Aug. 11, 1959 E. L. BRONSTIEN 2,898,950

SPRING ASSEMBLY MACHINES

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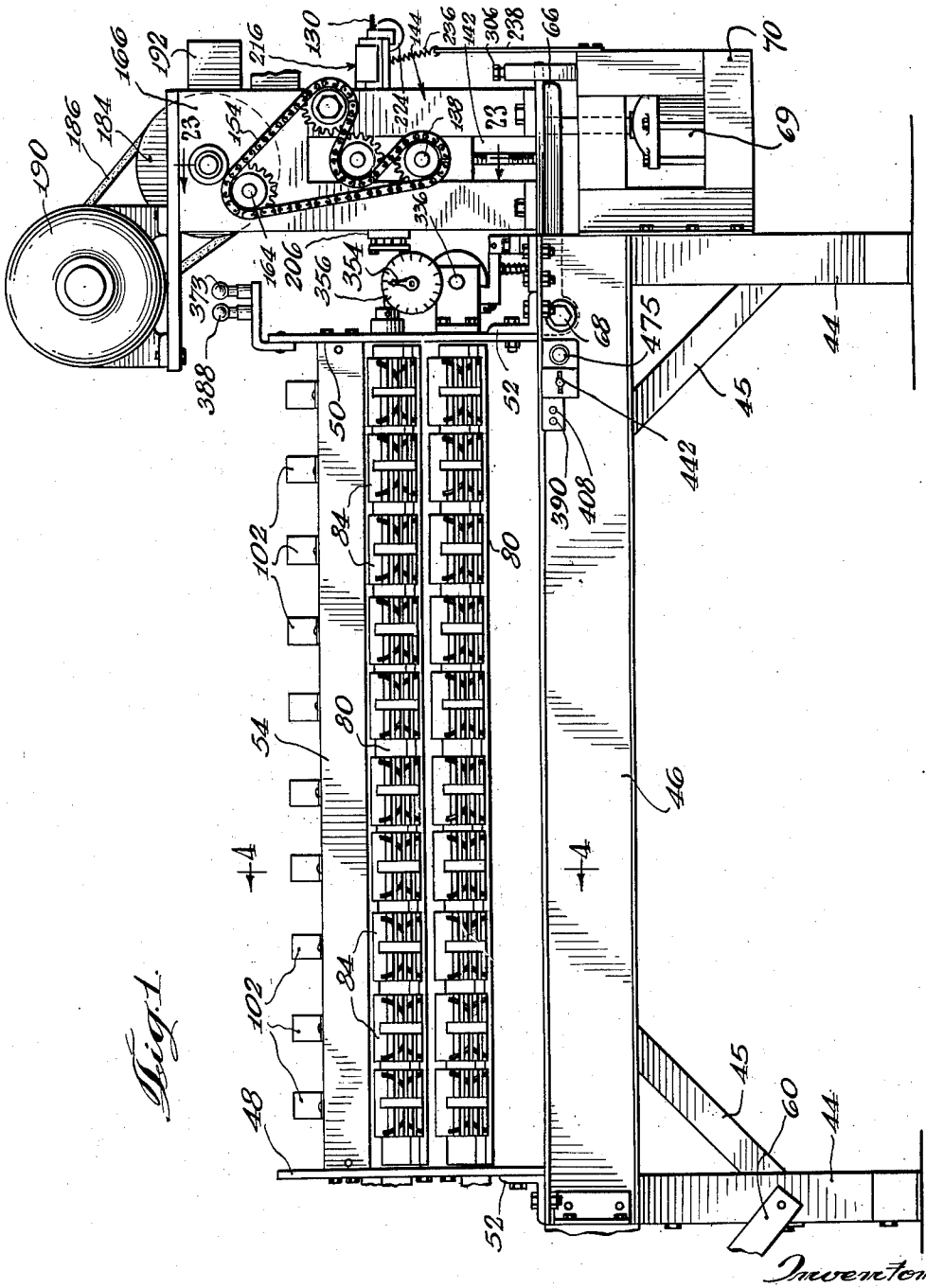


Fig. 1.

Inventor

Edward L. Bronstien

By Mann, Brown & Hausmann

Attorneys

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SPRING ASSEMBLY MACHINES

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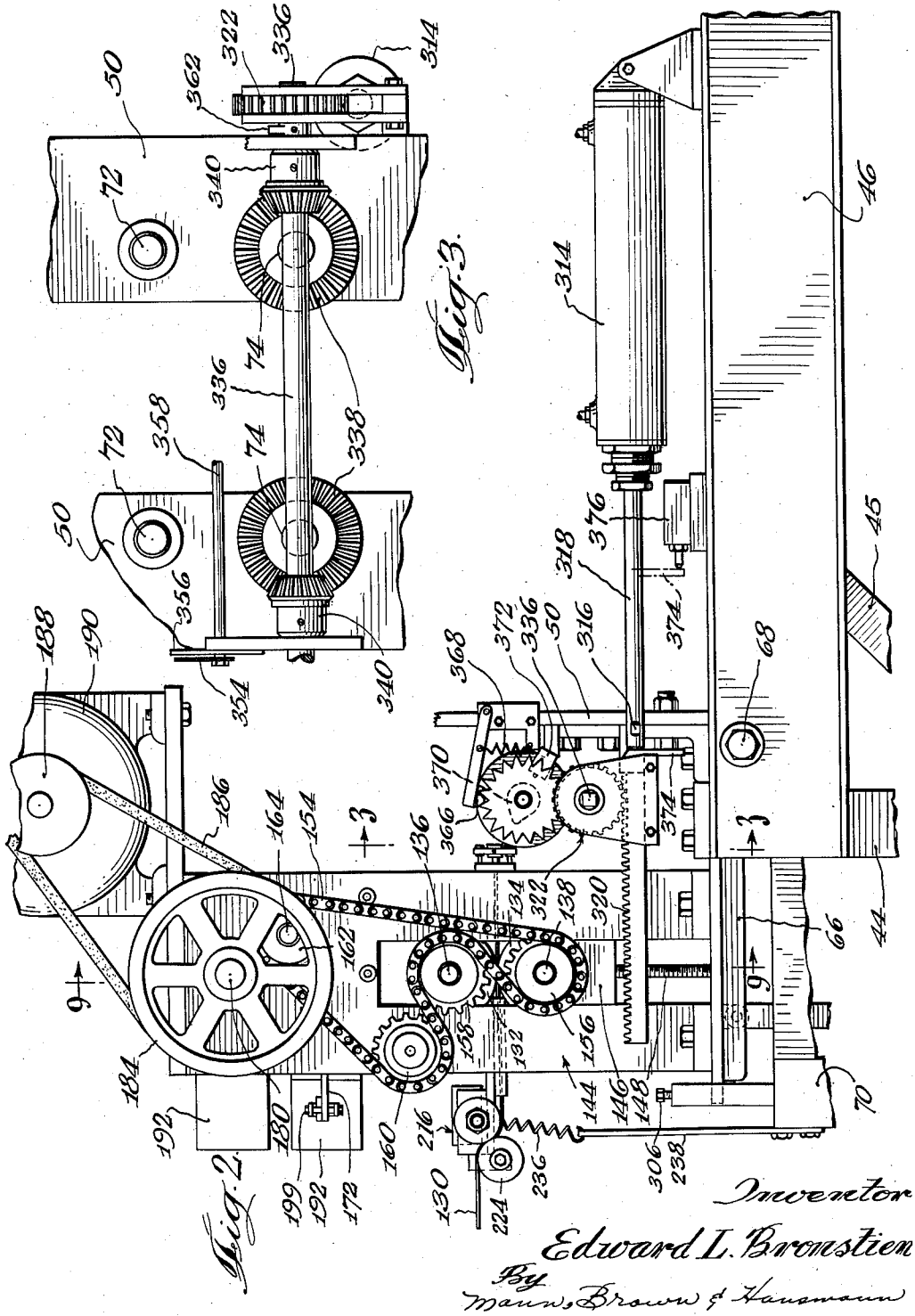


Fig. 2.

Fig. 3.

Inventor
Edward L. Bronstien
By
Mann, Brown & Hausmann
attorneys

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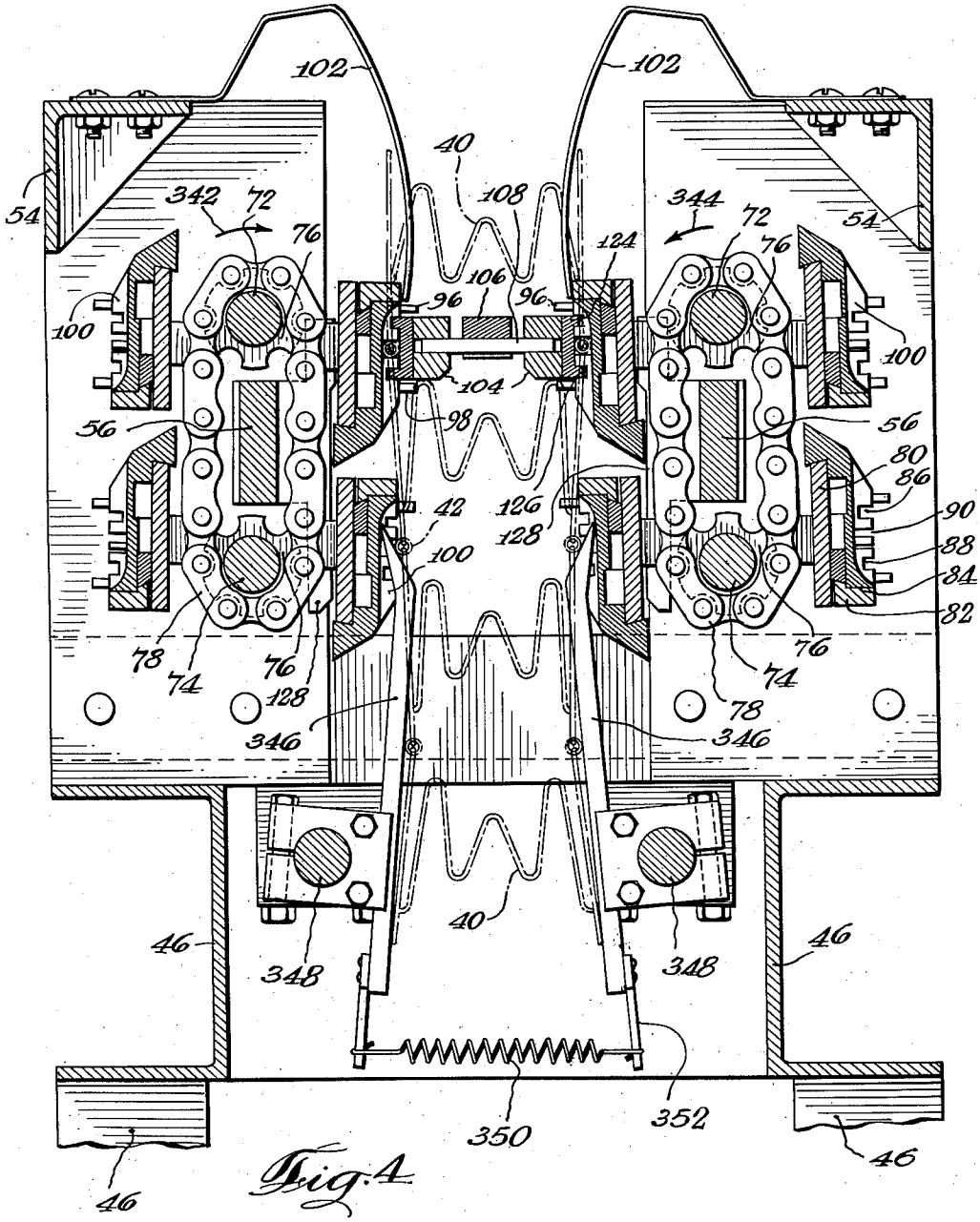


