

[54] **AUTOMATIC STAPLING SYSTEM**

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[51] Int. Cl. **B21f 15/06**, B25b 25/00

[58] Field of Search 29/203 D, 208 D, 211 D, 29/211 M, 212 D, 243.56, 243.57; 53/138 R, 138 A, 424; 72/403, 407; 140/11, 93 A, 93 D, 113

[56]

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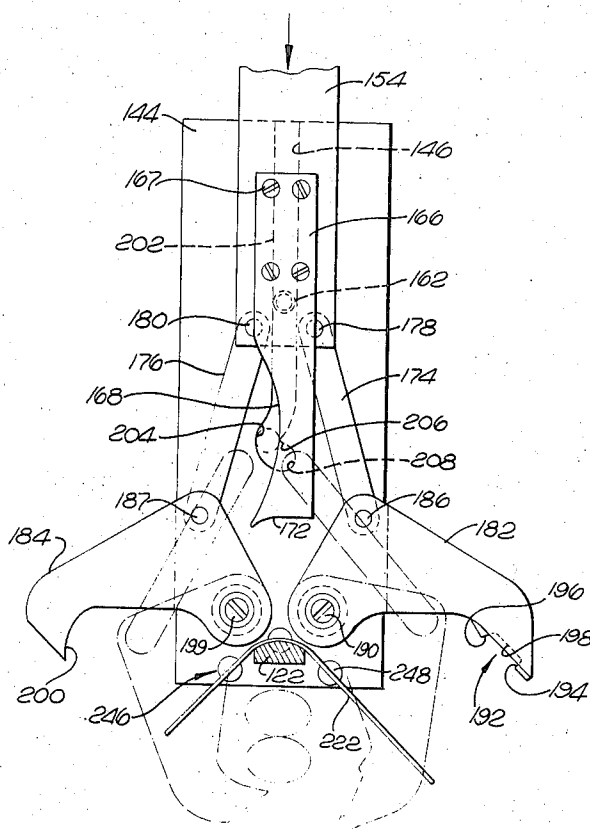
Attorney, Agent, or Firm—Nilsson, Robbins & Berliner

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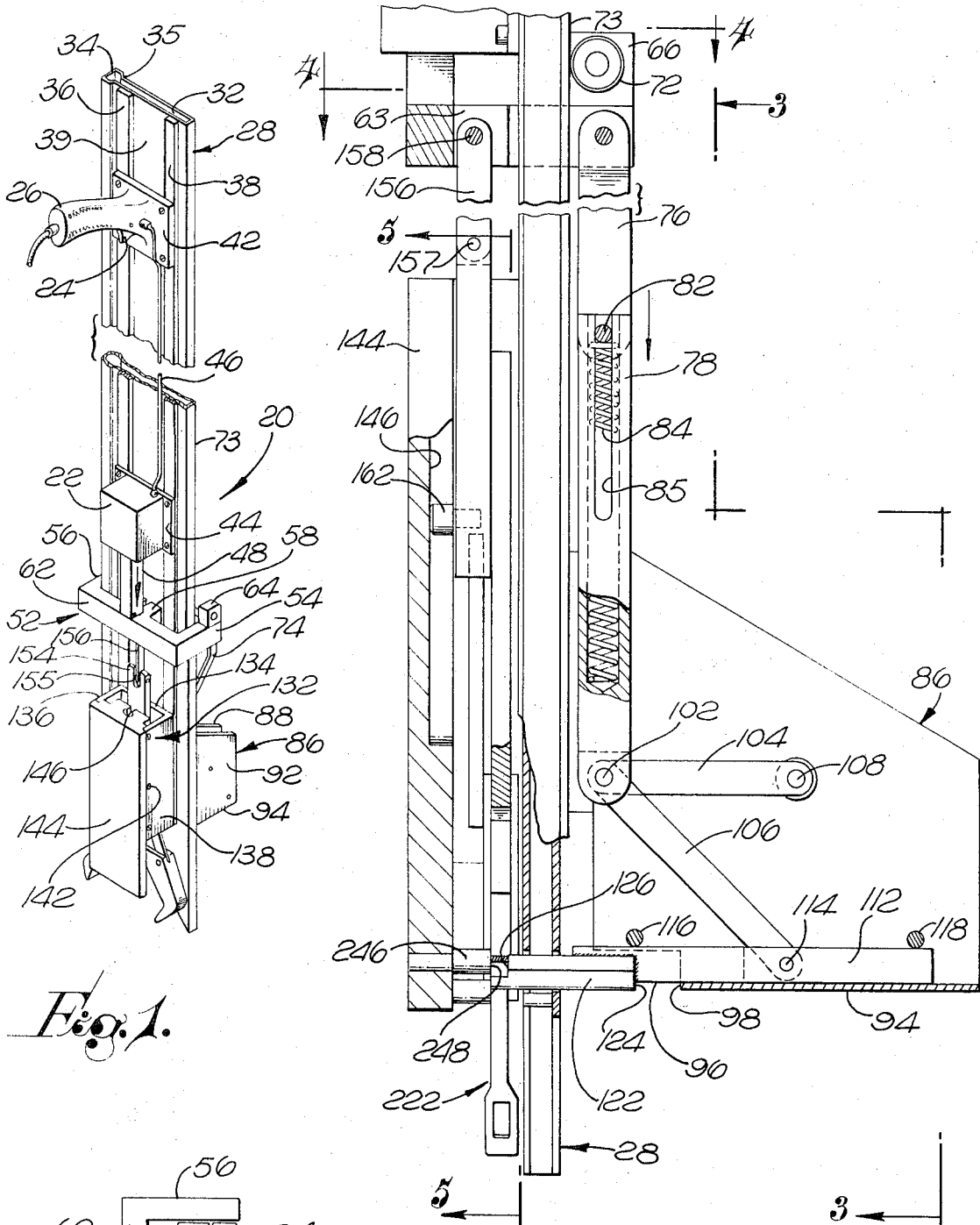
ABSTRACT

