

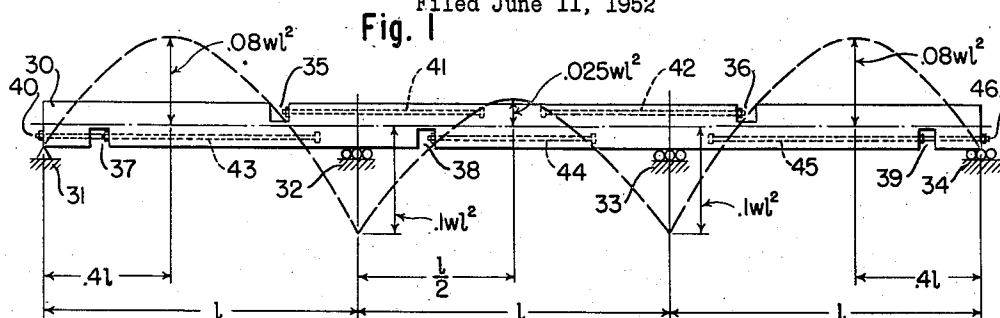
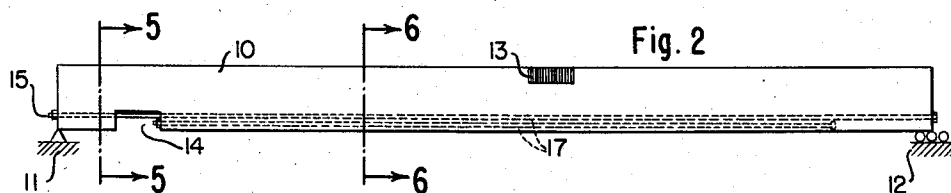
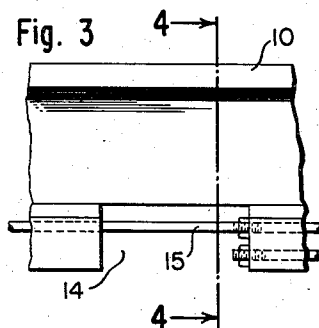
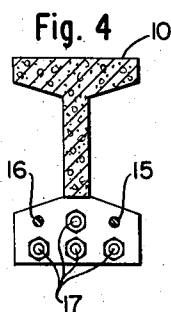
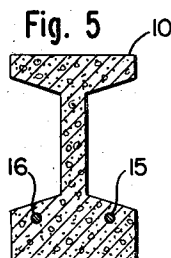
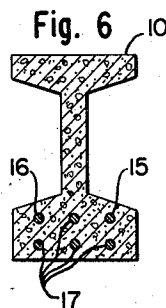
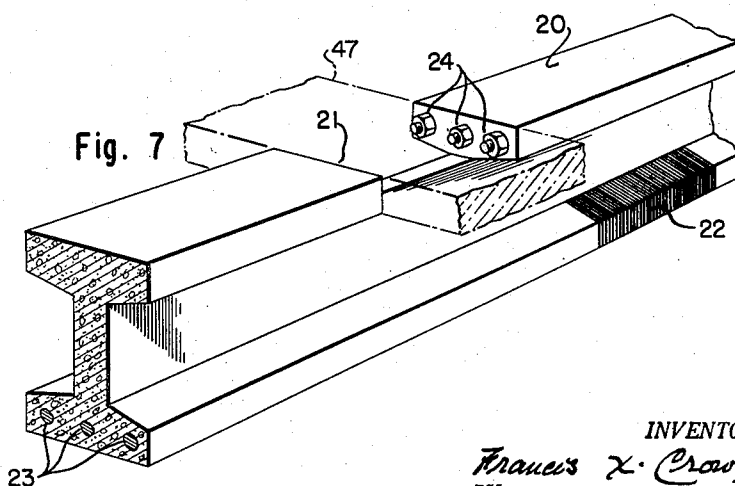
Nov. 11, 1958

F. X. CROWLEY

2,859,504

PROCESS OF MAKING PRESTRESSED CONCRETE STRUCTURES

Filed June 11, 1952



INVENTOR.

