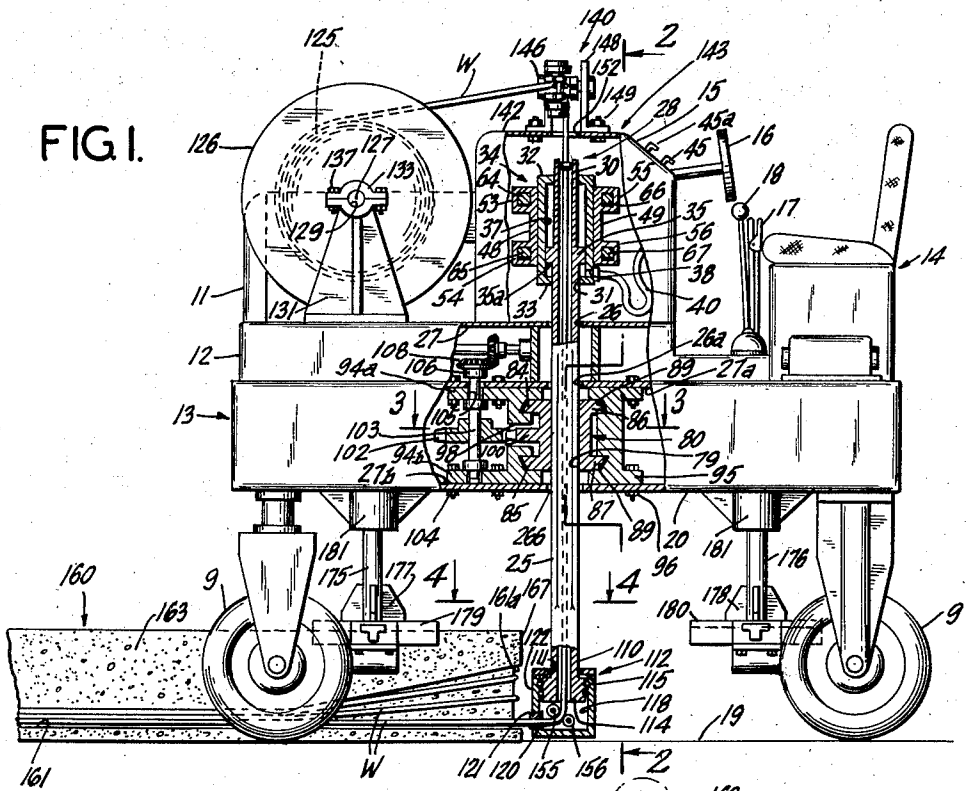
Sept. 23, 1958 T. R. CROM 2,853,250

APPARATUS FOR IMPARTING STRESSES TO STRUCTURAL MEMBERS

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FIG. 1.



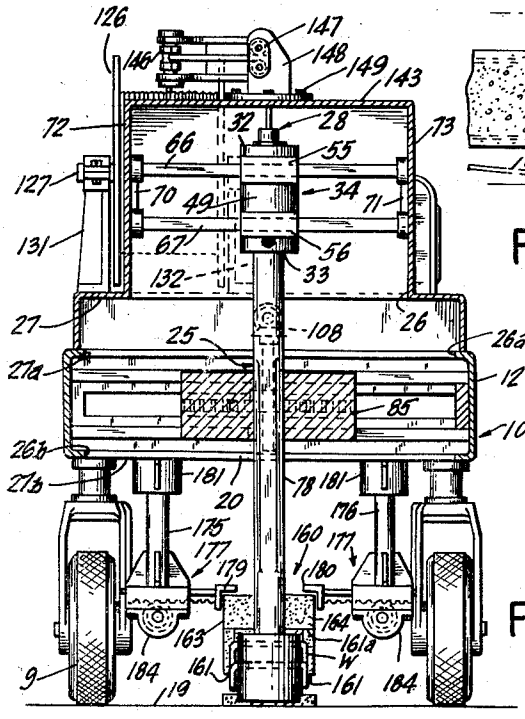


FIG. 2.

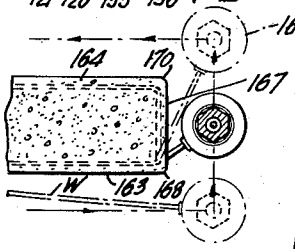
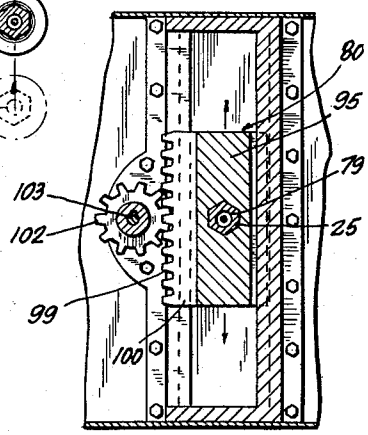


FIG. 4.

FIG. 3.



