

June 10, 1952

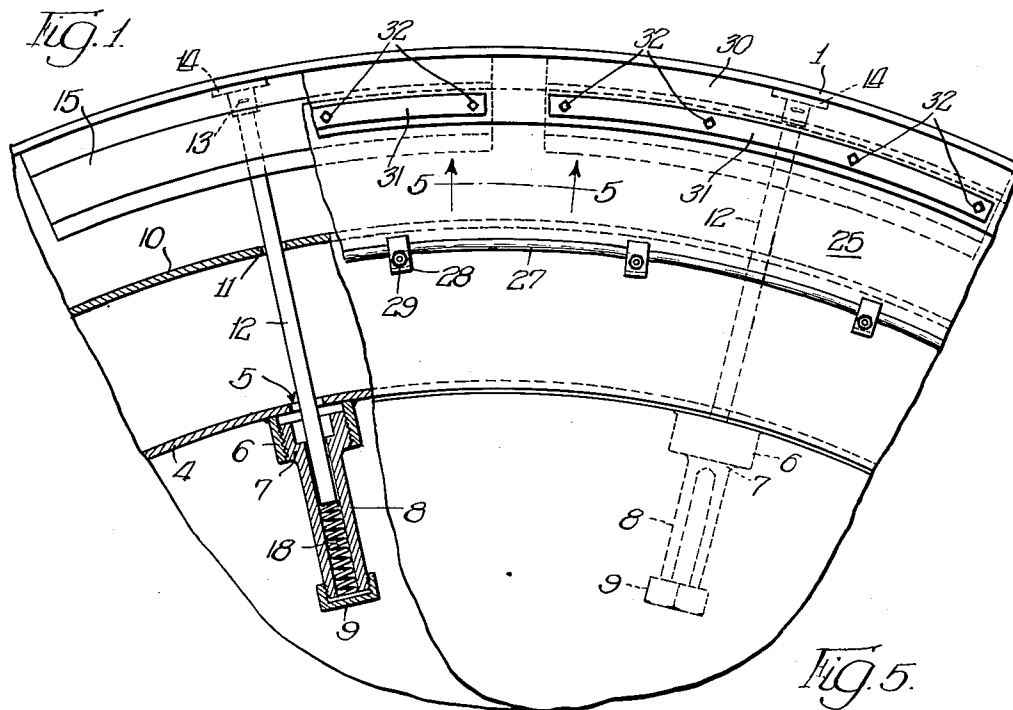
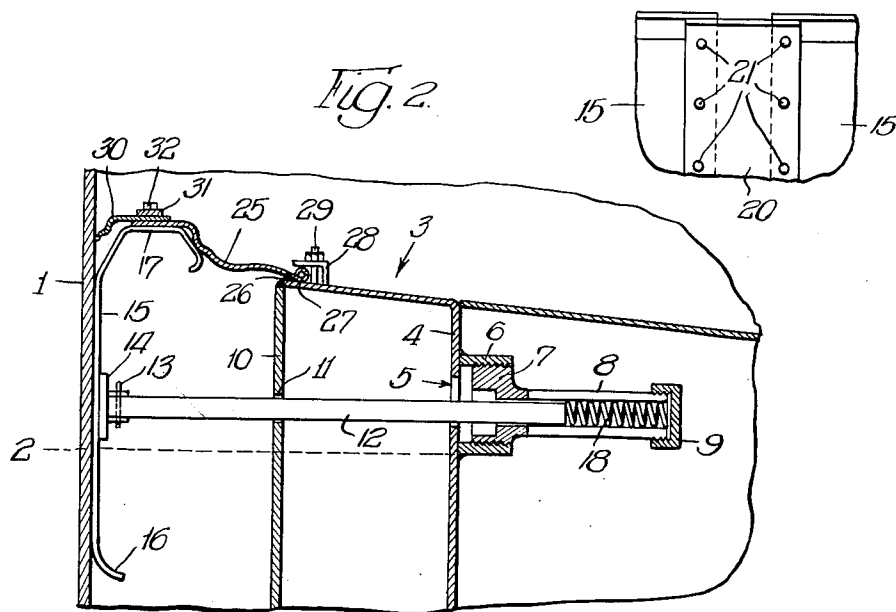
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2,600,237

