Oct. 13, 1931. K. WILLIAMS 1,827,056

COILING MACHINE

Filed July 3, 1929 8 Sheets-Sheet 1

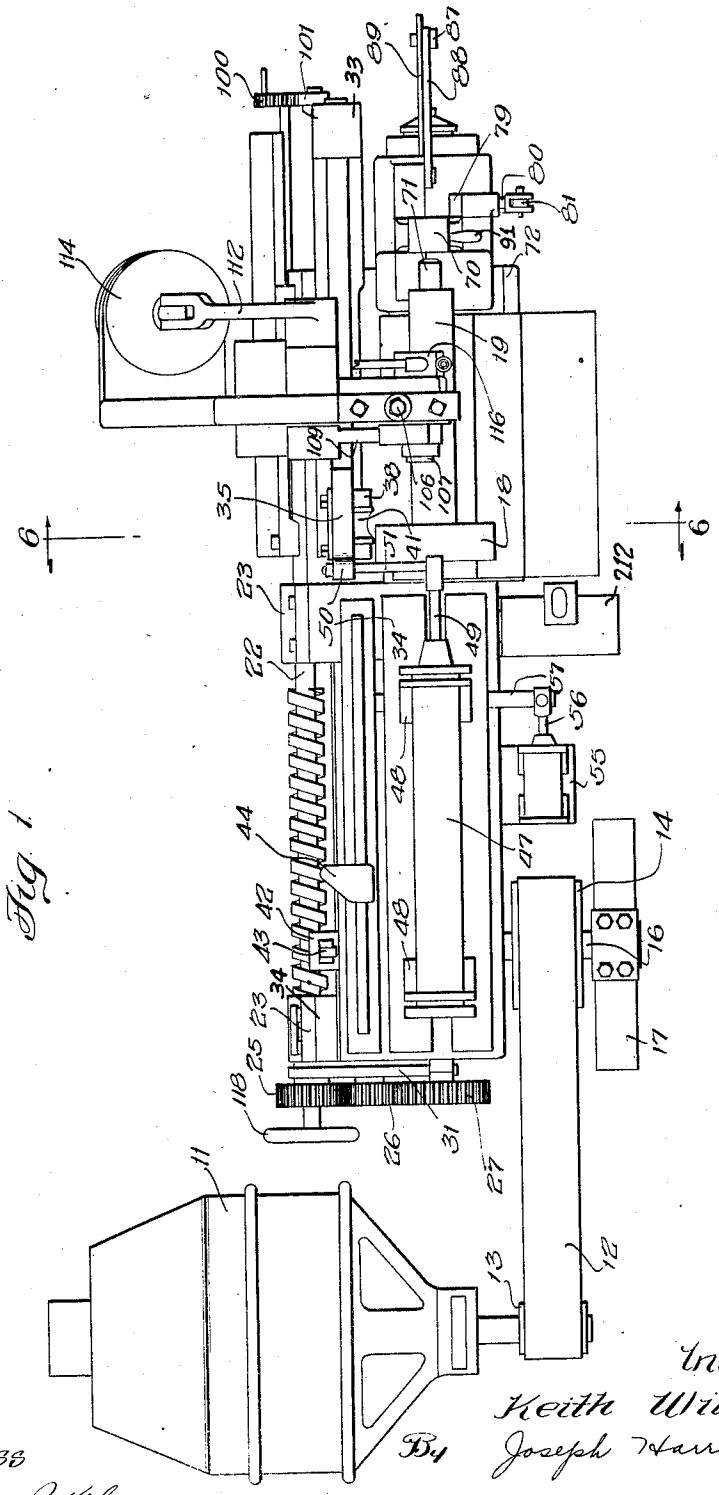


Fig. 1

Witness
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COILING MACHINE

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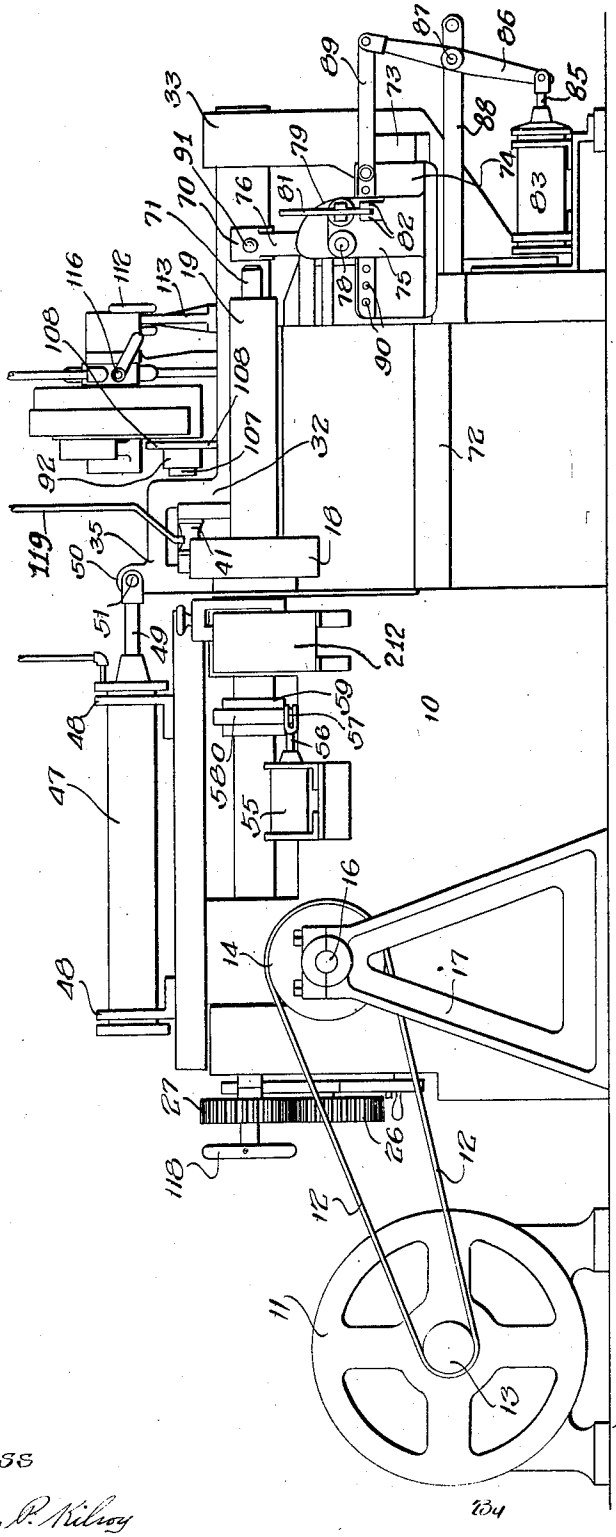


Fig. 2.

