March 24, 1925. 1,530,630

E. A. TUCKER

REENFORCED CONCRETE

Filed July 24, 1923

Fig. 1.

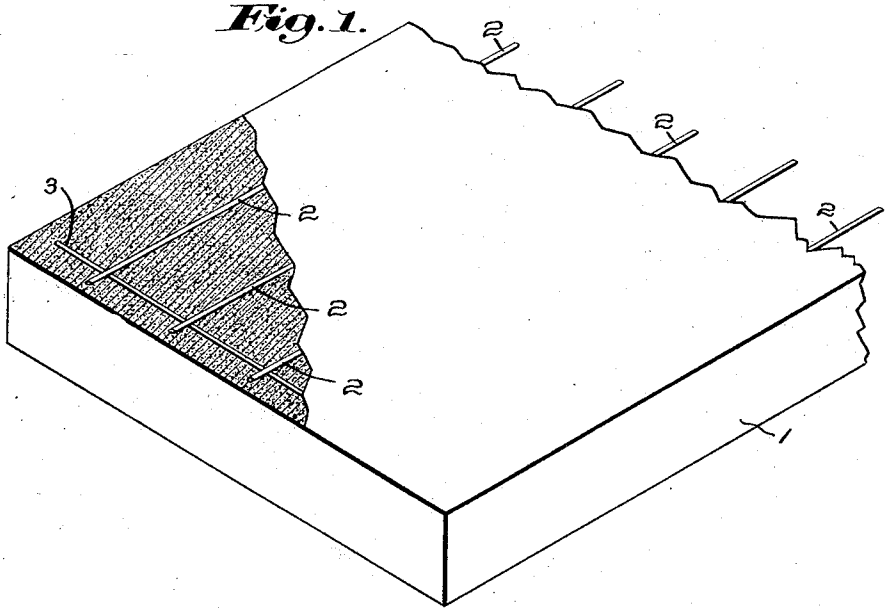


Fig. 2.

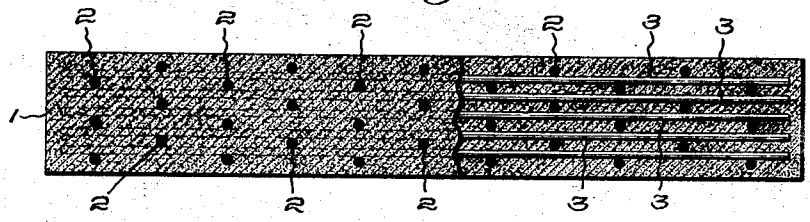
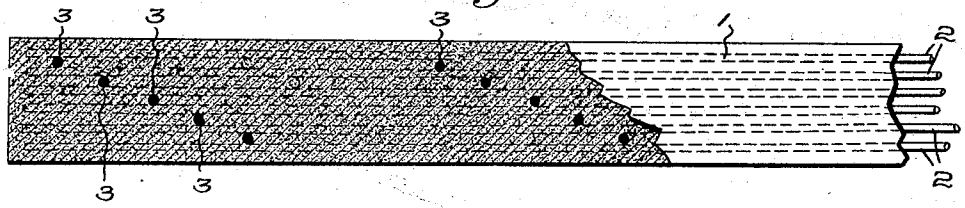


Fig. 3.



Inventor:
Edward A. Tucker.
by Emery Booth Janney & Varney
Attys.

Patented Mar. 24, 1925. 1,530,630

UNITED STATES PATENT OFFICE.

EDWARD A. TUCKER, OF WINCHESTER, MASSACHUSETTS.

REENFORCED CONCRETE.

Application filed July 24, 1923. Serial No. 653,461.

