

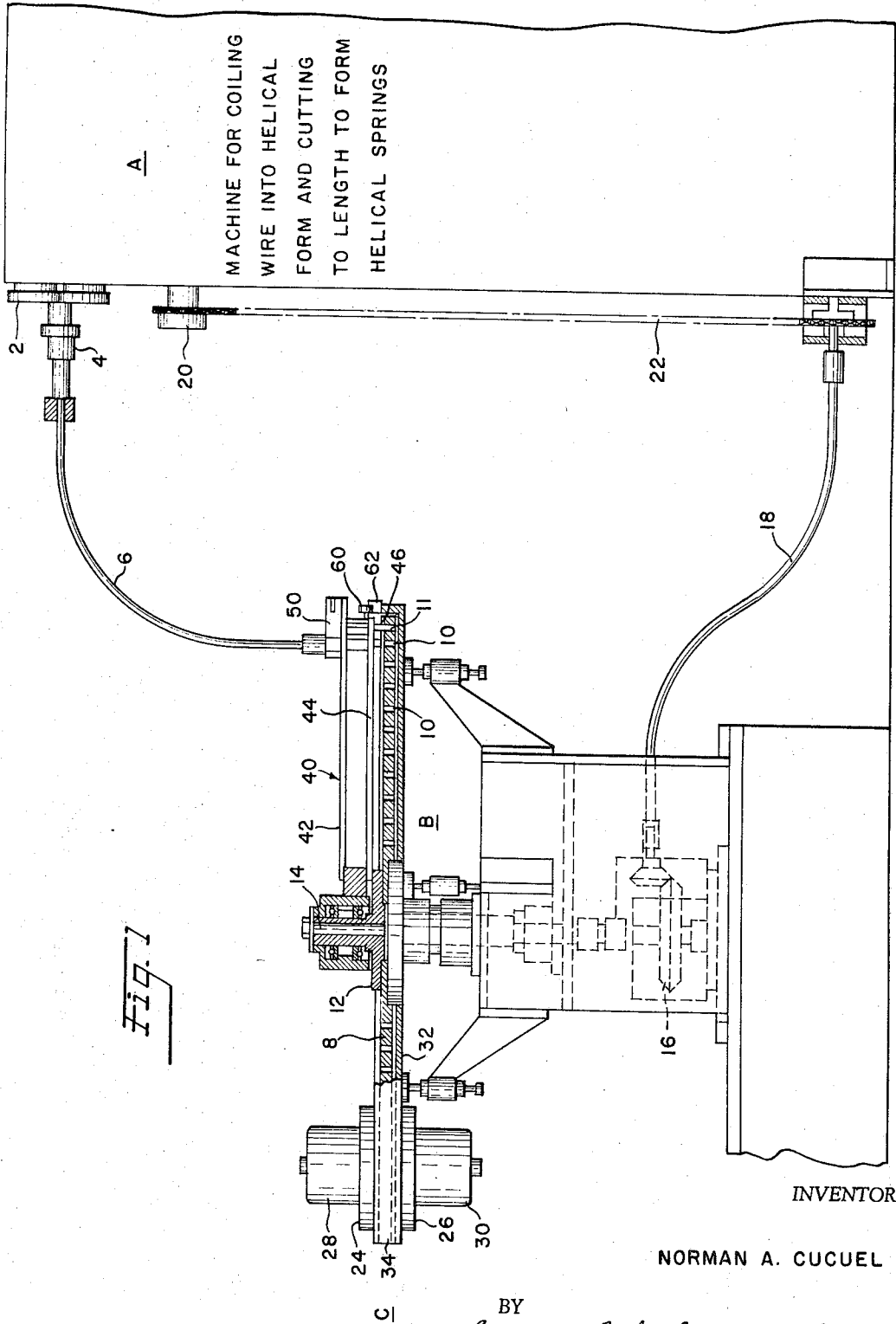
Oct. 31, 1967

N. A. CUCUEL  
CONTINUOUS SPRING FORMING, GRINDING AND  
SETTING OUT MACHINE

3,349,473

Filed Nov. 15, 1966

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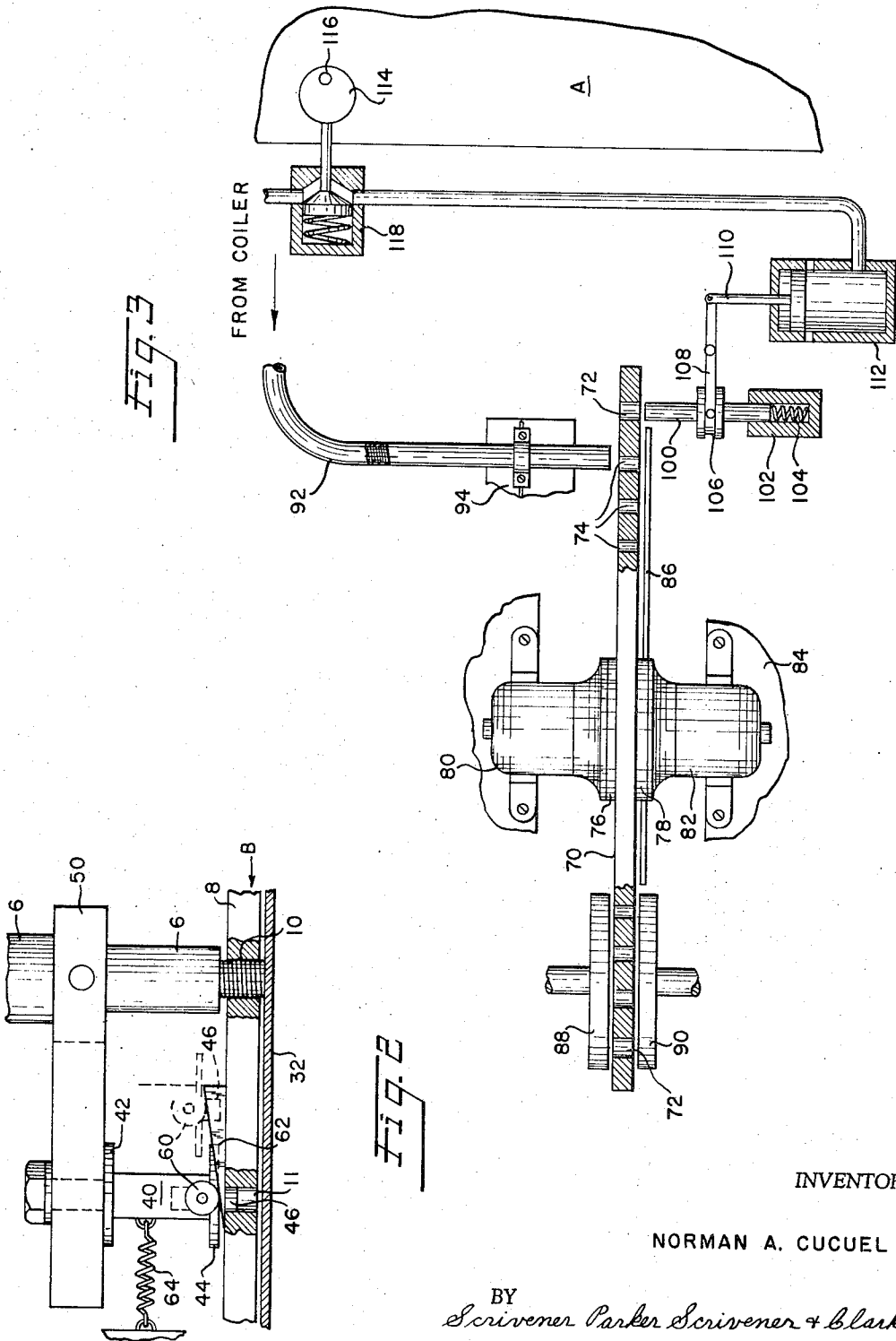
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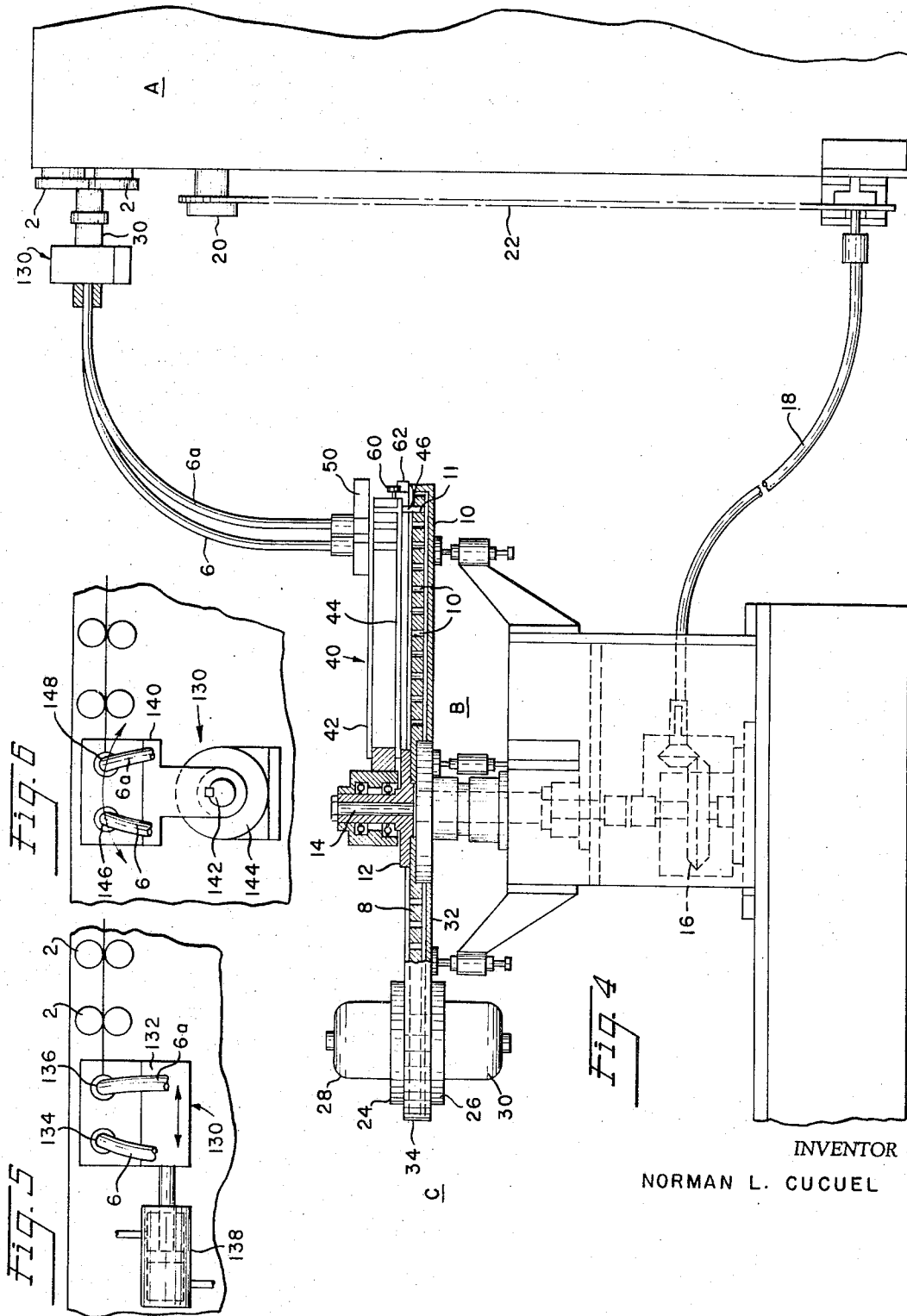
