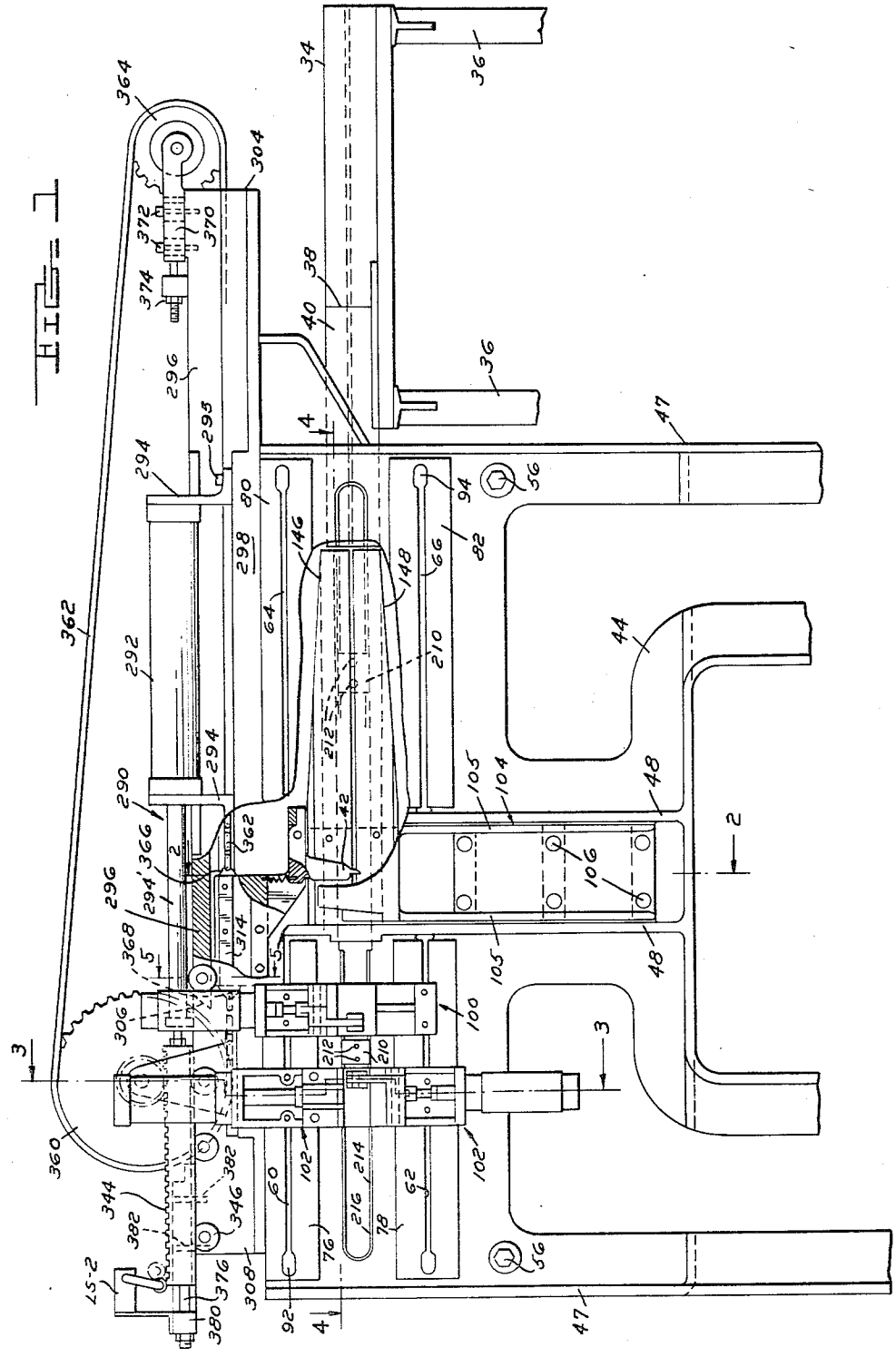
June 14, 1960 H. H. FANTE ET AL 2,940,480

MACHINE FOR BENDING PREFORMED SINUOUS WIRE

Filed June 24, 1955 7 Sheets-Sheet 1



June 14, 1960 H. H. FANTE ET AL 2,940,480

MACHINE FOR BENDING PREFORMED SINUOUS WIRE

Filed June 24, 1955 7 Sheets-Sheet 2

FIG. 2

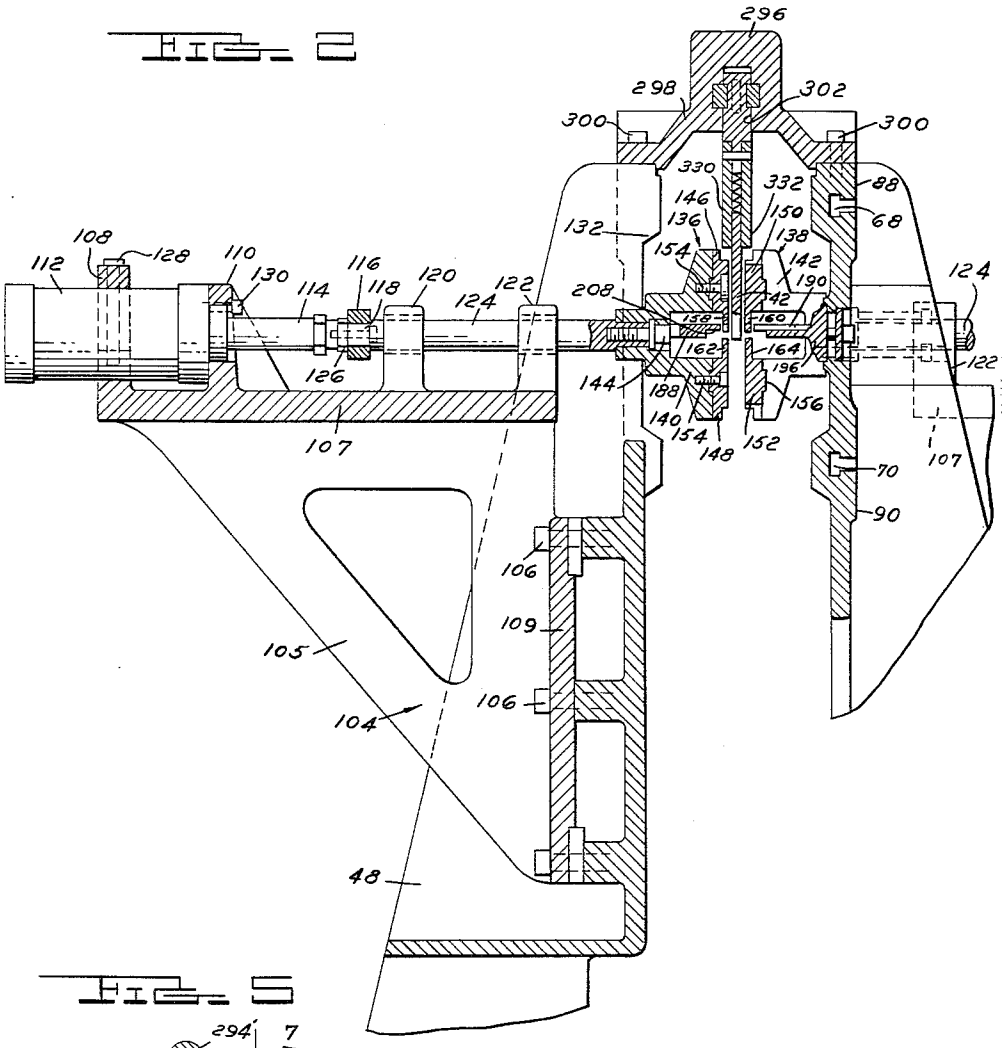
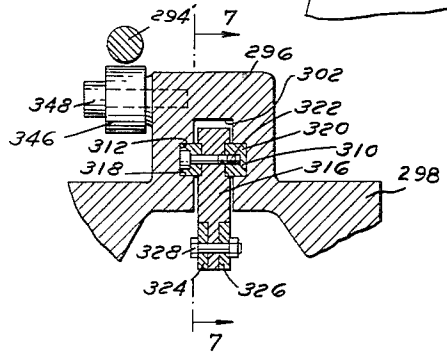


