

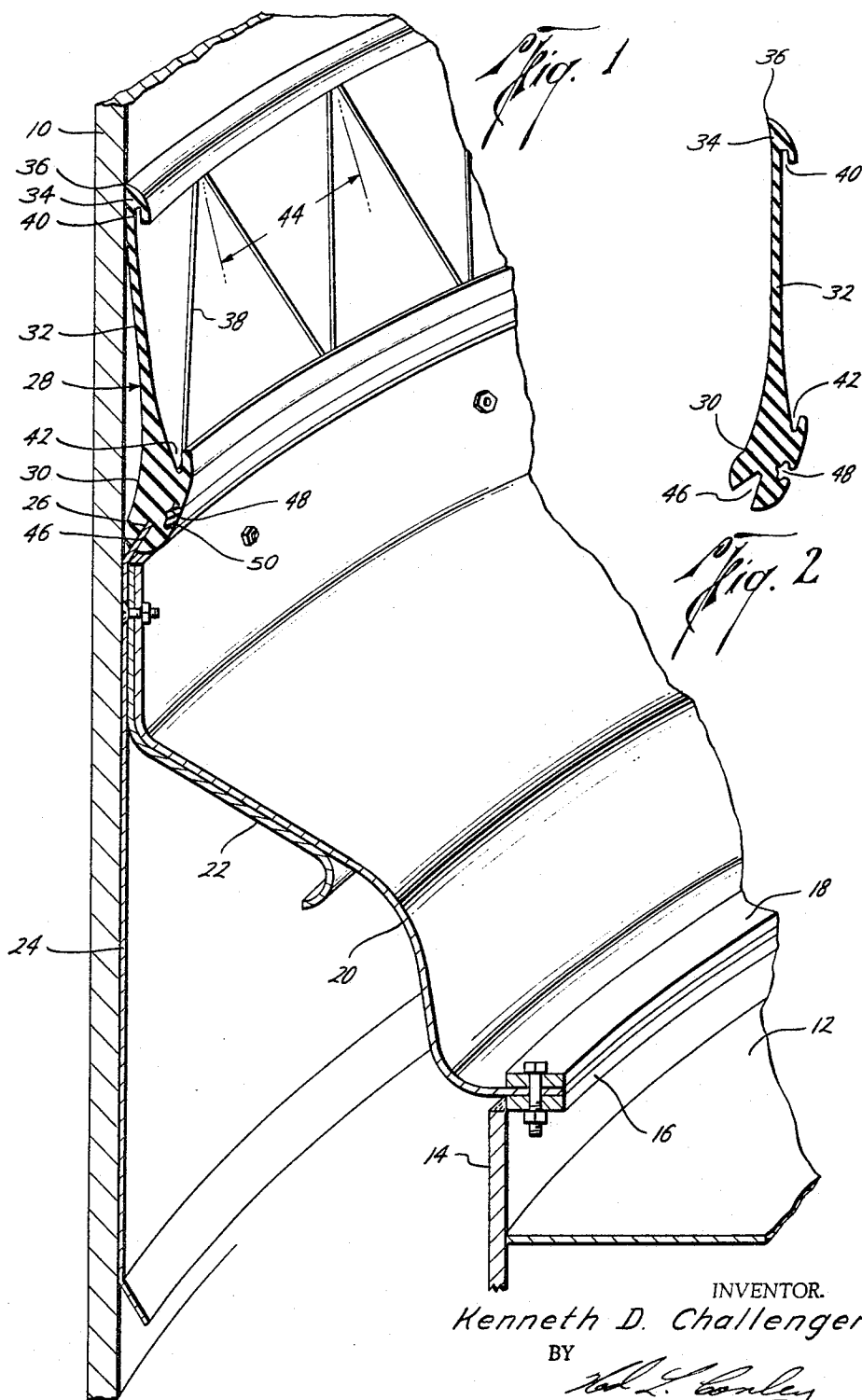
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SECONDARY SEAL

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1

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SECONDARY SEAL

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7 Claims. (Cl. 220-26)

This invention relates to storage tanks such as for oil and oil products and the like of the type having a floating roof or covering that floats on the liquid stored in the tank so that it rises and falls with the liquid level, and more particularly it relates to improved means for providing a seal between the periphery of the roof and the wall of the tank in which the roof is used.