CENTERING AND SEALING DEVICE FOR FLOATING TANK ROOFS

Filed May 16, 1947

2 SHEETS—SHEET 1



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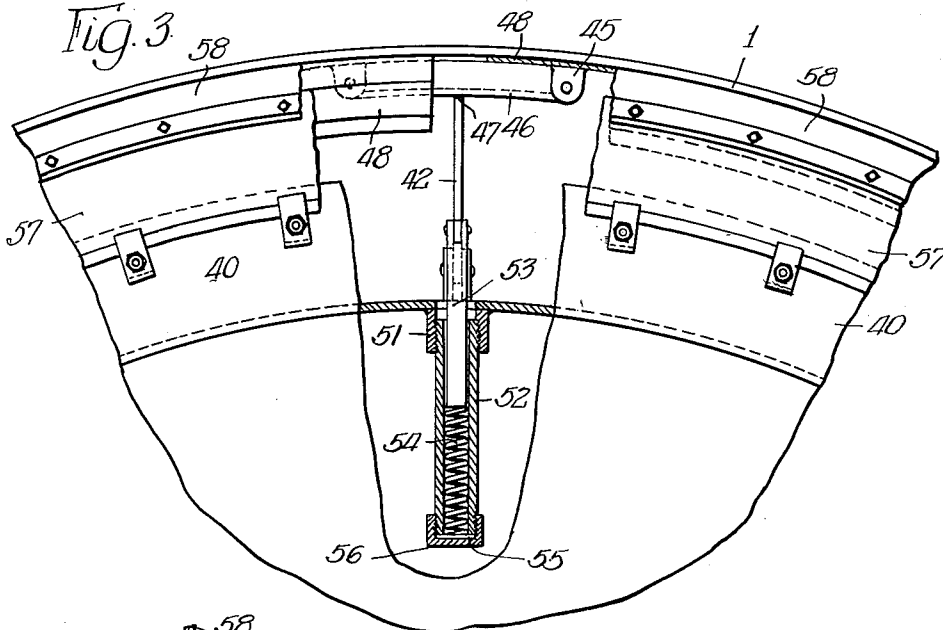
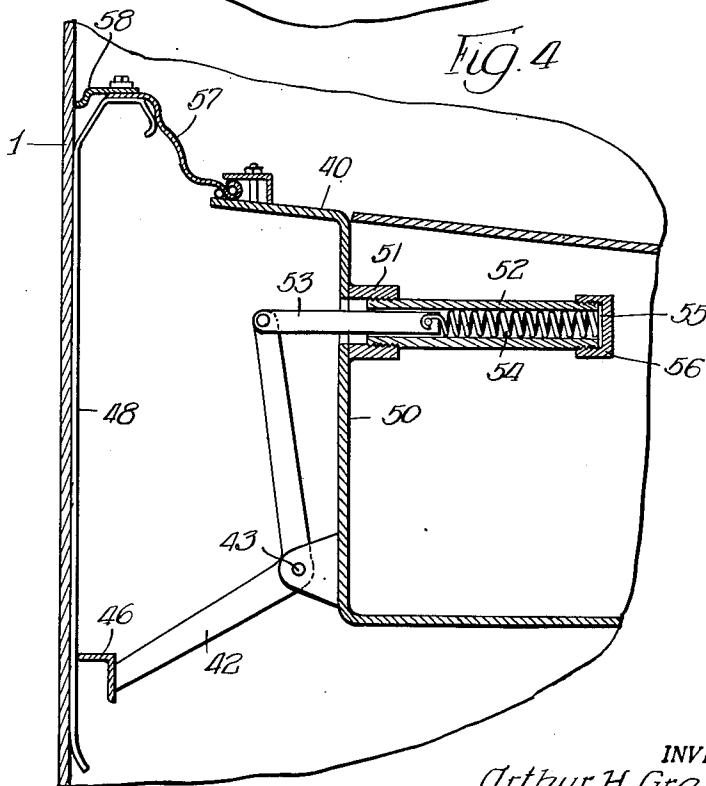
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CENTERING AND SEALING DEVICE FOR FLOATING TANK ROOFS

