Oct. 13, 1959 S. B. BROUSE ET AL 2,908,216

TENSIONER FOR AUTOMATIC WIRE-TYING MACHINE

Filed May 28, 1957

5 Sheets-Sheet 1

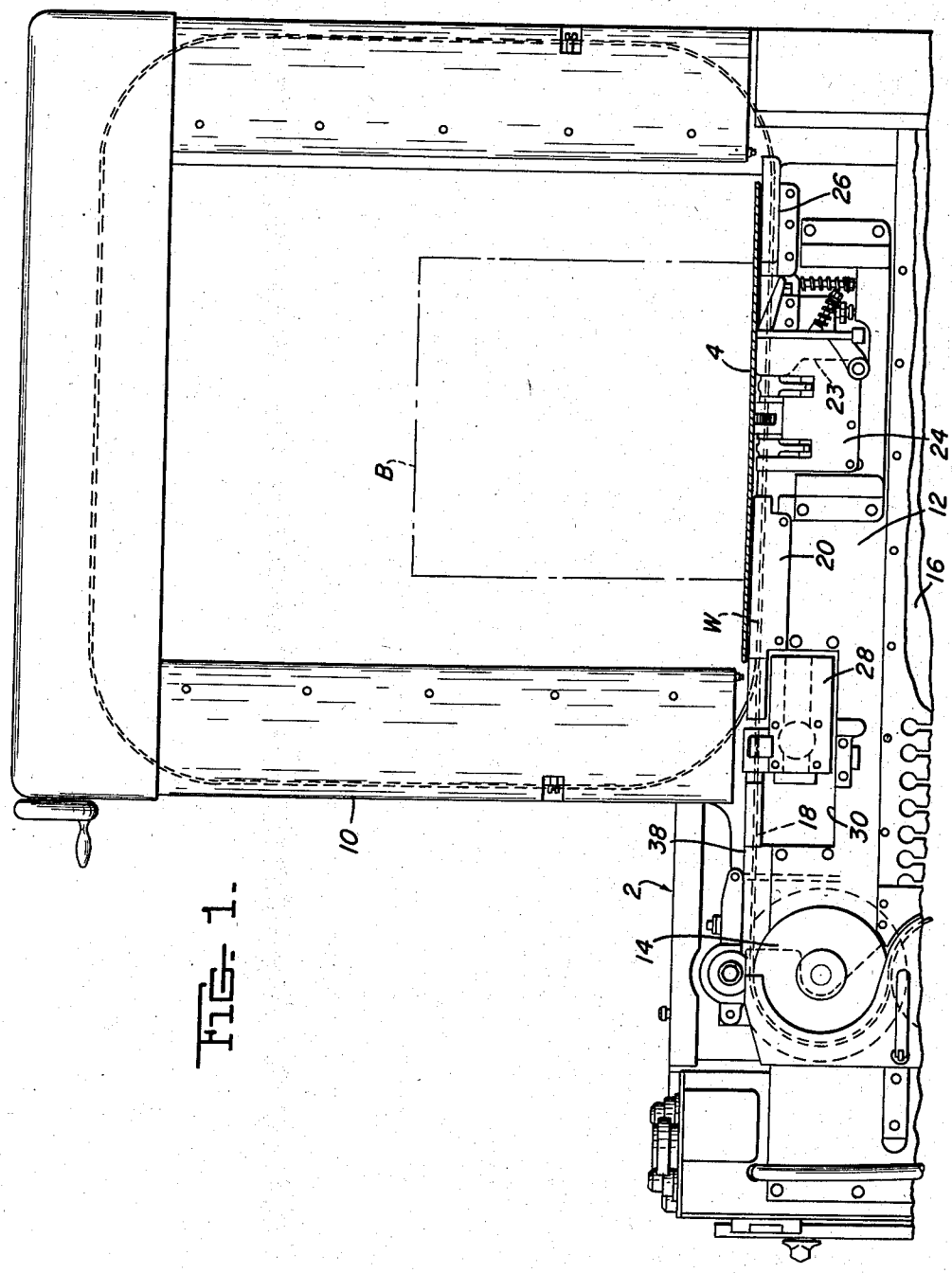

FIG. 1.

