Jan. 2, 1940. R. C. KENNEDY 2,185,749

MEANS OF REINFORCING CONCRETE

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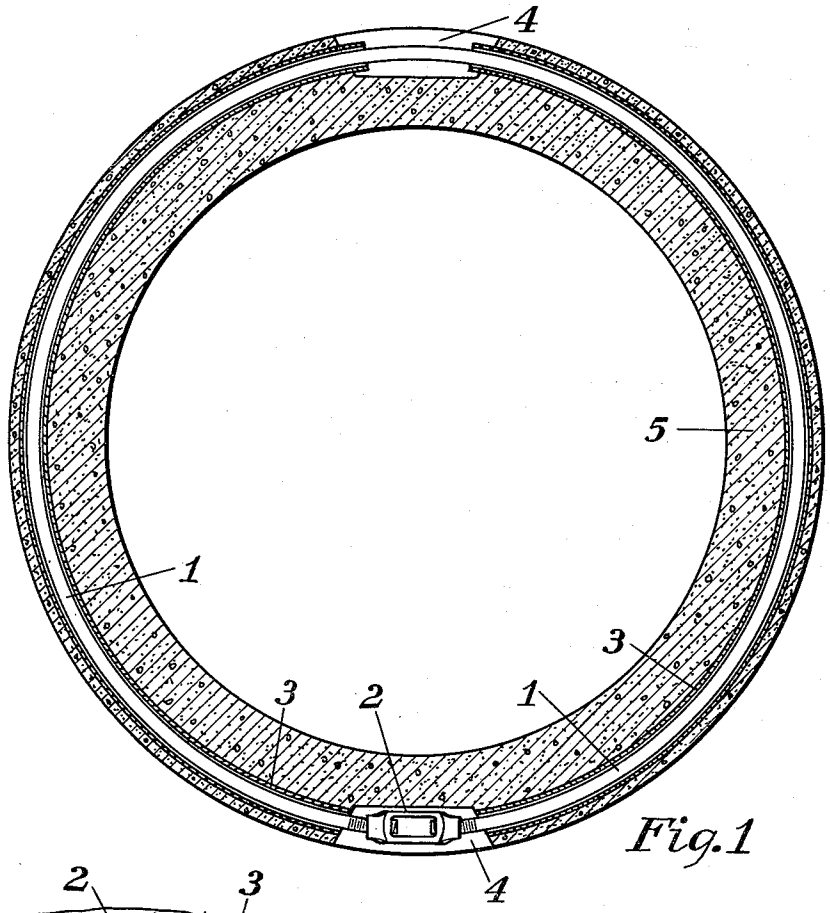


Fig. 1

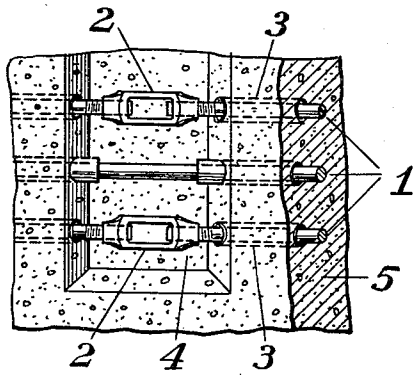


Fig. 2

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MEANS OF REINFORCING CONCRETE

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1 Claim. (Cl. 72—71)

This invention relates to a method of combining metal and concrete to form the walls of pressure vessels such as tanks and pipes, or other concrete structures, in such manner as to prevent cracks developing in the concrete and to fully utilize the strength of the metal.

It is common experience in building concrete vessels reinforced with steel rods simply embedded in the concrete, that the concrete, being low in tensile strength, will develop cracks before the steel has assumed its proper working stress. Such cracks also result from the natural tendency of concrete to shrink as it sets. Such tendency, being resisted by the rigid steel bars, causes cracks to develop. Cracks result in leakage, and the weakening of the concrete wall for taking compressive and shearing stresses which it may also at times be required to withstand. Other results are corrosion of the steel bars and progressive disintegration of the concrete.

A method has heretofore been utilized for preventing the cracking of concrete pressure vessels by means of steel bands equipped with turnbuckles, placed around the previously constructed concrete walls and tightened to such degree by means of the turnbuckles that the concrete is placed in compression. By adjusting the stress in the steel and concrete to proper degree in this manner before pressure is placed in the vessel, it is possible to prevent any tension in the concrete when under pressure, and thereby cracks are avoided. However, since it is not economically feasible to construct the concrete walls to a perfectly cylindrical shape, the rods tend to bear on isolated points around the circumference instead of securing uniform bearing throughout their length. As a result, a crushing of the concrete takes place at these high points. Also with this method, advantage cannot be taken of the economy high-strength steels, since higher stressed rods would cut still deeper into the concrete. In order to provide the additional bearing required even for ordinary soft steels, it has been customary to apply a layer of concrete outside of the steel rods, some part of which flows into the spaces between the rods and the concrete. The additional concrete layer also protects the rods from corrosion and provides architectural advantages.

