

March 5, 1940.

C. F. FISHER ET AL

2,192,260

WIRE COILING MACHINE

Filed Sept. 14, 1938

7 Sheets-Sheet 1

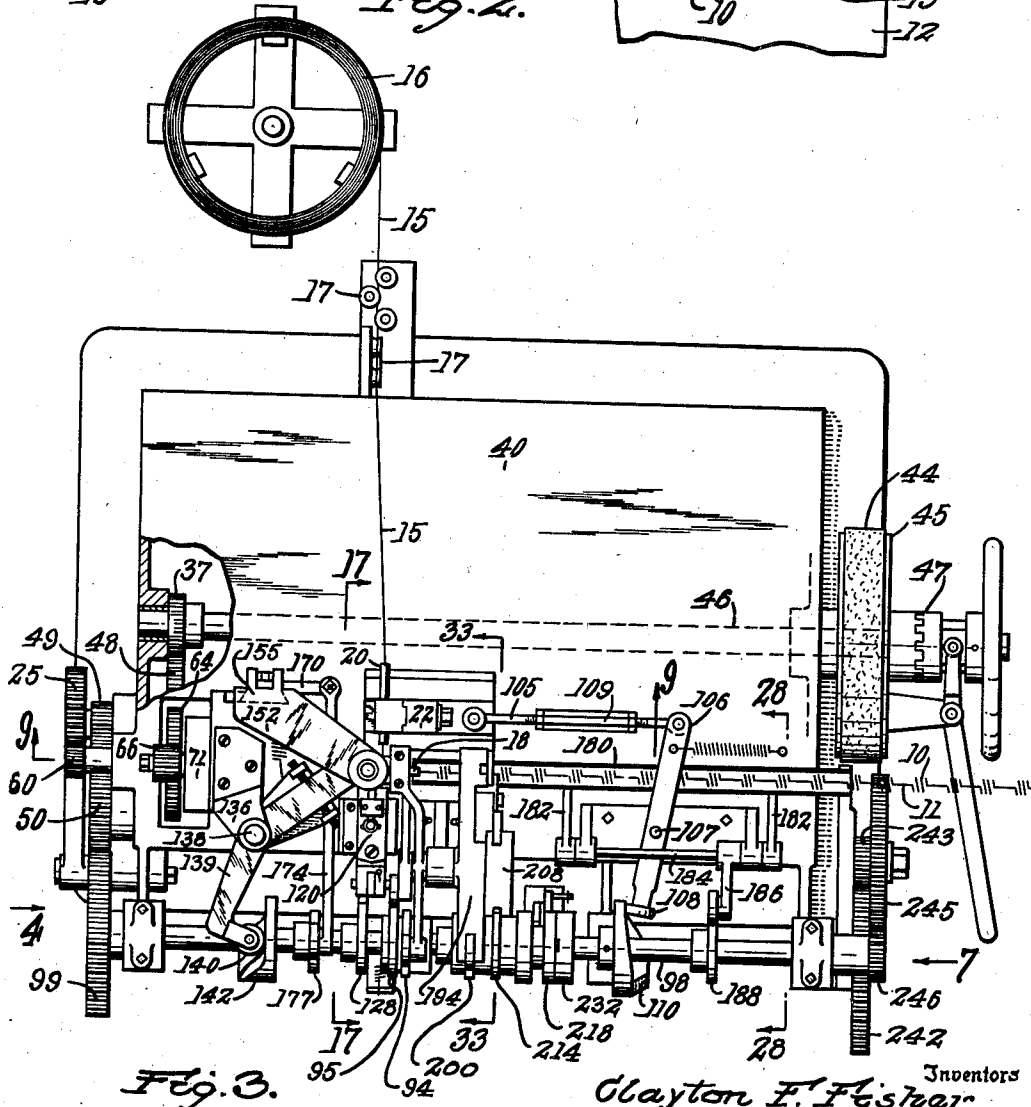
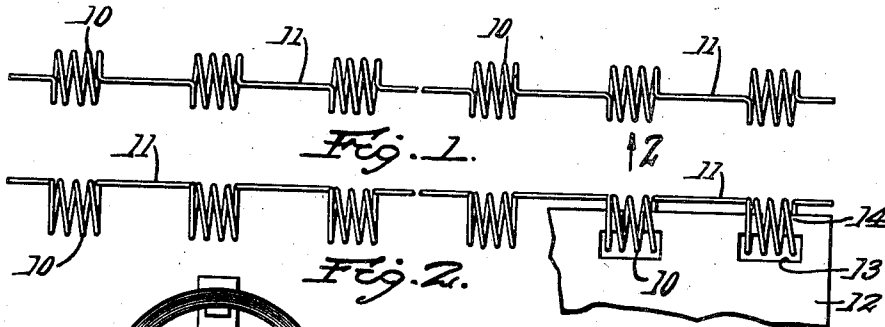


Fig. 3.

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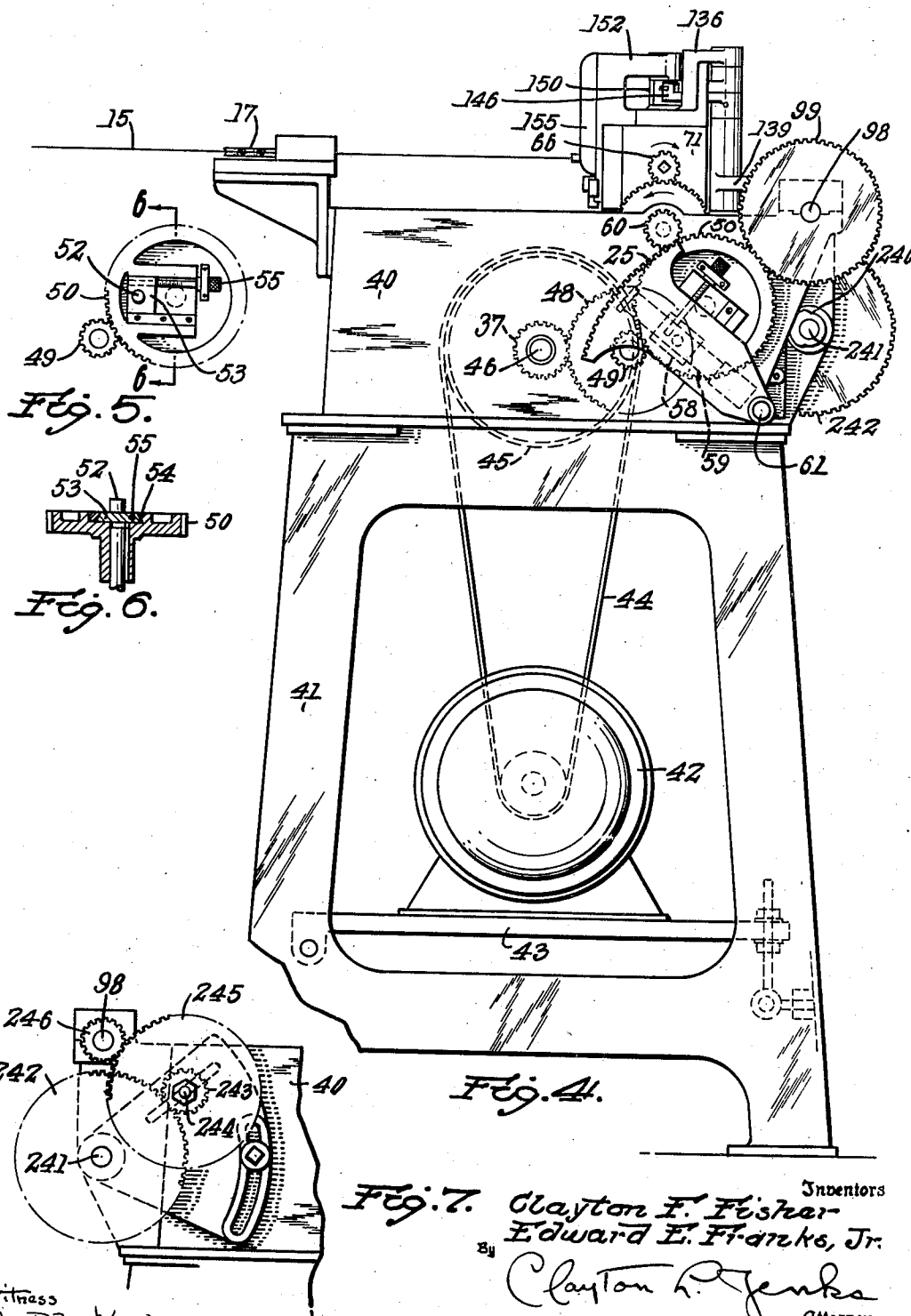
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7 Sheets-Sheet 2



