A spring assembly machine having two vertically spaced rows of spring supporting members, each spring supporting member having a fixed clamping jaw and a movable clamping jaw arranged for movement transversely of said rows toward and away from the fixed clamping jaw. Each of the spring supporting members is adjustable lengthwise of said rows to accommodate the manufacture of spring assemblies having different coil spacings. This adjustment can be made without moving the mechanism for actuating the movable clamping jaw. An ejector mechanism discharges the assembled coils from the clamping members and a puller mechanism thereafter moves the assembled coils away from the spring supporting members. The ejector mechanism and the puller mechanism are adjustable with the clamping members.
1. SPRING ASSEMBLER CLAMP ASSEMBLY

FIELD OF THE INVENTION

This invention relates to a spring assembly machine and, more particularly, to a machine for joining a plurality of coil springs into a spring assembly for use in bed springs, mattresses, and spring units for seats and upholstered furniture wherein the coil engaging components of the machine are adjustable to accommodate different spacings between the coil springs, and are replaceable to accommodate springs of different diameters.

BACKGROUND OF THE INVENTION

Spring assembly machines have been known for many years and an example of one type of spring assembly machine is illustrated in the U.S. Pat. No. 3,053,289. A reoccurring problem in the manufacture of spring assembly machines is the maintenance of accurate tolerances so that, when the machine is assembled, the various component parts will be aligned and operate satisfactorily without interference. Known spring assembly machines do not, as far as I am aware, provide any type of easy adjustment for aligning the various components on the machine. As a result, and as often happens, an extreme force is applied at one particular location in the machine due to an inadvertent jamming during the spring assembly operation which results in a bending and/or misalignment of some of the component parts. Thus, it is necessary to stop the machine and disassemble the parts which have become misaligned or bent and realign same or insert new components to replace the damaged ones. Since the spring assembly machine is a complex arrangement of many parts, disassembly thereof for realignment of the various parts is difficult and time consuming.

The above referred to disadvantages of the known machines become more serious when it is desired to manufacture a new line of bed springs, mattresses and the like having coil springs with different diameters or different lateral spacings. That is, when different sized spring supporting members were used, it was virtually necessary to remodel the known machines by including the dismantling thereof to remove the one sized spring supporting members and then reassemble the machine with the new sized spring supporting members. In the case where the coil springs are of the same diameter but the lateral spacing is varied, it is still necessary with the known machines to disassemble same and then reassemble the machine with the same spring supporting members but in different positions. This problem is further aggravated by the fact that there is not enough room in the machine to permit mechanics to operate conveniently while disassembling and then reassembling the machine.

Accordingly, it is an object of this invention to provide a spring assembly machine having spring clamping members, spring ejector mechanisms and spring puller mechanisms which are readily adjustable to accommodate coil springs of different diameters and/or spacings.

It is a further object of this invention to provide, in a spring assembly machine, an adjustment of the spring clamping members which does not require a corresponding adjustment of the clamp actuating device, which device can also remain unaltered while new clamping members are installed to accommodate coil springs of different diameters.

It is a further object of this invention to provide, in a spring assembly machine, a relatively simple arrangement for individual and lateral adjustment of the clamping members relative to the remaining components of the machine without necessitating any alteration in the clamp actuating mechanism or in the relative positions of the fixed and movable clamping jaws.

Other objects and purposes of this invention will be apparent to persons acquainted with spring assembly machines of this general type upon reading the following specification and inspecting the accompanying drawings, in which:

FIG. 1 is a perspective view of the frame for the spring assembly machine;
FIG. 2 is a perspective view of the frame of the spring assembly machine, similar to FIG. 1, but with a portion of the spring supporting members mounted thereto;
FIG. 3 is a sectional view taken along the line III—III of FIG. 2;
FIG. 4 is a sectional view taken along the line IV—IV of FIG. 3;
FIG. 5 is a sectional view taken along the line V—V of FIG. 3;
FIG. 6 is a partially sectional, fragmentary view similar to FIG. 5 except that the clamping members have been separated and the puller mechanism has been advanced to the rearwardmost position;
FIG. 7 is a sectional view taken along the line VIII—VIII of FIG. 5;
FIG. 8 is a rear elevational view of the left end of the spring assembly machine illustrated in FIG. 2;
FIG. 9 is a sectional view taken along the line IX—IX of FIG. 2;
FIG. 10 is a sectional view taken along the line X—X of FIG. 9;
FIG. 11 is a sectional view taken along the line XI—XI of FIG. 8;
FIG. 12 is a left end view of structure illustrated in FIG. 8;
FIG. 13 is a fragmentary illustration of a portion of FIG. 12 but with the components moved to a different position;
FIGS 14—17 are illustrations similar to FIG. 7 but showing other, sequential positions between the components; and
FIG. 18 is an electrical and pneumatic schematic for the machine.

Certain terminology will be used in the following descriptive material for convenience in reference only and will not be limiting. The words "up," "down," "right" and "left" will designate directions in the drawings to which reference is made. The words "front" and "rear" will refer to the right and left sides, respectively, of the machine illustrated in FIG. 3. The words "in" and "out" will refer to directions toward and away from, respectively, the geometric center of the device and designated parts thereof. Such terminology will include derivatives and words of similar import.
SUMMARY OF THE INVENTION

The objects and purposes of the invention are met by providing a spring assembly machine having two vertically spaced rows of spring supporting members, each supporting member having a fixed clamping jaw and a movable clamping jaw arranged for relative movement in a direction transverse of said rows. Connecting means drivingly interconnects a driving device to the movable clamping jaws to actuate same. The connecting means include guide means which permit relative lateral sliding movement between the driving device and the movable clamping jaws while maintaining the driving connection therebetween. Means are further provided for releasably locking the spring supporting members into a fixed relative relationship after adjustments have been made by the aforesaid relative lateral sliding movement.

