

April 9, 1963

W. D. ALLERS ETAL

3,084,910

APPARATUS FOR FORMING PRESTRESSED CONCRETE SHEETS

Filed April 29, 1960

4 Sheets-Sheet 1

Fig. 1

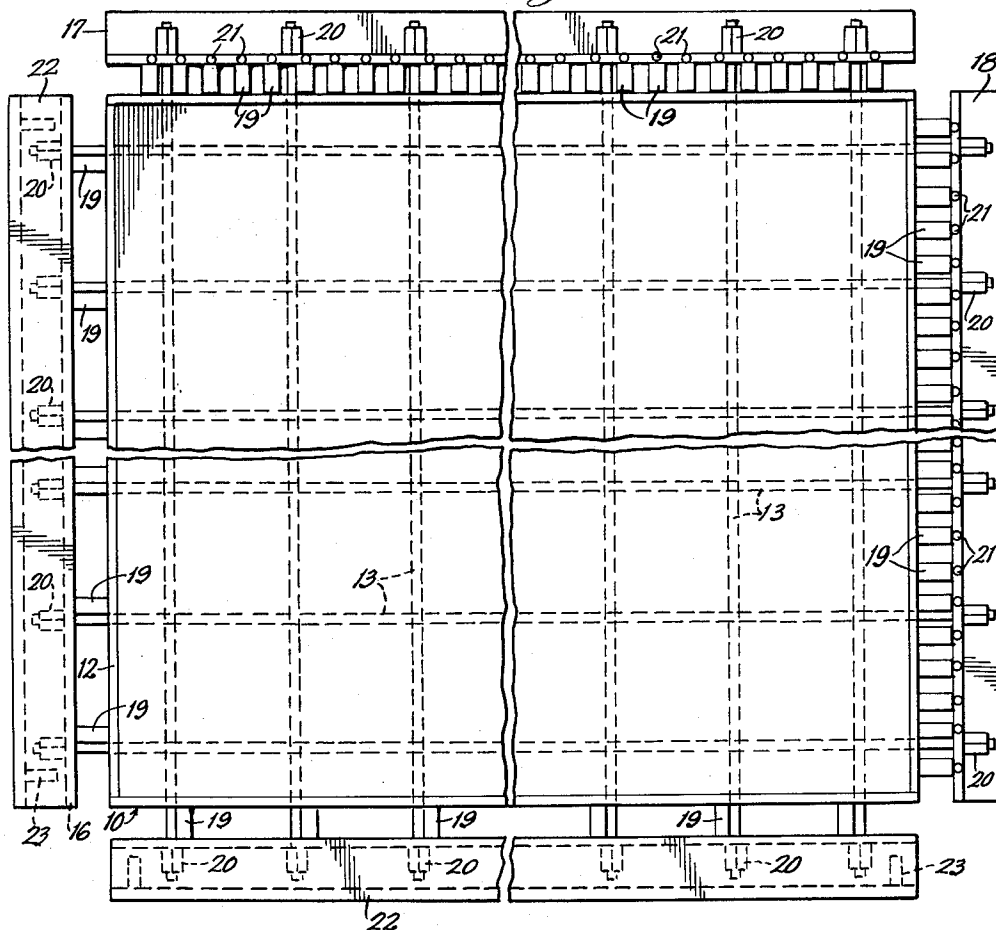
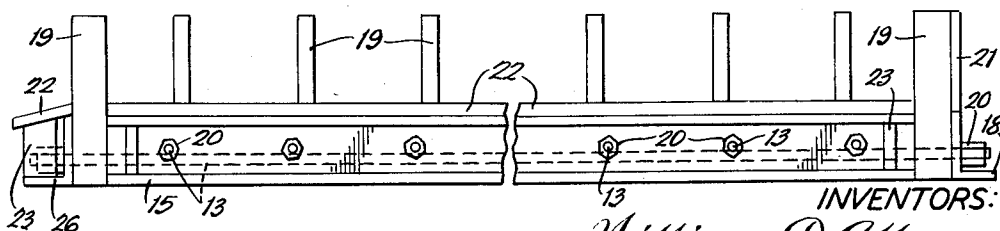


Fig. 2



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Fig. 4

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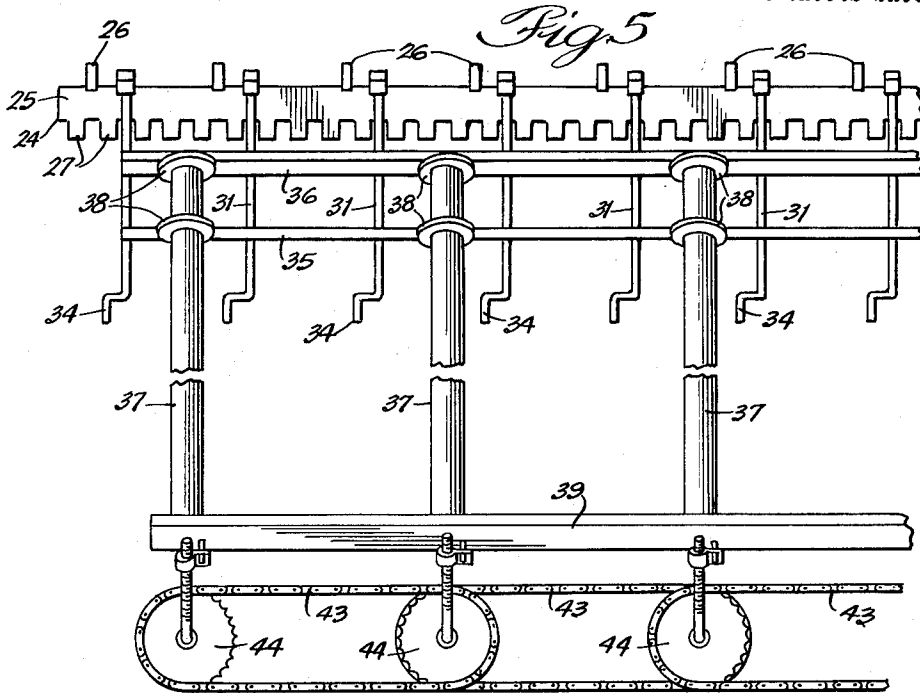


