June 21, 1932. C. H. ZILER 1,863,916

WIRE SPRING MAKING MACHINE

Filed March 16, 1931 8 Sheets-Sheet 1

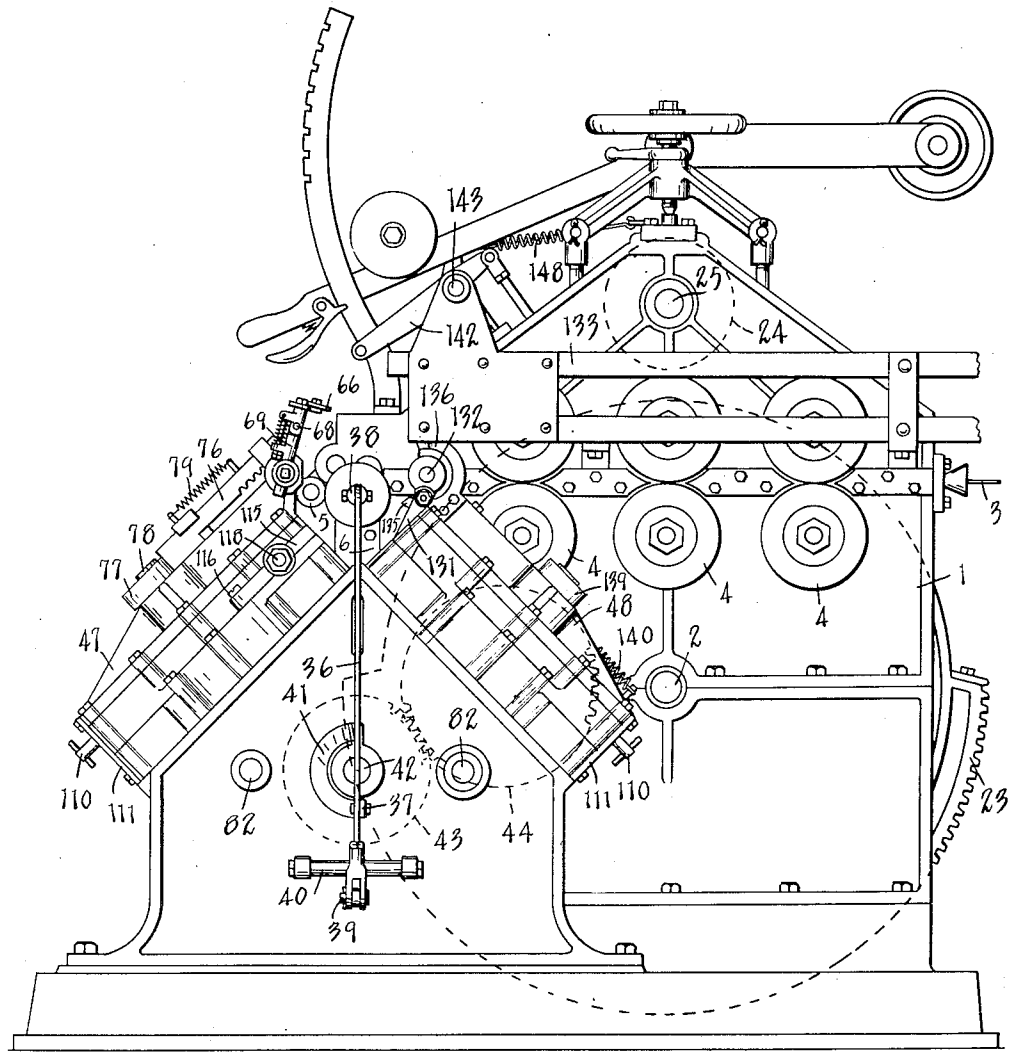


Fig. 1

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WIRE SPRING MAKING MACHINE

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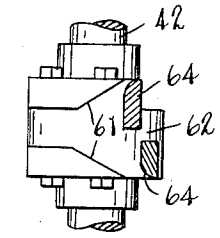


Fig. 15

Fig. 2

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WIRE SPRING MAKING MACHINE

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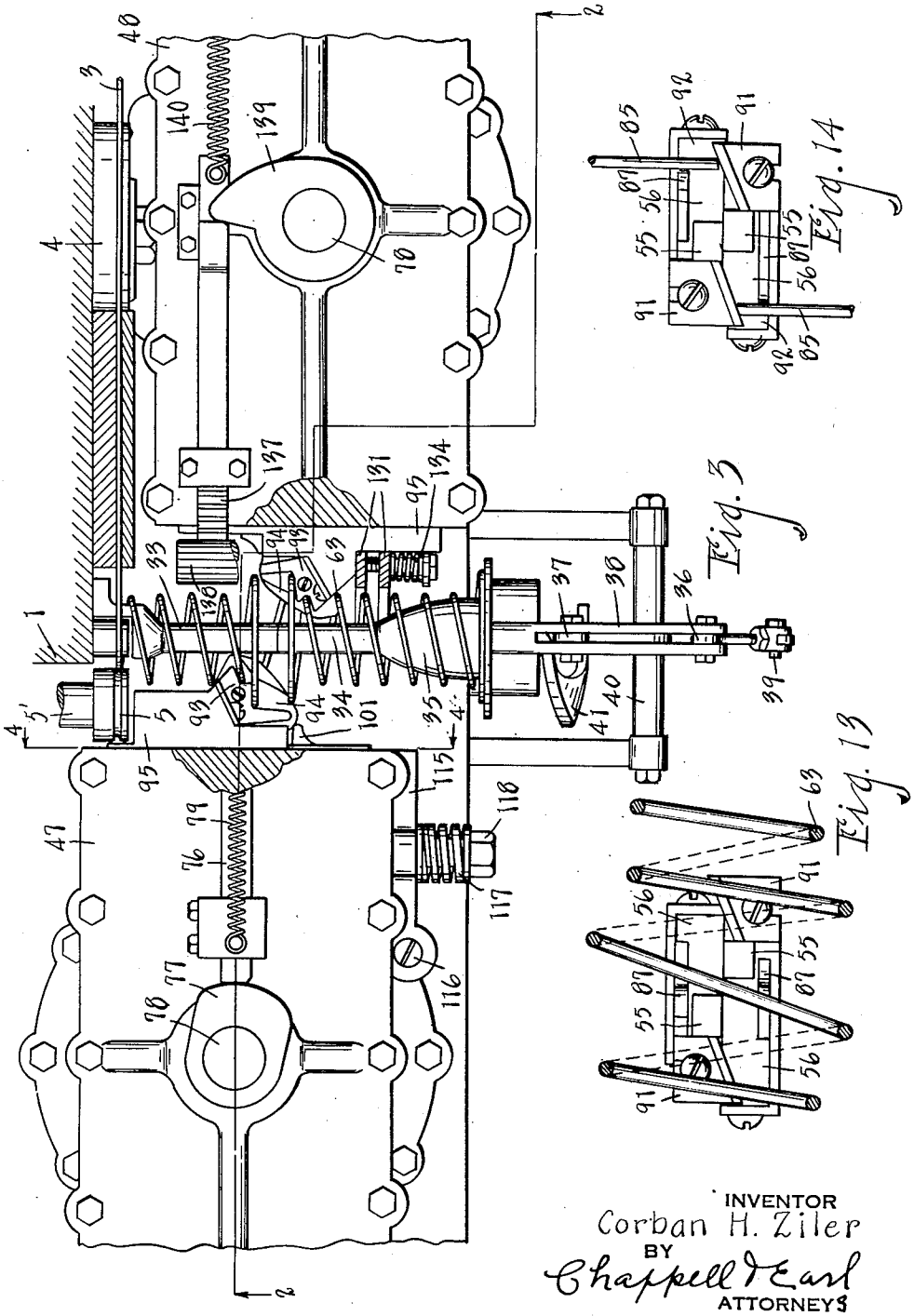