DETAILED DESCRIPTION

The spring assembly 10 (FIG. 1) comprises a frame 11 and a plurality of spring supporting members 12 and 13 arranged in two vertically spaced and parallel rows which extend crosswise of the machine 10. The supporting members in the upper row are aligned with the supporting members in the upper row. Referring first to the components of the frame 11, a pair of spaced and parallel beams 16 and 17 extend crosswise of the machine and are connected at their ends to transverse leg members 18 and 19, as by welding, to define a rectangular base 20. The leg members 18 and 19 extend outwardly beyond the corners of the base to stabilize same.

The frame 11 has a pair of upstanding beams 21 and 22 (FIG. 2) on one end of the machine and a pair of upstanding beams 23 and 24 on the opposite end of the machine, each upstanding beam being secured to one of the leg members 18 or 19 by a plurality of bolts 25. In this particular embodiment, the upstanding beams 21 and 23, located at the rear of the frame 11 are shorter than the front beams 22 and 24. A brace member 26 is connected to the upper end of the upstanding beam 21 and to the upstanding beam 22 at a point spaced downwardly from the upper end thereof. A brace member 27 is connected to the upper end of the upstanding beam 23 and to the upstanding beam 24 at a point which is spaced downwardly from the upper end thereof. A stabilizer plate member 28 (FIG. 1) extends between and is secured to the upper ends of the upstanding beams 22 and 24.

Angle bars 29 and 31 are secured to the outer sides of the upstanding beams 21, 22 and 23, 24, respectively, and are spaced upwardly from the leg members 19 and 18. The angle bars 29 and 31 further stabilize the upstanding beams 21 to 24.

A pair of support plates 32 and 33 are secured to the brace member 26 by a plurality of bolts 34. Another pair of support plates 32A and 33A (FIG. 3) identical to the support plates 32 and 33 are secured to the brace member 27 by a plurality of bolts not illustrated. The support plates 32, 33, 32A and 33A each extend perpendicularly away from the respective brace members 26 and 27, and the brace members 26 and 27 are inclined between the upstanding beams 21, 22 and 23, 24 at an angle of approximately 45 degrees. Thus, the support plates 32, 33 and 32A, 33A extend rearwardly and upwardly at an angle of 45 degrees.

The bracket assembly 36 (FIG. 2), which is secured to the support plate 32 by means such as bolts 37, includes a pair of L-shaped angle members 38 and 39 (refer also to the L-shaped angle members 38A and 39A) which are secured to each other by means such as bolts. In this particular embodiment, the L-shaped angle member 38 is inverted from the L-shaped angle member 39 so that the vertically aligned leg portions thereof lie in horizontally spaced planes. The vertically oriented leg portions of the L-shaped angle member 38 is secured to the support plate 32.

The bracket assembly 36A (FIG. 3) is secured to the support plate 32A. However, since the bracket assemblies 36 and 36A are mirror images of each other, the details of the bracket assembly 36A (FIGS. 1 and 3) are substantially the same as those of the assembly 36 discussed above in detail.

Bracket assemblies 42 and 42A are secured to the support plates 33 and 33A, respectively, and they are mirror images of each other. Thus, only the details of the bracket assembly 42 (FIGS. 1 and 2) will be discussed in detail. The parts of the bracket assembly 42A will be referred to by the same reference numerals designating corresponding parts of the bracket assembly 36 in addition to the suffix "A."

The bracket assembly 42 (FIG. 2), which is secured to the support plate 33 by a plurality of bolts 43, is preferably identical to the bracket assembly 36 described hereinabove, except that the structural components are inverted so that the two bracket assemblies 36 and 42 are in reversed positions and are vertically spaced apart. The same is also true for the bracket assemblies 36A and 42A (FIG. 3). That is, L-shaped angle members 44 and 46 (FIG. 2) are secured to each other by means such as bolts and are positioned so that the vertically disposed flanges thereof are vertically aligned with the vertically disposed flanges of the L-shaped angle members 38 and 39 in the bracket assembly 36.

The frame 11 further comprises an inverted L-shaped angle beam 48 (FIGS. 2 and 3) which extends between and is secured to the rearward edges of the L-shaped angle members 39 and 39A of the bracket assemblies 36 and 36A, respectively. The leg 49 of the L-shaped angle beam 48 extends in parallel relationship with the brace members 26 and 27, and the leg 51 extends frontwardly from the leg 49 in a perpendicular relationship to the brace members 26 and 27. In this particular embodiment, the leg 51 is secured to the L-shaped angle members 39 and 39A so that the upper surface thereof is flush with the upper edge of the L-shaped angle members 39 and 39A. The leg 51 has a plurality of threaded holes 55 (FIG. 7) therein adjacent the frontwardmost edge thereof.

A further L-shaped angle beam 52 extends between and is secured to the L-shaped angle members 39 and 39A. However, the angle beam 52 is secured to the angle members 39 and 39A at the forward edge thereof. In this particular embodiment, the leg 53 extends in parallel relationship to the brace members 26 and 27 and the leg 54 extends rearwardly from the leg 53 and is perpendicularly oriented to the brace members 26 and 27. The upper surfaces of the legs 51 and
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mounting plate 76 adjacent the front edge thereof by any convenient means such as screws 79. The spacer block 78 serves to space the clamp mounting plate 76 upwardly from the upper surface of the leg 54 of the angle beam 52 so that the clamp mounting plate 76 lies essentially in a plane parallel to the upper surfaces of the legs 51 and 54 of the angle beams 48 and 52, respectively. A recess 81 is provided in the lower surface of the spacer block 78 and receives the key 74. Thus, the clamp mounting plate 76 is capable of sliding movement laterally crosswise of the machine, same being guided by the keys 72 and 74. An elongated slot 82 is provided in the clamp mounting plate 76 and is aligned with the plurality of threaded holes 55 provided in the leg 51 of the angle beam 48. A bolt 83 is received by the slot 82 and is threadedly engaged with one of the holes 55 to lock the clamp mounting plate 76 in a fixed position. An elongated slot 86 is provided in the clamp mounting plate 76 in the region of the gap 56.