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FIG. 1a

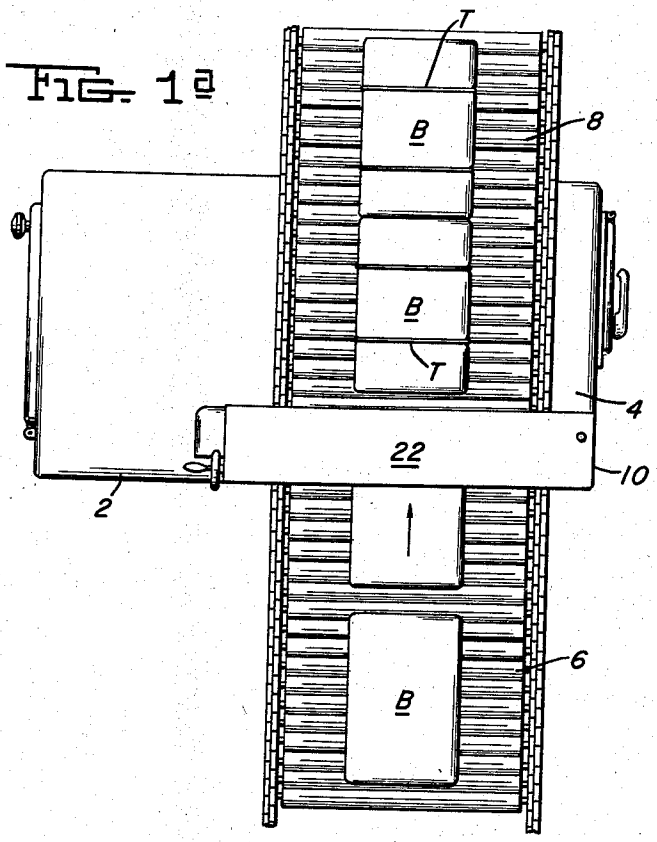

FIG. 1b.

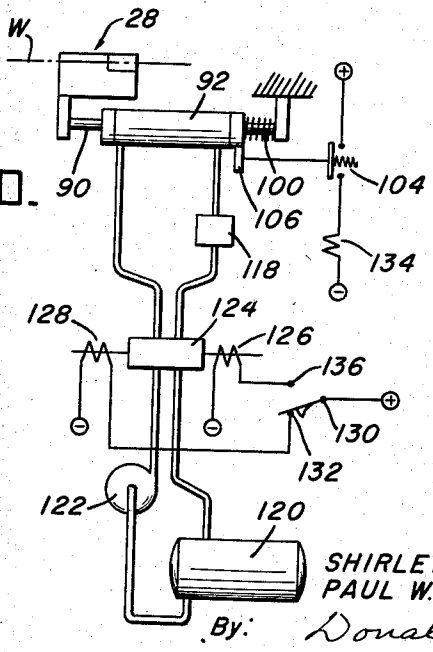

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FIG. 2.

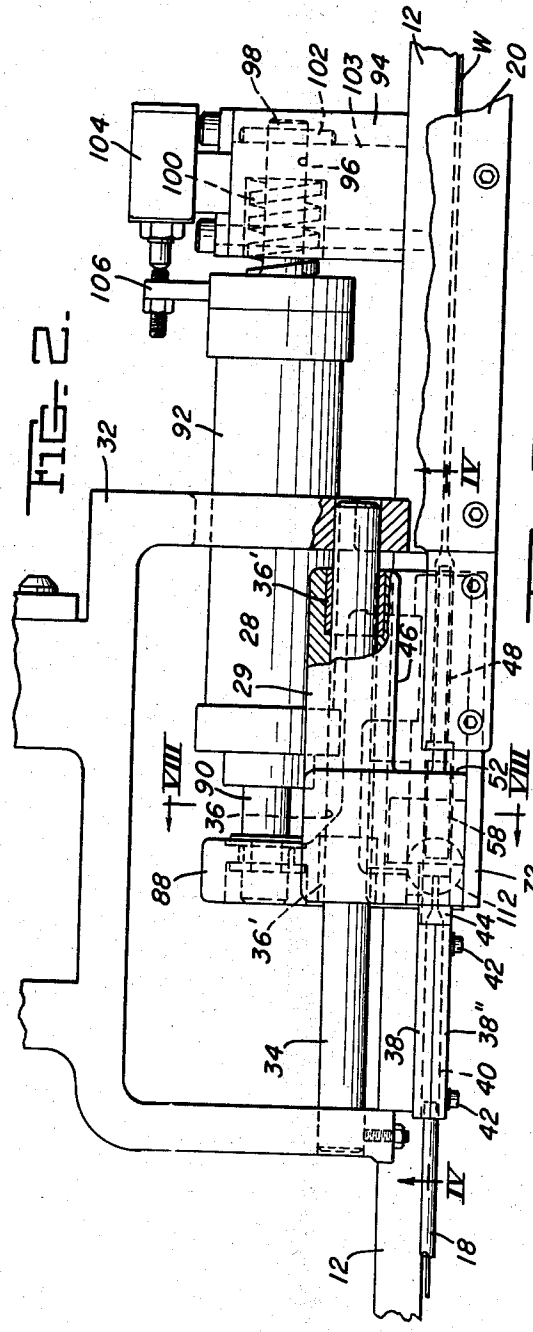
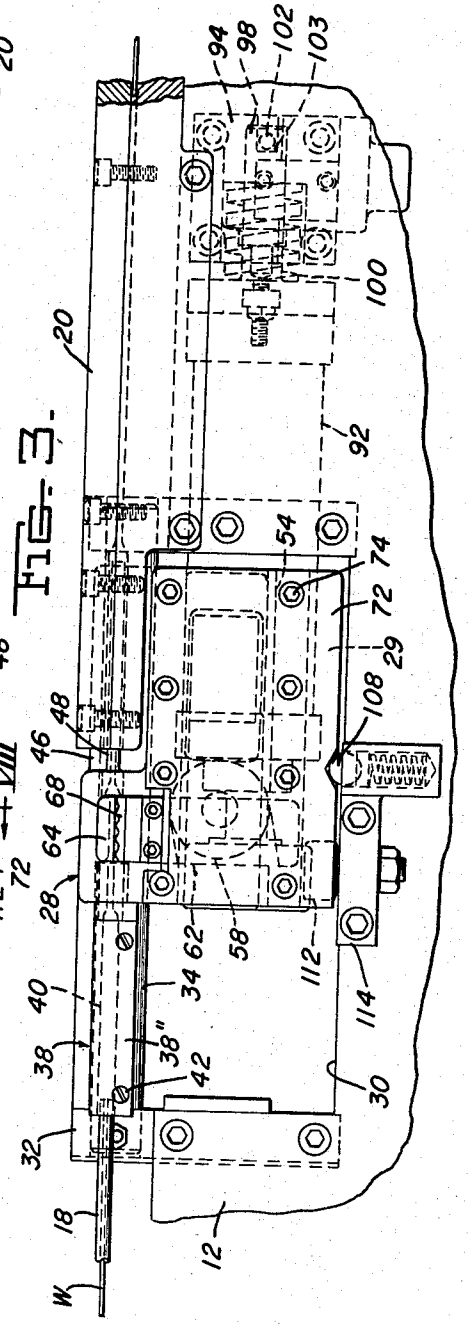


