May 29, 1951 R. E. ZERUNEITH 2,554,691

WIRE STITCHING APPARATUS

Filed June 24, 1948 4 Sheets-Sheet 1

Fig. 2.

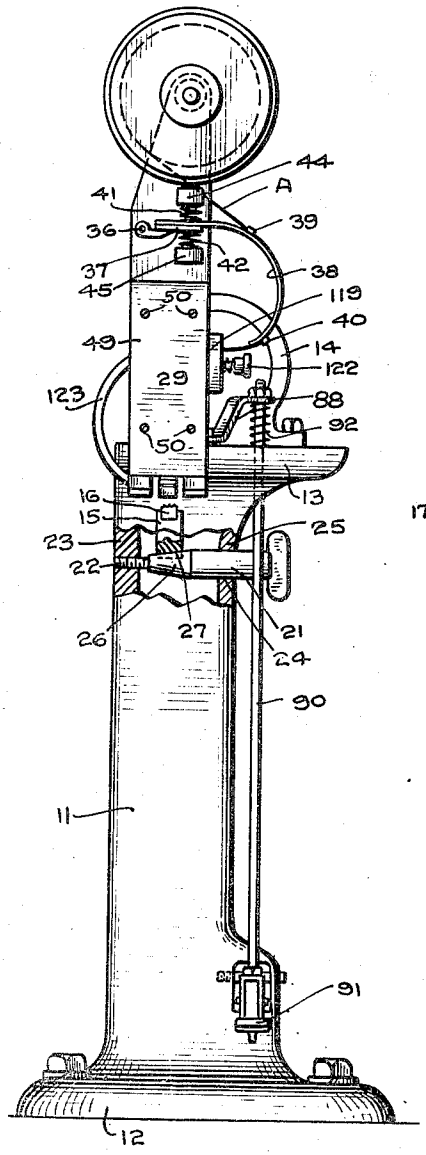
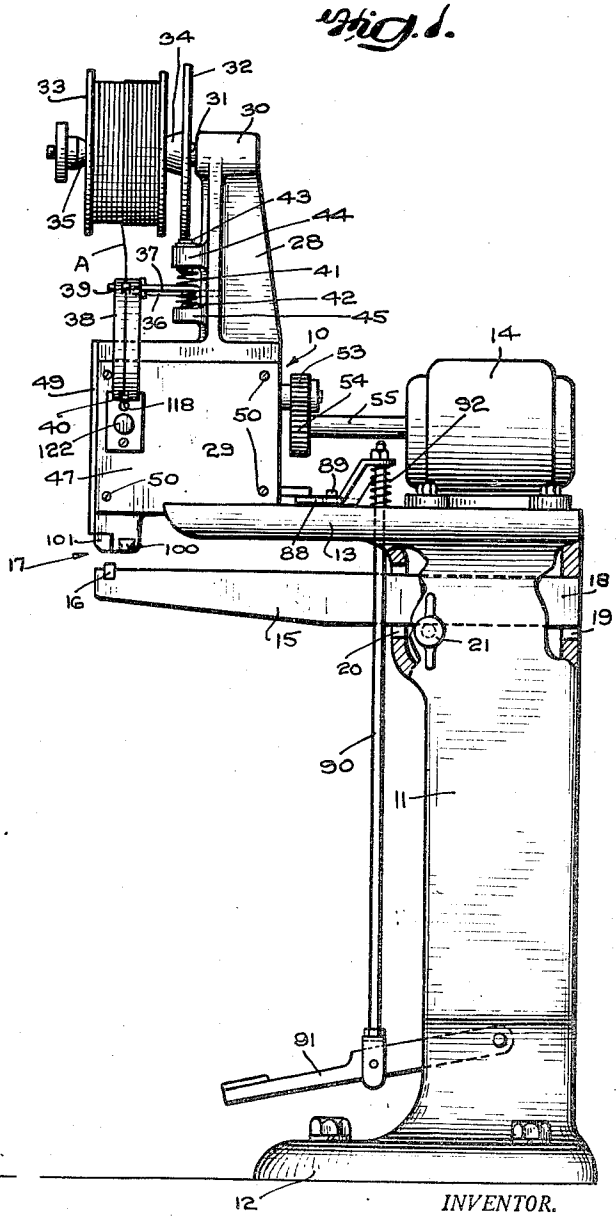


Fig. 1.



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WIRE STITCHING APPARATUS

Filed June 24, 1948 4 Sheets-Sheet 2

Fig. 4.

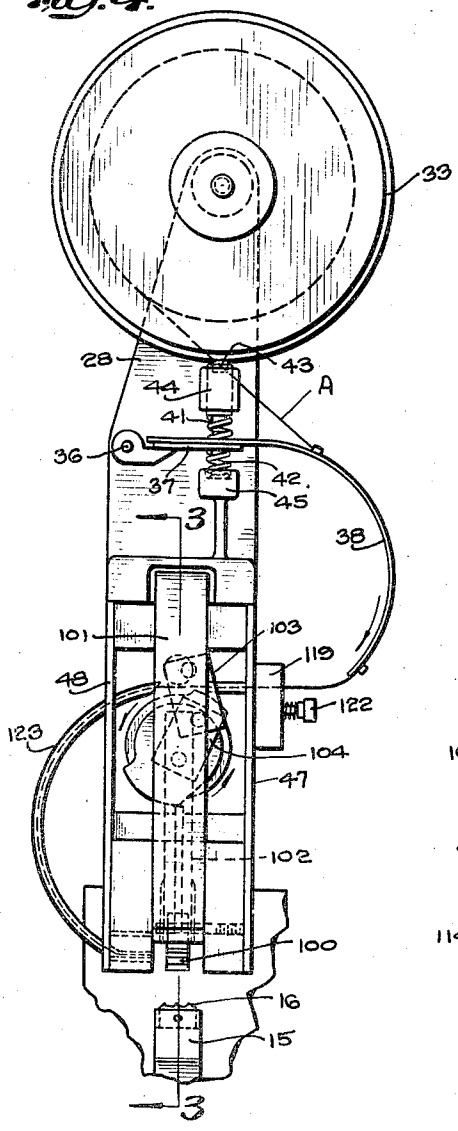
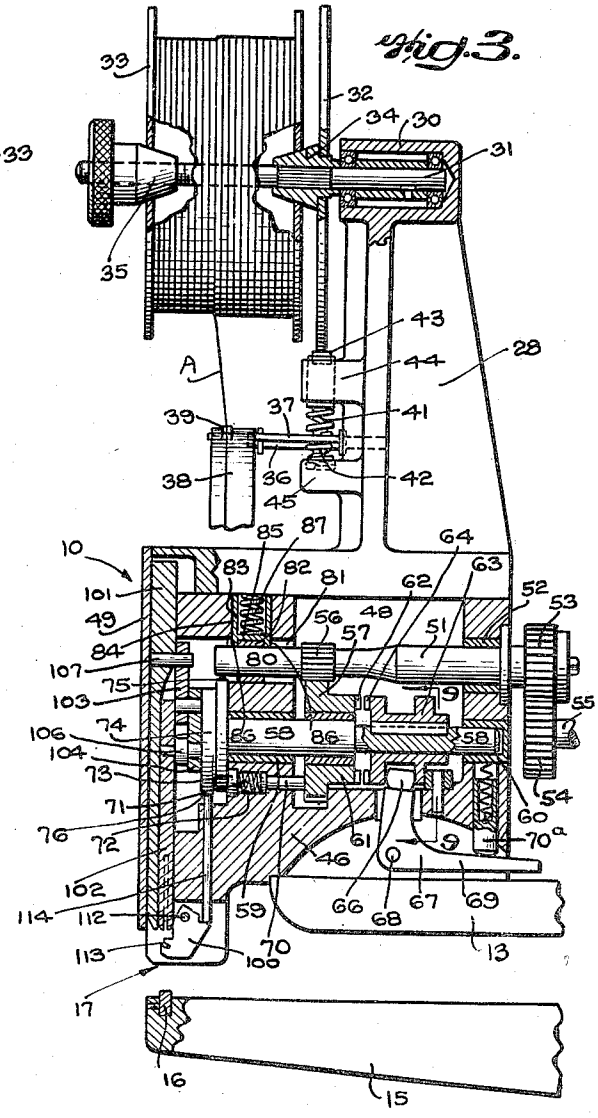


