July 27, 1954 L. P. DRUEHL 2,685,019

SPRING ANNEALING MACHINE

Filed Oct. 6, 1950

5 Sheets-Sheet 1

Fig. 1.

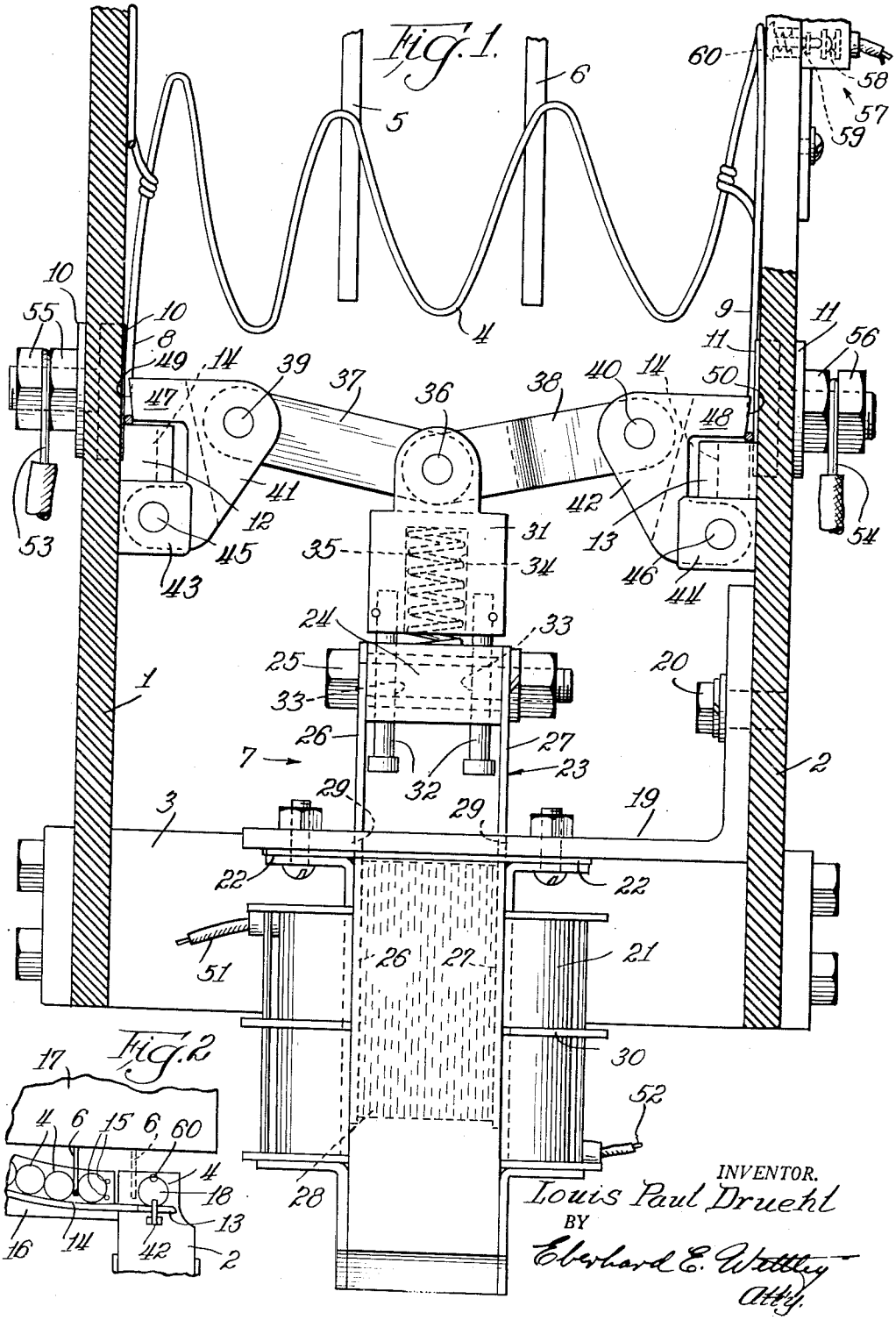

Fig. 2.