FIG. 3.



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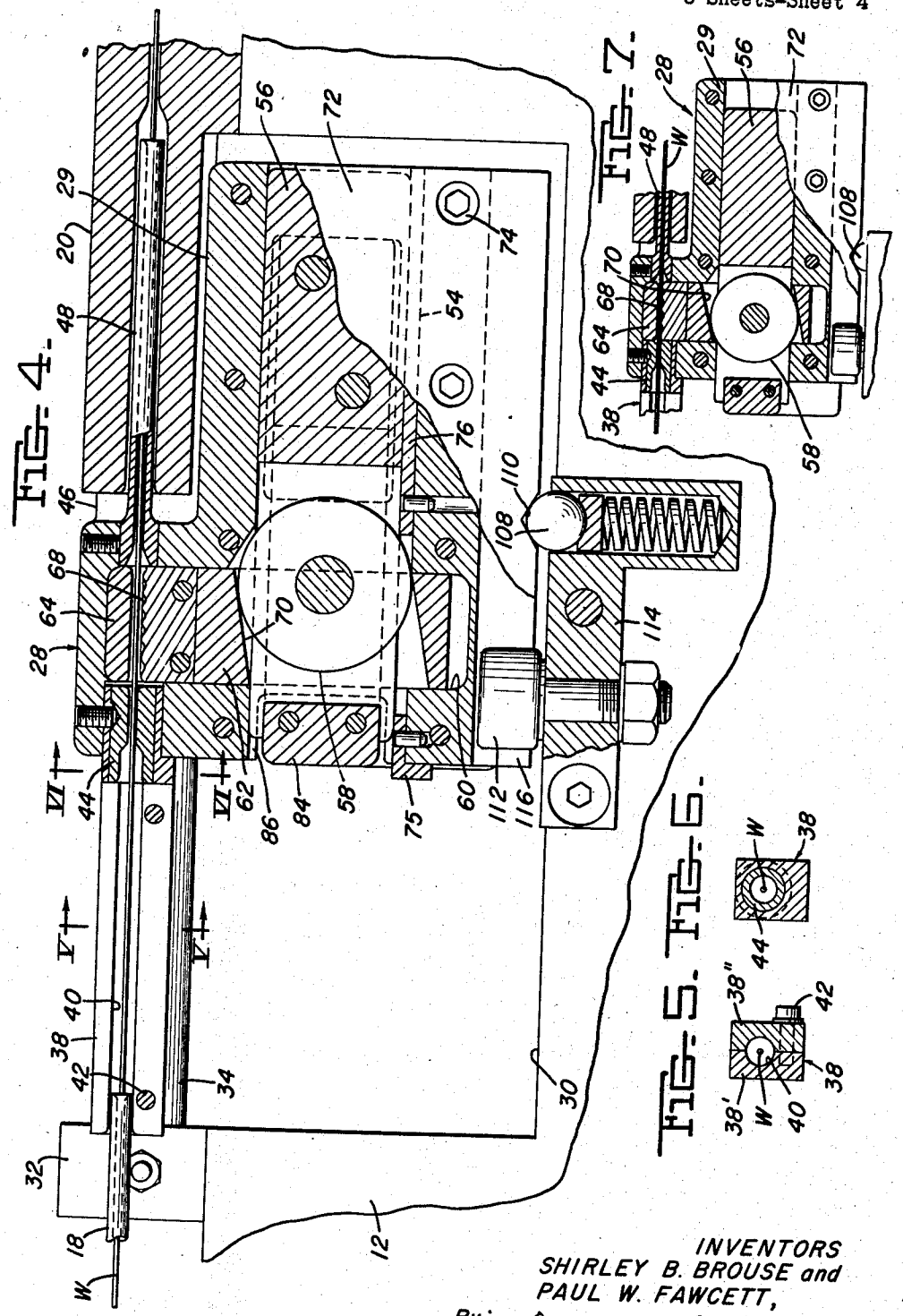

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TENSIONER FOR AUTOMATIC WIRE-TYING MACHINE

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FIG. 9.

