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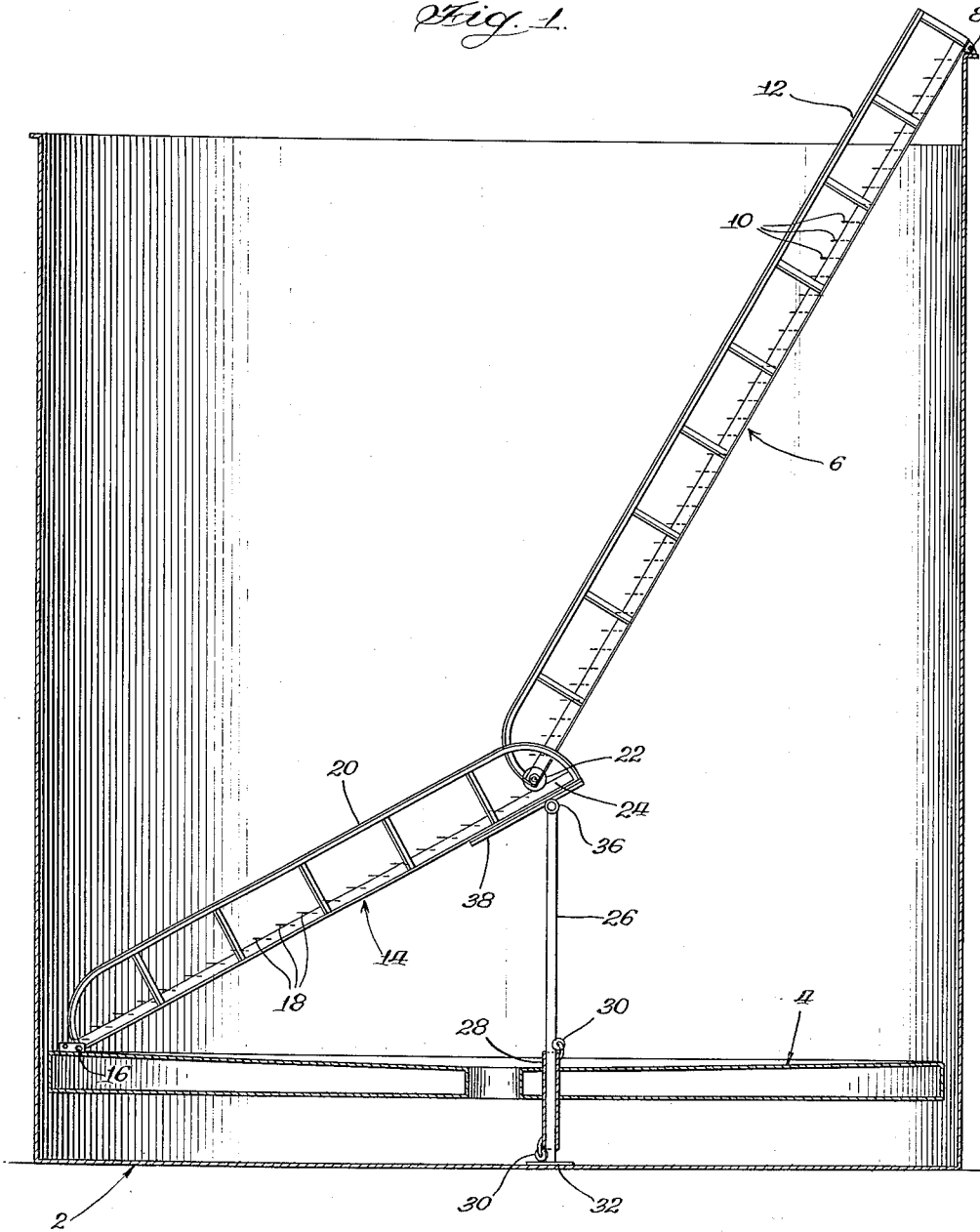
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LADDER ARRANGEMENT FOR FLOATING ROOF STORAGE TANK

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2 Sheets-Sheet 1

Fig. 1.



