Sept. 8, 1964 M. J. ZENK 3,147,894

METHOD AND APPARATUS FOR AUTOMATICALLY TYING A RIBBON INTO A BOW

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FIG. 1

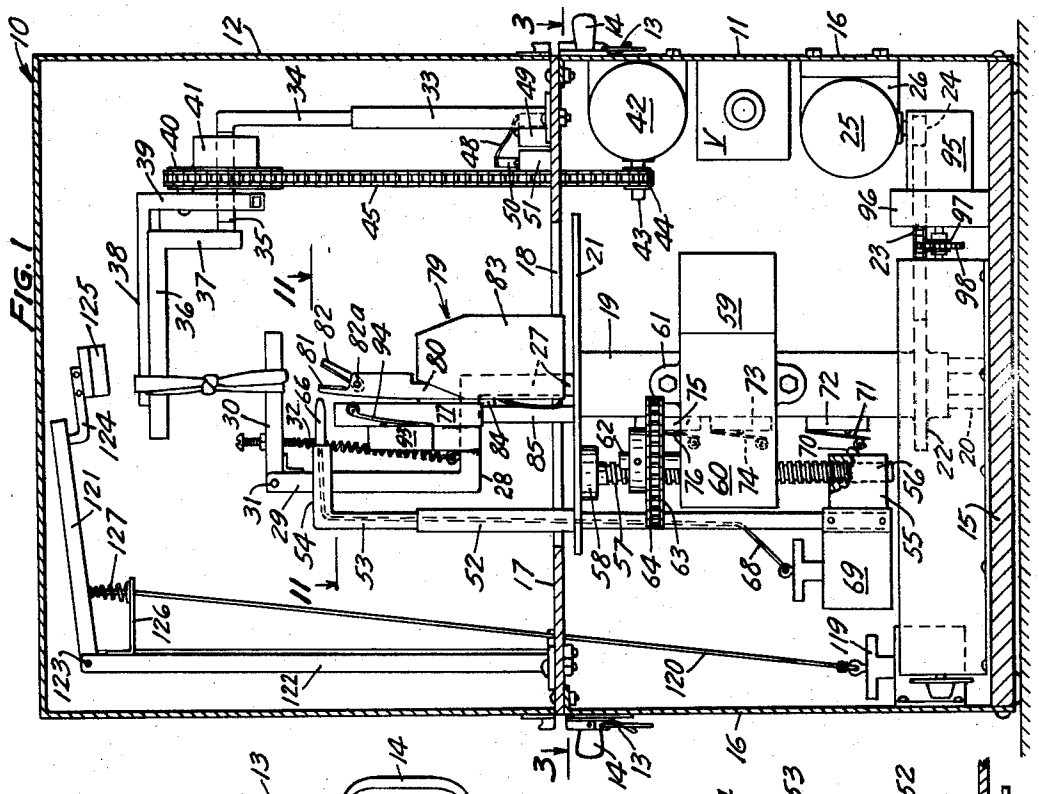


FIG. 2

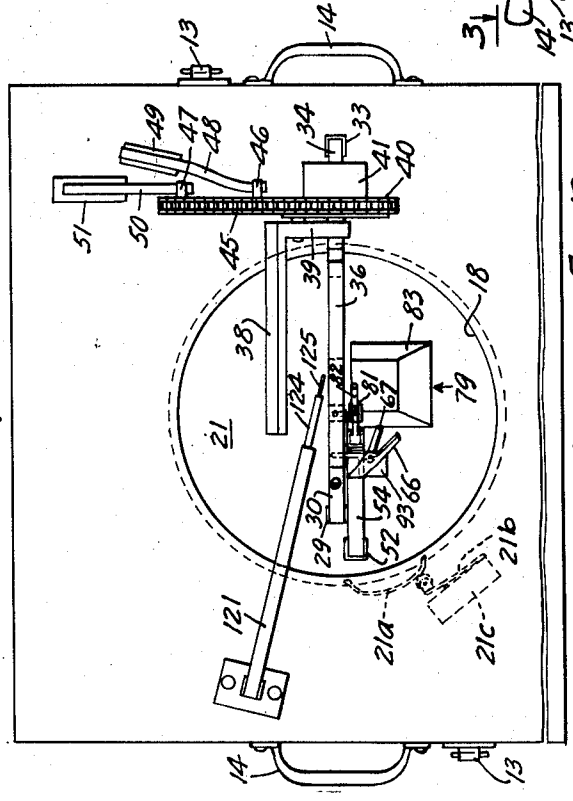


FIG. 12

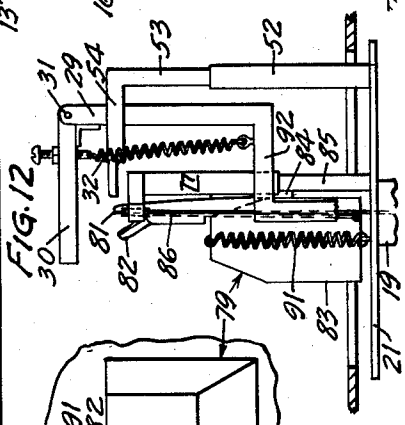
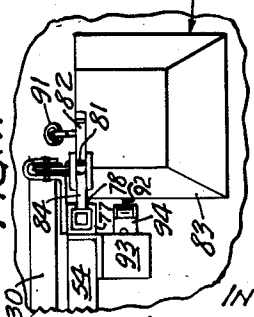


FIG. 11



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FIG. 3

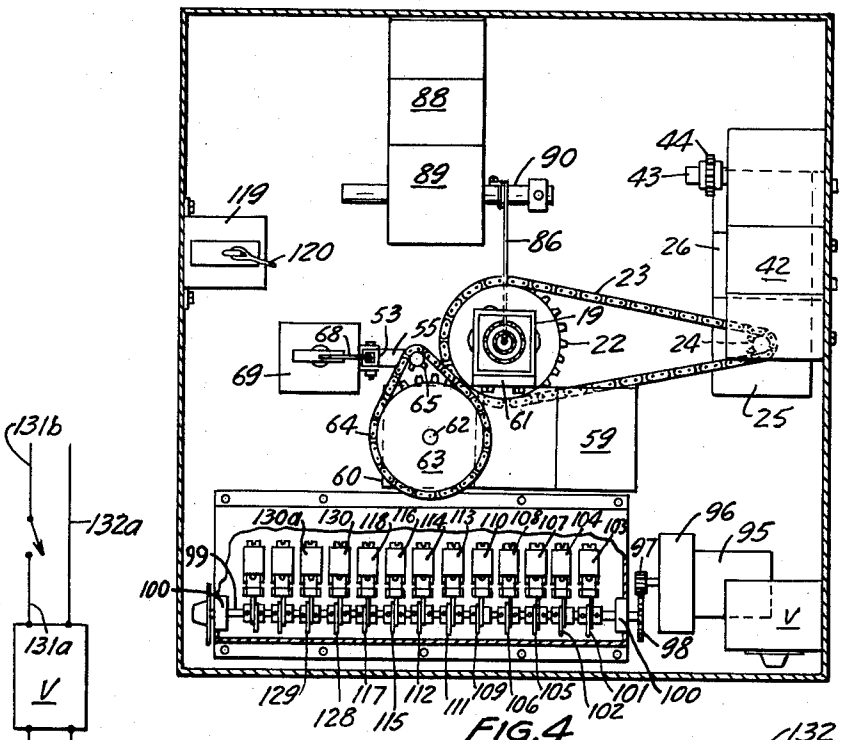
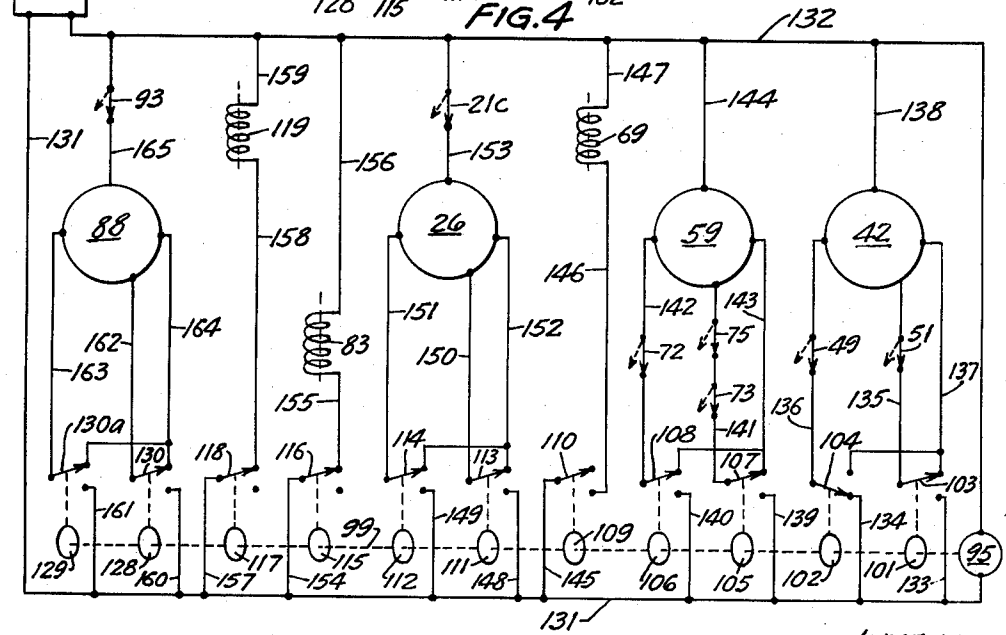


