# United States Patent

**Crafford et al.**

[15] **3,640,164**

[45] **Feb. 8, 1972**


[54] **AUTOMATIC CHAIN-CUTTING MACHINE**


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[21] Appl. No.: **822,422**

[52] **U.S. Cl.** .....**83/67,** 83/66, 83/69, 83/354, 83/369, 59/11

[51] **Int. Cl.** .....**B26d 5/24,** B26d 5/28

[58] **Field of Search** .....83/63, 66, 67, 69, 354, 369, 83/370, 371, 262, 279, 280; 59/11



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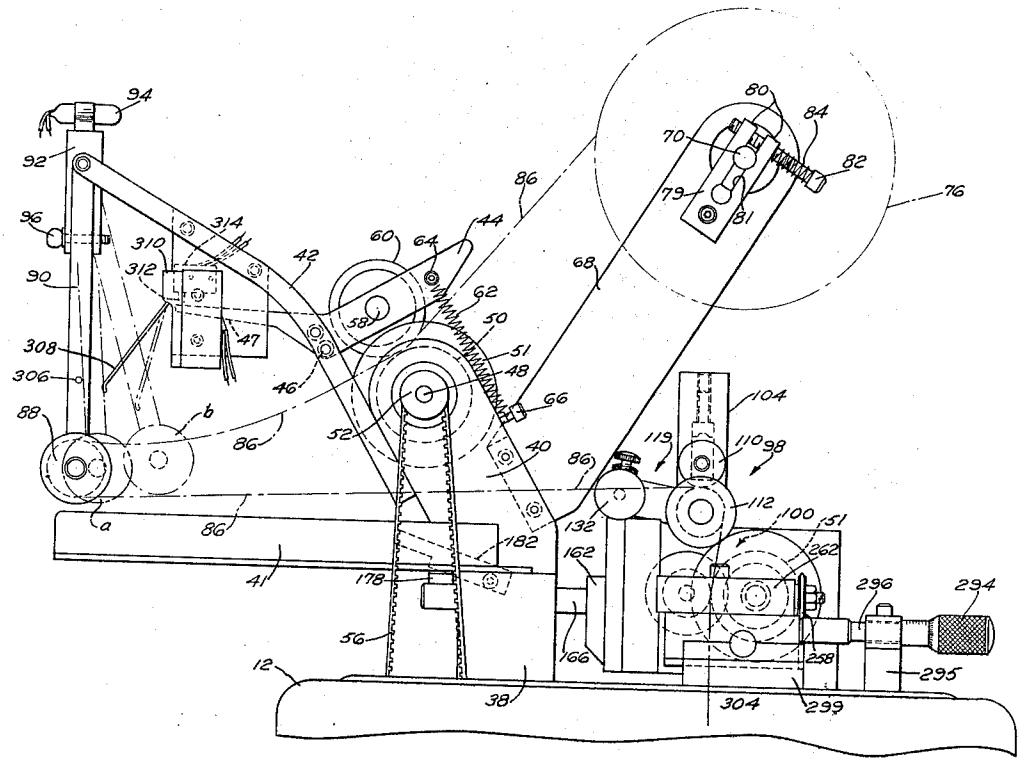
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[57] **ABSTRACT**

A machine for automatically cutting chain in predetermined lengths and including means for feeding the chain to a cutting station, means responsive to a drive for the feeding means for generating a series of electrical impulses, and a cutting assembly located at the cutting station and being operative in response to generation of a selected number of electrical impulses for periodically cutting the chain in the predetermined lengths.


**10 Claims, 14 Drawing Figures**



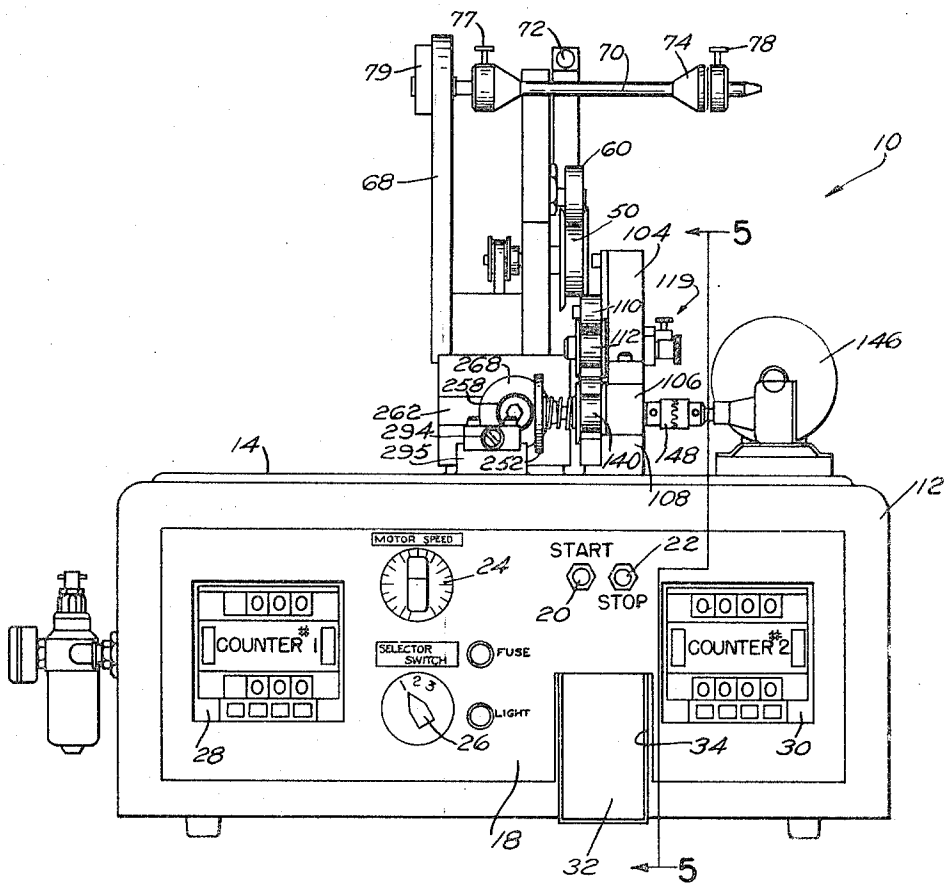



FIG. 1

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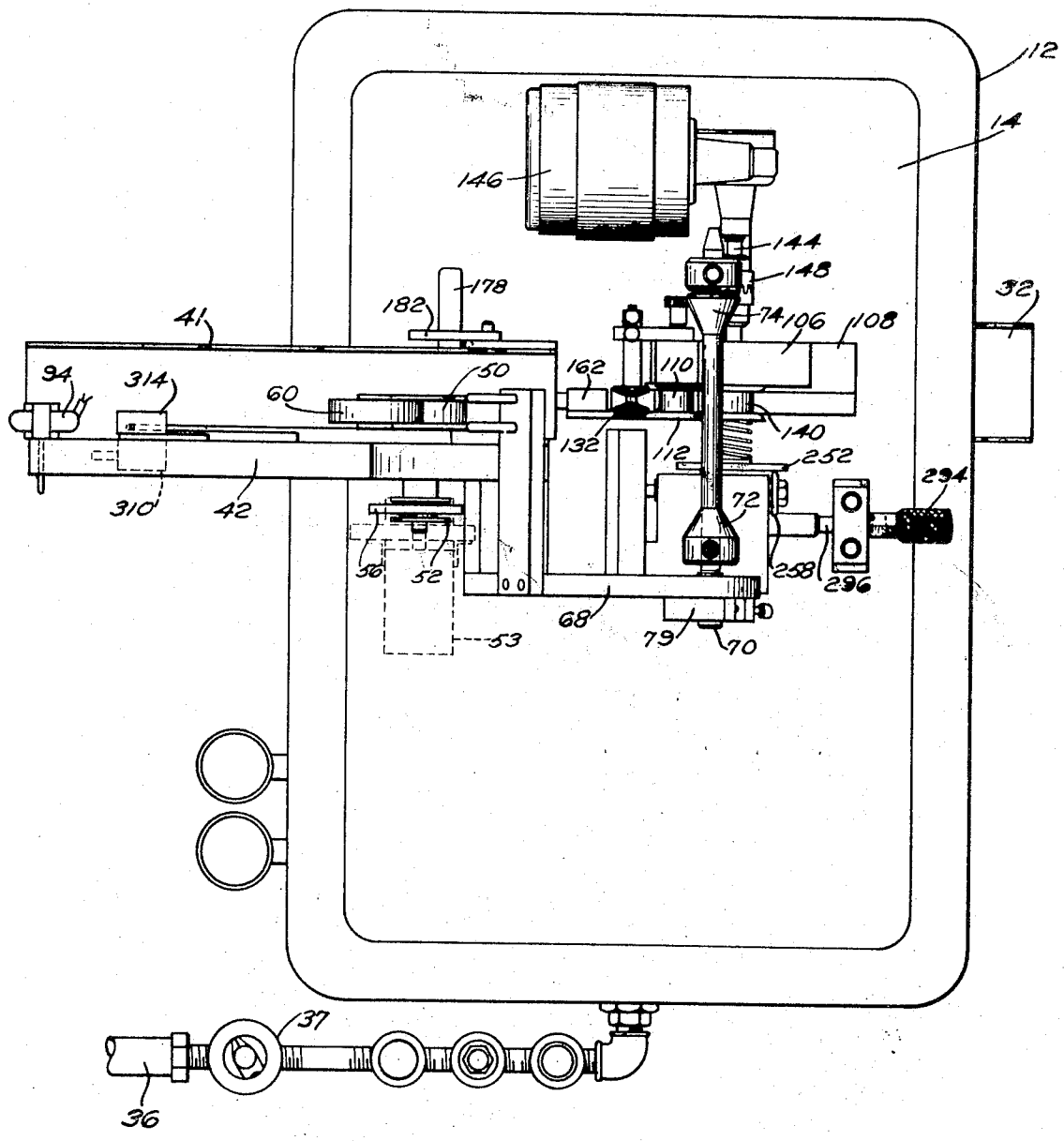
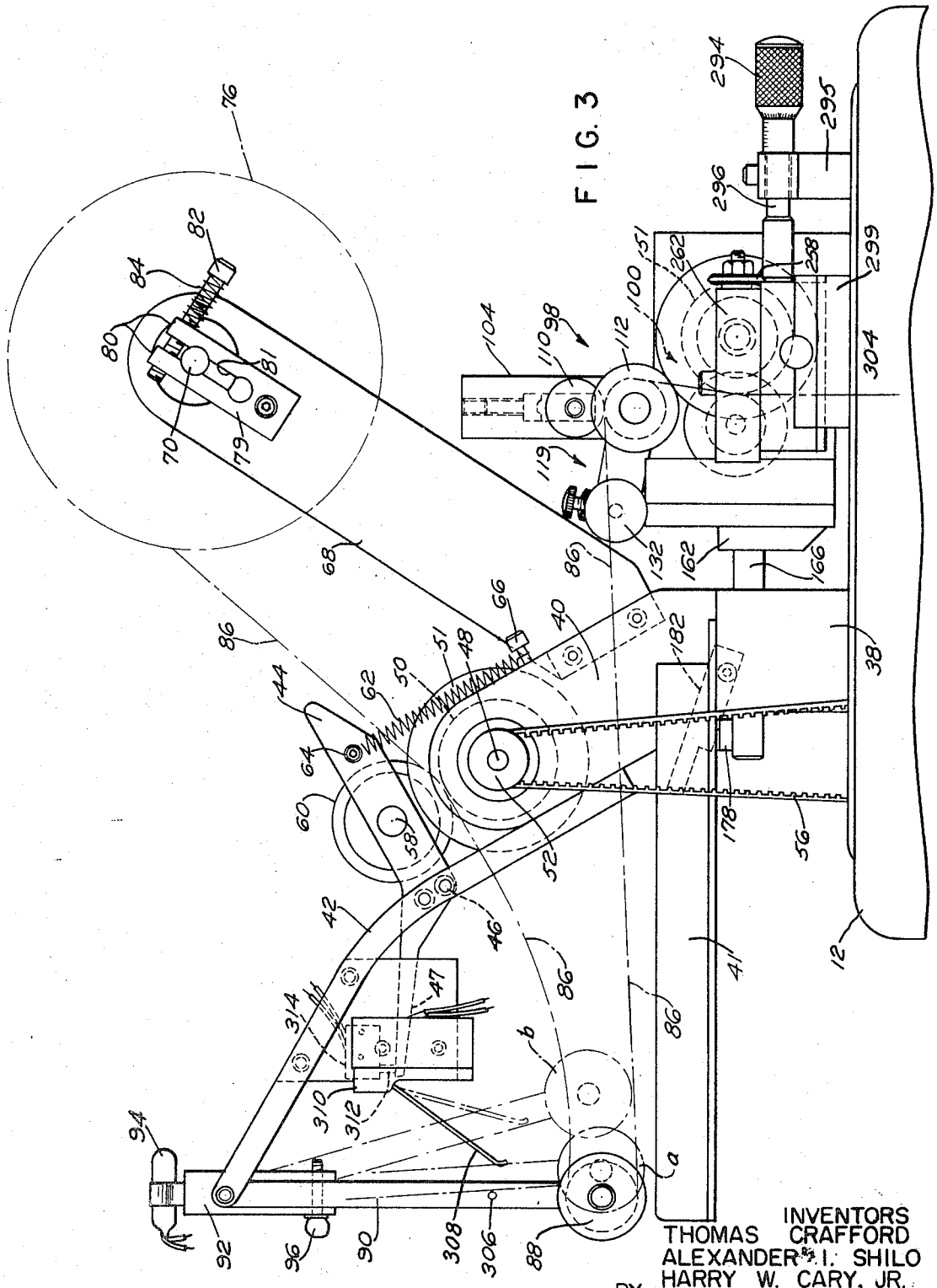



