

Jan. 18, 1949.

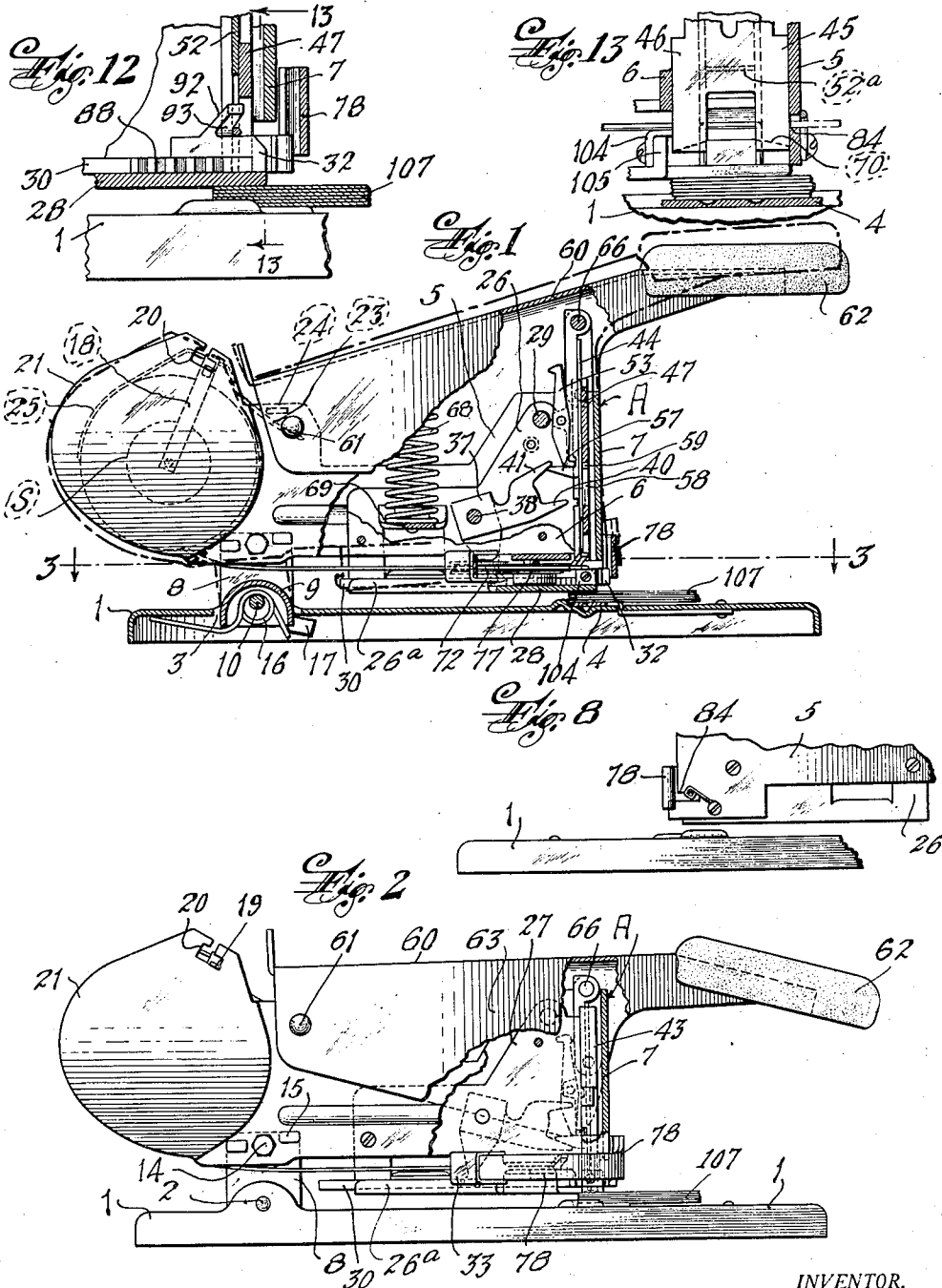
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2,459,313

STAPLING MACHINE

Filed May 25, 1945

5 Sheets-Sheet 1.



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2,459,313

STAPLING MACHINE

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5 Sheets-Sheet 2

Fig. 3

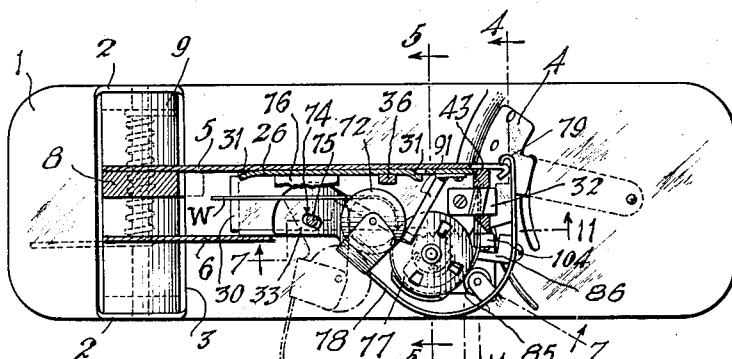


Fig. 4

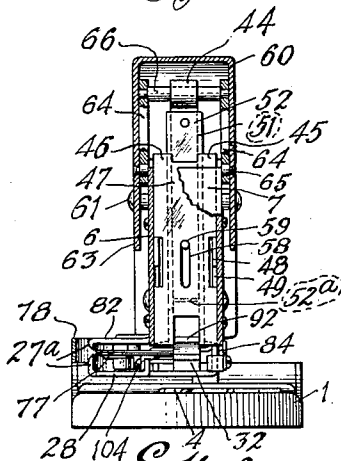


Fig. 11

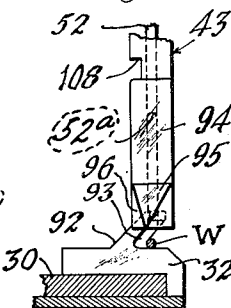


Fig. 5

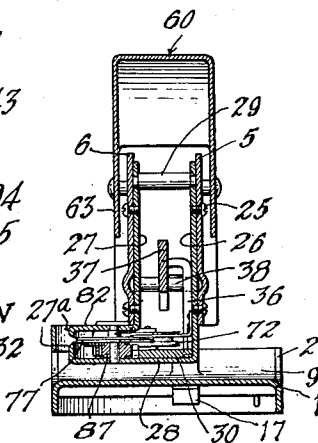


Fig. 6

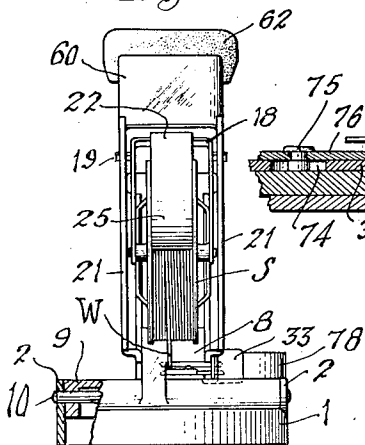
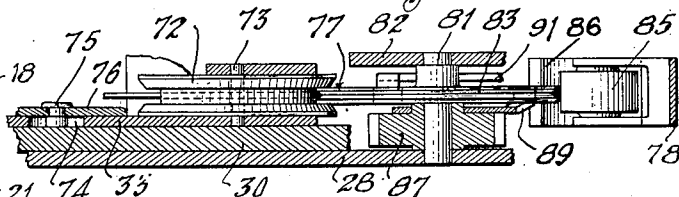


