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Shelander

[11] **3,824,751**

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[54] **PRECAST CONCRETE WALL STRUCTURE FOR WASTE TREATMENT TANKS**

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[52] **U.S. Cl.** ..... **52/173,** 52/223 R, 52/245, 137/363

[51] **Int. Cl.** **E04h 7/20**

[58] **Field of Search** ..... 52/173, 230, 227, 223 R, 52/245, 220, 198, 192, 432, 437, 221, 582, 578, 583, 224; 137/363, 364

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Attorney, Agent, or Firm—Curtis, Morris & Safford

[57] **ABSTRACT**

A construction for a waste treatment tank comprised of a plurality of precast concrete panels extending to approximately the full height of the tank is shown. Each of the precast concrete panels has a plurality of horizontal stressing tendons which are freely movable and pass through the panels and through continuous vertical edge plates on either side of the panels. Coupling plates attached to the edge plates are butt-welded to one another at their junctions. The tension in the prestressing tendons may be controlled at any time before, during or after the erection of the tank and the construction configuration provides easy access to the prestressing tendons. The configuration is particularly well suited for the through passage of piping connection and for the attachment of internal structure to the steel coupling plates.

3 Claims, 5 Drawing Figures

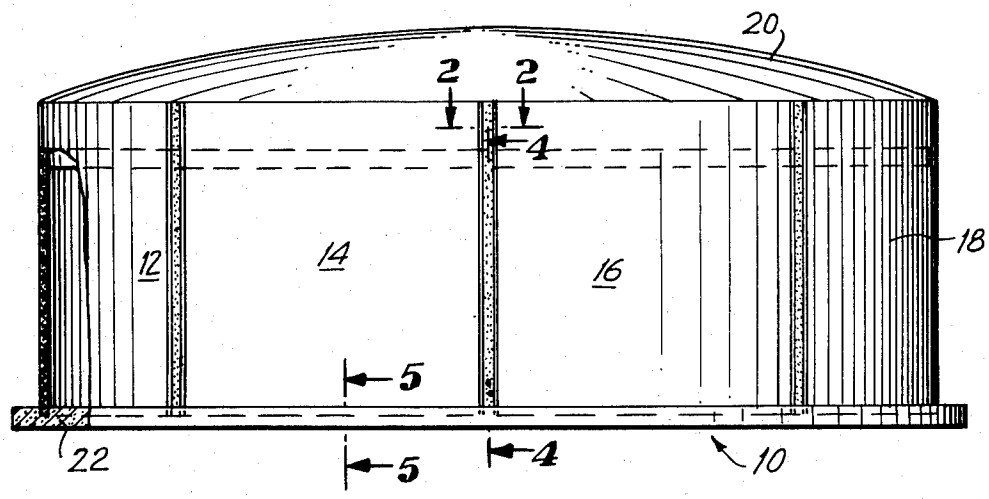

FIG. 1

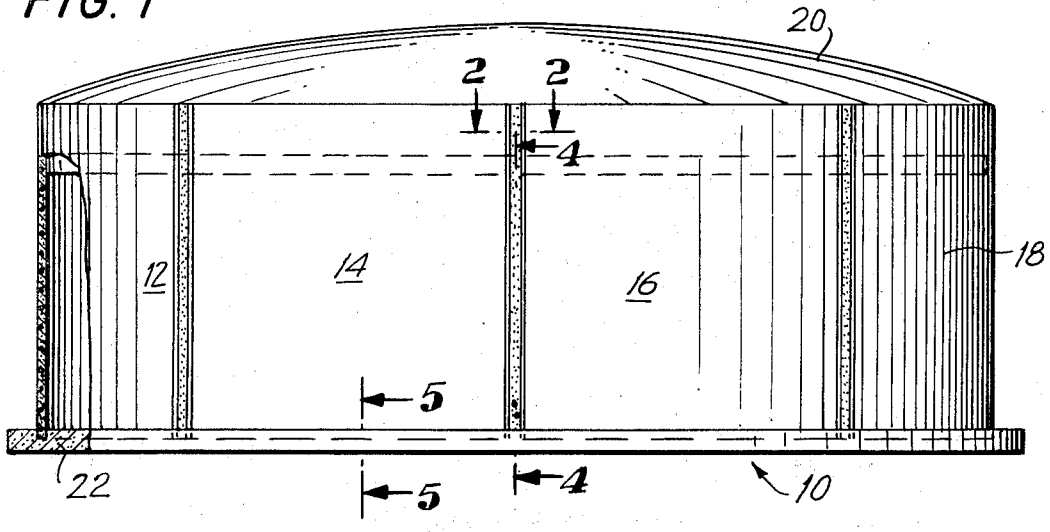

FIG. 4

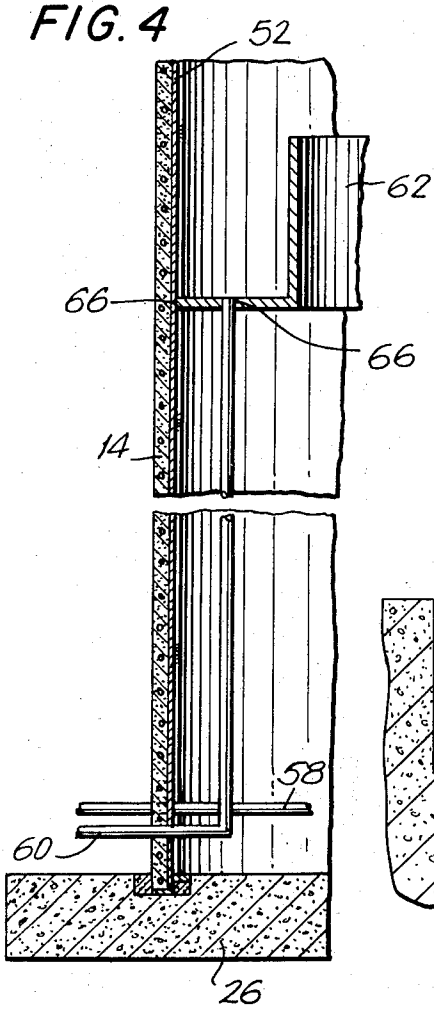

FIG. 5

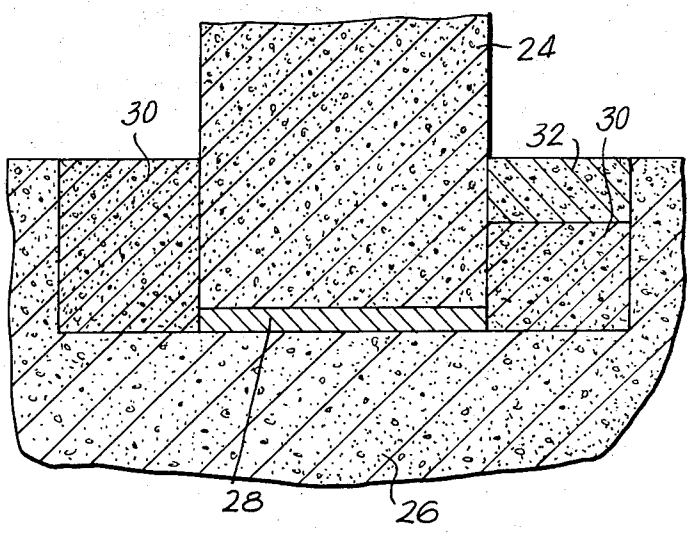

FIG. 2

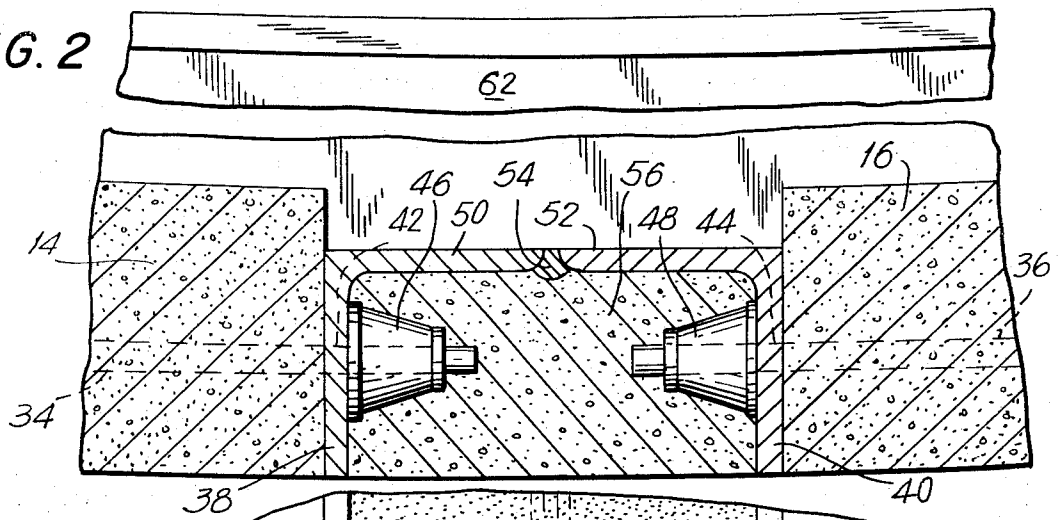
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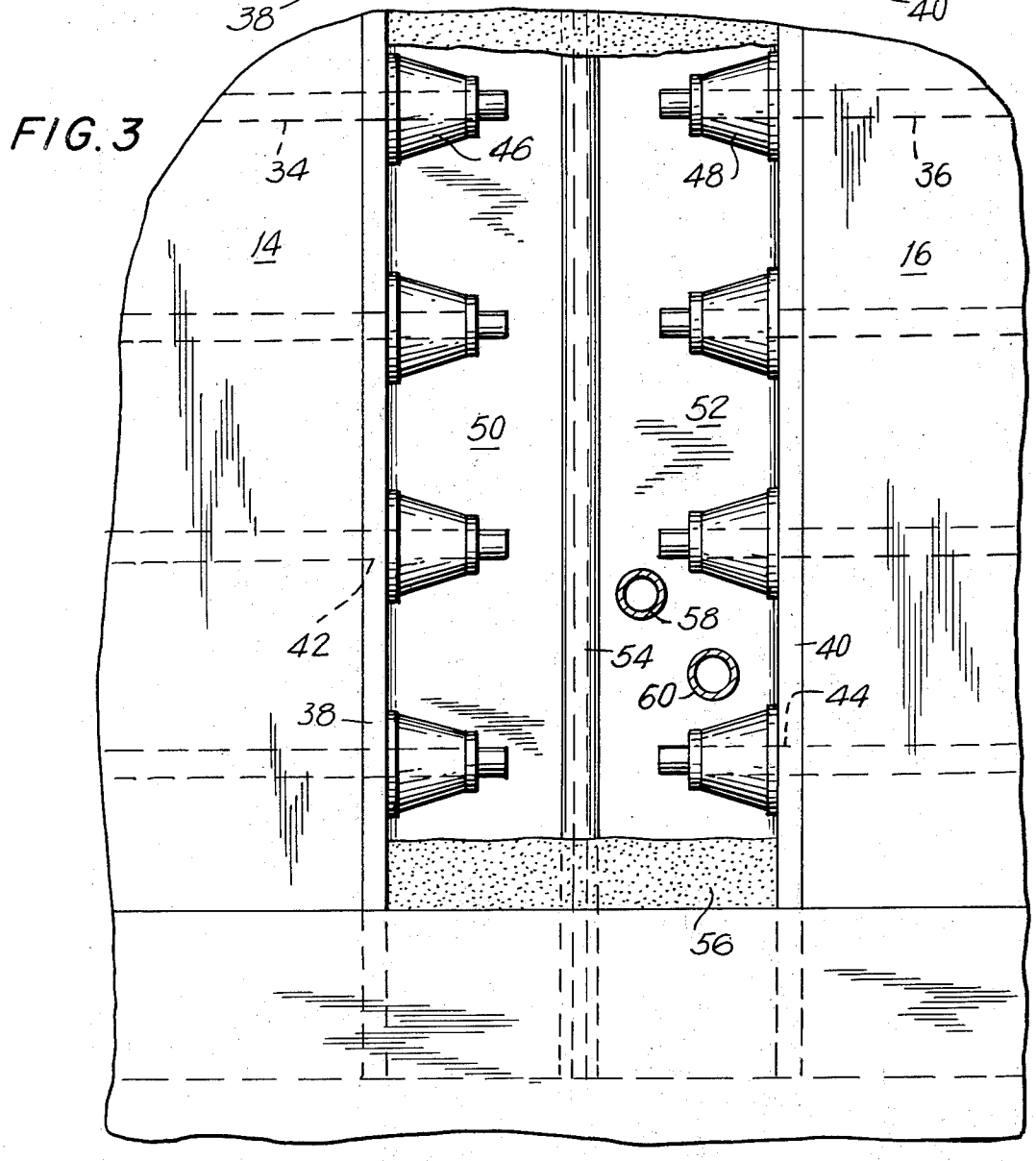
FIG. 3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PRECAST CONCRETE WALL STRUCTURE FOR WASTE TREATMENT TANKS