FIG. 4



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METHOD AND APPARATUS FOR AUTOMATICALLY TYING A RIBBON INTO A BOW

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FIG. 5

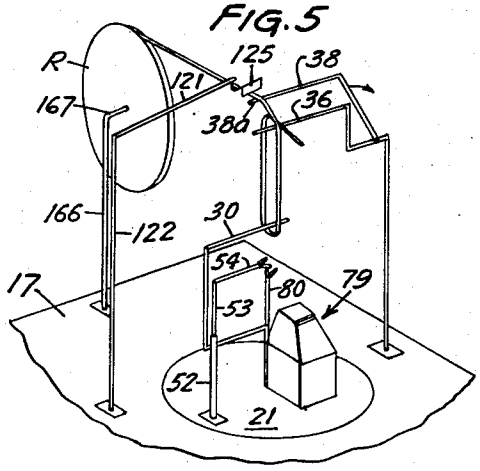


FIG. 6

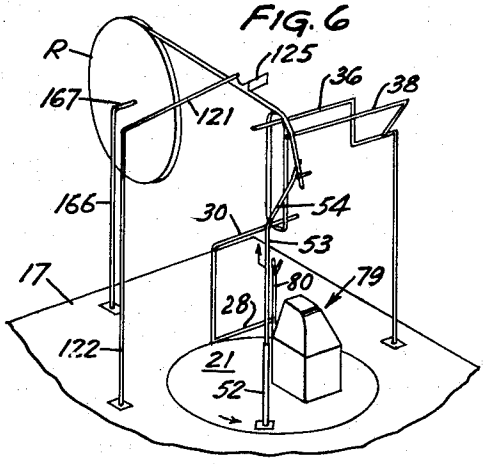


FIG. 7

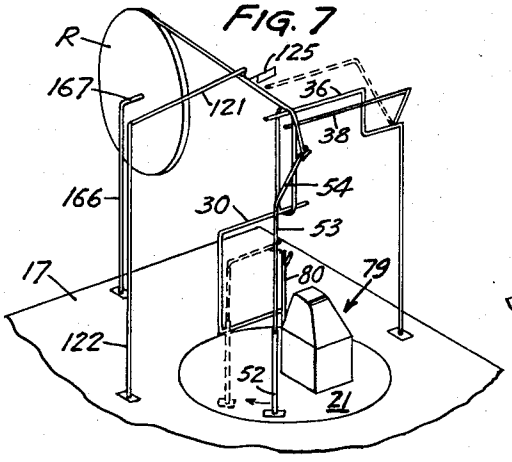


FIG. 8

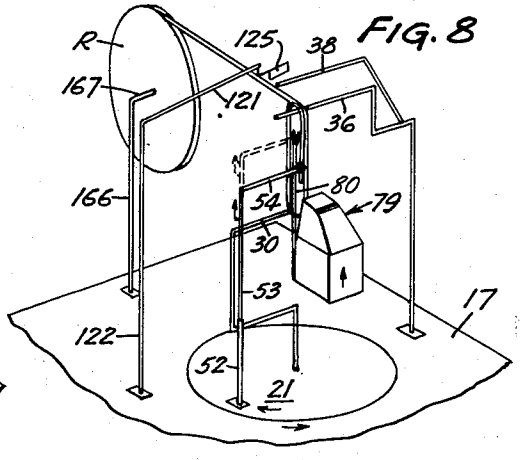


FIG. 9

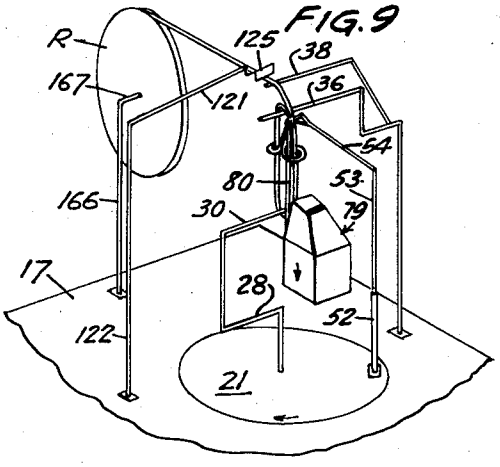
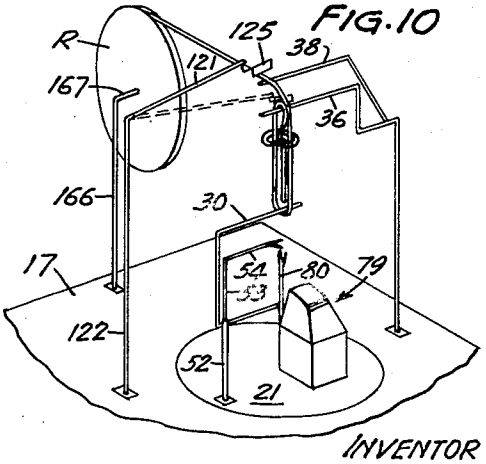


FIG. 10



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United States Patent Office 3,147,894 Patented Sept. 8, 1964

3,147,894

METHOD AND APPARATUS FOR AUTOMATICALLY TYING A RIBBON INTO A BOW

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Filed Jan. 17, 1962, Ser. No. 168,311
12 Claims. (Cl. 223—46)

This invention relates to a highly efficient method and apparatus for automatically tying an elongated ribbon formed of flexible, fabric material, into a bow.

An object of this invention is to provide a highly efficient method and apparatus for automatically tying an elongate ribbon, formed of flexible fabric material into an attractive bow, through a series of step-by-step timed operations.

Another object of this invention is to provide a novel method and apparatus of great commercial capacity for automatically tying an elongate ribbon, formed of flexible, preferably fabric material, into a highly attractive bow and whereby the method and apparatus may be utilized for continuous line production.

A more specific object of this invention is the provision of a novel and improved method and apparatus which through a series of timed sequential operations, automatically ties an elongate ribbon into an attractive bow and wherein the elongate ribbon is first wound upon spaced-apart wrapping surfaces to define an oval-shaped loop, and then while maintaining one end portion of the ribbon stationary, forming and knotting a small transverse loop around the median portion of the oval shaped loop to thereby complete the bow.

These and other objects and advantages of my invention will more fully appear from the following description made in connection with the accompanying drawing wherein like character references refer to the same or similar parts throughout the various views, and in which:

FIG. 1 is a side elevational view of the bow tying apparatus with parts of the housing broken away for clarity;

FIG. 2 is a top plan view of the bow-tying apparatus with the upper housing section removed therefrom;

FIG. 3 is a horizontal cross sectional view taken approximately along line 3—3 of FIG. 1 and looking in the direction of the arrows;

FIG. 4 is a diagrammatic schematic view of a circuitry which is advantageously employed in the invention;

FIGS. 5 to 10 are diagrammatic perspective views illustrating the various positions of certain parts of the bow-typing apparatus during each successive step of the bow-tying operation;

FIG. 11 is a transverse section taken approximately along line 11—11 of FIG. 1 and looking in the direction of arrows; and

FIG. 12 is a detailed elevational view of the loop-knotting mechanism.

Referring now to the drawings and more particularly to FIG. 1, it will be seen that one embodiment of my novel bow tying apparatus, designated in its entirety by the reference numeral 10, is there shown. The various mechanisms comprising my novel bow tying apparatus are preferably enclosed within a housing and this housing includes a lower housing section 11 which is of generally rectangular configuration. The various drive means and timing control means are disposed within this lower housing section 11. The housing also includes an upper housing section 12 also of rectangular configuration and which is detachably secured to the lower housing section by conventional over center locking means 13 as best seen in FIGS. 1 and 2. It will be noted that the lower housing section 11 is provided with carrying handles 14 which are affixed to opposed side walls thereof and which facilitate carrying of the apparatus.