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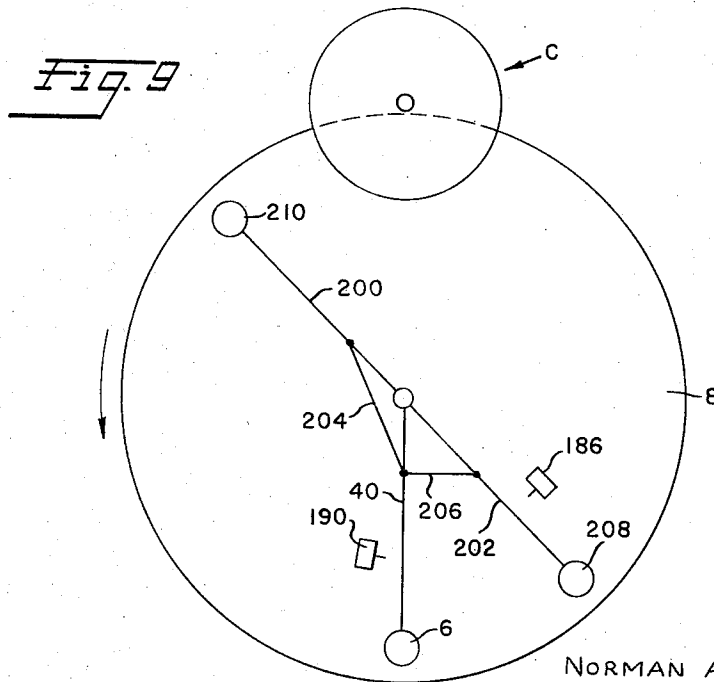
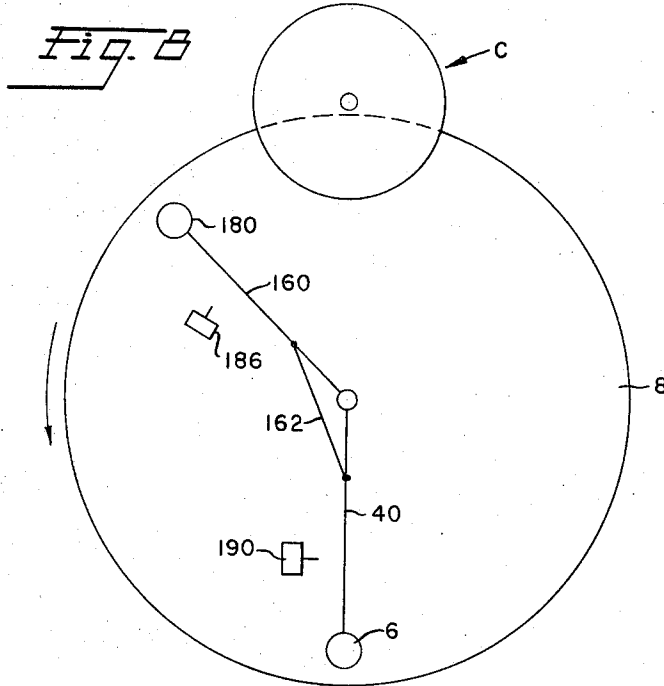
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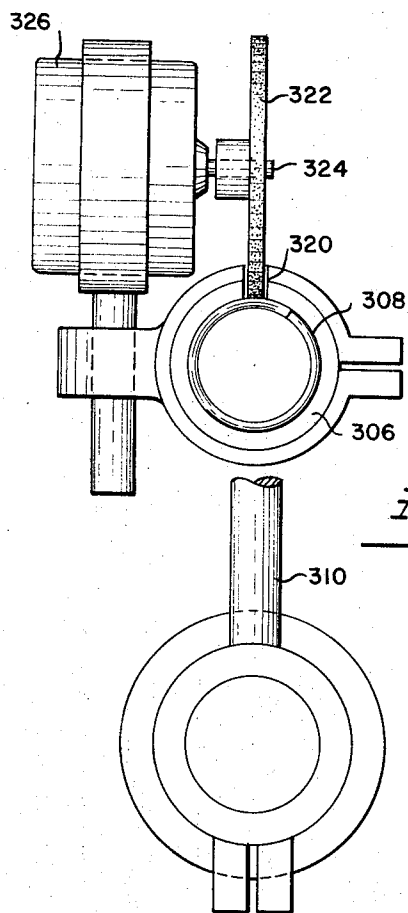
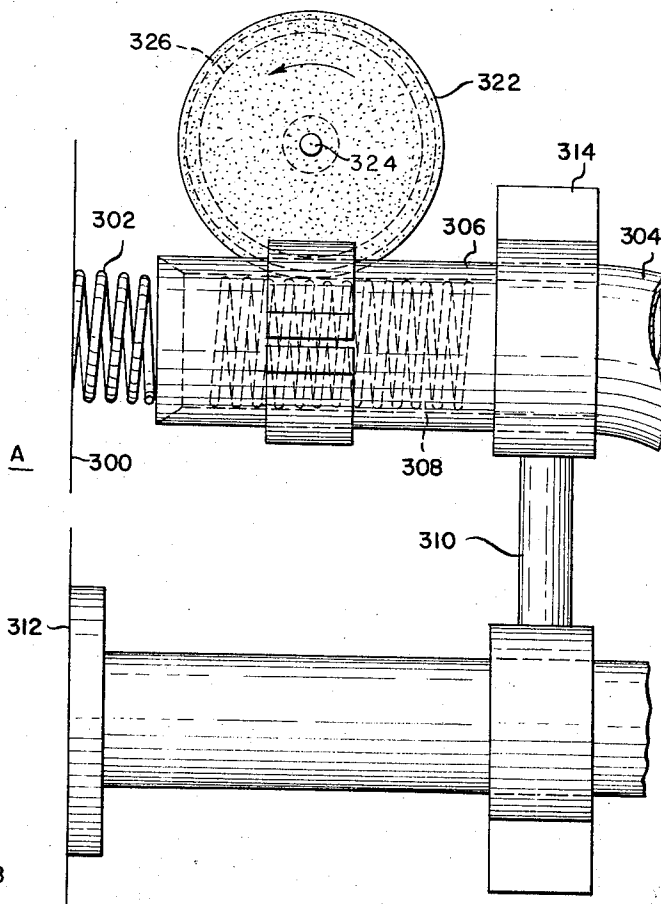
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*Fig. 10*