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Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
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7 Sheets-Sheet 3

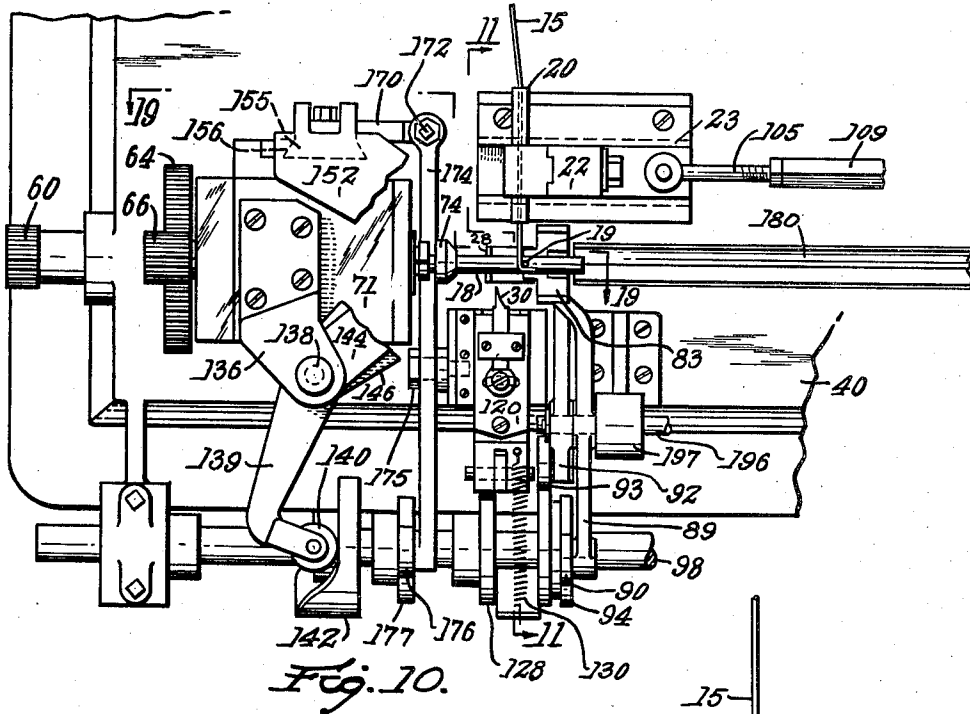
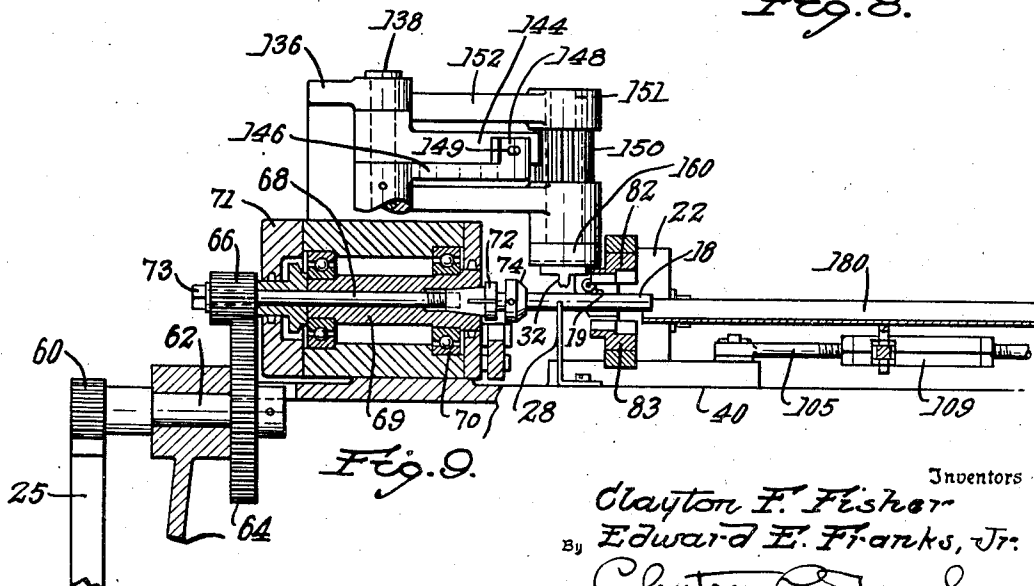


Fig. 8.



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7 Sheets-Sheet 4

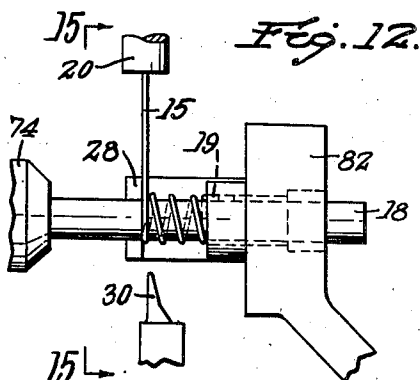
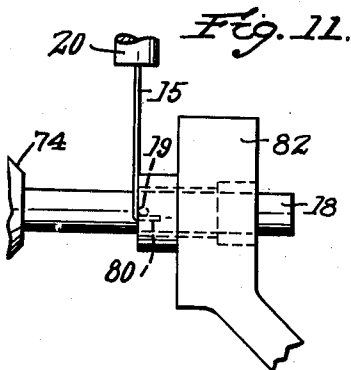
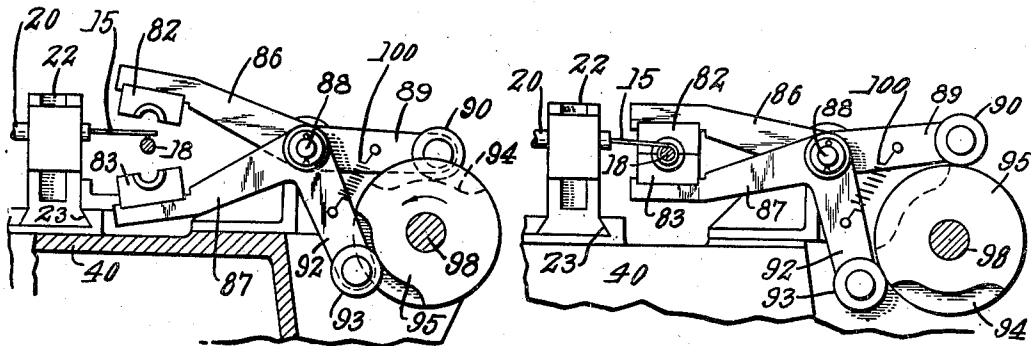


Fig. 13.

Fig. 14.

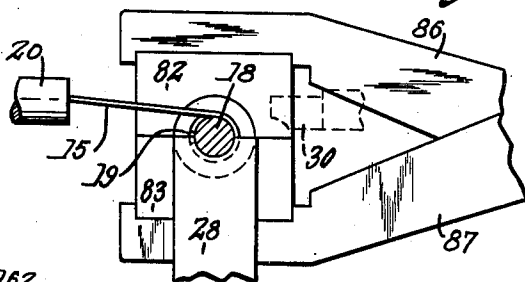


Fig. 15.

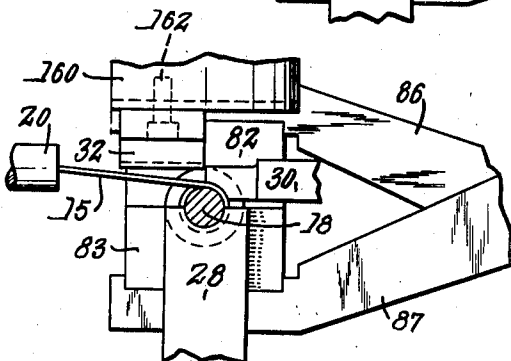


Fig. 16.

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7 Sheets-Sheet 5

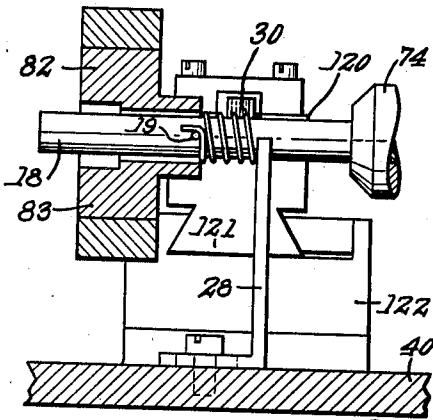


Fig. 18.

