May 21, 1957 L. TALBOT ET AL 2,792,852

WIRE BENDING APPARATUS

Filed March 20, 1953 9 Sheets-Sheet 1

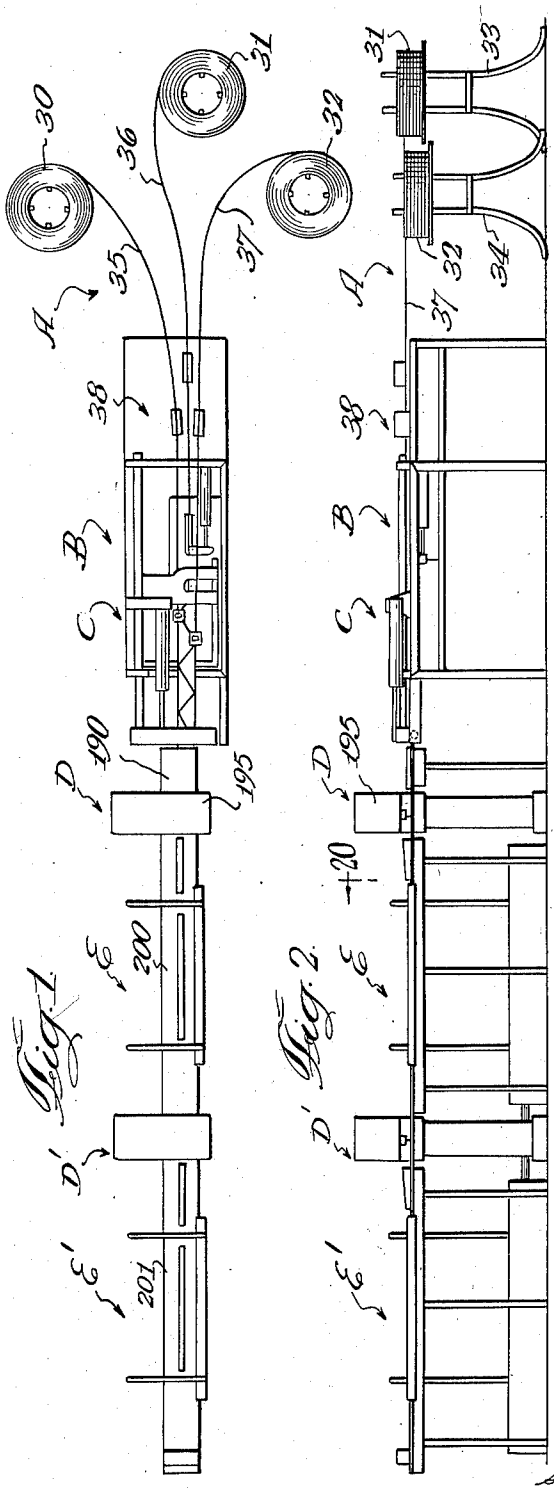


Fig. 1.

Fig. 2.

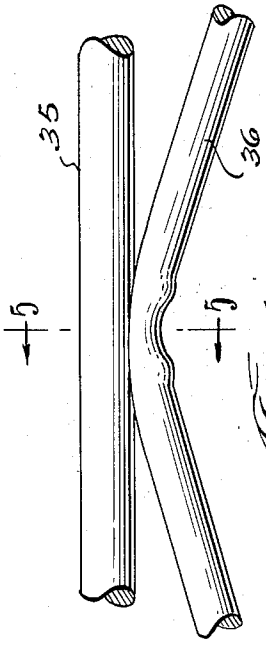


Fig. 4.

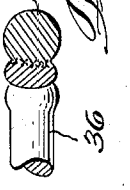


Fig. 5.

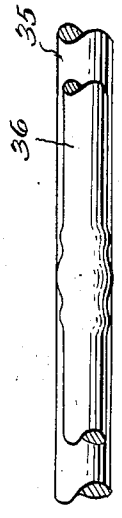


Fig. 3.

Inventors
Lloyd Talbot
Byard D. Simpson
By
Schroeder, Merriam, Hofgren & Brady
Attorneys

May 21, 1957 L. TALBOT ET AL 2,792,852

WIRE BENDING APPARATUS

Filed March 20, 1953 9 Sheets-Sheet 2

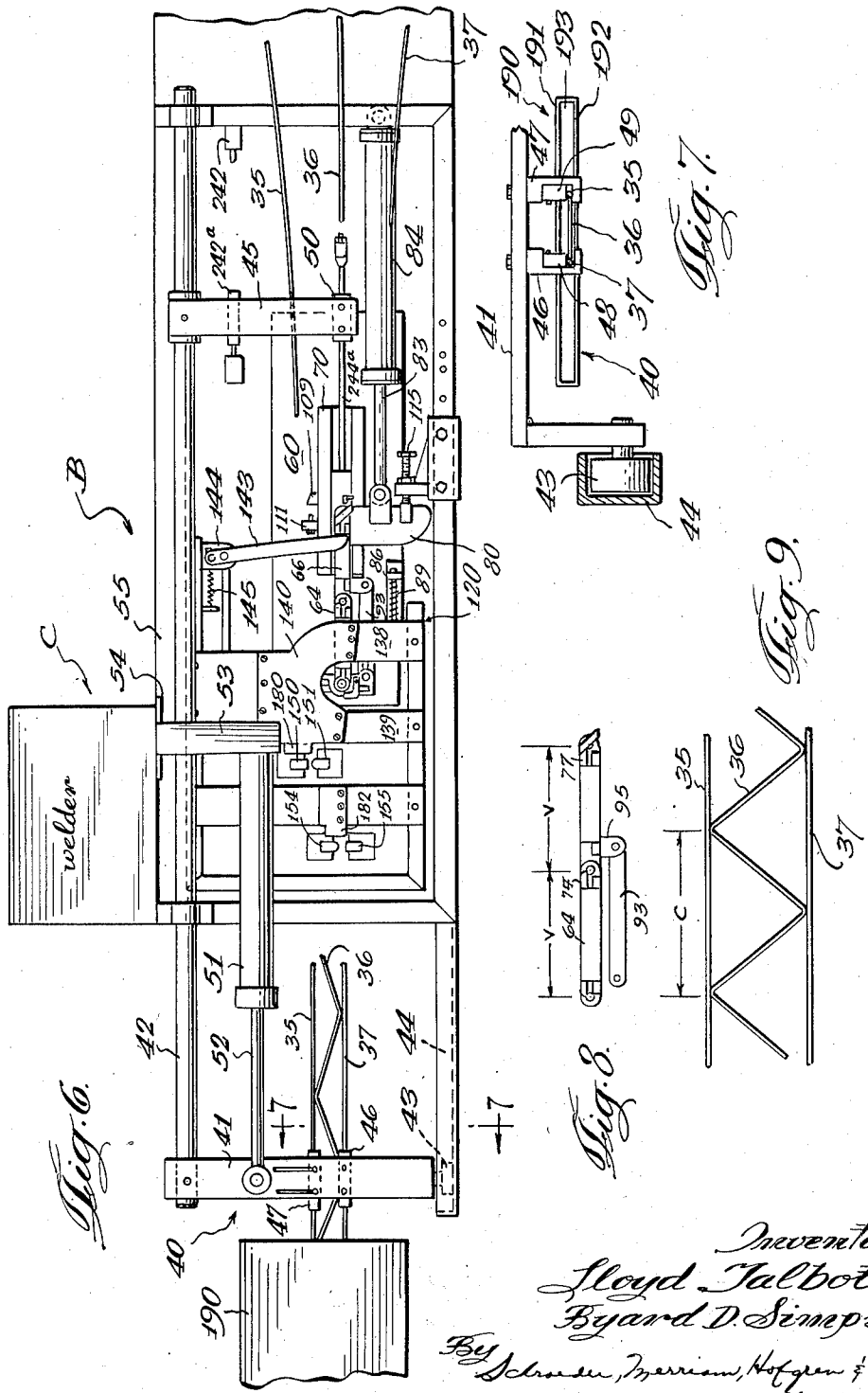


Fig. 6.

Fig. 7.

Fig. 8.

Fig. 9.

