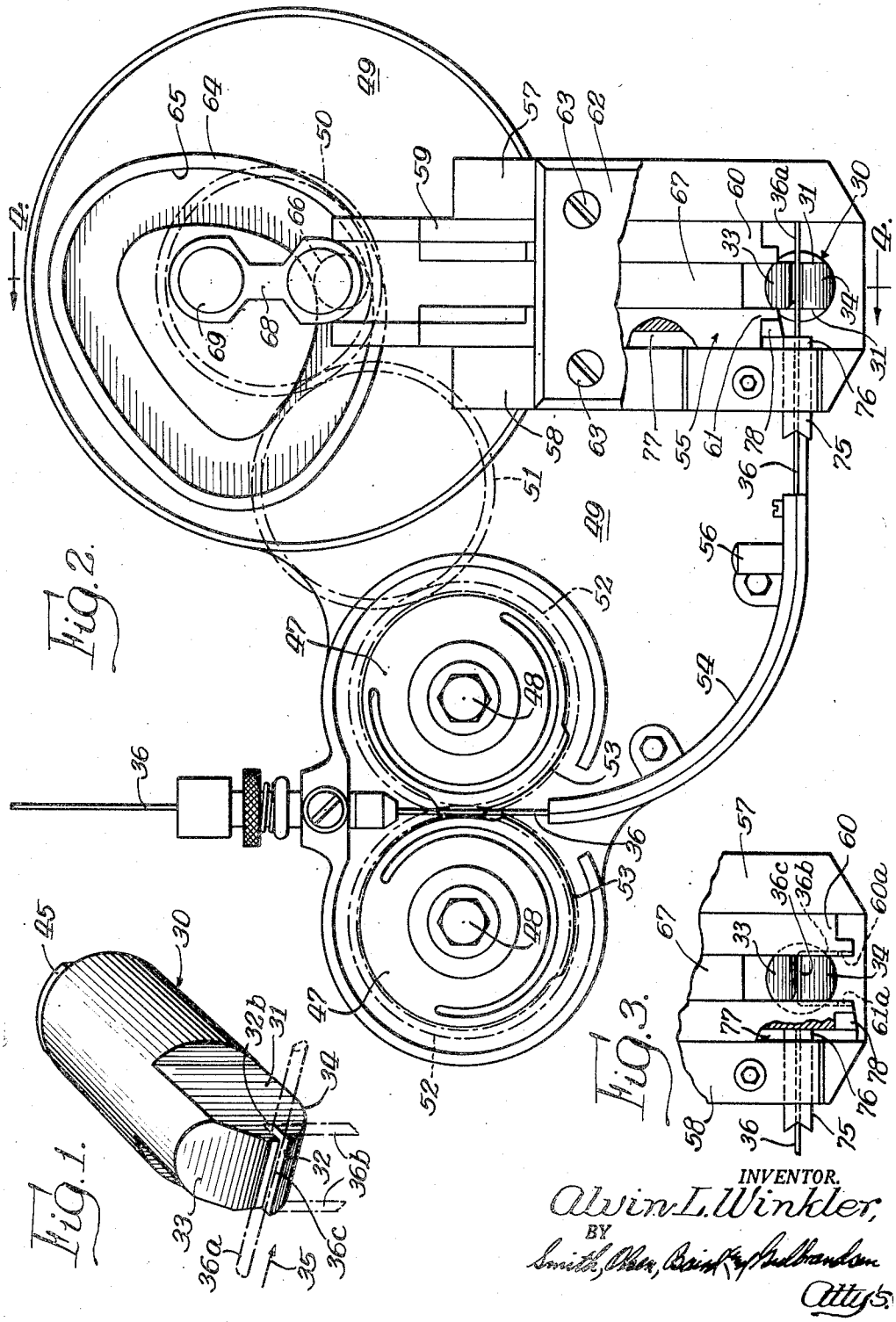
Dec. 28, 1954 A. L. WINKLER 2,697,829

ANVIL CONSTRUCTION

Filed Dec. 14, 1953 4 Sheets-Sheet 1



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ANVIL CONSTRUCTION

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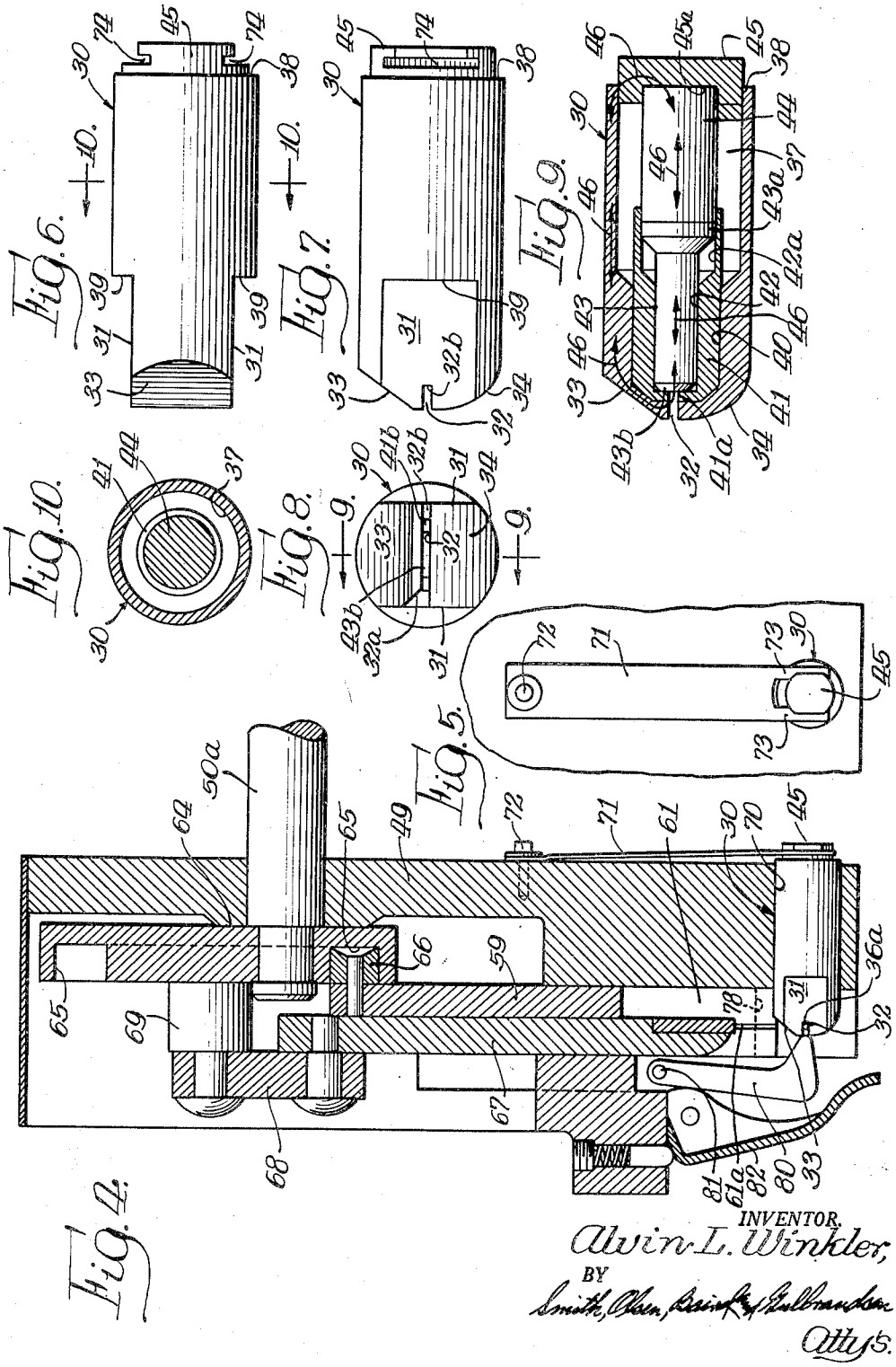


Fig. 6.

Fig. 7.

Fig. 9.

Fig. 10.

Fig. 8.

Fig. 5.

