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PRECAST CONCRETE SWIMMING POOL
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This invention relates to swimming pools, and more particularly to comparatively small swimming pools for private homes. It is directed to the problem of installing a swimming pool in an average residential yard at reasonable cost.

Private swimming pools of this type, although smaller than public pools, are expensive to install, particularly if a filtration system is included. A reinforced concrete pool of family size requires considerable time and labor to install, and is a "custom" job involving, besides excavation, expensive concrete and plumbing work. The overall costs of such pools are from $3,000 to $10,000.

My invention provides a comparatively light-weight concrete pool of novel construction which can be precast at the factory, equipped with an integral filtration plant complete with all plumbing, transported over the regular highway system to a selected location, and there installed in a suitable excavation, without the need for any extra plumbing. My novel structure preferably includes a pressure filter chamber cast integrally with the shell of the pool, and novel reinforcing means which makes it possible to use comparatively thin, light concrete shells. This provides a "life-time" pool at substantially less total cost than conventional swimming pools.

A primary object of my invention is, therefore, to provide a comparatively inexpensive lightweight precast concrete swimming pool having an integral pressure filter chamber, and provided with a sand and gravel pressure filtration plant complete with plumbing. Another object is to provide novel reinforcing means for concrete swimming pools. Another object is to provide a prestressed concrete swimming pool, i.e., one which is stressed after it has been cast, and before it is subjected to loads, such as those resulting from filling it, or stress loads caused by transporting it. Another object is to provide novel means for prestressing a concrete basin or tank. Other objects will become apparent from the following description and from the drawings, in which:

Fig. 1 is a plan view of a precast swimming pool shell made in accordance with my invention, the filter, filter cover and associated parts (which are shown in Figs. 12-14) being omitted;

Fig. 2 is a vertical section taken on line 2—2 of Fig. 1;

Fig. 3 is a side view of the same;

Fig. 4 is a section taken on line 4—4 of Fig. 1;

Fig. 5 is an end view of the same, taken at the deep end;

Fig. 6 is a section taken on line 6—6 of Fig. 1;

Fig. 7 is an enlarged fragmentary view taken on line 7—7 of Fig. 1;

Fig. 8 is an enlarged fragmentary view taken on line 9—9 of Fig. 1;

Fig. 9 is an enlarged fragmentary section taken on line 9—9 of Fig. 1;

Fig. 10 is an enlarged fragmentary portion of Fig. 1 showing in place portions of tension means which surround the filter cavity;

Fig. 11 is a fragmentary section taken on line 11—11 of Fig. 10;

Fig. 12 is a partial side view and longitudinal section taken on line 12—12 of Fig. 13, showing the pressure filter and associated equipment;

Fig. 13 is a plan view of the filter cover and associated equipment; and

Fig. 14 is a partial side view and transverse section taken on line 14—14 of Fig. 13;

Fig. 15 is a plan view of another precast swimming pool shell made in accordance with my invention, made in two sections disposed on opposite sides of the longitudinal axis, the filters, filter covers and associated parts, which are disposed in and above filter cavities 206 in the complete swimming pool, being omitted;

Fig. 16 is a side view of one section of the same, taken on line 16—16 of Fig. 17;

Fig. 17 is a section taken on line 17—17 of Fig. 15;

Fig. 18 is an end view of the pool of Fig. 15, showing the deep end;

Fig. 19 is a section taken on line 19—19 of Fig. 15;

Fig. 20 is an enlarged fragmentary section taken on line 20—20 of Fig. 15;

Fig. 21 is an enlarged fragmentary section taken on line 21—21 of Fig. 15;

Fig. 22 is an enlarged fragmentary section taken on line 22—22 of Fig. 15;

Fig. 23 is an enlarged fragmentary section taken on line 23—23 of Fig. 15;

Fig. 24 is an enlarged fragmentary section taken on line 24—24 of Fig. 15;

Fig. 25 is an enlarged fragmentary section taken on line 25—25 of Fig. 15; and

Fig. 26 is a schematic drawing of the piping connections and equipment of the pressure filter system of the embodiment of Fig. 15.

