Nov. 5, 1968 F. X. CROWLEY 3,408,784

PRESTRESSED CONCRETE TANK, PROCESS AND STRUCTURAL UNIT THEREFOR

Filed Jan. 10, 1966

FIG. 1

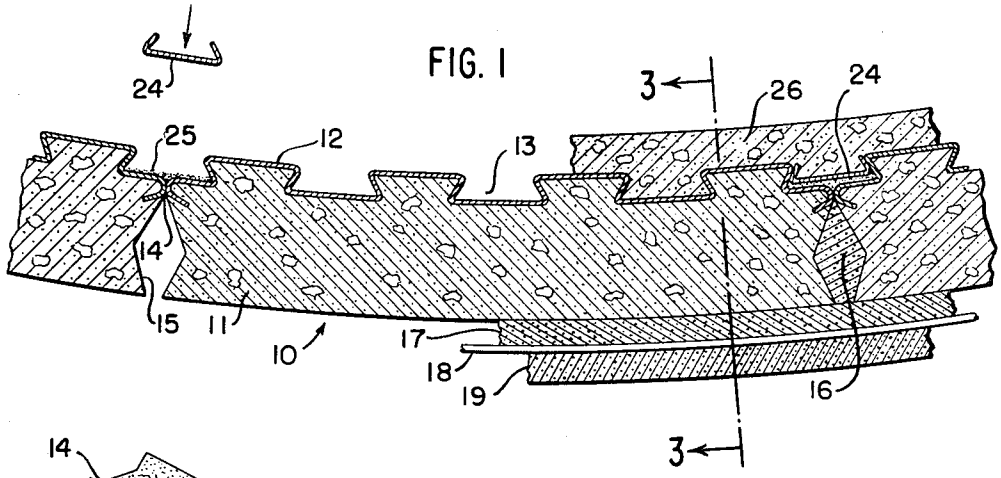


FIG. 2

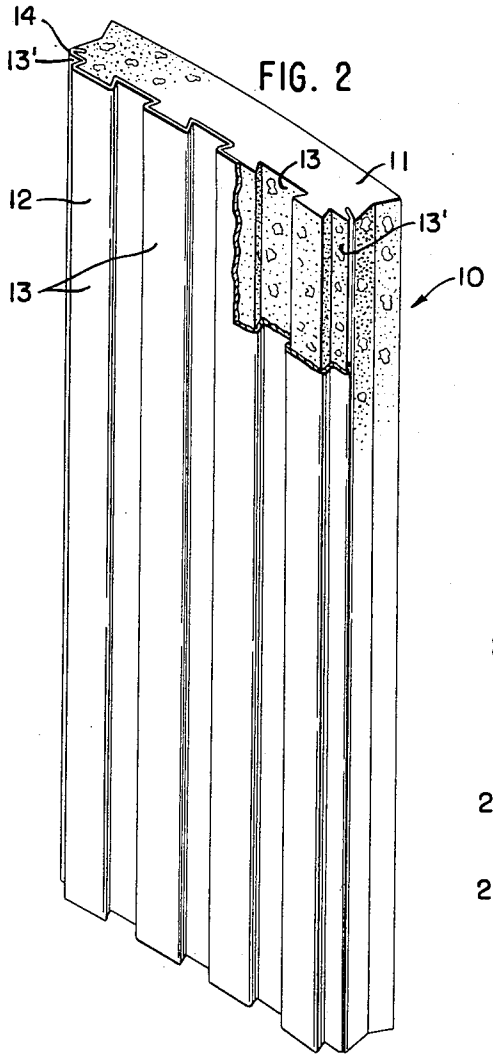
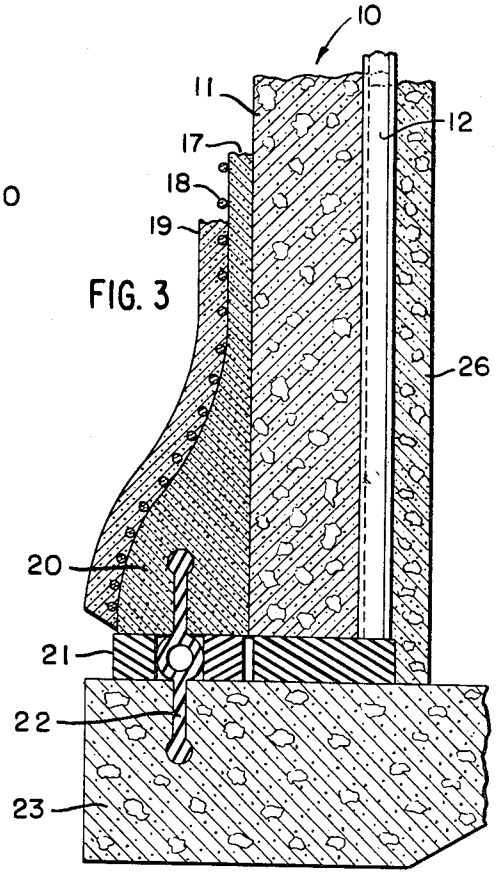