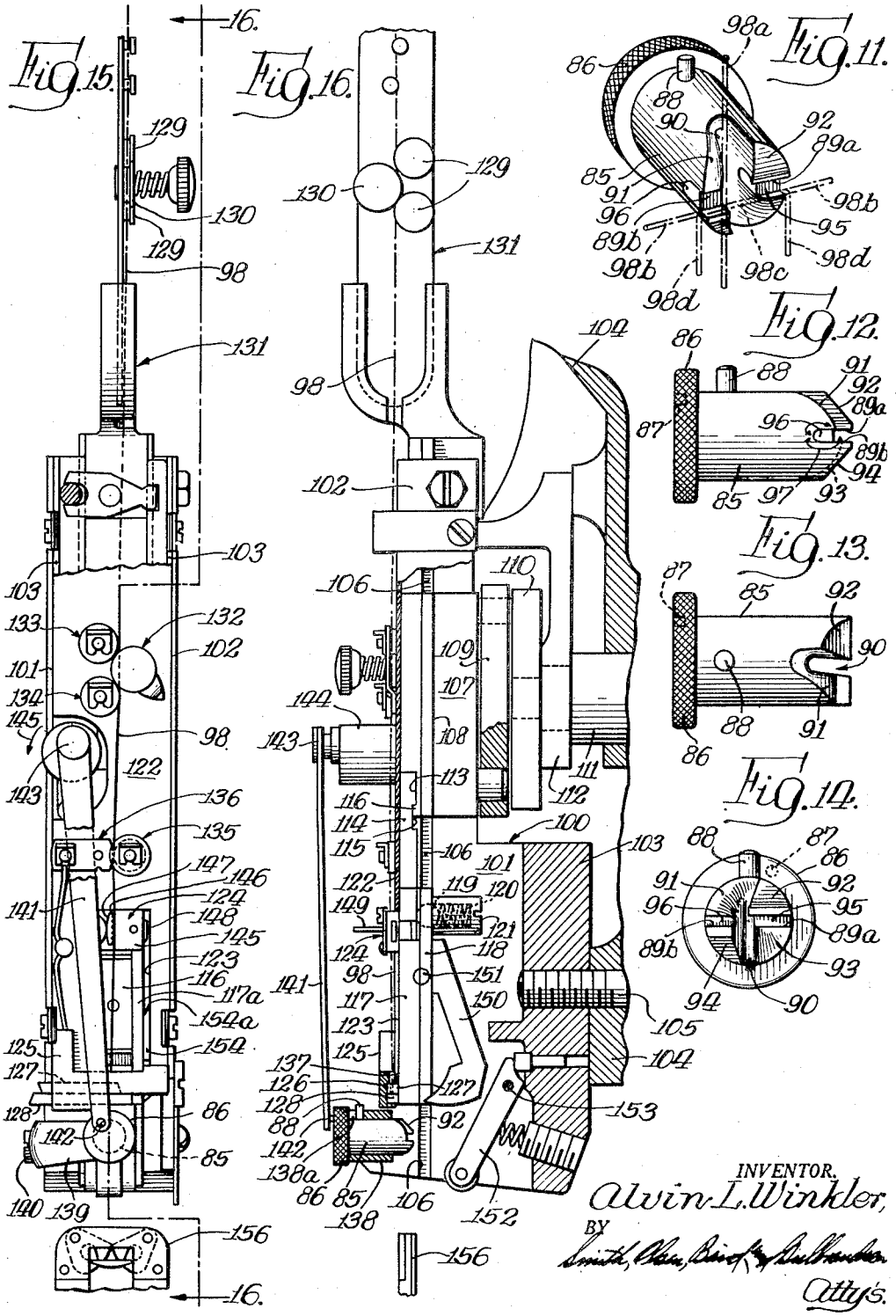
Fig. 4.

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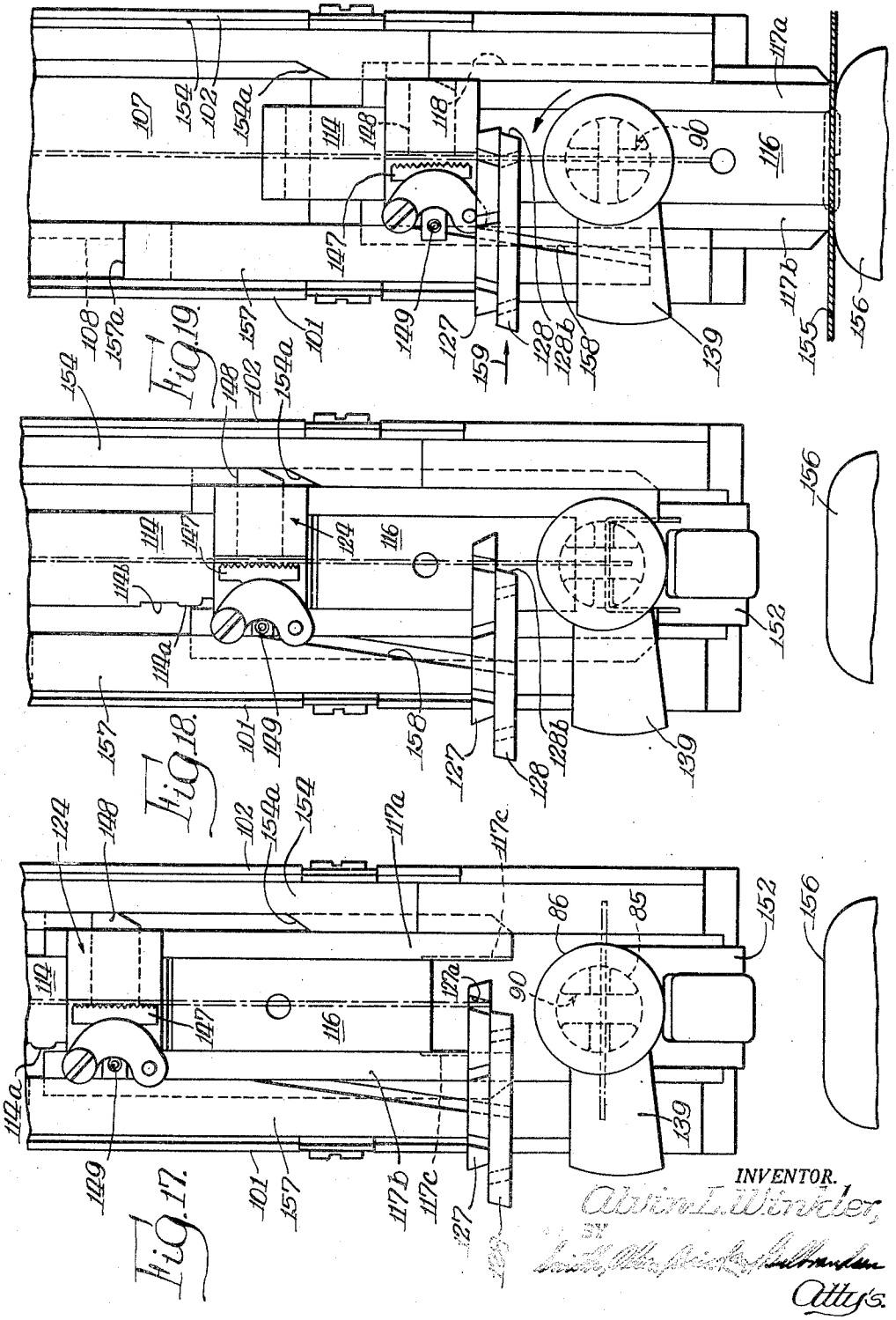
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ANVIL CONSTRUCTION

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ANVIL CONSTRUCTION

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Application December 14, 1953, Serial No. 397,873

18 Claims. (Cl. 1—2)

This invention relates to improvements in wire stapling machines of the kind that automatically drive and clinch staples formed in the machine from wire segments cut from a continuous wire supply. More particularly, the present invention is directed to a highly improved anvil for use in machines of this type.