Fig. 14

Fig. 3

Fig. 13

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WIRE SPRING MAKING MACHINE

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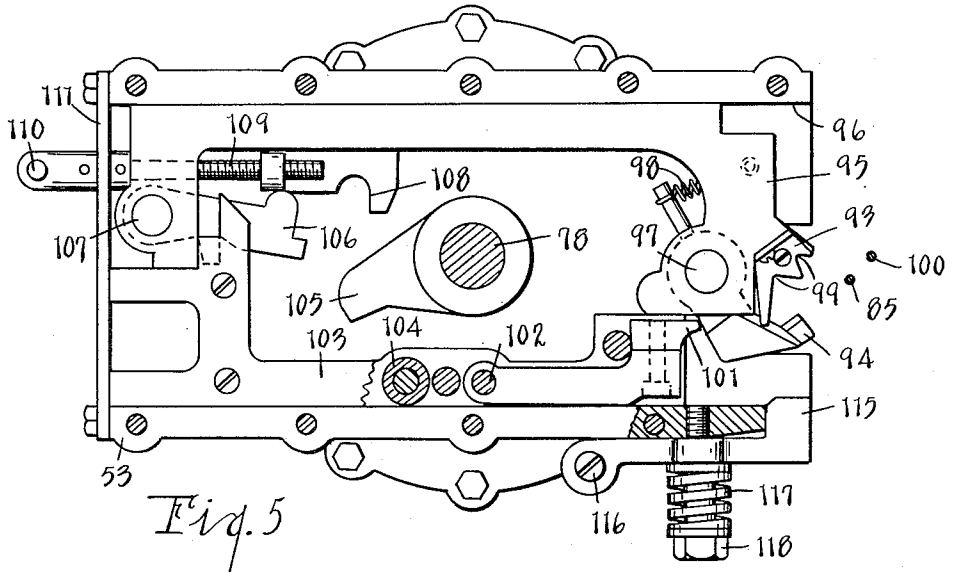


Fig. 5

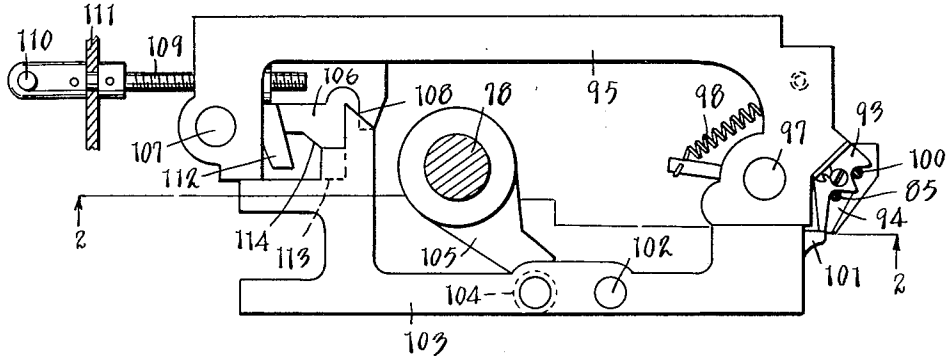


Fig. 6

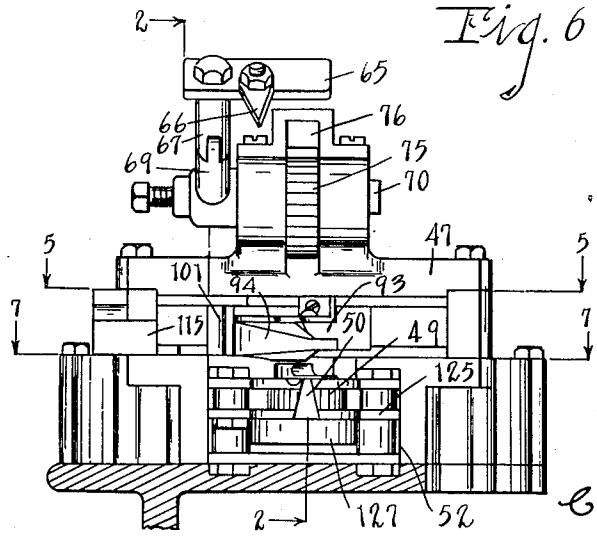


Fig. 4

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WIRE SPRING MAKING MACHINE

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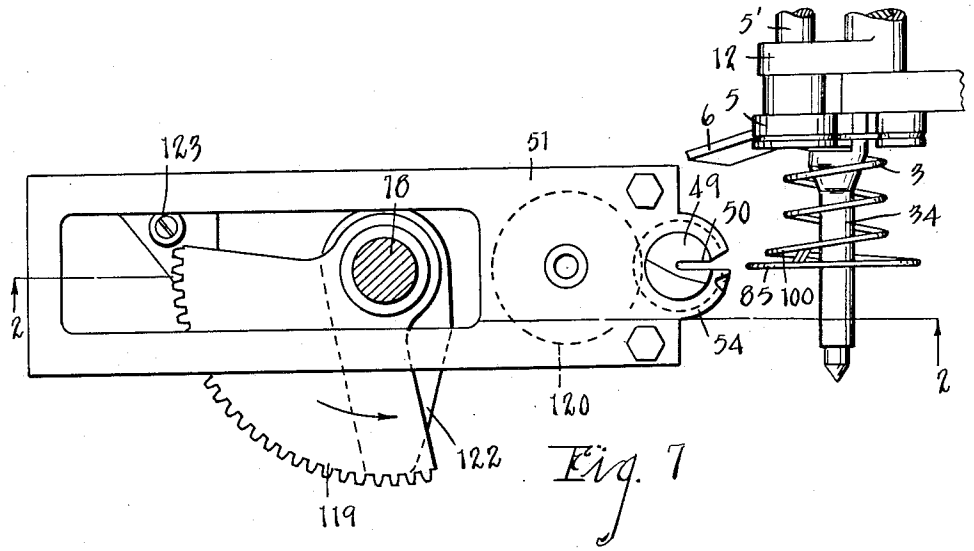