Fig. 7



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STAPLING MACHINE

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5 Sheets-Sheet 4

Fig. 10

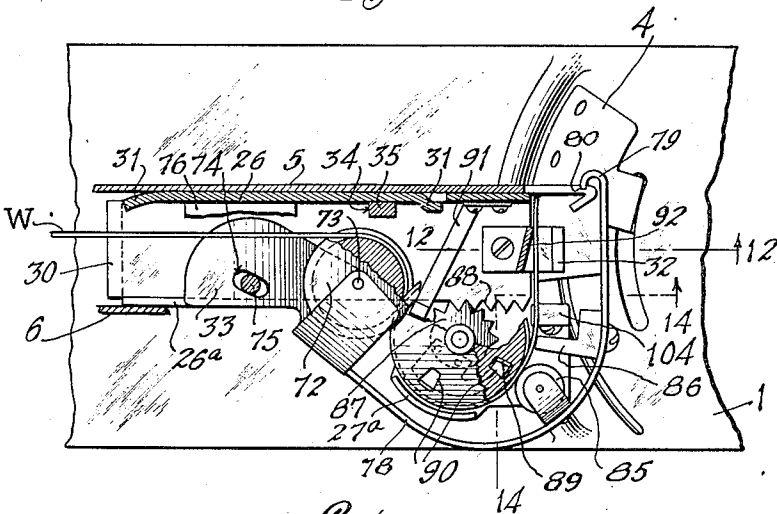


Fig. 17

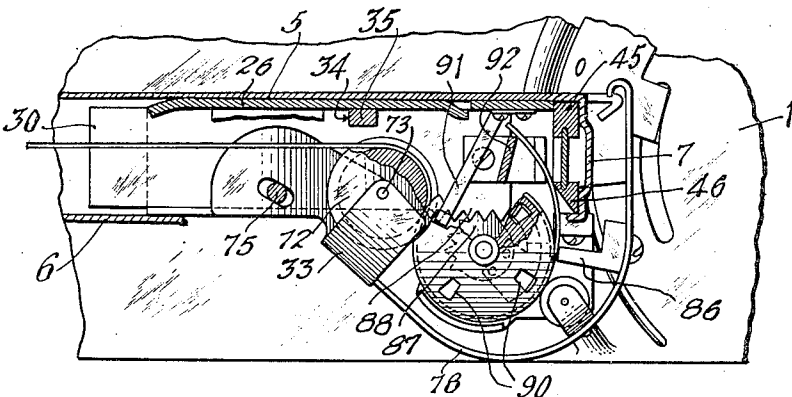
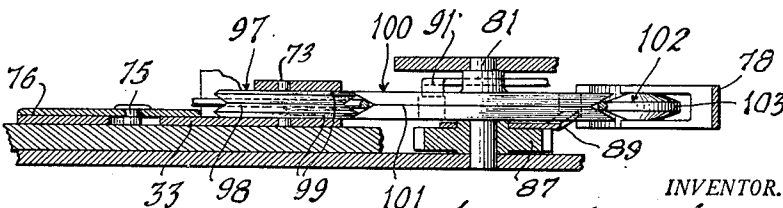


Fig. 19



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2,459,313

STAPLING MACHINE

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18 Claims. (Cl. 140—130)

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This invention relates in general to machines, for example, stapling machines, wherein wire is fed intermittently or step-by-step from a spool or other source, in successive and substantially uniform lengths to a predetermined position where said lengths are severed for use as desired, for example in the production of staples.

More particularly the invention contemplates stapling machines of the type described in United States Patent No. 1,897,625 dated February 14, 1933, for fastening together a plurality of superposed sheets of paper, which comprises a base provided with an anvil, a wire-feeding slide or member mounted for reciprocatory movement in a horizontal direction over said base and having a portion constituting a mandrel which in the movements of the slide, is brought to and removed from cooperative relation with said anvil, vertically movable and preferably manually operable means arranged to cooperate with the anvil and mandrel to form and clench the staples and biased to raised inoperative position and mechanism whereby such means in its vertical movements properly controls and effects the reciprocatory movements of the wire-feeding slide and its mandrel. The vertically movable means referred to is preferably in the form of a two-part plunger device, the construction being such that both parts of the plunger device are moved downwardly together during the cutting and forming of a staple and one of such parts is thereafter moved downwardly with respect to the other part to force the formed staple through and clench the same against the sheets being secured together. It is understood, however, that various features of my invention are adapted for application to or embodiment in other forms of fastening machines and also in machines designed for other uses.

In machines of this type, a pair of wire clutches are utilized for feeding the wire, one clutch being movable by and with said wire feeding slide to grip and pull the wire from the spool and to release the wire upon movement of the slide in opposite directions, respectively, and the other clutch to release and to grip and hold the wire against backward movement as the first-mentioned clutch grips and releases the wire respectively. When initially inserting a supply of wire into such machines, the wire is threaded through passages in said clutches and through a guide tube into proper relation to the mandrel and the plunger device which cooperate to form the staple.

A prime object of the present invention is to

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provide a novel and improved wire-feeding and guiding mechanism which shall be devoid of wire-feeding clutches and guide tubes and wherein the wire can be easily and quickly inserted into the machine and brought into proper relation to the mandrel and the plunger device by simple lateral movement of the wire into easily accessible open grooves, as distinguished from longitudinal threading movement of the wire through holes in wire feeding clutches.

Another important object of the invention is to provide such a wire-feeding and guiding mechanism which shall comprise a novel and improved construction and combination of rollers having grooves in their peripheries to receive, frictionally engage and guide the wire, and means for driving certain of said rollers to exert tractive force upon, and consequently to feed, the wire.

A further object is to provide a novel and improved plunger device to cooperate with said wire-feeding rollers so as to ensure the passage of the free or leading end of the wire as the wire is advanced in the machine, past the plunger device and over the mandrel to prevent entanglement of or interference with the wire by said plunger device, said slide and the guide for the latter.