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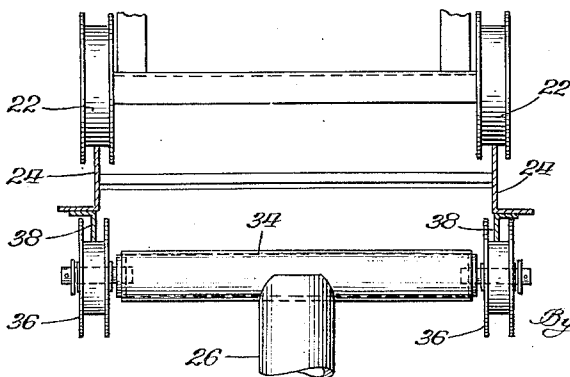
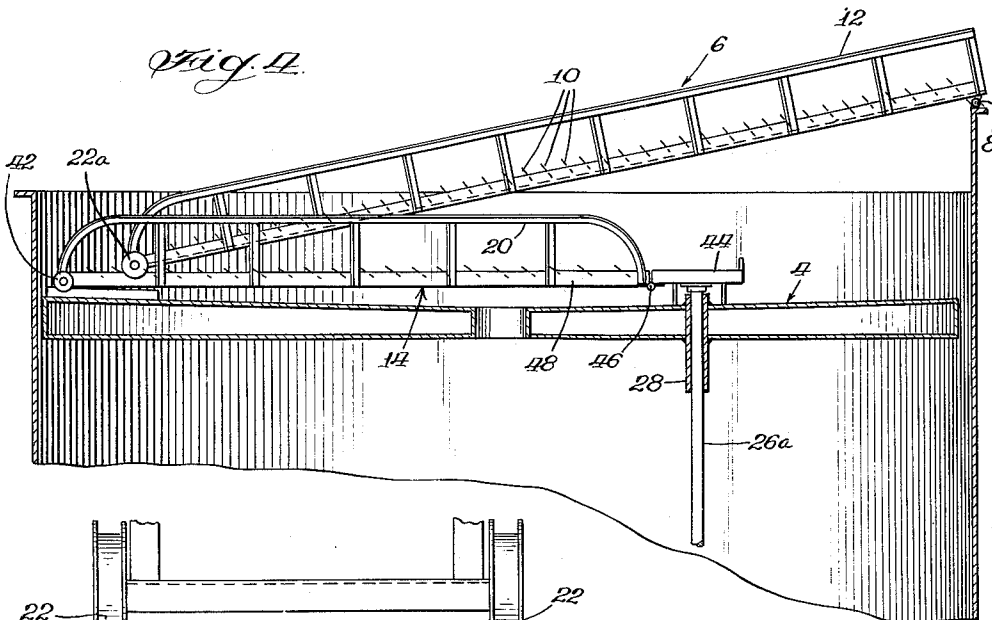
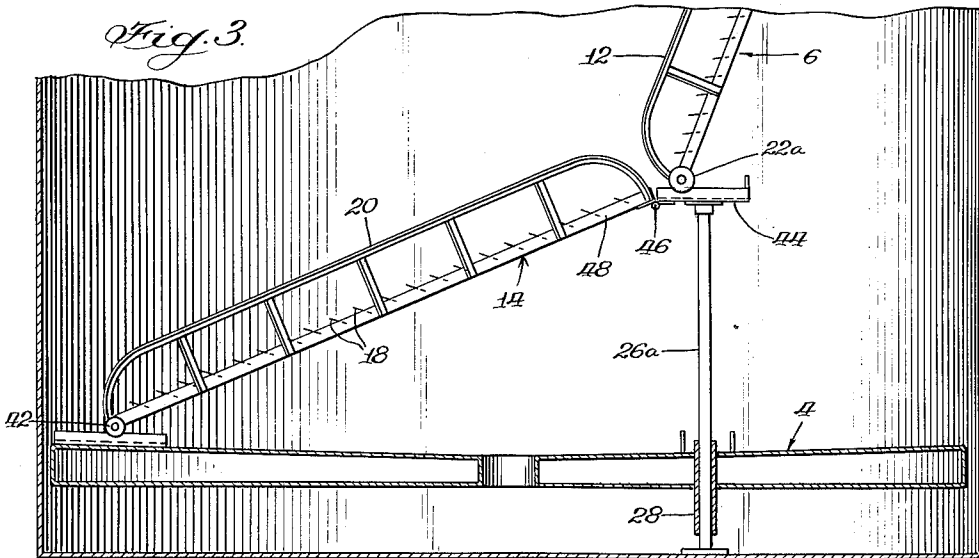
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2 Sheets-Sheet 2



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2,981,363

LADDER ARRANGEMENT FOR FLOATING ROOF STORAGE TANK

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9 Claims. (Cl. 182-84)

The invention relates to field storage tanks of the floating roof variety and in particular to a novel ladder arrangement therefor.