Fig. 7

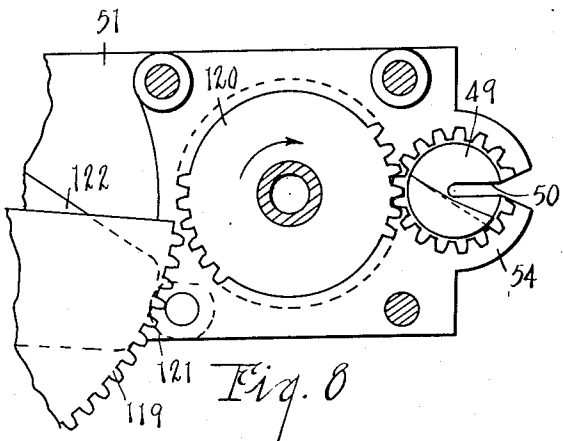


Fig. 8

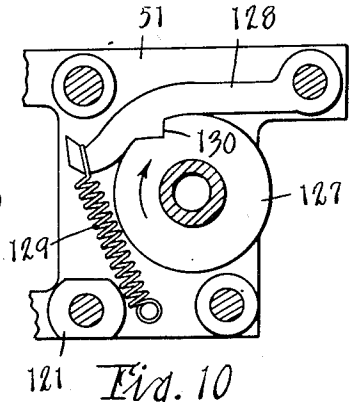


Fig. 10

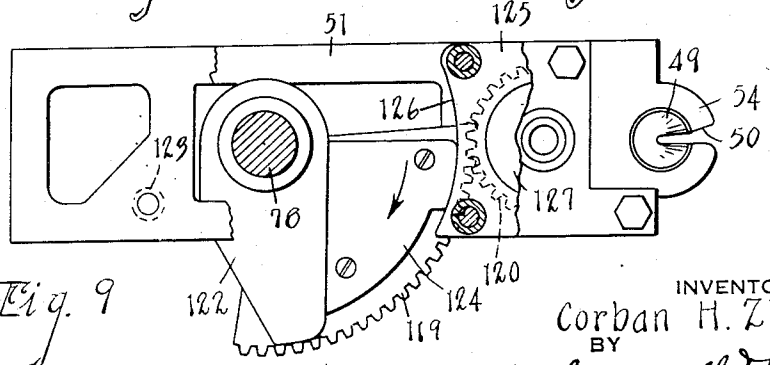


Fig. 9

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WIRE SPRING MAKING MACHINE

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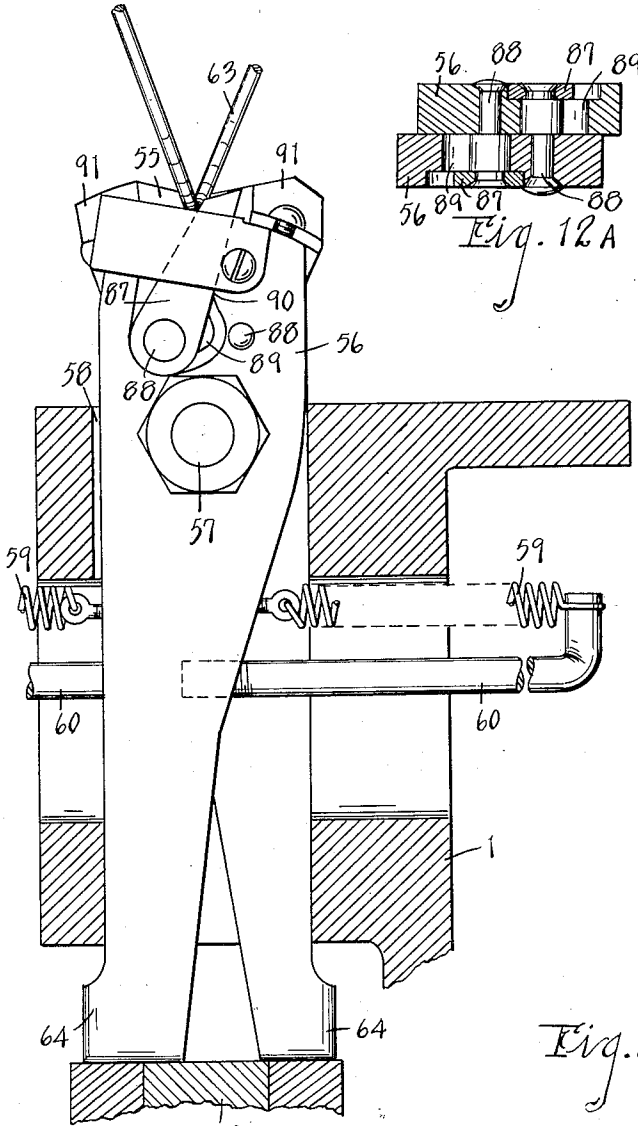


Fig. 11

Fig. 12A

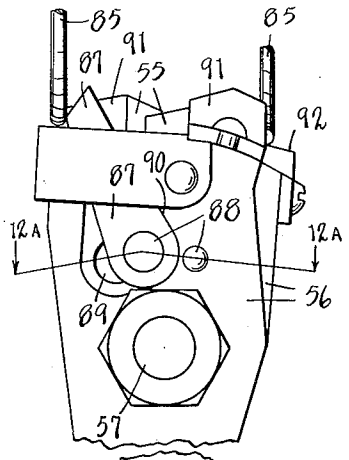
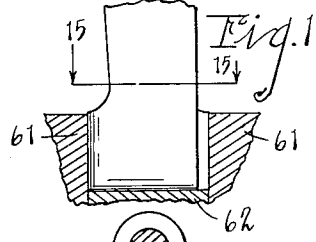


Fig. 12



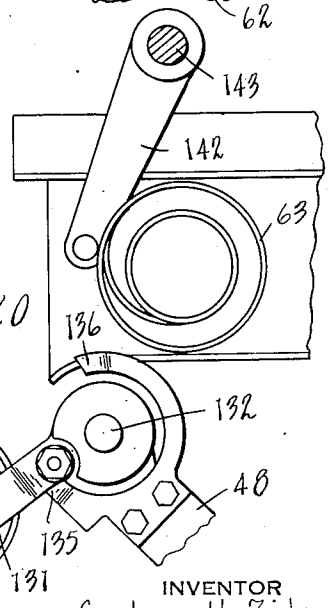


Fig. 20

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WIRE SPRING MAKING MACHINE

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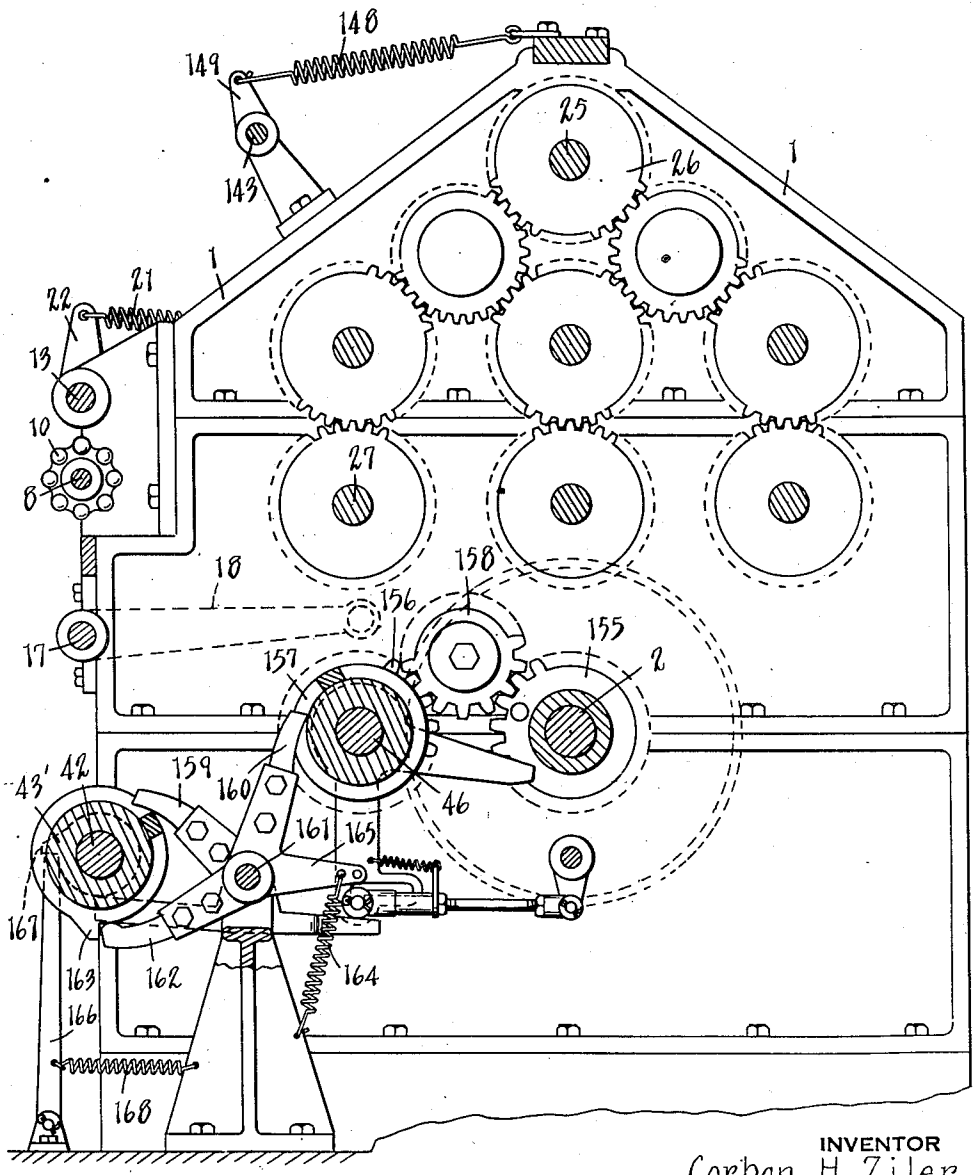