The invention also contemplates a structure comprising a base carrying the anvil and a support or frame carrying the plunger device and other mechanism, wherein said support or frame is pivotally connected adjacent one end thereof to said base at a point remote from the anvil and wherein means is provided for yieldingly maintaining the forward or free end portion of the support in predetermined raised or spaced position with respect to the anvil so as to permit the insertion of the sheets to be fastened or stapled together, and another object of the invention is to provide a novel and pivot member for connecting said base and said frame which shall provide clearance for lateral movement of the wire transversely of said base and said frame during charging of the machine with wire, and shall cause a minimum of obstruction to the insertion of sheets over said anvil between said base and said frame and permit the sheets to be adjusted for insertion of staples at different distances from the edges of the sheets.

A further object is to provide a machine of the general character described which shall include a novel and improved construction and combination of said plunger device and wire cutting blades, whereby the first operation after charging of the machine with wire shall produce a

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perfect staple and thereby eliminate the waste of wire and time incident to formation of an incomplete staple on the first operation of the known machines.

Other objects, advantages and results of the invention will be brought out by the following description in conjunction with the accompanying drawings in which

Figure 1 is a side elevational view, partially broken away and partly in section, of a machine embodying my invention, the parts being shown in their normal positions with the plunger device at the end of the up-stroke.

Figure 2 is a view similar to Figure 1 showing the parts in the positions they occupy at the end of a down-stroke of the plunger device.

Figure 3 is a horizontal sectional view taken approximately on the plane of the line 3—3 of Figure 1, portions being broken away for clearness in illustration.

Figure 4 is a transverse vertical sectional view on the plane of the line 4—4 of Figure 3.

Figure 5 is a similar view on the plane of the line 5—5 of Figure 3, portions being shown in full.

Figure 6 is a rear end elevational view of the machine.

Figure 7 is a vertical sectional view on an enlarged scale, taken approximately on the plane of the line 7—7 of Figure 3, portions being shown in full.

Figure 8 is a fragmentary side elevational view of the forward end of the machine with the parts in the position shown in Figure 1.

Figure 9 is a partial side elevational view and partial vertical longitudinal sectional view, on an enlarged scale, showing the parts approximately in the position shown in Figure 2.

Figure 10 is a fragmentary horizontal sectional view similar to Figure 3 but on an enlarged scale and with certain parts broken away and others omitted for clearness in illustration.

Figure 11 is a fragmentary vertical longitudinal sectional view approximately on the line 11—11 of Figure 3, with portions omitted for clearness in illustration.

Figure 12 is a fragmentary vertical longitudinal sectional view approximately on the plane of the line 12—12 of Figure 10, but showing the plunger device at an intermediate point in the down-stroke thereof.

Figure 13 is a fragmentary transverse vertical sectional view on the plane of the line 13—13 of Figure 12.

Figure 14 is a view approximately on the plane of the line 14—14 of Figure 10, but showing the plunger device at the intermediate point in its down-stroke approximately corresponding to that shown in Figures 12 and 13.

Figure 15 is a view similar to Figure 14, showing the plunger device advanced on its down-stroke beyond the position shown in Figure 14.

Figure 16 is a fragmentary transverse vertical sectional view approximately on the plane of the line 16—16 of Figure 9, showing the plunger device at the lower limit of its down-stroke and illustrating the formation of a clinched staple.

Figure 17 is a horizontal sectional view on the plane of the line 17—17 of Figure 9.

Figure 18 is a detached perspective view of the plunger device and

Figure 19 is a view similar to Figure 7 showing a modification of the invention.

Figure 20 is a view similar to Figure 1 with the

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frame in its upper normal position, showing a modification of the invention.

Figure 21 is an enlarged fragmentary horizontal sectional view approximately on the plane of the line 21—21 of Figure 20, portions being broken away for clearness in illustration.

Figure 22 is a fragmentary side elevational view of the machine with portions broken away and showing the position of the parts while threading wire into the machine.

Figure 23 is a schematic perspective view of the wire feeding clutches and a portion of the wire guide, and

Figure 24 is an enlarged fragmentary transverse vertical sectional view on the line 24—24 of Figure 21.

Referring to the drawings, the fastening machine shown comprises a substantially rectangular base 1 having a peripheral depending flange, a pair of lugs 2 struck-up therefrom adjacent its rear end at opposite sides of a substantially rectangular opening 3, and an anvil 4 suitably secured thereto adjacent its forward end. The support or frame A for carrying the spool of wire, the wire-feeding means, the plunger device and various associated parts, comprises a casing consisting of two spaced parallel plates 5 and 6 connected at their forward ends by an integrally formed transverse, vertical web 7, such casing being open at its top, bottom, and rear end.

The plates 5 and 6 are connected in spaced relation to each other to an arm 8 of a hinge element 9 which is pivotally connected by a pin 10 to the lugs 2 of the base, said arm projecting upwardly through the opening 3 in the base. The plates 5 and 6 are held in rigid relation to the hinge member and to each other by a bolt 14 and by lugs 15 on said arm 8 snugly fitting openings in said plates. A spring 16 constantly tends to maintain the frame or support A in its raised or uppermost position as indicated by heavy dot and dash outline in Figure 1, the hinge member having a lug 17 to abut said base and limit upward movement of said frame. The arm 8 of the hinge element is offset to one side of the longitudinal plane of the base that passes through the anvil 4 to facilitate charging of the machine with wire as hereinafter described and also to provide clearance for adjustment and location of sheets to be stapled.

The spool S carrying the wire W from which the staples are made, may be mounted in the frame A in any suitable manner. As shown the spool is journaled in an inverted U-shaped bracket 18 which has lugs 19 on its arms to pivotally and removably seat in undercut notches 20 in extensions 21 of the plates 5 and 6 which are held in spaced relation by a spacer bar 24. A spring 22 is connected to the bracket 18 and has one end 23 underlying a pivot pin 61 which will be described later, to maintain tension on the portion of the wire that is between the spool and wire-feeding mechanism which will be hereinafter described. The other end 25 of said spring frictionally drags as a brake on the wire on the spool to prevent over-running of the spool as the wire is fed.

The frame A includes a sub-frame which comprises spaced parallel vertically disposed plates 26 and 27 which are firmly secured between the forward portions of the plates 5 and 6 in any suitable manner, for example by screws and a spacer bolt 29 with the front vertical edges of said plates 26 and 27 in spaced relation to the inner surface of the front web 7 which connects

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the plates 5 and 6. The plate 26 (Figs. 1 and 5) has horizontal extension 28 which extends across the space between the plates 26 and 27 and is provided with a vertical flange 26a at its rear portion, disposed approximately in a common plane with the plate 27.

A wire-feeding slide 30, substantially rectangular in plan and in cross-section, is horizontally slidably mounted on said extension 28 between the lower portion of the plate 26 and the flange 26a, being held against vertical movement by spaced pairs of lugs 31 struck in from the plate 26 and by a bracket 33 of a wire-guiding roller to be described hereinafter. The slide 30 has connected to its forward end a mandrel 32, narrower than the slide, over which the staples are formed. Adjacent its forward end in the edges thereof next to the plate 26, the slide has a notch 34 in which is pivotally movable a bearing head 35 on one arm 36 of a bell crank lever 37 which is pivoted on a horizontal pin mounted in and extending between the plates 26 and 27. The end of the other arm 38 of said bell crank lever has two spaced projections or teeth 40 and 41.

