Nov. 29, 1949 J. H. MOORE 2,489,921

WIRE STRAIGHTENER AND CUTTER

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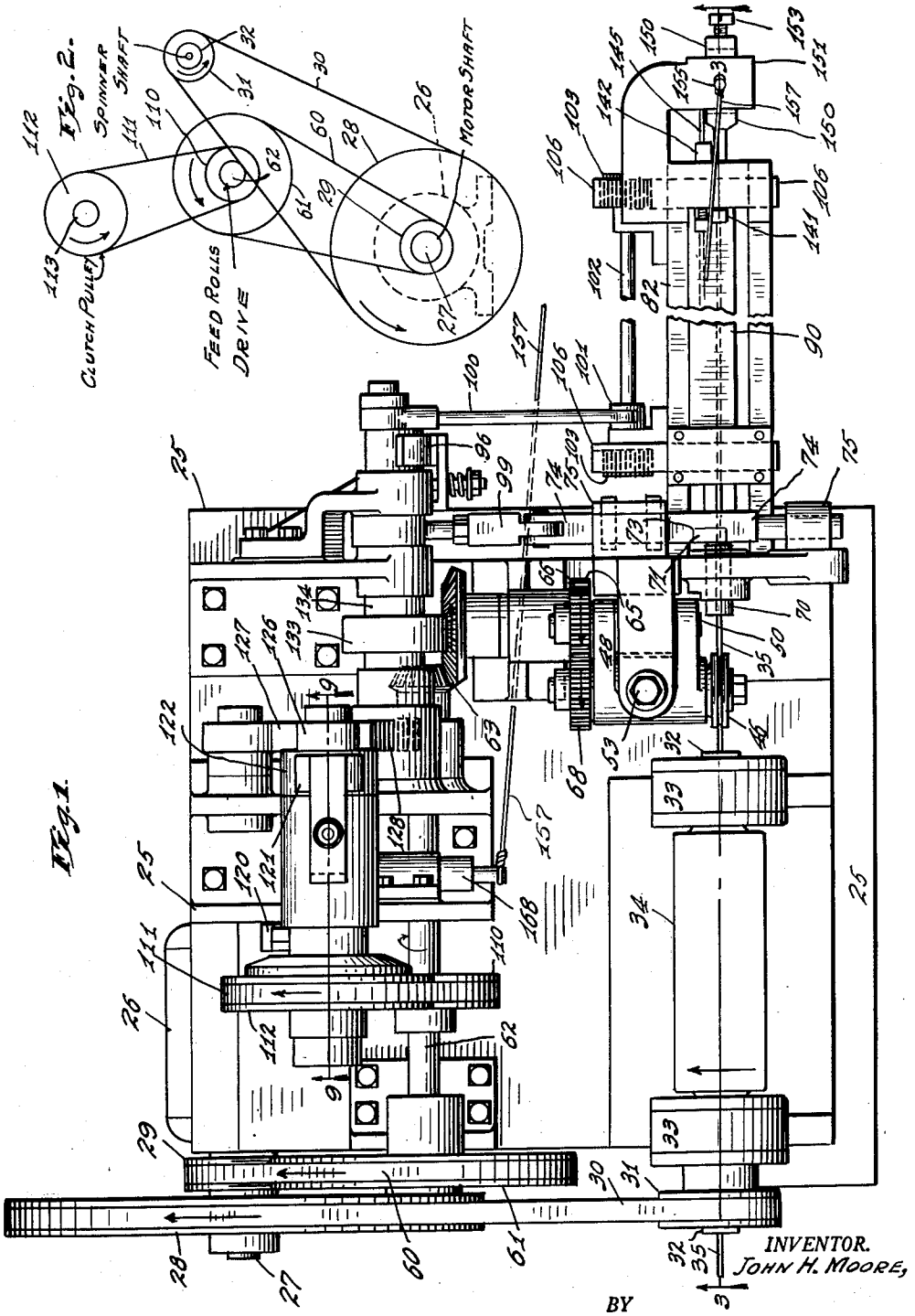


Fig. 1.

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WIRE STRAIGHTENER AND CUTTER

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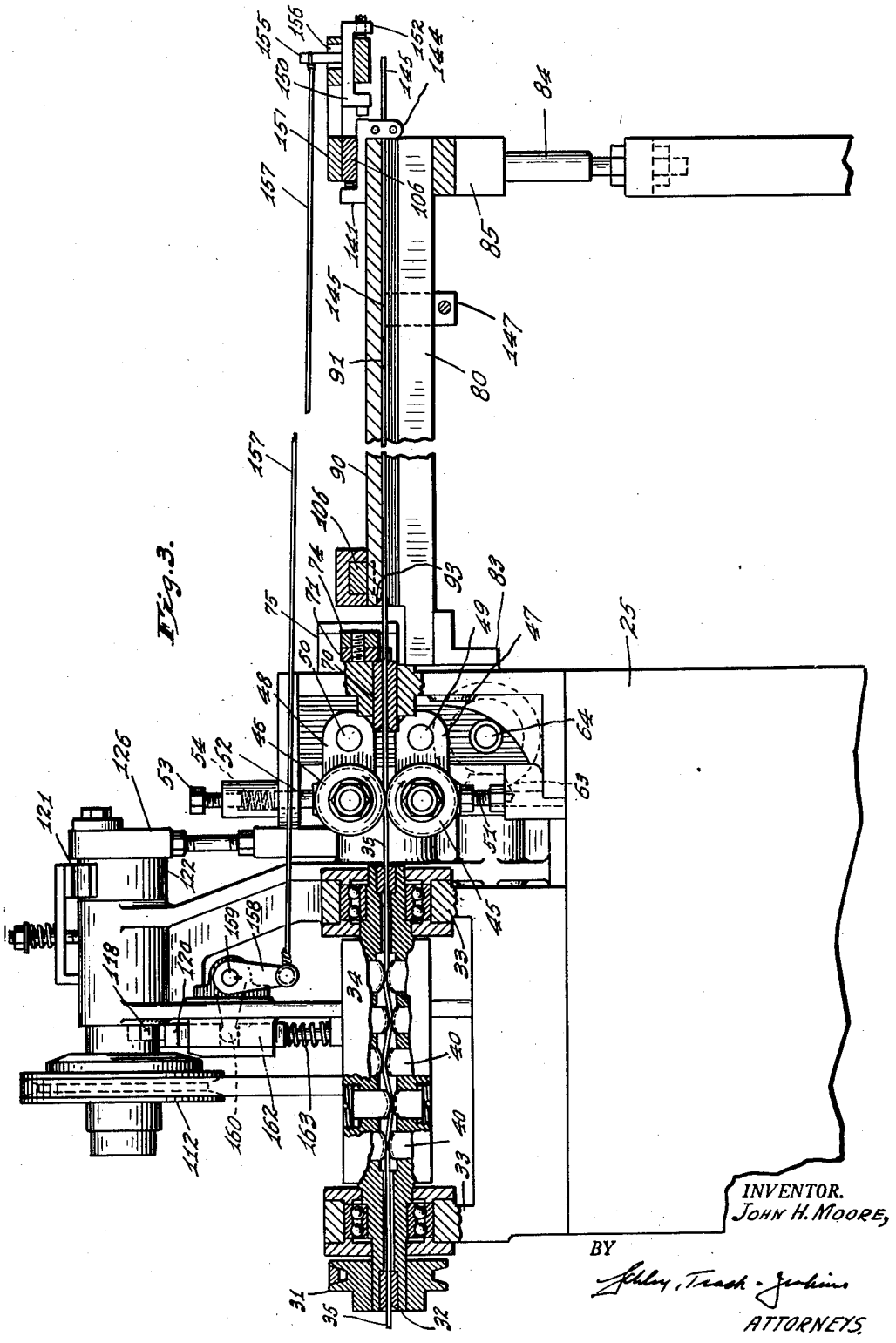