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2 SHEETS—SHEET 2



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UNITED STATES PATENT OFFICE

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CENTERING AND SEALING DEVICE FOR
FLOATING TANK ROOFS

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6 Claims. (Cl. 220—26)

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This invention relates to devices for centering a floating roof structure in a tank for storing volatile liquids and for sealing the space between the edge of the roof and the tank, and has for its principal object the provisions of a new and improved device of this kind.

It is a main object of the invention to provide a floating roof centering device that is of simple rugged construction, capable of being manufactured and maintained at low cost.

Another object of the invention is to provide a device for sealing the tank, which is located so as to be readily available for inspection and maintenance.

Another object of the invention is to provide a mounting for the tank engaging shoes that are attached to the floating roof, which mounting permits limited adjustment of the shoes vertically and horizontally with respect to each other and to the roof, and also permits movement of the shoes horizontally with respect to the roof and tank.

Further objects of the invention not specifically mentioned here will be apparent from the detailed description and claims which follow, reference being had to the accompanying drawings in which a preferred embodiment of the invention is shown by way of example, and in which:

Fig. 1 is a fragmentary plan view of a tank and floating roof with the devices of the invention applied thereto;

Fig. 2 is a fragmentary cross sectional view taken substantially along the line 2—2 of Fig. 1, looking in the direction of the arrows;

Fig. 3 is a fragmentary plan view with parts broken away and showing a modified form of the invention;

Fig. 4 is an elevational view of the modification shown in Fig. 3; and

Fig. 5 is a fragmentary elevational view taken substantially along the line 5—5, looking in the direction of the arrows.

Tanks for storing volatile liquids, such as for example gasoline, frequently consist of a tank shell of cylindrical configuration disposed with its axis extending vertically. The tank is closed by a roof structure which floats upon the surface of the liquid in the tank and is movable vertically as the level of that liquid varies during filling and emptying of the tank.

In the prior art of which I am aware, numerous devices have been employed to keep the floating roof centered in the tank, and, in addition, flexible sealing means have been employed to seal

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the space between the edge of the roof and the inner wall of the tank, so that gases or vapors rising from the liquid will be trapped within the roof structure where they may condense and be returned to the liquid.

Owing to the tendency of the roof to drift under varying conditions encountered in the storage of such volatile liquids, it is necessary that the roof centering devices be constructed as rugged units capable of maintaining the relatively large floating roof in the approximate center of the tank. Devices of the prior art of which I am aware, which have been employed for this purpose, have been unduly complicated and expensive, and it is to the simplification of such devices and consequent reduction in manufacturing and maintenance costs that the present invention particularly relates.

In the preferred form of the invention, the shoes which engage the inner surface of the tank are broken up into relatively small sections, each of which is supported by a single thrust rod that extends through suitable supporting means on the roof structure, which supporting means is arranged to permit limited adjustment of the shoe section vertically and horizontally with respect to other shoe sections, and to the roof so that the shoe sections may be properly aligned. Sealing is accomplished by a gas impervious flexible membrane secured to the roof by a gas-tight connection and to the top edges of the shoe sections, this membrane or a counterpart thereof extending across the space between the top edges of the shoe sections and the inner wall of the tank shell and engaging that wall to completely seal the tank so that vapors rising from the liquid will not be permitted to escape into the atmosphere where they would constitute a fire hazard.

In certain instances, it may be advantageous to employ as a support and tensioning device for the shoes, a lever arrangement positioned between the adjacent ends of adjacent sections of the shoe and connected to those adjacent sections by a singletree arrangement so that pressure put on the lever system, tending to force the shoes outwardly, will be transmitted to the adjacent ends of the two sections, the singletree arrangement permitting limited movement of the shoe sections with respect to each other to permit them to move over obstructions, such as welds or rivet heads, encountered in the shell of the tank.