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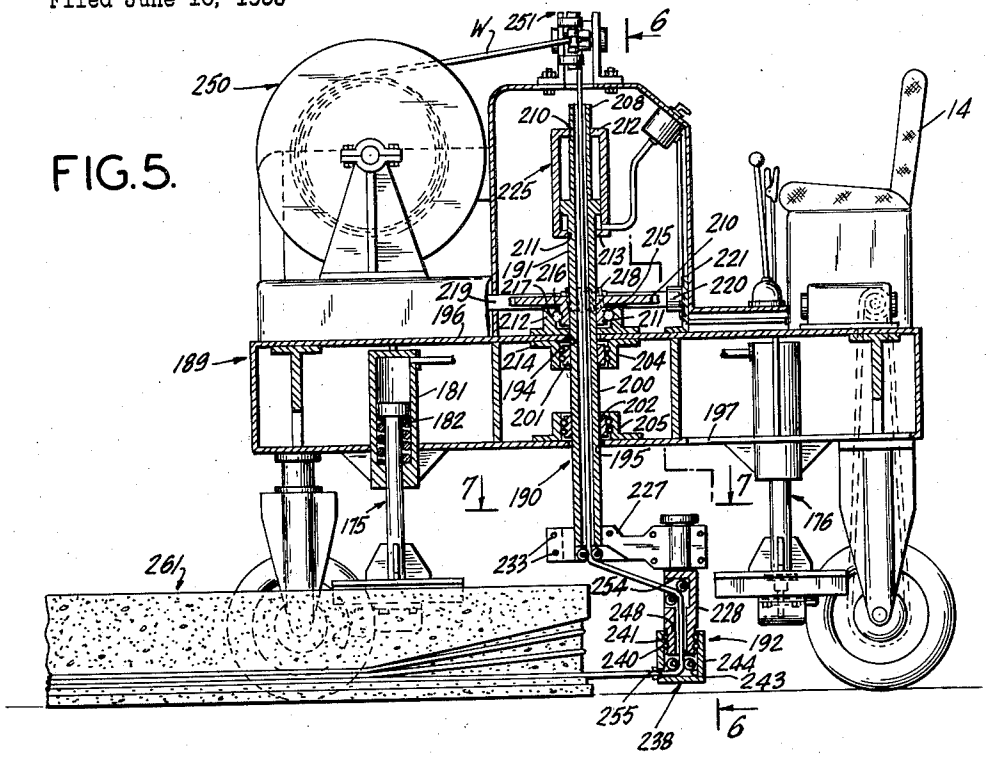
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APPARATUS FOR IMPARTING STRESSES TO STRUCTURAL MEMBERS

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FIG.5.



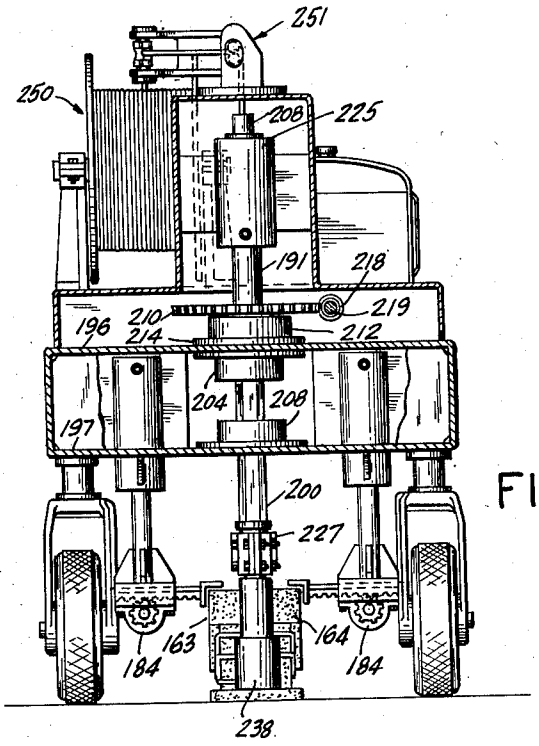
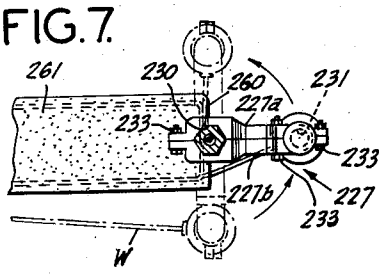


FIG.6.

FIG.7.



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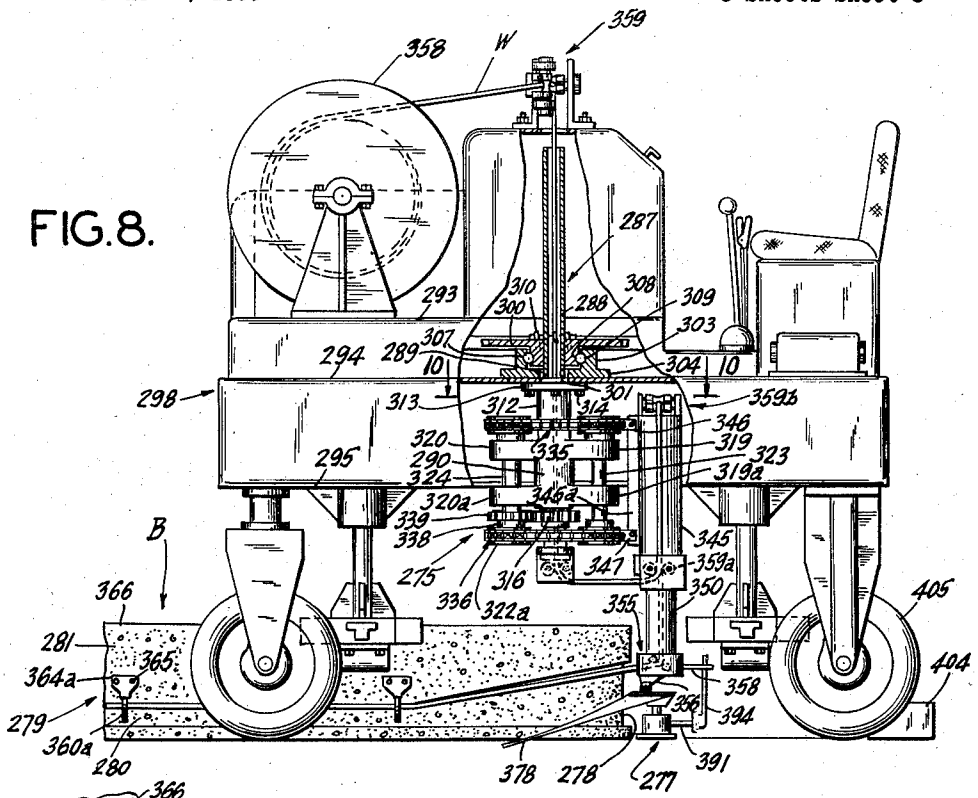
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APPARATUS FOR IMPARTING STRESSES TO STRUCTURAL MEMBERS

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FIG.8.