A stapling machine for automatically clamping a locking staple around a pair of rods. A pair of gripping jaws each have a first point pivotally fixed to the machine. A driver arm operates to close the jaws at different rates of speed, securing the staple around the rods. A finger is connected to the driver arm for positioning the staple adjacent the rods upon closure of the jaws. A solenoid which actuates the driver arm also spring loads a mechanism. The spring loaded mechanism opens the jaws after the staple has been secured around the rods. A staple housing holds a plurality of staples therein. Each time the jaws are opened, the spring loading mechanism positions the front staple in the staple housing for the next operation. The staple includes an elongated member having a curved portion interconnecting a first end and a head end. The head end has an eyelet area into which the first end is inserted and crimped when the staple is positioned around the rods.

7 Claims, 17 Drawing Figures



SHEET 1 OF 4



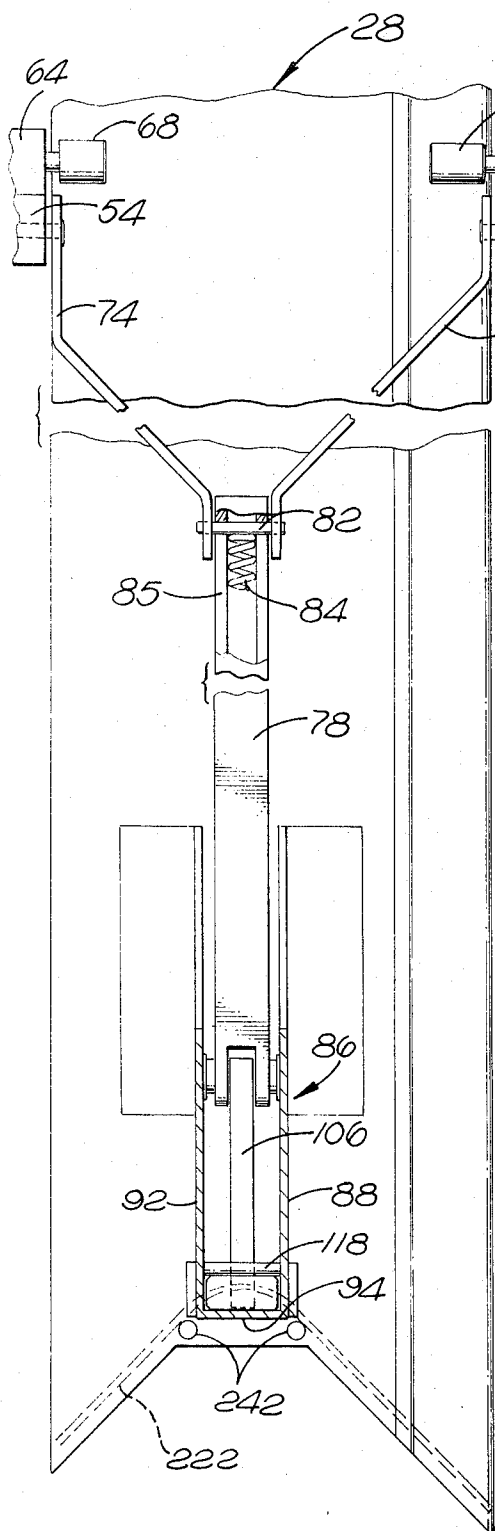


Fig. 3.