FIG. 2

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FIG. 3




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FIG. 4

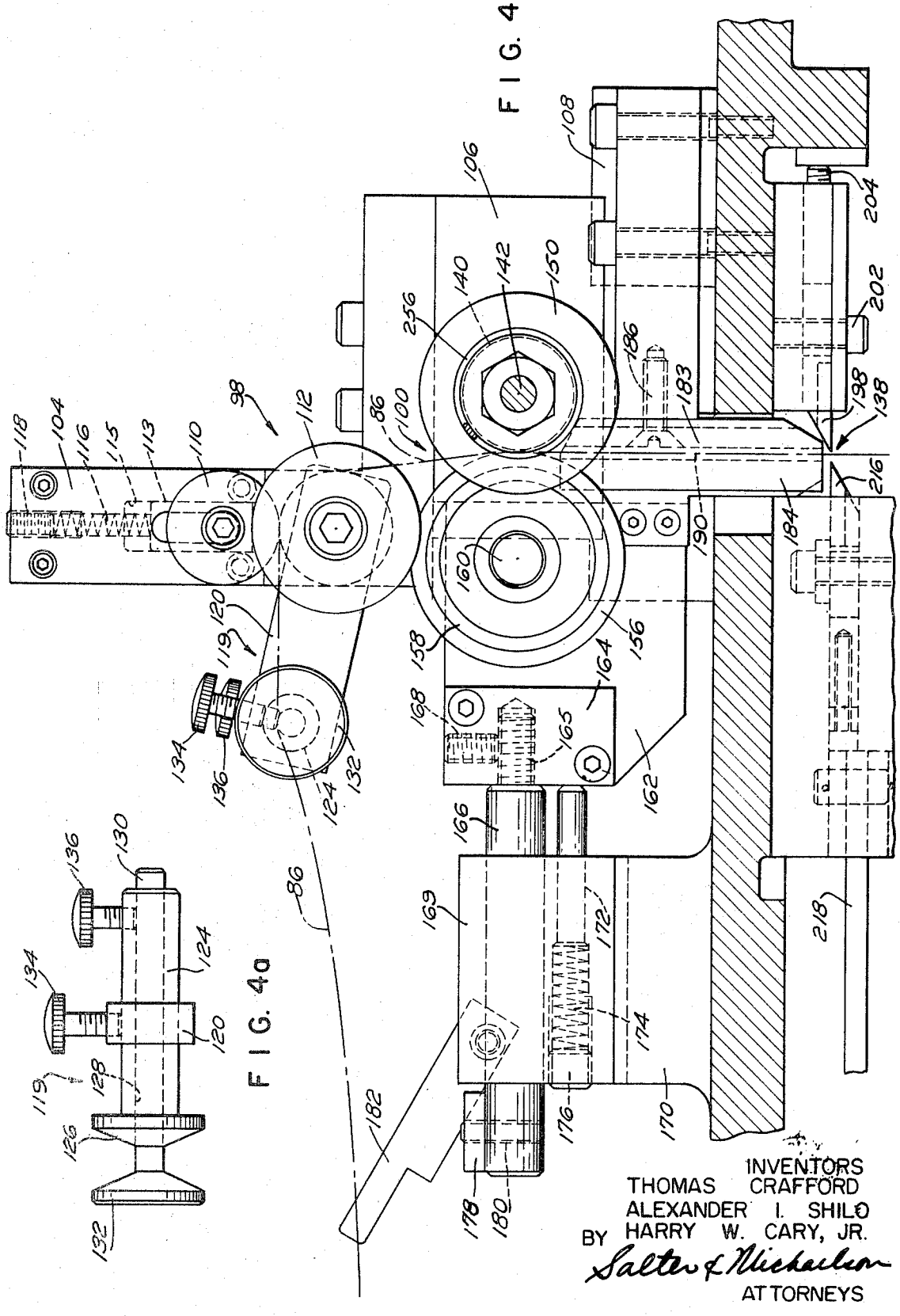



FIG. 4a

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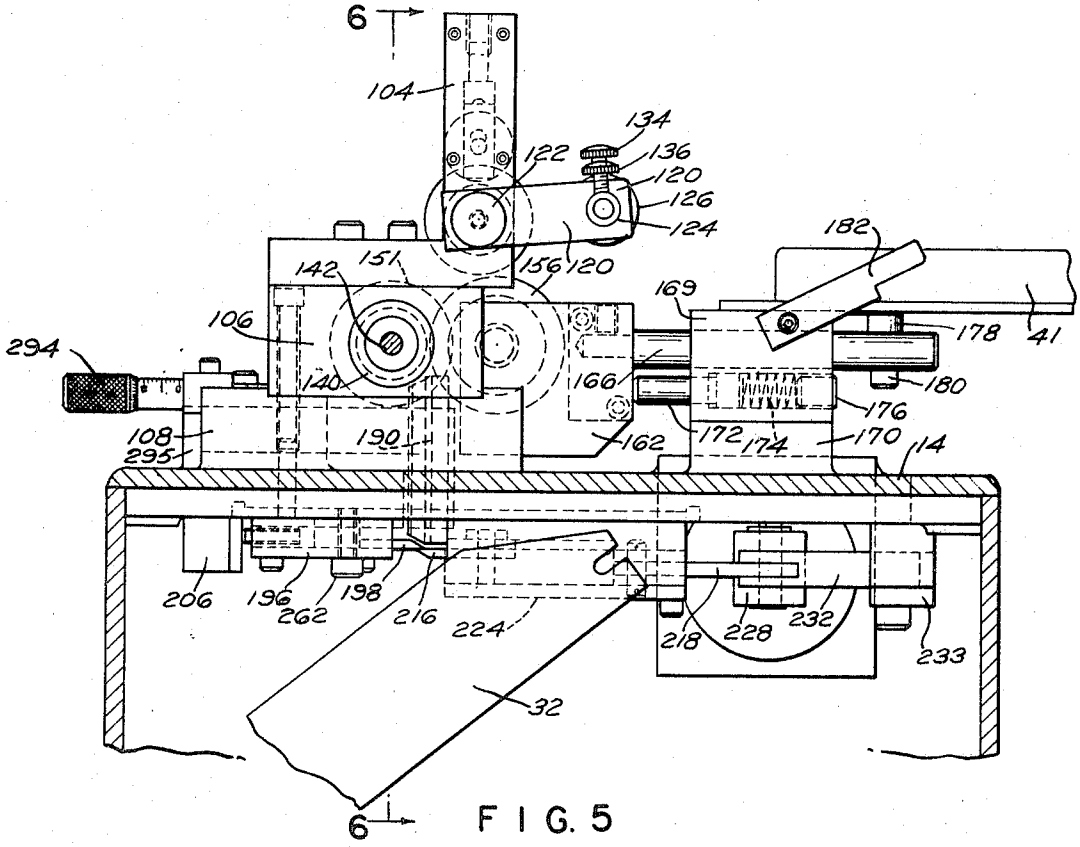