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COILING MACHINE

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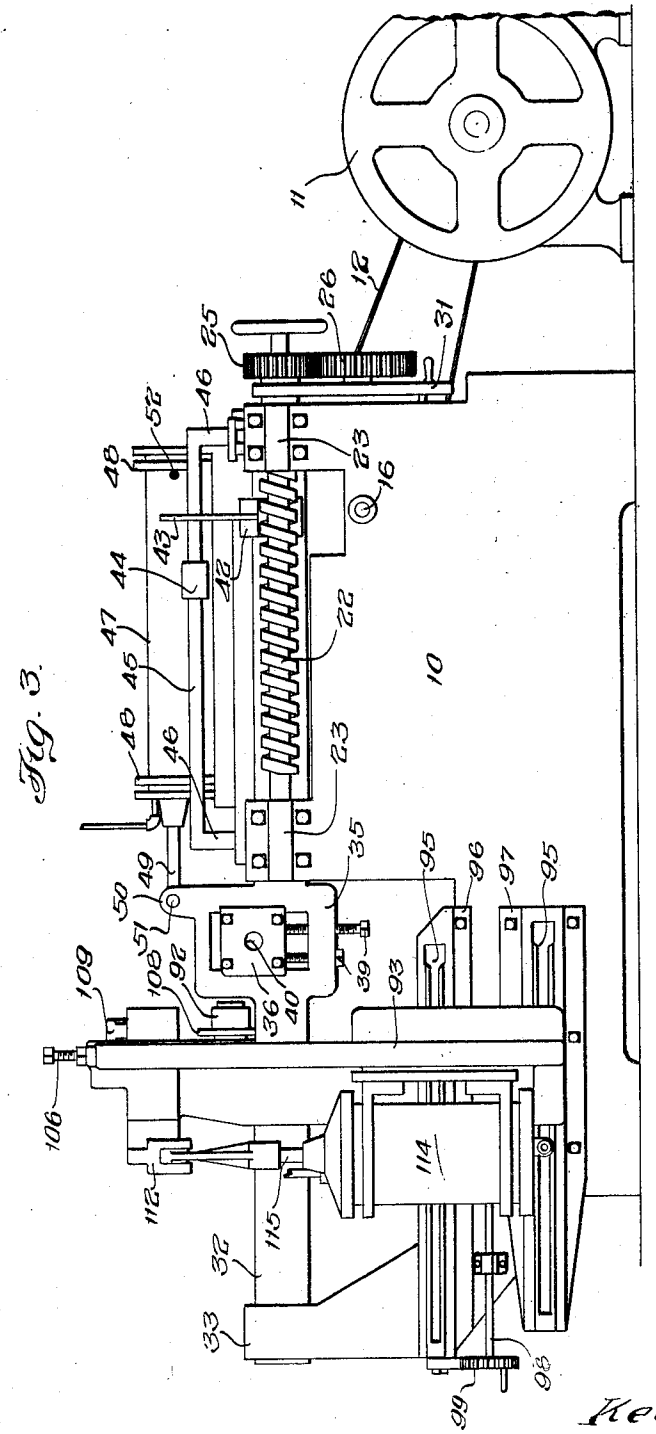


Fig. 3.

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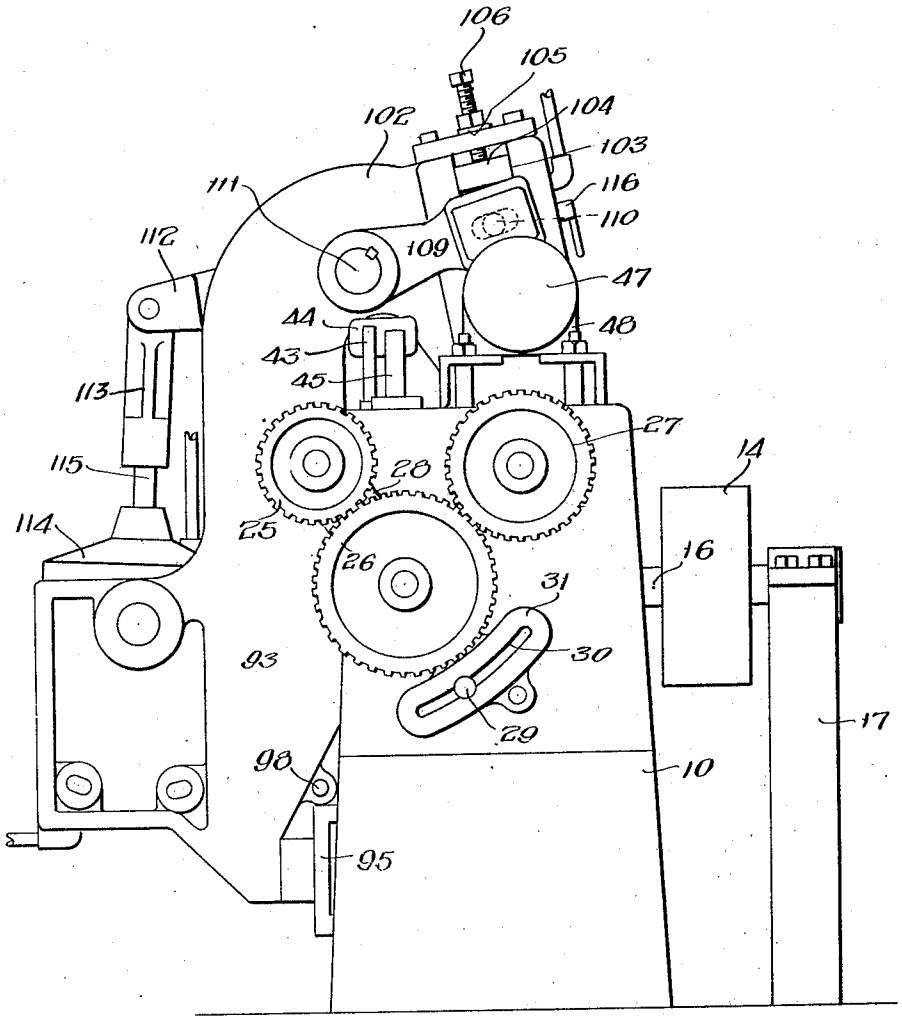
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Oct. 13, 1931. K. WILLIAMS 1,827,056

COILING MACHINE

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Fig. 4.



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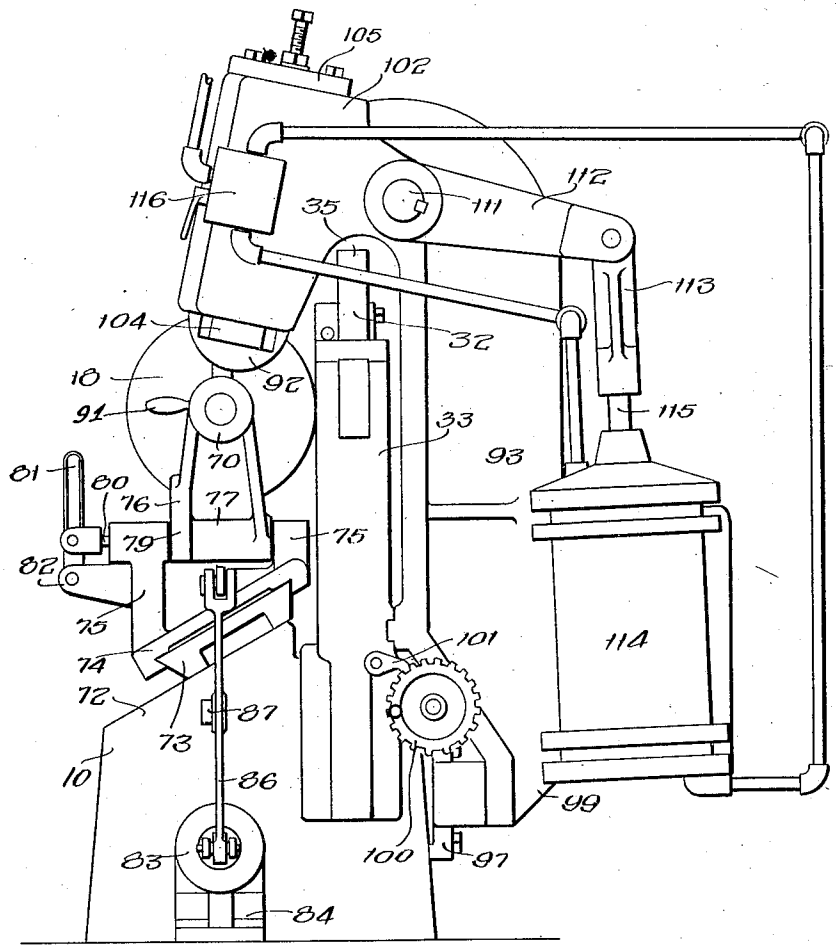
Witness
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Oct. 13, 1931. K. WILLIAMS 1,827,056

COILING MACHINE

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Fig. 5.