A second method for overcoming the cracking of reinforced concrete pressure vessels is to coat the adjustable rods with asphalt or other plastic material and then pour the entire thickness of concrete wall at one time, except for recesses for operating the turnbuckles. The plastic coating on the rods is for the purpose of decreasing the bond with the concrete, so that the rods can be tightened with the turnbuckles. One difficulty with this method is that it is not possible to sufficiently prevent bonding between the steel rods and the concrete by such plastic coatings as to permit of uniform stressing of the rods, unless the turnbuckles are placed at such short intervals as to be uneconomical. Another difficulty is that the economy of the higher strength steels cannot be secured, due to greater tendency of the smaller bars to cut through the plastic material along the curve and thus still further increase frictional resistance to proper tightening.

The purpose of my invention is to overcome the above mentioned disadvantages of existing types of construction and to provide a structure that will render equal or better service, and at the same time be less expensive to build.

My invention covers the reinforcing of concrete by means of adjustable metal rods which have been placed in tubes of metal or other material, such rods fitting loosely within the tubes so as to permit of free longitudinal movement of the rods. Grease or other lubricant may be enclosed in the tubes with the rods to facilitate movement and to act as a preservative. The entire thickness of tank wall is poured at one time, leaving recesses at proper intervals for the turnbuckles. After the concrete has set for the proper period, the rods are tightened by means of the turnbuckles to a predetermined stress. The recesses may either be filled with concrete after the adjustment is complete or left accessible for further adjustment if required.

Referring to Figures 1 and 2, the metal band is marked 1. This band is made up of one or more units, depending upon the size of the structure. Each unit is provided with threaded ends and coupled to the adjacent units by means of threaded turnbuckles 2, or is provided with other adjustable means for tightening. The bands are enclosed in tubes or sheaths 3 in which they are free to slide, except that the portions within the recesses are not so enclosed. These tubes may be bent around the rods by drawing the rods through a properly shaped orifice together with strips of sheet metal, or by spirally wrapping the strips around the rods or by inserting the rods in tubes previously formed, or by any other suitable method. A lubricant may be added either during or after the placing of the tubes around the rods. The rods and tubes are then bent to the required curve and secured in place by a suitable means, and the concrete forms are

erected in the usual manner, but with provision for forming recesses 4 at the turnbuckles. The distance between recesses should preferably be one-half the length of the rod units, as shown in Figure 1, so that the turnbuckles may be staggered, and so that the rods may be vibrated, mechanically or otherwise at points midway between turnbuckles to facilitate movement during tightening. The concrete wall 5 is then poured, to the full thickness and after a sufficient period of time for proper setting, the forms are removed. The turnbuckles are then tightened to a predetermined stress. The recesses may be filled with concrete or may be left accessible for future inspection and adjustment of the turnbuckles.

Advantages of my invention when used for cylindrical vessels such as tanks or pipes, are as follows:

(1) It makes possible the pouring of the full thickness of wall at one time, and saves the cost of additional concrete or mortar applied after the steel rods are adjusted.

(2) The tension in the adjustable rods is made approximately uniform throughout their length because of the low frictional resistance to movement of metal on metal.

(3) It makes possible uniform and adequate bearing for the adjustable rods throughout the length thereof.

(4) The saving in material cost through the use of high-strength metals is made possible because of the firm bearing secured between the metal tubes and the adjustable rods.

(5) The concrete wall may be made thinner because the use of small, high strength rods and turnbuckles is possible.

(6) It makes possible the further adjustment of the rods after the structure has been in service.

A similar method of permitting adjustment of metal reinforcing rods may be used for tanks or vessels having straight walls, or for beams. All of the advantages enumerated herein for cylindrical vessels when my method of reinforcing is used, apply also to the latter structures.

I claim as my invention:

Reinforcement for a curved concrete wall, consisting of metal rods placed loosely within tubes encased in the concrete and made continuous around the wall by means of adjustable threaded connections on said rods for placing the same in tension so as to exert a radial pressure on the concrete, said tube enclosures having their ends clear of the abutments on the rods so that none of the rod tension will be absorbed directly by axial compression in the enclosing tubes.

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