*Fig. 11*

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## CONTINUOUS SPRING FORMING, GRINDING AND SETTING OUT MACHINE

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20 Claims. (Cl. 29—564)

This application is a continuation-in-part of my application Ser. No. 265,547, filed Mar. 15, 1963, for Continuous Spring Forming and Grinding Machine, now abandoned, and my co-pending application Ser. No. 471,139, filed July 12, 1965, for Continuous Spring Forming and Grinding Machine, now abandoned, and of my copending application, Ser. No. 553,440, filed May 27, 1966, now abandoned, for Continuous Spring Forming, Grinding and Setting Out Machine.

This invention relates broadly to the manufacture of helical coil springs and, more particularly, to means for grinding one or both ends of such a spring, for setting the spring after grinding, and for feeding springs from a coiling machine to the grinding machine which forms part of this invention.

In the manufacture of helical coil compression springs, particularly those intended for such uses as valve springs, it is necessary to grind one or both ends of the spring in order to insure that they will be square with the axis of the spring. It is the known and usual practice to coil such springs from round or rectangular wire and then physically to transport the springs to a location removed from the coiler where the secondary operation of end grinding is performed. It will be apparent that the necessity of performing the coiling and grinding operations at different locations, involving as it does the transportation of the springs between the two locations and then loading them into the carrier of the grinder, involves additional cost and time. It has therefore been one of the principal objects of this invention to provide means which are so operative with coiling and grinding means that the coiled springs are moved immediately and in a continuous flow to the grinding means, thereby to provide a continuous coiling and grinding operation not requiring the usual transportation of the springs between the coiler and the grinder and loading of the springs into the carrier of the grinding machine.

In addition to the secondary operation of grinding, it is often desirable or necessary to "set out" helical coil compression springs as one step in the manufacturing process. This is accomplished by compression of the spring from its maximum free height to solid condition, resulting in a decrease in the free length of the spring with consequent improvement in its stress qualities. This secondary operation has heretofore been carried out at a place physically removed from the locations of both the coiling and grinding machines, with the consequent additional requirements of cost and time. In order to reduce materially these cost and time factors it has been another principal object of this invention to provide means, which are associated with and form part of the coiling and grinding means provided by the invention, for setting out helical coil compression springs as a part of, or as a further step in, the continuous coiling and grinding operation which is provided by the means and apparatus according to the invention.

It is often necessary to coil heavy wire into helical springs, and in the use and operation of the coiling, grinding and setting-out apparatus provided by the invention difficulties have been encountered in the passage of such heavy springs from the coiling machine to the grinding and setting-out machine, and it has therefore been a further

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object of this invention to provide novel means for facilitating such passage.

The invention is described in the following specification and is illustrated in the accompanying drawings, in which:

FIG. 1 is a side view, partly in section, of a spring coiling and grinding machine according to the invention;

FIG. 2 is an end view of parts shown in FIG. 1 for moving the spring delivery tube with the carrier plate of the grinding means;

FIG. 3 is a view which is similar to FIG. 1 and shows a second embodiment of the invention;

FIG. 4 is a view which is similar to FIG. 1 and shows a further embodiment of the invention in which the coiler supplies springs to two tubes which lead to the spring carrier of the grinding machine;

FIGS. 5 and 6 show, respectively, two alternative apparatus for supplying springs to the two tubes of the embodiment of FIG. 4;

FIG. 7 is a partial perspective view showing a further embodiment of the invention in which means are associated with the spring carrier of the grinding machine for setting out the springs before grinding;

FIG. 8 is a schematic plan view of a modification of the embodiment of the invention shown in FIG. 7, in which the springs are set out after grinding;

FIG. 9 is a view which is similar to FIG. 8 but shows means for setting out the springs both before and after grinding, and

FIGS. 10 and 11 are, respectively, front and side elevational views of the means provided by the invention for causing springs to pass from the coiling machine to the grinding and setting-out machine.