Referring again to FIGS. 1 and 2, it will be seen that

the lower housing section 11 includes a supporting base frame 15, upstanding side walls 16 and a top wall 17. The top wall 17 is provided with a centrally located circular opening 18 therein. An elongate upstanding turn table support post 19 is positioned within the lower housing 11 and this support post which is of hollow construction is also of substantially rectangular cross sectional configuration. Another post 20 is rigidly mounted in upstanding relation on the base frame 15 and projects into the turn table support post 19 to rotatably mount the same about its longitudinal axis. It is pointed out that post 20 will be provided with suitable bearings (not shown) upon which the turn table support post rotates.

Rigidly affixed to the upper end of the turn table support post 19 is a substantially circular turn table 21 which is slightly larger than the opening 18 in the top wall 17 and which is positioned in close proximity to the opening.

Means are provided for revolving the turn table 21 and this revolving means includes a relatively large sprocket 22 affixed to the bottom of the post 19 and revolvable therewith as best seen in FIG. 3. An endless chain 23 is trained around the sprocket 22 and around a smaller sprocket 24 which is affixed to a shaft drivingly connected to a conventional reversible electric motor 26 through gear box 25. The gear box 25, together with a chain and sprocket drive serve as a suitable speed reduction means.

A fixed post 27 projects upwardly through the turn table support post 19 and through a centrally located aperture in the turn table 21. This fixed central post does not revolve during rotation of the turn table 21 and it will be noted that this central post includes a lower offset portion 28 which is horizontally disposed. A central vertical portion 29 is affixed to the lower offset portion 28. A lower loop holding member 30 is pivotally connected to the upper portion of the central vertical portion by means of a pivot 31. The pivotal connection of the lower-loop holding member 30 permits vertical swinging movement of the latter about a substantially horizontal axis. A coil spring 32 normally urges this lower loop-holding member 30 to the horizontal position illustrated in FIG. 1.

A vertically adjustable post is affixed to the top wall 17 adjacent one side thereof and this vertically adjustable post includes a hollow lower post section 33. An elongate upper post section 34 is telescopically received within the lower post section 33 and is vertically adjustable relative thereto. The upper post section 34 has the transverse arm 35 affixed thereto and projecting laterally therefrom. A substantially horizontally disposed upper loop-holding member or arm 36 is rigidly affixed to the transverse arm 35 by means of a vertical portion or arm 37. It will be noted that this horizontally disposed loop-holding member is disposed in vertically spaced apart substantially parallel relation with respect to the lower loop-holding member 30 as best seen in FIG. 1. These upper and lower loop-holding members serve to provide spaced apart, substantially parallel wrapping surfaces upon which the elongate ribbon is originally wrapped. When a ribbon is so wrapped upon these surfaces in a manner to be described hereinbelow, the ribbon will define an oval-shaped loop.

Mechanism is provided for winding the ribbon around the respective upper and lower loop-holding members and this winding mechanism includes a ribbon winding arm 38 which is rotatably carried by the transverse arm 35 of the upper post section 34. This ribbon winding arm 38 is provided with a clamping surface which permits a ribbon to be pulled forwardly therethrough but which prevents the ribbon from being pulled rearwardly or removed from the clamp. The ribbon winding arm 38 terminates at one end in the vertical portion 39 which is affixed to a relatively large pulley 40. The pulley 40

is rotatably journaled upon the transverse arm **35** by means of a bearing structure **41** and it will be seen that rotation of the pulley also causes rotation of the ribbon winding arm **38**.

Means are provided for reversibly driving the pulley and winding arm and this means includes a reversible motor and gear box unit **42** affixed to one of the side walls **16** of the lower housing section **11**, as best seen in FIG. 1. The reversible motor and gear box unit **42** is provided with a conventional drive shaft **43** and a relatively small pulley **44** is keyed to the shaft **43** for rotation therewith. The relatively large pulley **40** and small pulley **44** are drivingly connected by an endless chain **45** to thereby permit the driven winding arm to be driven in both clockwise and counter clockwise directions.

Referring now to FIG. 2, it will be seen that the endless drive chain **45** is provided with a pair of abutment elements **46** and **47** which are affixed thereto and project laterally therefrom. A switch actuator arm **48** is positioned in obstructing relation with respect to abutment element **46** which when depressed actuates or opens the limit switch **49**. Another actuator arm **50** is disposed in abutting relation with respect to abutment element **47** and this actuator arm when depressed by the abutment element **47** opens a limit switch **51**. Thus, movement of the chain in a clockwise or winding direction will be limited by the coaction of the abutment element **46** and the limit switch **49** while the return movement in an unwinding or counter clockwise direction of the chain will be limited by the coaction of the abutment element **47** and the limit switch **51**. It is also pointed out that the turn table **21** while being revolvable in clockwise and counter clockwise direction is also provided with means for stopping revolving movement of the turn table after movement through a predetermined distance. It will be seen in FIG. 2 that the turn table is provided with an abutment element **21***a* which is affixed to the periphery of the turn table for movement therewith. An actuator arm **21***b* is positioned in abutting relation with respect to the abutment element and when depressed opens the limit switch **21***c* thus causing the revolving of the turn table to stop.

It is pointed out that when the driven winding arm is revolved, the winding arm will be moved from an initial position as illustrated in FIGS. 1, 2, 5 and 10, in an arc and in a winding or clockwise direction through a distance exceeding one complete revolution. The movement of the ribbon winding arm is illustrated in FIGS. 5, 6 and 7 including the return movement thereof. Thus it will be seen that when the ribbon winding arm has a ribbon clamped thereto and when the winding arm is wound around the loop-holding members, through an arc exceeding one complete revolution, the ribbon will be wound upon the loop-holding members and will define an oval shaped loop. The amount of movement in a given direction of the ribbon winding arm is controlled by the interaction of the abutment elements and limit switches and it is also pointed out that means are provided for automatically reversing the drive of the reversible motor and gear box unit **42**.

A loop-encircling mechanism is provided for sequentially forming a small transverse loop with one end portion of the ribbon about the oval shaped loop positioned upon the upper and lower loop-holding members. This loop-encircling mechanism includes a vertical guide element or post **52** which is affixed to the turn table **21** in upstanding relation thereto and adjacent a peripheral edge thereof. An elongate loop-encircling post or member **53** is vertically shiftable through the guide post **52** and affixed to the upper end of the member **53** is a horizontally disposed arm **54** as best seen in FIG. 1. The lower end of the loop-circling member **53** has a bracket **55** affixed thereto and this bracket **55** rigidly carries a traveling nut **56**. An elongate threaded actuator screw **57** is rotatably suspended from the lower surface to the turn table **21** adjacent one peripheral edge portion thereof by means of a screw bearing and retaining unit **58**.

Means are provided for revolving the screw **57** and this revolving means includes a reversible electric motor **59** also having a suitable speed reduction means in the form of a gear box **60**. This motor and gear box unit are affixed to the turn table support post **19** by means of an attachment bracket **61**. The motor and gear box unit are provided with a drive shaft **62** which has a relatively large sprocket **63** affixed thereto. This relatively large sprocket **63** is drivingly connected to a smaller sprocket **65** affixed to the actuator screw **57** by means of an endless drive chain **64**. Thus it will be seen that the actuator screw may be rotated in one direction to cause elevating movement of the loop-encircling post **53** through action of the traveling nut **56** and may be drivingly revolved in the opposite direction to cause lowering of the loop-encircling member.

Means are provided for permitting the loop-encircling post or member **53** to releasably grip the end portion of an elongate ribbon. This clamping means includes a fixed clamping element or jaw **66** affixed to the free end of arm **54** as best seen in FIG. 2. A movable clamping element or jaw **67** is pivotally mounted on the arm **54** for pivotal movement towards and away from the fixed clamping jaw **66** and cooperates with the fixed clamping jaw to releasably grip a ribbon therebetween. The movable clamping jaw **67** is normally urged to an open or released position by resilient spring element (not shown) and a cable **68** is affixed to the movable clamping jaw to swing and pivot the clamping jaw to the closed position. Cable **68**, as best seen in FIG. 1, extends downwardly through the post **52** and then outwardly through an opening formed in the post adjacent the lower end thereof. The lower end of the cable **68** is connected to a solenoid unit **69** which is also carried by the lower end of the loop-encircling post **53** and which is movable therewith. It will be seen that when the solenoid unit **69** is energized, the spring means (not shown) will urge the movable clamping jaw **67** to the open or released position.

Referring now to FIG. 1, it will be seen that the travelling nut **56** has an abutment member **70** affixed thereto and movable therewith. The actuator arm **71** of a lower limit switch **72** is disposed in abutting relation with respect to the path of travel of the abutment element **70**. It will be noted that the limit switch **72** is affixed to the turn table support post **19** adjacent the lower portion thereof. This normally closed lower limit switch **72** serves to limit downward movement of the loop-encircling member **53**. Limit switch means are also provided for limiting upward movement of the loop-encircling member **53** and it is also pointed out that the loop-encircling member also has an intermediate position when the post is moving with the turn table **21**. The means for limiting movement of the loop-encircling member **53** intermediate the path of travel comprises an intermediate limit switch **73** having an actuator arm **74**. An upper limit switch **75** is affixed to the turn table support post **19** adjacent the upper portion thereof and this upper limit switch **75** is provided with an actuator arm **76**.