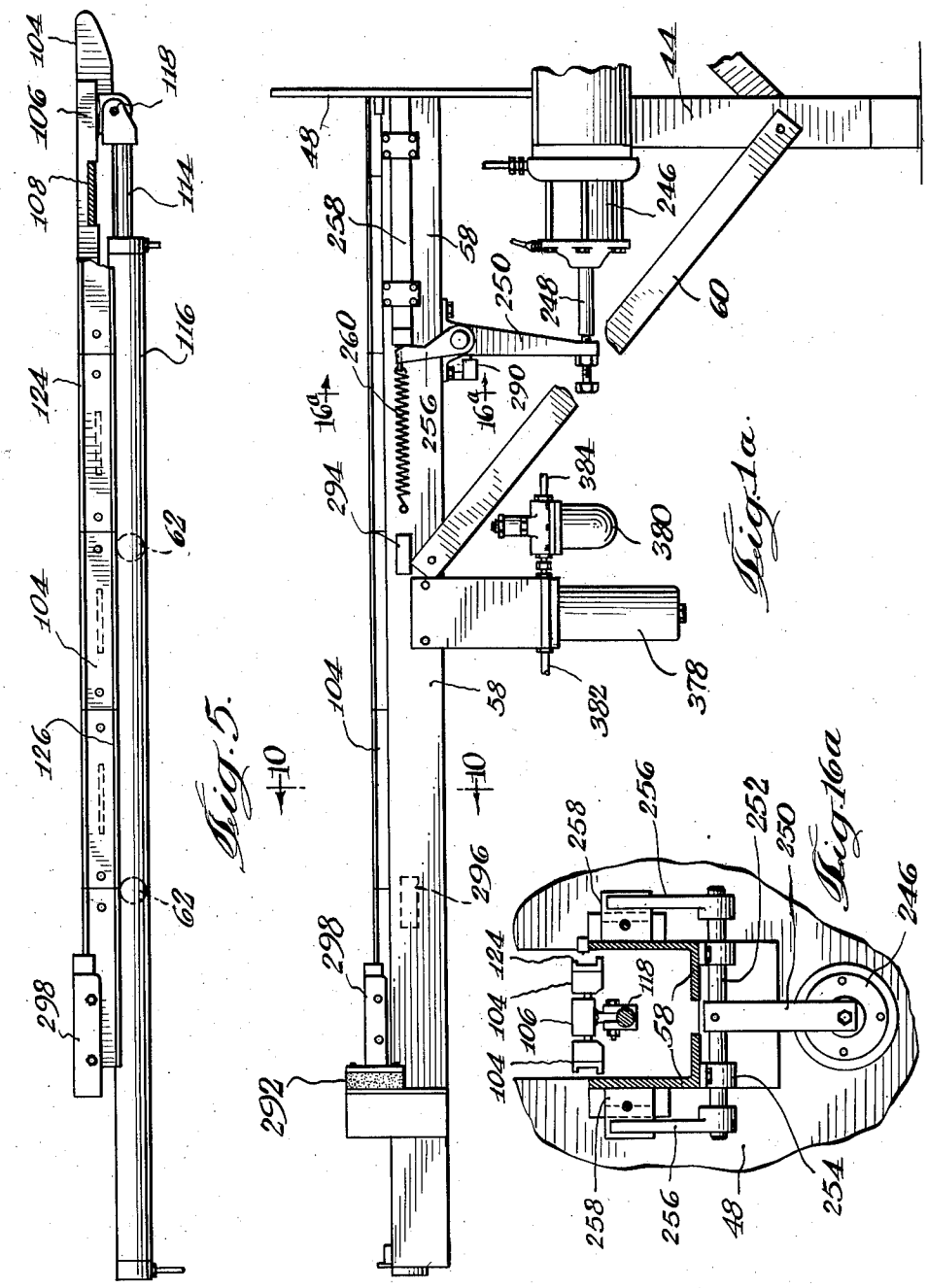
Fig. 4

Inventor
Edward L. Bronstien
By
Mann, Brown & Hausmann
Attorneys

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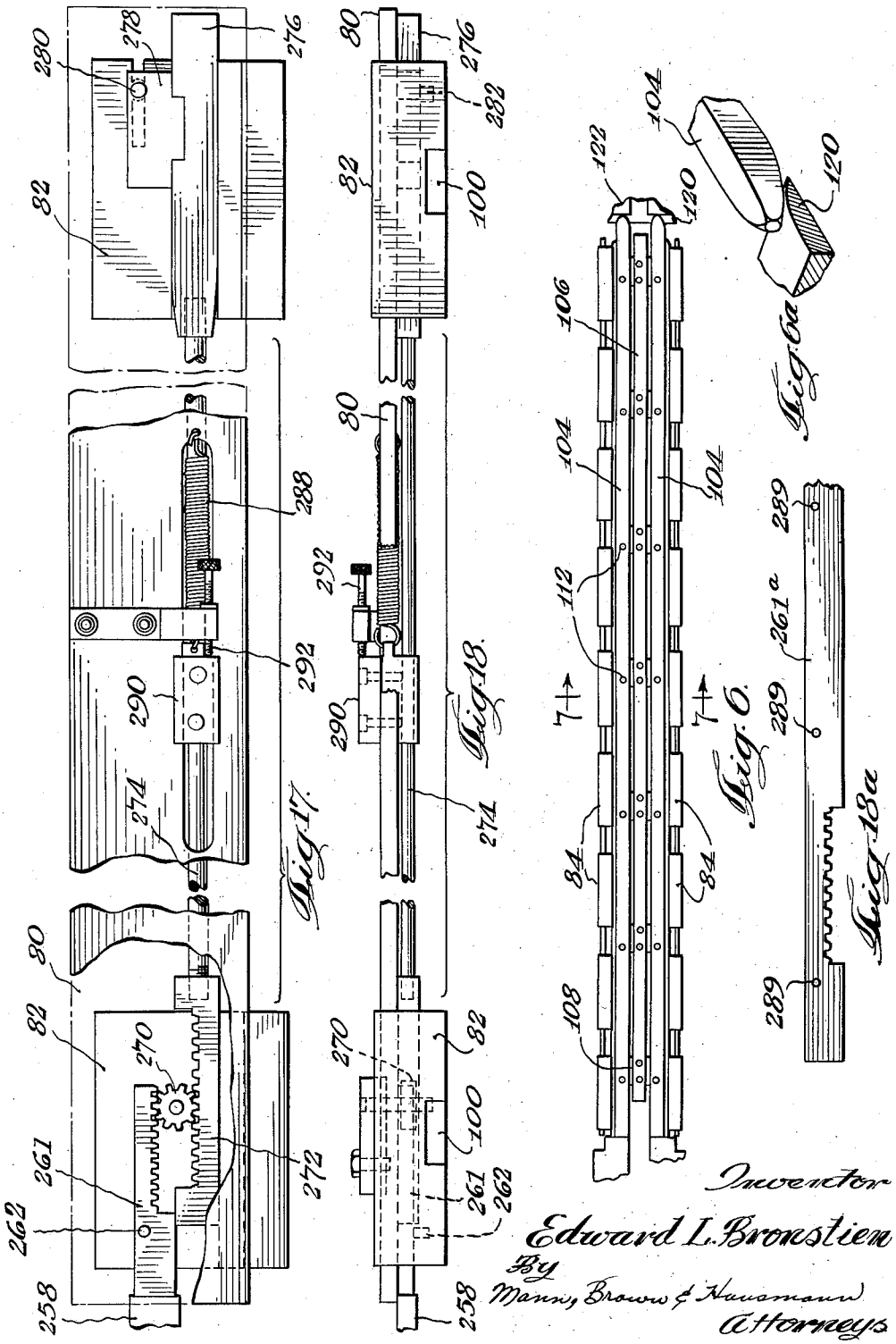


Inventor
Edward L. Bronstien
By Mann, Brown & Hausmann
Attorneys

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Fig. 7.

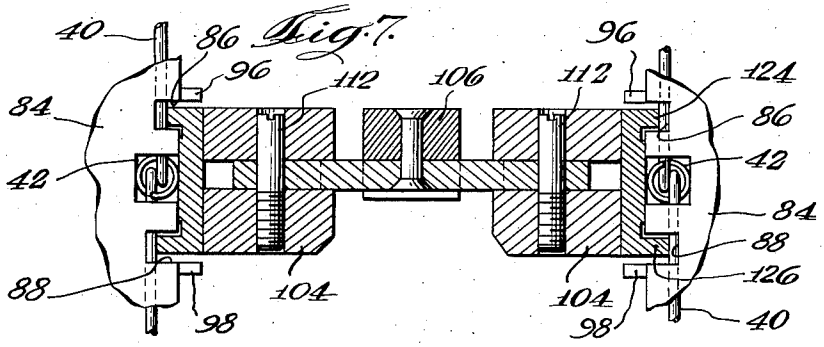
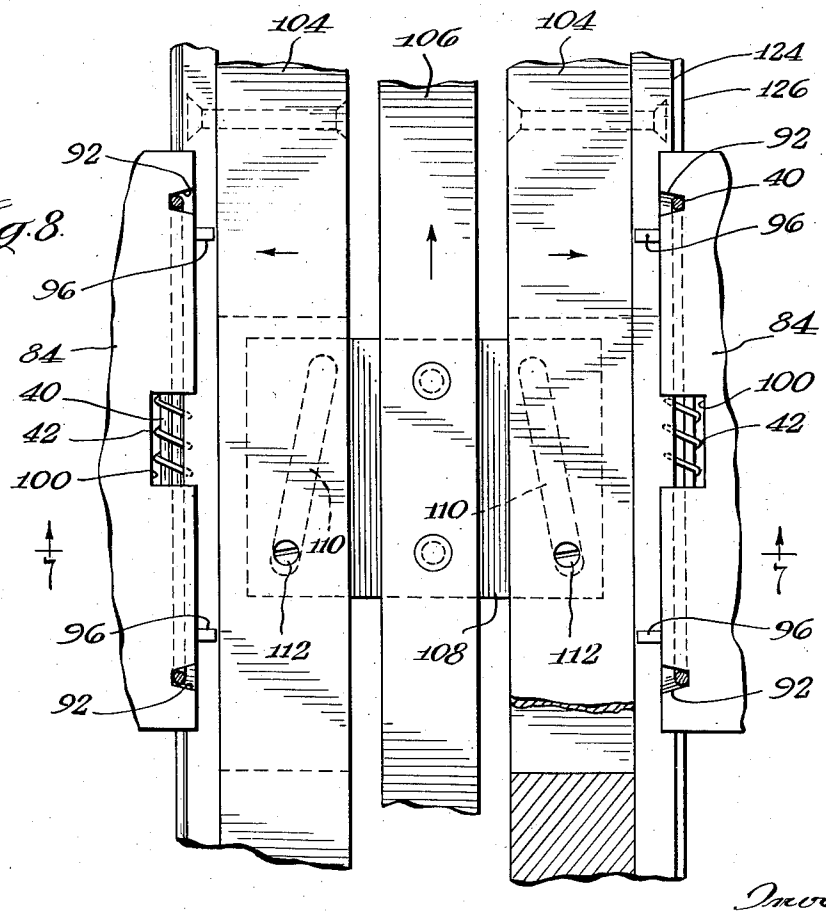


Fig. 8.



Inventor
Edward L. Bronstien
By
Mann, Brown & Hanamann
Attorneys

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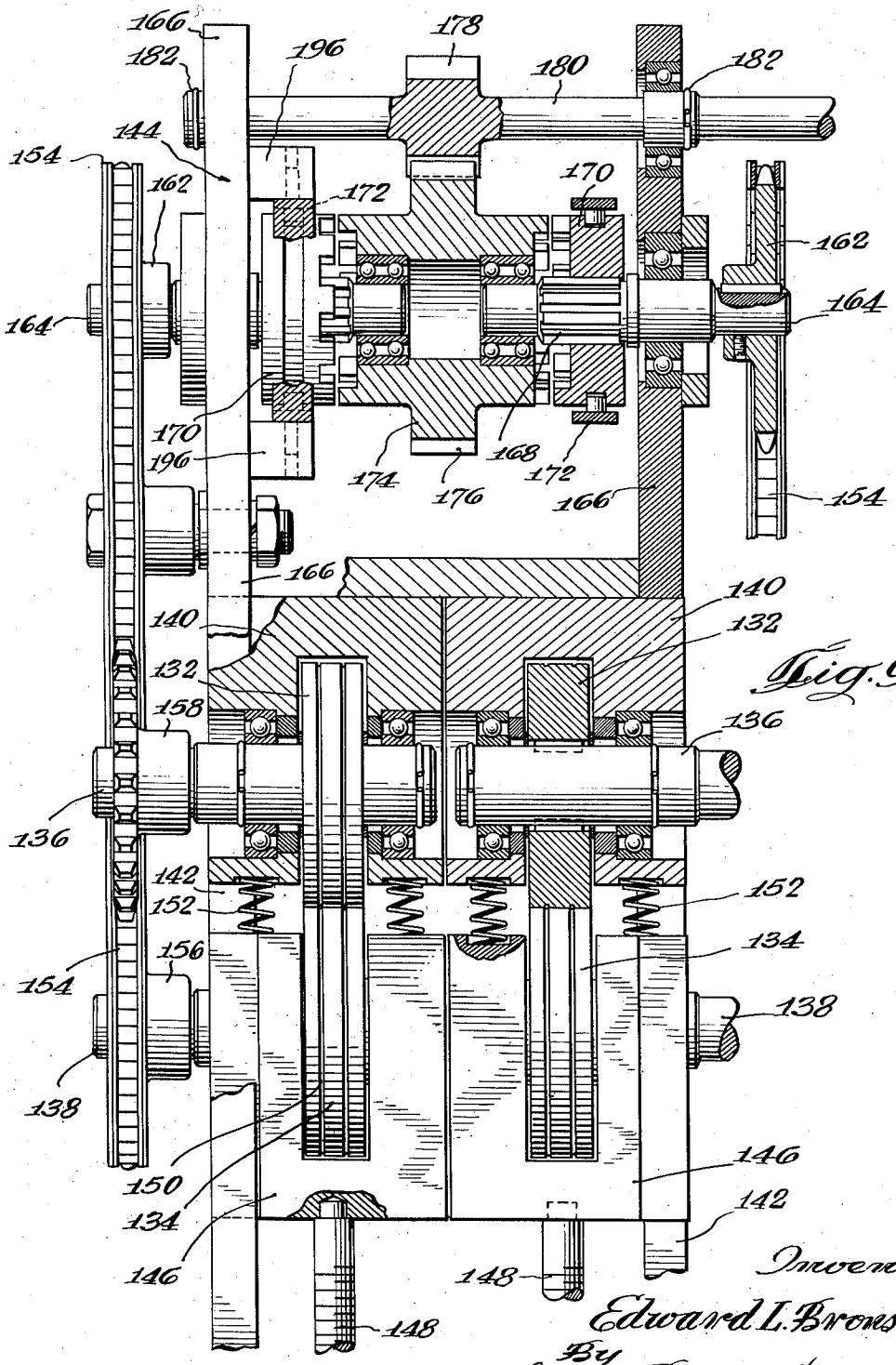


Fig. 9.

Inventor
Edward L. Bronstien
By
Mann, Brown & Hausmann
Attorneys

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Fig. 10.

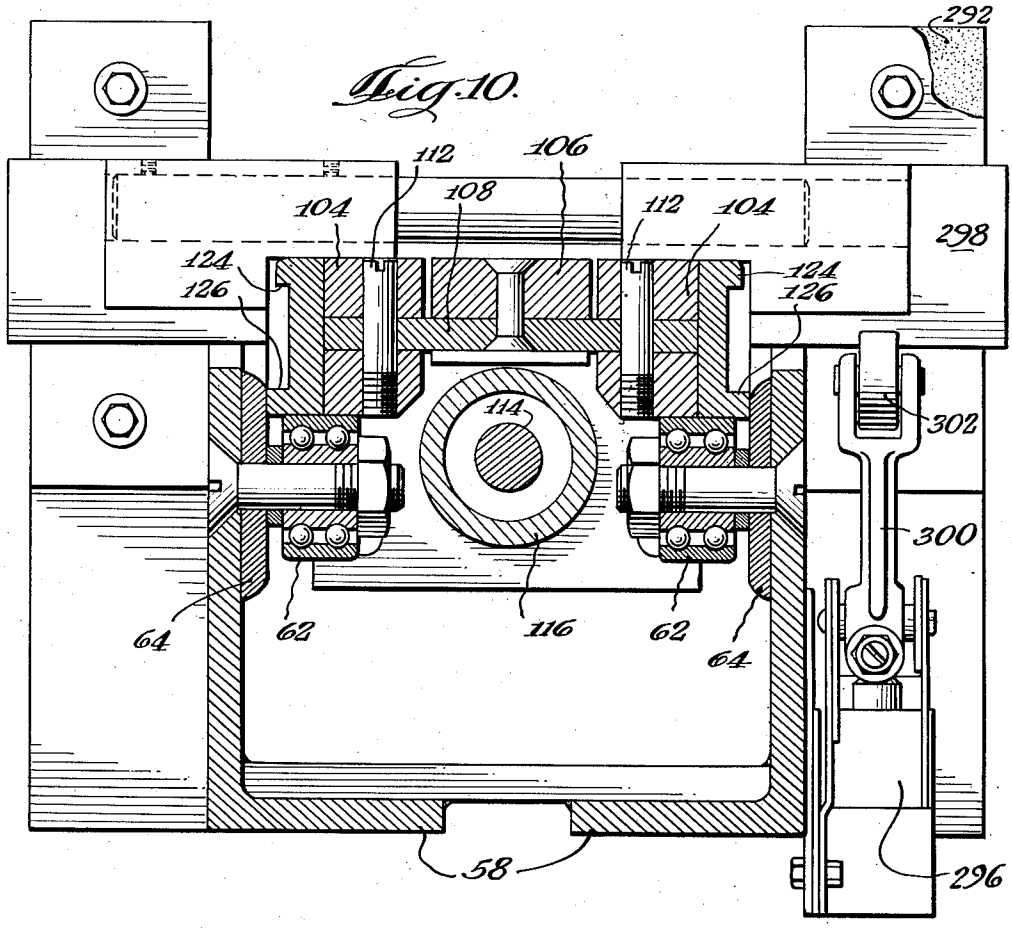
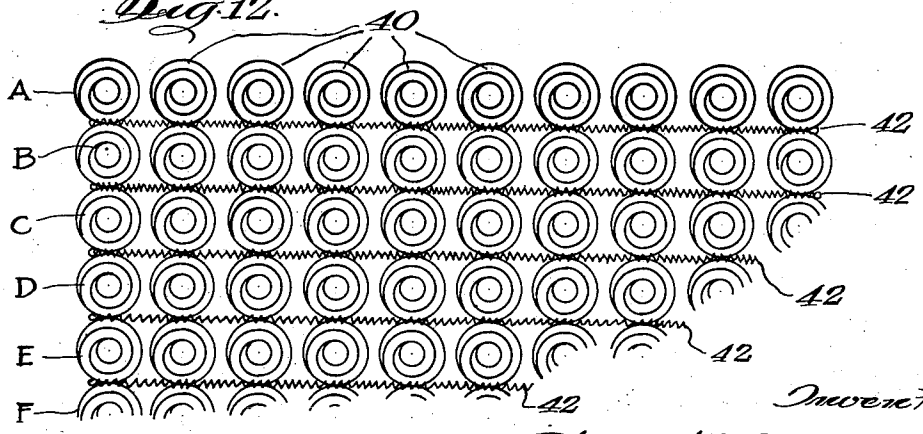


Fig. 12.

