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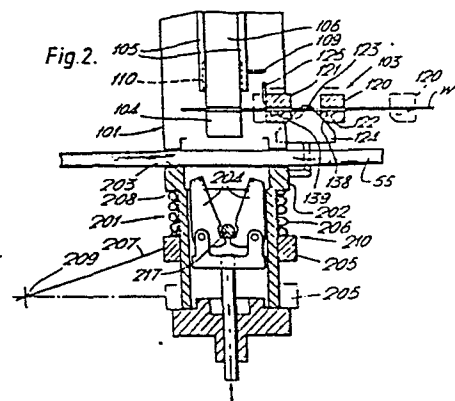
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54 Improvements in stitchers.

57 A stitcher including an anvil 104, a former 105 for forming a length of cut wire about the anvil 104 into a staple, and a driver 106 for driving the staple. The anvil is retractable and acts as a support for the staple during driving. The anvil is locked against movement during forming, and movement of the former 105 acts to release the anvil to permit it to move out of the path of the driver 106 during driving while supporting the staple. (Figures 2 and 5.)



IMPROVEMENTS IN STITCHERS

This invention relates to stitchers and particularly to such apparatus for binding sets or signatures of sheets or documents. Stitchers take various well-known forms. There are those (called staplers) which use pre-formed staples, those using pre-cut lengths of wire which are formed in the machine and those in which the staples are formed from a continuous wire wound on a spool from which pieces are cut and formed in the machine. In each case the legs of the formed staple or stitch are driven through the set until the crown of the staple lies against one face of the set and the ends of the staple legs are bent over against the opposite face of the set to form clinches. The present invention is concerned with stitchers of the kind in which the staples are formed in the stitcher either from wire stock or from pre-cut wire lengths.

When forming a staple from cut wire it is necessary that that portion which is to form the crown of the staple be supported. Subsequently this support must be retracted to permit the formed staple to be driven. It is further desirable that the staple be supported during driving since otherwise the resistance of the set may cause the staple to buckle and be improperly driven. In U.S. Patent No. 3876129 the cut wire is supported in a swivel while the wire is formed into a staple



using a former having grooves to accommodate the legs of the formed staple. The swivel is then acted upon by the driver to release the staple. A separate support member by which, in cooperation with the former, the legs of the staple are supported during driving is now moved into position beneath the driver. The support member is spring loaded and is progressively retracted during driving by a bar attached to the driver.

In U.S. Patent Nos 3751961 and 3917145 the same member about which the cut wire is formed acts also to support the staple during driving. As described and shown in U.S. Patent No. 3917145 this arbor or anvil is pivotally mounted and the staple wire is formed about the anvil by a grooved former (the grooves forming supports for the legs of the staple). The anvil is held in position during staple formation by a strong spring and is then pushed out of the way against the spring by the driver as it drives downwardly against the formed staple. During driving the staple is supported by the anvil, the staple crown being supported on the anvil and the staple legs being supported between the former and the anvil. However, although such an arrangement is less complicated and supports the staple during driving using the same member about which the staple is formed, the force available to drive the driver must also be sufficient to overcome the strong resistance of the anvil necessitated by the requirement that the anvil resist movement during the forming step.

It is an object of this invention to provide a stitcher in which a reduced driver force is required when the same anvil supports the wire during forming and the formed staple during driving.

To this end, the invention provides a stitcher including an anvil, a former for forming a length of cut wire about the anvil into a staple, and a driver for driving the staple, said anvil being retractable and acting as a support for the staple during driving, wherein the anvil is locked against movement during forming and movement of the former acts to release the anvil to permit it to move out of the path of the driver during driving while supporting the staple.

In one preferred form of the invention the anvil is pivotally mounted and spring-biassed to its forming position, being held against movement during forming by a latch which is acted upon to release the anvil by the former. Instead of a mechanical lock, a geometric lock may be utilised for the anvil.

The stitcher may be incorporated with a sheet stitcher/compiler as part of a finisher for a photocopier and such a finisher may form part of the photocopier or take the form of a separate unit.



In order that the invention may be more readily understood, reference will now be made to the accompanying drawings in which:-

Figure 1 is a schematic side elevation of an exemplary form of photocopier having a finisher incorporating a stitcher according to this invention,

Figure 2 is a schematic view illustrating the principles of one embodiment of stitcher of this invention suitable for use in the finisher of Figure 1,

Figure 3 is a scrap view of the stitcher shown in Figure 2 illustrating schematically the relationship of various of its major parts,

Figure 4 is a schematic perspective view of the clincher showing the drive therefor,

Figure 5 shows one embodiment of locking mechanism for the anvil,

Figure 6 is a side elevation of a second embodiment of stitcher suitable for use in the machine shown in Figure 1, and

Figure 7 is a section through the stitcher head of Figure 6



showing the locking mechanism for the anvil in greater detail.