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COILING MACHINE

Filed July 3, 1929 8 Sheets-Sheet 6

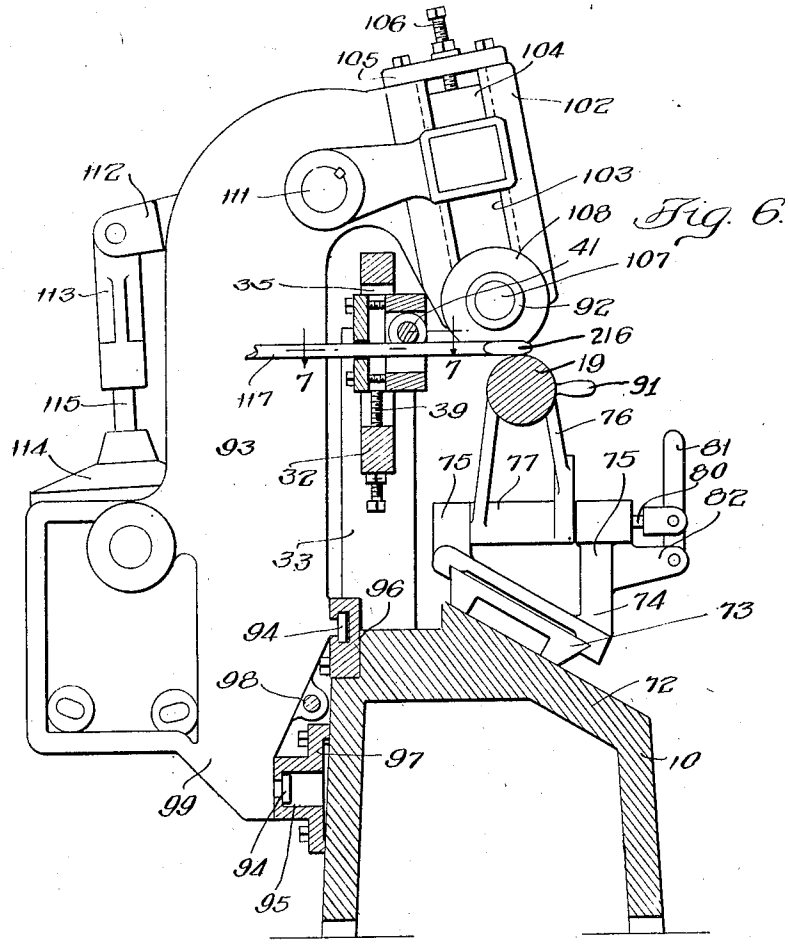
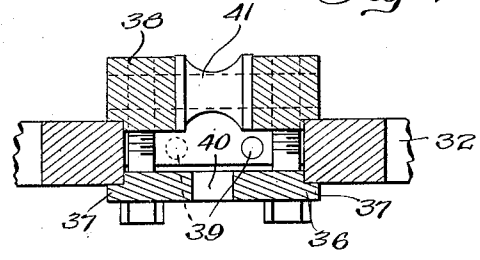


Fig. 6.

Fig 7



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COILING MACHINE

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Fig. 8.

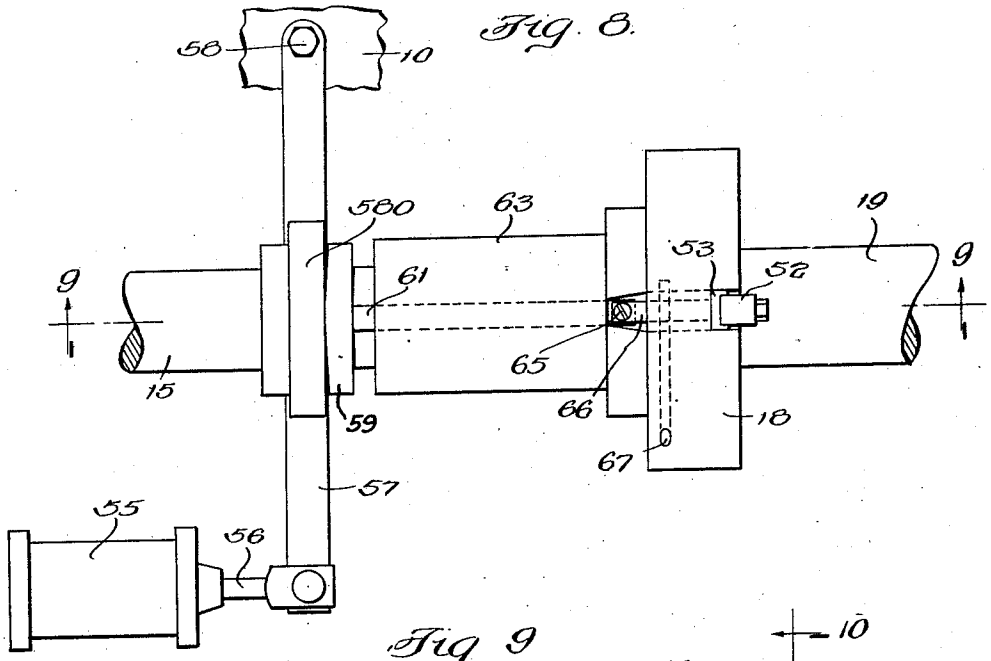


Fig 9

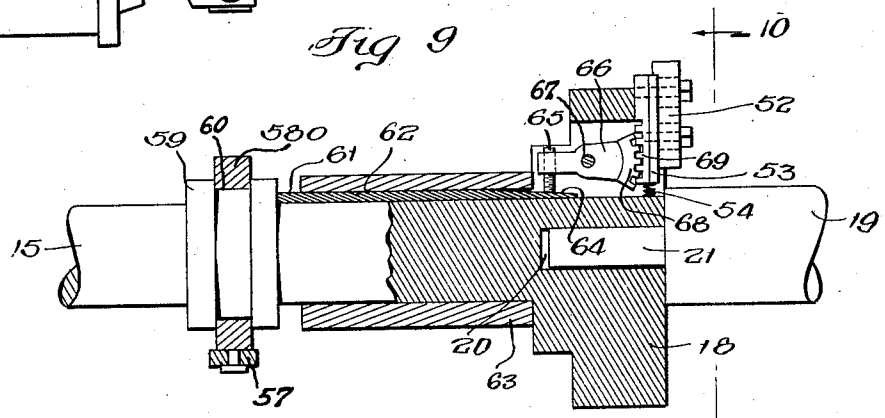
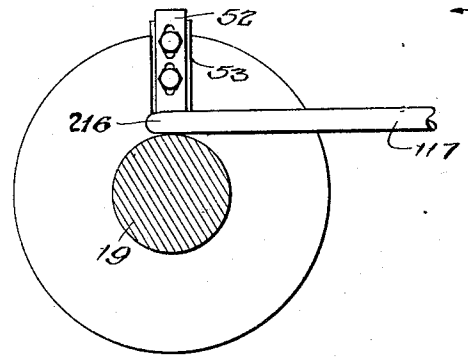


Fig. 10.



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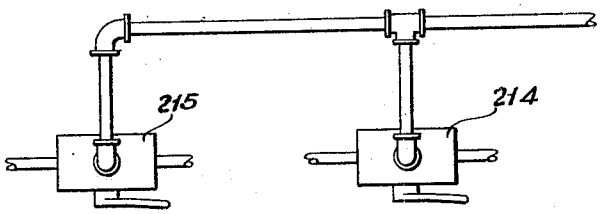
Witness
William P. Kilroy

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COILING MACHINE

Filed July 3, 1929 8 Sheets-Sheet 8

Fig. 11.



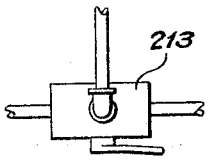


Fig. 15.