Fig. 16

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WIRE SPRING MAKING MACHINE

Filed March 16, 1931 8 Sheets-Sheet 8

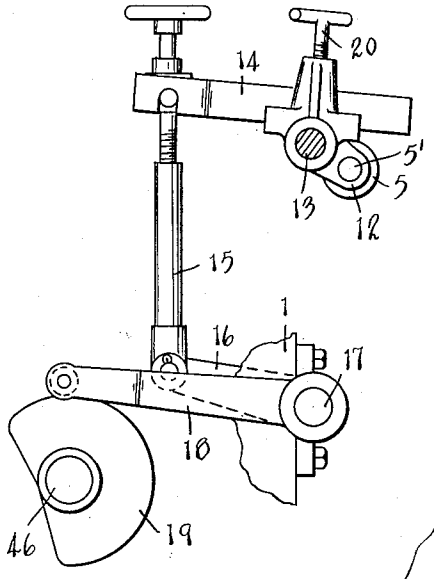


Fig. 17

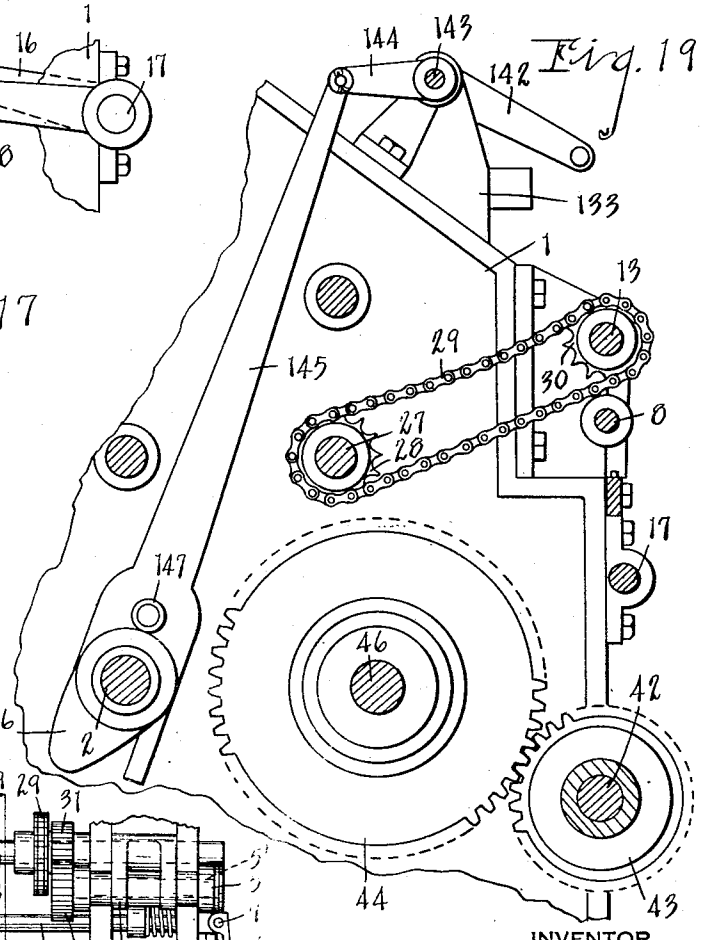
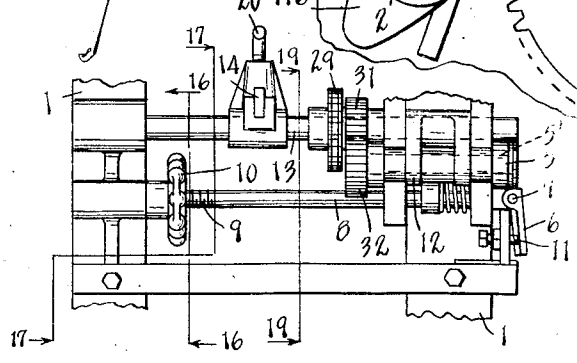


Fig. 19

Fig. 18



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UNITED STATES PATENT OFFICE

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WIRE SPRING MAKING MACHINE

Application filed March 16, 1931. Serial No. 522,973.

The main objects of this invention are:

First, to provide a wire spring making machine of large capacity and at the same time one which is comparatively compact.

Second, to provide a wire spring making machine in which hour-glass type of springs may be effectively produced and both ends knotted.

Third, to provide a coiled spring making machine adapted for the making of hour-glass type of springs in which the springs are effectively positioned as projected from the coiler relative to the knotting mechanism.

Fourth, to provide in a spring coiling machine having these advantages an improved cutter.

Objects pertaining to details and economies of my invention will definitely appear from the description to follow. The invention is defined in the claims.

A structure embodying the features of my invention is clearly illustrated in the accompanying drawings, in which:

Fig. 1 is an end elevation of my improved spring making machine.

Fig. 2 is a fragmentary view partially in vertical section on a line corresponding to line 2—2 of Figs. 3, 4, 6 and 7 showing the relation of the pair of knotting mechanisms and certain details of the knotting mechanism.

Fig. 3 is a diagrammatic plan view partially in section showing the relation of the knotting and coiling mechanism, the knotting mechanisms being shown in a horizontal plane in this view instead of in inclined relation as shown in Fig. 1.

Fig. 4 is an end view of one of the knotting mechanisms on a line corresponding to line 4—4 of Fig. 3, a portion of the supporting frame being shown in section.

Fig. 5 is a fragmentary view partially in section on line 5—5 of Figs. 2 and 4 showing details of the spring gripping or holding mechanism in retracted position.

Fig. 6 is a fragmentary view of the parts shown in Fig. 5 in actuated or spring holding position.

Fig. 7 is a fragmentary view partially in section on line 7—7 of Figs. 2 and 4 showing details of the knotter and its relation to the coiling mechanism.

Fig. 8 is a fragmentary view of certain parts shown in Fig. 7 in another position.

Fig. 9 is a fragmentary view partially in section on line 9—9 of Fig. 2 showing further details of the knotter mechanism, this being a bottom view of the parts shown in Fig. 7 in a different position.

Fig. 10 is a detail section on line 10—10 of Fig. 2 showing still further details of the knotter mechanism.

Fig. 11 is an enlarged fragmentary view partially in section on line 11—11 of Fig. 2 showing certain details of the cutting and positioning means.

Fig. 12 is a fragmentary view of the cutter and positioning means in fully actuated position.

Fig. 12A is a sectional view on line 12*a*—12*a* of Fig. 12.

Fig. 13 is a fragmentary plan view of parts shown in Fig. 11 illustrating the relation of the spring thereto.

Fig. 14 is a fragmentary plan view of parts shown in Fig. 12.

Fig. 15 is a detail section on line 15—15 of Figs. 2 and 12 showing details of the cutter actuating means.

Fig. 16 is a fragmentary vertical section on a line corresponding to line 16—16 of Fig. 18 showing certain details of the wire feeding means and the driving means for the motor mechanisms.

Fig. 17 is a fragmentary view partially in section on line 17—17 of Fig. 18 showing certain details of the coiling mechanism, primarily means for oscillating the forming roll.

Fig. 18 is a fragmentary elevation looking from the left of Fig. 16 showing further details of the coiling mechanism.

Fig. 19 is a fragmentary vertical section showing details of the nesting mechanism.

Fig. 20 is a fragmentary view partially in vertical section showing further details of the nesting mechanism.

In the embodiment of my invention illustrated I provide means for forming helically coiled springs of the hour-glass type, severing the coils at the desired point, simultane-

ously knotting the adjacent ends of the severed coils, and nesting the completed springs. The several steps are synchronized so that the operation is continuous except that the coiling mechanism pauses during the knotting operation.