A clamping jaw or member 87 is mounted on the upper surface of the clamp mounting plate 76 so that the working face 88 is positioned along one side of the gap 86. The clamping member 87 is fixedly secured to the clamp mounting plate 76 by a pair of bolts 89 (FIGS. 5, 6 and 7). The working face 88 of the clamping member 87 is provided with a groove 91 extending transversely crosswise thereof to define one-half of a helical channel guide. A pair of guide pins 92 and 93 (FIG. 6) are fixedly secured to the working face 88 of the clamping member 87 and project outwardly therefrom.

A movable clamping jaw or member 94 is slideably mounted on the clamp mounting plate 76 and is provided with a pair of horizontally spaced recesses 96 and 97 (FIG. 6) which receive the guide pins 92 and 93, respectively, to guide the movable clamping member toward and away from the fixed clamping member 87. The working face 98 of the movable clamp 94 is provided with a groove which extends crosswise of the working face 98 to define one-half of a helical channel guide. Thus, when the movable clamping member 94 is moved to the solid line position illustrated in FIG. 7 wherein the working faces 88 and 98 are engaged with one another, the grooves 91 and 99 define a helical guide channel circular shaped in cross section.

A groove 101 and a rib 102 are provided adjacent the front edge of the movable clamping member 94 and extend crosswise the width of the movable clamping member.

A plurality of L-shaped brackets 100 (FIG. 3) are mounted to the angle beam 62 and have a leg portion extending into the spring receiving gap 61. The brackets 100 serve to hold the right end of the spring supporting member 13 vertically axied while, at the same time, permitting a lateral movement thereof crosswise of the machine. The brackets 100 are positioned so as to not interfere with the other components of the machine discussed below which are movable into and out of the spring receiving gap 61. If desired, a plurality of similar type brackets 100A may be used adjacent the right end of the spring supporting members.

Alternatively, the legs 54 and 64 of the angle beams 52 and 62, respectively, may be provided with a plurality of laterally extending slots 82' (FIG. 7) similar to the slots 82 in the clamp mounting plate 76. The spacer
block 78 has a threaded hole 55' therein for receiving a screw 83' to secure the spacer block 78 to the leg of the respective angle beam. Thus, the use of the L-shaped brackets 100 or 100A can be omitted, used in combination with the screws 83' or used alone without the screws 83'.

CLAMP OPENING AND CLOSING MECHANISM

A clamp opening and closing mechanism 104 (FIGS. 3-7) is provided for moving the movable clamp 94 between open and closed positions. In this particular embodiment, the clamp opening and closing mechanism 104 is associated with the spring supporting member 12. The clamp opening and closing mechanism 104A associated with the spring supporting member 13 is identical to the mechanism 104 and will be described in detail with reference being had to FIG. 4. The parts of the opening and closing mechanism 104 will be designated by the same reference characters used to describe the mechanism 104A but the suffix "A" will be deleted therefrom.

A plurality of elongated bars 106 (only one bar 106 is illustrated in FIG. 5) are slideably mounted on the upper surface of the leg 54 of the angle beam 52 toward and away from the fixed clamping member 87. A plurality of threaded holes are provided in the bar 106.

A guide member 107 having an elongated, rectangular shaped slot 108 therein extending crosswise of the machine is fastened to the frontwardly facing side of the bar 106 by a plurality of bolts 109 illustrated in broken lines in FIGS. 5 and 7.

A connector plate 111 extends crosswise of the machine 10 and is fixedly secured to the bars 106 by a plurality of screws 112. The connector plate 111 extends rearwardly from the bars 106 and terminates in a tongue 113 and groove 114. A plurality of threaded openings 116 are provided through the tongue 113.

A second connector plate 118 has a tongue 119 and a groove 121 at the front edge thereof. A plurality of holes 122 are provided in the plate through the groove 121 portion thereof. The tongue 119 is received in the groove 114 in the connector plate 111. The tongue 113 on the connector plate 111 is received in the groove 121 in the connector plate 118 and a screw 123 is received in the holes 116 and 122 to secure the two connector plates together.

A tongue 124 and groove 126 are provided adjacent the rear edge of the connector plate 118. The tongue 124 is received in the groove 101 on the movable clamp 94 and the tongue 102 on the movable clamp 94 is received in the groove 126 in the connector plate 118.

A plurality of bearing housings 127A (two of which are illustrated in FIG. 4) are secured by any convenient means to the front side of the leg 63 of the angle beam 62. Shafts 128A are rotatably supported in each of the bearing housings 127A by any conventional, and therefore not illustrated, type bearing structure. An arm 129A is secured to each of the shafts 128A and movable between the solid line and broken line positions illustrated in FIG. 4. The free ends of the arms 129A are pivotally secured as to 131A to an elongated bar 132A. Stops 133A and 134A are provided on opposite ends of the elongated bar 135A. A bracket 136A is secured to the elongated bar 132A by a plurality of bolts 137A.

A bracket 138A (FIG. 4) is secured to the upstanding beam 22. One end of a pneumatic cylinder 139A is connected to the bracket 138. The rod 141A of the pneumatic cylinder 139A is fastened to the bracket 136A by a connecting pin 142A. Thus, appropriate actuation of the pneumatic cylinder will effect a movement of the rod 141A between the solid and broken line positions of FIG. 4 to effect a movement of the elongated bar 132A and rotation of the shafts 128A. An abutment member 143A is provided for limiting the leftward movement of the elongated bar 132. Similarly, an abutment 144A (FIG. 3) is secured to the upstanding beam 24 and is engageable with the stop 134A to limit the rightward movement of the elongated bar 132A.

Arms 146 (FIGS. 3 and 5) are secured to ends of the shafts 128 and each have a roller element 147 rotatably mounted adjacent the free end thereof. Thus, rotation of the shaft 128, described hereinabove, effects a movement of the roller 147 between the solid and broken line positions illustrated in FIG. 5.