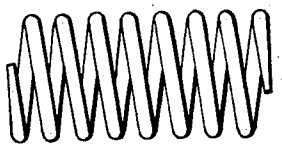


Fig. 13.

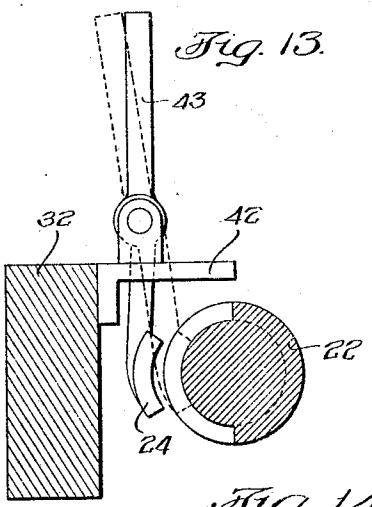


Fig. 12.

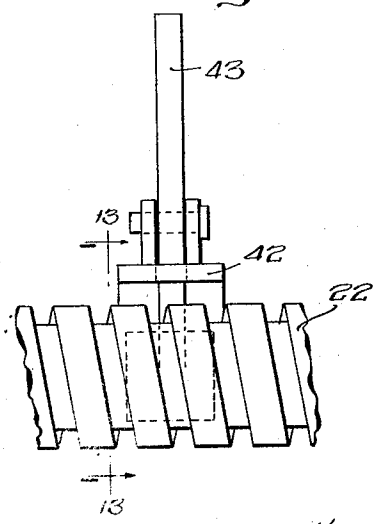
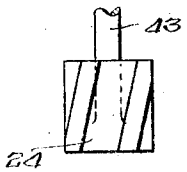


Fig. 14.



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UNITED STATES PATENT OFFICE

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COILING MACHINE

Application filed July 3, 1929. Serial No. 375,622.

This invention relates to improvements in coiling machines especially designed for producing helical springs.

One object of the invention is to provide an efficient spring-coiling machine so designed as to operate at high speed, thereby providing maximum capacity.

Another object of the invention is to provide a spring-coiling machine, including a rotary mandrel on which the material is coiled, together with bearing means for supporting the free end of the mandrel, wherein the bearing means is disengageable from the mandrel so as to clear the end of the same, thus permitting ready withdrawal or stripping of the finished coil spring from the mandrel.

A further object of the invention is to provide a coiling machine of the character indicated for forming helical springs from bar material, including a rotary coiling mandrel, means for guiding to the mandrel the bar from which the spring is formed, means for feeding the guide member lengthwise of the mandrel while the bar is wound on the same, together with fluid-operated means for quickly returning the guide to its initial position after the completion of each coiling operation.

Another object of the invention is to provide a machine for coiling springs, including a rotary mandrel on which a bar is coiled to helical form, together with means for clamping the leading end of the bar to the mandrel, wherein the clamping means is operated by fluid pressure to quickly and effectively clamp the end of the bar to the mandrel.

A still further object of the invention is to provide a coiling machine including a rotary coiling mandrel on which a bar is wound to helical form, wherein means in the form of a power-operated roller is provided for pressing the end of the bar as it leaves the guiding die, into intimate contact with the mandrel to properly shape the end of the coil.

Yet another object of the invention is to provide means of the character indicated in the preceding paragraph wherein the roller is provided with means for squaring the end of the coil so that the end face thereof is disposed at substantially right angles to the axis of the coil.

A further object of the invention is to provide a coiling machine including a rotary mandrel on which a helically coiled spring is formed and a breakdown roller cooperating with the mandrel, wherein the roller is moved toward and away from the mandrel by fluid-operated means.

Another object of the invention is to provide a mechanism for forming coiled springs from bar material, including a rotary coiling mandrel and a breakdown roller cooperating with the mandrel, wherein the roller is reciprocably mounted on a support adjustable lengthwise of the mandrel to different fixed positions to dispose the roller in proper operative relation to cooperate with springs of different lengths.

A still further object of the invention is to provide a mechanism including a rotary coiling mandrel permanently supported at one end and having a movable bearing support cooperating with the other end thereof, whereby the bearing member is retractable to disengage the same from the end of the mandrel, the bearing member being swingable to a position out of line with the mandrel so as to entirely clear the same and permit quick stripping of the finished coil spring therefrom.

A further object of the invention is to provide a bearing support for the free end of the rotary mandrel of a coiling machine, wherein the bearing support is retracted by fluid-operated means so as to disengage the same from the end of the mandrel.

Another object of the invention is to provide a machine for coiling springs, including a rotary mandrel on which the coils are formed, fluid-operated means for clamping to the mandrel the leading end of the bar from which the spring coil is formed, a bearing support for the free end of the mandrel, fluid-operated means for moving the bearing into supporting relation with the mandrel and disengaging the same therefrom, a guiding member movable lengthwise of the mandrel for feeding the bar to the same, fluid-operated means for returning the guide to initial

position after the completion of each coiling operation, and a fluid-operated breakdown roller for finishing the end of the coil, wherein all of the fluid-operated means are under the direct control of the machine attendants.

Other objects of the invention will more clearly appear from the description and claims hereinafter following.

In the drawings, forming a part of this specification, Figure 1 is a top plan view of a coiling machine illustrating my improvements in connection therewith. Figure 2 is a front elevational view of the machine illustrated in Figure 1. Figure 3 is a rear elevational view thereof. Figure 4 is an end elevation of the machine shown in Figure 1, looking from the left in said figure. Figure 5 is an end elevational view of the machine illustrated in Figure 1, looking from the right. Figure 6 is a vertical, transverse, sectional view corresponding substantially to the line 6—6 of Figure 1. Figure 7 is a horizontal, sectional view of the guide means for the bar material, corresponding substantially to the line 7—7 of Figure 6. Figure 8 is a top plan view of the clamping means of my improved mechanism, together with the operating means therefor and associated parts of the machine. Figure 9 is a longitudinal, sectional view corresponding substantially to the line 9—9 of Figure 8. Figure 10 is a vertical, sectional view corresponding substantially to the line 10—10 of Figure 9. Figure 11 is a diagrammatic plan view of certain control valves of my improved mechanism. Figure 12 is a view of the feed screw of the mechanism, partly broken away, illustrating the cooperating feed nut in connection therewith. Figure 13 is a transverse, vertical, sectional view corresponding substantially to the line 13—13 of Figure 12. Figure 14 is a detailed view of the feed nut which cooperates with the screw, which effects feeding of the guide means. And Figure 15 is a plan view of the finished article formed by my improved mechanism.

My improved coiling machine is of that type wherein the springs are formed from bar material which is coiled or wound about a rotary mandrel so as to form a spiral member. A machine of this type is illustrated in the drawings and comprises a supporting frame 10 on which the operating mechanism of the machine is carried. In the present instance, the coiling machine is illustrated as driven by an electric motor 11, which is mounted on the floor adjacent the machine and is operatively connected thereto in any well-known manner, the same being herein shown as provided with a driving belt 12 cooperating with a drive pulley 13 on the electric motor and a pulley 14 of the coiling machine.

In carrying out my invention, I provide a cylindrical mandrel drive shaft 15 which is suitably journaled in bearings of the framework 10. The shaft 15 is rotated by suitable drive gearing driven from the pulley 14. As shown, the pulley 14 is mounted on a transverse shaft 16 journaled in the framework 10 of the machine and extending through the same and having one end rotatably supported in the bearing member of a supporting pedestal 17 at the front side of the coiling machine. Driving gearing of any suitable character to produce rotation of the shaft 15 in the proper direction is interposed between the same and the shaft 16. At the outer end, the shaft 15 carries a chuck 18 which is rotatable in unison therewith. The coiling mandrel of the machine, which is indicated by 19, is connected at one end to the chuck 18 in operative relation as more clearly shown in Figures 8 and 9. As shown in these figures, the chuck 18 is provided with a bore 20 adapted to receive an extension 21 at the inner end of the mandrel. As will be evident, the mandrel 19 is thus detachable and different diameters of mandrels may be applied to the chuck so that the machine may be employed to produce helical springs of various diameters.