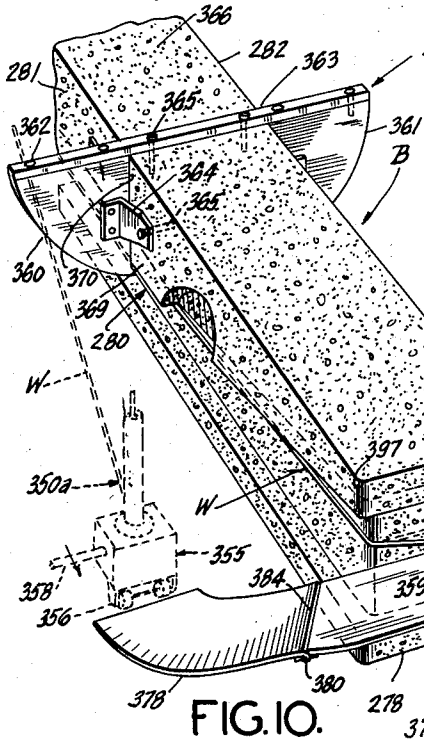


FIG.10.

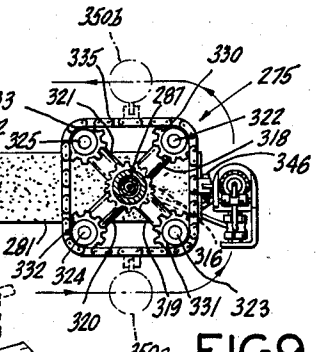


FIG.9.

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APPARATUS FOR IMPARTING STRESSES TO STRUCTURAL MEMBERS

Theodore R. Crom, Gainesville, Fla., assignor to John Maurice Crom, McAllen, Tex.

Application June 16, 1953, Serial No. 361,984

9 Claims. (Cl. 242—1)

This invention relates to a method and apparatus for imparting a stress to structural members, and more particularly it relates to a method and apparatus for prestressing beams, slabs or the like, by winding wire under tension thereon.

A method of prestressing structural members has been described in my copending application Serial No. 335,233, filed February 5, 1953, in which a structural member and a tensioned wire are wound relative to each other, and deflectors are utilized to position the wire in a desired pattern on the member. In the preferred embodiment described in the copending application the structural member is rotated. This method has been found highly practical for many prestressing purposes, particularly for reinforcing slabs and beams. However, its application is limited somewhat by the fact that it is frequently difficult or even impossible to rotate a relatively large beam or slab, and of course this would be impossible where the member is already set in a fixed position in a building structure.

In accordance with the method of the present invention, the structural member to be stressed is in a fixed position. It may be held in this position due solely to its weight, or it may be fastened by bolts or other fastening means. The wire is moved relative to the fixed structural member. More particularly, the wire under tension is wound around the structural member and during the winding the wire is deflected so as to position it at different locations on different parts of the structural member to impart the desired stress pattern.

In accordance with the apparatus of the invention, a traction vehicle is provided which is movable relative to the structural member with means mounted on the vehicle to position the wire in the manner described as the vehicle moves relative to the structural member. The vehicle may have different forms, as described hereinunder, and the means for positioning the wire relative to the structural member may have different embodiments, as will be described.

For a more complete understanding of the present invention, reference may be had to the accompanying drawings forming a part of the specification wherein:

Figure 1 is a side elevation of one form of the invention which is partly broken away to show the inner details thereof;

Figure 2 is a view in section taken through line 2—2 of Figure 1;

Figure 3 is a partial view in section taken along line 3—3 of Figure 1 showing the wire guide control mechanism;

Figure 4 is a partial view in section taken along line 4—4 of Figure 1 showing the end of a beam and the wire guide mechanism;

Figure 5 is a side elevation partly in section showing another form of this invention;

Figure 6 is a view in section taken along line 6—6 of Figure 5;

Figure 7 is a partial view in section taken along line 7—7 of Figure 5;

Figure 8 is a side elevation of another form of this invention which is partly broken away to show the inner details thereof;

Figure 9 is a partial view in section taken along line 10—10 of Figure 8; and

Figure 10 is a perspective view showing details of the deflectors and post guiding mechanism mounted on and adjacent to a beam.

Referring first to Figures 1 and 2, a four wheel vehicle 10 is driven by a motor located within a motor housing 11 positioned on the upper forward portion of a vehicle frame or chassis 12. A seat 14 for the vehicle operator is mounted on the upper rearward portion of the chassis 12, adjacent to a control panel 15. A steering wheel 16, a hand brake 17 and a gear shift lever 18 are provided to control the vehicle along with the conventional foot clutch and brake.

The mechanical arrangement for steering and controlling the vehicle as well as the mechanical means for driving it, are of conventional design and do not form a part of this invention. The vehicle may be driven forward or backward by one or more chains extending to the wheels 9. However, it will be noted that an important feature of this vehicle design is its relatively high clearance between the ground 19 and the underside 20 of the chassis 12, so that the vehicle may be driven over a beam 160 as will be described later.