In automatic wire stapling machines of the kind just mentioned, wire is intermittently advanced into the machine to a position wherein the innermost end portion of the wire lies across or through a slot in an anvil used in the formation of the staples. When the wire has reached this position a cutter automatically severs the end portion of the wire from the wire supply and a staple forming device then comes into contact with the severed wire segment to bend the same over the anvil to form a staple, the opposite ends of the severed segment becoming the legs of the staple. A driving member thereupon moves toward the head of the staple, first displacing the anvil from its staple supporting position, and then contacting the newly formed staple to drive it through a work-piece.

In automatic machine operation of the kind just stated a serious problem arises in gripping the relatively short segment of wire and retaining the same in proper position on the anvil during the brief period that elapses between the time when the segment is cut from the wire supply and the time when it is contacted and bent over the anvil by the staple forming member. In normal operation this time lapse may be only a fraction of a second, but the vibration of the machine and the operation of the cutter are such that the severed segment will often slip or move with respect to the anvil during this interval, causing an improperly shaped staple to be formed unless the segment is firmly retained in its proper position on the anvil. Previously used means for retaining the segment in proper position on the anvil during this period have comprised spring-pressed fingers built either into the anvil itself or constructed and positioned externally of the anvil so as to grip the segment before it is severed and thereafter retain the segment until it is subsequently contacted by the staple forming or driving members. Both schemes have had serious disadvantages. In instances wherein a spring-pressed finger has been embodied in the anvil itself, the anvil necessarily has been relatively expensive and complex in construction. Experience, furthermore, has taught that spring-pressed fingers cannot satisfactorily be embodied within anvils used in the formation of staples having a width less than one-fourth inch for the reason that the finger mechanism will occupy a major portion of the width of the working nose of the anvil, thereby weakening the nose portion of the anvil to a point at which it will not satisfactorily cope with the forces needed to bend wire of the gauge and temper generally used in staples of small size. Externally disposed spring-pressed fingers or plungers have not affected the strength of the anvils with which they have been employed, but in order that a machine embodying an externally disposed finger or plunger may be used to manufacture and drive staples of different widths it has been necessary that the finger or plunger be mounted in such a way that it could be moved from one position to another when an anvil of a different width was employed. The external finger or plunger required positioning close to an anvil for narrow widths to insure contact with the short wire segment and another positioning for the manufacture of staples of wider width to prevent the wider anvil from interfering with the external plunger or finger-like wire gripping means. The need for repositioning the external wire gripping means requires the use of special parts and is consequently undesirable in standardized machines capable of forming and driving staples of a variety of widths.

Another disadvantage encountered in the use of both the external spring-pressed wire gripping fingers or plungers and those embodied within the anvil is that the force of the fingers or plungers on the wire segments has tended to bend the segments in an objectionable manner, particularly when wire of small gauge is used in the stitching machine.

One of the objects of the present invention is to provide, in a machine of the general kind just referred to, an improved anvil having embodied therein only magnetic means for gripping and retaining a segment of wire in proper position on the anvil between the time the segment is severed from the wire supply and the time when it is further acted upon to be formed as a staple and driven, the magnetic means being entirely non-mechanical in nature and thus not being subject to any of the above mentioned disadvantages of prior constructions. A further object of the invention is to provide in an anvil of this character a slot for receiving a length of wire fed by the wire feeding means of the machine, one of the lateral walls of the slot being polarized magnetically to retain the length of wire in the slot during operation thereon by the wire cutting and staple forming means of the machine. Another object of the invention is to provide within the body of the improved anvil a magnetized block having at least one plane surface comprising one of the walls of the wire receiving slot for magnetically gripping and retaining the segment of wire until it can further be acted upon. Still another object of the invention is to provide in the anvil magnetic yoke means, including the body of the anvil and the opposite side walls of the wire receiving slot, for directing and concentrating lines of magnetic flux into the slot for gripping the wire segment.

These and other objects and advantages of the present invention will be apparent from the following description of certain preferred embodiments thereof, taken with the accompanying drawings wherein:

Fig. 1 is a perspective view of one form of the improved anvil;

Fig. 2 is an elevation of an automatic wire stitching machine of a kind in which the anvil of Fig. 1 may be employed;

Fig. 3 is a fragmentary elevational view, partly in cross-section, of the lower portion of the machine of Fig. 2, showing the relative position of the anvil and the staple forming means of the machine after the staple has been formed over the anvil but before driving the staple has begun;

Fig. 4 is a cross-section taken substantially along the line **4—4** in Fig. 2, showing a length of wire in the anvil before the forming operation has begun;

Fig. 5 is a fragmentary elevation of the rear side of the lower portion of the machine, showing a spring means for urging the anvil forwardly in the machine;

Fig. 6 is a top plan view of the anvil of Fig. 1;

Fig. 7 is a side view thereof;

Fig. 8 is a front view of the anvil;

Fig. 9 is a longitudinal cross-section taken substantially along line **9—9** in Fig. 8, showing the interior construction of the anvil;

Fig. 10 is a lateral cross-section taken substantially along line **10—10** in Fig. 6;

Fig. 11 is a perspective view of a second embodiment of the anvil of the present invention;

Fig. 12 is a side view thereof;

Fig. 13 is a top view of the anvil of Figs. 11 and 12;

Fig. 14 is an elevational view of the nose portion of the anvil of Figs. 11 to 13;

Fig. 15 is a front elevation, partly cut away, of a form of automatic wire stitching machine in which the second embodiment of the anvil of the present invention may be employed;

Fig. 16 is a cross-section of the machine taken substantially along line **16—16** in Fig. 15;

Fig. 17 is a schematic illustration showing the lower

front portion of the machine of Figs. 15 and 16 with a front plate removed to disclose the relative positioning of parts at the beginning of a staple forming and driving operation;

Fig. 18 is a similar view showing the position of the parts after the staple has been formed but before driving of the staple has begun; and

Fig. 19 is a like view showing the position of the parts when the staple has been driven and clinched but before the parts have begun to return to their normal positions illustrated in Fig. 17.

The anvil of the present invention, in its first embodiment, is shown in detail in the drawings in Fig. 1 and in Figs. 6 to 10. As there illustrated, the anvil comprises a generally cylindrical body **30**, of mild steel or the like, having two parallel planar work surfaces **31** formed on its opposite sides adjacent its forward end which, for the sake of clarity in description, will be called its nose or working end. A transverse open slot **32**, preferably of rectangular cross-section, is provided in this working end of the anvil body and extends from one work surface **31** to the other, the longitudinal axis of the slot being normal to both surfaces. From a level slightly above the slot **32**, the upper portion of the working end of the anvil body extends upwardly and rearwardly in an inclined planar surface **33**. That portion of the end of the anvil body below the slot, on the other hand, is curved downwardly and rearwardly as at **34** and converges smoothly with the generally cylindrical main portion of the anvil body. The effect of this construction is to provide the front of the anvil body with a forwardly extending nose-like arrangement having the transverse slot **32** formed therein into which stapling wire may be fed endwise in the direction shown by the arrow **35** in Fig. 1. In order to make it easier to feed the wire into the slot, the upper wall of the slot at one end thereof may be beveled upwardly as at **32***a* (Fig. 8) in order to provide a larger mouth for the slot.

The wire stapling machine in which this particular form of the anvil may best be employed, and the manner in which the anvil performs in the machine, will be described presently. At this point in the description, however, it will suffice to state that after a length of wire **36***a* has been fed endwise into the slot **32** to substantially the position shown by the straight broken lines in Fig. 1, with a portion of the wire extending from the opposite ends of the slot **32**, the wire is cut or severed from the wire supply and a staple former is thereupon passed downwardly in straddling fashion alongside the working surfaces **31** to bend the protruding ends of the wire downwardly to form a staple having legs **36***b*. During this operation, it will be seen that the portion **36***c* of the wire contained within the slot **32** becomes the crown or upper portion of the newly formed staple.

The anvil body **30** is hollow and, as will presently be explained, it forms a shell for contents that act forcibly to retain or grip the length of wire **36***a* in the slot **32** during the severing and bending operations just referred to.

