ABSTRACT

An automatic tieing or wire twisting tool for fastening structural elements together, such as intersecting pairs of angularly disposed reinforcing rods, in a latticework common in building and road construction, by way of fitting around the rods at each intersection thereof a U-shaped staple and therefollowing twisting together the legs of the staple at their free end portions, the tool including a staple drive plate for ejecting a staple from a stack thereof and a staple separator for separating the next adjacent staple from the stack.

4 Claims, 14 Drawing Figures
WIRE TIEING TOOL

In the road and building construction art, extended use is made of steel rods for reinforcing concrete construction wherein the rods are usually laid as a skeleton structure, normally at right angles to each other, in a network or quilted pattern or latticework or grid. The rods desirably are secured together at their intersecting points so that, when a wooden or metal form is built up around them and concrete is poured thereinto, the rods will not sag under the weight of the concrete.

The tool of the invention is for securing together steel reinforcing rods as used in the construction of poured concrete buildings, bridges, roads and the like, but can also be used for securing together other sections of wire fencing, netting and like reticulated wire fabrics, and it has other securing-together capacities as well, as for example, for binding together wires, ropes and like materials.

The tool is of the wire-typing type which ejects and twists staples around a pair of rods, and includes a frame, a powergenerating impeller, a magazine which may be detachably secured to the frame and is adapted to contain a spring-biased quota of preformed U-shaped staples or tie wires in stacked contiguous non-operating relationship, a staple ejecting and separating assembly and a staple twisting assembly.

In the drawings:

FIG. 1 is a view, in side elevation, showing the fully extended or operative position of the tool, with the cover removed for clarity;

FIG. 2 is a view, similar to FIG. 1, but showing the fully-retracted or non-operative, locked position of the tool;

FIG. 3 is a view, in top plan, of the tool of FIG. 1 with portions of the staple magazine broken away;

FIG. 4 is an enlarged, broken view, in side elevation and partly in section, of the power-generating assembly of the tool of the invention;

FIG. 5 is an enlarged, fragmentary view, in cross-section, taken on line 5—5 of FIG. 1, with portions omitted for clarity;

FIG. 6 is an enlarged view, in top plan and partly in section, of the spring-loaded staple follower of the magazine of the tool of the invention;

FIG. 7 is a view, in end elevation, taken on line 7—7 of FIG. 1, of the staple twisting assembly of the tool of the invention, with portions of the tool omitted;

FIG. 8 is a view, similar to FIG. 7, of the staple twisting assembly with the cover plate omitted;

FIG. 9 is a view, in cross section, taken on line 9—9 of FIG. 1;

FIG. 10 is a greatly enlarged, fragmentary view, in longitudinal cross section, taken through the staple twisting assembly with portions of the gear housing thereof omitted;

FIG. 11 is a fragmentary view, in side elevation, with the magazine omitted, showing the relationship of the tool to a pair of crossed rods to be tied together;

FIG. 12 is a greatly enlarged, fragmentary view, in top plan, showing the relationship of the staple ejecting and separating means relative to a stack of staples and relative to a pair of crossed rods to be tied together, with the magazine and other tool components omitted;

FIG. 13 is a greatly enlarged, fragmentary view, in end elevation, of the staple separating means, and showing the manner in which a staple is separated from a stack thereof; and

FIG. 14 is a fragmentary view, in end elevation, showing a pair of crossed rods tied together by a staple.

The main assemblies of the tool comprise a frame, a power-generating impeller extending longitudinally through and having parts suitably journalled for rotation within and relative to the frame, a magazine which may be detachably secured to the frame and being adapted to contain a spring-biased quota of preformed U-shaped staples or tie wires in stacked contiguous non-operating relationship, a staple ejecting and separating assembly and a staple twisting assembly.

For purposes of orientation, the terms "forward" will be understood to mean rightward and "rearward" to mean leftward, as the tool is viewed in most of the several figures.

The frame supports the several aforementioned assemblies and comprises an upright guide wall 10 having forward and rearward end plates 12 and 14 respectively fixed thereto and depending therefrom.

A cover, not shown, is releasably attached to the frame for protecting the several operating instrumentilities of the tool.

Forward end plate 12 includes an integral extension 16 which serves as a base wall and support for a staple magazine 18 fixed thereto as by screws 20 or the like, the magazine being disposed normal to and extending horizontally outwardly from guide wall 10.

The staple twisting assembly, generally indicated by 22, is fixed to and disposed in spaced parallelism to the forwardly facing face of forward end plate 12.