FIG. 5



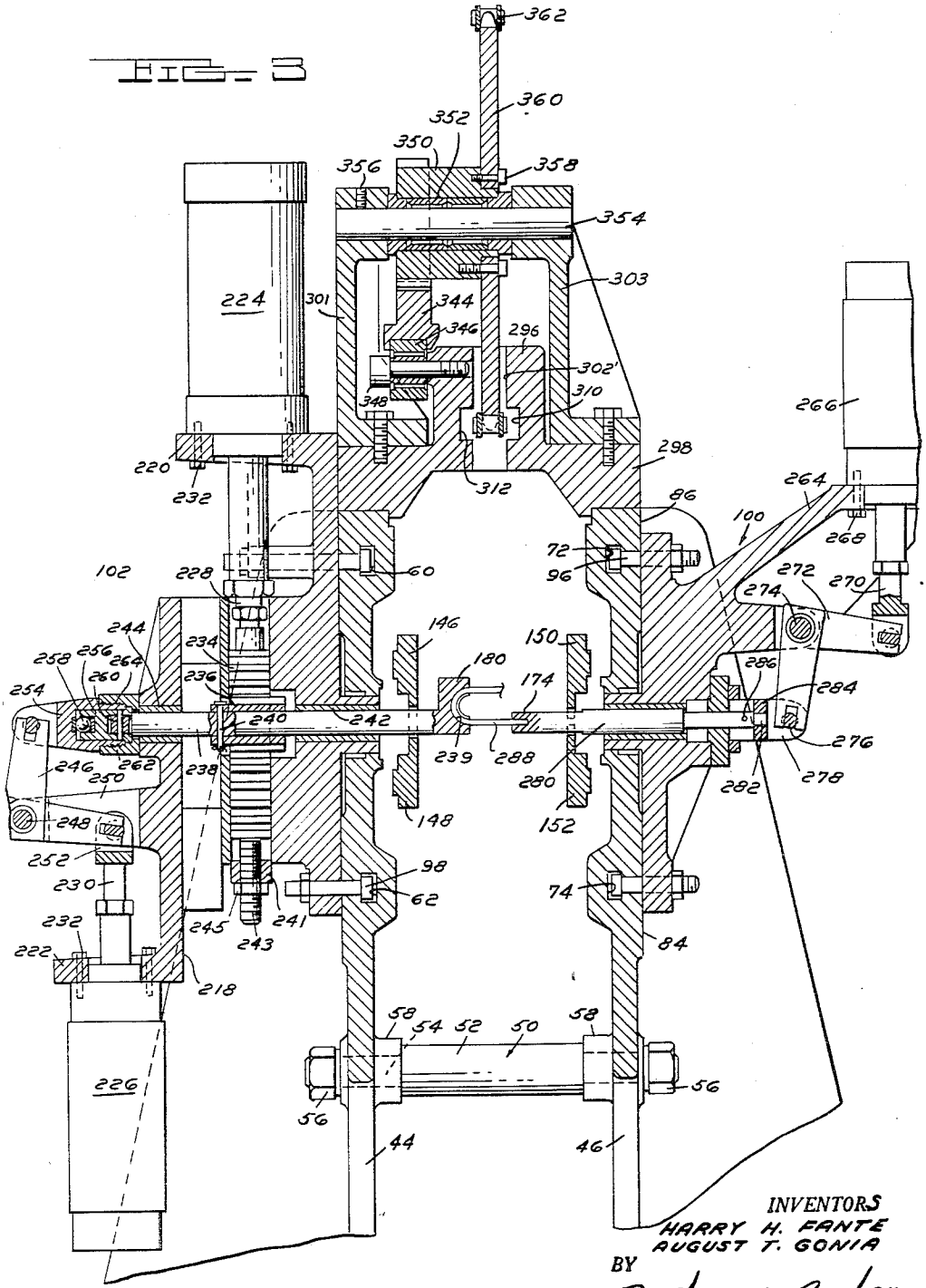
INVENTORS
HARRY H. FANTE
AUGUST T. GONIA
BY
Burton & Parker
ATTORNEYS

June 14, 1960 H. H. FANTE ET AL 2,940,480

MACHINE FOR BENDING PREFORMED SINUOUS WIRE

Filed June 24, 1955 7 Sheets-Sheet 3

FIG. 3

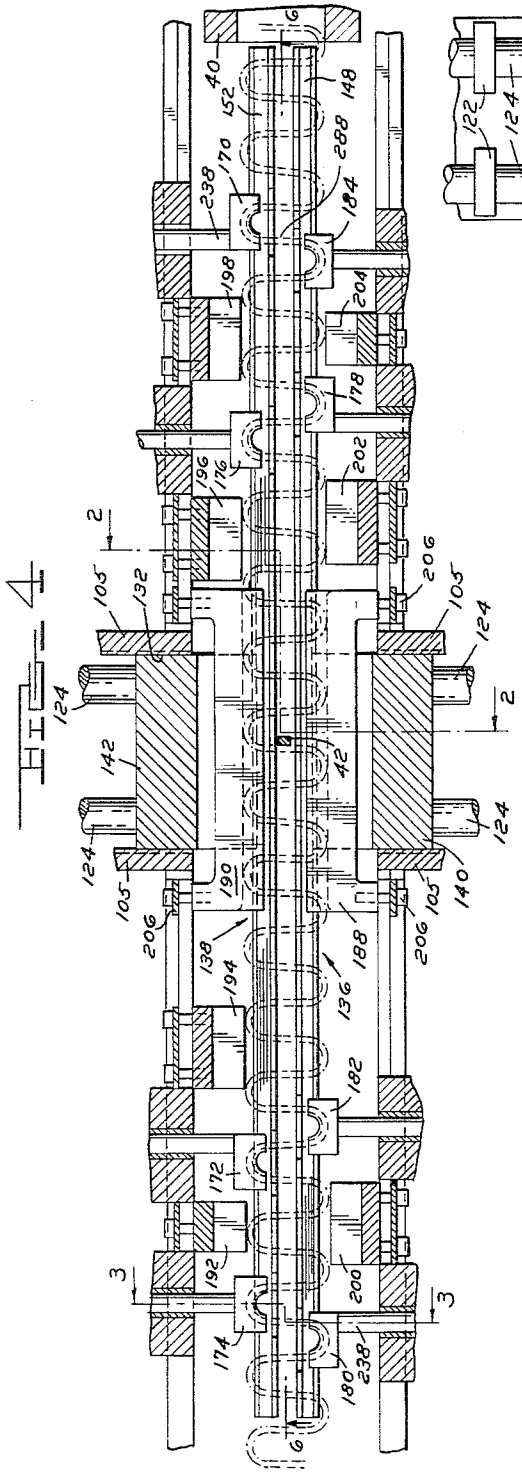


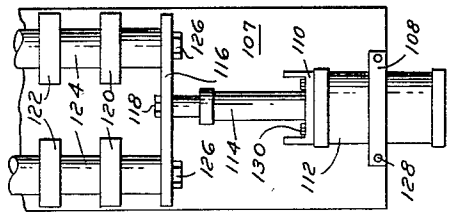
INVENTORS
HARRY H. FANTE
AUGUST T. GONIA
BY
Burton & Parker
ATTORNEYS

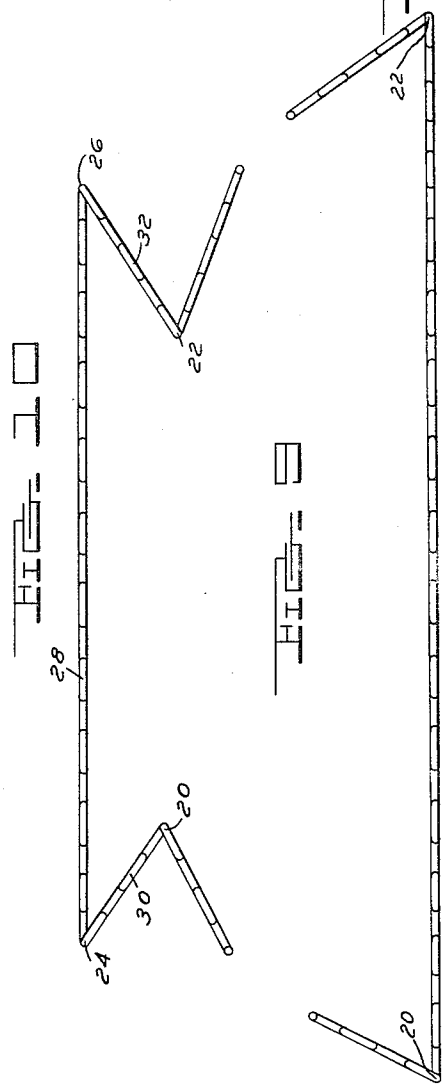
June 14, 1960 H. H. FANTE ET AL 2,940,480

MACHINE FOR BENDING PREFORMED SINUOUS WIRE

Filed June 24, 1955 7 Sheets-Sheet 4







INVENTORS
HARRY H. FANTE
AUGUST T. GONIA
BY
Burton & Parker
ATTORNEYS

June 14, 1960 H. H. FANTE ET AL 2,940,480

MACHINE FOR BENDING PREFORMED SINUOUS WIRE

Filed June 24, 1955 7 Sheets-Sheet 5

FIG. 6

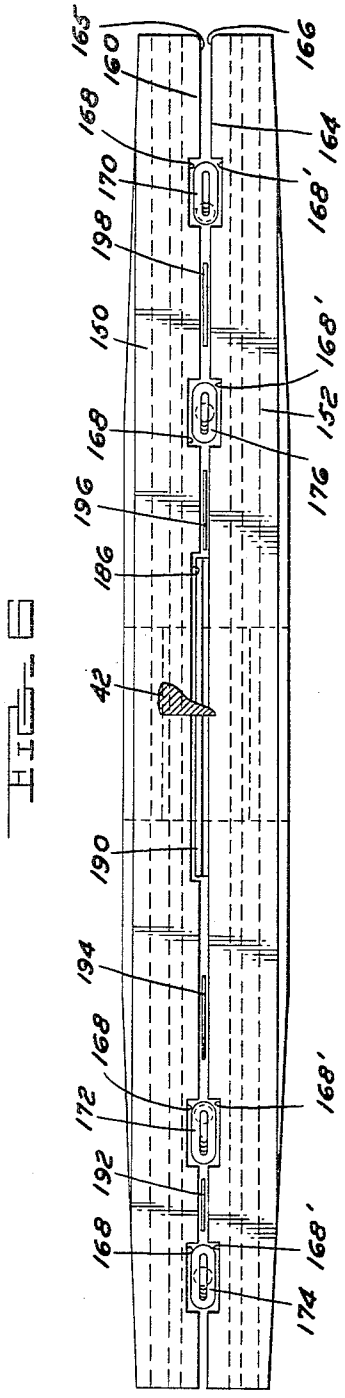
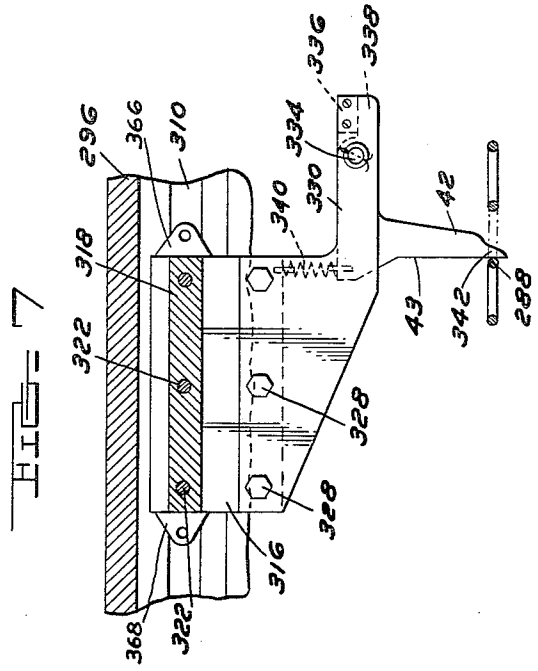