A hollow wire guide post 25 of hexagonal cross section extends vertically through laterally extending slots 26, 26*a* and 26*b* formed near the center in each of three horizontal frame members 27, 27*a* and 27*b* of the vehicle frame 12. The upper end 28 of the post 25 is slidably mounted through openings 30 and 31 in both ends 32 and 33 of an hydraulic cylinder 34. A piston or plunger 35 is formed concentrically about the post 25 within the cylinder 34, and is movable in sliding engagement with the inner wall 37 thereof.

An opening 38 extending through the side of the hydraulic cylinder 34 communicates with that portion of its hollow interior disposed between the lower surface 35*a* of the piston 35 and the adjacent end 33 of the cylinder. The opening 38 is connected with an hydraulic pressure source by a flexible hydraulic pressure line 40. The hydraulic pressure source may be of any type well known in the art.

The flow of the hydraulic pressure through line 40 and the venting of the pressure accumulated in the cylinder 34 (also through line 40) is controlled by a valve or other suitable means apparent to one familiar with the art, which in turn is operated by a valve switch 45 mounted on the instrument panel 15. Thus, when the switch 45 is set in one position, hydraulic fluid is admitted to the hydraulic cylinder 34 and the piston 35 and post 25 are raised. When the switch 45 is set in another position, the pressure accumulated in the cylinder 34 is vented, and by the force of gravity the piston 35 and post 25 are lowered. If desired, hydraulic fluid may be applied to the top of the piston to lower it.

The hydraulic cylinder 34 is mounted between and secured to a pair of supporting members 48 and 49. Each of the members 48 and 49 has a pair of horizontally disposed, outwardly extending shoulders 53, 54 and 55, 56. Each of these shoulders has an opening which is adapted to slidably receive two pairs of horizontal bars 64, 65 and 66, 67. With particular reference to Figure 2, it will be seen that the bars 64, 65 and 66, 67 are supported at their respective opposite ends by brackets 70 and 71 secured to two opposite vertical frame members 72 and 73. It will therefore be appreciated that the cylin-

der 34 and post 25 are free to move laterally back and forth on the bars 64, 65 and 66, 67 in respect to the chassis 12.

The center portion of the post 25, which is of hexagonal cross-section, extends through a correspondingly shaped opening 79 in a rack member 80 which has two pairs of horizontal and outwardly extending upper and lower shoulders 84, 85 and 86, 87 which are received within corresponding grooves 89 formed in the adjacent sides of horizontally disposed carriage members 94*a*, 94*b* and 95. The said carriage members are disposed between the middle and lower horizontal frame members 27*a* and 27*b*, and are secured to the frame members 27*a* and 27*b* by suitable means such as bolts and nuts 96. The carriage members 94*a* and 94*b* are separated by an opening or gap generally indicated at 98.

The rack member 80 is provided with a row of teeth 99 formed on the outer edge of a horizontally extending shoulder 100 between the adjacent supporting shoulders 84 and 85. The shoulder 100 extends through opening 98 between the carriage members 94*a* and 94*b*. A pinion 102 keyed to a vertical shaft 103 meshes with the rack teeth 99. The shaft 103 is journalled at its lower end through an opening 104 in the lower carriage member 94*b*. The upper portion of the shaft 103 extends through openings 105 and 106 formed in the upper carriage member 94*a* and the middle horizontal frame member 27*a*.

The shaft 103 is driven by a set of meshing beveled gears 108, which in turn are connected with suitable reversible clutching means and with the motor of the vehicle 10. The reversible clutching means does not form a part of this invention and any one of many suitable mechanical arrangements apparent to one skilled in the art may be used. In addition, it is to be understood that an independent hydraulic system, similar to that disclosed for raising and lowering the guide post 25, may be used to move the post 25 from side to side.

A suitable control 45*a* for operating the above-mentioned clutching means and thereby engaging and driving the rack pinion 102 may be mounted on the control panel 15. Thus, when the clutching means is engaged and the rack pinion 102 is driven, the rack member 80 (and post 25) is moved to one side of the chassis 12 or the other, between the carriage members 94*a* and 94*b* and 95. At the same time, the hydraulic chamber 34 is shifted along the bars 64, 65, 66 and 67. Also in this connection, it will be appreciated that the post 25 may be raised or lowered while it is being shifted laterally in respect to the chassis 12.

The lower end 110 of the guide post 25 is received through an opening 111 in a die box 112. Formed integral with the extreme end of the post 25 is a circular shoulder 114. Bearings 115 are disposed between the circumferential side of the shoulder 114 and the inner vertical wall 118 of the die box 112, and thus the latter is free to rotate with respect to the post 25. A wire drawing die 120 is mounted within an opening 121 which extends through the side 122 of the die box 112. A pair of guiding rollers 155 and 156 is mounted within the die box 112 to guide the wire as it leaves the end of the post 25 and passes through the die 120. A predetermined tension is required to draw the wire through the die, and the wire is reduced in diameter depending upon the size of the die opening. It will be understood, of course, that other tensioning devices well known to one skilled in the art may be used in place of the die, as for example, a braking apparatus wherein several turns of wire are wound about a capstan member which is braked to turn only when the wire is subjected to a given tension.

A coil of wire 125 is carried upon the upper side of the vehicle 10 by means of a large wire reel 126. The reel 126 is rotatably supported upon a horizontal shaft 127, the ends of which extend through openings formed by arcuate surfaces 129 in the upper ends of two vertically disposed stanchions 131 and 132, and arcuate split-bearing members 133. The split-bearing members 133 are secured to the upper ends of the stanchions 131 and 132 by bolts 137. The lower ends of the stanchions 131 and 132 are secured to the upper horizontal frame member 27, adjacent to the motor housing 11. The wire (W), as this word is used herein, is carried by the reel 126 and may be formed of iron or steel of any composition, nylon or other plastic or fibrous glass and the like, the latter materials having been found highly satisfactory for many prestressing purposes because of their relatively low cost and non-corrosive properties.

