July 2, 1968 H. SMITH 3,390,803

EXPANSION JOINT FOR FLOATING ROOF SEALING ASSEMBLY

Filed March 22, 1967 2 Sheets-Sheet 1

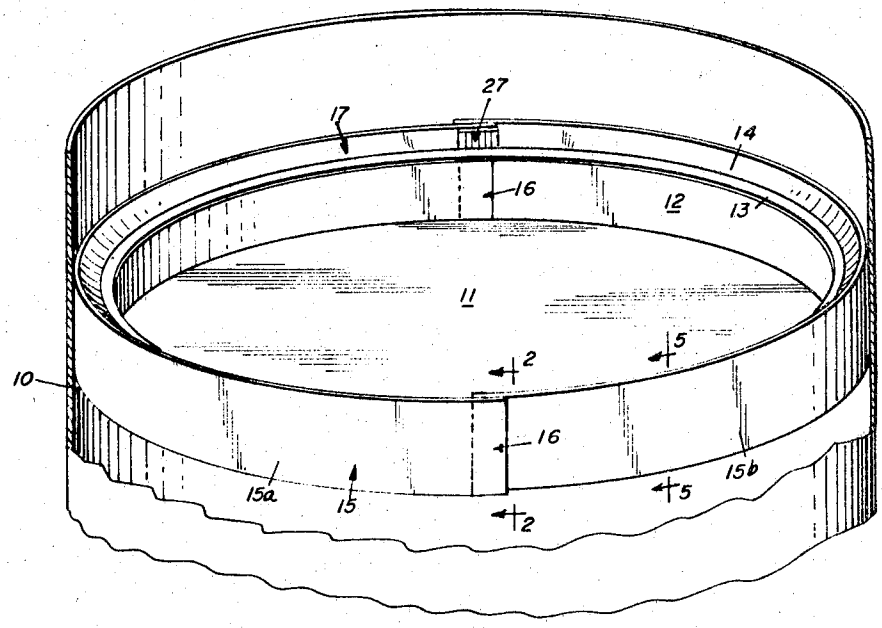


FIG. 1

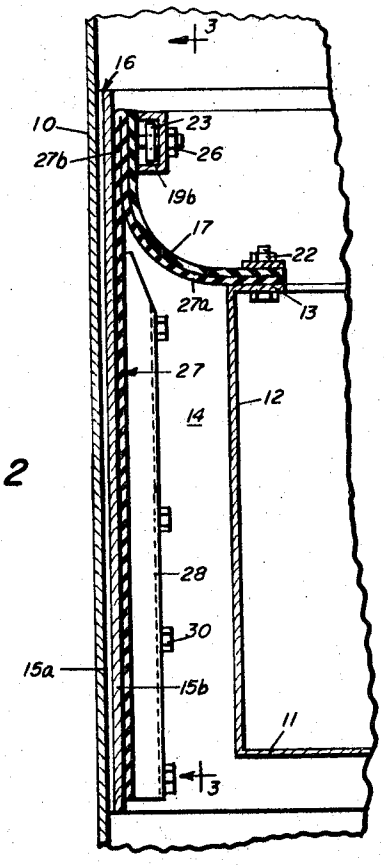


FIG. 2

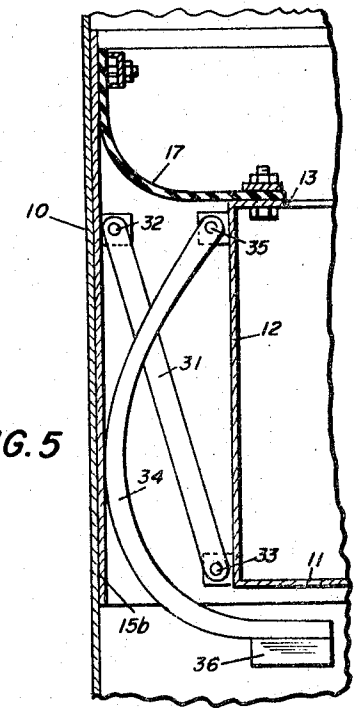


FIG. 5

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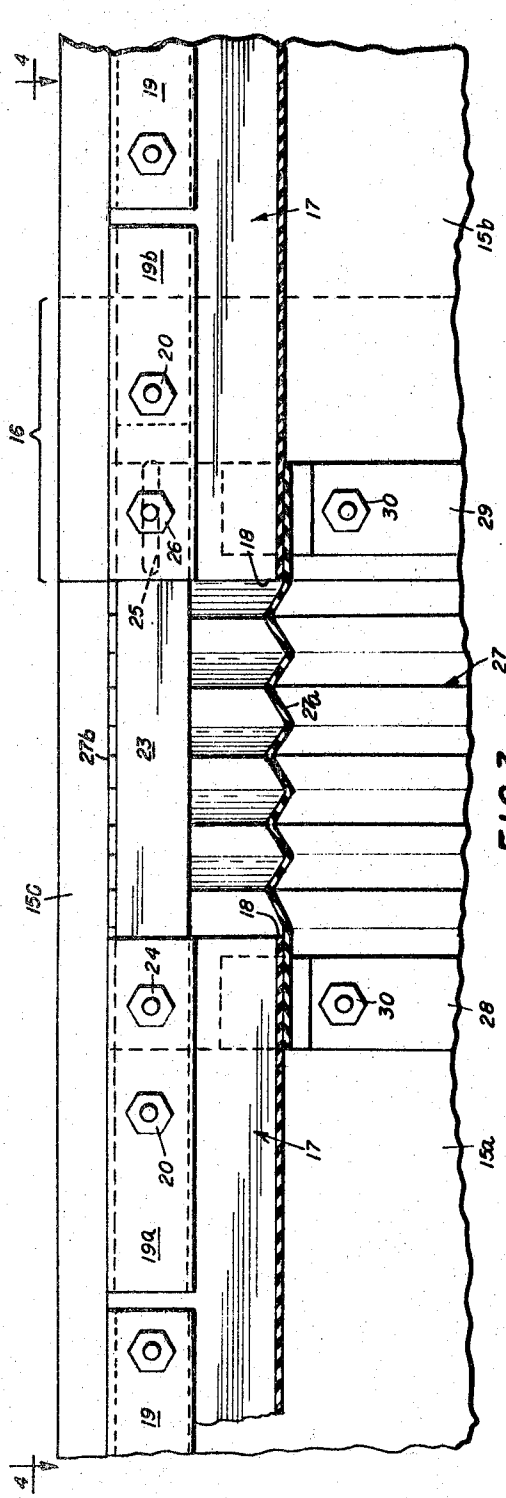


FIG. 3

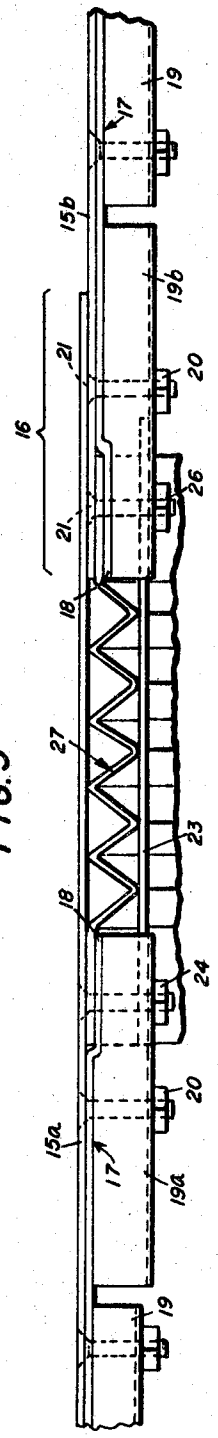


FIG. 4

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EXPANSION JOINT FOR FLOATING ROOF SEALING ASSEMBLY

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ABSTRACT OF THE DISCLOSURE

A peripheral sealing assembly for a fluid storage tank having a floating roof, including a multiple section shoe ring which embraces the inner surface of the tank wall with the longitudinal extremties of the sections of the ring in slidable overlapping relation. A multiple section master seal strip extends from the upper portion of the shoe ring to the floating roof, and its longitudinal extremities are relatively spaced adjacent the area of the overlapping portions of the shoe ring. A continuous expansion joint comprising a corrugated sealing web bridges the spaced ends of the master seal and the overlapping portions of the shoe ring and is expandible and contractible in response to relative sliding movement of the ends of the shoe ring sections.