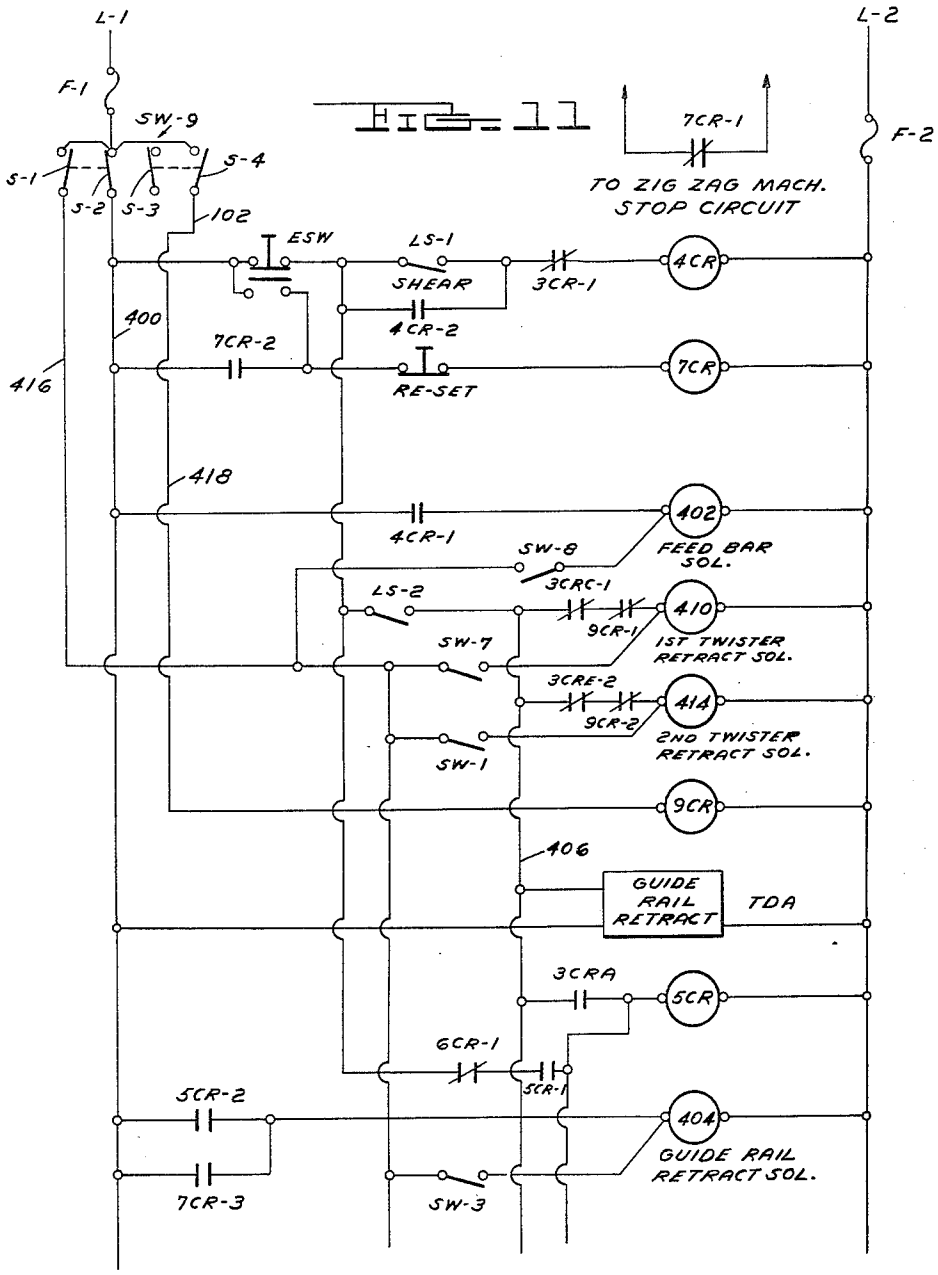
FIG. 7



INVENTORS
HARRY H. FANTE
AUGUST T. GONIA
BY
Burton & Parker
ATTORNEYS

MACHINE FOR BENDING PREFORMED SINUOUS WIRE

Filed June 24, 1955 7 Sheets-Sheet 6



INVENTORS
HARRY H. FANTE
AUGUST T. GONIA
BY
Burton & Parker
ATTORNEYS

June 14, 1960 H. H. FANTE ET AL 2,940,480

MACHINE FOR BENDING PREFORMED SINUOUS WIRE

Filed June 24, 1955 7 Sheets-Sheet 7

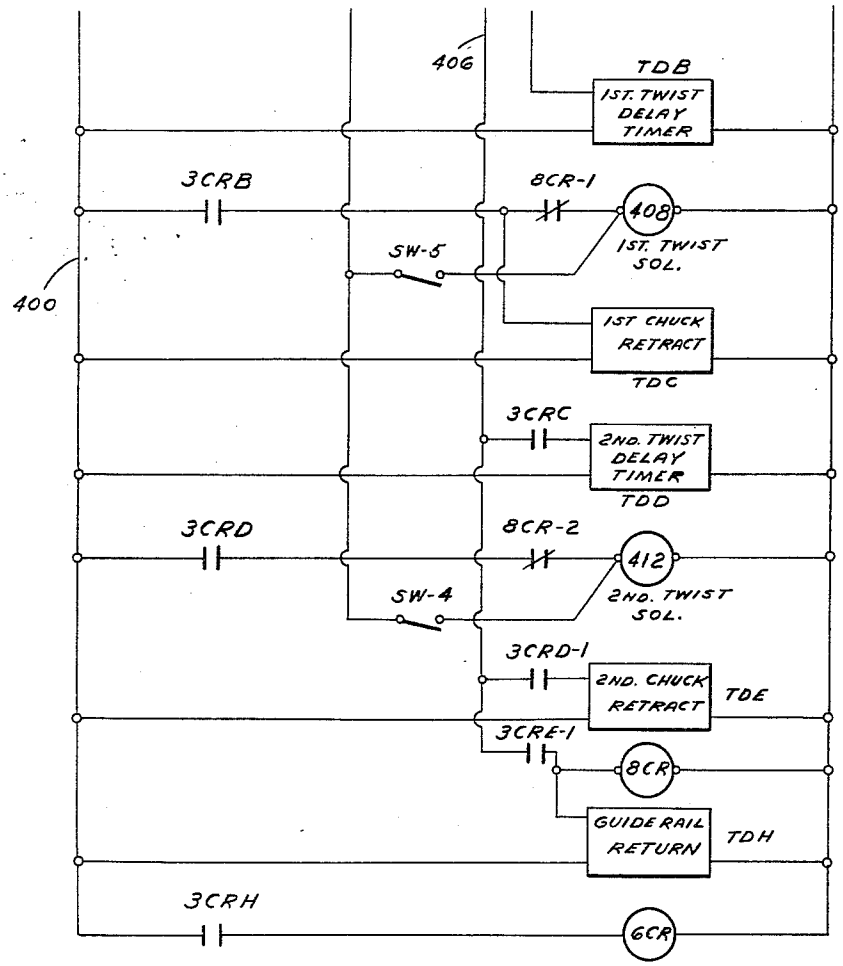


FIG. 12

INVENTORS
HARRY H. FANTE
AUGUST T. GONIA
BY
Burton E. Parker
ATTORNEYS

United States Patent Office 2,940,480 Patented June 14, 1960

2,940,480

MACHINE FOR BENDING PREFORMED SINUOUS WIRE

Harry H. Fante, Riverside, and August T. Gonia, Berwyn, Ill., assignors to Rockwell-Standard Corporation, a corporation of Pennsylvania

Filed June 24, 1955, Ser. No. 517,834

3 Claims. (Cl. 140—71)

This invention relates to a machine for bending wire and more particularly to a machine for bending preformed corrugated or zigzag wire sections into configurations adapted for use in automotive seat or back cushions or the like. Attention is called to our co-pending application relating to a machine for bending corrugated wire, Serial No. 313,892, filed October 9, 1952, now Patent No. 2,777,476, issued January 15, 1957, wherein disclosed is a machine for accomplishing the same general result. Certain drawbacks in the construction and operation of the machine in this prior application led to the development of the machine disclosed herein.