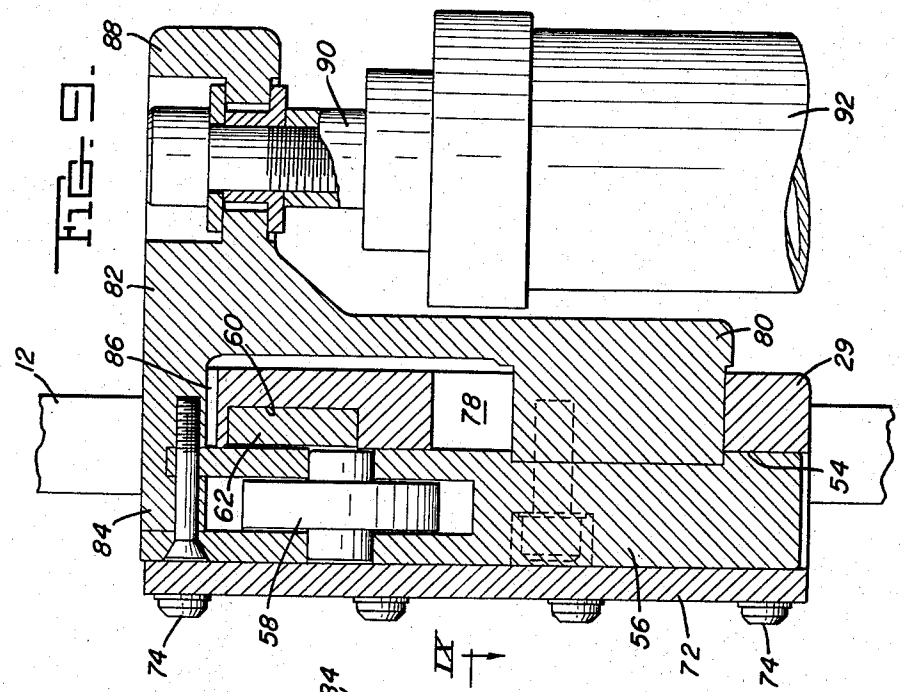
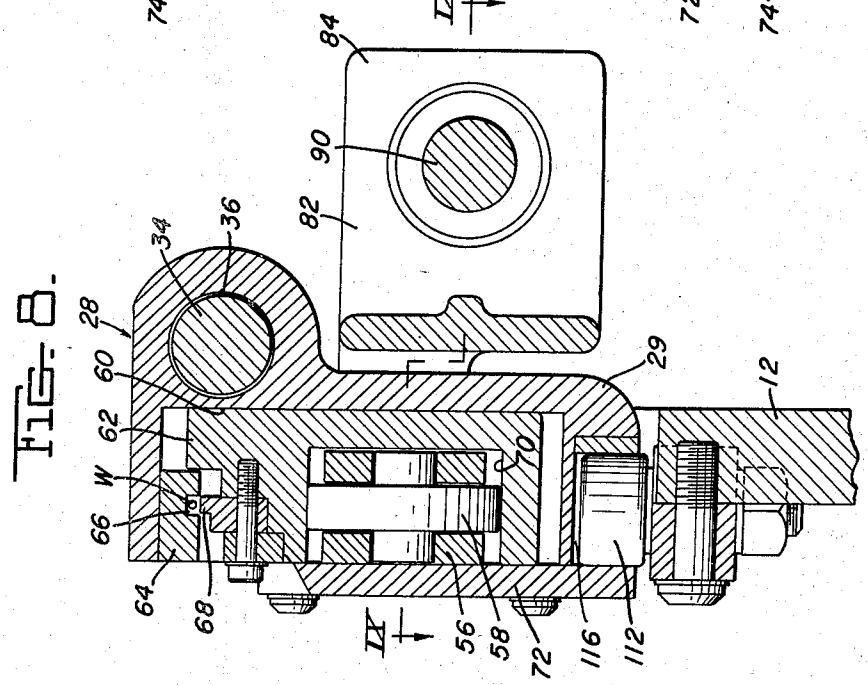


FIG. 8.