The frame designated generally by the numeral 1 is of suitable character to support the various operating parts. The drive shaft 2 derives its power from a suitable source not illustrated.

The stock 3 is fed into the machine by a series of feed rolls 4 and projected thereby against a forming roller 5 which in the embodiment illustrated is a driven roller. The pitch block 6, see Fig. 18, is operatively associated with the forming roller, the pitch block being pivotally mounted at 7 on the slide rod 8 which is provided with an adjusting screw 9 and hand wheel 10. The outer end of the pitch block is supported by the adjustable rest 11.

The forming roll is mounted on a swinging or oscillating frame 12 on the rockshaft 13 having an arm 14 thereon connected by the link 15 to an arm 16 on the rockshaft 17. A second arm 18 on this rockshaft coacts with a cam 19, see the details in Figs. 17 and 18. The purpose of this is to oscillate the forming roll and thereby control the diameter of the coils.

The arm 14 is adjustably secured to the upper portion of the rocker frame 12 by means of the set screw 20 thereby controlling the length of the arm and consequently the length of throw of the forming roll. The link 15 is adjustable as to length, being formed of threaded sections, and the adjustment of this link varies the position of the forming roll.

The rockshaft 13 is urged yieldingly in one direction by means of a coiled spring 21 connected to the frame and to an arm 22 on the rockshaft. This, through the connections described, also urges the arm 18 against the cam 19.

The feed rollers are intermittently driven, the drive shaft 2 having thereon a large segmental gear 23 which merges intermittently with the gear 24 on the shaft 25. This shaft 25 has a gear 26 thereon which is part of a train of gears driving the shafts of the feed rollers, see Fig. 16. The shaft 27 of one of these feed rollers is provided with a sprocket 28 connected by the sprocket chain 29 to a sprocket wheel 30 rotatably mounted on the shaft or spindle 13. This sprocket wheel 30 has a pinion 31 connected thereto meshing with a pinion 32 on the shaft 5′ of the forming roll 5 so that the forming roll is driven in synchronism with the feed rolls. This driving connection permits rocking or oscillating of the forming roll by means described for the purpose of controlling the shape of the spring, that is, the diameter of the coils.

As the spring is formed or coiled it is projected over a guiding spindle consisting of a fixed section 33 mounted in fixed relation to the forming roll and a movable section 34 having a conical base portion 35 for centering the outer end of the spring. This movable member is carried by a pair of parallel links 36 and 37 pivoted at their upper ends to the outwardly projecting arm 38 on the spindle member. The link 36 is mounted at its lower end on the pivot 39 while the link 37 is pivoted at its lower end on the pivot or rocker 40 which is of considerable length to support the link laterally.

The spiral cam 41 coacts with the inner arm so that as this cam is rotated it swings the spindle section 34 outwardly to release the formed and knotted spring. This cam 41 is on a shaft 42 which is the drive shaft for the cutting mechanism. This shaft 42 is connected to the main drive shaft 2 by means of a gear 43 rotatable on the shaft 42 and a clutch mechanism designated generally by the numeral 43′.

The gear 43 meshes with a gear 44 on the shaft 46 which is connected to the driving shaft 2 by means of the gears 155 on the shaft 2, a gear 156 connected to the shaft 46 through a clutch designated generally by the numeral 157 and an intermediate gear 158 meshing with the gears 155 and 156. The clutches 43′ and 157 are of the type that automatically throws out on one complete revolution.

The clutch releasing member 159 coacts with the clutch 43′ and the clutch releasing member 160 coacts with the clutch 157. Both of these are mounted on a rockshaft 161 provided with a tappet arm 162 coacting with a cam 163 on the driving member of the clutch 43′. A spring 164 connected to an arm 165 on the rockshaft 161 acts to hold the tappet arm in coacting relation to the cam 163. This results in driving of the shafts 42 and 46 in properly timed relation.

To prevent back throw of the cutting shaft 42 a pawl 166 is provided coacting with a dog 167 on the driven member of the clutch. The pawl is under tension of the spring 168.

The knotter mechanism comprises a pair of units designated generally by the numerals 47 and 48, these units being the same except that certain parts are reversed owing to their position in the machine so a description of one knotter mechanism, it is believed, will suffice.

Each knotter mechanism comprises a knotting gear 49 having a slot 50 therein. The knotter gear is rotatably mounted in a reciprocating slide or carriage 51 which is mounted in a slideway 52 in the frame 53 of the knotter unit. The knotter carriage is provided with jaws 54 with which the knotter gear coacts. The slide is reciprocated to advance the knotter to operating position, the

slides of both knotter units being simultaneously actuated.

This, as stated, is in timed relation to the cutter and positioning mechanism which, in the embodiment illustrated, consists of a pair of cutters 55 mounted on the upper ends of the cutter levers 56 pivotally connected at 57 and mounted for vertical sliding movement in a way 58. The levers are urged to open position by means of the coiled springs 59 connected to one of the levers and to a projecting arm 60 on the other lever, see Fig. 11.

The levers are actuated to close the cutters by means of the cam 61 which is associated with the lifting cam 62 so that the cutters are lifted to operative position relative to the spring indicated at 63 and the cutters closed or actuated in properly timed relation. The cam 61 engages beveled or rounded surfaces 64 on the ends of the levers, see Figs. 2, 11 and 15, gradually closing the cutters as the cam rotates. These cams are mounted on the shaft 42, see Fig. 2.

To hold the spring during this cutting operation I provide a holddown clamp 65 provided with a tapered locating nose 66, that is, this locating nose or member enters between the coils of the springs which are to be severed. This holddown clamp has a shank portion 67 pivoted at 68 on the arm 69 of the rockshaft 70. A coiled spring 71 is supported between the ears 72 on the holddown clamp shank and the ear 73 on the arm, a bolt indicated at 74 being provided for supporting the spring. This permits the holddown clamp to yield under undue stresses and to accommodate slight variations in the diameter of the coils with which it engages.

The rockshaft 70 is provided with a pinion 75 driven through a rack 76. This rack 76 is actuated by a cam 77 on the shaft 78, the rack being held against the cam by means of the coiled spring 79. These parts are best illustrated in Figs. 2 and 4. On the lower end of the shaft 78 is a gear 80 meshing with a worm 81 on the shaft 82. This shaft 82 has a gear 83 thereon meshing with a gear 84 on the shaft 42.

To properly position the severed ends of the coiled spring indicated at 85 in Figs. 12 and 14 so that they may be effectively engaged by the knotter, I provide the cutter device with a pair of spreaders or positioning members 87 mounted on pivots 88, one on each lever. The levers are slotted at 89 to receive the pivot.

It will be observed by reference to Figs. 11, 12 and 12A that while these positioning members lie at the side of the levers, their pivots are carried by the opposite lever, the pivots being disposed through the slots 89, which permits the swinging of the levers.

The levers are provided with thrust shoulders 90 on which the positioning members fulcrum so that the cutters are first actuated to sever the coil and the positioning members then actuated to spread the severed ends of the coil as indicated in Figs. 12 and 14. The severed ends of the coil are guided in this positioning movement by means of the guides 91, see Fig. 14, while supported by the rests 92.

While the parts are in this position the coil is engaged by the jaws 93 and 94 of the knotter mechanism, see Figs. 5 and 6, the jaws being shown in released position in Fig. 5 and in engaged position in Fig. 6. The jaw 93 is a fixed jaw and is immovably mounted on the slide 95 in the way 96 disposed above and parallel to the way 52 for the knotter carriage. The jaw 94 is pivoted at 97 to coact with the jaw 93 and is urged to open position by means of the spring 98. The jaw 93 has two spaced recesses 99 adapted to engage the severed end coil 85 of the spring and the adjacent coil 100, see Figs. 5 and 6.