The two-part plunger device (Fig. 18) comprises a cutting and forming member or die 43 which is substantially rectangular and is disposed for vertical reciprocatory movement in the guideway provided by the front vertical edges of plates 26 and 27 and the forward vertical end portion of the main frame or support A, and a substantially rectangular punch or staple driving member 44.

The die 43 consists of similar rectangular spaced side members 45 and 46 connected by a thin integral front web 47, a channel thus being provided in the rear of said web in which the punch 44 is mounted for sliding movement. The web 47 terminates some distance above the lower end of die 43, the construction being such that the lower spaced end portions of the side members of the die are adapted to straddle and fit fairly close over the mandrel 32 upon the down stroke of the plunger device. The side members 45 and 46 have notches 48 in their outer edges, and lugs 49 projecting from the front edges of plates 26 and 27, extend into these notches and coact with the ends thereof to limit the vertical movements of the die. The inner opposed edges of members 45 and 46 are provided for their entire length with small vertical grooves 50.

The punch 44 consists of a rear thick block or member 51 and a thin front plate or member 52 secured as by riveting to such block. The member 52 extends downwardly below the lower end of block 51 and its edge portions project beyond the side edges of the block and slidably engage the grooves 50 in the die, to which grooves such side edge portions conform. A pawl 53 in the form of an inverted U, embraces block 51 and is pivoted on a lug 53a which is integral with and projects rearwardly from the block. A small compression spring 54 disposed between block 51 and the upper end of pawl 53, tends to maintain the latter in the position shown in Figures 14 and 18 in which the teeth thereof engage angular notches 55 formed in the rear faces of members 45 and 46 of the die. At its upper end pawl 53 is provided with a rearwardly extending lug 56 adapted to coact with the upper screw or bolt 29, as will presently appear. At its lower end block 51 is provided with a rearwardly extending lug or tooth 57 which projects between and is adapted to coact with the teeth 40 and 41

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to effect angular movements of lever 37 and thereby backward and forward reciprocatory movement of slide 30 upon the down and up strokes, respectively, of the plunger device. The front web 47 of die 43 has a vertical slot 58, and a pin 59 secured to punch 44 extends into said slot and coacts with the upper end thereof to limit the upward reciprocatory movement of the punch with respect to the die.

For the manual actuation of the machine, I provide a long channeled lever 60 which is pivoted at its rear end, by means of the horizontal screw or bolt 61, to the main frame A at a point adjacent that portion of the latter in which spool S is mounted. At its front end, which is located a considerable distance forwardly of the front end of frame A, lever 60 is provided with a handle 62, and intermediate its ends such lever has a pair of similar downwardly extending flanges 63. These lugs 63 are preferably formed integrally with the sides of the channel piece from which lever 60 is formed and embrace the frame A at the front end portion thereof in which the plunger device is mounted. Two vertically disposed links 64 are respectively pivotally connected at their lower ends by pins 65 to the lower ends of the flanges 63 and lie adjacent the inner surface of the latter. A horizontal wrist pin or rod 66 is secured at its ends in the upper ends of links 64 and extends loosely through an opening 67 provided in the enlarged upper end of the block 51. The pins 65, links 64 and wrist pin 66, as is obvious, form an operative connection between the plunger device and lever 60. A compression spring 68, of considerably greater strength than the spring 16, is disposed between lever 60 and the auxiliary frame comprising plates 26 and 27, with its ends respectively seated in the channel of said lever and on a cross-piece 69 secured to the rear low end portions of said plates. This spring 68 constantly tends to maintain lever 60 and the plunger device in their raised or uppermost positions with respect to the main frame A, as shown by heavy broken lines in Figure 1, in which the lower ends of the notches 48 in die 43 engage the lugs 49 of plates 26 and 27, the pin 59 of punch 44 engages the upper end of slot 58 in the die and the teeth of pawl 53 rest in the notches 55 of the die.

The lower end faces of members 45 and 46 of the die are provided with transverse aligned angular notches 70 (Fig. 13) adapted, upon the down stroke of the die, to engage the end portions of the piece of wire to be formed into a staple and to guide the same into the vertical grooves 50 in said members, the inner ends of the notches respectively intercepting said grooves.

The wire-feeding and guiding mechanism is shown as comprising a grooved roller 72 which is journaled on a pin 73 in the bracket 33 which has been hereinbefore referred to. The bracket 33 has a slot 74 through which passes a pin 75 which is rigidly secured in an ear 76 which is struck inwardly from the plate 26 in spaced and approximately parallel relation to the extension 28 and at the opposite side of the slide 30. With this construction the bracket 33 may be swung outwardly into the position shown by dot and dash lines in Figure 3 to permit the laying of the wire W in the groove of the roller 72, or said bracket may be swung into position shown in solid lines in Figure 3 to cooperate with another grooved feeding roller 77, for feeding the wire. For holding the bracket in the solid line position shown in Figure 3, the bracket has a spring ex-

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tension 78 the extremity of which is formed with a hook 79 to snap into a groove 80 in the lower portion of the forward end of the plate 26.

The roller 77 is loosely rotatable on a pin 81 which is secured in and extends between the extension 28 of the plate 26 and the bearing ear 82 extending laterally from the plate 27 in vertically spaced and approximately parallel relation to the extension 28. The thickness of the roller 77 is so related to the width of the groove in the roller 72 that the roller 77 may extend into the latter groove and grip the wire W between itself and the base of said groove in the roller 72 as most clearly shown in Figure 7. Preferably the groove 83 in the roller 77 is V-shaped so as to firmly grip the wire, and the depth of the groove is such that the wire will project beyond the outer periphery of the roller so that there may be a three-point engagement of the wire with the base of the groove in the roller 72 and the sides of the groove 83 in the roller 77.

It will be observed that the lower edge of the plate 27 is in spaced relation to the extension 28 and the flange 26a of the plate 26 and that the web 7 connecting the plates 5 and 6 also terminates short of the extension 28. Also, the plates 26 and 5 have a horizontal notch 84 the upper edge of which is coincident of the lower edge of the web 7 and the lower edge of the plate 27. With this construction, the machine can be easily and quickly charged with wire from the spool S. To accomplish this, the bracket 33 and wire-feeding roller 72 are swung into the position shown by dot and dash lines in Figure 3, whereupon the wire is grasped in one hand, manually pulled from the spool, and, without release or change of the grasp, laid in the grooves of the rollers 72 and 77. Then the bracket 33 and roller 72 are pressed inwardly to snap the spring extension 78 into the notch 80 as shown in solid lines in Figure 3 so as to firmly grip wire between the rollers 72 and 77. To facilitate laying of the wire into the groove of the roller 77, the extension 28 of the plate 26 and the ear 82 on the plate 27 may have arcuate flanges 27a concentric with the roller 77, in edgewise spaced and opposed relation at opposite sides of said groove and formed with beveled edges to guide the wire W into the groove. The extension 78 also has a wire pressing roller 85 to hold the wire in tight frictional contact with the walls of the groove in the roller 77, and a guide finger 86 is also mounted on the extension 78 to guide the wire laterally of the slide 30 as best shown in Figures 3 and 10.