The roller 147 (FIG. 5) is received in the elongated slot 108 so that upon a rotation of the shaft 128 to move the roller between the solid and broken line positions illustrated in FIG. 5, a forward and rearward movement of the guide member 107, elongated bar 106, connector plates 111 and 118 and the movable clamping member 94 is effected. It is possible to vary the clamping pressure between the working faces 88 and 98 of the spring clamp assembly by inserting different sized shims 148 (FIG. 5) between the roller 147 and the elongated bar 106.

In the foregoing described apparatus, it is particularly pointed out that upon a loosening of the bolt 83, the clamp mounting plate 76 carrying the fixed clamping member 87 and the movable clamping member 94 are all movable laterally of the machine guided by the keys 72 and 74. The tongue 124 in the groove 101 and the tongue 102 in the groove 126 permit a relative lateral sliding movement between the movable clamping member and the connector plate 118. Thus, the clamp mounting plate 76 can be adjusted laterally of the machine between, for example, the solid and broken line positions illustrated in FIG. 5.

A flange 149A (FIG. 4) is secured to the arm 129A on the opposite side of the shaft 128A and extends toward but is spaced from the angle beam 62. A limit switch 150A is secured to the frame of the machine 10 and the actuator arm thereof is engageable with the flange 149A.

EJECTOR MECHANISM

Each of the spring supporting members 12 is provided with an ejector mechanism 151 (FIG. 7) and the spring supporting members 13 are provided with an ejector mechanism 151A. The ejector mechanisms 151 and 151A are identical and, accordingly, only the ejector mechanism 151 has been illustrated in detail in FIG. 7. However, for purposes of discussion the parts of the ejector mechanism 151A will be referred to by the same reference characters as is used to describe the ejector mechanism 151 except that the suffix "A" will be added thereto.

The ejector mechanism comprises a Z-shaped bracket having an upper leg 153 which is secured to the
under side of the clamp mounting plate 76 by the bolt 89. The lower leg 154 has an opening 156 therein which is vertically aligned with the gap 86 in the clamp mounting plate 76. A knock-out pin 157 is vertically slideably received in the opening 156 and is moveable vertically through the gap 89 between the solid and broken line positions illustrated in FIG. 7. A screw 158 is located at the lower end of the knock-out pin 157 and has a portion 159 which extends frontwardly therefrom.

A slide plate 160 is vertically slideably mounted on a rail 161 fixed to the frame of the machine and has a channel 162, U-shaped in cross section, at the upper edge thereof, which channel 162 receives the portion 159 of the screw 158. In this particular embodiment, the slide plate 160 is guided for vertical movement between the solid and the broken line positions illustrated in FIG. 7. The portion 159 of the screw 158 is slideable lengthwise of the slide plate 160 while maintaining a vertical driving connection between the slide plate 160 and the knock-out pin 157. The slide plate 160 has a plurality of openings 163 spaced lengthwise therealong.

Brackets 164 are mounted on the frontwardly facing side of angle beam 52 by a plurality of bolts 165. A shaft 166 is rotatably supported by bearings (not illustrated) mounted on the brackets 164. Arms 167 are secured to the shaft 166 by any convenient means, such as the conventional clamp mechanism 168 illustrated in FIG. 7. Each of the arms 167 are received in one of the openings 163 in the slide plate 160. Thus, upon an appropriate rotation of the shaft 166, the arm 167 will move between the solid and broken line positions illustrated in FIG. 7 to move the knock-out pin 157 vertically between the solid and broken line positions.

A drive mechanism 169 (FIG. 12) is provided for driving the shafts 166 and 166A. The drive mechanism 169 comprises crank arms 170 and 170A secured to the end of the shafts 166 and 166A, respectively, illustrated in FIGS. 8 and 12.

An elongated reciprocable bar 171 is guided by a pair of upper and lower guide brackets 172 and 173. The guide bracket 172 is secured to the brace member 27. The guide bracket 173 is secured to the mounting bracket 31. A transverse bar 174 is secured to the reciprocable bar 171 adjacent the upper end thereof and has a pair of link arms 176 and 177 secured to the opposite free ends thereof to interconnect the transverse bar 174 to the free ends of the crank arms 170 and 170A, respectively. Accordingly, reciprocation of the bar 171 will effect a rotation of the shafts 166 and 166A. A block 178 is secured to the reciprocable bar 171 adjacent the lower end thereof and is movable therewith.

A plurality of springs 179 (FIGS. 1 and 3) are connected at one end to the slide plate 160A associated with each of the spring supporting members 13. The springs 179 are connected at the opposite end of the plate member 28. The springs 179 serve to bias both the knock-out pins 157 and 157A to the solid line positions illustrated in FIGS. 3 and 7 due to the linkage mechanism 174, 176 and 177 secured to the reciprocable bar 171 interconnecting the shafts 166 and 166A. In this particular embodiment, a movement of the bar 171 downwardly to the left of FIG. 12 will effect a counterclockwise rotation of the shaft 166 and a clockwise rotation of the shaft 166A. A counterclockwise rotation of the shaft 166 in FIG. 12 is a clockwise rotation of the shaft 166A in FIG. 7. Thus, the aforementioned movement of the bar 171 will effect a rotation of the shaft and movement of the arm 167 between the solid and broken line positions illustrated in FIG. 7 against the urging of the springs 179 to move the knock-out pins 157 vertically upwardly.

The drive mechanism 169 further comprises a lever arm 181 (FIG. 12) which is pivotally secured as at 182 to the leg 18 of the frame 11. A hook member 183 is pivotally secured as at 184 to the lever arm 181. The nose 186 of the hook 183 is engageable with the upper rear edge 187 of the block 178. A flange 188 is secured to the body of the hook member 183.