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United States Patent Office 2,908,216
Patented Oct. 13, 1959

2,908,216

TENSIONER FOR AUTOMATIC WIRE-TYING MACHINE

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Application May 28, 1957, Serial No. 662,245

10 Claims. (Cl. 100—26)

The present invention relates generally to automatic machines for applying a wire tie to a bundle, tightening it therearound and securing the lapped ends of the wire by a twist or knot. An example of such a machine is shown in Vining et al. Patent No. 2,416,859. More particularly, this invention relates to an improved tensioner for automatic wire-tying machines. In the operation of this type of wire-tying machine the supply wire, from which a tie is to be made, is fed around a guide track in the form of a loop with the ends of the tie overlapped in the slot of a knotter pinion. Then, when a tie is to be applied to a bundle, the bundle is placed within the track, the wire is retracted to draw the tie tight around the bundle and is then tensioned to the desired final value. The overlapped ends of the tie are then twisted together by the knotter pinion and the tie is cut free from the supply wire and ejected from the pinion.

The improvements claimed herein relate to the means for finally tensioning the tie wire after it has been initially drawn taut around the bundle and before the knot has been formed. The novel features of the tensioner of our invention, as herein described and claimed may be employed in any known automatic tying machine of the same general type as the Vining et al. machine. Details of parts other than the tensioner and associated elements are not included herein.

It is, accordingly, an object of our invention to provide a tie wire tensioner adapted to be installed in an automatic tying machine for gripping a tie wire after it has been initially drawn taut about a bundle and then exerting a predetermined final tension on the tie wire just prior to knotting.

It is a further object of the invention to provide a tensioner as described above having a novel jaw arrangement wherein the tie wire is securely gripped for tensioning, without damage to the wire, between a fixed jaw and a positively actuated movable jaw.

It is another object of the invention to provide a tensioner for use in automatic tying machines which is provided with control means whereby it may be readily adjusted to vary the tensions of ties applied around a bundle as desired.

These and other objects will become more apparent after referring to the following specification and attached drawings, in which:

Figure 1 is an elevation of a tying machine, partly broken away, having the invention incorporated therein, showing the general arrangement of the principal operative units of the machine and their relation to the tensioner of the invention;

Figure 1*a* is a plan view of the tying machine of Figure 1 showing the feed-in and carry-away conveyors on opposite sides thereof, respectively;

Figure 2 is an enlarged plan view of the tensioner with portions broken away and portions shown in section;

Figure 3 is a front elevational view of Figure 2 with portions broken away;

Figure 4 is a longitudinal sectional view taken along the plane of line IV—IV of Figure 2;

Figure 5 is a cross-sectional view taken along the plane of line V—V of Figure 4;

Figure 6 is a view similar to Figure 5 taken along the plane of line VI—VI of Figure 4;

Figure 7 is a view similar to Figure 4 on a reduced scale with parts omitted showing the tensioner in operative position just prior to the tensioning operation;

Figure 8 is a cross-sectional view taken along the plane of line VIII—VIII of Figure 2;

Figure 9 is a sectional view taken along the plane of line IX—IX of Figure 8; and

Figure 10 is a diagrammatic illustration of an electrical control circuit for the tensioner.

Referring now in detail to the drawings and more particularly to Figures 1 and 1*a* for the present, the invention is shown incorporated in an automatic tying machine **2** having a table **4** with which a feed-in conveyor **6** and a carry-away conveyor **8** cooperate. A guide track, indicated generally at **10**, includes an elevated portion in the form of an arch or gate which bridges the common center line of the conveyors and a bottom portion parallel with table **4**. The track receives and holds tie wire W in the form of a loop. Bundles B moving along the conveyors are stopped one or more times while under the arch for the application of a tie T, the formation of a knot or twist on the bottom side of the bundle as it rests on the table **4**, and the cutting of the completed tie from a supply coil of wire. Other elements of the guide track **10** as well as other principal elements of the tying machine are mounted on a vertically disposed plate **12** which is secured to the main frame of the machine normal to the table **4**. These elements include a sheave-and-pinch roll feeding mechanism **14** for feeding into the track the tie wire W from the supply coil (not shown); a pocket or escapement **16** to receive temporarily the surplus length of wire when the tie is pulled back and tightened around the bundle; a left-hand guide tube **18**; a right-hand guide tube **20**; a tiltable gripper **23**; a knotter and shear **24**; and a right-hand guide **26**. The knotter includes the usual slotted twister pinion. The wire W is pushed into the machine from left to right during feeding and is retracted from right to left during the tensioning stage of the tying cycle, by the pinch-roll mechanism **14**.

The parts of the tying machine thus far described are not part of the present invention and are not claimed herein but have been included to insure a clear understanding of the invention.

The tensioner of the invention, indicated generally by reference numeral **28**, includes a block **29** which is disposed for movement parallel with the table **4** and the bottom of track **10** in a slot **30** formed in the top edge of the plate **12**, as best shown in Figure 4. A U-shaped yoke **32** is fastened to the rear face of plate **12** with its legs disposed one adjacent each end of slot **30**. The yoke **32** projects above plate **12** and supports a horizontal rod **34**. The block **29** is slidably supported on rod **34**, a longitudinal hole **36** being provided through the body of the block for this purpose. Sleeve bearings **36'** for rod **34** may be provided adjacent each end of the hole **36**.