For feeding the wire after it has been initially inserted into the machine as described, the roller 77 is driven by a mutilated pinion 87 which meshes with a tooth rack 88 on one edge of the slide 30 and has a spring pawl 89 rigidly connected thereto and cooperating with recesses or openings 90 in the roller 77, so that as the slide 30 is moved by the bell crank lever 37 during descent of the die 43, the roller 77 will be rotated in a counter-clockwise direction (see the Figures 10 and 17) to frictionally pull the wire W from the spool and project the free end thereof across the mandrel 32. A stop pawl 91 is provided to prevent backward rotation of the roller 77.

In order that the forward or leading end portion of the wire W shall be properly positioned over the mandrel 32 and lined up with and beneath the transverse notches or grooves 70 in the bottom end faces of the legs 45 and 46 of the die and with the lower face or end of the blade 52 of punch 44, when the slide is in its foremost position as shown

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in Figures 3 and 10, a block 92 of substantially the same width as the mandrel 30, and which preferably is integral with said mandrel, is mounted on the slide 30 at a point midway between the side edges of the latter and at the rear end of the mandrel. This block 92 has a suitable guide for the wire extending across the same and provided by an angular recess 93 which intercepts the front and bottom surfaces of said block and also the surfaces of both its sides, or which, in other words, is open at the front and bottom sides and at both ends. This recess 93 flares toward that end thereof which is opposite the roller 77, so as to receive and guide the leading extremity of the wire to the other end of said recess as best shown in Figures 9 and 17.

Bearing in mind that the wire W is moved transversely of the mandrel during a portion of the descending movement of the die, it is desirable to ensure against the possibility of the leading end of the wire becoming tangled with the die or being projected at the wrong or forward side of the die. Accordingly the leg 46 of the die adjacent the wire feeding roller 77, is cut away to form a plurality of wire deflecting facets which if struck endwise by the leading end of the wire, will deflect or guide the wire rearwardly. As shown best in Figure 13, one facet 94 extends diagonally rearwardly from the front edge of the leg 46 and merges at its lower end into a downwardly and outwardly extending facet 95. Preferably another facet 96 is formed on the lower front portion of the leg 46 beneath the main facet 94. The facet 95 will deflect the wire upwardly to prevent it from prematurely passing beneath the die, while the facets 94 and 96 will direct the wire into the angular recess 93 of the guide block 92.

At this point, it may be well to describe a modified form of the wire feeding or guiding mechanism which is illustrated in Figure 19. This mechanism is in general similar to that hereinbefore described, but the wire feeding rollers and the grooves therein are shaped differently from the rollers 72 and 77 and their grooves. More specifically, the roller 97 which corresponds to the roller 72 has a V-shaped groove 98 between the edges of which and the outer sides of the roller are beveled surfaces 99. The roller 100 which corresponds to the roller 77 has a deep V-shaped groove 101 the outer portions of the side walls of which frictionally engage the surfaces 99 of the roller 97 so that the latter roller is driven by the roller 100. In this form of the invention, the wire is not gripped between the rollers 97 and 100, but the roller 97, being driven by the roller 100, transmits a tractive force to the wire wound around roller 97 by virtue of the belt tension of the wire on said roller 97. Preferably the walls of the two grooves 98 and 101 are disposed at a 60 degree angle to each other which practically doubles the gripping force of the wire, and the wire is wrapped through an angle of about 180 degrees on the rollers, which again multiplies the tractive force on the wire. The roller 102 which corresponds to the roller 85 has its sides beveled to form a narrow peripheral surface 103 which is of a width to frictionally contact the wire in the groove 101 of the roller 100 but not contact the sides of said groove 101. This construction obviates the necessity for the guide flanges 27a shown in the preceding figures of the drawing, and obviously other modifications and changes in details of construction of this mechanism may be made within the spirit and scope of the invention. For severing a piece of wire of sufficient length

to form a staple, a small angular knife 104 is removably secured as by a screw, to a lug 105 struck up from the extension 28 of the plate 26 with its short horizontal arm extending inwardly so that its edge constitutes a cutting edge and is disposed to coact with the lower end of the leg 46 of the die member when the die is depressed, to shear the wire. Desirably, but not necessarily, the lower edge of the slot 84 may also cooperate with the lower edge of the other leg 45 of the die member to initially sever the excess length of wire that usually will project when the machine is first charged with wire as shown by the dot and dash lines in Figure 13, so that upon the first operation of the die member, a perfect and complete staple may be formed and thus avoid the loss of wire that usually occurs as a result of the formation of an incomplete staple on the first operation of known machines.

As hereinbefore indicated, the anvil 4 cooperates with the punch 44 in bending the wire to form the staples, and directly below the plunger, the anvil is provided with grooves 4A the form of which is best shown in Figures 13, 15 and 16. These grooves receive and upset the ends of a staple towards each other as the staple is being forced by the punch of the plunger device through superposed sheets 107 of material supported on the anvil, to thereby clinch the said ends against the lowermost of said sheets.

The spring 16 normally acts to maintain the frame A and the slide mounted thereon, in their raised uppermost positions with respect to the base 1, as shown by heavy dot and dash lines in Figure 1; and a spring 68 normally acts to maintain the lever 60 and thereby the plunger device in their raised uppermost positions with respect to the main frame. When the frame is in this uppermost position, the slide 30 is in its foremost position with the mandrel 32 directly beneath the plunger, and both the die 43 and the punch 44 are at the upper limit of their vertical movement with the lower ends of notches 48 in the die 43 engaging the fixed lugs 49, the pin 59 of punch 44 engaging the upper end of the slot 58 in the die, the teeth of pawl 53 engaging the notches 55 in the die, and the tooth 57 of block 51 engaging the upper of the two spaced teeth 40 and 41 on the lever 37. For convenience in the illustration, the frame A is shown in this drawing in the position assumed when it is initially pressed downwardly in contact with the sheets to be stapled and against the influence of the spring 16, but actually the normal position of the main frame A is that outlined by the heavy dot and dash lines in Figure 1.