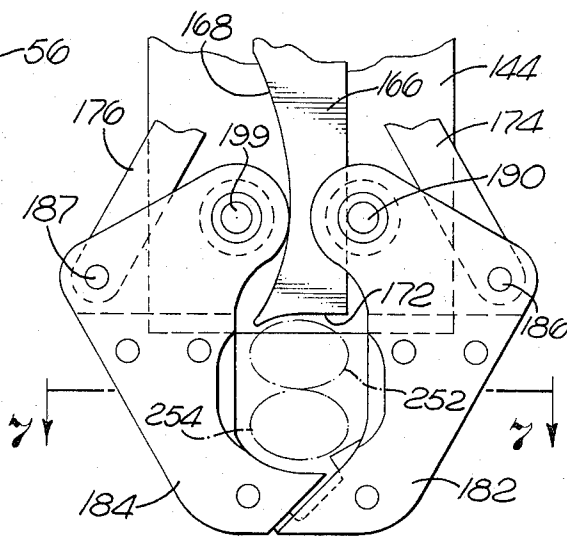


Fig. 6.

Fig. 5.

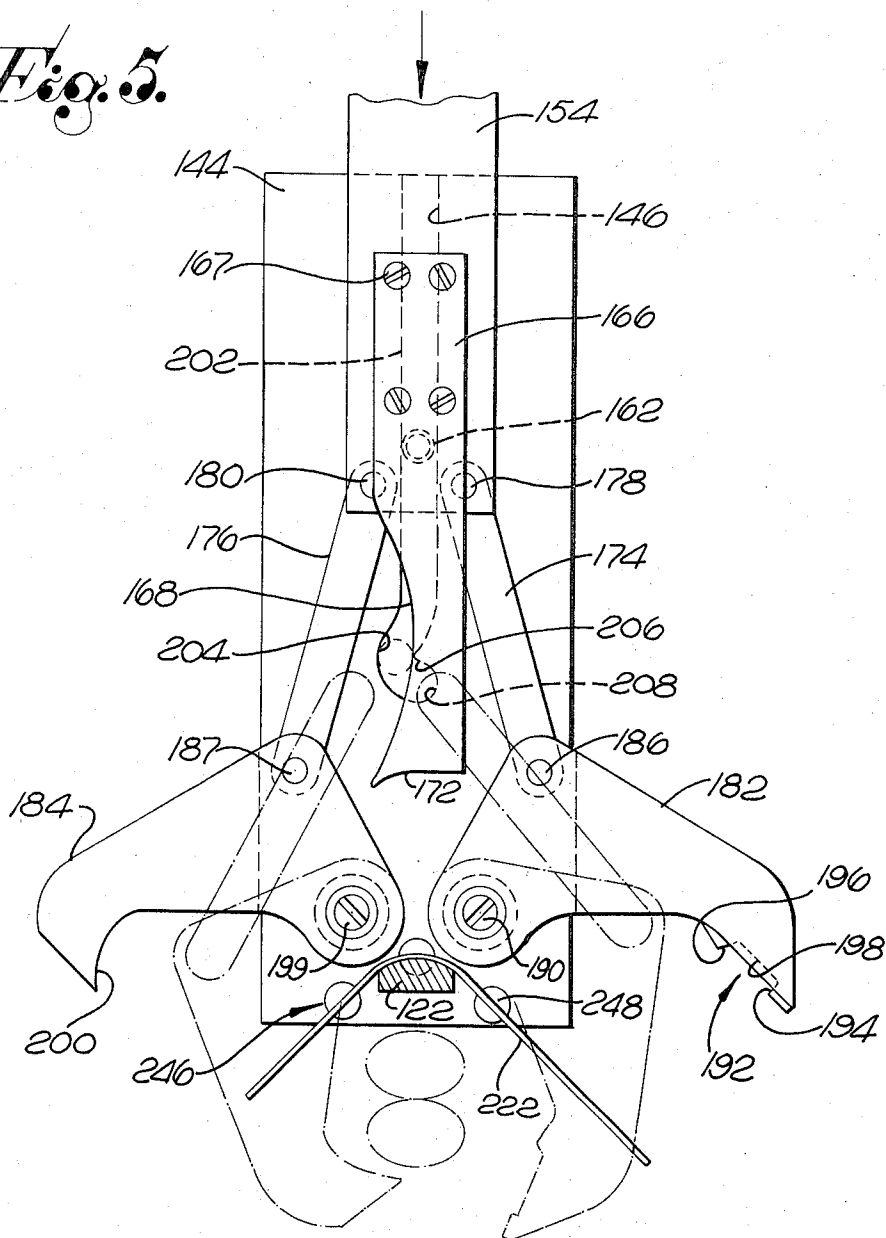


Fig. 7.