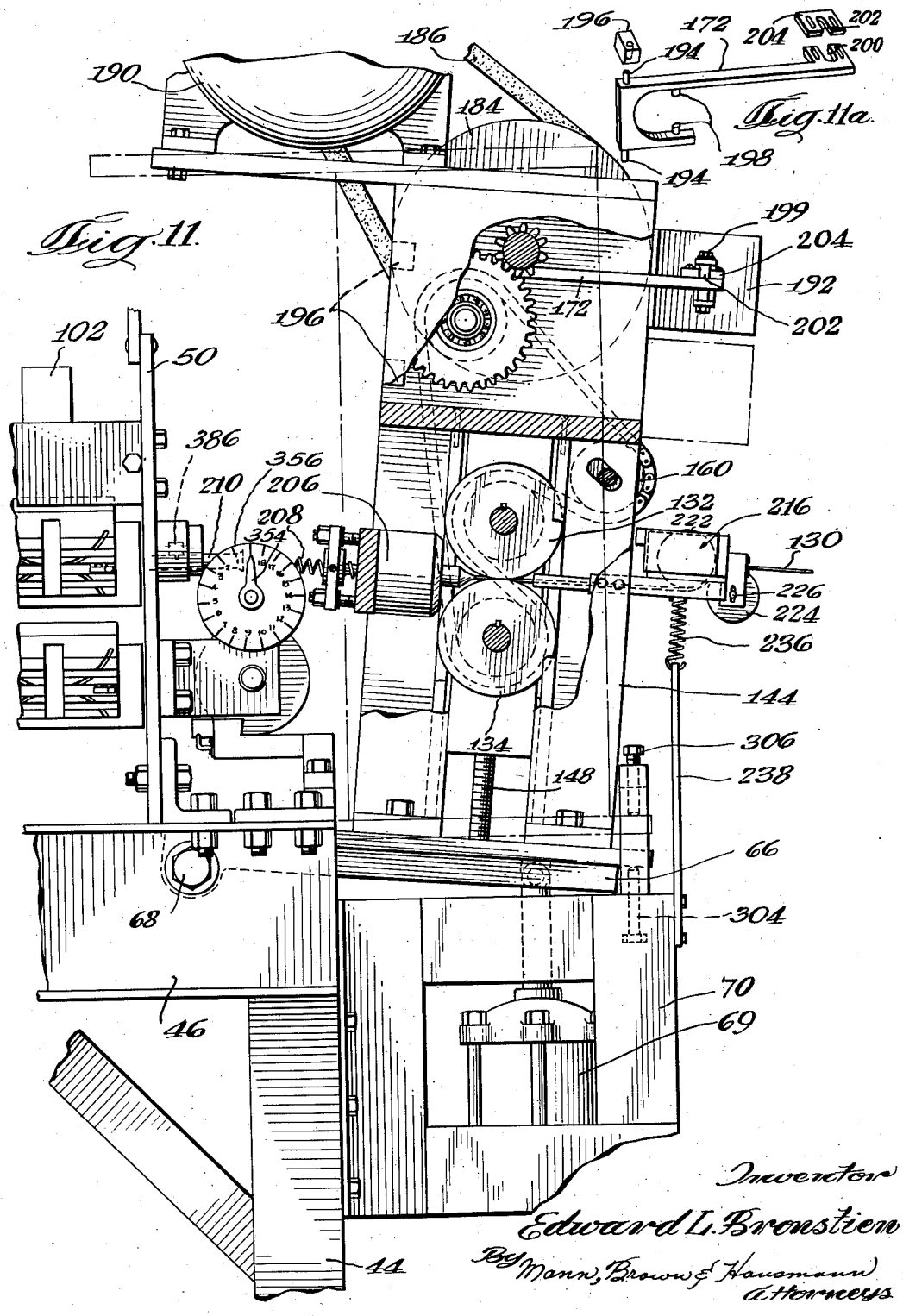


Inventor
Edward L. Bronstien
By Mann, Brown & Hanamann
Attorneys

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Inventor
Edward L. Bronstien
By Mann, Brown & Hausmann
Attorneys

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Fig. 13

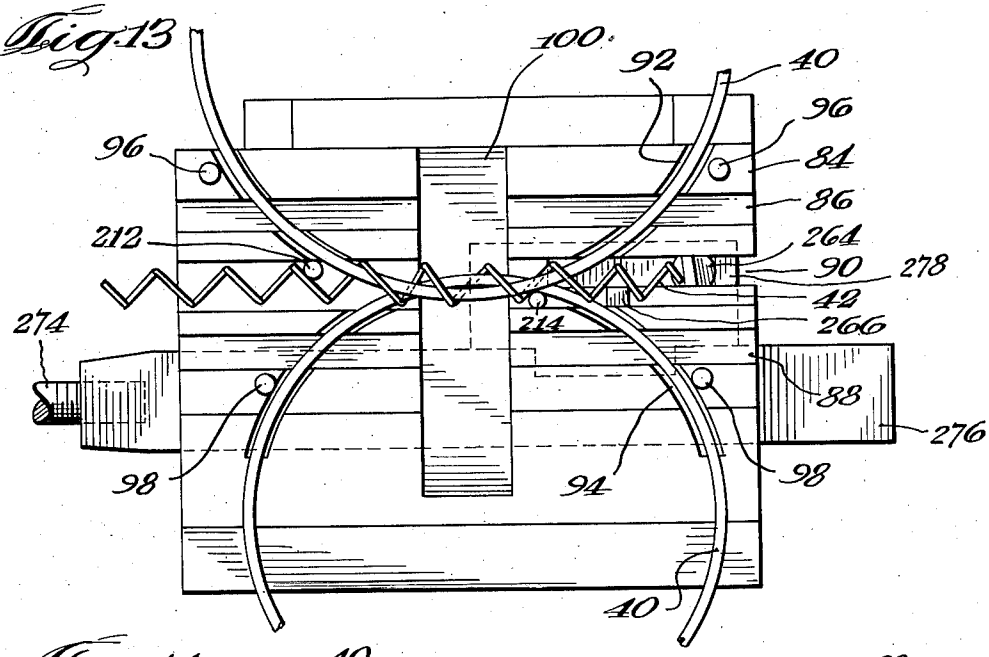
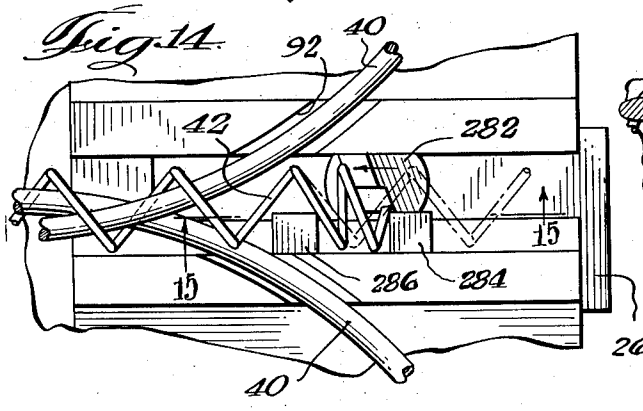


Fig. 14



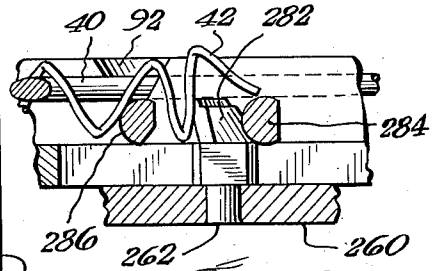


Fig. 15

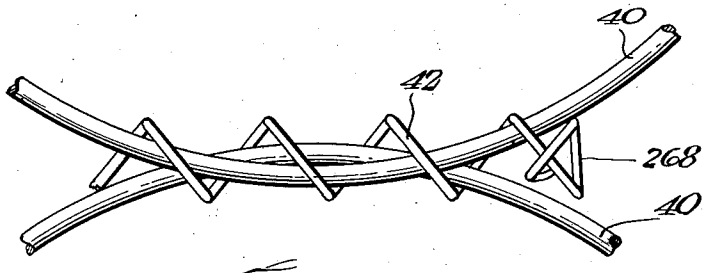


Fig. 16

Inventor

Edward L. Bronstien

By Mann, Brown & Hanamann

Attorneys

Aug. 11, 1959 E. L. BRONSTIEN 2,898,950

SPRING ASSEMBLY MACHINES

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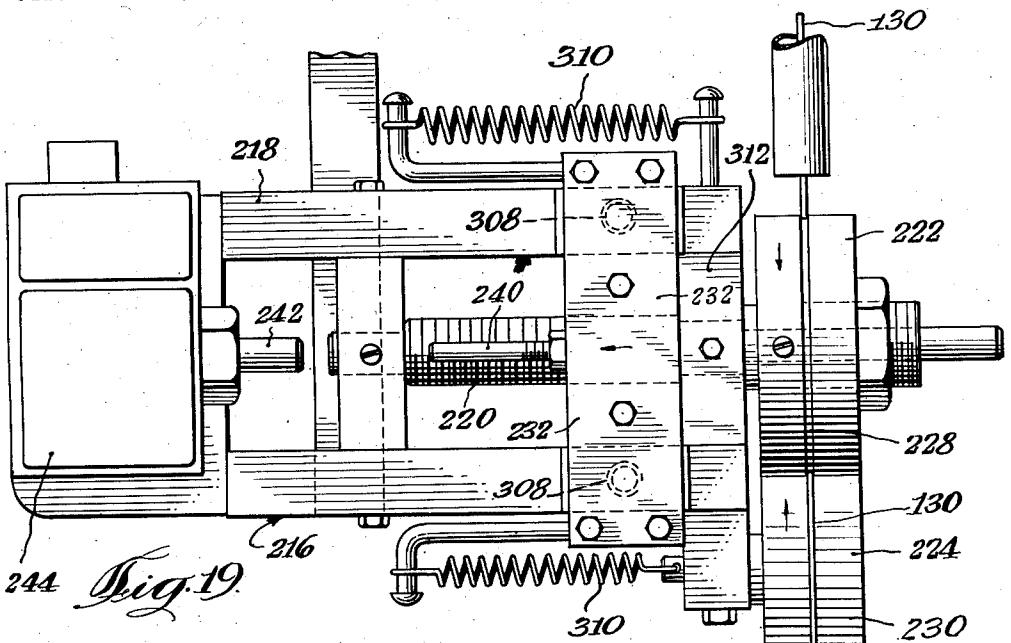


Fig. 19

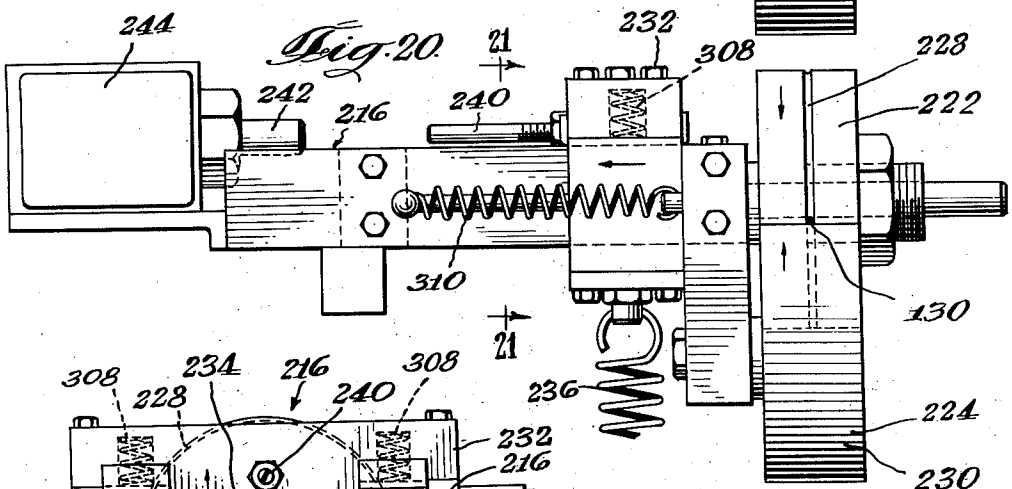


Fig. 20

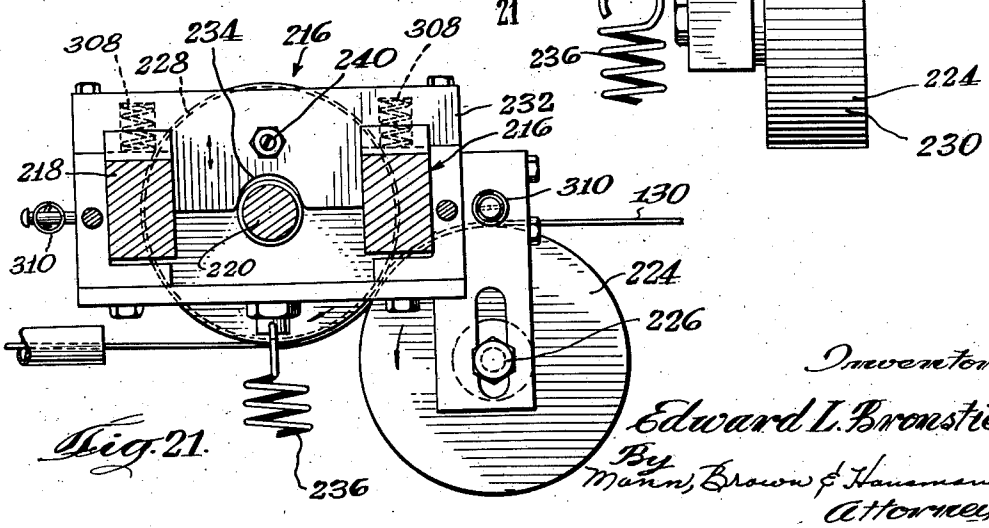


Fig. 21

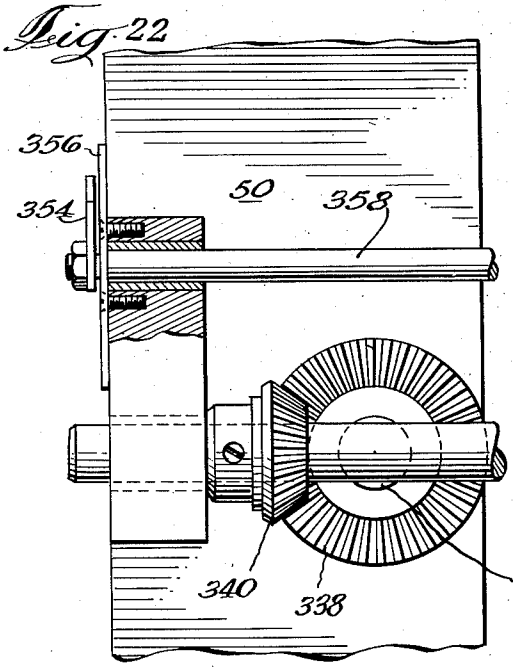
Inventor
Edward L. Bronstien
By Mann, Brown & Hausmann
Attorneys

Aug. 11, 1959 E. L. BRONSTIEN 2,898,950

SPRING ASSEMBLY MACHINES

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Fig. 22



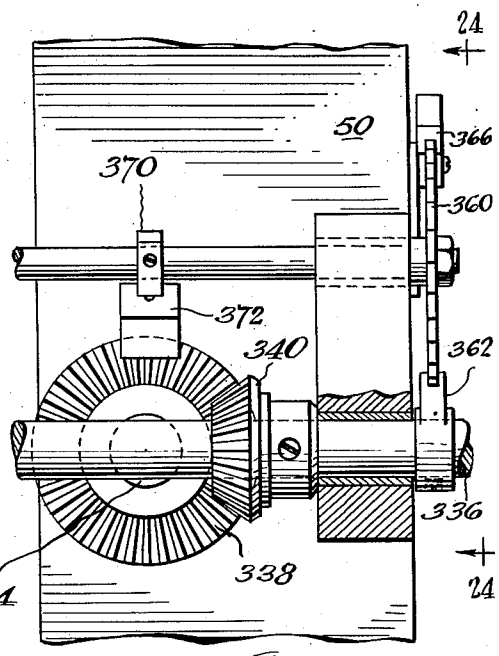


Fig. 23.