In a first embodiment of the invention, which is disclosed in FIGS. 1 and 2 of the drawings, there is provided a coiler for forming and cutting wire into helical springs of any desired length, grinding means, and means for moving the helical springs from the coiler to a constantly moving carrier which carries each spring into engagement with grinding wheels. The coiler is shown at A and may have any suitable construction and operation to form wire into a helix and cut it off to form springs of a desired length, and having feed rolls 2 which feed the wire to the coiling and cut-off point. In accordance with the invention means, which are indicated at 4 in the drawings, are located at the coiling point and are constructed and adapted to receive each spring as it is formed and to pass it into one end of a tube 6, the other end of which is positioned adjacent a rotating carrier B which carries springs into engagement with grinding wheels C so that one or both ends thereof will be ground.

The carrier B comprises a circular plate 8 which is provided over an area adjacent its periphery with a plurality of radially spaced, circular series of holes 10, the holes in each circular series being of the same diameter and the holes of different circular series being of the same or different diameters, so that springs of any desired diameter or diameters may be put into the holes of any series and moved by the carrier plate 8. The outermost circular series of holes, which is shown at 11, does not usually, but may, receive springs from the tube 6 and is provided for a primary purpose which is described hereinafter. The carrier plate 8 is supported by flange 12 on the upper end of a vertical shaft 14 which is constantly rotated through reduction gear 16 by drive shaft 18 which is operated from the cam shaft 20 of the coiler through sprocket and chain drive 22. The carrier plate is therefore rotated constantly during operation of the coiler.

The rotating carrier plate passes between the opposed surfaces of upper and lower grinding wheels 24, 26 of grinder C, which is of conventional construction and the wheels of which may be rotated by motors 28, 30. These

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grinding wheels are mounted above and below the carrier plate 8, respectively, and both are constantly rotated by their driving motors and may be adjusted toward and away from the carrier plate in order to permit the grinding of the ends of springs of different lengths or to any desired extent.

A circular plate 32 is disposed beneath the carrier plate 8 and is of somewhat larger diameter than the carrier plate, and has a surrounding peripheral wall 34 which partially encloses the carrier plate. The bottom plate 32 is provided with an opening through which the lower grinding wheel 26 extends. One purpose of plate 32 is to support the springs positioned in the holes in the carrier plate until they are moved between the grinding wheels.

Means are provided by the invention for introducing each wound spring produced by the coiler, and passing from the coiler through tube 6, into one of the holes of any one of the plurality of circular series of holes 10 in the constantly rotating carrier plate. Such means comprise, first, an arm 40 which, at its one end, is rotatably journaled on the upper end of shaft 14, but is not connected to that shaft for rotation therewith, and which extends radially of carrier plate 8 to the outer periphery thereof. This arm is formed by upper and lower, parallel, spaced, flat, horizontal arms 42, 44 which are resilient to yield vertically, and which are connected together at and adjacent their support on shaft 14 and also at and adjacent their outer ends to form a unitary assembly. Adjacent its outer end the arm 40 carries a downwardly extending pin 46 which is disposed vertically above the outer circular series of holes 11 in the carrier and is of such length that its lower end is normally below the upper surface of the carrier plate 8 so that its lower end normally tends to enter one of the holes 11 in the carrier. Adjacent its outer end the arm 40 is also provided with an arm 50 which receives and holds the end of tube 6 and which is so mounted on arm 40 that it may be moved to various positions along the arm in order to position the open end of the tube above any one of the circular series of holes in the carrier plate.

The downwardly extending pin 46 on the outer end of arm 40, extending as it normally does into the holes of the outer series 11 in the carrier plate, provides an intermittent connection between the arm 40 and the carrier plate, intermittently moving the arm and tube 6 with the carrier as it rotates, in order to permit a spring to pass from the tube into one of the holes 10. Means are provided by the invention for disconnecting arm 40 from the carrier after a spring has passed from tube 6 into the carrier plate, and then returning the arm and tube to their normal positions in order to permit the arm and tube to again be connected to, and move with, the carrier. Such means are particularly shown in FIG. 2 and comprise a roller 60 which is mounted on an axle extending radially outwardly from the outer end of arm 40 and which rides on a cam 62 which is mounted on the fixed plate 32 outside the periphery of the rotatable carrier plate 8, and the cam surface of which is inclined upwardly in the direction of rotation of the carrier plate. The rise of the cam surface and the length of the downwardly extending pin 46 are such that the pin is lifted out of a hole 11 and free of the carrier plate after the arm 40 has traveled with the carrier plate a distance sufficient to permit a spring to pass from tube 6 into a hole in the carrier plate. An extension spring 64 is connected between the outer end of arm 40 and the fixed peripheral wall 34 and constantly urges the arm 40 and the parts carried by it in the direction opposite to that in which the arm is moved by the engagement of pin 46 with the carrier plate.

In the operation of the coiling and grinding machine provided by the invention, wire fed to the coiler A is formed into helical coil springs which are delivered at the coiling point to tube 6, through which they pass to

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the open lower end of the tube, which is positioned above the carrier plate 8 of the grinding machine. The position of the lower end of the tube radially of the carrier plate may be adjusted in order to position the open end of the tube above a circular series of holes of the proper size to receive the springs which are being coiled. So long as the coiler is operated the carrier plate will be rotated through drive shaft 18, reduction gear 16 and shaft 14, which may be at a speed which will permit the springs which are being delivered through tube 6 to be positioned in each successive hole of one of the circular series of holes in the carrier plate.

The upper and lower resilient members 42, 44 which form arm 40 constantly urge the downwardly extending pin 46 on the outer end of the arm toward the carrier plate and to a position in which the lower end part of the pin is within one of the outer series of holes 11 in the carrier plate. The roller 60 on the outer end of arm 40 is always on the cam surface 62. When it is on the lower part of the cam surface the pin 46 is within a hole 11, and when it is on the upper part of the cam surface the pin is withdrawn from the hole, with its lower end above the upper surface of the carrier plate, the resilient members 42, 44 yielding vertically upwardly to permit such movement of the outer end of arm 40 and pin 46. This raised position of pin 46 is shown in dotted lines in FIG. 2.

When the lower end of pin 46 is within one of the holes 11 the arm 40 and tube 6 are moved with the constantly rotating carrier plate, so that a spring falling or forced from the lower end of the tube will pass directly into one of the holes in one of the circular series of spring-receiving holes 10 in the carrier plate. As the spring moves from the tube into the hole in the carrier plate, the roller 60 rides up the cam surface 62, which raises the roller, the outer end of arm 40 and the attached pin 46 sufficiently to move the lower end of the pin out of the hole in the carrier plate. When this occurs the resilient members 42, 44 and extension spring 64 combine to urge arm 40 and all parts connected thereto in the direction opposite to the direction of movement of the carrier plate. Roller 60 moves down cam surface 62 until pin 46 contacts carrier plate 8. Pin 46 rather than cam 62 then opposes resilient members 42, 44 while spring 64 continues to urge arm 40 in a direction opposite to that of the carrier plate movement until another hole 11 permits members 42, 44 to force pin 46 into a hole 11 in the carrier plate. The pin 46, arm 40 and tube 6 again move with the carrier plate sufficiently to permit a spring to pass from the tube into a hole in the plate.