The invention embodied in the machine herein disclosed is particularly suited to an automatic production line type of operation where the wire is manually handled only to stack it into bundles of wire sections after all of the bending and cutting operations have been accomplished on the wire. In the production line operation straight wire stock is wound off a coil and fed to a zigzag forming machine which imparts zigzag bends to the wire. The zigzag wire is fed out of the zigzag machine through a wire guide trough or the like and directly into the machine forming the subject of this application, and hereafter termed the bending machine. A suitable wire measuring device in the zigzag machine may be adjusted to determine the length of the wire sections that are fed from the machine. Shearing mechanism forming a component of the zigzag machine is actuated by this measuring device to cut the zigzag wire into sections of a determined length.

As each wire section is fed from the zigzag machine to the bending machine it is automatically picked up, after moving a determined distance into the bending machine, by a wire conveyor which draws the zigzag section into the bending machine and position it accurately therein for the bending operation. Wire guiding and supporting means are provided, in the bending machine, for guiding and initially supporting the wire during its movement into the machine. Such guiding and supporting means are automatically retracted away from the wire after it has reached the wire bending position, and the wire is held supported in the machine by a plurality of wire twisting devices and wire holding devices arranged along the opposite linear edges of the wire and received over the loops of the wire. These wire twisting devices are thereafter automatically acutated in determined successive timed relation to bend the wire at determined points along its length and are retracted automatically, as are the wire holding devices, after the bending operation, to permit the wire strip to fall out of the machine and on to a moving conveyor which carries the wire to a bundling station where the wire strips are stacked in bundles for distribution to seat fabricators.

Certain of the objects of the instant machine are: the reduction in cost of manufacturing this machine as compared with the prior art machines and particularly our machine disclosed in the prior co-pending application; the provision of a machine so constructed and arranged

that it may be adjusted to accommodate different sizes of zigzag wire; the provision of a machine so constructed and arranged that it may be adjusted to bend the zigzag wire at a variety of intervals along the linear extent of the wire, and bend the wire into many different configurations, whereby the same machine may at one adjustment bend wire for use in one type of automotive seat construction and at another adjustment bend wire for a different type of automotive seat construction requiring totally different bends at totally different intervals along the length of the wire.

Another object of the invention is the provision of a machine which is fully automatic in operation and which functions to perform a multiplicity of bends in a succession of zigzag wire sections without the attendance of an operator except to occasionally observe the operation of the machine.

Another object of the invention is the provision in a wire bending machine of the character herein disclosed of an electric timing device which synchronizes the various operations of the machine, and which device may be readily adjusted to increase or decrease the intervals of time between the various steps in the operation of the machine.

Another object of the invention is the provision in a wire bending machine adapted to bend a zigzag wire section, of a pair of opposed wire guiding members movable toward and away from each other, and a plurality of wire holding and positioning members and a plurality of wire twisting heads all disposed adajacent the guiding members to engage, position, and bend a wire disposed between the guiding members, with timing means connected to the guiding members, to the positioning and holding means, and to the twisting heads, to synchronize the movements thereof whereby the guiding members are retracted from the wire preparatory to the bending thereof by the twisting heads. A concomitant object is the provision in a wire bending machine of a pair of opposed movable wire guiding members extending throughout substantially the length of the wire that is to be bent, with a conveyor element adapted to engage the wire to draw it into position between the guiding members, and with a plurality of wire holding devices that engage and hold the wire when it is positioned by the conveyor between the guiding members, and the provision of timing means which synchronize the movements of the guiding members, the conveyor, and the holding devices whereby the guiding members retract away from the wire upon positioning thereof by the conveyor between the members with the holding devices engaging and supporting the wire.

The various bending operations and movements of the wire twisting and wire holding heads and the conveyor are controlled by timing mechanism which determines the time interval between successive operations of the various parts of the machine. This timing mechanism may be adjusted to increase or decrease the time intervals between successive operations of the machine. The timing mechanism is of such a character that upon initiation of one operation, as, for example, the retraction of the guide rails, a time interval begins to run, at the end of which the next operation is initiated. While many advantages result from the combination of such an adjustable timing mechanism and a wire bending machine for imparting a plurality of bends to a pre-formed zigzag wire, one advantage is that with such an adjustable timing mechanism, the wire bending heads and wire holding heads may be rearranged relative to each other so that the machine may be adapted to perform different types of bends in the wire, or perform bends at differently spaced intervals along the length of the wire, and time intervals between the operations of the wire bending heads

are adjusted to accommodate for these changes in the relative positions of the wire bending and wire holding heads.

Other objects, advantages, and meritorious features will more fully appear from the specification, claims, and accompanying drawings, wherein:

Fig. 1 (Sheet 1) is a side elevation of a machine embodying our invention;

Fig. 2 (Sheet 2) is a cross sectional view taken on the line 2—2 of Figs. 1 and 4.

Fig. 3 (Sheet 3) is a cross sectional view taken on the line 3—3 of Figs. 1 and 4;

Fig. 4 (Sheet 4) is a cross sectional view taken on the line 4—4 of Fig. 1;

Fig. 5 (Sheet 2) is a cross sectional view taken on the line 5—5 of Fig. 1;

Fig. 6 (Sheet 5) is a cross sectional view taken on the line 6—6 of Fig. 4;

Fig. 7 (Sheet 5) is a cross sectional view taken on the line 7—7 of Fig. 5;

Fig. 8 is a top view of the left side of the machine as shown in Fig. 2;

Figs. 9 and 10 illustrate successive stages in the bending of a pre-formed zig-zag wire strip in our herein disclosed machine; and

Figs. 11 and 12 schematically illustrate the electric circuits of the machine.

Shown in Fig. 10 is a zig zag or corrugated wire section after being bent in our improved machine. This wire section is adapted for use in automotive seat construction and may form either the seating portion or the back portion of an automotive seat. The wire was originally a flat piece of pre-formed zigzag wire. In the machine bends are first imparted to the wire at points **20** and **22**, near the opposite ends of the section, and thereafter the wire is bent at points **24** and **26**, which lie inwardly of points **20** and **22**. The bends in the wire are shown as V-shaped bends. As will be pointed out hereinafter, alligator jaw type bends may also be formed with our machine upon slight adjustment thereof, as well as many other types of bends, or a greater or lesser number of bends than those shown in Fig. 10. The wire section shown was formed of a flat section of pre-formed zigzag wire though, as will hereinafter appear, the machine is also adapted to bend a zigzag section having a pre-set arcuate shape.

In Fig. 1 is shown a side view of our improved machine. To the right hand side of Fig. 1 is shown a wire intake guide **34** supported upon legs **36**. The guide extends from the discharge side of a zigzag wire forming machine (not shown), wherein the zigzag configuration is imparted to the wire.

Meeting the end of the conveyor **34** at **38** is the wire intake guide proper **40** which forms a part of our machine. From the intake guide the wire is picked up by a conveyor finger **42** at substantially midway between the opposite ends of the wire section, and the finger draws the wire into the machine and positions it for the bending operation. Thereafter, a special arrangement of electric timers, wire holding devices, and wire twisting devices are actuated to hold, bend, and release the wire at determined intervals along its length. Upon completion of the last bending operation on the wire, it is permitted to fall downwardly out of the machine and onto a moving conveyor (not shown) which carries it to another station where it is stacked into bundles preparatory to use in the fabrication of automotive seats.

Our machine includes a pair of frame members **44** and **46** as shown in Figs. 1 and 3. The lower ends of these frame members rest upon the floor. Each frame member has reinforcing webs **47** at opposite ends with a pair of reinforcing webs **48** near the center of the frame. The frame members are held adjustably spaced apart by a plurality of spacer elements **50**, one of which is shown in Fig. 3. Each spacer includes a hollow cylinder **52** through which extends a stud bolt **54** provided at opposite ends with nuts **56**. The ends of the cylinder abut bosses **58** on the frame members and space the members apart by the length of the cylinder, while the nuts **56** and bolt **54** urge the frames against the ends of the cylinder. By interposing different length cylinders between the frames, the spacing apart of the frames may be varied. As will become apparent, such variability in the spacing apart of the frames will adapt the machine to various widths of zigzag wire. When the wire is drawn into the machine by finger **42**, it is drawn between the frame members, and upon completion of the bending operation is dropped downwardly between the frame members.

Each frame member, as shown in Figs. 1, 2, and 3 is provided with two pairs of vertically spaced apart horizontally extending keyhole slots indicated at **60**, **62**, **64**, **66**, **68**, **70**, **72**, and **74**, which open through the outside of the frames through the longitudinally extending bosses **76**, **78**, **80**, **82**, **84**, **86**, **88**, and **90**. At the outer ends of the slots they are provided with bolt head receiving openings such as are shown at **92** and **94**. Bolts are adapted to be received within the slots as indicated at **96** and **98** for the purpose of securing various wire twisting and wire holding units to the frames, such as the wire holding unit **100** and the wire twisting unit **102**. With the provision of the keyhole slots and bolts, the wire holding and twisting units may be slidably displaced along the frames to enable the units to engage the zigzag wire section at selected adjusted positions.

Mounted upon each frame between the webs **48** is a triangularly shaped bracket **104**, such as is shown in Figs. 1 and 2. While only one bracket is shown, it is believed that such is sufficient in view of the fact that both brackets are identical in construction. The brackets are mounted opposite one another on the outside of the frames. Each bracket includes a pair of upwardly outwardly extending web portions **105** connected at their upper edges by a horizontally extending table portion **107**. Extending between the web portions **105** at their vertical edges are the portions **109**. The brackets are secured to the frames by bolts **106** extending through the portions **109**.