When the apparatus is used for applying wire to a beam, as will be described hereinafter, the wire W is removed from the reel 126 and passes through a wire guiding mechanism 140 mounted on top of the control housing 143. The wire guiding mechanism 140 includes two adjacent pairs of vertically and horizontally disposed rollers 146 and 147 which are rotatably supported by a frame member 148 (see Fig. 2). The frame 148 is secured to the housing 143 by bolts 149. It is to be understood, of course, that other wire guiding means may be used.

The wire W extends from the wire guiding mechanism 140 downwardly through a slot 152 in the control housing 143, and then passes through the hollow center portion of the guide post 25, around the rollers 155 and 156 and then through the die 121.

The apparatus may be used for winding wire on structural members of any dimension and shape, such as beams and slabs, which may be of any material, such as iron, wood, concrete, cement blocks or other material. As will be seen in Figures 1 and 2, a beam 160 is positioned in a fixed position upon the ground or other support such as in a building structure. If the beam is large its weight will hold it in fixed position. If it is small it may be secured by any fastening means.

The beam 160, which is shown as illustrative, has a horizontally extending groove 161 formed about its vertically disposed sides 163, 164 and its ends 167, one of which is shown. Near the ends 167 of the beam 160 the width of the groove 161 is gradually increased (as indicated at 161*a*) so that at the extreme ends 167 of the beam 160 the width of the groove 161 is the greatest. Of course this groove construction may be modified depending upon the prestressing effect desired. This aspect of the invention is described in detail in my copending application 335,233, filed February 5, 1953.

The free end of the wire W is first secured to the beam or to the ground, and then the vehicle 10 is driven back and forth along the entire length of the beam, with the wheels of the vehicle straddling the beam. As the vehicle is moved, the wire W is drawn from the die box 112 and deposited within the groove 161, as the guide post approaches an end 167 of the beam 160 (as shown in Figures 1 and 4) the operator raises the guide post 25 by operating the hydraulic cylinder 34, so that the wire is raised to the desired position within the groove about the ends of the beam. When the vehicle reaches the end of the beam the operator engages the previously described clutching mechanism and thereby shifts the rack member 80 and the post 25 across the end of the beam and in so doing the tensioned wire W strikes a corner 168 of the beam, causing the die box 112 to rotate counter-clockwise approximately 90 degrees.

When the post 25 is shifted to the opposite side of the beam (as shown in dotted lines at 169 in Figure 4), the operator then drives the vehicle towards the opposite end of the beam. When the tensioned wire W strikes the opposite corner 170 of the beam, the die box 112 is again rotated counter-clockwise an additional 90 degrees. At the same time or shortly thereafter the operator lowers the post by means of the piston 134 so that the die box 112 is once again placed on the same level as the groove 161.

On succeeding loops of the wire the post 25 may be

raised a progressively lesser distance so that the subsequent loops of wire will be disposed adjacent to and just beneath each preceding loop of wire.

With reference to Figure 4, it will be seen that as the tensioned wire W is wound about the end **167** of the beam **160**, the side **163** and corner **168** thereof are subjected to a considerable force which may tend to tip the beam over on its side. To prevent this from happening, and to hold the beam **160** firmly in position in relation to the wire winding mechanism, the vehicle is equipped with two pairs of hydraulically operated beam supporting members **175** and **176** which extend downwardly from the underside of the chassis **12**. Each of the beam supporting members **175** and **176** has adjustable, inwardly extending, horizontal members generally indicated at **177** and **178**, which in turn have inverted L-shaped abutment members **179** and **180** (see Fig. 2) formed on the ends thereof.

As can best be seen in Figure 5, the supporting members **175** and **176** are shifted downwardly to the level of the beam by hydraulic mechanisms generally indicated at **181** when the vehicle reaches the end of the beam. When the hydraulic pressure therein is released, the supporting members **175** and **176** are shifted upwardly away from the beam by means of a coil spring **182** disposed within the hydraulic mechanisms **181**. The horizontal members **177** and **178** may be moved towards the sides **163** and **164** of the beam **160** by a rack and pinion arrangement diagrammatically illustrated at **184** in Figures 2 and 6. The rack and pinion mechanisms **184** may be hydraulically operated or they can be adjusted by hand before the winding operation is commenced.

The hydraulic mechanism **181** which raises and lowers the beam supporting members **175** and **176** may be operated by suitable controls mounted on the control panel **15**. Also the rack and pinion mechanisms **184** may be pre-adjusted for beams of a given width or may be operated by suitable controls mounted on the instrument panel **15**. Thus, as the vehicle and the wire guiding post approach the end **167** of the beam (before the post is shifted laterally in respect thereto) the operator may conveniently lower the rearward pair of supporting members **175** into engagement with the sides of the beam.

It is to be understood, of course, that other means, apparent to one skilled in the art, may be utilized to support the ends of the beam as the wire is wound thereon.

Figures 5 and 6 illustrate another embodiment of my invention in which a wire conveying vehicle **189** of the same general design as that disclosed previously. However, it will be noted that the wire guiding mechanism generally indicated at **190** is of modified design.

The wire guiding mechanism **190** is formed by a hollow shaft **191** which has a cantilever extension generally indicated at **192** secure to the lower end thereof. The shaft **191** is vertically disposed and extends downwardly through openings **194** and **195** in the upper and lower horizontal frame members **196** and **197**. The center and lower portion **200** of the shaft **191**, which is of hexagonal cross-section, has collars **201** and **202** slidably mounted thereon. The collars **201** and **202** are rotatably supported by a pair of concentrically mounted bearing assemblies, generally indicated at **204** and **205**, which in turn are secured to the upper and lower frame members **196** and **197**.