The springs which are placed, one by one, in the holes of the circular series of holes in the carrier plate move with the constantly rotating plate, their lower ends being supported by the fixed plate 32 until they pass between the opposed wheels of grinder C, by which their ends are ground. After passing between the grinding wheels they are discharged from the carrier plate through an opening in plate 32.

In a second embodiment of the invention the normally rotating spring carrying plate of the grinding machine may be intermittently stopped to receive a spring from a fixed tube which leads from a coiling machine to the spring carrying plate. Such an embodiment of the invention is disclosed in FIG. 3 of the drawings and comprises a preferably horizontal and circular spring carrying plate 70 having an outer circular series of holes 72 and a plurality of inner circular series of holes 74, the holes of each circular series being of the same size and those of different series being of the same or different sizes to provide means for accommodating springs of any sizes produced by a coiler A. The carrier plate is supported at its center between upper and lower nylon clutch discs 76, 78 which provide a friction drive for rotating the carrier plate and are carried, respectively, by the drive shafts

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of upper and lower driving motors 80, 82 which are mounted on the frame 84 of the machine. A fixed plate 86 is mounted below the carrier plate on the frame of the machine and provides a support for springs in the holes in the carrier plate. Grinding wheels 88, 90 are mounted above and below the carrier plate, respectively, and are operable to grind the ends of springs positioned in any and all of the circular series of holes 74.

Means are provided by the invention for guiding coiled springs from the coiler A to a point adjacent the carrier 70, from which point each spring may pass into one of the holes 74 in the carrier. Such means comprise the tube 92, one end of which is positioned at or adjacent the coiler to receive springs made there, and the other end of which is supported above the carrier 70 on a bracket 94 which is fixed with respect to the carrier, the arrangement being such that the tube may be adjusted radially of the carrier in order to permit it to be positioned above any one of the circular series of spring-receiving holes in the carrier.

Means are provided by the invention for intermittently stopping rotation of the carrier 70 to permit a spring to pass from the fixed tube 92 to one of the holes in the carrier. Such means comprise a vertical pin 100 positioned below the outer circular series of holes 72 in the carrier plate, the lower end of which is supported for vertical sliding movement in a cylinder 102 and is supported therein on the upper end of a compression spring 104 which constantly urges the pin upwardly to a position in which its upper end is within one of the holes 72 in the carrier plate. The cylinder is mounted on the frame of the machine and is therefore fixed with respect to the movable parts of the machine. Stop pin 100 carries a collar 106 between its upper end and cylinder 102 and this collar is engaged by the outer end of a lever 108 which is operated to move the pin toward and away from the carrier plate by the piston and piston rod 110 of an air cylinder operator 112. A cam 114 on the camshaft 116 of coiler A operates a valve 118 to admit air or fluid under pressure from a reservoir (not shown) to cylinder 112 to operate piston 110, lever 108 and pin 100.

In the operation of this embodiment of the invention motors 80, 82 constantly rotate the clutch discs 76, 78 which frictionally engage the opposite surfaces of the carrier plate 70, thereby rotating the carrier plate until it is engaged by the positive stop provided by insertion of the upper end of pin 100 into one of the holes of the outer series of holes 72 in the carrier plate. The pin is constantly urged to this raised stopping position by spring 104 and in this position of the pin the carrier plate is fixed, the clutch discs slide over its surface, and a spring passes from the open lower end of fixed tube 92 into one of the holes 74 in the carrier plate. At this time the valve 118 is closed and spring 104 holds the pin 100 in its upper, carrier stopping position and also holds piston 110 in its lower, inoperative position in cylinder 112. The camshaft 116 and cam 114 of the coiler are so adjusted with respect to other parts of the apparatus that when the carrier plate has remained in a fixed position for sufficient time to permit a spring to pass from the tube to the carrier the cam 114 opens valve 118 allowing fluid or air under pressure to flow to cylinder 112, operating piston 110 to move pin 100, through lever 108 and collar 106, to its lower position in which it is removed from the carrier plate. When this occurs the drive motors 80, 82 will again rotate the carrier plate. However, during such rotation the spring 104 causes the pin 100 to bear upwardly on the lower surface of the carrier plate, because of exhaust of pressure fluid from cylinder 112, and when the next succeeding hole 72 is in registry with the upper end of pin 100 the pin will move into the hole, stopping rotation of the carrier plate.

In this embodiment of the invention, therefore, the carrier plate is alternately rotated and stopped. When it is stopped a spring is passed into a hole in the carrier,

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after which the carrier is rotated through an arc equal to the distance between the centers of adjacent holes, where the stopping means again becomes effective to stop the carrier to permit another spring to be loaded into it.

Each of the two embodiments of the invention which have been described is operative to deliver one spring at a time to the carrier of the grinding machine. However, the coiler may produce springs at a faster rate than the carrier of the grinder can take them, and when this occurs coiled springs cannot be accepted by the carrier at the same rate as they are coiled and springs will therefore accumulate in the conduit leading from the coiler to the carrier. This condition will, of course, reduce the output of finished ground springs per unit of time, with consequent added cost of the entire operation. It has therefore been a further and important object of the invention to provide a combined machine for winding helical springs and grinding their ends, which will be most useful under conditions such as those set forth above and which will be operative to deliver springs from a high speed coiler to the low speed carrier of a grinding machine by means which will cause the carrier to accept all of the springs being wound, thereby increasing the output of the combined machine per unit of time.

An embodiment of the invention including such means is disclosed in FIGS. 4, 5 and 6 of the drawings and it will be seen that all the parts of this combined winding and grinding machine, with only the few exceptions which will be described, are identical with the parts of the machine disclosed in FIGS. 1 and 2, and therefore include the coiler A, the rotatable spring carrier 8 having spring-receiving holes 10 arranged in a plurality of annular series, an exterior annular series of holes 11 which receive the pin 46 through which the rotation of the carrier is transmitted to the arm 40, and the grinding wheels 24, 26. All of the parts of FIG. 4 which correspond to parts of the machine disclosed in FIGS. 1 and 2 are marked with identical numerals and no further description of them is believed to be required here.

In this embodiment of the invention a plurality of tubes 6, 6a are provided and lead from the coiling and cut-off point of the coiler A to radially spaced positions above the rotating carrier 8 of the grinding part of the machine where the depending open end of each tube is positioned vertically above one of the several annular series of spring-receiving holes 10. In the embodiment of the invention disclosed in FIGS. 4, 5 and 6 two such tubes are shown but it will be understood that more tubes than two may be provided if desired. As in the coiling part of other machines according to this invention there are provided in this embodiment the feed rolls 2 which drive the spring wire to the coiling point where it is formed into a helix and cut off to form a spring, all as in conventional practice. In this embodiment of the invention there is provided at and adjacent the coiling point means which are alternately movable into position to receive a spring which has just been formed and cut from the wire and to pass the spring alternately into one of the tubes 6, 6a. Such means are shown at 130 in FIG. 4 and in more detail in FIGS. 5 and 6, which latter figures show alternative means which may be provided for this purpose. The apparatus disclosed in FIG. 5 comprises a body 132 which is mounted for horizontal reciprocating movement on the frame of the coiling machine and is provided with two openings or passages 134, 136 which are connected respectively to the two tubes 6, 6a. An air or hydraulic cylinder and piston assembly 138 is provided and has its piston rod connected to the body 132 to impart reciprocating movement thereto, thereby alternately to bring the passages 134, 136 into position to receive a coil spring at the coiling point and to pass the same through tubes 6, 6a to one of the holes 10 in one of the annular series of spring-receiving holes in the carrier 8 of the grinding part of the machine.