The anvil body **30** is provided with a large cylindrical bore **37** extending axially inwardly from the rear end **38** thereof to a point short of shoulders **39** that define the innermost vertical edges of the working surfaces **31** on the sides of the body. From the inner end of the bore **37** the interior of the anvil body is provided with a smaller bore **40** that extends forwardly into the nose portion or the working end of the anvil body, the innermost or forward end of this bore **40** being progressively reduced in diameter and intersecting the slot **32** in the back wall **32***b* thereof. Fitted within the smaller bore **40** is a generally cylindrical sleeve member **41** formed of non-magnetic material, such as stainless steel, fiber, or plastic or the like, having high magnetic reluctance. This sleeve member conforms to the shape of the interior of the bore **40** and has a transverse slot **41***a* provided in its forward end which mates with and provides a continuation of the slot **32** in the forward end of the anvil body, the rear wall **41***b* of the slot in the sleeve being flush with the rear wall **32***b* of the corresponding portion of the slot in the anvil body **30**. The sleeve member is also provided with a longitudinal cylindrical bore **42** which, at its forward end, intersects the slot **41***a* in the rear wall **41***b* thereof (Fig. 8). The rear portion **42***a* of the bore **42** is of increased diameter and contains a cylindrical base **43***a* of a soft iron cylindrical block or core **43** contained within the bore **42**. As will best be seen in Fig. 9, this soft iron core **43** extends forwardly from its base portion **43***a*, the principal part of the core being of a diameter less than its base portion and conforming to the diameter of the bore **42** within which it is contained. The forward end **43***b* of the core **43** (Figs. 8 and 9) is flush with and forms a part of the rear wall of the slot **32**.

The enlarged rear portion **42***a* of the bore **42**, in addition to containing the base **43***a* of the core **43**, contains and supports one end of a cylindrical permanent magnet **44** in abutting engagement with the base of the core, the opposite end of the magnet being snugly received and supported within a recess **45***a* formed on the inner surface of a mild steel block **45** press-fitted into the open end of the bore **37** at the rear of the anvil body. The permanent magnet **44** has the same diameter as the base **43***a* of the core **43** and is preferably formed of a highly magnetic alloy such, for example, as the well-known aluminum-nickel-cobalt alloy now sold commercially under the name "Alnico 5," and its two magnetic poles are located adjacent its opposite ends along its longitudinal axis.

Lines of magnetic flux tend always to follow a path of least reluctance. It will therefore be seen that in the anvil just described, lines of flux emanating from the permanent magnet **44** will travel in a magnetic circuit, the upper half of which is indicated in Fig. 9 by the arrows **46**. As there shown, the parts providing the path for this magnetic circuit comprise the magnet **44**, the tightly fitting rear block **45**, the body **30** of the anvil, and the core **43**—**43***a* which firmly abuts the left-end of the magnet, as viewed in Fig. 9. The only material reluctance in this magnetic circuit is that created by the small air gap in the slot **32**, but this particular reluctance is greatly reduced when a length of wire is received in the slot, thereby producing an almost completely closed magnetic circuit through which the lines of flux are heavily concentrated and act firmly to grip and retain the length of wire in the slot while the wire is being severed and bent into staple shape. The annular air space in the bore **37** around the lateral sides of the magnet **44** of course has a very high reluctance and the same effect is produced laterally around the core **43**—**43***a* by the sleeve **41** which is non-magnetic and thus has substantially the same reluctance value as air. It will also be noted that the end **43***b* of the core **43** does not touch the interior of the body **30** of the anvil but is separated therefrom by the highly reluctant end portion of the sleeve **41**. The high reluctance value of the air space about the magnet **44** and of the sleeve **41** about the core **43**—**43***a* prevents the lines of flux traveling in the body **30** of the anvil from being prematurely shorted back to the magnet **44**, and the effect of this is to focus and direct a high concentration of lines of flux into the slot **32**, the body **30** of the anvil constituting a magnetic yoke for this purpose.

It will be seen that the concentration or density of the magnetic flux in the slot **32** in the anvil is also increased by the fact that the end portion **43***b* and the main body portion of the core **43** is of smaller diameter than the magnet **44**. This further increases the flux density in the slot and increases the holding or gripping power of the anvil. The flux density in the slot may still further be increased by permanently magnetizing the shell-like anvil body **30** before or after the anvil is assembled. When the body **30** of the anvil is permanently magnetized prior to assembly, care should be exercised to insure that the magnet **44** is inserted into the shell during assembly in a position such that the flux generated by the magnetized shell will be additive to that generated by the magnet.

The automatic wire stitching machine in which the anvil just described may best be used is illustrated in Figs. 2 to 5. Machines of this general type are well-known in the art and need not be described in great detail here. The machine comprises a pair of feed rollers **47** each of which is mounted on a shaft **48** rotatably carried on a supporting plate or frame member **49**. The rollers **47** are rotated in synchronism and in opposite directions by a gear **50**, carried and driven by a drive shaft **50***a* (Fig. 4), and by a pinion **51** which meshes with a gear **52** carried upon the back of the right-hand roller **47**, as seen in Fig. 2. This latter gear meshes with an identical gear **52** carried on the back of the other roller. The drive shaft **50***a* is operatively connected to a driving motor or other source of power, not shown.

Each roller **47** has a peripheral cam **53** formed thereon, with feeding of the staple wire **36** between the rollers

47 taking place when portions of the cams 53 are opposite each other. A detailed description of the operation of these rollers 47 and their cams 53 may be found in U. S. Patent No. 2,199,241. It will suffice here merely to state that the rollers act to advance the wire 36 intermittently, once upon each complete cycle of the machine. The wire 36 from the feed rollers 47 enters a wire guide 54 having a passage therein for slidably receiving the wire and directing the same to a wire cutting device indicated generally by the numeral 55. During its passage through the wire guide 54 the wire may pass under a wire check 56 of the kind described in detail in U. S. Patent No. 2,478,397.

The plate or frame member 49 has formed thereon a pair of upright spaced projections 57 and 58 which constitute a guideway for a vertical reciprocating sliding block 59 that has a pair of staple formers 60 and 61 formed on its lower end in spaced apart relation. Retention of the block 59 between the projections 57 and 58 is accomplished by a cover plate 62 extending across and secured to the projections 57 and 58 by screws 63. The sliding block 59 is reciprocated by means including a cam member 64 mounted upon the inner end of the drive shaft 50*a*. A cam groove 65 in the cam is adapted to receive a roller 66 carried on the sliding block 59 adjacent its upper end. From Figs. 2 and 4 it will be understood that the block 59 completes a downward stroke and returns to its uppermost position once during each complete revolution of the cam 64.

Slidably supported between the staple formers 60 and 61, for reciprocating movement, is a staple driver 67 that is pivotally connected adjacent its upper end to one end of a connecting link 68 (Fig. 4) which has its opposite end rotatably supported upon a stub shaft 69 fixed upon the forward face of the cam member 64 in a position offset with respect to the axis of the drive shaft 50*a*. It will thus be seen that the staple driver 67 is reciprocated upwardly and downwardly as the shaft 50*a* revolves. The arrangement of the parts is such that the feed rollers 47, the staple formers 60 and 61, and the staple driver 67 are operated in a timed relation, with each being moved through a complete cycle during one revolution of the shaft 50*a*.

The anvil described above is located in the machine between the plate projections 57 and 58, and below the staple driver 57, in a path that lies between the staple formers 60 and 61. The anvil is slidably supported in a round transverse opening 70 (Fig. 4) in the plate member 49. A leaf spring 71 is secured at one of its ends by a screw 72 to the back of the plate 49 and extends downwardly to a position in alignment with the back end of the opening 70 where the lower end of the spring 71 is bifurcated as at 73. These bifurcations are received in parallel slots 74 formed in the rear block 45 of the anvil and prevent rotation of the anvil body 30 within the opening 70. At the same time, the leaf spring 71 yieldingly urges the anvil body 30 forwardly.