An annular gear **210** having an hexagonal center opening is slidably mounted about the middle portion **200** of the shaft **191** just above the upper bearing assembly **204**. Inasmuch as the shaft is of hexagonal cross-section and fits within the hexagonal opening in the gear **210**, rotation of the gear **210** rotates the shaft **191**. The gear **210** has a downwardly extending collar or hub **211** which is received within a cylindrical member **212** having a base flange **214** formed about the opposite end thereof. The base flange **214** is secured to the upper horizontal frame member **196**. Ball bearings **215** are supported between cooperating raceways **216** and **217** formed about the collar or hub **211** of the gear **210** and the inner surface

of the cylindrical member **212**, respectively, which permit the gear (and shaft) to rotate.

The gear **210** is driven by a worm gear **218** carried by a shaft **219**. With reference to Figure 5, the right-hand end of the shaft **219** is rotatably supported by a bushing **220** secured to a vertical frame member **221**. The opposite or lefthand end of the shaft **219** may be drivingly engaged with the vehicle engine by any suitable means apparent to one skilled in the art.

The shaft **191** is raised or lowered by an hydraulic cylinder **225** which is connected near the upper end **208** thereof. This hydraulic arrangement may be the same as that shown in Figures 1 and 2. However, it is to be understood that other hydraulic or mechanical means apparent to one skilled in the art may be used for this purpose. Also, similar to the previously described modification, the operation of the hydraulic cylinder as well as the rotation of the gears **210** and **218** is controlled by suitable controls mounted on the instrument panel or in a convenient position adjacent the driver's seat.

The cantilever extension **192** mounted on the lower end of the shaft **191**, is formed of horizontal and vertical members **227** and **228**. The horizontal member **227** includes a pair of symmetrically shaped sections **227*a*** and **227*b*** (see Figure 7), each of which has two arcuate portions **230** and **231**. When the sections **227*a*** and **227*b*** are drawn together by bolts **233**, the adjacent arcuate portions form two openings; one of hexagonal design which receives the lower end of the shaft **191**, and the other of circular shape for receiving a portion of smaller diameter of the vertical member **228**.

A tensioning mechanism **238** similar to the type described in Figs. 1 to 4 is rotatably mounted on the lower end of the vertical member **228** by means of bearings **240** which are carried by concentric grooves or raceways **241** formed about the inner surface **243** of its housing **244**, and corresponding raceways **248** formed about the end of the vertical member. Thus the tensioning mechanism **238** is held in a fixed longitudinal relationship in respect to the vertical member **228**, but may rotate about the end thereof.

Similar to the previously described modification, as the wire W is unwound from the reel **250**, it is passed through a wire guiding device generally indicated at **251**, and is then passed through the hollow shaft **191**. After the wire leaves the lower end of the shaft **191**, it is passed through an opening **254** formed near one end of the vertical member **228** and out the opposite end thereof, and subsequently out through the die opening **255** of the tensioning mechanism **238**.

The operation of this form of the invention is similar to the previously described modification except as is shown in Figure 7, when the vehicle **189** is moved to such a position that the shaft **191** is disposed generally over the end **260** of the beam **261**, the shaft **191** is then rotated approximately 180°, so that the wire W may thereby be wound about the end of the beam. The extent and position of rotation must be determined in relation to the position of the vehicle as it is driven back and forth, in order that tension may be maintained on the wire throughout the winding operation.

It will be appreciated that the radius of the arc described in the vertical member **228** of the cantilever extension **192** may be varied by utilizing a shorter or longer horizontal member **227**. Such a variation will be necessary when winding beams of substantially different widths. For example, when winding a beam of relatively narrow width, it will be preferable to use a shorter horizontal member **227** in order that the arc described by the vertical member **228** will have a radius approximately equal to one-half of the width of the beam.

In a third modification disclosed in Figures 8, 9 and 10, it will be seen that the wire guiding mechanism generally indicated at **275** is of still another form, and the

wire guiding die post is raised and lowered by automatically operated jack mechanisms indicated at **277** disposed at each end **278** of the beam B, instead of by a system operated on the vehicle. In addition, wire deflecting devices **279** are utilized to guide the wire W into the longitudinally extending portions **280** of the circumferential groove of the beam previously described, such as that formed about the vertically disposed sides **281** and **282** and the ends **278** of a beam B.

Referring now to Figure 8, a vertically disposed hollow shaft **287** extends through openings **288**, **289** and **290** in the horizontal frame members **293**, **294** and **295** of the vehicle frame **298**. An annular gear **300** is keyed to the center portion of the shaft **287** and has a downwardly extending collar or hub **301**. The collar **301** is received within a cylindrical member **303** having a base flange **304** formed about the opposite end thereof, which is secured to the upper side of the middle horizontal member **294**. Ball bearings **307** are supported between corresponding raceways **308** and **309** formed about the collar or hub **301** of the gear **300** and the inner surface of the cylindrical member **303**, respectively. The gear **300** is driven by a worm gear **310** carried by a shaft which in turn is connected by suitable means to the vehicle engine as described in connection with Figs. 5 and 6.

The lower end of the shaft **287** is received within a sleeve **312** having a flange or collar **313** formed about its upper end. The flange **313** is secured by bolts **314** to the underside of the middle horizontal member **294**. The lower end of the shaft **287** which extends beyond the opposite end of the sleeve **312** has keyed thereto a circular gear **316**. Formed integrally with and extending horizontally from the sleeve are four symmetrical pairs of arms **318**, **319**, **320** and **321** (see Figure 9), each pair of which rotatably support the four shafts **322**, **323**, **324** and **325**. The pairs of arms **318**, **319**, **320** and **321** are so arranged that the shafts carried thereby are disposed vertically and at right angles to the arms.