An entrance guide member **38** having a longitudinal passage **40** therethrough is secured to the top portion of block **29** by means of set screws. The guide **38** is made up of a grooved main body **38'** and a grooved cover body **38''** removably secured together by means of cap screws **42**. Guide **38** extends toward the left-hand guide tube **18** and is telescoped over the exit end of the latter for conducting wire W from the guide tube to the tensioner. A bushing **44** may be fitted in the inner end of guide **38** for accurately guiding the entering wire end on initial thread-

ing. The entrance guide 38 is made up of two parts so that it can be easily disassembled to permit removal of wire in the event of kinking or jamming.

The upper portion of the block 29 is cut away to form a recess 46 for accommodating a projection of the right-hand guide tube 20, as best shown in Figure 4. An exit tube 48 projects from the shoulder 52 formed by recess 46 and is slidably telescoped at its outer end in the guide tube 20 to conduct the wire W from the tensioner into the guide tube 20. As best seen in Figure 4, the telescoping arrangement of the entrance guide 38 and tube 48 with the guide tubes 18 and 20 insures that the wire is confined at all times as the tensioner reciprocates the slot 30 as will become apparent hereinafter.

A horizontal recess 54 extends through the body of the block 29 parallel with the plane of table 4 for slidably accommodating a bar 56. A roller 58 is rotatably mounted adjacent one end of bar 56. The periphery of roller 58 extends beyond the top and bottom of the bar for a purpose which will become apparent.

A vertical guideway 60 intersects, at substantially right angles, the recess 54 for slidably accommodating a movable jaw 62. A fixed jaw 64 having a wire-receiving groove 66 in the gripping surface thereof is rigidly disposed in block 29 in the upper end of guideway 60. A projection 68 is formed on the upper surface of jaw 62 dimensioned to fit into the wire-receiving groove 66 to provide a tongue and groove arrangement for gripping the wire W. The wire-contacting surfaces of the groove 66 are smooth while the wire-contacting surface of projection 68 is provided with smooth corrugations having rounded edges so that the wire is not damaged while being tightly gripped. The groove 66 permits positive confinement of the wire while it is passing thru the tensioner when it is inactive and also serves to insure positive gripping of the wire when the tensioner is in operation.

The movable jaw 62 is provided with a tapered slot 70 in its body portion for receiving the roller 58. Bearing of the roller 58 on the upper bearing surface of slot 70 as it enters the slot causes the movable jaw to move upwardly when the bar 56 is moved toward the left to the position shown in Figure 7. When the roller 58 is retracted from slot 70 the movable jaw is positively caused to move away from the fixed jaw by bearing of roller 58 on the bottom bearing surface of slot 70. When the bar is in retracted position, as shown in Figure 4, the movable jaw is maintained in lowered position away from the fixed jaw by roller 58.

A cover plate 72, which is removably affixed to the front face of the block 29 by means of cap screws 74, confines the bar 56 and movable jaw 62 within the tensioner. Wear strips 75 and 76 may be disposed on the bottom of recess 54 on opposite sides of guideway 60 for the undersurface of bar 56.

A longitudinally elongated slot 78 is formed through the rear face of the block 29 which communicates with the recess 54. Slot 78 functions as a guideway for one leg 80 of a slidable bracket 82. Another leg 84 of bracket 82 fits into a cut-out portion 86 of the rear face of the block 29 adjacent its forward end, as best shown in Figure 9. Both legs 80 and 84 are rigidly connected with bar 56. The bracket 82 is connected with a fluid pressure motor which is in the form of a double-acting fluid-pressure cylinder 92 having a piston rod 90 projecting slidably therefrom. A third leg 88 of the bracket 82 loosely supports the projecting end of the piston rod 90. The head of cylinder 92 is supported in a block 94 which is mounted on the rear face of plate 12. Cylinder 92 by means of piston rod 90 and bracket 82 serves to advance and retract bar 56 in recess 54.

Block 94 has a counterbored opening 96 therethrough for receiving a rod 98 which is attached to and projects from the head of cylinder 92. A helical spring 100 is circumferentially mounted on rod 98 with one end bearing against the shoulder in opening 96 formed by the counterbore and its other end bearing against the head of cylinder 92. Spring 100 constantly urges the cylinder away from block 94. The rod 98 is retained in position by means of a pin 102 which is inserted through a transverse opening in the end of the rod. Pin 102 fits in a slot 103 in the block, as best shown in Figures 2 and 3. The pin 102 also prevents rotation of cylinder 92.

A spring loaded micro-switch 104 is mounted on block 94 and is adapted to be closed on rearward movement of cylinder 92 against the tension of spring 100 by an arm 106 which projects from the head of the cylinder. Switch 104 is connected with and actuates knotter 24 after the tie wire has been drawn taut around the bundle.