The jaw 94 is closed by means of a tappet 101 which is pivoted at 102 on a jaw actuating slide 103 which is operatively associated with the slide 95 for limited movement independently of the slide 95. The actuating slide is provided with a roller 104 with which the cam 105 on the shaft 78 coacts. The tension of the spring 98 is sufficient to move the slide 95 through the tappet 101 until the dog 106 pivoted at 107 on the slide 95 is brought into engagement with the stop 108.

This stop 108 is adjustably supported by the screw 109 having a finger piece 110 at its outer end. This screw is rotatably mounted on the cross piece 111 of the way 96. When the dog is in engagement with the stop, the jaw 93 has been advanced to position to engage the spring, so that continued movement of the slide 103 closes the jaw 94 as shown in Fig. 6. A stop shoulder 112 is provided on the dog 106 to limit the downward swing of the dog.

The actuating slide 103 is provided with a part 113 which coacts with the cam surface 114 on the locking dog to force it into locking engagement with the stop 108. As soon as the cam 105 has passed out of engagement with the roller 104 the parts return to their initial position, opening the jaws.

When the tappet is advanced to jaw closing position it rides up on the spring supported thrust member 115 which is pivoted at 116 and yieldingly supported by means of the coiled spring 117 on the headed stud or pin 118, see Fig. 5. This yielding thrust member also accommodates variations in the gage of wire.

The positioning means described in connection with the cutter position the ends of the severed spring 85 to be engaged by these jaws and these jaws hold the spring to be engaged by the knotter as it is advanced.

The knotter gear is driven from the segment 119 which is mounted on the shaft 78

and is adapted to coact with the gear 120 which in turn meshes with the knotter gear 49, see Figs. 2, 7 and 8. The slide 51 is slotted to receive the shaft 78, see Fig. 7, and carries a roller 121 with which the cam 122 on the shaft 78 coacts to advance the knotter to knotting position. The slide is first advanced to this position, the segment 119 then engaging the knotting gear and rotating the same to perform the knotting operation. Continued rotation of the cam 122 brings it into contact with the roller 123 on the knotter carriage, returning it to its initial position.

To prevent any return movement of the knotter carriage prior to the disengagement of the driving segment 119 with the gear 120, the driving segment is provided with a cam plate 124 having a portion adapted to engage with a thrust plate 125 having a curved edge 126, see Fig. 9. To properly position the knotter gear it is provided with a stop disk 127 coacting with the pivoted pawl 128 held yieldingly in engagement with the stop disk by means of the coiled spring 129. The stop disk has a notch 130 in its periphery with which the pawl engages. This stop is in engagement when the parts are in the receiving position shown in Figs. 7, 8 and 9.

As stated, both knotting devices are simultaneously actuated so that the adjacent severed ends of the coil are simultaneously knotted. A single knotting operation knots the outer end of the spring that is partially formed and the inner end of the completed spring, the terms "inner" and "outer" ends being relative to the position of the coil in the machine.

On the completion of the knotting operation the spring is engaged by the nester 131 mounted on the rockshaft 132, this nester being adapted to engage one of the intermediate coils of a completed spring, picking it up and carrying it into the chute 133.

The nester consists of a pair of arms which are urged toward each other by the spring 134, the arms being held in open position or separated by a spreader cam 135 when in receiving position and being separated to release the spring when in delivery position by means of the spreader cam 136. The shaft 132 is oscillated from the rack 137 coacting with a pinion 138 on the rockshaft, the rack being actuated by a cam 139 on one of the shafts 78 so that the nester is actuated in timed relation to the knotters. In its initial or retracted position to which it is returned by the coiled spring 140 the rack engages an adjustable stop 141, see Fig. 2.

To feed the springs into the nester I provide a feed arm 142 which is carried by the rockshaft 143, and arranged above the nester and actuated in timed relation to the nester so that the springs are engaged successively and pushed into the nester chute. This rockshaft 143 is provided with an arm 144 actuated by a pitman 145 forked to reciprocatingly engage the shaft 2 and actuated by the cam 146 on the shaft 2, coacting with a roller 147 on the pitman, see Fig. 19. The coiled spring 148 connected to the frame and to an arm 149 on the rockshaft 143 returns the rockshaft to its initial position and also holds the roller 147 against its actuating cam.

It will be understood that prior to the actuation of the nester the supporting spindle member 34 is retracted by the means described, its cam 41 being designed to release the spindle as soon as the nester arm has returned to its initial position.

With the parts arranged as described the springs are coiled and both ends knotted so that a complete spring is formed at each operation, although one knotting operation is on the partially formed spring.

The machine is of large capacity and at the same time is comparatively compact and simple in its parts. I have not attempted to illustrate certain embodiments and adaptations which I contemplate as it is believed that this disclosure will enable those skilled in the art to embody or adapt my improvements as may be desired.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a wire spring making machine, the combination of an intermittently acting coiling means, a supporting spindle operatively associated with said coiling means, said supporting spindle having a reciprocatingly mounted outer section provided with a conical spring engaging portion at its outer end, a pivotally mounted holddown clamp provided with a tapered tongue adapted to extend between a pair of coils of the spring, a cutter unit mounted for vertical reciprocation in opposed relation to said holddown clamp, a pair of knotter units disposed in opposed inclined relation to act on the adjacent ends of the severed coils of a spring and comprising reciprocatingly mounted knotters and reciprocatingly mounted holding jaws operatively associated with the knotters, said cutter unit being provided with means for positioning the severed ends to be engaged by the said knotter holding jaws, a transfer member positioned to engage a completed spring when released by said supporting spindle, and synchronized operating means for said coiler, holddown clamp, cutter unit, knotter units, supporting spindle and transfer means.

2. In a wire spring making machine, the combination of an intermittently acting coiling means, a supporting spindle operatively associated with said coiling means, said supporting spindle having a reciprocatingly mounted outer section provided with a conical spring engaging portion at its outer end,

a pivotally mounted holddown clamp, a cutter unit mounted for vertical reciprocation in opposed relation to said holddown clamp, a pair of knotter units disposed in opposed inclined relation to act on the adjacent ends of the severed coils of a spring and comprising reciprocatingly mounted knotters and reciprocatingly mounted holding jaws operatively associated with the knotters, said cutter unit being provided with means for positioning the severed ends to be engaged by the said knotter holding jaws, a transfer member positioned to engage a completed spring when released by said supporting spindle, and synchronized operating means for said coiler, holddown clamp, cutter unit, knotter units, supporting spindle and transfer means.

3. In a wire spring making machine, the combination of an intermittently acting coiling means, a supporting spindle operatively associated with said coiling means, said supporting spindle having a reciprocatingly mounted outer section provided with a conical spring engaging portion at its outer end, a pivotally mounted holddown clamp provided wth a tapered tongue adapted to extend between a pair of coils of the spring, a cutter unit mounted for vertical reciprocation in opposed relation to said holddown clamp, a pair of knotter units disposed in opposed inclined relation to act on the adjacent ends of the severed coils of a spring and comprising reciprocatingly mounted knotters and reciprocatingly mounted holding jaws operatively associated with the knotters, a transfer member positioned to engage a completed spring when released by said supporting spindle, and synchronized operating means for said coiler, holddown clamp, cutter unit, knotter units, supporting spindle and transfer means.

4. In a wire spring making machine, the combination of an intermittently acting coiling means, a supporting spindle operatively associated with said coiling means, said supporting spindle having a reciprocatingly mounted outer section provided with a conical spring engaging portion at its outer end, a pivotally mounted holddown clamp, a cutter unit mounted for vertical reciprocation in opposed relation to said holddown clamp, a pair of knotter units disposed in opposed inclined relation to act on the adjacent ends of the severed coils of a spring and comprising reciprocatingly mounted knotters and reciprocatingly mounted holding jaws operatively associated with the knotters, a transfer member positioned to engage a completed spring when released by said supporting spindle, and synchronized operating means for said coiler, holddown clamp, cutter unit, knotter units, supporting spindle and transfer means.