Background of invention

Conventional fluid storage tanks of the type employing a floating roof vapor seal are generally provided with an annular shoe ring seal formed of a plurality of arcuate plates which collectively embrace the inner wall of the tank in slidable relation, and are urged radially against the tank wall by suitable hangers which are attached to the shoe ring and the floating roof and pushers which are attached to the floating roof. At the junctions of the respective sections or plates, expansion joints are provided to accommodate for relative movement of the plates under expansion and contraction to accommodate variations in tank shell circumference. The annular space between the shoe ring and the floating roof is usually sealed by a continuous strip of fabric or the like extending from the upper edge of the shoe ring to the rim of the floating roof.

These conventional structures have been found to be deficient in providing adequate peripheral sealing because of the fact that in the areas where the shoe sections abut and the adjacent areas of the continuous peripheral sealing strip, there is no continuous expansion joint to adequately accommodate for expansion and contraction in the area from a point at or near the top of the shoe ring to the point of connection of the sealing strip to the floating roof. These structures must rely upon distortion, folds, stretching or slack in the material used for the sealing strip to accommodate any circular or horizontal expansion or movement of the shoe ring sections, which does not provide for adequate expansion in these areas.

Illustrative of a number of patents directed to this general field are Patents Nos. 1,574,013 to Wiggins and 1,931,551 to Larson.

Summary of invention

The present invention overcomes these difficulties by providing an expansion joint which extends continuously from at or near the bottom of the shoe ring, upwardly to or near the top of the shoe ring, and then radially inwardly to the edge of the floating roof. The shoe ring of the invention is preferably formed of two or more arcuate sections or plates which, as in the case of prior shoe rings, are maintained in slidable engagement with the inner surface of the tank shell. According to the invention, the terminal edges of respective plate sections

are arranged in overlapping relation at the expansion joint locations in order to provide for expansion and contraction, and a master seal is attached to the upper portion of the shoe ring and extends radially inwardly where it is connected to the floating roof. The master seal, as in the case of the shoe ring, is formed of two or more sections, each annularly spaced at its adjacent end from the next section, the spaces being arranged in the areas of the overlapping portions of the shoe ring sections.

Thus, the continuous expansion joint which is preferably formed of a strip of corrugated gas-tight material functions to accommodate expansion at any point from at or near the bottom of the shoe ring, to the top of the shoe ring, and thence to the connection of the master seal to the floating roof. The opposite side edges of the expansion joint web are connected in the respective areas to the opposite overlapping portions of the shoe ring sections and to the spaced edges of the master seal sections and to the floating roof, which provides far more freedom of movement in the expansion and contraction cycles of the complete peripheral sealing assembly and results in an improved shoe fit to the shell of the tank.

The drawings

Referring to the dawings in which numerals of like character designate similar parts throughout the several views:

FIG. 1 is a fragmentary perspective view, partially in section, illustrating the upper portion of a storage tank with the floating roof and peripheral sealing assembly installed;

FIG. 2 is an enlarged sectional view taken on line **2—2** of FIG. 1;

FIG. 3 is an enlarged sectional view taken on line **3—3** of FIG. 2;

FIG. 4 is a similar view taken on line **4—4** of FIG. 3; and

FIG. 5 is a fragmentary sectional view taken on line **5—5** of FIG. 1, illustrating one form of hanger and pusher arrangement for supporting the shoe ring assembly and maintaining sealing engagement of the shoe ring with the shell of the tank.

Description of preferred embodiment

Referring first to FIG. 1 of the drawings, **10** represents a conventional cylindrical fluid storage tank having the usual floating roof **11**, having a vertically extending annular wall **12** open at its upper extremity where it terminates in an inturned flange **13**. The floating roof and its wall **12** are inwardly spaced from the shell of the tank **10** by an annular clearance **14**, and the purpose of this invention is to provide an improved peripheral sealing assembly for this annular clearance.

