May 15, 1956 M. R. ROŠ 2,745,164

PRODUCTION OF PRESTRESSED BUILDING ELEMENTS

Filed Aug. 30, 1952 2 Sheets-Sheet 1

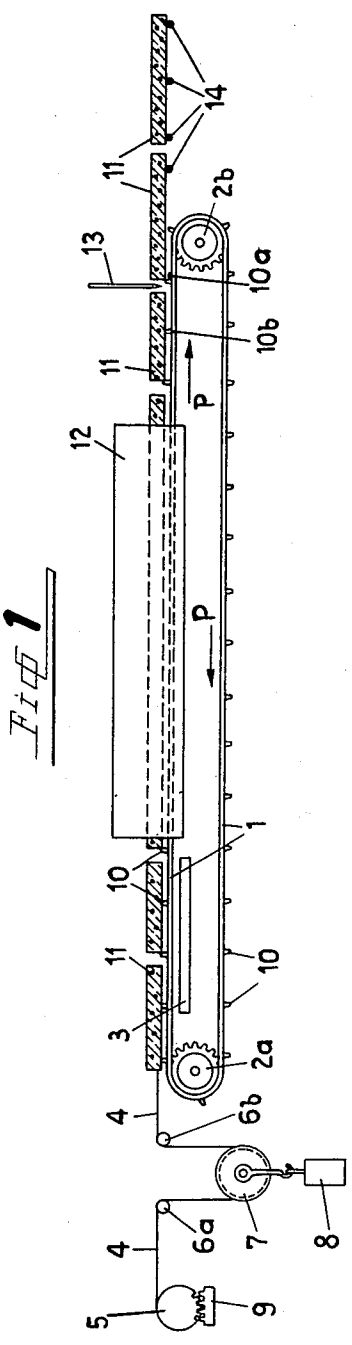


Fig. 1

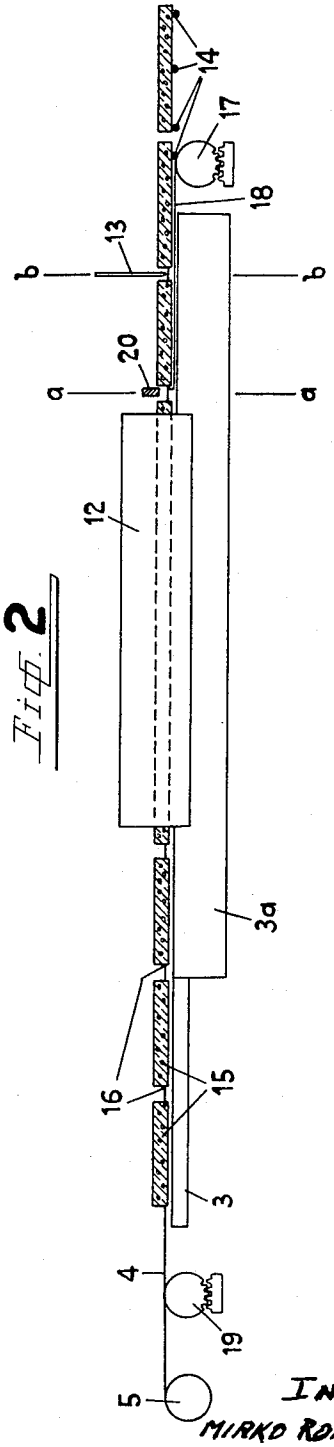


Fig. 2

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Fig. 3

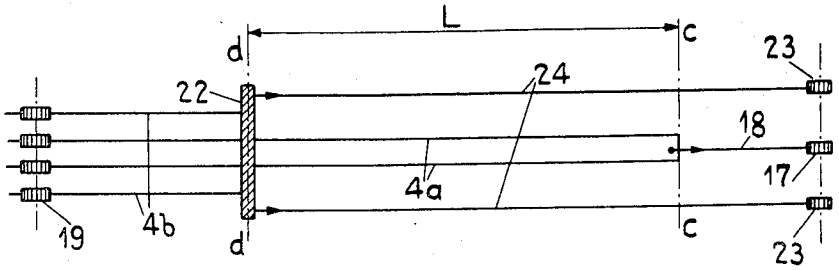


Fig. 4

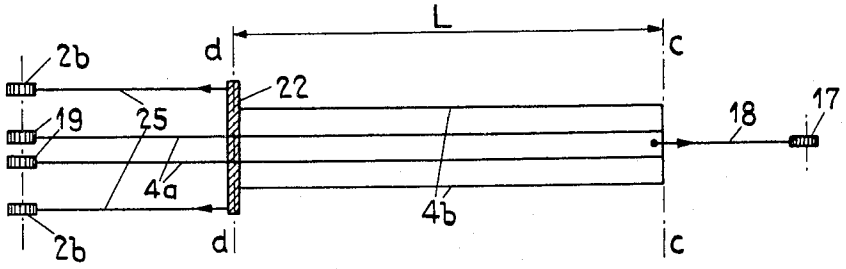
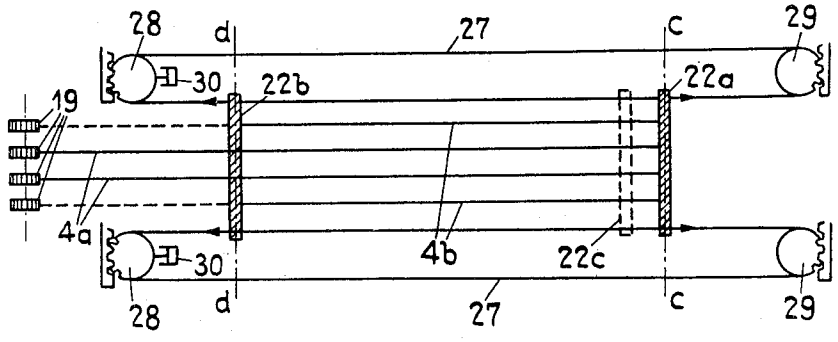


Fig. 5



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PRODUCTION OF PRESTRESSED BUILDING ELEMENTS

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Claims priority, application Switzerland August 30, 1951

5 Claims. (Cl. 25—118)

At present it is customary to produce pre-stressed concrete on long tracks above which steel wires are stretched. The concrete surrounding the wires is charged into shuttering, and after sufficient setting of the concrete the wires are released and cut. Instead of shuttering to be filled with concrete a line of moulded bricks provided with grooves for the reception of the reinforcing wires may be used, said grooves being filled with mortar.

The necessity of having to apply concrete and shuttering and moulded bricks respectively to the production track along the whole of its considerable length and to compact the concrete by vibration leads to tedious transport and complicated manufacturing operations.

Therefore the suggestion has been made to arrange a table at a certain point of the production track where the shuttering is assembled and the concrete is charged and compacted. The elements thus produced are then pushed along the reinforcing wires to their positions on the production tables where a second vibration takes care of a renewed tight envelopment of the wires by the concrete. After setting the elements are drawn by the wires to a further table where the shuttering is removed and the wires are cut between the individual elements. In this manner a certain rationalization can be achieved. The following disadvantages, however, still exist: For one it is necessary to lay out and pre-stress the wires on each track again after completing the production of a certain number of building elements; furthermore the elements contained in their shuttering have to be slid along the wires, necessitating as a rule that at the final setting place the concrete has to be compacted once more by vibration.