Referring now to the drawing in more detail, particularly in Figs. 1 and 2, it will be seen that

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the tank has an outer shell 1 formed as a cylinder disposed with its axis vertically. This shell, which is of rather large diameter and height, will be composed of a plurality of individual sections or plates suitably fastened together by means such as riveting or welding, omitted from the drawings to avoid an unnecessary complication thereof. Located within the tank and floating on the surface 2 of the liquid therein, is a roof structure, indicated generally at 3, which is of outer diameter substantially less than the inner diameter of the shell 1, so as to leave a substantial space therebetween. The particular type of floating roof structure is not of the essence of the present invention. In certain instances these structures are built to contain a plurality of sealed air chambers or pontoons by which buoyancy of the structure is achieved, and in other instances the roof is made boat or pan-like and achieves buoyancy through displacement of the liquid in the usual manner. The present invention may be employed equally advantageously with either type of floating roof structure.

In any event, the roof structure preferably contains an outer wall 4 which is cylindrical and contains a plurality of perforations 5 around which mounting sleeves 6 are disposed and secured preferably by welding. These sleeves are threaded internally to receive a bushing 7 which contains a perforation eccentrically located therein. The bushing projects radially inwardly of the roof, as shown at 8, and is capped at its inner end by a suitable cap 9.

Depending from the upper section of the roof 3 radially outwardly from the wall 4 is a support 10, which may be interrupted or continuous around the outer periphery of the structure. This support is perforated at 11 to receive a bar 12 that extends through it and the bushing 7 into juxtaposition with the inside surface of the shell 1.

The roof structure will contain a plurality of bars 12 each disposed radially and spaced around the outer perimeter of the roof in a uniform manner.

Mounted upon the outer end of each rod 12 by suitable means is a counter pin 13 and a pressure foot 14 that is welded to the inner face of a shoe 15, which shoe is formed as a section of the cylinder and adapted to register closely with the inner face of the shell 1. The lower edge of the shoe is curved as at 16, to facilitate moving the shoe over obstructions such as rivets or welds in the shell 1. The upper end of the shoe likewise tapers inwardly to a flat horizontal portion 17 for a purpose which will presently appear.

Mounted within the extension 8 of the bushing 7 is a spring 18 which is compressed between the inner end of the rod 12 and the cap 9, and tends to force the rod 12 outwardly, thereby pressing the shoe into firm engagement with the shell 1. Adjustment of the position of the shoe is achieved by rotating the eccentric bushing 7, causing the rod 12 to fulcrum in the perforation 11 of the support 10 and move the shoe vertically and horizontally as the eccentric is rotated. By this arrangement the shoe can be located in any desired position within the limits of the range of adjustment permitted by the eccentric bushing.

As will be seen in Fig. 1, the length of the shoe around the tank is relatively short and there are a plurality of shoes engaging the shell 1. These shoes are spaced apart and the space be-

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tween them may be sealed in a number of different ways. In Fig. 5, the space between adjacent ends of shoes 15 is sealed by a membrane-like member 20 disposed against the inner faces of the ends of the shoes and secured thereto by convenient means such as rivets 21.

The plurality of rods 12 pressing against the shoes 15 under the tension of springs 18 will tend to keep the roof 3 floating in the center of the tank and at the same time will permit that roof to rise vertically as the liquid level in the tank is raised and to fall with that liquid level.

In order to seal the space between the outer edge of the tank 3 and the inner face of the shell 1, a sealing member 25 is employed. Preferably this member is a membrane of fabric or similar material impregnated to make it gas-tight without sacrificing flexibility. A rod 26 is attached to the roof section 3 near its outer edge as by welding, and the fabric 23 extended over this rod and wrapped around a second rod 27 and clamped to the roof by suitable means such as clamping elements 28 that are pierced so as to slip over bolts 29 that project upwardly from the roof section. By this arrangement, a gas-tight seal between the roof and sealing element 25 may be readily formed.