In FIG. 6 of the drawings there is disclosed an apparatus for use at the coiling point which has oscillating instead of reciprocating movement. This apparatus comprises a body member 140 which is mounted on a shaft 142 to which oscillating movement is imparted by motor 144. The body member 140 has openings or passages 146, 148 therethrough which are connected respectively to the tubes 6, 6a.

It will be apparent that by the use of the embodiment of the invention disclosed in FIGS. 4, 5 and 6 two or more tubes leading from the coiler to the grinder may be supplied by the coiler. Each of the plurality of tubes is positioned vertically above one of the annular series of spring-receiving openings 10 in the carrier plate 8 and therefore a number of annular rows of openings will be supplied by the single coiler, thereby materially increasing to any desired extent the output of the combined winding and grinding machine per unit of time.

In a still further form which the invention may take, means are provided, in addition to the means for continuously supplying springs from the coiler to the grinding wheels of a grinding machine, for setting out the springs at some desired stage of the grinding operation, which may be before grinding, or after grinding, or both before and after grinding. One embodiment of this form of this invention is illustrated in FIG. 7, in which there are disclosed the tube (or tubes) 6 supplying springs to carrier 8, resilient arm 40 which carries roller 60, which rides on cam 62, all as described in connection with other forms of the invention. A second, but rigid arm 160 is loosely mounted on central shaft 14 above the carrier plate in a position between the arm 40 and the grinding wheels (which are not shown in this figure) in the direction of movement of the carrier plate which is shown by the arrow in FIG. 7, and this arm is connected to the arm 40 by link 162 so that it moves as a unit with arm 40 as that arm is moved with the carrier plate through the small arc determined by the length of cam 62, as described above.

The arm 160 extends radially outwardly beyond the periphery of the carrier plate 8 and has at its outer extremity a downwardly extending part 164 from the lower end of which there extends an inwardly and radially extending part 166, the upper surface of which closely underlies the lower surface of the carrier plate so that it provides a support for springs within the holes of any radial line of holes 10 in the carrier plate. As in the other forms of the invention, plate 32 underlies the rotating carrier plate 8, but in this embodiment is cut away for a short distance, as shown at 168, to permit oscillating movement of the inwardly extending arm 166. In order to provide support to the springs within holes 10 of the carrier plate over this cut-away part of support plate 32 an elongated sheet metal tongue 170 is connected at its one end to inwardly extending member 166 and extends toward arm 40 and closely underlies the lower surface of the carrier plate beneath the spring-receiving holes 10 therein, and a second similar metal tongue 172 extends from arm 160 in the direction away from arm 40 and also closely underlies the holes 10 in the carrier plate.

Means are provided in this embodiment of the invention for setting out springs which have been received within holes 10 in the carrier plate before such springs reach the grinding wheels, and such means comprise a solenoid 180 which is mounted on the upper surface of arm 160 and has plunger 182 which extends vertically downwardly in alignment with any annular series of holes 10 in the carrier plate. The solenoid has two oppositely wound windings 183, 184 which may be selectively or alternately energized to extend or withdraw the plunger 182. A switch 186 is supported on a fixed part of the machine adjacent the limit of travel of arm 160 in the direction of movement of the carrier plate 8 toward the grinding wheels, which is the direction shown by the arrow in FIG. 7, and the contacts of this switch are connected

to winding 183 of the solenoid. When this switch is closed, which occurs when switch operating member 188 is engaged by arm 160 at the limit of travel of the arm in the direction of movement of the carrier plate, the solenoid winding 183 is energized to retract the plunger 182. A second switch 190 is disposed adjacent the limit of travel of arm 40 in the direction opposite to the direction of movement of the carrier plate, and the contacts of this switch are connected to winding 184 of the solenoid. When this switch is closed by engagement of the switch operating member 192 by arm 40 the winding 184 is energized to move plunger 182 downwardly into engagement with a spring which has been received in a hole 10 in the carrier plate.

In the operation of this embodiment of the invention, the arms 40 and 160 move in an oscillatory manner about shaft 14, being moved in this way by the means described above in connection with the movement of arm 40 in other embodiments of the invention. When the two arms reach the limit of movement in the direction opposite to the movement of the carrier plate, arm 40 engages switch operator 192, closing switch 190 and energizing solenoid winding 184. This extends the solenoid plunger 182 causing it to engage a spring which has passed from tube 6 to a hole in the carrier plate. A time delay relay 194 in this circuit holds the plunger in depressed or extended position, compressing the engaged spring to solid condition, during subsequent movement of the arms 40 and 160 with the carrier plate. When arm 160 engages the operator 188 of switch 186 at the limit of movement of arms 40 and 160 in the direction of movement of the carrier plate the time delay relay 194 is de-energized and solenoid winding 183 is energized to retract the plunger 182 from engagement with the spring. Arms 40 and 160 are now moved in the direction opposite to the movement of the carrier plate, by the means described above, until switch contact member 192 is again engaged to cause depression of the plunger into engagement with the next spring delivered to the carrier plate, after which the cycle of operation is repeated.

It may be desirable to set out the springs after grinding, rather than before grinding, and the arrangement of parts to effect this is shown in FIG. 8, which illustrates in schematic manner carrier plate 8, the grinding machine C, the arm 40 which carries the tube 6 leading from the coiler, the arm 160 which carries the set out cylinder 180 and which is connected to arm 40 by link 162. In this embodiment of the invention arm 160 is positioned between arm 40 and the grinding wheels and on the output side of the grinding wheels and is rigidly connected to arm 40 in that position. Switch 190 is positioned adjacent the limit of movement of arm 40 in the direction opposite to the direction of movement of the carrier plate and is operable when engaged by arm 40 to energize one winding of the set out cylinder 180 to move the plunger of the solenoid into engagement with a ground spring within a hole 10 in the carrier plate. Switch 186 is positioned adjacent the limit of movement of arm 160 in the direction of movement of the carrier plate and when arm 160 engages the operating member of this switch the other winding of solenoid 180 is energized to retract the solenoid plunger out of engagement with the spring.