Referring now to the drawings, wherein like characters designate the same or similar parts, there is shown in Figures 1 to 14 one embodiment of my invention comprising a precast, prestressed concrete swimming pool or tank generally designated 100, comprising a basin or concave shell 101. Shell 101 is surrounded by a rim portion 102 at the top, from which depend side walls 103 on each side and end walls 104a and 104b at the deep and shallow ends respectively. The bottom of the shell is closed by a sloping bottom 105a which slopes downwardly from shallow end wall 104a toward deep end wall 104a. The rim portion, side walls, end walls and bottom wall are integral parts of the monolithic concrete shell wall 101. A drain well or pool outlet 116 is provided at the deepest point. Deep end wall 104a has an enlarged wall portion 105 extending downwardly from rim 102, and a deep filter cavity 106 extends downwardly in portion 105. The side and bottom walls of filter cavity 106 are pressure tight. A filter drain line 109 extends from the bottom of cavity 106 through the concrete to a point within the basin or shell adjacent drain 116. This is normally closed by a plug 110. The filter cavity 106 has an enlarged portion 107 above it, an annular shelf or shoulder 108 being provided at the bottom of the upper cavity portion 107 surrounding the lower portion 106.

The walls of cavity 106 may be strengthened by a spiral reinforcing rod 106a embedded in the concrete.

Filter cavity 106 contains a filter bed 111 of sand and gravel, sand being in the upper portion and layers of increasingly coarse gravel being disposed below that to fill the major portion of cavity 106, but leaving a small space at the top. A cover 112 rests on annular shelf 108 and is held in sealing engagement therewith by a gasket 113 and suitable anchor bolts 114 and nuts, thereby providing a pressure-tight cover for cavity 106. A supply pipe 111a
extends through the cover to the top portion of enclosed chamber 106, and a return line 111b also extends through the cover, from the bottom portion of the filter. Thus, closed cavity 106 constitutes an embedded or integral sand and gravel pressure filter in swimming pool 100. Instead of using the cavity walls themselves as filter, a filter may be embedded a filter tank in the cavity.

Mounted on top of cover 112 is a motordriven pump 115. Main drain line or supply pipe 137 connects the drain well 116 with the suction side of pump 115 through a stop valve, and a strainer 118 for catching hair, lint, and the like. Pump discharge pipe 119 connects with a multiport valve 120. When valve 120 is in its normal position it channels the water from pump 115 to the top of filter 106 through line 111a. Water from the pool passes down through the filter, is filtered, and emerges at the bottom into vertical tube 111b which leads it up through the top of the tank and back to multiport valve 120 which, in its normal position, channels the flow to outlet 122. Copper tubing return pipes 123 extend from outlet pipe 122 in both directions, are embedded in the walls of shell 101, and extend the length thereof on both sides to outlets 124 into the shell at the shallow end, for return of filtered water to the pool and bins described below. High quality, dense concrete is used; e.g. 5000 p.s.i. (pounds per square inch) concrete as compared to the 3000 p.s.i. quality normally used for swimming pools poured in situ. Means are provided for prestressing this comparatively thin dense shell before any loads are applied to it, so as to reinforce it and prevent it from cracking, and these means will now be described.

As will be noted in the vertical cross-sectional views of Figures 2, 4 and 6, rim portion 102 is thickened for a short distance below the top of the pool. Within rim portion 102 is a conduit 130 which extends clear around the pool, its ends terminating in upper cavity portion 107. An opening 102a is also provided at one point in rim 192 to accommodate a turnbuckle 134. A stiff steel ring 132 is provided in cavity portion 107. Leading outwardly from ring 132 in both direction and extending through conduits 130 on both sides are two sections of wire or rod 131. The ends of these sections of rod 131 terminate in turnbuckle 134. Turnbuckle 134, as well as nuts 133 adjacent ring 132, provide means whereby wire or rod 131 may be tensioned to apply an encircling compressive or contractive force to rim portion 102.

It will be noted that ring 132 is mounted so as to be free of concrete of enlarged portion 105. Although this is preferred for the particular shape of pool illustrated in this embodiment, the ends of wire or rod 131 adjacent the filter may be anchored to suitable reinforcing means embedded in the walls of enlarged portion 105, for example to an embedded stiff ring such as ring 132.

Surrounding tension means 130 to 134 inclusive is placed close to the top of shell 101 in order to be close to the stress-applying points of the transverse and longitudinal tension means described above.