FIG. 5

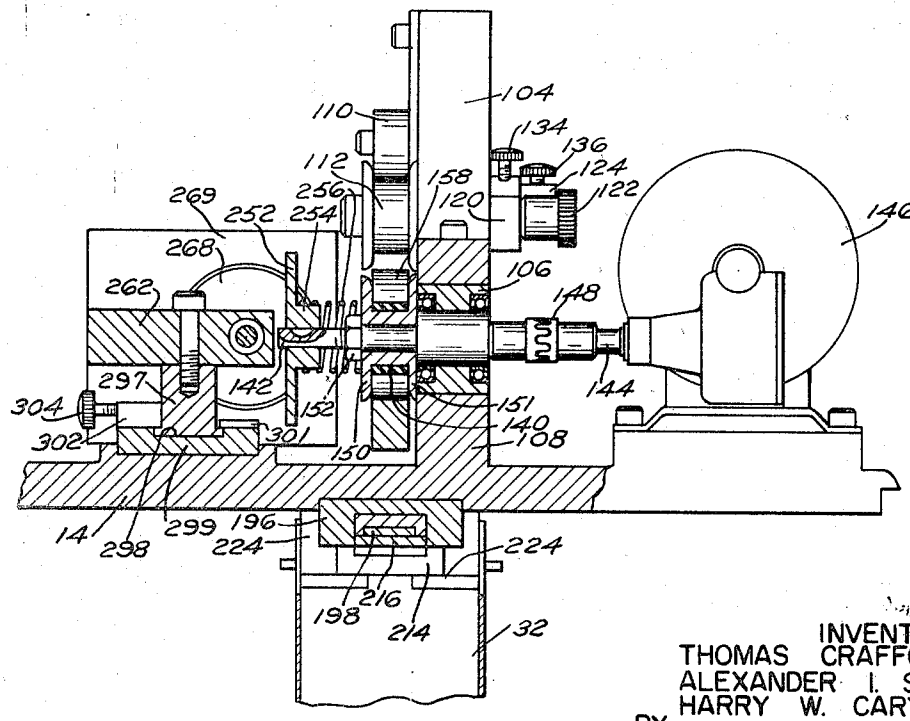



FIG. 6

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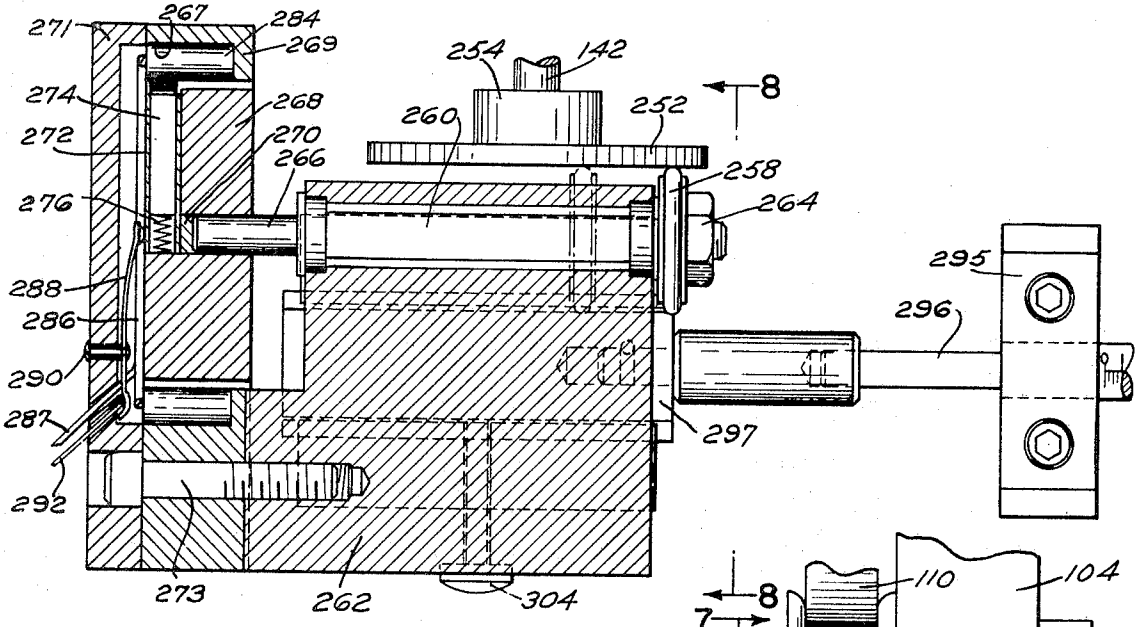



FIG. 7

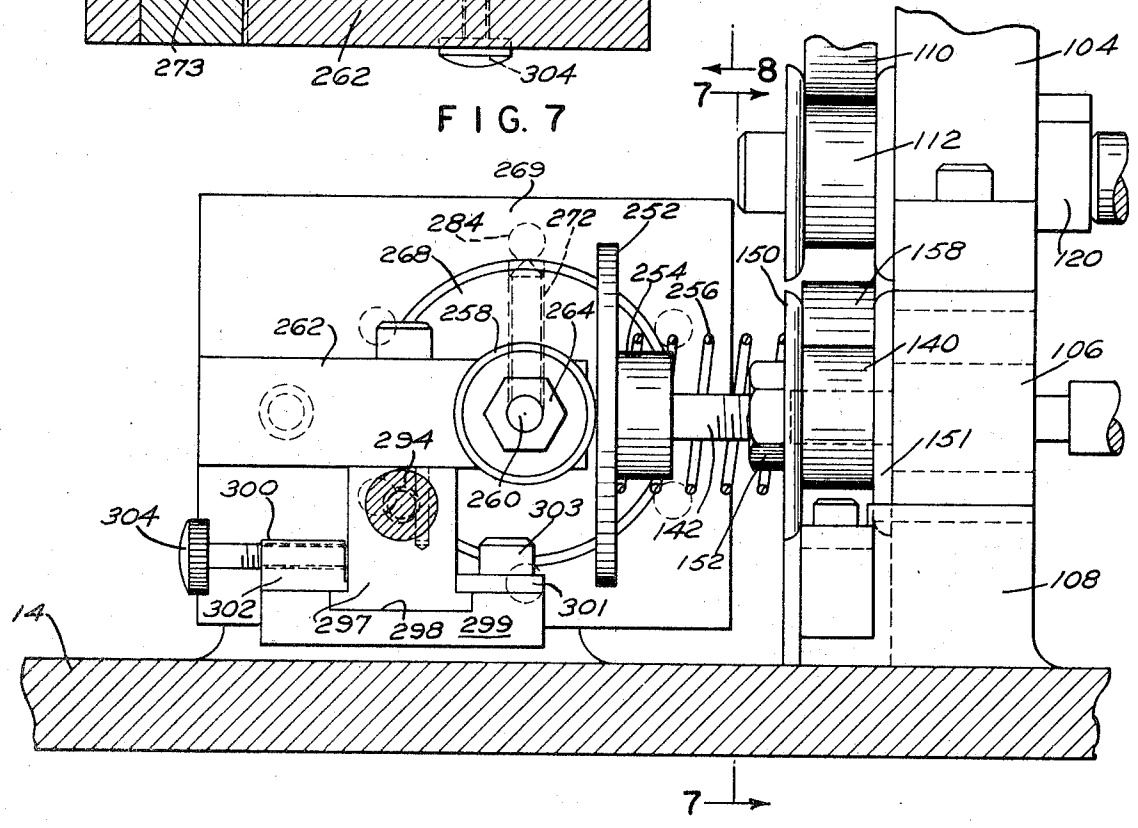



FIG. 8

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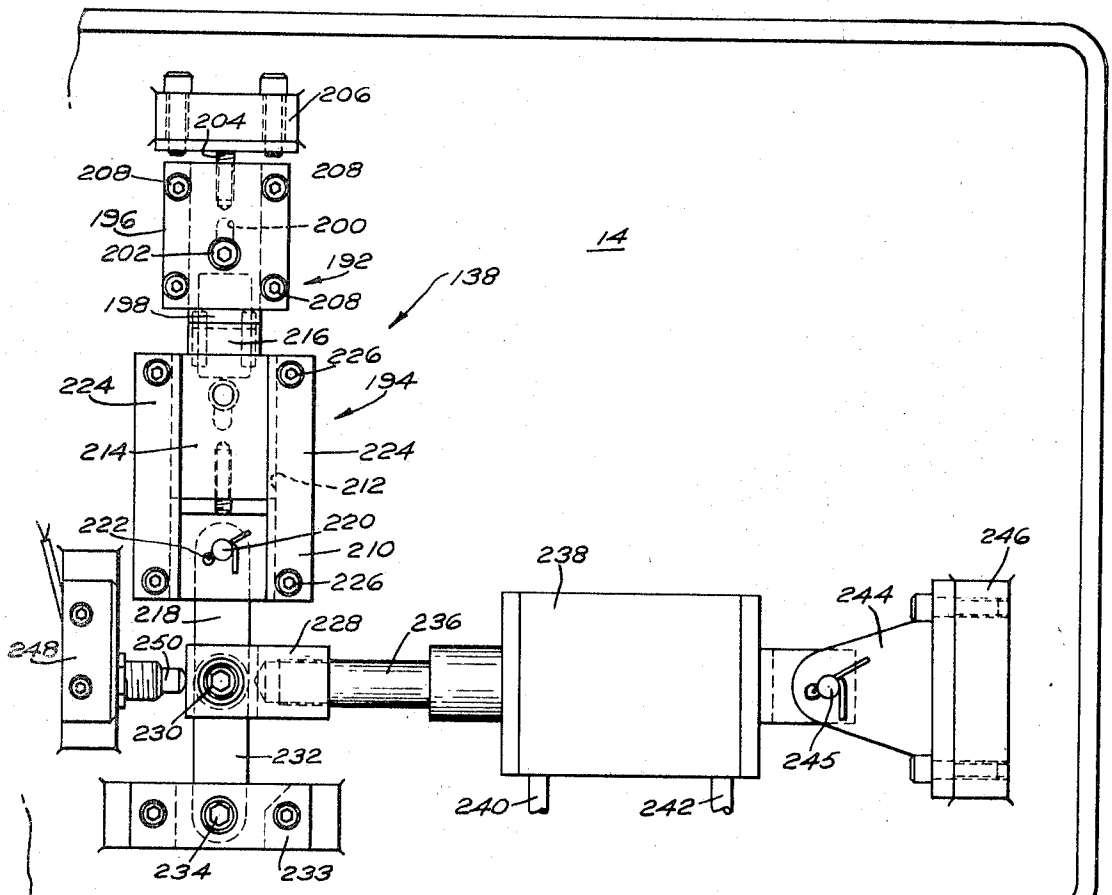