A pneumatic cylinder 189 (FIG. 12) is secured to the upstanding beam 24 by a bracket 191 (partially concealed). The rod 192 of the pneumatic cylinder 189 is pivotally secured as at 193 to the free end of the lever arm 181. A roller 194 is rotatably secured to the lever arm 181. Thus, upon an appropriate energization of the pneumatic cylinder 189 to effect an extension of the rod 192 to move the lever from the solid line position to the broken line position illustrated in FIG. 12, the nose 186 of the hook 183 engaging the upper rear edge of the block 178 will effect a sliding movement of the bar 171 downwardly.

A spring 196 is secured at one end to the free end of the hook member 183 and may be secured at the other end to any convenient frame component (not illustrated).

PULLER MECHANISM

The machine 10 further comprises a puller mechanism 201 illustrated in FIGS. 3, 9 and 11. The puller mechanism is mounted on a pair of parallel tracks 202 located at opposite ends of the machine. Each of the tracks 202 (FIG. 11) are inclined and are supported at the lower end by a pin 203 secured to a block 204 which is, in turn, connected to the upright beam 22.

The upper end of each of the tracks 202 are mounted on a bracket 206 (FIG. 11) which is secured to the mounting bar 67. A carriage 207 (FIGS. 9 and 11) comprises a pair of plates 208 (one plate of which is not shown) each one supported on one of the parallel tracks 202. Each plate 208 (FIG. 11) has a plurality of rollers 211 rotatably secured thereto and engaging the inclined track 202 to guide each plate 208 along the respective track 202.

A mounting bracket 212 is secured to each plate 208 by a plurality of bolts 213 and extends upwardly therefrom. A pair of parallel, L-shaped angle beams 217 and 218 are secured at opposite ends to the mounting brackets 212 by a plurality of bolts 219. The angle beams 217 and 218 serve to tie the two plates 208 together to cause same to move together along the tracks 202. The legs 222 and 223 of the angle beams 217 and 218 are preferably parallel with the two tracks 202. The legs 222 and 223 each have a plurality of elongated slots 224 therein extending in a direction lengthwise of each of the angle beams such as is illustrated in FIG. 5 (only the leg 223 is shown in FIG. 5).
A plurality of pairs of puller members 226 and 227 each comprise a base portion 228 and 229, respectively, and an elongated stem portion 231 and 232, respectively. In this particular embodiment, the stem portions 231 and 232 project into the spring receiving gap 61 as illustrated in FIGS. 3 and 9. The base portions 228 and 229 are each secured to the legs 222 and 223 of the angle beams 217 and 218 by a plurality of bolts 233 and 234, respectively.

A hook 236 and 237 is provided on the outer end of each of the stem portions 231 and 232, respectively of each of the puller members 226 and 227. The hooks 236 and 237 are positioned (FIGS. 5, 6 and 14–17) so that they are adjacent the front edge of the movable clamping member 94. Thus, upon a movement of the carriage 207 back and forth along the tracks 202, the hooks 236 and 237 will move through the positions illustrated in FIGS. 5, 6 and 14–17. The movement of the hooks 236 and 237 will be described in more detail in the section entitled "Operation."

The drive mechanism 241 (FIGS. 8, 9 and 12) for driving the carriage 207 along the tracks 202 comprises a shaft 242 rotatably supported in bearing housings 243 secured to each of the mounting brackets 29 and 31 (only bearing housing 243 secured to the mounting bracket 31 is illustrated in FIGS. 8 and 12). An arm 244 is fixedly secured to the shaft 242 by a conventional clamping mechanism 246 (FIG. 9). A link arm 247 is secured at one end to the free end of the arm 244 and at the other end to each of the plates 208 of the carriage 207. Accordingly, upon an appropriate rotation of the shaft 242, the arm 244 will move between the solid and broken line positions illustrated in FIG. 9 to move the hooks 236 and 237 of the puller members 226 and 227, respectively, through the positions illustrated in FIGS. 5, 6 and 14–17.

A pneumatic cylinder 248 (FIG. 12) is secured by a bracket 249 to the mounting bar 68. The rod 251 of the pneumatic cylinder 248 is connected to a crank arm 252 which has a conventional clamp mechanism 253 to secure same to the shaft 242. Accordingly, upon an appropriate actuation of the pneumatic cylinder 248 to extend and retract the rod 251, the shaft will be rotated.

A cam 254 (FIG. 12) is fixedly secured to the shaft 242 and is radially aligned with the roller 194 on the lever arm 181. A first cam surface 256 of the cam 254 is preferably concentric with the axis of the shaft 242. A second cam surface 257 is also provided on the cam 254 and which is also concentric with the shaft 242 but is oriented at a shorter radius about the shaft 242. A transition portion 258 is provided between the cam surfaces 256 and 257. A flange 259 is secured to the side surface of the cam 254 and is preferably radially aligned with the flange 188 secured to the hook member 183 on the lever arm 181.

A stop 261 (FIG. 9) is mounted on one of the plates 208 at the forward end thereof. A flange 262 is fixed to the clamping mechanism 246 and extends radially outwardly from the shaft 242.

CONTROL CIRCUITRY

The circuitry for synchronously controlling the operation of the machine 10 is illustrated in FIGS. 9 and 18 and will be referred to generally by the reference numeral 266. Referring first to FIG. 9, a flange 267 is secured to the upstanding beam 24 and projects frontwardly therefrom. A pneumatic valve 268 is mounted on the upper surface of the flange 267. A bracket 269 is secured to the flange 267 and extends downwardly therefrom. A pneumatic valve 271 is secured to the bracket 269 and has an actuator element 272 extending outwardly from one end thereof and having a flat head 273 on the outermost end thereof. The actuating element 272 is biased into the outermost position by a spring 274. A limit switch 276 is also secured to the bracket 269. A lever arm 277 is pivotally secured as at 278 to the bracket 269. A spring 279 is secured to the upper end of the lever arm 277 and to the flange 267 to bias the lever arm into the position illustrated in FIG. 9. An electromagnet 281 is secured to the flange 267 and has an actuator element 282 extending outwardly therefrom and pivotally engaging the upper end of the lever arm as at 283.