As most clearly shown in Figures 1 and 3, a feed screw 22 is rotatably mounted at the rear of the frame 10 of the machine, the feed screw having its opposite ends journaled in bearing members 23—23 fixed to the frame 10. As most clearly shown in Figures 1, 3, 12, 13 and 14, the feed screw 22 is provided with spiral threads which cooperate with a feed nut 24 for a purpose hereinafter more fully pointed out. At the left hand end of the machine, as shown in Figure 1, the cylindrical bearing portion of the feed screw 22 extends outwardly beyond the bearing member 23 and has a driving gear 25 fixed thereto. The driving gear 25 meshes with an idler gear 26 which in turn meshes with the gear 27 driven in any suitable manner from the drive shaft 16. The feed screw 22 is employed to effect feeding of the bar material lengthwise of the mandrel during the coiling operation so as to form a helical spring of the desired pitch. In order to vary the rate at which the bar being coiled is fed lengthwise of the mandrel during the coiling operation, the speed of rotation of the screw 22 with respect to the mandrel is altered. In the present instance, the idler gear 26 is shown as mounted on a swinging arm 28 which has a portion pivotally supported on the shaft of the feed screw 22 and a lower extremity which is clamped to the frame 10 of the machine by a clamping member 29 extending through an arcuate slot 30 in a laterally enlarged section 31 at the bottom end of the arm 28. When it is desired to change the relative speed of rotation of the screw 22, a gear of different diameter is substituted for the gear 27 and the gear 26 adjusted so as to properly mesh with the same by swinging the arm 28 about the axis

of the shaft of the screw 22. After the parts have been adjusted, the arm 28 is clamped in position by the locking clamp member 29. The arrangement of the gearing between the drive shaft 16 and the screw 22 and between the drive shaft and the mandrel shaft 15 is such that the screw 22 which has a lefthand thread will be rotated in the same direction as the rotary movement of the mandrel shaft, to effect proper feeding movement of the carriage 32 hereinafter described.

The carriage 32 is supported for longitudinal movement in the framework 10 of the machine. The carriage 32 comprises an elongated beam-like member having sliding engagement in a support 33 at one end of the framework 10 of the machine and sliding engagement with a pair of supporting guide members 34—34 on the frame proper, one of the supports being mounted between the ends of the machine. Intermediate the ends, the carriage 32 is provided with an enlarged section 35 which forms a holder for a guiding die means for directing the bar material to the coiling mandrel 19. As shown, the enlarged section comprises a frame member of substantially rectangular outline shown more clearly in detail in Figures 3, 6 and 7. A die plate 36 is mounted on one side of the frame member 35 and has sliding engagement therewith. As shown, the die plate 36 is cut away on the inner face at opposite sides thereof to provide flange sections 37—37 which engage over the side edges of the opening in the frame 35. At the opposite side of the frame, a supporting block 38 cooperates with the side members thereof, the supporting block being cut away at opposite edges on the inner side thereof to provide offset guide faces which engage with the outer faces of the side members of the frame. As shown most clearly in Figures 6 and 7, the block 38 is secured to the plate 36 by means of cap screws extending through the plate and threaded into openings provided in the block 38. As will be evident, when the cap screws are tightened, the block 38 and the plate 36 will be securely clamped together, thereby holding the same rigidly to the guide frame 35. In order to provide for fine adjustment of the supporting block 38 and plate 36 vertically in the opening of the frame 35, adjusting screws 39 are employed. As shown in Figures 6 and 7, the plate 36 is provided with a central opening 40 through which the bar material is fed to the coiling mandrel 19. In order to hold down the bar during the coiling operation, a guide roller 41 is rotatably mounted within the bearing block 38, the guide roller being shown as provided with a concave guide groove which engages the bar, the groove being of such a width as to permit the necessary inclination of the bar with respect to the axis of the mandrel to form a spiral coil of predetermined pitch. The roller 41 is freely rotatable on the block 38 and as shown is supported by a stub shaft extending through the roller and having its opposite ends fixed in the block, the block being provided with a suitable opening of the proper size to accommodate the guide roller 41 and also permit passage of the bar material through the block underneath said roller.

The carriage 32 which carries the guide plate and roller 41 is moved lengthwise of the mandrel from right to left as viewed in Figures 1 and 2 by means of the left-threaded feed screw 22 during a coiling operation, while the mandrel is being rotated in a contra-clockwise direction, as viewed from the right in Figures 1 and 2. The nut 24 which cooperates with the feed screw is operatively connected to the carriage 32 in any suitable manner. The particular means for intermittently connecting the feed screw 22 in driving relation with the carriage 32 may be of any suitable type and the particular means enters into my invention only so far as it forms an element of the operative combination. In the present instance, the carriage 32 is shown as provided with a supporting block or arm 42 which carries the nut member 24. As shown, the member 24 is in the form of a partial nut having interior threads which are adapted to engage with the threads of the screw 22. As shown, the section 24 of the nut is connected to the bottom end of a pivoted lever 43 which is swingingly supported on the bracket 42 and has the upper arm thereof extending above the bracket where the same is accessible so that it may be manipulated by the operator to throw the partial nut 24 in engagement with the threads of the screw 22. As will be obvious, when the nut 24 is thus engaged with the screw 22, the carriage 32 will be fed lengthwise of the mandrel in an outward direction.

Means is provided for automatically disengaging the partial nut 24 from the screw 22 when the helical coil has been completed. For this purpose a stop block 44 having a cam face is mounted on top of the frame of the machine and cooperates with the handle end of the lever 43 to throw the nut 24 out of engagement with the screw 22. As shown in detail in the drawings, the member 44 is slidably supported on a horizontally disposed bar 45 extending lengthwise of the machine and mounted above the framework 10 of the same, being supported at opposite ends by vertical legs 46—46. The member 44 may be adjusted to any desired point along the bar 45 and clamped in such adjusted position by any suitable means such as a set screw or other clamping device extending through the block and engaging the bar. As will be evident, when the block 44 has been adjusted to a predetermined position, the lever 43 which travels with the carriage 32 will even-

tually engage the cam face of the block, thereby forcing the upper end of the lever to the right as shown in Figure 13 and disengaging the nut 24 at the bottom end thereof from the screw 22. Movement of the carriage will thus be immediately arrested. As will be evident, when the nut has been disengaged from the screw, the carriage is free to slide with reference to the frame of the machine. In order to effect quick return of the carriage to its initial position so that the spring coiling operation may be repeated, I provide means controlled separately from the other operating mechanism of the machine. In the present instance, the returning means is of the fluid-operated type. This means comprises a relatively long fluid cylinder 47 supported on top of the framework of the machine by suitable brackets 48—48 at opposite ends of the cylinder. The cylinder has the usual piston means therewithin, having a piston rod 49 connected to an upstanding lug 50 on the framework 35 of the carriage 32 by means of a transverse bar 51 having its opposite ends secured to the outer end of the piston rod and the lug 50. The cylinder 47 is provided with a vent opening 52 at the right hand end thereof as shown in Figure 3 to eliminate back pressure on the piston while the screw is feeding the carriage outwardly of the mandrel. The cylinder 47 is provided with valve means of any suitable character for supplying fluid pressure to move the piston in a direction to pull the piston rod 49 inwardly of the cylinder. As will be evident, when the piston is operated in this manner, the carriage 32 will be quickly pulled back to its initial operative position.