Fig. 24.

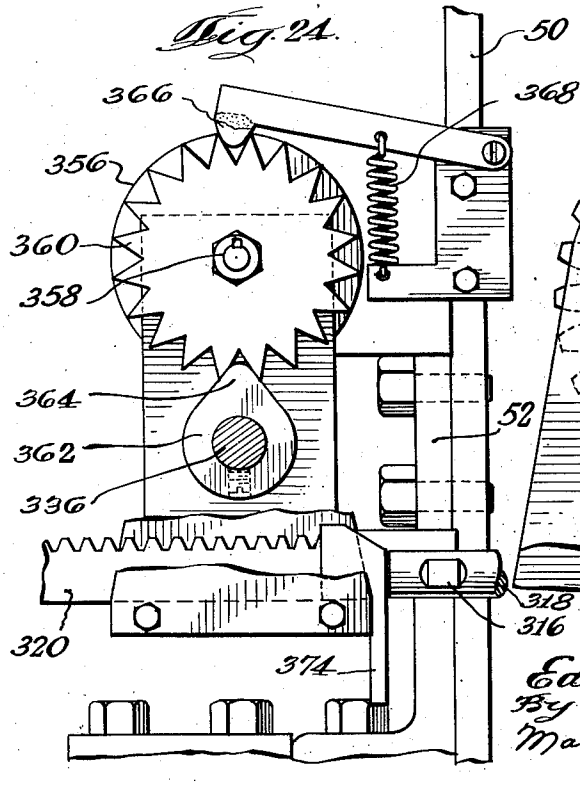
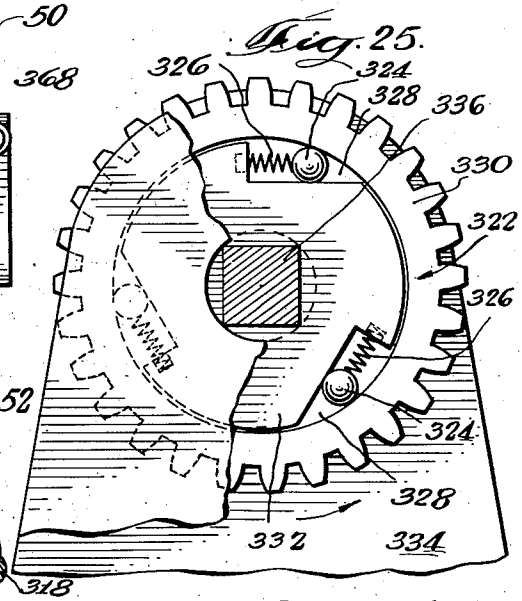


Fig. 25.



Inventor
Edward L. Bronstien
By
Mann, Brown & Hanamann
Attorneys

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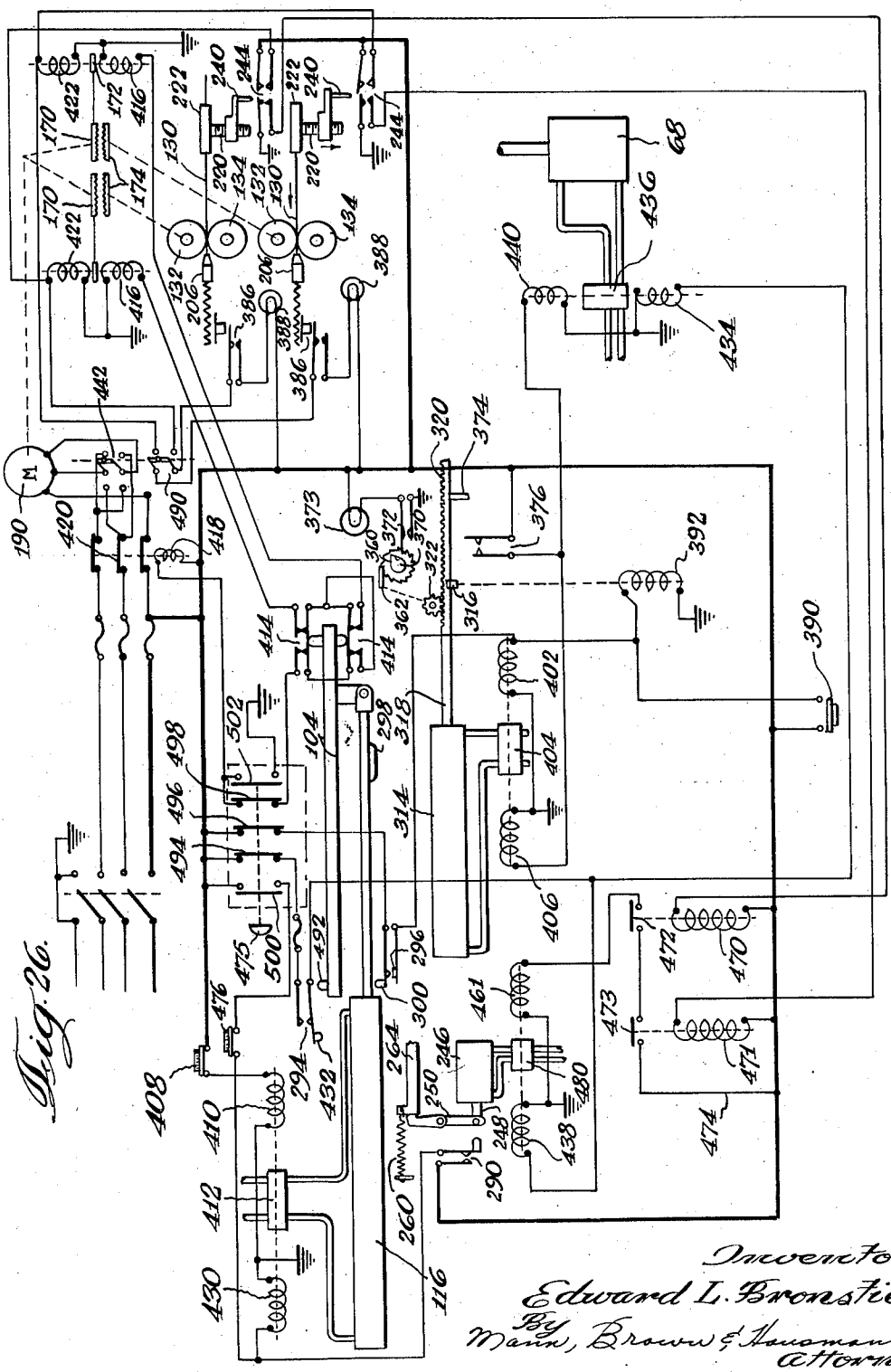


Fig. 26.

Inventor
Edward L. Bronstien
By Mann, Brown & Hanamann
Attorneys

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SPRING ASSEMBLY MACHINES

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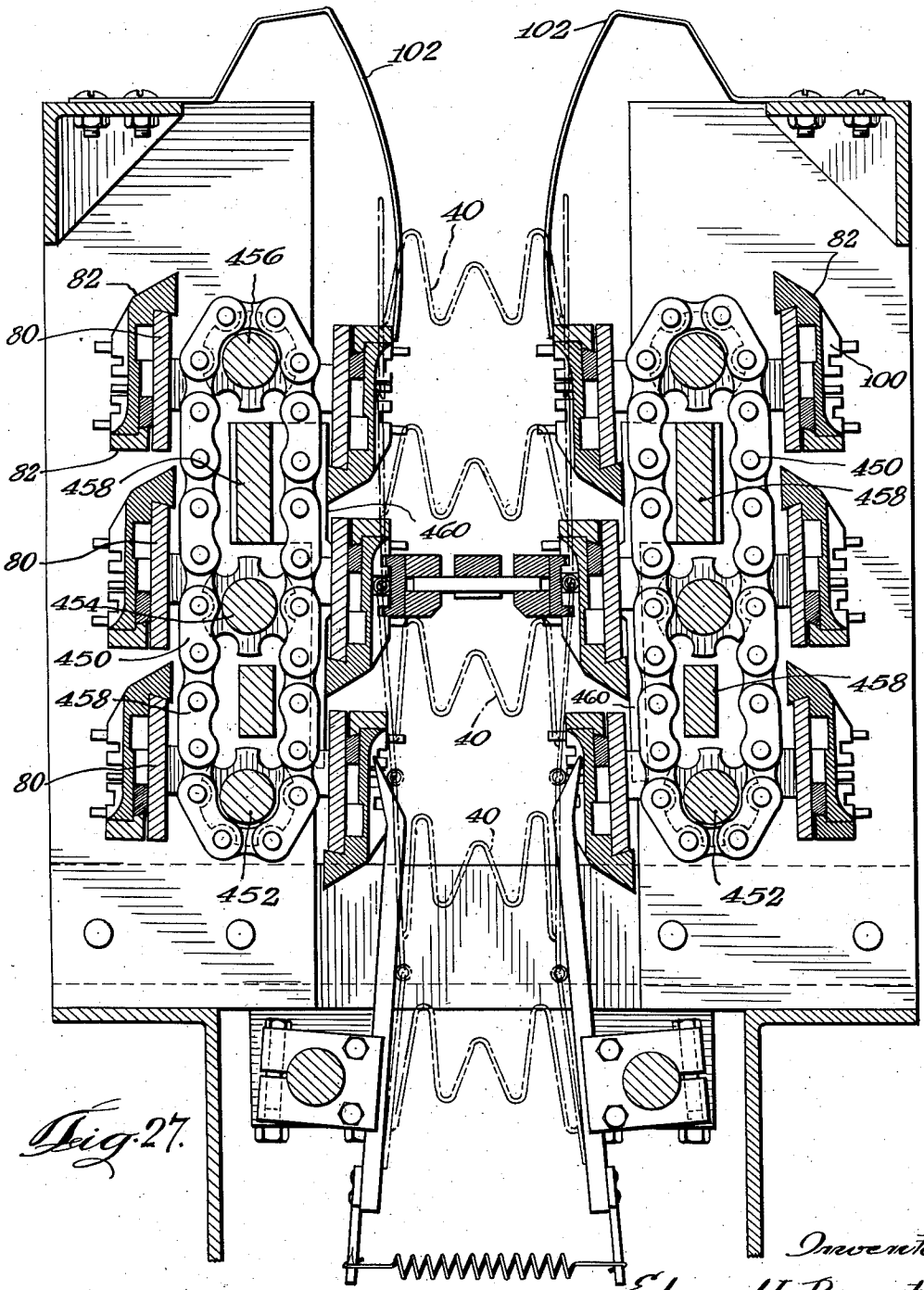


Fig. 27.

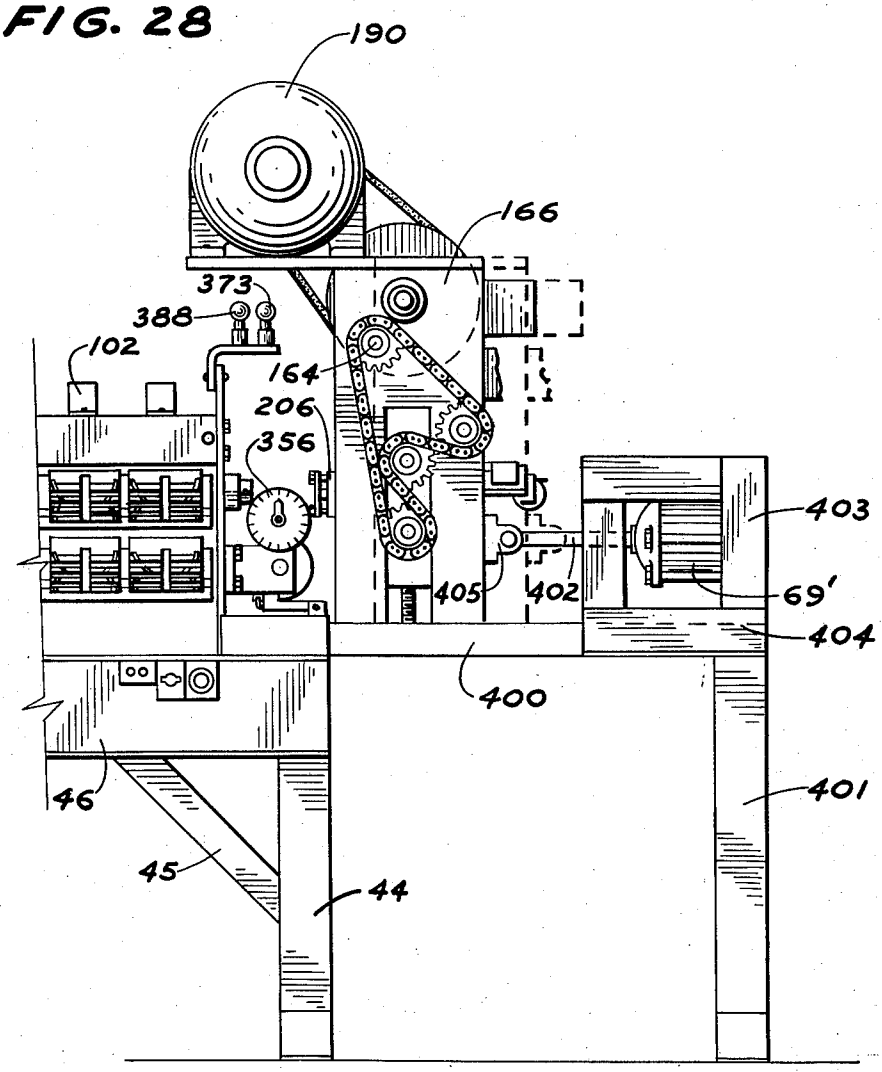
Inventor
Edward L. Bronstien
By
Mann, Brown & Hausmann
Attorneys

Aug. 11, 1959 E. L. BRONSTIEN 2,898,950

SPRING ASSEMBLY MACHINES

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FIG. 28



INVENTOR.
EDWARD L. BRONSTIEN
BY
Dorn, McDougall, Williams & Hersh

United States Patent Office 2,898,950 Patented Aug. 11, 1959

2,898,950

SPRING ASSEMBLY MACHINES

Edward L. Bronstien, St. Paul, Minn., assignor to The United States Bedding Co., St. Paul, Minn., a corporation of Minnesota

Application January 20, 1955, Serial No. 482,943

19 Claims. (Cl. 140—92.8)

My invention relates to spring assembly machines, and is an improvement over the type of machine of United States Letters Patent No. 2,351,659, dated June 20, 1944, which issued on an application filed in the name of myself and another.

This application is a continuation in part of application 216,219 filed March 17, 1951.

My novel machine is particularly designed to fabricate upholstery springs wherein individual coil springs are arranged in parallel rows and the top and bottom coils of the individual springs in adjacent rows are connected by means of helical tie wires. Spring assemblies of this kind are commony used in innerspring mattresses and seat cushions, and for similar purposes.

An object of my invention is to reduce the cost of manufacturing such spring assemblies by the provision of a new and improved machine which reduces the number of operations to be performed by the operator and eliminates the separate tie wire forming machines and separate handling of the tie wires heretofore required.

Another object of my invention is to provide a new and improved machine which is completely automatic, except for the initial insertion of the individual springs, whereby an inexperienced person can be quickly and easily trained to operate one or more of these machines.

Another object of my invention is to provide a machine having new and improved mechanism for clamping the individual springs in position while adjacent rows thereof are being secured together by helical tie wires.