This invention relates to concrete storage vessels and more particularly to cylindrical tanks having side walls made up of precast concrete panels. More specifically, this invention relates to relatively small, cylindrical tanks used for waste treatment having walls comprised of precast, reinforced concrete panels joined to one another by water tight connections. Even more specifically, this invention relates to cylindrical tanks of reinforced, precast concrete panels having unique provision for inlet and outlet piping and for internal structures associated with waste treatment tanks.

The use of prestressed, reinforced concrete tanks for storage of liquids is well known. According to prior art methods, tanks have been constructed by first erecting a continuous concrete core wall and then prestressing that wall by placing it in a state of compression by encircling the wall with steel tendons under tension. Among prior art patents relating to continuous methods of prestressing concrete walls are U.S. Pat. No. 2,433,652.

The advantages of continuously prestressing concrete tanks are significant over other prior art tank structures. Since concrete is well known to have compressive strength far in excess of its tensile strength, by placing reinforcing tendons under tension around the concrete wall, the wall itself is placed in compression. Thereafter, when the tank is filled with liquid, the normal hydrostatic pressure against the inside surfaces of the wall reduces the net compressive stress within the tank walls or places those walls in relatively low tension. The reinforced concrete walls do not need to be as thick as walls in unreinforced concrete tanks. The reinforced concrete tanks do not require the constant maintenance and expense characteristic of steel tanks and it has been found that the reinforced concrete walls have a substantially longer life than do wood walls.

There are a number of disadvantages associated with prestressed concrete tanks, however. Among them is the expense required to erect forms and set the concrete. Additionally, a substantial period of time must be allowed to permit the concrete to set and to cure and this setting and curing time delays erection of the tank. Thereafter the tendors must be wrapped around the wall, and this cannot be undertaken until the concrete itself develops sufficient strength to withstand the weight of the wrapping equipment and also to withstand the hoop tension of the prestressing tendors. Other disadvantages of continuous prestress operations include the relatively high use of on-site construction labor which is typically more costly than factory labor. Furthermore, on-site labor is often subject to delays due to site conditions, inclement weather, equipment breakdown and shortage of materials. Furthermore, the same care cannot be exercised by on-site labor as can be exercised by yard crews or factory crews operating under controlled conditions.

In order to overcome the disadvantages of continuously prestressed tanks, suggestions have heretofore been made for erecting tanks out of precast concrete panels. By precasting the concrete panels it is possible to carefully control production line conditions and obtain substantially better quality concrete. Other advantages of precast panels are that they may be prestressed under production line conditions and thus have a more

carefully controlled strength characteristic. On-site labor costs are greatly reduced and the overall time required for erection can be substantially diminished. A further advantage of precast, prestressed, concrete panels is that the prestressing tendons are located internally of those panels and are thereby protected from the elements. In contrast, a substantial cost incurred in continuously prestressed concrete tanks, is that of covering the prestressing tendons with a mortar of bitsumastic material to protect it from weather conditions and to inhibit corrosion. Typically, these operations are performed by highly skilled personnel who cover the exposed tendons with gunnite or other pneumatic mortar compositions. Since the prestressing tendons are protected by the concrete panels in which they are cast, this expense is saved when using precast construction.

