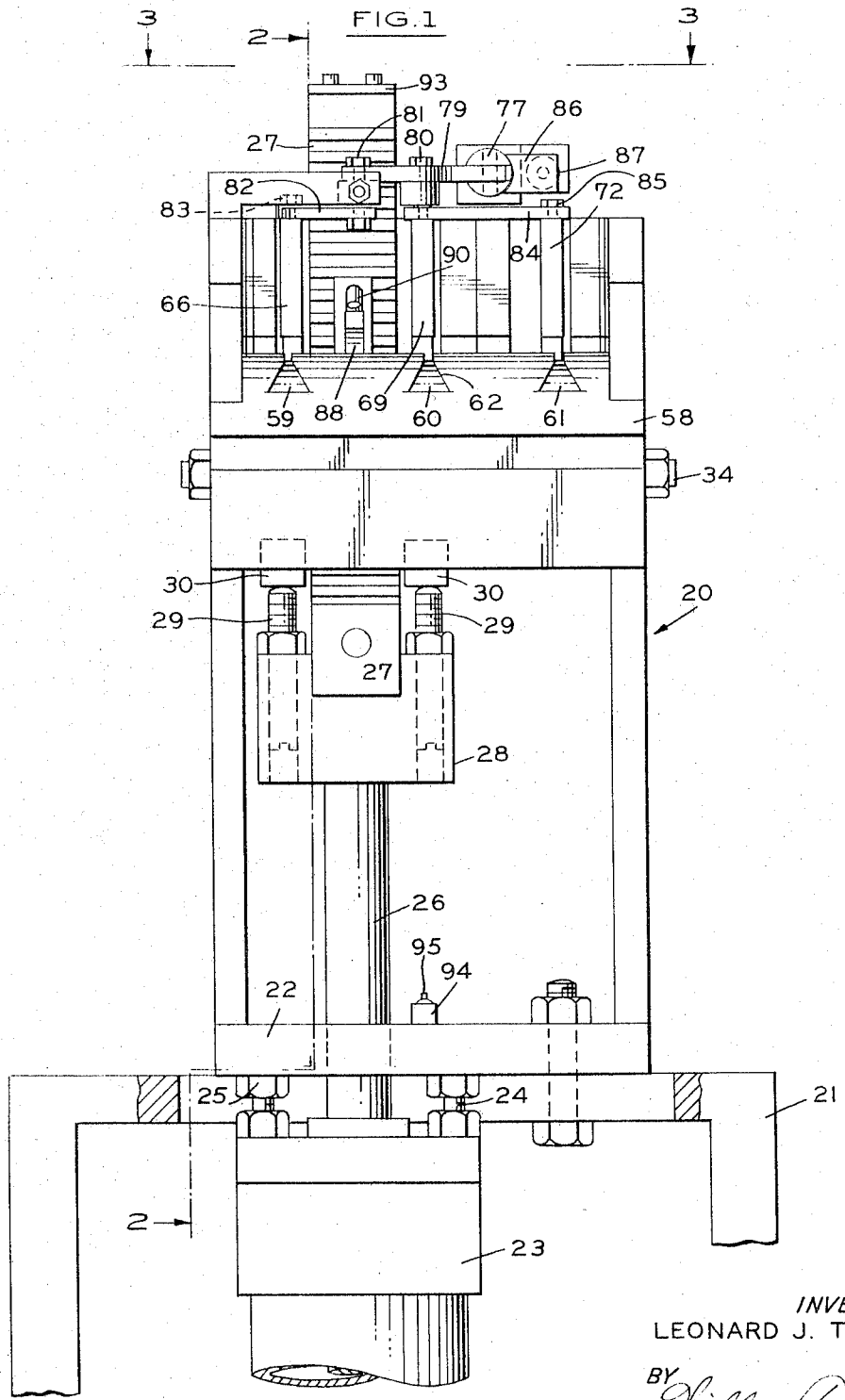
Jan. 10, 1967 L. J. TROTTA 3,297,059

AUTOMATIC MULTIPLE WIRE WRAPPING MACHINE

Filed Sept. 24, 1964 6 Sheets-Sheet 1

FIG. 1



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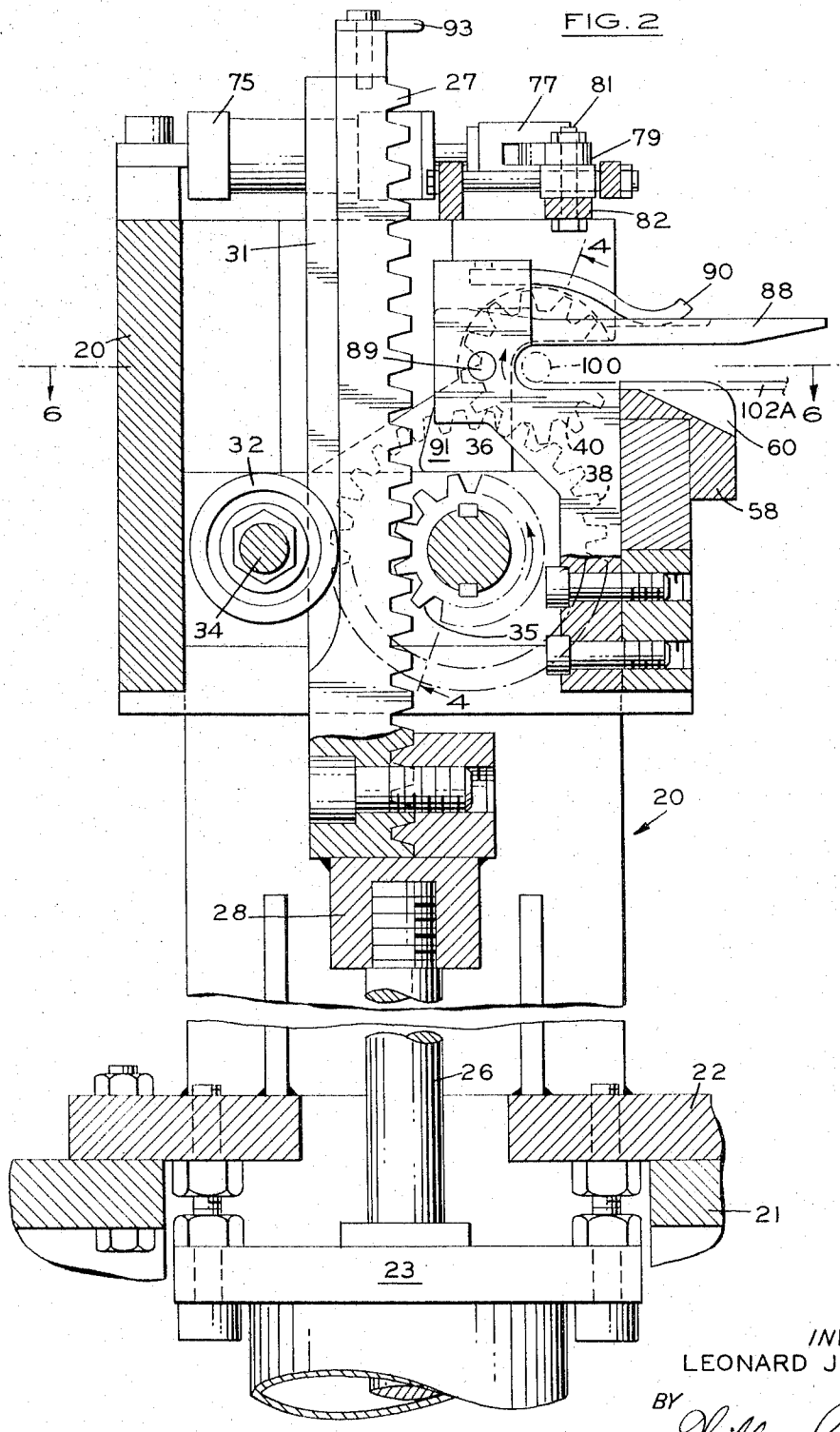
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AUTOMATIC MULTIPLE WIRE WRAPPING MACHINE