Thus it will be seen that the loop-encircling member **53** has three positions or stations with regard to vertical movement. It is also pointed out that when the loop-encircling member is revolved around the oval shaped loop through a distance exceeding at least one complete revolution, this loop-encircling member will cause the ribbon gripped thereby to form a small transverse loop around the median portion of the oval shaped loop.

Mechanism is also provided for knotting the small transverse loop around the median portion of the oval shaped loop and this loop knotting and tying mechanism includes a hollow guide member **77** which is affixed to the central post **27** and to the lower offset portion **28** of the central post. It will be noted that this hollow guide member **77** is vertically disposed and is provided

with an elongate slot **78** therein. This hollow guide member **77** serves as a guiding means for a loop-knotting member **79** which is vertically movable relative to the guide member. This loop-knotting member **79** includes a loop knotting post or arm **80**. This loop-knotting arm **80** has a fixed jaw **81** carried by the upper end thereof. A movable jaw **82** is pivotally connected by a pivot pin **82***a* to the loop-knotting arm **80** for pivotal movement towards and away from the fixed jaw **81**. It will be seen that the movable jaw **82** cooperates with the fixed jaw **81** to grip the ribbon therebetween. It is also pointed out that the jaw **82** is normally urged to an open or released position by resilient spring means (not shown). The means for moving the movable jaw **82** to the closed or clamped position includes a solenoid switch unit **83** suitably disposed within a housing. Although not shown in the drawings, the solenoid unit is connected to one end of a cable, the other end of the cable being secured to the movable jaw **82**.

Upon energization of the solenoid unit **83**, the cable will be tensioned to thereby move the movable jaw **82** to the closed clamping position and when the solenoid unit is de-energized, the resilient spring means (not shown) will urge the movable jaw to be opened or released.

A solenoid unit **83** has a plate **84** affixed thereto which projects through the slot **78** in the hollow guide member **77**. The slide post **85** is affixed to the plate **84** and is vertically slidable within the hollow guide member **77**. Thus the loop-knotting member **79** is vertically shiftable relative to the turn table and the central post **27**.

Means are provided for shifting the loop tying member **79** between upper and lower positions and this means includes a cable **86** affixed to the solenoid unit **83** and trained over a pulley unit **87**, the latter being carried by the vertical guide member **77**. This cable **86** extends downwardly through the central post **27** and through the turn table support post **19** and through the lower end of the latter.

Means are provided for tensioning the cable **86** and this means includes a reversible electric motor **88** having a suitable speed reduction in the form of a gear box **89**. The electric motor and gear box unit are provided with a conventional shaft **90** and it will be seen that the lower end of the cable **86** is secured to the shaft **90**. Therefore, when the shaft **90** is rotated in a clockwise direction, the cable **86** will be wound thereupon thus tensioning the cable and causing the loop-knotting members **79** to be elevated. Reversing the motor and gear box unit will cause the cable to be unwound from the shaft **90** so that the loop-knotting member **79** will be lowered. The resilient spring means **91** which extends between the solenoid unit **83** and the central post **27** assists in the return or lowering of the loop-knotting member **79**.

Means are provided for controlling and limiting the upward movement of the loop-knotting member **79**. This means includes an abutment element **92** carried by the solenoid unit **83**. The limit switch **93** is affixed to the vertical guide member **77** and is provided with an actuator arm **94**. It will, therefore, be seen that when the loop-knotting member **79** is shifted vertically upwardly the abutment element **92** will strike and press the actuator arm **94** thus opening the normally closed limit switch **93**. The further movement of the loop-knotting member **79** will be stopped. The loop-knotting member **79** will remain in its elevated position until the electric motor and gear box unit are reversed.

A timer control mechanism is provided for sequentially controlling the various components of the bow tying apparatus and this timer control mechanism includes an electric motor **95** having a gear box **96** for reducing the speed of the drive shaft. A drive gear **97** is affixed to the electric motor gear box unit drive shaft and this drive gear **97** is in enmeshing relationship with a larger driven gear **98**, the latter being keyed to an elongate cam shaft **99**. The cam shaft **99** is journaled for rotation between a pair of spaced apart bearing supports **100** as best seen in FIG. 3.

It will be seen that a plurality of cams are keyed to cam shaft **99** for rotation therewith and these cams serve to operate switches which in turn control operation of the various motors and solenoid units. The cam shaft **99** is provided with a pair of cams **101** and **102** affixed thereto adjacent the right end thereof as viewed in FIGS. 3 and 4 and these cams serve to open and close switches **103** and **104** respectively. Switches **103** and **104** control operation of motor **42** and when switch **103** is closed, switch **104** will be open and motor **42** will be driven in a direction to wind the ribbon around the loop-holding members and when switch **104** is closed, switch **103** will be opened and the ribbon winding arm will be driven in a reverse direction.

A pair of cams **105** and **106** which are also affixed to cam shaft **99** open and close switches **107** and **108** which are arranged in controlling relation with respect to reversible motor **59**. When switch **107** is opened, switch **108** will be closed and the motor **59** will be driven in one direction and alternatively, when switch **108** is closed switch **107** will be opened and the motor **59** will be driven in the opposite direction.

The cam **109** is operative to open and close switch **110** to thereby energize and de-energize the solenoid unit **69**. The pair of cams **111** and **112** are operable for opening and closing switches **113** and **114** respectively. It will be noted that these switches are arranged in controlling relation with respect to motor **26** and serve to permit the motor to be driven in opposite directions. The cam **115** is operable to open and close switch **116** for de-energizing and energizing solenoid unit **83**.

A cam **117** opens and closes a switch **118** for energizing and de-energizing a solenoid unit **119**. Referring now to FIG. 1, it will be seen that solenoid **119** is operatively connected to a pull rod **120** for shifting the pull rod longitudinally or in an axial direction. Pull rod **120** is connected to a cutter arm **121**, the latter being pivotally mounted on a support post **122** by a pivot pin **123**. It will be seen that this cutter arm **121** is pivotal about a substantially horizontal axis and carried at its outer end is a cutter bracket **124** which suitably supports a cutter element or blade **125**. A bracket **126** positioned below the cutter arm **121** carries a spring element **127** thereon and this spring element serves to normally urge the cutter arm **121** in an upwardly swinging direction. When the solenoid **119** is energized, the pull rod **120** will be pulled or shifted axially downwardly so that the strip or ribbon extending between the driven winding arm **38** and the upper loop-holding member **36** will be cut and severed by the cutter element **125**. When the solenoid **119** is de-energized, the spring **127** urges the arm **121** upwardly to the position illustrated in FIG. 1.

A pair of cams **128** and **129** are also affixed to the cam shaft **99** and serve to open and close switches **130** and **130***a* respectively. It will be noted that these switches **130** and **130***a* are arranged in controlling relation with respect to motor **88** to permit the motor to be selectively driven in opposite directions.

Referring now to FIG. 4, it will be seen that the circuitry employed in my bow-tying apparatus includes a pair of electrical conductors **131***a* and **132***a* suitably connected to a source of electric current and also connected to a voltage regulator V. A master switch **131***b* is interposed in controlling relation in the power line **131***a*. The voltage regulator V is connected on the discharge side to a main power bus **131** and is connected on the opposite side to a main return bus **132**. It will also be noted that the main power bus **131** is connected directly to the input side of the motor **95** and that the other terminal of the motor **95** is connected directly to the main return bus **132**.

It will therefore be seen that when the master switch **131***b* is closed, the motor **95** will be energized and cam

shaft 99 will begin rotation at the beginning of one cycle of operation of the apparatus.

One of the stationary contacts of switch 103 is connected onto the main bus 131 by a conductor 133 and one of the stationary contacts of switch 104 is connected directly to the main bus 131 by a conductor 134. The movable contact of switch 103 is connected to one end of one of the field coils of motor 42 and the other end of this field coil is interconnected by a conductor 136 to the movable contact or switch 104. It will be seen that limit switch 49 is interposed in controlling relation with respect to conductor 136 and that limit switch 51 is interposed in controlling relation in the circuit line conductor 135. It is pointed out that electric motor 42 is a conventional single phase induction motor and it will be noted that the other stationary contact of switch 103 is connected directly by conductor 137 to one end of the other field coil of motor 42. It will be noted also that since the motor 42 is reversible that the other stationary contact of switch 104 is interconnected directly to the conductor line 137. The other end of the last mentioned field coil of motor 42 is connected directly to the main return bus 132 by a conductor 138.