FIG. 9

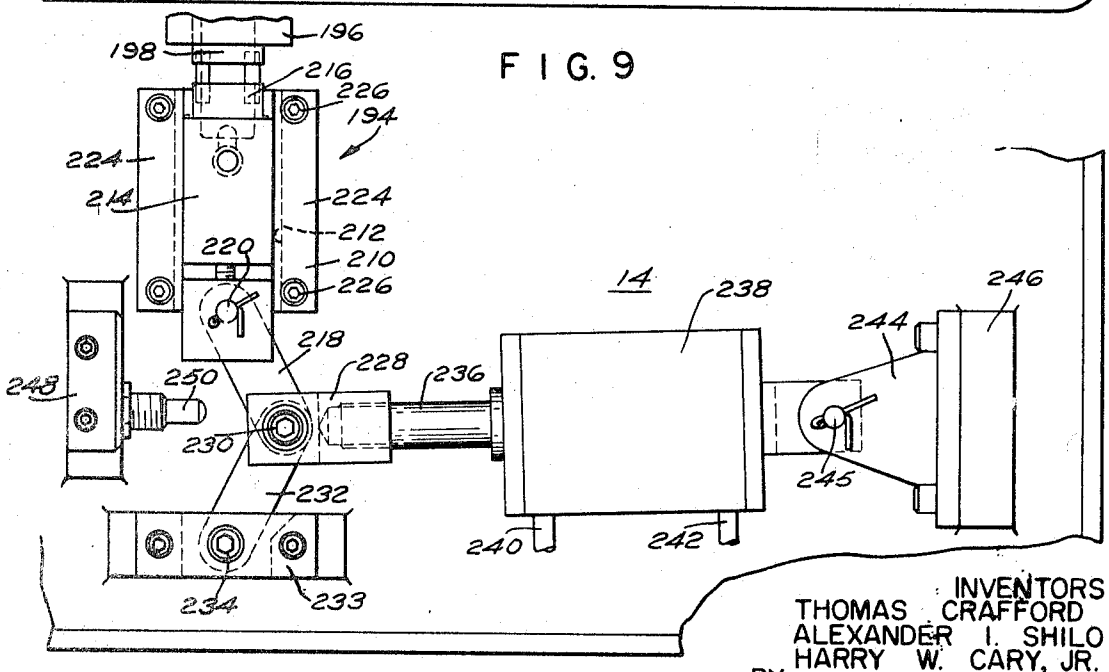



FIG. 10

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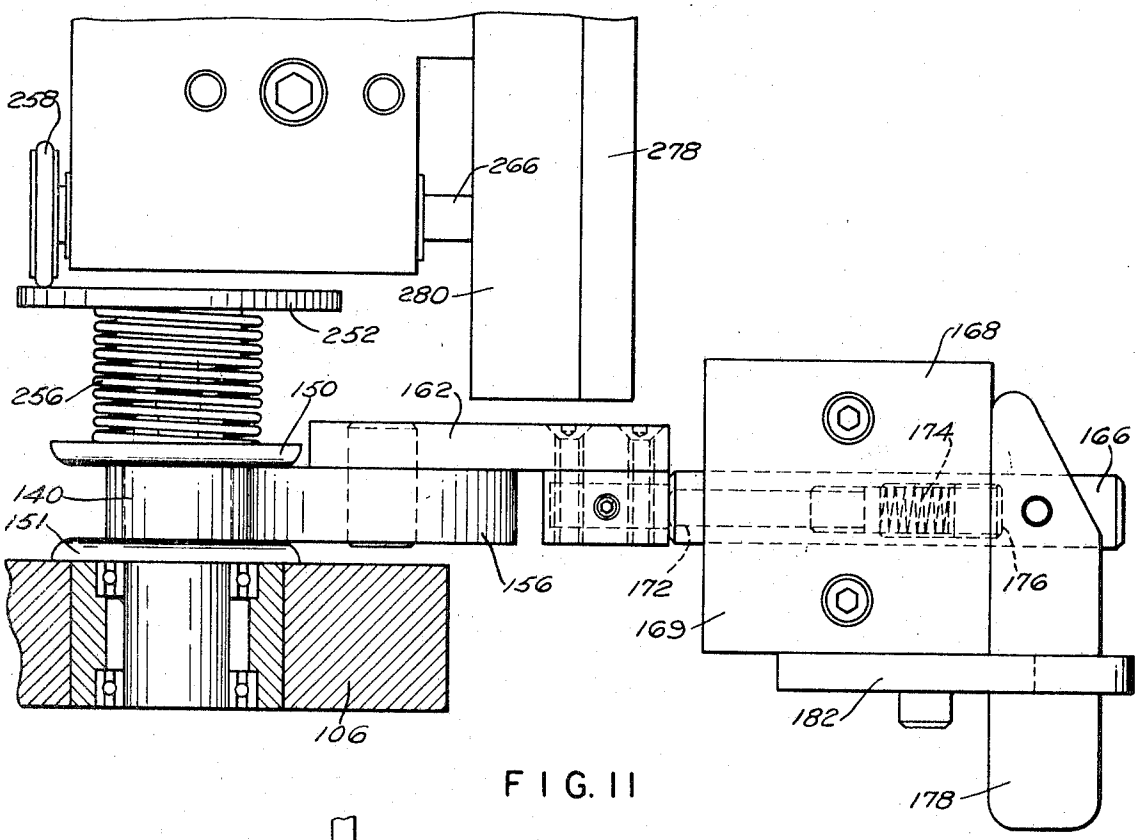



FIG. 11

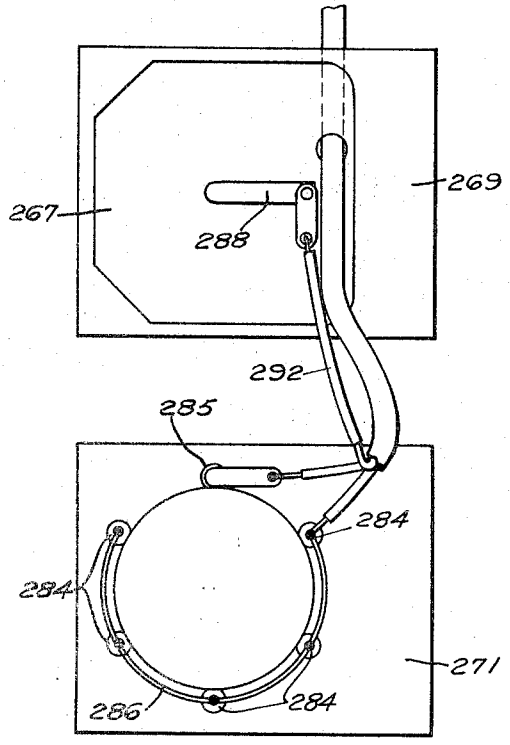
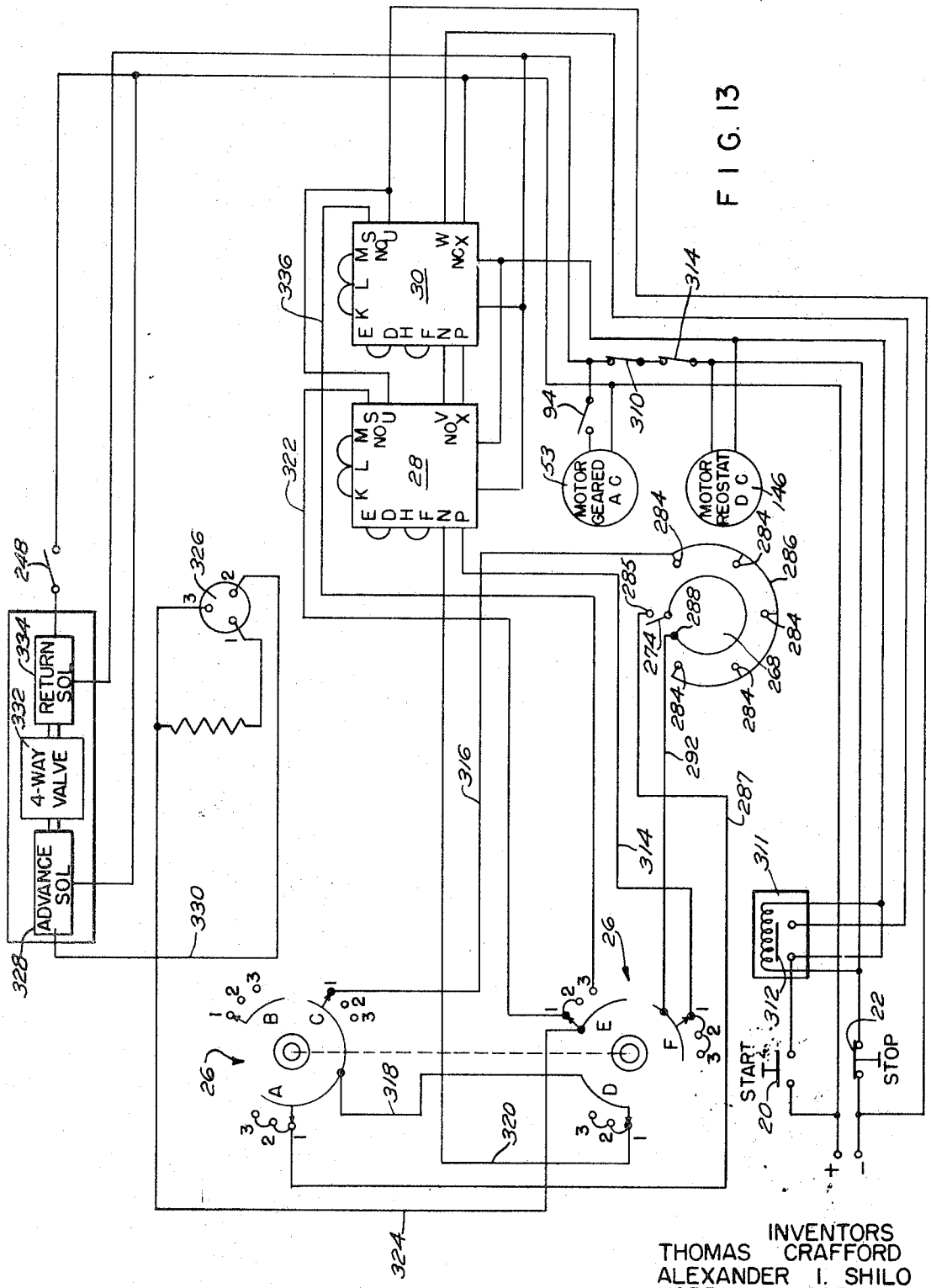



FIG. 12

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# AUTOMATIC CHAIN-CUTTING MACHINE

## BACKGROUND OF THE INVENTION

The present invention relates to apparatus for cutting chain in predetermined lengths and has particular application in the cutting of relatively small diameter wire as incorporated in a chain for use for ornamental purposes.