Four symmetrical pairs of gears **330**, **331**, **332** and **333** are mounted at each end of the vertical shafts **322**, **323**, **324** and **325**, respectively, the upper and lower sets of which are connected by chain belts **335** and **336**, respectively. One of the shafts **324** has a third gear **338** keyed **355** is pivotally mounted by suitable means on the lower chain gear **322***a*, which is drivingly engaged with the shaft gear **316** by a chain belt **339**.

A hollow vertically disposed guide post member **345** with a shoulder **345***a* extending longitudinally along the side thereof is secured to the upper and lower chain belts **335** and **336** by U-shaped clamps **346** and **347** which receive upper and lower portions of the shoulder **345***a*. The clamps **346** and **347** are secured to the shoulder and chain belts **335** and **336**.

Thus, when the shaft **287** and shaft gear **316** are rotated by gear **300**, the upper and lower chain belts **335** and **336** are rotated at the same rate of speed, and thereby the guide post member **345** is moved in a square shape pattern relative to the longitudinal axis of the shaft **287**, as indicated in Figure 9.

With reference to Figures 8 and 10, it will be seen that a post **350** is slidably received within the guide post member **345**. In Figure 10 the guide post member **345** and post **350** are shown apart from the chain belts **335** and **336** for simple understanding of the construction.

The guide post **345** is urged downwardly (towards the ground) by a coil spring **352** situated within the upper portion of guide post member **345** and which abuts a plunger **351** formed about the upper end of the post **350**.

As in the previously described modifications, a die box **355** is pivotally mounted by suitable means on the lower end of the guide post **350**. In most respects the die box **355** is the same as the previously described except it will be noted that a set of rollers **356** are rotatably mounted across the undersurface **357** of the die box **355** and a rod **358** extends horizontally away from the outwardly facing side **359** thereof. The purpose of these parts will be subsequently described.

The wire W carried by reel **358** is directed by the wire guiding mechanism **359** down through the center of shaft **287** and then upwardly by guiding mechanisms **359***a* and **359***b* secured to the side of the wire guide post member **345**. Next the wire W is directed downward through the member **345** and guide post **350** and finally out through the die box **355**.

The wire deflecting devices generally indicated at **279** are mounted adjacent to the vertically disposed sides **281** and **282** of the beam B. As will be seen in Figure 10, the devices **279** include a pair of downwardly facing arcuate members **360** and **361** which are bolted at **362** to a laterally extending member **363**. The arcuate members **360** and **361** which have brackets **364** secured to each side thereof, are secured to the sides **281** and **282** of the beam B by means of spikes **365** which are driven through openings in the brackets **364** into the beam. Also, the lateral member **363** may be similarly secured to the upper surface **366** of the beam B. The deflectors may also be secured to the beam by clamping.

Each of the arcuate members **360** and **361** has inwardly extending shoulders **369** formed integrally with an inwardly facing side **370** of adjacent members which are received within the narrow portion of the circumferential groove **280**. The shoulders **369** are of slightly smaller width than the groove **280** and extend nearly to the footing thereof.

It will be understood, of course, that the wire guiding devices **279** may be of modified design, as for example, as shown in Figure 8, the laterally extending member **363** (of Figure 10) may be omitted, and each of the arcuate members **360***a* having brackets **364***a* formed integrally with upwardly facing side thereof, are secured to the sides **281** and **282** of the beam B by spikes **365**. Also, it is to be understood that such wire guiding devices **279** may be utilized in previously described modifications of this invention if so desired. A more detailed description of those devices may be found in my copending application Serial No. 335,233, filed February 5, 1953.

With particular reference to Figure 10, it will be seen that the jack mechanism generally indicated at **277** includes a jack **374** which supports a horizontal member **375** extending laterally across the ends **278** of the beam B. Inclined members **378** and **379** are hinged at **380** and **381** to each end **384** and **385** of the member **375**, and extend downwardly towards the ground. The jack **374** is raised and lowered by a gear and pawl arrangement generally indicated at **390** which is mounted on the end of the jack drive shaft **391**. The pawl **392** is pivotally mounted on a lever **394**. The lever **394** in turn is pivotally mounted at its lower end **396** to the end of the jack shaft **391**, and extends upwardly to above the level of the rod **358** mounted on the die box **355**. Thus each time the rod **358** strikes the lever **394**, the latter is moved and thereby the jack is raised or lowered.

In the operation of the modification shown in Figures 8, 9 and 10, it will be assumed that the wire guide post **350** is presently being moved by the vehicle towards the right in Figure 8 toward the end **278** of the beam B, and is now in position shown in dotted lines at **350***a* to the left of the beam in Figure 10.

When the post **350** is in this position, it will be noted that the wire W (see Figures 9 and 10) extending from the die box **355**, extends at an angle from the vertical side **281** of the beam B. As the post **350** is moved towards the end **278** of the beam B, the rollers **356** on the die box **355** strike the inclined member **378** and the latter is thereby raised to the level (against the tension of spring **352**) of the horizontal member **375**.

When the wire guide post **350** reaches a position slightly beyond the end **278** of the beam B, it is moved laterally in respect thereto by drivingly engaging the shaft gear **300** with the vehicle engine and thereby rotating the shaft **287** and the chains **335** and **336**. As the wire guide post **350** is moved laterally in respect to the beam B, the wire W' strikes the arcuate member **360** of the wire deflecting device **279** and is thereby deposited into the groove **280**. The die box **355** pivots counterclockwise by means of the tension on the wire W striking the corner **397** of the beam, and as the die box **355** is moved across the horizontal member **375**, the wire W is deposited at the desired level about the ends **278** thereof.