The power-generating impeller is generally indicated by 24 and includes a handle 26 mounted upon the rearward end of a drive tube 28.

Drive tube 28, which is disposed below and in spaced parallelism to guide wall 10, passes freely through an opening provided in rearward end plate 14 and is supported at its inner forward end by a guide plate 30 which is slideably mounted upon a pair of spaced guide rods 32, 32 disposed one on each side of the drive tube and fixed at their ends to end plates 12 and 14.

As best seen in FIG. 4, the drive tube sleeves a bar screw 34 which is fixed at its inner, rearward end within the drive tube by a pin 36 to a guide nut 38 and passes outwardly of the drive tube through a bar screw nut 40 fixed in the forward open end of the drive tube, the bar screw nut being held against rotation by a retainer plate 42 disposed forwardly of the bar screw nut and fixed to guide plate 30 as by screws 44.

The bar screw is fixed at its forward end by a pin 46 to a coupling 48 pinned by a pin 50 to a clutch 52 disposed within a gear housing 54 of staple twisting assembly 22.

A drive member 56 is pinned by a pin 58 to clutch 52 and has a gear 60 fixed to a shaft 62 extending outwardly from the forward end of the drive member.

The drive tube is reciprocated horizontally relative to end plate 14 of frame 10 by handle 26, the drive tube being guided along guide rods 32 by guide plate 30.

Rubber bumpers or cushions 63 are sleeved on the drive tube adjacent its opposite ends to preclude damage to the tool upon contact of any of the components with end wall 14.

As the drive tube is reciprocated, bar screw nut 40 causes bar screw 34 to rotate wherefore a concomitant rotation in gear 60 is set up through coupling 48 and clutch 52.
As seen in FIGS. 7 - 10, gear 60 meshes with a spur gear 64 fixed to a stub shaft 66 mounted for rotation within gear housing 54, with gear 64, in turn, meshing with a ring gear 68 fixed to a tie ring 70 mounted for rotation relative to the gear housing of staple twisting assembly 22.

A cover plate 72, fixed to the forwardly-facing face of gear housing 54 as by screws 74, has a pin 76 fixed thereto and extending inwardly therefrom into the gear housing.

A pressure disc 78 is mounted for sliding movement relative to pin 76 and is circumscribed by the ring 70, the outer diameter of the disc being slightly less than the inner diameter of the tie ring wherefore the tie ring is freely rotatably relative thereto.

A compression spring 80 is trapped between the pressure disc and cover plate and urges the pressure disc rearwardly toward end plate 12.

A screw 82 is threaded in pin 76 and has washers 84 sleeved thereon to preclude the escape of the pressure disc from its position on the pin.

The outer peripheral edge of the rearwardly-facing face of the pressure disc is bevelled as at 86 and the inner peripheral edge of the rearwardly-facing face of the tie ring is bevelled as at 88 to form a substantially V-shaped groove 90, (see FIG. 10).

A plurality of equi-spaced notches 92 is provided on the inner periphery of tie ring 70, the notches extending inwardly from the base of V groove 90.

Staples ejected form the magazine are trapped between the pressure disc and tie ring with their ends lodged in the notches 92, whereby, as the tie ring is rotated, the ends of the staple are twisted, all in manner to be more fully explained hereinafter.

Staple ejecting and separating assembly, which is generally indicated by 100, includes a staple-drive plate 102 and a staple separator 104, both mounted for reciprocation relative to guide wall 10 of the frame.

As best seen in FIGS. 11 and 12, guide wall 10 is provided along its upper and lower edges with trackways 106 having grooves 108 therein to receive and confine the edges of staple drive plate 102, which is slideable along and relative thereto.

A second pair of trackways 110 is fixed to trackways 106 as by screws 112 and has grooves 114 therein to receive and confine the edges of staple separator 104, which is slideable along and relative thereto.

A rivet or pin 116 fixes staple separator 104 to staple drive plate 102 wherefore the two move unisonly.

A latch 118 is pivoted at one end to a stud 120 which extends outwardly from the staple drive plate, the latch extending rearwardly from the drive plate through a provided opening in end wall 14 of the frame and having a hook portion 122 at its opposite end adapted to be engaged by a catch 124 on a trigger 126 slideably mounted relative to a bracket 126 fixed to and extending forwardly from handle 26.

When the trigger if pressed inwardly, the catch engages hook portion 122 of latch 118 so that the latch and staple ejecting and separating assembly 100 are moved rearwardly when the handle is moved rearwardly, for purposes to appear.