Fig. 6

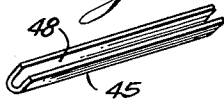


Fig. 7

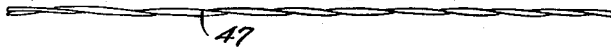


Fig. 8

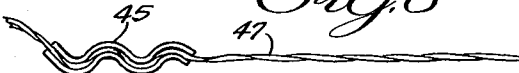
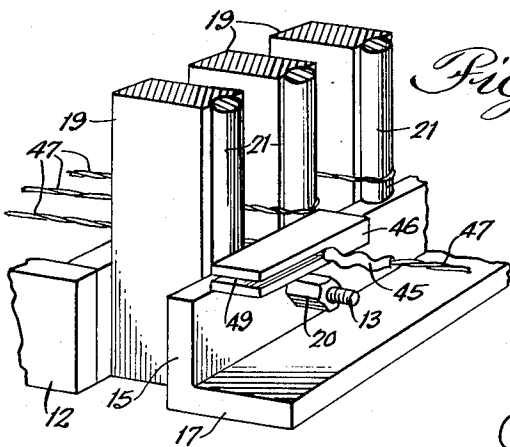
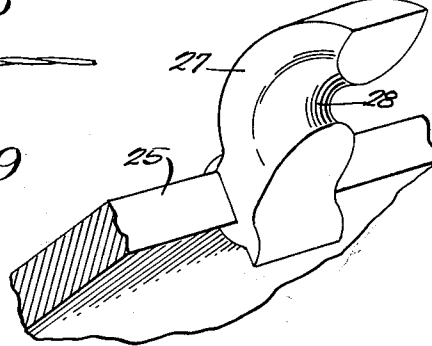


Fig. 10



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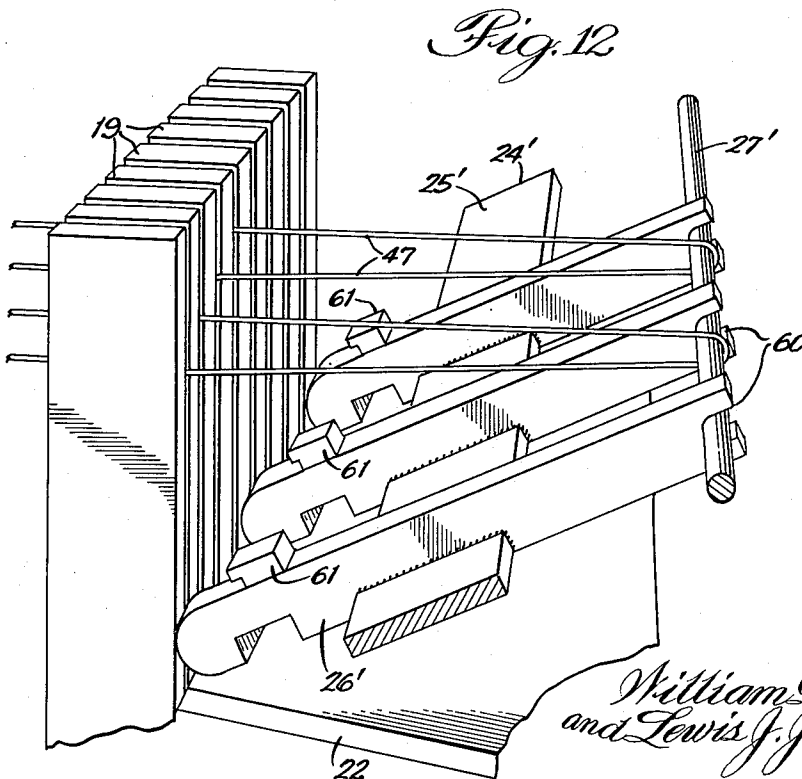
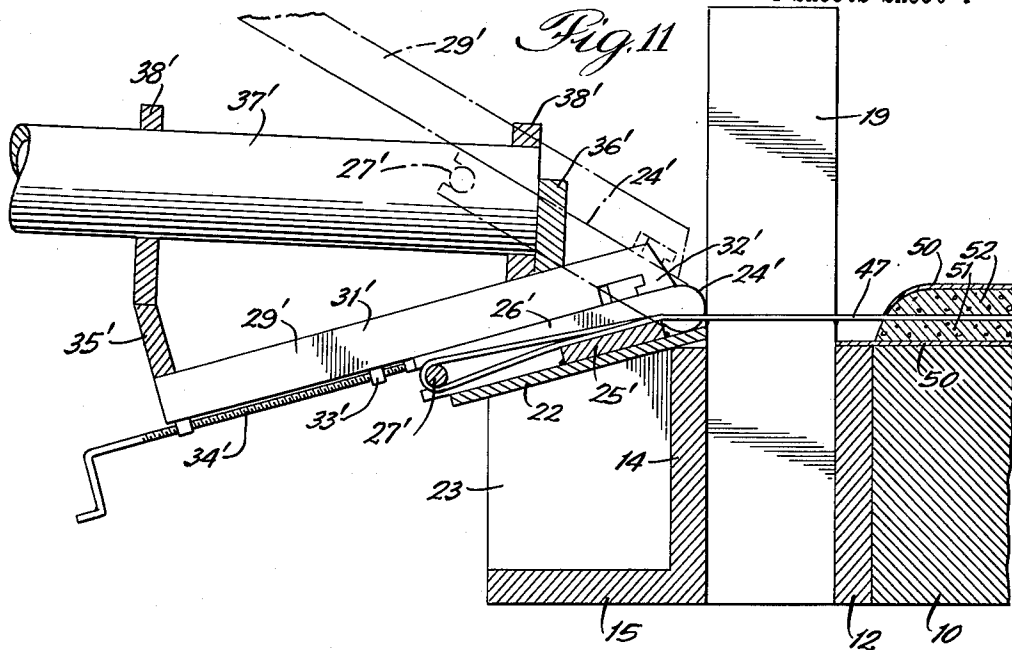
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4 Sheets-Sheet 4



