

June 23, 1942.

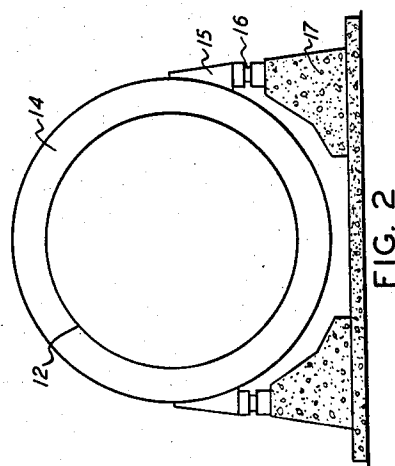
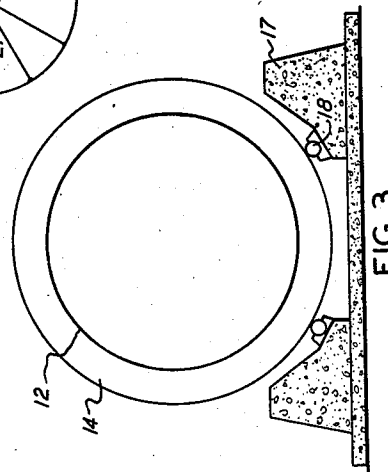
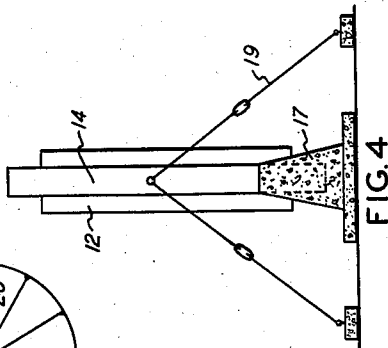
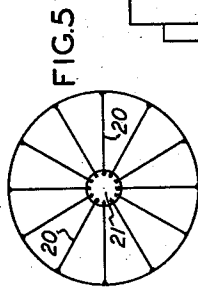
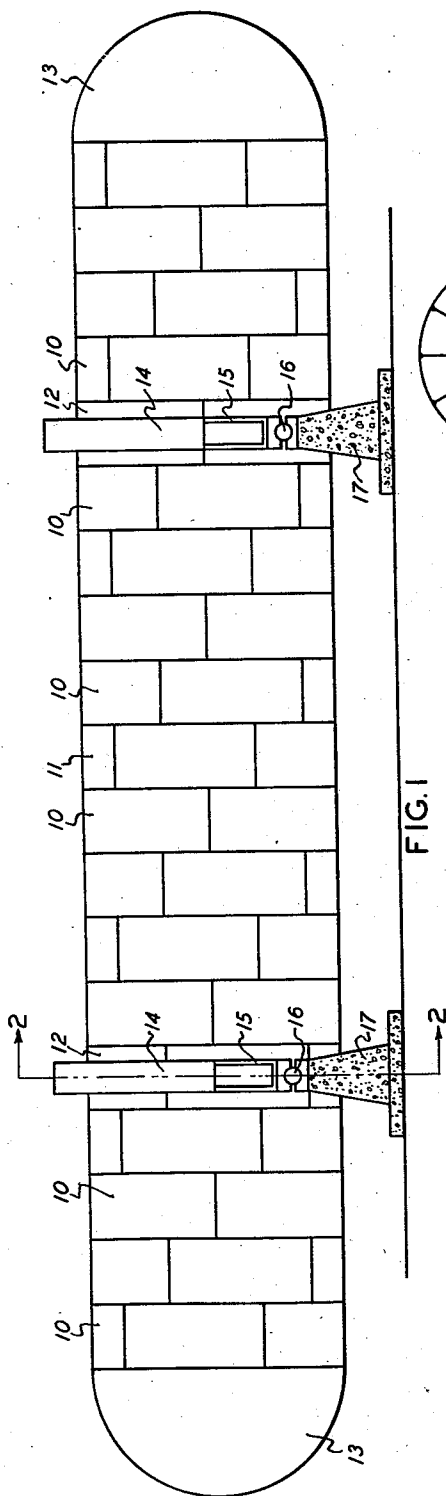
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2,287,198