Filed Sept. 24, 1964 6 Sheets-Sheet 2

FIG. 2



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AUTOMATIC MULTIPLE WIRE WRAPPING MACHINE

Filed Sept. 24, 1964 6 Sheets-Sheet 3

FIG. 3

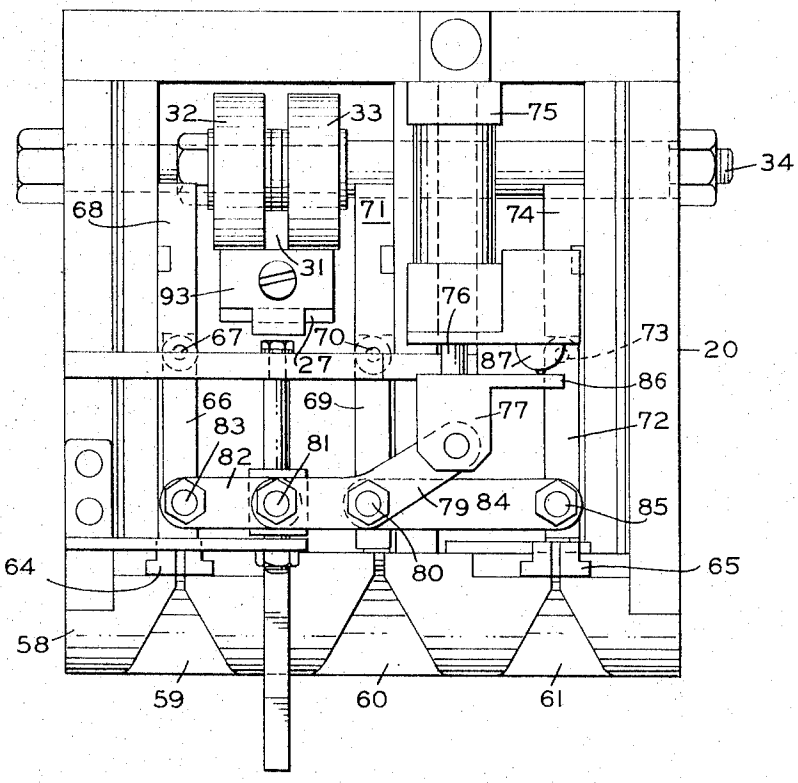
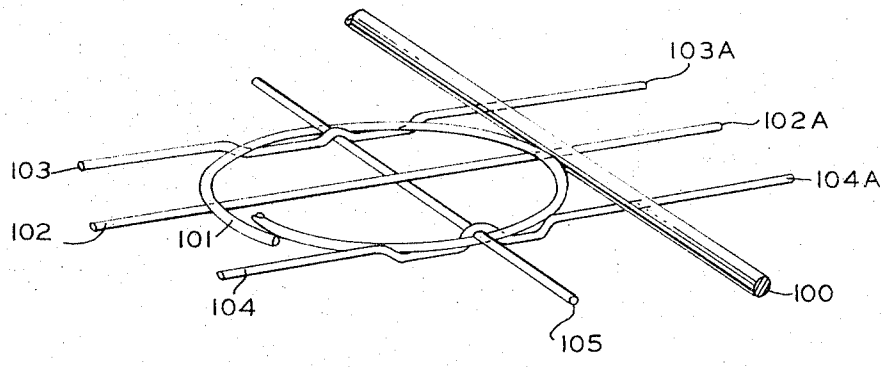


FIG. 10



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AUTOMATIC MULTIPLE WIRE WRAPPING MACHINE

Filed Sept. 24, 1964 6 Sheets-Sheet 4

FIG. 4

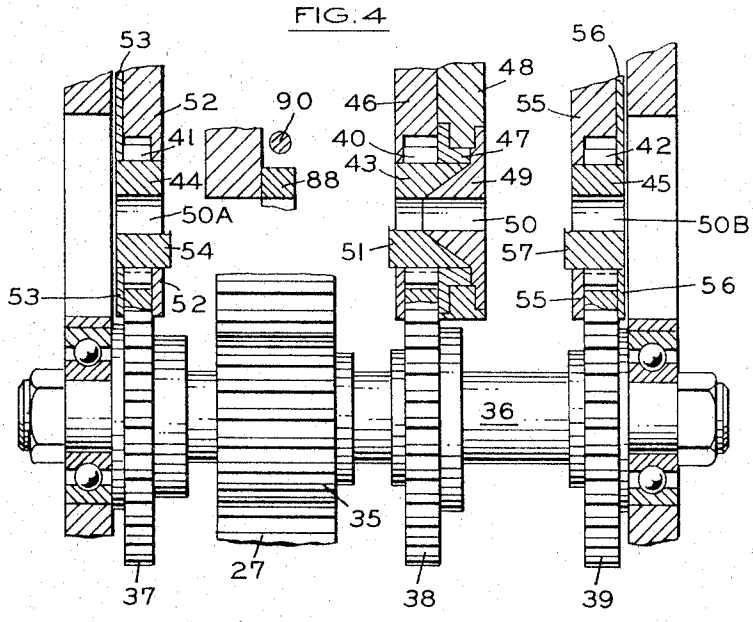
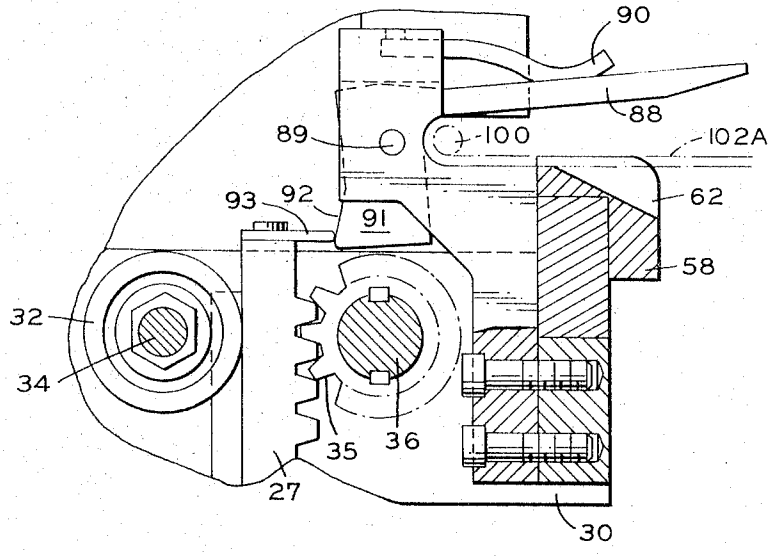


FIG. 5



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Jan. 10, 1967 L. J. TROTTA 3,297,059