One of the stationary contacts of switch 107 is connected directly to the power bus 131 by a conductor 139 while one of the stationary contacts of switch 108 is also connected to the power bus by a conductor 140. A movable contact of switch 107 is connected to one end of one of the field coils of motor 59 by a conductor 141 and the other end of the field coil is connected through the movable contact of switch 108 by a conductor 142. It will be noted that limit switches 73 and 75 are connected in series in the conductor line 141 and that limit switch 72 is interposed in the line 142. It is pointed out that motor 59 is a conventional single phase induction type motor. The other stationary contact of switch 107 is connected to one end of the other field coil of motor 59 by a conductor 143 and the other end of this field coil is connected directly to the main return bus 132 by a conductor 144. It will also be noted that the other stationary contact of switch 108 is connected to the conductor line 143 thus completing the reversing circuit.

The switch 110 has its movable contact connected directly to the power bus 131 while one of the stationary contacts of this switch is connected to one end of the coil of solenoid 69. The other end of the coil of solenoid 69 is connected directly to the return bus 132 by conductor 147.

With regard to the circuitry for reversibly controlling the electric motor 26 which is also of the single phase induction type, it will be noted that one of the stationary contacts of switch 113 is connected directly to the power bus by an electrical conductor 148 while one of the stationary contacts of switch 114 is connected to the power bus by a conductor 149. The movable contact of switch 113 is connected by a conductor 150 to one end of one of the field coils of motor 26 and the other end of this field coil is connected by a conductor 151 to the movable contact of switch 114. The other stationary contact of switch 113 is connected to one end of the other field coil associated with motor 26 by a conductor 152 while the other end of this field coil is connected to the return bus 132 by a conductor 153. It will also be noted that the other stationary contact of switch 114 is connected directly to the conductor 152. It will further be noted that the conductor 153 is connected to the return bus through limit switch 21c.

It will be seen that the movable terminal or contact switch 116 is connected directly to the power bus 131 by a conductor 154 while one of the movable contacts of the switch 116 is connected to one end of the coil of solenoid 83 by a conductor 155. The other end of the coil of solenoid 83 is connected directly to the return bus 132 by a conductor 156.

The movable contact of switch 118 associated with solenoid 119 is connected to the power bus 131 by a conductor 157 while one of the stationary contacts of the switch is connected to one end of the field coil of solenoid 119 by a conductor 158. The other end of the solenoid field coil is connected to the return spring 32 by a conductor 159.

One of the stationary contacts of the switches 130 and 130a are connected respectively to the power bus 131 by conductors 160 and 161. The movable contact of switch 130 is connected to one end of one of the field coils of motor 88 by conductor 162 and the other end of this field coil is connected to the movable contact of switch 130a by a conductor 163. It is pointed out that the motor 88 is of the single phase induction type. The other stationary contact of switch 130 is connected to one end of the other field coil of motor 88 by a conductor 164 while the other end of this last-mentioned field coil is connected through the limit switch 93 to the return bus 132.

Operation

Referring first to FIGS. 5 through 10, it will be noted that these illustrations represent a step by step sequential action of the apparatus in one cycle of operation. It is first pointed out that the bow-tying apparatus is provided with a suitable ribbon support and this ribbon support includes an upstanding post 166 affixed to the upper wall 17 of the lower housing section 11. The upper terminal portion of this ribbon support post 166 has a horizontally disposed ribbon support arm 167 affixed thereto and projecting laterally therefrom. This ribbon support arm 167 serves to rotatably support a roll of an elongate ribbon formed of flexible pliable material such as textile fabrics, plastics or the like.

Referring now to FIG. 5, the various parts thereof are illustrated during the initial part of one cycle of operation. It will be noted that the ribbon winding arm has one end of the role of ribbon R secured thereto by the clamping element 38a. It will be recalled that the clamping element 38a grips the ribbon and will retain the gripped portion of the ribbon thereto when the ribbon winding arm 38 is revolved in a clockwise or winding direction as indicated in FIG. 5 by the arrow. However, the clamp-element 38a will slip along the ribbon when the winding arm is revolved in the reverse direction. Therefore, the ribbon arm 38 will be disposed approximately in the position illustrated by this winding arm in FIG. 10. When the motor 42 is energized at the beginning of cycle, the ribbon winding arm will be revolved in a clockwise or winding direction as indicated by the arrow in FIG. 5 through approximately one and one-eighth revolution.

In FIG. 5 the ribbon winding arm 38 is illustrated in a position just prior to the completion of its movement in a winding or clockwise direction. At the completion of its winding movement, the winding arm 38 will be disposed in the position indicated in FIG. 6 and it will be noted that a complete oval shaped loop is formed upon the upper and lower loop-holding members 36 and 30 respectively.

During the terminal movement of the ribbon winding arm 38 in a winding direction, the loop-encircling member 53 is shifted vertically from the lower position, as indicated in FIG. 5, to an elevated position as indicated in FIG. 6. It is pointed out, however, that the position of the loop-encircling member 53 in FIG. 6 is disposed in a different angular position with regard to the central post since the turn table 20 is revolved slightly in a counter clockwise direction. It is pointed out, however, that the turn table 20 will be revolved approximately one-eighth of a turn in a counter clockwise direction from the position indicated in FIG. 5 to the position indicated in FIG. 6 only after the ribbon winding arm 38 has come to a stop after completing its movement in a winding or clockwise direction.

After the loop-encircling member 53 has been elevated and after the turn table 20 has been rotated one-eighth of

a turn, the end of the ribbon will be disposed between the fixed clamping jaw **66** and the movable clamping jaw **67**. Solenoid **69** will be energized to clamp the end of the ribbon between the jaws and the loop-encircling post will be lowered to its lowermost position and the turn table **20** will be revolved in a clockwise direction to its original position as indicated in FIG. 7. During lowering movement of the loop-encircling member **53**, the ribbon winding arm **38** will be reversibly driven from its position as indicated in FIG. 6 through one and one-eighth revolutions back to its original position as indicated in FIGS. 8 through 10. The loop-encircling member **53** will then be disposed in the position indicated by the dotted line configuration of FIG. 7. Thereafter, the motor **88** will be energized to move the loop-knotting member **79** vertically from the position indicated in FIGS. 5 to 7 to the position indicated in FIG. 8.

The loop-encircling member **53** is then elevated again to the position indicated in full line in FIG. 8 and the turn table **20** is thereafter rotated in counter clockwise direction through approximately one and one-third revolutions to the position indicated in FIG. 9. It is pointed out that during the last part of this movement by the turn table **20**, the loop-encircling member **53** is elevated from its intermediate position to the dotted line position in FIG. 8 and the full line position in FIG. 9. It will be seen that the loop-encircling member **53** when rotated by the turn table **20** in a counter clockwise direction will form a relatively small transverse loop around the median portion of the larger oval shaped loop. It will also be noted that the loop-encircling member **53** when in its intermediate position will be disposed substantially below the upper end of the loop-knotting arm **80**. However, during the last one-third travel of the turn table **20** in the counter clockwise direction, the loop-encircling member **53** will be raised from its intermediate position to the upper position indicated by a dotted line this combined elevating movement and rotation of the loop-encircling member **53** pulls the free end of the ribbon between the fixed jaw **81** and the pivoted jaw **82** on the loop-knotting arm **80**.

A solenoid unit **83** is energized thus clamping the ribbon between the fixed jaw **81** and the pivot jaw **82**. The solenoid **69** is then de-energized thus allowing the movable clamping jaw **67** to be moved to the released position with regard to the fixed clamping jaw **66**. Thus, the ribbon is released by the clamping means carried by the loop-encircling member **53** and the turn table is thereafter rotated in a clockwise direction from a position indicated in FIG. 9 back to its original position as indicated in FIG. 10. As the turn table **20** moves in a clockwise direction, the motor **88** is energized and the loop-knotting member **79** is moved downwardly thus pulling the free end of the ribbon through the small transverse loop to knot and tie the small transverse loop tightly around the middle of the oval shaped loop. This knotting and tying operation completes the formation of a very attractive bow.

The turn table **20** will be received in a counter clockwise direction until it reaches its original position and the loop-encircling member **53** will be lowered to its original position. When the turn table **20** has been reversibly revolved to its original position, a solenoid **119** will be energized to shift the pull rod **120** downwardly thereby causing the cutter arm to be moved downwardly so that the cutting element **125** severs the stretched ribbon extending between the ribbon winding arm and the upper loop-holding member **36**. The loop may thereafter be slipped off of the upper and lower loop-holding member by merely pivoting the lower loop-holding member **30** upwardly about its pivot. It will be noted that the free end portion of the ribbon after the completed bow has been severed, will be retained by the winding arm clamping means **38***a* and that all the various parts will be positioned to begin a new cycle of operation.