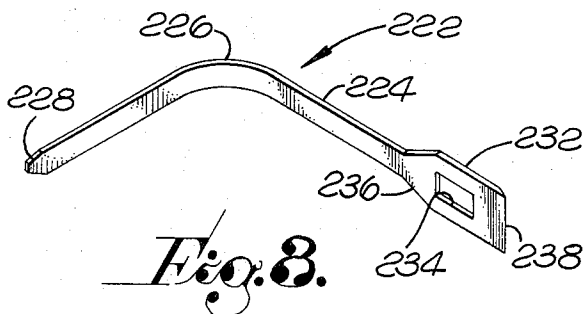
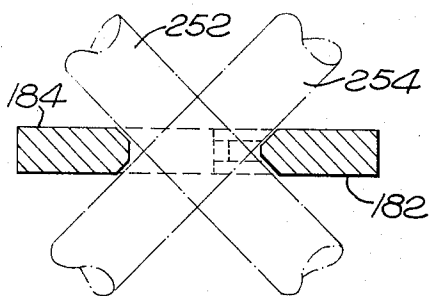
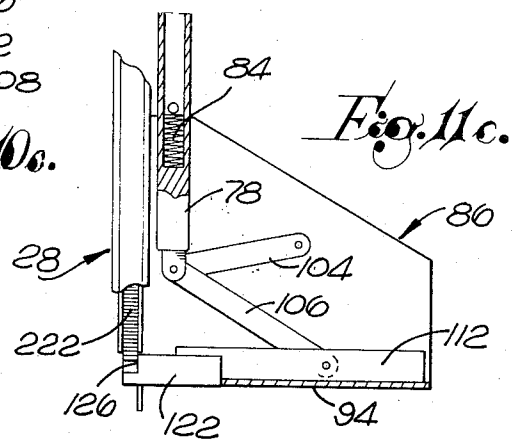
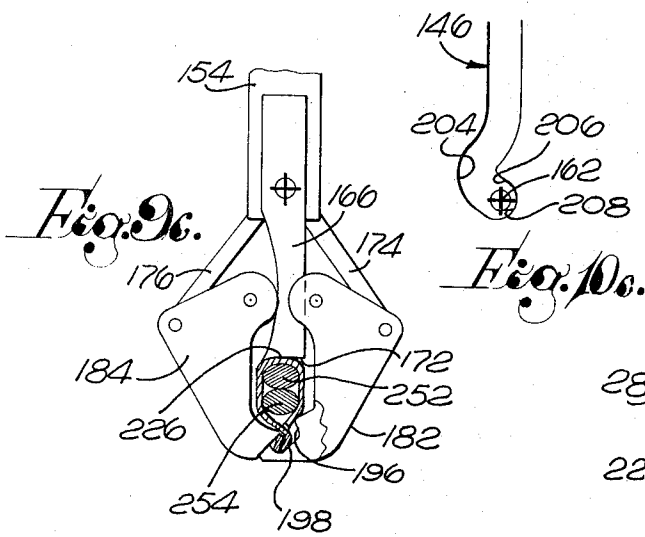
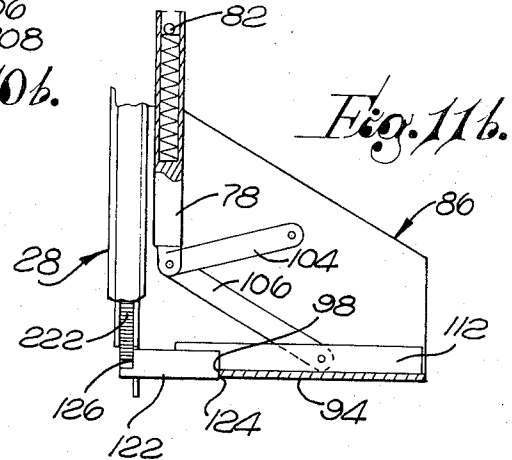
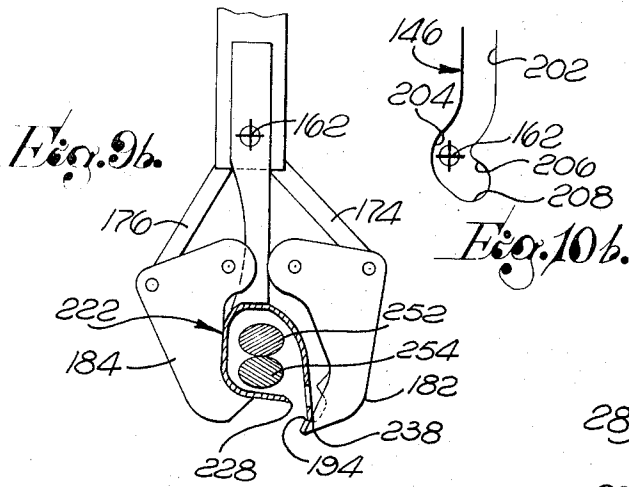
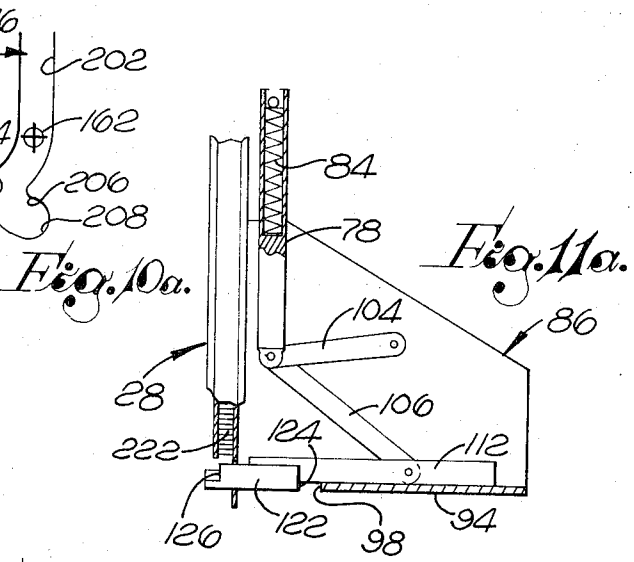
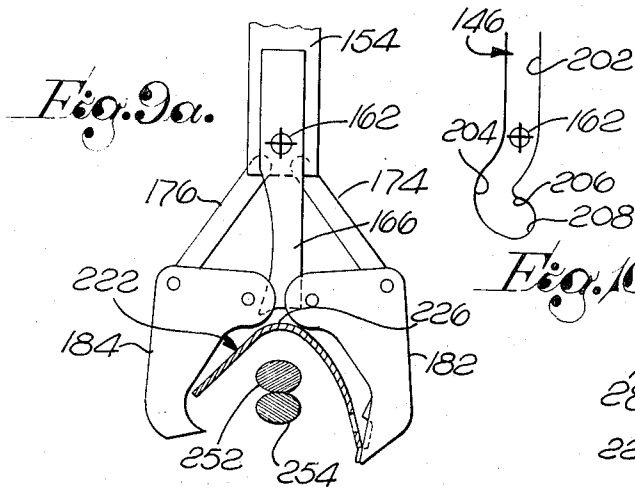