Sealing element 25 extends onto the flat portion 17 of the shoe sections where it lays under an auxiliary sealing element 30 that extends from this shoe section radially outwardly into engagement with the tank shell. A suitable clamp bar 31 held on the shoe by suitable means such as bolts 32, anchors the sealing elements to the shoe and forms a gas-tight connection.

In the embodiment of the invention shown in Figs. 3 and 4, the floating roof structure 40 is equipped with a plurality of brackets 41, in each of which a bell crank lever arm 42 is mounted by suitable means such as pivots 43.

The adjacent ends 44 of adjacent shoes carry brackets 45 to which a singletree member 46 is pivotally mounted, and this singletree member is connected to one end of the lever 42 by suitable means 47 which permits limited movement of the singletree with respect to the lever around both vertical and horizontal axes. The shoe 48, which is otherwise the same as the shoe 15, is thus permitted limited movement with respect to the lever.

Mounted upon a vertical wall 50 of the floating roof is a bushing 51 into which a bracket 52 is threaded. Connected to the upper end of the levers 42 are rods 53 which extend through the wall 50 and into the brackets 52. Fixed to the end of these levers 53 are springs 54 which are fixed to a washer 55 that abuts against the inner end of the bracket 52 and is held thereagainst by a suitable cap 56 threaded on the end of that bracket. Springs 54 are thus placed in tension tending to rotate the lever 42 clockwise, as seen in Fig. 4, thereby to force the shoes outwardly into firm engagement with the shell 1 of the tank. Each of the shoe sections 48 is engaged by a singletree unit at each of its ends, and the tension transmitted to these singletree units and shoes will tend to keep the roof floating accurately in the center of the tank. As the roof moves vertically, the shoes may ride over obstructions such as welds or rivets by moving with respect to the singletrees and without disturbing the adjacent shoes which may not be encountering such obstructions at the moment.

The space between the adjacent ends of the

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adjacent shoes 48 may be sealed by suitable means such as the membrane 20 shown in Fig. 5. The space between the outer edge of the roof 40 and the tank shell is sealed by membranes 57 and 58 mounted upon the shoes and roof in the manner more fully explained in connection with sealing members 25 and 30.

From the foregoing, it will be apparent that the floating roof centering devices of the present invention are simple rugged devices that may be fabricated at low cost and maintained in proper working condition with a minimum of expense. The flexible sealing membranes which are more likely to become defective than the centering devices are located so as to be readily accessible for frequent inspection and maintenance as may be required. The sealing devices effectively seal the space between the floating roof, which is of itself impervious to gases, and the tank shell, so that vapors or gases rising off of the volatile liquids in the tank will be trapped, condensed and returned to the liquid and not lost.

While I have chosen to show my invention by illustrating and describing a preferred embodiment of it, I have done so by way of example only, as there are many modifications of the specific details shown and adaptations which can be made by one skilled in the art within the teachings of the invention.

Having thus complied with the statutes, and shown and described a preferred embodiment of my invention, what I consider new and desire to have patented by Letters Patent is pointed out in the appended claims.

What is claimed is:

1. A device for centering a roof structure that floats on the surface of a volatile liquid in a tank and for sealing the space between the edge of the roof and the tank comprising: a pair of spaced apart perforated members on said roof, a bracket fixed on one of said members and extending around the perforation therein, an eccentric bushing threaded into said bracket, a bar extending through said bushing through said other member and radially toward the tank wall, a shoe fixed on the outer end of said bar and engaging said wall, a spring engaging said rod and tensioned to urge said shoe against the wall, and a flexible sealing member fixed to said roof and shoe for sealing the space therebetween.

2. A device for centering a roof structure that floats on the surface of a volatile liquid in a tank and for sealing the space between the edge of the roof and the tank comprising: a pair of spaced apart perforated members on said roof, brackets fixed on one of the members one extending around each of the perforations therein, an eccentric bushing threaded into each bracket, a rod supported by each bushing and extending through said members toward the wall of the tank, shoe sections fixed on said rods and engaging said wall, spring means engaging said rods and urging the same radially outwardly of said roof, and sealing means fixed to said roof and shoe sections and engaging said wall to seal the space between the roof and wall.