To all whom it may concern:

Be it known that I, EDWARD A. TUCKER, a citizen of the United States, and a resident of Winchester, in the county of Middlesex and State of Massachusetts, have invented an Improvement in Reenforced Concrete, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to reenforced concrete and methods of reenforcing the same, being intended, more particularly, though not exclusively, to provide a precast concrete member or body of relatively great length as compared with thickness and capable of withstanding not only the intended load to be sustained but also any deflection which, in the course of handling or transportation, may arise from the dead weight of such a member. The invention, however, in certain of its aspects may be applicable to members other than those which are precast and may have various other applications broadly different from that herein illustrated.

In the illustrated embodiment of the invention, its application is shown to the production of what may be designated as concrete lumber, or concrete members of relatively great length as compared with the thickness thereof. Precast concrete members, as heretofore made with the usual system of reinforcement, seldom have a ratio of length to least transverse dimension of more than 20 or 30. The deflection to which such a member is subjected, either from its dead weight in the course of transportation or when carrying its load, is relatively small and seldom exceeds 1/500 of the length of the member.

A reenforced concrete beam as usually constructed is a composite beam with the concrete supplying the compressive and shearing strength, and steel embedded near the surface on the tension side supplying the tensile strength. As the effectiveness of the steel varies with its distance from the neutral axis, all the steel is concentrated as near the surface of the beam as possible consistent with a proper embedment, and is generally arranged in one or two planes.

If a precast member employing the usual system of reenforcement is constructed with a relatively great length as compared with its thickness, as, for example, a ratio of length to least dimension of 100 or more, or, in other words, approximating proportions which commonly prevail in ordinary building lumber, the deflection due to dead weight in transportation or handling is apt to reach such magnitudes as to produce excessive cracks on the tension side of the concrete and destroy the value of the member as a building or construction unit.

I have found that by distributing longitudinal reenforcing members throughout the cross sectional area of the precast member and preferably with substantial uniformity, so that each portion of the concrete is within the effective bonding region of one of the reinforcing members, and there is provided a series of planes of reinforcement arranged in succession and lying across the smallest dimension of the member, it is possible to form a composite member of relatively great length as compared with thickness, and with proportions resembling those of wooden lumber, but capable of withstanding abnormal deflection, not only such as is incidental to the sustention of its intended load, but also such as arises from the dead weight of the member itself.

The invention will be best understood by reference to the following description when taken in connection with the accompanying illustration of one specific embodiment thereof, while its scope will be more particularly pointed out in the appended claims.

In the drawings,—

Fig. 1 is a perspective view of the end of a plank-like concrete member constructed according to one embodiment of the invention, the same being shown in partial section to illustrate the upper reinforcing members;

Fig. 2 is an end elevation in partial section showing the same member; and

Fig. 3 is a side elevation in partial section of the end portion of such member.

Referring to the drawings and to the illustrative embodiment of the invention therein disclosed, I have there shown the cross section of a composite concrete unit 1 which, by way of illustration, may have the form of a plank-like member having a ratio of length to least dimension considerably greater than that heretofore presented by precast concrete units. Such ratio, for example, may be from 100 to 150 and, by way of illustration, may represent a member 12 feet long, 1¼ inches thick, and 8 inches wide.

In forming each member I provide the same with reinforcement consisting preferably of a series of layers of metallic reinforcement, such as steel or iron, distributed with substantial uniformity throughout the cross section of the unit. Successive layers of reinforcement are preferably united in the form of a web or mat and, as such, may be placed in the molds and there located so as to bring each reinforcing member in its proper position in the completed unit.

The reinforcing members of each layer may consist of small rods, or wires, or a fabric, having longitudinal and transverse wires, but herein I have shown the same in the form of successive layers of longitudinal wires 2, 2 separated at intervals by interposed transverse wires 3, 3. In the illustrative example, where the member is assumed to have a cross section 8 by 1¼ inches, the longitudinal reinforcing members are formed of No. 12 wire, and are arranged in six layers, located serially across the thickness or least dimension of the concrete member, adjoining layers being in staggered relation to better distribute the reinforcement and having five and six members each. Succeeding layers of these longitudinal and transverse reinforcing wires are preferably secured to each other in some suitable way, as by wiring, tying, twisting, welding, or some other means. Herein I have shown the transverse and longitudinal units welded to each other at suitable intervals, the entire body of reinforcing members being thereby bound into what may be termed a reinforcing mat or web.