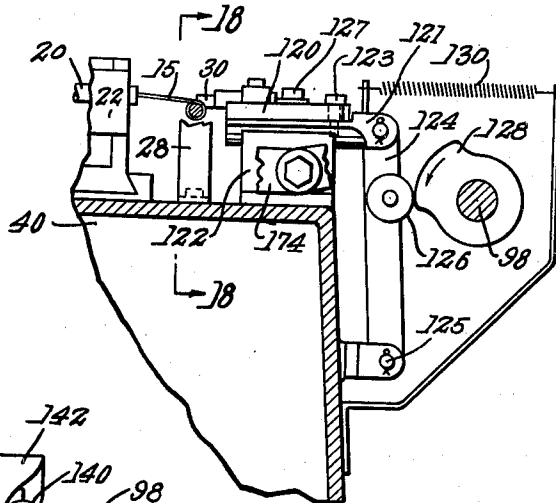


Fig. 17.

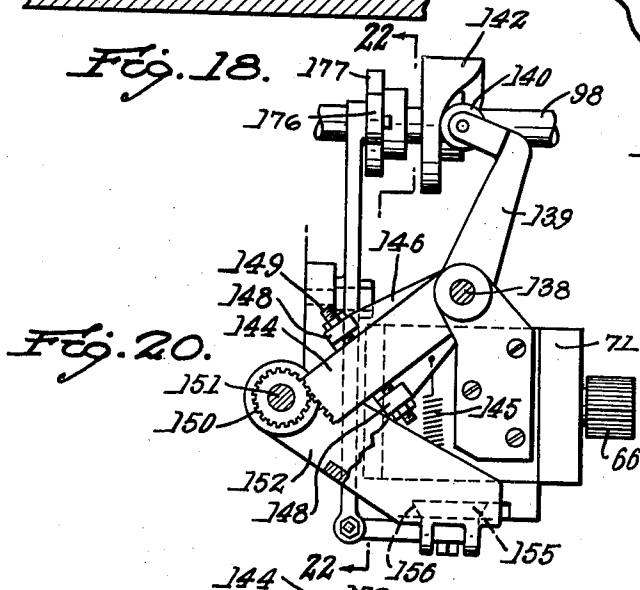


Fig. 20.

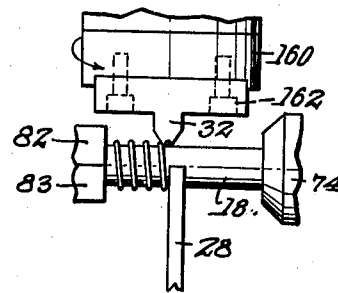


Fig. 21.

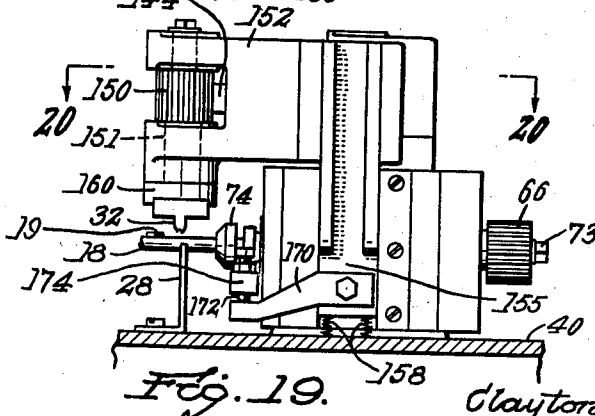


Fig. 19.

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7 Sheets-Sheet 6

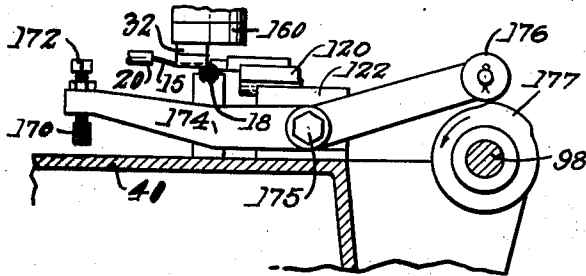


Fig. 22.

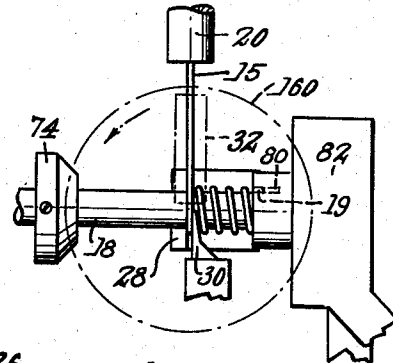


Fig. 23.

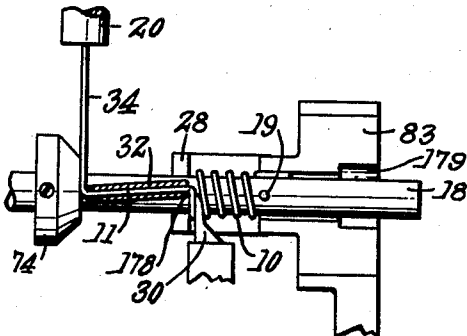


Fig. 24.

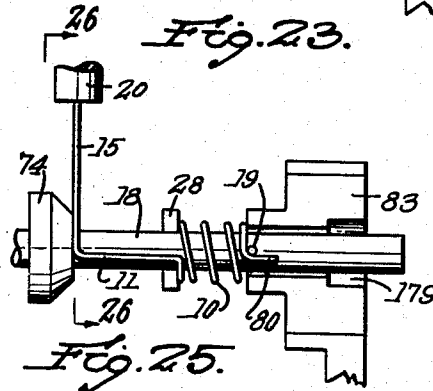


Fig. 25.

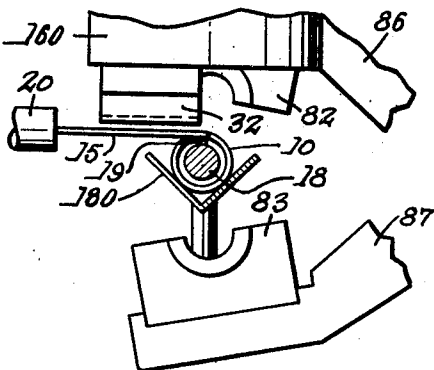


Fig. 26.

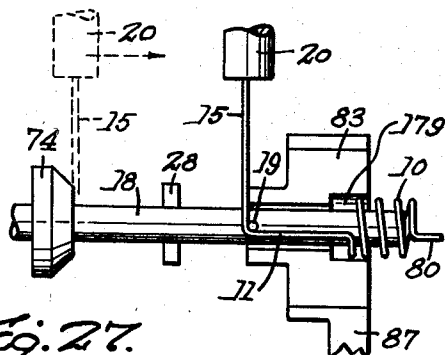


Fig. 27.

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WIRE COILING MACHINE

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7 Sheets-Sheet 7

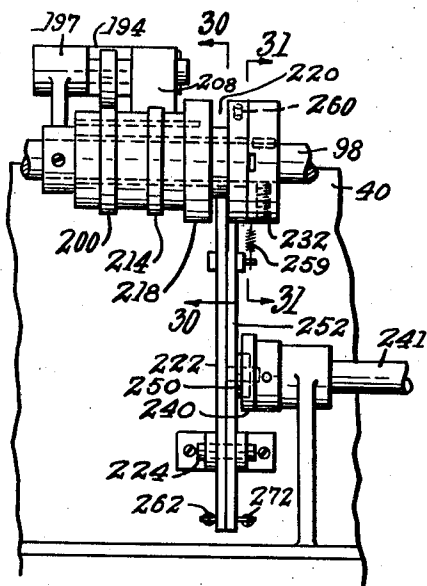


Fig. 29.

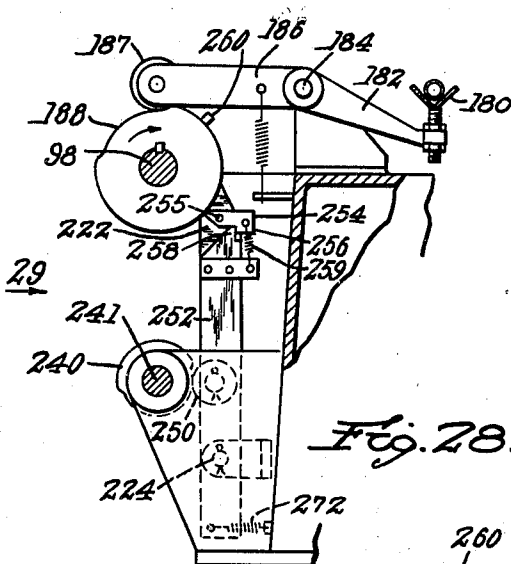


Fig. 28.

