Nov. 24, 1953 G. A. MANEY 2,660,049

PRESTRESSED CONCRETE STRUCTURAL COMPRESSION MEMBER

Filed May 29, 1947

Fig. 1

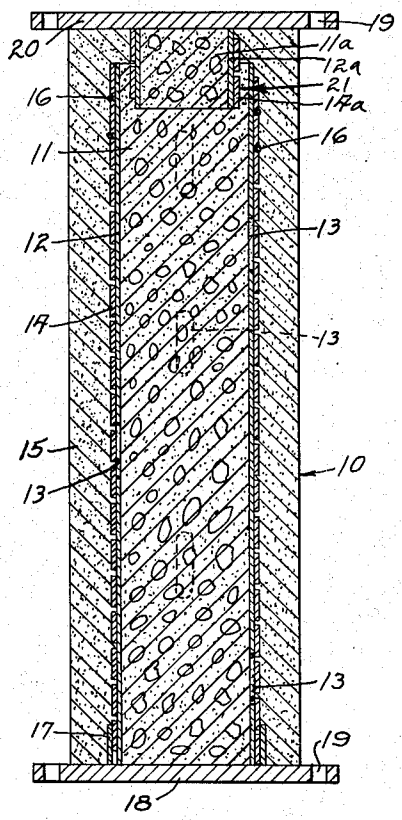


Fig. 2

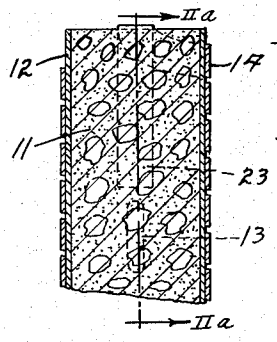


Fig. 2A

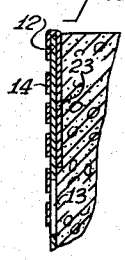


Fig. 4

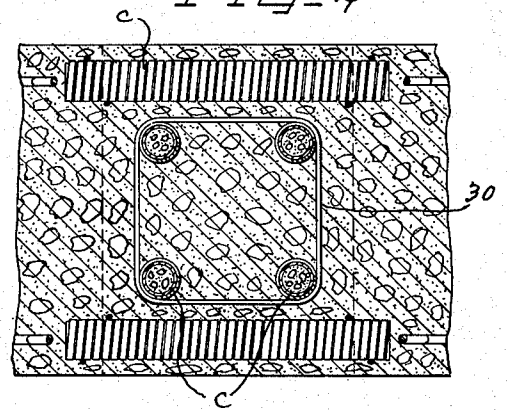
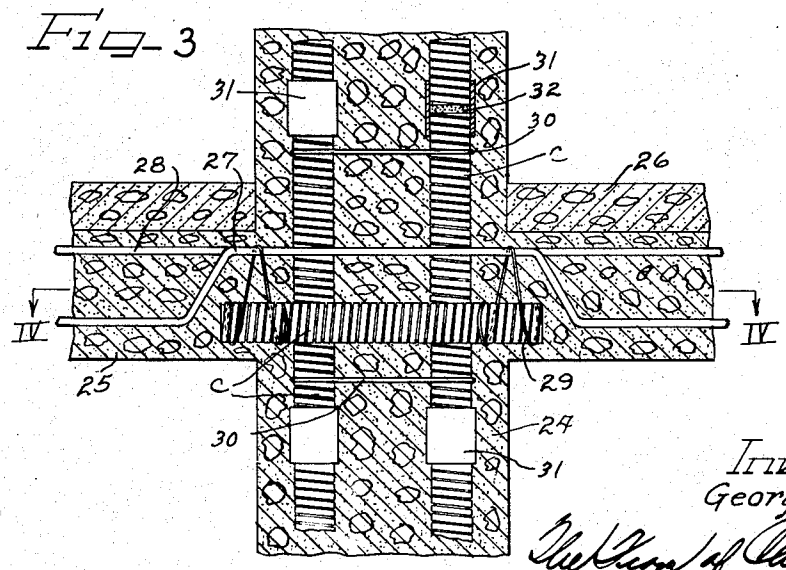


Fig. 3



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PRESTRESSED CONCRETE STRUCTURAL COMPRESSION MEMBER

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1 Claim. (Cl. 72—61)

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This invention relates to a structural member, and more specifically to a reinforced concrete structural member.

Structural compression members have heretofore been provided which include a core of concrete or the like bound with a helical wire or band of steel or the like, but such members have been unsatisfactory for the reason that under load the core would fail before the lateral deformation thereof produced sufficient tension in the helical band to permit the band to perform its function of strengthening the core against failure, or the helix would fail as a column before it would act to restrain deformation of the core. In accordance with the present invention, the shell for the core is provided by a helical wire or band of steel or the like having a high elastic limit which is tensioned about the core in manufacture. Since the shell is always under tension, a compressive load on the core cannot cause failure of the core or of the shell as a column before the shell becomes effective to restrain the lateral deformations of the core resulting from the compressive force.