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3,084,910

APPARATUS FOR FORMING PRESTRESSED CONCRETE SHEETS

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Filed Apr. 29, 1960, Ser. No. 25,707
17 Claims. (Cl. 254-77)

This invention relates to an apparatus for forming prestressed concrete sheets. Such sheets are particularly suited for use as non-load bearing partitions, roofs, wall panels, etc. for buildings and other structures although the thickness of such sheets and their combination with other sheets or structural elements may permit their use as load-bearing units if such use is desired.

A principal object of the present invention is to provide an apparatus for forming a prestressed concrete sheet wherein a plurality of highly-tensioned wires or cables extend through the sheet, such wires being spaced apart and lying along a plane extending between the sheet's opposite faces. Another object is to provide an apparatus for simultaneously and uniformly tensioning a plurality of wires or cables in the forming of a prestressed concrete sheet. In this connection, it is a specific object to provide means for gradually stretching a plurality of wire sections to substantially uniform maximum tension, such means being restrained against recoil movement in the event of wire breakage during the tensioning operation.

A further object is to provide an apparatus for successively forming a plurality of prestressed concrete sheets, the sequence of steps for forming any given sheet being undertaken prior to the hardening of the preceding sheet. Another object is to provide an apparatus wherein one sheet of concrete provides the supporting bed for the subsequent formation of another prestressed concrete sheet.

A still further object is to provide an apparatus wherein a single length of wire or cable is supported and stretched to provide a plurality of uniformly tensioned wire sections disposed along a single horizontal plane above a support surface. Yet a further object is to provide simple and highly effective terminal means for anchoring the ends of the length of wire during the tensioning operation.

Other objects will appear from the specification and drawings in which:

FIGURE 1 is a broken top plan view showing a bed used in the forming of prestressed concrete sheets;

FIGURE 2 is a side elevational view of the bed illustrated in FIGURE 1;

FIGURE 3 is an enlarged broken vertical sectional view illustrating the manner in which prestressed concrete sheets may be successively formed;

FIGURE 4 is a broken side elevational view taken partly in section and showing the lever system for tensioning the wire elements;

FIGURE 5 is a broken top plan view of the wire tensioning device with the lever assembly connected thereto;

FIGURE 6 is an enlarged perspective view showing a terminal element prior to deformation;

FIGURE 7 is an enlarged longitudinal view of a two strand cable particularly suitable for use in connection with the present invention;

FIGURE 8 is a longitudinal view illustrating the connection between a cable and a deformed terminal element;

FIGURE 9 is a broken perspective view showing the terminal in the operation of holding a wire or cable in a state of tension;

FIGURE 10 is an enlarged broken perspective view

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illustrating details of a hook element for the wire tensioning device;

FIGURE 11 is a sectional side view illustrating a modified tensor construction;

FIGURE 12 is a broken perspective view of the structure shown in FIGURE 11 but with the lever assembly omitted for clarity of illustration.

In the forming of prestressed concrete sheets wherein the prestressing elements are spaced and tensioned wires or cables extending through the sheet intermediate the opposite faces thereof, it is necessary to provide means for imparting substantially uniform tension to a large number of such wires prior to the setting of the concrete. Furthermore, it may be desirable to extend and tension the wires at different angles along the same plane such as, for example, at right angles to each other along the plane of the sheet. Such wires must not only be of uniform tension but should be maintained at maximum tension until the concrete has hardened. An important aspect of the present invention lies in the means and method for simultaneously and uniformly tensioning a large number of wire sections so that the multiple sections are all maintained at substantially the same optimum tension as the concrete layer in which they are imbedded hardens.