In the use of the machine, starting with the parts in their normal positions, and the wire threaded therethrough as described above, the sheets to be fastened are first inserted in the gap between the anvil 4 and mandrel 32 to bring the points in said sheets where it is desired to locate a staple directly over the groove 4a in the anvil and beneath the mandrel and plunger device. Pressure is then applied to the handle 62 of lever 60 sufficient to impart thereto a complete down stroke, such stroke being limited by the engagement of the wrist pin 66 with the upper end of die 43. It may here be noted that as the handle 62 of lever 60 is located a considerable distance forwardly of the point of connection between such lever and the plunger device, less pressure need be exerted in actuating the plunger device through its complete down stroke, because of the gained leverage obtained, than

where the manual pressure is applied directly to and in line with the plunger device as has been customary in machines of this type heretofore produced. Upon so applying pressure to the handle 62, the frame A together with the plunger device and all other parts mounted on such frame, including lever 60, are first moved as a unit about the pivot pin 10 against the tension of spring 16, the strength of the spring being less than that of spring 68, until the front end of the bottom web 28 of the auxiliary frame engages the sheets to be fastened with a pressure sufficient to securely hold the same in position as shown in Figure 1. Thereafter lever 60 is moved downwardly with respect to frame A about pivot 61 against the action of spring 68, the lever, through the links 64 and wrist pin 66 then imparting downward movement to the punch 44 of the plunger device. During the first part of the downward movement of punch 44 the die 43 is positively moved therewith because of the engagement of the teeth of pawl 53 with the notches 55 in the die, as shown in Figure 14. The positive downward movement thus imparted to the die continues until the lower ends of the members 45 and 46 thereof are almost down in engagement with the uppermost of the sheets being fastened together, during which movement the staple is formed as hereinafter described. At this point the pawl 53 is moved about its pivot against the action of spring 54, by reason of the engagement of its lug 56 with the upper screw 29, and the pawl teeth are thus disengaged from the notches 55, as shown in Figure 15. Thereafter the punch 44 continues to move down independently of the die until the lower end of its driving blade 52 is substantially flush with the lower ends of the die members 45 and 46, when further relative downward movement of the punch is prevented by the wrist pin 66 striking the top of the die. The said lower ends of blade 52 and die members 45 and 46 are now in engagement with the uppermost of the sheets being fastened, and the lugs 49 of plates 26 and 27 are nearly engaged by the upper ends of notches 48 in the die. By the simple construction described a constant throw and uniform action of each of the parts of the plunger device are obtained in the successive down strokes of the machine, and this regardless of the aggregate thickness of the superposed sheets being fastened together. Also by limiting the downward movement or throw of the punch and its blade 52, as described, any danger of the end of said blade forcing the base of a staple through all or any of the superposed sheets being secured together, no matter how thin the separate sheets or how little the aggregate thickness of the sheets may be, is entirely eliminated.

In the downward movement imparted to die 43 as described, the lower end of the member 46 thereof first coacts with knife 104 to cut off the transversely extending forward end section of the wire, and both die members 45 and 46 then bend the end portions of said wire section down over the sides of the mandrel 32 to form the legs of a staple, the notches 70 in the lower ends of the die members at the same time acting to line up said end portions or legs with and guide them into the inner grooves 50 of such members. At the completion of the down stroke of the die, the staple is thus completely formed and is located between the lower spaced end portions of the die members 45 and 46 with its legs disposed in the grooves 50 and with the lower

ends of said legs and said members substantially flush. Somewhat before the completion of the down stroke of die 43, the projection or tooth 57 on the punch member 52 is moved into engagement with the lower tooth 40 on the upper end of lever 37 and effects movement of the latter about pin 38 in a clockwise direction (referring to Figure 1) and thereby rearward movement of slide 30, the construction and arrangement being such that the mandrel 32 is wholly withdrawn from the path of the plunger device and the confines of the formed staple substantially as the down stroke of the die is completed. In the continued and independent downward movement of the punch 44, the lower end of punch blade 52 engages the base of the formed staple, pushes the staple from grooves 50, drives the legs of the staple through the sheets disposed over anvil 4, and forces the ends of said legs against the bottom of grooves 4a in the anvil to thereby bend over and clench the same against the lowermost of said sheets. Meanwhile the projection 57 of the punch has moved lever 37 still farther in a clockwise direction and thereby has effected further rearward movement of slide 30; and upon completion of the down stroke of the punch, the parts will be positioned as shown in Figures 2, 9 and 17.

It will be noted that during the initial portion of the descent of the plunger and die, the slide 30 will remain stationary until the lug 57 on the plunger block 51 engages the lower tooth 40 on the bell crank lever 37, and during this movement the die member will have bent the wire over the mandrel as shown in Figure 13 and the mandrel will have started to withdraw from beneath the plunger. Then during the remainder of the descent of the plunger, the lever 37 will be swung to move the slide 30 rearwardly to completely withdraw the mandrel from beneath the plunger and to simultaneously drive the wire feeding roller 77 or 100 as the case may be. At the same time, the plunger will complete its movement to drive and clinch the staple as shown in Figures 2, 9 and 16. The rotation of the wire-feeding roller pulls the wire from the spool and projects the leading end thereof across the mandrel as shown in Figure 17, the facets 94, 95 and 96 on the die member guiding the wire into the proper position.

The pressure on the handle 62 is then removed, whereupon the frame A and the parts carried thereby will be automatically returned to their normal positions as shown in Figure 1, the spring 16 acting to raise the frame about the pin 10 after the spring 68 has raised lever 60 to thereby move the plunger device through this upstroke and reciprocate the slide to its foremost position. The guide block 92 will push the end of the wire W into proper position transversely of the mandrel 32 as shown in Figures 1 and 10. It will be understood that the backward movement of the wire during return of the slide 30 is prevented by holding pawl 91. The machine then is ready for the next operation to produce, drive and clinch another staple.

In order to insure a positive return of the die member 43 to its uppermost position, it is desirable to provide notches 108 in the legs 45 and 46 of the die member to be engaged by the pawl 53 when the punch 44 reaches its lowermost position as shown in Figure 9, so that when the punch is raised under the influence of the spring 68, the die member will be positively lifted. The pawl 53 will be disengaged from the notches 108 as the punch approaches its uppermost position

by engagement of the lug 56 on the pawl with the bolt 29, and when the punch reaches its uppermost position, the pawl will automatically engage the notches 55 in the die member in readiness for the next staple forming operation.

A modification of the invention is shown in Figures 21 to 24 inclusive wherein the machine includes a base 110 which may be identical to the base 1, and a support or frame B which is pivotally mounted on the base 1 through a pivot pin 111 and an hinge element 112 substantially the same as the pin 10 and hinge element 9. On the frame is pivoted a channel lever 113 which may be identical with the lever 60 and which is connected to and operates a plunger device identical with the plunger device 43, 44.

The frame also includes spaced parallel plates 114 and 115, corresponding with the plates 5 and 6, and plates 116 and 117 corresponding to the plates 26 and 27, the former of which has a horizontal extension 118 corresponding to the extension 28 and formed with an upturned flange 119 to serve as a guideway for a slide 120 which corresponds to but is somewhat different in construction from the slide 30.