Inventors
Lloyd Talbot
Byard D. Simpson
By Schroeder, Merriam, Hofgren & Brady
Attorneys

May 21, 1957 L. TALBOT ET AL 2,792,852

WIRE BENDING APPARATUS

Filed March 20, 1953 9 Sheets-Sheet 3

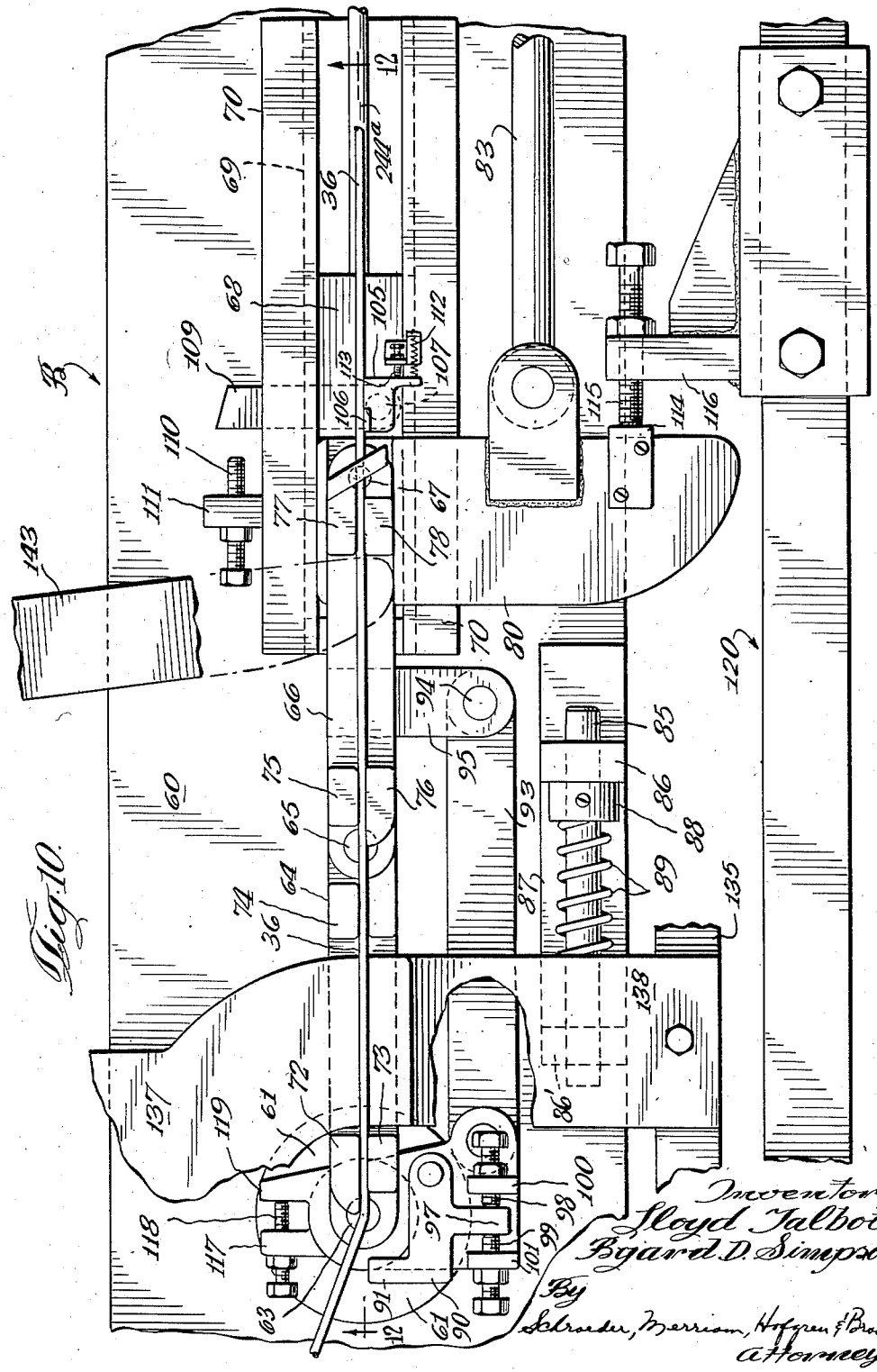


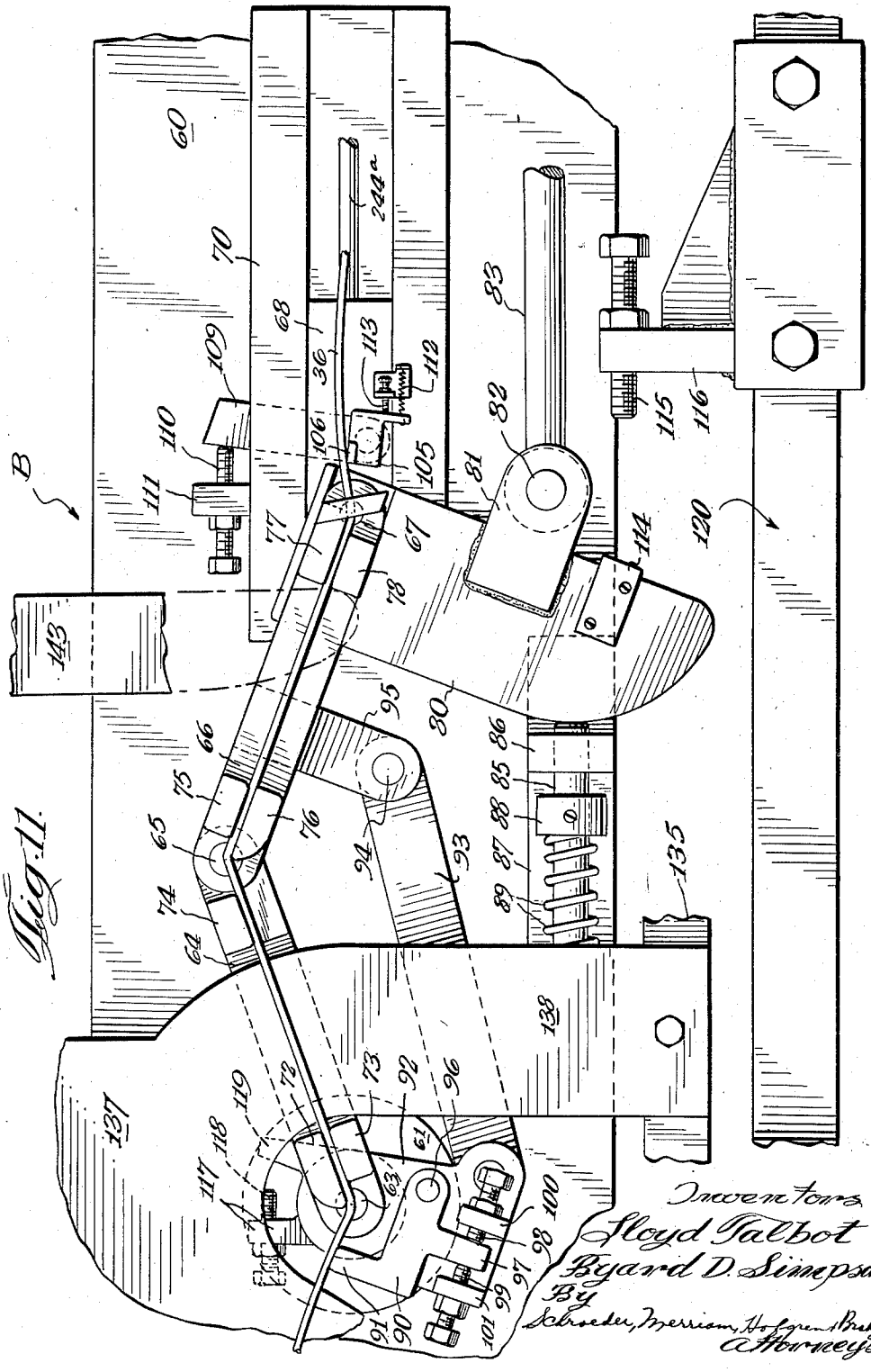
Fig. 10.