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SPRING ANNEALING MACHINE

Filed Oct. 6, 1950

5 Sheets-Sheet 2

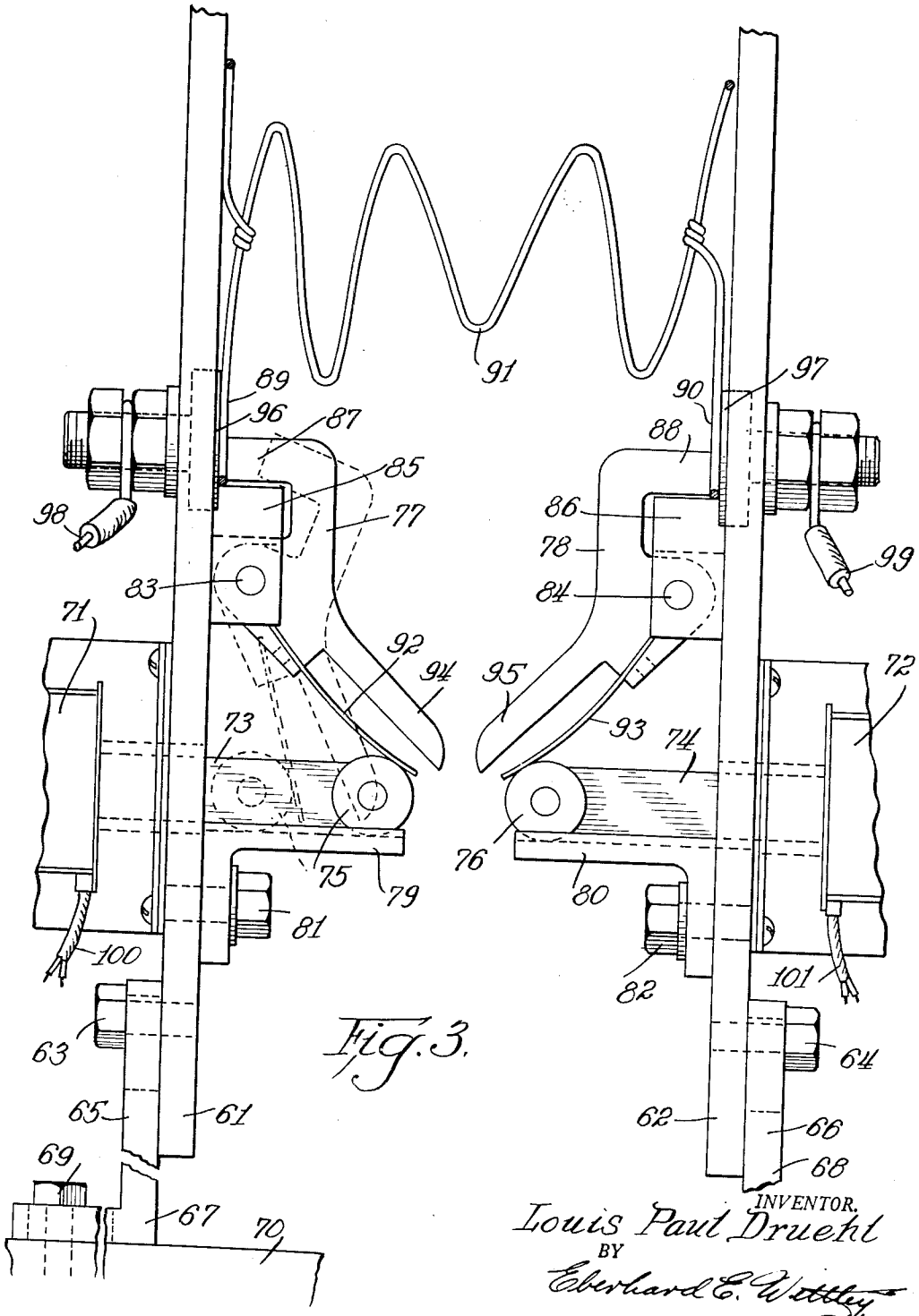

Fig. 3.

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SPRING ANNEALING MACHINE

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Fig. 5.

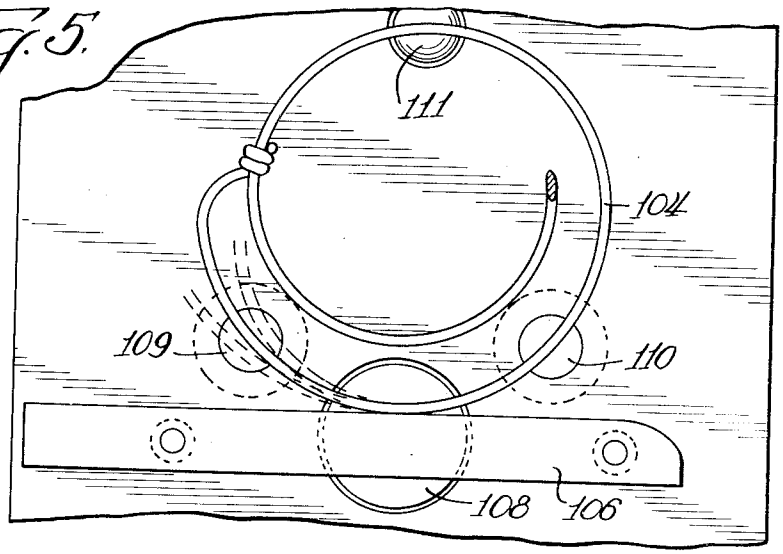
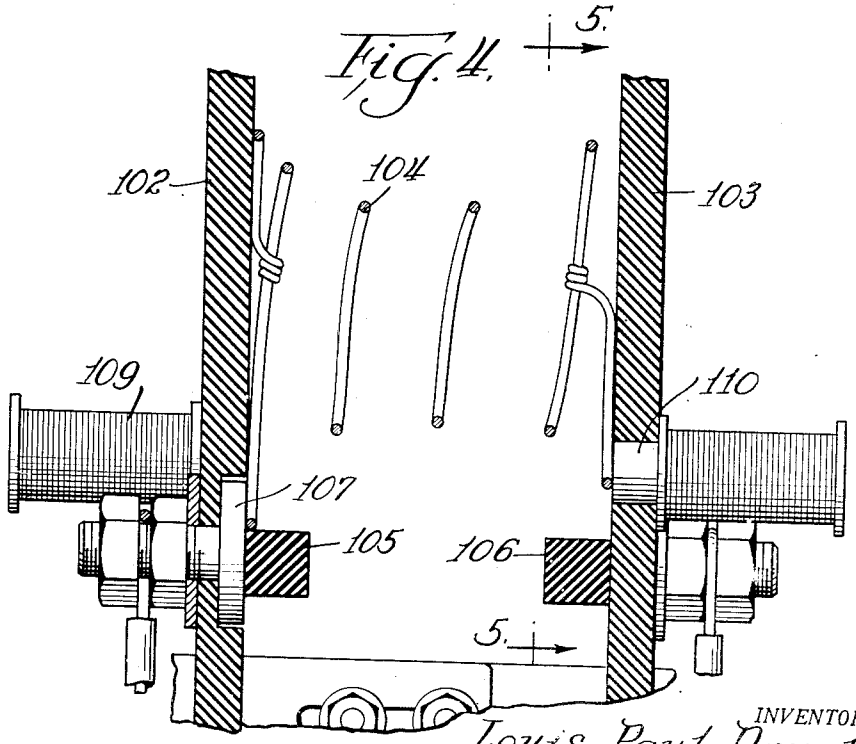


Fig. 4.