FIG. 3



INVENTOR.

FRANCIS X. CROWLEY

BY

Kenway Jenney & Hildreth Attys.

United States Patent Office

3,408,784
Patented Nov. 5, 1968

3,408,784

PRESTRESSED CONCRETE TANK, PROCESS AND STRUCTURAL UNIT THEREFOR

Francis X. Crowley, Wellesley, Mass., assignor to Crowley Hession Engineers, Boston, Mass., a partnership

Filed Jan. 10, 1966, Ser. No. 519,749
The portion of the term of the patent subsequent to Oct. 25, 1983, has been disclaimed and dedicated to the Public
5 Claims. (Cl. 52—224)

ABSTRACT OF THE DISCLOSURE

A prestressed tank constructed of panels of concrete precast with a sheath of sheet material presenting open channels in the inner face of the panel, that is to say, the face which is innermost in the complete tank, the panels being connected by key plates fitted in said channels and the assembled panels thus connected being wound with prestressing wire under tension. The disclosure also includes a process of making a tank of the aforesaid characteristics.

This invention comprises a concrete tank of a new and improved structure which makes it possible to assemble the tank on the site from precast concrete units and then subject it as an integrated assembly to prestressing. The invention also includes within its scope the structural unit herein disclosed as an element of the tank, as well as the novel process of erecting the tank.

Heretofore prestressed concrete tanks with a steel diaphragm have been erected from the ground up at the site with the assistance of temporary supporting structure, and the work has been subjected to all the annoyance and delay of inclement weather, delayed transportation of raw material, inavailability of labor, etc.

The present invention makes it possible to bring to the site precast concrete units which have been purchased by the contractor or fabricated by him at convenient time and place, as for example, during the Winter at his own headquarters.

These units are characterized by sheet metal sheathing permanently bonded to the inner face of a precast concrete panel and presenting parallel longitudinal undercut channels. The units may be conveniently formed of cementitious concrete deposited upon a sheet steel diaphragm in which the channels have been already formed, the panels being of a length commensurate with the height of the contemplated tank. The diaphragm is formed with a half channel at either edge of the panel, the complete channel being formed with a half channel of the adjacent panel and the complete channel being shaped to receive an elongated locking key plate which locks the panels together as an integrated assembly adapted for pretressing by encircling wire.

The longitudinal channels formed in the sheathing may be of any reentrant cross section, or more specifically, they may be undercut or formed with opposed reentrant angular walls so that the channel is wider at the bottom than at its open outer side. It is thus adapted to receive a locking key plate of the same general cross section. This may be inserted lengthwise in the channel or forced resiliently into place, and in association with a sealing layer or coating of elastomeric material which cooperates with the key plate to form a sealed fluid-tight but unwelded joint.

The panels assembled as a cylinder upon the foundation present longitudinal channels between their adjacent edges. These channels are filled with mortar and the cylinder may be then lined with pneumatically projected

mortar forming an inner coating or wall which may be varied in thickness from top to bottom, thus conforming to the structural requirements of the tank and facilitating the formation of a water seal. This wall is of course formed at the site of the tank and without the necessity of employing forms.

In my copending application Ser. No. 207,898, now U.S. Letters Patent No. 3,280,525, dated Oct. 25, 1966 I have disclosed and claimed a prestressed concrete tank and process in which the metallic sheathing is shown as applied to the outer face of the component panels.