Inventors
Lloyd Talbot
Byard D. Simpson
By
Schroeder, Merriam, Hofgren & Brady
Attorneys

May 21, 1957 L. TALBOT ET AL 2,792,852

WIRE BENDING APPARATUS

Filed March 20, 1953 9 Sheets-Sheet 4



Inventors
Floyd Talbot
Byard D. Simpson
By
Schroeder, Merriam, Hofgren & Braby
Attorneys

May 21, 1957 L. TALBOT ET AL 2,792,852

WIRE BENDING APPARATUS

Filed March 20, 1953 9 Sheets-Sheet 5

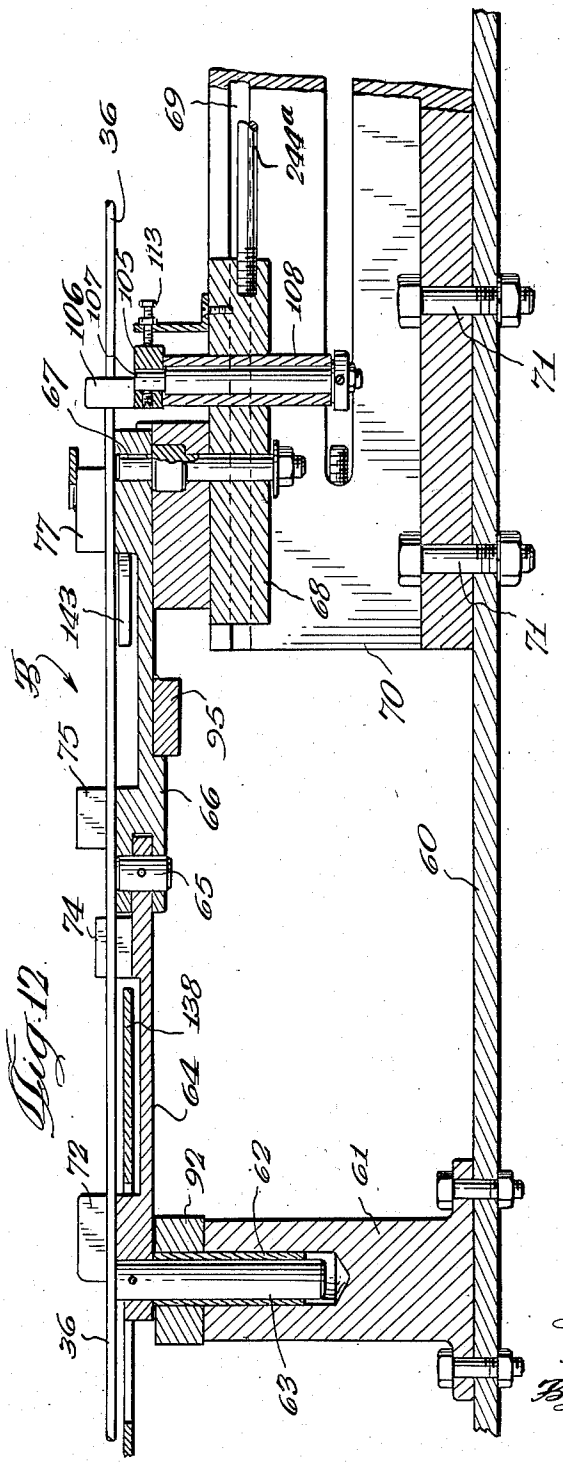


Fig. 12.

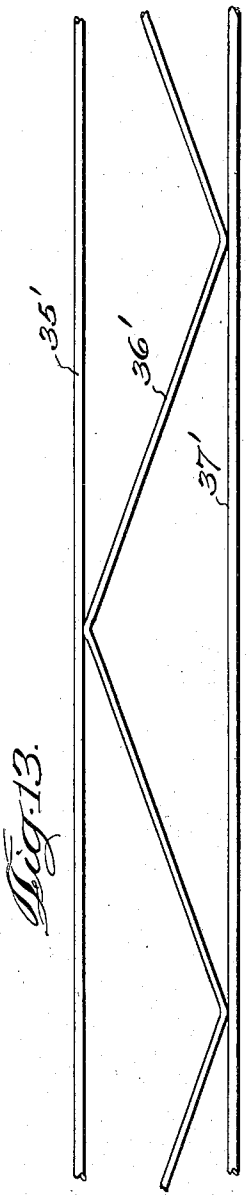


Fig. 13.

Inventors
Lloyd Talbot
Byard D. Simpson
By Schroeder, Merriam, Hoffgren & Brady
Attorneys

May 21, 1957 L. TALBOT ET AL 2,792,852

WIRE BENDING APPARATUS

Filed March 20, 1953 9 Sheets-Sheet 6

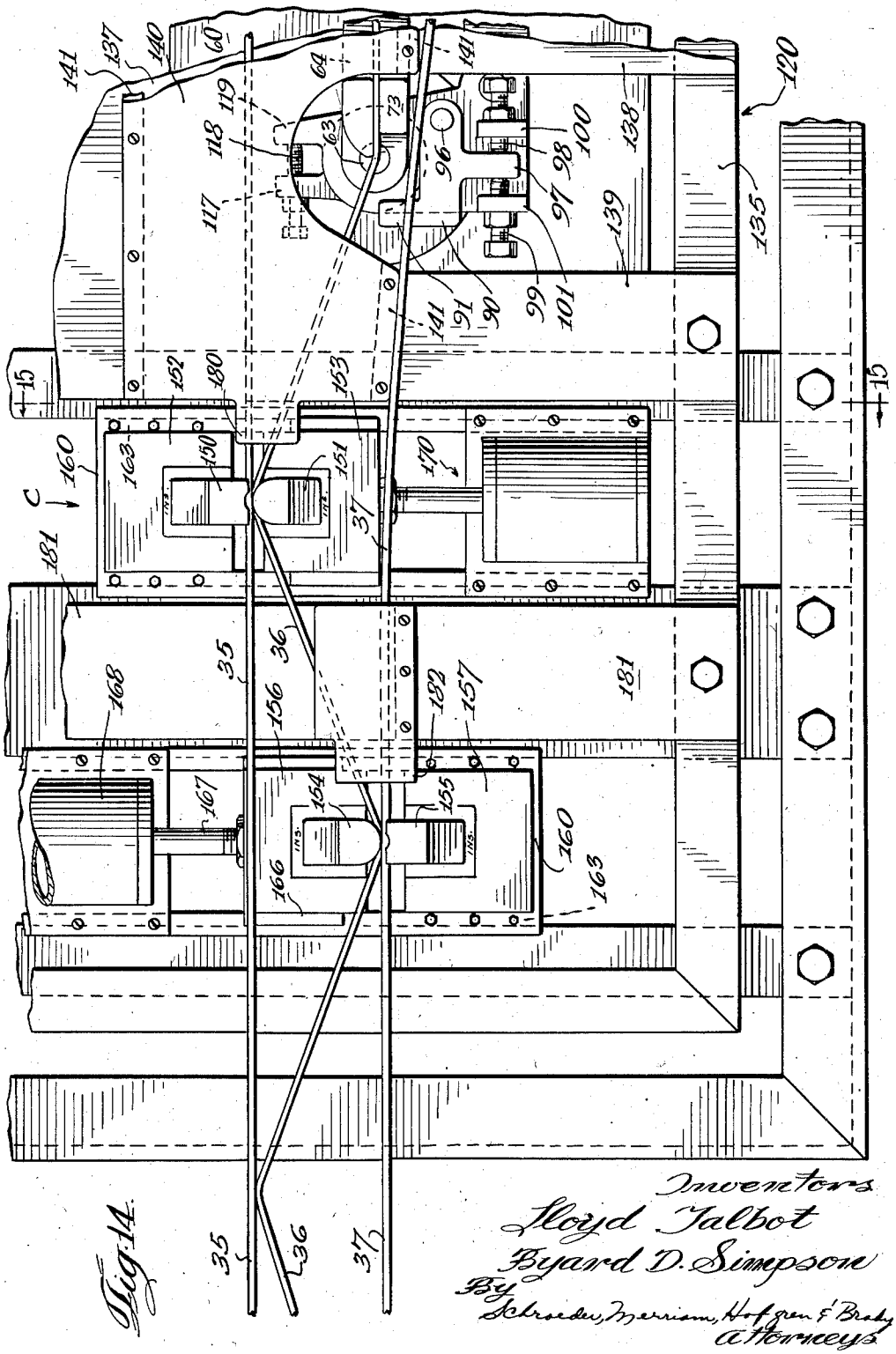


Fig. 14.

Inventors
Lloyd Talbot
Byard D. Simpson
By
Schroeder, Merriam, Hofgren & Brady
Attorneys

May 21, 1957 L. TALBOT ET AL 2,792,852

WIRE BENDING APPARATUS

Filed March 20, 1953 9 Sheets-Sheet 7

Fig. 15.