METHOD OF CONSTRUCTING HORIZONTAL CYLINDRICAL TANKS

Filed March 19, 1940

2 Sheets-Sheet 1



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METHOD OF CONSTRUCTING HORIZONTAL CYLINDRICAL TANKS

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2 Sheets-Sheet 2

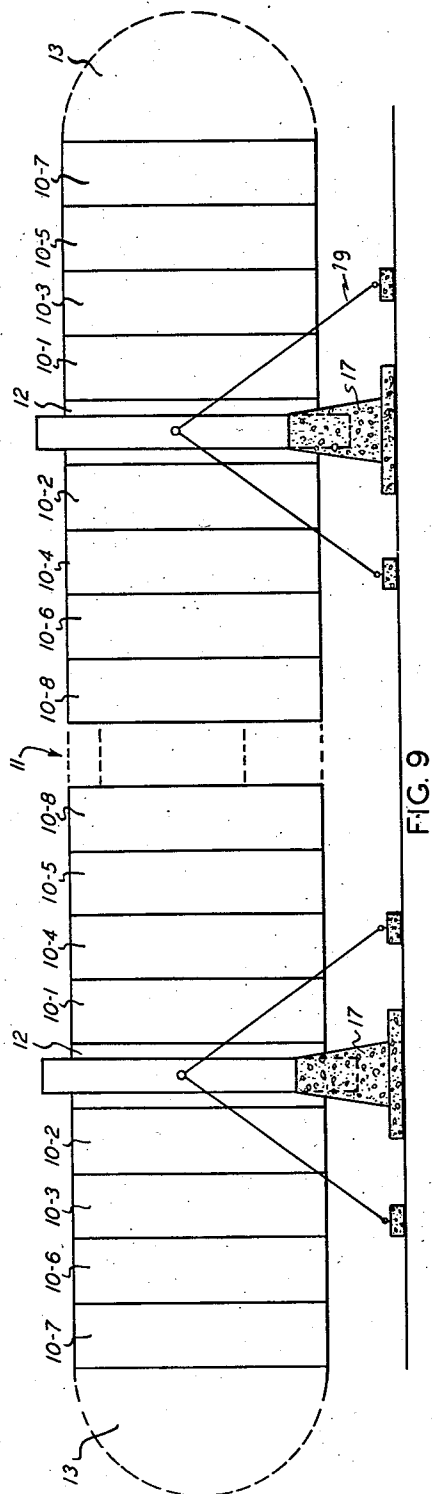


FIG. 9

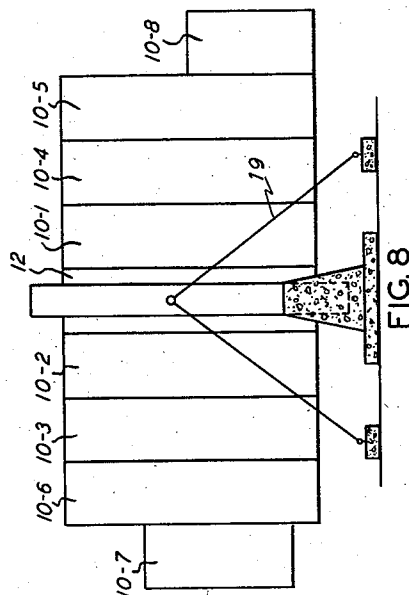


FIG. 8

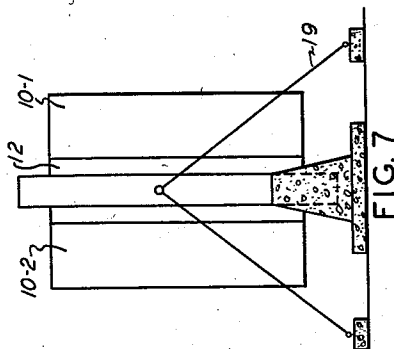


FIG. 7

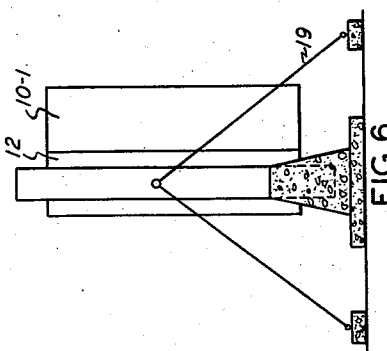


FIG. 6

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METHOD OF CONSTRUCTING HORIZONTAL
CYLINDRICAL TANKS

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4 Claims. (Cl. 29—148.2)

The invention relates to methods for constructing large cylindrical tanks in a horizontal position.

Tanks of this form, for the storage of light liquids or of compressed gases, have now attained great dimensions, as for example a diameter of thirty-two feet and a length of over two hundred feet, and the demand is for even larger tanks. Because of their size, which renders it impossible to move them any great distance, these containers must be constructed in the field, in the open air, and the methods conventionally used in the shop for assembling of smaller cylinders either fail completely or become unduly costly when applied under field conditions.