This assembly includes a shoe ring generally indicated at **15**, which is preferably made up of at least two arcuate shoe ring sections **15***a* and **15***b*, the meeting extremities of respective sections being arranged in sliding, overlapping relation, as at **16**, to accommodate relative sliding movement of the sections during expansion or contraction of the shoe ring. A master seal **17** of flexible, gas-tight material is secured along one longitudinal edge to the shoe ring **15** by means to be described, and overlies the annular clearance **14** between the tank shell and the floating roof, its opposite edge being connected to the flange **13** at the upper end of the floating roof wall **12**.

This master seal is also formed in sections corresponding to the number of sections in the shoe ring, and adjacent ends of the master seal sections are relatively spaced longitudinally as at **18** in the areas of the overlaps **16** of the shoe ring, as best seen in FIGS. 3 and 4. Thus, upon expansion and contraction of the shoe ring sections, the spaced ends **18** of the master seal move correspond-

ingly with the respective sections so that the individual sections of the master seal are not disturbed by bunching, stretching, or bulging.

The outer edge of the master seal is secured to the upper end of the shoe ring by a series of annularly spaced clamps **19**, bolted or otherwise fastened as at **20**. Preferably, the heads of the bolts **20** are inset as at **21** to facilitate the sliding engagement of the overlapping ends **15***a* and **15***b* of the shoe ring sections, as well as to permit a closer fit of the shoe ring to the tank shell. The opposite edge of the master seal is secured to the floating roof flange **13** by bolts **22** or other suitable means, as in FIG. 2.

In order to guide and control the relative sliding movement of the overlapping ends of the shoe ring sections, the two clamping members **19***a* and **19***b*, adjacent the spaced extremities of the master seal in the overlapping area of the shoe ring, are preferably in the form of horizontal channel irons, designed to receive opposite ends of a control bar **23**, one end of which is fixedly secured within the channel **19***a* by bolt **24**. The opposite end of the control bar is slotted as at **25** and extends within the opposite channel iron **19***b*, a bolt **26** in the channel iron slidably engaging the slot **25**. Thus, relative movement of the overlapping ends of the shoe ring is directionally controlled and limited in extent by the slot **25** and bolt **26**.

One of the primary features of the invention resides in the provision of an expansion joint for sealing both the overlapping ends of the shoe ring sections and the spaced ends of the master seal sections, adjacent these overlapping areas. In the preferred form of the invention, this expansion joint comprises a continuous, corrugated web of flexible, gas-tight material, as shown at **27** in FIGS. 3 and 4. Opposite edges of this web are clamped directly to the inner surfaces of the shoe ring sections **15***a* and **15***b* by vertically disposed clamping bars **28** and **29** respectively, secured by bolts or other suitable means **30**, as best seen in FIGS. 2 and 3. The same opposite side edges of the corrugated web **27** in the areas of the spaced ends of the master seal sections are secured to respective spaced ends by suitable clamps, adhesive or vulcanizing, so that the corrugated web will expand and contract with corresponding movements of the master seal and shoe ring sections.

As seen in FIG. 2, the upper portion **27***a* of the corrugated web overlies the annular clearance **14**, surrounding the floating roof, contiguous with the corresponding portions of the master seal. Preferably, the inturned portion **27***a* of the expansion joint web, adjacent the top of the shoe ring, is folded upon itself as at **27***b*, where it is clamped both to the edges of the respective master seal sections and to the adjacent area of the shoe ring by the channel iron clamps **19***a* and **19***b*. Its opposite inturned edge is secured to the floating roof flange **13** by the same bolts **22** which clamp the corresponding edge of the master seal.

Thus, in the area of the overlapping ends of the shoe ring sections, a continuous expansion joint seal is provided which extends from at or near the bottom of the shoe ring, to a point at or near the top of the shoe ring and thence inwardly where it is connected to the floating roof. This minimizes any leakage at these points and provides a free and easy movement of the overlapping shoe ring ends under conditions of expansion and contraction.

While I have shown and described a corrugated sealing web for the expansion joint, it is to be understood that in some instances, a flexible web without prefabricated corrugations may be feasible, provided the material of the web is such that upon expansion and contraction of the shoe ring, the web would adapt itself to accommodate the necessary expansion and contraction. Otherwise, the construction and installation of the web would be the same as that previously described. In other words, the web would extend continuously from a point adjacent the bottom of the shoe ring to a point adjacent the top of the shoe ring and then continue radially inwardly where it is connected to the floating roof.