Among the prior art relating to precast concrete panels are British Patent Specification No. 744,717 and U.S. Pat. No. 2,958,983. In the former reference, several constructions are shown for joining precast, prestressed concrete panels in such way that the ultimate structure is either discontinuously or continuously prestressed. Likewise, in the latter reference, a concrete storage structure is shown having a wall configuration which results in a continuous wall, discontinuously prestressed.

In recent years, particularly due to increased public awareness of ecological problems and legislation directed to pollution control, waste treatment facilities have been built, including waste treatment tanks which have posed novel construction problems. The waste treatment tanks are generally relatively low and may perform functions such as settling of the waste materials fed to them. It is desirable, of course, to erect such waste treatment tanks in the minimum period of time and to minimize the overall costs incurred in constructing them. The continuously prestressed tanks are relatively too expensive for smaller waste treatment service and for the several reasons discussed above, that technology is not suitably adapted to this purpose. Precast and prestressed concrete panels have been used for construction of such tanks; however, several problems have been encountered.

Primary among the problems encountered in the precast panels is that of finding a suitable water tight seal between adjacent horizontal panels. A second problem encountered in the construction of such tanks is that of protecting any exposed portions of the prestressing tendons used in the precast panels.

Still a further problem encountered, in designing and erecting waste treatment tanks, is that of providing for inlet and outlet piping to the tanks. It has been found that where the inlet and outlet piping passes through the panels themselves, there is a substantial disruption in the panels resulting in unknown stress conditions, high risk of deterioration of the panel or its reinforcing, and consequently a material risk of failure of the vessel or a part thereof. A related problem is encountered in affixing internal structure to the walls made of precast panels, insofar as the attachment of structure to the interior surface of the walls, requires either special reinforcing or results in unknown stress conditions, bending moments and the like at various positions along the wall. This requires either a substantially greater thickness of the precast panel or, alternatively, requires spe-

cial steel reinforcement which greatly adds to the cost of the wall.

A problem encountered in using prestressed, precast concrete panels, wherein the reinforcing tendons are bonded within the concrete panels is that there is established a fixed compressive stress condition within the concrete thereby leaving no flexibility for a future adjustment of the stress conditions within the wall of the tank.

It is thus the primary object of this invention to provide a construction for precast concrete panels for use in liquid storage vessels.

It is a related and further purpose of this invention to provide a construction of such panels which provides a substantial measure of protection for reinforcing tendons within such panels and which further provides an easy means for protecting the ends of such reinforcing tendons where they may be exposed to the elements.

It is still a further and related object of this invention to provide precast concrete wall panels for use in cylindrical waste treatment vessels, wherein the compressive stress imposed on the precast panels can be adjusted from time to time without effecting the integrity of the tank wall or incurring undue expense.

It is still a further object of this invention to provide precast concrete panels for use in cylindrical waste treatment vessels which permit the through fitting of piping fixtures and connections and the attachment of internal steel structure, without causing unknown stress conditions or requiring expensive reinforcement.

It is still a further and related object of this invention to provide precast concrete panels for cylindrical waste treatment vessels, wherein a relatively simple joint between the panels is provided wherein the stress conditions are either known or can be carefully controlled and which is essentially water-tight under any of the conditions of service which may be encountered.

It is still a further object of this invention to provide precast panels which can be economically and efficiently produced under controlled conditions, off-site and erected in a minimum amount of time on-site.

These and other objects of this invention are achieved in a precast concrete panel having a stressing tendon passing horizontally through it. The stressing tendon is substantially freely movable within the concrete panel. On either edge of the concrete panel is a metal plate which may be bonded or fastened to the respective side edges of the panel and which has holes therein for through passage of the stressing tendons and which further includes means to retain those tendons in tension. Attached to the metal edge plates and extending substantially circumferentially of the tank wall, are coupling plates which are adapted to be welded to adjacent, mating coupling plates of adjacent panels. Desirably, the coupling plates are integral with the inner sides of the edge plates to provide efficient exterior access to the tension retaining means associated with the edge plates.

