

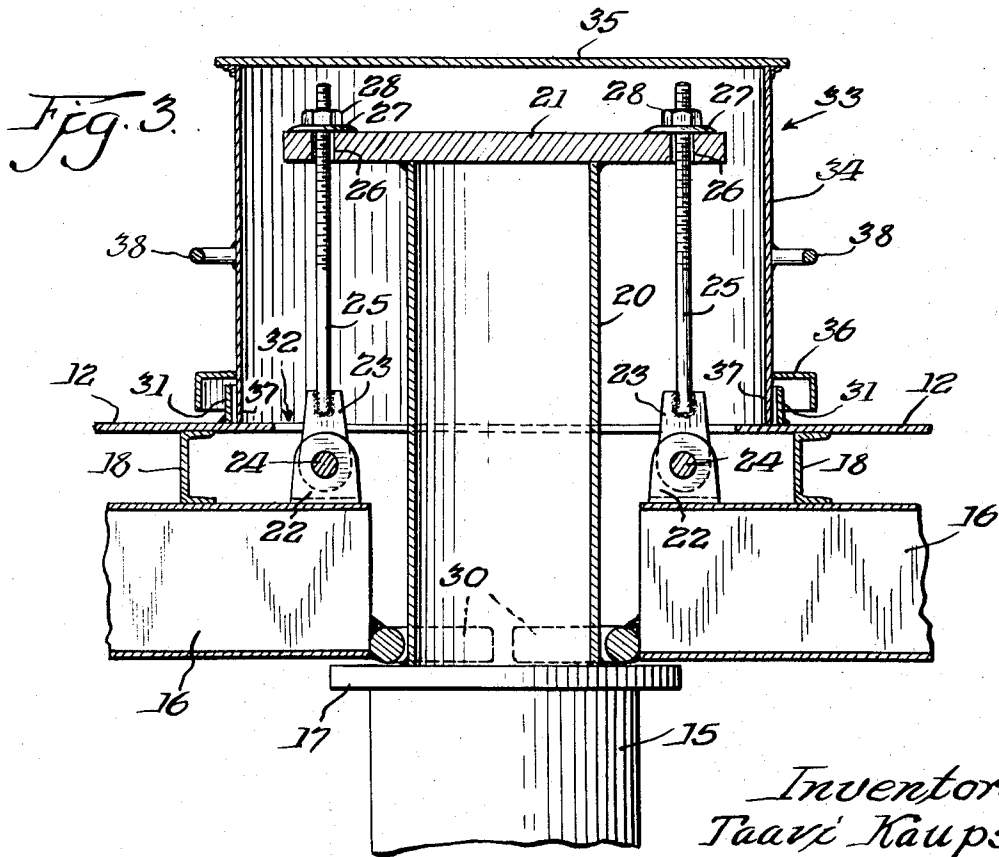
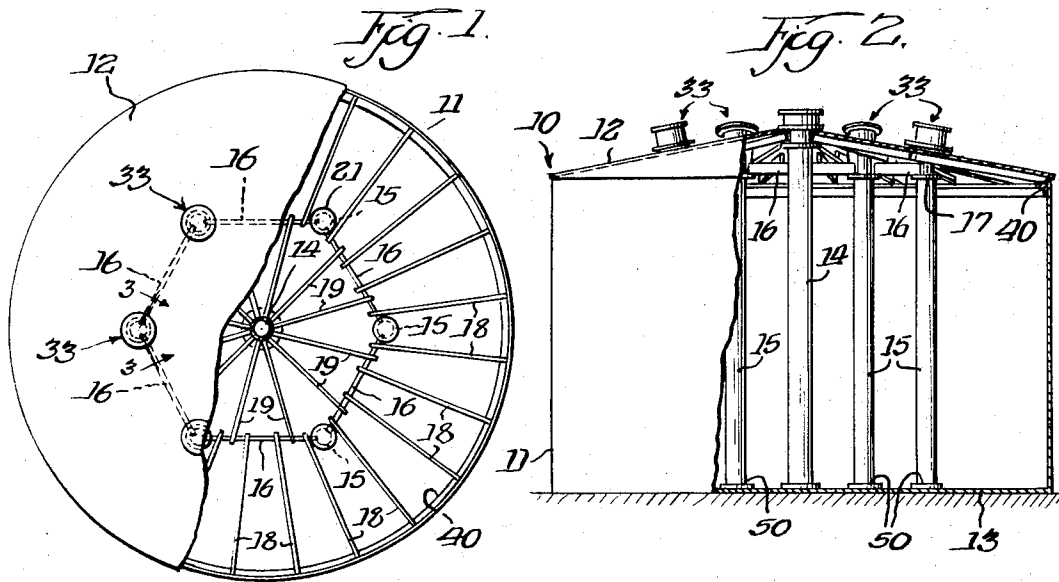
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ADJUSTABLE ROOF-SUPPORTING COLUMN FOR TANKS