Fig. 8.



AUTOMATIC STAPLING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The field of art to which the invention pertains includes the field of automatic stapling systems, particularly with respect to a power operated apparatus for automatically securing a pair of rods together by means of a locking staple.

2. Description of the Prior Art

The best known prior art is found in U.S. Pat. Nos. 2,012,027; 2,455,557; 2,470,727; 2,722,001; 2,740,514; 2,816,288; 2,847,674; 2,987,725; 2,989,948; 3,023,417; 3,102,627; 3,267,640; 3,282,490; 3,291,358.

Concrete structures utilize steel-reinforcing rods for added strength in such structures as floors, walls, pilings, and similar forms. Prior to pouring the concrete, it is necessary to tie the steel reinforcing rods together at the cross-points and the overlaps. The tying holds the steel in the desired position during the time the concrete is poured, placed, vibrated, and positioned prior to its hardening. The most successful technique utilized at the present time for securing cross-points or overlaps of reinforcing rods, is to manually wrap wire at the rod junction. Typically, the workman will carry a roll of wire on his belt. The wire is wrapped, twisted, and any excess clipped off at the junction. Such a technique has required that the workman devote relatively long periods of time to serving each junction, thus raising construction costs. In addition, numerous puncture wounds have occurred when the loose edges of the wire have been left exposed. Automated clamping tools for securing a presized tie to the intersection points on the reinforcing rods have been relatively unsuccessful. Typically, the fastener or staple used is of relatively complex shape as well as being bulky. Thus, it is relatively difficult for the workman to carry a sufficient supply of staples. In addition, the tool must be hand operated, and has been found to be more expensive than the conventional method of merely using a roll of wire which is hand wrapped at the junction points. Thus, automated power control stapling or tying machines, which can save labor as well as expense, are not presently available.

SUMMARY OF THE INVENTION

Apparatus for automatically clamping a staple around a pair of rods includes a pair of gripping jaws, each having a first point pivotally fixed to the apparatus. A driver arm closes the jaws at different rates of speed securing the staple around the bar members. A pair of linkages are pivotally connected at one end to the driver arm, and at the opposite end thereof, are pivotally fixed to a second point on one of the gripping jaws, respectively. The staple for securing the rods together includes an elongated member having a curved portion which interconnects a first end and a head end. The head end has an eyelet therein for insertion of the first end upon positioning of the staple around the rods.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a stapling machine made in accordance with the invention;

FIG. 2 is a fragmentary side view, partly in section, of the stapling machine of FIG. 1;

FIG. 3 is a fragmentary top view, partly in section, of the machine taken along the line 3—3 of FIG. 2;

FIG. 4 is a cross-sectional view of the machine taken along the line 4—4 of FIG. 2;

FIG. 5 is a fragmentary view, partly in section, illustrating the movements of the machine taken along the line 5—5 of FIG. 2;

FIG. 6 is a fragmentary view, similar to FIG. 5, illustrating an alternative operational position of the machine;

FIG. 7 is a cross-sectional view of the machine taken along the lines 7—7 of FIG. 6;

FIG. 8 is a perspective view of a staple used in the stapling machine of FIG. 1; and

FIG. 9(a-c), 10(a-c) and 11(a-c) are schematic illustrations showing the simultaneous positions of various portions of the machine during the operation thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, there is shown a stapling machine 20 which is made in accordance with the present invention. The stapling machine 20 is actuated by means of a solenoid 22 which is energized by depressing a trigger 24 on a handgrip 26. While the stapling machine 20 is illustrated as being actuated by means of a solenoid 22, it should be understood, of course, that other power systems such as a pneumatically operated drive, operated by means of compressed air or a simple hand operated mechanical arrangement could be also used to operate the machine.