More specifically, during the operation of the bow-tying apparatus **10** through one cycle of operation and with special reference to the electrical circuit diagram of FIG. 4, it will be seen that the master switch **128** will first be closed so that current is supplied to the circuit thus energizing the timer control mechanism motor **95** to cause rotation of the cam shaft **99**. It will be seen at the beginning of the cycle, the cam **102** will be positioned to close switch **104** thus energizing motor **42** for drive in a forward or wind direction. It will also be noted that the remaining cam switches will be opened. The ribbon winding arm **38** will be revolved in a forward or winding direction to wind the ribbon around the upper loop-holding member **36** and around the lower loop-holding member **30**. As the ribbon winding arm **38** approaches the completion of one revolution, cam **105** closes switch **107** to thereby energize motor **59** to elevate the loop-encircling member **53**. The loop-encircling member **53** will be elevated until limit switch **73** is opened so that motor **59** will thereby the de-energized and when this occurs cam **105** is operable to open switch **107**.

It will be noted that the ribbon winding arm **38** will still be revolving in a forward or winding direction and that this movement is through a distance approximating one and one-eighth revolutions. Cam **111** closes switch **113** to energize the motor **26** to rotate the turn table **20** in a counter clockwise direction. The turn table **20** is rotated to approximately one-eighth of a revolution or 45 degrees and the limit switch **21***c* will then be opened by the abutment element **21***a*. When this limit switch **21***c* is opened to de-energize motor **26**, cam **111** opens switch **113**. Thereafter, the abutment element **46** carried by chain **45** will strike the limit switch actuating arm **48** to open limit switch **49**. This de-energizes motor **42** and when this occurs, cam **102** opens switch **104**.

Cam **109** then closes switch **110** to energize solenoid **69** and moves the movable clamping jaw **67** into clamped relation with respect to the fixed clamping jaw **66**. Since the end portion of the ribbon will be positioned between these clamping jaws, energization of solenoid **69** will cause the ribbon to be clamped for movement with the loop-encircling member **53**. Cam **106** closes switch **108** to energize motor **59** so that loop-encircling member **53** is lowered and simultaneously cam **101** closes switch **103** to energize motor **42** in a reverse direction. It is pointed out that the field coils of the reversible motors are connected in series and that the circuitry for each motor is such that the current passes through one field coil of the motor and thereafter through the other field coil from the main power bus to the return bus. For example, with regard to the operation of motor **42**, in the forward winding operation the current flows through conductor **134**, conductor line **136**, conductor **137**, conductor **135** and thereafter through conductor **138** to the return bus **132**. However, during the reversing operation the current will flow through the main bus **131**, conductor **133** through closed switch **103**, conductor **135**, conductor **136** through switch **104**, conductor **137** and through conductor **138** to the main return bus **132**.

At this point of the operating cycle, motor **59** will be energized to lower the loop-encircling member **53** downwardly while motor **42** will be energized to revolve the ribbon winding arm **38** in a reverse direction through one and one-eighth revolutions back to its original position. Cam **112** closes switch **114** to energize motor **26** for operation in a reverse direction. At this time the actuator nut **56** will move downwardly so that the abutment element **70** engages the actuator switch arm **71** to open limit switch **72** thus de-energizing motor **59** and causing the loop-encircling member **53** to stop its downward movement. Cam **106** opens switch **108** and limit switch **72** is closed.

Thereafter, limit switch **21***c* is opened to de-energize motor **26** after the turn table is revolved one-eighth of a revolution or 45 degrees in a clockwise direction to its original position. Cam **112** then opens switch **114**. It

should be pointed out that the abutment element 21*a* carried by the turn table 20 and which actuates the limit switch 21*c* is in the form of an elongate track or engaging surface for contacting the roller element carried by the switch actuator arm 21*b*. The intermediate portion of the abutment element 21*a* permits the switch actuator arm to be contacted thereby without opening the switch while the opposite ends of this abutment element when engaged by the switch actuator arm will open the switch. One end of this abutment arm 21*a* which is engaged by the switch actuator arm roller during movement of the turn table in a counter clockwise direction through one-eighth of a turn has a relatively small length so that the switch actuator arm and roller therefor will be only temporarily opened by the coaction of the switch arm and even though the switch is momentarily opened, the abutment element will have moved past the switch arm. This will cause the limit switch 21*c* to be opened only momentarily and during movement in a counter clockwise direction when the abutment element 21*a* first engages the switch arm 21*b*. As pointed out, the other end of the abutment element 21*a* has a greater actuating length so that the switch arm when contacted thereby will be opened and maintained in an opened position. The distance between the effective actuating parts of the abutment element 21*a* is a distance to permit the turntable to be revolved through one-eighth of a turn or 45 degrees before the motor 26 will be de-energized.

After the motor 26 has been de-energized by opening the limit switch 21*c*, the abutment element 47 will engage the switch actuator arm 50 to open limit switch 57 and thereby de-energize the motor 42 thus stopping the reverse revolving movement of the ribbon winding arm 38. Cam 101 then opens switch 103. The ribbon winding arm 38 will then have returned to its original position as illustrated in FIG. 8.

Cam 128 then closes switch 130 to energize the motor 88 so that the loop-knotting member 79 is moved upwardly. This upward movement of the loop-knotting member 79 continues until limit switch 93 is opened to thereby de-energize motor 88. Cam 128 then opens switch 130. Cam 105 then closes switch 107 to energize motor 59 for moving the loop-encircling member 53 in an upward direction. This upward directional movement of the loop-encircling member 53 continues until limit switch 73 has been opened and this causes de-energization of motor 59. Cam 105 then opens switch 107. Thereafter, cam 111 closes cam switch 113 to energize motor 26 for rotating turn table 20 in a counter clockwise direction. The turn table 20 will be revolved through a distance approximating one and one-third revolutions or approximately 480 degrees and it will be noted that the loop-encircling member 53 will be disposed in an intermediate position during movement of a turn table 20 through one complete revolution. However, as the turn table 20 rotates through a distance of approximately one revolution, cam 105 serves to close switch 107 to energize motor 59 to raise the loop-encircling member still further upwardly. It is pointed out that this movement of the loop-encircling member 53 with the turn table 20 causes a small transverse loop to be wound around the median portion of the oval shaped loop formed on the upper and lower loop-holding members. Elevation of the loop-encircling member 53 continues until the upper limit switch 75 is opened and this de-energizes motor 59. At this time, cam 105 opens switch 107. Turn table 20 continues to revolve until limit switch 21*c* is opened to de-energize motor 26 and at this time cam 111 opens switch 113. The reason the loop-encircling member 53 is not raised to its final upper position until the latter stages of the counter clockwise movement of the turn table 20 is that this loop-encircling member 53 must be maintained in its intermediate position to clear the other parts of the apparatus. It is also pointed out that final movement of the turn table 20 in a counter clockwise direction and while the loop-encircling member 53 is in its uppermost position, the loop-encircling member will cause the end portion of the ribbon to be moved between the fixed jaw 81 and the pivoted jaw 82 of the loop-knotting arm 80. It is also pointed out that the turn table 20 is permitted to revolve through a distance exceeding one complete revolution notwithstanding the fact that the limit switch 21*c* may be instantly opened by action of the abutment member 21*a*.

As pointed out above, one end of this abutment element has an abutting surface which only temporarily opens the limit switch 21*c* but since cam switch 113 is maintained in closed position, this instantaneous de-energization of the motor 26 does not cause a turn table to be stopped at this time. Turn table 20 will be stopped only when the opposite end of the abutment element 21*a* opens the limit switch to de-energize motor 26 and at this time cam 111 opens switch 113.

After the turn table 20 has stopped, cam 115 closes cam switch 116 to energize solenoid 83 and cause the pivoted jaw 82 to be moved into ribbon clamping relation with the fixed jaw 81 and thereby clamp the end portion of the ribbon therebetween. Cam 109 opens switch 110 to de-energize solenoid 69 and thereby allow the movable clamping jaw 67 to be moved to the release position with regard to the fixed jaw 66 thereby allowing the ribbon to be released by the loop-encircling member 53.

Thereafter, cam 129 closes switch 130 to energize motor 88 and the loop-knotting member 79 will be moved in a knotting direction or downwardly until cam 129 opens switch 138 to thereby deenergize motor 88. During this downward movement of the loop-knotting member 79, the end of the ribbon will be pulled through the small transverse loop which encircles the median portion of the oval shaped loop. This tightens and knots the small transverse loop around the oval shaped loop thus completing the formation of an attractive bow.