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SPRING ANNEALING MACHINE

Filed Oct. 6, 1950

5 Sheets-Sheet 4

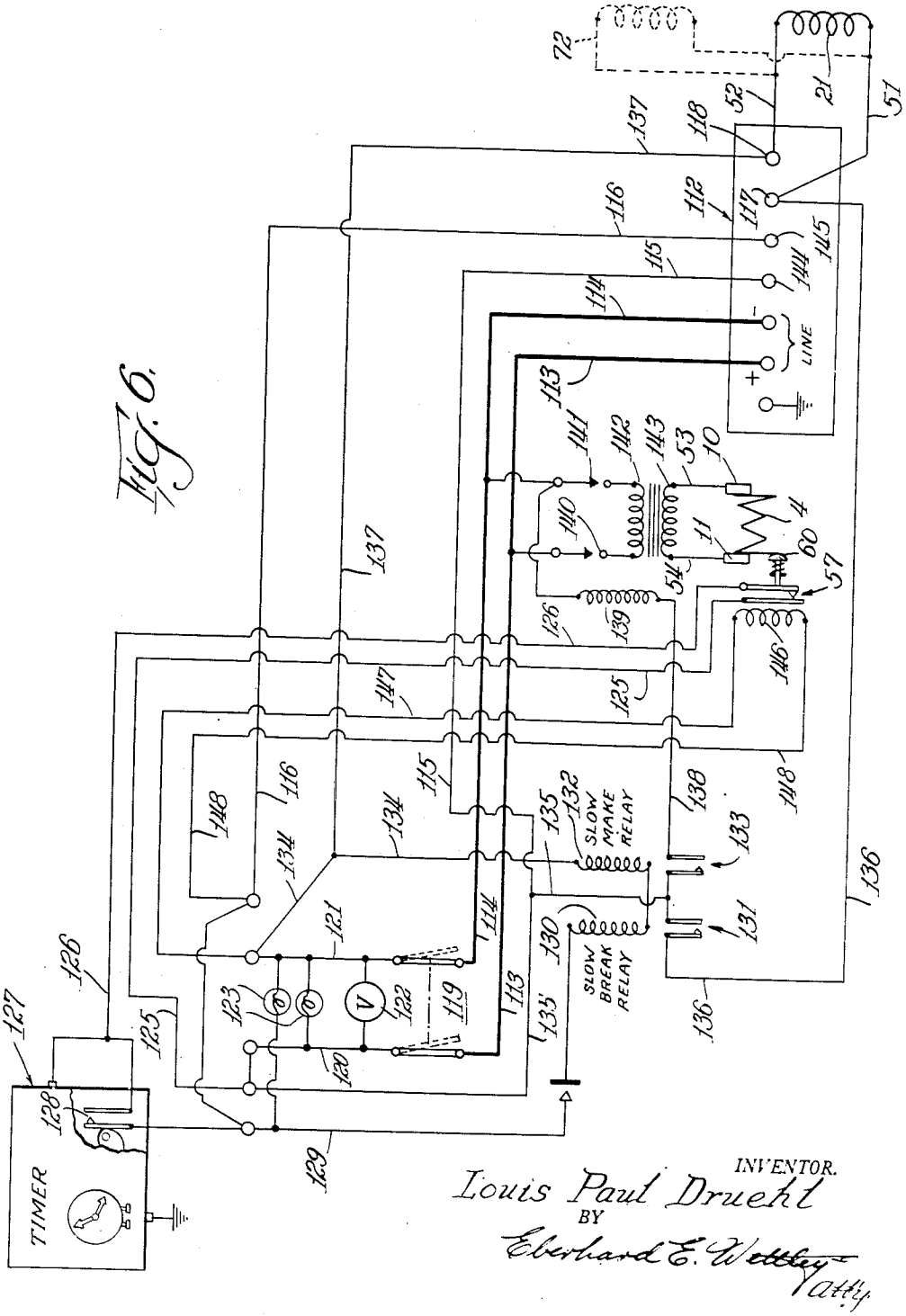

Fig. 6.

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SPRING ANNEALING MACHINE

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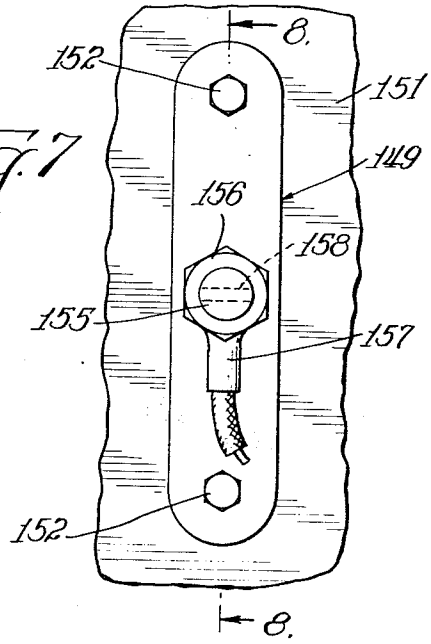
Fig. 7



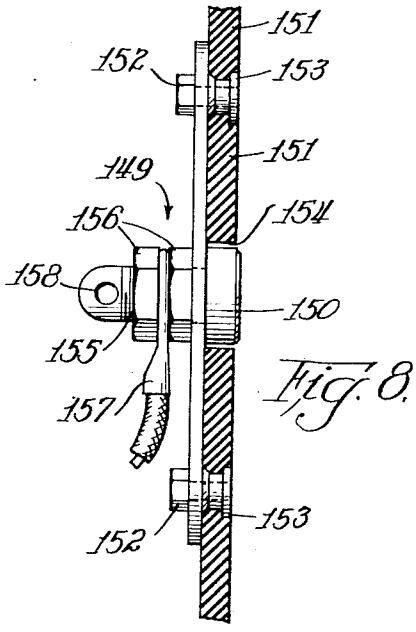


Fig. 8.

Fig. 9.

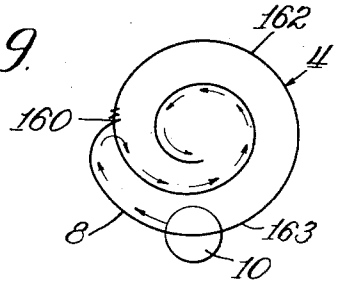


Fig. 10.

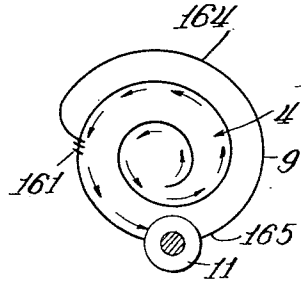


Fig. 11.

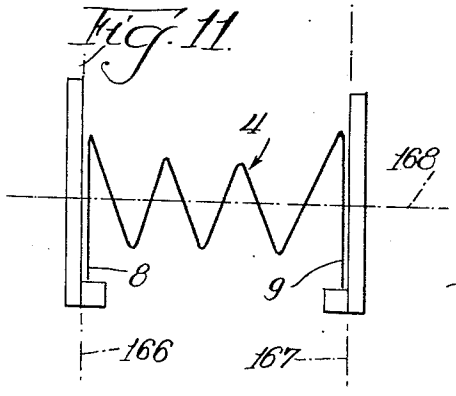
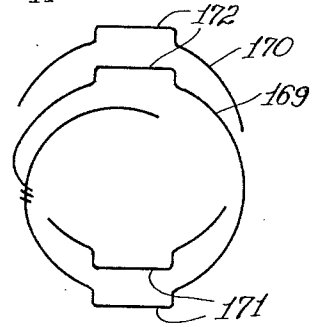


Fig. 12.



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UNITED STATES PATENT OFFICE

2,685,019

SPRING ANNEALING MACHINE

Louis Paul Druehl, Oak Park, Ill.

Application October 6, 1950, Serial No. 188,846

30 Claims. (Cl. 219—11)

1

This invention relates to a spring annealing machine which is more specifically adapted to provide a structure for annealing individual springs. This machine is used for annealing springs of the type more commonly found in upholstery, mattresses or bedsprings. The machine is also capable of accommodating wire or springs which can be of variable coil diameter within certain limits within the operative functions of this machine.

Various practices have been followed in the past in annealing springs and analogous products of this type such as batch annealing, which has not been found entirely satisfactory to produce a uniform spring of a given tension and resiliency. It has also been the practice to resort to excessive handling of the springs of this nature to carry out the annealing process.

It is one of the main objects of the present invention to provide a means which can be employed for quickly and efficiently annealing individual springs as they are fed into and extracted from the machine of this invention.

It is another object of this invention to produce a machine of this character which can be employed in the form of an attachment to wire or rod forming machines for the purpose of receiving the individual spring coils in timed relation from the forming machine to individually anneal each spring at a given cyclic arrangement with respect to the forming machine. In this respect, the annealing machine has been designed to receive the springs directly from the forming machine by placing the attachment in line with the conveying mechanisms that deliver the formed springs from the forming machine to a point of discharge. This point of discharge in this case will be the annealing station of the machine of the present invention at which point the spring is actuated by the discharge mechanism of the forming machine. In other words, this annealing machine as an attachment can be placed in the spring production line in the position wherein the spring is usually discharged through a trough or from other controlled delivery mechanisms as is the usual practice with forming machines.