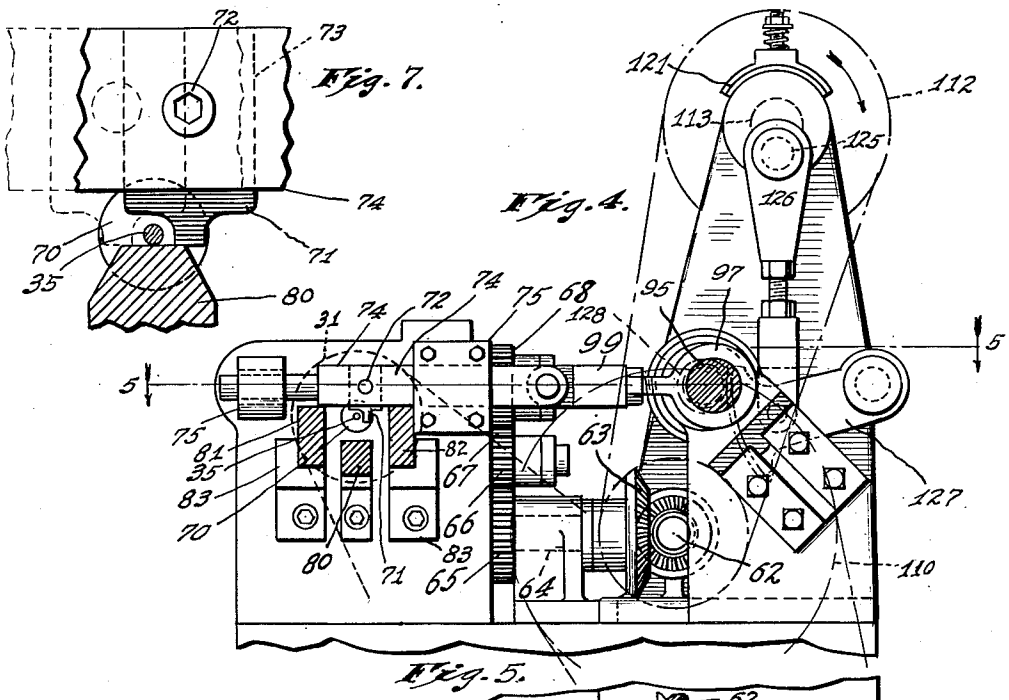
Fig. 3.

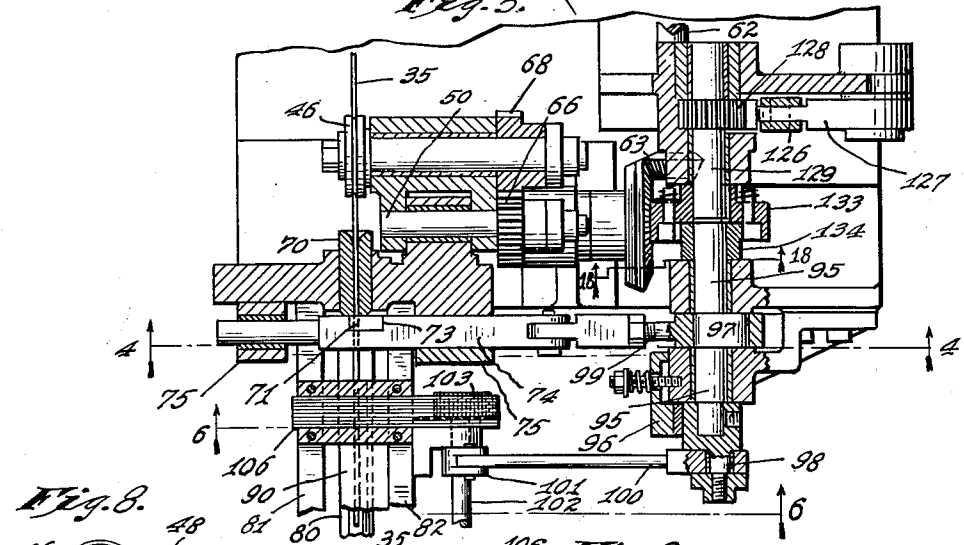
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WIRE STRAIGHTENER AND CUTTER

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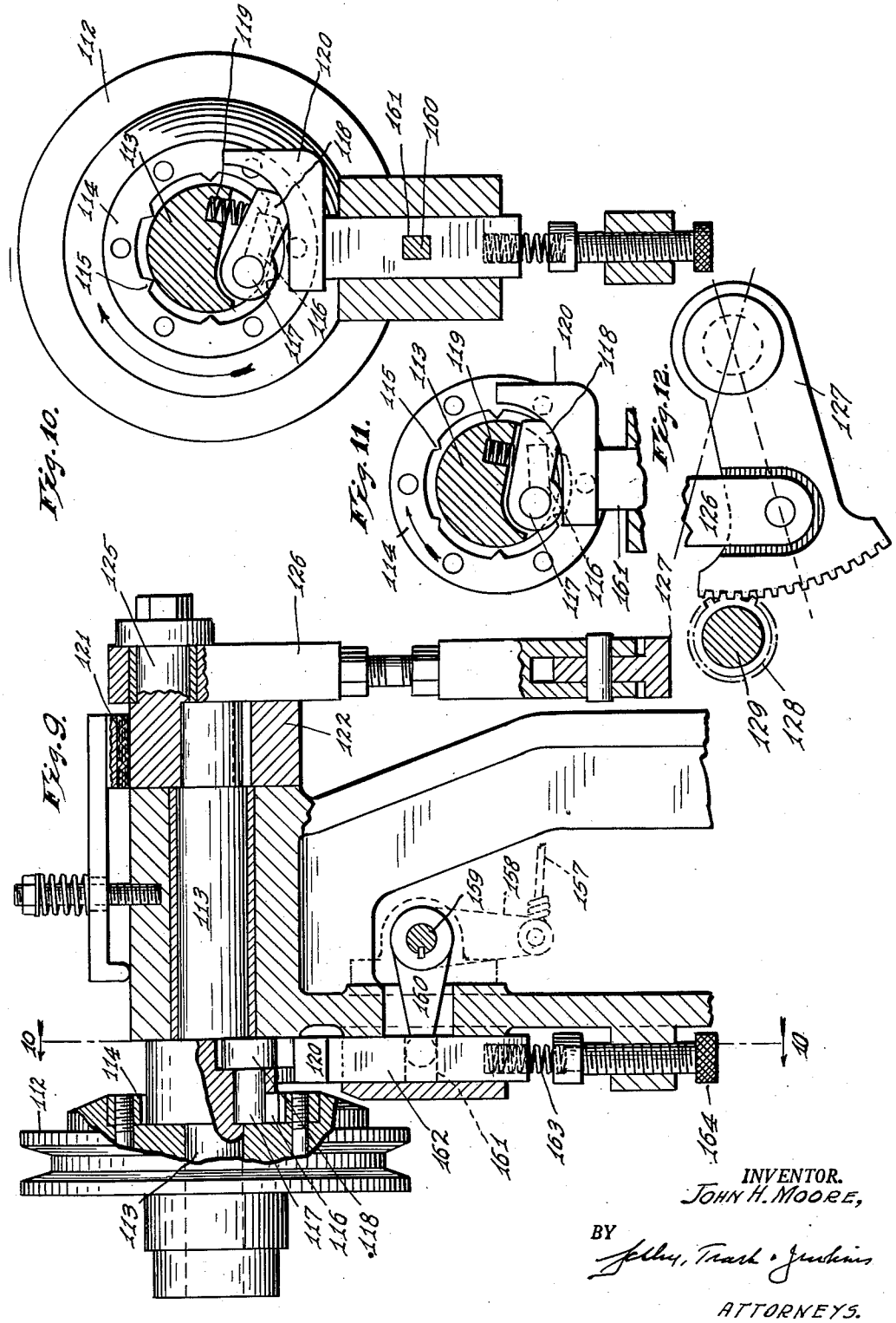


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WIRE STRAIGHTENER AND CUTTER

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Fig. 13.

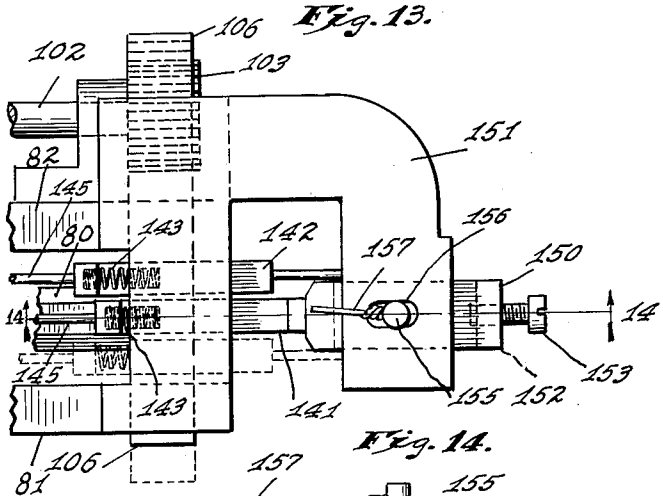


Fig. 14.