The latch and staple ejecting and separating assembly are loaded by a spring 130 which is fixed at one end to stud 120 on staple drive plate 102 and at its opposing end to a stud 132 on guide wall 10, the spring being entwined about a pulley 134 rotatably mounted on a bracket 136 also fixed to the guide wall adjacent magazine 18.

Latch 118 is provided at its inner or forward end with an integral offset finger 138 which is loaded by a spring 140 fixed at one end to a pin 142 on the finger and at its opposite end to a pin 144 on staple drive plate 102.

Finger 138 acts as a trip upon contact with a stop pin 146 provided on guide wall 10, the stop pin acting as an abutment to cause the latch to pivot in a clockwise direction relative to stud 120 wherefore hook portion 122 of the latch is raised and released from engagement with catch 124 of trigger 126 so that staple drive plate 102 and staple separator 104 are driven forwardly by the force of spring 130.

Following release of the latch, trigger 126 is moved outwardly to a non-operative position by a spring 148, (see FIG. 3), fixed thereto at one of its ends and fixed at its opposite end to bracket 128.

As the staple drive plate 102 and staple separator 104 move forwardly under the force of spring 130, the staple drive plate drives the innermost staple from a stack thereof outwardly from the magazine through a provided opening in end plate 12 to the staple twisting assembly and the staple separator separates the next adjacent staple from the stack in preparation for the next pass of the staple drive plate, in manner to appear.

Magazine 18 and its several component parts will now be described.

The magazine includes a U-shaped outer casing 150 releasably fixed to extension 16 of end wall 12 and to guide wall 10, the casing being open at its top, bottom and forward ends and enclosing a supply of U-shaped staples 151.

The staples are sleeved upon a pair of walls 152 which are spaced inwardly from the top and bottom walls of outer casing 150 and are fixed at their forward ends to extension 16 of end wall 12.

A spring-loaded U-shaped staple follower 154 is also sleeved upon the walls 152 and rests upon the outermost staple in a stack thereof.

Guides pins 156 on the staple follower ride in slots 158, (see FIG. 3), provided in the walls 152, the slots being capped by retainer blocks 160 having curved slots 162 therein communicating with slots 158 whereby the staple follower can be swung outwardly from the magazine.

The staple follower is loaded by a flat spring 164 fixed at one end as by a screw 166 to a mounting block 168 fixed to the staple follower as by screws 170, the opposite end of the spring being fixed to a roller 172 rotatably mounted relative to a bifurcated bracket 174. (See FIG. 6).

Mounting block 168 and bracket 174 are of such size as to be slideably receivable between walls 152, which walls may be suitably notched or grooved to provide guideways therefor.

A knob 176 fixed to a base wall 178 of bracket 174 facilitates movement of the bracket and staple follower.

Base wall 178 includes a tail portion 180, (see FIG. 6), which serves as a lock when engaged by a latch 182, (FIGS. 1 and 2), slideably mounted between retainer blocks 160, the latch being movable by thumb pressure
to the right as viewed in FIGS. 1 and 2 to permit the passage of the tail portion thereby.

When the thumb is removed, a spring, not shown, moves the latch to the left as seen in FIGS. 1 and 2 to a position wherein it overlies the tail portion to hold the bracket and staple follower between walls 152 whereby the staple follower maintains a constant pressure on the stack of staples.

The innermost staple of the stack thereof contained within the magazine rests flush against guide wall 10 so as to be disposed directly in the path of staple drive plate 102.

The forwardly-facing leading edge of the staple drive plate is provided with an arcuate groove or recess 184 of suitable dimensions and configuration to receive therein a complemental arcuate web portion 186 of staple 151, said web portion interconnecting the ends of a pair of forwardly-facing spaced parallel leg portions 188 thereof having free ends for reception in staple twisting assembly 22.

To insure ease of handling and to maintain proper staple alignment, the staples are coated with a thin layer of a suitable adhesive 190 which may be applied at spaced intervals or which may completely cover the staples. This layer of adhesive makes for easy handling and loading of a stack of staples into the magazine and maintains the staples in proper alignment within the magazine.

This adhesive coating or layer causes difficulties, however, in that when the staple drive plate ejects the innermost staple from the stack, the adhesive prevents a smooth, clean separation of that staple, wherefore it oftentimes twists prematurely to jam the tool.

These difficulties are solved by the use of staple separator 104 which separates the next-to-be ejected staple from the stack so that it can be driven smoothly and accurately by the drive plate.