AUTOMATIC MULTIPLE WIRE WRAPPING MACHINE

Filed Sept. 24, 1964 6 Sheets-Sheet 5

FIG. 6

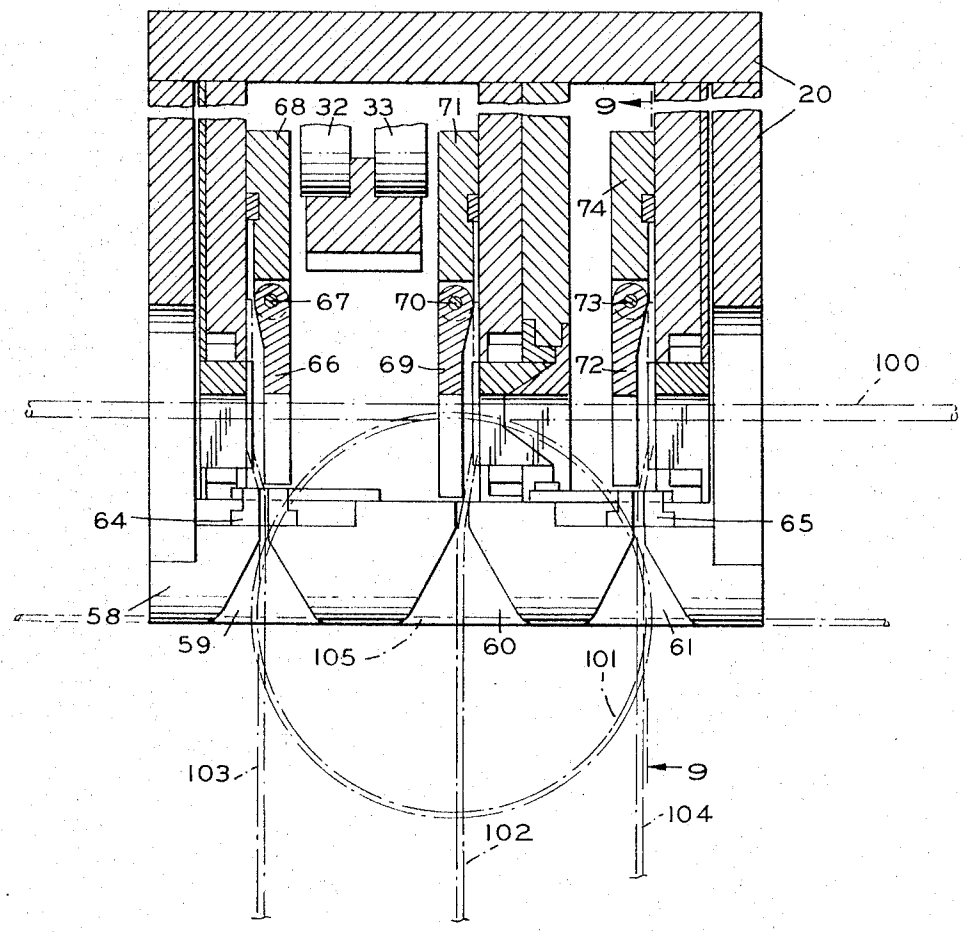
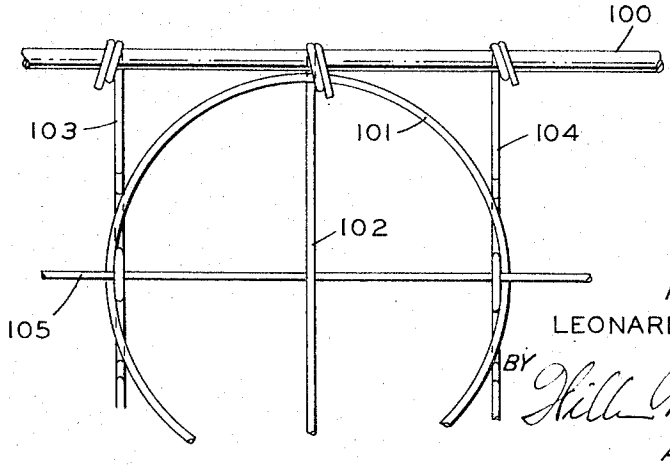


FIG. 11



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Jan. 10, 1967 L. J. TROTTA 3,297,059

AUTOMATIC MULTIPLE WIRE WRAPPING MACHINE

Filed Sept. 24, 1964 6 Sheets-Sheet 6

FIG. 7

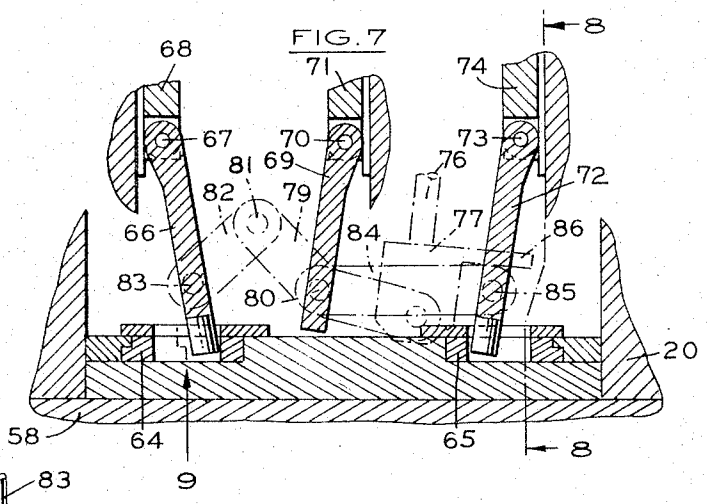


FIG. 8

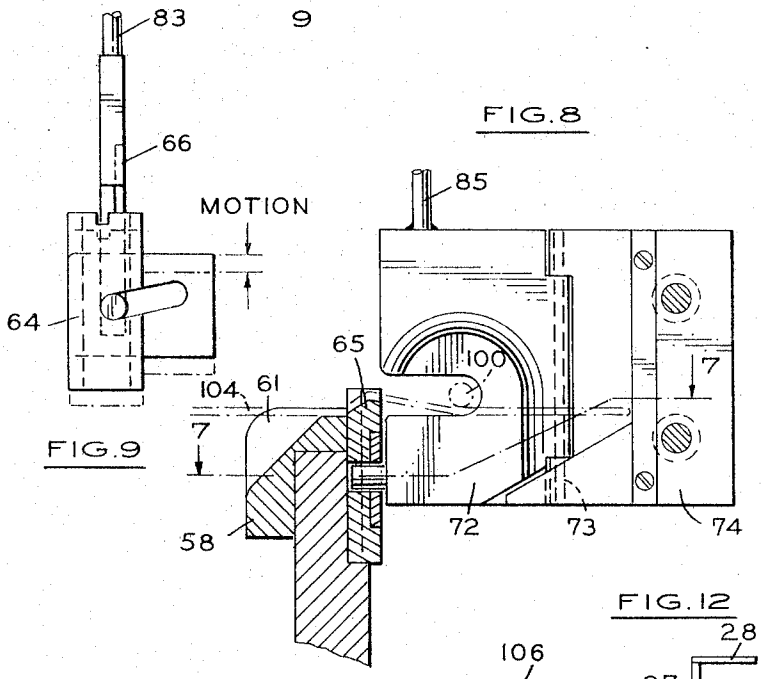
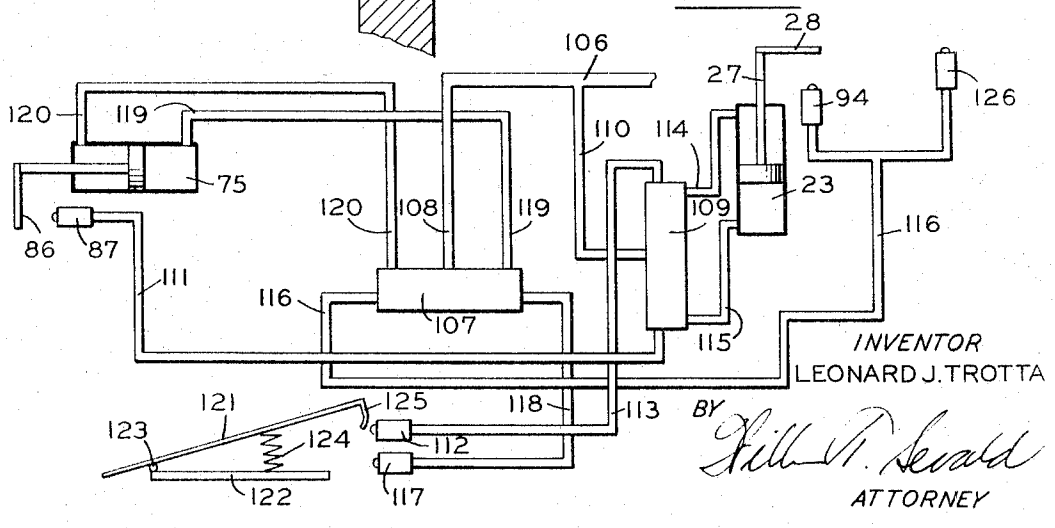