It is another object of this invention to substantially take the spring as formed and to convey it into a given space which will determine the final overall length of the spring and to anneal the spring when disposed between the gauge means provided.

It is another object of this invention to provide an annealing machine which is electrically controlled to position the spring before the annealing cycle begins and to interrupt the annealing cycle before removing the spring from its electrical energy source that is provided to heat the spring during the annealing cycle.

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It is still a further object to control the heating interval of the spring at the annealing station.

Other objects and advantages relating to the annealing machine of the present invention shall hereinafter appear in the following detailed description having reference to the drawings which form a part of this specification.

In the drawings:

Fig. 1 is an end elevational view of the annealing machine with certain parts broken away and in section to better illustrate the same;

Fig. 2 is a diagrammatic view to illustrate one manner of feeding individual springs from a supply to the annealing station of the machine;

Fig. 3 is another end elevational view of a modified construction of annealing machine embodying certain other principles of operation;

Fig. 4 is an end elevational view of another modified construction utilizing the principles set forth by this invention;

Fig. 5 is a vertical cross sectional view taken substantially along the line 5—5 in Fig. 4 to show certain other details of construction of the Fig. 4 modification;

Fig. 6 is a general circuit diagram illustrating the main principles of electronic control herein utilized in operating the machine of the present invention;

Fig. 7 is a fragmentary view of an outside portion of one of the panels illustrating a removable electrode construction;

Fig. 8 is a vertical sectional view taken along the line 8—8 in Fig. 7 to illustrate further details of construction of the removable electrode unit;

Fig. 9 is a diagrammatic view illustrating the relationship between one end of the spring and its adjacent electrode;

Fig. 10 is a similar view showing the relationship of the other end of the spring and its adjacent electrode;

Fig. 11 is a diagrammatic view of a spring between the panels of the machine to illustrate certain benefits obtained by annealing springs with the machine of the present invention; and

Fig. 12 is a diagrammatic perspective of another type of spring to illustrate certain other benefits obtained through the use of the present machine in annealing springs.

Referring to Fig. 1, the annealing machine of the present invention comprises in general a pair

of longitudinally arranged insulating panels 1 and 2 spaced apart laterally by one or more brackets 3 to provide a given distance between the panels with the latter providing guide means for the reception of a spring 4. Springs such as 4 may be successively fed into the position indicated by operable feed fingers 5 and 6 so as to be gripped and held in this position by means of a solenoid mechanism 7 that is arranged to hold and force the spring ends 8 and 9 against a pair of electrodes 10 and 11. As the springs 4 are brought into the station or position indicated in Fig. 1, the end coils of the springs rest upon positioning bars 12 and 13 that are laterally arranged between said guide means and represent continuations of guide rails 14, one of which is indicated in Fig. 2.

As best shown in Fig. 2, the individual springs 4 may be fed down the guide rails 14 by gravity into a suitable position that may be determined by a pair of buttons 15 for engaging either end of the springs 4 and which may be mounted upon the side guide panels 16. The fingers 5 and 6 are illustrated as a portion of an advancing mechanism housed within the chamber 17 which will act to advance the fingers 5 and 6 horizontally between the solid and dotted line positions shown in Fig. 2, and which will retract and return the fingers to engage behind another spring. Each time one of the springs is advanced to the annealing station indicated at 18, the previously annealed spring will be pushed off the end of the bars 12 and 13 to be collected in a suitable container or stacker.

Referring again to Fig. 1, the solenoid operating mechanism 7 is mounted centrally between the panels 1 and 2 upon a bracket 19 secured at 20 to one of the panels. The solenoid 21 is provided with flange means 22 adapted for bolting to the horizontal leg of the bracket 19 which will rigidly hold the solenoid 21 as seen in Fig. 1. The solenoid 21 has a plunger 23 connected with a block 24 by means of a bolt 25 passing through the block 24 and through aligned openings in the vertically operable spaced plates 26 and 27 of the plunger. A laminated core 28 is secured integrally with plates 26 and 27, and the entire plunger is guided within solenoid 21 and vertically within an opening 29 in bracket 19 as the plunger is driven upwardly by energization of the coil of solenoid 21. A clevis 31 is positioned above the block 24 for sliding movement between the plates 26 and 27 and a pair of headed pins 32 are secured to the clevis and are vertically slidable in openings 33 formed in the block 24. Clevis 31 includes a central bore 34 having a compression spring 35 therein which engages between the bottom of the bore 34 and the top of the block 24 to provide a resilient means interposed between the clevis and the block for providing a variable feature in the operation of the present device. Clevis 31 carries a pivot pin 36 to which a pair of toggle links 37 and 38 are pivotally attached, and the outer ends of the links 37 and 38 are connected by pins 39 and 40 to the rockable fingers 41 and 42. Fingers 41 and 42 are connected to fixed supports 43 and 44 by means of pins 45 and 46 so that the spring gripping ends 47 and 48 of the fingers 41 and 42 can be brought into operative engagement with the spring ends 8 and 9 when the latter are in the annealing station position supported upon the bars 12 and 13. The terminal portions of the spring gripping ends 47 and 48 are inclined as at 49 and 50 as indicated in Fig. 1 to provide a gripping surface on each of the gripping fingers that will tend to keep the spring ends down against the support bars 12 and 13, and also laterally outwardly with respect to the solenoid and against the electrodes 10 and 11.

The illustration in Fig. 1 of the machine of this invention shows the solenoid 21 as energized from a current source through the wires 51 and 52 which has moved the plunger 23 upwardly carrying the upward thrust on block 24 through the spring 35 against the clevis 31 which will straighten the toggle between the links 37 and 38 to lock both of the gripping fingers 41 and 42 for holding the spring 4 against the electrodes 10 and 11 in an annealing position. By suitable time delay or time control mechanism, the electrical circuit can produce a given current through the wires 53 and 54 which are attached by nuts 55 and 56 to the electrodes 10 and 11 to pass the current through the spring 4 from one to the other of the electrodes, thus heating springs 4 to a given temperature and for a given length of time. The electrical circuit also includes means through the time control mechanism which will interrupt the current to one of the other of the electrodes, therefore shutting off the flow of current through the spring 4 after a predetermined interval of time.

It is one of the objects of this invention to be able to bring a spring such as 4 into the position indicated in Fig. 1 before current passes between the electrodes 10 and 11 through the spring. Then by automatically operable means such as diagrammatically illustrated at 57 having switch contacts 58 operated by a plunger 59 that is actuated through a head 60 as the spring 4 stops in the annealing station, it is possible to set the electrical system in cyclic operation through a time interval to produce the sequence referred to in annealing a spring such as 4.