If desired, one or more additional encircling tension means such as members 130 to 134 inclusive, with embedded ring or anchoring means like ring 132, may be provided below the illustrated means for applying additional contractive forces to the shell. These may also be horizontal, vertical or both, or they may be inclined downwardly toward the deep end. Means are also provided to prestress the shell 101 transversely by tension means which extend along the shell wall from side to side, either outside the shell, or within it. For this purpose in the illustrated embodiment there are provided a plurality of transverse tension wires or rods 135 having means for bearing downwardly against the shell 101 at rim portion 102 on each side. Tension wires 135 are spaced along the longitudinal axis of the pool in vertical transverse planes. In the preferred form illustrated, each wire or rod 135 is freely slidable in a conduit 136 embedded in a rib 137 which is cast integrally with shell 101. Preferably, conduit 136 is not bonded to the concrete but is coated with a substance such as asphalt, to prevent bonding. In addition, the upper ends of conduit 136 on each side do not extend quite to the top of rib 137, so that a nut and washer 138, when set up tight to tension rod 135, will not bear against conduit 136. The purpose of this is to avoid resistance to the prestressing or compressing of the shell when rods 135 are tensioned by setting up on nuts 138.

Additional means are provided for applying compression to the shell longitudinally from the rim at one end to the rim at the other end. These means may be disposed within the shell or outside it. The preferred arrangement is similar to that for the transverse tension means, and comprises tension wires or rods 140 freely slidable in tubes or conduits 141 which are embedded in but not bonded to the concrete of covering ribs 142, said ribs being cast integrally with the shell 101. Tension means such as a nut and washer 143 is provided at each end of each rod 140 to apply downward or compressive force to the shell at rim portion 102 at each end of the pool. A plurality of these longitudinal tension means are provided in vertical longitudinal planes which are spaced transversely of the pool.

After the pool has been cast and has hardened, the various tension wires or rods are threaded through the respective conduits and the nuts, washers and turnbuckles placed in position. Tension is then gradually applied to each tension member so as to uniformly and gradually compress the shell. The amount of tension applied depends upon the particular installation and is a matter determined by experience, but a force of about 45 pounds applied to the nuts and turnbuckle at the end of a 2-foot lever (or torque of 90 pounds-feet) is satisfactory in most cases. When the shell has been properly tensioned the opening 102a in the rim is filled with concrete, embedding turnbuckle 134.

Thus, it will be seen that the several tension means form a reinforcing system of prestressing members disposed along the contour of the shell wall for applying compressive forces to the shell in directions along the shell contour.

Enlarged wall portion 195 with its enclosed filtration plant may be differently shaped and disposed, if desired. For example, referring to the plan view of the pool, instead of arranging the vertical axis of the filter in the center of a pool, the walls of enlarged portion 105, with or without the filter wall extending into the pool proper and the other side extending outwardly, enlarged portion 105 may be arranged inwardly or outwardly of the illustrated location with the filter side wall tangent to or coextensive with a
3,903, i57 flat end wall 104a. Such an arrangement avoids the necessity of using a ring such as 132, or anchoring means in enlarged portion 105 for tension wire or rod 131, which would be subject to bending to concrete, and directly embedded in the walls during precasting.

Another embodiment of my invention is shown in Figures 15 to 26. This pool or tank is made of two precast sections 206a and 206b of 5000 p.s.i. concrete which are assembled at the installation point. As assembled, this pool, generally designated 200, comprises a concrete shell or basin having side walls 203, a deep end wall 204a, and a shallow end wall 204b. Bottom wall 201a and b slopes downwardly from the shallow end wall 204b toward the deep end wall 204a and has a drain or pool outlet 216 in the deepest portion. The side walls and part of the bottom wall are lined with brick, filter, and portion and the bottom adjacent the abutting edges being thickened, and thickened rib portions are also provided over the longitudinal and transverse precasting members. Deep end wall 204c has an enlarged wall portion 205 in each section, and each enlarged wall portion has two cavities 206 extending downwardly therein, making a total of four such cavities 206, each of which holds a filter bed similar to that illustrated and described for the embodiment of Figures 1 to 14. Each of these filter cavities may be somewhat smaller than the single cavity of the first embodiment. Each filter cavity 206 has its own filter drain line 209 into the pool, which is normally closed by a drain plug 210. Each cavity 206 has a cover 212, and each filter bed is provided with supply and discharge lines similar to that shown for the embodiment in Figures 12 to 14 at 111a and 111b. Each filter is also provided with its own multi-port valve 220, similar to valve 120 of the first embodiment. However, only one motor-driven pump 215 is provided. Figure 26 shows a schematic of the piping arrangements which draw pool water from pool outlet or drain 216, through supply pipe 217, through suction strainer 218 to pump 215 and thence to the multi-port valves 220 through lines 219. In the normal or "filter" position of valves 220, pool water enters the filter jets through the top, goes through the filter bed and leaves through a tube leading upwardly from the bottom, back through multi-port valves 220 and thence through connection 222 to the return tubing 223. Return tubing 223 leads to four discharge inlets 224 into the pool, two at the shallow end, and two at the deep end. This tubing 223 is embedded in the pool wall. The supply pipe 217 from the pool drain is covered by a rib 217c which is cast integrally with one section of the shell of the pool. Thus, the plumbing for circulating the water from the pool to the filter and back again to the pool is embedded in the shell of the pool, and pool 200 has, as an integral part, a continuous gravel filter system.