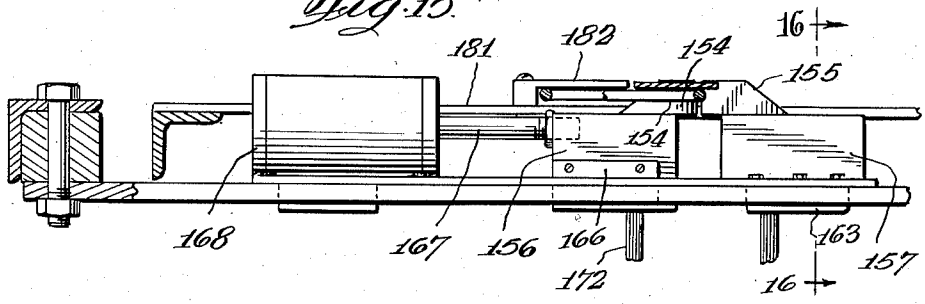
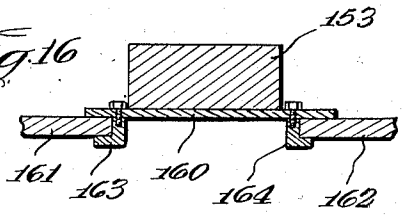


Fig. 16



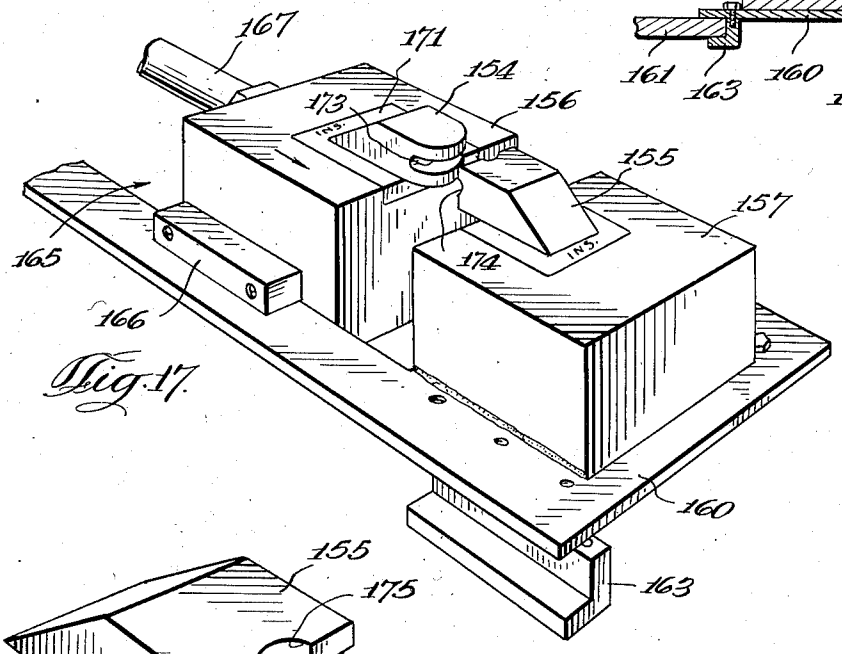


Fig. 17.

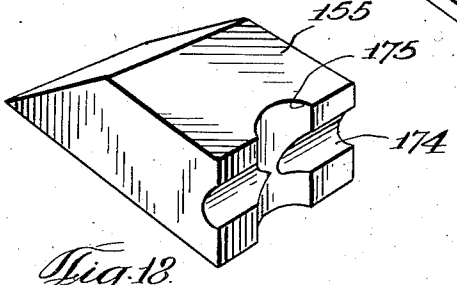


Fig. 18.

Inventors
Lloyd Talbot
Byard D. Simpson
By
Schroeder, Berriman, Hofgren & Brady
Attorneys

May 21, 1957 L. TALBOT ET AL 2,792,852

WIRE BENDING APPARATUS

Filed March 20, 1953 9 Sheets-Sheet 8

Fig. 19.

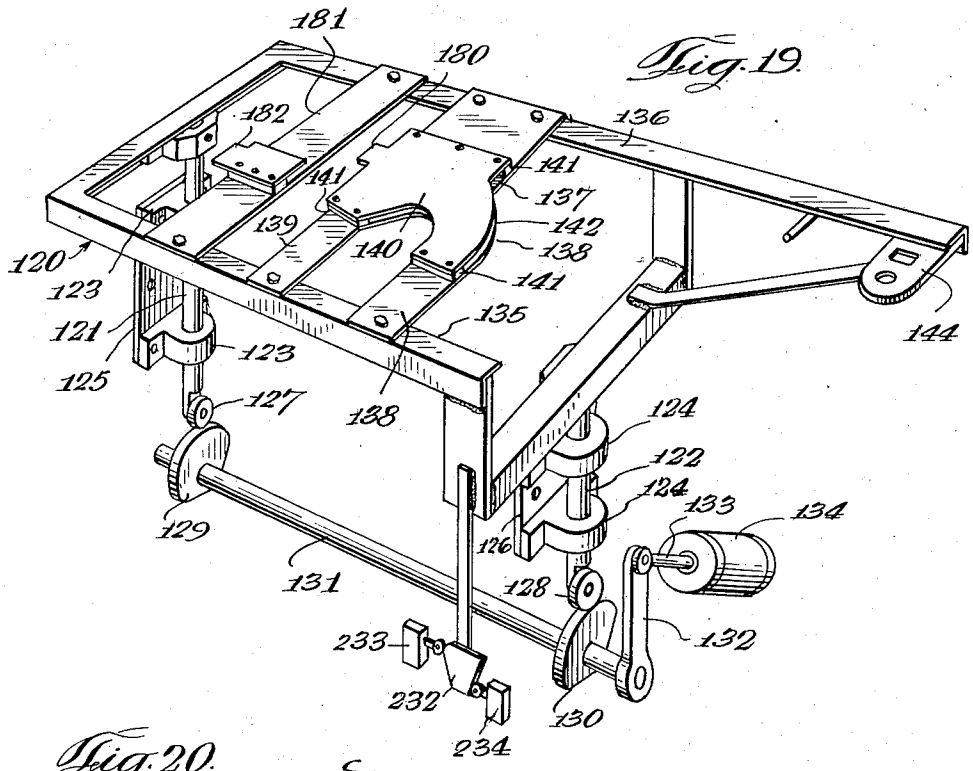
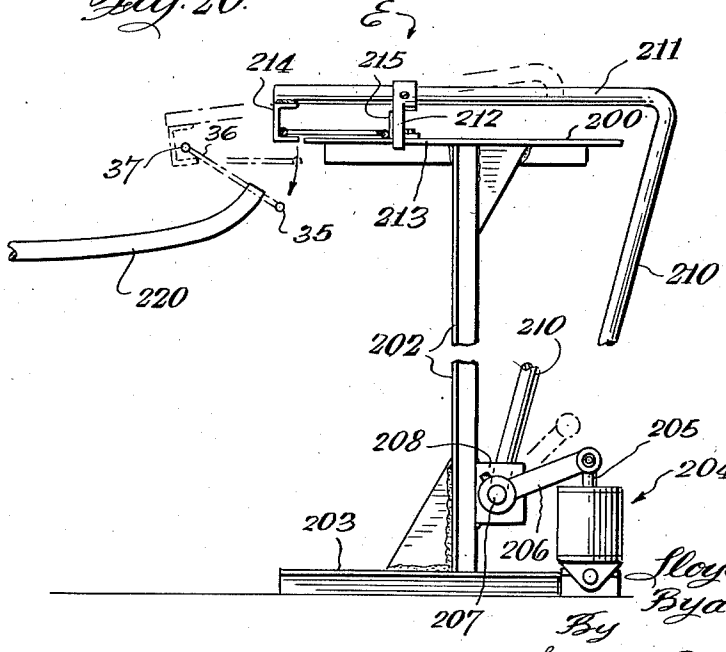


Fig. 20.



Inventors
Lloyd Talbot
Byard D. Simpson
By
Schroeder, Merriam, Hofgren & Brady
Attorneys