The aim of the present invention is to eliminate the described disadvantages. The invention relates to a method for producing pre-stressed building elements as well as to a device for carrying out said method.

The method according to the invention is characterized in that a reinforcement of any desired length is moved across a progressive production support and is simultaneously brought to the desired initial tension, and that the building elements are formed on the progressive production support by embedding the reinforcement in concrete, whereupon they are fed through a setting duct and thereafter are cut apart, care being taken that the initial tension in the reinforcement stretched along the progressive production support is maintained at all times.

The device for carrying out said method is characterized by a progressive production support for the elements to be produced provided with means for advancing the building elements, at least one stock spool for at least one reinforcing wire stretched longitudinally across the progressive production support in connection with a wire tensioning device arranged in advance of said support, and in addition by a setting duct through which said progressive production support passes, and a cutting-off or severing device arranged towards the end of said support for dividing the individual building elements.

By way of example several embodiments of the device according to the invention are shown in the drawings accompanying and forming part of this specification in which:

Fig. 1 is a first form of construction of the device shown diagrammatically in side elevation;

Fig. 2 is a second form of construction of the device, likewise in side elevation;

Fig. 3 is a third example of construction of the device in top view;

Fig. 4 is a fourth example of construction of the device in top view; and

Fig. 5 is a fifth form of construction of the device in top view.

According to the form of construction shown in Fig. 1 the device has a progressive production belt **1** passing endlessly over the rollers **2***a*, **2***b*, the rollers **2***a* being the driving rollers. It is assumed that the endlessly designed production belt **1** moves in the direction of the arrow P. Adjacent to the driving roller **2***a* of the production belt there is located a production table **3**.