A flange 284 (FIG. 10) is secured to the lever arm 277 and extends laterally leftwardly therefrom and engages a portion of the flat head 273. A second lever arm 286 (FIG. 10) is pivotally secured to the bracket 269 by the same pin 278 as pivotally connects the lever arm 277 to the bracket 269. The lever arm 286 engages the remainder portion of the flat head 273.

A bracket 287 (FIG. 12) is secured to the upstanding beam 24 and rotatably supports a cam plate 288 as at 289. A cam surface 291 is provided on the cam plate 288 which terminates in a step 292. In this particular embodiment, the lever arm 286 is radially aligned with the cam plate 288 as illustrated in FIG. 10. An arm 293 on the cam plate 288 is connected as at 294 through a link arm 296 to the carriage 207. The length of the link arm 296 is adjustable by the bolts 297 to permit an accurate alignment of the cam plate 288 relative to the lever arm 286.

Adjustment arms 298 are located at both ends of the machine 10. However, only the adjustment arm 298 at one end will be discussed in detail. The adjustment arm 298 (FIG. 9) is secured to the upstanding beam 24 and has a threaded rod 299 extending the length thereof. A mounting bracket 301 is threadedly engaged with the threaded rod 299 as at 301 and is adjustably movable lengthwise of the adjustment arm upon a rotation of the threaded rod 299. A limit switch 302 is secured to the mounting bracket 301. Further, a pneumatic cylinder 303 having a rod 303A is secured to the mounting bracket 300. The actuating element of the limit switch 302 and the rod 303A of the pneumatic cylinder 303 are engageable with a stop 261 secured to the lower end of the plate 208 of the carriage 207 when the carriage 207 is in the lowermost position. A limit switch 306 is secured to the mounting bracket 300 and has an actuating element engageable with the flange 262.

Referring now to FIG. 18, a source 308 of electrical energy is connected through the limit switches 150 and 150A to one side of a manually operated SHIFT switch through an electrical conductor 309. The other side of the SHIFT switch is connected to the electromagnet 281 through a conductor 311. The conductor 309 is also connected through the series connected limit switches 302 and 276 to a solenoid 312 on the pneumatic valve 268. The conductor 309 is also connected to one side of the limit switch 306. The other side of the
limit switch 306 is connected through a conductor 313 to a solenoid 314 on the opposite end of the pneumatic valve 268. The conductor 309 is connected through a manually operated CLOSE switch and conductor 216 to a solenoid 317 on a pneumatic valve 318. A conductor 319 interconnects the solenoid 321 on the opposite end of the pneumatic valve 318 to helical trip circuitry not illustrated.

A source 322 of pressure is connected to the inlet port of the pneumatic valve 268. A conduit 323 is connected to one of the outlet ports of the pneumatic valve 268 and is connected to the upper end of the pneumatic cylinder 189 and the lower end of the pneumatic cylinder 248. A conduit 324 is connected to the other outlet port of the pneumatic valve 268 and is connected to the inlet port of the pneumatic valve 271. A conduit 326 is connected to one of the outlet ports of the pneumatic valve 271 and is connected to the upper end of the pneumatic cylinder 248. A conduit 327 is connected to the other outlet port of the pneumatic valve 271 and is connected to the pneumatic cylinder 303.

The source 322 of pressure is connected to the inlet port of the pneumatic valve 318. A conduit 328 is connected to one of the outlet ports of the pneumatic valve 318 and is connected to the rear end of the pneumatic cylinder 139. A conduit 329 is connected to the other outlet port of the pneumatic valve 318 and is connected to the forward end of the pneumatic cylinder 139.

**OPERATION**

Although the operation of the mechanism described above will be understood from the foregoing description by skilled persons, a summary of such description is now given for convenience.

At the beginning of a cycle of operation, the clamping members 87 and 94 are in the open position as illustrated in FIG. 14. Coiled springs C1 and C2 are inserted into the machine 10 into the positions illustrated in FIG. 14. After all of the springs supporting members 12 and 13 have been loaded with coil springs in the C1 and C2 positions, the operator is then ready to initiate an assembly operation. The assembly operation is initiated by closing of the CLOSE switch to energize the solenoid 317 on the pneumatic valve 318 to shift the spool thereof leftwardly (FIG. 18) to direct pressurized fluid to the rear end of the pneumatic cylinder 139 to effect the extension of the rod 141 of the pneumatic cylinder 139.

An extension of the rod 141A (FIG. 4) effects a rightward movement of the elongated bar 132A to effect a counterclockwise rotation of the shafts 128A. Since the embodiment illustrated in FIG. 4 pertains to the clamp opening and closing mechanism associated with the spring supporting members 13, a corresponding movement of the shafts 128 associated with the spring supporting members 12 as illustrated in FIG. 5 would effect a counterclockwise rotation of the shaft 128 to move the roller 148 secured to the arm 146 from the break line position to the solid position to move the elongated bar 106 rearwardly (FIG. 7) to effect a rearward movement of the connector plates 111 and 118 leftwardly to move the movable clamping member 94 from the position of FIG. 14 to the position of FIG. 15.

Referring again to FIG. 18, a closing of the clamps 87 and 94 of the position illustrated in FIG. 5 will simultaneously open the limit switches 150 and 150A to deactivate the shift circuitry. Further, circuitry not illustrated will be energized by means also not illustrated to send a helical H (FIG. 5) through the grooves 91 and 99 in the working faces 88 and 98, respectively, of the clamping members 87 and 94 to tie the coiled springs C1 and C2 together. The helical sending device is illustrated in detail in application, Ser. No. 645,341, filed June 12, 1967, and assigned to the same assignee as the present application. Once the helical H has traversed the width of the machine, a signal is applied to the conductor 319 (FIG. 18) to energize the solenoid 321 to shift the spool of the pneumatic valve 318 rightwardly so that pressure from the source 322 is delivered to the conduit 329 to energize the forward end of the pneumatic cylinder 139 to retract the rod 141 thereof. A retraction of the rod 141 will move the movable clamp 94 to the position illustrated in FIG. 16 by a reverse of the process described above.

