April 19, 1960 C. DOBELL 2,932,964

TANK CONSTRUCTION

Original Filed Sept. 14, 1954 2 Sheets-Sheet 1

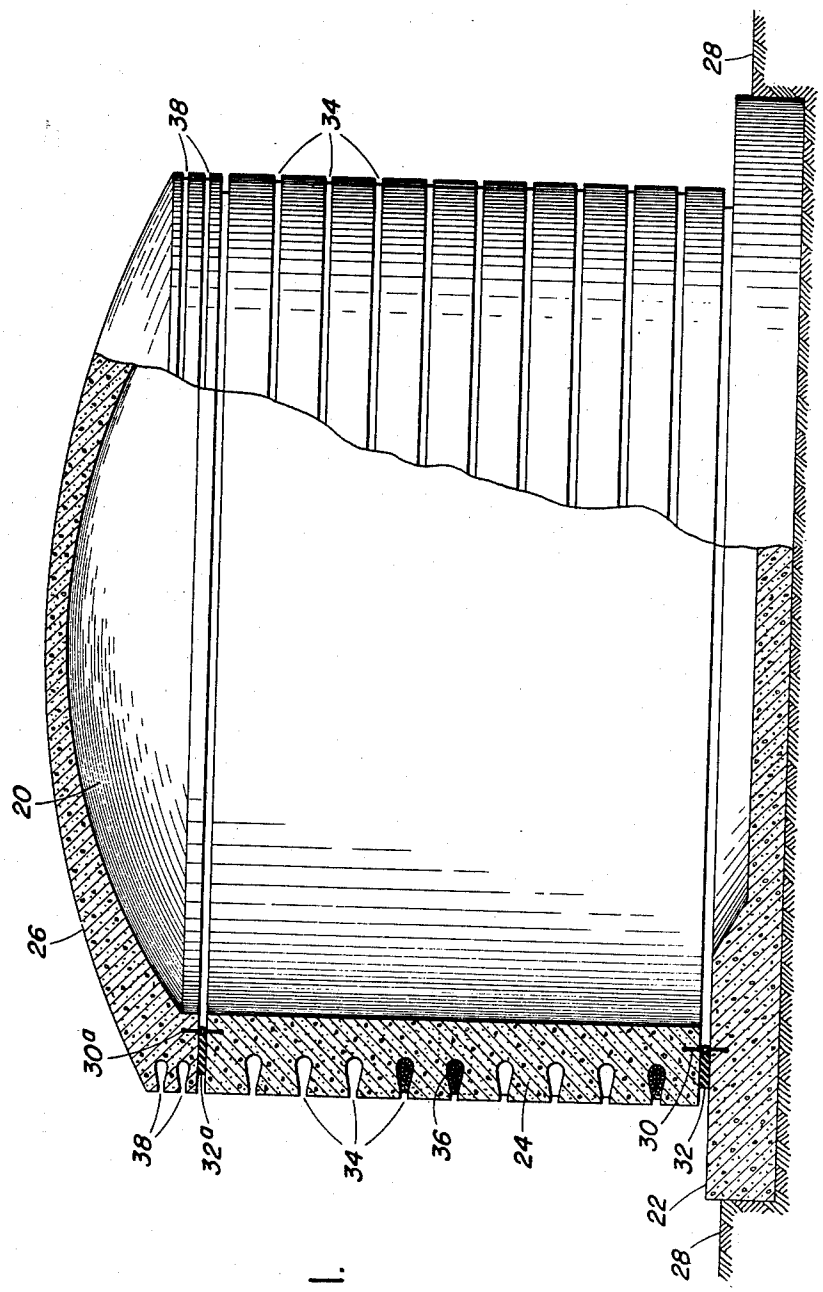

Fig. 1.

INVENTOR.
Curzon Dobell

BY William J. Fox

ATTORNEY

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Fig. 3.

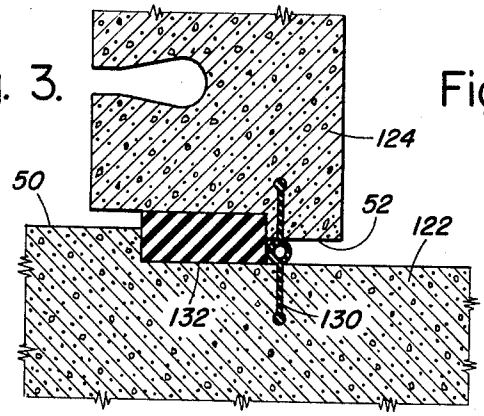


Fig. 5.