In forming springs from bar meterial, the material is wound about the mandrel 19 in spiral form, the leading end of the bar material being clamped to the mandrel before beginning the coiling operation. In order to tightly clamp the bar to the mandrel, I provide a clamping finger or jaw 52 which is slidably mounted for movement in a direction radially of the chuck 18 toward and away from the mandrel 19. The clamping finger 52 is preferably adjustably mounted on a slide 53 mounted in a guideway provided in the chuck 18. The slide 53 is yieldingly urged outwardly in the guide by means of a spring 54 interposed between an abutment face on the chuck 18 and the bottom end of the slide. The slide is reciprocated toward the mandrel 19 by fluid-operated means so as to quickly and tightly clamp the bar to the mandrel. This means comprises a cylinder 55 mounted on the base of the machine and having suitable pipe connections and a controlling valve associated therewith for controlling the fluid pressure in the cylinder. The cylinder 55 has the usual piston member associated therewith provided with a piston rod 56 pivotally connected at one end to a lever 57 which is pivotally supported at 58 on the framework of the machine. As shown, the lever 57 is connected intermediate its ends to a shifting collar 580 which cooperates with a sleeve 59 slidably mounted on the mandrel shaft 15. As shown, the lever 57 has a swiveled connection with the collar 580 and the collar engages in a guide groove 60 of the sleeve 59. The sleeve 59 has a slide 61 in the form of a bar fixed thereto, the slide being movable lengthwise in a guideway 62 formed in a sleeve portion 63 of the chuck 18. At the outer end, the bar 61 is provided with a beveled portion 64 which engages a screw 65 adjustably mounted in the free end portion of a rocking member 66 pivotally supported on a pin 67 mounted in the chuck 18. The rocking member 66 has an enlarged section 68 provided with teeth which cooperate with a rack 69 formed on the slide 53. As will be evident, when the sleeve 59 is moved to the right, as viewed in Figures 8 and 9, the slide 61 will be reciprocated, thereby raising the free end of the rocking member 66 and causing the slide 53 to move downwardly, carrying the clamping finger 52 therewith, thereby bringing the same into clamping relation with the mandrel 19. When the sleeve 59 is moved in the reverse direction to retract the slide 61, the screw 65 will ride downwardly on the beveled end portion of the slide, thereby permitting the spring 54 to return the slide 53 to its normal position, at the same time disengaging the clamping finger 52 from the work.

A supporting bearing member 70 is provided for the outer end of the mandrel so as to steady the same during the coiling operation. As most clearly shown in Figure 2, the outer end of the mandrel 19 is provided with a reduced bearing portion 71 which cooperates with the bearing member 70, the latter being provided with a suitable journal opening to receive the reduced section 71. The bearing member 70 is supported for sliding movement toward and away from the end of the mandrel 19. As shown in Figures 1, 2, 5 and 6, the supporting frame 10 of the machine is provided with an offset section 72 which forms a table portion on which a dovetail guide plate or block 73 is secured. A dovetail slide 74 cooperates with the guide 73 and carries upstanding bracket arms 75—75 between which is supported a standard 76. As shown, the standard 76 is provided with a pair of arms connected at the bottom end by a sleeve 77 through which a supporting pivot 78 extends, the pivot having its opposite ends mounted in the upper portions of the arms 75. The bearing proper which cooperates with the reduced end of the mandrel is at the upper end of the pedestal 76. As most

clearly shown in Figure 1, the pedestal 76 is provided with an offset weighted portion 79 at the bottom thereof, whereby the action of gravity will tend to swing the pedestal in a downward direction about the pivot 78. In order to support the pedestal in the vertical position with the bearing member 70 in alinement with the mandrel 19, a sliding latch 80 is provided which is actuated by a hand lever 81 pivotally secured at its bottom end to a pair of ears 82 projecting from one of the arms 75. As shown, the locking element 80 has a forked outer end between which the lever 81 extends, and a pin extends through said forked portion and the lever to operatively connect the parts. The locking pin 80 works in a guideway provided on the adjacent arm 75 of the slide and has the inner end thereof cooperating with a suitable locking opening provided on the offset weighted section 79 of the pedestal 76. As will be evident, when the pin 80 is withdrawn from engagement with the portion 79 of the pedestal by operation of the lever 81, the pedestal will immediately rock on its pivot due to the action of gravity, thereby swinging the bearing member 70 out of line with the mandrel 19.

Pneumatic means is provided for reciprocating the slide 74 and the parts carried thereby. As shown, a fluid cylinder 83 is supported on a bracket 84 immediately below the slide 74. The cylinder 83 has the usual piston cooperating therewith, which is provided with a piston rod 85 connected to the bottom end of a lever 86 pivotally supported between its ends on a pivot member 87 fixed to a supporting arm 88 projecting from the frame of the machine. The upper end of the lever 86 is pivotally connected to a bar or rod 89 at one end of the latter, the opposite end of the bar having an adjustable connection with the slide 74. As shown, the rod 89 is provided with a plurality of openings 90—90 to receive a connecting pivot member which is secured to the slide 74, the slide being provided with a single opening within which said connecting pivot member is secured. The openings 90 provide for adjustment of the slide with respect to the means for operating the same so as to position the bearing member 70 properly for mandrels of different lengths. The fluid cylinder 83 is controlled by valve mechanism of any suitable type whereby the piston may be reciprocated under the control of the operator. When the piston is moved in a direction to project the piston rod 85 outwardly, the lever 86 and connecting bar 89 will cause the slide 74 to move to the left as seen in Figure 2, thereby engaging the bearing member 70 over the reduced end 71 of the mandrel. The mandrel is thus supported at both ends during the operative rotation thereof, while the spring is being coiled. When the coiling operation has been completed, the operator manipulates the control valve of the cylinder 83 so as to retract the piston rod 85, thereby moving the slide 74 to the right as viewed in Figure 2, and disengaging the same from the mandrel. Immediately upon disengaging the bearing member, the operator pulls the lever 81 outwardly, thereby unlatching the locking pin 80 from the pedestal and permitting the same to swing downwardly on the pivot 78 so that the bearing 70 will entirely clear the end of the mandrel to permit the stripping of the finished coil spring therefrom. The parts are restored to their initial operative position by manually raising the pedestal, the same being provided with a hand grip member 91 for conveniently operating the same. The operator swings the pedestal 76 to the vertical position shown in Figure 2 and then operates the lever 81 to engage the locking pin 80 with the enlarged section 79 of the pedestal to hold the same in the vertical position. Before the next coiling operation, the slide 74 is moved to its innermost position by means of a fluid operated cylinder and piston to engage the bearing 70 in supporting relation with the outer end of the mandrel.

To complete the forming of the end of the helical coil as the bar material leaves the guiding means, I provide means, under the control of the attendant, for pressing the bar material against the mandrel. This means is preferably so designed as to also effect squaring of the end of the coil. For this purpose I employ a pressing member in the form of a flanged breakdown roller 92 which is movable toward and away from the mandrel in a plane at right angles to the axis thereof. Suitable means is employed for operatively supporting the roller 92 and the same includes an adjustable standard 93 supported on the framework of the machine. The standard is provided with a base portion having inwardly extending spaced guide projections in the form of T-shaped heads 94—94 which engage within guideways 95—95 formed in castings 96 and 97 bolted to the side of the machine. The standard 93 is adjustable lengthwise of the machine by means of an adjusting screw 98 operated by a hand wheel 99, the screw having a ratchet member 100 thereon with which a locking dog 101 cooperates in order to hold the screw in locked position after the standard has been properly adjusted. As most clearly shown in Figures 1, 2 and 3, the standard is located so that the upper portion thereof overhangs the mandrel 19 inwardly of the end thereof. At the upper end the standard 93 is provided with a laterally projecting arm portion 102 having a guideway 103 formed therein for a slide 104 which is adapted to reciprocate vertically in said guideway in a direction radial to the mandrel. The upper end of the guideway 103 is