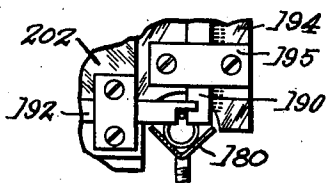


Fig. 34.

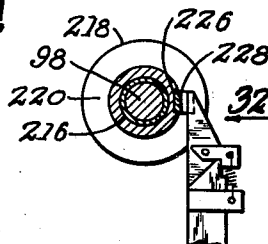


Fig. 30.

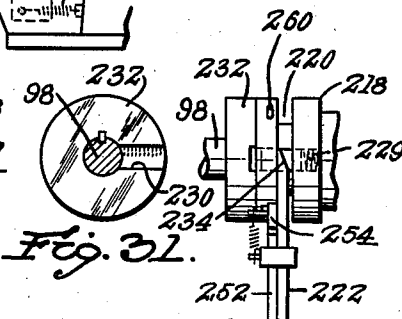


Fig. 31.

Fig. 32.

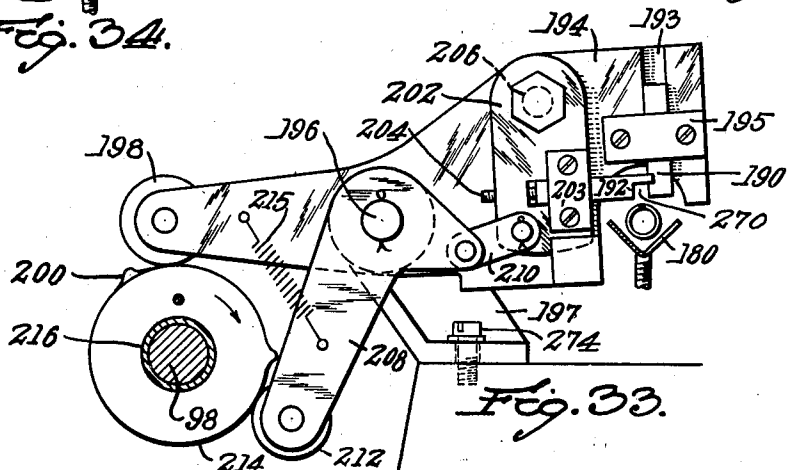


Fig. 33.

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UNITED STATES PATENT OFFICE

2,192,260

WIRE COILING MACHINE

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Hartley, Inc., Worcester, Mass., a corporation
of Massachusetts

Application September 14, 1938, Serial No. 229,958

27 Claims. (Cl. 153—67)

This invention relates to a wire coiling machine, and particularly to a machine which will form a plurality of spaced coils on a wire.

The primary object of the invention is to provide a machine of this class which will form a series of coils spaced by straight wire portions and sever the same in a desired length.

A further object is to provide a machine of this type which may be adjusted to provide coils of desired pitch and number of turns as well as to sever the wire after a predetermined number of spaced coils has been formed thereon.

A still further object is to provide a wire coiling machine which will make the coiled parts expeditiously and economically and which will coil and form the desired product from a single long piece of wire and cut the same in desired lengths without requiring manual operations.

Another object is to make a coiled wire strip suitable for use as a loose leaf book binder. Still other objects will be apparent in the following disclosure.

Referring to the drawings, we have there shown a preferred embodiment of this invention in which:

Fig. 1 is a plan view of a book binding coiled wire made by our machine;

Fig. 2 is a side view of the same looking in the direction of the arrow 2 of Fig. 1 and showing its use in binding loose-leaf pages into a binder;

Fig. 3 is a top plan view, with parts broken away, of a machine constructed for making said coiled wire;

Fig. 4 is a side elevation thereof, looking in the direction of the arrow 4 of Fig. 3;

Fig. 5 is a detail showing a part of the driving mechanism with the gear segment removed;

Fig. 6 is a section on the line 6—6 of Fig. 5;

Fig. 7 is a fragmentary view of the reduction gearing for driving the cam that controls the wire cutting operation, looking in the direction of the arrow 7 of Fig. 3;

Fig. 8 shows a fragmentary view of the leading end of the wire as it is first bent prior to the wire coiling operation;

Fig. 9 is a sectional vertical elevation, partly broken away, showing the coiling arbor and driving mechanism, the section being taken on the line 9—9 of Fig. 3;

Fig. 10 is a top plan view of the parts shown in Fig. 9;

Fig. 11 is a fragmentary section taken on the line 11—11 of Fig. 10;

Fig. 12 is a similar view showing a different position of the parts;

Fig. 13 is a fragmentary detail of the coiling arbor and associated parts as they are located at the beginning of the wire coiling operation;

Fig. 14 is a similar view showing the locations of the parts when the wire has been coiled;

Fig. 15 is a fragmentary section on the line 15—15 of Fig. 14, but with the parts in the initial coiling positions of Fig. 13;

Fig. 16 is a similar sectional view of the parts as arranged in Fig. 14;

Fig. 17 is a fragmentary sectional view taken on the line 17—17 of Fig. 3;

Fig. 18 is a sectional view on the line 18—18 of Fig. 17;

Fig. 19 is a fragmentary sectional view on the line 19—19 of Fig. 10;

Fig. 20 is a plan view on the line 20—20 of Fig. 19;

Fig. 21 is a detail of the parts arranged for bending the wire at the end of the coiling operation;

Fig. 22 is a fragmentary section on the line 22—22 of Fig. 20;

Figs. 23, 24 and 25 are details showing the steps involved in bending the wire at the end of the coiling operation;

Fig. 26 is a detail taken on the line 26—26 of Fig. 25;

Fig. 27 is a view corresponding with Fig. 25 showing the start of coiling another coil;

Fig. 28 is a sectional view on the line 28—28 of Fig. 3;

Fig. 29 is an elevation looking in the direction of the arrow 29 of Fig. 28;

Fig. 30 is a sectional view on the line 30—30 of Fig. 29;

Fig. 31 is a sectional view on the line 31—31 of Fig. 29;

Fig. 32 is a detail in elevation, looking in the direction of the arrow 32 of Fig. 30, or the reverse side of Fig. 29;

Fig. 33 is a sectional view on the line 33—33 of Fig. 3; and

Fig. 34 is a fragmentary detail of a cutter shown in Fig. 33, as positioned just prior to the cut.

This machine is intended primarily for making a wire having a series of spaced coils, as shown in Figs. 1 and 2, which are so constructed and arranged that loose-leaf sheets of paper may be bound thereby into a binder, although it will be appreciated that the machine is also adapted for making wire coils for various uses. The book binder comprises a resilient wire coiled to form several loops spaced by straight pieces

which are arranged in substantial alignment with one another and with a given peripheral portion of the coil. This coiled wire may be of the size shown in Figs. 1 and 2 and of varying lengths, although the diameter of the coil and the spaces thereof may be widely varied. The straight portions 11 of the binding wire are intended to be secured between the covers of the book or binder with the coils 10 projecting between the covers in such positions as to secure in place a set of paper sheets 12 which have T-shaped slots 13 and flaps 14 interfitting with the coils, as shown in Fig. 2. These sheets of paper may be inserted either by squeezing the coils together or by merely bending the flaps 14 of the paper so as to allow them to slip into place. This type of coiled wire may be made from a long piece of wire and cut off in desired lengths for use in the book binders.

The machine for making the coiled wire is so constituted and arranged that the wire 15 (Fig. 3) is drawn from a supply reel 16 of suitable construction and through a set of straightening rolls 17 by means of a rotating arbor 18 (Figs. 10, 13 and 14) which has a projecting pin 19 adapted to engage the advance portion of the wire lying at 90° to the line of feed. As the arbor rotates, the wire is moved longitudinally or parallel with the axis of the wire by means of a guide or sleeve 20 (Fig. 10) carried on a slide 22 mounted in dove-tailed slideways 23 and suitably reciprocated by a cam mechanism to be described. This reciprocated member determines the pitch of the coil or the spacing of the loops of the wire. The number of loops of the coil is determined by the operation of a reciprocable gear segment 25 (Fig. 4) and driving mechanism that is adjustable to rotate the arbor through a required number of turns. By the time the gear segment has reached the end of its forward drive, the feeding wire 15 has been made into the desired number of coils and the wire then butts against the side of an upstanding stop 28 (Fig. 14) which is longitudinally adjustable to vary the length of the coiled portion of the wire. Then a finger 30 moves forward from the position of Fig. 14 to that of Fig. 23 where it lies back of the upper part of the last wire coil on the opposite side of the wire from the stop 28. Then a grooved revoluble member 32 moves down and straddles the wire and revolves in the direction of the arrow in Fig. 23 so as to bend the wire outside of the coil into the position shown in Fig. 24. The finger 30 holds the coil against the thrust of the bending operation. This leaves a portion 34 of the wire arranged at substantially right angles to the straight portion 11 and thus in position for forming another coil.