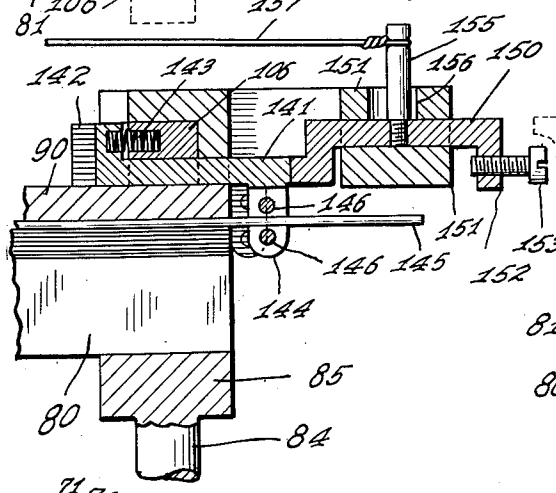


Fig. 15.

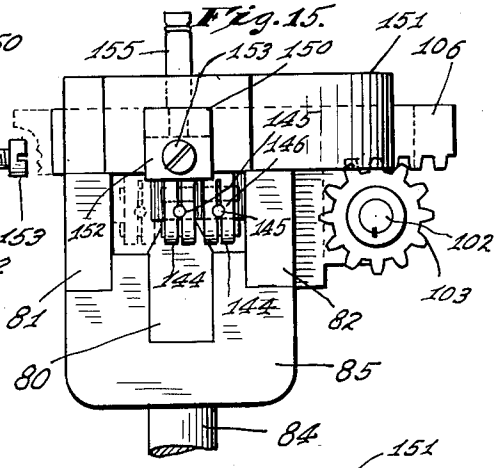


Fig. 16.

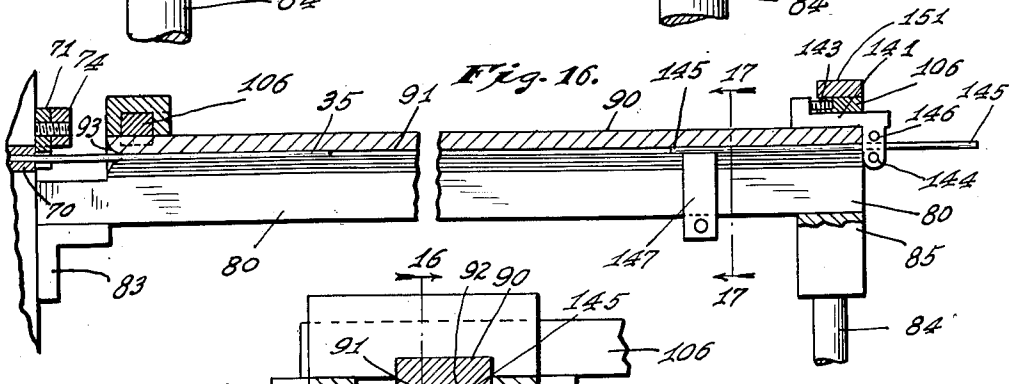
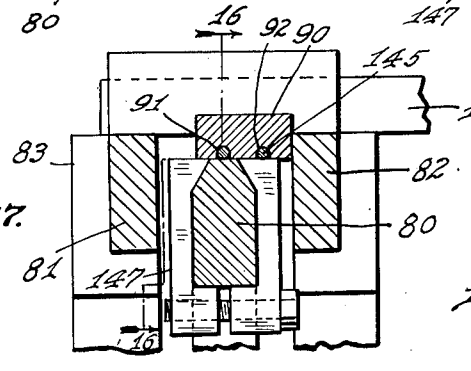


Fig. 17.



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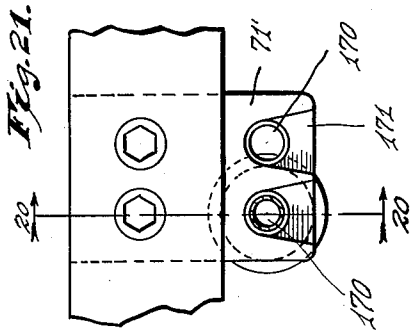
BY
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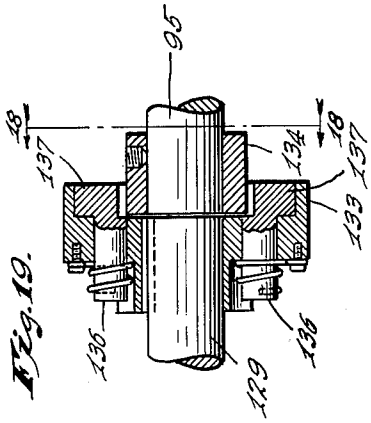
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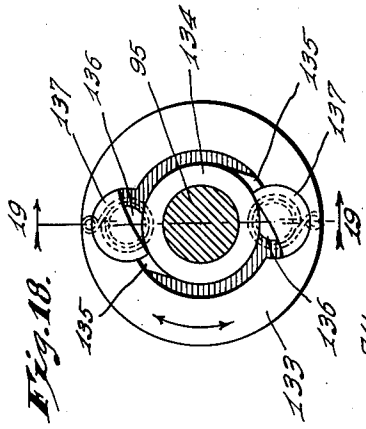
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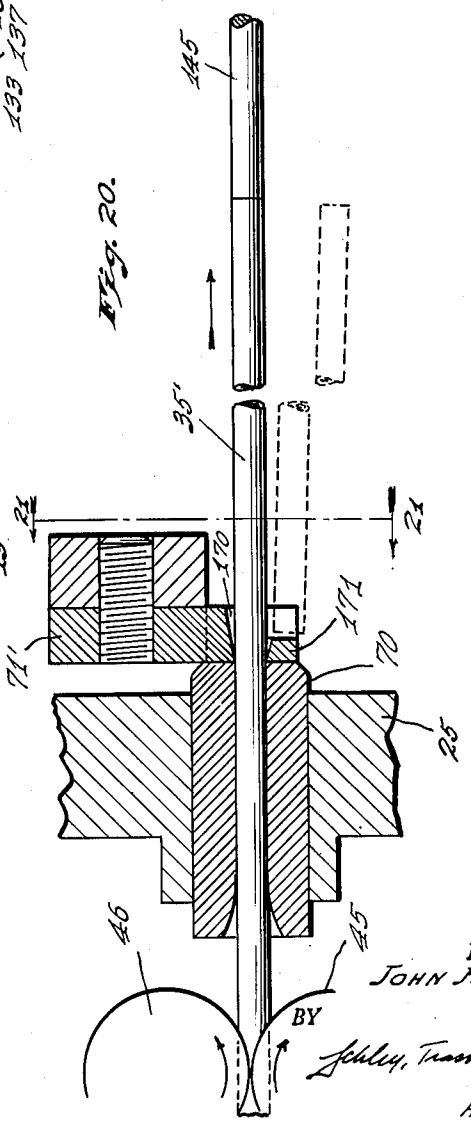
WIRE STRAIGHTENER AND CUTTER

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WIRE STRAIGHTENER AND CUTTER

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Fig. 22.

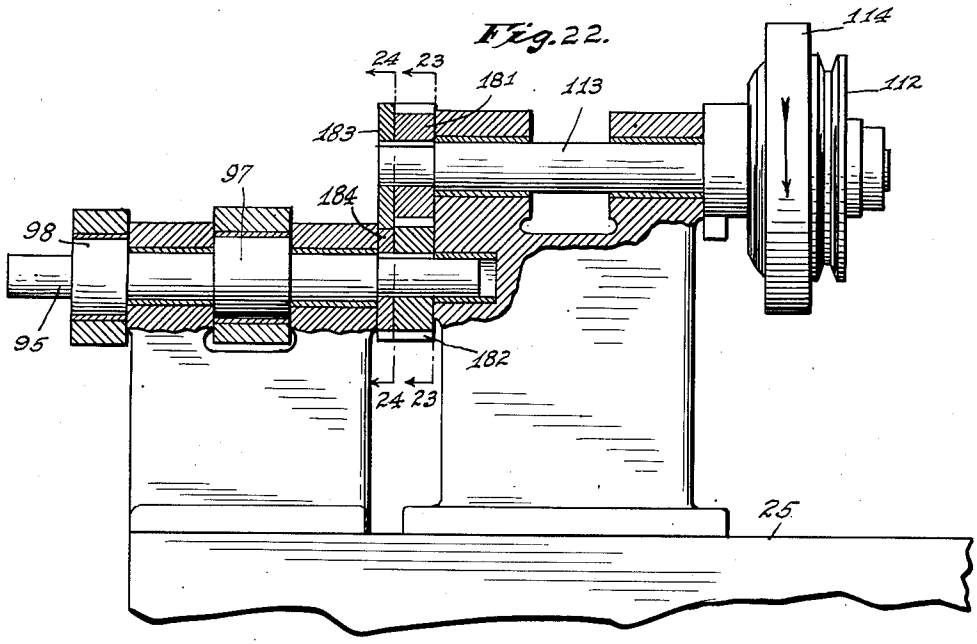


Fig. 23.