The operation of the tensioner 28 will now be described. As shown in Figures 2, 3, 4, 8 and 9, the tensioner is shown in normal retracted and inactive position. The tensioner remains in this position until the stage of the tying cycle is reached wherein it is necessary to tension the tie wire W to draw it taut around the bundle. When this stage of the tying cycle is reached the leading end of wire W is clamped by the tiltable gripper 23. At this point the gripper 23 is pulled and tilted by the end of the retracting wire W. In tilting, the gripper actuates a switch 130 (shown diagrammatically in Figure 10) to actuate cylinder 92 and cause the projection of piston rod 90. Projection of the piston rod causes the bar 56 to advance in recess 54 moving roller 58 into the slot 70. As the roller progresses into slot 70 it causes the movable jaw 62 to move upwardly to clamp the wire W in the slot 66 of fixed jaw 64 by projection 68. During this initial movement of bar 56 the block 29 is prevented from moving by a spring-loaded ball detent 108 which cooperates with a V-notch 110 in the bottom of the block. After the wire has been clamped the resistance of the spring-loaded ball is overcome by the wedging of projection 68 in the slot 66 which causes the block 29 to move to the left in slot 30, as viewed in Figures 2, 3 and 4, on continued projection of piston rod 90. Since the wire W is now securely clamped movement of the entire tensioner pulls the wire against the resistance of gripper 23 to draw the tie taut around the bundle B.

A horizontally disposed roller 112 is journaled in a bracket bearing 114 affixed to the front face of plate 12 and engages a slot 116 on the underside of the block 29 to maintain the block in proper vertical alignment so that it moves parallel with the path of wire W.

The amount of tension applied to wire W which in turn determines the degree of tension of the tie around the bundle B is controlled by regulating the flow of pressure fluid to the cylinder 92. This is done by means of an adjustable pressure reducing valve 118 (shown diagrammatically in Figure 10) in the fluid supply line to the cylinder. Thus, the pressure in the cylinder 92 may be varied for any gauge wire used for tying and for any desired tie tension around the bundle.

When the desired pressure within the cylinder 92 has been attained and it is equaled by the tension of the wire W, continued flow of fluid into the cylinder causes it to move rearwardly against the pressure of spring 100. When the cylinder depresses the spring 100 the arm 106 closes switch 104 to actuate the knotting mechanism 24 to form the knot in the tie. After the knot has been formed, the knotter actuates other means, which will be more fully explained hereinafter in the description of the control circuit shown in Figure 10, to de-energize cylinder 92 and cause retraction of piston rod 90. Upon retraction, piston rod 90, through bracket 82, retracts bar 56 to move roller 58 substantially out of the slot 70 causing the movable jaw 62 to move downwardly away from fixed jaw 64 and release the wire W. As the bracket 82 continues to retract bar 56 the leg 80 of the bracket 82 bears against the rear end of slot 78 and moves the block 29 back to its retracted and inactive position and the spring-loaded ball 108 is again engaged by notch 110. The tensioner is then ready for the next tensioning cycle.

A control circuit for the tensioner of the invention is illustrated diagrammatically in Figure 10 and functions as follows. The pressure fluid for cylinder **92** is delivered from a reservoir **120** by a pump **122** under the control of a solenoid operated valve **124**. Valve **124** is operated automatically in one direction or another from a neutral position by solenoids **126** and **128**. Thus, valve **124** controls projection or retraction of piston rod **90**. The adjustable pressure-reducing valve **118** in the supply line to the cylinder **92** controls the amount of pressure in the cylinder as described above.

During that part of the tying cycle of machine **2** wherein the leading end of the wire W is gripped in gripper **23** and the wire is being retracted to strip it from guide track **10** and draw it loosely around the package, a switch **130** is actuated by the tiltable gripper **23** to close a contact **132**. This completes a circuit to and energizes solenoid coil **128** to move the spool of valve **124** to the left to allow pressure fluid to flow into the cylinder **92**. This causes piston rod **90** to be projected and the wire W to be tensioned and drawn taut around bundle B. After the wire W has been tensioned to the desired degree cylinder **92** moves rearwardly depressing spring **100** and tripping switch **104** causing it to close completing a circuit to a coil **134** which in turn initiates action by the knotter **24**. After the knot has been formed in the tie, the knotter causes switch **130** to be again actuated to open contact **132** and close contact **136**. Opening of contact **132** causes de-energizing of solenoid coil **128** and closing of contact **136** causes energizing of coil **126**. Energization of coil **126** causes the spool of valve **124** to move to the right to reverse the flow of pressure fluid to the cylinder **92** causing the piston rod **90** to retract. Relieving pressure in cylinder **92** causes the tensioner to move back to its normal retracted and inactive position as shown in Figures 2, 3, 4, 8 and 9 and the switch **104** to reopen.

While one embodiment of our invention has been shown and described, it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

We claim:

1. In a wire-tying machine including a table adapted to support an article to be tied, a tensioner for tightening a tie wire drawn about the article, said tensioner comprising a block slidable parallel to said table, a wire gripper mounted on said block including a movable jaw, said block having a fixed jaw with which the movable jaw coacts, a fluid-pressure motor for reciprocating said block, said motor being free for axial movement in one direction, yieldable means constantly urging the motor axially in the other direction, and means whereby said fluid-pressure motor causes movement of said movable jaw on the block toward the fixed jaw before it actuates the block.