The wire 36 from the wire guide 54 passes through a cutter tube 75 carried in the plate projection 58, the staple former 61 being provided with a longitudinal groove 77 for slidably receiving the extended innermost end 76 of the cutter tube. A cutting tool 78 is mounted on the lower end of the staple former 61 for reciprocal movement therewith in a path across the end 76 of the cutter tube 75, the wire 36 being cut by the tool 78 as the tool passes across the wire opening in the cutter tube.

In the operation of the stitching machine just described the wire 36 is fed by the feed rollers 47 through the guide 54 and the cutter tube 75 into the transverse slot 32 in the anvil while the staple formers 60 and 61 and the staple driver 67 are in their uppermost positions as shown in Fig. 2. Upon completion of the feeding operation, the staple formers and the staple driver are moved downwardly by the cam 64. In the initial phase of this downward movement the block 59, and the staple formers 60 and 61 that are formed thereon, descends at a rate more rapid than that of the staple driver. As the staple formers 60 and 61 approach the length of wire 36*a* contained in the slot 32 of the anvil, the cutting tool 78 severs the wire as it passes the end 76 of the cutting tube 75. The cutting of the length of wire 36*a* in this operation, however, does not disturb or dislodge the wire from the slot 32 because it is firmly gripped or held therein by the magnetic field of flux in the slot. The length of wire 36*a* is thus retained in its proper position on the anvil, and when the staple formers 60 and 61 contact the wire, the ends of the wire protruding from the slot 32 are bent downwardly along the working surfaces 31 on the sides of the forward end of the staple body, the protruding ends of the length of wire 36*a* becoming the legs 36*b* of a newly formed staple. The legs 36*b* of the formed staple are thereupon retained in slots 60*a* and 61*a* (Fig. 3) provided in the staple formers 60 and 61, respectively, while the staple driving member 67 drives the staple.

As the staple driver approaches its driving position the lower edge thereof strikes the oblique surface 33 on the front of the anvil body 30, forcing the anvil body rearwardly in the opening 70 against the compression of the leaf spring 71. Inasmuch as the legs 36*b* of the newly formed staple are retained in the slots 60*a* and 61*a* in the staple formers 60 and 61, this rearward movement of the anvil body 30 withdraws the anvil from the staple, the force against the oblique surface 33 of the anvil being sufficient to overcome the magnetic attraction between the formed staple and the anvil. The staple driver then contacts the crown 36*c* of the newly formed staple and drives it downwardly into a carton or other work piece.

A member 80 (Fig. 4) is pivoted at 81 to the staple formers 60 and 61 for pivotal movement therebetween, the member 80 being yieldably movable to a position between the staple formers by a spring-pressed member 82 movably carried on the cover plate 62. The pivoted member 80 provides a support to prevent the staple legs from bending inwardly toward each other during the staple driving operation. The member 80 is pivoted outwardly from between the staple formers by the driver 67 as it approaches its lowermost position during the downstroke.

A second embodiment of the anvil of the present invention is best shown in Figs. 11 to 14 and is intended for use in a wire stitching machine of another type that is illustrated in Figs. 15 and 16 and in Figs. 17 to 19. The anvil in this form is comprised of a cylindrical body 85 having a knurled shoulder 86 formed on one end thereof, the shoulder being of a larger diameter than the body 85. The shoulder 86 has a small cylindrical opening 87 formed in its rear surface adjacent its periphery for receiving an impelling pin later to be described, and the cylindrical body 85 has a camming pin 88 extending radially outwardly therefrom, the purpose of which will also be described below. The inner end or nose of the anvil body 85 is provided with a transverse slot that is divided into two portions 89*a* and 89*b* by the intersection therewith of a much wider and deeper vertical slot designated generally by the numeral 90, both of the slots being formed substantially at right angles to one another and passing substantially through the longitudinal axis of the cylindrical body 85. As best seen in Fig. 14, the slots roughly divide the nose end of the anvil into quadrants. A surface 91 on the end of the anvil body, beginning at the upper edge of the slot 89*b* is curved upwardly, rearwardly and inwardly to merge with the slot 90 in a smooth complex curve, while a surface 92, beginning slightly above the upper edge of the slot 89*a* is beveled upwardly and rearwardly in a diagonally disposed plane. A surface 93, beginning at the lower edge of the slot 89*a* is shaped substantially like the surface 91 in that it curves downwardly and inwardly to merge smoothly with the interior of the vertical slot 90, and a surface 94 in the remaining quadrant is shaped substantially like the surface 92 in that it is planar and also slopes rearwardly beginning somewhat below the lower edge of the slot 89*b*.

The rear walls of the slots 89*a* and 89*b* are formed respectively by the forward faces of two permanent magnets 95 and 96 formed of "Alnico 5" or the like, and firmly embedded in the body 85 of the anvil. In its construction, as in the construction of the first embodiment of the invention described above, the body of the anvil forms a magnetic yoke around each magnet and serves to direct and concentrate lines of magnetic flux into the transverse slots 89*a* and 89*b* to firmly retain a length of stitching wire therein from which a staple is to be formed. In the second embodiment of the invention now being described, the path of the flux between the rear end of each magnet and the sides of the two portions 89*a* and 89*b* of the transverse slot is shown by the arrows 97 in Fig. 12.

The wire stapling machine in which this second em-

bodiment of the anvil is employed, and the manner in which it performs in the machine, is described below. It may be helpful at this point in the description, however, to explain that in the machine a length of wire 98*a* is fed endwise in a downward direction through the vertical slot 90 in the anvil to substantially the position shown by the vertical broken lines in Fig. 11 and, at the same time, a staple former straddles the nose of the anvil in a downward direction to bend downwardly the laterally extending end portions 98*b* of a previously severed length of wire 98*c* being firmly gripped or held in the transverse slots 89*a* and 89*b* by the magnetic flux generated therein by the magnets 95 and 96. The downwardly bent portions 98*b* of the segment of wire in the slots 89*a* and 89*b* at this time become the legs 98*d* of a newly formed staple, as shown in Fig. 11. A descending staple driver thereupon comes into contact with the diagonally disposed planar surface 92 on the nose of the anvil to cam the anvil longitudinally to the left (as viewed in Figs. 12 and 13), thereby displacing the nose of the anvil from the path of the driver and withdrawing the anvil from the newly formed staple, the legs 98*d* of the staple being held in place in the staple former. The descending staple driver then comes into contact with the crown of the newly formed staple and drives it downwardly into a carton or other item. At the same time this driving action is taking place, the anvil body 85 is rotated approximately 90 degrees in a clockwise direction (as viewed in Fig. 14) and also is cammed still further longitudinally by the camming pin 88 to receive the length of wire 98*a* in the now empty slots 89*a* and 89*b*. The length of wire 98*a* is thereupon severed from the wire supply and all parts, including the staple former and driver and the anvil, are returned to their original positions. During this returning movement the anvil is rotated counter-clockwise and is advanced back to its original position, carrying the now severed length of wire 98*a* to the exact position previously occupied by the wire 98*b*—98*c*, thus completing one cycle of operation. During the severing of the length of wire 98*a* from the wire supply and during the returning rotation and longitudinal movement of the anvil, the concentration of magnetic flux from the magnets 95 and 96 in the transverse slots 89*a* and 89*b* firmly grips and retains the length of wire 98*a* in proper position within the slots, so that when the cycle of operation is completed the wire 98*a* is positioned properly to be formed into a staple by the staple former and thereupon to be driven by the driver.

The machine in which this second embodiment of the anvil is employed is also of a kind well known in the art. As previously stated, it is illustrated in Figs. 15 and 16 and somewhat schematically in Figs. 17 to 19. The machine is comprised of a channel-like upstanding frame, designated generally by the numeral 100 (Fig. 16), the frame having forwardly projecting side panels 101 and 102 joined together at their lower ends by a heavy cross web 103. The frame 100 which carries the principal parts of the machine may be secured to a base 104 by means of a stud 105 threaded into the web 103.