Another object of my invention is to provide a machine wherein all of the wire used in making the helical tie wires forms an essential part of the finished assembly with resulting elimination of the scrap ends of the helical tie wires which heretofore constituted a useless waste and a danger to employees and others in the plant.

Another object of my invention is to provide a machine having new and improved mechanism for forming the helical tie wires as part of the assembly operation, and for cutting off and clinching the wire so formed.

Another object of my invention is to provide a machine having new and improved driving mechanisms.

Another object of my invention is to provide a machine having new and improved controls whereby the machine, when once started by manual manipulation, automatically completes an entire cycle of operations without further attention on the part of the operator.

Another object of my invention is to provide a machine having new and improved emergency controls which are effective only where there is some interference with the normal operation of the machine and which serve to protect the machine and advise the operator of such interference.

Another object of my invention is to provide a machine having novel mechanism for determining the length of the helical tie wires.

Other objects and advantages will become apparent as the description proceeds.

In the drawings:

Figure 1 is a front elevational view of the right hand portion of a machine embodying a form of my invention;

Figure 1*a* is a front elevational view, partly broken away, showing the left hand portion of the machine of Figure 1;

Figure 2 is a rear elevational view of the upper right hand end of Figure 1;

Figure 3 is a vertical, sectional view taken on the line 3—3 of Figure 2 and showing a detail of the driving mechanism;

Figure 4 is a transverse, vertical, section taken on the line 4—4 of Figure 1;

Figure 5 is a side elevational view, with parts broken away, showing the clamp bars and their supporting and operating mechanism. In this view the clamp bars are shown in retracted position;

Figure 6 is a top plan view of the clamp bars of Figure 5, but showing these bars in advanced or clamping position and engaging the spring supporting dies;

Figure 6*a* is an enlarged detail view showing the engagement between the right hand end of a clamp bar and its aligning cam when in the advanced position shown in Figure 6;

Figure 7 is a transverse, vertical sectional view taken on the line 7—7 of Figure 6, and also 7—7 of Figure 8;

Figure 8 is an enarged top plan view of a portion of the structure shown in Figure 6;

Figure 9 is an elevational view largely in section of the feed rollers and their driving mechanism, and is taken generally on the line 9—9 of Figure 2;

Figure 10 is a vertical, transverse, sectional view taken on the line 10—10 of Figure 1*a*;

Figure 11 is a front elevational view, with parts cut away, showing the right hand end of the machine with the helical wire forming mechanism in tilted and stopped position;

Figure 11*a* is an exploded view of a clutch operating lever;

Figure 12 is a view of part of a spring assembly produced by the machine;

Figure 13 is a face view of an end die block showing springs assembled thereon and the crimping mechanism for one end of a helical tie wire;

Figure 14 is a similar view of a die block at the other end of the machine showing the means for cutting off the end of a helical tie wire;

Figure 15 is a horizontal section taken on the line 15—15 of Figure 14;

Figure 16 is a view showing the manner in which coils of adjacent springs are secured together by a helical tie wire and also showing a crimped end of such wire;

Figure 16*a* is a vertical, transverse, sectional view taken on the line 16*a*—16*a* of Figure 1*a*;

Figure 17 is an elevational view, partly cut away, showing the cutting and crimping mechanism;

Figure 18 is a top plan view of the mechanism shown in Figure 17;

Figure 18*a* is an elevational view of an alternative form of rack bar;

Figure 19 is a top plan view of a wire measuring mechanism;

Figure 20 is a side elevational view of the mechanism of Figure 19;

Figure 21 is a vertical sectional view taken on the line 21—21 of Figure 20;

Figure 22 is a partial vertical sectional view showing the pointer for indicating the number of rows of springs assembled and part of the driving mechanism for indexing the die blocks;

Figure 23 is a section similar to Figure 22 and taken on the same plane but showing other parts of the pointer driving mechanism and die block indexing mechanism;

Figure 24 is a sectional view taken generally in the plane of lines 24—24 of Figure 23;

Figure 25 is a detail view, partly broken away, to show the ball clutch for the drive of the die block indexing mechanism;

Figure 26 is a diagrammatic view of the operating mechanism and controls therefor;

Figure 27 is a vertical, transverse, sectional view similar to Figure 4, but showing a modified form of my invention, and

Figure 28 is a fragmentary elevational view similar to that of Figure 1 showing a modification in the means for displacing the tie wire forming mechanism into and out of position of use.

In Figure 12 of the drawings, I have shown one phase of a spring assembly of the type produced by my novel spring assembly machine. In this assembly the individual springs **40** are arranged in parallel rows indicated by the letters A, B, C, D, E and F, and the top coils of each row are secured to the top coils of an adjacent row by a helical tie wire **42**. It will be understood that the bottom coils of the individual springs **40** of each row are similarly connected to the bottom coils of the springs of an adjacent row by a tie wire **42**. The spring assembly may have any desired number of horizontal and vertical rows of springs although the particular machine shown herein is limited to spring assemblies having a maximum of ten vertical rows. This machine may be readily adapted to make spring assemblies having less than ten vertical rows and my invention is equally capable of being embodied in machines for making spring assemblies having more than ten vertical rows of springs.

My novel machine comprises, in general, a frame having legs **44** supporting a pair of channel irons **46** (Figures 1 and 4). These channel irons and legs may be provided with braces as indicated by reference character **45**. Vertically disposed transverse plates **48** and **50** are connected to the channel irons **46** by brackets **52**. The upper corners of the plates **48** and **50** are connected by angle irons **54**, and the intermediate portions of these plates are connected by spaced supporting members **56** (Figure 4).

Referring to Figures 1*a* and 10, it will be seen that a pair of angle irons **58** have their right hand ends attached to the plate **48** and are supported by braces **60** attached to the left hand legs **44**. These angle irons **58**, as best shown in Figure 10, support rollers **62** and guide plates **64** which together constitute supporting and guiding means for clamping mechanism which I shall hereinafter describe.

A tilting head of platform **66** (Figures 1 and 11) is pivotally attached at **68** to the channels **46** and supports the mechanism for feeding and forming the helical tie wires. This head is moved between the horizontal position shown in Figure 1 and the tilted position shown in Figure 11 by an air cylinder **69** mounted in a sub-frame **70** attached to the right hand pair of legs **44**.

Referring to Figure 4, it will be seen that my machine has two pairs of longitudinally extending shafts **72** and **74**, the ends of the shafts being journaled in suitable bearings attached to the plates **48** and **50**. Sprockets **76** are carried by the shafts **72** and **74**, and these sprockets in turn carry endless chains **78**. Two or more chains **78** are provided for each set of shafts **72**, **74**, and these chains carry bars or rails **80** on which die blocks **82** are mounted at spaced intervals longitudinally of the machine, as best shown in Figure 1. In the form of my invention illustrated in Figures 1 to 26 inclusive, each pair of shafts **72** and **74** has four bars associated therewith, and each of these bars is illustrated as having ten die blocks **82** spaced lengthwise thereof. It will be understood, however, that the machine can be designed so that each die bar carries any desired number of die blocks, the number of die blocks used being determined by the number of individual springs required to provide a spring assembly of the desired width.

The die blocks **82** have hardened faces **84**, best shown in Figures 4 and 13. Each of these faces has a pair of horizontal channels **86** and **88** adapted to receive the ribs of a clamping bar, and an intermediate horizontal channel **90** for receiving one of the tie wires **42**. Each die face also includes an arcuate groove **92** for receiving a portion of an end coil of an upper row of springs **40**, and a second arcuate groove **94** for receiving a portion of the end coil of a spring **40** in a lower and immediately adjacent row. It will be noted from Figure 13 that the end coils of the springs overlap in the horizontal groove **90** into which the helical tie wire **42** is fed. An upper set of pins **96** is provided to facilitate the insertion of the spring coil into the arcuate groove **92**, and a lower set of pins **98** is provided to assist in locating the end coil of the lower spring into the arcuate groove **94**. The pins **98** also guide the clamping mechanism to be hereinafter described.

The die blocks also are provided with vertical channels **100** adapted to cooperate with stripping mechanism which serves to remove the coiled springs from the die blocks as the assembly progresses. The particular die block shown in Figure 13 is one of the die blocks located immediately adjacent the plate **48** and is provided with certain crimping mechanism to be hereinafter described.

Referring to Figure 4, it will be seen that the springs are inserted individually between opposed pairs of spring guides **102**, a pair of which is provided for each vertical series of die blocks. In inserting the springs the end coils engage the guides **102** which lead these end coils into engagement with the arcuate grooves **92** in opposing die blocks. The pins **96** prevent the end coils of the springs from being pushed downwardly beyond these arcuate grooves and facilitate the introduction of the end coils into such grooves. In starting a spring assembly a complete row of springs is inserted into the top row of opposing die blocks, as indicated in Figure 4, and then the machine is indexed to rotate the shaft **72** and **74** to move the die blocks downwardly between the sets of shafts from the upper position shown in this figure to the lower position shown in this figure. In so doing, a new set of die blocks is brought into spring receiving position.

As the new set of die blocks moves into spring receiving position, the die blocks engage the upper portions of the coils of the row of springs previously inserted and pins **98** guide the end coils of such previously inserted springs into the arcuate grooves **94**. The operator then inserts a new row of springs and the end coils of the previously inserted row of springs are held in overlapping relation by the die blocks, as shown in Figure 13. The operator then closes the switch which initiates the cycle of operations which is automatically carried out by the machine and requires no further attention by the operator. This cycle of operations connects, by helical tie wires, the end coils of the two rows of springs which have been inserted, and indexes the die blocks to receive a new set of springs.

The first step in the cycle of operations is the introduction of clamping means for holding the overlapped end coils of the springs firmly in the die blocks as a prerequisite to securing these coils together by means of helical tie wires. This clamping means is best shown in Figures 4, 5, 6, 7 and 8, and comprises a pair of clamping bars **104** and an actuator bar **106**. The actuator rod **106** has plates **108** attached thereto at spaced intervals throughout its length, and each of these plates has a pair of inclined slots **110** in which are located the pins **112** of clamping bars **104**. When the clamping bars **104** and actuator bar **106** are not in use they are supported on the rollers **62** carried by the angle irons **58** forming the left hand end of the machine and are located between the guide bars **64** attached to such angle irons (as shown in Figure 10).

The clamping bars **104** and actuator bar **106** are moved

to operative or clamping position by the piston and piston rod 114 of a pneumatic cylinder 116. The piston rod 114 is attached to the right hand end of the actuator bar 106 as indicated at 118 (Figure 5). When the cylinder 116 is supplied with fluid under pressure, the actuator bar 106 is moved to the right and carries with it the clamping bars 104. These clamping bars are in the collapsed position, that is, with their pins 112 in the lower ends of the slots 110, as viewed in Figure 8. As shown in Figure 10, guide plates 64 prevent spreading of the clamping bars 104 during their initial movement, after which there is no appreciable tendency for these bars to spread until their forward movement is retarded in the manner hereinafter described.

As the clamping bars move to the right between the upper set of die blocks holding the newly introduced row of springs with their end coils in overlapped relation to the end coils of a previously introduced row of springs, the clamping bars ride on and are guided by the pins 98 of such die blocks. Just before the forward movement of the clamping bars 104 is completed, the tapered forward ends of these bars come in juxtaposition to a tapered shelf 120 of an abutment member 122 (Figures 6 and 6a), which cams or lifts the clamping bars into exact alignment with the die blocks if the pins 98 have become bent or for any other reason have failed to maintain these clamping bars in such alignment. Engagement of the forward ends of the clamp bars with abutment member 122 stops the forward movement of these bars, and thereafter continuing movement of actuator bar 106 spreads the clamping bars into firm engagement with the die blocks and spring coils located therein.

The clamping bars include hardened plates providing spaced ribs 124 and 126 which engage in horizontal channels 86 and 88, respectively, of the die blocks. Between the ribs 124 and 126 each clamping bar is provided with a face cooperating with the recesses 90 of the die blocks to form closed channels for the helical tie wires 42. Spreading of the clamping mechanism into final position closes a switch associated with the bars to initiate the next step in the cycle, which is the forming of the helical tie wires and the spinning of these wires about the overlapped end coils of the springs. The thrust exerted by the clamping bars 104 against the die blocks is resisted by engagement of the die blocks with the inwardly directed faces of guide plates 128. These guide plates are attached to, and spaced longitudinally of, support members 56.

A feature of my invention lies in the fact that it is only necessary to supply my new and improved machine with straight wire in the coiled form in which such wire comes from the manufacturer, and my machine simultaneously forms this wire into helical form and spins it about the overlapping end coils clamped between the clamping bars and die blocks. The wire is measured as it is formed into helicals and fed into the machine so that there is no wastage of wire, and there are no cut-off sections of helicals to fall on the floor and provide insecure footing for the operator and others working near or passing by the machine. This feature of my invention contributes materially to the efficiency and cleanliness of the assembly operation and eliminates the separate forming and intermediate handling of the helical tie wires necessitated by prior assembly machines.

Two coils of wire of a size suitable for forming the helical tie wires may be supported on any suitable means (not shown) adjacent the right-hand end of the machine, and the wire 130 from each coil is fed into the machine by a pair of feed rollers 132 and 134 (Figure 11). The two pairs of feed rollers are best shown in Figure 9, each feed roller 132 being mounted on a shaft 136, and each feed roller 134 being mounted on a shaft 138. The shafts 136 are mounted in roller bearings carried by blocks 140 located in the upper extremity of a vertical slot 142 provided by a housing 144 mounted on the platform or head 66. Shafts 138 are mounted in similar bearings in the blocks 146 slidable in the slot 142 and urged upwardly by screws 148 which force the feed rollers 134 toward the feed rollers 132. The feed rollers are preferably provided with grooves 150 somewhat shallower than half the diameter of the wire to be fed so that by adjusting the screws 148 any desired frictional engagement can be secured between the feed rollers and the wire 130 fed thereby. Springs 152 are preferably interposed between the blocks 140 and the blocks 146.

Each set of feed rollers is driven by a chain 154 (Figures 2 and 9) which passes over a sprocket 156 on shaft 138, a sprocket 158 on shaft 136, an idler sprocket 160, and a driving sprocket 162 on a jack shaft 164. The jack shafts 164 are mounted in bearings carried in the upwardly extending sides 166 of the housing 144 and have splined inner ends 168 on which clutch members 170 are mounted for longitudinal movement.

In Figure 9 the clutch members 170 are shown in disengaged position but are adapted to be independently moved by clutch levers 172 into engagement with an intermediate clutch member 174 journaled on bearings carried by the inner ends of shafts 164 and held against longitudinal movement by such bearings. The clutch member 174 has gear teeth 176 which mesh with and are driven by a pinion 178 mounted on a main shaft 180 journaled in bearings in the upper end of the housing sides 166 and held against longitudinal movement by snap rings 182. Shaft 180 has a pulley 184 at one end thereof, and a belt 186 connects the pulley 184 with a smaller pulley 188 driven by a motor 190.

The clutch levers 172 are each positively operated in both directions by a solenoid 192 (Figure 11). One of these clutch operating levers is shown in detail in Figure 11a and comprises a pivot pin 194 mounted in blocks 196 attached to the housing 144. This lever has pins 198 engaging an annular groove in a clutch member and an actuated end having a central opening in which there is located the actuating pin 199 of a solenoid 192. This opening is formed by complementary recesses 200 and 202, the former being formed in an integral part of the lever 172 and the latter being formed in a cooperating plate 204 secured to the lever 102 by bolts passing through registering elongated slots in the lever and plate whereby the effective length of the opening formed by the recesses 200 and 202 can be varied to give the desired clutch adjustment.