5. In a wire spring making machine, the combination of an intermittently acting coiling means, a pivotally mounted holddown clamp provided with a tapered tongue adapted to extend between a pair of coils of the spring, a cutter unit mounted for vertical reciprocation in opposed relation to said holddown clamp, a pair of knotter units disposed in opposed inclined relation to act on the adjacent ends of the severed coils of a spring and comprising reciprocatingly mounted knotters and reciprocatingly mounted holding jaws operatively associated with the knotters, said cutter unit being provided with means for positioning the severed ends to be engaged by the said knotter holding jaws, and synchronized operating means for said coiler, holddown clamp, cutter unit and knotter units.

6. In a wire spring making machine, the combination of an intermittently acting coiling means, a pivotally mounted holddown clamp, a cutter unit mounted for vertical reciprocation in opposed relation to said holddown clamp, a pair of knotter units disposed in opposed inclined relation to act on the adjacent ends of the severed coils of a spring and comprising reciprocatingly mounted knotters and reciprocatingly mounted holding jaws operatively associated with the knotters, said cutter unit being provided with means for positioning the severed ends to be engaged by the said knotter holding jaws, and synchronized operating means for said coiler, holddown clamp, cutter unit and knotter units.

7. In a wire spring making machine, the combination of an intermittently acting coiling means, a cutter unit mounted for vertical reciprocation, a pair of knotter units disposed in opposed inclined relation to act on the adjacent ends of the severed coils of a spring and comprising reciprocatingly mounted knotters and reciprocatingly mounted holding jaws operatively associated with the knotters, said cutter unit being provided with means for positioning the severed ends to be engaged by the said knotter holding jaws, and synchronized operating means for said coiler, cutter unit and knotter units.

8. In a wire spring making machine, the combination of an intermittently acting coiling means, a pivotally mounted holddown clamp provided with a tapered tongue adapted to extend between a pair of coils of the spring, a cutter unit mounted for vertical reciprocation in opposed relation to said holddown clamp, a pair of knotter units disposed in opposed inclined relation to act on the adjacent ends of the severed coils of a spring and comprising reciprocatingly mounted knotters and reciprocatingly mounted holding jaws operatively associated with the knotters, and synchronized operat-

ing means for said coiler, holddown clamp, cutter unit and knotter units.

9. In a wire spring making machine, the combination of an intermittently acting coiling means, a pivotally mounted holddown clamp, a cutter unit mounted for vertical reciprocation in opposed relation to said holddown clamp, a pair of knotter units disposed in opposed inclined relation to act on the adjacent ends of the severed coils of a spring and comprising reciprocatingly mounted knotters and reciprocatingly mounted holding jaws operatively associated with the knotters, and synchronized operating means for said coiler, holddown clamp, cutter unit and knotter units.

10. In a wire spring making machine, the combination of an intermittently acting coiling means, a cutter unit mounted for vertical reciprocation, a pair of knotter units disposed in opposed inclined relation to act on the adjacent ends of the severed coils of a spring and comprising reciprocatingly mounted knotters and reciprocatingly mounted holding jaws operatively associated with the knotters, and synchronized operating means for said coiler, cutter unit and knotter units.

11. In a wire spring making machine, the combination of a coiling means, spring supporting means adapted to receive the spring as formed by said coiling means, a cutter adapted to sever a coil at a point substantially spaced from the coiling means, a holddown clamp acting to engage the spring in opposed relation to the cutter during the cutting operation, means for positioning the severed ends, knotters acting on the adjacent severed ends, a transfer member for the completed spring, and means for actuating the coiler, holddown clamp, cutter, positioning means, knotters, releasing the supporting spindle and actuating the transfer member in timed relation.

12. In a wire spring making machine, the combination of a coiling means, spring supporting means adapted to receive the spring as formed by said coiling means, a cutter adapted to sever a coil at a point substantially spaced from the coiling means, means for positioning the severed ends, knotters acting on the adjacent severed ends, a transfer member for the completed spring, and means for actuating the coiler, cutter, positioning means, knotters, releasing the supporting spindle and actuating the transfer member in timed relation.

13. In a wire spring making machine, the combination of a coiling means, spring supporting means adapted to receive the spring as formed by said coiling means, a cutter adapted to sever a coil at a point substantially spaced from the coiling means, a holddown clamp acting to engage the spring in opposed relation to the cutter during the cutting operation, knotters acting on the adjacent severed ends, a transfer member for the completed spring, and means for actuating the coiler, holddown clamp, cutter, knotters, releasing the supporting spindle and actuating the transfer member in timed relation.

14. In a wire spring making machine, the combination of a coiling means, spring supporting means adapted to receive the spring as formed by said coiling means, a cutter adapted to sever a coil at a point substantially spaced from the coiling means, knotters acting on the adjacent severed ends, a transfer member for the completed spring, and means for actuating the coiler, cutter, knotters, releasing the supporting spindle and actuating the transfer member in timed relation.

15. In a wire spring making machine, the combination of a coiling means, a cutter adapted to sever a coil at a point substantially spaced from the coiling means, a hold down clamp acting to engage the spring in opposed relation to the cutter during the cutting operation, means for positioning the severed ends, knotters acting on the adjacent severed ends, and means for actuating the coiler, holddown clamp, cutter, positioning means, and knotters in timed relation.

16. In a wire spring making machine, the combination of a coiling means, a cutter adapted to sever a coil at a point substantially spaced from the coiling means, means for positioning the severed ends, knotters acting on the adjacent severed ends, and means for actuating the coiler, cutter, positioning means and knotters in timed relation.

17. In a wire spring making machine, the combination of a coiling means, a cutter adapted to sever a coil at a point substantially spaced from the coiling means, a holddown clamp acting to engage the spring in opposed relation to the cutter during the cutting operation, knotters acting on the adjacent severed ends, and means for actuating the coiler, holddown clamp, cutter and knotters in timed relation.

18. In a wire spring making machine, the combination of a coiling means, a cutter adapted to sever a coil at a point substantially spaced from the coiling means, knotters acting on the adjacent severed ends, and means for actuating the coiler, cutter and knotters in timed relation.

19. In a wire spring making machine, the combination of a coiling means, a pair of knotters operatively associated therewith, a cutter adapted to sever a formed coil at a central point relative to the knotters, and means for positioning the severed ends in operative relation to the knotters operatively associated with the cutter and acting while the severed ends are supported by the cutter.

20. In a wire spring making machine, the combination of a coiling means, a pair of knotters operatively associated therewith,

and a cutter adapted to sever a formed coil at a central point relative to the knotters.

21. The combination with a coiler mechanism, of a pair of knotters reciprocatingly mounted in oppositely disposed relation at the sides of the path of the coils as projected from the coiler, a reciprocatingly mounted cutter disposed centrally relative to said knotters, and means for actuating the coiler, cutter and knotters in timed relation.

22. The combination with a coiler mechanism, of a pair of knotters mounted in oppositely disposed relation at the sides of the path of the coils as projected from the coiler, a cutter disposed centrally relative to said knotters, and means for actuating the coiler, cutter and knotters in timed relation.

23. In a spring making machine, a coiler mechanism, a cutter positioned to sever a coil at a point substantially spaced from the coiler, a reciprocatingly mounted knotter positioned to act on one of the severed ends of the coil, and means operatively associated with the cutter to be actuated therewith for positioning the severed end acted upon by the knotter in position to enter the knotter as it is reciprocated to operative position.

24. In a spring making machine, a coiler mechanism, a cutter positioned to sever a coil at a point substantially spaced from the coiler, a knotter positioned to act on one of the severed ends of the coil, and means operatively associated with the cutter to be actuated therewith for positioning the severed end acted upon by the knotter.

25. In a spring making machine, a coiler mechanism, a cutter positioned to sever a coil at a point substantially spaced from the coiler, and a reciprocatingly mounted knotter positioned to act on one of the several ends of the coil.