A vacuum line 226 is also provided to the suction side of pump 215. This line is normally covered by a cap 227, but a vacuum device may be attached to it for pool-cleaning purposes.

For backwashing the filter, valves 220 are thrown to the backwash position, which reverses the flow through the filter and discharges the water through line 225 to waste.

A reinforcing system is provided, similar to that of the first embodiment described above, for prestressing or compressing the shell. Horizontal or encircling means 230, 231, and 234a in rim portion 202 correspond to means 130, 131, and 134, respectively, but no ring such as 132 is required, the encircling member being disposed in the wall 204c between the filters and the pool proper. A second horizontal encircling member is spaced below the upper means, and has its own turnbuckle 234b. Transverse tension means 235, 236, and 238, disposed in ribs 237, correspond to means 135, 136, and 137, respectively. Longitudinal tension means 240, 241, and 243 disposed in ribs 242, correspond to means 140, 141, 143, and 142, respectively.

In pool 200, prestressing members 231 and 235 serve not only to compress the shell walls, but to draw the two sections tightly together. The tubes or conduits 230 and 236 are, of course, each in two parts, one embedded in one pool section 200a and the other in pool section 200b. The two parts of each conduit are carefully located in their respective pool sections so that, when the pool is assembled, their adjacent ends will be aligned.

To provide efficient sealing, grooves 249 are provided in the abutting edges of the two halves of the pool, and live rubber gasket 250 extending throughout the lengths of these grooves insures proper sealing. In addition, caulking 251 may be provided above the gasket.

To assemble pool 200, the two sections are placed closely adjacent each other and the various prestressing members are threaded through their respective conduits and the turnbuckles and nuts and washers placed on their ends. The gasket 250 is placed in position. By getting up on the turnbuckles and nuts gradually to a torque of about 90 pounds-feet, the two sections are drawn tightly together in correct alignment, with gasket 250 between them to seal the pool, and with the shell properly stressed. Access openings in the shell around turnbuckles 234a and 234b are then filled with concrete.

Although not essential, transverse rods 252 and 253 are provided on each side of the bank of filters, in order to compress and give additional rigidity and support to this portion of the structure.

In both the illustrated embodiments, the ribs on the outer sides of the shell (137 and 142, or 237 and 242) provide reinforcement to the shell and make possible the use of thinner shells which weigh less, in addition to providing efficient means for mounting the tension means for compressing the shell. However, the ribs are not essential, and the tensioning means may be stretched along the outer surface of the shell or be enclosed within the walls of the shell, the ends of the transverse and longitudinal tension members being provided with suitable means to tension the same and pull down on the rim of the shell.

The longitudinal prestressing means passing under the pool from the pool edge at one end to the pool edge at the other end may be dispensed with in some pool configurations, especially if the pool is comparatively long and narrow and of more uniform depth than those illustrated. In this case, more encircling tension wires or rods are used, the lower ones being inclined downwardly toward the deep end so to give better distribution of the encircling reinforcement around the deep end.

Although the preferred method of reinforcing precast pools made in accordance with my invention is to prestress or compress the shell as described above for the two illustrated embodiments, I may also make a precast swimming pool with integrally cast filter chamber, and with installed sand and gravel pressure filter system complete with plumbing, using embedded, unstressed reinforcing. In this form, the walls are reinforced by steel wire mesh, preferably 4" x 4" No. 6 electric welded steel wire mesh, and the ribs on the outer side of the pool (which cover the prestressing means in the two illustrated embodiments) are omitted.