After the clamps have opened, the limit switches 150 and 150A will have closed again and the operator can then close the SHIFT switch so that an electrical signal is applied to the conductor 311 to energize the electromagnetic 281 to effect a movement of the actuator element 282 rightwardly so that the lever arm 277 is pivoted clockwise about the pivot axis 278 against the urging of the spring 279 (FIG. 9). At the completion of the clockwise movement of the lever arm 277, the actuator element 272 of the pneumatic valve 271 is shifted rightwardly and the limit switch 276 is closed. However, the limit switch 302 is still open so that the electromagnetic solenoid 312 remains unenergized. Thus, the rod 251 of the cylinder 248 is extended to effect a counterclockwise rotation of the shaft 242 and cam 254. A counterclockwise rotation of the shaft 242 in FIG. 12 is a clockwise rotation of the shaft 242 in FIG. 9. Thus, the arm 244 secured to the shaft 242 is moved clockwise so that the carriage 207 and the stop 261 will move downwardly to the full downstroke to close the limit switch 302. A closing of the limit switch 302 energizes the pneumatic solenoid 312 to shift the spool of the valve 268 leftwardly to direct pressurized fluid through the conduit 323 to the upper end of the pneumatic cylinder 189 and the lower end of the pneumatic cylinder 248 to thereby initiate an upstream of the carriage 207. Thus, the operator need not hold the SHIFT switch closed but may release the SHIFT switch to permit same to open early on the upstream. The limit switch 302 is only momentarily closed by the stop 261 when in the full downstroke position after which time the switch 302 is opened due to the carriage 207 and stop 261 moving upwardly away therefrom.

Referring now to FIG. 12, since both the pneumatic cylinders 189 and 248 are simultaneously energized, a discussion of the function performed by each of the cylinders will be discussed separately. An extension of the rod 192 of the pneumatic cylinder 189 effects a movement of the lever arm 181 about the pivot axis 182 from the solid line position to the broken line position. This movement will cause the hook member 183 secured to the lever arm 181 to be moved rearwardly (leftwardly) to pull the block 178 secured to the elongated bar 171 rearwardly therewith. As discussed above, a rearward movement of the bar 171 effects a
clockwise rotation of the shaft 166A and a counterclockwise rotation of the shaft 166. Since a rotation of the shaft 166 performs the same function as does the rotation of the shaft 166, only the operative sequence resulting from the rotation of the shaft 166 will be explained in detail, it being understood that the discussion pertains also to the sequence of events caused by a rotation of the shaft 166A. As also stated above, a counterclockwise rotation of the shaft 166 in FIG. 12 is a clockwise rotation of the shaft 166 in FIG. 7. Thus, the arm 167 secured to the shaft 166 will drive the slide plate 160 upwardly to move the knock-out pin 157 upwardly through the guide opening 156 in the Z-shaped bracket 151 to push the assembled coiled springs C1 and C2 upwardly from between the clamps 87 and 94 as illustrated in FIG. 16.

A retraction of the rod 251 (FIG. 12) of the pneumatic cylinder 248 effects a clockwise rotation of the shaft 242 and cam 254. A clockwise rotation of the shaft 242 in FIG. 12 is a counterclockwise rotation of the shaft 242 in FIG. 9. Thus, the arm 244 secured to the shaft 242 is moved from the solid line position to the broken line position. The link arm 247 is driven leftwardly to move the carriage 207 upwardly along the tracks 202. Thus, the hooks 236 and 237 of the puller members 226 and 227, respectively, are moved upwardly into the spring receiving gap 61. In other words, the hook 237 is moved leftwardly from the position illustrated in FIG. 15 to the position illustrated in FIG. 16. It is to be particularly noted that the knock-out pin 157 effects a vertical movement of the assembled coiled springs C1 and C2 prior to the hook 237 reaching the area of the working faces 88 and 98 so that the stem portion 232 passes beneath the assembled coiled springs C1 and C2. Simultaneously therewith, the cam plate 288 is rotated clockwise about the bolt 289. Thus, a release of the SHIFT switch will open the circuit to the electromagnet 281 to cause a counter-clockwise pivotal movement of the lever 277 to the position illustrated in FIGS. 9 and 18 and under the urging of the spring 279. As a result, the limit switch 302 is opened but the circuit to the solenoid 312 has previously been opened by the opening of the limit switch 302. However, the spool of the valve 268 thereof will remain in the above-mentioned shifted position to continue to direct pressurized fluid to the pneumatic cylinders 189 and 248.

The cam plate 288 will hold the lever 286 in the clockwisemost position to maintain the pneumatic valve 271 in the shifted condition.

When the hook members 236 and 237 have reached the uppermost position, the flange 259 on the cam 254 (FIG. 13) engages the flange 188 secured to the hook member 183. The nose 168 of the hook member 183 is lifted above the block 178 to release its engagement with the elongated bar 171. Since each of the slide plates 160 and 160A are resiliently urged to a position wherein the knock-out pins 157 and 157A are retracted to a position out of alignment with the clamping members 87 and 94 by the spring 179, a release of the engagement between the hook 183 and the elongated bar 171 will effect an upward movement of the bar 171 to automatically retract the knock-out pins 157 and 157A to set the assembled coiled springs C1 and C2 on the upper surface of the stem portions of the puller members 226 and 227 as partially illustrated in FIG. 17.