Francis X. Crowley

BY

Henry James Witten & H. H. Witten
Attys.

1

2,859,504

PROCESS OF MAKING PRESTRESSED CONCRETE STRUCTURES

Francis X. Crowley, Boston, Mass.

Application June 11, 1952, Serial No. 292,877

1 Claim. (Cl. 25—154)

This invention relates to prestressed concrete structures and comprises a new and improved process of making prestressed slabs, beams, girders and other structural members. The term "prestressed" is used herein to mean that the reinforcing members are tensioned after the concrete has been cast and acquired its structural strength and prior to the application to the structure of the external live or dead loads; in other words, the structure is prestressed by post tensioning of the reinforcing steel. The invention is based on the premise that in prestressed concrete structures, construction joints may be advantageously located in areas that will remain under permanent compression when the structure is subjected to load and this is an essential feature of the invention.

Heretofore, the rods in post tensioned prestressed concrete members have been anchored externally, generally at their opposite ends. In the case of simple end supported beams, it has been the practice to employ rods bent in parabolic curvature in order to remove the tension introduced into the top fibers at the end of the beam by eccentric prestressing.

The process of the present invention is characterized by the steps of casting a concrete structure with one or more recesses in areas which are to be subjected only to compression, prestressing the structure, and then filling the recess with concrete which, in the loaded structure, will of course never be subjected to tension. The recess may be used to facilitate the creation of the desired prestress by providing access for stressing reinforcing members of less length than the entire structure, for example, rods extending between intermediate supports of a continuous girder. The recesses may also be used to facilitate the formation of joints between a girder and transverse members.

The process of this invention has the advantages that:

- (1) Continuous beams or girders may now be fabricated and prestressed economically in situ,
- (2) Continuous beams of unequal spans may be made with the necessary amount of prestressing in each span,
- (3) Concrete bridges or building structures may be cast monolithically and subsequently prestressed,
- (4) All required or desired prestressing may be carried out with straight cables or rods and the use of parabolic reinforcing members thus obviated,
- (5) Transverse beams or joists may be cast monolithically with their supporting girders and subsequently prestressed,
- (6) Slabs or, in fact, entire floor sections may be cast monolithically and subsequently conveniently prestressed,
- (7) Recesses may be left in compression areas to facilitate forming joints between principal and transverse members,
- (8) The amount of prestressing steel required may be reduced to conform to reduced stresses in intermediate spans, and, in general, the amount of prestressing in any section may be made to correspond to the amount required by the maximum moment of that particular section.

Heretofore the art of prestressing concrete structures

2

has had little application in building, but with the present invention existing handicaps are largely overcome and the field of its use is greatly enlarged.

These and other features and advantages of my invention will be best understood and appreciated from the following illustrated embodiments thereof, selected for purposes of illustration and shown in the accompanying drawings in which:

Fig. 1 is a diagrammatic view of a continuous girder supported at two intermediate points with a superposed curve in broken lines showing graphically the moment in the uniformly loaded beam,

Fig. 2 is a diagrammatic view of a prestressed beam supported at its end,

Fig. 3 is a fragmentary view on an enlarged scale of the end section of the beam of Fig. 2,

Figs. 4, 5 and 6 are views in cross-section on the lines 4—4, 5—5 and 6—6, respectively, and

Fig. 7 is a view in perspective of another prestressed beam.

In Fig. 2 is shown a concrete girder 10 having points of support 11 and 12 at its opposite ends. In casting this beam a rectangular recess has been formed in its upper or compression side, and after prestressing, the recess has been filled with cement or mortar 13 which of course forms a solid block integrally bonded with and indistinguishable from the finished beam. The beam 10 is herein shown as having two reinforcing and prestressing rods 15 and 16 which extend entirely through the beam from end to end, being located as shown in the cross-section of Fig. 5 and exposed on both ends so that they may be subjected to tension.