Fig. 3.



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WIRE STITCHING APPARATUS

Filed June 24, 1948 4 Sheets-Sheet 3

Fig. 5.

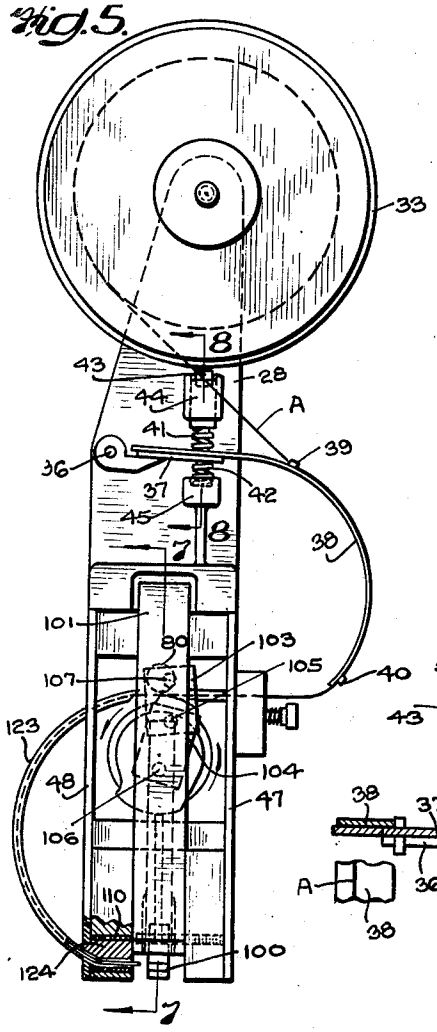


Fig. 7.

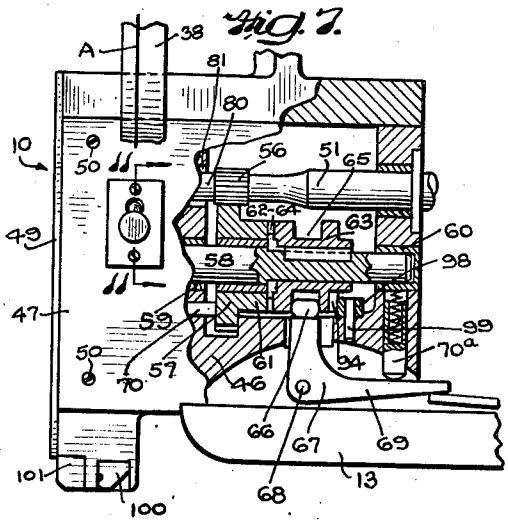


Fig. 9.

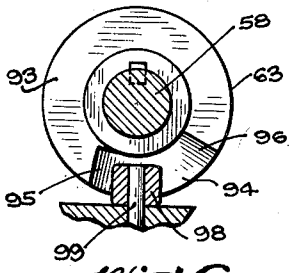


Fig. 8.

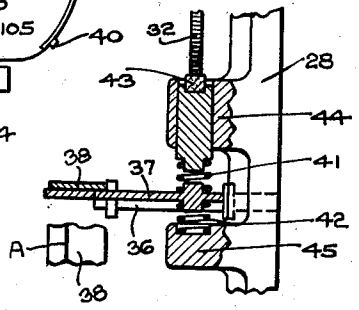


Fig. 6.

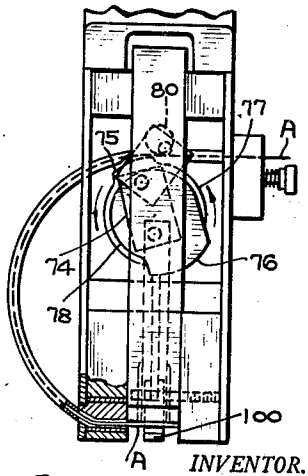


Fig. 10.

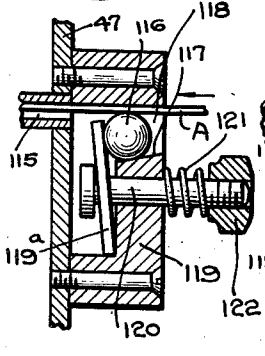
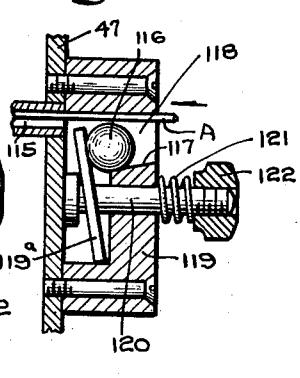


Fig. 11.



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May 29, 1951 R. E. ZERUNEITH 2,554,691

WIRE STITCHING APPARATUS

Filed June 24, 1948 4 Sheets-Sheet 4

Fig. 12.

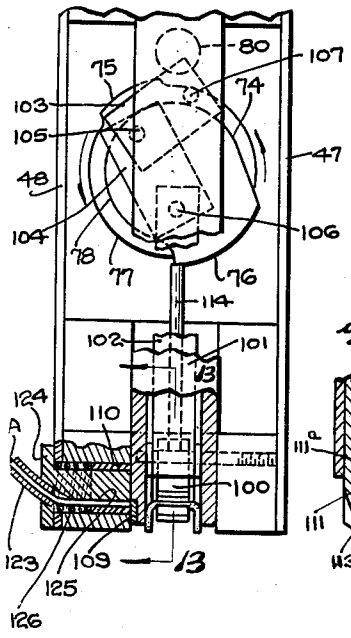


Fig. 13.

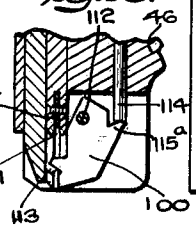


Fig. 14.

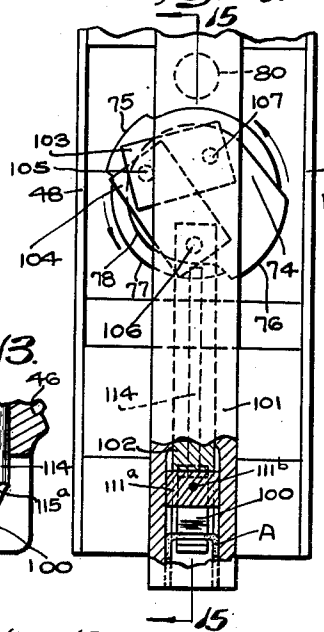


Fig. 15.