As shown in Figs. 2 and 8, the table portion **107** of each bracket is provided with upwardly projecting lugs **108** and **110**. These lugs support a fluid pressure cylinder **112** having a piston rod **114**. A cross arm **116**, secured to the piston rod, as by the bolt **118**, projects laterally horizontally from the piston rod. Near the opposite side edges of the table are two pairs of upwardly extending aligned lugs **120** and **122**. Through each pair of lugs extends a connecting rod **124**. The connecting rods are shown in Figs. 2, 4, and 8. The connecting rods are supported for reciprocation in the lugs in suitable bearings. The connecting rods extend through the cross arm **116** near the ends thereof and are secured thereto as by the nuts **126**. The lug **108** may be formed of two parts that clamp the cylinder **112** therebetween as by means of the bolts **128**. Bolts **130**, extending through lug **110**, secure the connecting-rod-end of the cylinder to the table **107**. Upon reciprocation of the piston rod **114**, the connecting rods **124** will be reciprocated.

The frame members are cut away as at **132** to permit reciprocation of the connecting rods **124**. Secured to the inner ends of the connecting rods **124** are the wire guiding and aligning rails generally indicated at **136** and **138** and shown in Figs. 2 and 4. As more particularly described hereinafter, wire twisting and holding heads and wire strippers extend through apertures in the rails to engage, hold, twist and release a wire strip disposed between the rails. These rails include opposed supporting portions **140** and **142**, each of which is secured by means of bolts **144** to the inner ends of the connecting rods **124**. Removably secured to the opposed faces of supports **140** and **142** and comprising the guide rails are

the linearly extending wire guiding and aligning members 146, 148, 150, and 152. Such members are secured to the supporting portions by means of the bolts 154 and the keyway and slot configuration 156 of the rails and members 136 and 138.

The members 146, 148, 150, and 152 are shown in Fig. 4 as extending throughout substantially the length of a zigzag wire section disposed in the machine. The members, as above described, are supported intermediate their ends upon the supports 140 and 142. The pair of members 146 and 148 and the pair of members 150 and 152 are adapted for movement throughout their length toward and away from each other upon reciprocation of the connecting rods 124.

The wire guiding rails are provided, as shown in Fig. 2, with narrow wire supporting and guiding portions 158, 160, 162, and 164, which extend in vertical planes, with the portions 158 and 160 of the upper members 146 and 150 extending downwardly toward the upwardly extending portions 162 and 164 of the lower members 148 and 152. The opposed edges of the portions 158 and 162, and the opposed edges of the portions 160 and 164, form wire guiding and supporting surfaces between which a strip of zigzag wire is supported in the machine preparatory to being bent. These surfaces also cooperate to form a wire guideway within which the wire is guided as it is drawn into the machine by the depending conveyor finger 42. By virtue of the fact that the wire guiding rails are secured by means of bolts 154 to the members 140 and 142 only at a point intermediate the length of the rails, the rails may be readily removed from the machine and replaced with other rails to adapt the machine for handling different sized wire, or wire which is to be bent at different intervals along its length.

In Fig. 6 (Sheet 5), which figure is taken along the line 6—6 of Fig. 4, are shown two of the wire supporting members, viz: members 150 and 152. The other two members would be of similar construction, differing only as hereinafter mentioned. The opposed edges of the narrow wire guide portions 160 and 164, are indicated at 165 and 166. It will be noted that these edges 165 and 166 are cut away at intervals along the length of the rails to form openings 168 and 168^1 through the narrow wire guide portions 160 and 164. The cutouts 168 and 168^1 cooperate to form wire twisting head and wire holding head receiving apertures through the wire guiding and aligning rails. Wire twisting heads are indicated at 170 and 172 and wire holding heads or devices are indicated at 174 and 176. The opposed members 146 and 148 are also provided with cutouts through which project the wire twisting heads 178 and 180 and the wire holding devices 182 and 184. The cutouts in members 146 and 148 are distributed along the length of the rails to accommodate the twisters and holders disposed in the relationship shown in Fig. 4.

Upper members 146 and 150 are similarly cut away as at 186 in members 150 shown in Fig. 6, to permit retraction of the rails around the centrally disposed wire strippers and holders 188 and 190. Other wire strippers 192, 194, 196, 198, 200, 202, and 204, distributed along the length of the rails as shown in Figs. 4 and 6, are adapted to project between the opposed edges of the supporting members, as between edges 165 and 166 shown in Fig. 6, when the rails retract away from a wire strip.

The centrally disposed wire strippers and holders 188 and 190 are shaped as shown in Figs. 2 and 4 and are secured to the frames 44 and 46 by bolts 206. Each of these strippers and holders is generally U-shaped to permit reciprocation of the members 140 and 142. Each stripper 188 and 190 is cut away at its free edge as at 208, with the overhanging lip of the stripper adapted to overlie the upper surface of a zigzag wire strip lying between the wire guiding rails, and the shoulder adjacent the lip is adapted to abut the side edge of the strip. The overhanging lip 208 will prevent the wire strip from buckling upwardly at the center of the strip where there is the greatest distance between the twisting and holding heads. While there may be a tendency for the flat preformed zigzag wire strip to buckle upwardly at the center of the strip during the bending operations on the strip, there is a greater tendency for a pre-formed zigzag wire strip having a pre-set arcuate shape to buckle upwardly as at the center of the strip and adjacent the overhanging lip at 208.

Distributed along the length of the wire guiding rails at 146, 148, 150, and 152, and to each side of the central strippers 188 and 190, and disposed between the wire twisters and holders, are the other strippers 192, 194, 196, 198, 200, 202, and 204, each of which is secured to one of the frames 44 and 46 by a plate 210 and bolts 212. The plates are disposed against shoulders 214 within longitudinal slots 216 cut through the frames 44 and 46 (see Figs. 1 and 2). The strippers overlie the frames adjacent the slots, and the bolts 212 extend through the plates and into the strippers to lock the strippers in place. Upon loosening the bolts, the strippers may be shifted to adjusted determined positions longitudinally of the machine. It will be noted in Fig. 4 that the strippers are disposed between adjacent twisters and wire holders. The reason for this will be set forth hereafter.

The wire twisters or wire bending heads 170, 172, 178, and 180 are mounted for both rotatable and reciprocable movements. Their supporting and actuating mechanism comprise four twisting units, each of similar construction, with one unit, unit 102, being shown in Fig. 3. While the machine disclosed herein is provided with only four such units, it is to be understood that more or less than this number could be incorporated in the machine, to impart a greater or lesser number of bends to the wire. The twisting unit 102 includes a generally Z-shaped frame assembly 218, with the arms of the frame provided with centrally apertured flanges 220 and 222. A pair of fluid pressure actuated cylinder-piston combinations 224 and 226 are mounted on the flanges with the piston rods 228 and 230 projecting through the apertures in the flanges. Bolts 232 secure the cylinder-piston combinations to the flanges. To the lower end of piston rod 228 is secured a rack bar 234, the teeth of which mesh with the teeth of a pinion gear 236 mounted on twister shaft 238, and held thereon against rotation and axial shiftable movement by the pin 240. An adjustable rack bar stop includes a bar 241 secured by bolts to shoulders (not shown) formed on frame 218, with an adjustable stop pin 243 threaded through bar 241 with a lock nut 245 on the pin. By adjustment of pin 243, the travel and therefore the rotation of the twister head may be adjustably determined.

The twister shaft 238 is supported in the frame 218 and the main frame 44 by bearings 242 and 244. The inner end of the twister shaft is provided with the slotted twister head 180 and the outer end of the shaft is coupled with the cylinder-piston combination to be reciprocated thereby. A bell-crank arm 246 is pivoted as at 248 upon a projection 250 of frame 218, and is connected at one end, through member 252, to the piston rod 230, and is connected at the other end to the swivel member or link 254. The member 254 is hollow and is adapted to receive the connector 256 having a ball bearing 258 carried in the outer end, and which bearing bears against the inner end of the bore in the hollow member 254 forming a thrust bearing. The other end of the connector 256 is secured, by means of pin 260, to the outer end of twister shaft 238. A collar 262 is threadedly engaged with the hollow member as at 264 and is adapted to hold the connector within the hollow member. Upon reciprocation of the piston rod 230, the twister shaft is moved toward and away from the wire. Upon reciprocation of piston rod 228, the twisting shaft is rotated.

Disposed on the opposite side of the wire strip from each of the twisting heads, and adapted to engage the adjacent oppositely disposed loop of the wire from the loop engaged by the twisting heads is a wire holder or locater. There is one holder or locater for each twisting head, and, as above mentioned, the holders are indicated at 174, 176, 182, and 184. The holders and their actuating mechanism comprise four wire holding and locating units, one of which is shown in Figs. 1 and 3 at 100. As the four units are of similar construction, a description of the unit shown in Fig. 3 will suffice. Each wire holding and locating unit is provided with a frame 264, which is secured, as above described, to the frames 44 and 46 by the bolts 96, and is shiftable longitudinally of the frame to adjustable determined positions. Mounted on the frame 264 is a fluid pressure actuated piston-cylinder combination 266, which is secured to the frame as by bolts 268. A piston rod 270, projecting downwardly out from the cylinder and through frame 264, is connected at its lower end to one end of a bell-crank arm 272, which arm is pivoted as at 274 upon frame 264. The lower end of the bell-crank arm 272 is connected as at 276 to a link 278. The outer end of wire holding and locating shaft 280 is received as at 282 within a web portion 284 of the link, and a pin 286 locks the shaft and link together. Each of shafts 280 is provided with one of the wire holding and locating heads, with the shaft 280 of unit 100 being provided with head 174.