Thereafter, cam 113 closes switch 114 to energize motor 26 for revolving turn table 20 in a clockwise or reverse direction. Cam 106 closes switch 108 and energizes motor 59 for lowering the loop-encircling members 53. The turn table 20 will be revolved through a distance approximating 480 degrees or one and one-third turns to its original position and it is again pointed out that the switch 114 will be maintained in closed position even though the limit switch 21*c* may be temporarily opened by co-action of the abutment element 21*a* and the switch actuator arm 21*c* at the completion of one revolution. However, the turn table revolves to its original position and is stopped by the co-action of the abutment element 21*a* with the limit switch 21*c*. At this time, the cam 112 opens switch 114.

The loop-encircling member will continue its downward movement until the abutment element 70 co-acts with the limit switch actuating arm 71 to open limit switch 72. In this connection, it is pointed out that the abutment element 70 will move past the limit switch actuating arm 74 to temporarily open the limit switch 73 to de-energize the motor 59. However, since the cam switch 108 is maintained in its closed position, the motor 59 will continue to operate to lower the loop-encircling member 53. Cam 117 closes switch 118 to energize solenoid 119 and thereby to shift pull rod 120 downwardly. This action of the pull rod 120 causes corresponding downward swinging of the cutter arm 121 and the cutter element 125 will sever the ribbon extending between the ribbon winding arm 38 and the upper abutment supporting member 36. The cam 117 will immediately close switch 118 after energization of the solenoid 119. Thereafter, cam 102 closes switch 104 and one cycle of operation of the bow-tying apparatus will have been completed and the various parts of the apparatus will be disposed in proper position for the beginning of another cycle of operation.

From the foregoing, it will be seen that I have provided a novel method and apparatus for automatically

tying an elongate ribbon into a very attractive bow. It will be seen that, from the preceding paragraphs, the parts of my novel apparatus are arranged and interrelated for precise sequential operation so that an elongate ribbon may be tied into a bow in one cycle of operation without necessitating human intervention.

It will also be noted that my novel apparatus and method permit a ribbon to be wound upon a pair of loop-holding members and while maintaining one end of the ribbon stationary, the other end portion of the ribbon is wound first transversely around the first made loop and thereafter knotted and tightened upon this loop to form a very attractive bow.

It will, therefore, be seen that I have provided a novel method and apparatus for automatically and continuously tying a ribbon into a bow but that my apparatus functions in a more efficient manner than any heretofore known comparable devices.

It will, of course, be understood that various changes may be made in the form, details, arrangements and proportions of the various parts without departing from the general scope of my invention.

What is claimed is:

1. Bow-tying apparatus for automatically tying an elongate ribbon, formed of flexible, preferably fabric material, into a bow, said bow-tying apparatus comprising a bow-holding structure having a pair of spaced apart substantially parallel wrapping surfaces,

a shiftable winding mechanism adapted to be revolved around said bow-holding structure and having means thereon for gripping one end of a ribbon thereto,

drive means interconnected with said winding mechanism and being operable to revolve said winding mechanism around said bow-holding structure through a distance of at least completing one revolution, and thereby causing the ribbon clamped by said winding mechanism to be wound upon wrapping surfaces of said bow-holding structure to define an oval-shaped loop.

a loop-encircling mechanism being revolvable around the loop wound upon said bow-holding structure and having means thereon for releasably clamping one end portion of the ribbon thereto as the one end portion of the ribbon is released by the winding mechanism,

drive means interconnected with said loop-encircling mechanism and being operable to revolve said loop-encircling mechanism around the loop wound upon said bow-holding structure to cause the end portion of the ribbon to completely encircle the loop and thereby define a relatively small transverse loop around the median portion of said first-mentioned loop,

and a shiftable loop-knotting mechanism being positioned within the confines of the small transverse loop formed by said loop-encircling mechanism and being shiftable in a knot forming direction, releasable clamping means of said loop-knotting mechanism for releasably clamping the one end portion of the ribbon thereto when the one end portion of the ribbon is released by the loop-encircling mechanism,

and means interconnected with said loop-knotting member being operable to shift said loop-knotting member in a knot forming direction to thereby cause the loop-knotting member to pull the one end portion of the ribbon through the small transverse loop to knot the same upon the median portion of the first mentioned loop.

2. Bow-typing apparatus for automatically tying an elongate ribbon, formed of flexible, preferably fabric material, into a bow.

said apparatus comprising a loop-holding structure having a pair of spaced-apart, substantially parallel wrapping surfaces,

a shiftable winding mechanism adapted to be revolved around said loop-holding structure and having gripping means thereon for releasably gripping one end of a ribbon thereto,

drive means interconnected with said winding mechanism and being operable to revolve said winding mechanism around said loop-holding structure through a distance of at least one complete revolution to thereby cause a ribbon gripped by the winding mechanism to be wound upon the loop holding structure to define an oval-shaped loop,

a loop-encircling mechanism being revolvable in a transverse orbit around the oval-shaped loop and having means thereon for releasably clamping a one end portion of the ribbon thereto as the one end portion of the ribbon is released by the winding mechanism,

drive means interconnected with said loop-encircling mechanism and being operable to revolve said loop-encircling mechanism in a transverse orbit around the oval-shaped loop to thereby cause the end portion of the ribbon to completely encircle the loop and to define a relatively small transverse loop around the median portion of the oval-shaped loop,

a shiftable loop-knotting mechanism being positioned within the confines of the small transverse loop formed by said loop-encircling mechanism and being shiftable in a knot-forming direction,

said loop-knotting mechanism having releasable clamping means thereon for releasably clamping one end portion of the ribbon thereto when the one end portion of the ribbon is released by the loop-encircling mechanism,

means interconnected with said loop-knotting mechanism and being operable to shift said loop-knotting mechanism in a knot-forming direction to pull the one end portion of the ribbon through the small transverse loop to knot the same upon the oval-shaped loop,

timer control means interrelated in controlling relation with said winding mechanism and being operable for sequentially first actuating said winding mechanism revolving means through a cycle of operation to revolve the winding mechanism around the loop-holding structure and then actuating the loop-encircling mechanism around the oval-shaped loop, and thereafter actuating said loop-knotting mechanism.

3. Bow-tying apparatus for automatically tying an elongate ribbon, formed of flexible, preferably fabric material into a bow,

said apparatus comprising a pair of vertically spaced apart substantially parallel loop-holding members,

a shiftable winding mechanism adapted to be revolved in a vertical orbit around said loop-holding members and having gripping means thereon for releasably gripping one end of the ribbon thereto,

drive means interconnected with said winding mechanism and being operable to revolve said winding mechanism around said loop-holding structure through a distance of at least one complete revolution thereby causing the ribbon clamped by the winding mechanism to be wound upon the loop-holding structure to define a substantially vertically disposed, oval-shaped loop,

a loop-encircling mechanism being revolvable in a horizontal transverse orbit around the oval-shaped loop and having means thereon for releasably clamping one end portion of the ribbon thereto when the one end portion of the ribbon is released by the winding mechanism,

drive means interconnected with said loop-encircling mechanism and being operable to revolve said loop-encircling mechanism in a transverse substantially horizontal orbit around the oval-shaped loop to thereby cause the end portion of the ribbon to completely encircle the loop and to define a relatively

small transverse loop around the median portion of the vertically disposed oval-shaped loop,

a vertically shiftable, loop-knotting mechanism being positioned within the confines of the small transverse loop formed by said loop-encircling mechanism and being vertically shiftable downwardly,

said loop-knotting mechanism having releasable clamping means thereon for releasably clamping one end portion of the ribbon thereto when the one end portion of the ribbon is released by the loop-encircling mechanism,

means interconnected with said loop-knotting mechanism and being operable to vertically shift said loop-knotting mechanism downwardly to pull the one end portion of the ribbon through the small transverse loop to thereby and knot the same upon the oval-shaped loop,

and actuator means for sequentially first actuating said winding mechanism revolving means through a cycle of operation to revolve the winding mechanism around a loop-holding structure and then actuating the loop-encircling mechanism to revolve the means to revolve the loop-encircling mechanism around the oval-shaped loop, and thereafter actuating said means for shifting the loop-knotting mechanism downwardly.

4. The structure as defined in claim 3 wherein said loop-encircling mechanism includes a substantially horizontally disposed turn table revolvable about a substantially vertical axis and having a loop-encircling member connected thereto for revolving movement therewith.

5. The structure as defined in claim 4 wherein said loop-encircling member is vertically shiftable relative to said turn table.