As is well-known to those skilled in the art many field storage tanks are provided with roofs which are arranged to float on product stored in the tank and consequently raise and lower in the tank in response to filling and evacuation of product therein. Reasons of service, maintenance and the like dictate that means be provided whereby personnel can have easy access to the roof regardless of the position thereof in the tank. The obvious method to provide such access is to have a ladder or stairway structure connected to the upper edge of the tank and depending therefrom to engage the roof. Of course, the fact that the roof is movable precludes any permanent connection between the lower end of the ladder and the roof itself. Extensive experience with prior art ladder arrangements have shown them to be unsatisfactory from many standpoints. Initially, their design has been bulky and consequently expensive. Further, the weight of the ladder arrangement and its angular position in the tank has tended to place undesired side thrust on the roof tending to uncenter same which in turn leads to unsatisfactory roof operation. Of course, operational deficiencies are accentuated when the roof is in its lower positions in the tank.

With the above in mind it is a general object of the invention to provide a unique ladder arrangement for the type of tanks here under consideration, that avoids the difficulties currently found in prior art devices and is of particular utility wherein the tank is provided with a shell height greater than the tank diameter.

It is a specific object of the invention to provide a ladder arrangement of the type described that is relatively economical in initial cost.

It is a further specific object of the invention to provide a ladder arrangement having relatively movable sections arranged to operably connect with the tank so that the relative position of the sections will change in response to certain roof movements.

These and other objects of the invention will become apparent in the course of the following description and an examination of the associated drawings, wherein:

Fig. 1 is a side elevational partially sectional view of a floating roof tank and illustrating one adaptation of the invention,

Fig. 2 is a detailed view of the upper end of the platform post employed in the structure of Fig. 1,

Fig. 3 is a fragmentary side elevational view of a slightly altered modification of the invention, and

Fig. 4 is a fragmentary detailed view of the embodiment of Fig. 3 in the roof high position.

Describing the invention in detail and directing attention to Fig. 1, it will be seen that a field storage tank is indicated generally at 2. The tank 2 is provided with a floating roof 4 disposed therein and arranged to move vertically in the tank 2 in response to change in stored

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product level. Those skilled in the art will understand that the tank 2 and roof 4 are illustrated schematically, the structural detail of same being unimportant for the purpose of the invention herein disclosed.

The ladder arrangement herein employed comprises a first stairway, indicated generally at 6, said first stairway being pivotally connected at its upper ends as at 8 to the upper ends of tank 2. The stairway of course comprises steps or rungs 10 and hand rails 12 for the convenience of using personnel. A second stairway, indicated generally at 14, is also provided, said second stairway being supported by the floating roof and having one end thereof 16 movably connected to the roof and preferably in a pivoted manner. Again, the second stairway 14 comprises rungs or steps 18, and a side rail or rails 20 for the convenience of using personnel. Adjacent ends of the stairways 6 and 14 are operatively connected, said operative connection being such that relative movement between the stairways is accommodated. In the embodiment illustrated in Fig. 1, such relative movement is provided for by a pair of rollers 22 journally mounted on the lower end of stairway 6 and arranged to rollably receive tracks 24 which form part of the structure of the stairway 14.

A platform post 26 is carried by the floating roof via a guiding sleeve 28 which is fixedly mounted on the roof 4 and vertically extends therethrough. The platform post 26 is telescopically and slidably received in the sleeve 28 for relative vertical movement therethrough. If desired guide rollers 30 may also be employed to facilitate vertical movement of the post 26. The lower end of the post 26 is provided with an abutment 32, said abutment being engageable with the tank bottom when the roof is in its low positions in the tank. The upper end of the post 26 has mounted thereon a crossbar 34, said crossbar journally carrying rollers 36 at opposed ends thereof. Spaced tracks 38, are secured to the underside of the stairway 14 to operatively engage the rollers 36.

Through the operation of the embodiments of Figs. 1 and 2 will probably now be obvious to those skilled in the art, it will nevertheless be briefly explained.

When the roof 4 is in its high positions in the tank, the stairway 14 will be in its down position and completely supported by and parallel to the roof. Movement of the roof in its high positions of course changes the angular relation between the tank 2 and the stairway 6, the stairway 14 merely acting as a guiding element for the rollers 22. As the roof moves downwardly and approaches its lower positions the platform post 26 will engage the tank bottom and begin vertical movement in relation to the roof 4. This action causes the post 26 to elevate the adjacent end of the stairway 14 while the other end 16 of the stairway 14 pivotally moves relative to the deck. In effect, the post 26 now supports both the adjacent ends of the stairways 6 and 14. It will be noted that this supporting effect results in a major portion of the weight of the stairways being transmitted through the roof to the tank bottom thereby markedly reducing the uncentering effect the ladder arrangement may have on the roof.