The slide is actuated by a bell crank lever 121 in exactly the same manner as the slide 30 is actuated by the lever 37.

Mounted on and projecting outwardly from the plate 116 above the slide 120 is a wire guiding block 122 the outer end of which is curved and has a wire guide groove 123 which cooperates with a complementary groove 124 in a wire keeper lever 125 which is pivotally mounted by a pin 126 from a pivot ear 127 that projects inwardly from the frame plate 117. One end of the wire guide groove is directed transversely of the mandrel 127 which is mounted on the slide 120 so as to guide the free end of the wire across the mandrel, and a wire guiding lug 128 corresponding to the lug 92 is mounted on the slide and projects through a slot 129 on the wire guide block 122.

The plunger device cooperates with the mandrel 127 in the same way that the plunger device cooperates with the mandrel 32 in the construction shown in Figures 1 to 18 inclusive, and has been omitted from Figure 21 for clearness in illustration.

At the rear end of the frame opposite the wire guide block 122 is the wire spool S.

The plates 115 and 117 terminate short of the flange 119 to provide a clearance for the wire guide block 122, the wire keeper lever 125 and for clearance to permit the threading of the wire from spool S into the wire feeding clutches. As shown, there are two clutches generally designated C and D, the former being mounted on the plate 116 and comprising two juxtaposed jaws 131 to receive and grip the wire W between their adjacent ends, the other ends of said jaws being pivotally mounted on a bracket 132, the jaws normally being influenced toward each other by a spring 133 so as to prevent backward movement of the wire, that is, movement of the wire toward the spool.

The other clutch includes two jaws 134 identical with the jaws 131 and pivotally mounted in the same manner on a bracket 135 which is carried by the slide 120. These jaws 134 normally are influenced toward each other to grip the wire by a spring 136 and so that they will slip over the wire when the slide 120 is actuated rearwardly or toward the spool and will grip the wire to feed the same when the slide moves in the opposite direction or forwardly.

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In accordance with the invention means is provided to facilitate threading of the wire into the clutches in such a manner that the wire may be grasped in one hand, manually pulled from the spool and without release or change of the grasp, slipped between the jaws of both clutches C and D. This means is shown as comprising jaw-opening fingers 137, one for each jaw of each clutch, mounted on an actuating rod 138 which is slidably mounted in the brackets 132 and 135. The rod 138 is pivotally connected at 139 by a link 140 to an arm 141 on the wire keeper lever 125. The parts are so proportioned and related that when the wire keeper lever is in its normal position as shown by solid lines in Figure 21 and in Figures 20 and 23, the jaw opening fingers 137 are so positioned that the jaws may be operated to feed the wire upon reciprocation of the slide 120 during staple-forming operations. However, when the wire keeper lever is swung outwardly into the dot and dash position of Figure 21 and as shown in Figure 22, the jaw-opening fingers are pulled forwardly as shown by dot and dash lines in Figure 21 and in Figure 22. In this position, the fingers will force the jaws of the clutch C apart, and when the slide 120 is pushed rearwardly the jaw opening fingers will also open the jaws of clutch D as shown in Figure 22. For holding the jaws in their open positions, a detent lever 142 is mounted on the base 140 to engage a notch 143 on the underside of the slide when the latter is pushed rearwardly so as to hold the slide against return movement forwardly. A spring 144 normally influences the detent 142 into an out-of-the-way position as shown in Figure 20.

While the jaws are in their open positions as shown in Figure 22 and the keeper lever is swung outwardly as shown in dot and dash lines in Figure 21, the wire may be pulled from the spool and slipped laterally of the frame B between the jaws 131 and 134 of the two clutches, after which the wire may be drawn into the grooves 123 and 124 of the wire guide block 122 and keeper lever as shown by dot and dash lines in Figure 21. Then the lever 125 is swung inwardly toward the block 122 so as to loosely hold the wire in the guideway formed by the grooves 123, 124 (see Figure 24). By shaping the keeper lever and pivoting it as shown in the drawing, it will be observed that it is really not necessary for the operator to guide the wire between the jaws of the clutches because when the wire is laid in the grooves 123, 124 and the lever is swung inwardly the wire automatically is pushed laterally between the clutch jaws.

For the purpose of illustrating the principles of the invention I have shown it embodied in two specific embodiments, particularly two types of wire feeding means, but it should be understood that many modifications and changes may be made in the details of construction of the machine, and the wire feeding mechanism may be embodied in other types of machines all within the spirit and scope of the invention.

What I claim is:

1. The combination with a horizontal base, a frame thereon, a device mounted on said frame for vertical reciprocatory movement to act upon wire, and a support for a wire supply, of means above said base for pulling wire from said supply and for feeding it to a predetermined position to be acted upon by said device, said means including a plurality of cooperative wire-gripping elements normally to grip said wire between them,

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said elements being relatively bodily movable in planes substantially parallel to said base so that they may be moved apart and the wire may be manually grasped with one hand and while the grasp is retained may be pulled from said supply and placed in proper relation to said elements to be gripped between them when they are moved toward each other, means for actuating at least one of said elements to feed said wire from said supply to said predetermined position, and means holding said wire-gripping elements normally in wire-gripping relation.

2. The combination with a horizontal base, a frame thereon, a device mounted on said frame for vertical reciprocatory movement to act upon wire, and a support for a wire supply, of means above said base for pulling wire from said supply and for feeding it to a predetermined position to be acted upon by said device, said means including a plurality of cooperative wire-gripping rollers normally to grip said wire between their peripheries, said rollers being mounted to rotate on axes perpendicular to said base and being relatively bodily movable so that they may be moved apart in a plane perpendicular to their axes and the wire may be manually grasped with one hand and while the grasp is retained may be pulled from said supply and placed in proper relation to the peripheries of said rollers to be gripped between them when the rollers are moved toward each other, means holding said rollers normally in wire-gripping relation, and means for actuating at least one of said rollers to feed said wire.

3. A machine of the character described comprising a base, means disposed above said base for withdrawing wire from a source and for feeding the same towards a certain point including a frame, a reciprocatory device mounted thereon, a pair of wire-feeding rollers journaled on said frame in a common plane, each having a peripheral groove one of which is V-shaped, said wire between said source and the leading end of said wire being wrapped around a portion of the periphery of one of said rollers and then around a portion of the periphery of the other roller in frictional contact with the walls of said grooves and the edge of said roller having the V-shaped groove being disposed within said groove of the other roller at the point where said wire passes from one roller to the other whereby the wire will be gripped between the sides of said V-shaped groove and the base of the groove in the other roller, and means including an operative connection between said reciprocating device and one of said rollers for rotating said rollers in the direction to feed said wire.