FIG. 9

FIG. 12



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3,297,059

AUTOMATIC MULTIPLE WIRE WRAPPING MACHINE

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Filed Sept. 24, 1964, Ser. No. 399,005
8 Claims. (Cl. 140—3)

This invention relates to improvements in automatic wire wrapping machinery and in particular to a machine for winding or wrapping a plurality of wires around another wire or wires.

The machine of the invention is especially useful and efficient in the manufacture of coil spring units used in bed springs, mattresses, seats, seatbacks, sofas, davenports, cushions, and the like. A coil spring unit of this type has rows of coil springs which may be connected at one end of the coil by bottom cross-support wires interwound in the base of the coil of each spring, by a wooden frame connected to the base of the coil springs, by metal frame members, or by other means as desired.

The tops of the coil springs are relatively movable and constitute the relatively resiliently movable portion of the spring unit to provide flexibility. A relatively heavy continuous peripheral wire or base wire surrounds the assembly of coil springs at their top. Top cross-tie wires are woven through the top spiral of each coil spring. The cross-tie wires are in two sets usually with each set lying normal to the other. The cross-tie wires thereby hold the top spiral of each coil spring in position in the unit and together with the top spiral of the coil springs form a mesh for supporting upholstery padding. The ends of the cross-tie wires extend past the peripheral edge wire prior to bending or wrapping. The extending ends of the cross-tie wires are then bent in a loop or wrapped around the peripheral edge wire.

In the prior art the cross-tie wires are usually bent into a U-shape around the peripheral edge wire by hand using a hand tool. Sometimes a few cross-tie wires are wound around the peripheral edge wire by hand or by use of a power tool. It is preferable that all the top cross-tie wires be wound around the peripheral edge or base wire as this makes the spring unit stronger by eliminating end-play in the cross-tie wires and by securely connecting the peripheral edge or base wire with the other components in the spring unit.

A first set of three cross-tie wires may be inter-connected through the top spiral of each coil spring in one direction and a second set of top cross-tie wires inter-connected through the top spiral of each coil spring with a second set lying normal to the first set. The opposite ends of both sets of wires extend beyond the peripheral edge wire at the sides and ends of the spring unit and must be bent back or preferably wound around the peripheral edge wire. The center wire of each set is also wound around the top spiral of the coil spring at its tangent point to the peripheral edge wire. This not only connects the cross-tie wires and peripheral edge wire together, but also connects the top spirals of the outer coil springs to the peripheral edge wire.

The machine of the invention has been developed to securely wind the center cross-tie wire of each set around the peripheral wire and the top spiral of the coil spring at which the peripheral edge wire lies tangent and at the same time to wrap the side cross-tie wires of each set around the peripheral edge wire in one operation. This occurs automatically upon the operator positioning the unit and wires in the machine and initiating its operation. The machine then securely wraps or winds the cross-tie wires as stated.

While a set of three cross-tie wires is shown and described as an example, the machine may be used to wrap

one or two wires or may be modified to wrap more than three wires at one time, Also the spring unit may have the same construction at both top and bottom, such as in a davenport cushion and the wires also wrapped at the bottom of the unit.

With the foregoing in view, it is a primary object of the invention to provide an automatic multiple wire wrapping or winding machine which is simple in design and construction, positive and efficient in action, inexpensive to manufacture, which is capable of high-speed production use, which is durable in operation over a long period of time to obviate breakdown and interruption of its high production capacity, and which is easy and facile to use.

An object of the invention is to provide a machine for wrapping wires around a base wire or wires which has a mouth or receiver portion which properly positions the wires relative to each other and relative to the machine.

An object of the invention is to provide a machine having abutments or bosses which position and secure the wires while they are being wrapped or wound.

An object of the invention is to provide a machine having wire positioning and holding gates which maintain engagement of the wire with the wrapping element or dogs of the machine.

An object of the invention is to provide an automatic system for the machine controlling its operation.

An object of the invention is to provide power means and adjustable operating means in the machine which are simple and effective to wrap the wires the desired number of turns and to leave the ends of the wrapped wires extending inwardly of the spring unit.

These and other objects of the invention will become apparent by reference to the following description of the automatic wire wrapping machine embodying the invention taken in connection with the accompanying drawings in which:

FIG. 1 is a face elevational view of a machine embodying the invention with the main power cylinder and supporting base broken away.

FIG. 2 is an enlarged cross-sectional view of the machine of FIG. 1 fore-shortened in the piston rod location taken on the line 2—2 of FIG. 1 showing the power cylinder, rack, pinion gear, a wire wrapping gear, and other structural elements, and showing the spring unit in dotted lines.

FIG. 3 is an enlarged top plan view of the machine of FIG. 1 taken on the line 3—3 thereof showing the positioning and holding gates, the cylinder for actuating the gates, the wire positioning troughs, and other structural elements.

FIG. 4 is an oblique partial cross-sectional view of FIG. 2 taken on the line 4—4 thereof showing the rack, pinion gear, the wrapping gears, and other structural elements.

FIG. 5 is a partial cross-sectional view of the top portion of the machine as seen in FIG. 2 with the rack in the down position after the wires are wrapped cocking the clamping guide open to permit easy removal of the spring unit and showing a spring unit in dotted lines.

FIG. 6 is a cross-sectional view of FIG. 2 taken on the line 6—6 thereof showing the wrapping gears and side gates and with the spring unit in dotted lines prior to the wrapping operation.

FIG. 7 is a schematic partial cross-sectional view of FIG. 8 taken on the line 7—7 thereof showing the gate structure and showing linkage and the spring unit in dotted lines.

FIG. 8 is a partial cross-sectional view of the machine such as on the line 8—8 of FIG. 7 showing a wrapping

gear, trough, positioning means, and stop means and showing the wires of a spring unit in dotted lines.

FIG. 9 is a partial cross-sectional view of the machine such as on the line 9—9 of FIG. 8 showing a gate and linkage in the operated or closed position.

FIG. 10 is a perspective fragmentary view of the top spiral of a coil spring, a peripheral wire, a first set of three cross-tie wires, and a single center transverse cross-wire lying normal to and interlaced with the wires of the first set prior to the wrapping operation.

FIG. 11 is a top plan view of the device of FIG. 10 after the wrapping operation; and

FIG. 12 is a diagrammatic showing of the machine automatic power and control system and components.