Means are also provided by the invention for setting out springs both before and after grinding, and such means are disclosed in FIG. 9, in which there are illustrated the carrier plate 8, the grinding means C, the arm 40 which carries the tube 6 leading to the coiler. In this form of the invention two diametrically aligned arms 200, 202 are connected to arm 40 by rigid links 204, 206 and therefore move with arm 40 as a unit. Arm 202 is disposed between arm 40 and the input side of the grinding wheels and carries set out cylinder 208, while arm 200 is disposed between arm 40 and the output side of the grinding wheels and carries set out cylinder 210. Switch

190 is positioned adjacent the limit of movement of arm 40 in the direction opposite the direction of movement of the carrier plate and controls circuits including windings of solenoids 208 and 210 which when energized operate the plungers of these solenoids into engagement with springs in the holes in the carrier plate, the plunger of solenoid 208 engaging and compressing to solid condition a spring which has not yet been ground, and the plunger of solenoid 210 engaging and compressing to solid condition a spring in the carrier plate which has been ground. Switch 186 is positioned adjacent the limit of travel of arm 202 in the direction of movement of the carrier plate and controls circuits of the second windings of solenoids 208 and 210, whereby upon engagement of the operating member of this switch by arm 202 these windings will be energized to retract the solenoid plungers from engagement with the springs in the carrier plate. The arms 40, 200, 202 will then be moved in the direction opposite to the movement of the carrier plate by the means fully disclosed in connection with other embodiments of the invention, and when arm 40 reaches its limit of movement in this direction switch 190 will be closed to energize the appropriate windings of solenoids 208, 210 to move the plungers into engagement with the next springs delivered to the carrier plate, to repeat the cycle of operation.

It has been found in actual operation of the coiling grinding and setting-out machine provided by the invention that difficulty is sometimes encountered in the passage of coiled helical springs from the coiler to the grinding and setting-out machine, and means are therefore provided by the invention for facilitating such passage, thereby insuring that the tube or tubes leading from the coiler to the grinder do not become clogged with consequent possibility of damage to the machinery and with certainty of delay or break-down in operation. These means are shown in FIGS. 10 and 11 of the drawings, in which the numeral 300 designates the coiling machine A, the numeral 302 designates a spring which is partially coiled, the numeral 304 designates a tube leading from the coiling machine to the carrier B of the grinding machine and which may be a single tube, as in certain embodiments of the invention, or multiple tubes as illustrated in the embodiment disclosed in FIGS. 4, 5 and 6.

Interposed between the end of the tube 304 which is between the coiling point and the upper end of tube 304 is an auxiliary tube 306 (which may be an integral part of the tube 304) having an internal diameter equal to that of tube 304 and being connected at its one end to tube 304. At its other end tube 306 is positioned adjacent the coiling point to receive springs being coiled there, and it will be noted that in FIG. 10 of the drawings partially wound spring 302 is about to enter the intake end of tube 306 while a fully wound spring 308 is positioned within the tube. A supporting member generally designated at 210 is supported at 312 on the coiling machine and has a part 314 which surrounds tube 306 to support it in the described position with respect to the coiling point and tube 304.

Means are provided by the invention for moving springs along the length of tube 306 in order to insure that coiled springs will pass into the tube 304 and through that tube to the carrier of the grinding machine. Such means comprise, first, a slot 320 which is formed in the wall of tube 306 and extends entirely therethrough, as most clearly shown in FIG. 11. A wheel 322 which is mounted on the shaft 324 of electric motor 326, which is carried by the coiling machine frame, has its periphery extending through slot 320 to a sufficient extent to firmly engage the outer periphery of a spring which has been coiled at the coiling point and is within the tube 306 at or adjacent the intake end thereof. The periphery of the wheel may be faced with rubber, wire, bristles or any other suitable material which will engage the periphery of the spring and positively move it along tube 306 to the entrance end of

tube 304. It is not believed that any additional description of this apparatus or its operation is required.

While I have described and illustrated a number of embodiments of my invention, it will be understood by those skilled in the art that other embodiments, as well as modifications of those disclosed, may be made and practiced without departing in any way from the spirit or scope of the invention, for the limits of which reference must be made to the appended claims.

What is claimed is:

1. In combination, a machine for coiling wire into helical form and cutting it to length to make separate helical springs, and opposed grinding wheels for grinding the ends of springs passed between them, a rotatable spring carrier having a part movable in an endless path of which a part lies between the opposed surfaces of the grinding wheels, said part of the carrier having a plurality of annularly spaced means for receiving separate springs each in a position to have its ends ground by the grinding wheels as said part passes between the grinding wheels, and means for separately passing each spring produced by the spring making machine directly from the machine to one of the spring receiving means in the carrier.

2. In combination, a machine for coiling wire into helical form and cutting it to length to make separate helical springs, and opposed grinding wheels for grinding the ends of springs passed between them, a rotatable spring carrier having a part movable in an endless path of which a part lies between the opposed grinding wheels, said part of the carrier having a plurality of annularly spaced means for receiving separate springs each in position to have its ends ground by the grinding wheels as said part passes between the grinding wheels, a conduit for passing springs produced by the spring making machine directly from the machine to a point closely adjacent said part of the carrier, and means for intermittently moving said conduit with the carrier to permit a spring to pass from the conduit to one of the spring receiving means of the carrier.

3. In combination, a machine for coiling wire into helical form and cutting to length to make separate helical springs, and opposed grinding wheels for grinding the ends of springs passed between them, a rotatable spring carrier having a part movable in an endless path of which a part lies between the opposed grinding wheels, said part of the carrier having a plurality of annularly spaced means for receiving separate springs each in position to have its ends ground by the grinding wheels as said part passes between the grinding wheels, a conduit for passing springs produced by the spring making machine directly from the machine to a point closely adjacent said part of the carrier, means for continuously rotating said carrier, and means for intermittently moving said conduit with the carrier to permit a spring to pass from the conduit to one of the spring receiving means of the carrier.

4. In combination, a machine for coiling wire into helical form and cutting it to length to make separate helical springs, and opposed grinding wheels for grinding the ends of springs passed between them, a rotatable spring carrier having a part movable in an endless path of which a part lies between the opposed grinding wheels, said part of the carrier having a plurality of annularly spaced means for receiving separate springs each in position to have its ends ground by the grinding wheels as said part passes between the grinding wheels, a conduit for passing springs produced by the spring making machine directly from the machine to a point closely adjacent said part of the carrier, means for continuously rotating said carrier, means for intermittently moving said conduit with the carrier to permit a spring to pass from the conduit to one of the spring receiving means of the carrier, and means for moving the conduit in a direction opposite to the direction of rotation of the carrier after each intermittent movement of the conduit with the carrier.

5. The invention according to claim 2, in which the means for rotating the carrier is operated by the spring making machine.

6. In combination, a machine for coiling wire into helical form and cutting it to length to make separate helical springs, and opposed grinding wheels for grinding the ends of springs passed between them, a rotatable spring carrier having a part movable in an endless path of which a part lies between the opposed grinding wheels, said part of the carrier having a circular series of holes therethrough each of which is adapted to receive a spring in position to have its ends ground by the grinding wheels as said part passes between the grinding wheels, a tube leading from the spring making machine to a point above the circular series of holes in the carrier for supplying springs to the carrier, means for intermittently moving the tube in the direction of movement of the carrier and above and in vertical alignment with one of said holes through a part of the rotary movement of the carrier to permit a spring to pass from the tube to said hole, and means for moving the tube in a direction opposite to the direction of movement of the carrier after a spring has passed from the tube to the carrier.