6. Bow-tying apparatus for automatically tying an elongate ribbon, formed of flexible, preferably fabric material, into a bow,

said apparatus comprising a pair of vertically spaced apart loop-holding members,

a shiftable winding mechanism adapted to be revolved in a vertical orbit around said loop-holding members and having gripping means thereon for releasably gripping one end of a ribbon thereto,

drive means interconnected with said winding mechanism and being operable to revolve said winding mechanism around said loop-holding members through a distance at least exceeding one complete revolution to thereby cause the ribbon gripped by the winding mechanism to be wound upon the loop-holding structure to thereby define a vertically disposed oval-shaped loop,

a loop-encircling mechanism being revolvable in a horizontal transverse orbit around the oval-shaped loop,

clamping means carried by said loop-encircling mechanism and including a pair of clamping jaws interconnected for movement between clamping and release positions,

means for moving said jaws between clamping and release positions,

drive means interconnected with said loop-encircling mechanism and being operable to revolve said loop-encircling mechanism in a transverse orbit around the oval-shaped loop to thereby cause the end portions of the ribbon to completely encircle the loop and to define a relatively small transverse loop around the median portion of the vertically disposed oval-shaped loop,

actuator control means operatively connected with said clamping means and being operable to shift the jaws thereof to the clamping position at the end of the winding orbit of said winding mechanism, and to thereafter sequentially actuate the means for revolving the loop-encircling mechanism,

a vertically shiftable loop-knoting mechanism being positioned within the confines of the small transverse loop formed by said loop-encircling mechanism and being vertically shiftable downwardly,

a second clamping means carried by said loop-knotting mechanism and including a pair of clamping jaws movable between clamping and release positions for releasably clamping a ribbon therebetween,

means for shifting the jaws of said second clamping means between clamping and release positions,

means interconnected with said loop-knotting mechanism and being operable to vertically shift said loop-knotting mechanism downwardly,

said actuator means being operatively connected in controlling relation with said means for shifting said loop-knotting mechanism and said means for shifting the jaws of said second mentioned jaws clamping means,

said actuator means being operable at the end of the loop-forming orbit of said loop-encircling mechanism to shift the clamping jaws of said jaw shifting means for the jaws of said first mentioned clamping means to release position, and then to sequentially actuate said jaw shifting means for the jaws of said second clamping means to shift the jaws of the second mentioned clamping means to the clamping position so that the one end portion of the ribbon is clamped therebetween, and to thereafter actuate sequentially said means for shifting the loop-knotting mechanism downwardly from an upper position wherein the loop-knotting mechanism is disposed within the confines of the small transverse loop, to the lower position to thereby pull the one end portion of the ribbon through the small transverse loop and to knot the same upon the oval-shaped loop.

7. Bow-tying apparatus for automatically tying an elongate ribbon, formed of flexible, preferably fabric material, into a bow,

said apparatus comprising a pair of vertically spaced-apart loop-holding members,

a shiftable winding mechanism adapted to be revolved in a vertical orbit around said loop-holding members and having gripping means thereon for releasably gripping one end of the ribbon thereto,

drive means interconnected with said winding mechanism and being operable to revolve said winding mechanism around said loop-holding members through a distance at least exceeding one complete revolution to thereby cause the ribbon gripped by the winding mechanism to be wound upon the loop-holding structure to thereby define a vertically disposed oval-shaped loop,

a loop-encircling mechanism being revolvable in a horizontal transverse orbit around the vertically disposed oval-shaped loop,

clamping means carried by said loop-encircling mechanism and including a pair of clamping jaws interconnected for movement between clamping and release positions,

means for moving said jaws between clamping and release positions,

drive means interconnected with said loop-encircling mechanism and being operable to revolve said loop-encircling mechanism in a transverse orbit around the oval-shaped loop to thereby cause the end portions of the ribbon to completely encircle the loop and to define a relatively small transverse loop around the median portion of a vertically disposed oval-shaped loop,

actuator control means for actuating said jaw shifting means to shift the jaws of said clamping means to the clamping position at the end of the winding orbit of said winding mechanism, and to thereafter sequentially actuate the means for revolving the loop-encircling mechanism,

a vertically reciprocable loop-knitting mechanism being mounted for reciprocating movement between

an upper ribbon-receiving position and a lower knot-forming position,

means interconnected with said loop-knotting mechanism and being operable to vertically shift the same downwardly in a knot-forming direction,

second clamping means carried by said loop-knotting mechanism and including a pair of clamping jaws movable between clamping and release positions and releasably clamping a ribbon therebetween,

said actuator means being operatively connected in controlling relation with said means for shifting said loop-knotting mechanism and with said means for shifting said jaws of said second mentioned clamping means,

said actuator means being operable at the end of the loop-forming orbit of said loop-encircling mechanism to actuate the jaw shifting means for the clamping jaws of said first mentioned clamping means to shift the jaws of said first mentioned clamping means to the release position, and to then sequentially actuate said second mentioned clamping means to the clamping position so that the one end portion of the ribbon is clamped therebetween, and to thereafter sequentially actuate said means for shifting said loop-knotting mechanism downwardly to thereby pull the one end portion of the ribbon through the small transverse loop and to knot the same upon the oval shaped loop.

8. The structure as defined in claim 7 wherein said loop-encircling mechanism includes a horizontally disposed turntable revolvable about a substantially vertical axis and having an upstanding loop-encircling arm affixed thereto adjacent the periphery thereof.

9. Bow-tying apparatus for automatically tying an elongate ribbon wound upon a roll and being formed of flexible, preferably fabric material, into a bow,

said apparatus comprising a ribbon-roll supporting member for rotatably supporting thereon a roll having an elongate ribbon wound therearound,

a pair of vertically spaced-apart loop-holding members,

a shiftable winding mechanism adapted to be revolved in a vertical orbit around said loop-holding members and having gripping means thereon for releasably gripping one end of the roll ribbon thereto,

electric motor means drivingly connected with said winding mechanism and being operable to revolve said winding mechanism around said loop-holding members through a distance at least exceeding one complete revolution to thereby cause the ribbon gripped by the winding mechanism to be wound upon the loop-holding structure to thereby define a vertically disposed oval-shaped loop,

circuit means for supplying electrical current to said electric motor means,

a loop-encircling mechanism being revolvable in the horizontal transverse orbit around the vertically disposed oval-shaped loop,

clamping means carried by said loop-encircling mechanism including a pair of clamping jaws interconnected from movement between clamping and release positions,

solenoid means operatively connected to said jaws and being interconnected to said circuit means and when energized serving to move said jaws from the release to a clamping position,

second electric motor means interconnected with said circuit means and being operatively connected to said loop-encircling mechanism for revolving the latter in a transverse orbit around an oval-shaped loop thereby causing the end portions of the ribbon to completely encircle the loop and to define a relatively small transverse loop around the median portion of the vertically disposed oval-shaped loop,

actuator control means interposed in current controlling relation with said circuit means and being operable for sequentially first actuating the solenoid means to shift the jaws of the clamping means to clamp position at the end of the winding orbit of said winding mechanism, and to thereafter actuate the electric motor means for revolving the loop-encircling mechanism,

a vertically reciprocable loop-knotting mechanism being mounted for reciprocating movement between an upper ribbon-receiving position and a lower knot-forming position,

clamping means carried by said loop-knotting mechanism and including a pair of clamping jaws movable between clamping and released positions for releasably clamping a ribbon therebetween,

solenoid means operatively connected to said last mentioned jaws and being interconnected to said circuit means and when energized serving to move said jaws from released to clamping position,

third electric motor means interconnected to said circuit means and being operatively connected to said loop-knotting mechanism for verrtically reciprocating the latter,

said actuator means being operable at the end of the loop-forming orbit of said loop-encircling mechanism to de-energize the solenoid means for said first mentioned clamping means to thereby shift the clamping jaws thereof to the released position, and then to sequentially energize and actuate said second clamping means to shift the clamping jaws thereof to the clamped position so that the one end portion of the ribbon is clamped therebetween, and to thereafter energize and actuate said electric motor means for shifting the loop-knotting mechanism downwardly from an upper position wherein the loop-knotting mechanism is disposed within the confines of the small transverse loop to the lower position to thereby pull the one end portion of the ribbon through the small transverse loop and to knot the same around the oval-shaped loop and to completely form the bow.

10. The structure as defined in claim 9 and a cutter mechanism being mounted for movement in a cutting direction and for return thereof, means for shifting said cutter mechanism including a solenoid operatively connected to the latter and being interconnected to said circuit means and when energized cutting the portion of the ribbon extending between the bow and the ribbon row.

11. The structure as defined in claim 9 wherein said actuator means includes a plurality of revolvable cams and a plurality of cam actuated switches.

12. The structure as defined in claim 9 wherein the respective electric motor means for said winding mechanism, said loop-encircling mechanism, and said loop-knotting mechanism are each of the reversible type.

References Cited in the file of this patent

UNITED STATES PATENTS

1,209,525	Webb	Dec. 19, 1916
1,224,268	Bricken	May 1, 1917
2,905,368	Runyan	Sept. 22, 1959