Each pair of feed rollers 132, 134, draws a wire 130 from the coil in the form in which the wire is delivered by the manufacturer and the rollers force this wire through a forming die 206 (Figure 11). This die may be of any conventional type and causes the wire to assume the helical form indicated at 208. From the forming die 206 the helical tie wire is fed into the end of a tube 210 fixed to the frame plate 50 and in alignment with the channel formed by a clamping bar 104 and the longitudinal series of die blocks with which it is engaged. As the helical tie wire is fed through the tube 210 and channel just described, this wire rotates about its longitudinal axis and is wrapped or spun about the overlapping portions of the end coils of the springs clamped between the clamping bar and associated die blocks. The manner in which this tie wire is wrapped about the overlapping coils is clearly indicated in Figures 13 and 16. Pins 212 and 214 are mounted on each die block in the channel 90 to guide the forward end of the helical tie wire and position it for the desired wrapping or spinning action about the overlapping portions of the spring coils.

As each wire 130 is fed into the machine by its feed rollers 132 and 134, this wire passes through a measuring means, indicated generally by the reference character 216 (Figures 1 and 11) which is illustrated most fully in Figures 19, 20 and 21. Each measuring means is attached to the housing 144 and has a frame 218 supporting a threaded shaft 220 carrying the driving roller 222. An idler 224 is also carried by the frame 218 and is ad-

justably mounted therein as indicated at **226**, whereby the idler **224** can be so positioned as to press the wire **130** against the driving roller **222** with sufficient force to eliminate slippage therebetween. The rollers **222** and **224** are preferably provided with shallow grooves **228** and **230** respectively.

As the threaded shaft **220** is driven by roller **222**, the shaft moves a carriage **232** which has a half thread **234** engaging the shaft **220**. The carriage **232** is slidable on the frame **218** and is held in engagement with the shaft **220** by a spring **236** whose upper end is attached to the carriage **232**. The lower end of the spring **236** is attached to a bar **238** mounted on the housing **70** (Figures 1 and 11).

An adjustable contact **240** is mounted on carriage **232** and engages the contact **242** of a microswitch **244** when the desired amount of wire has been fed to the machine by the associated pair of feed rollers **132, 134**; that is, when the wire fed into the machine has been formed into a helical tie wire and this helical tie wire has been wrapped about the overlapping portions of all of the coils clamped between its clamp bar and the die blocks engaged thereby. The microswitch **244** operates one of the solenoids **192** to open the clutch **170, 174**, for its associated feed rollers. While both of the feed roller clutches are being opened by the two microswitches **244**, the switches also close a circuit controlling the valve which admits air to the cylinder **246** (Figures 1*a* and 16*a*) which operates the cutting and clinching mechanism shown in detail in Figures 17 and 18.

The piston rod **248** of the cut-and-clinch cylinder **246** actuates one end of a lever **250** to move this end toward the left, as viewed in Figure 1*a*. This lever is attached to a cross-shaft **252** mounted in brackets **254** attached to angle irons **58**. An arm **256** is attached to each end of the shaft **252** and actuates a slide **258**. A spring **260** is attached to each slide **258** and these springs normally hold the slides **258** in retracted position with the associated lever mechanism and piston rod in corresponding positions.

Each slide **258** is in alignment with a rack bar **261** (Figures 17 and 18) carried by the die bar or rail **80**, whose die blocks are at the moment engaging one of the clamp bars. The rack bar **261**, when moved to the right by the slide **258** as viewed in Figures 17 and 18, operates a pin **262** integral with or attached to the clinch member **264** (Figure 13) and moves this member to the left, as viewed in the latter figure. Such movement forces the forward end of the tie wire **42** back toward a stop block **266** and puts a crimp in the end of the tie wire, as indicated at **268** in Figure 16. This crimp and the corresponding crimp formed at the other end in a manner presently described serves to prevent the tie wire from unwinding from about the overlapped portions of the end coils.

The right-hand movement of the rack bar **261**, as viewed in Figures 17 and 18, also rotates a pinion **270** mounted on a shaft supported in the die block **82** shown at the left-hand side of these figures. Rotation of this pinion pulls rack **272** toward the left and with it rod **274** and its associated slide **276**. This slide carries a plate **278** which engages a pin **280** attached to the cutter **282** (Figures 14 and 15). When this cutter is moved to the left as viewed in these figures, it coacts with a block **284** to cut the adjacent portion of the helical tie wire **42** and then continues toward the left to force the cut end of the tie wire **42** toward the stationary block **286** and thereby crimp the end of the tie wire.

The cut-and-clinch slide **276** and its associated mechanism is returned to retracted position by the spring **288** having one end attached to a collar **290** affixed to the rod **274** and its other end attached to the die bar or rail **80**. An adjustable stop **292** limits the retractile movement of the cut-and-clinch mechanism. It will be understood that each die bar **80** and its associated die blocks have attached thereto cut-and-clinch mechanism of the kind illustrated in Figures 17 and 18, but only the cut-and-clinch mechanisms associated with the die blocks currently engaged by the clamping bars are in alignment with the slides **258** for actuation thereby. Only the end die blocks adjacent the vertical frame plate **48** are provided with the clinching means **264, 266** of Figure 13, and only the end die blocks adjacent the vertical frame plate **50** are provided with the cutting and clinching means **282, 284**, and **286** of Figures 14 and 15.

In order to make the machine adaptable to manufacture spring assemblies of less width, e.g. having less than ten springs in each horizontal row, rack bars **261***a* (Figure 18*a*) may be substituted for the rack bars **261**. Each bar **261***a* has a plurality of openings **289** adapted to engage a pin **262** of a clinch member **264** associated with a die block. By shifting the pins **262** and clinch members **264** to any one of the three vertical series of die blocks in registry with the openings **289**, different widths of assemblies may be produced. The contacts **240** of the tie wire measuring switches will have to be correspondingly adjusted.

As the lever **250** of the cut-and-clinch mechanism completes its operative stroke, it contacts and closes a microswitch **290** (Figure 1*a*). This switch operates the valve of clamp bar actuating cylinder **116** to admit air to the right-hand end of the cylinder, as viewed in Figure 5, and return the clamping bars to their original position in contact with the rubber bumper **292**. The return movement of the clamping bars permits the switches associated therewith to open and break the motor circuit. The initial movement of the piston rod **114** retracts the actuating bar **106** while the inertia of the clamping bars **104** and the frictional engagement of these bars with the die blocks hold them against return movement. The relative movement between the clamping bars **104** and the actuating bar **106** causes pins **112** to slide in inclined slots **110** so that the clamping bars are drawn inwardly and away from engagement with the die blocks. Continued backward movement of the actuating bar **106** carries the clamping bars with it. As these bars move backwardly they successively engage the switches **294** and **296** (Figure 1*a*), each of which has an upstanding arm with a roller positioned at the upper end thereof for engagement by the cam block **298** attached to the clamping bars. In Figure 10, I have illustrated the arm **300** and roller **302** which is engaged by the cam block **298** and serves to actuate the switch **296**.

The switch **294** releases the pressure in the cut-and clinch cylinder **246** and permits the springs **260** and **288** to return their respective assemblies to idle positions. This switch **294** also operates a circuit to release pressure from the cylinder **69** beneath the table or head **66**, thereby permitting this head and the wire feeding and measuring mechanism carried thereon to drop from the position shown in Figure 1 to the position shown in Figure 11. Downward movement of the head **66** is limited by an adjustable stop **304**. A similar adjustable stop **306** determines the upper position of this head. As the head **66** drops, tension on spring **236** is released, and the portion of helical tie wire between the forming die **206** and the cutter associated with the adjacent die block is drawn backwardly an amount sufficient to compensate for any overrunning of the feed rolls subsequent to the cutting operation. This backward movement also withdraws this portion of the helical tie wire away from the adjacent die block so that there is no interference with the indexing of the die blocks which brings another die bar and its associated die blocks into alignment with the tube **210**.

Instead of rocking the head **66** about its pivot **68**, the desired displacement of the head **66** between normal position with the helical tie wire aligned with the tie wire channel between the die blocks and retracted position, wherein the helical tie wire between the forming

die 206 and the cutter associated with the adjacent die block is drawn backwardly by an amount to compensate for the overrunning of the feed rolls and wherein the helical tie wire is withdrawn from between the adjacent die blocks to avoid interference with the indexing of the die blocks, may be achieved by linear displacement of the head, as illustrated in the modification shown in Figure 28.

In this modification, the table or head 66 is supported for linear displacement longitudinally in the direction toward and away from the die blocks on horizontally disposed ways 400 rigid with the frame or channel members 46 and supported at its forward end on legs 401. The piston arm 402 of the air cylinder 69' fixed within a housing 403 on the table 404 is pivotally engaged at its end onto a bracket 405 fixed to the head 66 for displacement thereof between normal or operative position, indicated by the solid lines, and retracted position, shown by the broken lines in Figure 28. When displaced to retracted position responsive to operation of switch 294 to release pressure from cylinder 69' the helical tie wires are withdrawn, as described, from between the die blocks. Upon return of the head to normal or operated position corresponding to the raised position in the modification previously described, the helical tie wires are returned to between the adjacent die blocks in alignment with the channels through which the tie wires are advanced for joining a set of spring coils.

Controls for the operation of the cylinder 69' for displacement of the head 66 between normal and retracted position correspond to the controls for operation of the cylinder 69 but instead of rocking the head 66 about its pivot 68, between normal and retracted or tilted position, the head is displaced linearly between normal and retracted position.

The release of tension on spring 238 permits the measuring means to return to initial position and thereby conditions these means for measuring two new tie wires when the two pairs of feed rollers are again operated. As soon as the tension of spring 236 is released, springs 308 raise carriage 232 so that half thread 234 is out of engagement with threaded shaft 220. Thereupon, springs 310 return the carriage 232 to the starting position shown in Figures 19 and 20 wherein this carriage engages the cross-member 312 of frame 218.

Switch 296, which is closed shortly after the closing of switch 294, controls the valve for admitting the air to the indexing cylinder 314 (Figure 3). This switch 296 also actuates a solenoid to withdraw latch pin 316 which normally holds the piston rod 318 of cylinder 314 against movement. A rack 320 is attached to piston rod 318, and movement of the piston rod and rack toward the right in Figure 2 rotates a one-way clutch 322, shown more fully in Figure 25. This clutch has balls 324 urged by springs 326 toward the tapered ends of openings 328 formed between the outer clutch member 330 and the inner clutch member 332. When the clutch member 330 is driven in the direction of the arrows 334, no motion is transmitted to the shaft 336 whereas motion is transmitted to this shaft when the clutch member 330 is rotated in the opposite direction by rack 320.

Shaft 336 is connected by sets of beveled gears 338 and 340 to shafts 74 which drive the die bar carrying chains 78 in the direction of the arrows 342 and 344 of Figure 4. Thus, the right-hand movement of piston rod 318 and rack 320, as viewed in Figure 2, indexes the die bars to bring a new pair of bars into spring receiving position. As the lower set of spring carrying die blocks move downwardly and outwardly around the lower sides of shafts 74, strippers 346 assist in separating these die blocks from the springs carried therein. This is accomplished through the engagement of the upper ends of the strippers with the channels 100 (Figure 13) in the die blocks. The strippers are mounted on shafts 348 pivotally supported in the machine frame. Springs 350 are attached by arms 352 to the end pairs of strippers and are located laterally thereof to permit the spring assembly to pass between the springs 350 without interference thereby. These springs 350 assist in holding the upper ends of the strippers in engagement with the die blocks.

The indexing mechanism also operates an indicating mechanism comprising a movable pointer 354 and a stationary dial 356 (Figures 1 and 22). The pointer is driven by a shaft 358 having a toothed wheel 360 (Figure 24) attached to one end thereof. This toothed wheel is driven by a gear 362 mounted on shaft 336 and having a single tooth 364 which engages the toothed wheel 360. The construction of the parts is such that the shaft 336 rotates through one complete revolution for each indexing movement and drives the toothed wheel 360 one notch. This wheel 360 is engaged by a finger 366 yieldably urged into engagement with the notches in the wheel 360 by a spring 368, the purpose of this mechanism being to prevent overrunning of the wheel 360 and to hold the pointer against accidental displacement. A cam 370 is adjustably mounted on the pointer shaft 358 and engages the contact point of a switch 372 which operates light 373 (Figure 1), to indicate to the operator that a spring assembly has been completed.

As the piston of the cylinder 314 (Figure 2) completes its indexing stroke, a finger 374 engages a microswitch 376 which admits air to the right-hand end of the cylinder 314 and returns the indexing mechanism to the position shown in this figure. During such return movement the two parts of the clutch 322 slip with respect to each other and transmit no motion to the shaft 336. The switch 376 also admits air to the cylinder 68 and causes this cylinder to return the head 66 and its associated mechanism to the upper position shown in Figure 1.

From the time the operator actuated the starting button until the indexing mechanism and head 66 had been returned to normal position, all of the operations were automatically performed in a predetermined sequence and required no attention on the part of the operator. The machine has now completed its cycle of operation and is ready for the insertion of a new row of springs. As soon as such springs have been inserted and the starting button again pressed the cycle of operations is repeated. This procedure is continued until the pointer 354 and signal light 273 advise the operator that the spring assembly has been completed. The operator then presses the indexing switch. Following a single indexing movement of the die bars the machine is ready for the insertion of the first row of springs of the next spring assembly.

The operator then inserts the first row of springs for the next assembly and immediately presses the indexing button. This releases the last row of springs of the completed assembly from the die blocks and permits this assembly to be withdrawn from beneath the machine. The operator next inserts a second row of springs and presses the starting button to initiate the normal cycle of operations, and these alternating steps of inserting a row of springs and pressing the starting button are repeated until the new spring assembly is completed.

The air cylinders are provided with conventional air valves which are unbiased and shifted in both directions by electrical coils. These cylinders are supplied with compressed air or any other gas under pressure from any suitable source. As shown in Figure 1*a*, a filter 378 and a lubricator 380 may be interposed between the air supply line 382 and the line 384 leading to the several air cylinders on the machine.

In addition to the controls for carrying out the cycle as heretofore described, I also provide certain emergency controls which become operative only if something interferes with the normal cycle of operations. Referring to Figure 11, it will be seen that I have provided a microswitch 386 associated with each tube 210. If the forward

feed of the helical tie wire into the channel formed by its clamping bar and associated die blocks stops, the helical will bow upwardly and engage this switch. This causes one of the solenoids **192** to open the clutch connection between the motor and feed rolls for that particular tie wire, and simultaneously lights the lamp **388** to indicate such stoppage.

Figure 26 is a diagrammatic representation of the controls. I shall now describe these controls in connection with a summary of the operation of the machine. Assuming the machine is empty and the operator is about to start the assembly of a new unit, the operator first inserts a spring between a pair of guides **102** and presses downwardly on the spring until its end coils engage in the arcuate recesses in the opposed pair of die blocks immediately below such guides. The operator repeats this until all of the die blocks in spring receiving position have had a spring inserted thereinto. The operator then presses indexing switch **390**, Figures 1 and 26, to operate the indexing mechanism.

The push button indexing switch **390** when closed energizes coil **392** to withdraw latch **316** and thereby condition the indexing mechanism for operation. At the same time switch **390** energizes coil **402** to shift the valve **404** of the indexing cylinder **314** (Figure 2) and to admit air under pressure to the forward end of the cylinder and retract the piston rod **318**. This causes rack **320** to rotate roller clutch **322** and drive shafts **74** on which are mounted the endless chains **78** carrying the rails **80** on which the die blocks are mounted. The stroke of piston rod **318** is such that the die blocks are advanced one position. Upon releasing button **390** coils **392** and **402** are deenergized, but the valve **404** remains in the same position since it then has no biasing force applied to it.

The clutch **322** also drives the single-toothed gear **362** which advances the notched wheel **360** one position. This wheel, in turn, drives the pointer **354** (Figure 1) and advances it one position with respect to its dial **356**. At the same time, switch cam **370** is similarly advanced.