Referring to the drawings, the numeral 10 generally designates a bed having a flat horizontal top surface 11 and incased within a peripheral frame 12. The bed may be formed of concrete and, as shown most clearly in FIGURES 1 and 3, has a plurality of spaced rods 13 extending horizontally therethrough. It will be observed that the rods are arranged in two groups, the rods of the respective groups extending at right angles to each other. Each rod has its opposite ends projecting outwardly through the perimetric frame 12 and through the vertical walls 14 of angle irons 15-18.

Each angle iron extends along one side of the rectangular bed and is spaced from the bed to accommodate upstanding bearing members or posts 19 therebetween. Nuts 20 threaded upon the ends of the rods 13 urge the angle irons toward the bed and tightly clamp the posts 19 between the angle irons and the adjacent portions of frame 12 parallel therewith.

Referring again to FIGURE 1, it will be seen that the posts 19 along two adjacent sides of the rectangular bed are arranged in closely and uniformly spaced series and that behind each of the closely spaced posts is an upstanding bar 21 welded or otherwise secured thereto. The bars provide smooth bearing surfaces for wires or cables strung about the posts, as will be described shortly. However, it is to be understood that substantially the same results may be achieved by eliminating the bars and rounding off the rear surfaces of the posts 19.

Along the remaining two sides of the bed—that is, along those sides of the bed bordered by angle irons 15 and 16—the upstanding posts 19 may be spaced farther apart and are provided with flat rather than rounded outer or rear faces. In addition, angle irons 15 and 16 are covered by downwardly and outwardly inclined support plates 22 which are fixed in position by standards 23, the standards being welded or otherwise secured to the bases of the angle irons and the under surfaces of the support plates. As illustrated in FIGURES 1, 2, 3 and 4, the longitudinally extending front or inner edges of the support plates 22 abut the outer surfaces of posts 19 above the upstanding sides of the angle irons.

Each support plate is adapted to support one or more tensors or wire-tensioning devices 24. As shown most clearly in FIGURES 3-5 and 10, each tensor consists of an elongated bar 25 having substantially the same length as the support plate 22 upon which it rests. Along the front or inner edge of the bar are a plurality of spaced

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shoes 26 having curved front surfaces adapted to bear against the rear or outer surfaces of the posts 19 projecting upwardly above support plate 22. The spacing between the shoes therefore corresponds with the spacing between the posts 19 adjacent either angle iron 15 or angle iron 16.

The rear or outer edge of each bar 25 is provided with loop retaining means comprising a closely spaced series of rearwardly and downwardly facing fingers 27. Each finger has a generally semi-torus shape with the rearwardly and downwardly facing reeve-way defined thereby being smoothly curved to retain a loop of wire while at the same time permitting longitudinal slipping or sliding movement of the wire therethrough. Referring to FIGURE 5, it will be seen that the fingers 27 are spaced closer than shoes 26. Specifically, the fingers are aligned with the spaces between the posts along the opposite side of the bed. Both the fingers and the shoes may be welded to the bar or secured thereto by any other suitable means.

As will be described shortly, each tensor is adapted to stretch a plurality of wires (or a single wire having a plurality of sections) and, for that purpose, is moved between the raised and lowered positions indicated in FIGURE 3. The tensor is pivoted between these positions by a lever assembly 29 connected to a driving assembly 30. Referring to FIGURES 4 and 5, the lever assembly comprises a plurality of arms 31 disposed above and extending along the plane of tensor 24. Each arm extends between a pair of hooks of the tensor and has its front lower surface resting upon the upper surface of bar 25. At its front end, each arm is provided with a hook 32 which extends beneath the front edge of the bar 25 as illustrated in FIGURE 4. A fitting 33 affixed to the under surface of the arm behind bar 25 threadably receives a crank shaft 34 which may be rotated into tight frictional engagement with the rear edge portion of the bar. Thus, the lever assembly may be attached to or detached from a tensor by simply winding or unwinding the cranks 34 to permit attachment or release of hooks 32.

Arms 31 are connected in a parallel series by beams 35 and 36 which, in the illustration given, are welded to the top edges of the several arms. A series of upwardly and rearwardly extending lever tubes 37 are detachably connected to the beams by means of collars 38 secured to the respective beams. The tubes may be withdrawn from the collars when disassembly of the lever structure is desired.

At their upper ends, the tubes 37 are connected by a bar 39 which is in turn hooked upon riders 40 threadably carried by shafts 41 of the driving assembly 30. Preferably, the shafts 41 are disposed behind each of the lever tubes 37 to insure uniform application of force to the tensor 24 although some variation in this arrangement may of course be made depending upon the rigidity of the lever assembly and the resistance of the wires to be stretched. Suitable mountings 42 are provided for the shafts so as to permit pivotal movement of each shaft about its lower end while at the same time restraining longitudinal movement thereof. Rotation of the shafts is synchronized by chains 43 entrained about sprockets 44 carried by each shaft. The last shaft at one end of the series is in turn connected by its chain to a suitable power source such as, for example, an electric motor (not shown).