3. A device for centering a roof structure which floats on the surface of a volatile liquid in a tank and for sealing the space between the edge of the roof and the tank, comprising: shoe sections conforming to the inside surface of the tank wall; a flat ledgelike extension on each shoe section, extending radially inwardly

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from the top edge thereof; a vertically disposed perforated wall on said roof structure; radially disposed rods slidably disposed in the perforations and supported by the wall and fixed to said shoe sections to support the same on the roof structure; a second vertically disposed wall on said roof structure disposed inwardly of the first wall and having perforations aligned with and larger than the perforations in the first wall; a bushing on said second wall for each of said rods engaging the rod to support the same; a spring carried by each bushing and tensioned to urge the rod outwardly thereby to press the shoe sections into engagement with the tank wall to keep the roof structure centered therein; a flexible gas impervious member fixed to the top of said roof structure and to the ledgelike extensions on said shoe sections to form a seal between the shoe and roof structure; and a second gas impervious flexible member fixed to said ledgelike extension and engaging the tank wall to form a seal between the shoe and tank wall.

4. A device for centering a roof structure that floats on the surface of a volatile liquid in a tank and for sealing the space between the edge of the roof and the tank, comprising: shoe sections disposed in the space between the roof and tank wall and capable of moving across said space as the roof moves on said liquid; a gas impervious flexible sealing member extending from said roof to said shoe sections; a rod fixed to said roof adjacent the edge thereof and forming a hoop over which said sealing member extends; a second rod disposed inside said first rod and around which said sealing member is extending; a plurality of clamps engaging that part of the sealing member that encircles said second rod to clamp the member to the roof and form a gas-tight connection therebetween; a second sealing member extending from said shoe sections to said tank wall to seal off the space therebetween; and means for clamping said sealing members to said shoe sections.

5. In a device for centering a roof structure that floats on the surface of a volatile liquid in a tank and for sealing the space between the edge of the roof and the tank; a shoe section conforming to and engaging the inner face of the tank; a flat extension on said shoe projecting radially inwardly from the top edge thereof; a vertical wall on said roof; a rod fixed upon said shoe and projecting through a perforation in and engaging said wall and extending radially inwardly therefrom; a second vertical wall on said roof, having a perforation through which said rod projects; means fixed on said second wall and engaging said rod to support the inner end of the rod and thereby aid said first wall in supporting the rod and shoe on the roof, said means being adjustable to vary the position of the inner end of said rod and thereby adjust the position of the shoe with respect to the roof; a spring carried by said means and engaging said rod and tensioned to urge the rod and shoe outwardly from the roof; a gas impervious flexible member fixed to the top of the roof and to the extension on said shoe to form a seal between the shoe and roof; and a second gas impervious flexible member fixed to said shoe extension and engaging the tank to form a seal between the shoe and tank.

6. In a device for centering a roof structure that floats on the surface of a volatile liquid in a tank and for sealing the space between the edge of the roof and the tank; a shoe section conform-

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ing to and engaging the inner face of the tank; a flat extension on said shoe projecting radially inwardly from the top edge thereof; a vertical wall on said roof; a rod fixed upon said shoe and projecting through a perforation in and engaging 5 said wall and extending radially inwardly therefrom; a second vertical wall on said roof having a perforation through which said rod projects; means fixed on said second wall and engaging said rod to support the inner end of the rod and there- 10 by aid said first wall in supporting the rod and shoe on the roof, said means being adjustable to vary the position of the inner end of said rod and thereby adjust the position of the shoe with re- 15 spect to the roof; a spring carried by said means and engaging said rod and tensioned to urge the rod and shoe outwardly from the roof; a gas impervious flexible member fixed to the extension on said shoe and extending to said roof; a bar shaped to conform to the shape of the edge of the 20 roof and around which said flexible member is wrapped; bolts fixed on said roof; clamp members engaging said bolts, roof, and the flexible member around said bar for clamping the mem- 25 ber to the roof to form a seal between the shoe

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and roof; and a second gas impervious flexible member fixed to said shoe extension and engaging the tank to form a seal between the shoe and tank.

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