Oct. 25, 1949. I. L. WISSMILLER 2,485,683

LEVELING SYSTEM FOR LIFTER ROOF TANKS

Filed April 29, 1946 2 Sheets-Sheet 1

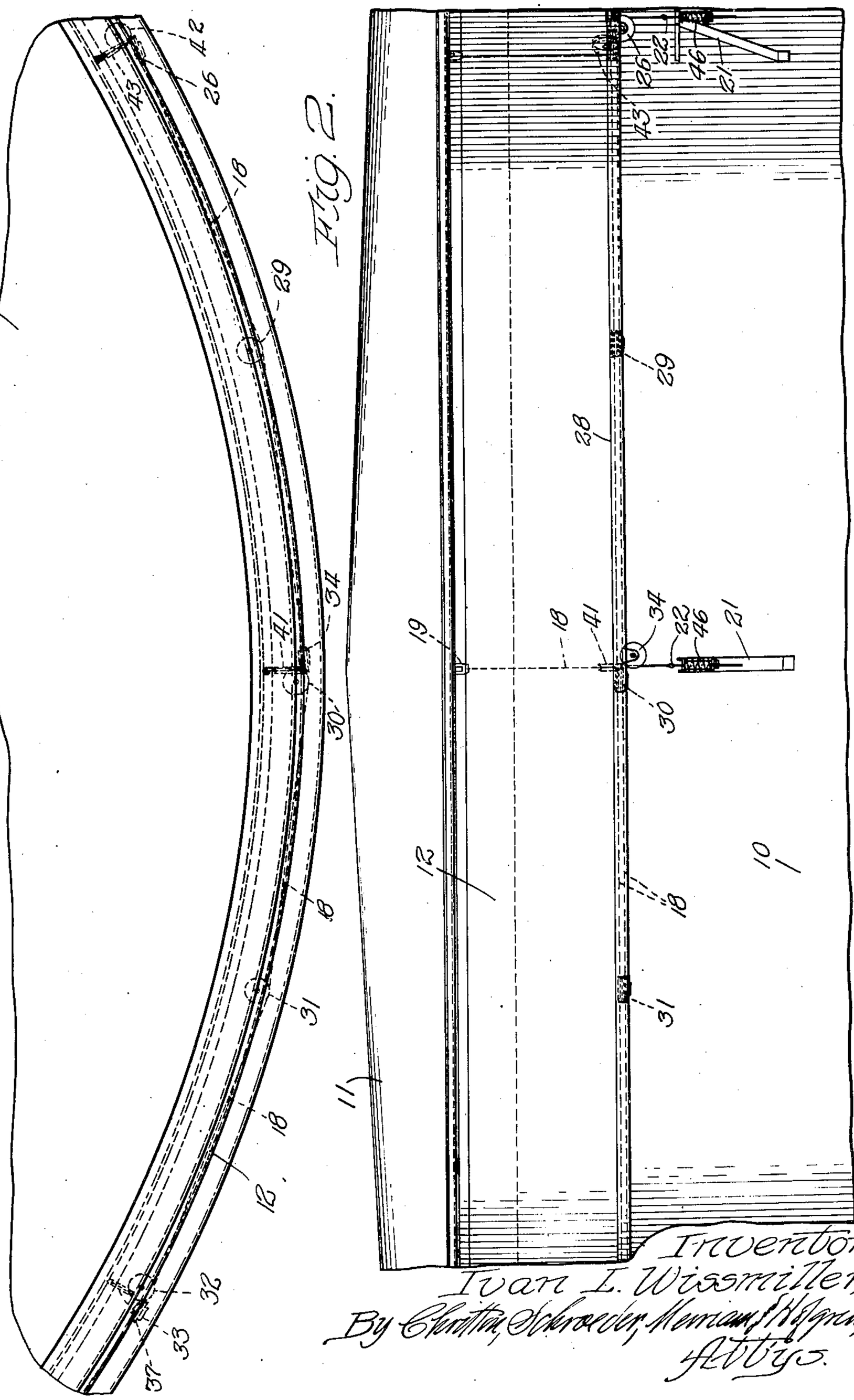

Fig. 1.

Fig. 2.