In the embodiment shown in the Figures, a substantially cylindrical tank, adapted for waste treatment is shown, erected of a plurality of precast concrete panels, each of which extends substantially to the full height of the tank. Each of these precast concrete panels has a plurality of horizontal stressing tendons passing therethrough. In the casting operation, the prestressing tendons are covered with a sheath of a plastic material such as polyethylene, polypropylene, polyvinylfluoride or the like which prevents the bonding of the tendon to the concrete as it is cast. Accordingly, the prestressing tendons are substantially freely movable within the concrete panel. Each concrete panel has two continuous, metal edge plates bonded to its vertical side edges. These metal edge plates have holes therein for free passage of the stressing tendons and they include means, well-known in the art, to retain the tendons in any desired degree of tension. Metal coupling plates, integral with the metal edge plates, at the inner side thereof, extend circumferentially of the tank wall and are butt-welded to one another at their mating extensions.

A particular advantage of the precast panels disclosed herein and of the wall construction made thereof is that the metal coupling plates may be provided with pipe connections or through fittings for receiving inlet or outlet piping associated with the sewage treatment tank. By passing the piping through the metal coupling plates, it is possible to obtain a relatively stress free interface between the piping and the tank wall, as compared with prior art methods of inserting the piping through the precast concrete panels. A related advantage is achieved insofar as internal steel structure, such as launderers, as further described below, may be directly fastened as by welding to the interior surfaces of the metal coupling plates. This avoids imposition of unknown bending moments on the precast panel.

Still a further advantage of the construction shown is that the butt-welded joints between the metal coupling plates are relatively easy to make and the stresses therein can be readily established. Still another advantage of the configuration shown is that the stress within the precast panels can be adjusted either prior to erection or after erection. If the panels are stressed prior to erection then the coupling plates and the welds connecting them are in essentially neutral stress after erection and are in tension when the waste treatment tank is filled with liquid. Alternatively, if the stressing tendons are put in tension only after the precast panels are erected, then the coupling plates and their welds are initially in tension and thereafter are put in additional tension when the waste treatment tank is filled.

Whatever the sequence of construction, the tension within the coupling plates and in the welds can be readily established and, if desired, the tank can be retensioned at any time. It may be desirable to cover the coupling plates, the weld and the tension retaining means associated with the edge plates, with mortar or other corrosion control mediums. The present design provides an easy means for removing the mortar and retensioning the tendons and thereafter replacing the mortar or other corrosion control composition. Furthermore, since the mortar used to cover the coupling plates is not a structural part of the tank itself, any cracks which develop or imperfections in that mortar do not effect the tanks' performance.

IN THE DRAWINGS

FIG. 1 is an elevation view of a waste treatment tank constructed from concrete panel according to the invention;

FIG. 2 is a section view taken along lines 2—2 of FIG. 1 showing the coupling between adjacent concrete panels;

FIG. 3 is an expanded elevation view of a portion of the tank wall of FIG. 1 showing the coupling between adjacent concrete panels;

FIG. 4 is a section view taken along lines 4—4 of FIG. 1 and showing inlet and outlet piping associated with the waste treatment tank and other associated internal structure; and

FIG. 5 is a section view taken along lines 5—5 of FIG. 1 showing the base joint of the concrete tank.

In FIG. 1, reference numeral 10 refers generally to a concrete tank for waste treatment or storage. Reference numerals 12, 14, 16 and 18 refer to adjacent, precast concrete panels which extend to the full height of the tank. Reference numeral 20 refers to a roof or dome structure which may be of any conventional design. Reference numeral 22 refers to a concrete platform for tank 10. Shown in more detail in FIG. 5, reference numeral 24 refers to a concrete wall panel, positioned above foundation 26. The elevation of panel 24 may be controlled by a shim or shims 28 and the lateral position of the concrete panels is fixed by the positioning of mortar 30 and polysulfite 32.