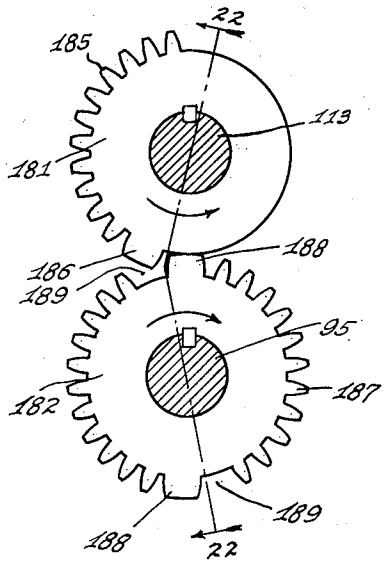
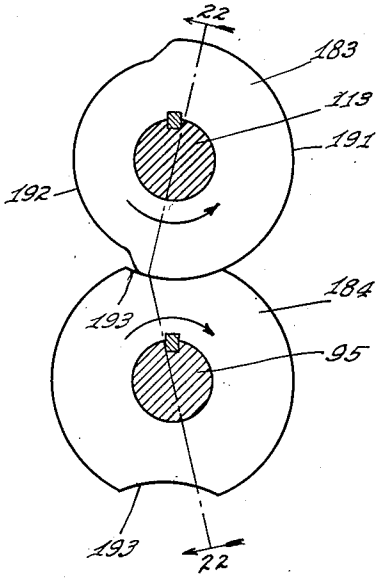


Fig. 24.



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UNITED STATES PATENT OFFICE

2,489,921

WIRE STRAIGHTENER AND CUTTER

John H. Moore, Roscommon, Mich., assignor to Carl W. Richter, Rochester, Mich.

Application September 12, 1946, Serial No. 696,540

4 Claims. (Cl. 140—139)

1

My invention is a machine for straightening and cutting wire and tubing.

It is the object of my invention to provide a machine which straightens wire or tubing, and cuts it into straight pieces of adjustably predetermined length; and which does this effectively and expeditiously, with minimum delay of the travel of the wire or tubing through the machine, and with little or no marring of the wire or tubing during the cutting-off operation.

In carrying out my invention, I pass the wire or tubing first through a rotating spinner having a number of pairs of transverse pusher-dies through which the moving wire or tubing passes and which act to bend it back and forth to straighten it; a pair of feed rolls between which the wire or tubing passes and which pull it through the spinner and push it through the cut-off device and along the length-measuring device; a cut-off device having a transversely reciprocable blade which on each of its transverse movements, in either direction, cuts off the wire or tubing, and which makes its cutting-off stroke on the first half of a movement initiated by the length-measuring device, and in this way reduces to a minimum any stoppage of the wire or tubing incident to the cutting-off operation; a length-measuring device which moves transversely with the cutting-off knife, and which has two parallel wire-receiving openings which are brought respectively into line with the on-coming wire at the two stop-positions of the cut-off knife and length-measuring device; and clutch mechanism which is set into operation when the on-coming wire or tubing reaches an adjustably predetermined position in the length-measuring device and which operates to produce a single transverse movement, alternately in opposite directions, of the cut-off blade and the length-measuring device.

The accompanying drawings illustrate my invention:

Fig. 1 is a plan of my wire-straightening and cutting machine, with an intermediate part of the length-measuring device broken away; Fig. 2 is a schematic end view of the belt drives shown at the left of Fig. 1; Fig. 3 is a front elevation of the wire-straightening and cutting machine of Fig. 1, with some parts broken away, and with some parts in section on the line 3—3 of Fig. 1 in the vertical plane of the traveling wire; Fig. 4 is a fragmental transverse vertical section through said machine, substantially on the line 4—4 of Fig. 5, to show the cut-off mechanism and its operating drive; Fig. 5 is a fragmental horizontal

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section substantially on the line 5—5 of Fig. 4, to show the wire-feeding and cut-off mechanism and part of the length-measuring device, and their operating drives; Fig. 6 is a fragmental vertical section substantially on the line 6—6 of Fig. 5; Fig. 7 is an enlarged fragmental elevation of the cut-off blade and directly associated parts; Fig. 8 is a schematic view of the mounting and gear-drive of the feed rolls; Fig. 9 is an enlarged vertical section, with some parts in elevation, on the line 9—9 of Fig. 1, showing the one-revolution clutch; Fig. 10 is a vertical transverse section on the line 10—10 of Fig. 9, with the clutch dog in clutching position; Fig. 11 is a view similar to the upper part of Fig. 10, but with the clutch dog in un-clutching position; Fig. 12 is a transverse section through the rocker shaft for operating the cut-off knife and the length-measuring device, with a fragment of its operating mechanism as seen from the right-hand end of Fig. 9; Fig. 13 is an enlarged plan of the clutch-control mechanism at the end of the length-measuring device; Fig. 14 is a section on the line 14—14 of Fig. 13; Fig. 15 is an end view of the clutch-control mechanism shown in Figs. 13 and 14, and the associated rack and pinion for operating it; Fig. 16 is a vertical longitudinal section through the length-measuring device, substantially on the line 16—16 of Fig. 17; Fig. 17 is a transverse section on the line 17—17 of Fig. 16; Fig. 18 is a transverse section through the ratchet mechanism, taken substantially on the line 18—18 of Figs. 5 and 19; Fig. 19 is a fragmental section on the line 19—19 of Fig. 18; Fig. 20 is a fragmental partial elevation, and partial longitudinal section on the line 20—20 of Fig. 21, through the cut-off mechanism and clutch-control mechanism, of a modification particularly adapted for tubing; Fig. 21 is a transverse section on the line 21—21 of Fig. 20; Fig. 22 is a partial elevation, and partial vertical longitudinal section substantially on the lines 22—22 of Figs. 23 and 24, of a modified drive mechanism for the cut-off blade and wire-receiving plate, embodying an intermittent gearing in place of the ratchet and rock-shaft and rocker-arm mechanism of earlier views; Fig. 23 is a vertical transverse section on the line 23—23 of Fig. 22; and Fig. 24 is a transverse vertical section on the line 24—24 of Fig. 22.

A main frame 25 carries most of the working mechanism. Suitably mounted on it is a motor 26 having a shaft 27 carrying a large pulley 28 and a small pulley 29. The large pulley 28 is connected by a belt 30, conveniently a V-belt, to a smaller pulley 31 on a hollow spinner-shaft 32, rotating

at high speed and suitably mounted in ball bearings carried in pedestals 33 supported by the frame 25. On the spinner shaft 32 is a spinner 34, the body of which is conveniently of one piece with the spinner shaft 32.

The wire 35 which constitutes the work (and by the term "wire" I include tubing when the context permits,) and which is to be straightened and cut into pieces of adjustably predetermined length, passes through the hollow spinner-shaft 32 and the spinner 34, entering at one end (the left-hand end in Figs. 1 and 3), and thence going on to the feeder mechanism, the cut-off mechanism, and the length-measuring mechanism, to be described.

The spinner body 34 is provided with a plurality of pairs of transverse pusher-dies 40, arranged along the length of the spinner body and adjustable so that the space between adjacent ends of any pair of pusher-dies may be set at any adjusted distance from the spinner axis. The several pairs of pusher-dies 40 are differently adjusted, so that the wire 35 as it passes lengthwise through the spinner is deflected by the successive pairs of pusher-dies, alternately in opposite directions, with the rotation of the spinner body superposed upon that alternate opposite deflection. This results in an effective straightening of the wire, so that the wire as it leaves the spinner 34 and spinner-shaft 32 at the right end thereof is effectively straight.

