March 25, 1952 V. WEINBERG 2,590,478

APPARATUS AND METHOD FOR MOLDING PRESTRESSED CONCRETE STRUCTURAL MEMBERS

Filed June 2, 1950 2 SHEETS—SHEET 1

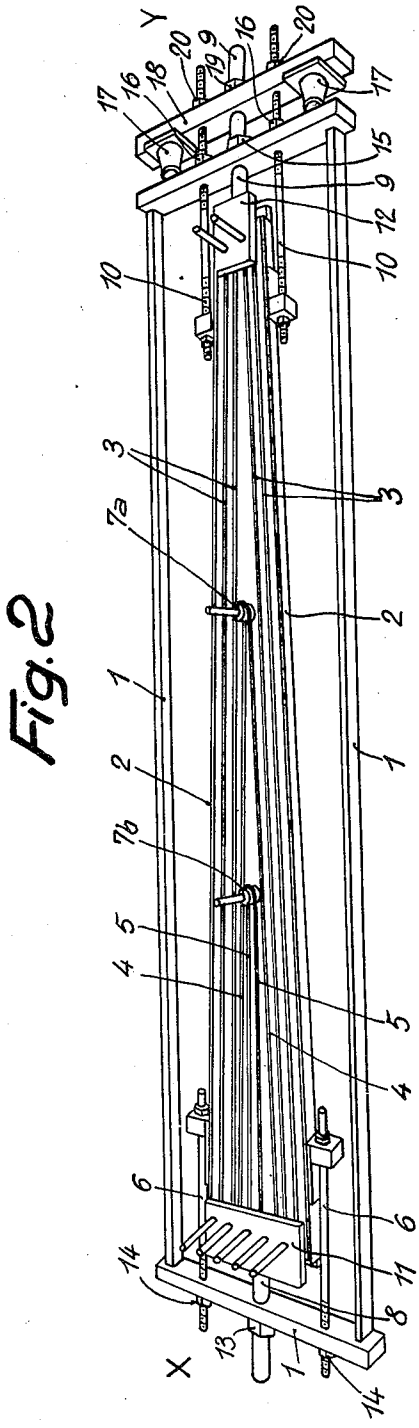


Fig. 2

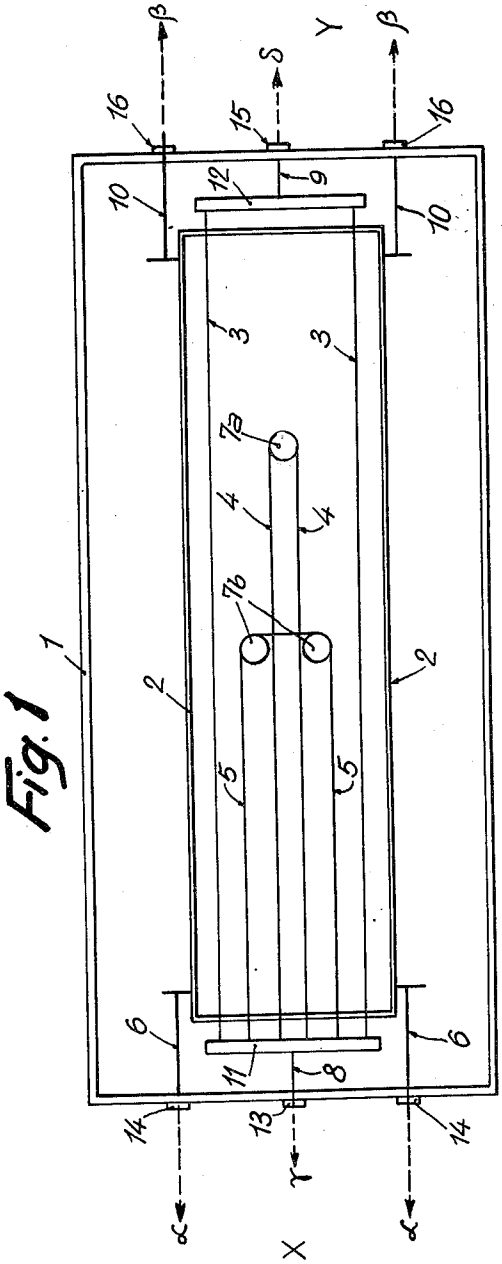


Fig. 1

Inventor
V. Weinberg
By Glenn Downing & Dubb
Attys.