Each of these heads is slotted to receive a loop of a zigzag wire strip, as shown in Figs. 3 and 4. The slot opens toward the wire strip, and is semi-circular as shown in Fig. 4, to conform to the configuration of the loops of the zigzag wire strip. This semi-circular configuration of the slots serves to accurately position the strip in the machine preparatory to the bending thereof by the twisting heads.

From a consideration of Figs. 3 and 4, it will be noted that the axes of rotation of the twisting shafts 238 lie on the axes of the transverse loop connecting portions 288 of the wire strip when the same is positioned for bending in the machine. It will also be noted that the wire receiving slots 239 in the twisting heads are semi-circular as in the wire receiving slots in the holding and locating heads, and that the end of the slots in the twisting heads and the holding heads lies on the axes of the loop connecting transverse wire portions 288.

The conveyor finger 42, shown in Figs. 1, 2, and 4, forms the wire strip engaging part of a conveyor unit indicated generally at 290. The conveyor unit includes a fluid pressure actuated cylinder-piston combination 292, mounted by means of flanges 294 and bolts 295 upon a bridge 298, which bridge extends longitudinally of the machine along the top of the frames 44 and 46 and is secured thereto by bolts 300. The bridge is shaped throughout its length to provide a head portion 296, throughout the major portion of the length of which it exhibits a downwardly opening channel 302 as shown in Figs. 1, 2 and 5. This channel extends from the right hand end 304 of the bridge to the point 306. At 306 on toward the left end 308 of the bridge, the slot opens vertically through the top and bottom of the bridge as at 302^1, as shown in Figs. 1 and 3.

Opening through the opposed side walls of slots 302 and 302^1 are the complementary opposed channels 310 and 312, which are adapted to support for sliding movemetn in the bridge, the conveyor finger carrier 314. The carrier comprises, as shown in Figs. 2, 5, and 7, a vertically disposed plate 316, complementally longitudinally channeled on opposite sides to seat opposed supporting bars 318 and 320, which bars are secured to the plate by bolts 322, and are adapted to be slidably received within the opposed channels 310 and 312 of the bridge. The lower edge of plate 316 is cut away on opposite sides of the plate to receive the opposed parallel conveyor finger supporting brackets 324 and 326 which are secured to the plate 316 by the bolts or the like 328. The lower edges of the brackets 324 and 326 slope downwardly and terminate in the extensions 330 and 332 which pivotally support therebetween upon a pin 334 the L-shaped wire conveyor finger 42. A tie bar or the like 336 extends between the extensions 330 and 332 to space them rigidly apart in determined relationship. The conveyor finger 42 is provided with a part 338 adapted to underlie the tie bar 336 to prevent counterclockwise rotation of conveyor finger 42 beyond the point shown in Fig. 7. A light coil spring 340 is adapted to abut at its lower end the conveyor finger 42 and at its upper end the lower edge of plate 316. The spring tensions the conveyor finger yieldingly toward the position shown in Fig. 7. The lower end of conveyor finger 42 is shaped as shown in Fig. 7 to provide a narrow wire engaging portion 342, one edge of which curves upwardly and the other edge of which is a straight vertical edge. Upon movement of the conveyor finger to the left, as viewed in Fig. 7, the portion 342 will engage a transverse loop connecting portion 288 of the wire and urge the wire strip to the left. However, if the conveyor finger moves to the right, as viewed in Fig. 7, while the wire strip is held stationary, the curved edge of the wire will engage the transverse loop connecting portion 288 of the wire strip and the finger 42 will be cammed upwardly and in a clockwise direction, thereby permitting the finger to pass over the top of the wire strip in moving from left to right. There is, in other words, a type of ratchet connection between the conveyor finger 42 and the transverse loop connecting portions 288 of the wire, with such ratchet relationship being adapted to urge the wire strip to the left or into the machine where the conveyor finger moves to the left, while when the finger moves to the right, the finger will pivot clockwise and ride across the top of the strip and the strip will remain stationary. Of course, such clockwise movement of the finger is against the tension of spring 340, and consequently when the finger is brought to rest at the end of its movement toward the right hand end of the machine, the finger will snap back to a vertical position such as that shown in Fig. 7. When a wire strip is introduced into the machine, it is pushed beneath the conveyor finger which pivots upwardly to permit the wire to pass beneath it and when the wire has reached a determined position, the conveyor finger moves to the left carrying with it the wire strip. After the wire strip is positioned in the machine by the conveyor finger, the finger moves to the right end of the machine, as viewed in Fig. 1, preparatory to picking up another wire strip and drawing the wire strip into the machine.

In order to move the conveyor finger from right to left and back again, a rack bar 344 is secured to the outer end of the piston rod 294' of the cylinder-piston combination 292. The lower edge of the rack bar is suitably channeled to be received over the rollers 346, which are mounted on the side of the bridge head 296 as shown in Figs. 1, 3, and 5. The rollers are mounted on the bridge head by means of bolts or the like 348. The rollers support the rack bar for reciprocable movement in a horizontal plane along the bridge. The teeth on the upper surface of the rack bar 344 are adapted to engage the pinion gear 350 which is mounted upon suitable bearings 352 which encircle the shaft 354 extending transversely of the bridge. A set screw 356 is adapted to secure the shaft 354 in place. The shaft is supported by upstanding members 301 and 303 bolted to the bridge 398 as shown in Fig. 3.

Connected to the pinion gear 350 by means of bolts 358 is a sprocket gear 360. Entrained over the sprocket gear is a conveyor chain 362, which extends along its top span from the sprocket gear 360 to a second sprocket gear 364 mounted at the right end of the machine as viewed in Fig. 1. Along the lower span of conveyor chain 362, one end of the chain is attached to plate 316 by means of ear 366, and the other end of the chain is

attached to the plate by means of ear 368. The chain sprocket 364, or idler sprocket, is mounted upon a bracket 370 which is secured as by means of bolts 372 to the bridge. A chain tightening device 374, of conventional construction, is mounted upon the bridge head 296 to adjustably tension the conveyor chain 362. Upon movement of piston rod 294' out of cylinder-piston combination 292, the conveyor chain 362 is moved and actuates the conveyor finger to move the same from right to left as viewed in Fig. 1. Upon retraction of piston 294' into the cylinder-piston combination 292, the conveyor finger moves from left to right.

The limit of travel of the conveyor finger 42 from left to right as viewed in Fig. 1 is determined by the piston in cylinder-piston combination 292 bottoming in the cylinder. The limit of travel of the finger from right to left is determined by a rack bar stop 376 mounted upon an L-shaped bracket 380, which bracket is secured as by means of the bolts 382 to the bridge head 296. The stop 376 is adapted to abut the left end of the rack bar 344 and limit its travel toward the left. In this way the position of the conveyor finger 42, and particularly the vertical edge 43 of the conveyor finger, as shown in Fig. 7, may be accurately predetermined at opposite ends of its travel. It is necessary to accurately predetermine the position of the vertical edge 43 of the conveyor finger because such vertical edge must engage a pre-selected transverse loop connecting portion 288 of the wire strip to accurately position the strip in the machine for the subsequent bending operations on the strip. Selected loops of wire must be positioned in the correct twisting heads and selected transverse loop connecting portions of the wire must be positioned such that they lie on the axes of rotation of the twister heads if the wire is to be bent properly and at the correct points along its length.

Which of the transverse loop connecting portions of the wire are positioned on the axes of rotation of the twister heads is determined by which transverse loop connecting portion is engaged by the conveyor finger 42 in moving the strip into the machine and the distance that the finger moves into the machine. To accurately select the one particular transverse loop connecting portion of the wire which must be engaged by the finger 42 to position the correct loops in the twister heads with the transverse loop connecting portions of the wire lying on the axes of rotation of the heads, an electric switch is actuated by the shearing mechanism in the zigzag wire forming machine, which switch serves to initiate movement of the finger from right to left as viewed in Fig. 1. The shearing mechanism in the zigzag machine, as pointed out hereinabove, is actuated by a measuring device which may be adjusted to determine the length of zigzag sections that are fed from the zigzag machine. This shearing mechanism always cuts the wire at the same point and therefore is a reliable starting point for the subsequent timed operations of the bending machine. A determined number of transverse loop connecting portions of the zigzag wire will have passed beneath finger 42 when the shearing mechanism cuts the wire and consequently at the instant of cutting the finger is actuated to abut the last transverse wire portion passing thereunder to draw the wire into the bending machine.

Operation

In the following description of the operation of the machine, it is assumed that the wire guide rails 136 and 138 have been moved toward each other to their wire supporting and guiding position and that the conveyor finger 42 has previously moved from the position shown in Fig. 1 to its extreme right hand position ready to convey a wire section received from the zigzag machine into the bending machine to position such strip for the subsequent bending operations. As the pre-formed zigzag wire strip is fed from the zigzag machine it moves into the wire guide 34 and thence into the wire guide proper 40 and passes beneath the conveyor finger 42 pivoting the same upwardly in a clockwise direction as viewed in Fig. 1. After substantially one-half the length of the zigzag wire strip has been introduced into the bending machine and lies to the left hand side of conveyor finger 42, the wire shearing mechanism in the zigzag machine cuts the wire, and as hereinabove explained, the actuation of such shearing mechanism in cutting the wire completes an electric circuit, which, as hereinafter explained, serves to feed fluid pressure to the cylinder-piston combination 292 to move the conveyor finger from right to left carrying with it the zigzag wire strip. The travel of the conveyor finger into the machine is limited by the rack bar stop 376 and the wire is accurately positioned with predetermined loops thereof disposed where they will be engaged by the slots in the twisting heads and wire holding heads 170—184. As the wire is drawn into the bending machine by the conveyor finger, it slides over the shoulders 162 and 164 of the guide rails, and between such shoulders and the depending shoulders 158 and 160 of the guide rails. The opposite side edges of the loops forming the strip abut the wire stripping devices 188, 190, 192, 194, 196, 198, 200, 202, and 204, which position the strip laterally of the guide rails 136 and 138.