The stapling machine 20 includes a generally elongated staple housing member 28. The housing member 28 contains a reduced height bore portion 32 and an enlarged height bore portion 34 adjacent thereto. The bore portions 32 and 34, which extend along the longitudinal axis of the staple machine, are interconnected by tapered side walls 35. A pair of rails 36 and 38 are positioned on the bottom surface 39 of the staple housing member 28 and extend along the longitudinal axis of the stapling machine. The hand-grip 26 is integrally formed with a mounting plate 42 which is secured to the rails 36 and 38. The solenoid 22 is mounted on a base plate member 44 which is also secured to the rails 36 and 38. Electrical conductors 46 interconnect the hand-grip 26 and the solenoid 22 so that when the trigger 24 is depressed, the solenoid 22 is energized.

Actuation of the solenoid causes a solenoid armature 48 to move in the direction shown by the arrow. Secured to the front end of the armature 48 is an E-shaped section 52 formed in a plan perpendicular to the longitudinal axis of the stapling machine. The E-shaped section 52 comprises a first side arm 54, a second side arm 56 and a central arm 58, with all the arms being joined together by means of an end arm 62.

Referring now to FIG. 2, 3 and 4, the interconnections to the E-shaped section 52 are shown in greater detail. The inner surfaces of the first side arm 54 and the second side arm 56 are adjacent the end walls of the staple housing member 28. The central arm 58 contains a slot 63, which is positioned adjacent the bottom surface 39 of the housing member and between the rails 36 and 38. A first roller support member 64 and a second roller support member 66 are secured to the ends of the first side arm 54 and the second side arm 56, respectively. Secured to the first roller support member

64 and second roller support member 66 are a first roller 68 and a second roller 72, respectively. The rollers 68 and 72 are freely rotatable and abut the top surface 73 of the staple housing member 28. When the armature 48 moves the E-shaped section 52, the rollers 68 and 72 facilitate such movement, while simultaneously positioning the E-shaped section with respect to the staple housing member 28.

A first bracket 74 and a second bracket 76 are secured to the inner end surface of the first side arm 54 and second side arm 56, respectively. The brackets extend from the ends of the first side arm 54 and the second side arm 56 towards each other and terminate at opposite sides of one end of a spring housing member 78. The ends of the brackets adjacent the spring housing member are joined together by means of a transversely extending pin 82. The spring housing member contains a longitudinally extending spring member 84. The side walls of the housing member 78 contains a longitudinal slot 85 enabling the pin 82 to move along the longitudinal axis of the housing. Thus, the spring 84 is compressed when the pin 82 is moved with respect to the housing 78.

The spring housing 78 normally extends forward in a plane parallel to the longitudinal axis of the machine 20 and towards a generally trough shaped member 86, having a pair of side walls 88 and 92 and an end wall 94. The end wall 94 interconnects the side walls 88 and 92. Adjacent the staple housing 28, the end wall 94 is removed to define an opening 96. The end wall 94 terminates at the opening 96 in a downwardly facing shoulder 98. The side walls 88 and 92 are secured at one end to the top surface 73 of the staple housing member 28.

A pin 102 is positioned at the front end of the spring housing member 78. The pin 102 is used to fasten one end of a first linkage 104 and one end of a second linkage 106 to the front end of the housing member 78. The other end of the first linkage 104 is secured between the side walls 88 and 92 of the trough 86 by means of a pin 108.

When the solenoid 22 is deenergized and no movement of the E-shaped section 52 and its associated driving mechanisms have occurred, the linkage 104 is in a plane perpendicular to the spring housing 78 as shown in FIG. 2. The other end of the linkage 106 is secured to a rod 112 by means of a pin 114. The linkage 106 normally extends at approximately a 45° angle from the front end of the spring housing 78 with respect to the first linkage 104 as shown in FIG. 2.

One side of the rod 112 is positioned adjacent the end wall 94 of the trough 86. The other side of the rod is positioned adjacent a pair of pins 116 and 118 secured between the side walls 88 and 92. The distance between the pins 116 and 118 and the end wall 94 is equal to the thickness of the rod 112. Forward motion of the spring housing member 78 in the direction of the arrow shown in FIG. 2 causes the rod 112 to move in a plane perpendicular to the stapling machine longitudinal axis. Thus, the rod 112 is retained between the pins 116 and 118 and the end wall 94. In addition, a plunger member 122 is secured to the front end of the rod 112, adjacent the staple housing member 28. The plunger member has a top shoulder 124 which is adjacent the opening 96 and upon movement of the rod 112 in the direction of the arrow abuts the downwardly facing shoulder 98 of the end wall 94, preventing further

motion of the rod 112. In addition, the other end of the plunger 122 is indented to form a downwardly facing shoulder 126.