It is an object of this invention to provide a novel structural member.

It is a further object of this invention to provide a concrete column or other member designed to take load in compression having a novel reinforcing design therein.

Another object of this invention is to provide a novel reinforced concrete member in which the reinforcing members are in effect preloaded.

It is another and further object of this invention to provide a structural compression member having a core within an encasement, the core being preloaded and the encasement pretensioned so as to restrain lateral deformation of the core immediately upon application of a compressive load to the member in use.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, as to its organization, manner of construction, and methods of operation, together with further objects and advantages thereof, may best be understood by reference to the accompanying drawings, in which:

Figure 1 is a vertical sectional view of one form of compression member;

Figure 2 is a fragmentary detail view illustrating one manner of securing an end of a helical encasing member for the core of the compression member;

Figure 2A is a partial sectional view taken

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substantially along the line IIA—IIA of Figure 2.

Figure 3 is a vertical sectional view of a concrete column and a concrete beam supported thereby, in which compression members according to this invention are employed as reinforcing members; and

Figure 4 is a horizontal sectional view taken substantially along the line IV—IV of Figure 3.

As shown in Figure 1, the compression member 10 has a core 11 of concrete or the like within a sleeve 12 which has apertures 13 in the walls thereof, and which sleeve 12 serves as a form and reinforcement for the concrete core. The apertures 13 permit drainage of excess water from the concrete aggregate before setting of the concrete. The sleeve 12 may be of any suitable material, but is preferably made of steel for greater strength in resisting buckling of the member under compression. The sleeve may be apertured otherwise than by means of the aperture 13, as for example, by a longitudinal slit. A wire or band 14 is wound helically about the sleeve 12, the pitch being preferably slightly greater than the width or diameter of the band 14. A coating 15 preferably of fireproofing cement or composition having a low modulus of elasticity may be applied about the wire 14. The coating 15 serves as a finishing coat for the member.

The wire 14 is preferably flat as shown, and made of steel having a high elastic limit such, for example, as approximately 150,000 pounds per square inch. The ends of the wire 14 may be soldered, brazed, welded, banded or otherwise secured to prevent uncoiling of the wire. In Figure 1, the coil is illustrated as being secured at one end by welding adjacent turns of the wire 14, as indicated at 16, and at the other end by welding the wire 14 to a band or collar 17. A plurality of bands or hoops may be employed instead of the helix of wire 14, if desired.

One end of the member 10 is provided with a plate 18 of steel or the like having apertures 19 for securement to other structural members by rivets, bolts or the like. The plate 18 may be welded or otherwise secured to the sleeve 12 and wire 14. At its other end, the member 10 is provided with a plate 20 similar to the plate 18, but having on its inner face a projection 21 which is formed in substantially the same manner as the compression member 10. A core 11a of concrete or the like is formed in a sleeve 12a similar to the sleeve 12, and a helical coil of wire 14a similar to the wire 14 is wound around the sleeve

12a. The sleeve 12a and the wire 14a may be welded or otherwise suitably secured to the plate 20, and the wire 14a may have its ends secured in the same manner as the wire 14 of the member 10. The projection 21 has a diameter smaller than the inner diameter of the sleeve 12, so that the plate 20 may be placed with the projection 21 extending into the core 11. The projection 21 serves to fill up any space at the end of the member and to force the material of the core to fill the sleeve 12 from end to end. The plate 20 is secured to the member by the projection 21 being held in the core 11. If desired, the plate may be disposed in contact with the end of the sleeve 12, and welded or otherwise secured to the sleeve and the wire 14.

It is not necessary that the structural compression member be provided with plates at the ends thereof, although probably in the majority of applications the plates are advantageous in providing strong bearing surfaces for the ends of the member and means for convenient connection with other structural members.

The various elements of the member are purposely not shown to scale in the drawings in order that all elements may be clearly illustrated. For a member having a core approximately eight inches in diameter, the wire 14 may have a width of about one inch and a thickness of approximately one-eighth inch, with the coils spaced apart about one-sixteenth of an inch. The coating 15 may be some two inches thick, giving the member a diameter of about twelve inches.

In Figure 2, one manner of securing an end of the wire 14 to prevent uncoiling is illustrated. The end 23 of the wire is bent over the end of the sleeve 12 along the inner surface of the sleeve. The material of the core 11 when inserted in the sleeve holds the end 23 securely. The end turn or turns of the wire 14 may be temporarily secured against unwinding in any suitable manner until the end 23 has been secured as described. This manner of fastening the end of the wire 14 is advantageous in that no collars, bands, or the like need be employed about the wire 14, and no welding or similar operation need be employed.

The compression member of this invention is preloaded in manufacture by stressing the core 11 and tensioning the wire 14, so that in use the lateral components of a compressive load on the member are immediately restrained by the wire 14. In the manufacture of the compression member, the sleeve 12 is encased in the helix formed by the wire 14, and the concrete or other material of the core 11 is placed in the sleeve. The material is then compacted by pressure and vibration, the pressure causing the material to expand the sleeve 12 somewhat and tensioning the encasing wire 14. The concrete or other material of the core 11 is kept under pressure until it has set sufficiently to hold the sleeve 12 expanded and the wire 14 under tension.