As shown more clearly in FIGS. 2 and 3, each of concrete panels 12, 14, 16 and 18 are comprised of concrete panels having horizontal stressing tendons passing therethrough. The tendon associated with panel 14 is designated by reference numeral 34 and that associated with panel 16 is designated by reference numeral 36. The stressing tendons pass substantially freely through the concrete panel and this is accomplished in the casting stage by sheathing the stressing tendons in a plastic membrane so that the steel is not bonded to the concrete. Located on both vertical side edges of each of the concrete panels 14 and 16 are metal edge plates 38 and 40. Metal edge plates 38 and 40 have holes 42 and 44 through which the prestressing tendons 34 and 36 pass. These tendons are retained by tension retaining nuts 46 and 48 as are well known in the art. Fastened to the inner edge of each of metal edge plates 38 and 40 are metal coupling plates 50 and 52 which extend substantially circumferentially of the tank wall and which are welded to one another by butt weld 54. As shown, the metal edge plate and the metal coupling plates are preferably integral with one another and are comprised of a single angle member. Although this is the preferred design, the edge plate and the coupling plates can be separate if desired. As shown in FIG. 2, the volume between the metal edge plates may be filled with mortar 56 to protect the ends of tendons 34 and 36 and their tension retaining bolts 46 and 48, as well as the metal edge and coupling plates, from atmospheric corrosion.

As shown best in FIG. 3, each of vertical panels 14 and 16 include a plurality of tendons spaced horizontally above one another, each of which passes through suitable holes in the continuous edge plates. It will be appreciated that the mortar 56 which is shown in FIG. 2 can be used to fill the entire volume between edge plates 42 and 44 and that it can be removed to permit retensioning of the tendons. This permits efficient use of the tank and the retensioning of it should that be necessary.

As shown best in FIGS. 3 and 4, an advantage of the invention, is in the facility of the tank to receive inlet and outlet piping. In FIG. 3 reference numeral 58 refers to an inlet pipe and reference numeral 60 to an outlet pipe, both of which pass through coupling plate 52 associated with panel 16. Outlet pipe 60 is in turn associated with a launderer 62 which comprises a circumferential weir located around the upper part of the interior of tank 10. Launderer 62 may be connected directly, as at 64, to the steel edge plates 52 and 50 as well as the edge plates connecting other panels around the circumference of the tank. The purpose of launderer 62 is to provide a overflow weir for liquids from which solid matter has settled. The relatively solid free liquid may then be removed via drain 66 and outlet piping 60. The advantage of the tank constructed according to the present invention is that attachment of launderer 62 to the steel coupling plates is efficiently accomplished and does not create unknown stresses in the precasting panels.

What is claimed is:

1. In a tank having a substantially cylindrical wall comprised of a plurality of precast, individually prestressed concrete panels, alternately positioned with steel wall members, the combination comprising:
   a. a plurality of precast, individually prestressed concrete panels, each panel having a plurality of horizontal stressing tendons passing substantially freely therethrough, each of said plurality of tendons passing through and being retained in tension against metal edge plates fastened to both vertical side edges of each of said concrete panels; and
   b. metal wall members fastened to said metal edge plates at the inner sides thereof and extending substantially circumferentially of said tank wall, said wall members being butt-welded to one another at their mating extensions to form said tank.

2. In a tank having a substantially cylindrical wall comprised of a plurality of precast, individually prestressable concrete panels, alternatively positioned with steel wall members, the combination comprising:
   a. a plurality of precast, individually prestressable, concrete panels, each panel having a plurality of horizontal stressing tendons passing substantially freely therethrough, each of said plurality of tendons passing through and being retained in tension against metal edge plates fastened to both vertical side edges of said concrete panels; and
   b. metal wall members fastened to said metal edge plates at the inner sides thereof and extending substantially circumferentially of said tank wall, said wall members being butt-welded to one another at their mating extensions to form said tank, at least one of said wall members being provided with pipe connection fittings for receiving piping associated with said tank.

3. In a tank having a substantially cylindrical wall comprised of a plurality of precast, individually prestressable concrete panels, alternately positioned with steel wall members, the combination comprising:
   a. a plurality of precast, individually prestressable, concrete panels, each panel having a plurality of horizontal stressing tendons passing substantially freely therethrough, each of said plurality of tendons passing through and being retained in tension against metal edge plates fastened to both vertical side edges of said concrete panels;
   b. metal wall members fastened to said metal edge plates at the inner sides thereof and extending substantially circumferentially of said tank wall, said wall members being butt-welded to one another at their mating extensions to form said tank; and
   c. a circumferential launderer fastened to the upper interior surfaces of said metal wall members.

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