Tanks of this type are customarily made up of a plurality of rings joined end to end, the longitudinal seams being staggered around the circumference and the heads being hemispherical or otherwise outwardly curved. They may be constructed with all the seams riveted, or with the longitudinal seams riveted and the roundabout seams welded, or with all the seams welded, as may be preferred, all of these alternatives being found in prior practice. It is also well known to rotate the tank at intervals, during construction, to bring portions being worked on into convenient locations, particularly to bring seams to be welded into an approximately horizontal position.

Briefly stated, the method consists in first erecting on each of the permanent foundations a ring-shaped section of the tank provided with a strong and rigid girder; in guying or bracing these girder sections to prevent their being overturned by a relatively small unbalanced weight; in adding material (as prefabricated rings or individual sheets) on each side of each erected section in such manner as to avoid too great an overturning moment due to unbalanced weight, until the assembled portions of the shell approach to the point at which the gap may be closed by the insertion of a single section or of the sheets of which it is composed.

Wherever "girder" is referred to herein, reference is made to a circumferential girder, which may be inside or outside the shell.

The method is applicable to the construction of tanks resting on one, two, or a greater number of foundations, but as the use of two foundations is ordinarily the best practice the method is so illustrated in the attached drawings, in which:

Fig. 1 is a side elevation of the tank as completed and resting on its permanent foundations;

Fig. 2 is a section as on the line 2—2 of Fig. 1;

Fig. 3 is an end elevation and Fig. 4 a side elevation of one of the girder rings resting on temporary rollers during the assembling of the shell;

Fig. 5 is an end elevation on a reduced scale of a fabricated ring showing a preferred method of temporarily staying it against deformation;

Figs. 6, 7, and 8 are elevations of a portion (one-half) of the tank in various stages of assembling, and

Fig. 9 is an elevation of the entire tank at the stage at which the halves may be joined by the insertion of a single ring.

Referring first to Figs. 1 and 2, the tank may be considered as consisting of a plurality of ring shaped sections 10—10—10, a closure ring 11, two girder rings 12—12 and the two heads 13—13.

Each girder ring is provided with a girder 14, shown as being placed outside the tank though it may equally well be placed inside. The girder rings are also provided with pairs of brackets 15 which, when the tank is completed, rest on expansion rollers and enclosing boxes 16 seated on concrete or other piers 17.

The first step in the construction of the tank is to erect on each of the foundations a girder ring 12 in or on which the girder has already been permanently fixed in position. During the construction period these rings rest on temporary rollers 18 supported from the footings as shown in Fig. 3. These rollers are so placed and proportioned that the tank which is to be constructed on them will be in its final position when completed. As shown in Fig. 3, the brackets 15 and expansion rollers 16 have not yet been placed at this stage. The rings are maintained in an upright position by suitable means, shown in Fig. 4 as guys 19, though struts may be used, if preferred.

The next step is to add material on each side of each girder ring in such manner as to avoid an unbalanced condition exceeding the restraining capacity of the guying means provided. This addition of material may be in the form of complete rings or of single plates, or both.

Where complete rings are added, which will be possible until the assembly projects at least two or three rings beyond the foundation, the rings are fabricated on the ground and are stayed or braced temporarily to permit them to be lifted into position and bolted to the shell sections already assembled. For this purpose

I prefer the method of staying described and claimed in my copending application Serial No. 324,837, filed simultaneously herewith. This method consists briefly in placing radius rods 20 in tension between a centrally disposed disc or hub 21 and the inner face of the ring. These rods may be welded at their inner ends to the hub and also welded at their outer ends to the wall of the ring, or the rods may be passed through holes drilled in the ring and tightened with outside nuts. In either case the staying means is removed as soon as the ring is assembled with the shell and is available for use in the next ring to be constructed, and any preferred staying means may be used, the purpose being merely to prevent undue deformation of the ring while it is being lifted and mated with the part of the shell already assembled.

The choice between adding prefabricated rings and building them in place by adding a sheet at a time to the part of the shell already assembled will depend on the momentary relation between the projected length of the assembly and the strength of the guying or other restraining means 19. Assuming that the girder 14 is stiff enough to resist local deformation and maintain the girder ring truly circular, the projected portion of the uncompleted shell is a true cantilever beam and has no tendency to deform at its outer end. This, however, is true only as long as the plane of the girder ring is the sole plane of support. If any attempt is made to resist overturning force by supports placed under the projecting end, as for example by means of blocking, the outer end of the shell will be deformed and it will be impossible to continue the assembling. For this reason, in following the method herein described, the guying means 19, of whatever nature, is the sole means for resisting the tendency of the momentarily heavier end of the shell to subside, and as the distance from the girder ring increases, this force correspondingly increases for any given increment of weight. Consequently, while it may be cheaper and more convenient to prefabricate the rings on the ground and add them as units, it is seldom or never possible to continue doing so for the entire length of the assembly, and at some point along this length (which will be determined solely by the judgment of the constructor) it will be necessary to fabricate the rings in place by adding one sheet at a time.