The machine (Fig. 4) comprises bed plates 40 arranged to carry the shafting and supported on base frame 41, which in turn carry a driving motor 42 adjustably supported on a swinging shelf 43. This motor connects through a belt 44 with a pulley 45. This pulley is loose on the shaft 46 and serves to drive the shaft through a suitable manually controlled clutch mechanism 47 (Fig. 3), the pinion 37 drives through a large gear 48 the small gear 49 keyed on the same shaft therewith, and the latter in turn drives another large gear 50 which operates the segment 25. This gear 50 which is suitably mounted on the machine, carries a pin 52 (Fig. 5) projecting from a sliding block 53 carried in under cut slideways 54 (Fig. 6) and adjustable into position radially of the gear 50 by a hand operated adjusting screw

55. This pin 52 engages a suitably shaped hole in the block 58 (Fig. 4) which is slidably mounted in a slot 59 in the gear segment 25. The latter is pivotally mounted on a short shaft 61 on the bed and arranged to swing back and forth and be driven by the connecting pin 52, as the gear 50 rotates. The radial throw of the pin 52 is varied by the adjusting screw 55 and this determines the distance of movement of the gear segment and the number of revolutions of the coiling arbor.

This gear segment 25 drives a small gear 60 keyed on the end of the cross shaft 62 (Fig. 9) which has keyed on its opposite end a large gear 64 driving a small gear 66 fixed on a sleeve 69 mounted on the ball bearings 70 which are in turn suitably mounted in the surrounding housing 71 on the frame. The right hand end of the sleeve 69 is tapered to receive the spring collet 72 slidably fitted therein and held in position by the clamping bolt 68. A nut 73 on the opposite end of the bolt 68 serves to draw the collet tightly into the sleeve and make the sleeve and shaft rotate together. The collet is hollow and has slots in its sides forming resilient members adapted to clamp against the left hand end of the arbor 18 and hold it in position for rotation. This makes it possible to utilize arbors of different diameters and lengths for making different types of wire coils. The arbor 18 has a tapered collar 74 secured thereto by a set screw and this is of large diameter and shaped to bear against the in-feeding wire at the end of the operation of forming the straight part 11 of the binder wire, as shown in Fig. 24. That is, the revoluble member 32 forces the wire against the inner face of this collar and bends it at right angles thereagainst and thus leaves the wire in proper position for forming a new coil.

When the wire 15 is first threaded through the guide or sleeve 20 for starting a coiling operation the advance end is bent by hand at right angles, as shown in Fig. 8, and this bent portion 80 is positioned back of the pin 19 for starting the first coil. As shown in Figs. 11, 12 and 13, the starting end 80 of the wire is held against the arbor 18 by means of two clamping jaws 82 and 83 having half cylindrical surfaces thereon of a slightly larger radius than that of the arbor plus the thickness of the wire thereon, so that the jaws will hold the wire in interlocking engagement with the pin 19 and the latter will drag the wire therewith and cause it to coil on the arbor. The clamping jaw 82 (Fig. 12) is mounted on a rocking lever 86, and the other jaw 83 is mounted on a rocking lever 87, both of which are pivoted on the short shaft 88 suitably mounted on the framework. A continuation 89 of the lever 86 has the roller 90 thereon, and a similar continuation 92 of the lever 87 has another roller 93 thereon. These rollers are adapted to engage cams 94 and 95 mounted on the shaft 98. This cam shaft (Figs. 3 and 4) has a gear 99 keyed thereon, which meshes with the gear 50 and thus is rotated at a very slow speed, which is once for the total number of convolutions of the coil to be made, such as 4.75 turns of which four remain after the coil has unwound due to the resiliency in the wire. These cams are so shaped that the clamps are held stationary surrounding the advance end of the wire during the entire stage of making the convolutions, as shown in Fig. 12, so that the wire cannot escape from contact with the driving pin 19. A spring 100 serves to hold the jaw levers against the cams.

The pitch of the coil is determined, as above stated by the guide or sleeve 20 carried on the slide block 22 which is moved steadily towards the left during the coiling operation. This motion is accomplished by an adjustable linkage 105 (Fig. 3) which is connected to the upper end of a rocking lever 106 pivoted at 107 on the framework. The lower end of this lever has a roller 108 engaging the side face of a cam 110 on the cam shaft 98. This cam is so shaped that, as the arbor makes its complete number of turns in the coiling direction, the slide block and its sleeve 20 will move at a desired rate of speed towards the left. The rate of this speed of the pitch of the coil may be varied by changing the cam for another of a different face shape. The rod 105 has a turnbuckle 109 therein to adjust its length and thus adjust the starting position of the coil.

At the end of the coiling operation, the wire 15 has been moved by the sliding guide or sleeve 20 so that it now touches the inner face of the stop 28 (Fig. 9) which is an L-shaped member adjustably mounted on the framework of the machine. The throw of the gear segment has been so adjusted that the rotation of the arbor stops when the wire is at this point. Then, the finger 30 moves forward, as above described, to hold the wire in position. This finger 30 is tapered, as shown particularly in Figs. 14 and 24, so that it slips in between the last coil and the straightaway portion of the wire 15 and it serves as a backstop to take the back pressure of the coil when the next stage of bending the wire is effected. As shown in Figs. 17 and 18, this finger 30 is movably mounted on a block 120 pivoted at 123 on a dovetailed slide 121 mounted on a slideway in the top of the member 122 suitably carried on the base. The block 120 is held in an adjusted position by a cap screw 127 passing through an elongated slot in the block 120 and threaded in the slide 121. This adjustment moves the finger 30 laterally to position it tightly against the wire when the bend is made.

The rear end of the slide 121 is connected to the short upper end of the lever 124 pivotally mounted at 125 on the base of the machine. The lever has a roller 126 adapted to be moved by the peripheral face of the cam 128 mounted on the cam shaft 98 and held in place by a spring 130. This cam is so shaped that the finger 30 moves to engage the last convolution of the coil only after the coiling has been finished and to stay there during the next step of bending the wire. Then the finger 30 is removed from contact with the coil and another coiling operation may proceed. As shown particularly in Fig. 16, the stop 28 engages only the lower half of the coil, while the finger 30 engages the upper half of the coil on the opposite side of the wire. These two parts, although not opposite each other, nevertheless serve as a guide which holds the wire therebetween and it permits the wire to be bent above the top edge of the stop 28.

On the top of the housing 71 which carries the arbor and its ball bearings, as shown in Fig. 9, is mounted a bracket 136, which supports a vertical shaft 138. An arm 139 (Figs. 10, 19 and 20) which is pinned on this shaft 138 has a roller 140 on its inwardly bent end which engages the side face of the cam 142 keyed on the shaft 98. Loosely mounted on the shaft 138 is a swinging gear segment 144 (Fig. 20) and keyed to the shaft 138 is an arm 146 which is wider than the gear segment 144. This arm has two upstanding lugs

148 which carry adjusting screws 149 therein arranged to engage the opposite sides of the gear segment 144 and thus adjust the position of the segment as well as to move the same under the action of the cam 142. A spring 145 serves to return this arm 146 and the segment 144. The gear segment 144 meshes with a small pinion 150 on a shaft 151. This gear 150 is mounted between the arms of a yoke 152. On a continuation of the yoke 152 is a vertical projection 155 which is dovetailed in shape and serves as a slide adapted to interfit with a slideway 156 in the housing 71. The springs 158 (Fig. 19) serve to hold the slide in an uppermost and inoperative position.

The lower end of the shaft 151 (Fig. 9) carries a disk shaped head 160 arranged to receive and support the wire bending member 32. Two cap screws 162 (Fig. 21) serve to secure the element 32 on the head. The member 32 is shaped as a downwardly projecting, narrow, tapered body, and it is provided with a slot in its under face of a size slightly greater than the diameter of the wire, so that it will straddle the same at the end of the last convolution and beyond the stop 28 and the back member 30. The gear 150 therefore serves to rotate the wire bending tool 32 at a required time as driven by the gear segment 144 which in turn is operated by the cam 142.