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Fig. 3

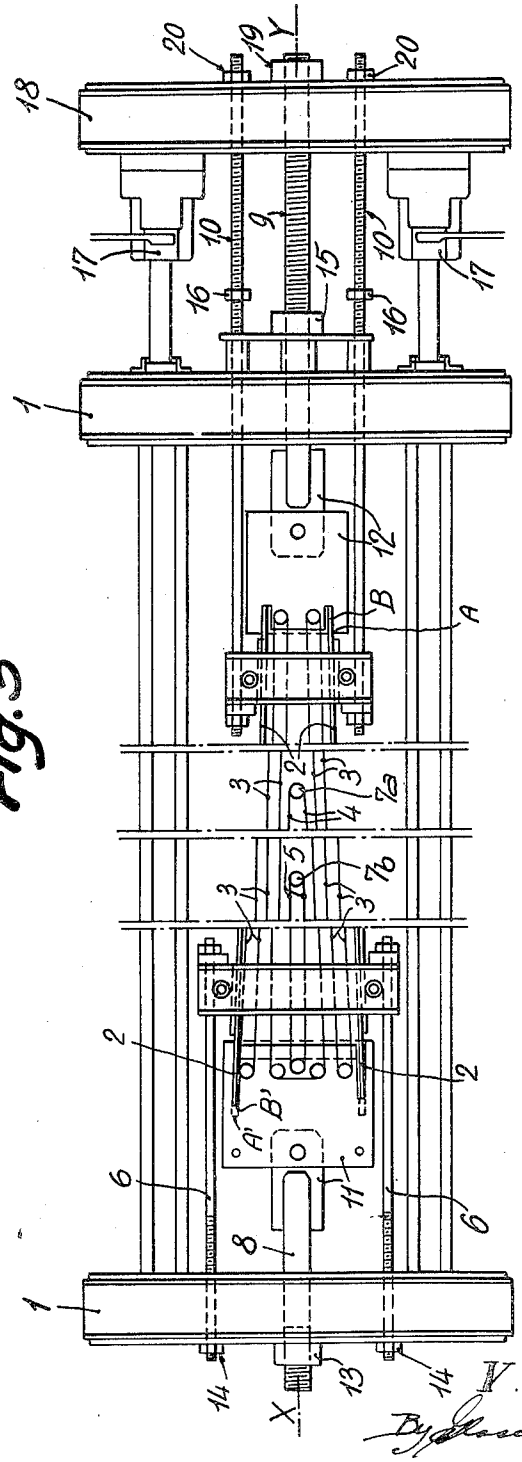
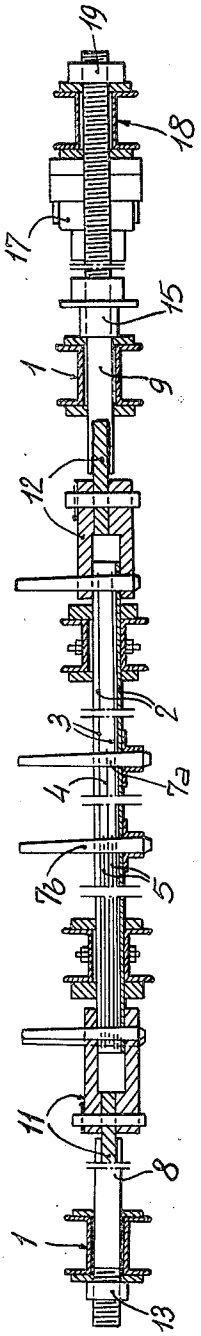


Fig. 4



Inventor

V. Weinberg

By Howard Doering Peebles

Attys.