Thus Fig. 1 illustrates the use of a time annealing mechanism using a vertically operable solenoid structure which actuates a pair of gripping members simultaneously to hold the ends of a spring against panels in a given relation to each other, and wherein the ends of the spring are in contact with electrodes that will function to pass current through the spring for heat treating such a unit. With the use of the resilient connecting clevice and block 24, it is obvious that the spring wire thicknesses may be varied without affecting the operation of the mechanism, and the variations in the parts and the pivotal connections can all be readily compensated for by reason of the cushioning effect created between the clevice 31 and block 24. It is also obvious that various diameters of coil springs can likewise be fed through a channel between the panels 1 and 2 and that the gripping mechanism will still function in its designed capacity to grip the spring against the electrodes for the annealing cycle of the machine.

Referring now to the modified arrangement illustrated in Fig. 3, this construction also involves a pair of panels 61 and 62 that are adjustably connected by means of the bolts 63 and 64 to the vertical legs 65 and 66 of brackets 67 and 68. The latter are also adjustably connected by bolts such as 69 to a supporting bed 70 common to the supported mechanism of the machine. This construction entails more specifically the use of a pair of solenoids 71 and 72 having plungers 73 and 74 that carry rollers 75 and 76 which are arranged to operate the gripping fingers 77 and 78. Rollers 75 and 76 operate upon guide rails

79 and 80 which are bolted in place at 81 and 82 to the panels 61 and 62.

The gripping fingers 77 and 78 in this construction are pivotally supported upon the pins 83 and 84 on the spring supporting bars 85 and 86. These fingers terminate with gripping ends 87 and 88 which contact the spring ends 89 and 90 of a spring 91, and are also provided with leaf springs 92 and 93 which coact with the rollers 75 and 76 of the plungers 73 and 74 to cause such fingers to oppositely rotate upon their pivots for the purpose of gripping the spring ends. By the use of the leaf springs 92 and 93 various thicknesses of spring wire may be gripped and a resilient connection introduced between the fingers and the plungers that will allow certain tolerances in construction which will help to produce a less expensive annealing machine. It should also be noted that the fingers 77 and 78 are provided with tails 94 and 95 which help to shield the leaf springs 92 and 93 from the heat of the spring being annealed, and which tails also provide weighted ends to normally maintain the gripping fingers in inoperative positions with the springs 92 and 93 in engagement with the rollers 75 and 76, one of such positions being shown in dotted lines in the left hand portion of Fig. 3. This construction includes the electrodes 96 and 97 that are suitably supplied by electrical currents through the wires 98 and 99 to pass current through the spring 91 to heat the latter for annealing.

It is to be understood that the guide bars 85 and 86 are preferably made of metal although they may be constructed of an insulating material such as Bakelite as are the panels 61 and 62. This same construction prevails in the Fig. 1 device so that the guide bars 12 and 13 may be made of metal or of insulating material. When the bars are of insulation, they will isolate the electrodes in each of these constructions to obtain a predetermined current flow only through the spring which is located in the annealing position should conditions or materials require such isolation.

In the Fig. 3 structure, the solenoids are horizontally mounted to permit the supporting of the mechanism upon the base 70 previously described, which base may be a portion of the wire forming machine. This latter construction also contemplates the use of individually operable gripping fingers which are simultaneously operated through simultaneous current introduction through the wires 100 and 101 into the solenoids 71 and 72. It is also possible with this construction to individually operate fingers 77 and 78 at slightly different intervals or at different levels should either or both of these relations be desirable.

Figs. 4 and 5 are directed to a construction which uses magnetic holding means in place of the solenoid operated gripping fingers described in the first two annealing machine constructions. Fig. 4 illustrates two panels 102 and 103 of insulating material such as Bakelite, receiving the spring 104 therebetween upon the insulated guide bars 105 and 106 at the annealing position opposite the electrodes 107 and 108. As seen in Fig. 5, each panel mounts a pair of magnets 109 and 110 that are laterally spaced for the purpose of contacting any one of a number of springs within a given diameter range. In this construction a suitable plunger operated switch means 111 can be utilized in the magnetic circuit to introduce a holding circuit that will energize the magnets

109 and 110 for holding the spring 104 in the position indicated. The circuit is arranged to introduce current through the electrodes 107 and 108, immediately after the holding circuit has been established, to heat the spring for the purpose of treating the same. Thereafter the electrodes are de-energized before the magnetic circuit breaks, thus eliminating or reducing electrical arcing to a negligible minimum. The construction of the annealing machine contemplated in Figs. 4 and 5 has the facility of eliminating a good many mechanically operable mechanisms and may be well adapted for use under certain conditions of operation, particularly where space limitations are important.

Referring now to the circuit diagram illustrated in Fig. 6, this diagram is applicable to the constructions shown in Figs. 1 to 5 inclusive, and a description of the operation of the control circuit is as follows. For the purposes of description, the mechanical details in the circuit shall be given the same reference numerals as similar parts described in connection with Fig. 1.

The circuit generally includes a terminal panel 112 as a central unit from which lead line wires 113 and 114, switch control equipment wires 115 and 116, and the panel has terminals 117 and 118 for wires 51 and 52 that connect with the coil of the solenoid 21.

The line wires 113 and 114 connect to the balance of the annealing machine control circuit through a main switch 119 into wires 120 and 121 including a voltmeter 122 to check the potential and indicating lights 123. One side of the line circuit then connects by wire 125 to switch 57 that is normally open and which is closed by plunger or pin 60 when a spring 4 is actuated into position at the annealing station of the machine, at which station spring 4 has its end coils aligned with the electrodes 10 and 11 as diagrammatically indicated in Fig. 6.

Spring 4 thus closes switch 57 to continue the line circuit through wire 126 to the automatic timer 127 which can be set to close the normally open switch 128 for a predetermined interval to suit the timed requirements of the spring feeding mechanism indicated in Fig. 2 or to the requirements of any other synchronized mechanism that controls the interval of advance of each spring to be annealed.

Timer 127 then closes switch 128 so current passes through wire 129 to a quick make and slow break relay 130 which controls the opening and closing of switch 131. The same circuit includes a slow make and quick break relay 132 that controls the opening and closing of switch 133, the circuit being completed through lead 134 back to wire 121, switch 119 and to the other side 114 of the line circuit.

Switches 131 and 133 receive current through wire 135 from the line circuit through wire 120. With switches 57 and 128 closed, coil 130 immediately closes switch 131 creating current flow from wire 135 through leads 136 and 51 to the solenoid 21 from which the circuit is completed through wire 137 to the other side of the line comprising wire 114. This action causes the operating mechanism of the machine to grip the spring 4 in the manner shown in Fig. 1.

This step is then followed by the closing of switch 133 by the slow make relay 132 sending line current through lead 138 to the coil 139 that causes the closing of the primary contacts 140 and 141 of the primary coil 142 to energize the high potential secondary coil 143. The latter

then sends current into the electrodes 10 and 11, and through the spring 4 to resistance heat the latter.