The cutting of ornamental chain heretofore has been substantially performed by the manual operation of a guillotine-type cutter or by a punch-press-type cutter. When cutting chain in required lengths with the guillotine-type cutter, the operator would hang a plurality of chain lengths from a bracket and would then pivot the cutter in a cutting operation to cut the chain in the required lengths. The cutter was adjustable in a vertical direction in accordance with the length of chain required.

The punch-press-type cutter was easier for the operator to perform the cutting operation, but here again it was necessary for the operator to physically locate a plurality of lengths of chain in a cutting position below the cutter, whereafter the operator would step on a treadle or operate a device to sever the chain in the required lengths. It will be understood that such cutting devices were considerably dangerous to the operator and posed a safety problem. Further, the requirement for physically locating the length of chain in the cutting position required additional time for the operator to perform and materially increased the cost of the finished chain.

Some efforts have been made heretofore to automatically cut ornamental- or jewelry-type chain in selected lengths, but prior to the instant invention there was no machine available that could effectively and automatically cut jewelry chain in desired lengths.

## SUMMARY OF THE INVENTION

The automatic chain cutter embodied in the present invention provides for feeding of a continuous length of chain to a cutting device at which the chain is automatically severed in predetermined lengths. In carrying out the invention, the chain is extracted from a source such as a reel or spool by a takeoff drive and directed to feed rolls that are driven by a separately mounted motor, the feed rolls directing the chain to a cutting device. The cutting device is adapted to be operated at preselected intervals depending upon the length of chain required. In order to operate the cutting device at the preselected intervals, an air-operated motor associated with the cutting device is responsive to the generation of a predetermined number of electrical impulses. The electrical impulses are generated by rotatably driving an electrical contact or brush that successively makes electrical engagement with a series of fixed contacts. As the movable brush engages each fixed contact, an electrical impulse is generated and the impulses so generated are sensed by a counter that has been preset to generate a signal, thereby energizing a circuit to which the motor for the cutting device is responsive. Thus as the counter receives a predetermined number of electrical impulses, it will produce a signal that will, in turn, cause the cutting device to be operated, thereby producing a cutting action and a severing of the chain. By varying the speed of the means for producing the electrical impulses, by controlling the speed of the drive motor for the feed rollers and by arranging the counter so as to produce a signal in accordance with a predetermined number of impulses, the chain can be cut in any length desired.

Accordingly, it is an object of the present invention to provide a machine for automatically cutting chain in predetermined lengths.

Another object of the invention is to provide an automatic chain-cutting machine that includes controls that may be preset for cutting a continuous length of material in predetermined lengths and in predetermined batches.

Still another object is to provide an automatic chain-cutting machine that includes means for feeding the chain to a cutting station without interruption wherein the chain-cutting operation is performed, and that further includes means for automatically discontinuing the operation of the feeding means in response to a jam-up of the machine or a material runout.



Still another object is to provide control means for use in an automatic chain-cutting machine that provides for setting the length of the chain to be cut and for counting the number of lengths of cut until a predetermined batch is obtained, whereafter the machine is automatically deenergized.

Still another object is to provide an automatic chain-cutting machine wherein the length of the chain cut is determined by setting a counter for receiving a predetermined number of electrical impulses, wherein after the predetermined number of electrical impulses have been received, a cutting device is operated to sever the chain in the required lengths.

Other objects, features and advantages of the invention shall become apparent as the description thereof proceeds when considered in connection with the accompanying illustrative drawings.

## DESCRIPTION OF THE DRAWINGS

In the drawings which illustrate the best mode presently contemplated for carrying out the present invention:

FIG. 1 is a front elevational view of the automatic chain-cutting machine embodied in the present invention;

FIG. 2 is a top plan view of the machine;

FIG. 3 is a side elevational view of the machine looking toward the right as seen in FIG. 1;

FIG. 4 is an enlarged side elevational view with parts shown in section illustrating the drive means for feeding the chain to the cutting station;

FIG. 4*a* is an elevational view of the guide member that guides the chain to the guide assembly;

FIG. 5 is a sectional view taken along line 5—5 in FIG. 1;

FIG. 6 is a vertical sectional view taken along line 6—6 in FIG. 5;

FIG. 7 is a sectional view of the timing mechanism taken along line 7—7 in FIG. 8;

FIG. 8 is an elevational view of the timing mechanism taken along line 8—8 in FIG. 7;

FIG. 9 is a bottom plan view of the cutting assembly as it is shown in the cutting position;

FIG. 10 is a bottom plan view of the cutting assembly similar to FIG. 9 showing the cutting mechanism in the open position;

FIG. 11 is a top plan view of the pressure or tension device for the feed roller;

FIG. 12 is an internal view of the impulse timer showing the electrical contacts and wiring therefor; and

FIG. 13 is a circuit diagram of the control circuit of the chain-cutting machine embodied herein.

## DESCRIPTION OF THE INVENTION

Referring now to the drawings and particularly to FIG. 1, the chain-cutting machine embodied in the present invention is illustrated and is generally indicated at **10**. In use of the chain-cutting machine **10**, chain formed by relatively small-diameter wire is adapted to be cut, and such chain is normally of the ornamental type as used in the jewelry industry. However, it is understood that the chain-cutting machine as embodied herein may be employed for automatically cutting various size chain depending upon the requirements of use thereof.

The chain-cutting machine **10** is substantially portable in that it may be carried from one location to another, although in the use thereof it will necessarily be fixed in position because of the requirements for electrical power and a source of compressed air, as will be described. As illustrated in FIG. **1**, the chain-cutting machine **10** includes a cabinet or housing **12** on which a top plate or base **14** is mounted. Located on the front of the housing **12** is a panel **18** that contains the controls for operating the machine. In this connection, the front panel **18** includes a pushbutton start switch **20** and a pushbutton stop switch **22**, a motor speed control switch **24**, a selector

switch 26, a first counter 28 and a second counter 30. A discharge chute 32 extends outwardly through an opening 34 in the front panel 18 and directs the lengths of chain that have been cut by the device to a discharge area at the front of the machine. Although not shown, the machine is connected to a source of electrical power for the purpose of operating the electrical circuit embodied in the device and for energizing the electrical motors that are provided for feeding the chain, as will be described. A conduit 36, as shown in FIG. 2, is connected to a source of air pressure and communicates with an air motor located within the housing shell 12, as will be described, through a shutoff valve 37 and appropriate filters located outside of the housing 12.

Referring now to FIG. 3, a block 38 is shown mounted on the base or top plate 14. Extending upwardly from the block 38 is an arm 40, while fixed to the arm 40 and extending rearwardly with respect thereto is a horizontal channel 41 on which the chain may be collected as will be described. A bent extension 42 is also fixed to the arm 40 and extends rearwardly, a pressure arm 44 being pivotally mounted on the extension 42 at 46. Joined to the pressure arm is a rearwardly extending finger 47 which is movable to engage a switch contact as will be described. Mounted on the arm 40 is a shaft 48 on which a drive roll 50 is rotatably mounted, opposed flanges 51 being joined to the drive roll 50. A pulley 52 is mounted on the shaft 48 on which the drive roll 50 is mounted, and a belt 56 operatively interconnects the pulley 52 to an AC motor 53 (FIG. 13) fixed within the housing 12. It is understood that upon energizing of the motor 53 within the housing 12, the drive roll 50 will be rotated. Secured to the pressure arm 44 is a shaft 58 on which a pressure roller 60 is rotatably mounted. The pressure arm 44 is biased downwardly in pivoted relation toward the drive roller 50 by a spring 62 that interconnects the pressure arm 44 and the arm 40 by pin connections 64 and 66. It is seen that the pressure roller 60 is normally biased toward the drive roller 50 and the chain to be cut extends between the pressure roller 60 and the drive roller 50 and normally raises the roller 60 relative to the roller 50 thereby pivoting the pressure arm 44 such that the pressure finger 47 will not depress the contact it engages. The pressure roller 60 and the feed roller 48 are preferably formed of a rubberlike material so as to protect the chain as it moves therebetween.

Fixed to the arm 40 and extending forwardly in an inclined direction with respect thereto is a reel arm 68. Mounted for rotation at the uppermost end of the reel arm 68 is a spindle 70 that projects from the reel arm 68 in cantilever relation as illustrated in FIG. 1. Reel-adjustment collars 72 and 74 are mounted on the spindle 70 and are adjustable longitudinally with respect thereto so as to center a reel 76 having a continuous length of chain wound thereon. The adjustable collars 72 and 74 are fixed in the adjusted position on the spindle by lock screws 77 and 78. In order to restrict free movement of the reel 76 as the chain is removed therefrom, a friction brake 79 is provided and is fixed to the end of the spindle 70 as illustrated in FIG. 3. The brake 79 is split to define spaced legs 80 between which a space 81 is formed, the spindle 70 extending into the space 81 between the legs 80. A bolt 82 threadably engages the legs 80 and a spring 84 provides for tension adjustment of the bolt 82. It is understood that as the bolt 82 is rotated to clamp the legs 80 around the spindle 70, the spindle will be restricted in the movement thereof and will prevent the reel 76 from running free as the chain is removed therefrom.