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**ADJUSTABLE ROOF-SUPPORTING
COLUMN FOR TANKS**

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This invention relates to tanks and structure for supporting roofs on the same. More particularly, this invention is concerned with an adjustable roof-supporting column that has particular use in tanks having roofs supported by columns positioned on soil or other supporting sub-structure which is subject to differential subsidence or elevation.

Many tanks are constructed with truss-supported roofs. The entire weight of the roof is thereby borne by supporting walls around the periphery or sides of the tank. Such self-supporting roofs are employed to a considerable extent on smaller sized tanks. As the roofs become larger, it becomes increasingly less practical and certainly more costly to construct self-supporting truss roofs.

In many tanks it is entirely suitable to support the roofs by an appropriate number of internal columns. Such a system is satisfactory so long as there is no substantial differential subsidence or elevation of the load-bearing support beneath the columns. In those situations where the columns settle or are raised to a differential degree, stresses are caused in the roof and deformation can take place with possible serious damage to the roof structure.

Tanks with internal column-supported roofs are widely employed throughout the world to store various fluid materials, and particularly, oil, gasoline and other liquid petroleum materials. This type of construction can be used to make comparatively large tanks at a considerably lower cost than similar size tanks having truss roofs free of internal column supports.

Differential subsidence or elevation of the support on which a roofed tank having internal columns rests can occur at any time subsequent to erection, although substantial change can occur when a tank is subjected to a water-test for strength and leakage. Some such water-tests last four weeks or more and during this time, it is not unusual for up to 75% of the settlement to take place. At times, settlement during a water-test may approximate 12 inches or more, with the settlement, of course, not being uniform from column to column or between columns and the peripheral soil area supporting the tank wall. It has accordingly been necessary to interrupt the water-test to adjust the columns. Adjustment of the columns has been conventionally done by emptying the tank to obtain entry to the tank and apply suitable shims to the bottom of the column. This approach is inherently disadvantageous and time-consuming and accordingly, there has been a need for a system which would permit much more ready adjustment between the supporting columns and the roof to much better accommodate differential settlement.

Differential subsidence and elevation of roof-supporting columns is also widespread after a tank has been in service for an extended period. It is time-consuming and expensive to make internal column adjustments in tanks used to store flammable, volatile and toxic materials because such tanks must first be emptied and cleaned to make them safe for humans to enter.

There is accordingly provided by this invention a novel and unobvious combination comprising a column and means for externally adjusting the height of a structure supported by the column, such as after subsidence or elevation of the column foundation.

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The combination broadly comprises a column, a load structure movable vertically supported or borne by the column, a supporting member connected to the load structure and the column to support the load structure, and means for displacing the supporting member while connected to the load structure to raise or lower the load structure.

The most suitable means for displacing the adjustable supporting member is screw means so that upon displacement of the screw, the supporting member will be raised or lowered and simultaneously secured in place against further displacement.

Also provided herewith is the improvement in a tank for the storage of materials having a bottom, a side wall, a roof and a plurality of vertically disposed columns within said tank supporting said roof, which comprises adjustable means connecting the upper ends of said columns with said roof whereby vertical displacement of said column-supported roof, resulting from soil or foundation subsidence or elevation beneath the columns can be compensated for by adjustments made in said adjustable means to raise or lower the roof, said adjustable means being operably adjustable from outside the tank.

The invention will now be described further in conjunction with the attached drawings in which:

FIGURE 1 is a plan view, partially broken away, of a tank with adjustable columns supporting the roof;

FIGURE 2 is a side elevation, partially in section and broken away, of the tank of FIGURE 1; and

FIGURE 3 is a vertical sectional view taken along the line 3—3 of FIGURE 1.

Unless otherwise designated, the elements which are the same or similar in the various figures, will be identified by the same reference number.