26. In a spring making machine, the combination with a coiler mechanism, a supporting spindle operatively associated with said coiler mechanism to receive the coiled spring therefrom, said supporting spindle having a movably mounted outer section coacting with the outer end of a spring as projected from the coiler mechanism, means for severing at an intermediate coil, knotters provided with holding jaws, means for supporting the severed ends until engaged by said holding jaws, and means for releasing the completed spring from the spindle after the knotting action of the knotters.

27. In a spring making machine, the combination with a coiler mechanism, a supporting spindle operatively associated with said coiler mechanism to receive the coiled spring therefrom, said supporting spindle having a movably mounted outer section coacting with the outer end of a spring as projected from the coiler mechanism, means for severing at an intermediate coil, and means for releasing the completed spring from the spindle after the knotting action of the knotters.

28. In a spring making machine, the combination with a coiler mechanism, means for severing at an intermediate coil, knotters provided with holding jaws, and means for supporting the adjacent severed ends until engaged by said holding jaws.

29. In a spring making machine, the combination with a coiler mechanism, a supporting spindle operatively associated with said coiler mechanism to receive the coiled spring therefrom, said supporting spindle having a movably mounted outer section coacting with the outer end of a spring as projected from the coiler mechanism, means for severing at an intermediate coil, a knotter provided with a holding jaw, means for supporting one of the severed ends until engaged by said holding jaw, and means for releasing the completed spring after the knotting action of the knotters.

30. In a spring making machine, the combination with a coiler mechanism, means for severing at an intermediate coil, a knotter provided with a holding jaw, and means for supporting one of the severed ends until engaged by said holding jaws.

31. In a spring making machine, the combination of a coiling means, a knotter operatively associated therewith and comprising a reciprocating carriage, a knotter gear on said carriage, a pinion meshing with said knotter gear, a shaft disposed transversely of the carriage, a segment on said shaft coacting with said pinion, a cam on said shaft for advancing said carriage to operative position, a work clamp slide disposed to reciprocate in parallel relation to said carriage and provided with a relatively fixed jaw and with a coacting pivoted jaw provided with a spring acting to urge it to open position, a jaw actuating slide provided with a pivoted tappet coacting with the pivoted jaw, a spring supported thrust member for said tappet coacting therewith when the tappet is in jaw closing position, a pivoted stop dog on said work clamp slide, an adjustable stop coacting therewith, said jaw actuating slide being provided with a cam coacting with said pivoted stop dog, and a cam on said shaft for actuating said slides.

32. In a spring making machine, the combination of a coiling means, a knotter operatively associated therewith and comprising a reciprocating carriage, a knotter gear on said carriage, a pinion meshing with said knotter gear, a shaft disposed transversely of the carriage, a segment on said shaft coacting with said pinion, a cam on said shaft for advancing said carriage to operative position, a work clamp slide disposed to reciprocate in parallel relation to said carriage and provided with a relatively fixed jaw and with a coacting pivoted jaw provided with a spring

acting to urge it to open position, a jaw actuating slide coacting with the pivoted jaw, a pivoted stop dog on said work clamp slide, an adjustable stop coacting therewith, said jaw actuating slide being provided with a cam coacting with said pivoted stop dog, and a cam on said shaft for actuating said slides.

33. In a spring making machine, the combination of a coiling means, a knotter operatively associated therewith and comprising a reciprocating carriage, a knotter gear on said carriage, a pinion meshing with said knotter gear, a shaft disposed transversely of the carriage, a segment on said shaft coacting with said pinion, a cam on said shaft for advancing said carriage to operative position, a work clamp slide disposed to reciprocate in parallel relation to said carriage and provided with a relatively fixed jaw and with a coacting pivoted jaw provided with a spring acting to urge it to open position, a jaw actuating slide having a lost motion connection to said work clamp slide provided with a pivoted tappet coacting with the pivoted jaw, a spring supported thrust member for said tappet coacting therewith when the tappet is in jaw closing position, and a cam on said shaft for actuating said slides.

34. In a spring making machine, the combination of a coiling means, a knotter operatively associated therewith and comprising a reciprocating carriage, a knotter gear on said carriage, a pinion meshing with said knotter gear, a shaft disposed transversely of the carriage, a segment on said shaft coacting with said pinion, a cam on said shaft for advancing said carriage to operative position, a work clamp slide disposed to reciprocate in parallel relation to said carriage and provided with a relatively fixed jaw and with a coacting pivoted jaw provided with a spring acting to urge it to open position, a jaw actuating slide having a lost motion connection to said work clamp slide coacting with the pivoted jaw, and a cam on said shaft for actuating said slides.

35. In a spring making machine, the combination of a coiling means, a reciprocating knotter operatively associated therewith, a work clamp slide disposed to reciprocate in parallel relation to said knotter and provided with a relatively fixed jaw and with a coacting pivoted jaw provided with a spring acting to urge it to open position, a jaw actuating slide having a lost motion connection with said work clamp slide and provided with a pivoted tappet coacting with the pivoted jaw, a spring supported thrust member for said tappet coacting therewith when the jaw is in closed position, and means for actuating said work clamp slide acting through said jaw actuating slide.

36. In a spring making machine, the combination of a coiling means, a reciprocating knotter operatively associated therewith, a work clamp slide disposed to reciprocate in parallel relation to said knotter and provided with a relatively fixed jaw and with a coacting pivoted jaw provided with a spring acting to urge it to open position, a jaw actuating slide having a lost motion connection with said work clamp slide coacting with the pivoted jaw, and means for actuating said work clamp slide acting through said jaw actuating slide.

37. In a spring making machine, the combination with a coiling means, of a pair of knotters disposed in opposed relation, a pair of cutter levers mounted for pivotal movement relative to each other and longitudinal reciprocating movement to and from the work, cutters mounted on said levers, said levers being provided with supporting surfaces in operative relation to the cutters and with inclined guides coacting with the severed ends of the coils, members pivotally mounted one on each of said levers to coact with a thrust member on the other lever to position the severed ends on said supporting surfaces, and means acting to reciprocate said cutter levers and actuate them on their pivot.

38. In a spring making machine, the combination with a coiling means, of a pair of knotters disposed in opposed relation, a pair of cutter levers mounted for pivotal movement relative to each other and longitudinal reciprocating movement to and from the work, cutters mounted on said levers, said levers being provided with supporting surfaces in operative relation to the cutters, members pivotally mounted one on each of said levers to coact with a thrust member on the other lever to position the severed ends on said supporting surfaces, and means acting to reciprocate said cutter levers and actuate them on their pivot.

39. In a spring making machine, the combination with a coiling means, of a pair of knotters disposed in opposed relation, a pair of pivotally connected cutter levers mounted for pivotal movement relative to each other and longitudinal reciprocating movement to and from the work, cutters mounted on said levers, said levers being provided with supporting surfaces in operative relation to the cutters and with inclined guides coacting with the severed ends of the coils, means actuated by the continued cutter closing movement of said levers to position the severed end on said surfaces, and means acting to reciprocate said cutter levers and actuate them on their pivot.

40. In a spring making machine, the combination with a coiling means, of a pair of knotters disposed in opposed relation, a pair of pivotally connected cutter levers mounted for pivotal movement relative to each other and longitudinal reciprocating movement to and from the work, cutters mounted on said levers, said levers being provided with supporting surfaces in operative relation to the cutters, means actuated by the continued cut-

ter closing movement of said levers to position the severed end on said surfaces, and means acting to reciprocate said cutter levers and actuate them on their pivot.

41. In a spring making machine, the combination with a coiling means, of a pair of knotters, and a reciprocating cutter unit operatively associated with said knotters and provided with means for positioning the severed ends of adjacent springs relative to said knotters.

In witness whereof I have hereunto set my hand.

CORBAN H. ZILER.