Referring to Figure 1 there is shown an automatic xerographic reproducing machine 10 having a finisher 70 incorporating a stitcher 100 according to this invention. The copying machine 10 is capable of producing either simplex or duplex copies in sets from a wide variety of originals which may be advanced in recirculating fashion by recirculating document apparatus 12 described in U.S. Patent No. 3556512. Although the present invention is particularly well suited for use in automatic xerography, the apparatus generally designated 100 is equally well adapted for use with any number of devices in which cut sheets of material are delivered or compiled in a set or stack.

The processor 10 includes a photosensitive drum 15 which is rotated in the direction indicated so as to pass sequentially through a series of xerographic processing stations: a charging station A, an imaging station B, a developer station C, a transfer station D and a cleaning station E.

A document to be reproduced is transported by document handling apparatus 12 from the bottom of a stack to a platen 18 and scanned by means of a moving optical scanning system to produce a flowing light image on the drum at B. Cut sheets of paper are moved into the transfer station D from sheet registering apparatus 34 in synchronous relation with the

image on the drum surface. The copy sheet is stripped from the drum surface and directed to a fusing station. Upon leaving the fuser, the fixed copy sheet is passed through a curvilinear sheet guide system, generally referred to as 49, incorporating advancing rolls 50 and 51. The advancing rolls forward the sheet through a linear sheet guide system 52 and to a second pair of advancing rollers 53 and 54. At this point, depending on whether simplex or duplex copies are desired, the simplex copy sheet is either forwarded directly to the finisher 70 via pinch rolls 61, 62 or into upper supply tray 55 by means of a movable sheet guide 56 before the finishing apparatus for the duplexed copy. Movable sheet guide 56, and associated advancing rolls are repositioned by appropriate machine logic system to direct the individual sheets into the desired path.

The finisher 70 comprises a tray 71 having a base or support surface 72 inclined downwardly in the direction of sheet travel towards a registration corner defined by registration fences 74, 75 extending along the lower edge and one side of the tray. Above the upper end of the support surface is arranged a pair of coacting sheet feed rolls 64, 65 arranged to receive sheets fed along path 63 by pinch rolls 61, 62. From the feed rolls 64, 65, a sheet is directed by guide throat 78 towards the tray 71. A corner registration device 79 such as a paddle wheel like that described in U.S. Patent No. 3669447 is arranged over the surface 72 to urge the sheets S



into the registration corner to position them for receiving a stitch from the apparatus 100. The registration corner 74 is rotatable about an axis 74a so that it may be retracted for ejection of bound sets SS into a collection tray 69. Any suitable ejection mechanism, such as drive rollers, may be employed.

Referring now to Figures 2 and 3 of the drawings, the stitcher 100 comprises a stitcher head 101, a reel 102 (Figure 1) from which wire W is supplied via a dancer (not shown) to the head 101 and an active clincher 201. The head 101 includes a wire advancing and cutting mechanism generally indicated at 103 for presenting lengths of cut wire to the stitcher head, an anvil 104 for supporting the wire, a former 105 including two elements at opposite sides respectively of the driver for forming the wire into a generally U-shape about the anvil and a driver 106 for driving the formed staple through the set SS. The clincher 201 comprises a clincher housing 202 having a clamping surface 203 by which a set SS may be clamped against the underside of the stitcher head 101 and containing clinch ears 204 arranged to receive and act upon staple legs driven through the set and into the housing through a slot in the surface 203.

In Figure 2, the clincher 201 is shown in its operative position with a set SS positioned against the head 101 which is fixed in position above the compiler tray. It will be understood, however, that during compilation of the set, the

clincher is lowered so that the clamping surface 203 is below the upper surface 101 of the set. In the clamping operation the clincher 201 is raised to lift the set SS against the underside of the head 101 and clamp it in position. Variations in set thickness are accommodated by the drive mechanism 210 by which the clincher housing is raised to lift the set against the underside of the stitcher head and clamp it into position to receive a stitch. This mechanism comprises a force applying ring 205 which lifts the housing via a compression spring 206, being moved through a fixed distance by a lever 207 (see Figure 4). The spring 206 is positioned between the force applying ring 205 and a shoulder 208 and the lever 207 which is arranged to pivot about axis 209 is actuated by a cam (not shown) which acts on its free end 207a. As shown in Figure 4 the other end of the lever is bifurcated to form a yoke 207b which is pivotally connected to the force ring 205. The clincher housing 202 is supported and guided by a pair of arms 211 pivotally connected between the housing and the frame of the stitcher. The mechanism 210 in addition to accommodating varying set thicknesses, varies the clamping pressure applied to the set as a function of set thickness. Thus, the thinner the set the less the compression of spring 206 and the less the clamping force applied. The clincher ears 204 are positioned in fixed relation to the housing 202 so that they are always presented to the set in the same relation regardless of the set thickness.