FIGS. 1 and 2 show cone roofed tank 10 having wall 11, cone roof 12 and bottom plate 13. Roof 12 is supported about its periphery on the upper edge of wall 11. In addition, the roof is supported by central column 14 and a course of six essentially identical columns 15 positioned in a ring. Girders 16 run from two adjacent columns 15 and are initially supported at their ends by flange 17. The girders 16 can be I-beams or other suitable structural members. A series of rafters 18 are positioned to rest at their outer ends on a ring 40 positioned around the upper inside edge of the tank wall 11, and with the inner end of the rafter resting on a girder 16. Desirably, about four such rafters 18 are positioned between each two adjacent columns 15, spaced apart at about 15° radial angles. Rafters 19 are positioned to run from the central column 14 to rest on girders 16 at their outer ends. Two such rafters 19 can be positioned to rest on each girder 16 at approximately a 30° radial angle between two adjacent columns 15. The described arrangement of supporting columns, girders and rafters is a conventional arrangement in a cone roof tank, and its description here is primarily to facilitate the description and utilization of the subject invention.

Referring to FIG. 3, positioned on the top of supporting flange plate 17 on column 15 is tubular column extension 20, advisably welded at its lower edge to plate 17. On the upper end of tubular extension 20 is plate 21. Mounted on the top edge and end of each girder 16 is bracket 22 which, together with plate 23 and pin 24, forms a pivot connection. Connected to plate 23, such as by welding, is extension bolt 25, which projects upward through hole 26 above the top of plate 21. Washer 27 placed over the end of bolt 25 and nut 28 secured thereon. Attached to the end of each girder 16 is a horizontal semicircular guide means 30 formed visibly out of round stock. The guide means 30 can

conveniently attached to the end of the girder by welding to permit vertical movement of the girder end while preventing lateral or horizontal movement thereof out of position with the column 15 and tubular extension 20. Hole 32 is provided in the roof top 12 in substantial alignment with each supporting column 15 to obtain access to the upper portion of the column while the tank is full. Positioned around the periphery of hole 32 is vertical ring 31 which keeps water from flowing into the hole. Hole 32 is covered by cap 33 which has cylindrical wall 34 and top 35. Positioned along the lower outside edge of wall 34 is inverted angle 36 which circumscribes cap 33 so that when the inner edge 37 of the cap is positioned inside of ring 31, the angle 37 will fit over and around the outer edge of ring 31 to form a weather seal. Handles 38 are provided on wall 34 for manual removal and repositioning of the weather-protecting cap 33.

At any time when there is differential subsidence or elevation of columns 15, such as when the tank is full of water during a water-test or subsequently when it is full of product, adjustment of columns 15 can be readily effected by removing cap 33 and tightening the nuts 33 so as to cause upward movement of bolts 25 and the girder 16 supported thereby. Threading of the nuts 28 can continue until the settlement of the column has been partially or totally compensated for by raising girders 16 as required. After such adjustment has been made, the girder 16 will be suspended above the supporting flange 17. Because the roof will then be suspended by means of the bolts 25 they must be strong enough to handle the load. After the column has been so adjusted for settlement, weather cap 33 can be repositioned in place.

Central supporting column 14 can also be provided with column-adjusting means as already described in conjunction with columns 15. Each of the rafters 19 can be suspended by means of the bolt means 25 adjacent their ends abutting the central column. Thus, all columns positioned internally of the tank can be constructed to provide for adjustment for differential movement of each column independent of the others.

Since settlement of column supports is likely to be far more common than column foundation elevation, it is usually suitable to simply rest the ends of girders 16 on supporting flange 17 in initial erection of the tank. This is not essential, however, and in various instances it is advisable to initially suspend the ends of girders 16 above flange 17 so that the roof can be raised or lowered later as desired by means of bolts 25. However, even if the girders 16 are initially placed on flange 17 and some of columns 15 are elevated and others settle during tank use the roof adjusting means can be employed on those columns which settle to raise that part of the roof supported by them to a height adequate to compensate for the settlement.

In tanks of the type described, it is conventional to rest the column base 50 on the floor surface of the tank, i.e. on the metal bottom 13. Heaving and settlement of the bottom 13, and the columns resting thereon, does not very often impair the product-retaining integrity of the bottom. Substantial yielding and flexing of the bottom, without cracking or splitting of joints, is normal and generally is no cause for concern in itself. However, the rains and distortion induced in the roof requires column adjustment to maintain or reacquire roof form and integrity.