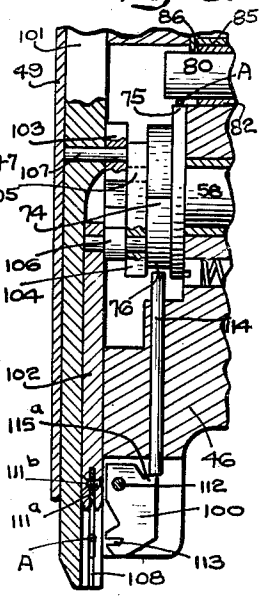


Fig. 16.

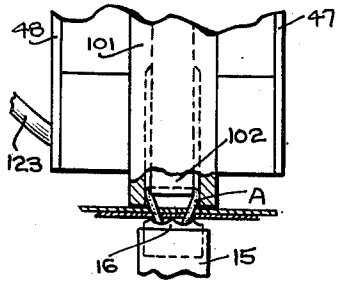


Fig. 17.

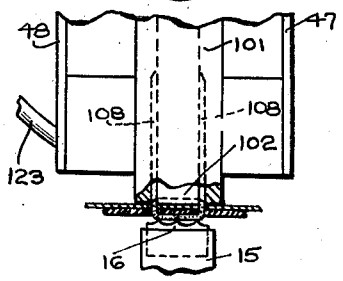


Fig. 18.

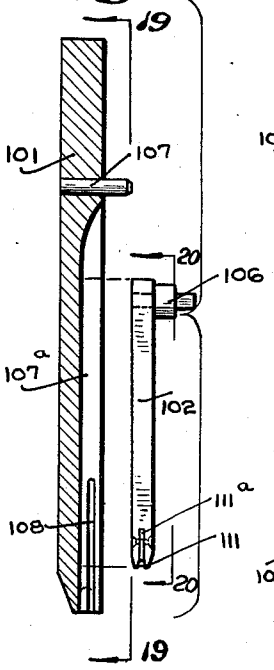


Fig. 19.

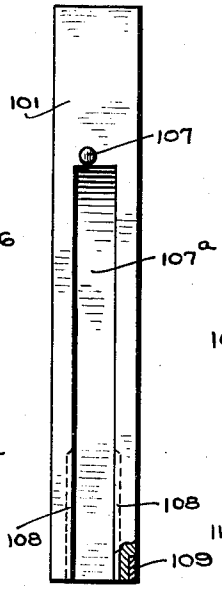
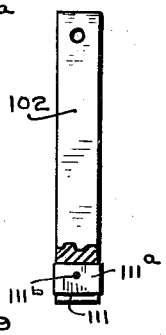


Fig. 20.



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Patented May 29, 1951

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UNITED STATES PATENT OFFICE

2,554,691

WIRE STITCHING APPARATUS

Rudolph E. Zeruneith, Philadelphia, Pa.

Application June 24, 1948, Serial No. 35,006

8 Claims. (Cl. 1—2)

1

This invention relates to improvements in motor-driven automatic wire-stitching machines, it being among the general objects of the present invention to provide a safe and efficient machine which is readily adapted to produce in rapid succession a series of wire staples formed from a continuous length of wire fed intermittently to and through the staple-forming head of the machine, each staple being formed of a length of wire cut to predetermined length.

Further general objects of the present invention are to provide a wire-stitching machine which is strong and durable in use, which is compact and relatively inexpensive in construction, which is easily and conveniently serviced as occasion may require, and which is capable of producing a line of more or less closely spaced individually formed staples to stitch together a wide variety of articles as the latter are fed into and through the stitching head of the machine.

Among the more specific objects of the present invention is the provision of a simple and effective means for so controlling the feed of the supply spool or reel of the staple-forming wire that while the latter is freely fed intermittently through the stitching head of the machine to produce in rapid succession a series of individually formed staples as aforesaid, the wire is at all times under such controlled state of tension as to prevent any undesirable slack therein.

Still another and important object of the invention is to provide an exceedingly compact and efficient means for effecting sequential operation of the several mechanisms included within the stitching head of the machine for forming each individual staple, said mechanisms including (1) a pivoted anvil which is swingable into position to rigidly support the wire while it is initially cut to predetermined length and then formed into staple shape, (2) a reciprocating staple forming bar, and (3) a reciprocating staple driving bar for driving the formed staple into the work to be stitched.

Still another and important object of the present invention is to provide a simple and effective means for intermittently advancing predetermined lengths of the staple forming wire to and through the stitching head of the machine, said means being self-adjustable during operation to compensate for possible variations in the diameter of the wire to thereby insure proper feed of the wire through the machine.

A still further and important object of the invention is to provide a drive mechanism for the machine which is so operative that upon interrupting operation of the machine, as upon disengagement of the clutch from the continuously operating motor driven shaft, the stitching mechanism will complete the particular stitch in process of being formed but will not repeat a stitch by operation of the machine of its own momentum, thereby insuring that the stitching head of the machine is at all times ready to instantly form a new stitch upon resuming operation of the machine.

2

Other objects and advantages of the present invention will appear more fully hereinafter, it being understood that said invention consists substantially in the combination, construction, location, and relative arrangement of parts, all as will be described in the following specification, as shown in the accompanying drawings and as finally pointed out in the appended claims.

In the accompanying drawings,

Figure 1 is a side elevational view of a wire stitching machine as constructed in accordance with the principles of the present invention;

Figure 2 is a front elevational view of the machine;

Figure 3 is an enlarged view, partially in section, of the stitching head and associated parts of the machine, the sectioned parts being principally those as viewed along the line 3—3 of Figure 4;

Figure 4 is a front elevational view of the mechanism shown in Figure 3;

Figure 5 is a view corresponding to Figure 4 but showing the staple forming wire advanced to and partially through the stitching head;

Figure 6 is a view corresponding to the lower portion of Figure 5 showing the staple forming wire fully advanced through the stitching head to form a wire staple;

Figure 7 is a view, partially in section, as taken along the line 7—7 of Figure 5;

Figure 8 is a sectional detail as taken along the line 8—8 of Figure 5;

Figure 9 is a sectional detail as taken along the line 9—9 of Figure 3;

Figures 10 and 11 are sectional views, each taken along the line 11—11 of Figure 7, showing the device for preventing reverse withdrawal of the staple-forming wire fed into the stitching head of the machine;

Figure 12 is a front elevational view, partially in section, of the stitching head showing the operation of the staple forming mechanisms;

Figure 13 is a transverse sectional view as taken along the line 13—13 of Figure 12;

Figure 14 is a view similar to Figure 12 but

showing the pivoted wire-supporting anvil swung free of the wire and out of the path of the staple driving bar;

Figure 15 is a vertical sectional view as taken along the line 15—15 of Figure 14;

Figures 16 and 17 are views showing the relative positions assumed by the staple-forming bar and the staple-driving bar in relation to the clinch die as the staple is finally formed;

Figure 18 is a view showing in separated relation the relatively movable staple-forming bar and staple-driving bar;

Figure 19 is a face view of the staple-forming bar as viewed from the line 19—19 of Figure 18; and

Figure 20 is a face view of the staple-driving bar as viewed from the line 20—20 of Figure 18.