As illustrated in FIG. 3, a length of the chain indicated at 86 extends from the reel 76 between the drive roller 50 and pressure roller 60 toward the rear of the machine. The chain 86 then extends around a guide roller 88 that is mounted on the lowermost end of a control arm 90, the control arm in turn being pivotally interconnected to the outermost end of the extension 42. The control arm 90 includes a switch block 92 on the uppermost end of which a mercury switch 94 is located and a thumb screw 96 extends through the switch block 92 at the lower end thereof to effectively lock the switch block 92 on the control arm 90. As will be described, the mercury switch 94 is located in the circuit of the AC motor 53 that drives the drive roller 50 and thus the switch 94 must be tilted to close the contacts therein in order to energize the motor 53 for rotating the drive roller 50 and for drawing the chain 86 from reel 76. As the chain 86 extends around the roller 88, it is directed to a guide assembly 98 and then to a feed assembly generally indicated at 100, the feed of the chain by the feed assembly 100 producing a tension on the chain 86 and thereby moving the control arm 90 slightly to the right to the dotted line position *a* as seen in FIG. 3, whereby the mercury switch is tilted to close the contacts therein for energizing the motor 53.

In order to direct the chain 86 to the feed assembly 100, the guide assembly 98 is provided and is located vertically above the feed assembly 100. Referring to FIG. 4, the guide assembly 98 is shown including a bracket 104 that is mounted on a bearing block 106 that, in turn, is mounted on a mounting block 108. Mounted for rotation on the bracket 104 are vertically aligned rubber guide rollers 110 and 112, that receive the chain therebetween and thus guide the chain toward the feed assembly 100. The guide roller 110 is fixed to a slide 113 and is also adjustable relative thereto within a slot 114. The slide 113 is movable within a slot 115 and is urged downwardly by a spring 116 that is held in position by a set screw 118 that projects into the bracket 104 from the upper end thereof. It is seen that the spring 116 urges the slide 113 and the roller 110 secured thereto toward the roller 112, the spring 116 exerting the required pressure on the roller 110 to retain the chain between the guide rollers 110 and 112 and to prevent slack from forming in the chain during the feeding thereof.

As the chain 86 is moved to the feed assembly 100 by way of the guide assembly 98, it passes through a guide member generally indicated at 119 which, as illustrated in FIGS. 2 and 4*a*, includes a bracket 120 that is mounted on the bracket 104 and that extends rearwardly with respect thereto. As shown in FIG. 2, a lock nut 122 extends through the bracket 120 and into the bracket 104 for locking the guide member 119 in place thereon. Extending through an opening in the bracket 120 is an elongated sleeve 124 on an end of which a frustoconical portion 126 is formed. Extending through a central bore 128 formed in the sleeve 124 is a shaft 130 having a conical portion 132 formed on the outer end thereof. A setscrew 134 is adapted to fix the sleeve 124 in the bracket 120, and a second setscrew 136 fixes the shaft 130 with respect to the sleeve 124. It is seen that horizontal alignment of the guide member 119 for the chain is provided by shifting the sleeve 124 relative to the bracket 120, while location of the conical portion 132 with respect to the portion 126 spaces these portions apart sufficiently to accommodate various size chain as it is guided therebetween to the guide assembly 98.

The feed assembly 100 positively feeds the continuous chain 86 to a cutting assembly generally indicated at 138 that is located below the baseplate 14 and for this purpose the feed assembly 100 includes a feed roll 140 which as shown in FIG. 6 is mounted on a shaft 142. The shaft 142 extends through the bearing block 106 and is operatively interconnected to a shaft 144 of a DC motor 146 through a coupling 148. The feed roller 140 is rubber coated and is mounted between opposed flanges 150 and 151, the shaft 142 extending outwardly of the flange 150, and a locknut 152 being secured to a threaded portion of the shaft 142 for securing the flanges 150 and 151 in place on both sides of the roller 140. It is seen that the DC motor 146, when energized, will cause the feed roller 140 to rotate and, as will be described, the feed roller 140 cooperates with a tension or pressure roller 156 located adjacent thereto for feeding the chain 86 to the cutting assembly 138.

Referring now to FIGS. 4 and 5, the pressure roller 156 is shown mounted on a ball bearing housing 158 that is rotatably received on a stub shaft 160. The stub shaft 160 is fixed in a support plate 162 which, as will be described, is movable relative to the bearing block 106 and the mounting block 108. Fixed to the support plate 162 is a guide member 164 into which a reduced end 165 of a guide pin 166 extends for securement therein by a setscrew 168. The pin 166 extends

through a suitable opening in a support block 169 that is mounted on a support member 170. The support plate 162, together with the pressure roller 156, is normally urged toward the feed roller 140 by a plunger 172 that extends through a bore in the block 169 and is loaded by a spring 174 that is held in position in the bore in the block 169 by a cap 176. It is seen that the normal position of the support plate 162 is toward the feed roll 140 so that the pressure roll 156 cooperates with the feed roll 140 to feed the chain 86 therebetween. In order to locate the chain 86 between the feed roll 140 and the pressure roll 156, the support plate 162 is retracted from its loaded position by pivoting a lever 178 that is fixed to the pin 166 by a stud 180. The corner of the lever 178 adjacent to the support block 168 engages the support block as the lever 178 is pivoted, the lever 178 being cammed with respect to the block 169 and thereby withdrawing the pin 166 and the support plate 162 fixed thereto relative to the feed roll 140. The pin 166 is locked in the retracted position by a lock lever 182 that is moved to its down position as seen in FIG. 4, wherein the pressure roll 156 is held in the withdrawn position.

As the chain 86 is fed through the feed assembly 100 by the feed roller 140 and pressure roller 156 to the cutting assembly 138, it passes through a guide area defined by a fixed guide 183 and an adjustable guide 184 that is fixed to the support plate 162 and is movable therewith. Fixed to the mounting block 108 by a screw 186 is the fixed guide 183 that is spaced from the adjustable guide 184 and defines a throat 190 therewith. The guides 183 and 184 project below the baseplate 14 to a position just above the cutting assembly 138 and direct the chain 86 to the cutting assembly for the cutting operation. It is understood that when the support plate 162 is retracted by the lever 178 the adjustable guide 184 is movable therewith to open the throat 190, whereby the chain may be introduced into the throat 190 between the guides 183, 184 during the starting up or loading operation. It is also understood that once the chain is threaded between the feed and pressure rollers 140 and 156 and between the guides 183 and 184, the support plate 162 is released to locate the chain in feeding relation between the feed and pressure rollers and guides.

Referring now to FIGS. 9 and 10, the cutting assembly 138 is illustrated and comprises a fixed cutter unit generally indicated at 192 and a movable cutter unit generally indicated at 194. The fixed cutter unit includes a mounting block 196 that is secured to the underside of the baseplate 14 and that has a central groove formed therein in which a fixed cutter 198 is located. A slot 200 formed in the fixed cutter and an adjustment screw 202 extending into the slot 200 for engagement with the block 196 provide for longitudinal adjustment of the cutter 198. A stop screw 204 located in the rear end of the fixed cutter 198 is adapted to engage a stop 206 formed as part of the baseplate and further adjustably locates the fixed cutter 198. Suitable screws 208 secure the mounting block 196 to the bottom surface of the baseplate 14. Also secured to the underside of the baseplate 14 and spaced from the mounting block 196 is a block 210 of the cutter unit 196 in which a central groove 212 is formed for receiving a movable slide member 214. Fixed to the end of the slide member 214 adjacent to the fixed cutter 198 is a cutter 216 that is movable with the slide member 214 and that cooperates with the fixed cutter 198 to sever the chain in the required lengths. The slide member 214 is interconnected to a link 218 by a pin 220 having a cotter pin connection 222. Spaced guide plates 224 overlie the block 210 and the marginal edges of the slide member 214 for retaining the slide member in position, while bolts 226 extend through the guide plates 224 for securing the guide plates and the block 210 to the undersurface of the baseplate 14.

The link 218 is pivotally connected to a toggle block 228 through a pivot connection 230, a second toggle link 232 also being pivotally connected to the toggle block 228 and to a fixed bracket 233 at a pivot connection 234. Secured to the toggle block 228 is a shaft 236 that is joined to a piston located in an air-operated cylinder 238 having airhose connections 240 and 242 joined thereto that communicate with opposite sides of the piston located in the cylinder. The cylinder is fixed at the rear end thereof to a bracket 244 through a pin connection 245, the bracket 244 being mounted on a block 246 secured to the underside of the baseplate 14. As will hereinafter be described, the air cylinder 238 is solenoid operated, the solenoid being energized in accordance with a predetermined signal and in accordance with the cutting requirements of the machine to control a four-way valve that controls flow of compressed air to either of the hoses 240, 242. As further illustrated in FIG. 9, a microswitch 248 is mounted on the underside of the baseplate 14 and has a push-button contact 250 extending outwardly therefrom for engagement by the toggle block 228. The microswitch 248 is operative to energize the solenoid that controls the four-way valve that introduces air into the air cylinder 238 for returning the movable cutter 216 to the noncutting position thereof as illustrated in FIG. 10. Thus, when the cylinder 238 is operated to move the shaft 236 to the position illustrated in FIG. 9, for producing a cutting action, the toggle block 228 will engage the switch contact 250, thereby closing a circuit for operating the solenoid that controls the four-way valve for directing compressed air to the cylinder 238, wherein the shaft 236 is retracted to the position shown in FIG. 10, in which position the movable cutter 216 is retracted from the cutting area.

As mentioned hereinabove, the cutting assembly 138 as represented by the cutter units 192 and 194 is operated in accordance with a predetermined signal that has been established by the operator of the machine. The signal is obtained by generating a series of electrical impulses, these impulses being counted until a predetermined number is generated and the signal thereafter initiating operation of the solenoid that controls flow of air through the four-way valve to the cylinder 238. In order to generate the series of electrical impulses, a timing disc 252 is provided and is fixed to the outer end of the shaft 142 that is coupled to the DC motor shaft 144. As seen in FIGS. 6 and 8, a hub 254 formed as part of the timing disc 252 is keyed directly to the shaft 142 for securement thereon. A spring 256 is interposed between the timing disc 252 and the flange 150 of the feed roll 140 and exerts an outward force on the timing disc 252.