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APPARATUS AND METHOD FOR MOLDING PRESTRESSED CONCRETE STRUCTURAL MEMBERS

Victor Weinberg, Paris, France

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8 Claims. (Cl. 25—118)

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The present invention is a continuation in part application of my co-pending specification Ser. No. 773,136 filed September 10, 1947, now abandoned.

My invention has for its object a novel and improved system for the casting of structural members made of preliminary stressed concrete, of any type whatever. According to my invention, the mold or molds are tensioned and suspended inside a rigid frame and on the other hand said mold or molds are made rigid with a number of intermediary reinforcing members that do not extend throughout the length of the prestressed member or members, said reinforcing members being tensioned through a tractional stress exerted on the mold or molds. The tensioning of these reinforcing members is then performed automatically in unison with the mold.

This novel system is of particular advantage for the molding of prestressed posts or beams having a varying transversal cross-section and including stretched reinforcing members that do not extend throughout the length of posts or beams, in other words, that stop at those points for which calculation shows that reinforcing members are useless beyond such points by reason of the reduction of the bending momentum and are even objectionable by reason of the exaggerated compression provided in the concrete through the presence of such supplementary reinforcing members.

I have illustrated in accompanying drawings a preferred embodiment of an arrangement according to my invention.

In said drawings:

Fig. 1 is a diagrammatic view of an arrangement according to the invention.

Fig. 2 is a perspective showing of a plant executed in conformity with the diagram of Fig. 1 and adapted for the casting of prestressed concrete posts of a varying cross-section.

Fig. 3 is a plan view of a similar industrial plant in accordance with the diagram of Fig. 1 and the perspective view of Fig. 2, adapted for the execution of a similar post.

Fig. 4 is a cross-sectional view through the longitudinal axis of symmetry of Fig. 3.

In the various figures:

1 designates the outer rigid frame or tensioning frame constituted by shaped iron members.

2 designates the actual mold constituted by thin steel sheets.

3 designates continuous reinforcing wires.

4 and 5 designate intermediary shorter reinforcing wires.

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6 and 10 designate tie rods for attaching the mold to the frame 1 at either end thereof, i. e. at X and Y, the arrows α—β of Fig. 1 showing the direction of the tensional stresses.

7*a* and 7*b* designate the anchoring means securing one end of the intermediary reinforcing members to the actual mold 2, said anchoring means being constituted e. g. by steel tubes round which said reinforcing members form loops and that are secured in their turn to the mold through a pin.

8 and 9 designate the tie rods for attaching to the frame 1 traction-transmitting cross members or straps 11 and 12 carrying the corresponding ends of the reinforcing members 3, the arrows γ—δ of Fig. 1 illustrating the direction of the tensional reactions exerted on the reinforcing members or wires.

The ends of the intermediary reinforcing wires 4—5 that are not attached to the mold are also secured to the corresponding cross member 11 that is rigid with the frame through the tie rod 8 and associated adjusting nut 13.

14, 15 and 16 designate further nuts or the like stops used for securing or locking the various tie rods when the associated parts have been properly tensioned.

Furthermore, in Figs. 2 to 4, 17 designates jacks carried by the frame and adapted to exert tractional stresses while 18 designates the cross member to which said stresses are applied and

Lastly 19 and 20 designate nuts or the like abutments through which the cross member 18 acts on the tie rods 9 and 10.

The operation of the arrangement illustrated is as follows:

The continuous wires 3 held between the cross members 11—12 are mounted independently of the mold 2 and may, therefore, be stretched separately e. g. through the agency of the jacks 17 illustrated in Fig. 2; the action of the jacks on the cross-member 18 and tie rod 9 produces a shifting, towards the head end Y of the arrangement, of the cross member 12, carrying the looped ends of the reinforcing wires; on the other hand, the cross member 11 at the foot end of the arrangement is connected with the frame 1 through the tie rod 8 and is locked on said frame through a nut or the like securing member 13. The tractional stresses may be exerted on the cross-member 12 either mechanically, say through the jacks 17 or manually e. g. through action on the nut 15 fitted over the tie rod 9. After the reinforcing wires 3 have received the desired elongation, they are rigidly secured to the frame 1 through a

screwing home of the locking nut 15 or the like member over the tie rod 9.