Referring now to the drawings wherein like numerals refer to like and corresponding parts throughout the several views, the automatic wire wrapping machine disclosed therein as an exemplary embodiment of the invention comprises a machine frame 20 mounted on a support 21 which positions the machine at the desired height, FIG. 2. The machine 20 has a base 22 to which a rack actuating cylinder 23 is attached by a plurality of bolts 24 and nuts 25. The cylinder 23 has a piston rod 26 leading through the base 22. The rack 27 is connected on the piston rod 26 by a collar 28. The collar 28 has adjustably extendable set screws 29 abutting stops 30 on the machine frame 20. The adjustment of the set screws 29 and stops 30 properly locates the rack 27 in position relative to the gears rotated by the rack 27 as hereinafter set forth.

The rack 27 has a back web 31, FIGS. 2 and 3. A pair of bearings 32 and 33 abut the back of the rack 27 on the opposite sides of the web 31. The bearings 32 and 33 permit up and down movement of the rack 27 and support and position the rack linearly in its movement. The bearings 32 and 33 are in turn supported on a shaft 34 connected to the machine frame 20.

An intermediate drive pinion gear 35, FIGS. 2, 4, and 5, meshes with the rack 27. The pinion gear 35 is fixed on a drive shaft 36 which is rotatably supported by the machine frame 20. Three drive gears 37, 38 and 39 are also fixed on the drive shaft 36 and rotate therewith.

A center wire wrapping gear 40 meshes with the drive gear 38. Side wire wrapping gears 41 and 42 mesh with the drive gears 37 and 39 respectively on either side of the center wire wrapping gear 40. The wire wrapping gears 40, 41, 42 are rotatably supported externally rather than internally. The wrapping gears 40, 41 and 42 have hollow hubs 43, 44, and 45 respectively. A plate 46 abuts one side of the wrapping gear 40 and has an aperture receiving and surrounding the hub 43. A flanged collar 47 abuts the other side of the wrapping gear 40. A plate 48 abuts the collar 47. A plug 49 having a frusto-conical outer surface abuts the plate 48, collar 47, and the hub 43. The hub 43 has a frusto-conical internal surface mating the plug 49. All the parts are radially interrupted forming a slot 50 radially of the hub 43 defining a receiving mouth. The slot 50 allows the insertion of the spring unit peripheral edge base wire and a tangential portion of an adjacent top spiral of a coil spring unit so that they lie axially within the hub 43 and wrapping gear 40.

In this connection it will be understood that the wrapping gear 40 and hub 43 are interrupted radially by the slot 50. The internal axial portion of the hub 43 lies at the tangent point of the top spiral coil of the spring unit at the peripheral edge wire and the arcuate portion of the adjacent coil of the spring lies within the internal conical portion of the hub 43. The internal conical portion of the hub 43 permits it to by-pass the arcuate portion of the top spiral of the coil adjacent the tangent point of the peripheral edge wire. Only the wrapping gear 40 and hub 43 rotate; the other parts remain stationary. The hub 43 carries a boss 51 which engages the cross-tie wire to be wrapped and winds the cross-tie wire around the peripheral edge wire and the top spiral of the spring coil as it rotates with the wrapping gear 40 and hub 43 as hereinafter more fully described in conjunction with the operation of the machine. The stationary plug 49 holds the top spiral of the coil in position during the wrapping operation by abutting the adjacent arcuate portion of the spiral of the spring coil.

The side wrapping gear 41 and hub 44 are axially and radially rotatably positioned by the side plates 52 and 53. The plate 52 is relieved in the location of the gears 41 and 37. The plates 52 and 53 have apertures receiving the hub 44 on either side of the gear 41. The plates 52 and 53, gear 41, and hub 44 are interrupted by a radial slot 50A which allows the peripheral edge wire to be located on the axis of the gear 41 and hub 44. The hub 44 is equipped with a boss 54 which engages the cross-tie wires to be wrapped and winds the cross-tie wire around the peripheral edge wire as the boss 54 rotates with the wrapping gear 41 and hub 44.

Likewise the side wrapping gear 42 and hub 45 are axially and radially rotatably positioned by a side plate 55 and a side plate 56. The plate 55 is relieved in the location of the gear 42 and hub 39. The plates 55 and 56 have apertures receiving the hub 45 on either side of the gear 42. The plates 55 and 56, gear 42, and hub 45 are interrupted by a radial slot 50B which allows the peripheral edge wire to be located on the axis of the gear 42 and hub 45. The hub 45 is equipped with a boss 57 which engages the cross-tie wire and winds it around the peripheral edge wire as the boss 57 rotates with the wrapping gear 42 and hub 45.

The length of the rack 27 and the size of the pinion gear 35 as well as the size of the intermediate drive gears 37, 38, and 39 and the size of the wire wrapping gears 40, 41, and 44 are designed so that the wire wrapping gears 40, 41 and 44 make the desired number of revolutions when the rack is moved.

A nose plate 58 is mounted on the machine 20, FIGS. 1, 2, 3, 5, and 6. The nose plate has three guide troughs 59, 60, and 61. Each trough has a wide front narrowing inwardly and upwardly constituting receiving portion 62 leading and converging to a locating channel portion 63. The channel portion 63 of each trough 59, 60, and 61 is positioned so as to provide a wire guide leading in projected extension closely above the bosses 54, 51, and 57 closely to the sides of the hubs 44, 43, and 45 respectively. The troughs 59, 60, and 61 properly locate the extending ends of the cross-tie wires above the bosses 54, 51 and 57 in the desired location when the wires are inserted in the machine.

A stop abutment 64 and a stop abutment 65, FIGS. 3, 6, and 8 is positioned inwardly of the nose plate 58 inwardly of the side troughs 59 and 61 respectively. The stops 64 and 65 engage a crimp in the side cross-tie wires. The abutment of the crimp in the wire against the stop prevents pulling the wire inwardly during the winding operation.

A side gate 66, FIGS. 3, 6, and 7, is pivotally hinged on a pin 67 carried by an arm 68 on the machine frame 20. The side gate 66 closes sidewise against the side of a cross-tie wire in the trough 59 to hold cross-tie wires in the desired vertical plane above the boss 54 on the hub 44 of the side wrapping gear 41.

A side gate 69 is pivotally hinged on a pin 70 carried by an arm 71 on the machine frame 20. The side gate 69 closes sidewise against the side of a cross-tie wire in the trough 60 holding it in the desired vertical plane above the boss 51 on the hub 43 of the center wrapping gear 40.

A side gate 72 is pivotally hinged on a pin 73 carried by an arm 74 on the machine frame 20. The side gate 72 closes sidewise against the side of a cross-tie wire in the trough 61 holding it in the desired vertical plane above the boss 57 on the hub 45 of the side wrapping gear 42.

The gates 66, 69, and 72 are actuated by linkage which comprises a power cylinder 75 mounted on the machine frame 20. The cylinder has a piston rod 76 equipped

with a clevis 77. The clevis 77 has a pin 78 engaging an end of a bell-crank 79. The bell-crank 79 is fulcrummed on the gate 69 on the stud 80. The other end of the bell-crank 79 is pivotally connected by a pin 81 to a link 82. The link 82 is pivotally mounted on the gate 66 by a stud 83. A second link 84 has an end pivotally mounted on the stud 80 on the gate 69. The other end of the link 84 is connected to the gate 72 by a stud 85. The linkage and gates are shown in the closed position in FIGS. 3 and 6 and in the open position in FIG. 7. The clevis 77 has an extension 86 which abuts a poppet valve 87 which actuates the rack cylinder 23.

In the open position of the gates 66, 69, and 72, FIG. 7, the gate piston rod 76 is extended from the cylinder 75. In the closed position of the gates 66, 69, and 72, the piston rod 76 is retracted into the cylinder 75, FIGS. 3 and 6.