Timer 127 will then open the circuit to the relay coils 130 and 132 by opening switch 128. When this occurs switch 133 is immediately opened by the fast break of relay 132 to cut out the transformer circuit and current supply through spring 4 and this action is immediately followed by opening of switch 131 when the slow break relay 130 functions. This releases the hold of the machine on spring 4 by de-energization of the solenoid 21. Spring 4 is then moved out and replaced by another at which time the cycle is repeated.

It may be desirable to cut out the automatic control of switch 57 by plunger 60 and to use other switch controlling equipment connected with wires 115 and 116 through terminals 144 and 145. In that event switch 57 would be closed by suitable electrical means 146 connected by suitable leads 147 and 148 to wires 115 and 116.

The circuit controlling operations of the annealing machine are so arranged to allow clear cut entry of each spring into the machine to first position the spring, to then grip same, and to then supply current for the annealing cycle. And the circuit cuts off the annealing current prior to release of the spring and also prior to removal of the spring from the electrodes 10 and 11 to eliminate all arcing which is highly objectionable and damaging both to the product and to the machine.

Fig. 6 also shows the addition of a coil 72 in dotted lines while coil 21 may be used as coil 71 to illustrate the use of this circuit for the Fig. 3 construction of annealing machine. Both coils 21 and 72 shown in Fig. 6 can be replaced by pairs of magnetic circuits to control magnetic gripping means such as 109 and 110 used in Figs. 4 and 5.

Referring to Figs. 7 and 8, this structure contemplates a removable plate 149 that carries electrode 150 upon adjacent panel 151. The plate 149 is secured at 152 to the bushings 153 that are molded into the panel 151 and the electrode 150 projects through the opening 154 in the panel 151 in a position where it may be contacted by a spring that is to be annealed. In this construction, the electrode stem 155 is threaded to receive the nuts 156 and secure the electrode 150 against the plate 149 and to also secure the terminal 157 to the electrode. The stem 155 is also provided with a cross opening 158 to permit the insertion of a rod for rotationally adjusting the electrode 150 when a certain portion thereof becomes worn through use.

This particular electrode structure lends itself to easy replacement of worn electrodes with a minimum amount of time and effort. This structure also has the advantage of being serviced from outside of the spring guiding panels and away from all the mechanism that is housed between the panels for holding the spring in place. Obviously, the entire unit may be replaced by removal of the bolts 152 or the same process may be followed to remove the units and to merely introduce a new electrode in place of the worn one without changing the plate holding structure. Or an electrode can be refaced and replaced with a backing shim to again bring the surface of the electrode to its original operative position on a panel.

Having described the mechanisms employed and the control circuits used in carrying out the functions of the mechanisms in annealing springs, attention should be directed to the most important advantages that are attained by this invention for annealing springs.

Some of the advantages may be better understood with reference to Figs. 9 to 12 inclusive. Referring to Figs. 9 and 10 wherein each shows the head portion of the same spring in operative contact with its associated electrodes, it should be noticed that the current passes from the electrode in each of these figures to the knots 160 and 161 at the spring heads and then directly through the coil to the knot on the opposite side. In other words, the current short circuits at the heads of the spring, thus leaving a greater portion of each head in an unannealed state. In Fig. 9, the portion of the head 162 between the point 163 and the knot 160 is left unannealed. In the same spring and in Fig. 10, the portion of the head 164 between the point 165 and the knot 161 is also left unannealed.

This particular relationship which is readily obtained by the apparatus of the present invention, has a number of advantages that have to do with the handling and assembling of springs into spring units and so on. When the annealing machine is used in a location to directly receive individual springs from the spring forming machine, these springs are covered with a lubricant from the spring forming machine. This lubricant remains upon the spring head portions 162 and 164 in Figs. 9 and 10, while the rest of the spring becomes dry due to the annealing. Obviously, when the springs leave the annealing machine with slick heads such condition is advantageous in separating springs that have been bundled or stacked, and the slick condition of the spring ends is also extremely advantageous when an operator must assemble the individual springs into composite spring units. The slick spring ends greatly aid the operator performing the different spring unit assembly functions by permitting easier threading of the helices or pig-tailed springs through the heads of the assembled composite spring units. This results in a great saving of time and labor costs.

With a machine of this kind, all extra handling of springs from the coiler to the oven and from the oven to an assembly station is eliminated since the springs are heat treated automatically as each leaves the coiler.

This machine provides a definite channel through which the springs may be passed bodily sidewise which may be adjusted as described in connection with Fig. 3 or by changing the links 37 and 38 in Fig. 1 for accommodating springs of different overall lengths.

Referring to Fig. 11, it should be noted that the heads of the springs are normally held parallel by the panels so that the springs come out annealed with each of the heads 8 and 9 disposed in the parallel planes 166 and 167. Each spring 4 also leaves its annealing station with the barrel thereof symmetrically disposed about the axial line 168 and also aligning the heads 8 and 9 axially about this line.

Furthermore, the springs are so annealed that the knots 160 and 161 shown in Figs. 9 and 10 will always be aligned to facilitate easy stacking and removal of the individual springs from the stacks. Another advantage in annealing springs by this present method is shown in Fig. 12 illustrating the heads 169 and 170 of an offset type of spring containing the lower offsets 171 and the upper offsets 172, wherein the annealing process will retain the offsets 171 and 172 in the same co-

planar relationship with respect to the long axis of the spring. In heat treating springs, the wire used must have certain limits of carbon content to comply with specifications set forth by the steel industry for the manufacture of mattresses or bed springs and the like. The machine of this invention has the capacity to control the position of the knots or offsets by the time interval of energization, regardless of variations in the carbon content within the range specified by the steel industry. This controlled heat treatment is not possible in spring bundle furnaces.

Where the offset type of spring can be produced with the heads as shown in Fig. 12, any assembled spring structure using springs of this type in connection with the helices or pig-tailed springs will produce a perfectly square and flat assembled spring unit. In all springs that are not of this head aligned form, internal torsion is set up within the spring when assembled into a spring unit to align the heads which results in a distorted assembled spring unit.

Contributing mainly to a perfectly annealed spring having the attributes immediately above set forth is a control circuit which is capable of delivering a current of a given potential through each spring for a given time interval. The method of performing this function, together with the apparatus for holding the spring in the manner described, all tend to produce springs that are uniform and highly desirable for use in all constructions requiring annealed springs. Furthermore, the present method of annealing springs not only produces uniform springs, but does so with considerable saving in cost both as to equipment used and in the cost of the operation of the same. With the machines herein described, power of any volume is only consumed when a spring is actually being annealed which is not the case in the oven method of annealing. An oven must first be brought up to temperature for use, and much heat is lost each time the oven doors are opened to take out and to replace a bundle or batch of springs.