The reinforcement consisting of at least one reinforcing wire **4** is led from a stock spool **5** arranged in front of the production belt over the guide pulleys **6***a*, **6***b* and the pulley **7** from which a weight **8** is suspended. From the guide pulley **6***b* the reinforcement **4** passes longitudinally above the conveyor track **1** and is anchored in a manner described further on. By the weight **8** the reinforcement **4** is tensioned to the desired initial tension on the side of the production belt and the stock spool **5**. For this purpose the stock spool **5** is provided with a releasable lock **9** by which the wound-on reinforcing wire **4** is prevented from unwinding from the stock spool **5**. Instead of the weight an hydraulic press might be provided for tensioning the reinforcement. The hydraulic press **30**, seen in Fig. 5, comprises a piston moving in a cylinder. The hydraulic fluid prevents the rotation of the stock spool, as illustrated.

On the production table **3** the pre-stressed reinforcing wires already provided in the right number and distribution are surrounded by molding means such as an enclosure or way of example by a shuttering, and the latter is filled with binding material. The building elements to be produced are already given their shape on the production table **3** so that with exception of the setting and the removal of the shuttering the production procedure is completed at this point.

The production belt **1** which is provided with special drivers **10** pushes the element **11** lying on the production table **3** into the heating duct **12**. For this purpose the drivers **10** may abut against the shuttering to which the wires **4** are connected, or they may be connected directly to the wires **4**. The shuttering may be connected frictionally to the wires **4** whereby the clamping action of the component parts of the shuttering will be sufficient to pull the shutterings along with the wires.

After passing the heating duct **12** the element **11** has been artificially set so that the set elements **11** issuing from the heating duct **12** can have the shuttering removed. On its return to the driving roller **2***a* the production belt **1** can carry along with it the shuttering elements inasfar as such are required for the production of the elements.

In the rear of the heating duct **12**, but still above the production belt **1**, there is provided a cutting device **13** by which the reinforcing wires **4** are cut apart between the individual elements **11** so that the finished elements can be fed onto a roller table **14** arranged behind the production belt for their removal.

The anchoring of the pre-stressed wire **4** takes place in the foremost set element **11** which is supported on the production belt **1** by means of the driver **10***a*. As

soon as the cutting machine 13 separates the outermost element the full anchoring force is transferred to the next driver 10*b*. By means of its drivers the endless chain of the production belt ensures continuous anchorage. On feeding the elements 11 through the heating duct 12 the weight 8 is lifted. By releasing the locking device 9 at the stock spool 5 the weight 8 can again be lowered. Stock spool 5 comprises a toothed wheel, which upon rotation feeds wire 4. Locking device 9 comprises a toothed rack which can effect the requisite rotation of stock spool 5. By locking the toothed rack against movement, the stock spool is also prevented from moving and the desired tension can be maintained.

At the start of production there is not the possibility of anchoring the reinforcement in the set elements as at that moment no such elements are yet in existence. In this case the procedure is as follows:

The weight 8 is first of all locked by preventing relative movement of spool 5 and toothed rack 9. Then the reinforcing wires 4 are secured to the drivers 10 by means of a special device and are then put under initial tension by operation of the drive 2*a*, whereupon production of the elements can start. As soon as the first element with the special securing device reaches the cutting machine 13, said device can be removed from the driver, since the anchorage of the reinforcement is ensured by the elements set in the heating duct 12 themselves. The special device may comprise a notch in drivers 10 which notch is lined with frictional material, thereby assuring seating of the wires 4 in the notch and simultaneously preventing relative movement of the wires and drivers. Alternately, a spring clamp may be seated in the apex of the notch to secure the wires 4 in position.

The operators have to attend to:

(1) The production table 3 where the main work is carried out, namely shuttering, charging of the material, vibrating, and from where the feed of the production belt 1 is controlled.

(2) The cutting machine 13, and

(3) The roller table 14, where the finished elements are loaded for conveying to store.

The advancing speed of the production belt 1 and thus the output of the device is conditioned by:

(1) The time required for producing one element on the production table,

(2) The setting time in the heating duct.

By the correct choice of the length of the heating duct an advancing speed can be used which depends on the production time at the production table only. If the length of the heating duct is not to be too great, several elements might be produced side by side on the production table 3 by one worker, said elements also moving on side by side on one and the same production belt.

The advance of the production belt 1 can at will take place continuously or intermittently.

The employment of a weight 8 is not necessary for obtaining the initial tension of the reinforcement. The initial tension can also be obtained by a co-action of the drive 2*a* and the lock 9 adapted to each other. Furthermore, instead of having the production belt with the drivers take up the pre-stress force and all frictional forces, an arrangement could be provided with which the production belt and the drivers would have to overcome the frictional forces only, whilst a special feed device located at the outgoing end would take up the pre-stress force. In the most simple case there is a sliding plane instead of the production belt. In this case the feed device handles the sum of the pre-stress forces and the frictional forces.