When the conveyor finger has reached its extreme inward or left hand position, as viewed in Fig. 1, the rack bar 344 engages the limit switch LS–2 which is shown in Fig. 1 as being mounted upon the stop 376, which upon being actuated by the abutment of the rack bar serves to complete an electric circuit, as hereinafter explained, which starts the timing cycle in the timing apparatus of the machine and also causes the wire twisting heads and wire holding heads to be extended to their wire engaging and holding positions with a loop of the wire received within the semi-circular slots in the heads. Thereafter the guide rails 136 and 138 are retracted away from the wire such that the wire is supported in the machine only by the wire twisting heads and wire holding heads. After the rails are retracted the wire twisting heads 170 and 180 at opposite ends of the wire strip are actuated to twist the wire about the axes of the transverse loop connecting portions of the wire lying on the axes of rotation of such heads. Upon completion of the bending of the wire at the outer ends by heads 170 and 180, the heads are retracted away from the wire. At the time that twisting heads 170 and 180 retract, the wire holding heads or chucks 174 and 184 also retract away from the wire, thereby leaving the wire unsupported outwardly of twisting heads and holding chucks 172 and 182 at one end of the wire and 176 and 178 at the other end of the wire.

After twisting heads and holding chucks 170, 174, 180, and 184 have retracted, the conveyor finger 42 is returned to its starting position at the extreme right hand end of the machine as viewed in Figure 1. The return of the conveyor finger to its starting position may occur immediately after it has positioned the wire in the machine for the bending operation, or it may return to its starting position at any other suitable time such as above described.

Wire twisting heads 172 and 178 are now rotated to bend the wire strip. The strip is bent by the heads twisting the wire along the axes of the transverse loop connecting portions of the strip. Such transverse loop connecting portions lie on the axes of rotation of the heads. After the strip has been bent by heads 172 and 178, such heads together with wire holding chucks 176 and 182 are retracted and the wire, being unsupported, falls downwardly out of the machine and onto a suitable conveyor, not shown, which carries the wire to a bundling station. At this point all of the wire holding chucks, wire twisting heads, and the guide rails, have been retracted away from a wire supporting position and the wire twisting heads have been rotated to positions of misalignment with the space between the wire guiding shoulders of the guide rails. The timing mechanism, herein-

after described, at this point actuates the twisters to rotate them to positions of alignment with the wire supporting shoulders of the guide rails, and actuates the guide rails to shift them laterally back to their closed or extended wire receiving and guiding positions. The bending machine is now ready to receive the next strip of zigzag wire and repeat the above described cycle.

It will be noted that the wire positioning and stripping members **188**, **190**, **192**, **194**, **196**, **198**, **200**, **202**, and **204** prevent the wire strip from sticking in the wire twisting heads or wire holding chucks as the latter are retracted away from the wire. The wire positioning and stripping members also serve to position the wire laterally of the guide rails as the wire is drawn into the machine by the conveyor finger.

Electrical control circuits

Figs. 11 and 12 schematically illustrate the electrical control circuits for the machine. It will be apparent to those skilled in the art, after the following description of Figs. 11 and 12, that certain changes may be made therein to cause the actuation of the various mechanisms of the machine in a different order from that set forth in the description, such as the retraction of the conveyor finger, hereinabove mentioned, to its starting position after the twisting heads at the outer ends of the wire have been retracted away from the wire.

A suitable source of electric current supplies electricity to lines L–1 and L–2 shown in Fig. 11. Disposed in these lines at F–1 and F–2 are suitable line fuses. Immediately below fuse F–1 is a test switch SW–9 which comprises two pairs of throws S–1, S–2, and S–3, S–4. The operation of the test switch will be described hereinafter. With the switch in the position shown in Fig. 11, current flows through L–1 to line **400** and from line **400** through emergency stop switch ESW to switch LS–1. Switch LS–1 is mounted in the zigzag machine and is coupled with the shear mechanism to be closed when the shear mechanism cuts a section of wire in the zigzag machine. Upon closure of LS–1 the current passes the normally closed switch 3CR–1 to the solenoid of relay 4CR and thence to line L–2.

On energization of solenoid 4CR, normally open relay switches 4CR–1 and 4CR–2 are closed. 4CR–2 serves to supply current to solenoid 4CR and bypass switch LS–1 which is only momentarily closed by the actuation of the shearing mechanism in the zigzag machine. Closure of 4CR–1 energizes the feed bar or conveyor solenoid **402**. On energization of solenoid **402** a suitable valve is opened in the fluid pressure line feeding the right hand end of cylinder-piston combination **290** whereby the conveyor finger **42**, is immediately urged to its extreme inward or left hand position as viewed in Fig. 1.

Rack bar **344** then closes switch LS–2 shown in Fig. 11, which serves to energize twister retract solenoids **410** and **414** which open suitable valves admitting fluid pressure to the top end of cylinders **226** and **266** to extend the wire twisting heads and wire holding heads to their wire engaging positions. The closure of LS–2 also energizes the guide rail retract timer TDA, and this starts the time cycle in such timer. There are a number of these timers in the control circuits. They are of conventional construction and therefore are shown schematically. Upon their energization a time interval begins to run and upon expiration of this time interval, suitable switches in the timer are closed whereby electric mechanism connected with the timer is energized thereby. When TDA is energized its time cycle commences and upon expiration of the time interval, normally open switch 3CRA is closed, which serves to energize relay solenoid 5CR, which in turn serves to close relay switch 5CR–1 and 5CR–2. Switch 5CR–2 serves to energize the guide rail retract solenoid **404**. When solenoid **404** is energized fluid pressure is fed to cylinders **112** to retract the guide rails away from the zigzag wire strip disposed in the machine. The closure of switch 5CR–1 serves to start the time delay period in the first twister delay timer TDE shown in Fig. 12. The closure of switch 5CR–1 also serves to bypass switch LS–2 which opens as hereinafter described, whereby electric voltage is maintained in line **406** all as shown in Fig. 11.

At the end of the time delay period of the first twister delay timer TDE, normally open switch 3CRB is closed, which serves to energize the first twister solenoid **408**. Upon energization of solenoid **408**, fluid pressure is fed to cylinder-piston combinations **224**, which actuate twister heads **170** and **180** to twist the wire at such heads. The closing of normally open switch 3CRB also starts the time delay period in the first twister chuck retract timer TRC shown in Fig. 12.

The first chuck retract timer controls the retraction of the wire twisters and wire holding chucks at the outer ends of the wire strip, viz: heads **170** and **180** and chucks **174** and **184**. After the time delay period of the first chuck retract timer TDC has expired, normally open switch 3CRC is closed and this starts the time delay period in the second twister delay timer TDD and opens normally closed switch 3CRC–1 shown in Fig. 11. The opening of switch 3CRC–1 serves to de-energize the first twister retract solenoid **410**. Upon de-energization of solenoid **410**, fluid pressure is admitted to cylinder-piston combinations **226** and **266** which control the reciprocatory movements of wire holding chucks **174** and **184** and wire twisting heads **170** and **180** to retract such chucks and heads away from the wire. After the time delay of the first chuck retract timer TDC has expired, it also serves to open normally closed switch 3CR–1 and this de-energizes relay solenoid 4CR and serves to open switches 4CR–1 and 4CR–2. Upon the opening of switch 4CR–1, a feed bar or conveyor solenoid **402** is de-energized. Upon de-energization of solenoid **402**, fluid pressure is admitted to the left hand end of cylinder **292** to return the conveyor finger to its extreme right end or starting position in the machine as viewed in Fig. 1, opening LS–2.

After the expiration of the time delay period of the second twister delay timer TDD, switch 3CRD, shown in Fig. 12, is closed, and this serves to energize the second twister solenoid **412** and cause fluid pressure to be delivered to cylinder-piston combinations **224** connected to twister heads **172** and **178** to cause rotation of such heads to twist the transverse loop connecting portions of the wire strip lying on the axes of rotation of such heads to bend the wire. Normally open switch 3CRD–1 is also closed upon the expiration of the time delay of the second twister delay timer TDD, and this serves to start the time delay cycle in the second chuck retract timer TDE.

At the expiration of the time delay period of the second chuck retract timer TDE, normally open switch 3CRE–1 is closed, which serves to start the time delay period in the guide rail return timer TDH, and normally closed switches 3CRE–1 and 3CRE–2 are opened, which serves to de-energize the second twister retract solenoid **414**. Upon de-energization of solenoid **414**, fluid pressure is admitted to cylinder-piston combinations **226** and **266** coupled with twister heads **172** and **178**, and wire holding chucks **176** and **182**, to retract the same away from the wire. Upon retraction of these twister heads and holding chucks, the wire falls downwardly out of the machine. The closing of switch 3CRE–1 also energizes solenoid relay switch 8CR, which opens normally closed switch 8CR–1, which de-energizes the first twister solenoid **408**. Upon de-energization of solenoid **408**, fluid pressure is admitted to cylinder-piston combinations **224** coupled with twister heads **170** and **180** to rotate them back to their wire receiving positions in which the slots in the heads are aligned with the spaced apart wire guiding shoulders of the guide rails. The energization of relay solenoid 8CR also serves to open switch 8CR–2, which in turn de-energizes the second twister solenoid **412**. On de-energization of solenoid **412**, fluid pressure

is admitted to cylinder-piston combinations 224 connected to wire twister heads 172 and 178 to rotate them back to their wire receiving positions in which the slots in the heads are aligned with the spaced apart wire receiving shoulders of the guide rails.