The beam is shown as provided with a second recess 14 in its under or tension side but located so close to the point of support 11 that its area is not subjected to substantial tension from external and dead loads. The purpose of the recess 14 is to expose the threaded ends of four reinforcing rods 17 located as shown in the cross-sections of Figs. 4 and 6 so that they may be suitably tensioned. The shorter reinforcing rods may be cast in the beam and thus securely anchored at their right-hand ends while their left-hand ends are exposed in the recess 14. After the short rods are stressed, the recess is filled with concrete or grouting mortar in the same manner as the inserted block 13 was formed. This inserted block is subjected to compression by the subsequent stressing of long rods 15 and 16. This elimination of a large portion of the prestressing near the end of the beam will reduce the tension in the top fibers to a point where parabolic cables are unnecessary.

The beam 20 shown in Fig. 7 is cast with a recess 21 in its upper flange and with a similar recess which has been filled with a block 22 of concrete or grouting in its lower flange. The lower flange is reinforced and prestressed by three rods 23. It may be assumed that these rods have been stressed and are now embedded in the block 22 and that the block 22 is located in a compression area so that construction joints 47 and 48 are under continued compression. The upper flange is shown as being reinforced and prestressed by three rods having nuts 24 located in the recess 21. After these rods have been placed under tension the recess 21 will be filled with a cast block of concrete in an area free from tension.

The continuous girder 30 of Fig. 1 is shown diagrammatically as supported at four points 31, 32, 33 and 34 and as having been cast with recesses 35 and 36 in its upper portion and with recesses 37, 38 and 39 in its lower portion. The ends of prestressing rods are exposed in the recesses 35, 36 and 38 and after the rods are subjected to the requisite tension, the recesses will be filled with

3

inserts of concrete or grouting which, on account of their location, are subjected to continual compressing in the loaded girder.

The lower portion of the beam is shown as prestressed by rods 40, 43, 44, 45 and 46. The long rods 40 and 46 extend from an intermediate compression area to the end of the beam. The shorter rods 43 and 45 are cut off at recesses 37 and 39 in order to reduce tension in the upper fibers and so eliminate the necessity of parabolic rods. Rods 44 run completely through the tension area from compression area to compression area and are stressed at recess 38. It will be understood that these rods are placed under tension and then the recesses are filled with concrete inserts which are under continual compression. The insert in recess 38 will be under compression from external loads. The inserts in recesses 37 and 39 will be maintained under continual compression by the subsequent stressing of long rods 40 and 46.

Ordinarily, where possible, one end of the prestressing rod will be embedded in the beam so that the number of recesses required will be kept at a minimum. This may be done by casting the rod in the beam encased in a sleeve which may or may not be later filled with grout after the prestressing operation.

The term "rod" has been used herein to mean any high tensile steel reinforcing member adapted for the prestressing or post tensioning functions above described. It may take the form of bridge wire, cable, bar or rod of any suitable cross section.

The prestressed concrete structures herein disclosed are the subject-matter of my co-pending divisional application Ser. No. 359,039 filed June 2, 1953.

Having thus disclosed my invention and described illus-

4

trative examples thereof, I claim as new and desire to secure by Letters Patent:

The process of making prestressed concrete structures which is characterized by the steps of casting a concrete structure with long straight reinforcing rods extending from end to end, and shorter rods which have one of their ends anchored in inaccessible locations in the concrete of the structure and their unanchored ends exposed in recesses located in areas subject to compression in flexing of the structure under load, tensioning the shorter rods from their ends which are exposed in said recesses, grouting in said recesses, and then placing the said grouting under compression by tensioning the said long reinforcing rods that extend out through the opposite ends of the structure.

References Cited in the file of this patent

UNITED STATES PATENTS

903,909	Steiner	Nov. 17, 1908
1,684,663	Dill	Sept. 18, 1928
1,818,254	Hewett	Aug. 11, 1931
2,080,074	Freyssinet et al.	May 11, 1937
2,185,749	Kennedy	Jan. 2, 1940
2,255,022	Emperger	Sept. 2, 1941
2,315,895	Crom	Apr. 6, 1943
2,319,105	Billner	May 11, 1943
2,596,495	Macerata	May 13, 1952

FOREIGN PATENTS

46,379	France	Mar. 24, 1936
898,076	France	June 26, 1944
557,025	Great Britain	Nov. 2, 1943