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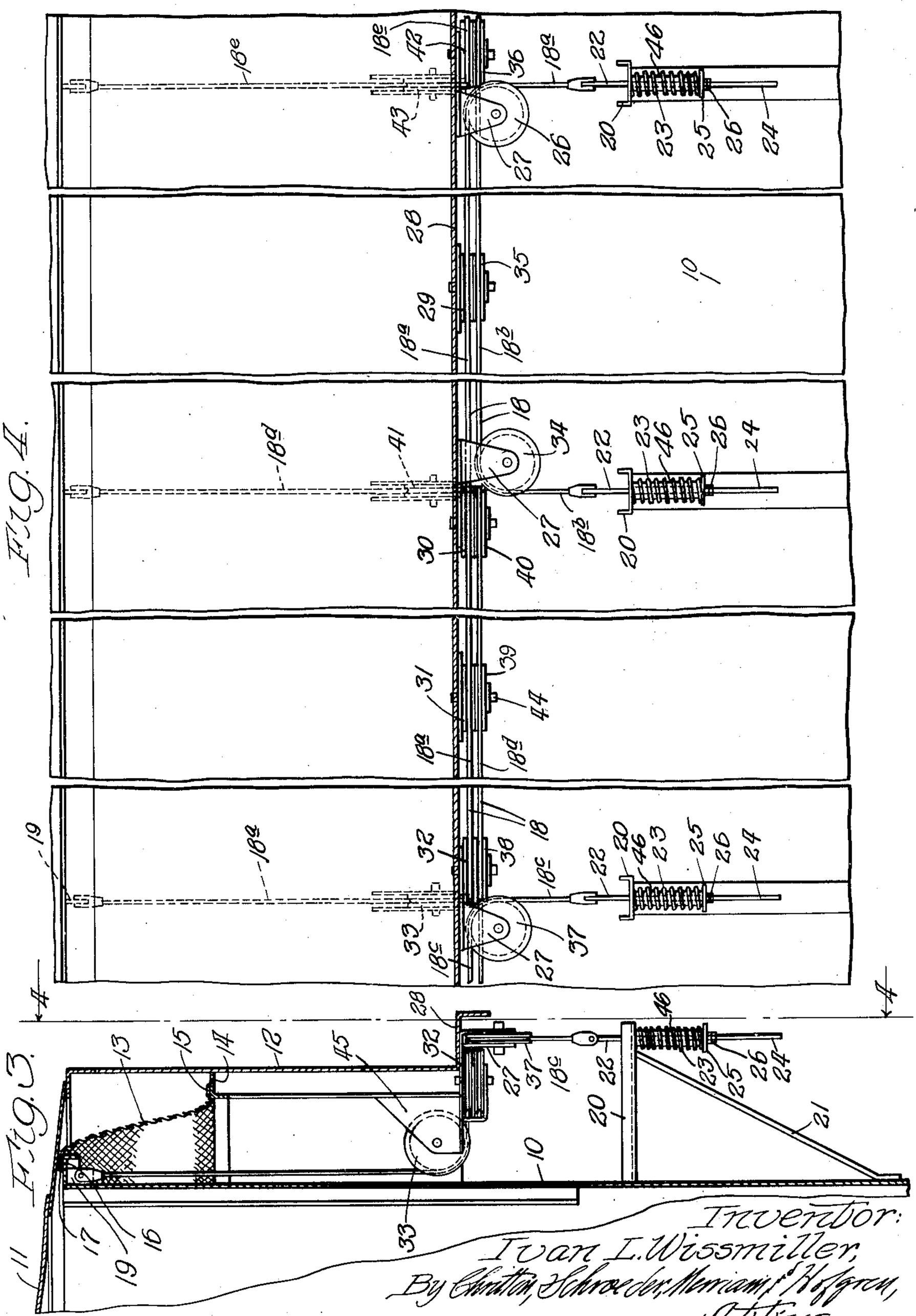

Fig. 3.

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LEVELING SYSTEM FOR LIFTER ROOF TANKS

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6 Claims. (Cl. 48—176)

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This invention relates to a stabilizing means for a lifter roof tank wherein the roof is maintained level at substantially all times.

Lifter roof tanks are designed for the storage of gas, or liquid with confined gases above the liquid surface. In these tanks the roof floats on top of the gas and rises and falls as the volume of gas or liquid and gas within the tank is increased and decreased. In order to resist unbalanced loads tending to tip the roof such as those of wind, snow, and the like, it is necessary that the tanks have stabilizing means attached thereto. Various types of stabilizing means have been proposed in the past, but many of these have been unsatisfactory for various reasons.

The stabilizing means of the present invention comprises a plurality of pulleys attached to the roof, and a flexible member attached at at least two points to the shell, with the section of flexible member between said points passing around the pulleys. The flexible member passes from a fixed point on the shell, up over one pulley on the roof, under the second pulley and up to another fixed point of attachment on the shell. As the roof rises and falls the pulleys roll over the flexible member. This flexible member may be a chain, cable, or the like.