I may use my preferred reinforcing system of prestressing members for reinforcing the concrete basins or shells of swimming pools or like tanks which do not have integral filters.

For comparatively small swimming pools, ranging up to about fifteen by thirty feet, I prefer to use the first embodiment, designated 100. For larger sizes I prefer...
the second embodiment 200 or a pool made of more than two large sections. The method of assembly of both embodiments has been described above. To prevent cracking during transportation, pools 100 and 200 are thoroughly prestressed before being moved. In the case of pool 200, the two sections, of course, separately prestressed, utilizing the embedded conduits in each section for running special stressed rods or wires. In installing either embodiment, a suitable excavation is prepared, slightly wider than the pool. A sand bed is laid on the bottom of the excavation and the pool is moved into place from the shallow end with suitable handling equipment. The pool is trued and levelled on the sand bed. Earth is then back-filled all around the pool slowly, with tamping, while the pool is filled a little at a time, the water level being kept at the height of the fill, or slightly above. No underground piping to or from the pool is necessary, hoses being used to fill the tank directly, or to drain it from the backwash line.

For the tubes or conduits through which the prestressing members extend I prefer to use flexible conduit, such as standard one-inch BX electric conduit. For the prestressing members I prefer to use one-half inch high carbon steel rod. In the appended claims the term "wire" is to be broadly interpreted and includes "rod" as well as "wire."

The advantages of my prestressed concrete swimming pools will be apparent to those skilled in the art. Fittings, tubes, and piping are cast in place in the concrete shell, and a complete unit may be assembled, ready for installation, thereby saving the usual costs of "custom" installation. The cost of a pool of my improved type, installed, is less than that of comparable installations with which I am familiar, and my pools can be mass-produced. The advantages within the appended claims will be apparent to those skilled in the art. For example, any prestressing member may be anchored to the shell intermediate its ends, or may be made in sections with the adjacent ends anchored to the shell, and both portions or sections tensioned so as to provide a substantially continuous prestressing member.

I claim:

1. A transportable swimming pool comprising a precast concrete shell, said shell being concave with a rim portion around the top and having a pair of opposite end walls depending from said rim portion disposed transversely to the longitudinal axis of said pool and a pair of opposite side walls depending from said rim portion, one on each side of said axis, one of said walls having an enlarged wall portion and a cavity extending downwardly therein, a pressure-tight filter tank in said cavity, said filter tank comprising a pressure-tight cover spaced above the bottom of said cavity, said cover enclosing the portion of said cavity below said cover and forming the top of said pressure-tight filter tank, a filter supply pipe embedded substantially throughout its length in said shell and extending therealong from an outlet from said shell to a point adjacent said tank, a filtered-water return pipe embedded substantially throughout its length in said shell and extending from a point adjacent said tank to an inlet into said shell, said tank having a filter therein, said pool having a circulating system including a pump and said supply and return pipes for circulating water transversely to said rim portion, a plurality of transverse tension members disposed transversely to said encircling member and extending along said shell from the rim portion at one of said end walls to the rim portion at the opposite of said side walls, and a plurality of transverse tension members disposed transversely to said encircling member and extending along said shell from the rim portion at one of said side walls to the rim portion at the opposite of said side walls, a plurality of concrete ribs cast integrally with said shell on the outer side thereof, each said rib covering one of said tension members, said ribs terminating at an opposite end bearing surfaces, each of said bearing surfaces being adjacent said rim portion on opposite sides respectively of said shell, one of said tension members being slidably disposed in a channel extending along said shell, and means on said one of said tension members applying a prestressing force to said encircling member around said pool comprised of a prestressed concrete swimming pool complete with filtration plant which can be precast, assembled, and prestressed in one location, transported to another location, and there installed in a suitable excavation.

2. A transportable swimming pool comprising a precast reinforced-concrete shell, said shell comprising a concave shell wall with a rim portion around the top, a system of prestressing members disposed along the contour of said shell wall and applying compressive forces thereto in directions along said contour, said system comprising an encircling member around said pool applying a prestressing contractive force to said rim portion, and a plurality of transverse tension members disposed transversely to said encircling member extending along said shell wall from the rim portion on one side of said shell to the rim portion on the opposite side thereof, said tension members being slidably disposed in a channel extending around said shell and having means applying a compressive force against said opposite end bearing surfaces of said rib to prestress said shell wall, said shell wall having an enlarged wall portion and a cavity extending downwardly therein, a pressure-tight filter tank in said cavity, said filter tank comprising a pressure-tight cover spaced above the bottom of said cavity, said cover enclosing the portion of said cavity below said cover and forming the top of said pressure-tight filter tank, said shell having a circulating system for circulating water from said shell through said filter tank and back to said shell; whereby said swimming pool may be precast and completely assembled in one location, transported to another location, and there installed in a suitable excavation.