Simultaneous with the hook members 236 and 237 reaching their uppermost positions the flange 307 (FIG. 9) secured to the shaft 242 strikes the actuator element of the limit switch 306 to close same to apply a signal to the conductor 313 (FIG. 18) to energize the solenoid 314 of the pneumatic valve 268 to cause the spool therein to be shifted rightwardly to the position shown so that pressure from the source 322 is delivered to the conduit 324, thence through the pneumatic valve 271 to the conduit 326 and upper end of the pneumatic cylinder 248. Thus, energization of the solenoid 314 will effect an extension of the rod 251 (FIG. 12) to cause the shaft 242 to rotate counterclockwise. As stated above, a counterclockwise rotation of the shaft 242 in FIG. 12 is a clockwise rotation of the shaft 242 in FIG. 9. Accordingly, the carriage 207 is driven rightwardly toward the lowermost position to pull the assembled coiled springs C1 and C2 rightwardly (FIG. 17) to the broken line position X and the cam plate 288 is rotated counterclockwise. The stop 261 will engage the actuating element of the limit switch 302 and the retracted rod 303A of the pneumatic cylinder 303 at the lowermost point of travel of the carriage 207. Simultaneously, the lever arm 286 will fall off the cam surface 291 into the step 292 whereupon the pressure holding the actuator element 272 of the pneumatic valve 271 is removed and the spring 274 is permitted to drive the actuator element 272 leftwardly to shift the spool in the valve 271 (FIG. 18) leftwardly so that the pressure applied to the conduit 324 is delivered to the conduit 327 and pneumatic cylinder 303. A pressurization of the pneumatic cylinder 303 will effect an extension of the rod 303A to push the carriage 207, particularly the hook members 236 and 237 on the puller members 226 and 227 upwardly to the left (FIG. 9) to move the hooks from the position X (FIG. 17) to the position Y. Thus, when the movable clamping member 94 is moved toward the fixed clamping member 87, the assembled joint will not engage the hooks 236 and 237.

The foregoing described process has resulted in the movement of the coiled spring C1 from the position illustrated in FIG. 14 to the C2 position. The machine will remain in the stopped condition at the completion of the foregoing cycle of operation until a new coiled spring C1 is inserted into the position illustrated in FIG. 14 after which time the operator may effect a closing of the CLOSE switch to repeat the foregoing described process.

If it is desired to effect an adjustment of the spring supporting members 12 and 13, the screws 83 (FIGS. 5 and 7) holding the clamp mounting plates 76 fixed relative to the frame 11 of the machine 10, may be loosened so that the clamp mounting plate 76 may be adjusted laterally of the machine to, for example, the broken line position illustrated in FIG. 5. Once the clamp mounting plate 76 has been properly adjusted, the screws 83 may be tightened again to lock the clamp mounting plate 76 relative to the machine frame 11. Similarly, the puller members 226 and 227 (FIGS. 5 and 9) may be adjusted by loosening the bolts 233 and 234 to permit a sliding of the puller members crosswise of the machine in the slots 224 (FIG. 5) so that the stem portions 231 and 232 may be aligned with the
newly adjusted positions of the clamping members 87 and 94.

A movement of the clamp mounting plate 76 also effects an automatic movement of the ejector mechanism 151 laterally therewith. The portion 159 of the screw 158 will slide laterally in the channel 162 of the new adjusted position. All of the foregoing adjustments can be accomplished without having to disassemble any of the machine components.

Although a particular preferred embodiment of the invention has been disclosed in detail for illustrative purposes, it will be recognized that variations or modifications of the disclosed apparatus, including the rearrangement of parts, lie within the scope of the present invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a spring assembly machine having a upright frame, the combination comprising:
a plurality of spring supporting members arranged in two horizontal, parallel and vertically spaced apart rows, said supporting members in one row being vertically aligned with supporting members in the other row, and each spring supporting member having mounting plate means mounted on said upright frame for slideably movement in a direction parallel to said row, said mounting plate means supporting a fixed clamping jaw and a movable clamping jaw, said movable clamping jaw being supported for movement relative to said mounting plate means and transversely of said row between open and closed positions;
driving means;
positive connecting means for drivingly connecting said driving means to said movable clamping jaw to positively drive said movable clamping jaw both toward and away from said fixed clamping jaw, said connecting means including guide means permitting relative movement lengthwise of said row between said driving means and said movable clamping jaw while maintaining the driving connection between said driving means and said movable clamping jaw; and
means for releasably locking said mounting plate means upon said frame.

2. The spring assembly machine defined in claim 1, wherein said guide means on said connector means comprises a track extending parallel to said rows; and wherein said movable clamping jaw includes means for slideably engaging said track for permitting said relative movement lengthwise of said row between said driving means and said movable clamping jaw.

3. The spring assembly machine defined in claim 2, wherein said track comprises a groove; and wherein said means slideably engaging said track comprises projection means on said movable clamping jaw received in said groove.

4. The spring assembly machine defined in claim 1, including ejector means slidably secured to each of said mounting plate means and second driving means therefor; and second connecting means for drivingly connecting said second driving means to said ejector means whereby said ejector means is driven by said second drive means between said fixed clamping jaw and said movable clamping jaw when same are in the open position, said second connecting means including guide means permitting a relative lateral movement between said ejector driving means and said ejector means while maintaining said driving connection therebetween.

5. The spring assembly machine defined in claim 4, wherein said second connecting means comprises a second track extending parallel to said row; and wherein said ejector means includes second means for slideably engaging said second track for permitting a relative movement lengthwise of said row while maintaining said driving connection therebetween.

6. The spring assembly machine defined in claim 5, wherein said second track comprises a second groove; and wherein said second means slideably engaging said second track comprises a pin on said ejector means slideably received in said second groove.

7. The spring assembly machine defined in claim 4, including puller means, said puller means including first support means adapted for movement transversely of said row, said puller means including second support means adapted for adjustment lengthwise of said row to permit alignment of said puller means with said clamping jaws and said ejector means.

8. The spring assembly machine defined in claim 7, wherein said first support means comprises guide means extending parallel to said row; and wherein said puller means includes means guided by said guide means and for securing said puller means to said first support means.

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