As shown in Figs. 19 and 22, an arm 170 projects outwardly from the slide 155 near its bottom end. The outer end of this arm 170 engages an adjustable screw 172 on the end of a further rocking lever 174 pivoted at 175 on the member 122. A roller 176 on the opposite end of this rocking lever engages a cam 177 keyed on the cam shaft 98. This serves at a predetermined time to move the slide upwardly or to allow it to move down, so that the wire bending tool 32 will engage the wire as needed. The bending tool 32 has a length substantially equal to the straight portion 11 on the finished product. The right hand edge of the forming tool 32 (Fig. 22) is slightly to the left of a vertical diametrical line of the arbor and coil but close enough thereto so as to form a very sharp bend 178 (Fig. 24) in the wire.

The sleeve or guide 20 is located somewhat above the top of the arbor so that when the forming tool 32 comes down and grips the wire, it will bend the wire slightly downwards, as shown in Fig. 22. The resiliency of the wire thus tends to lift the coil after the forming tool 32 has receded from contact therewith. That is, as shown in Fig. 26, when the jaws 82 and 83 are opened, the coil is lifted so that the upper portion of the coil is above the forming pin 19. Hence, the resilience of the wire holds the coil in that position and the forward movement of the coil caused by the reverse movement of sleeve 20 towards the right will carry it past the pin 19 to the position shown in Fig. 27. Both of the segments 144 and 25 return to their initial starting positions while the clamping jaws 82 and 83 are in an open position. This allows the arbor pin 19 to revolve in a reverse direction to its starting position and not to interfere with the loops of the coil. That is, the spring wire, owing to its natural resiliency, will open up to a much larger loop than the diameter of the coiling arbor, hence there is room inside of the coil for the coiling pin 19 to revolve freely to its starting position. At the end of the return stroke of the driving segment, the pin 19 has revolved to a point where it may contact the bent loop 178

and is again in position for making a new coil. At the same time, the jaws 82 and 83 (Figs. 11 and 24) move downwards to hold the wire in contact with the pin 19 so that a new coil will be started. The coil that has been previously made is free and revolves about its axis as the next loop of the wire is being formed, an enlarged recess 179 being provided in the jaws for receiving the coiled wire.

- 10 During the time that the forming tool 32 swings around to bend the wire (Fig. 23) the sleeve 20 is being moved on its slide block to the position shown in Fig. 24, where the straight portion 34 of the wire is in line with the sleeve. Then the sleeve 20 moves again towards the right to the position shown in Fig. 27 and thus shoves the previously made coil out of the coiling position and leaves the wire ready for making a new coil. The coiling operation then proceeds anew, and the cycle of operations is repeated until the required number of coils has been made and the wire is to be cut off.

- The wire with its spaced coils comes off the coiling arbor and ultimately rests in a trough 180 which serves to support the same in the machine while it coils; also it centers the coil relative to the arbor so that the pin 19 may revolve freely during its return stroke. This V-shaped trough 180, as shown particularly in Fig. 28 is supported on two rocking arms 182 which are pivotally mounted on a cross shaft 184 suitably supported on the machine frame. A further arm 186 (Figs. 3 and 28) is keyed to the shaft, and this has a roller 187 thereon engaging the peripheral surface of the cam 188 which is keyed to the cam shaft 98. This cam has a high cylindrical surface, as shown in Fig. 28, which serves to hold the trough in the position of Fig. 26 slightly away from the coil during the wire coiling operation. Then the roller 187 rides onto a lower cylindrical portion of the cam and lifts the trough 180 into the position shown in Figs. 28 and 34, where the trough acts as a support for the coiled wire against the pressure of the wire cutting tool.

- The cutting operation is accomplished by means of a stationary cutter 190 (Fig. 33) cooperating with a movable cutter 192 arranged to grasp the wire therebetween and cut the same. The stationary cutter 190 is a suitably shaped rectangular bar with a sharpened rear edge which is removably inserted in a slot 193 in the right hand end of the rocking arm 194 and is held in place by a removable plate 195, as illustrated. The arm 194 is pivotally mounted on a stud 196 carried by a bearing 197 suitably mounted on the framework of the machine. The left hand end of the rocking lever 194 has a roller 198 thereon, which engages a cam 200 mounted loosely on the cam shaft 98. This cam 200 has a single hump on its periphery, as shown in Fig. 33, which is adapted to lift the roller 198 momentarily and to rock the arm 194 bearing the cutter knives.

- The other cutter tool 192 is slidably mounted in a groove in the swinging arm 202 and held in place by a plate 203, and it is adjusted to a desired position by a screw 204 threaded through the rocking arm 202 and engaging the rear of the cutter bar 192. The arm 202 is pivotally mounted on a stud 206 secured in the side of the rocking lever 194, so that the cutter 192 may swing relative to the other cutter. This swinging motion is accomplished by means of a rocking lever 208 freely pivoted on the stud 196 and connected by a short link 210 with the swinging arm 202. This

lever 208 has a roller 212 on its lower end engaging a further cam 214 also loosely mounted on the cam shaft 98. A spring 215 tends to hold the two rollers on the levers in engagement with their respective cams.

The two cams 200 and 214 are fixed on a sleeve 216 which is loosely mounted on the shaft 98. This sleeve has a member 218 integral therewith at its right hand end which is shaped as a spool (Fig. 29) providing a deep annular groove 220 within which rides the upper end of a lever 222. The latter is a part of a clutch mechanism that controls the number of coils that may be made on the wire before the cutters sever it. This spool shaped member 218 is rotated by the shaft 98 at certain timed intervals as determined by the clutch mechanism to be described.

The clutch mechanism which locks the spool 218 to the shaft 98 comprises the swinging lever 222, which is pivotally mounted on a stud 224 (Fig. 29) carried on the base of the machine. The spool 218 has a slot 226 (Fig. 30) therein parallel with its axis, within which slides a sliding bar 228 held toward the lever by means of a spring 229 which tends to push the sliding bar 228 toward the left, as shown in Fig. 32. This sliding bar is adapted to be moved by the spring into a groove 230 located in the clutch member 232 (Figs. 29 and 32) which is keyed to the shaft 98. This bar normally rides with the spool, and it locks the spool to the rotating member 232 only when the bar 228 has been slid into the slot 230. The bar is moved from its unlocked position to a locked or clutched position by means of the arm 222 which is provided with a beveled end 234 engaging a correspondingly shaped part projecting upwardly from the sliding bar 228. The lever 222 is normally in the position of Fig. 30 in which its beveled end engages the beveled block 228 and holds the sliding bar 228 out of the groove 230, so that the spool is not rotated. When the lever 222 is, however, moved in the opposite direction by a cam mechanism, it swings away from the wedge block and the spring 229 then causes the sliding bar to strike against the inner face of the rotating member 232 and ride thereagainst until the groove 230 comes around, whereupon the bar slips into the groove and thus locks the spool 218 to the rotating sleeve 232 which in turn is driven by the cam shaft 98.

The clutch mechanism is controlled by a cam 240 (Fig. 28) mounted on a short shaft 241 on the machine. This shaft 241 is rotated, as shown in Fig. 7, by means of a large gear 242 keyed to the shaft 241 which is driven by a small gear 243 on a further short shaft 244 which carries a large gear 245 keyed thereto. This large gear is in turn driven by a small gear 246 on the cam shaft 98. These parts are so constructed and arranged that the large gear 242 and its cam 240 are rotated at a very slow rate as compared with the cam shaft 98. The gear ratio may be varied as desired by an exchange of gears, and this makes it possible to make a desired number of coils before the wire is cut. The gear ratio, for example, may be such as to produce 6, 11 or any other desired number of coils.

This slowly rotating cam 240 has high and low parts on its periphery which are arranged to engage a roller 250 (Figs. 28 and 29) on a rocking lever 252 mounted on the same shaft 224 that carries the locking lever 222. The rocking lever 222 has a latch 254 pivoted at 255 thereon, and this latch has a downwardly projecting lug 256 adapted to serve as a latch to hold against the

pointed top 258 of the lever 252. A spring 259 connected to the rocking latch 254 and a plate projecting from the lever 252 tends to hold the latch in its locked position, so that when the cam 240 rotates and pushes on the roller 250 it causes the lever 252 to move towards the right and thus move the lever 222 with it. When the high part of the cam 240 moves its levers towards the right, this releases the locking bar 228 and causes it to engage the slot 230 and lock the spool 218 to the driving plate 232. This causes the cams 200 and 214 to rotate and operate the cutter bar mechanism. The spool 218 has a pin 260 (Fig. 28) projecting from its periphery, and this pin is adapted to strike against the lefthand end of the latch 254 and lift the latch from its locking position and permit a spring 262 (Fig. 29) on the bottom of the lever 222 to swing the same forward into engagement with the sliding bar 228 and thus pull the bar from its locking position. That is, the pin 260 on the spool unlocks the latch for each revolution of the spool, so that the spool can make only one complete revolution before the clutch is thrown and the spool is stopped. A spring 272 holds the lever 252 with its roller against the cam.