Referring now to the drawings and more particularly to Figures 1 and 2 thereof, it will be observed that the wire stitching machine of the present invention is generally in the form of a compact motor driven organization designated 10 which is adapted to be suitably supported at the upper end of a vertically extending pedestal 11 having a floor engaging base 12. In the form of the machine as illustrated in the drawings, the pedestal 11 is provided at its upper end with a relatively broad platform 13 upon which is suitably mounted all of those parts to be presently described which constitute the stitching machine proper of the present invention, including an electric motor 14 by means of which the machine is driven. If desired, the platform 13 may be formed separately of the pedestal 11 for removable securement to the latter, in which case the platform 13 would form a component part of the wire stitching machine 10 to provide therefor a base by means of which it may be mounted upon any suitable support, as for example, a work table, floor pedestal or the like.

Operatively mounted upon the pedestal 11 immediately beneath the upper platform 13 thereof is a horizontally extending work-supporting stitcher-arm 15 in the outer free end of which is fitted a clinch member or die 16 for clinching the staples as the same are successively formed in the stitching machine and driven through the work to be stitched. The stitching arm 15 is supported in the pedestal 11 or in the base of the stitching machine 10 in such vertically spaced relation with respect to the platform 13 and the lower end 17 of the stitching head as to permit the work to be stitched to be freely shifted across the top of the stitcher-arm 15. In the particular apparatus illustrated, the work-supporting stitcher-arm 15 is preferably of rectangular cross-sectional shape and is disposed with its rear end 18 more or less snugly fitted within a rectangular opening 19 formed in the rear wall of the support for the wire stitching machine 10, the arm 15 projecting forwardly of the support through a second opening 20 formed in the front wall of the support in registry with the opening 19. Extending transversely of this support 11 is a bearing pin 21, one end of which is threaded as at 22 (see Figure 2) for engagement with a side wall 23 of the support, while the other end of the pin is journalled as at 24 in the opposite side wall 25 of the support.

The intermediate body portion of the pin is tapered as at 26 for seating engagement within a complementally tapered notch 27 formed in the bottom edge of the stitcher-arm 15, the taper 26 of the pin being of such length that as the pin is threaded into the wall 23 of the support it forces

the stitcher-arm to rise vertically to thereby present the clinch die 16 into closer relation with respect to the lower end 17 of the stitching head. Conversely, as the bearing pin 21 is axially withdrawn from the wall 23 the stitcher-arm 15 assumes a lowered position to increase the spacing between the clinch die 16 and the lower end 17 of the stitching head. It will be apparent, of course, that the tapered portion 26 of the transverse bearing 21 coacts with the transverse notch 27 in the stitcher-arm 15 to lock the latter against longitudinal displacement relatively to its support. Due to the fact that the openings 19 and 20 snugly embrace opposite sides of the stitcher-arm 15, the latter is restrained against lateral displacement and is capable only of vertical adjustment accordingly as the bearing pin 21 is axially adjusted transversely of the stitcher-arm. By so providing for vertical adjustment of the stitcher-arm proper adjustment may be effected between the clinch die 16 and the stitching head to accommodate varying thicknesses of work to be stitched.

The stitching organization 10 generally includes a vertical spool-supporting bracket 28 suitably supported upon a box-shaped support or housing 29 for the staple-forming mechanisms presently to be described, said mechanisms including a mechanism for intermittently feeding wire to and through the stitching head, a swingable anvil for supporting predeterminately fixed lengths of the wire in position to be formed into individual staples, a vertically reciprocating staple-forming bar, a vertically reciprocating staple-driving bar and a gear transmission for operating the several mechanisms in predetermined sequence by means of the electric motor 14.

The spool-supporting bracket 28 is provided at its upper end with a bearing 30 within which is journalled a freely rotatable spindle 31 of greater length than and extending from one end of the journal 30. Keyed or otherwise nonrotatably secured to the spindle 31 is a brake disk 32. Also secured nonrotatably to the freely extending portion of the spindle 31 is a wire supply spool or reel 33, the latter being secured to the spindle 31 for rotation therewith by means of a pair of tapered seats 34 and 35, one of which is preferably formed integrally with the brake disk 32 and the other one of which is formed as the end terminal portion of a rotatable clamping nut which threadedly engages the threaded free end of the spindle 31, the arrangement being such that upon tightening said clamping nut its tapered seat 35 coacts with the tapered seat 34 fixed to the brake disk 32 and so to the spindle to nonrotatably clamp the spool or reel to the rotatable spindle.

Pivotally mounted upon a bearing pin 36 fixed to and projecting laterally from the spool-supporting bracket 28 is a horizontally disposed plate 37 to which is secured a flexible wire-guiding leaf spring 38 of the arcuate form most clearly shown in Figures 2, 4 and 5, this wire-guiding leaf spring being provided with suitable wire-guiding elements 39 and 40 respectively disposed at the leading and trailing edges of the spring for guiding the spool forming wire longitudinally over the outer surface of the spring along a line spaced centrally between its opposite side edges. These guide means 39 and 40 may be in the form of raised eyelets through which the wire is threaded or they may be in the form of pairs of spaced parallel guide pins, such

as those designated 88—88 in my prior United States Letters Patent No. 2,226,916, granted December 31, 1940. If desired, the number of the wire-guiding elements mounted on the flexible leaf spring 38 may be increased to suit any particular requirements and the curvature of said leaf spring.

The pivoted plate 37, which serves as the support for the freely extending arcuately shaped leaf spring 38, is maintained in substantially horizontal position by interposing a freely extending edge portion thereof between a pair of vertically alined compression springs 41 and 42. The upper spring 41 rests upon the top of the pivoted plate 37 and exerts an upward thrust against a vertically shiftable braking element 43 in frictional engagement with the periphery of the brake disk 32, said braking element 43 being supported for vertical movement within a suitably bored boss 44 formed as an integral part of the spool-supporting bracket 28. The lower compression spring 42 is supported upon a second boss 45, also formed as an integral part of the bracket 28, and exerts a thrust upwardly against the under surface of the pivoted plate 30.

It will be apparent that when the leaf spring 38 is in its unflexed state, that is, when it is not flexed downwardly and inwardly under pull of the wire A lengthwise of its outer surface, the compression springs 41—42 conjointly exert a sufficient force upwardly on the braking element 43 to cause it to bear against the brake disk 32 with sufficient pressure to prevent rotation of the spindle 31 and, accordingly, of the spindle or reel 33. As the wire A extending along the leaf spring 38 is pulled lengthwise thereof, the leaf spring is flexed downwardly and inwardly and at the same time causes its supporting plate 37 to swing downwardly about its pivot 36, thereby compressing the lower spring 42 simultaneously as the pressure of the upper spring 41 against the braking element 43 is reduced. Upon such pressure abatement of the braking element 43 against the brake disk 42, the reel 33 is free to rotate to pay out a length of the wire A sufficient to form a staple by the mechanisms of the stitching head to be presently described. As the requisite length of wire is fed into the staple-forming head of the machine it is held therein against reverse movement, following which the leaf spring 38 resumes its normal unflexed position to take up all slack in the portion of the wire extending from the reel 33 and at the same time re-energizes the spring-pressed braking element 43 for such increased frictional engagement with the brake disk 32 as to lock the wire supply reel 33 against rotation. By means of the arrangement above described, the downward pull exerted on the wire A results in lessening of the braking pressure upon the brake disk 32 to an extent corresponding exactly with the extent of the downward pull, thereby permitting the unwinding of just enough wire to meet the requirements of the machine. Thus, the wire does not become tangled nor run wild.