In this specification the words "wire" and "cable" have been used interchangeably to refer to the tendons which are stretched upon pivotal movement of the tensor into lowered position. Either single or multiple strand wire may be used. Furthermore, the wire may in some instances be formed from a material other than metal such as, for example, nylon, oriented Teflon, glass or fibrous materials. Depending on the requirements for a given installation, tendons of different material or of various gauges and tensions may be used in a single sheet or unit.

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While a large number of single wires might be used to form the prestressing core of a concrete sheet, we prefer to string a single length of wire back and forth between consecutive hooks or fingers of a tensor and the rods 21 and posts disposed along the opposite side of the bed. A single planar core may thus be formed from a single length of wire strung between the fingers and posts.

As indicated above, the bars or rods 21 behind posts 19 do not prevent longitudinal sliding movement of the wire. Neither do the fingers 27 of the tensor with their smooth arcuate reeve-ways 28. The only restraint against longitudinal movement of the wire occurs at the ends of a series of upstanding rods where terminals 45 are tightly affixed to the ends of the wire and, in combination with terminal blocks 46, securely hold those ends in place. As a result, the movement of the tensor 24 downwardly and away from the posts along the opposite side of the bed not only tensions the wire but results in an equalization of the tension of the parallel sections or stretches of that wire.

Terminal 45 is shown in FIGURE 6 as an elongated channel-shaped element adapted to receive a portion of a wire 47 (FIGURE 7). After an end portion of wire 47 is inserted into the channel 48 of the terminal, the terminal is placed within a suitable press which closes the channel and which bends the terminal into the S configuration shown in FIGURE 8. Referring to FIGURE 9, it will be noted that the end portion of the wire passes through a slot 49 in terminal block 46, the wire being held in place by the terminal 45 which engages the block 46, the latter in turn bearing against the bars 21 of posts 19. If desired a sheet 50 of polyethylene or other suitable non-porous material may be placed over the bed to prevent adhesion between that bed and the concrete sheet to be formed thereon. Thereafter, a wire 47 is strung back and forth between the tensor 24 and the closely-spaced posts and rods 21 along the opposite side of the bed.

It is believed apparent that wire 47 is brought under tension as the tensor 24 is gradually pulled downwardly from the raised position of FIGURE 4 into a lowered position upon the downwardly inclined surface of support plate 22. Since the wire is free to slip longitudinally about hooks 27 and rods 21 (except for the end portions of the wire restrained by terminals 45), the tensioning force is equalized between the multiple stretches or sections of the wire. When fully tensioned, the parallel stretches of wire all extend along a horizontal plane spaced a selected distance above the top surface of bed 10.

The size, shape and angle of the tensor not only determines the final distance of the wire above the bed but also determines the final tension of that wire. When the tensor 24 is in its lowered position, wire 47 should be stretched nearly to its breaking point. Since the extent of maximum stretch depends in turn upon the properties of the wire and the length of the bed, it is apparent that for any given tensioning operation a tensor having certain definite finger-to-shoe dimensions must be selected.

When the tensor is in its lowered inclined position, it will be noted (FIGURE 3) that wire 47 extends over the leading edge of tensor bar 25 and then downwardly at an angle toward the loop-retaining means 27. Since the upper front corner of the bar 25 is disposed below the pivot point of the shoe 26 (or below the point of contact between the curved front surface of the shoe and post 19) the tension of the wire 47 locks the tensor in its lowered position. To achieve this self-locking action without appreciably reducing the tension of the wire as the tensor is pivoted below a horizontal position, the platform should have an angle ranging between 10 to 17 degrees, and preferably, an angle between 12 to 15 degrees, from the horizontal.

After the wire 47 has been tensioned and the tensor 24 is in self-locking position, the same operation may be repeated to extend wires or wire sections at right angles

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to and along a plane parallel with the wire sections of the first set. In other words, a substantially identical tensor may be operated by levers and driving means upon the support plate along and adjacent side of the bed. Whether or not such an additional set of wire sections is necessary or desirable depends, of course, upon the intended characteristics of the final prestressed concrete sheet product. It is believed apparent that the strength of a sheet is related to the number of tendons or wires passing therethrough. If desired, multiple planes of tendons may be provided, especially where it is desired that the unit in which such tendons are imbedded have load bearing properties.

Following the wire tensioning operation, a pourable material capable of hardening into a rigid state such as concrete, is poured over the bed and is smoothed to form a layer 51 which conceals the tensioned wires 47. For maximum planar stability of the final product, the thickness of the layer should be approximately double the distance between the tensioned wire 47 and the bed 10 so that the wire sections pass through the layer intermediate the upper and lower surfaces thereof.

If desired, the wires may be only partially tensioned prior to the laying of the concrete and may then be fully tensioned after the concrete has been poured but before it has set. Conventional vibrating devices may be utilized to eliminate gas bubbles and to insure proper surface contact between the wet concrete and the wire sections.

Ordinarily, the wires or tendons will be stretched between tensors and stationary posts disposed on opposite sides of a bed. However, it is to be understood that with a bed of extremely large size it may be desirable to arrange pivotal tensors in facing relation on opposite sides of the bed, thereby increasing the wire tensioning capacity of the apparatus by doubling the distance of tensor movement for any given set of wires. In such a case, the terminals 45 would of course be held in place by the fingers of a tensor rather than by stationary bars.