A top clamping guide 88, FIGS. 2 and 5, is pivoted on the machine frame 20 on a pin 89. A spring 90 is fixed on the machine frame 20 and bears against the clamping guide 88 urging it downwardly into clamping position. The inner end of the clamping guide 88 has a depending portion 91 equipped with a cam surface 92. The cam surface engages an arm 93 on the rack 27, FIG. 5, in the down position of the rack 27. The arm 93 on the rack 27 cams against the cam surface 92 on the extension 91 moving it inwardly which moves the clamping guide 88 upwardly against the spring 90. This opens the clamping guide 88 automatically when the rack 27 reaches its down position. When the rack moves upwardly, its initial movement releases the clamping guide 88, permitting it to close under the power of the spring 90. When the rack 27 is in its final downward movement, the clamping guide depending portion 91 is engaged by the arm 93 and the guide 88 is opened against the power of the spring 90.

A fluid pressure system, FIG. 12, powers and operates the automatic cycle of the machine and air pressure is described as an example. Air pressure supply line 106 supplies air to a two-position control valve 107 through a line 108. The supply line 106 also furnishes air to a two position control valve 109 through a line 110. The control valves 107 and 109 are mounted on the machine support 21. Each control valve has a slide piston controlling the air distribution and feed of the valve. The distribution piston of each valve moves from one end of the valve to the other upon venting an orifice controlled by a first poppet valve. The distribution piston stays at that end until another orifice is vented by a second poppet valve and then it moves back to its first position. This is well understood by those having ordinary skill in the fluid valve art and such devices are readily available on the market.

The poppet valve 87 is connected by a line 111 to one end of the control valve 109. A poppet valve 112 is connected by a line 113 to the other end of the rack control valve 109. The rack control valve 109 is connected by lines 114 and 115 to the opposite ends of the rack cylinder 23. Actuation of the poppet valve 87 actuates the rack control valve 109 to feed air via the line 115 to the rack cylinder 23 to move the rack 27 upwardly. Actuation of the poppet valve 112 actuates the rack control valve 109 to feed air to the rack cylinder 23 to move the rack 27 downwardly.

The poppet valve 94 is connected by a line 116 to one end of the gate control valve 107. A poppet valve 117 is connected by a line 118 to the other end of the gate control valve 107. The gate control valve 107 is connected by lines 119 and 120 to the opposite ends of the gate cylinder 75. Actuation of the poppet valve 94 actuates the gate control valve 107 to feed air via the line 119 to the gate cylinder 75 to open the gates and to move the clevis extension 86 outwardly. Actuation of the poppet valve 117 actuates the gate control valve 107 to feed air via the line 120 to close the gates and to move the clevis extension 86 inwardly.

A foot pedal 121 is pivoted on a base 122 as at 123. A spring 124 normally locates the pedal 121 in the up position shown. The pedal 121 has a cam face 125 which contacts the popped valves 112 and 117. The pedal is moved downwardly manually and moved upwardly by the spring 124.

A poppet valve 126 is connected in parallel with the poppet valve 94. This is a hand operated poppet valve separate from the automatic cycle of the machine. The poppet valve 126 is provided to allow the operator to reverse the cycle should a jam occur or should the rack collar 28 fail to actuate the poppet valve 94.

The normal condition of the pneumatic system is illustrated in FIG. 12 with the rack cylinder 23 positioning the rack 27 upwardly and the gate cylinder 75 holding the gates open with the clevis extension 86 positioned outwardly. This condition is established by actuation of the poppet valve 112. When the operator lifts his foot from the pedal 121, the spring elevates the cam face 125 off the poppet valve 117 into contact with the poppet valve 112.

Upon actuation of the poppet valve 112, air is released from the line 113 causing the rack control valve 109 to take a position venting air from line 114 and feeding air to line 115 moving the rack 27 to the up position. When the operator again depresses the pedal 121, the cam face 125 first moves past and actuates the poppet valve 112. This does not cause a change in the system because the system has already responded to poppet valve 112 actuation.

As the operator fully depresses the pedal 121, the cam face 125 contacts and actuates the poppet valve 117. This causes the gate control valve 107 to shift venting air from line 119 and feeding air to line 120. This causes the gate piston rod, clevis, and clevis extension 86 to move inwardly relative to the cylinder 75. This closes the gates. This also brings the clevis extension 86 into contact with poppet valve 87.

Upon the actuation of the poppet valve 87, the rack control valve 109 shifts position venting air from line 115 and feeding air to line 114 causing the rack piston rod, rack 27, and collar 28 to move downwardly. This brings the rack collar 28 into contact with the poppet valve 94 which actuates gate control cylinder 107 to shift position venting air from line 120 and feeding air to line 119 causing the gate piston rod, and clevis to extend opening the gates and moving the clevis extension off the poppet valve 87.

Thus upon the operator depressing the foot pedal the gates are automatically closed. Thus upon the gates being closed, the rack is automatically moved down and the wire wrapping operation performed. Thus upon the operator lifting his foot from the pedal, the rack is automatically moved up to receive the next wires to be wrapped.

Preparatory to operation of the machine, the operator opens a valve to the main air supply line 106. This furnishes an ever ready supply of air to the control valves 107 and 109 which, in turn, supply the cylinders and system with air. In the normal or "ready" condition of the system the foot pedal 121 is up, the gates are open, and the rack is up.

The foot-operated two position pedal 121 controls the operation of the machine leaving the operator's hands free. When the operator depresses the pedal 121, the gate power cylinder moves first to close the gates against the wires to be wound. Upon the gates closing, the clevis extension 86, contacts the poppet valve 87 which causes the rack to move downwardly to wind or wrap the wires.

The rack 27 moves downwardly until the collar 28 depresses the poppet valve 94 opening the gates. The operator then removes the wrapped wire assembly, then the operator releases the foot pedal 121, and the spring moves the pedal cam face past poppet valve 112 which causes the system to move the rack upwardly to the ready position.

FIGS. 10 and 11 show a portion of a spring unit having a relatively heavy peripheral edge base wire **100**, a top spiral **101** of a coil spring, a center cross-tie wire **102**, side cross-tie wires **103** and **104**, and an interlaced transverse cross-tie wire **105** lying normal to the cross-tie wires **102**, **103**, and **104**.

In operation of the machine **20**, the operator opens the valve to the main supply line **106** in the pneumatic system. This furnishes air pressure supply to the rack cylinder **23** an dthe gate cylinder **75** as controlled by the control valves and actuating poppet valves in the system. In the "ready" condition of the system, the foot pedal **121** is in the up or elevated position. This position last actuates the valve and control means furnishing air power to the proper side of the rack power cylinder **27** to move it to the up position as illustrated in FIGS. 1 and 2 and to move the gate cylinder **75** to the extended position, FIG. 7, opening the gates **66**, **69**, and **72**. The set screws **29** are adjusted relative to the stops **30** on the machine **20** so that the rack in its up position has rotated the wire winding gears **40**, **41**, and **42** so that their respective slots **50**, **50A**, and **50B** open outwardly towards the delivery portion of the troughs **60**, **59**, and **61** respectively in parallel with the slots of the support plates defining the mouth of the machine.