2. Apparatus as defined by claim 1 including switch means actuated by bodily movement of the motor.

3. In a wire-tying machine including a table adapted to support an article to be tied, a tensioner for tightening a tie wire drawn about the article, said tensioner comprising a block slidable parallel to said table, a wire gripper mounted on said block including a movable jaw, said block having a fixed jaw with which the movable jaw coacts, means for reciprocating said block, said block having a recess therein parallel to its line of travel and a guideway transverse to and intersecting said recess, said movable jaw being slidable in said guideway, a slide bar movable in said recess, and means actuated by movement of the slide bar in the block whereby said block-reciprocating means causes movement of said movable jaw on the block toward the fixed jaw to set said gripper before it actuates the block in one direction and causes movement of said movable jaw on the block away from the fixed jaw to release said gripper before it actuates the block in the opposite direction, said slide-bar-actuated

means including a cam surface on said movable jaw and a roller on said slide bar engaging said cam surface.

4. In a wire-tying machine including a table adapted to support an article to be tied, a tensioner for tightening a tie wire drawn about the article, said tensioner comprising a block slidable parallel to said table, a wire gripper mounted on said block including a movable jaw, said block having a fixed jaw with which the movable jaw coacts, tubular wire-guiding passages on opposite sides of said jaws, tubular wire-guiding members on the block extending in opposite directions from said jaws and in telescoping relation with said passages, means for reciprocating said block, and means whereby said block-reciprocating means causes movement of said movable jaw on the block toward the fixed jaw before it actuates the block.

5. In a wire-tying machine including a table adapted to support an article to be tied, a tensioner for tightening a tie wire drawn about the article, said tensioner comprising a block slidable parallel to said table, a wire gripper mounted on said block including a movable jaw, said block having a fixed jaw with which the movable jaw coacts, a fluid-motor for reciprocating said block, a frame plate normal to said table, means secured to said frame plate mounting said motor, a guide rod carried on said frame plate parallel thereto, said block having a bore through which said rod extends, said block being slidable on said rod, and means whereby said motor causes movement of said movable jaw on the block toward the fixed jaw before it actuates the block.

6. In a wire-tying machine including a table adapted to support an article to be tied, a tensioner for tightening a tie wire drawn about the article, said tensioner comprising a block slidable parallel to said table, a wire gripper mounted on said block including a movable jaw, said block having a fixed jaw with which the movable jaw coacts, a fluid motor for reciprocating said block, a frame plate normal to said table, means secured to said frame plate mounting said motor, said motor being free for axial movement in one direction, yieldable means constantly urging the motor axially in the other direction said block having a longitudinal slot in the bottom thereof, a vertical guide roller on said frame plate fitting in said slot for guiding said block during reciprocation thereof, and means whereby said motor causes movement of said movable jaw on the block toward the fixed jaw before it actuates the block.

7. In a wire-tying machine including a table adapted to support an article to be tied, a tensioner for tightening a tie wire drawn about the article, said tensioner comprising a block slidable parallel to said table, a wire gripper mounted on said block including a movable jaw, said block having a fixed jaw with which the movable jaw coacts, a fluid-motor for reciprocating said block, a frame plate normal to said table, means secured to said frame plate mounting said motor, said motor being free for axial movement in one direction, yieldable means constantly urging the motor axially in the other direction means whereby said motor causes movement of said movable jaw on the block toward the fixed jaw before it actuates the block, and a detent resiliently projecting from said frame plate and engaging said block for yieldably restraining reciprocal movement of said block in one direction while said motor causes movement of said movable jaw on the block toward the fixed jaw before it actuates said block.

8. In wire-tying machine including a table adapted to support an article to be tied, a tensioner for tightening a tie wire drawn about the article, said tensioner comprising a block slidable parallel to said table, a wire gripper mounted on said block including a movable jaw, said block having a fixed jaw with which the movable jaw coacts, the opposed surfaces of said fixed and movable jaws being of tongue and groove conformation, means for

reciprocating said block, and means whereby said block-reciprocating means causes movement of said movable jaw on the block toward the fixed jaw before it actuates the block.

9. In a wire-tying machine including a table adapted to support an article to be tied, a tensioner for tightening a tie wire drawn about the article, said tensioner comprising a block slidable parallel to said table, said block having a guideway therein normal to said table, a wire gripper carried by said block including a movable jaw slidable in said guideway, said block having a fixed jaw with which the movable jaw coacts, a fluid-pressure motor for reciprocating said block, and cooperating wedging-means on said motor and said movable jaw, respectively, whereby

said motor causes movement of said movable jaw on the block toward the fixed jaw before it actuates the block.

10. Apparatus as defined by claim 9 characterized by said block having a recess therein parallel to its line of travel and intersecting said guideway, and a slide bar movable in said recess, said motor being connected with said slide bar, one of said wedging-means being a roller carried by said slide bar.

References Cited in the file of this patent

UNITED STATES PATENTS

2,416,859	Vining et al.	Mar. 4, 1947
2,624,270	Sykes	Jan. 6, 1953