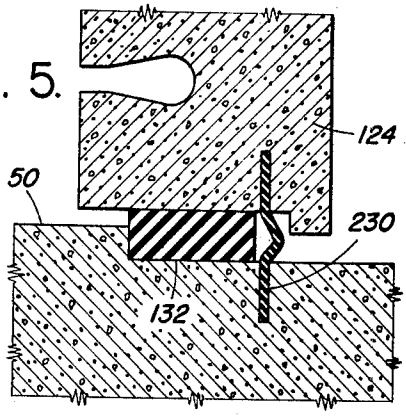


Fig. 4.

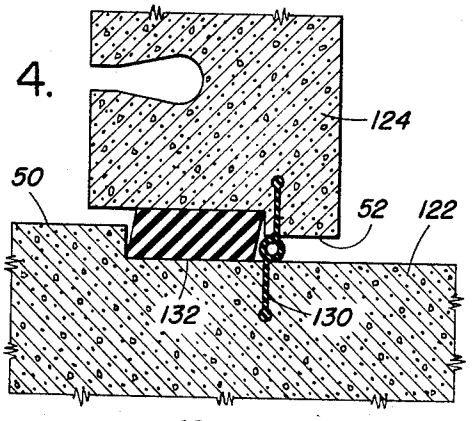
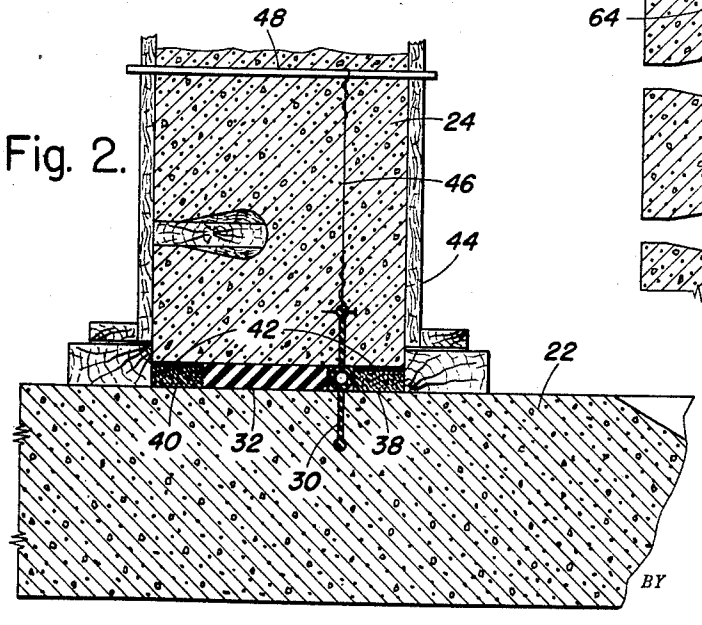


Fig. 2.



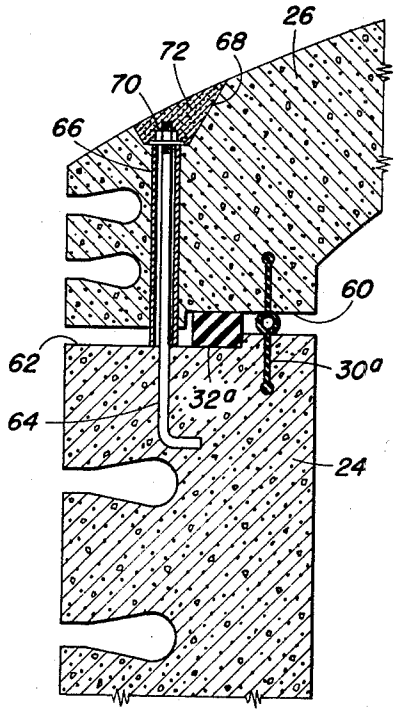


Fig. 6.

INVENTOR.
Curzon Dobell

BY William J. Fox

ATTORNEY

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2,932,964

TANK CONSTRUCTION

Curzon Dobell, New York, N.Y., assignor to The Preload Company, Inc., New York, N.Y., a corporation of Delaware

Original application September 14, 1954, Serial No. 456,037. Divided and this application October 25, 1955, Serial No. 542,717

3 Claims. (Cl. 72—13)

This invention relates to methods for the construction of concrete tanks and more particularly relates to an improved method of prestressing such tanks.