The operator then takes a spring assembly having sections such as seen in FIG. 10, and moves the extending ends **102A**, **103A**, and **104** of the cross-tie wires into the troughs **60**, **59**, and **61** respectively until the projecting ends of the cross-tie wires have passed the dogs **51**, **54**, and **57** on the wire winding gears **40**, **41**, and **42** respectively and until the peripheral edge base wire **100** abuts the internal periphery of the annular wall in the hubs **43**, **44**, and **45** defining the interior end of the slots **50**, **50A**, and **50B**. This condition is illustrated in FIG. 6. In inserting the wire assembly of FIG. 10 as hereinbefore described into the mouth of the machine, the peripheral edge wire **100** and the top spiral **101** of the coil spring are forced past the clamping guide **88** against the spring **90**. In this regard the guide **88** elevates against the spring **90** to permit the passing of the wire assembly and then is spring pressed into clamping position to hold the wire assembly in the inserted position. The machine is now ready to wrap the extending ends **102A**, **103A**, and **104** of the cross-tie wires.

The operator then depresses the foot pedal actuating the poppet valve **117** causing the control valve to supply air to the gate cylinder to close the gate. The gate cylinder **75** retracts the piston rod **76** actuating the gate closing linkage to close the gates which forces the extending wire ends **102A**, **103A**, and **104** into a vertical plane over the dogs **51**, **54**, and **57** on the hubs **43**, **44**, and **45** of their respective wrapping gears.

Upon the gates being closed, the extension **86** on the clevis **77** closes the poppet valve **87** which actuates the rack control valve **109** to supply air to the rack cylinder **23** to retract the piston rod **26** moving the rack **27** downwardly. As the rack **27** moves downwardly it rotates the intermediate drive pinion gear **35** and the drive shaft **36** upon which the final drive gears **37**, **38**, and **39** are also fixed. The rotation of the final drive gears **37**, **38**, and **39** causes the rotation of the wire wrapping gears **41**, **40**, and **42** respectively together with their hubs **44**, **43**, and **45** respectively. This causes the dogs **54**, **51**, and **57** on their respective hubs **44**, **43**, and **45** to rotate and respectively contact the projecting ends **103A**, **102A**, and **104** of the cross-tie wires. In their rotation, the dogs **54**, **51**, and **57** orbit around the peripheral edge wire **100** and wrap the extending ends of the cross-tie wires **103A**, **102A**, and **104** around the preipheral edge wire **100**. In this regard the dogs **54**, **51**, and **57** make several revolutions in their orbiting of the peripheral edge wire **100** and wrap the extending ends **103A**, **102A**, and **104** several times around the peripheral edge wire **100** as seen in FIG. 11.

Immediately after the wire wrapping operation is completed, the collar **28** on the rack piston rod **26** contacts the poppet valve **94** actuating the gate control valve **107** to supply air to the gate power cylinder **75** to extend the piston rod **76** to actuate the linkage to open the gates **66**, **69**, and **72**. This frees the wrapped wire assembly relative to the gates. Also upon the rack **27** reaching its down position, FIG. 5, the arm **93** on the rack **27** contacts the cam surface **92** of the extension **91** on the clamping guide **86** moving the clamping guide **88** upwardly against the spring **90** and freeing the wrapped wire assembly relative to the clamping guide **88**.

The operator then removes the wrapped portion of the wire assembly as seen in FIG. 11 from the machine.

The operator removes his foot from the operating pedal permitting the pedal to move to its spring biased up-position which actuates the poppet valve **112** which causes the rack power cylinder to move the rack **27** to the up position as seen in FIG. 1. The device is now ready to have another portion of the wire unit assembly as seen in FIG. 10 inserted and wrapped as previously described.

From the foregoing it will be understood that the operator simply turns on the main air supply valve and this simple operation places the machine automatically in the ready position. He then inserts the wire unit assembly as seen in FIG. 10 in the machine and depresses the foot pedal. The machine then automatically clamps and wraps the cross-tie wires around the peripheral edge wire and unclamps the wires. He then extracts the wrapped section of the wire unit from the machine and releases his foot from the pedal and the machine automatically moves to the ready position to receive the next unwrapped portion of the wire unit.

The machine provides guide troughs to properly locate the projecting ends of the cross-tie wires in the machine in a horizontal plane, automatic gates to properly locate the cross-tie wires in a vertical plane relative to the wrapping dogs, and the clamping guide to hold the assembly in the machine when fully inserted.

The machine also furnishes automatic releasing mechanism to free the wraped wire assembly upon the cross-tie wires being wrapped on the peripheral edge wire. This is effected by the gates automatically opening upon the wires being wrapped and upon the clamping guide **88** being moved allowing the operator to extract the wrapped wire portion of the assembly from the machine.

The machine provides automatic means for wrapping three cross-tie wires automatically as illustrated and described. However, it is within the perview of the invention to wrap any number of wires as may be desired and suitable in the production of the spring unit to suit the best efficiency of the operation. While the machine has been shown and described as pneumatically controlled and operated, it is believed that equivalent hydraulic, mechanical, and electrical systems are within the scope of the invention.

Although but a single pneumatic embodiment of the inventive machine has been disclosed and described in detail, it is obvious that many changes may be made in the size, shape, detail, and arrangement of the various elements in the invention within the scope of the appended claims.

I claim:

1. An automatic wire wrapping machine for winding a plurality of wires around a base wire at the same time comprising,

a plurality of wire wrapping gears on a common rotational axis, each said gear having opposite sides, a hub projecting axially on either side of each said wire wrapping gear, a circumferential edge, and a radial slot leading through said circumferential edge and said hub to a point beyond and including the rotational axis of said wire wrapping gear;

a machine frame,

paired mounting plates on said machine frame on either side of each said wire wrapping gear; said plates hav-

ing aligned bearing apertures receiving and rotatably mounting each said hub and abutting the opposite sides of each said wire wrapping gear;

each said mounting plate having a receiving slot leading to its said bearing aperture and aligned parallel relative to one another defining a wire receiving mouth in the machine leading to the radial slot in each said wire wrapping gear;

said wire wrapping gears being rotatable to align their radial slots with the receiving slots in said plates so that a base wire moved radially sidewise through said plate slots also moves through said radial slots of said wire wrapping gears so as to take a proper work position with the axis of the base wire lying on the rotational axis of said wire wrapping gears so that said wire wrapping gears may rotate around said base wire;

a drive gear engaging each said wire wrapping gear,

a drive shaft rotatably mounted on said machine frame supporting said drive gears,

a drive pinion gear on said drive shaft,

a rack reciprocably supported on said machine frame engaging said pinion gear,

a rack cylinder mounted on said machine frame having a piston rod connected to said rack for reciprocating said rack;

movement of said rack rotating said pinion gear, drive shaft, and drive gears with said drive gears rotating said wire wrapping gears; and

a radially positioned axially projecting wire wrapping dog on each said hub adjacent the radial slot in each said wire wrapping gear;

said rack being adjusted in reciprocating movement so that at the ends of travel in both directions said wire wrapping gears are positioned with their radial slots in alignment with the slots in said mounting plates so that the base wire may be inserted and extracted relative to said wire wrapping gears;

said base wire being inserted and extracted together with cross-tie wires lying normal to the base wire with their ends projecting beyond said base wire and past and in the plane of said dogs on said wire wrapping gears;

rotation of said wire wrapping gears with said wires so disposed orbiting said dogs around said base wire with said dogs engaging said cross-tie wires while orbiting, thereby wrapping the extending ends of said cross-tie wires around said base wire.

2. In a machine as set forth in claim 1,

a side gate pivoted on said machine frame at each said wire wrapping gear on the side thereof having said dog,

linkage on said frame connected to each said gate for closing said gate against said dog to hold a cross-tie wire in the plane of said dog,

and a gate operating cylinder on said frame having a piston rod connected to said linkage for swinging and holding said gates between and in their open and closed positions.