As indicated in FIGURE 3, a removal of layer 51 after it has hardened is not necessary for the purpose of forming additional prestressed concrete sheets on the same bed. Instead, a second sheet may be formed by utilizing the first sheet as the supporting surface. After the first layer has hardened (but even before it is fully cured) a second protective sheet 50 of polyethylene or other material may be placed over the top surface of the first layer and a second set of wires or wire sections may be tensioned thereabove. The second tensor 24 is operated in a manner identical with the first and, when it is in lowered position, rests directly thereupon. After the second layer 52 has set, additional layers may be similarly formed thereon to produce a stack of prestressed concrete sheets.

Finally, when the concrete has hardened, wires 47 are cut along the edges of each sheet and the sheets may then be separated. The sheets may either be cut to size, as indicated by the broken line 53 shown in FIGURE 3, or a suitable frame (not shown) having slots permitting the tensioning wires to pass therethrough may be fixed upon the bed to control the planar dimensions of the sheets as they are being formed.

Since wire breakage during a tensioning operation is always a possibility, an important aspect of the present invention lies in the self-locking of a tensor when it is fully lowered and in providing means for preventing any sudden movement of the tensor and lever assembly should such breakage occur during downward pivoting of a tensor. Since the riders 40 permit only gradual movement of the rear portion of the lever assembly 29 along the longitudinal axis of the threaded shafts 41, and since the lever structure is securely clamped to the tensor, sudden upward or downward movement of the heavy lever assembly along the shafts 41 or sudden release of the lever structure, driving means and tensor are impossible.

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The embodiment illustrated in FIGURES 11 and 12 is substantially identical to the structure already described except for the construction of tensor 24' and lever assembly 29'. In the modified structure shoes 26' are elongated and are provided with notches or recesses 60 at their rear ends. The multiple shoes are rigidly secured in spaced parallel relation to elongated bar 25' and the rounded front ends of the shoes rest upon support plate 22 and bear against the rear or outer surfaces of upstanding posts 19. Along their upper surfaces and adjacent the front ends thereof, shoes 26' are equipped with forwardly facing hooks 61.

The loop-retaining means comprises a cylindrical bar 27' which is parallel with connecting bar 25' and which is loosely and rotatably received within recesses 60 at the rear ends of the shoes. As shown most clearly in FIGURE 12, the filaments or wires 47 loop around bar 27' between the spaced shoes and pass forwardly through the spaces between posts 19.

Referring to FIGURE 11, it will be seen that the lever assembly 29' comprises a plurality of arms 31' disposed above and extending along the plane of tensor 24'. The hook 32' at the forward end of each arm engages the forwardly facing hook 61 of a shoe 26' and a crank shaft 34', threadedly carried by fittings 33', securely clamps each arm in hooked position upon the shoe therebeneath.

The series of arms 31' is connected by beams 35' and 36' and lever tubes 37' are detachably connected to the beams by means of collars 38'.

As lever tubes 37' are pulled downwardly in the manner already described in connection with the preceding embodiment, lever assembly 29' and tensor 24' pivot downwardly from the raised position illustrated by broken lines in FIGURE 11 into the fully lowered position represented by solid lines. With the under surfaces of shoes 26' resting upon support plate 22, the tensor is forcefully locked in lowered position by the fully tensioned wires 47. Later, when the concrete layers 51 and 52 have hardened, the portions of the wire or wires projecting outwardly beyond the periphery of the concrete sheet are cut with a torch or any other suitable means to release tensor 24'.

An advantage of the construction illustrated in FIGURE 11 and 12 lies in the fact that the stretches of wire passing over bed 10 may be spaced extremely close to each other, the only limitation being the width of the upstanding posts 19. In other words, since the wire loops extend vertically about horizontal bar 27', the tensor itself imposes no limitation on the closeness of spacing of the wire stretches.

As mentioned above, bar 27' is rotatably received within the recesses 60 of the tensor shoes. Thus, as the tensor is forced downwardly to tension the stretches of wire, rod or bar 27' will tend to rotate within the recesses and thereby maintain uniform tension on the stretches of wire extending above and below it. If desired, the slotted rear ends of the shoes may be equipped with suitable anti-friction bearings to reduce resistance to rod rotation. In addition, the bar or rod 27' may be provided with a suitable lever or key so that as the tensor is urged downwardly the bar may be manually or mechanically rotated to maintain uniform tension in the stretches of wire.

In both forms of the invention illustrated in the drawings the tension of the wire elements or tendons increases as the tensor is lowered, reaching a maximum tension when the tensor is substantially horizontal. Thereafter, as the tensor pivots below a horizontal position, the tension is relieved to a slight but definite extent and this "stress relieving" of the wire is believed to contribute significantly in reducing the brittleness and improving the handling characteristics of the wire.

While in the foregoing we have disclosed two embodiments of the invention in considerable detail for purposes of illustration, it will be understood by those skilled in

the art that many of these details may be varied without departing from the spirit and scope of the invention.