This being performed, the same jacks are used for exerting a tractional stress on the mold 2 through the agency of the tie rods 10 at the head end of the arrangement, the tie rods 6 holding the mold at the foot end of the arrangement not being yet locked by the nut 14. This tractional stress provides for a gradual tensioning of the section of the mold comprised between its head facing the side Y and the anchoring means 7b together with the tensioning of the intermediary tensioning wires 4 and 5 between said anchoring means and the stationary cross-member 11. The foot end of the mold facing the side X moves freely away from said left hand side X towards the right hand side Y until the nuts 14 or the like stops on the tie rods 14 engage the frame 1; obviously, from this moment onwards, the mold section comprised between 7b and the foot end facing X is also tensioned under the action of the tractional stresses exerted on its head end.

The location of the nuts 14 on the tie rods 6 is adjusted in a manner such that they abut against the frame only at the moment at which the reinforcing wires 4 and 5 have acquired the almost complete desired elongation and consequently the desired prestressing.

Furthermore, if the reinforcing members 4 and 5 should acquire, as is generally the case, a final tensioning that is identical with that of the reinforcing members 3, in other words, if their total elongation is different for a same unitary elongation, the reinforcing wires 5 that are the shortest, should be given a length such that they extend before the tensioning beyond the anchoring points 7b by a predetermined length. Supposing a is the total elongation to be given to the wires 4, and b that to be given to the wires 5, a is larger than b for a same elongation per unit of length. At the beginning of the tensioning operation i. e. at the moment at which the wires 4 engages the anchoring means 7a under the action of the tractional stresses exerted on them through the mold, the wires 5 will still extend beyond their anchoring point 7b by a length $a-b$. As soon as the wires 4 have been stretched by a length equal to this difference which corresponds to a displacement by an equal amount of the mold from the left hand side X towards the right hand side Y, the mold, being at the moment considered tensioned between its head at Y and the point 7a and submitted to no tensioning between said point 7a and the foot end X, the anchoring means 7b should abut in their turn against the loop formed by the reinforcing wires 5 and as the tractional stress continues being executed at the head end of the mold, said wires 5 are submitted in their turn to elongation. Simultaneously, the mold section comprised between 7a and 7b also begins being tensioned. It is easy to ascertain that if said traction is continued until the anchorage 7b begins moving towards Y, the wires 5 and 4 will have received a total elongation equal respectively to b and to a; care should be taken to adjust the position of the nuts 14 so that they may be located at a distance of the frame that is slightly less than the total shifting elongation a. Consequently, towards the end of the stressing, the mold is locked through its foot end by said nuts 14 and is consequently also stretched between the point of attachment with the tie rods 6 up to a point in register with the anchorages 7b. The complete tensioning of the mold 2 and wires 4 and 5 is then

at an end and the locking nuts 15 are tightened against the frame 1 so as to transfer onto the latter the tension of the mold and of the reinforcing wires to be considered.

In the actual plant illustrated in Figs. 2, 3 and 4, the operation is similar to that disclosed with reference to Fig. 1: the tractional stress is exerted by symmetrical jacks 17 acting on the transversal cross member 18. During the preliminary stretching of the continuous reinforcing wires 3, the nut 19 is locked while the nuts 20 are in contradistinction unscrewed to move away from the cross-member 18. The jacks 17 being now actuated, this shifts the cross-member 18 towards the right hand side Y by the necessary amount that is equal to the elongation it is desired to give the wires 3. The nut 15 on the tie rod 9 is then locked in order to transfer the tension of the wires 3 onto the frame 1 following which the jacks may be returned into their inoperative position. The nuts 20 are then locked and the nut 19 is moved away from the cross member. A further action of the jacks will then shift the cross-member 18 towards the right hand side at Y whereby the mold 2 is carried along through the tie rods 10. This produces a tensioning of the mold 2 and of the wires attached at 7a and 7b in the same manner as disclosed hereinabove. This operation being at an end, the nuts 16 are locked also as described hereinabove and the jacks 17 are released.