May 21, 1957 L. TALBOT ET AL 2,792,852

WIRE BENDING APPARATUS

Filed March 20, 1953 9 Sheets-Sheet 9

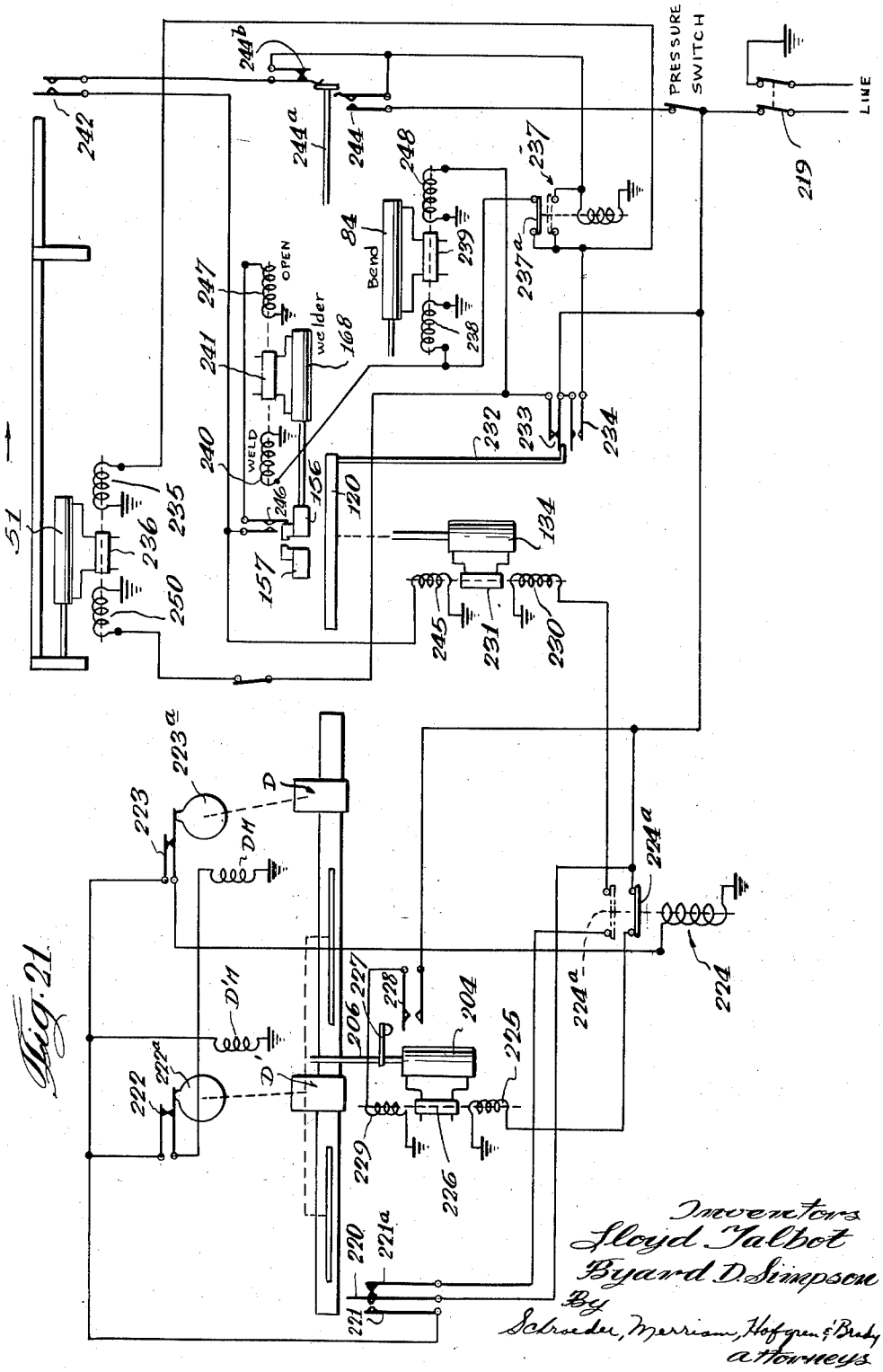


Fig. 21.

Inventors
Lloyd Talbot
Byard D. Simpson
By
Schroeder, Merriam, Hofgren & Brady
attorneys

United States Patent Office 2,792,852 Patented May 21, 1957

2,792,852

WIRE BENDING APPARATUS

Lloyd Talbot and Byard D. Simpson, Chicago, Ill., assignors to Cedar Rapids Block Co., a corporation of Iowa

Application March 20, 1953, Serial No. 343,636

7 Claims. (Cl. 140—71)

This invention relates to a bending apparatus and more particularly to a machine for bending wire.

It is the general object of this invention to produce a new and improved bending machine.

While it will be readily apparent to those skilled in the art that the features of the machine of this invention may be utilized for bending wire into a variety of shapes, it is particularly adapted for use in feeding a plurality of lengths of wire, bending one of the wires, welding the bent wire to another of the wires and then measuring and cutting off the welded wires into predetermined lengths.

One of the features of the invention is the provision of a bending machine having a pair of bending arms pivotally connected together to form a bending knee together with means for feeding a length of wire to the arms to be retained thereon as the knee is flexed to produce a bend in the wire together with means for preventing damage to the pivotal connection between the arms when the same are returned to a substantially linearly aligned position.

A further feature of the invention is the provision of means for lifting a length of bent wire from the bending knee to permit it to be fed forwardly along the machine.

Yet another feature of the invention is the provision of means for moving the bent wire and another wire into the space between a pair of welding heads together with means for moving the heads together to contact the wires and weld them together.

A further feature of the invention is the provision of a novel form of welding means particularly adaptable for use in the machine of the invention which includes a pair of grooved welding heads, with the grooves being proportioned to engage a wire so that when the heads are moved together and the wires thus brought into contact with each other they may be welded to form a completed device which has a thickness no greater than the thickness of one of the wires.

Yet another feature of the invention is the provision of a support for the welded wires which is provided with a cutter to cut the welded wires into predetermined lengths together with push-off means associated with the support for pushing off a cut length of welded wire onto a storage or receiving device.

Another feature of the invention is the provision of a suitable electrical and pneumatic circuit for cyclically operating the machine to produce automatic operation, cutting and push-off of the wires.

Other and further features of the invention will be readily apparent from the following description and drawings, in which:

Fig. 1 is a plan view of apparatus embodying the invention;

Fig. 2 is a side elevation of the apparatus shown in Fig. 1;

Fig. 3 is an enlarged detailed side view showing the manner in which the wires are welded together;

Fig. 4 is a plan view of the wire shown in Fig. 3;

Fig. 5 is a sectional view taken along line 5—5 of Fig. 4;

Fig. 6 is an enlarged detailed plan view of the wire bending and welding part of the machine;

Fig. 7 is a sectional view taken along line 7—7 of Fig. 6;

Fig. 8 is a detailed view of the wire bending arms;

Fig. 9 is a plan view of the completed wire device;

Fig. 10 is a plan elevation of the bending apparatus of the machine;

Fig. 11 is a view like Fig. 10 showing the bending arms in a different position;

Fig. 12 is a vertical sectional view taken along line 12—12 of Fig. 10;

Fig. 13 is a view like Fig. 8 of the completed wire device when the machine is set for a slightly different operation;

Fig. 14 is a plan elevational view of a portion of the welding apparatus for welding the wires together;

Fig. 15 is a sectional view along line 15—15 of Fig. 14;

Fig. 16 is a vertical sectional view along line 16—16 of Fig. 15;

Fig. 17 is an isometric view of the welding heads;

Fig. 18 is an enlarged isometric detailed view of one of the welding heads;

Fig. 19 is an isometric view of the mechanism for elevating the wires after the completion of the welding operation;

Fig. 20 is an end elevational view of the push-off mechanism; and

Fig. 21 is a schematic diagram showing the electrical and pneumatic circuits for operating the machine.

For the purposes of exemplary embodiment the features of the invention are shown as incorporated into a machine for making welded reinforcing devices suitable to be embedded in mortar, for example in the mortar holding concrete blocks together, as a reinforcement. While the invention is shown in its preferred embodiment, it is to be understood that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated. The scope of the invention will be pointed out in the appended claims.

Referring now to Fig. 1, the machine comprises a mechanism for feeding three wires simultaneously, such mechanism being generally designated by the letter A, with the wires being fed to a bending mechanism B and a welding mechanism, generally designated C. In the bending and welding mechanism one of the three wires fed to the machine is bent in the form of a series of V's and subsequently welded to two other wires at the apices of the V. The completed welded wire is then fed to cut-off mechanisms, generally designated D and D', for cutting the wires into predetermined lengths suitable for use as a reinforcing device for concrete or mortar and particularly for reinforcing mortar courses in concrete block structures. After the wires have been cut they are pushed off the cutting mechanism by push-off apparatus, generally designated E and E'.

The welded wire reinforcing device is fed to a table upon which the cutting mechanism D and push-off mechanisms E are associated, and it is the contemplated operation of the machine that a double length of the welded wire will be fed and simultaneously cut by the cutting mechanism D and D' into two lengths which are subsequently pushed off the table by the pusher mechanism E and E'. If lengths greater than the distance between the two cutters D and D' are desired, the cutter D' may be deactivated and the principal purpose of employing two cutters is to speed the operation so that two lengths are cut simultaneously. If such speed is not desired the cutter mechanism and push-off mechanism D' and E' may be omitted.

The wires are fed from three supply spools 30, 31 and 32 each rotatably mounted on pedestals, such as

the pedestals 33 and 34. Three lengths of wire 35, 36 and 37 are fed from each of the spools through straightening apparatus, generally designated 38, which may comprise the usual form of a plurality of rollers for bending each wire back and forth a plurality of times so that it emerges as a substantially straight length.

A reciprocating feed mechanism, generally designated 40, is provided for intermittently feeding predetermined lengths of each of the wires into the bending and welding apparatus B and C. As shown in Fig. 6, the feed mechanism comprises an angle iron 41 secured at one end to a push rod 42 reciprocably carried in the machine, with the other end of the angle iron being provided with a roller 43 adapted to roll in a track 44 secured to the frame. Also secured to the push rod 42 is a second angle iron 45. The angle iron 41 is provided with a pair of gripping means 46 and 47 each of which is provided with a plurality of gripping dogs 48 and 49 adapted to grip the wires 35 and 37 to move the wires in a feed direction. The dogs are pivotally mounted on the gripping means so as to be able to slide over the wires in the opposite direction without imparting movement thereto. The angle iron 45 is also provided with gripping means indicated at 50 similarly constructed to the gripping means 46 and 47, with the means 50 being adapted to feed the central wire 36. Reciprocation of the push rod 42 and hence reciprocation of the feeding means is accomplished through a pneumatic piston and cylinder device including a cylinder 51 having a piston rod 52 connected to a piston therein, with the rod being connected to the angle iron 41 as shown. Valve means later to be described are provided for introducing air under pressure alternately to the opposite ends of the cylinder 51 to cause reciprocation of the piston therein. The piston 51 is mounted on a U channel 53 secured at its outer end to a plate 54 in turn connected to a stationary part of the frame 55.