This invention is particularly directed toward reducing the restraint to which the side walls of such tanks are subjected especially at or near the top and/or bottom of such wall.

In prestressing tanks, the side walls are subject to considerable inward movement due first to the setting of the concrete but more importantly due to the wrapping of high tensile strength reinforcement around the wall to prestress it.

In prior techniques, care has been given to free the lower portion of the wall so that it might move inwardly, a typical method being shown in U.S. Patent 2,433,652. The top portion of the wall has usually been rigidly locked to the roof, usually by heavy reinforcing, so that there was considerable restraint acting on the top of the wall. These came either from the expansion or contracting of the roof or due to the varying liquid levels in the tank, which might at times vary from a high maximum to a low zero. To overcome these forces heavy vertical reinforcing, usually prestressed was required to counteract the bending moments caused by such restraint which might otherwise cause the walls to crack.

It is therefore an object of this invention to eliminate as much as possible the restraint acting on the sidewalls of a concrete roofed tank. It is a further object to provide a concrete tank in which the sides, roof, and base are free to move relatively independently of each other without sacrificing liquid tightness at the junction of these components. It is a further object to provide means for positively providing a water barrier in the case the footing and the side wall separate from each other. It is yet a further object to provide all of the above while nevertheless protecting the tank against earthquake and other shock that might cause the wall to move on its base or the roof on the wall. These and other objects will appear as this specification proceeds.

This invention proposes to have the concrete sidewalls of a tank attached at both the top and bottom to the dome and base respecively, firstly by resilient means permitting freedom of movement laterally and also secondly, by a further resilient means permitting independent vertical movement without loss of liquid seal. This invention further proposes to provide a chamfered key between side walls and base in combination with the above.

An understanding of both the details and the principles of this invention may best be had by an immediate reference to the drawings which illustrate the preferred mode of application of the principles of this invention and to the following detailed description of this mode of application of this invention.

In the drawings, Figure 1 is a partial sectional elevation of a domed tank showing the sidewall construction.

Figure 2 shows an enlarged, cross-sectional view of the method of connecting the sidewall to the base.

Figure 3 shows a cross-sectional view of a chamfered key base and sidewall before prestressing.

Figure 4 shows the final position of the chamfered key sidewall after prestressing.

Figure 5 is a sectional elevation showing the resilient means at the top of the tank.

More particularly in the drawings, the tank 20 comprises base 22 resting on subsoil 28, sidewalls 24 and roof 26. The sidewalls 24 are completely freed from rigid contact with both the dome and the base by the use of a resilient pad 32, preferably of rubber of low durometer such as 40, at the top and bottom of the sidewall. To retain the liquid seal, dumbbell 30 is used also at the top and bottom. If the base or footing should settle in any one sector, as occasionally occurs despite the most elaborate precautions, then the dumbbell 30, being locked in position, retains the seal and prevents the resilient pad 32 from being dislodged by the internal liquid pressure.

The base 22 as shown in this figure is constructed with a high outer sector and a low inner sector in order to provide as much volume as possible within the tank.

The sidewalls 24 have narrow-mouthed receptacles 34 built into the wall during construction. Into these receptacles are placed the prestressing wires 36 after which they are covered with grout.

The steps in construction of the tank sidewall are shown in Figure 2. In this figure the base 22 is poured and into it is inserted the dumbbell 30. After the concrete has set, rubber pad 32 is laid in place and then a level base is built up on each side of the pad 32 to provide a more or less level bottom surface edge for the sidewall. An inexpensive material usually available at most sites is clay which is roughly shaped as shown in built-up sections 38 and 40 and covered with paper separator 42. Formwork 44 is built up and the upper end of dumbbell 30 is attached by wire 46 to rod 48 at intervals. The dumbbell must be continuous and sealed at the joints. The rubber pad 32 must be continuous but need not be sealed. The wall 24 is then poured in place. It has been found that a resilient pad the full width of the wall produces too much restraint. The pad must be as narrow as possible consistent with supporting the superimposed dead load, hence the need for a filler each side.

After the concrete of the wall has set, the clay is flushed out, or in some instances may be left in place depending on the wishes of the constructor. The wall is then subjected to prestressing by any of the conventional methods, the one shown in the drawings being that using internal channels or receptacles for holding prestressing wires. When the concrete of the wall sets there is a slight inward movement of the wall due to shrinkage, but the greater movement is due to the prestress. The final position of the wall is shown in Figure 4. The above description is that of the deformation of the resilient pad at the bottom of the sidewall.