closed by a top plate 105 bolted to the same, the plate 105 having an adjusting screw 106 threaded therethrough and adapted to engage the top of the slide so as to limit the upward movement thereof. The breakdown roller 92 is supported at the bottom end of the slide 104 and is movable therewith. The roller 92 is mounted for free rotation on a stub shaft 107 fixed to the slide and extending laterally therefrom parallel to the mandrel. As most clearly shown in Figure 2, the roller 92 has an annular flange section 108 which is adapted to engage the outer end portion of the helical coil formed on the mandrel so as to dispose the edge of said coil in a plane substantially at right angles to the axis of the mandrel. An operating lever member 109 has a slot and pin connection 110 with the slide 104. As will be evident, when the lever 109 is oscillated, the slide 104 will be reciprocated, the slot and pin connection taking care of the relative lateral displacement of the parts during the operation. The lever 109 is keyed to a shaft 111 extending through the standard 102 and rotatably journaled therein. At the opposite end the shaft 111 has a lever 112 fixed thereto, the outer end of the lever being pivotally connected to a link 113. The lever 112 is oscillated by a fluid pressure controlled operating means including a fluid cylinder 114 secured to the side of the standard 93. The cylinder 114 has the usual piston member cooperating therewith, the piston having a piston rod 115 connected thereto which in turn is connected to the bottom end of the link 113 so that the link 113 will be reciprocated in unison with the piston and piston rod. The fluid pressure in the cylinder 114 is controlled by a valve 116 mounted on the arm portion 102 of the standard 93. The valve 116 has suitable pipe connections, as shown in Figure 5, which lead from the source of supply to the valve and from the valve to the opposite ends of the cylinder 114. As will be obvious, when the valve 116 is properly manipulated the piston rod is moved either inwardly or outwardly of the cylinder, depending upon the position of said valve. When it is desired to bring the breakdown roller 92 into engagement with the work on the mandrel, the valve 116 is manipulated so that the piston rod 115 will be moved upwardly, thereby swinging the lever 112 upwardly and the lever 109 downwardly, thereby forcing the slide downwardly along the guideway and bringing the roller 92 into engagement with the work. When the operation has been completed, the roller 92 is withdrawn by reversing the valve 116, causing the piston rod 115 to pull the lever 112 downwardly, raising the lever 109 and the slide 104 which carries the roller 92. As will be evident, when the standard 93 has been adjusted for a definite size of spring, the same remains in that position until a different size of spring is to be coiled by the machine. Adjustments are made for different sizes of coils by moving the standard lengthwise of the frame of the machine through the adjusting screw 98. After proper adjustment, the standard is locked in position by the dog which cooperates with the adjustment screw, as hereinbefore pointed out.

In order to control the starting and stopping of the machine, I mount a controller 212 for the electric motor 11 on the framework of the machine at a point convenient to the operator, as clearly shown in Figure 2.

The arrangement of controlling valves for operating the clamping jaw or finger of the chuck, the spindle or mandrel support and the means for returning the carriage 32 to its initial position is diagrammatically illustrated in Figure 11. In this figure, a controlling valve 213 is shown which communicates with the clamping jaw operating cylinder 55, a controlling valve 214 which communicates with the cylinder 83 for operating the bearing support for the end of the mandrel 19, and a controlling valve 215 which communicates with the cylinder 47 for returning the slide 32. The controlling valves 213, 214 and 215 are of well-known type and need no further description, they being so designed that when the same are manipulated by the operator fluid pressure will be supplied to the proper end of the corresponding cylinder to reciprocate the piston and piston rod thereof in the desired direction. These controlling valves are not shown in the remaining views of the drawing to avoid confusion, it being understood that the same are located on the machine frame 10 all within easy reach of the operators of the machine.

In forming helically coiled springs with my improved machine, the bar material from which the coils are formed is supplied in definite lengths so as to provide the proper length of coil. These bars each have their opposite ends beveled before they are fed to the mandrel of the coiling machine and the beveled edge portions at opposite ends of the finished coil are brought into parallelism by the combined breakdown and finishing roller 92. The bars are fed to the machine while in relatively highly heated condition so that they will readily coil about the mandrel when guided thereto.

The operation of my improved coiling machine is as follows: The operator passes a length of heated bar through the opening of the guide member beneath the guide roller 41, bringing the beveled end 216 of the bar 117 into engagement with the top of the mandrel, immediately beneath the clamping finger or jaw 52. With the bar in this position, the valve 213 is operated to supply fluid pressure to the proper side of the clamp operating cylinder 55 to reciprocate the slide 61 and move

the clamping member 52 toward the mandrel, tightly gripping the leading end of the bar 117. The clamping member 52 is maintained in clamping relation with the mandrel throughout the spring coiling operation. In this connection, it is pointed out that when the coiling operation is to begin with the bar clamped to the mandrel as described, the free outer end of the mandrel 19 is supported by the bearing member 70, the same being in its innermost position. As will be evident, the mandrel is thus adequately supported for rotation at its opposite ends. Immediately after the bar has been clamped to the mandrel, the controlling switch 212 for the electric motor is operated to start the machine. At this time, the sectional nut 24 is in engagement with the threads of the screw 22. When the motor 11 is thrown into operation, the mandrel shaft together with the attached mandrel 19 will be rotated in a direction to wind the bar 117 thereon. As the mandrel is rotated, the feed screw 22 will be rotated in unison therewith, thereby feeding the nut 24 lengthwise outwardly of the mandrel and carrying the carriage 32 therewith. The guide roller 41 will thus be carried lengthwise of the mandrel at a uniform rate, thereby properly guiding the bar 117 to form a spiral coil of desired pitch about the mandrel 19. The machine attendant who has charge of the operation of the breakdown roller 92 operates the valve 116 when the coiling operation is practically completed, that is when the rear end of the bar leaves the guide roller 41. The valve 116 is operated in such a manner that the piston and attached piston rod 115 of the cylinder 114 will be moved outwardly, thereby oscillating the levers 112 and 109 to depress the roller 92 and bring the same into tight engagement with the rear end of the bar to force the same against the surface of the rotating mandrel. The flange 108 at this time engages the beveled end portion of the spring coil, thereby squaring the same with respect to the axis of said coil, that is bringing the end edge into a plane at right angles to the longitudinal axis of the coil to form the finished spring shown in Figure 15. When the coiling operation has been thus completed, the lever 43 engages the cam block 44, thereby automatically disengaging the sectional nut 24 from the screw feed and stopping movement of the carriage 32 and the guide roller 41 mounted thereon. At the same time the operator manipulates the control 212 for the motor to stop the same and arrest rotation of the mandrel 19. The valve 213 is then again operated so as to reverse the fluid pressure in the cylinder 55 and retract the operating wedge bar 61, thereby permitting the spring 54 of the clamp 52 to retract the same, thereby unclamping the end of the coil. The spindle support control valve 214 is then manipulated so as to operate the piston and piston rod 85 of the cylinder 83 to pull the supporting slide 74 outwardly away from the mandrel 19, thereby disengaging the bearing 70 from the reduced journal portion 71 of the mandrel. When the slide has been moved to approximately the position shown in Figure 2, the operator retracts the locking pin 80 by the lever 81, thereby permitting the pedestal on which the bearing 70 is mounted to swing downwardly through the action of gravity, out of line with the mandrel 19. As will be evident, the finished coil spring may then be readily stripped manually from the mandrel. In order to return the carriage 32 and the guide roller carried thereby to the initial position, the valve 215 is operated so as to supply fluid pressure to the cylinder 14 and pull the piston rod 49 thereof to the left as seen in Figure 2, thereby pulling the carriage 32 backwardly also through the medium of the connecting bar 51. After the carriage has been returned, the cylinder 14 is vented through the valve 215 so as to permit the feeding of the carriage by the screw 22. Preliminary to the succeeding coiling operation, the pedestal 76 is swung upwardly to the vertical position shown in Figure 2 and the locking pin 80 reengaged so as to maintain the pedestal in that position. The valve 214 is then manipulated to actuate the piston of the cylinder 83 in such a direction as to return the slide 74 to its innermost position wherein the bearing member 70 engages about the journal 71 of the mandrel. Before beginning the next coiling operation, the nut 24 is reengaged with the screw 22 by properly manipulating the lever 43. It is sometimes necessary to adjust the feed screw with respect to the nut so that the threads will interengage. A hand wheel 118 is provided for this purpose, the same being fixed to the outer end of the shaft of the screw 22. As will be evident upon rotation of the hand wheel the screw 22 will be rotated also, thereby bringing the threads of the screw into registration with the threads of the nut. With the parts adjusted as described, the coiling operation, as hereinbefore set forth, is repeated.