The bending means for the machine is mounted on a plate 60 secured to a stationary part of the frame and includes an upstanding member 61 provided with a vertical cylindrical bearing 62 rotatably supporting a shaft 63 which carries at its upper end one end of a bending arm 64. The other end of the arm 64 is pivotally connected at 65 to a second bending arm 66 rotatably supported at its other end on a shaft 67. The shaft 67 is mounted in a movable slide 68 slidably held in grooves 69 provided in a pair of upstanding plates 70 mounted on opposite sides of the frame. The plates 70 are secured to the plate 64 by bolts 71 as shown.

Referring now to Figs. 10 and 11, the central wire 36 to be bent is fed into the bending arms when the arms 64 and 66 are linearly aligned as shown in Fig. 10. The wire 36 is held in the arms between guide blocks 72 and 73 mounted at one end of the arm 64 and a further guide block 74 mounted at the other end of the arm 64. The arm 66 is also provided with a pair of guide blocks 75 and 76 mounted at the end adjacent the pivot 65 and a second pair of guide blocks 77 and 78 mounted adjacent the pivot 67.

After the wire 36 has been fed to the arms 64 and 65 and is retained in position thereon between the guide blocks just described, means are provided for then pivoting the arms to the position shown in Fig. 11 to bend the wire 36 into the desired V shape. For this purpose there is provided a power plate 80 secured at one end to the end of the arm 66 adjacent the pivot 67, with the plate being provided with push plate 81 pivotally secured at 82 to a piston rod 83 secured to a piston reciprocable in a pneumatic cylinder 84. As the piston in the cylinder 84 is moved to the left to move the piston rod 83 to the left (as seen in Fig. 11), the arms are moved to the position shown in that figure, with the arms 64 pivoting about the stationary pivot 63 and the arm 66 pivoting about its pivot 67, with such pivot at the same time being moved toward the stationary pivot by sliding movement of its supporting block 68.

Should the wire 36 be bent by the arms only to the desired degree of bend, it is clear that upon return movement of the arms the wire, by its resiliency, would have a tendency to return at least partially to its initial shape. Accordingly means are provided for overbending the wire at each angle during the bending operation so that it will retain the V shape desired.

To provide an overbend at the pivot point 65 the arms are actually moved so as to produce a bend of the wire at that point greater than the final desired angle. Thus as the piston rod 83 is moved to the left (as seen in Fig. 11) the power plate 80 contacts a rod 85 which is slidably supported in bearings 86 and 86' carried by a stationary plate 87. Secured to the rod 85 is an adjustable collar 88 against which one end of a compression spring 89 bears, with the other end of the spring contacting the bearing 86'. When the arms have been moved to produce the greatest desired degree of bend, the spring 89 is compressed so that when pressure is relieved in the cylinder 84 the spring 89 serves to move the arms slightly in the reverse direction, thus permitting the wire to lie loosely between the guides so that it may be subsequently lifted out of the guide blocks and shifted longitudinally along the machine.

There is also provided an overbending member 90 provided with a finger portion 91 adapted to contact the portion of the wire 36 just beyond the end of the arm 64. The overbending member 90 is fixed to a member 92 rotatably supported on the shaft 63 and pivotally connected to an arm 93 pivoted at 94 to a second arm 95 secured to the bending arm 66. Thus as the bent arms are operated from the position shown in Fig. 10 to the position shown in Fig. 11, the member 92 is rotated clockwise (as viewed in Fig. 11) to bring the finger 91 into contact with the wire to increase the bend at the pivot point 63. The degree of overbend achieved during this operation may be adjusted depending upon the amount required to retain the wire in the desired shape and for this purpose the bending member 90 is pivotally secured at 96 to the member 92 and is provided with a second finger 97 held between a pair of adjustable stops in the form of screws or bolts 98 and 99 threadably engaging upstanding plates 100 and 101 secured to the plate 92. By rotating the bolts 98 and 99 in opposite directions the finger 97 can be shifted thus to pivot the bending member 90 about its pivot 96, thereby adjustably positioning the finger 91 relative to the wire.

The other end of the portion of the wire 36 being bent is also overbent during the bending operation and for this purpose there is provided an overbending block 105 carrying a bending finger 106, with the block being rotatably supported on a shaft 107 carried in a bushing 108 secured to the block 68. The block 105 is provided with a laterally extending portion 109 adapted to contact an adjustable bolt 110 threaded into a block 111 fixed to the plate 60. As the block 68 slides to the left, as shown in Figs. 11 and 12, the portion 109 contacts the bolt 110 to rotate such portion and thus to move the bending finger 106 against the wire to produce an overbend at that point. After the overbending operation just described and upon return movement of the block 68, the bending member 105 is rotated back to its normal position under the urging of a return spring 112 and against an adjustable stop 113 secured to the block 68.

The power plate 80 is provided with an aligning plate 114 fixedly secured thereto adapted to contact an adjusting bolt 115 threadably received in a fitting 116 secured to the frame. Rotation of the bolt 115 will serve to move the plate 80 and thus slightly shift each of the arms 64 and 66 so as to provide means for aligning the arms in linear relationship and thus to permit the wire

36 to be fed to the guide blocks thereon without difficulty.

To also serve as a stop when the arms are moved to their linearly aligned position there is provided on the upstanding plate 61 a finger 117 having a threaded opening to receive an adjusting bolt 118 adapted to contact a finger portion 119 forming a part of the member 92. Thus as the arms are moved to linearly aligned position the finger 119 contacts the bolt 118 at substantially the same time that the plate 114 contacts the bolt 115. In addition to providing means for linearly aligning the arms the two stop means, namely the plate 114 and bolt 115, and the finger 119 and bolt 118, also serve to prevent a "snapping" action at the pivot point 65 of the arms and thus the force which would otherwise be exerted thereon when the arms are returned rapidly to linearly aligned position is absorbed by the two stop means rather than the pivot.

The degree of bend of the bending arms and hence the amount of bending of the wires 36 may be varied. Thus the machine may be used to form a reinforcing device of the type shown in Fig. 9 or, by producing a lesser degree of bend, a reinforcing device may be produced such as the one shown in Fig. 13 including the wires 35', 36' and 37'. By varying the length of the arms 64 and 66 the degree of bend and the spaces between the apices of the V formed in the central wire may be varied as well as the spacing between the outer wires.

When the portion of the wire held in the arms has been bent by the means just described, other means are provided for lifting the bent portion of the wire out of the guide blocks so that the subsequent feeding operation can be accomplished without interference.

As best shown in Fig. 19, the means for lifting the wire out of the guide block includes a frame 120 mounted for vertical reciprocation in the stationary part of the machine on a pair of rods 121 and 122 slidably mounted in bearings 123 and 124, with the bearings being secured to plates 125 and 126 secured to the stationary frame. The lower end of each of the rods is provided with a cam follower 127 and 128 each adapted to contact cams 129 and 130 secured to a rotatably mounted actuating shaft 131. The shaft is oscillated to produce alternate rise and fall of the frame 120 and is therefore provided at one end with an arm 132 pivotally secured to a piston rod 133 secured to a piston reciprocable in a pneumatic piston and cylinder device 134.

The frame 120 extends across the machine and is provided with a pair of parallel side portions 135 and 136 which support a plate 137 which is divided at one end into a pair of legs 138 and 139, each of which is secured to the side member 135. A keeper plate 140 is spaced above the plate 137 and secured thereto through the medium of a plurality of spacing blocks 141, thereby to provide a slot 142 therebetween. The wires 35 and 36 are fed through the slot 142 while the wire 37 is positioned laterally outwardly of the keeper plate 140.

Also carried by the movable frame 120 is a stripper finger 143 pivotally secured to a bracket 144 mounted on the movable frame and urged against the guide blocks 77 and 78 by means of a spring 145 as shown in Fig. 6. The finger 143 is positioned to underlie the wire 36 when it is held in the bending arms and by reason of its pivotal mounting may move as the arms are moved to bend the wire.

Means are provided for introducing compressed air into cylinder 134 to oscillate the shaft 131 and thus to raise the frame 120 upon the completion of the bending operation. Upon such upward movement of the movable frame the plate 137 contacts the bent wire 36 and thus lifts it from the spaces between the guide slots provided on the arms, with the stripper finger 143 lifting the wire from between the guide blocks 77 and 78, thereby to free the bent wire from the arms for subsequent feeding movement longitudinally of the bending machine by the feed means previously described.