Although the above description is more specifically confined to the various structures illustrated to carry out the automatic annealing of single spring products by the principles set forth under the original concept of this invention, other changes and modifications are also contemplated in these structures without departing from the invention. Such variations in design shall, however, be governed by the breadth and scope of the appended claims directed to the annealing machine of this invention.

What I claim is:

1. A spring annealing machine comprising spaced cooperative guide means to receive a spring therebetween, said guide means acting to direct a spring to a given station, fixed electrodes positioned at said station and in the path of the spring for contact with spaced portions of said spring to send current through said spring to heat the latter at said station, and electrical control equipment connected with said electrodes to energize the latter at predetermined intervals comprising a current supply circuit, a transformer connected with said circuit and with said electrodes, operative means responsive to the positioning of a spring at said station to cause current flow from said transformer to said electrodes and through said spring, and timing means in said circuit to regulate the interval of current flow comprising a circuit control switch to regulate the flow of current to said spring, and timing mechanism to open and close said switch.

2. A spring annealing machine comprising cooperative guide means to direct a spring along a given path, actuating means to move said spring along said path to a given station, electrodes positioned at said station to contact portions of said spring to send current through the spring for heat treating the same, mechanism to hold said spring at said station and in contact with said electrodes, a solenoid to actuate the holding mechanism, and electrical control equipment connected with said electrodes to energize the latter at predetermined intervals and to operate said solenoid, said equipment comprising a current supply line circuit connected with said electrodes, a secondary circuit leading from said line circuit to said solenoid, and timing means interposed in said line circuit to control the current flow interval to said electrodes and said solenoid.

3. A spring annealing machine comprising cooperative guide means to direct a spring along a given path, actuating means to move said spring along said path to a given station, electrodes positioned at said station to contact portions of said spring to send current through the spring for heat treating the same, mechanism to hold said spring at said station and in contact with said electrodes, a solenoid to actuate the holding mechanism, and electrical control equipment connected with said electrodes to energize the latter at predetermined intervals and to operate said solenoid, said equipment comprising a current supply line circuit connected with said electrodes, a secondary circuit leading from said line circuit to said solenoid, and timing means interposed in said line circuit to control the current flow interval to said electrodes and said solenoid, said timing means including slow make and break relays interposed in said line and secondary circuits to cause the solenoid to function before the electrodes are energized and to continue to function until after the electrodes are de-energized.

4. In a spring annealing machine, guides to direct a spring to a given station, actuating means to move said spring to said station, electrodes at said station to contact opposite ends of said spring, and operative holding mechanism to engage the opposite ends of said spring and to urge said ends into positive electrical contact against said electrodes, said holding mechanism comprising a toggle, spring gripping fingers at the ends of said toggle, a head connected with the center of said toggle, and a solenoid to actuate said head and toggle.

5. In a spring annealing machine, guides to direct a spring therebetween to a given station, actuating means to move said spring along said guides to said station, electrodes at said station to contact opposite ends of said spring, and operative holding mechanism to engage the opposite ends of said spring and to urge said ends into positive electrical contact against said electrodes, said holding mechanism comprising movable fingers supported to engage the spring ends, power means connected to actuate said fingers, and resilient means interposed between said power means and said fingers whereby variable thicknesses of spring wire can be accommodated.

6. In a spring annealing machine, guides to direct a spring to a given station, actuating means to move said spring to said station, electrodes at said station to contact opposite ends of said spring, and operative holding mechanism to engage the opposite ends of said spring and to urge

said ends into positive electrical contact against said electrodes, said holding mechanism comprising magnets disposed at said station and near said electrodes for gripping said spring ends.

7. In a spring annealing machine, guides to direct a spring to a given station, actuating means to move said spring to said station, electrodes at said station to contact opposite ends of said spring, and operative holding mechanism to engage the opposite ends of said spring and to urge said ends into positive electrical contact against said electrodes, said holding mechanism comprising magnets disposed at said station and near said electrodes for gripping said spring ends, said holding mechanism comprising pairs of magnets at each electrode to grip the spring ends at such electrodes, each of said pairs of magnets being positioned along an arc passing through the adjacent electrode with said arc simulating an arc of an average sized spring end of a spring to be treated.

8. In a spring annealing machine, insulated guides, a knotted coil spring therebetween with its opposite head coils at said guides respectively, and a pair of electrodes to contact given peripheral points near the knots of each spring head coil respectively, whereby current may be shunted directly through said coil spring body from knot to knot leaving a greater portion of each head coil unannealed.

9. In a spring annealing machine having insulated panels to receive a spring therebetween, and electrical units arranged to engage end portions of said spring, said units comprising a fixture, an electrode releasably secured to said fixture, said panel having an opening, and means to secure said fixture to said panel with said electrode extending through said panel opening and disposed for contact by a spring.

10. In a spring annealing machine having insulated panels to receive a spring therebetween, and electrical units arranged to engage end portions of said spring, said units comprising a fixture, an electrode releasably secured to said fixture, said panel having an opening, and means to secure said fixture to said panel with said electrode extending through said panel opening and disposed for contact by a spring, and said electrode having rotatable means to bodily revolve said electrode to present another portion of said electrode for contact by a spring.

11. The method of annealing individual knotted coil springs consisting of the step of prepositioning each coil spring in a given head to head space, retaining each coil in this position with the head coil knots aligned, passing a current through said spring between portions of said head coils, and supplying said current at a given potential and for a given interval of time.

12. In a spring annealing machine, spaced guide members to receive a spring end to end therebetween, trackways associated with said guide members for circumferential contact with peripheral portions of a spring to direct the latter along a given path between said guide members, and electrical contact units positioned along the path of movement of the spring to shunt an electrical current therethrough, and operable feed means to abut and to bodily actuate a spring along said trackways and along said given path between said guide members.

13. In a spring annealing machine, spaced guide members to receive a spring end to end therebetween, trackways associated with said guide members for circumferential contact with peripheral portions of a spring to direct the latter along a given path between said guide members, and heat transmitting means arranged along the path of movement of the spring to supply heat thereto, and operable feed means to directly engage an integral portion of a spring and to bodily actuate said spring along said trackways and between said guide members.

14. In a spring annealing machine, spaced guide members to receive a spring end to end therebetween, trackways associated with said guide members for circumferential contact with peripheral portions of a spring to direct the latter along a given path between said guide members, and electrical contact units positioned along the path of movement of the spring to shunt an electrical current therethrough, and rockable fingers to engage the trackway contacting portions of a spring to hold the latter adjacent said electrical contact units.

15. In a spring annealing machine, spaced guide members to receive a spring end to end therebetween, trackways associated with said guide members for circumferential contact with peripheral portions of a spring to direct the latter along a given path between said guide members, and heat transmitting means arranged along the path of movement of the spring to supply heat thereto, and rockable fingers to engage the trackway contacting portions of a spring to hold the latter adjacent said heat transmitting means.