Referring to FIGS. 7 and 8, a timing roller 258 is shown frictionally engaging the timing disc 252 through urging of the spring 256 and is fixed to a timing shaft 260 mounted for rotary movement in an adjustable bearing block 262. A locknut 264 secures the timing roller 258 on the shaft 260 and a reduced end 266 of the shaft 260 projects through a central opening in a timing wheel 268 and is fixed therein, whereby the timing wheel 268 is rotatably driven by the frictional engagement of the timing roller 258 with the timing disc 252. The timing wheel 268 is mounted for rotation within a recess 267 formed in a block 269 to which a switchretaining block 271 is secured by a bolt 273. Fixed within the timing wheel 268 and insulated from the shaft portion 266 by a washer 270 is a brush holder 272 having a brush 274 located therein. A spring 276 positioned in the lowermost end of the brush holder 272 positively urges the brush 274 to the outer position thereof. Located within the recess 267 in the interior of the block 269, as illustrated in FIG. 12, are a plurality of spaced contacts 284 that are electrically interconnected by a lead 286. Also located in the recess 267 but not connected electrically to the contacts 284 is a contact 285, the contact 285 being electrically connected to a lead 287. When the switch-retaining block 271 and the block 269 are joined together by the bolt 273 with the timing wheel 268 located within the block 269, the brush 274 will successively engage the contacts 284 and 285 upon rotation of the timing roller 258. Located in electrical engagement with the brush holder 272 is a spring contact 288 that is mounted within the switch-retaining block 271, the spring contact 288 being held in position within the block 271 by a rivet 290 and making electrical contact with a

lead 292 that extends outwardly of the block 271. It is seen that as the timing roller 258 is rotated by the timing disc 252, the timing wheel 268 will be rotated to cause the brush 274 to successively engage the contacts 284 and contact 285. As the brush 274 engages each of the contacts 284, an electrical impulse may be generated and the impulses as generated are counted by the counters 28 and 30. When a predetermined number of impulses has been generated, a circuit responsive thereto is operative to energize the solenoid that controls the four-way valve that in turn controls operation of the air cylinder 238, thereby producing a cutting action by the cutter assembly 138 for severing the chain 86 in a required length.

As will be described, the counters 28 and 30 and the controls therefor are utilized for varying the length of chain cut. However, a fine adjustment is used in conjunction with this control to obtain the precise length of chain, and this fine adjustment is obtained by controlling the speed of rotation of the timing wheel 268, thereby varying the rate of generation of the electrical impulses. The speed of rotation of the timing wheel 268 is varied by moving the timing roller 258 in a radial direction with respect to the timing disc 252 and this is accomplished by rotation of a micrometer dial 294 (FIGS. 3 and 7) rotatably mounted on a fixed block 295. Mounted for reciprocation on the block 295 and movable in response to rotation of the dial 294 is a shaft 296 to which a slide block 297 is secured. The slide block 297 is received in a channel 298 formed in a block 299, guides 300 and 301 being secured to the block 299 and overlying opposite flanges of the slide block for retaining the slide block within the channel 298. Screws 302 and 303 extend through the guides 300, 301 for locking them to the block 299 and a lock screw 304 projects through a portion of the block 299 for engagement with the slide block 297 for securing the slide block in its adjusted position. As the dial 294 is rotated, the slide block 297 and bearing block 262 are shifted longitudinally carrying the timing roller 258 and timing wheel assembly therewith. As the timing roller 258 moves toward the axis of the timing disc 252, the speed of the roller and its shaft 260 are increased, thereby increasing the speed of rotation of the timing wheel 268. Since the brush 274 engages the contacts 284 with greater frequency, the impulses generated by closing the circuit to the contacts are increased in frequency and the length of chain to be cut is correspondingly reduced.

In the operation of the machine, it is desirable to provide controls for discontinuing operation of the motor 146 that controls the drive for the feed assembly and timing disc 252 as well as motor 53 for the drive roll 50 in the event of a jam of the chain or if the chain is exhausted from the reel 76. Should the chain become jammed during the feed thereof through the drive roll 50 and pressure roll 60, a pulling action by the chain will be exerted on the roller 88 located at the bottom of the control arm 90. In this event the control arm will be pulled to the right to the position shown at *b* in dotted lines in FIG. 3, causing a pin 306 fixed to the control arm 90 to engage a switch arm 308 extending from a switch 310. The switch 310 which is mounted on the extension 42 is located in circuit with the motors 53 and 146 and when the arm 308 is pivoted, the switch 310 will act to deenergize these motors for discontinuing the operation of the machine.

As the chain 86 is fed from the reel 76 between the pressure roller 60 and the feed roller 50, it lifts the arm 44 that is urged in a clockwise direction by the spring 62. The finger 47 formed at the outermost end of the arm 44 engages a movable contact 312 of a switch 314, and should the material or chain run out from between the rollers 60 and 50, the arm 44 will be pivoted to the right as seen in FIG. 3 by the spring 62 in a clockwise direction to cause the finger 47 to move the contact 312 inwardly of its switch 314. This operation of the switch 314 also breaks the circuit to the motors 53 and 146 and discontinues operation of the machine.

During operation of the machine, the AC motor 53 is intermittently operated as the control arm 90 is pivoted in accordance with the demand of the chain being withdrawn from the reel 76. Since the motor 53 operates independently of the motor 146, the operation thereof may be discontinued should excessive chain accumulate as it is being withdrawn from the reel 76 regardless of the frequency of the cutting operation. Should more chain be withdrawn from the reel than is demanded for cutting, a slack in the chain will occur between the drive roll 50 and feed roll 140, thereby causing the control arm to return to the inoperative position and opening the circuit in the switch 94 and motor 53. The excess chain that has been withdrawn collects in the channel 41, and in the meantime the drive to the drive roll 50 is discontinued. As the cutting action continues and more chain is demanded, the chain collected in the channel 41 is fed to the feed assembly until the chain is once again tensioned to pivot the control arm 90 to the operative position for energizing the motor 53. The drive roller 50 is now operative to continue withdrawing chain from the reel 76.

## OPERATION

In describing the operation of the machine, reference is made to the circuit illustrated in FIG. 13, and it will be assumed in the first instance that a relatively short length of chain is to be cut. In this instance the selector switch 26 is placed in the No. 1 position as illustrated in FIG. 1, and the chain on the reel 76 is threaded between the feed roller 50 and pressure roller 60, around the roller 88 on the lower end of the control arm 90, above the channel 41, through the guide assembly 98 and then through the feed assembly 100 for entry between the guides 183 and 184. Prior to threading the chain as indicated, the lever 182 is rotated to retract the support 162 together with the pressure roller 156 and guide 184. The throat 190 between the guide 184 and fixed guide 183 is then open for threading the chain therebetween. Once the chain is threaded, the pressure roller 156 and guide 184 are returned to their normal positions and the circuit is then energized by pressing the start button 20, which energizes a relay 311 that causes normally open contact 312 to close, thereby holding in the circuit. With the contact 312 closed, the DC motor 146 that rotates the timing disc and the feed roll 140 is energized, and since the jam switch 310 and the material-moniter switch 314 are normally closed, the circuit is complete to the remaining components of the device, with the exception of the motor 53 that controls the reel-feed drive roll 48. However, as the feed roll 140 rotates to move the chain toward the cutter assembly 138, the chain is pulled to the right as seen in FIG. 3, thereby pivoting the control arm 90 in a counterclockwise direction to close the mercury switch 94 and energize the reel-feed motor 53. As the feed roll 140 rotates to drive the chain toward the cutting station 138, the timing disc 252 is also rotated, which in turn drives the timing roller 258, shaft 260 and timing wheel 268. The location of the timing roller 258 has been predetermined with respect to the timing disc 252 so as to fine adjust to obtain the length of chain required. As shown in FIG. 7, the timing roller 258 is located substantially away from the axis of the timing disc 252 and thus the shaft 260 and timing wheel 268 will be rotated at a relatively slower speed than when the timing roller 258 is located adjacent to the axis of the timing disc 252. This adjustment of the timing roller will provide for a greater length of chain than when the timing roller is closer to the axis of the timing disc 252. As the timing wheel 268 rotates, the brush 274 makes successive contact with the contacts 284 that are all interconnected through the lead 286 and then with the contact 285. Referring again to FIG. 13, as the brush 274 engages each of the contacts 284, a circuit is completed to counter 28 by way of the lead 292 connected to the brush 274, contact F1 in the selector switch 26, line 314 and contact P in counter 28. In the same circuit to counter 28, line 286 that joins the contacts 284 is interconnected to contacts C1 in the selector switch 26 through line 316. The circuit is then complete to the counter 28 by way of line 318, contact D1 in selector switch 26, line 320 and contact N in counter 28. Thus as the brush 274 engages each of

the contacts 284, a pulse is generated at counter 28 for energizing a relay therein. Energizing of the relay in counter 28 closes a circuit through the contact S, line 322, contact E1 in the switch 26 and line 324 to the thyristor 326. The thyristor 326 momentarily completes a circuit to the coil of a solenoid 328 through a line 330, but is deenergized by the alternating current of the circuit after it generates a pulse to energize the solenoid 328. The solenoid 328 is operative to advance the cutter 216 in a cutting stroke, and for this purpose controls a four-way valve 332, the valve 332 providing for flow of compressed air through connection 242 to the air cylinder 238. The piston in the air cylinder 238 is then advanced to cause the cutter 216 to move with respect to the fixed cutter 198 thereby producing a cutting action of the chain that is located between the cutters.

As the toggle block 228 of the cutting assembly 138 moves to the cutting position illustrated in FIG. 9, the end of the toggle block engages the switch contact 250 that closes the switch 248. As is further shown in FIG. 13, closing of the switch 248 energizes a solenoid 334 which is also operative to control the four-way valve 332. The four-way valve 332 then applies compressed air to the air cylinder 238 through hose connection 240 to move the shaft 236 and the toggle block 228 together with the cutter 216 to the inoperative position as illustrated in FIG. 10.

It is seen that as each of the contacts 284 is engaged by the brush 274 a pulse is generated in counter 28 that in turn causes the four-way valve 332 to operate the air cylinder for producing a cutting action. Prior to beginning the operation of the machine, counter 30, which is a batch counter, has been preset to a selected number, each number representing a length of chain that is cut. As each pulse is generated by counter 28, it is transmitted to counter 30 and indicated. When the predetermined number of pulses have been counted which represent the number of lengths of chain that have been cut, a relay in counter 30 is energized to open the normally closed contacts WX. Since the circuit in which the contacts WX are located are also in circuit with relay 310 and are necessary for holding the relay contacts closed, as the circuit to WX is opened, the relay 310 is deenergized to open the contacts 312 and thereby open the circuit to the feed motor 146 and the reel-feed motor 53. The operation of the machine is then discontinued.