As the piston rod **318** reaches the end of its stroke, finger **374** closes switch **376**. This energizes coil **406** of valve **404** to admit air under pressure to the rear end of index cylinder **314** and return piston rod **318** to extended position and energizes coil **440** of valve **436** to admit air under pressure to the lower end of the head raising cylinder **68** to raise the head **66**. During the return stroke of the piston rod, roller clutch **322** slips and does not transmit movement to its shaft **336**. When piston rod **318** is fully extended, latch **316** engages the opening in the piston rod and locks the piston rod in this position since coil **392** is now deenergized due to the release of button **390**.

As the indexing takes place, and the new sets of die blocks are moved into opposing position, they engage the end coils of the springs on the sets of die blocks immediately therebelow. The operator then inserts a new set of springs between the guides **102** and presses each spring downwardly to engage its end coils in a set of die blocks. The end coils of the newly inserted spring overlap the end coils of a spring of the previously inserted row. When a complete new row of springs has been inserted, the operator presses starting button **408** (Figures 1 and 26) to initiate the automatic cycle. Button **408** energizes coil **410** of valve **412** and thereby shifts this valve to admit air under pressure to the left-hand end of clamp bar cylinder **116**, as viewed in Figures 5 and 26. This cylinder moves the clamp bars **104** and spreader bar **106** into position between the opposing pairs of die blocks having the overlapped ends of both rows of springs located therein. When the forward ends of the clamping bars engage tapered shelf **120**, they are brought into accurate alignment with the channels **90** in the die blocks and then the forward movement of the clamping bars is arrested by stop **122**. Continued movement of the spreader bar **106** forces the clamping bars laterally into firm engagement with the die blocks.

As the clamping bars **104** are spread laterally to engage the die blocks, each bar engages and closes a switch **414**. Each switch **414** energizes a coil **416** of solenoid **192** (Figure 11) to move its clutch lever **172** and associated clutch member **170** into engagement with one side of clutch member **174**. This establishes a driving connection between each pair of feed rollers **132** and motor **190**.

The two switches **414** are connected in series in a circuit which includes the coil **418** of motor starting relay **420** so that when both of the switches **414** are closed the motor **190** is energized.

Energization of the motor **190** and engagement of the slidable clutch members **170** with the central clutch member **174** drives the two sets of feed rollers **132**, **134**, and forces the wire **130** into and through the forming dies **206**. From these forming dies the helical tie wires generated therein feed longitudinally of the channels formed between the clamping bars and die blocks and wrap about the overlapped end coils of the springs clamped between such bars and blocks.

If the forward movement of a helical tie wire is obstructed for any reason, the tie wire will buckle sidewise and engage a switch **386**. This switch will energize the pull-out coil **422** of its clutch operating solenoid **192** to disengage the corresponding sliding clutch member **170** and thereby stop the feed rolls for that particular tie wire. At the same time the switch **386** energizes the lamp **388**, which is in series with the coil **422**, to apprize the operator of such stoppage of the helical tie wire. The energization of pull-out coil **422** is effective in releasing the clutch member **170** even though coil **416** remains energized, since the force exerted on clutch lever **172** by pull-out coil **422** is greater than that of coil **416**.

The operator may then stop the motor by opening the motor reversing switch **442**. The operator may then make any adjustments necessary. After the adjustment has been made, the motor may be restarted by closing the motor reversing switch **442** to its previous position. More often, however, the difficulty can be overcome by throwing the motor reversing switch to its other position to reverse the motor for a brief interval and to withdraw the helical tie wires slightly and then restarting the motor by closing the motor reversing switch to its previous position. In order to permit the withdrawal of the helical tie wire, pull-out coils **422** must be deenergized to insure a driving engagement between slidable clutch members **170** and clutch members **174**. This is accomplished by switch **490** in series with the switches **386** and coils **422** and "ganged" with the motor reversing switch **442**. Thus, to withdraw a jammed helical tie wire the operator simply throws the motor reversing switch **442** to the motor reversing position.

As the wires **130** are drawn into the machine by the two pairs of feed rollers **132** and **134**, each of these wires engages and drives a measuring roller **222**. Each measuring roller in turn rotates a screw **220** to advance a switch contact **240**. When the desired amount of wire has been fed into the machine by its associated feed rolls, a contact **240** engages and closes a switch **244**. This switch energizes the throw-out coil **422** of its clutch solenoid **192** to disconnect a pair of feed rolls **132**, **134** from the driving motor. The two switches **244** independently control their respective solenoids **192**, but jointly control and actuate coil **461** of valve **480** to admit air under pressure to the right-hand end of the cut-and-clinch cylinder **246** (Figures 1*a* and 26). The joint control of coil **461** is effected by relay coils **470** and **471** with relay arms **472** and **473**. When contact fingers **240** engage and close switch **244**, the switch contacts shown at the left in Figure 26 are closed and energize coils **470** and **471** which then close relay contacts **472** and **473**.

Thus, the lead 474 is connected to coil 461 only when both of the switches 244 are closed.

The cut-and-clinch piston 248 actuates the lever 250 and cut-and-clinch bars 261 and 272 (Figures 17 and 18). These bars in turn operate the clinching members 264 (Figure 13) to clinch the ends of the helical tie wires adjacent the transverse plate 48 and also operate the cut-and-clinch members 282 (Figures 14 and 15) to cut and clinch the ends of the helical tie wires adjacent the transverse plate 50.

As the piston of the cut-and-clinch cylinder 246 completes its stroke, lever 250 closes switch 290 thereby energizing coil 430 of valve 412 which admits air to the right-hand end of cylinder 116 and returns the clamping bars 104 to rest position opening switches 414 to deenergize the coils 416 of solenoids 192 and the coil 418 of the motor starting relay 420. Motor starting relay 420 is biased toward open position, and the withdrawal of the clamping bars from between switches 414 permits the relay to open the circuits to motor 190.

As the clamping bars 104 return to rest position a cam 492 engages the contact arm 432 of switch 294. This momentarily energizes coil 434 of valve 436 to release air pressure in cylinder 68 and permit head 66 to drop. Switch 294 also energizes coil 438 to shift valve 480 and withdraw the piston of the cut-and-clinch cylinder 246. Springs 260 and 288 restore the parts of the cut-and-clinch mechanism to normal positions. Valve 412 remains in the position required to withdraw the clamping bars even after switch 290 is opened, since no force is then being exerted on the valve 412.

Further movement of the clamping bars causes cam block 298 to engage arm 300 of switch 296 which energizes coil 392 to withdraw latch 316 from the indexing mechanism. Switch 296 also simultaneously energizes coil 402 and operates the indexing mechanism to advance the die blocks 82, pointer 354 and signal light cam 370 one position each. The stop 374 on the piston rod of indexing cylinder 314 engages switch 376 to energize coil 406 and restore the rack 320 to rest position. Switch 376 also energizes coil 440 to admit air to cylinder 68 and raise head 66. This completes the automatic cycle.

It should be noted that switches 294 and 296 will be actuated by the clamping bars on their movement from clamping to rest position, and from rest to clamping position. Since it is necessary that these switches do not operate on the movement of the clamping bars from rest to clamping position, the switches are adapted to be closed by unidirectional movement, namely, the direction of movement of the clamping bars when moving from clamping to rest position.

The operator then inserts another row of springs and presses the button 408 to start the automatic cycle. This procedure is repeated until contact 370 engages switch 372 to light lamp 373 thereby notifying the operator that the assembly has been completed. The operator thereupon presses indexing button 390 to create a space between the finished assembly and the next assembly. The first row of springs of the new assembly is then inserted and the index button 390 again pressed. This separates the last row of springs of the old assembly from the die blocks, and it can then be withdrawn from between the legs 44.

In case of a helical jam or any other trouble it might be found desirable to run the clamping bars in and out without allowing the switches, which are operated by the clamping bars, to carry out the automatic cycle. Manual switch 475 of Figure 26 is adapted to make the above-mentioned switch ineffective. Switch legs 494, 496 and 498 are opened to make switch 294, 296 and 414 ineffective, respectively. Switch leg 500 is closed to make push button 476 effective to withdraw the clamping bars from the clamping position. Switch leg 502 is closed to hold motor relay 420 in a closed position so that operation of the motor can be effected by reversing switch 442. Thus, when the switch 475 is operated, the clamping bars may be withdrawn by pushing button 476 or moved to the clamping position by pushing button 408 without the circuits of switches 294, 296 and 414 being effected.

It will be understood that the particular circuits shown in the wiring diagram of Figure 26 are only one of many possible circuit arrangements for accomplishing the desired sequence of operation, emergency controls, and manual operations. Features of my invention, however, reside in the automatic sequence of operations, the emergency or safety control, and the flexibility made possible by the disconnection of the automatic controls and the provision for manual control of certain functions of the machine.

In the embodiment of my invention illustrated in Figures 1 to 25 inclusive, the operator has no duties to perform while the machine is going through its automatic cycle of operations initiated by pressing switch button 408. It is contemplated that a single operator will operate and control two of these novel machines in such manner that while one machine is performing its automatic cycle the operator is loading the other machine by inserting a row of springs thereinto. By thus alternately loading the two machines an operator's production of completed spring assemblies can be almost doubled over the production attained by an operator having only a single machine. Such increased production more than compensates for the capital investment and overhead of the second machine and substantially reduces the cost of production of these spring assemblies.

In Figure 27 I have illustrated a modified form of my novel machine which permits the operator to preload the machine with a row of springs while the machine is performing its automatic cycle and tying together two previously inserted rows of springs. The purpose of the modification of Figure 27 is to utilize in a single machine the spare time which the operator would otherwise have while the machine is performing its automatic cycle and thus accomplish in a single machine substantially the same lower production costs which result when a single operator operates two machines of the kind shown in Figures 1 to 25 inclusive.

In the first embodiment of my invention, each set of endless chains 78 (Figure 4) carries four die block rails. As each rail makes a complete circuit about its chain supporting shafts 72 and 74, such rail assumes each of the four positions shown in Figure 4. Only two of these positions may be considered as active positions, these two positions being the positions in which such rail is in spring supporting position between the two sets of chains 78. In the upper of these two positions the die blocks on the rail support the overlapping terminal coils of two rows of springs which are tied together during the automatic cycle, whereas, in the lower of these two active positions the die blocks of such rail engage the end coils of two rows of springs previously tied together, one of these latter rows of springs also being in engagement with the die blocks in the upper position for purposes of being tied to a new row of springs.

Referring to Figure 27, it will be seen that each set of chains 450 is supported on three shafts 452, 454 and 456, and that each of these sets of chains carries six rails 80 supporting die blocks 82, as in the previous embodiment. It will be understood that the shafts 452 may be driven by the same mechanism and in the same manner as the shaft 74.

Each of the die block rails 80 of the embodiment of Figure 27 is shifted to each of the six positions shown in that figure as such rail makes a complete circuit of its chain supporting shafts 452, 454 and 456. Three of these positions may be considered as active positions, these being the three positions in which the rail is between the two sets of chains 450. The lower two of these positions correspond to the two active positions of the embodiment shown in Figure 4. The upper active position provides

an additional row of opposing sets of die blocks immediately below the guides **102** and in position to receive springs pressed downwardly between such guides. These die blocks perform no function during the automatic cycle of the machine and are in spring receiving position during such cycle. In other words, while the automatic cycle is taking place the operator may load the machine in preparation for a further cycle by inserting a row of springs into the die blocks immediately beneath the guides **102**.

In the embodiment of Figure 27, four supporting members **458** are used in lieu of the two supporting members **456** of the first embodiment. Also, the guide plates **128** of the first embodiment are replaced by longer guide plates **460** to receive the thrust exerted on the die blocks by the clamping bars and to hold the die blocks in proper spaced relation with respect to the opposing die blocks with which they cooperate.

Except for the foregoing distinctions, the form of my invention shown in Figure 27 corresponds in structure and mode of operation with the forms shown in Figures 1 to 26, inclusive, so that detailed description of the structure and mode of operation of the embodiment of Figure 27 is unnecessary.

It is to be understood that my invention is not limited to the particular embodiments illustrated herein but may assume numerous other forms, and includes all variations, modifications, and equivalents coming within the scope of the appended claims.

I claim:

1. In a spring assembly machine of the class described having a frame, a series of pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means movably supporting said carriers in said frame, guide channels for helical tie wires for securing together the end coils of adjacent rows of springs, clamping bars for holding said springs engaged with said carriers while the tie wires are formed about the end coils of the springs, said guide channels and clamping bars being supported by said frame, the combination therewith of a platform pivotally mounted on said frame, means carried by said platform for forming helical tie wires and feeding them into said guide channels, means maintaining a predetermined relationship between each wire forming and feeding means and a particular guide channel whereby each wire forming and feeding means supplies only its own guide channel, and means mounted on said frame for raising and lowering said platform.

2. In a spring assembly machine of the class described having a frame, a series of pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means movably supporting said carriers in said frame, guide channels for helical tie wires for securing together the end coils of adjacent rows of springs, clamping bars for holding said springs engaged with said carriers while the tie wires are formed about the end coils of the springs, said guide channels and clamping bars being supported by said frame, the combination therewith of a platform pivotally mounted on said frame, means carried by said platform for forming helical tie wires and feeding them into said guide channels, wire measuring means on said platform, means mounted on said frame for raising and lowering said platform, and means on said frame for cutting and clinching the helical tie wires responsive to said measuring means.

3. In a spring assembly machine of the class described having a frame, a series of pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means movably supporting said carriers in said frame, means supported by said frame for moving said carriers into and out of spring-engaging positions, guide channels for helical tie wires for securing together the end coils of adjacent rows of springs, the combination therewith of clamping bars for holding said springs engaged with said carriers while the tie wires are formed about the end coils of the springs, said guide channels and clamping bars being supported by said frame, each of said clamping bars having a pair of pins, a spreader bar having inclined slots engaged by said pins, and a cylinder for moving said clamping bar and spreader bar into and out of clamping position.

4. In a spring assembly machine of the class described having a frame, a series of pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means movably supporting said carriers in said frame, means supported by said frame for moving said carriers into and out of spring-engaging position, guide channels for helical tie wires for securing together the end coils of adjacent rows of springs, clamping bars for holding said springs engaged with said carriers while the tie wires are formed about the end coils of the springs, said guide channels and clamping bars being supported by said frame, the combination therewith of a platform pivotally mounted on said frame, means carried by said platform for forming helical tie wires and feeding them into said guide channels, means mounted on said frame for raising and lowering said platform, a motor for driving said feeding means, clutches between said motor and feeding means, and mechanism operated by lateral bending of said helical tie wires to open said clutches.

5. In a spring assembly machine of the class described having a frame, a series of pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means movably supporting said carriers in said frame, means for shifting said carriers, guide means for helical tie wires for securing together the end coils of adjacent rows of springs, clamping bars for holding said springs engaged with said carriers while the tie wires are formed about the end coils of the springs, the combination therewith of a platform pivotally mounted on said frame, means carried by said platform for forming helical tie wires and feeding them into said guide channels, means mounted on said frame for raising and lowering said platform, and automatic control mechanism for operating said clamping bars, tie wire forming and feeding mechanism, platform raising and lowering means and carrier shifting mechanism in predetermined sequence, said automatic control mechanism having a manual starting switch.