The first of the two successive operations described does not affect the mold as the continuous reinforcing wires 3 are secured to the frame and are not secured to the mold. In the second operation, on the contrary, the mold is shifted from the position A, A' to the position B, B', the shifting by AB at one end being however slightly greater than the shifting A'B' at the other end as the former is the sum of the shifting A'B' and of the elastic elongation of the mold produced through its tensioning.

The method of which an embodiment has been described is applicable to a system of molds or of a series of molds arranged in parallelism with reference to one another inside a single frame and the tensioning operations described that have been disclosed hereinabove may then, if desired, be executed simultaneously for two or more molds or series of parallel molds.

On the other hand, the method remains of interest with however a simplified sequence of operative steps when the structural members of prestressed concrete to be molded are not provided with intermediary reinforcing wires such as 4 and 5. The traction exerted on the mold has then for its sole object to tension the latter.

I have found by experience that the method according to the invention shows numerous advantages such as follows:

The tensioning of the mold increases to a considerable extent the intensity of the vibrations that may be applied to said mold, chiefly when the vibration is executed at a high frequency, say at a rhythm of 6,000 to 9,000 per minute. As a matter of fact, when the mold stretched in accordance with the invention is provided with one or more vibrators secured through any known means, it is found, provided the tensioning stress applied is properly adjusted, that the intensity of the vibration is substantially improved which leads to a better settling of the concrete when compared with the results obtained with an ordinary mold.

The fact that the prestressing reinforcing wires

are anchored to a rigid frame independently of the mold, allows reducing the weight of the latter and executing it more economically than heretofore.

The tensioning of the intermediary reinforcing members in structural members of prestressed concrete that was heretofore difficult to obtain in practice, is provided very simply in accordance with the present invention.

What I claim is:

1. An arrangement for molding prestressed concrete structural members comprising an elongated rigid frame, at least one mold lying inside the frame, two cross-members lying inside the frame near the ends of the mold, between which reinforcing members are adapted to be laid, means for rigidly connecting one of said cross-members to the adjacent end of the frame, means for tensioning the other cross-member to stretch the reinforcing members between the two cross-members, means for tensioning the mold through action thereon in the vicinity of said other cross-member and means associated with the end of the mold adjacent the first cross-member and including an abutment cooperating with the first mentioned end of the frame to form a resistance to the tensioning of the mold.

2. An arrangement for molding prestressed concrete structural members comprising an elongated rigid frame, at least one mold lying inside the frame, two cross members lying inside the frame near the ends of the mold and between which reinforcing members are adapted to be laid, means for rigidly connecting one of said cross-members to the adjacent end of the frame, means for tensioning the other cross-member to stretch the reinforcing members between the two cross-members, at least one anchoring member rigid with the mold and adapted to hold one end of intermediary reinforcing members the other end of which is anchored to the cross-member that is rigidly connected with the frame, means for tensioning the mold and associated intermediary reinforcing members through action thereon in the vicinity of said other cross-member and means associated with the end of the mold adjacent the first cross-member and including an abutment cooperating with the first mentioned end of the frame for forming a resistance to the tensioning of the mold.

3. an arrangement for molding prestressed concrete structural members comprising an elongated rigid frame, at least one mold lying inside the frame, two cross-members lying inside the frame near the ends of the mold and between which reinforcing members are adapted to be laid, means for rigidly and adjustably connecting one of said cross-members to the adjacent end of the frame, means for tensioning the other cross-member to stretch the reinforcing members between the two cross-members, means for tensioning the mold through action thereon in the vicinity of said other cross-member and means associated with the end of the mold adjacent the first cross-member and including an abutment cooperating with the first mentioned end of the frame for forming a resistance to the tensioning of the mold.