When the wire guide post **350** has been moved laterally to the opposite side **282** of the beam B and a slight distance in the opposite direction as indicated in dotted lines at **350***b* in Figures 9 and 10, the vehicle may then be moved in the opposite direction, i. e., to the left as viewed in Figure 8. As the wire W strikes the opposite corner **398** of the beam B the die box **355** again pivots counterclockwise. While the die box **355** is moved along the opposite inclined member **379**, the coil spring **352** urges the guide post **350** downwardly to its initial position.

It will also be noted that as the die box **355** is moved across the horizontal member **375**, the rod **358** strikes the jack lever **394**, and thus the jack is lowered a sufficient amount so that the next succeeding loop of wire will be deposited just beneath the preceding loop on the end of the beam.

In connection with this modification it is to be understood that the wire guiding drive mechanism **275** may be operated by other means besides the vehicle engine; for example by an independent electric motor. Also it will be understood that the movement of the guide post **350** may be automatically controlled as well as being manually operatable by the vehicle driver.

It is to be understood that in any of the modifications the vehicle may be towed by a chain or belt rather than being self-propelled, and in this connection tracks may be provided to guide the wheels of the vehicle so that the latter is maintained in the proper position in respect to the structure about which the wire is wound.

Furthermore, it is to be understood that the various structural parts of this device are susceptible to considerable modification without departing from the basic concept of this invention. Therefore, the form of the invention described above should be considered as illustrative and not as limiting the scope of the following claims.

I claim:

1. Apparatus for prestressing a structure with wire comprising a wire conveying vehicle movable in a fixed path relative to and over said structure, swivel means carried by said vehicle for guiding the wire to position it in the desired pattern on said structure as said vehicle is moved relative thereto, means for moving the swivel means relative to the vehicle to adjust the height thereof, means for displacing the swivel means laterally relative to the vehicle, and means to tension the wire.

2. Apparatus for prestressing a structure with wire comprising a vehicle movable relative to and over said structure, means for supporting a quantity of wire on said vehicle, a movable wire guiding means mounted on said vehicle, means to vary the position of said wire guiding means relative to the vehicle in both vertical and horizontal directions to position the wire in the desired pattern on said structure as said vehicle is moved relative thereto, the vertical position of said wire guiding means determining the height at which the wire is positioned on the structure, and the horizontal movement of the wire guiding means relative to the vehicle serving to pay out the wire independently of and at right angles to the direction of movement of the vehicle, and means to tension the wire as it is positioned on the structure.

3. Apparatus as described in claim 2 for prestressing a structure having longitudinal grooves extending between each end thereof, said apparatus including wire deflecting means to guide said tensioned wire into the grooves as said wire guiding means is moved relative thereto.

4. Apparatus for prestressing a structure having longitudinal grooves extending between each end thereof to receive tensioned wire, comprising a vehicle, means to move said vehicle relative to and over said structure, means for supporting a quantity of wire on said vehicle, a wire guiding means mounted on said vehicle to position said wire on said structure, actuatable means for moving the wire guiding means relative to the vehicle to adjust the height at which the wire is dispensed and positioned on said structure, and actuatable means to move said wire guiding means laterally in respect to the longitudinal axis of said vehicle, and means to tension the wire as it is positioned on said structure.

5. Apparatus for prestressing structural members with wire comprising a traction driven, self-propelled vehicle, means to steer said vehicle, means for carrying wire on said vehicle, means for tensioning said wire, a movable arm carried by and extending beneath said vehicle, a wire guiding means pivotally mounted on said arm, means for moving said arm and wire guiding means laterally in respect to said vehicle, means for raising and lowering said wire guiding means, to thereby deposit tensioned wire in the desired pattern on said structural member as said vehicle is moved relative to and over said structure.

6. Apparatus for prestressing an elongated stationary structure having sides extending between each end on which to position tensioned wire, comprising a traction driven, self-propelled vehicle, means for carrying wire on said vehicle, means for tensioning said wire, an arm extending generally vertically beneath said vehicle, wire guiding means pivotally mounted on said arm, and horizontally disposed guide means for bodily translating said arm laterally in respect to said vehicle, to thereby guide said tensioned wire across the ends of said structure as the vehicle is moved relation to and over the structure.

7. Apparatus for prestressing with wire an elongated beam fixedly positioned relative to the ground, said beam having grooves on the sides near the bottom, comprising a four-wheeled traction driven vehicle having a high center to clear the beam as the vehicle is driven back and forth on the ground over the beam from one end of it to the other, means mounting a supply of wire on the vehicle, means for tensioning the wire, means on said vehicle to displace the wire laterally as the vehicle is driven back and forth over the beam to position the wire alternately on the sides of the beam, and means to displace the wire vertically to position it in said grooves.

8. Apparatus for prestressing a structure with wire comprising a wire conveying vehicle movable in a fixed path relative to and over said structure, swivel means carried by said vehicle for guiding the wire to position it in a desired pattern on said structure as said vehicle is moved relative thereto, means for moving the swivel means relative to the vehicle to adjust the height thereof, means for displacing the swivel means laterally relative to the vehicle, and means to tension the wire.

9. Apparatus for prestressing a structure with wire comprising a vehicle movable relative to and over said structure, a movable wire guiding means mounted on said vehicle, means to vary the position of said wire guiding means relative to the vehicle in both vertical and horizontal direction to position the wire in a desired pattern on said structure as said vehicle is moved relative thereto, the vertical position of said wire guiding means determining the height at which the wire is positioned on the structure, and the horizontal movement of the wire guiding means relative to the vehicle serving to pay out the wire independently of and at right angles to the direction of movement of the vehicle, and means to tension the wire as it is positioned on the structure.

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