Just to the right of the spinner 34 are a pair of mating feed rolls 45 and 46, each circumferentially grooved. At the meeting points of the two feed rolls 45 and 46, the circumferential grooves in them form a wire-receiving opening in line with the axis of the spinner shaft 32; and the two rolls 45 and 46 grip the wire 35 and pull it through the spinner 34, and pass it on to the cut-off mechanism and length-measuring mechanism farther to the right.

The two feed rolls 45 and 46 are mounted on the free ends of roll-carrying arms 47 and 48, in turn mounted on pivot-pins 49 and 50 respectively. The free end of the lower roll-carrying arm 47 rests on an adjusting screw 51, by which it may be adjusted up and down to proper position. The free end of the upper roll-carrying arm 48 is pressed downward by a spring-actuated pin 52, which thus acts to force the upper feed roll 46 against the wire 35, and to force the wire against the lower feed roll 45, to obtain the desired grip of the feed rolls on the wire. The strength of this grip is adjustable by a set-screw 53 for adjusting the spring 54 acting on the pin 52; and the adjustment of this screw 53 is such that the feed rolls 45 and 46 effectively pull the wire through the spinner 34, and push it on through the wire-cutting and length-measuring devices, but can slip on the wire slightly as demanded when a split-second stoppage of the wire occurs during the cutting-off operation. For reasons which will be apparent, this stoppage is for such a short time that the pusher-dies 40 do not materially mark the momentarily stationary wire 35.

The feed rolls 45 and 46 travel in opposite directions, indicated by the arrows in Fig. 3, to move the wire 35 from left to right. The power for obtaining this motion is derived from the small pulley 29 on the motor shaft 27. A belt 60, conveniently a V-belt, connects the small pulley 29 to a larger pulley 61 on a feed-roll-drive shaft 62, which is connected by a bevel gearing 63 to a transverse shaft 64. The shaft 64 carries a gear 65, which meshes with an idler pinion 66 rotatable on the axis of the pivot pin 49. The idler pinion 66 also meshes with a gear 67 fixed to the feed roll 45; and the gear 67 meshes with a same-size gear 68 fixed to the feed roll 46. This driving mechanism serves to drive the two feed rolls 45 and 46 continuously while the motor 26 is in operation; to feed the wire 35 continuously through the spinner 34 from left to right (Fig. 1) unless that wire is stopped in some manner, in which event the feed rolls 45 and 46 slip a little on the momentarily stationary wire. The mechanism is such, however, that any such stoppage of the wire is of minimum duration, of the order of a small fraction of a second.

After leaving the feed rolls 45 and 46, the wire 35 enters a cut-off bushing 70, suitably held in the frame 25, having a longitudinal hole through it in line with the discharge from the feed rolls 45 and 46 and of barely sufficient size to permit the free passage of the straightened wire 35.

The discharge end of this cut-off bushing 70 (the right-hand end as seen in Figs. 1 and 3) is the stationary shear member of the cut-off mechanism, and co-operates with a movable shear blade 71. This shear blade 71 is held by a screw 72 in a vertical groove 73 in a transversely reciprocable cross-head 74, suitably mounted in extensions 75 of the frame 25 to move horizontally and rectilinearly in a vertical plane perpendicular to the straightened wire 35.

The shear blade 71 of the cut-off mechanism is arranged to cut the wire on each stroke, forward or backward; so that it comes to rest after making a cut by moving once across the wire, and does not at once return to its original position. In this way any stoppage of the wire 35 for a cutting-off operation is made as short as possible. If solid wire or sturdy tubing is being cut, the shear blade 71 is of the shape shown enlarged in Fig. 7; and has a fairly wide body by which it is fastened in the groove 73, and a relatively narrow downwardly projecting shear portion which on a stroke in either direction moves completely across the area of the wire 35 between the full and dotted line positions of Fig. 7, and thus shears the wire on either stroke.

After leaving the cut-off mechanism, the wire travels through a short open space, and then passes on to the upper flat surface of a stationary wire support 80, which extends to the right (Figs. 1, 3, and 16) somewhat farther than the greatest length of wire to be cut off. The upper face of the wire support 80 is flat, and lies in a horizontal plane; and is somewhat narrower than than the body of such wire support, to which it is connected by two sloping wire-discharging faces, as is clear from Figs. 6, 7, and 17. On both the front and rear sides of the wire support 80 if desired, and slightly spaced therefrom, there may be vertical guide plates 81 and 82, which extend the full length of the wire support; but these may be omitted. At the ends toward the main frame 25 (the left-hand ends in Figs. 1, 3, and 16) the wire support 80 and the guide plates 81 and 82 rest on and are fixed to brackets 83; and at the ends remote from that main frame (the right-hand ends in Figs. 1, 3, and 16) they rest on a suitable pedestal 84, of which the upper part forms a notched carrying bar 85 which directly carries them, as is perhaps most clearly shown in Fig. 15.

On top of the wire support 80 is a wire-receiving plate 90, which on its under face has two longitudinal wire-receiving grooves 91 and

92 respectively. These grooves 91 and 92 extend the whole length of the wire-receiving plate 90; and that wire-receiving plate is bodily reciprocable horizontally across the upper face of the wire support 80, to bring either the groove 91 or the groove 92 over the medial plane of the wire support 80 and into line with the hole through the cut-off bushing 70. Either the groove 91 or the groove 92 may thus be moved into position to receive the on-coming wire from the cut-off bushing 70; and in either case the other of such grooves 91 and 92 is over an open space either in front of or behind the wire support 80 and between that wire support and one or the other of the two guide plates 81 and 82. Thus when the front wire-receiving groove 91 is receiving the on-coming wire, a cut-off length of wire is being dropped from the open under-face of the rear wire-receiving groove 92 into the space between the wire support 80 and the rear guide plate 82; and when the rear wire-receiving groove 92 is receiving the on-coming wire, a cut-off length of wire is being dropped from the open under-face of the front wire-receiving groove 91 into the space between the wire support 80 and the front guide plate 81.

At its left-hand end, Figs. 3 and 16, each wire-receiving groove 91 and 92 has a counter-sunk portion 93, mating with a counter-sunk portion at the left-hand end of the upper face of the wire support 80, to provide a flaring entrance for the on-coming wire to the receiving end of that wire-receiving groove.

The cross-head 74 with its shear blade 71, and the wire-receiving plate 90, move substantially in unison, either to their forward positions or to their rearward positions. They receive power for this movement from a counter-shaft 95, which upon the operation of a tripping mechanism, to be described hereafter, moves a half-turn on its axis, in a counter-clockwise direction as viewed in Fig. 18. A constantly acting spring-pressed brake-shoe 96 prevents the shaft 95 from overrunning beyond the half-turn.

The counter-shaft 95 has two eccentrics 97 and 98, arranged to make their eccentric throws substantially simultaneously.

The eccentric 97 is connected by a connecting rod 99 to the rear end of the cross-head 74, and this eccentric and cross-head are of sufficiently sturdy construction for the shearing operation of the shear blade 71 against the cut-off bushing 70. On one half-turn of the counter-shaft 95, the eccentric 97 moves that shear blade 71 forward for one shearing operation. On the next half-turn of the counter-shaft 95, the eccentric 97 moves that shear blade 71 backward for the next shearing operation.

The eccentric 98 is connected by a connecting rod 100 to the crank-arm 101 on a rock-shaft 102; which extends parallel to and in the rear of the wire support 80 for substantially the full length thereof. At each end the rock-shaft 102 carries a pinion 103; and each pinion 103 meshes with a rack-bar 106 extending transversely across the wire support 80 and the guide plates 81 and 82 and suitably attached to the wire receiving plate 90. On the same half-turn of the counter-shaft 95 which moves the shear blade 71 forward, the eccentric 98 moves the connecting rod 100 also forward; and so rocks the rock-shaft 102 forward to move the two rack-bars 106 forward, and thus to move the wire-receiving plate 90 forward to bring the wire-receiving groove 92 into the medial plane of the wire support 80 and in line with the on-coming wire 35; while on the next half-turn of the counter-shaft 95, the half-turn which moves the shear blade 71 backward, the eccentric 98 moves the connecting rod 100 also backward; and so rocks the rock shaft 102 backward to move the two rack bars 106 backward, and thus to move the wire-receiving plate 90 backward to bring the wire-receiving groove 91 into the medial plane of the wire support 80 and in line with the on-coming wire 35.