In the illustrative example, the longitudinal reinforcing members of successive layers are spaced apart on centers by a distance equivalent to about two diameters of the wire so that, except as to the top and bottom layers, they are in substantial contact with the transverse members 3 both above and below, the latter acting as separators for the successive layers. While it is not necessary that there should be this close arrangement of the reinforcement in the direction of the least dimension of the unit, preferably they should be so arranged that each layer of the concrete will be within the effective bonding region of one of said longitudinal reinforcing members, and to achieve this result preferably the layers should be separated by an amount equivalent to not more than five diameters on centers.

It is unnecessary that the spacing of the longitudinal rods in each layer and in the direction at right angles to the least dimension be less than a distance equivalent to three diameters.

The transverse reinforcing rods in the illustrative example, are of No. 14 wire, and are preferably inserted only at occasional intervals, as, for example, at points separated by from one to three times the width of the concrete member. The size of the reinforcement will, of course, be varied to properly care for the intended load, and it will be understood that the dimensional examples given are illustrative merely.

In arranging the reinforcement in the mold and in pouring the concrete, there is preferably allowed only for a slight covering of the cement over the mats sufficient to give necessary embedment of the outer reinforcing strands.

The effect of this disposition of the reinforcement is to distribute steel or other metallic reinforcing strands throughout the entire cross section in a series of planes or layers and symmetrically with reference to the axis and spaced closely enough so that the concrete in any plane or layer at right angles to the least dimension is held together and rendered capable of greatly increased elongation, in the same manner as any concrete immediately surrounding a reinforcement member. A multiplicity of reinforcing planes, not less than four in number, is preferably employed so that with a substantially uniform distribution of the planes of reinforcement there is at least a plurality of planes of reinforcement on opposite sides of the neutral axis.

In the usual method of reinforcement, where reinforcement is concentrated and placed unsymmetrically with relation to the axis of the member, only those portions of the concrete near such reinforcement, and ordinarily near the outer surface, are made capable of increased elongation, whereas, in the illustrated embodiment of the invention, all portions are made similarly capable of increased elongation because of the substantially uniform distribution of the steel throughout the entire cross section. Furthermore, the capacity of elongation for the outer surface is further increased because of the fact that these portions are helped out or relieved of some of the strain by the concrete and strands in each adjacent layer, which, being of the same capacity and under less strain because nearer the neutral axis, will help hold the outer fibres or strands from rupture and at a higher strain than such fibres or strands would stand if only the surface concrete were reenforced.

A concrete member having the proportions which pertain in the case of the illustrative example and reenforced by the ordinary system of reinforcement, could not withstand the deflection of several inches which would arise from its own dead weight in transportation without serious surface cracks developing, whereas when reenforced by the described method an abnormal deflection may be experienced without detriment

and there is provided a member capable of taking elongation in each component layer in a manner resembling that characteristic of a homogeneous beam.

In referring to concrete members, I have used the term in its broad sense to include not only members or units formed of cement, sand and coarser aggregates, but also those composed of cement and sand alone, or of cement alone. It should also be understood that the invention is not necessarily limited to members which are precast, but may be used in the formation of members for floors, walls, roofs, or the like, which are molded in their final position, since the system of reinforcement herein described will prevent the formation of cracks, from whatever cause the latter may be produced.

Claims:

1. A reenforced, precast, concrete member of relatively great length compared to its width and thickness and composed of a multiplicity of concrete layers, at least four in number, the layers extending in the direction of its length and lying across its thickness one adjacent the other, each layer being of substantially the same depth and the layers being distributed throughout the thickness of the member with substantial uniformity, each layer being separately reenforced by longitudinal reinforcement, the latter providing for each layer a substantially continuous reinforcing effect throughout its length whereby there is provided a member capable of taking elongation in each component layer in a manner resembling that characteristic of a homogeneous beam.