Conventional shoe rings are ordinarily provided at their upper and lower edges with inturned flanges, and, in most instances, the adjacent ends of the shoe ring sections abut and are provided with so-called expansion joints. I have found that by eliminating any flanges at the top or bottom of the shoe ring and overlapping the adjacent longitudinal ends thereof, a considerably improved performance is obtained. The previous inturned flanges, particularly at the top, had the effect of trapping rain and permitting it to leak in behind the shoe ring, a problem which the unflanged shoe avoids. Furthermore, the elimination of flanges tends to improve the flexibility of the shoe ring and facilitates its adjustability in expansion and contraction.

Ordinarily, suitable hangers are provided for connecting the floating roof to the shoe ring, including means for urging the shoe ring outwardly into close engagement with the inner wall of the tank. While any conventional means may be employed for this purpose, FIG. 5 illustrates one form which has been found to be effective with the present invention. Here, it will be seen that a bar **31** is pivotally connected to the inner face of the shoe ring as at **32** and to the floating roof as at **33**. The upper end of a curved bar **34** is pivoted to the floating roof wall at **35**, and its opposite end, which is directed inwardly beneath the floating roof, is provided with a weight **36**. Thus, the effect of the weight is to urge the curved bar **34** into contact with the shoe ring for pushing it radially outwardly into contact with the tank wall. It will be understood that a series of these hangers are appropriately spaced around the floating roof.

From the foregoing, it is believed that the invention may be readily understood by those skilled in the art without further description, it being borne in mind that numerous changes may be made in the details disclosed without departing from the spirit of the invention as set forth in the following claims.

I claim:

1. In a cylindrical fluid storage tank having a floating roof, a peripheral sealing assembly therebetween, comprising an annular multiple section shoe ring in slidable surface contact with the inner face of the shell of said tank with the longitudinal extremities of the sections of the ring in slidably adjustable, overlapping engagement, a multiple section master seal secured along one edge to the inner surface of the upper portion of said shoe ring, with its opposite edge directed inwardly toward and secured to said floating roof, the annular extremities of the sections of said master seal, including its inwardly directed portion, terminating in spaced relation adjacent the adjustable ends of said shoe ring, a continuous expansion joint seal including a flexible sealing web bridging the spaced ends of said master seal, and the overlapping extremities of said shoe ring extending substantially from the bottom to the top edge of said shoe ring, with its upper portion inturned to meet said floating roof, means for connecting the inturned portion of said expansion joint web to said floating roof, means for connecting the side edges of said expansion joint web to the adjacent spaced ends of the master seal, and means for securing the respective spaced ends of said master seal and corresponding side edges of said expansion joint web to said shoe ring, at points adjacent opposite adjustable ends of the latter.

2. A sealing assembly as claimed in claim **1**, wherein a vertical cross-section through said shoe ring at any point lies in an uninterrupted vertical plane from edge to edge.

3. A sealing assembly as claimed in claim **1**, wherein said shoe ring is formed of a plurality of arcuate sections, adjacent extremities of respective sections being arranged in overlapping relation, and expansion joint seals being

provided adjacent the overlapping extremities of said sections.

4. A sealing assembly as claimed in claim 3, wherein said master seal is formed in sections corresponding to those of said shoe ring.

5. A sealing assembly as claimed in claim 1, wherein said expansion joint seal comprises a corrugated web to facilitate expansion and contraction.

6. A sealing assembly as claimed in claim 5, wherein respective side edges of said expansion joint web adjacent the overlapping ends of said shoe ring are secured directly to the latter.

7. A sealing assembly as claimed in claim 1, including means for directionally controlling and limiting the movement of the overlapping ends of said shoe ring upon expansion and contraction of the latter.

8. A sealing assembly a claimed in claim 7, wherein

said last-named means comprises a control bar fixed at one end adjacent one end of said shoe ring, the opposite end of said control bar being slotted for sliding engagement with an abutment fixed to the opposite end of said shoe ring.

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