irregularities, rough seams and the like.

The bulk of product P is protected from evaporation loss by the deck plate DP of the floating roof. In order to avoid evaporation loss also in the peripheral space PS, that space is covered by a flexible seal FS of annular shape. The inner edge of this seal is secured to the top of the rim plate RP. The outer edge has a thin, metallic seal shoe SS marginally secured thereto, which bears against the inside of the tank shell TS. Preferably said outer edge is located above the top of the rim plate RP, and the seal shoe SS extends downward to an elevation below the liquid level LL. Horizontally, the seal shoe extends around the entire floating roof FR. Usually it has one or several expansion joints, of well known construction, not shown. The number of these joints is minimized since they are expensive and relatively inefficient for vapor sealing. As a result, the thin seal shoe SS is only horizontally flexible and vertically rigid.

The weight of the seal shoe SS and a substantial part of the flexible seal FS must be supported from the floating roof FR. This is achieved by rigid support or hanger arms or struts **10**, which are suitably spaced around the floating roof and which pivotally interconnect the floating roof and seal shoe structures.

For this purpose a horizontal pivot pin **11** extends across or through the upper end **12** of each arm **10**. It is pivoted in a pair of pivot clips **13** secured to an upper part of the seal shoe SS. Another pivot pin **14** is secured to the lower end **15** of the arm **10** and pivoted in a clevis **16** which is held to a lower part of the floating roof FR. The connection between the clevis **16** and the floating roof FR is vertically yielding and resilient. This is achieved by securing the clevis **16** to an upright, solid or tubular slide member **17**, vertically slidable within and guided by an outer, tubular guide or slideway member **18**. That member is rigidly secured to the underside of the deck plate DP by a gusset **19**. A vertically oriented compression spring **20** is interposed, with a bottom end **20A** rigidly bearing against the top of the guide member **18**, and with a top end **20B** rigidly bearing against the underside of the clevis **16**. Preferably the spring coaxially surrounds the slide member **17**. Excessive upward expansion of the spring **20** and loss of engagement between the members **17** and **18** is prevented by a stop plate **21**, secured to the bottom end of the slide member **17** below the bottom of the guide member **18**.

It is also possible, as shown in Figure 5, to reverse the relative positions of the rigidly attached clips **12** and the resiliently supported clips **16**. In other words, a support arm **10A** may be pivoted by a pin **11A** to clips **13A** secured to the bottom part of the floating roof FR; and the upper, outer end of the arm **10A** may be pivoted to a clevis **16A** resiliently secured to the seal shoe SS by a slide member **17A** within a guide member **18A** secured to the shoe.

The arrangement of Figure 1 has the important advantage that the relatively slidable members **17** and **18** are permanently lubricated by the product P. Also, a maximum of design flexibility is provided for the seal shoe SS. In the arrangement according to Figure 5, inspection and servicing of the slidable and spring loaded members **17A**, **18A** is facilitated. Both embodiments differ from those of my earlier application in that the resilient spring and slide member is separated from the rigid arm itself, so that the entire arm can be made of material best suited to its function as a strut, for instance plain, mild steel, or galvanized steel, while the spring and slide unit can be made, without excessive cost, from materials most suitable for movable devices, including stainless steel, and the like.

In operation, the local width of the peripheral space

PS, at different points thereof, is subject to change, although the average width of this space is kept substantially uniform. Local changes are caused for instance by rivets and other irregularities in the tank shell TS, or by wind pressure acting on the floating roof FR or tank shell TS or both. When such a change takes place the floating roof FR and parts rigid therewith, such as sleeve **18**, move along horizontal paths H relative to the shell. Arm **10** is constrained to rotate about pivot **11**; therefore the lower end **15** of this arm, with pivot **14** and clevis **16**, moves in a circular arc C relative to the pivot **11**. The vertical component of the arcuate movement is allowed by the resilience of the spring **20**. If it were not allowed, the upper pivot **11** with the shoe SS thereon would be forced to move in an arc about the pivot **14**, causing a deformation of the seal shoe; and due to the vertical rigidity of the shoe such deformation would extend over a substantial area of the peripheral space PS, causing undesirable loss of sealing efficiency.

Such losses are effectively prevented by the new support arm connector **17, 18, 20**. Further, as shown above, the connector as well as the arm itself can remain in successful and economical service over an extended period of time.

I claim:

In a support arrangement for a seal shoe member for use on an upright liquid storage tank having a shell and a floating roof member within the tank in spaced relation to the shell, said shoe member surrounding the roof member and engaging the inner periphery of the shell and providing a space between the members, the combination of resilient hanger means located in the space between the members and providing a flexible connection between the members, said resilient hanger means comprising a rigid hanger arm in general angular relation to the vertical and extending between the members, a pivot on one member connected to one end of the arm and a flexible connection between the other end of the arm and the other member, said flexible connection constituting the only connection between the other end of the arm and said other member, said connection comprising a guide element and an element having a substantially vertical slot therein to slidably receive and guide the guide element, one of said elements being pivotally connected to the other end of the arm and the other of said elements being fixedly connected to the other member, abutments on both of said elements, and a compression spring interposed between and having its opposite ends engaging the abutments to provide resilient relative movement between the elements, whereby, the pivot, the hanger arm, said one element, the compression spring and the other of said elements are in operative series relation to each other.

References Cited in the file of this patent

UNITED STATES PATENTS

1,673,984	Kuhl	June 19, 1928
2,148,811	Griffin	Feb. 28, 1939
2,478,422	Plummer	Aug. 9, 1949
2,542,444	Wilkin	Feb. 20, 1951
2,576,136	Moyer	Nov. 27, 1951
2,587,508	Moyer et al.	Feb. 26, 1952
2,696,930	Moyer	Dec. 14, 1954