Turning to Figs. 3 and 4, it will be seen that the structure of the stairways 14 and 6 is substantially similar to that employed in the previous embodiment. The lower stairway 14 however is provided with a pair of journally mounted rollers 42 to rollably engage the deck surface during stairway movement. The platform post 26a is provided at its upper end with spaced rails 44 which pivotally connect as at 46 with rails 48 on the lower stairway 14. The rollers 22a on the upper stairway 6 operatively engage the rails 44 and 48 during ladder movement. Fig. 4 illustrates the embodiment of Fig. 3

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when the roof is in its high positions in the tank and the lower stairway 14 is lying flat on the roof deck. The operation of the embodiment illustrated in Figs. 3 and 4 can be readily ascertained from the description earlier given.

Thus, it will be seen that the invention provides a ladder arrangement for a floating roof which comprises simplicity of operation and structure and relatively low initial cost thus remedying the difficulties encountered in prior art arrangements.

The invention as shown is by way of illustration and not by limitation and may be subject to various modifications without distracting from the spirit thereof or the scope of the appended claims.

What is claimed is:

1. In a ladder arrangement, the combination with a field storage tank and a roof arranged to float on product therein; of a first stairway movably connected to the tank adjacent the upper edge thereof, a second stairway operatively connected to the roof, means interconnecting adjacent ends of the stairways to accommodate relative movement therebetween, and supporting means movably secured to said roof and including an upper portion operatively connected to at least one of the ends of the adjacent ends of said stairways and the lower end portion engageable with the floor of said tank to support the adjacent ends of said stairways.

2. In a ladder arrangement, the combination with a field storage tank and a roof arranged to float on product therein; of a first stairway operatively connected to the tank adjacent its upper edge, a second stairway operatively connected to the roof, said second stairway being in a substantially horizontal position on said roof when said roof is above a predetermined level in said tank, means interconnecting adjacent ends of the stairways to accommodate relative movement therebetween permitting an end of the first stairway to move lengthwise over the body of the second stairway when the roof moves above said predetermined level, and rigid means operatively connected to at least one of the adjacent ends of said stairways and operatively engageable with a stationary rigid part of the lower end portion of the tank only when the roof is below said predetermined level to support the adjacent ends of the stairways.

3. In a ladder arrangement, the combination with a field storage tank and a roof arranged to float on product therein; of a first stairway movably connected at a first end to the tank adjacent its upper edge, a second stairway movably connected at a first end to the roof, said

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second stairway being solely supported by the roof when said roof is above a predetermined level in said tank, means interconnecting the stairways to accommodate relative movement therebetween permitting a second end of said first stairway to move along the second stairway during vertical movement of said roof above said predetermined level in the tank, and means operatively interconnected between at least one of the second adjacent ends of said stairways and a stationary portion of the tank when said roof is below a predetermined level in the tank to support the adjacent ends of the stairways so that said second stairway is jointly supported by said interconnecting means and said roof during vertical movement of said roof below said predetermined level in the tank.

4. In a ladder arrangement, the combination with a field storage tank and a roof arranged to float on product therein; of a first stairway operatively connected to the tank adjacent its upper edge, a second stairway operatively connected to the roof, means interconnecting adjacent ends of the stairways to accommodate relative movement therebetween, and a post extending through and movable relative to the roof, the upper end of said post being movably connected to at least one of the stairways and the lower end of said post being engageable with the tank bottom when the roof is in lower positions in the tank to support the adjacent ends of the stairways.

5. A ladder arrangement according to claim 4 wherein said post is rollably connected to said second stairway.

6. A ladder arrangement according to claim 4 wherein said first stairway is pivotally connected to the tank and said second stairway is connected to the roof so as to accommodate relative movement therebetween.

7. A ladder arrangement according to claim 4, wherein said adjacent ends of said stairways are rollably interconnected.

8. A ladder arrangement according to claim 4, wherein said second stairway is rollably connected to the roof.

9. A ladder arrangement according to claim 4, wherein said roof is provided with a sleeve guide extending therethrough and telescopically receiving the post.

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