The box-shaped support or housing 29, in which are operatively disposed the several mechanisms of the stitching machine, generally comprises a main casting 46 (see more particularly Figures 3, 7 and 15) which serves as a support for the pivoted anvil and the vertically reciprocable staple-forming and staple-driving bars hereinbefore referred to, as well as a bearing for the gear train and clutch mechanism operatively interposed between the driving motor 14 and said

operating mechanisms of the stitching head. Preferably the casting 46 is fitted wtih removable side face plates 47 and 48 and with a removable front face plate 49, these plates being secured to the casting by suitable screws such as 50.

The casting 46 is suitably secured in any suitable manner upon the front portion of the platform 13, the disposition of the casting upon the platform being such that the front portion of the casting overhangs somewhat the frontal edge of the platform 13. As most clearly appears in Figure 1, the electric motor 14 for driving the stitching machine is also mounted upon the platform 13 in suitably spaced relation with respect to the stitching machine head casting 46. As most clearly appears in Figures 3 and 7, the casting 46 has suitably journalled therein a shaft 51, this shaft being principally journalled as at 52 in the rear wall of the gear housing 46 and being provided at its outer end with a gear 53 in constant mesh with a gear 54 keyed to and rotatable with the drive shaft 55 of the motor 14. Keyed or otherwise secured to the shaft 51 for rotation therewith is a pinion gear 56 which in turn is in constant mesh with a gear 57 journalled on and freely rotatable about a shaft 58 suitably journalled within the casting 46 as at 59 and 60.

The gear 57 which is journalled upon the shaft 58 constitutes one element of a clutch and, accordingly, said gear is provided with an axially extending hub 61, the annular edge of which is provided with a series of circumferentially spaced clutch teeth 62. Splined to the portion of the shaft 58 disposed rearwardly of the clutch gear 57 is a clutch member 63 having on its frontal face a series of circumferentially spaced clutch teeth 64 adapted for clutching engagement with coacting clutch teeth 62 of the clutch gear 57. The clutch member 63, while splined to the shaft 58 for rotation therewith is, nevertheless, free to shift axially in opposite directions along said shaft whereby to effect engagement or disengagement of the coacting clutch teeth 62 and 64. In order to axially shift the clutch member 63 into and out of operative engagement with the clutch gear 57, the clutch member is provided with an annular channel or groove 65 into which projects the inner end 66 of a bell-crank clutch shifting lever 67 suitably pivoted to the housing casting 46 as at 68. This clutch shifting lever 67 is provided with a rearwardly extending arm 69 which is engageable by a spring-pressed plunger 70a which imposes a normal bias upon the lever 67 tending to shift the clutch member 63 out of engagement with its cooperating clutch gear 57. The mechanism for actuating the clutch shifting lever 67 will be described hereinafter.

In order to prevent jamming of the coacting clutch teeth 62 and 64 when the clutch member 63 is axially shifted into engagement with the clutch gear 57, the latter is resiliently backed by a spring-pressed pin 70, this pin being urged into close relation to the continuously revolving clutch gear by a compression spring 71 disposed within a suitable socket 72 having its outer end closed by an axially adjustable threaded insert 73. It will be apparent that this spring-biased pin 70 permits the clutch gear 57 to yield axially away from the clutch member 63 when the latter is shifted into clutching position until such time as the cooperating clutch teeth 62 and 64 slip into full engagement with one another, the clutch gear 57 being thereupon maintained in operative mesh with the clutch member 63 until such time when the latter is disengaged from the

clutch gear 57 under the normal bias of the spring-pressed plunger 70a, as will more fully appear hereinafter.

Secured to the forward extremity of the driven shaft 58, preferably as an integral part thereof, is a cam disk 74 having a pair of angularly related, axially spaced raised cam edges 75 and 76. The raised cam edge 75 is disposed axially inward of the raised cam edge 76, each of said cam edges being spaced radially outward of and extending along a circular arc concentric with a circular dwell edge. Thus, in the case of the inner cam edge 75 of the cam disk 74 it rises from a circular dwell edge 77 having a radius substantially less than that of the circular cam edge 75. Similarly, in the case of the cam edge 76, it rises from a circular dwell edge 78 having a radius substantially less than that of the circular cam edge 76.

For reasons which will be apparent immediately hereinafter, the circular cam edges 75 and 76 respectively extend through arcs of predetermined degree, the arc of the cam edge 75 being of sufficient length to insure intermittent feed of predetermined lengths of wire successively into the stitching head of the machine, while the arc of the cam edge 76 is of sufficient length to insure proper disposition of the wire-supporting anvil in timed relation to the intermittent feed of the wire into and through the stitching head of the machine, and to the movements of the vertically reciprocable staple-forming and staple-driving bars. It will be noted that to this latter end the angularly related cam edges 75 and 76 are disposed approximately 180 degrees apart, that is, they are respectively disposed at approximately diametrically opposite sides of the cam disk 74.

As has been previously mentioned, the shaft 51 is principally journalled at its rear end, as at 52, with its forward end 80 of reduced diameter projecting axially into an enlarged bore 81 formed in the front end of the casting support 46. It will be noted that the reduced end of the shaft 51 extends forwardly a distance sufficient to overlie the cam edge 75 of the cam disc 74 so that conjointly with the latter it provides a feeding mechanism for the wire drawn from the supply reel 33. A bearing sleeve 82 fitting on the reduced forward end of the shaft and loosely disposed within the bore 81 serves as a front bearing for the revoluble shaft 51, said bearing sleeve 82 having a capacity for limited movement transversely of the bore 81. A shoe 83 slidably fitted within a bore 84 extending vertically normal to the horizontal axis of the bore 81 is resiliently urged into engagement with the bearing sleeve 82 to prevent axial displacement of said sleeve while permitting it to shift transversely of the axis of rotation of the shaft 51. To this end, the shoe 83 is provided at its inner end with an arcuately shaped seat 85 in engagement with the peripheral surface of the bearing sleeve 82 and with depending side flanges 86—86 embracing opposite edges of said bearing sleeve in the region above the shaft 51. A coiled compression spring 87 interposed between the base of the spool-supporting bracket 28 and the bottom of the shoe 83 serves to resiliently press the latter radially against the bearing sleeve 82 and so resiliently maintains the shaft 51 in such position that the peripheral surface thereof at its outer free end coacts with the raised circular cam edge 75 of the cam disc 74 to provide an intermittently operative feed mechanism for drawing successive lengths of the wire A from the supply spool 33 and for feeding them to and through the staple-forming head of the wire stitching machine.