4. A machine of the character described comprising a base, a support for a supply of wire, means disposed above said base for withdrawing wire from such supply and for feeding the same towards a certain point including a frame, a pair of rollers journaled on said frame in a common plane with one between the other and said support, each having a peripheral groove, said wire between said source and the leading end of said wire being wrapped around a portion of the periphery of one of said rollers and then around the periphery of the other roller in frictional contact with the walls of said grooves, the edges of said rollers being in frictional contact with each other, and means for rotating the one of said rollers that is farther from said source whereby the other roller will be driven by the first-mentioned roller and said rollers will fric-

tionally pull said wire from said source, and means for guiding the free leading end of said wire.

5. A machine of the character described, comprising the combination with a horizontal base, a frame, a plunger device mounted on said frame for vertical reciprocatory movement, a slide mounted on said frame for horizontal reciprocatory movement between two extreme positions in one of which it cooperates with said plunger device to act upon a piece of wire, a support for a wire supply, of wire-feeding mechanism including a roller mounted on said frame for rotation in one direction about a vertical axis, said wire between said source and its free end being wrapped around a portion of the periphery of said roller in frictional contact therewith, and means including an operative connection between said slide and said roller for rotating the latter to pull said wire from said source, and means to guide said wire into a predetermined position relatively to said slide and said plunger device to be acted upon by said plunger device.

6. In a fastening machine of the class described, the combination with a horizontal base, means for acting upon wire, of a frame on said base, a plunger device mounted on said frame above said base for vertical reciprocatory movement and biased to a raised inoperative position, a slide mounted for horizontal movement between two extreme positions, said slide having a mandrel with which the plunger device is adapted to coact and which is located beneath said device in one extreme position of the slide, means whereby upon each operation of the machine said slide withdraws wire from a source and projects the free end of said wire into a predetermined position beneath said plunger device, said means including a wire-feeding roller rotatable about a vertical axis around a portion of the periphery of which said wire is wrapped in frictional contact therewith, a guide on said frame engaging said wire between said roller and the leading end of said wire, means including an operative connection between said roller and said slide for rotating said roller to advance said wire from said source, and a guide lug on said slide in such position with respect to said guide as to be engaged by the wire so advanced and to direct the wire into said predetermined position.

7. The fastening machine set forth in claim 4 with the addition of means mounting the first-mentioned one of said rollers for bodily movement in said plane away from the other roller.

8. The machine set forth in claim 3 with the addition of means for yieldingly influencing one of said rollers toward the other.

9. The machine set forth in claim 4 with the addition of means for yieldingly holding said rollers in frictional contact with each other, and means for yieldingly pressing said wire into the groove of the first-mentioned roller.

10. The machine set forth in claim 3 wherein said wire is wrapped through an angle of about 180° around each roller.

11. The machine set forth in claim 4 wherein said wire is wrapped through an angle of about 180° around each roller.

12. In a fastening machine of the character described, the combination with a base, a frame on said base, mechanism on said frame for acting upon wire, a support for a spool of wire on said frame in spaced relation to said mechanism, of means for withdrawing wire from said spool and feeding it to a predetermined position to be acted

upon by said mechanism, said means including wire-gripping elements forming wire-receiving passages between them extending in the direction from said spool to said predetermined position, said elements being relatively adjustable so that the wire may be grasped manually with one hand and while so grasped may be pulled from said source and inserted into said passages in a direction transverse to the first-mentioned direction, and means for actuating said wire-gripping elements to feed said wire.

13. In a fastening machine of the character described, the combination with a base, a frame on said base, mechanism on said frame to act upon wire, a support for a wire supply on said frame in spaced relation to said mechanism, of means for withdrawing wire from said source and feeding it to a predetermined position to be acted upon by said mechanism, said means including wire-gripping elements forming wire-receiving passages between them and being movable toward and from each other to grip and release a wire respectively, means for actuating said wire-gripping elements to feed said wire, said passages between said elements also opening laterally in a direction approximately perpendicular to the direction of feeding movement of said wire between said elements, and means for moving said wire-gripping elements apart so that the wire may be grasped in one hand and while so grasped may be pulled from a source and slipped laterally into said passages.

14. The machine set forth in claim 1 with the addition of a guide for directing said wire to said predetermined position including two parts to form a wire passage between them when they are in juxtaposed relation to each other, one of said parts being movable away from the other to allow insertion of wire into said passage between them, and an operative connection between said movable part and the last-named means for moving said wire-gripping elements apart simultaneously with movement of said movable part of said wire guide away from the other part.

15. A machine of the character described comprising a base, means disposed above said base for withdrawing wire from a source and for feeding the same towards a predetermined position including a frame, a reciprocatory device mounted thereon, a pair of wire-feeding rollers journaled on said frame, said wire between said source and the leading end of said wire being wrapped around a portion of the periphery of one of said rollers and then around a portion of the periphery of the other roller in frictional contact therewith, means including an operative connection between said reciprocating device and one of said rollers for rotating said rollers in the direction to feed said wire toward said predetermined position, a third roller receiving said wire between itself and said one of said pair of rollers to hold said wire in tight frictional contact with said one roller, and means mounting the other of said pair of rollers and said third roller for bodily movement away from said one roller to facilitate laying of wire between the peripheries of said rollers.

16. A machine of the character described comprising a base, means disposed above said base for withdrawing wire from a source and for feeding the same towards a predetermined position including a frame, a reciprocatory device mounted thereon, a pair of wire-feeding rollers journaled on said frame, said wire between said source and the leading end of said wire being wrapped

around a portion of the periphery of one of said rollers and then around a portion of the periphery of the other roller in frictional contact therewith, means including an operative connection between said reciprocating device and one of said rollers for rotating said rollers in the direction to feed said wire toward said predetermined position, a third roller receiving said wire between itself and said one of said pair of rollers to hold said wire in tight frictional contact with said one roller, and yielding means common to the other of said pair of rollers and to said third roller for mounting them for bodily movement toward and away from said one roller and for yieldingly pressing said other roller and said third roller toward said one roller to force said wire into tight frictional contact with said one roller.

17. In a stapling machine, means for withdrawing wire from a source of wire supply including a vertically reciprocable device spaced from said source in a horizontal direction and adapted to act on said wire, a member slidably mounted for horizontal reciprocating movement under the control of the vertical reciprocation of said device, elements gripping said wire between them controlled by said slidable member to feed said wire from said source to said device upon each reciprocation of said member, and manual actuating means for relatively moving the normally cooperating elements away from each other so that the wire may be grasped with one hand and while so grasped may be pulled

from said source and inserted between said gripping elements transversely to the direction of reciprocation of said slidable member.

18. In a stapling machine as defined in claim 17, said gripping elements comprising two normally cooperating rollers, at least one of which is rotated in one direction under the control of said slidable member, said actuating means being arranged to move said rollers away from each other in a substantially horizontal plane to facilitate insertion of said wire between them.

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