Thus the counter-shaft 95, which moves a half-turn at a time, acts on one half-turn to move both the shear blade 71 and the wire-receiving plate 90 forward, and on the next half-turn to move both of them backward.

The counter-shaft 95 is given this intermittent movement, a half-turn at a time always in the same direction, from a driving mechanism which includes both a one-revolution clutch and an intermittent drive, and which is controlled by a trip mechanism operated by the on-coming wire when the wire extruded from the cut-off bushing 70 has reached the desired length. The intermittent drive may be a ratchet or an intermittent gearing; both of which are shown as modifications, the ratchet in the earlier figures and the intermittent gearing in Figs. 22, 23, and 24.

The power for the half-turn operations of the counter-shaft 95 is supplied from the shaft 62, which is provided with a pulley 110 connected by a belt 111 to a pulley 112 loose on a shaft 113 but connectible to said shaft 113 by the one-revolution clutch above referred to. The shaft 113 is normally at rest; while the pulley 112 is normally in constant rotation, in the direction of the arrow in Fig. 10. On its right-hand face (Fig. 9) the pulley 112 carries a clutch-ring 114, having an inner circumferential series of teeth 115. A clutch dog 116 on a carrying pin 117, mounted eccentrically in the shaft 113 parallel to the shaft axis, lies inside the clutch-ring 114, and is movable either outward into the circular path of the teeth 115 or inward out of that circular path. The carrying pin 117 also carries an operating finger 118, the inward or outward movement of which controls the position of the clutch dog 116 so that it either engages or misses the traveling teeth 115 of the clutch-ring 114. A compression spring 119 acts on the operating finger 118 and tends to push it outward, to move the clutch dog 116 into the path of the teeth 115.

A cam plate 120 lies in the transverse plane of the operating finger 118, and is movable either to the inner or unclutching position of Fig. 11 or to the outer or clutching position of Fig. 10. When the cam plate 120 is in its inner or unclutching position (of Fig. 11), in which it normally stands, it pushes the operating finger 118 inward against the spring 119, and so pushes the clutch dog 116 out of the path of the traveling teeth 115; and in consequence the pulley 112 then rotates freely without producing any movement of the shaft 113. When, however, the cam plate 120 is moved to its outer or clutching position (of Fig. 10), it permits the operating finger 118 to be moved outward by the spring 119; and this permits the spring 119 to move the clutch dog 116 into the path of the teeth 115, so that the first of such teeth 115 which then comes along in the rotation of the constantly moving pulley 112 engages that clutch dog 116 and through it clutches the pulley to the shaft 113 to rotate the latter, also in the direction of the arrow of Fig. 10. That rotation is for only one revolution; for, by mecha-

nism to be described hereinafter, the outward movement of the cam plate 120 to the clutching position of Fig. 10 is followed quickly by an inward movement of such cam plate 120 to the releasing position shown in Fig. 11. So as the shaft 113 completes one revolution after being clutched to the pulley 112, the operating finger 119 strikes the camming surface of the cam plate 120; and it and the clutch dog 116 are moved outward thereby to the unclutching position of Fig. 11, to produce a declutching of the shaft 113 from the pulley 112. Over-run of the shaft 113 is prevented by a spring-pressed brake shoe 121 acting on a collar 122 keyed to the shaft 113, as is clear from Fig. 9.

In the modification which uses a ratchet (or over-running clutch, shown best in Figs. 9, 12, 18, and 19, the collar 122 carries an eccentric pin 125, which is connected by a connecting rod 126 to a rocking gear-segment 127 meshing with a pinion 128 on a rock-shaft 129 in line with and closely adjacent to the counter-shaft 95. The eccentric pin 125 normally stands at the bottom of its eccentric throw, as is shown in Fig. 4, so that the rocking gear-segment 127 is in its bottom position and the rock-shaft 129 is as far clockwise (Figs. 4 and 12) as it can go. When the cam plate 120 is moved to its clutching position, to produce clutching for one revolution between the pulley 112 and the shaft 113, the eccentric pin 125 also moves through one revolution, in the direction of the arrow in Fig. 4, to reach its topmost position (shown in Figs. 3 and 9) and then to return to its bottommost position. This moves the rocking gear-segment 127 first upward and then downward; and this rocking movement of the gear-segment 127 moves the rock-shaft 129 first counter-clockwise (Fig. 12) for a half-turn and then clockwise for a half-turn.

A ratchet or over-running clutch, above referred to, interconnects the rock-shaft 129 and the counter-shaft 95 so that they move together during the first or counter-clockwise half-turn of the rock-shaft 129, but so that the counter-shaft 95 stands still during the return or clockwise half-turn of the rock-shaft 129. This ratchet mechanism or overrunning clutch is best shown in Figs. 18 and 19.

Two collars 133 and 134 are suitably fastened on the abutting ends of the rock-shaft 129 and the counter-shaft 95 respectively. The collar 134 carries outwardly projecting ratchet teeth 135, shown as two in number and as diametrically opposite each other; and these teeth 135 have radial faces at their clockwise ends as viewed in Fig. 18, and inclined faces at their counter-clockwise ends. The outer part of the collar 133 overhangs the teeth 135, and completely encloses them circumferentially. Two pins 136 are pivotally mounted in diametrically opposite eccentric holes in the collar 133, and each pin is spring-pressed counter-clockwise (as viewed in Fig. 18) in its carrying hole. Each of the pins 136 is provided in the transverse plane of the teeth 135 with a segmental head 137; which tends to stand in the position shown in Fig. 18 by the spring pressure on the associated pin 136, to interengage the radial face of one of the teeth 135. This provides a driving connection from the rock-shaft 129 to the counter-shaft 95 when the rock-shaft is moved in the counter-clockwise direction (Fig. 18). But when the rock-shaft 129 is moved in a clockwise direction (Fig. 18) the camming action of the inclined counter-clockwise faces of such teeth 135 cam the segmental heads 137 out of the way of such teeth, so that in that clockwise direction of movement of the rock-shaft 129 there will be no driving connection from such rock-shaft to the countershaft 95, and that countershaft will remain at rest while the rock-shaft returns to its initial position.

The action of the clutch between the loose pulley 112 and the shaft 113, and so the rocking movement of the rock-shaft 129, and the intermittent movement by half-turns of the countershaft 95, and therefore the movements of the shear blade 71 and the wire-receiving plate 90, are all controlled by the cam plate 120; and that cam plate 120 is controlled by trip mechanism set in motion by the on-coming wire 35 when the latter protrudes a predetermined length beyond the cut-off bushing 70. The control mechanism for this is best shown in Figs. 1, 3, 13, 14, 15, and 16.

The rack-bar 106 remote from the main frame 25 is slotted transversely of its length on its under face to receive slide-bars 141 and 142 respectively, each of which is spring-pressed to the left (Figs. 13 and 14) by compression springs 143 acting between the rack-bar 106 and upturned fingers at the left-hand ends of those slide-bars. These slide-bars are in the vertical planes of the two wire-receiving grooves 91 and 92 of the wire-receiving plate 90, and move with such wire-receiving plate 90 transversely of the wire support 80. Each slide-bar 141 and 142 near its right-hand end has a pair of downwardly extending clamping fingers 144, which receive between them a stop-wire 145 which may be adjusted lengthwise between the pair of clamping fingers and locked in any desired adjusted position by clamping screws 146. Thus there are two stop-wires 145, and they lie in the two wire-receiving grooves 91 and 92 respectively and extend into those wire-receiving grooves from the right-hand ends thereof to any desired distance as determined by their adjustment. If they extend so far that their ends have a tendency to sag out of such wire-receiving grooves, they may be supported by one or more supports 147 clamped on the wire support 80 and having upper surfaces on both sides of such wire support flush with the flat upper face of that wire support. The left-hand ends of the stop-wires 145 determine the lengths of wire 35 to be cut off; for the free or right-hand end of the oncoming wire 35 strikes the left-hand end of one of the stop wires 145 to produce the cutting-off operation, and initiates that cutting-off operation by moving the stop-wire 145 to the right against the action of the associated spring 143.