In this connection, it is pointed out that the lengths of bars from which the spiral springs are formed are fed to the mandrel in such a position that the faces of the beveled ends will be disposed vertically. When the leading end of a bar is clamped to the mandred in this position, the beveled end face of the bar will lie in flat face contact with the outer side of the chuck 18. Inasmuch as the flange 108 of the breakdown roller 92 is disposed in a plane parallel to the outer face of the chuck, the rear end of the bar will be brought to a position with the beveled face thereof parallel to the beveled face at the opposite end of the coil.

To prevent overheating of the chuck 18

and mandrel, a water jet 119 is preferably provided. This jet may be of any suitable type and is so positioned above the chuck so that the same may be sprayed, between coiling operations to cool the same and the mandrel before the next coiling operation.

From the preceding description taken in connection with the drawings, it will be evident that I have provided an exceedingly efficient spring coiling machine which may be operated at high capacity so as to produce the maximum number of springs in a given period of time. By providing fluid control means for returning the carriage to its initial position, for operating the supporting bearing from the end of the mandrel, for operating the breakdown roller and also for operating the clamping jaw, all of these mechanisms are instantaneously operated, thereby effecting a great saving in time. It is further pointed out that the different control valves of the machine may be operated simultaneously by different operators so that the return of the guide die carrying member, the operation of the supporting bearing for the end of the mandrel and the releasing of the clamping jaw may be effected simultaneously, thereby greatly speeding up the operation of the machine.

I have herein shown and described what I now consider the preferred manner of carrying out my invention, but the same is merely illustrative and I contemplate all changes and modifications that come within the scope of the claims appended hereto.

I claim:

1. In a machine for forming helical springs, having the free ends of the coils tapering, the combination with a rotary mandrel; of guiding means for feeding a bar having the opposite ends reversely beveled to the mandrel; means for continuously advancing said guiding means during the coiling operation; clamping means for clamping the work to the mandrel; a reciprocating breakdown roller for finishing the end of the coil spring, said roller having means thereon for squaring the end of the coil to dispose the outer face of the beveled portion parallel to the outer face of the beveled portion at the opposite end of the coil; and fluid-operated means for actuating said breakdown roller.

2. In a coiling machine for forming springs from bar material, the combination with a rotary mandrel on which the spring member is coiled; of guide means movable lengthwise of the mandrel for feeding a bar to the same; means for clamping the leading end of the bar; a movable bearing support for the free end of the mandrel; and fluid operated means for disengaging the bearing support from the end of the mandrel to permit stripping of the coil spring therefrom.

3. In a coiling machine for forming spring members from bars, the combination with a rotary mandrel; of a guide member movable lengthwise of the mandrel to feed the bar thereto; means for clamping the leading end of the bar to the mandrel; a supporting bearing for the free end of the mandrel; means for moving said supporting bearing to engage the same with and disengaging the same from the mandrel; a breakdown roller cooperating with the mandrel to finish the end of the coil; means for returning the guide member to initial position after each coiling operation; and fluid operated means for actuating said clamping means, said means for moving the supporting bearing, said breakdown roller, and said means for returning the guide member.

4. In a coiling machine for forming spring members from bars, the combination with a rotary mandrel; of a guide member movable lengthwise of the mandrel to feed the bar thereto; fluid-operated means for clamping the leading end of the bar to the mandrel; a supporting bearing for the free end of the mandrel; fluid-operated means for engaging said supporting bearing with and disengaging the same from the mandrel; fluid-operated breakdown roller means cooperating with the mandrel to finish the end of the spring being coiled; and fluid-operated means for returning the guide member to initial position after each coiling operation.

5. In a spring coiling machine for forming helically coiled springs from bars, the combination with a rotary mandrel on which the bar is coiled; of means cooperating with the mandrel for squaring the end of the coil while said mandrel is being rotated.

6. In a spring coiling machine for forming helically coiled springs from bars, the combination with a rotary mandrel on which said bar is coiled; of means for feeding the bar to the mandrel; and a reciprocating breakdown roller cooperating with the mandrel for finishing the end of the coil, said roller being reciprocably mounted on a fixed support.

7. In a spring coiling machine for forming helically coiled springs from bars, the combination with a rotary mandrel on which said bar is formed; of means for feeding the bar to the mandrel; a reciprocating breakdown roller cooperating with the mandrel, said roller being slidably mounted on a fixed support for movement toward and away from the mandrel; and means for adjusting said support lengthwise of the mandrel to operate on springs of different lengths.

8. In a machine for forming helically coiled springs from bar material, the combination with a rotary mandrel; of a chuck rotatable with the mandrel; a clamping element reciprocably mounted on said chuck; wedge actuated means for moving said clamping element toward the mandrel; spring means for returning the same; a fluid

cylinder; piston means cooperating with the cylinder for actuating the wedge means; and means for controlling the fluid pressure for operating said piston means.

9. In a machine for forming helically coiled springs, the combination with a rotary mandrel on which coiled spring members are formed, one end of said mandrel being operatively connected to means for rotating the same, said mandrel having a bearing portion at the opposite end thereof; a bearing member for receiving and rotatably supporting the other end of the mandrel; and fluid operated means for moving said bearing member out of engagement with the mandrel to permit withdrawal therefrom of the finished coil spring.

10. In a machine for forming helically coiled springs, the combination with a rotary mandrel; of means connected to one end of the mandrel for rotating the same; a sliding support; a bearing member pivotally mounted on said support and adapted to engage and support the outer end of the mandrel; means for moving said sliding support to disengage the same from the mandrel, said bearing member being swingable on its pivot when disengaged from the mandrel to a position out of line with the mandrel to permit stripping of the finished spring from the same.

11. In a machine for forming helically coiled springs, the combination with a rotary mandrel; of means connected to one end of the mandrel for supporting and rotating the same; a movable bearing engageable with the other end of the mandrel for rotatably supporting the same; and fluid operated means for reciprocating said bearing toward and away from the mandrel to respectively engage the same in supporting relation with the mandrel and disengage the same therefrom.

12. In a machine for forming helically coiled springs, the combination with a rotary mandrel; of means for rotating the mandrel; a support adjustable to different positions lengthwise of the mandrel; a breakdown roller on said support movable toward and away from the mandrel; a cylinder on said support; a fluid operated piston means cooperating with the cylinder; and means for operatively connecting the piston and roller for moving the latter toward the mandrel.

13. In a machine for forming helically coiled springs from bars having the opposite ends beveled, the combination with a rotary mandrel about which said bars are coiled; of a clamping chuck cooperating with the mandrel for gripping the leading end of each bar with the beveled face thereof engaging the outer face of the clamping chuck; and a breakdown roller cooperating with the opposite end of the bar being coiled on the mandrel, said roller having means thereon engaging the beveled end portion of the coil to dispose the beveled face thereof parallel to the beveled face at the leading end of the coil.

In witness that I claim the foregoing I have hereunto subscribed my name this 25th day of June, 1929.

KEITH WILLIAMS.