In tanks of this type a problem is encountered in providing and maintaining an effective seal between the edge of the floating roof and the wall of the tank. Necessarily the roof is spaced inwardly of the wall of the tank so as to leave annular space therebetween. It has previously been the practice to provide guide shoes which are attached to the roof and which are resiliently biased against the wall of the tank and which include a flexible seal member extending from the guide shoe to the tank to provide means for preventing foreign material from falling through the annular space into the oil or oil products stored below the roof. For example one such structure is as is shown in U.S. Patent No. 2,478,422. To further insure against leakage a secondary seal of resilient material such as rubber extending between the guide shoe and the wall of the tank is sometimes used. However considerable difficulty has been encountered in maintaining the secondary seal in sealing engagement with the guide shoe and the wall of the tank.

The present invention has for its principal object the overcoming of difficulties heretofore encountered in attaining and maintaining the secondary seal in sealing engagement with both the guide shoes and the wall of the tank. According to an embodiment of this invention a secondary seal is provided which has a groove for sealingly engaging the upper edges of the guide shoes and means for forcing the walls of the groove into sealing engagement with such upper edges. Furthermore flexible stiffening means are provided to engage the secondary seal to maintain the seal in engagement with the wall of the tank. Such separate stiffening means are separable from the secondary seal and are insertable into the secondary seal after installation of the seal to provide the desired stiffening. The stiffening means is in the form of an undulatory or wavy spring which extends substantially from the guide shoe engaging portion of the secondary seal to the tank wall engaging portion of the seal.

For a better understanding of the invention reference is now made to the following description and to the attached drawing, wherein—

FIGURE 1 is a fragmentary sectional view showing one embodiment of an installation according to this invention, and

FIGURE 2 is a sectional view of a seal member embodying this invention.

FIGURE 1 depicts a cylindrical wall 10 of a conventional oil storage tank. The floating roof 12 of the tank is a hollow body having a relatively short height and having a diameter somewhat smaller than the inside diameter of the tank. In the embodiment shown the floating roof is provided with an upstanding wall 14 around its circumference to retain on the roof any foreign materials which may fall into the open top of the tank. The wall 14 has at its upper end an intumed flange 16 which, together with the clamp ring 18, provides means to attach to the floating roof a flexible primary seal member 20. The primary

2

seal is supported by a segmented support ring 22 each segment of which support ring is attached to a guide shoe 24. The guide shoe support rings are made in short sections, as is well known in the art but not shown in the drawing, extending around the circumference of the tank. Generally the guide shoes are biased against the inside of the wall 10 of the tank by means not shown here, but which are well known in the art, so that the guide shoes are held in contact with the wall as the floating roof rises and falls with changes in the liquid level in the tank.

The guide shoes are provided at their upper edges with intumed flanges 26 which form an acute angle with the wall of the tank. The flanges 26 are sealingly engaged by an annular secondary seal member 28. The seal member 28 comprises a relatively thickened flange engaging portion 30, a relatively thinned intermediate web portion 32, and a thickened outer wall engaging outer edge 34. The wall engaging portion 34 is provided with a tapered sealing lip 36, which is adapted to sealingly engage the wall of the tank. As best seen in FIGURE 2, in its normal condition (prior to installation) the intermediate web portion is straight, being substantially flat on both surfaces and of substantially uniform thickness. However, the width and shape of the secondary seal member are such that upon installation on the flanges 26, the wall engaging portion bends upwardly so that the web portion is curved upwardly slightly and a portion of the web contacts the tank wall. However, the rubber or other resilient material used has the characteristic of taking a set in a stressed position so that a firm engagement of the secondary seal with the tank wall is not maintained. The maintenance of such firm engagement is made particularly difficult by welds or other minor protuberances on the inside of the tank wall. However, according to this invention, the thickened outer edge 34, a small portion of the intermediate web, and the sealing lip 36 are held in engagement with the wall of the tank by means of a resilient undulatory or wavy spring member 38 which is engaged, in a plane substantially parallel to the intermediate web 32, in oppositely facing grooves 40 and 42 formed in the thickened portions 30 and 34. These grooves have a width about the same as or slightly greater than the thickness of the spring wire, and a depth preferably at least about twice the width.

The spring 38 is preferably made of stainless steel or bronze wire or similar corrosion resistant material having a diameter usually less than about $\frac{1}{16}$ inch. Preferably the pitch of the spring, indicated by the numeral 44, is no greater than its height, in order to obtain relatively high radial stiffness without making the installation of the spring too difficult.