Either slide-bar 141 or 142 may be brought into line with a third slide-bar 150, which is permanently in the vertical plane of the wire 35 and is suitably mounted to slide in that plane lengthwise of the wire 35. As shown, this third slide-bar 150 is carried by a sub-frame 151 supported from the pedestal 84. The slide-bar 150 has a downwardly projecting finger 152 in which there is an adjusting screw 153 for limiting the leftward movement (Figs. 13 and 14) of that slide-bar; which may be moved to the right by either slide-bar 141 or 142, whichever is in line with it and with the on-coming wire 35.

A pin 155 extends upward from the slide-bar 150, through a slot 156 in the sub-frame 151. This pin 155 is connected by a tension wire 157 to a downwardly extending arm 158 on a rock-shaft 159; and that rock-shaft 159 also has on it a horizontally extending operating finger 160 which

extends into and fits slidably in a transverse hole 161 in a slide-bar 162 that carries the cam plate 120. The slide-bar 162 is pushed upward by a compression spring 163 adjustable in compressive strength by a thumb-screw 164. The spring 163 thus tends to move the cam plate 120 to its unclutching position shown in Fig. 11; and also tends to rock the rock-shaft 159 clockwise (Figs. 3 and 9) and to act through the wire 157 to move the slide-bar 150 leftward (Fig. 14).

The operation is as follows:

At the start of the operation, the shear blade 71 and the wire-receiving plate 90 are either both in their rearmost position, shown in Figs. 1, 4, 5, and 17, and in full lines in Figs. 6 and 7, or both in their foremost position, shown in dotted lines in Figs. 6 and 7. When the motor 26 is started it drives the spinner shaft 32, the feed-roll-drive shaft 62, and the clutch-drive pulley 112 continuously in the direction of the arrows of Figs. 1 and 2, to provide a continuous drive for the spinner 34 in the direction of the arrow in Fig. 1, and for the feed-rolls 45 and 46 in the directions of the arrows of Fig. 3; but the clutch shaft 113 and all parts driven from it are at rest, with the rocking gear-segment 127 down and the rock-shaft 129 at its motion-limit in the clockwise direction, because the cam plate 120 is in the unclutching position shown in Fig. 11.

The wire 35, supplied from any convenient source such as a suitably supported roll of wire, is fed into the spinner 34 from the left, and between the two feed rolls 45 and 46; and is carried forward by the feeding action of those two continuously rotating feed rolls. This feeding action pulls the wire 35 through the constantly rotating spinner 34, in which the wire is effectively straightened by the action of the several pairs of pusher dies 40, and pushes it forward through the cut-off bushing 70 and across the open space just beyond the cut-off bushing into that one of the wire-receiving grooves 91 and 92 which is in line with it.

Assume that that groove is the groove 91, as it is when the wire-receiving plate 90 and the shear blade 71 are in their rearmost position shown in Fig. 1. The stop wires 145 are adjusted in the wire-receiving grooves 91 and 92, conveniently before the operation starts, for the desired length into which the wire 35 is to be cut; and that one of these stop wires which is in the wire-receiving groove 91 (on the stated assumption that the wire-receiving plate 90 is in its rearmost position) is in the path of the on-coming wire 35 as it travels to the right along that wire-receiving groove 91.

When in that travel the advancing end of the wire 35 strikes the stop wire 145, it moves that stop wire to the right; and the stop wire 145 carries rightward with it the slide-bar 141 (see Figs. 13 and 14) so that that slide-bar engages and moves rightward the slide bar 150. That rightward movement of the slide-bar 150, and of the pin 155 carried thereby, pulls the tension wire 157 rightward; and the tension wire 157, acting through the arm 158, rocks the rock-shaft 159 counterclockwise (Figs. 3 and 9) so that the operating finger 160 carried thereby will shift the slide-bar 162 and cam plate 120 downward from the unclutching position of Fig. 11 to the clutching position of Fig. 10. This downward movement of the cam plate 120 allows the clutch dog 116 to swing into the circle of travel of the teeth 115 of the constantly rotating clutch ring 114, so that it is engaged by the first tooth 115 which thereafter comes to it in that rotation. This locks the normally stationary shaft 113 to the constantly rotating pulley 112, to drive that shaft 113 in the direction of the arrow of Fig. 10; but that movement of the shaft 113 is for one revolution only, as will now appear.

During the first half of the rotation of the shaft 113 the connecting rod 126 is moved upward, to rotate the rock-shaft 129 counter-clockwise (Fig. 12); and during this counter-clockwise movement of the rock-shaft 129 it acts through the ratchet drive 133—137—135—134 to move the counter-shaft 95 one half-turn, also counter-clockwise (Fig. 18). This half-turn acts through the eccentrics 97 and 98 to move both the shear blade 71 and the wire-receiving plate 90 forward, from their rearmost positions to their foremost positions. The shear blade 71 shears off the wire 35, at the desired point as determined by the setting of the stop wire 145, and does so by the movement of the shear blade 71 in one direction, and as it shears the wire it stops the wire for a small fraction of a second; but as soon as the shear blade has passed the plane of the wire 35 the momentarily stopped wire 35 at once resumes its rightward movement. The wire-receiving plate 90 as it moves forward carries the sheared-off length of wire forward, and off of the wire support 80, thus moving the wire-receiving groove 91 out of line with the on-coming wire and the wire-receiving groove 92 into line with that on-coming wire. The sheared-off length of wire drops immediately out of the wire-receiving groove 91, as the fresh-cut end of the on-coming wire now passing to the rear of the shear blade 71 passes across the space beyond the cut-off bushing 70 and on to the wire support 80 and into the wire-receiving groove 92. The cut-off length of wire starts to drop by the time the wire-receiving plate 90 has reached its forward position, and so by the time the shaft 113 has completed a half-rotation, and by the time the rocker-arm 127 has reached the top of its movement and the rock-shaft 129 has reached the end of its counter-clockwise movement. As the cut-off length of wire drops out of the groove 91, it becomes disengaged from the stop wire 145; and thereupon the spring 163 quickly moves the slide-bar 162 upward to return the cam plate 120 to its unclutching position (Fig. 11). The spring 163, acting through the finger 160 and the rock-shaft 159 and arm 158 and tension wire 157, also returns the slide-bar 150 to its leftward limit of movement, ready for the next operation; and the spring 143 returns the slide-bar 141 leftward to normal position, and if it fails to do so for any reason is supplemented by the action of the spring 163 and the overlap of the slide-bar 150 over both slide-bars 141 and 142. These returning movements all happen very quickly during the early part of the second half-turn of the shaft 113; so that as the one full turn of the shaft 113 approaches its end the cam plate 120 acts on the operating finger 118 to move the clutch dog 116 out of engagement with the tooth 115 which has been acting on it, and thus permits the shaft 113 to stop at the end of that movement under the action of the brake shoe 121. During the second half-turn of the shaft 113, the rocker-arm 127 is moved downward and the rock-shaft 129 is moved clockwise (Fig. 12) to their respective normal positions; but in this clockwise movement of the rock-shaft 129 the ratchet mechanism permits the counter-shaft 95 to stand still,

so that the shear blade 71 and the wire-receiving plate 90 remain in their forward position.

During this time the wire 35 has been passing through the cut-off bushing 70 to the rear of the shear blade 71, across the open space beyond the cut-off bushing, and into the groove 92. When the advancing wire 35 reaches the stop wire 145 in that wire-receiving groove 92, it acts on that stop wire to repeat with the slide-bar 142 the action that has just been described for the action of the slide-bar 141; to move the slide-bar 150 and the tension wire 157 to the right, and thereby to move the cam plate 120 into clutching position to permit another one-revolution movement of the shaft 113. This time, however, that one-revolution movement of the shaft 113, and the resultant half-turn of the counter-shaft 95, act through the eccentric pins 97 and 98 to move the shear blade 71 and the wire-receiving plate 90 backward, from their forward position to the full-line position shown in Figs. 1, 4, 5, 6, and 7. This cuts off a length of wire by the rearward movement of the shear blade 71, so that immediately thereafter the advancing wire 35 may pass in front of the shear blade 71; and it discharges that cut-off length of wire through the open space at the rear of the wire-supporting plate 80, between it and the guide plate 82. Upon that discharge of this cut-off length of wire, the cam plate 120 and the slide-bars 162 and 150 and 142 are returned to their normal position by the action of the springs 163 and 143.