The example of embodiment shown in Fig. 2 employs a stationary table 3, 3*a* instead of a conveyor belt, said stationary table serving as a production support of the building elements to be produced. For reducing the friction during feeding of the elements the production table can be provided with special means such as closely spaced rollers forming the support for the elements.

This embodiment is particularly suitable for the production of the building elements by means of shutterings 15. Each shuttering is connected at its rear side to the reinforcement 4, for example by clamping plates clampable to the reinforcement as is indicated in the drawing at 16. For the feed of the elements and the shutterings 15 respectively and for the initial tensioning of the reinforcement a driving roller 17 is arranged at the end of the progressive production table to which, by way of example by the interposition of a pulley block, a reciprocating draw belt 18 is secured the free ends of which can be linked to the shuttering of an element already set or to the reinforcement directly by means of a hook or the like for the purpose of advancing the elements. Before being led over the progressive production table, the reinforcement unwound from the stock spool 5 is passed through a tensioning device consisting of a roller 19 provided with a catch or toothed rack, the arrangement being such that the catch of the roller 19 is made to co-operate with the driving roller 17 in such a manner that the reinforcement is always maintained at the prescribed tension, even during feeding thereof. To achieve this the driving roller 17 is at all times rotated slightly more than the roller 19 thus to balance the linear extension of the reinforcement resulting from the initial tensioning.

As soon as the draw belt 18 has advanced a coupled building element by its forward movement towards the driving roller 17 and thus all the elements on the production support connected to the reinforcement 4 have advanced by one step from *a*—*a* to *b*—*b* a securing member 20 of beam-like shape and abutting against special abutments is placed behind the next-following element 15 at *a*—*a* in order to maintain the initial tension in the reinforcement 4, whilst the draw belt 18 is released and its end provided with the hook is returned, for example by hand, from *b*—*b* to *a*—*a* and is hooked to the next element. The cutting-off device 13 for separating the individual elements can come into operation whilst the securing member 20 is in engagement. The two rollers 17 and 19 may with advantage be electric winches.

Obviously the two examples of construction may be combined, e. g. in such a manner that in the device according to Fig. 2 the progressive production support is an endless conveyor belt which may or may not be provided with drivers and is in connection with a drive the movements of which being additionally coordinated with those of the driving rollers 17 and 19. In this case the conveyor belt can be used for overcoming the frictional, and the draw device 17, 18 for the actual advance of the elements and for tensioning the reinforcing wires.

By means of the described device it is possible to produce an element by the progressive production line method. Once the reinforcements have been anchored any desired lengths can be produced without interruption since after exhaustion of the supply on the spools the reinforcing wires can be lengthened by joining. Thus with the most rationalized, normal method of operation by increasing the working time or by introducing shift-work there is the possibility hitherto unattainable with pre-stressed concrete of increasing the production output without having to expand the existing plant. By the special arrangement according to the invention all the well-known advantages of progressing production are exploited. Compared with the so-called tension table method considerable saving of working time results by avoiding pauses, by simplifying the operating cycle, by reducing the various types of operations and by extensive mechanization.

To permit more or less heavily reinforced building elements to be produced on the same production line without interruption it must be possible to change the

number of reinforcing wires at any time without affecting the initial tension of the reinforcing wires in the element in the process of production at the time. This is possible with the constructions of the device according to Figs. 3 to 5, which represent top views of devices generally similar to that of Fig. 2. The several reinforcing wires 4*a* and 4*b* are equivalent to wire 4 of Fig. 2.

The wires are fed from respective sources while maintained under uniform stress. They are separated into an inner group and an outer group and these groups are displaced relative to each other between two positions. In displacement towards each other, the number of reinforcing wires in each element is increased. In displacement away from each other, the number of reinforcing wires is decreased. This is effected by the use of coupling means to which all of said wires are connected. Winches may be employed to maintain the stress on the wires being displaced, the winches being positioned on that side of the coupling means where the groups of wires are more distant from each other.

By way of example Fig. 3 shows how the number of reinforcing wires may be increased from two to four after elements of the production length L have produced. The additional wires 4*b* running off the stock spools **19** provided with catches or toothed racks are anchored by their beginnings to a coupling member **22** extending transversely across the production line and also passing through the heating duct not shown. The ends of the coupling member **22** are connected to tensile elements **24**, wires or wire cables, which in turn are connected to a winch **23** each. By driving the winches **23** and at the same time locking the rollers **19** the reinforcing wires 4*b* are subjected to the desired initial tension without thus affecting the initial tension on the two other wires 4*a*. The tensile elements **24** pass through the heating duct not shown, but are disposed outside of the elements positioned on the production line. At each advance step of the building elements the winches **23** and the stock spools **19** are rotated simultaneously in such a manner that the coupling member **22** moves to the right from the point *d*—*d* in Fig. 3 and the tension on the wires 4*b* is continuously maintained. When the point *d*—*d* has reached the point *c*—*c* the initial tension force can be transferred to the drive **17** by means of the draw device **18**.