We claim:

1. In a wire tensioning apparatus for the forming of prestressed concrete sheets, a tensor arm pivotally mounted for movement in a vertical plane about one end thereof between a first position wherein the other end of said arm is disposed substantially above said one end and a second position wherein said other end is disposed a predetermined distance below and behind said one end, upstanding stationary abutment means engaged by said one end of said arm for preventing displacement of the pivot axis of said arm, said other end of said tensor arm being provided with means for retaining loops of wire while at the same time permitting limited movement of the wire of said loops along the wire's longitudinal axis, and a driving mechanism operatively associated with said tensor arm for gradually pivoting the same between said first and second positions and for preventing sudden movement of said other end of said tensor arm in response to abrupt changes in the forces acting thereon.

2. The structure of claim 1 in which said tensor comprises a horizontally elongated bar, said retaining means comprising at least one rearwardly and downwardly facing finger fixed to said bar.

3. The structure of claim 2 in which said finger is semi-torus in shape and defines a smooth reeve-way for retaining a wire loop while at the same time permitting longitudinal sliding movement of the wire therethrough.

4. The structure of claim 1 in which said tensor comprises a horizontal rod about which said wire is looped, and means supporting said rod for rotation as said tensor is moved between said first and second positions.

5. In a wire tensioning apparatus for the forming of prestressed concrete sheets, a tensor comprising a horizontally elongated member having front and rear longitudinal edges, stationary support means for supporting said member along said front longitudinal edge, said member being pivotally mounted upon said support means for pivotal movement about a line extending along the front edge thereof between a raised position wherein said rear edge is disposed behind and a substantial distance above the pivot point and a lowered position wherein said rear edge is disposed a greater distance behind and slightly below said pivot point, means provided along said rear longitudinal edge for retaining a plurality of forwardly-extending wires looped thereabout, and means operatively associated with said member for gradually pivoting the same between raised and lowered positions, said stationary support means comprising a plurality of upstanding posts spaced apart to accommodate stretches of wire extending horizontally from said rear edge and passing below said pivot point when said member is in its lowered position.

6. The structure of claim 5 in which said last-mentioned means includes an upstanding power-driven shaft, said shaft being threaded and being fixed at its lower end against longitudinal movement, a rider having an opening threadedly receiving said shaft, and lever means connecting said rider to said member.

7. The structure of claim 6 in which said support means includes a rearwardly and downwardly inclined support plate directly behind said posts, said member being provided with means along the front longitudinal edge thereof for slidably engaging the upper surface of said plate and the rear surfaces of said posts for pivotal movement of said bar between raised and lowered positions.

8. The structure of claim 7 in which said means engaging said plate and posts comprises a plurality of spaced shoes extending forwardly from the opposite edge of said member and having arcuate front surfaces slidably engaging said plate and said upstanding posts.

9. In an apparatus for the forming of prestressed con-

crete sheets, a horizontal bed adapted to support a sheet of concrete, a plurality of spaced upstanding members disposed along one side of said bed, tensor support means extending along the opposite side of said bed, a tensor comprising a horizontally elongated bar having a rear longitudinal edge and having a front longitudinal edge provided with support elements for pivotally supporting said tensor upon said support means, said tensor being pivotally supported for movement between a raised position wherein said rear edge is disposed above the pivot line of said bar and a lowered position wherein said rear edge is disposed below said pivot line and at an increased distance from said upstanding members, means provided along the rear edge of said bar for retaining a plurality of forwardly- and horizontally-extending wires looped thereabout and about said upstanding members, and means for pivoting said tensor between said raised and lowered positions, whereby, said tensor is operative upon movement into lowered position to tension wires extending between said upstanding members and said retaining means and to lock in such position under the force of the tensioned wires.

10. The structure of claim 9 in which said means for pivoting said tensor between raised and lowered positions includes an upstanding and rotatable shaft adapted to be power driven, said shaft being threaded and being fixed at its lower end against longitudinal movement, a rider having an opening threadedly receiving said shaft, and lever means connecting said rider to said bar.

11. The structure of claim 9 in which said retaining means comprise hooks of semi-torus shape provided with smooth arcuate reeve-ways for retaining loops of wire while at the same time permitting longitudinal sliding movement of said wire therethrough.

12. In a wire tensioning apparatus for the forming of prestressed concrete sheets, a tensor comprising a horizontally elongated member equipped with a plurality of spaced transversely extending shoes, stationary supporting means supporting said shoe-equipped member for pivotal movement about a line parallel with and spaced from the longitudinal axis thereof, a rod rotatably supported by said shoes and extending along a line parallel with said member and spaced from the pivot line thereof, said member being pivotally supported by said shoes for movement between a raised position wherein said rod is disposed behind and a substantial distance above said pivot line and a lowered position wherein said rod is disposed a greater distance behind and slightly below said pivot line, said stationary support means preventing forward movement of said member as the same is pivoted between its raised and lowered positions, and means operatively associated with said shoe-equipped member for gradually pivoting the same between raised and lowered positions, whereby, when horizontal stretches of wire extending forwardly along planes parallel with the direction of movement of said tensor are looped about said rod, downward movement of said tensor simultaneously tensions said wire and locks said tensor in its lowered position.