This cycle may be repeated indefinitely, to cut off desired lengths from the ever-advancing wire 35. That advancing wire 35 is straightened by the spinner 34 as it approaches the cut-off bushing 70, and is stopped only for a fraction of a second by the shearing operation. The stoppage of the wire is wholly within the first half of the one revolution made by the shaft 113, so that the wire is already again advancing by the time the second half of that one revolution starts; and the stopping time is so short that the pusher dies 140 do not cut into, or burn, or even appreciably mar, the momentarily stationary wire 35. In addition, the timing is desirably such that the split-second stopping of the wire 35 is done by the shear blade 71 itself, before the slide-bar 150 reaches its rightward limit of movement, so that there is no tendency to buckle the wire between the cut-off bushing 70 and the stop wire 145; and the action of the shear blade is so quick that it produces in the wire no appreciable deviation from a straight cut at the cut-off plane. All this makes for greatly increased speed of operation.

I have described the operation of my wire straightening and cut-off mechanism as applied to solid wire, but it works equally well with metal tubing in place of solid wire. If the tubing is fairly sturdy, no change at all need be made in the mechanism. However, for thin tubing, it is desirable to modify the shear blade slightly. The modified shear blade 71′ is shown in Figs. 20 and 21. The difference consists primarily in the shear-blade portion that does the actual shearing. In place of merely a downward tongue as shown in Fig. 7, that is suitable for solid wires and for sturdy tubing, for thin tubing I provide the shear blade 71′ with two wire openings 170 that completely surround the tubing 35′ in and near the shearing-off plane, and that flare slightly toward the right (Fig. 20) from that shearing-off plane. The shear-blade portions 171 that lie beneath the tubing 35′ are made narrower than the body of the shear blade, as is clear from Figs. 20 and 21, to facilitate the dropping out of a cut-off length of the tubing 35′, as is indicated in dotted lines in Fig. 20. By having the shear blade completely surround the tubing at the shear plane the tubing is effectively prevented from buckling at the shear during the shearing-off operation.

Instead of connecting the clutch shaft 113 to the counter-shaft 95 by the connecting rod 126, the rocking gear-segment 127, the pinion 128, the rock-shaft 129, and the ratchet mechanism 133—134—135—136—137, I may connect that clutch shaft to that counter-shaft by an interlocking intermittent gearing, shown in Figs. 22, 23, and 24.

In this modification, if desired, the clutch shaft 113 and the counter-shaft 95 may be and conveniently are in the same vertical plane; but in any event their adjacent ends overlap longitudinally, as is clear from Fig. 22. The clutch shaft 113 is a one-revolution shaft, as has already been explained; and is driven from the constantly rotating pulley 112 and clutch-ring 114 by the one-revolution-clutch mechanism already described, although in Fig. 22 the clutch ring 114 is shown as larger instead of smaller than the pulley 112. The counter-shaft 95 is provided with the eccentrics 97 and 98 already described in connection with it and shown in Fig. 5 and others, for operating the shear blade 71 and the wire-receiving plate 90 respectively.

On the overlapping ends of the clutch shaft 113 and the counter-shaft 95 are two gears 181 and 182 respectively, and two interlocking cam plates 183 and 184 respectively, all keyed to the shafts on which they are respectively mounted. The gear 181 is the drive gear; and is a mutilated gear, having teeth 185 for slightly less than half its circumference, the forwardmost tooth 186 of which is a heavy knocker-tooth, and having its teeth cut away for the remainder of its circumference, as is clear from Fig. 23. The gear 182 is the driven gear; and has teeth 187 around its entire circumference, with diametrically opposite knocker teeth 188 each adjacent to a wide tooth-space 189 to mate with the knocker-tooth 186 on the gear 181. The cam plate 183 has a large-radius portion 191 extending slightly more than 180°, and a small-radius portion 192 extending slightly less than 180°; and the cam plate 184 is a disk with two diametrically opposite curved locking notches 193 in its periphery of such size and location that they interlock with the large-radius portion 191 of the cam plate 183, as is clear from Fig. 24.

In operation, the part normally stand in substantially the positions shown in Figs. 23 and 24. When by the operation of the length-measuring device the one-revolution clutch interconnects the clutch ring 114 to the clutch shaft 113, that clutch shaft 113 starts its one revolution; which is counter-clockwise as seen in Figs. 23 and 24, as is indicated by the arrows. As it starts this counter-clockwise movement, the large-radius portion 191 of the cam plate 183 moves out of the notch 193 to unlock the cam plate 184 and the knocker-tooth 186 on the drive gear 181 engages a knocker-tooth 188 on the driven gear 182 and thus starts the counter-shaft 95 and the parts carried thereby into movement in a clockwise direction, as is shown by arrows in Figs. 23 and 24. The teeth 185 and 187 mesh to continue this movement for a half-revolution of the counter-shaft 95, during which time an unnotched portion of the cam plate 184 rides

freely in the small-radius portion 192 of the cam plate 183.

At the end of the half-revolution of the counter-shaft 95, the last or farthest-clockwise tooth 185 passes out of engagement with the teeth 187; and the large-radius portion 191 of the cam plate 183 enters the opposite locking notch 193 from the one which it had last engaged. This both stops the driving of the counter-shaft 95 and locks that counter-shaft in stationary position exactly at the end of a half turn.

But the clutch shaft 113 continues for a second half-turn, in the manner that has already been described; during which time the cut-away portion of the gear 181 passes over the ends of the teeth 187 so that there is no driving connection between the two gears 181 and 182, and the large-radius portion 191 of the cam plate 183 slides in a locking notch 193 of the cam plate 184 to lock the counter-shaft 95 in fixed position.

During its half-turn the counter-shaft 95 moves the shear blade 71 and the wire-receiving plate 90 from one limit of movement to the other, in the manner already described.

This operation is repeated, to make a full turn of the clutch shaft 113 and a half-turn of the counter-shaft 95, for each cutting-off operation.

I claim as my invention:

1. A wire cut-off machine, comprising feed rolls for feeding wire, a cut-off bushing through which said feed rolls feed wire, a reciprocable shear blade cooperating with said cut-off bushing to shear the wire, said shear blade being arranged to shear the wire by its movement in either direction of its reciprocating movement and to clear the wire at both ends of that movement, a constantly rotating member, a member adapted to be driven thereby, a one revolution clutch for intermittently connecting the constantly rotating member to the driven member, an eccentric linked to the shearing device, and driving means between said driven member and said eccentric which drives the eccentric during only the first half revolution of said driven member and during said first half-revolution moves the eccentric through a half-revolution to move the shearing device through a reciprocating stroke in one direction, and means responsive to the feeding of a predetermined length of wire for energizing said one revolution clutch, in combination with a wire support onto which the wire is fed from said cut-off bushing, a wire-receiving plate cooperating with said wire support and having two positions therein for receiving the on-coming wire, the wire-supporting plate being spaced axially of the wire from said cut-off bushing and shear blade, and means for moving said wire receiving plate from one to another of said wire-receiving positions.

2. A wire cut-off machine, comprising feed rolls for feeding wire, a cut-off bushing through which said feed rolls feed wire, a reciprocable shear blade cooperating with said cut-off bushing to shear the wire, said shear blade being arranged to shear the wire by its movement in either direction of its reciprocating movement and to clear the wire at both ends of that movement, a constantly rotating member, a driven member adapted to be clutched thereto, a one revolution clutch therebetween, driving means between said driven member and said shearing blade including a plurality of eccentrics operating in series and converting the rotational movement of each to linear movement whereby the speed varying effects of such conversions are compounded, and means for energizing said one-revolution clutch, in combination with a wire support onto which the wire is fed from said cut-off bushing, a wire receiving plate cooperating with said wire support and having two positions therein for receiving the on-coming wire, the wire-supporting plate being spaced axially of the wire from said cut-off bushing and shear blade, and means for moving said wire receiving plate from one to another of said wire-receiving positions.

3. A wire cut-off machine as defined in claim 1 in which the clutch actuating means comprises a stop associated with each of the wire-receiving positions of the wire-receiving plate in position to be actuated by the on-coming wire, and a trigger actuated by each of said stops when said stops are respectively in wire engaging position, and means connecting said trigger to actuate said clutch.

4. A wire cut-off machine as defined in claim 2 in which the clutch actuating means comprises a stop associated with each of the wire-receiving positions of the wire-receiving plate in position to be actuated by the on-coming wire, and a trigger actuated by each of said stops when said stops are respectively in wire engaging position, and means connecting said trigger to actuate said clutch.

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