The provision of externally adjustable supporting columns in the tank makes it possible to adjust the roof as needed without actually entering the tank. The needed adjustments can be made while the tank is in service or undergoing test. This eliminates emptying and cleaning the tank before adjustment could otherwise be made. Although the specification and drawings describe and illustrate a single embodiment of the invention, other embodiments will be readily apparent to those skilled in the art after seeing this disclosure. The adjusting means con-

necting the columns and roof need only be so positioned and constructed as to be operable by a person from outside the tank. It is generally considered most feasible to position the adjusting means at about the upper end of the column so that it is accessible and operable from outside the roof. Although some or all of the operating mechanism of the adjusting means can be below the roof level and operated by special tools, it is more convenient to locate the operating mechanism above the roof level for ease of access and adjustment.

Various changes and modifications of the invention can be made and, to the extent that such variations incorporate the spirit of this invention, they are intended to be included within the scope of the appended claims.

15 What is claimed is:

1. In a tank for the storage of materials comprising a bottom, a side wall, a roof and a plurality of vertically disposed columns within said tank supporting said roof, the improvement which comprises adjustable means connecting the upper ends of said columns with said roof whereby vertical displacement of said columns, and commensurate displacement of the column-supported roof, resulting from soil or foundation subsidence or elevation beneath the columns can be compensated for by adjustments made in said adjustable means to raise or lower the roof, said adjustable means being operably adjustable from outside the tank.
2. The improved tank of claim 1 having means for access to said adjustable means from above the roof so that a person can operate said adjustable means without entrance into the tank.
3. In a tank for the storage of petroleum products or other flammable or toxic liquids comprising a bottom, a cylindrical side wall, a roof and a plurality of vertically disposed columns within said tank resting on said bottom and supporting said roof, the improvement which comprises adjustable means connecting the upper ends of said columns with said roof whereby vertical displacement of said columns, and displacement of the column-supported roof, resulting from soil or foundation subsidence or elevation beneath said bottom and columns can be compensated for, and the true conformation of said roof maintained, by adjustments made in said adjustable means to raise or lower the roof, and means of access to said adjustable means from above said roof so that a person can operate said adjustable means without requiring entrance into said tank.
4. A tank comprising a bottom, wall and roof, said roof being supported by the wall and a plurality of vertical columns in the tank, at least some of said columns being adjustable columns, the adjustable columns each having adjustable support means near the upper end thereof, and connected to the roof, for supporting the roof, said adjustable support means being operable from outside without requiring entrance into the tank to raise or lower the roof with respect to the columns.
5. A tank according to claim 4 in which means for access to the adjustable support means are provided on the roof.
6. A tank according to claim 4 in which the adjustable support means comprises a suspending member having a lower end connected to the roof and an upper end secured to the column, and means for applying tension to the suspending member while attached to the roof to raise the roof.
7. A tank according to claim 4 in which the adjustable support columns project through the roof.
8. A tank according to claim 6 in which each adjustable column has flange means for supporting a roof girder end, the lower end of the suspending member is joined to the girder end, and the girder end has means to prevent

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horizontal displacement of the girder out of register with the column.

9. A tank according to claim 8 in which tension is applied to the suspending member by screw means to raise the roof girder and roof thereon.

10. A tank according to claim 7 having a weather cap over the top of the column and depending to the roof surface.

11. The combination of a column and adjusting means for adjusting the height of a structure borne by the column comprising

a column,

a load structure movable vertically borne by the column,

a supporting member connected to the load structure and the column to support the load structure,

and means for displacing the supporting member while connected to the load structure to raise or lower the load structure.

12. In the combination of claim 11, a supporting member having a lower end joined to the load structure and an upper end secured to the column to support the load structure by tension in the supporting member, and

means for displacing the supporting member upwardly while connected to the load structure to thereby raise the load structure.

13. In the combination of claim 12, a screw means

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on the upper part of the supporting member to achieve displacement of the supporting member.

14. The combination of claim 11 in which the column has a flange for supporting the load structure in initial position, said load structure comprising a girder resting on the flange and roof elements supported by the girder.

15. The combination of claim 14 in which the column has a plate to which the supporting member is slidably secured by screw means.

16. The combination of claim 11 in which the supporting member is pivotally connected to the load structure.

17. The combination of claim 14 in which the end of the girder rests on the flange and guide means are positioned on the girder end to maintain the girder registered with the column against horizontal movement while permitting vertical movement.

18. The combination of claim 14 including a weather-protecting cap means over the suspending member and in sealing arrangement with the roof.

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