7. In combination, a machine for coiling wire into helical form and cutting it to length to make separate helical springs, opposed grinding wheels for grinding the ends of springs passed between them, a rotatable spring carrier having a part movable in an endless path of which a part lies between the opposed grinding wheels, said part of the carrier having a circular series of holes therethrough each of which is adapted to receive a spring in position to have its ends ground by the grinding wheels as said part passes between the grinding wheels, a tube leading from the spring making machine to a point above the circular series of holes in the carrier for supplying springs to the carrier, and means intermittently operable for connecting the tube to the carrier and, from its normal position, moving it with the carrier during a small arc of rotation of the carrier with its end positioned vertically above one of the holes in the carrier to permit a spring to pass from the tube to the hole, and means operable at the end of said arc of movement for releasing the tube from the carrier and returning it to its normal position.

8. In combination, a machine for coiling wire into helical form and cutting it to length to make separate helical springs, and opposed grinding wheels for grinding the ends of springs passed between them, a rotatable spring carrier having a part movable in an endless path of which a part lies between the opposed surfaces of the grinding wheels, said part of the carrier having a plurality of annularly spaced means for receiving separate springs each in a position to have its ends ground by the grinding wheels as said part passes between the grinding wheels, means for continuously exerting a rotating force on the carrier to cause it normally to rotate, guiding means leading from the spring making machine to a fixed location adjacent the carrier from which springs may be supplied to the carrier, and means for intermittently stopping rotation of the carrier to permit a spring to pass from guiding means to the carrier.

9. In combination, a machine for coiling wire into helical form and cutting it to length to make separate helical springs, and opposed grinding wheels for grinding the ends of springs passed between them, a rotatable spring carrier having a part movable in an endless path of which a part lies between the opposed surfaces of the grinding wheels, said part of the carrier having a plurality of annular rows of spaced means for receiving separate springs each in a position to have its ends ground by the grinding wheels as said part passes between the grinding wheels, and a plurality of means for separately passing springs produced by the spring making machine directly from the machine to one of the spring receiving means in the carrier.

10. In combination, a machine for coiling wire into helical form and cutting it to length to make separate helical springs, and opposed grinding wheels for grinding the ends of springs passed between them, a rotatable spring carrier having a part movable in an endless path of which a part lies between the opposed grinding wheels, said part of the carrier having a plurality of annular rows of spaced means for receiving separate springs each in position to have its ends ground by the grinding wheels as said part passes between the grinding wheels, a plurality of conduits for passing springs produced by the spring making machine directly from the machine to points closely adjacent said annular rows of spring receiving means, and means for intermittently moving said conduits with the carrier to permit a spring to pass from each conduit to one of the spring receiving means of the carrier.

11. In combination, a machine for coiling wire into helical form and cutting it to length to make separate helical springs, and opposed grinding wheels for grinding the ends of springs passed between them, a rotatable spring carrier having a part movable in an endless path of which a part lies between the opposed grinding wheels, said part of the carrier having a plurality of annular rows of annularly spaced means for receiving separate springs each in position to have its ends ground by the grinding wheels as said part passes between the grinding wheels, a plurality of conduits each leading from the spring making machine to a point closely adjacent one of said annular rows of spring receiving means in the carrier, means for continuously rotating the carrier, and means for intermittently moving the conduits with the carrier to permit a spring to pass from each conduit to one of the spring receiving means of the carrier.

12. In combination, a machine for coiling wire into helical form and cutting it to length to make separate helical springs, and opposed grinding wheels for grinding the ends of springs passed between them, a rotatable spring carrier movable in an endless path of which a part lies between the opposed grinding wheels, said part of the carrier having a plurality of annular rows of annularly spaced means for receiving separate springs each in position to have its ends ground by the grinding wheels as said part passes between the grinding wheels, a plurality of conduits each leading from the spring making machine to a point closely adjacent one of said annular rows of spring receiving means in the carrier, means for continuously rotating the carrier, means for intermittently moving the conduits with the carrier to permit a spring to pass from one of the conduits to one of the spring receiving means of the carrier, and means for moving the conduits in a direction opposite to the direction of rotation of the carrier after each intermittent movement of the conduits with the carrier.

13. In combination, a machine for coiling wire into helical form and cutting it to length to make separate helical springs, and opposed grinding wheels for grinding the ends of springs passed between them, a rotatable spring carrier having a part movable in an endless path of which a part lies between the opposed grinding wheels, said part of the carrier having a plurality of circular series of holes therethrough each of which holes is adapted to receive a spring in position to have its ends ground by the grinding wheels as said part passes between the grinding wheels, a plurality of tubes each leading from the spring making machine to a point above one of the circular series of holes in the carrier for supplying springs to the holes of that series, means for intermittently moving the tubes in the direction of movement of the carrier and above and in vertical alignment with the series of holes through a part of the rotary movement of the carrier to permit a spring to pass from at least one of the tubes to the hole, below it means for moving the tubes in a direction opposite to the direction of movement of the carrier after

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a spring has passed from a tube to the carrier, and means for successively moving the ends of the tubes adjacent the spring making machine into position to receive a spring from the machine.

14. In combination, a machine for coiling wire into helical form and cutting it to length to make separate helical springs, opposed grinding wheels for grinding the ends of springs passed between them, a rotatable spring carrier having a part movable in an endless path of which a part lies between the opposed grinding wheels, said part of the carrier having a plurality of concentric circular series of holes therethrough each of which holes is adapted to receive a spring in position to have its ends ground by the grinding wheels as said part passes between the grinding wheels, a plurality of tubes each leading from the spring making machine to a point above one of the circular series of holes in the carrier for supplying springs to the holes of that series, means intermittently operable for connecting the tubes to the carrier and, from their normal position, moving them with the carrier during a small arc of rotation of the carrier with the end of each tube positioned vertically above one of the holes in the carrier to permit a spring to pass from the tube to the hole, and means operable at the end of said arc of movement for releasing the tubes from the carrier and returning them to their normal positions.

15. The machine according to claim 1 comprising, in addition, means for compressing each spring received in one of the spring receiving means in the carrier and holding it in a compressed state during a part of the movement of the carrier which is not between the opposed surfaces of the grinding wheels.

16. The machine according to claim 1 comprising, in addition, means for compressing and holding in a compressed state, during a part of the movement of the carrier in its endless path but before it passes between the opposed surfaces of the grinding wheels, each spring received in one of the spring receiving means in the carrier.

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17. The machine according to claim 1 comprising, in addition, means for compressing each spring received in one of the spring receiving means in the carrier and holding it in a compressed state during a part of the movement of the carrier in its endless path after it passes between the opposed surfaces of the grinding wheels.

18. The machine according to claim 1 comprising, in addition, means for compressing each spring and holding it in a compressed state during part of the movement of the carrier in its endless path but before it passes between the opposed surfaces of the grinding wheels, and means for compressing each spring and holding it in a compressed state during part of the movement of the carrier in its endless path after it passes between the opposed surfaces of the grinding wheels.

19. The machine according to claim 1, in which the means for passing each spring from the coiling machine to the carrier comprises a tube, and means associated with the tube for engaging each spring within the tube and moving it along the tube.

20. The machine according to claim 1, in which the means for passing each spring from the coiling machine to the carrier comprises a tube, a slot in the wall of the tube extending entirely therethrough, a wheel having its peripheral part within the slot to engage a spring within the tube, and means for rotating the wheel in a direction to move a spring within the tube from the coiler to the carrier of the grinding machine.

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