It will be apparent that although the shaft 51 rotates continuously upon operation of the motor 14, feeding of the wire through the stitching machine is effected only as the cam edge 75 of the cam disc 74 rotates into position to grip the wire between said cam edge and the cylindrical surface of the shaft 51. Inasmuch as the latter is spring-pressed toward the wire-gripping surface of the cam 75 of the cam disc 74, the spacing between the wire-gripping surfaces of the cam disc 74 and of the shaft 51 is automatically adjusted to compensate for variations in the diameter of the wire being to and through the machine, the spring-pressed shoe 83 being operative to at all times cause the rotating shaft 51 to press the wire against the rotating wire-feeding cam edge 75 of the cam disc 74 with sufficient force to insure a positive intermittent feed of the wire through the machine.

The extent of the advance of the wire A through the machine by the coacting wire-gripping surfaces of the cam disc 74 and the shaft 51 is determined by the arcuate length of the cam edge 75, the wire being seized immediately as the leading point of said cam edge rotates into approximate tangential relation to the shaft 51 and being released immediately as the trailing point of said cam edge rotates out of such tangential relation.

It will be understood, of course, that rotation of the cam disc 74 for intermittent feed of the wire through the machine is effected only when the clutch member 63 is operatively connected to the clutch gear 57, in which case the motive power from the motor 14 is transmitted from the motor shaft 55 through the gears 54 and 53 to the feed roll shaft 51, thence through the gears 56 and 57 and the interengaged clutch teeth 62 and 64 to the driven shaft 58 of the cam disc 74. As has been previously described, the clutch member 63 is normally maintained disengaged from its coacting clutch gear 57 by the spring-pressed plunger 70a acting upon the arm 69 of the pivoted clutch-shifting lever 67. In order to shift said lever into its clutch engaging position as shown in Figure 7, the arm 69 thereof is pressed upwardly against the spring-pressed plunger 70a by a lever 88 (see Figure 1), suitably fulcrumed as at 89, and connected, as by a rod 90, to a foot-operated pedal 91. A coiled compression spring 92 interposed between the fulcrumed lever 88 and the platform 13 maintains the lever 88 and its operating foot pedal 91 in its inoperative or clutch disengaging position. Of course, any other suitable means may be employed for actuating the clutch-shifting lever 67.

An important feature of the present invention is the provision of means automatically operative to maintain the clutch engaged for a period sufficient to insure completion of each cycle of operation in which a given staple is formed and driven into the work to be stitched or stapled. To this end the axially shiftable clutch member 63 is provided in its rear flat face 93 with a camming recess 94 having a flat dwell surface extending between of pair of circumferentially spaced oppositely inclined cam surfaces 95 and 96, each of which rises from the flat dwell surface of the camming recess 94 to the outer flat face 93 of the clutch member.

A cam roller 98 journalled upon a pin 99 fixed vertically in the casting member 46 and rotatably

engageable with the rear surface of the clutch member 63 is adapted to register with the camming recess 94 once for each revolution of said clutch member. This camming recess is of such arcuate extent and is so angularly related to the cam edge 75 of the cam disc 74, which latter together with the clutch member 63 are rotatable together as a unit with the driven shaft 58, as to insure against any staple being partially formed or repeated by the machine upon movement of any of the parts thereof under their own momentum following disengagement of the clutch member 63 from its coacting clutch gear 57.

Thus, assuming the machine to be in operation with the clutch members 57 and 63 thereof interengaged as shown in Figure 7, the shaft 58 will be driven by the feed roll shaft 51 to effect rotation of the cam disc 74 with corresponding operation of the wire feeding mechanism heretofore described and the staple-forming and staple-driving mechanisms still to be described. Upon release of the foot pedal 91 or other means employed for controlling the clutch-shifting lever 67 whereby the latter is urged into its inoperative position shown in Figure 3 by the bias of the spring-pressed plunger 70a, the clutch member 63 will remain in engagement with the clutch gear 57 until its camming recess 94 rotates into registry with the cam roller 93, whereupon the clutch member 63 is instantly free to shift axially out of engagement with the clutch gear.

Inasmuch as the clutch member 63 is thus disengageable from the clutch gear 57 only when the camming recess 94 is in registry with the cam roller 93, it will be apparent that release of the clutch-shifting lever 67 will not interrupt rotation of the cam shaft 58 until it has rotated sufficiently to complete the cycle of forming and clinching a given staple, such cycle being repeated only upon further actuation of the clutch-shifting lever to effect interengagement of the clutch members 57 and 63. During operation of the motor 14 and so long as the clutch members 57 and 63 remain engaged, the machine will operate to form and clinch in succession an indefinite number of staples each formed of an equal length of the wire supplied from the supply spool or reel 33.

As has been previously indicated, the cam disk 74, which is rotatable with the driven shaft 58, is not only operative to actuate the wire feeding cam edge 75 in association with the continuously rotating feed roll shaft 51, but it is also operative to actuate, through the intervention of suitable means presently to be described, a pivotally mounted anvil 100, a vertically reciprocable staple-forming bar 101 and a vertically reciprocable staple-driving bar 102. These latter vertically reciprocable bars 101 and 102 are arranged in nested relation as shown more particularly in Figures 12 to 20, inclusive, and are adapted to be relatively reciprocated by links 103 and 104 pivotally connected together by a crank pin 105 projecting forwardly of the cam disk 74. The outer free end of the link 104 is connected to the flat rear face of the staple-driving bar 102 by a pin 106, while the outer end of the link 103 is pivotally connected to the staple-forming bar 101 by a pin 107. The general arrangement of the vertically reciprocable bars 101 and 102 and of the pivoted anvil 100 is substantially similar to that shown in my prior United States Letters Patent No. 2,226,916 hereinbefore referred to, the staple-forming bar 101 being suitably guided in its vertical reciprocation within a channel suitably formed in the front end of the casting member of support 46. This staple-forming bar 101 is provided in its rear face with a vertically extending channel 107a in which the staple-driving bar 102 is nested for guided vertical reciprocation relatively to the staple-forming bar 101.

The opposed inner surfaces of the side walls of the channel 107a formed in the staple-forming bar 101 are respectively provided at their lower ends with vertical grooves 108—108 (see Figures 18 and 19) each of a width and depth determined by the cross-sectional size of the wire from which the staples are formed. The staple-forming bar 101 is additionally provided in one outer side thereof adjacent its bottom edge with a hardened metal insert 109 which serves as a wire cutting element, this element coacting with a second hardened metal insert 110 which is fitted in the guide for the vertically reciprocable bar 101 for shearing off each length of the wire to be formed into a staple, the shearing operation being effected upon each downward stroke of the staple-forming bar 101. The staple-driving member 102 which is guided by and is vertically reciprocable relatively to the staple-forming member 101 is provided at its lower end with a transverse groove or notch 111 of a width and depth determined by the gauge of the wire of which the staples are to be formed, said notch being adapted to engage the horizontally extending portion of the formed staple during the operation of driving the latter through the work and clinching it upon the clinch plate. The wire-engaging base of the notch 111 is preferably formed by an insert plate 111a secured in position within the lower end of the driving bar 102 by a screw 111b, the opposite edges of the plate projecting slightly beyond either side of the bar 102 for sliding accommodation within the opposed grooves 108—108 of the staple-forming bar 101 during relative movement of the bars 101 and 102.