3. In a machine as set forth in claim 1,

a nose plate on said frame having a receiving and channeling trough for each said cross-tie wire funneling down to a delivery channel leading to the mouth of said machine in the plane of each said dog on each said wire wrapping gear facilitating quickly inserting the projecting ends of the cross-tie wires in the machine in the proper location and position.

4. In a machine as set forth in claim 1,

a clamping guide pivotally mounted on said frame over the mouth of said machine adapted to engage, channel, and locate a base wire in said wire winding gears on their rotational axis,

a spring urging said clamping guide into clamping relationship relative to a base wire and permitting insertion of a base wire past said clamping guide by allowing movement of said clamping guide;

said spring pressed clamping guide holding a base wire in position in said wire wrapping gears after insertion in the mouth of the machine;

a depending portion on said clamping guide on the opposite side of said clamping guide relative to said pivotal mounting on said frame,

and an arm on said rack adapted to engage said depending portion on said clamping guide at the end of travel of said rack to pivot said clamping guide away from the base wire to allow easy removal of the base wire from the mouth of the machine.

5. In a machine as set forth in claim 1, a fluid pressure power and control system including said gate cylinder and said rack cylinder comprising,

a fluid pressure supply line,

a gate control valve connected to said supply line for selectively bi-directionally powering said gate cylinder to open said gates and to close said gates,

a rack control valve connected to said supply line for selectively bi-directionally powering said rack cylinder to move said rack up and down to rotate said wire wrapping gears;

a gate closing poppet valve and a gate opening poppet valve connected to said gate control valve,

a rack lowering poppet valve and a rack raising poppet valve connected to said rack control valve;

said gate control valve and said rack control valve being actuated by tripping said poppet valves;

said gate closing poppet valve and said rack raising poppet valve being operationally paired;

a two position lever having a first "wrap" position actuating said gate closing poppet valve and a second "relocate" position actuating said rack raising poppet valve;

said rack lowering poppet valve being actuated by said gate cylinder when said gates are closed to cause lowering said rack to orbit said wire wrapping gears and the wires being wrapped around said base wire;

said gate opening poppet valve being actuated by said rack cylinder when the orbiting of said wire wrapping gears is completed;

movement of said lever to the wrap position tripping said gate closing poppet valve to automatically close said gates to abut the wires to be wrapped; closing said gates automatically tripping said rack lowering poppet valve to lower said rack to orbit said wire wrapping gears to wrap the wires; and completion of lowering said rack automatically tripping said gate opening poppet valve to open said gates to release wrapped wires for removal from the machine;

movement of said lever to the "relocate" position tripping said rack raising poppet valve to raise said rack to the ready position.

6. In a device as set forth in claim 5, a foot pedal constituting said lever; said pedal having an up ready position actuating said rack raising poppet valve, and

a spring normally urging said pedal in said up ready position;

said pedal having a down wrap position actuating said gate closing poppet valve;

said pedal being depressable by an operator against said spring to actuate said gate closing poppet valve to set automatic cycle of said machine in operation;

said spring moving said pedal to the up position upon release by the operator to actuate said rack raising poppet valve to place said rack in the ready position.

7. An automatic wire wrapping machine for winding a plurality of wires around a base wire at the same time comprising,

a plurality of wire wrapping gears on a common rotational axis, each said gear having opposite sides, a hub projecting axially on either side of each said wire wrapping gear, a circumferential edge, and a

radial slot leading through said circumferential edge and said hub to a point beyond and including the rotational axis of said wire wrapping gear;

a machine frame,

paired mounting plates on said machine frame on either side of each said wire wrapping gear; said plates having aligned bearing apertures receiving and rotatably mounting each said hub and abutting the opposite sides of each said wire wrapping gear;

each said mounting plate having a receiving slot leading to its said bearing aperture and aligned parallel relative to one another defining a wire receiving mouth in the machine leading to the radial slot in each said wire wrapping gear;

said wire wrapping gears being rotatable to align their radial slots with the receiving slots in said plates so that a base wire moved radially sidewise through said plate slots also moves through said radial slots of said wire wrapping gears so as to take a proper work position with the axis of the base wire lying on the rotation axis of said wire wrapping gears so that said wire wrapping gears may rotate around said base wire;

a drive gear engaging each said wire wrapping gear;

a drive shaft rotatably mounted on said machine frame supporting said drive gears,

a drive pinion gear on said drive shaft,

a rack reciprocably supported on said machine frame engaging said pinion gear,

a rack cylinder mounted on said machine frame having a piston rod connected to said rack for reciprocating said rack;

movement of said rack rotating said pinion gear, drive shaft, and drive gears with said drive gears rotating said wire wrapping gears; and

a radially positioned axially projecting wire wrapping dog on each said hub adjacent the radial slot in each said wire wrapping gear;

said rack being adjusted in reciprocating movement so that at the ends of travel in both directions said wire wrapping gears are positioned with their radial slots in alignment with the slots in said mounting plates so that the base wire may be inserted and extracted relative to said wire wrapping gears;

said base wire being inserted and extracted together with cross-tie wires lying normal to the base wire with their ends projecting beyond said base wire and past and in the plane of said dogs on said wire wrapping gears;

rotation of said wire wrapping gears with said wires so disposed orbiting said dogs around said base wire with said dogs engaging said cross-tie wires while orbiting thereby wrapping the extending ends of said cross-tie wires around said base wire.

a side gate pivoted on said machine frame at each said wire wrapping gear on the side thereof having said dog.

linkage on said frame connected to each said gate for closing said gate against said dog to hold a cross-tie wire in the plane of said dog,

a gate operating cylinder on said frame having a piston rod connected to said linkage for swinging and holding said gates between and in their open and closed positions,

a fluid pressure power and control system including

said gate cylinder and said rack cylinder comprising,

a fluid pressure supply line,

a gate control valve connected to said supply line for selectively bi-directionally powering said gate cylinder to open said gates and to close said gates,

a rack control valve connected to said supply line for selectively bi-directionally powering said rack cylinder to move said rack up and down to rotate said wire wrapping gears;

a gate closing poppet valve and a gate opening poppet valve connected to said gate control valve,

a rack lowering poppet valve and a rack raising poppet valve connected to said rack control valve;

said gate control valve and said rack control valve being actuated by tripping said poppet valves;

first means actuating said gate closing poppet valve and second means actuating said rack raising poppet valve;

said rack lowering poppet valve being actuated by said gate cylinder when said gates are closed to cause lowering said rack to orbit said wire wrapping gears and the wires being wrapped around said base wire;

said gate opening poppet valve being actuated by said racks cylinder when the orbiting of said wire wrapping gears is completed;

movement of said first means tripping said gate closing poppet valve to automatically close said gates to abut the wires to be wrapped; closing said gates automatically tripping said rack lowering poppet valve to lower said rack to orbit said wire wrapping gears to wrap the wires; and completion of lowering said rack automatically tripping said gate opening poppet valve to open said gates to release wrapped wires for removal from the machine;

movement of said second means tripping said rack raising poppet valve to raise said rack to the ready position.

8. In a device as set forth in claim 7, a foot pedal constituting said first and second means; said pedal having an up ready position actuating said rack raising poppet valve; and

a spring normally urging said pedal in said up ready position;

said pedal having a down wrap position actuating said gate closing poppet valve;

said pedal being depressable by an operator against said spring to actuate said gate closing poppet valve to set the automatic cycle of said machine in operation;

said spring moving said pedal to the up position upon release by the operator to actuate said rack raising poppet valve to place said rack in the ready position.

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