16. In a spring annealing machine, spaced guide members to receive a spring end to end therebetween, trackways associated with said guide members for circumferential contact with peripheral portions of a spring to direct the latter along a given path between said guide members, and electrical contact units positioned along the path of movement of the spring to shunt an electrical current therethrough, and rockable fingers to engage the trackway contacting portions of a spring to hold the latter adjacent said electrical contact units, said fingers having their spring contacting portions movable over and adjacent said trackways with the terminal ends directed toward said spaced guide members.

17. In a spring annealing machine, spaced guide members to receive a spring end to end therebetween, trackways associated with said guide members for circumferential contact with peripheral portions of a spring to direct the latter along a given path between said guide members, and electrical contact units positioned along the path of movement of the spring to shunt an electrical current therethrough, and rockable fingers to engage the trackway contacting portions of a spring to hold the latter adjacent said electrical contact units, said fingers having their spring contacting portions movable over and adjacent said trackways with the terminal ends directed toward said spaced guide members, and said terminal ends of said fingers being inclined to urge the contacted portions of the spring ends toward said guide members and simultaneously against said trackways.

18. A spring annealing machine comprising spaced guide members to receive a spring therebetween, spring supporting members to position said spring in a given location with respect to said spaced guide members, electrodes connected with certain of said members for contact with opposite ends of said spring when the latter is disposed in said given location with respect to said members, and clamping units carried by certain of said members and arranged to individ-

ually urge the spring ends respectively against said certain members and to hold said spring ends in fixed relation against said electrodes.

19. A spring annealing machine comprising spaced panels, bodily shiftable feed fingers for engaging a spring to actuate said spring in sidewise relation between and relative to said panels, guide means interposed between said panels and arranged for contact by said spring and to direct the spring to a given station between said panels, and electrical contact units to engage the ends of said spring at said station.

20. A spring annealing machine comprising spaced cooperative guide means to receive a spring transversely therebetween with the end portions of the spring disposed adjacent said cooperative guide means, spring supporting bars independently mounted on each of said guide means respectively for edge contact with transversely spaced portions of said spring, actuating means to direct said spring bodily over said supporting bars and between said guide means toward a given station, and electrodes positioned at said station for contact with spaced portions of said spring to send current through the spring and to heat the latter between said spaced portions thereof.

21. A spring annealing machine comprising spaced cooperative guide means to receive a spring transversely therebetween with the end portions of the spring disposed adjacent said cooperative guide means, support bars independently mounted on each of said guide means respectively to provide a guiding trackway for edge contact with transversely spaced portions of said spring and to direct said spring bodily toward a given station, and electrodes positioned at said station for contact with spaced portions of said spring to send current through the spring and to heat the latter between said spaced portions thereof, and current control means connected with said electrodes and including operative means responsive to said spring when in said station position to energize said electrodes.

22. A spring annealing machine comprising spaced cooperative spring end guides to receive a spring transversely therebetween, rail means associated with said spring end guides to support said spring at peripheral portions thereof for rolling motion between said spring end guides and acting to direct a spring to a given station, operative means to actuate a spring over said rail means and between said guides to said station, electrodes positioned at said station for contact with spaced portions of said spring to send current through said spring to heat the latter, and electrical control equipment connected with said electrodes to energize the latter at predetermined intervals.

23. A spring annealing machine comprising spaced cooperative guide means to receive a spring transversely therebetween, rails fixedly connected with said guide means respectively to support the spring ends peripherally and acting to direct a spring to a given station, fixed electrodes positioned in the rail guided path of the spring at said station for contact with spaced portions of said spring to send current through said spring at said station to heat the spring, and electrical control equipment connected with said electrodes to energize the latter at predetermined intervals, said electrical control equipment including current flow timing means to regulate the current heating interval of the spring.

24. A spring annealing machine comprising spaced cooperative guide means for contact with the laterally outward faces of the head ends of a spring, transversely spaced supporting means arranged between said guide means for engagement with the peripheral edge portions of said head ends of the spring respectively and comprising means to guide a spring along a given path to a given station between said guide means, electrodes positioned at said station for contact with spaced portions of said spring to send current through said spring to heat the latter, and electrical control equipment connected with said electrodes to energize the latter at predetermined intervals, said electrical control equipment including transformer mechanism having a predetermined energy output and connected with said electrodes to pass a current of given potential through said spring.

25. A spring annealing machine comprising spaced cooperative guide means to receive a spring therebetween and to engage the end portions of said spring, said guide means acting to direct a spring by its end portions to a given station, electrodes positioned at said station for contact with spaced portions of said spring to send current through said spring at said station to heat the spring, and an electrical circuit, control equipment in said circuit connected with said electrodes to energize the latter at predetermined intervals, said control equipment including transformer mechanism having a predetermined energy output in circuit with said electrodes to pass a current of given potential through said spring, and timing means interposed in said electrode circuit to regulate the interval of current flow through said spring comprising a circuit control switch to regulate the flow of current to said spring, and timing mechanism to open and close said switch.

26. In a spring annealing machine, spring guides to direct a spring to a given station, actuating means to engage and bodily move said spring along said guides and to said station, electrodes at said station and in contact with the opposite ends of a spring there located, and spring holding units operative to engage the opposite ends of said spring respectively and to urge said ends individually into positive electrical contact against each of said electrodes respectively.

27. The method of annealing individual coil springs having knotted head ends thereon which consists of the step of locating a spring with the head ends thereof subject to opposite polarity electrical current sources, introducing an electrical current through said spring and from one head end knot thereon to the other head end knot thereon, and maintaining said knot to knot current active at a given potential and for a given interval of time.

28. In a spring annealing machine, longitudinally arranged spaced guide members to transversely receive a spring end to end therebetween, individual trackways longitudinally positioned in a fixed relation with respect to said guide members and arranged in laterally spaced relation between said guide members for individual circumferential contact with the peripheries of the end portions of a spring, said trackways providing guide means for said spring end portions and being arranged along a given path between said guide members, and electrical contact units positioned along the path of movement of the spring to shunt an electrical current therethrough.

29. In a spring annealing machine, laterally

spaced guide members to receive a spring end to end therebetween, individual trackways for each of said guide members and positioned in laterally spaced relation between said guide members and extending in the general direction of the latter to provide circumferential edge contact for the spring ends respectively whereby to direct said spring along a given path between said guide members, and heat transmitting means arranged along the guided path of movement of the spring to supply heat thereto.

30. A spring annealing machine having a spring handling guideway and means to move said spring therealong, said guideway comprising spaced wall members to guide endwise spaced portions of a transversely positioned spring between said wall members, fixed guide units on said wall members to support circumferential

edge portions of said spring in a given relation with respect to said wall members and to guide said spring to a given station between said wall members, and electrodes on said wall members for contacting engagement with spaced segments of said spring to introduce electrical energy into said spring and between said spaced segments of said spring.

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