Each of the side panels 101 has a vertical slot 106 formed in its inner surface. These two opposed vertical slots, only one of which is shown (Fig. 16), face each other and provide a vertical track for guiding and retaining certain reciprocating parts of the machine about to be described. A block 107, having a tongue 108 formed on each of its sides and riding in the slots 106 of the panels 101 and 102, is disposed between the panels and is arranged to be reciprocated up and down by means of a link 109 pivotally mounted at one of its ends to the lower back portion of the block 107 and pivoted at its other end to a crank arm 110 carried and fixed upon the inner end of a rotating drive shaft 111. This drive shaft 111 may be mounted in a suitable bearing support 112 formed on the base 104 (Fig. 16). The forward face of the block 107 adjacent its lower end is provided with a transverse groove 113 that receives in interlocking fashion the upper end of a connecting block 114, this connecting block 114 likewise having a transverse slot 115 on its rear face for receiving a transverse projection 116 formed on the front of the block 107 immediately below the transverse slot 113 therein. The lower end of the connecting block 114 is connected to the upper end of a staple driver 116 in a tongue and groove fashion substantially like that just described. The staple driver 116 is mounted for reciprocal movement between the legs 117*a* and 117*b* of a staple former 117 that, in turn, is mounted for reciprocal movement between the panels 101 and 102 of the frame 100, the staple former 117 being provided on its opposite sides with tongues 118 that ride in the grooves 106 provided in the panels.

The staple driver 116 is arranged for reciprocal motion with respect to the staple former 117, the opposite side edges of the staple driver being provided with tongues (not shown) which ride in suitable grooves provided in the opposed inner surfaces of the legs 117*a* and 117*b* of the staple former. This reciprocal motion of the staple driver 116 with respect to the staple former 117 tends to be arrested, however, by a ball 119 carried by the staple former and caused to be pressed tightly against the back surface of the staple driver 116. Pressure by the ball 119 against the back surface of the staple driver 116 is provided by a compression spring 120 contained within a hollow cap 121 that is threaded into an opening in the staple former 117.

The front of this second machine is enclosed by a face plate 122 that fits into recesses 103 (Fig. 15) formed on the forward edges of the side panels 101 and 102 of the frame 100. The face plate has a rectangular opening 123 therein opposite the normal retracted position of the staple former 117, as best seen in Figs. 15 and 16. This opening 123 provides passage room for a wire feeding mechanism, designated generally by the numeral 124, that is formed in fixed position upon, and extends between, the forward surfaces of the legs 117*a* and 117*b* of the staple former 117. The lower end of the face plate 122 is provided with an outwardly projecting L-shaped frame element 125 having a transverse groove 126 formed in its under surface for containing two coacting wire cutter members 127 and 128.

Wire 98, from which staples are formed and driven by the machine, is fed downwardly into the machine through wire straightener rolls 129 and 130 carried upon a frame element 131 secured at the upper end of the machine between the side panels 101 and 102, and then downwardly through a second wire straightener mechanism, designated generally by the numerals 132, 133 and 134, mounted upon the front of the face plate 122. From the last mentioned wire straightener mechanism, the wire 98 passes downwardly through a unidirectional detent mechanism indicated generally by the numerals 135 and 136, then downwardly through the wire feed mechanism 124 and thence through a small vertical opening 137 provided in the L-shaped frame 125 on the lowermost end of the face plate 122 (Fig. 16). From this small opening 137 the wire 98 passes downwardly through an opening 127*a* (Fig. 17) in the wire cutting member 127, this wire cutting member being located in fixed position within the transverse slot 126 in the L-shaped frame member 125, with the opening 127*a* being in alignment with the small opening 137. From the opening 127*a* in the wire cutting member 127 the wire 98 is fed downwardly through the large slot 90 in the nose portion of the anvil body 85 (Figs. 11 and 19), the anvil being rotatably carried in a cylindrical sleeve 138 (Fig. 16) formed at the end of one leg of an L-shaped frame 139 secured as by a screw 140 (Fig. 15) to the outer surface of the side panel 101 of the frame of the machine.

As illustrated in Figs. 15 and 16, the nose portion of the anvil body 85, in its normal position, is disposed beneath the staple driver 116 and in position such that when the staple former 117 descends, the legs 117*a* and 117*b* thereof will straddle the nose portion of the anvil body.

The anvil body 85 is mounted within the sleeve 138 both for rotation and for longitudinal sliding motion, the anvil being spring pressed into the sleeve by means of a leaf-spring arm 141. The lower end of this leaf-spring arm has a pin 142 formed thereon that is received in the opening 87 provided in the outer end of the anvil. The upper end of the arm 141 is pivotally mounted in an off-center position, as by a pin 143, on a rotor 144 that is turned 90° in the direction of the arrow 145 (Fig. 15) during downward movement of the block 107, this rotation of the rotor 144 being affected by a Geneva movement (not shown) provided in the base of the rotor and on the block 107. As will be more fully brought out

hereinafter, the lower end of the staple driving member **116** engages the diagonal surface **92** on the nose of the anvil body **85** during the downward stroke of the staple driver, thereby sliding the anvil body to the left, as viewed in Fig. 16, whereafter the Geneva movement just mentioned comes into play to turn the rotor. Counterclockwise rotation of the rotor, through the medium of the leaf spring arm **141**, turns the anvil approximately 90° in the sleeve **138**, the anvil being cammed further to the left (again as viewed in Fig. 16) during this rotative movement by means of the camming pin **88** thereon which rides in a camming slot **138***a* formed in the sleeve **138**.

With this general arrangement of the machine in mind, the operation of the machine and the anvil therein will readily become apparent. At the beginning of each cycle of operation, the block **107**, the connecting block **114**, the staple driver **116** and the staple former **117** begin to descend as a unit. During this downward motion the wire feeding mechanism **124** feeds the wire **98** downwardly through the opening **127***a* of the stationary wire cutting member **127** and into the large slot **90** in the anvil. The wire feeding member itself is comprised of a block **145** fixed upon the front of the staple former **117**, one side **146** of the block serving as one jaw of the wire feeding mechanism. Cooperating with this side of the block is a movable jaw **147** formed on one end of a camming block **148** that is slidably mounted and extends through the block **145**. During the first part of the downward stroke, the jaw **147** is pressed toward the side **146** of the block **145**, with the wire **98** gripped therebetween, by an outwardly projecting wire spring **149** (Fig. 16). As the staple former and driver descend, the legs **117***a* and **117***b* of the staple former come into contact and bend downwardly the extending portions **98***b* of a severed length of wire **98***c* previously received and being magnetically retained within the transverse slots **89***a* and **89***b* in the nose portion of the anvil. This operation forms the length of wire **98***c* into a new staple, as shown in Fig. 17.

As the new staple is being formed, a staple holder **150** pivotally mounted at **151** to the back side of the staple former **117** comes into camming contact with a spring biased lever **152** that is pivotally mounted upon a pin **153** extending between the panels **101** and **102** of the frame. The lower end of the staple holder **150** is cammed forwardly by the lever **152** to a position between the newly formed legs **98***d* of the new staple, these legs at the same time being retained in shallow grooves **117***c* formed in the opposed surfaces of the legs **117***a* and **117***b* of the staple former (Figs. 17 and 18). Further descending movement brings the staple driver **116** into contact with the slanting surface **92** on the nose of the anvil, thereby displacing the anvil to the left (as viewed in Fig. 16) and out of the path of the staple driver. This displacement of the anvil leaves the newly formed staple in the grooves **117***c* in the staple former, where the new staple is supported by the staple holder **150** in position to be contacted and driven downwardly by the lower end of the staple driver **116**. At the time the staple driver **116** engages the top of the staple, the block **107** has moved downwardly to a position at which the Geneva movement thereon begins to rotate the rotor **144** in the direction of the arrow **145** to begin rotation of the anvil through the agency of the leaf-spring lever **141**. When the anvil has been turned approximately 30° the camming block **148** of the wire feed mechanism **124** engages a cam surface **154***a* on a bar **154** positioned on the right side of the staple former, as viewed in Figs. 15 and 17 to 19. Engagement of the camming bar **148** with the camming surface **154***a* cams the block **148** to the left, thereby separating the jaw **147** from the jaw **146** of the wire feed mechanism **124** and halting the downward motion of the wire **98** in the deep slot **90** in the nose portion of the anvil.