The wire advancing and cutting mechanism 102 comprises movable wire advancing and cutter blocks 120, 121 and an inhibitor member 124 positioned by the clincher 201 in dependence on the thickness of the set of sheets SS. The blocks 120, 121 include wire diodes 122, 123 which grip the wire only against movement relative to the respective block in the direction opposite the wire advancing direction. Thus, the diodes grip the wire when the blocks are moved to the left but allow each block to be moved to the right along the wire while the other block holds the wire. At the start of a wire feed cycle, the blocks 120 and 121 are positioned as shown in dotted lines in Figure 1. To feed the wire W, the advancing block 120 is moved to the left, its diode 122 gripping the wire, to advance the wire past the rest or start-of-cycle position of the cutter 125 by a distance made up of a constant (crown length plus twice clinch length) plus the set thickness and the cutter block is retracted from its rest position by a distance equal to the set thickness. These movements and thus the length of wire W presented to the stitcher head 101 for severing by the cutter 125 are determined by the inhibitor member 124 which limits the movement of the blocks 120, 121, according to the thickness of the set. The blocks 120, 121 are shown in full lines in their final positions at the end of a wire advancing movement. As the mechanism recycles to its start position (which takes place at the end of the complete stitching cycle) the cutter block 121 returns to its rest position pulling the wire with it - so that the wire end is always in



the same position at the start of a feed cycle -and the advancing block 120 traverses back along the wire to its rest position. The mechanism 103 is more fully described and illustrated in our copending U.K. Application Nos. 50328/78 (our case R/00178) and 50325/78 (our case R/01478) filed on 29 December 1978.

While the inhibitor member 124 may be directly connected to the clincher housing 202 as schematically represented in Figure 2, other arrangements are possible. Thus in a second embodiment as shown in Figure 6, the inhibitor member 124 is carried on an arm 143 pivoted to the stitcher head at 144 and is positioned by means of an actuator 145 mounted on one of the clincher housing guide arms 211. As shown the actuator is adjustable for correctly setting the mechanism and comprises a bolt 146 threaded through a bracket 147 and locked into position by a nut 148. While the clincher is retracted, the inhibitor is supported by a limit stop 149.

The embodiment of Figure 6 also includes a modified drive for the force ring 205 in which as a space-saving measure, the lever 207 carries a cam follower 270 intermediate the force ring 205 and pivot axis 209 which is controlled by a face cam 219 the centre-line of the guideway of which is shown by the dash-dot line 219_a. The cam 270 is mounted on a cam shaft 218.

The length of wire presented to the stitcher head 101 by the



mechanism 103 is cut, formed and driven in the following manner. While the anvil 104, which is pivotally mounted at 107 and biased to its start-of-cycle position by a spring 108 as shown in Figure 2, is held against movement, the driver 106 is moved downwardly against the wire to clamp it in position on the anvil. The former elements 105 then start moving downwardly. Initial movement of the former operates the cutter 125 through actuator 109 to sever the required wire length and further movement thereof shapes the wire about the anvil 104 into a generally U-shape. In order to accommodate the wire during this operation, the formers have guide grooves 110 along their inner faces. At the end of the forming operation the former is in its lower limit position with the lower ends of the former elements 105 below the underside of the anvil 104 and adjacent the set. The driver 106 is now driven downwardly, pivoting the anvil about its axis 107, to drive the formed staple. As seen in Figure 3, the anvil includes a sloping surface 104a. During the driving operation the anvil surface 104a forms a support for the crown of the staple. Similarly the former elements serve to support the legs of the staple in the grooves 110 during the driving movement.

It will be realised from the foregoing that the anvil must be held against movement during the cutting and forming stage but be pushed out of the way during the driving stage. This may be achieved by using a spring 108 which is strong enough to hold the anvil stationary during cutting and forming.



However, this requires that the force available to drive the driver must be sufficient to overcome the resistance of the spring. It is preferred therefore that as described with particular reference to Figures 5 and 7, the anvil be held locked in position during the cutting and forming stage and released by the former 105 at the end of its travel whereby only a relatively light spring 108 is required which is sufficient to return the anvil to its start-of-cycle position and to ensure that the anvil supports the staple crown during the driving stage.