The anvil 100 is suitably journalled upon a transverse pivot pin 112 fixed in the casting 46 and is provided in its depending nose portion with a transversely extending notch 113 into and through which the wire A is fed by means of the hereinbefore described feed roll shaft 51 and its cooperating cam edge 75 of the cam disk 74. Slidably fitted within the casting 46 is a cam follower rod 114, the upper end of which bears against that edge of the cam disk 74 which is provided with the raised cam edge 76, while its lower end bears against a rearwardly extending projection 115a formed on the anvil 100.

As most clearly appears in Figure 3, when the upper end of the cam follower 114 is engaged by the cam edge 76 of the cam disk 74, the follower is depressed to shift the anvil 100 into its position as shown, the anvil remaining locked in such shifted position during all of the period that the cam follower 114 is engaged by the cam edge 76. When said cam edge passes beyond and out of contact with the follower 114, the latter is free to be shifted vertically upward by any downward force exerted upon the front of the pivoted anvil 100, as when the staple driving bar 102 engages the notched nose of the anvil during the operation of driving the formed staple into the work to be stitched. In this latter operation the lowered notched end of the drive bar 102 shifts the pivoted anvil from its position shown in Figure 13 into its position shown in Figure 15 simultaneously as the formed staple is engaged by the drive bar preliminarily to driving the staple

through the work and against the clinch plate on the work-supporting arm. The weight of the suspended portion of the pivoted anvil 100 may in itself be sufficient to cause it to swing into its position shown in Figure 15 when the upper end of the cam follower 114 is freed of its engaging cam edge 76, in which latter case the cam follower 114 is vertically raised into its position shown in Figure 15.

It will be understood, of course, that the pivoted anvil is disposed for swinging movement into and out of the path of vertical reciprocation of the staple-driving bar 102 and, accordingly, said anvil is so disposed that when swung into its operative position shown in Figure 3 by means of the cam follower 114 and its actuating cam edge 76, its notched nose fits snugly within the channel 107a of the staple-forming bar 101. In such operative position of the anvil, the staple-forming wire is held in the notch 113 with its opposite ends projecting equally beyond the parallel vertically extending side wall planes of the channel 107a with the result that when the staple-forming bar 101 is shifted into its lowermost position, as shown in Figure 14, the grooved side walls of the channel, which respectively embrace the anvil 100, cooperate with the latter to form the opposite side legs of the wire staple. Thereupon, the drive bar 102 shifts downwardly to drive the staple through the work and against the clinch plate.

In operation of the mechanism just described, upon rotation of the drive shaft 58 both the staple forming bar 101 and the staple-driving bar 102 will be reciprocated vertically, although not in unison, through the medium of the crank pin 105 and the connecting links 103 and 104. Actually, although both the staple-forming bar 101 and the staple-driving bar 102 descend on each down stroke of the crank pin 105, these members do not descend in synchronism due to the relative movement which takes place between the connecting links 103 and 104.

Because of the unlike instantaneous positions constantly assumed by the connecting links 103 and 104 relative to the crank pin 105, the staple-forming bar 101 will be driven downwardly at the initial portion of the crank pin down stroke at a faster rate than the staple-driving member 102. Thus, when the crank pin 105 completes its first quarter turn, the corresponding lower ends of the bars 101 and 102 are furthest apart. During the second quarter turn of the crank pin, the downward velocity of the staple-driving member 102 increases, while that of the staple-forming member 101 decreases. When the crank pin completes its second quarter turn, the lower ends of both of the bars 101 and 102 will have been brought into registry with each other. In other words, on each down stroke of the crank, the staple-forming bar 101 initially descends ahead of the staple-driving bar 102, following which the staple-driving bar catches up to the staple-forming bar as these bars reach the end of their down stroke.

On the up stroke of the crank pin 105, both the staple-forming and driving bars are raised, but this time they move in reverse order, the staple-driving bar being lifted ahead of the staple-forming member. At the completion of the inoperative up stroke, the staple-forming member catches up to the staple-driving member, thereby completing one cycle of operation.

In respect to the anvil 100, in actual operation of the stitching machine, the lower end of the driving bar 102 descends and engages the notched nose of the anvil, and since at this phase of the cycle of operation the cam edge 77 of the cam disk 74 has passed freely beyond the upper end of the cam follower rod 114, the anvil is free to be swung into an inoperative position about its pivot pin 112. On the inoperative return or up stroke of the driving bar 102, the cam edge 77 reengages the upper end of the cam follower 114 and so depresses the latter against the pivoted anvil 100 with the result that said anvil swings into its operative wire supporting position just as the lower end of the ascending driving bar 102 clears the notched nose of the anvil.

The wire A which is fed from the supply spool 33 to and through the stitching head of the machine moves along a generally S-shaped course, the initial portion of which is lengthwise along the arcuate outer surface of the wire tensioning leaf spring 38. From the free extremity of this leaf spring, the wire passes through a suitable opening 115 provided in the side plate 47 and thence along a horizontal path transversely of the casting 46 and between the feed roll shaft 51 and the cooperating wire feeding cam disk 74, the wire being caught between the cam edge 75 of said cam disk and the feed roll shaft 51 as hereinbefore described, successive equal lengths of the wire being thus intermittently drawn from the spool. In order to hold the wire against retraction from the stitching head during each interval that the wire is freed from the gripping and advancing action of the cooperating feed roll shaft 51 and the cam edge 75, a spring pressed detent is employed in the form of a ball 116 adapted to be wedged against the wire to lock it immovably in position.

This ball detent 116 is operatively disposed upon a tapered seat 117 formed in a member 119 secured to the side plate 47 in the immediate vicinity of the entrance opening 115 through which the wire passes for engagement by the cooperating wire feed members. The tapered seat 117 constitutes the bottom wall of a wire passage 118 formed in the member 119 in registry with the entrance opening 115, the ball detent being urged downwardly of its tapered seat and into holding engagement with the wire A by a plate 119a loosely secured to a stud 120 normally biased outwardly by a coiled compression spring 121 the outer end of the stud being suitably provided with a knob 122. Upon pressing this knob inwardly against the action of the spring 121, the ball detent is free to roll out of wedging engagement with the wire to permit it to be withdrawn outwardly from the passage 118 should this be desired.

It will be apparent that the wire detent is operative to permit the successive lengths of the wire to be drawn freely into and through the staple-forming mechanisms of the machine by the cooperating wire feed members hereinbefore described, at the same time that it holds the wire securely in position when its advance through the machine is interrupted and while each staple is being formed.

The wire advanced by the cooperating feed roll members is guided in its movement from said feed members to the stitch-forming head of the machine through an arcuately-shaped tubular guide 123 which is suitably fixed in position to the side plate 48 of the stitch-forming machine. The upper end of this tubular guide 123 is in horizontal registry with the line of transverse movement of the wire through the entrance opening 115 and between the cooperating wire feed members, while its lower end is in horizontal registry with the

transverse notch 113 of the anvil 100 when the latter is swung into its operative wire-supporting position, as shown in Figures 12 and 13.

As appears most clearly in Figures 5 and 12, the hardened cutter element 110 is in the form of a ring which is pressed or otherwise fitted into that part of the casting 46 which forms a vertically extending side guide wall for the reciprocable staple-forming bar 101, said cutter ring 110 being slip-fitted on a stud 124 suitably mounted in the casting 46. A wire guide bore 125 is formed in this stud in tangential relation to the internal surface of the cutter ring 110 at the bottom thereof, said bore being in horizontal registry with the lower horizontal path of movement of the wire into position to be received by the anvil for the staple-forming operation. A coiled compression spring 126 is preferably interposed between the head of the stud 124 and the cutter ring 110 to insure wire cutting engagement of the ring with the wire cutter element 109 fixed to the lower end of the staple-forming bar 101.