2. A reenforced, precast, concrete member of relatively great length compared to its width and thickness having longitudinal reinforcement, said reinforcement being sub-divided in the direction of the least dimension of said member into a multiplicity of sets of small units, not less than four in number, extending in substantially parallel arrangement throughout the entire length of said member and being distributed throughout each substantial part of the entire cross section of said member whereby there is provided a concrete member capable of taking elongation in each component layer in a manner similar to that provided by a homogeneous beam.

3. A reenforced, precast, concrete member of relatively great length compared to its width and thickeness having a multiplicity of reinforcing members providing a substantially continuous longitudinal reinforcement throughout the length of said concrete member, said members being distributed throughout substantially the entire cross section of said concrete member and providing at any given cross section thereof a series of reinforcing members in a multiplicity of layers, not less than four in number, serially arranged transverse the thickness of the concrete member whereby there is provided a member capable of taking elongation in each component layer in a manner resembling that characteristic of a homogeneous beam.

4. A reenforced, precast, concrete member of relatively great length compared to its width and thickness having a multiplicity of reinforcing members providing a substantially continuous longitudinal reinforcement throughout the length of said concrete member and distributed throughout substantially its entire cross section, and providing at any given cross section thereof a series of reinforcing members in a multiplicity of layers, not less than four in number, serially arranged transverse the thickness of the concrete member, each layer having a plurality of such reinforcing members.

5. A reenforced, precast, concrete member of relatively great length compared to its width and thickness having a multiplicity of reinforcing members providing a substantially continuous longitudinal reinforcement throughout the length of said concrete member and distributed throughout substantially its entire cross section, providing at any given cross section thereof a series of reinforcing members arranged in a multiplicity of layers across the thickness of the concrete member, each layer having a plurality of such reinforcing members, and the members of successive layers being in staggered relation.

6. A reinforcing, precast, concrete member of relatively great length compared to its width and thickness having a multiplicity of longitudinal reinforcing members arranged in a series of planes transverse to the thickness of the concrete member, the distance between successive planes of reinforcement being not greater than five diameters of the reinforcing members.

7. A reinforcing, precast, concrete member of relatively great length compared to its width and thickness having a multiplicity of longitudinal reinforcing members arranged in a series of planes transverse to the thickness of the concrete member, the distance between successive planes of reinforcement being not greater than five diameters of the reinforcing members and not less than two diameters thereof.

8. A reinforcing mat for a concrete member of relatively great length compared to its width and thickness and comprising a multiplicity of layers of longitudinal reinforcement, successive layers being in substantially parallel planes and each layer having a multiplicity of reinforcing members, and interposed transverse members uniting the layers of longitudinal reinforcement into a unitary structure.

9. A reinforcing mat for a concrete mem-

ber of relatively great length compared to its width and thickness and comprising a multiplicity of layers of longitudinal reinforcing members, each layer having a multiplicity of members and successive layers being arranged in substantially parallel planes, transverse members separating and spacing the longitudinal members, and means uniting the transverse and longitudinal members into a unitary structure.

10. A reinforcing mat comprising a series of layers of reinforcing members, and transverse members separating and positioning the longitudinal members, the longitudinal members being united into a unitary structure and the layers being spaced by a distance not greater than five times the diameter of the reinforcing member.

11. A reinforcing mat for a concrete member comprising a multiplicity of layers of longitudinal reinforcement, successive layers being in substantially parallel planes and substantially uniformly spaced, and each layer having a multiplicity of reinforcing members and transverse spacing members, said longitudinal and transverse members being mounted into a unitary structure.

In testimony whereof, I have signed my name to this specification.

EDWARD A. TUCKER.