Referring again to FIG. 1, a U-shaped member 132 is positioned adjacent the bottom of the staple housing member 28 near the front end thereof. The U-shaped member 132 is defined by a central wall 134 secured to the rails 36 and 38 and a pair of side walls 136 and 138 extending from the central wall. A guide member 144 is secured in the U-shaped body by means of screws 142. The guide member 144 contains a slot 146 formed in the surface adjacent the central portion of the U-shaped body 132. The slot extends along the length of the guide member 144.

One end of a driver arm 154 has a tapered opening 155 into which one end of a rod 156 is secured by means of a pin 157. The other end of the rod 156 is secured in the central arm slot 63 by means of a pin 158. Movement of the E-shaped section causes the rod 156 and driver arm 154 to move in the same direction as the armature 48. The driver arm 154 has a follower head 162 secured to its bottom surface which is positioned in the slot 146 of the guide member 144.

Referring now to FIG. 5, the drive arm 154 initially moves in the direction of the arrow as the follower head 162 travels in the path of the slot 146. A finger 166 is secured to the top surface of the driver arm 154 by means of screws 167. The finger 166 is of generally rectangular configuration, but has a somewhat curved side surface 168 near its front end, as well as an acutely shaped front end surface 172.

A first driver linkage member 174 and a second driver linkage member 176 are pivotally secured by means of pins 178 and a pin 180, respectively, to the front end of the driver arm 154. As viewed in FIG. 5, the first drive linkage member 174 is secured to the right side of the drive arm and the second drive linkage member 176 is secured to the left side of the drive arm. The other end of the first drive linkage member 174 and the second drive linkage member 176 are each secured to a first corner of a first gripping jaw 182 and a second gripping jaw 184 by means of a pin 186 and a pin 187, respectively. The first gripping jaw 182 has a second corner thereof secured to the guide member 144 by means of a fastener 190, thus forming a fixed pivot point for the jaw 182. In addition, the third corner of the jaw 182 contains an interior surface slotted indentation 192 having an inwardly facing shoulder 194 and an outwardly facing shoulder 196 with a generally smooth surface 198 interconnecting the two shoulders 194 and 196. The second gripping jaw 184 is also secured to the guide member at a second corner by means of a fastener 199 to form a fixed pivot point. The third corner of the jaw 184 is formed of a hook 200 which is tapered inwardly toward the first jaw 182.

The slot 146, whose shape controls the movement of driver arm 154, the linkages 174 and 176 and, thus the closure rate of the jaws 182 and 184, contains a generally longitudinally extending near portion 202. The slot then transitions to a first curved portion 204 which extends away from the first gripping jaw 182. The gripping jaw 184 closes faster than the gripping jaw 182, as shown in dotted line in FIG. 5, when the follower head 162 travels along the curved portion 204. A reverse curved portion 206 forms a continuation of portion 204 then causes the first gripping jaw 182 to increase in closure speed upon further travel of the follower head. Fi-

nally, a shoulder 208 defines the front end of the slot 146 and prevents further movement of the head in the slot 146. When the follower head reaches the shoulder 208, the linkages 174 and 178 have moved a sufficient distance to enable the jaws to close as shown in FIGS. 6 and 7.

Referring now to FIG. 8, the locking staple used in the staple machine of FIG. 1 is shown in greater detail. The staple is normally made of steel so as to readily secure reinforcing bars together, although other material could be used as well. The staple 222 consists of a generally rectangular portion 224 which is curved at its center 226 and extends from a pointed end 228 to an enlarged head portion 232. The staple is curved to facilitate its closure around the rod members as well as for correct positioning in the staple housing 28. The enlarged head portion 232 which fits into the enlarged bore portion 34 of the housing member 28, has an eyelet 234 formed therein. The pointed end 228 can be bent so that it extends through the eyelet 234. In addition, the end of the enlarged head portion 232 contains a tapered section 236 for forming a convenient transition to the portion 224. The other end of the enlarged portion 232 is tapered to a thin edge 238. The staple housing member bore portion 32 and enlarged bore portion 34 are designed so that the curved staples can be positioned therein with the center 226 inserted last. In addition, a spring loading mechanism (not shown) may be used to force the staples, inserted from the rear end of the housing 28, toward the front end as is conventional.