6. A spring assembly machine of the class described comprising a frame, a series of pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means mounting said carriers in said frame for movement into and out of spring-engaging positions, clamping bars for holding said springs engaged with said carriers while tie wires are formed about the end coils of the springs of adjacent rows, a fluid cylinder for moving said clamping bars into and out of position, a pair of feed rollers for each of said tie wires, a motor for driving said feed rollers, a clutch between said motor and each pair of feed rollers, a fluid cylinder for indexing said carriers, measuring means for said tie wires, means for cutting and clinching said tie wires, a fluid cylinder for operating said last-named means, and an electrical control circuit comprising a manual switch for operating said first-mentioned fluid cylinder to move said clamping bars into position, a pair of switches operated by said clamping bars to engage said clutches and start said motor to drive said feed rollers, switches operated by said measuring means to disengage said clutches and operate the fluid cylinder which drives the cut and clinch means, a switch operated by the cut and clinch cylinder to initiate return of said clamping bars to idle position, and switches operated by return movement of said clamping bars to stop said motor, return the cut and clinch cylinder to initial position and operate the indexing cylinder to advance the carriers, and a switch operated by the indexing mechanism to return said mechanism to initial position.

7. A spring assembly machine of the class described comprising a frame, a series of pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means movably mounting said carriers in said

frame, guide channels for helical tie wires for securing together the end coils of adjacent rows of springs, clamping bars for holding said springs engaged with said carriers while tie wires are formed about the end coils of the springs, a fluid cylinder for moving said clamping bars into and out of position, a pair of feed rollers for each of said tie wires, a motor for driving said feed rollers, a clutch between said motor and each pair of feed rollers, a fluid motor for indexing said carriers, measuring means for said tie wires, means for cutting and clinching said tie wires, a fluid motor for operating said last-named means, and an electrical control circuit comprising a manual switch for operating said first-mentioned fluid motor to move said clamping bars into position, a pair of switches operated by said clamping bars to engage said clutches and start said motor to drive said feed rollers, switches operated by said measuring means to disengage said clutches and operate the fluid motor which drives the cut and clinch means, a switch operated by the cut and clinch motor to initiate return of said clamping bars to idle position, and switches operated by return movement of said clamping bars to stop said motor, return the cut and clinch motor to initial position and operate the indexing motor to advance the carriers, and a switch operated by the indexing motor to return said motor to initial position.

8. A spring assembly machine of the class described comprising a frame, a series of pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means movably mounting said carriers in said frame, guide channels for helical tie wires for securing together the end coils of adjacent rows of springs, clamping bars for holding said springs engaged with said carriers while tie wires are formed about the end coils of the springs, a fluid cylinder for moving said clamping bars into and out of position, a pair of feed rollers for each of said tie wires, a motor for driving said feed rollers, a clutch between said motor and each pair of feed rollers, a fluid cylinder for indexing said carriers, measuring means for said tie wires, means for cutting and clinching said tie wires, a fluid cylinder for operating said last-named means, and an electrical control circuit comprising a manual switch for operating said first-mentioned fluid cylinder to move said clamping bars into position, a pair of switches operated by said clamping bars to engage said clutches and start said motor to drive said feed rollers, switches operated by said measuring means to disengage said clutches and operate the fluid cylinder which drives the cut and clinch means, a switch operated by the cut and clinch cylinder to initiate return of said clamping bars to idle position, and switches operated by return movement of said clamping bars to stop said motor, return the cut and clinch cylinder to initial position and operate the indexing cylinder to advance the carriers, a switch operated by the indexing mechanism to return said mechanism to initial position, and switch means for stopping and reversing said motor.

9. A spring assembly machine of the class described comprising a frame, a plurality of series of pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means movably mounting said carriers in said frame, guide channels for helical tie wires for securing together the end coils of adjacent rows of springs, clamping bars for holding said springs engaged with said carriers while tie wires are formed about the end coils of the springs, a fluid cylinder for moving said clamping bars into and out of position, a pair of feed rollers for each of said tie wires, a motor for driving said feed rollers, a clutch between said motor and each pair of feed rollers, a fluid cylinder for indexing said carriers, measuring means for said tie wires, forming means for said tie wires, means for cutting and clinching said tie wires, a fluid cylinder for operating said last-named means, and an electrical control circuit comprising a manual switch for operating said first-mentioned fluid cylinder to move said clamping bars into position, a pair of switches operated by said clamping bars to engage said clutches and start said motor to drive said feed rollers, switches operated by said measuring means to disengage said clutches and operate the fluid cylinder which drives the cut and clinch means, a switch operated by the cut and clinch cylinder to initiate return of said clamping bars to idle position, and switches operated by return movement of said clamping bars to stop said motor, return the cut and clinch cylinder to initial position and operate the indexing cylinder to advance the carriers, and a switch operated by the indexing cylinder to return said cylinder to initial position.

10. A spring assembly machine of the class described comprising a frame, a series of pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means movably mounting said carriers in said frame, guide means for helical tie wires for securing together the end coils of adjacent rows of springs, clamping bars for holding said springs engaged with said carriers while tie wires are formed about the end coils of the springs, a fluid cylinder for moving said clamping bars into and out of position, a pair of feed rollers for each of said tie wires, a motor for driving said feed rollers, a clutch between said motor and each pair of feed rollers, a fluid cylinder for indexing said carriers, measuring means for said tie wires, means for cutting and clinching said tie wires, a fluid cylinder for operating said last-named means, and an electrical control circuit comprising a manual switch for operating said first-mentioned fluid cylinder to move said clamping bars into position, a pair of switches operated by said clamping bars automatically to engage said clutches and start said motor to drive said feed rollers, switches operated by said measuring means automatically to disengage said clutches and operate the fluid cylinder which drives the cut and clinch means, a switch operated by the cut and clinch cylinder automatically to initiate return of said clamping bars to idle position, switches operated by return movement of said clamping bars automatically to stop said motor, return the cut and clinch cylinder to initial position and operate the indexing cylinder to advance the carriers, and a switch operated by the indexing cylinder automatically to return said cylinder to initial position.

11. A spring assembly machine of the class described comprising a frame, a series of pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means movably mounting said carriers in said frame, guide channels for helical tie wires for securing together the end coils of adjacent rows of springs, clamping bars for holding said springs engaged with said carriers while tie wires are formed about the end coils of the springs, a fluid cylinder for moving said clamping bars into and out of position, a pair of feed rollers for each of said tie wires, a motor for driving said feed rollers, a clutch between said motor and each pair of feed rollers, a fluid cylinder for indexing said carriers, measuring means for said tie wires, means for cutting and clinching said tie wires, a fluid cylinder for operating said last-named means, and an electrical control circuit comprising a manual switch for operating said first-mentioned fluid cylinder to move said clamping bars into position, a pair of switches operated by said clamping bars to engage said clutches and start said motor to drive said feed rollers, switches operated by said measuring means to disengage said clutches and operate the fluid cylinder which drives the cut and clinch means, a switch operated by the cut and clinch cylinder to initiate return of said clamping bars to idle position, and switches operated by return movement of said clamping bars to stop said motor, return the cut and clinch cylinder to initial position and operate the indexing cylinder to advance the carriers, a switch operated by the indexing cylinder to return said cylinder to initial position, and emergency

switches operated by stoppage of said tie wires to disengage said clutches.

12. A spring assembly machine of the class described comprising a frame, a series of pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means movably supporting said carriers in said frame, guide means for helical tie wires for securing together the end coils of adjacent rows of springs, clamping bars for holding said springs engaged with said carriers while the tie wires are formed about the end coils of the springs, means for forming helical tire wires and feeding them into said guide channels, wire measuring means, a first actuator for moving said clamping bars into and out of position, a motor for driving said feeding means, clutches between said motor and said feeding means, a second actuator for indexing said carriers, a lock for said second actuator, means for cutting and clinching said tie wires, a third actuator for operating said last-named means, and an electrical control circuit comprising a starting switch for operating said first actuator to move said bars into clamping position, a switch operated by each clamping bar to engage one of said clutches, said switches jointly acting to start said motor to drive the feeding means, switches operated by said measuring means to disengage said clutches and operate the actuator which drives the cut and clinch means, a switch operated by the cut and clinch actuator to initiate return of the clamping bars to idle position, switches operated by return movement of said clamping bars to stop said motor, return the cut and clinch actuator to initial position, withdraw the indexing latch, and operate the indexing actuator to advance said carriers, and switch means operated by said indexing actuator to return said actuator to initial position and restore said latch.

13. A spring assembly machine of the class described comprising a frame, a series of pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means movably supporting said carriers in said frame, guide means for helical tie wires for securing together the end coils of adjacent rows of springs, clamping bars for holding said springs engaged with said carriers while the tie wires are formed about the end coils of the springs, a platform pivotally mounted on said frame, means carried by said platform for forming helical tie wires and feeding them into said guide channels, wire measuring means on said platform, a first actuator for moving said clamping bars into and out of position, a motor on said platform for driving said feeding means, clutches between said motor and said feeding means, a second actuator for indexing said carriers, a lock for said second actuator, means for cutting and clinching said tie wires, a third actuator for operating said last-named means, a fourth actuator for raising and lowering said platform, and an electrical control circuit comprising a switch for operating said first actuator to move said bars into clamping position, a switch operated by each clamping bar to engage one of said clutches, said switches jointly acting to start said motor to drive the feeding means, switches operated by said measuring means to disengage said clutches and operate the actuator which drives the cut and clinch means, a switch operated by the cut and clinch actuator to initiate return of the clamping bars to idle position, switches operated by return movement of said clamping bars to stop said motor, lower said platform, return the cut and clinch actuator to initial position, withdraw the indexing latch, and operate the indexing actuator to advance said carriers, and switch means operated by said indexing actuator to return said actuator to initial position, restore said latch, and raise said platform.

14. A spring assembly machine of the class described comprising a frame, a series of pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means movably supporting said carriers in said frame, guide means for helical tie wires for securing together the end coils of adjacent rows of springs, clamping bars for holding said springs engaged with said carriers while the tie wires are formed about the end coils of the springs, a platform pivotally mounted on said frame, means carried by said platform for forming helical tie wires and feeding them into said guide channels, wire measuring means on said platform, a first actuator for moving said clamping bars into and out of position, a motor on said platform for driving said feeding means, clutches between said motor and said feeding means, a second actuator for indexing said carriers, a lock for said second actuator, means for cutting and clinching said tie wires, a third actuator for operating said last-named means, a fourth actuator for raising and lowering said platform, and an electrical control circuit comprising a switch for operating said first actuator to move said bars into clamping position, a switch operated by each clamping bar to engage one of said clutches, said switches jointly acting to start said motor to drive the feeding means, switches operated by said measuring means to disengage said clutches and operate the actuator which drives the cut and clinch means, a switch operated by the cut and clinch actuator to initiate return of the clamping bars to idle position, switches operated by return movement of said clamping bars to stop said motor, lower said platform, return the cut and clinch actuator to initial position, withdraw the indexing latch, and operate the indexing actuator to advance said carriers, switch means operated by said indexing actuator to return said actuator to initial position and restore said latch, and a switch operating a signal to indicate completion of the assembly.

15. A spring assembly machine of the class described comprising a frame, a series of pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means movably supporting said carriers in said frame, guide means for helical tie wires for securing together the end coils of adjacent rows of springs, clamping bars for holding said springs engaged with said carriers while the tie wires are formed about the end coils of the springs, a platform pivotally mounted on said frame, means carried by said platform for forming helical tie wires and feeding them into said guide channels, wire measuring means on said platform, a first actuator for moving said clamping bars into and out of position, a driving means on said platform for said feeding means, clutches between said driving means and said feeding means, a second actuator for indexing said carriers, a lock for said second actuator, means for cutting and clinching said tie wires, a third actuator for operating said last-named means, a fourth actuator for raising and lowering said platform, and an electrical control circuit for automatically effecting a series of operations comprising a manual switch for operating said first actuator to move said bars into clamping position, a switch operated by each clamping bar to engage one of said clutches, said switches jointly acting to start said driving means to drive the feeding means, switches operated by said measuring means to disengage said clutches and operate the actuator which drives the cut and clinch means, a switch operated by the cut and clinch actuator to initiate return of the clamping bars to idle position, switches operated by return movement of said clamping bars to stop said driving means, lower said platform, return the cut and clinch actuator to initial position, withdraw the indexing latch, and operate the indexing actuator to advance said carriers, switch means operated by said indexing actuator to return said actuator to initial position and restore said latch, emergency switches operated by buckling of said helicals to disengage said clutches and operate a signal light, and a second manual switch for interrupting said automatic operation.

16. A spring assembly machine of the class described comprising a frame, a series of pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means movably supporting said car-

riers in said frame, guide means for helical tie wires for securing together the end coils of adjacent rows of springs, clamping bars for holding said springs engaged with said carriers while the tie wires are formed about the end coils of the springs, a platform pivotally mounted on said frame, means carried by said platform for forming helical tie wires and feeding them into said guide channels, wire measuring means on said platform, a first actuator for moving said clamping bars into and out of position, a motor on said platform for driving said feeding means, clutches between said motor and said feeding means, a second actuator for indexing said carriers, a lock for said second actuator, means for cutting and clinching said tie wires, a third actuator for operating said last-named means, a fourth actuator for raising and lowering said platform, and an electrical control circuit comprising a switch for operating said first actuator to move said bars into clamping position, a switch operated by each clamping bar to engage one of said clutches, said switches jointly acting to start said motor to drive the feeding means, switches operated by said measuring means to disengage said clutches and operate the actuator which drives the cut and clinch means, a switch operated by the cut and cllinch actuator to initiate return of the clamping bars to idle position, switches operated by return movement of said clamping bars to stop said motor, lower said platform, return the cut and clinch actuator to initial position, withdraw the indexing latch, and operate the indexing actuator to advance said carriers, and switch means operated by said indexing actuator to return said actuator to initial position and restore said latch.

17. In a spring assembly machine of the class described having a frame, pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means movably supporting said carriers in said frame, guide channels for helical tie wires for securing together the end coils of adjacent rows of springs, clamping means for holding said springs engaged with said carriers while the tie wires are formed about the end coils of the springs, said guide channels and clamping means being supported by said frame, the combination therewith of means for forming helical tie wires and feeding them into said guide channels, tie wire measuring means, means on said frame for cutting and clamping the helical tie wires responsive to said measuring means, and means for shifting said helical tie wire means into and out of position for aligning the formed helical tie wires with the guide channels to withdraw the free ends of the helical tie wires from the carriers to free the carriers for movement without obstruction by the free ends of the tie wires extending from said forming means.

18. In a spring assembly machine of the class described having a frame, pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means movably supporting said carriers in same frame, means for shifting said carriers into and out of spring engaging position, guide channels for helical tie wires for securing together the end coils of adjacent rows of springs, clamping means for holding said springs engaged with said carriers while the tie wires are formed about the end coils of the springs, the combination therewith of means for forming helical tie wires and feeding them into said guide channels, means for shifting said helical tie wire forming means into and out of position for aligning the formed helical tie wires with the guide channels and to withdraw the portions of the helical tie wires from the guide channels to enable shifting movement of the carriers without obstruction by portions of the helical tie wires extending from said forming means, and control means interconnected for operating said clamping means, tie wire forming and feeding means, tie wire forming and carrier shifting means in predetermined sequence, said control means having a manual starting switch.

19. In a spring assembly machine of the class described having a frame, a series of pairs of opposed carriers for holding the end coils of adjacent rows of upholstery springs, means movably supporting said carriers in said frame, means for shifting said carriers into spring engaging position and out of spring engaging position with the assembled springs, guide channels for helical tie wires for securing together the end coils of adjacent rows of springs, clamping means for holding said springs engaged with said carriers while the tie wires are formed about the end coils of the springs, the combination therewith of means for forming helical tie wires and feeding them into said guide channels, and means for displacing the helical tie wire forming means linearly between normal and retracted position for withdrawing the ends of the wires from the guide channels when in retracted position to enable shifting movement of the carriers with the springs in the spring assembly and for returning the ends of the helical tie wires to said channels when in normal position for subsequent advancement through the channels in joining the spring coils engaged between the carriers.

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