Whichever method of addition is followed, the unbalanced weight due to the addition of a ring or a sheet is immediately compensated by the addition to the opposite side of a corresponding element. This is illustrated in Figs. 6 to 9, inclusive. In Fig. 6 a first ring 10—1 has been bolted on the right hand of the girder ring 12; in Fig. 7 a second ring 10—2 has been added on the left hand, thus restoring the weight balance; in Fig. 8 three rings on each side of the girder ring have been completed and rings 10—7 and 10—8 have been started by the addition of one sheet at each end of the assembly.

In Fig. 9 the shell is shown in the last stage of incompletion; the two halves (which may have been constructed simultaneously or successively) having approached each other until the gap can be spanned by a single closure ring 11. The numbering of the rings on each half of the tank shows the two orders which may have been followed in adding rings or sheets. It will be noted that on the left half the order is right-left-left-right while on the right half the order is right-left-right-left. The first order is usually more

convenient, but otherwise they are strictly equivalent, the unbalance due to the addition of a single unit on one side being corrected by the following addition of a similar unit on the other side of the plane of support.

As soon as the closure ring 11 has been bolted into place, the guying means 19 may be removed. The heads 13 are then placed and the assembling of the tank is completed. It may then be rotated on the rollers 18, as by means of a roundabout cable and a winch, for convenience in the ensuing operations of riveting and/or welding. The tank having thus been made tight is tested and, finally, the expansion rollers and boxes 16 are placed on the piers, the brackets 15 are positioned on the boxes and attached to the girders, and the temporary rollers 18 are then withdrawn, allowing the weight of the tank to rest on the brackets. The temporary rollers may be removed without lifting the tank if they are initially placed on wedges which may be driven out after completion of the job.

In case it is not desired to rotate the tank during the construction period, as for example if it is to be constructed by the addition of single sheets to the girder ring and the welding of each seam as the sheet is placed, the use of the temporary rollers may be omitted. In such case the brackets 15 are attached to the girder ring when it is first erected, and the expansion rolls and enclosing boxes 16 are placed between the brackets and the foundations at that time, thus bringing the girder ring into its final position at the time of erection.

If the completed tank is to be used for the storage of liquids, the girders which would be required to prevent deformation in use will be sufficiently strong and stiff to maintain the shell cylindrical during the assembling operation. It should be noted, however, that if the tank is to be used for the storage of gas under pressure, the girders calculated for the stresses existing in the use of the tank may be considerably too light to maintain the cylindrical form during assembly, and in calculating their section the stresses existing during construction should also be considered.

In the attached claims, the word "foundation" is used in the singular to define the ultimate support for the tank in any one plane normal to the longitudinal axis, this ordinarily consisting of two piers which may or may not rest on a common footing.

I claim as my invention:

1. In the construction of horizontal cylindrical tanks: the step of projecting a self-supporting cylinder from opposite sides of a girder-stiffened ring section resting in an erect position on a foundation, by successive additions of tank-shell material to opposite sides of said erect section, the total weight of said section and said added material being transmitted through said girder to said foundation.

2. In the construction of horizontal cylindrical tanks: the step of projecting a self-supporting cylindrical shell from opposite sides of a ring section stiffened by a circumferential girder and resting in an erect position on a foundation, by successive additions of prefabricated rings of tank-shell material to opposite sides of said erect section, said additions being made alternately on the two sides of said section, the total weight of said section and said added rings being transmitted through said girder to said foundation.

3. In the construction of a horizontal cylindrical tank, the steps comprising: erecting in an axially horizontal position a ring-shaped section

of said tank including a stiff circumferential girder; bracing said girder to resist an overturning force; attaching tank shell material at each end of said section and thus forming a cylinder of progressively increasing length, and supporting said cylinder during said construction solely on a foundation bearing only against said girder-including section.

4. In the construction of a horizontal cylindrical tank, the steps comprising: erecting in an axially horizontal position a ring-shaped section

5 of said tank including a stiff circumferential girder; bracing said girder to resist an overturning force; attaching prefabricated rings of tank shell material alternately at each end of said section and thus forming a cylinder of progressively increasing length, and supporting said cylinder during said construction solely on a foundation bearing only against said girder-including section.

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