When the indicator of the selector switch 26 is located in the No. 1 position, the length of chain to be cut can be varied, as previously mentioned, by changing the position of the timing roller 258 with respect to the timing disc 252. This is accomplished by rotation of the micrometer dial 294. The length of the chain may also be varied somewhat by rotating the shaft 144 and timing disc 252 at various speeds. Thus the motor speed control 24 which controls a rheostat can be operative to produce various speeds of the motor 146 and thereby vary the length of chain.

In order to produce considerably longer lengths of chain, the selector switch 26 is moved to the No. 2 position. Referring again to FIG. 13, it is seen that when the selector switch is in the No. 2 position, the contacts 284 which are interconnected through lead 286 and line 316, are disconnected from the circuit. Thus a pulse is produced only when the brush 274 contacts the contact 285. A pulse is then generated by way of the line 287, contact A2, line 318, contact D2 and line 320 to the counter 28. Since the pulse is generated only upon a complete revolution of the timing wheel 268, a longer period elapses before the thyristor 326 and advance solenoid 328 are energized for producing a cutting action. Hence a longer length of chain will be cut. As described above, when the batch counter receives a number of pulses in accordance with a predetermined setting, the relay 310 is deenergized to discontinue the operation of the machine.

When a large length of chain is required, counter 30 is set in accordance with the length desired, that is, according to the number of pulses that will be required to operate the cutting assembly 138. The selector switch is then moved to position No. 3 and in position No. 3 of the selector switch, the thyristor 326 cannot be fired by closing of the relay in counter 28 since contact S in counter 28 is no longer in circuit with the thyristor. Thus as each pulse is generated in counter 28 it will be transferred to counter 30 by way of the contacts VX and NP respectively. When the predetermined count is reached in counter 30, a relay is closed and the normally open contacts SU in counter 30 are closed, thereby closing a circuit to the thyristor by way of line 336, contact E3 and line 324. A cutting operation then takes place as described above. At the same time, the normally closed contacts WX in counter 30 are opened to deenergize the relay 310 and discontinue the operation of the machine.

What is claimed is:

1. In apparatus for automatically cutting chain in predetermined lengths, a base, a cutoff station, means on said base for feeding a continuous length of chain to said cutoff station, means on said base for driving said feeding means at a preselected speed, cutting means at said cutoff station for severing said chain in the predetermined lengths thereof, means operatively engaging said driving means and being driven thereby, means responsive to the rotation of said driven means for generating a series of electrical impulses, said cutting means being operative in response to generation of a predetermined number of electrical impulses for periodically severing said chain in the predetermined lengths thereof, means for selecting the length of chain to be cut, and means for controlling the speed of said driving means, wherein the rotational speed of said driven means is controlled to vary the frequency of generation of said electrical impulses, thereby controlling the length of chain that is cut.

2. In apparatus for automatically cutting chain in predetermined lengths, a base, a cutoff station, means on said base for feeding a continuous length of chain to said cutoff station, means on said base for driving said feeding means at a preselected speed, cutting means at said cutoff station for severing said chain in the predetermined lengths thereof, means operatively engaging said driving means and being driven thereby, means responsive to the rotation of said driven means for generating a series of electrical impulses, said cutting means being operative in response to generation of a predetermined number of electrical impulses for periodically severing said chain in the predetermined lengths thereof, means for selecting the length of chain to be cut, said impulse-generating means being responsive to said selecting means for reducing the frequency of generation of said impulses for each revolution of said drive means, thereby increasing the length of the chain to be cut.

3. In apparatus as set forth in claim 2, said impulse-generating means including a plurality of fixed contacts, and a movable contact responsive to rotation of said driven means for successively engaging said fixed contacts, said movable contact cooperating with said selecting means when said selecting means is located in a first position for generating an electrical impulse upon engagement with each fixed contact, wherein said cutting means is operable upon generation of a selected number of impulses for severing said chain.

4. In apparatus as set forth in claim 3, said driving means including a disc having a predetermined diameter, said driven means including a roller follower frictionally engaging said disc and being rotatably driven thereby, and means for adjusting the position of said follower with respect to said disc, for varying the rotational speed of said follower and the frequency of the generation of said electrical impulses.

5. In apparatus as set forth in claim 4, the axis of said follower being perpendicular to the axis of said disc, so that said follower is adjustable along the radius of said disc, said follower being operatively connected to said movable contact to produce rotation thereof, whereby the adjustment of said follower with respect to said disc along the radius thereof produces a corresponding frequency of generation of electrical impulses as said movable contact successively engages said fixed contacts.

6. In apparatus as set forth in claim 4, means for controlling the speed of said driving means, wherein the rotational speed of said disc is controlled to vary the speed of rotation of said follower and consequently the frequency of generation of said electrical impulses, thereby further controlling the length of chain that is cut.

7. In apparatus for automatically cutting chain in predetermined lengths, a base, a cutoff station, means on said base for feeding a continuous length of chain to said cutoff station, means on said base for driving said feeding means at a preselected speed, cutting means at said cutoff station for severing said chain in the predetermined lengths thereof, means operatively engaging said driving means and being driven thereby, means responsive to the rotation of said driven means for generating a series of electrical impulses, said cutting means being operative in response to generation of a predetermined number of electrical impulses for periodically severing said chain in the predetermined lengths thereof, means for selecting the length of chain to be cut, means mounted on said base for withdrawing the continuous length of chain from a source for movement to said feeding means, said withdrawing means being operated independently of said feeding means and means for sensing the presence of said chain at said withdrawing means and for discontinuing operation of said apparatus when chain is not present at said withdrawing means, said withdrawing means including a drive roll and a pressure roll between which said chain extends, said sensing means including a pivotally mounted arm on which said pressure roll is mounted and a switch, a contact of which is spaced from an end of said arm, said pressure roll being located in a predetermined position with respect to said drive roll when said chain extends therebetween to maintain the end of said arm in spaced relation from the switch contact, and being located in engagement with said driving roll in the absence of chain therebetween to pivot the arm, thereby moving the end of said arm into contact with said switch contact to cause the operation of said apparatus to be discontinued.

8. In apparatus for automatically cutting chain in predetermined lengths, a base, a cutoff station, means on said base for feeding a continuous length of chain to said cutoff station, means on said base for driving said feeding means at a preselected speed, cutting means at said cutoff station for severing said chain in the predetermined lengths thereof, means operatively engaging said driving means and being driven thereby, means responsive to the rotation of said driven means for generating a series of electrical impulses, said cutting means being operative in response to generation of a predetermined number of electrical impulses for periodically severing said chain in the predetermined lengths thereof, means for selecting the length of chain to be cut, means mounted on said base for withdrawing the continuous length of chain from a source for movement of said feeding means, said withdrawing means being operated independently of said feeding means, said withdrawing means including opposed rollers between which said chain is directed, a motor operatively driving one of said rollers, and a pivotal control arm having a guide roll mounted thereon for controlling operation of said withdrawing means, said chain extending from said opposed rollers around said guide roll and to said feeding means, said chain being normally tensioned by said feeding means to pivot said control arm to an operative position for actuating of a switch, wherein the motor driving one of said opposed rollers is operatively connected to a source of power and is energized during the chain-cutting operation, and a switch connectable in circuit to said motor that drives the opposed rollers and to the driving means for said feeding means, said switch having an elongated switch arm mounted for engagement by said control arm when said control arm is pivoted to an overcenter position by said chain when said chain becomes jammed during the feed thereof from said opposed rollers to said feeding means, wherein continued operation of said feeding means causes said chain to pull said control arm to the overcenter position for actuating said switch arm, thereby discontinuing operation of said apparatus.

9. In apparatus for automatically cutting chain in predetermined lengths, a base, a cutoff station, means on said base for feeding a continuous length of chain to said cutoff station, means on said base for driving said feeding means at a preselected speed, cutting means at said cutoff station for severing said chain in the predetermined lengths thereof, means operatively engaging said driving means and being driven thereby, means responsive to the rotation of said driven means for generating a series of electrical impulses, said cutting means being operative in response to generation of a predetermined number of electrical impulses for periodically severing said chain in the predetermined lengths thereof, means for selecting the length of chain to be cut, means for mounting a source of said chain on said base, said mounting means including a bracket and said source of chain including a reel on which said chain is wound in a continuous length, said reel being received on said bracket in rotatable relation, said reel as mounted on said bracket being located above said feeding means, and means for withdrawing said chain from said reel for movement to said feeding means, said withdrawing means being operated independently of the means for driving said feeding means, and a pivotally mounted control arm having a guide roll positioned on the lowermost end thereof, said control arm and guide roll being located rearwardly of said reel and said feeding means, said chain extending from said directing means around said reel and then to said feeding means to form a loop, and switch means located at the upper end of said control arm and being disposed in circuit with the drive for said withdrawing means, the loop as formed by said chain as it moves around said roll from said withdrawing means and is fed to said feeding means normally locating said arm such that the contacts in said switch means are closed to complete a circuit to said drive for the withdrawing means, said arm being operable when said chain is not being fed to said feeding means to cause said switch to break the circuit to said drive for the withdrawing means to discontinue the operation thereof.

10. In apparatus for automatically cutting chain in predetermined lengths, a base, a cutoff station, means on said base for feeding a continuous length of chain to said cutoff station, means on said base for driving said feeding means at a preselected speed, cutting means at said cutoff station for severing said chain in the predetermined lengths thereof, means operatively engaging said driving means and being driven thereby, means responsive to the rotation of said driven means for generating a series of electrical impulses, said cutting means being operative in response to generation of a predetermined number of electrical impulses for periodically severing said chain in the predetermined lengths thereof, means for selecting the length of chain to be cut, means for mounting a source of said chain on said base, said mounting means including a bracket and said source of chain including a reel on which said chain is wound in a continuous length, said reel being received on said bracket in rotatable relation, said reel as mounted on said bracket being located above said feeding means, and means for withdrawing said chain from said reel for movement to said feeding means, said withdrawing means being operated independently of the means for driving said feeding means, an adjustable guide member located adjacent to said feeding means and guiding said chain from said withdrawing means to said feeding means, said adjustable guide member including a fixed element and a movable element, that define a guide channel for guiding the chain therebetween, said movable element being adjustable with respect to said fixed element to compensate for different size chain, and means for adjustably centering said guide with respect to said feeding means.

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