3. A transportable swimming pool comprising a precast concave reinforced-concrete shell, a system of prestressing members disposed along the contour of said shell and applying compressive forces thereto in directions along said contour, said system comprising an encircling member around said pool applying a prestressing contractive force to said rim portion, and a plurality of transverse tension members disposed transversely to said encircling member extending along said shell from the rim portion on one side of said shell to the rim portion on the opposite side thereof, said system comprising a prestressing force to said rim portion, and a plurality of transverse tension members disposed transversely to said encircling member and extending along said shell from the rim portion at one of said side walls to the rim portion at the opposite of said side walls, a plurality of concrete ribs cast integrally with said shell on the outer side thereof, each said rib covering one of said tension members, said ribs terminating at an opposite end bearing surfaces, each of said bearing surfaces being adjacent said rim portion on opposite sides respectively of said shell, one of said tension members being slidably disposed in a channel extending along said shell, and means on said one of said tension members applying a prestressing force to said encircling member around said pool comprised of a prestressed concrete swimming pool complete with filtration plant which can be precast, assembled, and prestressed in one location, transported to another location, and there installed in a suitable excavation.
wardly therein, a pressure-tight filter tank in said cavity, said filter tank comprising a pressure-tight cover spaced above the bottom of said cavity, said cover enclosing the portion of said cavity below said cover and forming the top of said pressure-tight tank, a filter supply pipe embedded substantially throughout its length in said shell and extending therealong from an outlet from said shell to a point adjacent said tank, and a filtered water return pipe embedded substantially throughout its length in said shell and extending from a point adjacent said tank to an inlet into said shell, said tank having a filter therein, said pool having a circulating system including a pump and said supply and return pipes for circulating water from said shell to said filter tank through said filter and back to said shell; whereby said swimming pool may be precast and completely assembled in one location, transported to another location, and there installed in a suitable excavation.

4. A prestressed concrete tank comprising a concave shell wall having a rim portion around the top, an encircling tension member disposed along said rim portion and applying a prestressing contractive force thereto, and a plurality of transverse tension members disposed transversely to said encircling tension member along said shell wall substantially from the rim portion on one side of said shell to the rim portion on the opposite side thereof, said transverse tension members applying prestressing compressive forces to said shell transversely to said rim portion, whereby said encircling and transverse tension members coact to apply prestressing compressive forces to said shell substantially all along the contour thereof, at least one of said transverse tension members being covered by a concrete rib cast integrally with said shell wall on the outer side thereof, said rib terminating in opposite end bearing surfaces, each of said bearing surfaces being adjacent said rim portion on opposite sides respectively of said shell, said one of said tension members being slidably disposed in a channel extending around said shell and having means applying a compressive force against said opposite end bearing surfaces of said rib to prestress said shell wall.

5. A prestressed concrete tank comprising a concave shell wall having a rim portion around the top, said shell wall having a pair of opposite end wall portions depending from said rim portion disposed transversely of the longitudinal axis of said tank and a pair of opposite side wall portions depending from said rim portion, one on each side of said axis, an encircling member around said tank applying a prestressing contractive force to said rim portion, a plurality of longitudinal tension members disposed transversely to said encircling member extending along said shell wall substantially from the rim portion at one of said end wall portions to the rim portion at the opposite of said side wall portions, said longitudinal and transverse tension members applying prestressing compressive forces to said shell transversely to said rim portion, whereby said encircling and transverse tension members coact to apply prestressing compressive forces to said shell substantially all along the contour thereof, each said longitudinal and transverse tension member being covered by a concrete rib cast integrally with said shell wall on the outer side thereof, said rib terminating in opposite end bearing surfaces, each of said bearing surfaces being adjacent said rim portion on opposite sides respectively of said shell, said tension member being slidably disposed in a channel extending around said shell and having means applying a compressive force against said opposite end bearing surfaces of said rib to prestress said shell wall.

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