The flexible member may be continuous around the tank, with spaced points of attachment to the shell of the tank and corresponding sets of pulleys between each two adjacent points of attachment. The flexible member may also be discontinuous and formed in sections with each end of each section attached to the shell, and each section passing over one set of pulleys.

In tanks of relatively small diameter only one flexible member need be used. If desired, this flexible member may be in the form of individual sections, with all sections extending in the same direction around the circumference of the tank. In tanks of large diameter there may be two continuous flexible members around the tank, or there may be two sets of sections of flexible members extending around the tank with one section of the flexible member substantially coinciding with another section but extending in an opposite direction thereto.

The invention will be described as related to the embodiment set out in the accompanying drawings. Of the drawings Fig. 1 is a fragmentary plan view of a lifter roof tank embodying the invention; Fig. 2 is a fragmentary elevation of the top edge of the tank; Fig. 3 is an enlarged fragmentary vertical section through a top edge of the tank; and Fig. 4 is a vertical section taken along line 4—4 of Fig. 3.

The lifter roof tank shown in the accompanying drawings comprises a shell 10 and a lifter roof 11 thereover. Around the edge of the roof there is located a downwardly extending weather skirt 12 that is outside of the shell 10. A flexible sealing member 13 of fabric impregnated with a flexible impervious material such as synthetic rubber extends from the top of the shell 10 to an angle bracket 14 on the weather skirt 12. The outer edge of the flexible member 13 is held on the angle bracket 14 by a washer bar 15. The inner edge of the sealing member 13 is held on a second angle bracket 16 mounted on top of the shell 10 by means of a second washer bar 17.

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Around the tank there is located a plurality of cables 18 passing over various pulleys. These cables are all substantially the same length, and each set of pulleys for each cable is substantially equally spaced. Each cable is attached to the shell at its upper end by means of a bracket plate 19 on the top of the shell and is attached at its lower end to a second bracket 20 extending from the shell. Each second bracket 20 is braced by a brace bar 21. The lower end of a cable is attached to a rod 22 extending through a hole at the outer end of the second bracket 20 and passing through a compression spring 23 on the under side of the second bracket 20. The lower end 24 of the rod 22 is threaded, and the compression spring 23 is held in place by means of a washer 25 and a nut 26.

As shown in Fig. 4, one cable 18*a* passes up from its holding rod 22 around a first pulley 26 held in a holder 27 mounted on a horizontal extension 28 on the bottom of the weather skirt 12. The cable 18*a* passes up over the pulley 26 and to the left where it passes over a first idler pulley 29, a second idler pulley 30, a third idler pulley 31, and a fourth idler pulley 32. From the fourth idler pulley 32 the cable is led inwardly toward the shell and around a vertical pulley 33 that is adjacent the shell. From the vertical pulley 33 the cable passes up to its point of attachment on the shell.

A second cable 18 has its lower end attached to the shell at a point to the left of the first cable 18*a*, and up over the pulley 34, similar to pulley 26, and to the right of its first idler pulley 35, second idler pulley 36, and on around the tank until it passes over its vertical pulley similar to vertical pulley 33 and to its point of attachment at the top of the shell.

A third cable 18*c* has its lower end attached to the shell at a position to the left of cable 18*b* and passes to the left over its pulley 37 corresponding to pulleys 26 and 34. The third cable passes around the tank like the first and second cables 18*a* and 18*b*.

In Fig. 4 a fourth cable, 18*d*, is shown coming from the left and passing over idler pulleys 38, 39, and 40 and up around its vertical pulley 41 corresponding to pulley 33 to its point of attachment at the top of the shell. To the right of Fig. 4 is shown a fifth cable 18*e* passing over its idler pul-

ley **42** and under its vertical pulley **43** corresponding to pulley **33** to its point of attachment at the top of the shell.

Each pair of idler pulleys, **36** and **42**, **35** and **29**, **40** and **30**, **39** and **31**, and **38** and **32**, are mounted in horizontal position on a single spindle **44** that is held on the bottom of the weather skirt **12**. Each of the first pulleys **26**, **34**, and **37**, is vertically mounted, and is substantially parallel to the adjacent section of the shell. Each of the vertical pulleys **33**, **41**, and **43** is mounted on brackets **45** located on the bottom of the weather skirt **12**, and extending inwardly so that these pulleys are at right angles to the shell and are closely adjacent thereto. The vertical pulleys **33**, **41**, and **43**, and other corresponding pulleys not shown serve as centering means for the lifter roof.