Immediately after the wire feeding mechanism **124** has been opened as just described, the bottom ends of the legs **117***a* and **117***b* of the staple former **117** bottom against the workpiece **155** disposed upon a staple clinching anvil **156** (Figs. 17 to 19), thereby stopping the downward motion of the staple former. The staple driver **116**, however, continues to be driven downwardly by further downward motion of the block **107** and the connecting block **114**, relative lost motion between the driver **116** and the staple former **117** being permitted by frictional movement between the spring pressed ball **119** and the back surface of the staple driver **116**. This last phase of the downward movement of the staple driver drives the newly formed staple through the work piece **155** and against the clinching anvil **156** to clinch the staple as shown in Fig. 19. During this last part of the driving motion of the staple driver, the anvil body **85** is rotated to its full 90° position where the slots **89***a* and **89***b* therein receive the downwardly extending length of wire **98***a* that was fed into the large slot **90** in the anvil before the wire feeding mechanism **124** was opened.

During the last portion of the downward movement of the block **107**, the lower end of one of the tongues **108** thereon comes into contact with the upper end **157***a* of a bar **157** that is slidably disposed on the left side of the staple former, as best seen in Figs. 17 to 19. Contact by the end of the tongue **108** of the block **107** with the upper end of the bar **157** forces the bar downwardly. The bar **157** has a diagonal camming groove **158** formed therein within which a projection (not shown) on the wire cutter **128** rides. The downward motion of the bar **157** thus slides the wire cutting member **128** to the right, as illustrated by the arrow **159** in Fig. 19, causing the end **128***b* of the member **128** to slide beneath the opening **127***a* in the stationary cutter member **127**, thereby severing the wire **98** and leaving the severed portion **98***a* thereof magnetically retained in the slots **89***a* and **89***b* in the anvil body **85**.

During this last phase of the downward motion of the staple driver **116**, the jaw **147** of the wire feeding mechanism **124** is locked to an open position. This is accomplished by means of a camming surface **114***a* and a recessed retaining surface **114***b* formed on one side of the connecting block **114** (Fig. 18). Relative movement of the connecting block **114** and the driver **116** with respect to the staple former **117**, after the staple former has bottomed upon the work **155**, causes the camming surface **114***a* on the block **114** to engage a projection (not shown) on the camming block **148** of the wire feed mechanism **124**, this projection then being received in the recess **114***b* of the block **114** to hold the jaws of the wire feeding mechanism **124** in open position during later returning movement of the staple former **117** to its upper-most position.

When the staple driver **116** has reached the bottom of its stroke, one-half of the cycle of operation has been completed and all parts thereafter begin to return to their original positions shown in Figs. 15, 16 and 17. Because of the frictional engagement between the ball **119** and the back side of the staple driver **116**, the staple former **117** and the driver **116** begin their returning ascent as a unit along with the block **107** and the connecting block **114**. While these parts are rising as a unit the jaws of the wire feeding mechanism **124** are retained in open position by reason of the fact that the previously mentioned projection on the camming slide **148** still remains in the recess **114***b* in the connecting block **114**. When the staple former **117** has been carried upwardly to its original position, however, the upper edge of the block **145** of the wire feeding mechanism strikes the upper edge of the opening **123** in the face plate **122**, thus stopping further upward movement of the staple former. The block **107**, the connecting block **114** and the staple driver **116** continue their upward movement to their original positions, however, and in so doing the projection on the camming block **148** of the wire feeding mechanism is freed from the recess **114***b* in the connecting block, thereby permitting the jaws of the wire feeding mechanism again to be closed on the wire **98** in which condition the wire will again be fed downwardly into the anvil when the next cycle of operation begins.

During the returning ascent of the parts just described the wire cutter member **128** is returned to its original position and the anvil body **85** also is rotated back to normal position, the leaf-spring arm **141** sliding the anvil longitudinally to its original state as soon as the staple driver **116** has cleared the nose of the anvil. During this returning rotation and longitudinal movement of the anvil, the newly severed length of wire is firmly retained in the slots **89***a* and **89***b*, without danger of slipping or displacement, by reason of the magnetic flux generated in these slots by the magnets **95** and **96**. Thus, when the anvil reaches its original position the newly severed

segment of wire is perfectly positioned and ready to be formed into a staple and driven during the next cycle of operation.

It will be noted that nothing is involved in the construction of either of the anvils described above tending to weaken them, for the need for providing spring-pressed fingers in the anvils has been entirely avoided. Thus, anvils embodying the features of the present invention may be employed in automatic wire stitching machines arranged to produce and drive all sizes of staples, including very narrow ones. The anvil of the present invention furthermore requires no adjustment and there are no parts involved that will quickly become worn or damaged with use. All of the disadvantages, initially referred to herein, inherent in prior constructions are eliminated.

The foregoing description has been given for clearness of understanding only, and no unnecessary limitations should be inferred therefrom. Although only two specific embodiments of the invention have been illustrated and described, it will be apparent to those skilled in the art that various changes may be made in the constructions without departing from the spirit and scope of the appended claims.

I claim:

1. In combination with a wire stitching machine including wire feeding means, means for cutting said wire and a staple former, an anvil comprising, an anvil body adapted to coact with said staple former in the formation of staples, said body having an open transverse slot in one end thereof for receiving a length of wire fed by said wire feeding means, one of the lateral walls of said slot being polarized magnetically to retain said length of wire in said slot during operation thereon by said cutting means and said staple former.

2. In combination with a wire stitching machine including wire feeding means, means for cutting said wire and a staple former, an anvil comprising, an anvil body having opposite side surfaces adapted to cooperate with said staple former for shaping a staple, said body having an open transverse slot in one end thereof for receiving a length of wire fed by said wire feeding means, one of the lateral walls of said slot being polarized magnetically to retain said length of wire in said slot during operation thereon by said cutting means and said staple former.

3. In combination with a wire stitching machine including wire feeding means, means for cutting said wire and a staple former, an anvil comprising, an anvil body adapted to coact with said staple former in the formation of staples, said body having an open transverse slot in one end thereof for receiving a length of wire fed by said wire feeding means, and a magnetic flux producing element in said body creating a magnetic field of force in said slot for retaining said length of wire in said slot during operation thereon by said cutting means and said staple former.

4. In combination with a wire stitching machine including wire feeding means, means for cutting said wire and a staple former, an anvil comprising, an anvil body adapted to coact with said staple former in the formation of staples, said body having an open transverse slot in one end thereof for receiving a length of wire fed by said wire feeding means, and a magnetized block in said body having at least one plane surface comprising one of the walls of said slot for retaining said length of wire in said slot during operation thereon by said cutting means and said staple former.

5. In combination with a wire stitching machine including wire feeding means, means for cutting said wire and a staple former, an anvil comprising, an anvil body adapted to coact with said staple former in the formation of staples, said body having an open transverse slot in one end thereof for receiving a length of wire fed by said wire feeding means, and a magnetized block in said body having a surface at one of its ends forming at least a part of the innermost wall of said slot, said body and the opposite side walls of said slot providing a magnetic yoke through which lines of magnetic force may flow between the opposite end of said block and said opposed side walls of said slot to retain said length of wire in said slot during operation thereon by said cutting means and said staple former.

6. In a wire stitching machine including wire feeding means, means for cutting said wire, and staple forming means for shaping staples from said wire, the combination comprising, an anvil body adapted to coact with said staple forming means in the formation of staples, said body having a transverse slot therein open at its opposite ends for receiving a length of wire fed by said wire feeding means, magnetic flux producing means in said body, and magnetic yoke means including said body and opposite sides of said slot for directing and concentrating lines of said flux in said slot for retaining said length of wire therein during operation by said cutting means and said forming means upon said length of wire.

7. In combination with a wire stitching machine including wire feeding means, means for cutting said wire and a staple former, an anvil comprising, an anvil body adapted to coact with said staple former in the formation of staples, said body having an open transverse slot in one end thereof for receiving a length of wire fed by said wire feeding means, and a permanent magnet in said body having a surface comprising one of the walls of said slot for retaining said length of wire in said slot during operation thereon by said cutting means and said staple former.