The staple separator is yoke-shaped and includes a web portion 192 interconnecting the ends of a pair of forwardly-facing spaced, parallel leg portions 194 each of which carries a depending knife-like separator blade 196 adjacent its forward free end.

The legs portions 194 are receivable in grooves 114 of second trackways 110 and are slideable therealong.

Rivet or pin 116, which joins the staple separator to the staple drive plate, passes through web portion 192.

Separator blades 196 are cut away and tapered as clearly shown in FIGS. 11 and 13 so to pass cleanly between the legs of a pair of staples, cutting easily through the adhesive layer 190 which coats the staples.

Since the staple drive plate and separator move unison, the separator is separating the next adjacent staple from the stack as the drive plate is ejecting the innermost staple from the magazine.

The tool is provided with a second handle 198 which is fixed to guide wall 10 and extends horizontally outwardly therefrom, wherefore a workman may employ both hands to manipulate the tool.

A lock 200 slideably mounted on end plate 14 is adapted, when moved downwardly, to engage bracket 128 on handle 26 to lock said handle against movement. When the lock is moved upwardly, the handle may be moved at will.

The tool is used to tie together pairs of crossed steel rods 202 of the type used in reinforced concrete structures.

In use, end plate 12 is butted against one of the rods 202 as shown in FIG. 11, handle lock 200 is released, trigger 126 is depressed to engage hook portion 122 of latch 118 with catch 124, and handle 26 is pulled rearwardly to move drive tube 28 and staple ejecting and separating assembly 100 rearwardly therewith.

When offset finger 138 of latch 118 engages stop pin 146, the latch is rotated to release the hook portion from engagement with the catch whereupon the staple ejecting and separating assembly is driven forwardly under the force of spring 130 to simultaneously eject the innermost staple from the magazine and to separate the next adjacent staple from the stack.

Since end plate 12 is butted against rod 202, the web portion 186 of the staple bears directly thereupon immediately upon ejection from the magazine through the end plate opening, with the legs straddling the rods at their point of intersection and the ends of the legs being trapped in the notches 92 between the pressure disc 78 and the ring 70 of twisting assembly 22.

The staple is now ready to be twisted about the rods. Handle 26 is still in an extended position similar to that shown in FIG. 1 even though the staple ejecting and separating assembly has been released.

Thus, an inward or pushing force applied to handle 26 moves drive tube 28 forwardly, wherefore bar screw nut 40 causes bar screw 34 to rotate, setting up rotation of tie ring 70 through gears 60, 64 and 68 to twist the ends of the staple around the cross rods.

Handle 26 and drive tube 28 may be freely reciprocated without movement of the staple ejecting and separating assembly so long as trigger 126 is not engaged with latch 118.

Therefore, one or two additional passes of the drive tube may be made along the bar screw to completely twist the legs of the staple about the crossed rods as shown in FIG. 14.

Continued twisting of the legs eventually draws them from their position of entrapment between the pressure disc and tie ring so that the tool is free to be moved to the next operation.

I claim:
1. A tying mechanism having a magazine containing a supply of U-shaped staples for securing together a pair of crossed members comprising:
   a. a frame having the magazine mounted thereon;
   b. a staple twisting assembly operatively connected to the frame and having a plurality of openings therein;
   c. a power-generating impeller journaled in the frame and operatively connected to the staple twisting assembly for imparting rotative movement thereto;
   d. a staple ejecting and separating assembly operatively connected to the frame and to the power-generating impeller for driving the innermost staple from the magazine while simultaneously separating the next adjacent staple from the supply thereof, the innermost staple being driven into contact with the staple twisting assembly on each side of the crossed members and engaged in the openings in the staple twisting assembly, whereby as the staple twisting assembly is rotated the wire is twisted around the crossed members; and
   e. the staple ejecting and separating assembly comprising, a staple drive plate, a separator mounted
on the drive plate, a pair of opposed knife-like blades on the separator, and spring means connected to the drive plate and frame for spring-loading the assembly, the supply of staples in the magazine being coated with an adhesive and the separator blades being adapted to cut through the adhesive between the legs of adjacent staples as the staple drive plate drives the innermost staple from the magazine.

2. A tying mechanism according to claim 1, wherein the power-generating impeller comprises, a drive tube, a bar screw sleeved by the drive tube and means integral with the drive tube for setting up rotative movement of the bar screw as the drive tube is reciprocated.

3. A tying mechanism according to claim 2, including a gear train linking the bar screw to the staple twisting assembly.

4. A tying mechanism according to claim 1, wherein the power-generating impeller is selectively reciprocable independently of movement of the staple ejecting and separating assembly.

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