4. An arrangement for molding prestressed concrete structural members comprising an elongated rigid frame, at least one mold lying inside the frame, two cross-members lying inside the frame near the ends of the mold and between which reinforcing members are adapted to be laid, means for rigidly connecting one of said

cross-members to the adjacent end of the frame, a cross-beam on the outside of the end of the frame furthest removed from the end that is secured to a cross-member, a series of tie-rods rigidly connected with the other cross-member nearest said cross-beam, a second series of tie-rods rigidly connected with the end of the mold nearest the cross-beam, means for selectively connecting the cross-beam with either of the series of tie-rods and jacks fitted between the cross-beam and the nearest end of the frame to urge the cross-beam away from the latter to provide for the longitudinal stressing movement of the reinforcing members and of the mold according to the tie-rod series that is secured to the cross-beam.

5. A method for molding prestressed concrete structural members in a mold located inside a stationary frame consisting in laying reinforcing members between two transversal cross-members located near the ends of the frame and one of which is rigid with the frame, tensioning said reinforcing members through action on the other cross-member and tensioning the mold through the end opposed to the cross-member that is rigid with the frame and casting the concrete over the reinforcing members in said mold.

6. A method for molding prestressed concrete structural members in a mold located inside a stationary frame consisting in laying reinforcing members between two transversal cross-members located near the ends of the frame and one of which is rigid with the frame, laying auxiliary reinforcing members between predetermined points of the mold and the cross-member that is rigid with the frame, tensioning said first mentioned reinforcing members through action on the other cross-member and tensioning the mold through the end opposed to the cross-member that is rigid with the frame to stretch first the auxiliary reinforcing members and the portion of the mold lying between them and the end of the mold to which the tensioning is applied, securing the other end of the mold to the frame and continuing the tensioning of the entire mold together with the auxiliary reinforcing members and casting the concrete over the reinforcing members in said mold.

7. A method for fitting the reinforcements inside a mold with a view to molding therein prestressed concrete structural members in a mold located inside a stationary frame consisting in laying reinforcing members between two transversal cross-members located near the ends of the frame and one of which is rigid with the frame, laying auxiliary reinforcing members between predetermined points of the mold and the cross-member that is rigid with the frame, tensioning said first mentioned reinforcing members through action on the other cross-member and tensioning the mold through the end opposed to the cross-member that is rigid with the frame to stretch first the auxiliary reinforcing members and the portion of the mold lying between them and the end of the mold to which the tensioning is applied, securing the other end of the mold to the frame and continuing the tensioning of the entire mold together with the auxiliary reinforcing members, the shorter auxiliary reinforcing members being engaged originally on the corresponding anchoring points with some clearance to provide an idle relative travel of these shorter auxiliary reinforcing members during the beginning of the tensioning of the longer auxiliary reinforcing members and mold.

8. A method for molding prestressed concrete

structural members in a mold located inside a stationary frame consisting in laying reinforcing members between two transversal cross-members located near the ends of the frame and one of which is rigid with the frame, inserting tensioning devices between the front end of the frame near the other cross-member and a cross-beam to the front thereof, transiently connecting said cross-beam with the said front cross-member, tensioning the reinforcing members through operation of the tensioning means on the cross-beam, connecting the front cross-member with the frame, disconnecting the cross-beam with reference to the front cross-member, connecting transiently the cross-beam with the front end of the mold, causing the tensioning means to act again on the cross-beam to stretch first the auxiliary reinforcing members and the portion of

the mold lying between them and the end of the mold to which the tensioning is applied, securing the other end of the mold to the frame and continuing the tensioning of the entire mold together with the auxiliary reinforcing members and disconnecting the mold with reference to the cross-beam and connecting its front end to the frame.

VICTOR WEINBERG.

REFERENCES CITED

The following references are of record in the file of this patent:

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