When the solenoid 22 is not energized, the position of the staple and the jaws 182 and 184 are shown in solid lines in FIG. 5. In addition, at this time, the spring 84 is in an unloaded position as shown in FIG. 2. The staples 222 are positioned with the first staple in the front end of the housing 28 abutting a pair of pins 242, as shown in FIG. 3. Three cylindrical magnetic members 246 have one end positioned on the guide member 144 adjacent the opening in the front end of the staple housing member. When the plunger member 122 moves in the direction opposite to the direction of the arrow shown on the rod 112, the downwardly facing shoulder 126 will grasp the first staple adjacent the pins 242 and position it adjacent the end 248 of three cylindrical magnetic members.

Referring now to FIGS. 9(a-c), 10(a-c) and 11(a-c), the various positions of the jaws 182 and 184 and its associated linkage as well as the spring 84 and its associated linkages are depicted in time sequence as the solenoid 22 is energized. Also, it is assumed at this time, that a staple 222 has been released from the housing 28 and is in a position shown in FIG. 2. As depicted in FIGS. 9a, 10a and 11a, the driver arm 154 moves forward and the follower head 162 travels along the rear portion 202 of the slot 146, closing the jaws 182 and 184 at a relatively equal rate. In addition, the finger 166 which is secured to the drive member 154 moves forward toward the center 226 of the staple 222. The energization of the solenoid 22 additionally causes the spring housing 78 to move forward, simultaneously moving the rod 112 and the plunger member 122 in the direction shown by the arrow in FIG. 2.

When the rod 122 has moved a distance sufficient to clear the front opening of housing 28. The front staple in the housing is released and held in position by the pins 242. Further movement of the driver arm as shown

in FIGS. 9b, 10b, and 11b causes the jaw 184 to close more rapidly as the head 162 moves in the curved portion 204 of the slot. The pointed end 228 of the staple commences to fold inwardly around a pair of intersecting structural rods 252 and 254. Additionally, the thin edge 238 of the staple abuts the jaw shoulder 194. Then, as shown in FIG. 9b, the shoulder 124 of the plunger member 122 abuts the shoulder 98 on the end wall 94. At this point, the spring housing 78 can no longer move forward. As shown in FIG. 11c, further movement of the brackets 74 and 76 causes the pin 82 to move forward in the slot 85, loading the spring 84.

As the driver arm 154 continues forward movement and head 162 enters the curved portion 206 of the slot, as shown in FIG. 10c, the front surface 172 of the finger 166 commences to abut the staple center 226. In addition, the jaw 182 commences to close at a more rapid rate than the jaw 184. The staple eyelet 235 and the staple pointed end 228 move toward each other. The pointed end 228 enters the eyelet adjacent the shoulder 196 of the jaw 182. The end 228 slides along the surface 198 causing the staple to reverse lock around itself, as can clearly be seen in FIG. 9c. It should be noted that the resultant crimped staple does not have a sharp projecting end as in the case of the wrapping wire. At this time, the head 162 is adjacent the shoulder 208 of the slot and the driver arm can no longer move forward. When the solenoid 22 is deenergized, the jaws 182 and 184 open as the loaded spring 84 causes the E-shaped member 52 to return to its initial position. As the plunger 122 then returns to the position shown in FIG. 2, the front staple adjacent the pins 242 will be grasped by the shoulder 126 and positioned adjacent the magnets 246 to await the next stapling operation.

It should be noted that the rod 156 is connected to the driver arm 154 at a tapered opening. Thus, the driver arm can shift from a straight path defined by the axis of the machine as the head 162 travels along the curved portion 204 and 206 of the slot. Also, the finger 166 has been formed with a curved surface 168 so as to enable movement around the pin 199.

I claim:

1. Apparatus for automatically clamping a staple around a pair of rods comprising:
 - a pair of gripping jaws each having a first point pivotally fixed to said apparatus;
 - driver means for closing each of said jaws at different rates of speed and securing the staple around the rods; and
 - a pair of linkages pivotally connected at one end to the drive means and at the opposite end thereof, each pivotally fixed to a second point on one of the gripping jaws, respectively.
2. Apparatus in accordance with claim 1 and further comprising means connected to said driver means for positioning said staple adjacent said rods upon closure of said jaws.
3. Apparatus in accordance with claim 1 and further comprising actuating means for imparting motion to said drive means wherein said jaws are closed.
4. Apparatus in accordance with claim 3 wherein said actuating means includes a solenoid.
5. Apparatus in accordance with claim 3 and further comprising a spring loading mechanism which is loaded by said actuating means upon closure of said jaws, said

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spring loading mechanism opening said jaws after said actuating means no longer imparts forward motion to the driver means.

6. Apparatus in accordance with claim 5 and further comprising a staple housing secured to said apparatus for holding a plurality of staples therein, said spring loading mechanism positioning one of said staples in said housing adjacent said jaws each time said jaws are

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opened.

7. Apparatus in accordance with claim 6 wherein a plurality of magnets are positioned on said apparatus, said magnets enabling said staple to be correctly positioned adjacent said jaws each time said jaws are opened.

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