8. In a wire stitching machine including wire feeding means, wire cutting means and staple forming means for shaping staples from said wire, the combination comprising, an anvil body adapted to coact with said staple forming means in the formation of staples, said body having a first open slot in an end thereof for receiving a length of wire as it is fed by said wire feeding means and a second open slot in said end disposed at an angle to and intersecting said first slot, means for rotating said anvil body through said angle to bring said second slot into position previously occupied by said first slot and to receive said length of wire therein, and a magnetized block in said body having a surface thereon forming at least a part of the innermost wall of said second slot for retaining said length of wire in said second slot during operation thereon by said wire cutting means and said staple forming means.

9. In a wire stitching machine including wire feeding means, wire cutting means and staple forming means for shaping staples from said wire, the combination comprising, an anvil body adapted to coact with said staple forming means in the formation of staples, said body having a first open slot in an end thereof for receiving a length of wire as it is fed by said wire feeding means and a second open slot in said end disposed at an angle to and intersecting said first slot, means for rotating said anvil body through said angle to bring said second slot into position previously occupied by said first slot and to receive said length of wire therein, and a pair of permanent magnets in said body on opposite sides of said first slot, each of said magnets having a surface thereon forming at least a part of the innermost wall of said second slot for retaining said length of wire in said second slot during operation thereon by said wire cutting means and said staple forming means.

10. In a wire stitching machine including wire feeding means, wire cutting means and staple forming means for shaping staples from said wire, the combination comprising, a metallic anvil body adapted to coact with said staple forming means in the formation of staples, said body having an open slot in an external surface thereof for receiving a length of wire fed by said wire feeding means, a bore in said anvil body intersecting said slot, magnetic flux producing means in said bore, support means having high magnetic reluctance for supporting said flux producing means within said bore and for physically isolating the same from the inner walls of said bore, and magnetic yoke means including said body for directing magnetic flux from said flux producing means to the interior of said slot for retaining said length of wire therein during operation thereon by said cutting means and said staple forming means.

11. In a wire stitching machine including wire feeding means, wire cutting means and staple forming means for shaping staples from said wire, the combination comprising, an anvil body adapted to coact with said staple forming means in the formation of staples, said body having an open slot in an external surface thereof for receiving a length of wire fed by said wire feeding means and having a cavity intersecting said slot, a core in said cavity, a surface on said core flush with a wall of said slot at the intersection of said cavity and said slot, sup-

port means having high magnetic reluctance for supporting said core and for physically isolating the same from the inner walls of said cavity, and means in said cavity for magnetizing said core to produce a field of magnetic flux in said slot for retaining said length of wire therein during operation thereon by said wire cutting means and said staple forming means.

12. In a wire stitching machine including wire feeding means, wire cutting means and staple forming means for shaping staples from said wire, the combination comprising, a metallic anvil body adapted to coact with said staple forming means in the formation of staples, said body having an open slot in an external surface thereof for receiving a length of wire fed by said wire feeding means, a bore in said anvil body intersecting said slot in the inner wall thereof, a paramagnetic core in said bore having a surface thereon flush with the inner wall of said slot at the intersection of said bore and said slot, support means having high magnetic reluctance for supporting said core and for physically isolating the same from the walls of said bore, means for magnetizing said core, and a magnetic circuit including said core and said anvil body for directing and concentrating lines of magnetic flux in said slot for retaining said length of wire therein during operation thereon by said cutting means and said staple forming means.

13. In a wire stitching machine including wire feeding means, wire cutting means and staple forming means for shaping staples from said wire, the combination comprising, a metallic anvil body adapted to coact with said staple forming means in the formation of staples, said body having an open slot in an external surface thereof for receiving a length of wire fed by said wire feeding means, a bore in said anvil body intersecting said slot in the inner wall thereof, a paramagnetic core in said bore having a surface at one of its ends flush with the inner wall of said slot at the intersection of said bore and said slot, support means having high magnetic reluctance for supporting said core and for physically isolating the same from the walls of said bore, means at the opposite end of said core for magnetizing the same, and a magnetic circuit including said core and said anvil body for directing and concentrating lines of magnetic flux in said slot for retaining said length of wire therein during operation thereon by said cutting means and said staple forming means.

14. In a wire stitching machine including wire feeding means, wire cutting means and staple forming means for shaping staples from said wire, the combination comprising, a metallic anvil body adapted to coact with said staple forming means in the formation of staples, said body having an open slot in an external surface thereof for receiving a length of wire fed by said wire feeding means, a bore in said anvil body intersecting said slot in the inner wall thereof, a paramagnetic core in said bore having a surface at one of its ends flush with the inner wall of said slot at the intersection of said bore and said slot, support means having high magnetic reluctance for supporting said core and for physically isolating the same from the walls of said bore, a permanent magnet abutting said core at its opposite end for magnetizing said core, and a magnetic circuit including said core and said anvil body for directing and concentrating lines of magnetic flux in said slot for retaining said length of wire therein during operation thereon by said cutting means and said staple forming means.

15. In a wire stitching machine including wire feeding means, wire cutting means and staple forming means for shaping staples from said wire, the combination comprising, a metallic anvil body adapted to coact with said staple forming means in the formation of staples, said body having an open slot in an external surface thereof for receiving a length of wire fed by said wire feeding means, a cavity in said anvil body intersecting said slot in the inner wall thereof, a paramagnetic core in said cavity having a surface on its outer end flush with said inner wall of said slot at the intersection of said bore and said slot, support means having high magnetic reluctance for supporting said core and for physically isolating the same from the walls of said cavity, and means at the inner end of said core for magnetizing the same and thereby producing a field of magnetic flux in said slot for retaining said length of wire therein during operation thereon by said cutting means and said staple forming means.

16. In a wire stitching machine including wire feeding means, wire cutting means and staple forming means for shaping staples from said wire, the combination comprising, a metallic anvil body adapted to coact with said staple forming means in the formation of staples, said body having an open slot in an external surface thereof for receiving a length of wire fed by said wire feeding means, a cavity in said anvil body intersecting said slot in the inner wall thereof, a paramagnetic core in said cavity having a surface on its outer end flush with said inner wall of said slot at the intersection of said bore and said slot, support means having high magnetic reluctance for supporting said core and for physically isolating the same from the walls of said cavity, and means at the inner end of said core for magnetizing the same and thereby producing a field of magnetic flux in said slot for retaining said length of wire therein during operation thereon by said cutting means and said staple forming means, said core being of greater cross-section at its said inner end than at its said outer end for intensifying said field of magnetic flux.

17. In a wire stitching machine including wire feeding means, wire cutting means and staple forming means for shaping staples from said wire, the combination comprising, a metallic anvil body adapted to coact with said staple forming means in the formation of staples, said body having an open slot in an external surface thereof for receiving a length of wire fed by said wire feeding means, a bore in said anvil body intersecting said slot at its inner wall, a cylindrical paramagnetic core in said bore having a surface at its outermost end flush with the inner wall of said slot at the intersection of said bore and said slot, said core being of smaller diameter at said outer end than at its opposite end, support means having high magnetic reluctance for supporting said core and for physically isolating the same from the walls of said bore, a permanent cylindrical magnet in said core having one of its ends supported by said support means in abutting relation to said opposite end of said core, and paramagnetic means engaging the walls of said bore for supporting the other end of said magnet, said paramagnetic support means, said core, said magnet and the body of said anvil providing a magnetic circuit for directing lines of magnetic flux into said slot for retaining said length of wire therein.

18. An anvil for holding a work-piece comprising, a metallic anvil body having a cavity in an exterior surface thereof for loosely receiving said work-piece, a bore in said anvil body intersecting said cavity, a paramagnetic core in said bore having a surface thereon substantially flush with an inner surface of said cavity at the intersection of said bore and said slot, support means having high magnetic reluctance for supporting said core and for physically isolating the same from the inner walls of said bore, and means for magnetizing said core to produce a magnetic field in said cavity for retaining said work-piece therein.

No references cited.