From the bending means B the wires are fed to the welding means C wherein means are provided for welding the bent wire at the apex of each of the V's formed therein to the edge wires 35 and 37. As best shown in Fig. 14, the welding means comprise a first pair of welding heads 150 and 151 each carried by slide blocks 152 and 153, respectively, and a second pair of welding heads 154 and 155 each carried by slide blocks 156 and 157, respectively.

Referring now to Figs. 15–18, the manner of mounting and moving the slide blocks and welding heads and the construction thereof will be described. As the two pairs of welding heads and their associated slide plates are similarly constructed, the construction only of one pair, namely the blocks 156 and 157, will be described in detail.

The blocks 156 and 157 comprise substantially cubicle blocks of metal, with the block 157 being secured as by welding to a slide plate 160 adjustably mounted on side plates 161 and 162. To retain the plate 160 in adjusted position there is provided a pair of clamping angles 163 and 164 which may be tightened against the plates by bolts, as shown in Fig. 16. The plate 160 is solid from edge to edge at the location of the block 157 but is cut away at its central portion at the location of the block 156 so as to provide a slide space indicated at 165 between the two opposed lateral edges of the plate. Sliding in this space is the block 156 which is provided with a pair of slide blocks 166 secured to opposite sides thereof adapted slidably to engage the top surface of the plate 160 so that the block 156 may be moved relative thereto.

For sliding the block 156 the same is connected to a piston rod 167 secured to a piston operating in a pneumatic piston and cylinder device 168. A similar piston and cylinder device, generally indicated at 170, is secured to the block 153 for the same purpose.

The welding head 154 is secured to a block of insulation 171 inset into the block 156, with the welding head being connected to a source of electrical current through the wires 172 which extend through the block. The welding head 154 is provided with an arcuate groove 173 shaped so as to contact the inner surface of the wire 36 at the apex of the V formed therein and to move the same against the wire 37 held in a linear groove 174 formed in the welding head 155. A vertical groove 175 is also provided in the head 155 which intersects the horizontal groove 174 so as to permit any welding flashing to escape.

The purpose of mounting the blocks 152 and 157 on slide plates is to permit lateral adjustment of these blocks and hence lateral adjustment of the welding heads carried thereby so that the machine may be used to form wire reinforcement of different widths.

When the wires are fed from the bending mechanism C to the welding mechanism D and are stopped in position with the apices of the V's to be welded adjacent each pair of welding heads, means are provided for forcing the wires downwardly into the space between the head. For this purpose the top plate 140 (Fig. 19) is provided with a lip 180 positioned to overlie the wires 35 and 36 and thus as the movable frame 120 is moved downwardly by the means previously described, the lip 180 contacts both of said wires and moves them downwardly into the space between the welding heads 150 and 151, it being understood that at this point in the operation of the machine the block 153, and hence the welding head 151, has been retracted by the piston and cylinder device 120. The movable plate also carries a transverse plate 181 which is also provided with a lip portion 182 adapted to overlie the wires 36 and 37 and thus to contact the same and move them downwardly between the welding heads 154 and 155 as the movable frame 120 moves downwardly. Thus, as indicated above, plate 137 and finger

143 serve as first pressing means for moving the bent wire laterally upwardly from the guide blocks of the bending means and lips 180 and 182 serve as second pressing means for moving the bent wire laterally downwardly into the welding head spaces.

After the completion of the welding operation the welded lengths of wires are fed to the cutting mechanisms D and D' and kick-off mechanisms E and E'. Leaving the welding apparatus C the welded lengths of wire enter a guide chute 190 having spaced upper and lower plates 191 and 192 forming a slot 193 into which the wires are fed. Immediately beyond the slot 193 is a first wire cutting mechanism 195 of usual construction and provided with a cutting blade for simultaneously cutting all three wires. The second cutting mechanism is similarly constructed so that upon operation the reinforcing device is cut to predetermined lengths. The kick-off mechanisms comprise tables 200 and 201 which are similarly constructed. Referring to Fig. 20, the table 200 is supported above the floor on suitable supporting columns 202. Secured to the base 203 of the supporting columns is a pneumatic piston and cylinder device 204 having a piston rod 205 pivotally connected to one end 206 of a crank lever secured to a shaft 207 rotatably mounted in journals 208 provided on the supports 202 and extending substantially the length of the table 200. Also secured to the shaft 208 is an arm having an upwardly extending portion 210 and a generally horizontally extending portion 211. Adjustably secured to the portion 211 is a push-off mechanism forming spaced guide means for the welded wires together with a finger 212 extending downwardly beneath the table through a slot 213 formed therein. The guide means is in the form of a U channel 214 secured to the outer end of the portion 211 and a guide channel 215 adjustably secured to the top of the table 200. After the cutting operation has been completed and a predetermined length of wire reinforcement now rests on the table 200 between the channels 214 and 215, the pneumatic piston and cylinder device 204 is operated to move the arm from the position shown in solid lines in Fig. 20 to the position shown in dotted lines and thus to move the pusher finger 212 and channel 214 to the dotted position shown. As the wire 35 clears the edge of the table 200 it falls downwardly so that the welded device swings in an arc as shown. A plurality of storage arms 220 are provided along a line parallel with the tables 200 and 201 and are positioned so as to be received in the spaces between the wires and thus catch the wires as they fall from the channel 214. The arms 220 may be on movable racks or on a conveyor as desired.

It will be noted by a reference to Figs. 3–5 that during the welding operation the bent wire 36 does not overlie the wire 35 (or the wire 37) but rather is pressed against the inner surface thereof so that the welded reinforcement lies substantially between parallel planes defined by the upper and lower surfaces of the outer wires. Preferably the bent wire 36 has a diameter slightly less than the diameter of the two outer wires so that any distortion due to the welding will not expand it beyond the diameter of the wire 35.

The wire bending and welding machine of this invention is substantially automatic in operation and for this purpose an electrical control circuit and a pneumatic actuating circuit are provided and combined so as to produce cyclical operation of the various parts of the machine previously described.

Upon initiating the operation of the machine the wires 35, 36 and 37 are fed through to the feed dogs 46, 47 and 50 by hand. With the wires in place the master switch 219 is closed connecting the electrical circuit shown in Fig. 21 with a suitable source of power. For simplicity of explanation, the description of the electrical and pneumatic circuits will be undertaken to describe the operation of the circuits during one of the operating cycles of the machine. For this purpose it is assumed that previous lengths of wires have been fed into the machine, bent and welded together and fed through to the cutting table and kick-off apparatus. As the welded strip of reinforcing material is fed across the cut-off table the strip contacts the center terminal 220 of a switch to bring such terminal into contact with a second terminal 221. Upon closing of the contacts 220–221 the motor D'M of the cutting mechanism D' is energized to cut the strip therebeneath on the table. Switch 222 is momentarily closed at the initiation of operation of the motor D'M but immediately opened because of the operation of the cam wheel 222*a* and the switch remains open until the cutter D' has completed its cutting operation at which time the cam wheel 222*a* will be rotated to the position shown in Fig. 21, closing switch 222, thereby energizing the cutting motor DM associated with the cutter D. This cutter then serves to cut the other end of the device and it is also provided with a cam 223*a* rotated to the position shown upon the conclusion of the cutting operation to close the contacts of switch 223. Switch 223 energizes a relay 224 to move its contacts 224*a* to the position shown in solid lines. When in this position the solenoid 225 is energized to operate a valve 226 associated with the push-off or kick-off cylinder 224. Operation of this cylinder serves to swing the arm 211 and thus to drop off the cut length of reinforcing material onto the storage arms 220. When the piston and cylinder device 204 has completed its stroke, an arm 227 carried by the piston rod 206 closes a switch 228 to energize solenoid 229, thereby moving the valve 226 to a position returning the piston and cylinder device to its initial position. At the time the strip was pushed from the table the contacts 220 and 221 opened, de-energizing the relay 224 and thus moving the switch arm 224*a* upwardly to the position shown in dotted lines to bridge the contacts shown. The central terminal 220 then is in contact with a switch terminal 221*a*. When the switch arm 224*a* bridges the contacts, solenoid 230 is energized serving to operate valve 231 associated with the movable frame cylinder 134 and thus to lower the movable frame from its up position shown.

The movable frame carries an arm 232 which, when in the up position shown, closes a switch 233 but when the frame moves downwardly permits that switch to open and closes a second switch 234. When switch 234 is closed solenoid 235 is energized and serves to operate a valve 236 for the feed cylinder 51 to move the feeding mechanism on its return or idling stroke. Closing of the switch 234 also operates a solenoid 238 through the switch arm 237*a* of a relay 237, with the solenoid 238 being connected to operate a valve 239 associated with the bending arm cylinder 84. This operation of the valve serves to introduce air under pressure into the cylinder 84 to provide a bend in the wire 36 held in the bending arms.