Fig. 4 shows diagrammatically how the production of building elements having four reinforcing wires can be changed over to the production of elements having two wires only. For this purpose the ends of the wires 4*b* to be removed are anchored to a coupling member **22** connected by means of the tensile elements **25** to the winches **23** which can be retarded in accordance with the desired initial tension in the wires 4*b* when the drive **17** pulls the wires to the right in Fig. 4 by means of the draw device **18**. When the coupling member **22** has moved from the point *d*—*d* to the point *c*—*c* said coupling member can be removed. The winches 2*b* may be identical with stock spools **19** provided with a lock.

The device shown in Fig. 5 has two endless draft ropes **27** extending along the production line and passing over a drive pulley **29** and a reverse pulley **28** each of the latter being adapted as a tensioning pulley and being under the action of an hydraulic press **30**. At least one strand of the draft rope **27** passes within the heating duct not shown, but outside of the building elements being produced, and is detachably connected to two coupling members **22***a* and **22***b*. By means of the front coupling member **22***a* the full initial tension force is transferred to the driving rollers **29**, since the front ends of the reinforcing wires are anchored to the coupling member **22***a*. The two central reinforcing wires 4*a* run off from the stock spools **19** provided with locks whilst, the two outside reinforcing wires 4*b* are anchored with their rear ends to the coupling member **22***b* in the example shown since in this case there is to be a changeover from production with four wires to that with two wires. If production with four wires were to be continued, the outside wires would run off the stock spools **19**. During production of the building elements the coupling members **22***a* and **22***b* move to the right in Fig. 5. After the coupling member **22***a* has travelled a certain distance a further coupling member **22***c* has to be connected to the wires 4*a* and 4*b* further on, whereupon the front coupling member **22***a* can be removed. With further progress of the production the two coupling members **22***a* and **22***c* must be exchanged in their role continuously.

If an endless production belt is used, it can be used on its return path not only for returning the empty shuttering or the finished building elements, but it can also be used for the production of pre-stressed building elements.

It may be of advantage to sink the whole device to such an extent that the heating duct is disposed completely below the surface of the ground. In this manner a better heating insulation is obtained and in addition the whole area between the production table and the cutting-off device can be used as storage space.

Instead of by customary heating the concrete of the building elements can be made to set in the heating duct by high frequency heating, by infra-red irradiation, by treatment with gases and vapours, or by continuous vibration.

What I claim and desire to secure by Letters Patent is:

1. An apparatus for continuous production of prestressed reinforced concrete elements, including supporting means, a plurality of molding means for said elements, reinforcing means passing through said molding means consecutively, supply means for said reinforcing means, means for advancing said molding means along said supporting means, means for supplying concrete to said molding means, and means for severing said reinforcing means between adjacent elements on said supporting means, said supply means for said reinforcing means including spool feeding means, intermittently actuated locking means for said spool feeding means, and weighed means suspended on said reinforcing means for maintaining a predetermined stress on said reinforcing means, said weighted means being positioned between said locking means and said molding means.

2. The apparatus according to claim 1, said means for advancing said molding means including a reciprocating draw device for advancing each of said molding means upon arrival of the latter at a predetermined location and further locking means for maintaining said predetermined stress when said reciprocating draw device is being returned to said predetermined location while disengaged from said molding means.

3. An apparatus according to claim 2, including coupling means to which said reinforcing means are connected, the relative positions of said reinforcing means being different on either side of said coupling means, said relative positions representing a compacted position wherein all of said reinforcing means are included in said element and a distant position wherein only part of said reinforcing means are included in said element, whereby the number of reinforcing means passing through each element may be varied.

4. An apparatus according to claim 3, including a winch for each of said reinforcing means to be displaced and coupled thereto, said winch being positioned on that side of said coupling member where said reinforcing means are in said distant position.

5. An apparatus according to claim 1, said supporting means including an endless belt, and said means for advancing said molding means including a plurality of lugs projecting from said endless belt, whereby upon actuation of said belt said molding means are advanced

and said predetermined stress on said reinforcing means is maintained by the coaction of said lugs, said weighted pulley means, and said locking means.

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