The rotation of the cams 200 and 214 by this clutch mechanism first causes the roller 198 to strike the hump on cam 200 and swing the right hand end of the rocking bar 194 downwardly until the wire is located in a space 270 (Fig. 34) between the fixed cutter bar 190 and the notched end of the movable bar 192. Then after this has taken place, the hump on the second cam 214 strikes the roller 212 on the rocking lever 208 and thrusts the movable cutter 192 towards the right and thus severs the wire. The roller 198 will not have passed the hump 200 before the cutting operation takes place. The cutter parts are so located as to cut substantially half way between two coils and thus leave a projection on each end of the binder wire, as shown in Fig. 1. The cutter assembly is held in position by cap screws 274 set into the frame and located in long slots in the support 197, so that the cutters may be adjusted along the wire and thus form long or short ends (Fig. 1) on the coiled wire binder.

The operation of this device will be apparent in view of the above disclosure. The machine comprises a rotatable, non-reciprocating arbor which is rotated intermittently through a predetermined but variable number of turns. The arbor has a coiling pin 19 thereon adapted to engage a bend in the wire and to wind the wire around the rotating arbor. The incoming wire is fed tangentially to the arbor from a source of supply which includes straightening rolls 17 that grip the wire with sufficient pressure to insure a considerable frictional drag and thus make the wire coil tightly about the arbor. The pitch of the coiled wire is determined by the longitudinal sleeve or guide 20 which is reciprocated by cam mechanism through a given distance and at a rate that is determined by the throw of the cam. The distance and rate may be varied by changing the shape of the cam 110 or otherwise adjusted, such as by varying the position of the pivot point 107 of the lever 106 that is moved by the cam 110. The adjustable turnbuckle 109 determines the starting or stopping positions of the wire. The driving mechanism, which includes the driven gear segment 25 and its adjustable connection with the driving gear 50, determines the extent of rotation of the arbor 18 and thus controls the number of turns or coils of wire which

are wound on the arbor during its forward motion. The pitch determining sleeve or guide 20 moves steadily in a lateral direction to wind the wire in evenly spaced coils. When it reaches its end position as determined by the throw of its driving cam the wire then comes against the stationary but adjustable stop 28 so that the pitch changes at this point and the wire is substantially at right angles to an axial plane, as shown in Figs. 23, 24 and 25. The arbor is substantially stationary at this time while the gear segment drive for the arbor is going over dead center, and the bending tool 32 is lowered by its cam 177 and the cooperating levers 174 and the arm 170 (Fig. 19) so that the bending tool straddles the incoming portion of the wire 15. Before the bending tool 32 can rotate, the finger 30 is also moved forward by its cam 128 (Fig. 17) so that it is in the position of Fig. 23 and forms with the part 28 a guide which holds the coiled wire immovable while the bending takes place. Then the member 32 is revolved by its driving gear 150 and the gear segment 144 which are in turn actuated by the cam 142 (Fig. 20). This bending tool 32 revolves from the position of Fig. 23 to that of Fig. 24, and preferably slightly more than 90°, so that the natural resiliency in the wire may be permitted to straighten the bend to some extent and leave the wire substantially parallel with a diametrical plane of the arbor. Then the pitch determining sleeve or guide 20, which has moved rapidly to the left as the tool 32 bent the wire, now starts back towards the right. The clamping jaws 32 and 33 have heretofore been in the closed position of Fig. 12 during the coiling operation so that the wire cannot jump off the coiling pin 19. The cams 94 and 95, which control these jaws, are so timed relative to the other mechanism that the jaws are open by the time the coiling pin 19 has made a turn or partial turn in the non-coiling direction, and then permits the coil of wire 10 to expand under its natural resiliency and thus be released from the coiling pin. The jaws in their wide open position permit the coil to be moved to the right as the sleeve 20 travels rapidly to its initial starting position where the straight portion 15 of the wire strikes the pin 19. Then the arbor and coiling pin 19 start again in their reverse direction and the sleeve 20 again moves to the left for a new coiling operation. At the same time, the jaws close to prevent the wire from jumping off the pin.

This coiling operation is repeated until the desired number of coils have been formed on the wire. Then the cutter timing mechanism comes into play and the cutting tools governed by the cams 200 and 214 sever the wire at a time when the trough 180 has been moved upwardly by its cam 133 to serve as a rest to steady the wire while it is being cut. The cutters are preferably so timed that the recoil or uncoiling of the coiled wire has stopped after the jaws have opened so that the coiled wire is stationary. The clutch mechanism illustrated particularly in Figs. 29 to 32 controls the numbers of coils that may be made on the wire before the cutters sever it. This variation in coils is effected in the present construction by varying the ratio of the teeth on the driving gears 242 and 243 shown in Fig. 7, the mountings for which are so arranged that different sizes of gears may be readily substituted for those previously used. One may, if desired, substitute other types of speed control mechanism therefor. The cam 240 and associated mechanism controls the clutch connection of the spool

218 to the driving plate 232 and thus controls the operation of the cutter cams.

The position of cutting the wire between two coils is determined by sliding the cutter assembly back and forth. If it is desired to have no wire projecting from the end coils, then two pairs of cutters may be placed side by side in the cutter mechanism and operated simultaneously so as to cut out a predetermined portion of the wire and cause that part to be removed from the object to be produced.

It will be appreciated that many other changes may be made in the constructional features of this mechanism and that one may substitute equivalent mechanical movements for those shown in the drawings. For example, one may use adjustable cams and thus avoid the necessity for changing the cams to vary their action. Other constructions may also be employed to vary the throw of the cam follower for each of these cams. Also, equivalent devices, such as slots and shoulders formed on the coiling arbor may be substituted for the coiling pin. It will further be appreciated that the clamping jaws 82 and 83 form a tubular member which is movable to hold the wire operatively associated with the coiling pin during production of the coil and thereafter to permit recoil or expansion of the coiled wire and leave it free for movement along the arbor; hence various tubular constructions which surround the arbor and pin may be employed in place of the split tube here shown. Also the guide 20 may be variously shaped and arranged to deliver or feed the wire to the arbor and determine the pitch, as well as to move the coil axially along the arbor. The finger 32 and the collar 74 form spaced stops against which the wire is bent, and it is to be noted that each contacts with the wire on the outside of the bend so as to allow the wire to take a natural shape determined by its physical properties and thus avoid cutting the wire. However, other constructional arrangements may be substituted therefor which will serve to shape the incoming wire after one coil has been made and leave the wire positioned for making a second coil spaced from the first. It will also be understood that various constructional features herein described may be used in other types of wire coiling apparatus, such as one which comprises a reciprocating, rotating arbor, and that they are not necessarily limited in their use to the machine shown in the drawings. Hence, the above disclosure is to be considered as illustrative of the invention and not as limiting it except as defined by the claims appended hereto.

We claim:

1. A wire coiling machine comprising a rotatable, non-reciprocable arbor having a coiling pin thereon, means for rotating the arbor intermittently in opposite directions and means including a guide reciprocated in timed relation with the arbor rotation which feeds wire to the arbor and determines the coil pitch during movement in one direction and which moves the coil axially along the arbor during the reverse movement thereof.

2. A wire coiling machine comprising a rotatable, non-reciprocable arbor having a coiling pin thereon, means for rotating the arbor intermittently in opposite directions, means including a guide reciprocable parallel with the arbor axis in one direction for feeding wire to the arbor and determining the pitch of the coil and in the other direction to move the wire coil axially of the arbor, and means associated therewith for shaping

the uncoiled wire and leaving it in operative association with said pin for making another coil.

3. A wire coiling machine comprising a rotatable and non-reciprocable arbor having a coiling pin thereon, means for rotating the arbor, intermittently actuated means for holding the wire in coiling association with said pin and for releasing the same therefrom, and means including a reciprocable guide which feeds wire to the arbor and determines the pitch of the coil while moving in one direction and which moves the coil axially along the arbor when the coil is released from said pin.

4. A wire coiling machine comprising means including a rotatable arbor having a coiling pin for making a wire coil on the arbor and a tubular member surrounding the arbor and coiling pin for holding the coiled wire in position against the pin during the coiling stage.

5. A wire coiling machine comprising means including a rotatable arbor having a coiling pin thereon arranged to engage and coil a wire delivered thereto, and means providing a movable tubular member surrounding the coiling pin and arbor which is movable to hold the wire in engagement with the pin during the coiling operation and thereafter release the coil.