Simultaneously with the energization of the solenoid 238, solenoid 240 is energized to operate a valve 241 to introduce air into each of the piston and cylinder devices associated with the welding heads, only the cylinder 168 being shown. Introduction of air into each of such cylinders moves the welding heads toward each other to grip a wire therein.

During the welding operation the feed cylinder is returning on its idle stroke and when it reaches the end of its stroke it closes a switch 242 through the medium of a contact arm 242*a* carried by the transverse plate 45.

The welding apparatus shown in Fig. 1 includes a pressure responsive switch for feeding current to each of the welding heads to effect a weld of the wires held therein when the pressure in the piston and cylinder devices associated therewith reaches a predetermined amount. The current is maintained through the welding heads for a period determined by a timing switch and then is closed off. Such timing and pressure responsive switches are well known in apparatus of this type and are not shown in the drawings but may be enclosed in the housing for

the electrical part of the welding apparatus shown in Fig. 6.

When the bending arms reach the full extent of their bending stroke, a switch **244** is closed by an actuating arm **244***a* carried by the block **68** to shift the relay switch arm **237** (through normally closed stop switch **244***b*) from the position shown in solid lines to the position shown in dotted lines, thus energizing solenoid **245** to move the movable frame **120** upwardly, opening switch **234** and closing switch **233** while lifting the bent wires from between the guide blocks. At the same time the switch **246** is closed by the movement of the welding blocks toward each other, thus to energize relay **247** to operate the valve **241** and thus move the welding blocks apart. Simultaneously the solenoid **248** is energized to move the bending arms back toward a linear position and solenoid **250** is energized to operate valve **236** to move the feed mechanism on its forward or feeding stroke. When the welded strip on the push-off table moves to contact the central terminal **220** and move it into contact with the terminal **221** a subsequent cycle is initiated.

We claim:

1. In a wire bending machine having a frame: bending means comprising a first arm pivoted at one end to the frame, a second arm pivoted at one end to the other end of the first arm to form a bending knee, means for retaining a wire on the arms, means for flexing the knee from a first position in which the arms are substantially linearly aligned to a second position in which the arms are angularly aligned by moving the other end of the second arm toward the first mentioned end of the first arm whereby to bend a length of wire retained on the arms into substantially the shape of a V, means for returning the arms to said first position, a member rotatably mounted on the frame and connected to the arms to be rotated thereby with flexure of the knee, a stop finger on the member, and a stop adjustably mounted on the frame and positionable to contact the finger as the arms reach said first position to arrest movement of the arms.

2. In a wire bending machine having a frame: bending means comprising a first arm pivoted at one end to the frame, a second arm pivoted at one end to the other end of the first arm to form a bending knee, a power plate fixed to the other end of the second arm, a piston and cylinder device connected to the power plate to flex the knee from a first position in which the arms are substantially linearly aligned to a second position in which the arms are angularly aligned by moving the other end of the second arm toward the first mentioned end of the first arm whereby to bend a length of wire retained on the arms into substantially the shape of a V, means for returning the arms to said first position, a member rotatably mounted on the frame and connected to the arms to be rotated thereby with flexure of the knee, a stop finger on the member, a first stop adjustably mounted on the frame and positionable to contact the finger, and a second stop adjustably mounted on the frame and positionable to contact the power plate, with said stops making such contacts as the arms reach said first position to arrest movement of the arms.

3. In a wire bending machine having a frame: bending means comprising a first arm pivoted at one end to the frame, a second arm pivoted at one end to the other end of the first arm to form a bending knee, means for retaining a wire on the arms, means for flexing the knee from a first position in which the arms are substantially linearly aligned to a second position in which the arms are angularly aligned by moving the other end of the second arm toward the first mentioned end of the first arm whereby to bend a length of wire retained on the arms into substantially the shape of a V, means for returning the arms to said first position, a member rotatably mounted on the frame and connected to the arms to be rotated thereby with flexure of the knee, a stop finger on the member, a stop adjustably mounted on the frame and positionable to contact the finger as the arms reach said first position to arrest movement of the arms, and an overbending finger carried by said member and positioned to contact the wire adjacent said one end of the first arm as the arms approach said second position to overbend the wire at one apex of the V.

4. In a wire bending machine having a stationary frame and wire bending means on the frame including: a first arm pivoted at one end to the frame, a second arm pivoted at one end to the other end of the first arm to form a bending knee, means for retaining a wire on the arms, means for flexing the knee from a first position in which the arms are substantially linearly aligned to a second position in which the arms are angularly aligned by moving the other end of the second arm toward the first mentioned end of the first arm whereby to bend a length of wire retained on the arms into substantially the shape of a V, means for removing a bent wire from retained position on the arms comprising a second frame movably mounted on the stationary frame, a plate carried by the movable frame and overlying the first arm, a stripper finger carried by the movable frame and overlying the second arm, means for feeding a length of wire over said plate and finger and into the retaining means on the arms, and means for moving the movable frame outwardly of the arms to lift a bent wire out of said retaining means.

5. In a wire bending machine having a stationary frame and wire bending means on the frame including: a first arm pivoted at one end to the frame, a second arm pivoted at one end to the other end of the first arm to form a bending knee, means for retaining a wire on the arms, means for flexing the knee from a first position in which the arms are substantially linearly aligned to a second position in which the arms are angularly aligned by moving the other end of the second arm toward the first mentioned end of the first arm whereby to bend a length of wire retained on the arms into substantially the shape of a V, means for removing a bent wire from retained position on the arms comprising a second frame movably mounted on the stationary frame, a plate carried by the movable frame and overlying the first arm, a second plate mounted on the movable frame in spaced parallel relation to the first mentioned plate to form therewith a guide slot, a stripper finger carried by the movable frame and overlying the second arm, means for feeding a length of wire into said slot and over said finger, and means for moving the movable frame outwardly of the arms to lift a bent wire out of said retaining means.

6. In a wire bending machine having a stationary frame and wire bending means on the frame including: a first arm pivoted at one end to the frame, a second arm pivoted at one end to the other end of the first arm to form a bending knee, means for retaining a wire on the arms, means for flexing the knee from a first position in which the arms are substantially linearly aligned to a second position in which the arms are angularly aligned by moving the other end of the second arm toward the first mentioned end of the first arm whereby to bend a length of wire retained on the arms into substantially the shape of a V, means for removing a bent wire from retained position on the arms comprising a second frame movably mounted on the stationary frame, a bifurcated plate carried by the movable frame and having a pair of spaced leg portions one of which overlies the first arm with the pivotal connection of the first arm to the stationary frame being located in the space between the leg portions, a second plate mounted on the movable frame in spaced parallel relation to the leg portions of the first mentioned plate to form therewith a guide slot, a stripper finger pivotally carried by the movable frame and overlying the second arm, means for feeding a length of wire into said slot and over said finger, and means for moving the mov-

able frame outwardly of the arms to lift a bent wire out of said retaining means.

7. In a wire working machine, means for moving a wire to permit successive operations on a portion thereof, comprising: a frame arranged for reciprocation; means carried by the frame for reciprocation therewith and forming a slot extending perpendicularly to the direction of reciprocation and through which the wire may be longitudinally fed; first pressing means carried by the frame for reciprocation therewith and adapted to move the wire laterally in one direction of reciprocation of the frame; second pressing means operatively associated with the frame for reciprocation therewith and adapted to move the wire laterally in a direction of reciprocation of the frame opposite to that of the first pressing means; and means for moving the wire longitudinally when the wire has been moved to an extreme lateral position by the first pressing means, said means cooperatively causing each portion of said wire to move in a U-shaped path extending in a direction transverse to the direction of reciprocation of said frame whereby a first operation may be performed on a wire portion at one end of the path and a second operation may be performed on the wire end portion at the other end of the path.

References Cited in the file of this patent

UNITED STATES PATENTS

804,029	Nilson et al.	Nov. 7, 1905
1,416,359	Lachman	May 16, 1922
1,695,836	Whitmer	Jan. 10, 1927
1,908,050	Reed	May 9, 1933
2,055,955	Wagonbach	Sept. 29, 1936
2,128,620	Lyons	Aug. 30, 1938
2,279,490	Pearne	Apr. 14, 1942
2,455,346	Wickwire	Nov. 30, 1948
2,485,282	Green	Oct. 18, 1949
2,502,695	Aylen	Apr. 4, 1950
2,588,062	Vorderstrasse	Mar. 4, 1952
2,722,242	Talbot	Nov. 1, 1955