Figures 3 and 4 show another modification of base and sidewall using the resilient pad-dumbbell combination of this invention. In these embodiments an even greater internal volume is possible than in the embodiment shown in Figure 1. In these figures, the base 22 is provided with an elevated peripheral step 50. The dumbbell 130 is anchored in place when the base is poured. When hardened, the resilient pad 132 is mounted in place as shown. It must be of sufficient thickness so that when compressed there will be ample clearance between the wall and the base, and such that the maximum expected movement of the base and wall does not distort it through an angle change of over 70°. It must be of sufficient width that the loading on the pad caused by the wall and its overburden will not cause compressive stress of

more than 500 p.s.i. In practice in a thirty foot diameter tank, the step or key 50 is about ⅜ inch in height, and the pad 132 is ⅝ inch in thickness. Using forty durometer rubber, the clearance will be 3/16 inch after the wall is poured.

Clay (not shown) is now placed on top of the step 50 to a level equal to the top of the pad but is placed on the base 122 inside the dumbbell only to the top of its hollow bulb. When the wall is poured the overlapping protrusion 52 will be formed. This overlap between 50 and 52 provides a convenient key to assure that the tank will stay on its footings during earthquakes, etc. The key is also valuable to keep the tank in position when the tank is backfilled unevenly and movement occurs.

Figure 4 shows the condition after prestressing. The clay is washed out and prestressing is accomplished. The wall 124 will then have moved inwardly to a position as shown.

Figure 5 shows the use of a copper waterstop 230 as a substitute for the resilient rubber waterstop shown in the remaining figures.

Figure 6 shows a detail for constructing the joint at the top of the wall when a dome is used. The sidewall 24 is formed with a peripheral lip 62 and hold-down bolts 64 are set in place. The dome 26 is then poured. Bonding of the bolts 64 to the concrete of the dome is prevented by coating the bolts with a heavy bituminous cover and then further covering them with a pipe sleeve 66, the inside of which has also been heavily coated with a bituminous cover. The protrusion 60 on the dome is made in the same manner as at the base of the wall. The pad-dumbbell combination at the top as well as the base of the wall, together with the keyway overlap of dome and sidewall provide a useful prestressed construction to resist shock, earthquake, hurricane, etc.

This application is a division of my copending application Serial No. 456,037, filed September 14, 1954 and now abandoned.

I claim:

1. A concrete structure for containing fluids comprising a base, an endless prestressed sidewall mounted thereon but separated from the base to form a space, an endless elastic connector continuously embedded in both the base and the sidewall to prevent fluid leakage from the structure, the connector having three sections, a first section embedded in the wall to prevent detachment therefrom, a second section bridging the said space and of sufficient strength to withstand the maximum hydraulic pressure to which it may be subjected and simultaneously sufficiently flexible to accommodate the maximum movement between the wall and the base, and a third section attached to the second section and sufficiently embedded in the base to prevent detachment therefrom, and resilient means of width substantially less than the width of the sidewall and under compression between

the sidewall and the base to separate one from physical contact with the other and to permit predetermined movement.

2. A concrete structure according to claim 1, characterized thereby in that the said first and third sections of the connector are provided wtih a deformation in each section to maintain it in an embedded condition.

3. A concrete structure for containing fluids comprising a base, an endless prestressed side wall having a lower surface, said lower surface defining an inner edge with the inner surface of the side wall and an outer edge with the outer surface of the side wall, resilient pad means disposed between said lower surface of the side wall and the upper adjacent surface of the base, said resilient pad means being under compression and spacing the side wall from the base and yet permitting predetermined movement therebetween, said pad means being of a width substantially less than the width of the side wall, the pad means being spaced inwardly of said outer edge of the side wall and being spaced outwardly of said inner edge of the side wall, and an endless elastic connector, said connector including three sections, a first section being embedded in said base to prevent detachment therefrom, a second section bridging the space between said side wall and the base and being of sufficient strength to withstand the maximum hydraulic pressure to which it may be subjected and yet being sufficiently flexible to accommodate the maximum degree of movement between the side wall and the base, a third section of the connector being embedded in the side wall and projecting through the lower surface of the side wall lying between the inner edge of the side wall and the pad means.

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