An advantage in applying the sheathing to the inner surface of the panel unit rather than its outer surface is that the reinforcing effect of the diaphragm against vertical bending in the wall is in this way substantially increased as it provides greater resistance to moments caused when prestressing the tank wall. This increased resistance is due to the increased distance of the sheathing from the compressive face of the tank wall.

Another particular advantage of inside sheathing is that the mortar cover layer may be placed over the diaphragm free of weather interference as soon as the roof of the tank has been at least partially covered in.

The sheathing may be of sheet steel or of non-corrosive material as copper, or it may be of fibre glass or extruded plastic composition. An important advantage of using non-corrosive sheathing is that the inner surface of the tank wall is thus left uncovered in the finished tank and so freely exposed for inspection in case of leakage. The expense and labor cost of an inner protective coating is also saved in a tank so constructed.

Still another advantage of inside sheathing is that the fluid pressure of the tank contents tends always to force into compression the adhesive sealing or gasket material interposed between the key plates and the seat provided for them in the channels of the sheathing. If the fluid pressure is acting in the opposite direction, as would be the case with the sheathing on the outer face of the tank, the sealant would be placed in shear and tension, a condition not desirable from the water-proofing standpoint.

The inside sheathing feature also permits the prestressing wire to be directly laid on the outer concrete face of the assembled panels without the necessity of an intermediate protecting coating as is required in using panels having an external metallic sheathing.

In summary it may be said that the concrete tank of this invention is characterized by interfitting panel units internally sheathed with channeled sheet material impervious to the particular contents of the tank. The internal sheathing powerfully reinforces the panels against outward bending or bulging and also has the useful effect of compressing sealing material placed beneath the sheathing. Further, it facilitates inspection of the tank from the inside where any leakage of the tank will first become apparent.

These and other features and advantages of the invention will be best understood and appreciated from the following description of a preferred embodiment thereof, selected for purposes of illustration and shown in the accompanying drawings, in which—

FIG. 1 is a cross sectional view of portions of assembled panels,

FIG. 2 is a view in elevation of a complete panel, shown with a portion broken away, and

FIG. 3 is a fragmentary view in longitudinal section, partly on the line 3—3 of FIG. 1.

The structural units **10** of which the tank is composed have a precast body **11** of concrete, herein shown as sheathed upon its inner face with sheet steel **12**, or it may be other sheet metal. The body **11** is formed on the sheathing with parallel longitudinal undercut channels **13** having opposed reentrant angular walls that make the

channel wider at its closed inner wall than at its outer open side. At each side edge the body **11** of the unit is formed in a half channel **13'** so that when assembled the half channels of adjacent units form together a complete common undercut channel.

The sheathing for each unit is erected or laid out as part of a mold diaphragm and the concrete body **11** is then precast upon it, preferably by depositing concrete thereon. In this step the concrete encases the projecting dovetail ribs on the outer face of the sheathing and becomes permanently bonded thereto. The sheathing is folded along each edge **14** to provide a reinforced contact or gauge edge for determining the correct assembled relation of the units as indicated in FIG. 1. The folded edge of the sheathing is embedded in the concrete body **11** so that no raw edge of metal is exposed at the longitudinal edges of the assembled units.

The edge walls **15** of the concrete body are given a clearance angle such that they define open spaces or channels between the assembled units where their contact edges meet. These spaces are filled in a subsequent constructional step with mortar **16** or other suitable cementitious grouting.

The units thus constructed may be commensurate in length with the height of the contemplated tank, for example 20 to 40 feet or more, 6 to 8 feet in width and 3 to 12 inches in thickness. They are thus portable and may be transported to and stacked at the site of the tank in readiness for assembling and erecting at the contractor's convenience.

At the selected site a solid foundation **23** is first constructed and upon this the sheathed panel units are erected in circular or polygonal assembly with their contact edges engaged and without the necessity of elaborate supporting structure. The half channels in the steel sheathing are brought in cooperative relation so that the whole internal surface of the sheathing presents a series of equally spaced vertical undercut channels. The units are now locked together in flush relation by the insertion of metal key or connecting plates **24** which are similar in cross section to that of the channels but just enough smaller to fit snugly when forcibly inserted in place thus forming a complete unwelded metal enclosure for the tank. The connecting plates **24** may be of rigid construction or they may be sufficiently resilient to be forced or driven into locking position in the channels of the sheathing.