As can be seen, each pair of cables, such as **18***a* and **18***b*, extend in opposite directions around their portions of the shell, and each cable has one section substantially parallel to and adjacent a section of the other cable.

In order to aid in installing the cables each cable is made of the same length, and each compression spring **23** is made of the same length. On the inside of each compression spring there is provided a pipe **46** substantially concentric to the spring and to the rod **22**. These pipe sections all have the same length. When the cables are installed the compression springs are tightened by means of nuts **26** and washer **25** until the spring is the same length as its pipe **46**. When this has been done all cables will have substantially the same tension applied to them, and this tension aids in maintaining the roof level.

The arrangement of cables and pulleys shown in the drawings and described herein is particularly useful in tanks of relatively large diameter. On tanks of small diameter the system may be simplified in that the cables may all extend around the tank in the same direction and the number of pulleys may be reduced.

The load on any cable may be reduced by one-half, if desired, by using a pulley at each point of attachment of the cable to the shell and extending each end of the cable around one of these shell pulleys and to an attachment on the roof skirt.

Although the leveling and stabilizing system is shown and described as being used on a tank employing a dry seal, it is also applicable to tanks using wet seals. The system is not limited to any kind of lifter roof tank or any type of seal.

Having described my invention as related to the embodiment set out in the accompanying drawings, it is my intention that the invention be not limited to the details of description unless otherwise specified, but rather be construed broadly within its spirit and scope as set out in the accompanying claims.

I claim:

1. In a storage tank comprising a shell, a vertically movable roof thereover, and downwardly extending skirt on the roof and outside the shell, stabilizing means comprising a cable resiliently attached to the shell at one point and attached to the shell at another point and a series of pulleys attached to the lower edge of the skirt, said cable extending from one point of attachment on the shell wall, passing up over a first pulley arranged in substantially vertical position and substantially parallel to the shell, over an idler pulley arranged substantially horizontally, over a third pulley arranged substantially horizontally, under a fourth pulley adjacent the third pulley and spaced above and inwardly therefrom and arranged substantially vertically and at substantially right angles to the shell, and up to a higher point of attachment on the shell, said fourth pulley being arranged adjacent the shell to serve also as a centering device for the roof.

2. The stabilizing means of claim 1 wherein the portion of the cable below the first pulley is substantially vertical, the portion from the first pulley over the idler pulley, over the third pulley and to the fourth pulley is substantially horizontal, and the portion above the fourth pulley is substantially vertical, with that portion of the cable between the idler pulley and the third pulley being at substantially right angles to the portion between the third pulley and the fourth pulley.

3. The stabilizing means of claim 1 wherein there are provided a plurality of sets of said pulleys around the skirt and a plurality of cables with one cable engaging at least one set of pulleys, with one of the cables passing in an opposite direction to another of the cables and each having a section substantially parallel to and adjacent a section of the other.

4. The stabilizing means of claim 1 wherein there are provided a plurality of sets of said pulleys with the pulleys of one set spaced from each other substantially equally to those of another set, a plurality of cables of substantially equal length with each member engaging one set of pulleys, and a tensioning means at one end of each cable, each of said tensioning means comprising a compression spring and a rigid member adjacent thereto with all springs being equal in length and all rigid members being equal in length whereby when a spring is compressed to a point where it is equal in length to its rigid member all cables will be under the same tension.

5. In a storage tank comprising a shell, a vertically movable roof thereover, and a downwardly extending skirt on the roof and outside the shell, stabilizing means comprising a plurality of cables attached to the shell with each cable being resiliently attached to the shell at one point and attached to the shell at another point and a plurality of pulleys attached to the skirt, each of said cables extending from one point of attachment on the shell wall, passing up over a first pulley arranged in substantially vertical position, under a second pulley horizontally spaced from and in substantially the same plane with the first pulley, and up to a higher point of attachment on the shell.

6. In a storage tank comprising a shell, a vertically movable roof thereover and a downwardly extending skirt on the roof and outside the shell, stabilizing means comprising a plurality of cables attached to the shell with each cable being resiliently attached to the shell at one point and attached to the shell at another point, and a plurality of pulleys attached to the skirt, each of said cables extending from one point of attachment on the shell wall passing up over a first pulley arranged in a substantially vertical position around a second pulley horizontally spaced from the first pulley and then around a third pulley arranged in substantially vertical position and up to a higher point of attachment on the shell.

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No references have been cited.