If a core material including water or other liquid is used, such as concrete, the pressure on the core squeezes excess liquid out of the material. The water or other liquid passes through the apertures 13 in the sleeve 12. Preferably, less than the usual quantity of liquid is employed in mixing the material of which the core 11 is formed. In using concrete, for example, a quantity of water of the order of one-fourth of the usual quantity is used. The vibration to which the core material is subjected while under pressure assures that the small quantity of liquid is thoroughly mixed with the dry ingredients, and

the use of a small quantity of liquid greatly reduces the setting time of the core material. The concrete or other core material may be introduced into the sleeve 12 in progressive stages, or the entire sleeve filled at one time and an additional quantity of material added after the original quantity has been compacted.

The coating 15 may be applied either in the manufacture of the structural member or after the member has been disposed in the position or location it is to occupy in a structure. The coating may be applied in any suitable manner, as by troweling, casting or molding. If the end plates are employed on the member, they may be applied either during manufacture or at the time the member is placed in position.

For most loads, the sleeve 12 provides sufficient strength and rigidity in the member to prevent bending or buckling of the member. Where greater loads are to be supported, the member may be additionally reinforced in any of several different ways. The reinforcement may take the form of rods extending longitudinally in the core, or other suitable means.

The slight spacing between the turns of the wire 14, or bands or hoops if employed instead of the wire helix, permits the member to be compressed under load without bringing the turns or hoops into contact with each other to act as a hollow column which might fail under the load.

Structural compression members according to this invention may be made in any desired practical size, although members having diameters of from two inches to eight inches, excluding the thickness of the coating 15, are preferred. If several members are to be secured in end-to-end relation, the end plates may be employed for this purpose, or the members provided without end plates and connected by means of a sleeve, as more fully explained below.

In Figures 3 and 4, structural members C are illustrated, employed as compression reinforcing members for a column 24 and a beam 25 supported by the column. A slab 26 of concrete or the like is supported by the beam 25. A plurality of compression members C are disposed horizontally in the beam 25 in the lower portion thereof, extending transversely of the column 24. The horizontal compression members may extend through the column 24, as shown in Figure 4, or may extend around the column. In the latter case, the beam 25 is widened adjacent the column 24 and contains the compression members in the widened portion thereof. The beam 25 may, of course, be provided with suitable tension reinforcing members 27 and 28, and suitable stirrups 29 may be employed to connect the tension and compression reinforcing members.

A plurality of compression members are disposed vertically in the column 24, and suitable ties 30 may be employed to hold them in desired relation. The column 24 is preferably reinforced throughout its vertical extent by the compression members C, and for this purpose the compression members are each connected or spliced to compression members in vertical alignment therewith. One form of connection is illustrated in Figure 3, and comprises a sleeve 31 secured about the meeting ends of the compression members, with a quantity of suitable cement, mortar, or the like 32 within the sleeve 31 between the ends of the members.

The application of the compression members of this invention shown in Figures 3 and 4 is illustrative only, and it will be obvious that the com-

pression member of this invention may be employed in numerous applications where a compressive load is encountered. The compression member of this invention is well adapted to serve as a column in buildings and similar structures, and may be employed in multiple to provide a vertical column of any desired height. The members may be joined as a unitary column by means of the end plates or by means of the sleeves 31, or in any other suitable manner, and may carry beams or other structural members secured thereto by means of the end plates or otherwise.

By reason of the preloading of the core and the pre-tensioning of the encasing wire 14, the compression member has great strength under load. Because the encasing wire is initially under tension, it acts immediately to restrain lateral deformation of the core when a load is placed on the compression member. It is not necessary for the core first to be deformed by the load sufficiently to place the encasing wire under tension, with the possibility of failure before the wire becomes effective. The compression member, as shown by tests, has the strength of solid steel and the weight and stiffness of aluminum, giving a strength-weight ratio approximately two and one-half times that of a solid steel column. It is obvious that compression members of this type, providing great strength which may be utilized mainly for live loads, provide great advantages when employed in buildings, bridges, caissons, and the like, in the form of vertical columns or otherwise, and also as compression reinforcing members for reinforced concrete in any application.

It will, of course, be understood that various details of construction may be varied through a wide range without departing from the principles of this invention, and it is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claim.

I claim as my invention:

A prestressed concrete structural compression member comprising an expansible cylindrical metal sleeve, a flat metal helical tensioned band having the turns thereof closely spaced with respect to each other surrounding said sleeve, the ends of said band being turned over the ends of said sleeve and extending inwardly therealong and secured thereto, and a compressed concrete core within said sleeve, said band being tensioned by the compressed concrete core hardening under pressure and said ends of said band being secured to the sleeve by the compressed concrete core.

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