It will be understood, of course, that the present invention is susceptible of various changes and modifications which may be made from time to time without involving any departure from the general principles or real spirit thereof, and it is accordingly intended to claim the same broadly, as well as specifically, as indicated in the appended claims.

What is claimed as new and useful is:

1. A wire-stitching machine of the character described comprising a continuously rotatable main drive shaft having a freely extending end portion, a driven shaft adapted to be rotated by said drive shaft at a reduced speed and having a radially extending portion rotatable in a plane normal to and intersecting said freely extending end portion of the drive shaft, the peripheral edge of said radially extending portion being coincident with a circle which is approximately tangential to the surface of and of a diameter substantially greater than said end portion of the drive shaft, said peripheral edge being of an arcuate length sufficient to advance a predetermined length of staple-forming wire through the machine upon each revolution of the driven shaft, a pair of constantly entrained gears respectively associated with said shafts, one of said gears being keyed to the drive shaft and the other being freely revoluble about said driven shaft, and clutch means operative to interengage said drive shaft and its revoluble gear to effect conjoint rotation of said shafts and intermittent feed of successive lengths of staple-forming wire therebetween.

2. A wire-stitching machine of the character described comprising a continuously rotatable main drive shaft having a freely extending end portion, a driven shaft adapted to be rotated by said drive shaft at a reduced speed and having a radially extending portion rotatable in a plane normal to and intersecting said freely extending end portion of the drive shaft, the peripheral edge of said radially extending portion being coincident with a circle which is approximately tangential to the surface of and of a diameter substantially greater than said end portion of the drive shaft, said peripheral edge being of an arcuate length sufficient to advance a predetermined length of staple-forming wire through the machine upon each revolution of the driven shaft, a pair of constantly entrained gears respectively associated with said shafts, one of said gears being keyed to the drive shaft and the other being freely revoluble about said driven shaft, and

clutch means operative to interengage said drive shaft and its revoluble gear to effect conjoint rotation of said shafts and intermittent feed of successive lengths of staple-forming wire therebetween, said clutch means being operative automatically to complete the full advance of a predetermined length of the wire through the machine for each complete revolution of the drive shaft.

3. A wire-stitching machine of the character described comprising a continuously rotatable main drive shaft having a freely extending end portion, a driven shaft adapted to be rotated by said drive shaft at a reduced speed and having a radially extending portion rotatable in a plane normal to and intersecting said freely extending end portion of the drive shaft, the peripheral edge of said radially extending portion being coincident with a circle which is approximately tangential to the surface of and of a diameter substantially greater than said end portion of the drive shaft, said peripheral edge being of an arcuate length sufficient to advance a predetermined length of staple-forming wire through the machine upon each revolution of the driven shaft, a pair of constantly entrained gears respectively associated with said shafts, one of said gears being keyed to the drive shaft and the other being freely revoluble about said driven shaft, and clutch means operative to interengage said drive shaft and its revoluble gear to effect conjoint rotation of said shafts and intermittent feed of successive lengths of staple-forming wire therebetween, said clutch means being operative, during operation of the drive shaft, to interrupt rotation of said driven shaft alone only after full advance of a predetermined length of the wire through the machine.

4. A wire-stitching machine of the character described comprising a continuously rotatable main drive shaft having one end thereof rotatably journalled in a bearing having a capacity for limited displacement laterally of the axis of rotation of said shaft, a driven shaft disposed in laterally spaced, parallel relation to said drive shaft and having a radially projecting portion terminating in a peripheral surface coincident with a circle which is of a diameter substantially greater than and is approximately tangential to the surface of said laterally displaceable end of the rotatable drive shaft, spring means operable only upon said axially projecting end of said main drive shaft for resiliently urging said end of the drive shaft toward said radially projecting portion of the driven shaft whereby upon conjoint rotation of said shafts successive lengths of staple-forming wire are intermittently gripped between and advanced by said tangential surfaces of said shafts, gear means respectively fitted on said shafts intermediate their journalled ends for insuring conjoint rotation thereof at equal surface speeds of revolution, and an axially shiftable clutch member rotatable with said driven shaft for rendering said gear means effective to rotate said driven shaft.

5. A wire-stitching machine of the character described comprising a continuously rotatable main drive shaft, a driven shaft disposed in laterally spaced, parallel relation to said drive shaft and having a radially projecting portion terminating in a peripheral surface coincident with a circle approximately tangential to the surface of said drive shaft whereby upon conjoint rotation of said shafts successive lengths of staple-forming wire are intermittently gripped between and

advanced by said tangential surfaces of said shafts, gear means respectively fitted on said shafts intermediate their journalled ends for insuring conjoint rotation thereof at equal surface speeds of revolution, an axially shiftable clutch member rotatable with said driven shaft for rendering said gear means effective to rotate said driven shaft, said clutch member being axially biased for normal disengagement from said gear means whereby to interrupt rotation of said driven shaft, and means operatively associated with said clutch for maintaining it in engagement with said gear means against its normal disengaging bias until after a predetermined length of the staple-forming wire has been advanced into the machine by the aforesaid tangential wire-gripping surfaces of the conjointly rotating drive and driven shafts.

6. In a wire-stitching machine as defined in claim 5 wherein said last-mentioned means includes a revoluble cam roller disposed for accommodation within a cam recess formed in the outer face of the axially biased clutch member.

7. In a wire-stitching machine as defined in claim 5 wherein said clutch member is provided in its rear face with a cam recess adapted for registry with a cam roller journalled for rotation about a relatively fixed axis, said cam roller being adapted to maintain said axially biased clutch member in operative engagement with said gear means until such instant as the cam recess is brought into registry with the cam roller whereupon the clutch member shifts, under its normal bias, out of engagement with said gear means to interrupt rotation of said driven shaft.

8. In a wire-stitching machine of the type having a pivotally suspended anvil adapted to receive and support a predetermined length of wire during a staple-forming operation, a vertically reciprocable cam-follower rod operatively associated with the anvil for temporarily locking it in position during the staple-forming operation, a reciprocatory staple-forming bar operative upon the wire supported by the positionally locked anvil, and a reciprocatory staple-driving bar operative upon the formed staple to drive it into position when the anvil is released and for shifting said anvil clear of the path of movement of said staple-driving bar; a rotatably journalled drive shaft having a freely extending end portion, a driven shaft adapted to be clutched to said drive shaft for conjoint reduced speed rotation therewith, and a cam disk fixed to and rotatable with said driven shaft, said cam disk being provided with angularly related radially extending portions each of which terminates in an arcuate edge coincident with the arc of a circle concentric with said driven shaft, one of said arcuate edges being operative conjointly with the end portion of said rotatable drive shaft to provide a feed mechanism for intermittently advancing successive portions of the staple-forming wire into position to be supported by said anvil and the other of said arcuate edges being operative as the controlling cam for said cam-follower rod, the wire-feeding arcuate edge of the cam disk being coincident with a circle which is of a diameter substantially greater than said end portion of the drive shaft.

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