A layer or gasket **25** of any suitable elastomeric sealing compound may be inserted beneath the key plates **24** in each common channel thus forming a fluid-tight joint between the side walls of adjacent sections.

Having completed the erection and connection of the panels as above explained an intermediate wall **17** of concrete may, if desired, be formed upon the outer facing of the assembled units of the tank. This may be formed of cement pneumatically projected by the Gunite process or any casting procedure.

The sheath, if formed of sheet steel, may be covered and protected by an inner lining **26** of concrete. However, if the sheath and connecting key plates are formed of noncorrosive material such as fiber glass or a plastic composition, the inner surface of the tank is left uncovered as suggested by the left hand section of the wall shown in FIG. 1. Under these circumstances the expense of the lining coating is obviated and inspection within the finished tank for leakage is facilitated.

The tank at this stage in its construction is prestressed by wires **18** wound under high tension upon the surface of the intermediate wall **17** or, if the wall **17** is omitted, directly upon the outer surface of the assembled panel units. In this way the tank as a whole is maintained always under compression regardless of the level of its contents.

After the prestressed step an outer or cover wall **19** is applied over the wire **18** and bonded to the intermediate wall **17** or directly to the panel units as the case may be. This wall may be shaped as desired and is herein shown as having an outwardly bulged foot section **20** which imparts stability and improves the appearance of the tank structure. The lower turns of the prestressing wire may be put in place as the foot section **20** is being built up.

The entire wall of the tank may be supported on blocks or segments **21** of rubber or other elastomer and a fluid-tight seal between the wall **11** and the base **23** is insured by a molded ring **22** of rubber or other elastomer which is embedded in the foundation and the foot of the intermediate wall **17** when these elements are constructed at the site of the tank. In this way the wall of the tank is given the freedom of movement that may be required to compensate for expansion or contraction due to variations of temperature or prestressing without impairing the integrity of the seal.

The outwardly opening channels between the prestressed bodies **11** of the units may be filled with mortar **16** at any convenient stage as, for example, during or before the formation of the intermediate wall **17**. The presence of this filler is necessary in order to transmit the prestressing force from one panel to another. Any shearing stress between the units is dissipated at the joints which include the filler **16**.

Having thus disclosed my invention and described an illustrative procedure for carrying it out, I claim as new and desire to secure by Letters Patent:

1. A prestressed concrete tank wall having a core comprising elongated panels of concrete precast with an inner sheath of sheet material covering the faces of the panels which are to be directed inwardly in the tank and presenting parallel open channels with opposed reentrant angular walls, the said panels being assembled side by side and interlocked in flush relation and connected by key strips of sheet material fitted for connecting the sheaths of adjacent units, prestressing wires under tension subjecting the assembled panels to edgewise compression and a surface coating of cementitious mortar protecting the wire and enclosing the tank wall as a whole.

2. A prestressed concrete tank wall as defined in claim **1**, further characterized in that a layer of elastomeric sealing compound is introduced into the channels beneath the said connecting strips and thereby placed under compression by direct contact with the fluid contents of the tank.

3. A prestressed concrete tank wall as defined in claim **1**, further characterized in that each panel of the tank is curved transversely and has a continuous sheath of sheet material upon its concave surface presenting alternate ribs and channels within the completed tank.

4. A prestressed concrete tank wall as defined in claim **1**, further characterized in that the sheath is of non-corrosive material and is exposed for inspection from inside the completed tank.

5. A prestressed concrete tank as described in claim **1**, further characterized in that the adjacent edges of the panels have clearance angles defining spaces opening through the outer surfaces of adjacent panels and filled with cementitious grouting transmitting edgewise pressure from panel to panel.

References Cited

UNITED STATES PATENTS

907,552	12/1908	Zurn	52—443
3,280,525	10/1966	Crowley	52—396

FOREIGN PATENTS

718,606	11/1954	Great Britain.

HENRY C. SUTHERLAND, *Primary Examiner.*