At the end of the time delay period of the guide rail return timer TDH, normally open switch 3CRH is closed, energizing relay solenoid 6CR. With the energization of solenoid 6CR, normally closed switch 6CR–1 is opened, and this in turn de-energizes relay solenoid 5CR and opens switches 5CR–1 and 5CR–2. Upon opening of 5CR–2, the guide rail retract solenoid 404 is de-energized which thereby serves to open a valve admitting fluid pressure to the outer end of cylinders 112 causing the guide rails to be extended to their closed or wire receiving position. Switch LS–2 has been opened when the conveyor finger has been moved back to its starting position. The result of the opening of switch 5CR–1 is that the guide rail retract timer TDA is set back to zero time or, in other words, is ready to be re-energized to start a new time cycle. Upon the de-energization of the guide rail retract timer TDA and its return to zero time, switch 3CRA is opened. With 3CRA open and 5CR–1 open and 6CR–1 open, all of the timers, other than the guide rail retract timer TDA, which has already returned to zero time, are returned to zero time, and this is so because no current is permitted to flow to line 406.

If a wire section when fed into the machine jams either in the guide rails or in the twister heads or holding chucks, provision is made for clearing the wire out of the machine. An emergency stop switch ESW, shown in Fig. 11, may be manually depressed by a workman and this will break the circuit to relay solenoid 4CR as well as any current which may be flowing through relay solenoid 5CR. With relay solenoid 4CR de-energized, switch 4CR–2 is opened and switch 4CR–1 is opened, and upon the opening of these switches the conveyor finger, if it is feeding from right to left, is returned to its starting position. In addition, the opening of these switches interrupts the flow of the current to line 406 and all of the timers are returned to zero time.

When switch ESW is depressed, it completes the circuit through relay solenoid 7CR, energizing the solenoid which, in turn, closes normally open switches 7CR–2 and 7CR–3 and opens normally closed switch 7CR–1. Switch 7CR–1 is connected in the power circuit to the zigzag machine, and upon being opened, stops the zigzag machine. Upon closing of switch 7CR–3, the guide rail retract solenoid is energized to retract the guide rails. The wire is now free to fall away from the machine. To re-start the operation of the machine, the operator opens the reset switch, shown in Fig. 11, and this breaks the circuit to relay solenoid 7CR, permitting switch 7CR–1 to close, thereby starting the zigzag machine, opening switch 7CR–2 and switch 7CR–3. Upon opening of switch 7CR–3 the guide rail retract solenoid 404 is de-energized, and this causes the guide rails to return to their wire supporting position.

To test the operation of the machine preparatory to placing it under automatic operation, the operator manually closes test switch SW–9 which permits current to flow through lines 416 and 418. This energizes relay solenoid 9CR, which in turn opens normally closed switches 9CR–1 and 9CR–2 and prevents the timers from starting their time delay cycles. The operator then manually closes switch SW–8 to energize the feed bar or conveyor solenoid 402 to cause the conveyor finger to be drawn from right to left. Switches SW–7 and SW–1 may be manually closed and these will extend the twister heads and holding chucks toward a wire supporting position. Switches SW–5 and SW–4 may then be closed and these will serve to rotate the twister heads. Upon closure of switch SW–3 guide rail retract solenoid 404 is energized to cause the guide rails to retract away from a wire supporting position. Thereafter the operator may open all of the aforesaid switches and all of the mechanism of the machine will be returned to the starting or wire receiving position.

It is now apparent that each successive operation of the machine, once the conveyor has drawn the wire into the machine, is dependent upon the expiration of a time interval which begins to run at the instant the immediately preceding operation commences. For example, at the instant that the guide rail solenoid 404 is energized to retract the guide rails, the time interval for the first twisters begins to run because of the energization of the first twister delay timer TDB, and it is upon the expiration of the time interval of TDB that the first twister heads 170 and 180 are actuated to bend the wire. Therefore, the time interval running, which upon expiration starts the next operation, occurs during an operation. While the guide rails are being retracted, in the above example, the time period for the first twisters is running, and upon its expiration the twisters are rotated to bend the wire. The time interval may be adjusted to be made so that it lasts for only that length of time necessary to retract the rails before the twisters are rotated.

If different degrees of bends are desired to be imparted to the wire, adjustment of the amount of rotation of the heads is accomplished by the rack bar stop pin 243, shown in Fig. 3. If only a small degree of rotation of the twisting heads is to be made, it will require less time to rotate the heads through this small degree of rotation than if the wire is to be bent more acutely. Consequently, the time interval during which the twister is rotating may be made shorter than when the twister is rotating through a greater arc. Adjusting the time interval for different degrees of rotation of the twisters may be accomplished readily with the above described timing circuit by merely adjusting the timer involved. Heretofore when a mechanical timer was employed as in our co-pending application, Serial No. 313,892, this adjustment was very difficult.

Also, where the twisting units are shifted along the frame to new positions such that the bends are imparted to the wire strip at newly selected intervals, an adjustment in the time intervals between successive operations may be desirable. Different wire characteristics such as flexibility, strength, etc., zigzag shape and wire size, all contribute to the desirability and necessity of adjusting the time intervals between successive operations. Further, with readily adjustable time intervals between successive operations, a very accurate or vernier adjustment in the time intervals may be obtained whereby zigzag wire strips of any given character may be bent and released from the machine in the shortest possible time thereby increasing the output of the bending machine.

What we claim is:

1. In a machine for bending pre-formed sinuous wire strips, a frame, a pair of opposed spaced apart linearly extending wire guiding and supporting rails mounted upon the frame for shiftable movement toward and away from each other to support or release a wire strip disposed therebetween, each rail including a pair of vertically spaced apart linearly extending wire strip supporting and guiding members with the space between the members sufficient to receive a marginal linear edge of a wire strip, means mounted on the frame and coupled to each rail intermediate its opposite ends and spacing apart the wire guiding and supporting members and adapted to shift the rails toward and away from each other, a plurality of wire twisting heads mounted on the frame and extending through the space between the wire strip guiding and supporting members of the rails and rotatable and reciprocable relative to the rails to hold and bend and release a wire strip dsiposed between the rails after the rails have been retracted away from a wire supporting position, means mounted on the frame and coupled with the heads for rotating and reciprocat-

ing the same, and timing mechanism coupled with the means for shifting the rails and coupled with the means for rotating and reciprocating the twisting heads to time the movements of the rails and the heads.

2. In a machine for bending pre-formed sinuous wire strips, a frame, a pair of opposed spaced apart linearly extending wire strip guiding and supporting rails mounted upon the frame for shiftable movement toward and away from each other to support or release a wire strip disposed therebetween, each rail including a pair of vertically spaced apart linearly extending wire strip supporting and guiding members with the space between the members sufficient to receive a marginal linear edge of a wire strip, means mounted on the frame and coupled to each rail intermediate its opposite ends and spacing apart the wire guiding and supporting members and adapted to shift the rails toward and away from each other, a plurality of wire twisting heads mounted on the frame and extending through the space between the wire guiding and supporting members of the rails and rotatable and reciprocable relative to the rails to hold and bend and release a wire strip disposed between the rails after the rails have been retracted away from a wire supporting position, means mounted on the frame and coupled with the heads for rotating and reciprocating the same, a plurality of wire stripping devices mounted on the frame and extending through each rail between the vertically spaced wire guiding members thereof and adapted to abut the linear marginal edge of a wire strip disposed between such members, and timing mechanism coupled with the means for shifting the rails and coupled with the means for rotating and reciprocating the heads to time the movements of the rails and the heads.

3. In a machine for bending pre-formed sinuous wire strip, a frame, a pair of opposed wire strip guiding and supporting members mounted on the frame and each movable toward and away from the other and each shaped to define linearly extending wire strip guiding and supporting surfaces with the surfaces of the opposed members cooperable to support a wire strip between and extending lengthwise of the members, means mounted on the frame and coupled with said members for reciprocating the same, each of said members provided with a cut out, a pair of wire strip twisting heads each extendable through one of said cut outs and mounted on the frame for rotation and reciprocation through and relative to each one of said members with each head provided with a wire strip receiving slot alignable with the wire strip guiding and supporting surfaces of the members upon determined rotation of the head, means mounted on the frame and coupled with the heads to rotate and reciprocate the same, and timing mechanism coupled with the means for reciprocating the members and coupled with the means for rotating and reciprocating the heads to time their respective movements.

References Cited in the file of this patent

UNITED STATES PATENTS

1,206,240	Norton	Nov. 28, 1916
2,331,294	Bank et al.	Oct. 12, 1943
2,450,876	Blumensaadt	Oct. 12, 1948
2,632,482	Lincoln	Mar. 24, 1953
2,675,848	Greenshields	Apr. 20, 1954
2,681,085	Levine	June 15, 1954
2,743,933	Baines	May 1, 1956
2,744,546	Williams	May 8, 1956
2,777,476	Fante	Jan. 15, 1957
2,800,928	Norman	July 30, 1957

FOREIGN PATENTS

475,733	Canada	July 31, 1951