13. In an apparatus for the forming of prestressed concrete sheets, a horizontal bed, a plurality of spaced upstanding members along one side of said bed, tensor support means along the opposite side of said bed, a tensor comprising a horizontally elongated bar having a series of spaced hooks along one longitudinal edge thereof, said hooks facing away from said upstanding members along the said one side of said bed, said tensor also being provided along the opposite longitudinal edge thereof with shoes pivotally engaging said support means for pivotal movement of said tensor along a horizontal pivot line, said tensor being pivotally supported for movement between a raised position wherein said hooks are disposed above said pivot line and a lowered position wherein said hooks are disposed below said pivot line and at an increased distance from the upstanding mem-

bers along said one side of said bed, a wire extending back and forth successively between and being looped about opposing hooks and upstanding members across said bed, means for pivoting said tensor between said raised and lowered positions, and means for anchoring the ends of said wire to certain of said upstanding members.

14. The structure of claim 13 in which the wire-contacting surfaces of said hooks and said upstanding members are smooth and curved to permit longitudinal sliding movement of the portions of said wire looped thereabout.

15. In a wire tensioning apparatus for the forming of prestressed concrete sheets, a horizontal bed adapted to support a sheet of concrete, a plurality of spaced upstanding members disposed along one side of said bed, tensor support means extending along the opposite side of said bed, a tensor comprising a horizontally elongated member equipped with a plurality of spaced transversely extending shoes resting upon said support means, said shoe-equipped member being pivotally supported upon said support means for pivotal movement about a line parallel with and spaced from the longitudinal axis thereof, a rod rotatably supported by said shoes and extending along a line parallel with said member and spaced from the pivot line thereof, said member being pivotally supported by said shoes for movement between a raised position wherein said rod is disposed behind and a substantial distance above said pivot line and a lowered position wherein said rod is disposed a greater distance behind and slightly below said pivot line, means operatively associated with said shoe-equipped member for gradually pivoting the same between raised and lowered positions, and at least one wire extending back and forth over said bed and being looped about said rod and said upstanding members for the tensioning of said wire as said tensor is pivoted from its raised to its lowered position, said horizontally elongated member also being engageable with the stretches of wire between said rod and said upstanding members to urge said stretches into coplanar relation as said member is moved into its lowered position.

16. In a wire tensioning apparatus for the forming of prestressed concrete sheets, a horizontal bed adapted to support a stack of concrete sheets, a plurality of spaced upstanding posts disposed along one side of said bed, a plurality of spaced upstanding members along the opposite side of said bed, a tensor comprising a horizontally elongated bar equipped with a plurality of spaced transversely-extending shoes bearing against said upstanding members, said tensor being mounted for pivotal movement about a line parallel with and spaced from the longitudinal axis of said bar, a rod rotatably supported by said shoes and extending along a line parallel with said bar and spaced from the pivot line thereof, said tensor being pivotally supported by said shoes for movement between a raised position wherein said rod is disposed behind and a substantial distance above said pivot line and a lowered position wherein said rod is disposed a greater distance behind and slightly below said pivot

line, means operatively associated with said tensor for gradually pivoting the same between raised and lowered positions, and at least one wire extending back and forth over said bed and being looped about said rod and said upstanding posts for the tensioning of said wire as said tensor is pivoted from its raised to its lowered position, said bar also being engageable with the stretches of wire between said rod and said posts for urging said stretches into coplanar relation as said tensor is moved into its lowered position, whereby, tensors may be stacked upon each other to form vertically-spaced and horizontally extending planes of wires, the wires of each of said planes being positioned and arranged to pass through one of the concrete sheets of said stack.

17. In a wire tensioning apparatus for the forming of prestressed concrete sheets, a horizontal bed adapted to support a stack of concrete sheets thereon, a plurality of spaced upstanding posts disposed along one side of said bed, a plurality of spaced upstanding members disposed along the opposite side of said bed, a tensor comprising a horizontally elongated bar equipped with a plurality of spaced transversely-extending shoes bearing against said upstanding members, said tensor being pivotally mounted for pivotal movement about a line parallel with and spaced from the longitudinal axis of said bar, said tensor being provided with means spaced from said shoes for retaining the loops of at least one wire stretched back and forth between said means and said posts, said tensor being pivotally supported for movement between a raised position wherein said means is disposed behind and a substantial distance above said pivot line and a lowered position wherein said means is disposed a greater distance behind and slightly below said pivot line, a lowering mechanism operatively associated with said tensor for gradually pivoting the same between raised and lowered positions, said bar being engageable with the stretches of wire between said tensor and said posts for urging said stretches into coplanar relation as said tensor is moved into its lowered position, said tensor when the same is lowered having vertical dimensions substantially less than the height of said upstanding posts and members, whereby, tensors may be stacked upon each other against said upstanding members to form vertically-spaced planes of wires, the wires of each of said planes being positioned and arranged to pass through one of the concrete sheets of a stack.

References Cited in the file of this patent

UNITED STATES PATENTS

1,075,065	Pryor	Oct. 7, 1913
1,920,716	Schafer	Aug. 1, 1933
2,408,149	Miller et al.	Sept. 24, 1946
2,897,668	Graham	Aug. 4, 1959
2,961,215	Schroeder	Nov. 22, 1960

FOREIGN PATENTS

53,548	Germany	Oct. 2, 1890
393,576	Great Britain	May 26, 1931
887,115	France	July 26, 1943
921,138	Germany	Dec. 9, 1954