The thickened portion 30 of the secondary seal member is provided with an annular substantially downwardly opening groove 46 which sealingly engages the lips 26 on the guide shoes. The thickened portion 30 also has a wedge shaped annular groove 48 on its inner side and beginning just above the bottom of the lip engaging groove 46. As seen in FIGURE 2, the lip engaging groove 46 is, in its initial condition, opened so that it is wider at its outer edge than at its bottom, and is closed tightly upon the lips 26 of the guide shoes by inserting a wedge 50 into the wedge shaped groove 48. The wedge 50 forces the walls of the groove 46 together to sealingly engage the lips 26. The outer edge of wedge shaped groove 50 is reversely tapered to provide a lock tending to prevent the wedge 50 from being forced out.

The secondary seal member of this invention is preferably made of resilient plastic material, such as a synthetic rubber, which is preferably resistant to both hydrocarbons and water. Preferably the wedge 50 is of the same material.

Installation of the secondary seal of this invention is highly facilitated by its novel design. The flanges 26 of the guide shoes are preferably cleaned and then coated with cement such as rubber cement or an epoxy resin. The groove 46 of the secondary seal is then slipped onto these flanges. Because of the thinned web 32 of the secondary seal this portion is relatively flexible so that although the outer portion 34 and sealing lip 36 of the secondary seal are engaged with the wall of the tank to the point that intermediate portion 32 is bent into a reverse curve and a part of the intermediate portion is engaged with the wall of the tank, there is insufficient force exerted to prevent adequate engagement of the groove 46 with the inturned flanges 26 of the guide shoes. Once the groove 46 is thusly engaged, the wedge 50 may be inserted into the groove 48 so as to force the thickened portion 30 into secure gripping engagement upon the inturned lips 26.

Once this is accomplished the spring 38 is inserted into the oppositely facing grooves 40 and 42. To accomplish this the spring may be manually stretched for ease of insertion into the grooves. Upon release the spring will of course contract so as to exert a force against the bottoms of the grooves 40 and 42 and thereby substantially stiffen the intermediate thinned web 32. It will be noted that after installation of the secondary seal grooves 40 and 42 are not directly in alignment, but instead groove 42 is facing a point below groove 40. Thus the walls of the groove 42 bear upon the portions of the spring within the groove and tend to bend the outer or upper edge of the spring downwardly and radially outwardly, so as to exert a radial force on the outer edge of the secondary seal. Thus although the intermediate thinned section 32 has a flexibility such that installation of the secondary seal is facilitated, the use of the spring 38 after the secondary seal member is installed greatly increases the resilient force tending to hold the outer thickened portion 34, the lip 36, and a part of the intermediate portion 32 into sealing engagement with the wall of the tank.

As a consequence of such tight sealing engagement and the flexibility afforded by the use of the undulatory or wavy spring the sealing lip 36 is maintained in good engagement with the wall of the tank as the floating roof moves up and down with change in the level of the liquid therein even over welds and other interruptions in the smooth interior face of the tank wall.

Although a preferred embodiment of this invention has been shown and described herein the invention is not limited to such embodiment but only as set forth by the following claims.

I claim:

1. A secondary seal for use with a floating roof in an open-end tank comprising
 - a flexible annular seal member adapted to fixedly engage the edge of said floating roof and to slidably engage the inside wall of said tank, said seal member comprising

a relatively thickened annular edge adapted to fixedly engage the edge of said floating roof,
a relatively thinned intermediate annular portion, and
a thickened wall-engaging edge, and including
an undulatory spring spanning said intermediate portion and bearing against said edge portions to bias said wall-engaging edge into engagement with said wall.

2. A secondary seal as defined by claim 1 and including oppositely facing grooves in said thickened edges in which said spring is removably received.

3. A secondary seal as defined by claim 2 wherein the pitch of said spring is no greater than its height.

4. In combination with an open end container for holding liquids,

a floating roof therefor adapted to move upwardly and downwardly in said container with changes in the liquid level in said container,

a primary seal having a plurality of shoes supported by said roof in contact with the inside wall surface of said container, and

a secondary seal affixed on the inwardly extending top edges of said plurality of shoes of said primary seal and slidably contacting said inside wall surface, said secondary seal comprising a flexible annular member having

a relatively thickened annular edge fixedly engaging the inwardly extending top edges of said plurality of shoes,

a relatively thinned intermediate annular portion, and
a thickened wall-engaging edge, and including
an undulatory spring spanning said intermediate portion and bearing against said edge portions to bias said wall-engaging edge into engagement with said wall.

5. The combination of claim 4, and including oppositely facing grooves in said thickened edges in which said spring is removably received.

6. The combination of claim 5, wherein the pitch of said spring is no greater than its height.

7. The combination of claim 5, wherein the walls of the groove in the shoe-engaging thickened edge bear against the portions of the spring in that groove so as to cause the portions of the spring in the other groove to bear radially outwardly against the wall-engaging edge of the member.

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