6. A wire coiling machine comprising a rotatable, non-reciprocable arbor having a coiling pin adapted to wind wire thereabout, a wire feeding guide reciprocable parallel to the axis of the arbor which determines the pitch of the coil when moving in one direction and which moves the coil axially along the arbor when moving in the opposite direction, and means comprising a tubular member which holds the wire in coiling contact with the pin during the coiling operation and thereafter permits removal of the coiled wire from the arbor.

7. A wire coiling machine comprising a rotatable, non-reciprocable arbor having a coiling pin thereon, a pair of jaws movable to provide a tubular surface surrounding the arbor and coiling pin and holding the wire in engagement therewith during the coiling operation, a reciprocable guide for feeding wire to the arbor and determining the pitch of the coil while moving in one direction and which moves the coil axially along the arbor when moving in the opposite direction and means for opening the tubular jaws to permit recoil of the wire and removal of the coil past the coiling pin.

8. A wire coiling machine comprising a rotatable, non-reciprocable arbor having a coiling pin thereon, a guide reciprocable for feeding wire to the arbor and determining the pitch of the coil when moving in one direction and for removing the coil from the arbor while moving in the opposite direction and means actuated in timed relationship with the guide movement for severing the coiled wire.

9. A wire coiling machine comprising a rotatable, non-reciprocable arbor having a coiling pin thereon, a guide reciprocable parallel with the arbor axis for feeding wire to the arbor and determining the pitch of the coil while moving in one direction and for moving the coil axially along the arbor during the reverse movement, means for shaping the end of the wire after the coiling operation, and cutter mechanism operated in timed relationship therewith for severing the end of the shaped wire.

10. A wire coiling machine comprising a rotatable, non-reciprocable arbor having a coiling

pin thereon, means including a reciprocable guide for feeding wire to the arbor and determining the pitch of the coil and thereafter moving the coil axially along the arbor, means for bending the incoming portion of the wire and leaving it positioned for a further coiling operation and means for severing the wire after a multiplicity of coils has been formed thereon.

11. A wire coiling machine comprising a rotatable, non-reciprocable arbor having a coiling pin thereon, means including a reciprocable guide for feeding wire to the arbor and determining the pitch of the coil and thereafter moving the coil axially along the arbor, means operated in timed relationship with the reciprocating guide for bending the incoming wire towards an axial plane of the coil and leaving it in position for further engagement with the revolving coiling pin, and means associated with the coiling pin for holding the wire in operative contact therewith during the coiling operation and for releasing the same to permit axial movement thereof.

12. A wire coiling machine comprising a rotatable arbor, means for rotating the arbor and forming a coil of wire thereon, means comprising a movable member for bending the end of the coiled wire towards a diametrical plane of the arbor, and means for supporting the wire against the bending thrust which contacts with the wire on that side which is on the outside of the bend.

13. A wire coiling machine comprising a rotatable, non-reciprocable arbor having a coiling pin thereon, a guide reciprocable for feeding wire to the coil and determining the pitch thereof, means including a movable bending tool which engages the incoming wire at the end of the coiling operation and bends the same, and means for holding the wire coil against the bending stress.

14. A wire coiling machine comprising a rotatable, non-reciprocable arbor having a coiling pin thereon, a guide reciprocable for feeding wire to the coil and determining the pitch thereof, means including a movable bending tool adapted to engage the wire at the end of the coiling operation and to bend the same towards an axial plane of the arbor and means including a finger movable to engage and support the wire against the bending stress and thereafter release the wire.

15. A wire coiling machine comprising a rotatable arbor having a coiling pin for winding a wire fed thereto, means associated therewith for making a coil of predetermined pitch and number of turns on the arbor, a stop remote from the finished coil and means which grips the incoming straight wire and bends it against said stop and thus forms a straight portion connected with the coil.

16. A wire coiling machine comprising a rotatable arbor having a coiling pin for winding a wire fed thereto, means associated therewith for making a coil of predetermined pitch and number of turns on the arbor, two stops, one located near the finished coil and the other remote therefrom, and means which grips the incoming wire and bends it against the stops and provides a straight portion connected with the coil which is at an angle to the incoming wire.

17. A wire coiling machine comprising a rotatable, nonreciprocable arbor, a reciprocable guide for feeding the incoming wire to the arbor and determining the pitch of the coil and thereafter moving the coil axially for forming a new coil on the wire, two spaced stops arranged to contact with the wire near the coil and remote

therefrom and means for gripping the wire and bending it against said stops and thus forming a straight portion of wire between said coil and the next coil to be made after axial movement of the coiled wire.

18. A wire coiling machine comprising a rotatable, non-reciprocable arbor having a coiling pin thereon, a guide reciprocable in one direction for feeding wire to the coil and determining the pitch thereof and in the other direction for moving the coil axially of the arbor, means including a bending tool arranged to engage the wire at the end of the coiling operation and bend the same towards an axial plane of the arbor and thereafter to release the wire and means for operating the parts in a timed relationship so that the guide moves in the same direction during the wire coiling and bending stages and thereafter moves the bent wire into position for making another coil.

19. A wire coiling machine comprising a rotatable, nonreciprocable arbor having a coiling pin thereon, a guide reciprocable for feeding wire to the coil and determining the pitch thereof, means for bending the wire at the end of the coiling operation towards a diametrical plane and thereafter permitting the guide to move the coiled wire axially of the arbor to position it for a further coiling operation and time controlled mechanism for severing the wire after a predetermined number of coils has been formed.

20. A wire coiling machine comprising a rotatable arbor having a coiling pin thereon, means associated therewith for making a coil of predetermined pitch and removing the coiled wire therefrom, a support carrying the removed coil, a cutter opposed to said support and means for moving the cutter and support relatively to hold the coiled wire stationary and to sever the wire.

21. A wire coiling machine comprising a rotatable, nonreciprocable arbor having a coiling pin thereon, a guide reciprocable for feeding wire thereto and determining the pitch of the coil while moving in one direction and for removing the coil from the arbor when moving in the opposite direction, a support for receiving the coiled wire which is movable towards the coil axis, a cutter opposed to said support, means for moving the support to hold the coil stationary and means actuated in timed relationship therewith to operate the cutter and sever the supported wire.

22. An apparatus of the type covered by claim 21 comprising two cutters independent of said support which engage opposite sides of the wire and sever the same.

23. A wire coiling machine comprising a rotatable, non-reciprocable arbor having a coiling pin thereon, a guide reciprocable in opposite directions to feed wire to the arbor and determine the pitch of the coil and thereafter to remove the coiled wire from the arbor, means cooperating therewith for bending a portion of the wire towards a diametrical plane of the coil and leaving the wire positioned for making another coil, and means including a cam actuated cutter mechanism operated in timed relationship with the wire coiling and bending mechanism which severs the wire after a predetermined number of coils have been made thereon.

24. A wire coiling machine comprising a rotatable, non-reciprocable arbor having a coiling pin thereon, means including a reciprocable guide for feeding wire to the arbor and determining the pitch of the coil and thereafter moving the coil

along the arbor, means for rotating the arbor through a predetermined number of turns in opposite directions in timed relation with the guide movement, means for releasably holding the wire in operative association with the pin during the coiling stage and thereafter permitting recoil of the wire and axial movement along the arbor, means including a bending tool movable to engage the incoming wire after a coil has been made and bend the wire and leave it positioned for making another coil spaced from the first and means for severing the wire after a predetermined number of coils has been made.

25. A wire coiling machine comprising a rotatable, non-reciprocable arbor having a coiling pin projecting therefrom and engageable with the wire to be coiled, means including a reciprocable guide for feeding wire to the arbor and determining the pitch of the coil and means which serves to hold the wire in engagement with the coiling pin during the coiling operation but which releases the coiled wire thereafter for movement axially of the arbor.

26. A wire coiling machine comprising a rotat-

able, non-reciprocable arbor having a coiling pin projecting therefrom and engageable with the wire to be coiled, means for rotating the arbor intermittently, means including a guide which is reciprocated in timed relationship with said rotation for making a coil of predetermined pitch and length on the arbor, and means which serves to hold the wire in operative association with said arbor and pin during the coiling operation and which thereafter releases the coil for axial movement along the arbor by said guide.

27. A wire coiling machine comprising a rotatable, non-reciprocable arbor having a coiling pin projecting therefrom and engageable with the wire to be coiled, means including a reciprocable guide cooperating with the arbor and pin for making a coil of wire of a predetermined pitch and length, and means associated therewith which holds the end of the coil fixed in position and bends the uncoiled wire only at a given point to provide a predetermined shape.

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