As shown in Figure 5 this is achieved by means of a rotatable latch shaft 150 mounted behind the anvil 104 which has fixed to it a lever 151 actuated by the former 105 at the end of its forming movement. The shaft 150 has a relieved or D-section portion 152 opposite the rear face 153 of the anvil and in the position shown in Figure 5 the peripheral surface of the shaft engages the anvil and locks it against movement. Depression of the lever 151 by the former 105 rotates the shaft 150 to unlock the anvil and allow it to rotate about its axis 107. During recycling of the stitcher, the spring 108 returns the anvil to its start-of-cycle position and a spring 154 acting on the lever 151 returns the shaft 150 to its anvil locking position.

As described above, the stitcher has a two stage driver action in which following wire feed a first stage motion operates to grip the wire W against the anvil 104 during cutting and forming and a

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second stage motion into follow up driving of the formed staple. A mechanism suitable for this operation based on pivoted motion which first moves against the anvil and then provides the driving motion all from one continuous input lever travel is described in our copending U.K. Application No. 50324/78 (our case R/08077) filed on 29 December 1978.

The ends of the staple legs are turned over and wiped flat against the underside of the set by the clincher ears 204. The clincher 201 is operated as described more fully in our copending U.K. Application No. 50327/78 (our case R/07877) filed 29 December 1978 so that the staple legs having passed through the set move through air and meet no further resistance during driver travel. This is achieved by arranging the clincher ears out of the paths of the staple legs during driver travel so that leg wander is accommodated wholly within the clinch ears by profiling the ears with a groove wide enough to accommodate the maximum leg wander anticipated. The drive to the clincher ears may be by a spring which is loaded during return motion of the clincher housing at the completion of a stitching operation as more fully described in our copending U.K. Application No. 50323/78 (our case R/08177) filed on 29 December 1978, the clinch ears being held latched in the position shown in Figure 2 prior to the operation thereof, or by a cam drive 250 as illustrated in Figure 6 where the clincher rod 213 is driven by an edge or ramp cam 250 mounted on the same drive shaft 218 as, and alongside, the cam 219 which drives the force-ring lever 207.



The drive to the clincher rod from the cam 201 is effected by a roller follower 251 mounted on one end of a crank arm 252 pivoted to a bracket 253 depending outwardly from the clincher housing 202. The other end of the crank arm carries a stop 254 which engages the bottom end of the clincher rod 213. As shown, the stop 254 is adjustable to permit setting of the clincher ear movement. The clincher ears 204 are biased to their open, retracted position by a spring schematically represented at 255. The cam shaft 218 is driven in synchronism with the head 101 drive and the cam 250 is disposed so that the clincher rod is driven only after the formed staple has been completely driven through the set. It will be noted that by using a drive arrangement such as shown with the face cam 250, variations in set thickness are accommodated without affecting the timing (except to an insignificant degree caused by slight variations in the position of the cam follower 251 to cam 250) of the clincher ear movement relative to that of the driver.

In Figure 5, there is described a way of mechanically locking the anvil 104 in position during cutting and forming steps, the anvil then being released by the former at the end of its travel so as to swing away during the driving step. Figures 6 and 7 show an alternative embodiment in which instead of being mechanically locked in position during the cutting and forming steps, the anvil is geometrically locked in position. As best shown in Figure 7, the geometric lock is simply achieved by arranging that the driver press the wire against



the anvil along a force plane extending through the pivot axis 107 of the anvil and the line along which the wire lies on the anvil. The anvil pivot 107 is shown above the anvil surface and the anvil and its integral support arm form a generally U-shaped member 114. The member 114 is pivotally supported by an axle 171 and the spring 108 takes the form of a bundle of leaf springs secured between a flange 172 on member 114 and the axle 171, being anchored to flange 172. The springs act on the top of the driver with the desirable result that since, as the anvil pivots, the driver correspondingly descends, an approximately constant force is exerted by the spring bundle 108. The anvil limit position beneath the driver 106 is defined by a stop 174 formed by a lip pressed out of the set support surface 101a of the stitcher head. The member 114 carries a curved actuator surface 170 which is acted upon by the projection 190 on the former 105 to break the geometric lock and unlatch the anvil to position the wire on anvil surface 104a which is so shaped that as described above the driver progressively swings the anvil aside during the driving step against the force of the spring 108, the anvil supporting the crown of the staple during this operation. The actuator surface 170 is adjustable by an adjuster 176.

Whilst specific embodiments of the invention have been described above it will be understood that various modifications may be made to the specific details referred to herein without departing from the scope of the invention as



defined in the appended claims. Thus, the principles of this invention although described in connection with a flat bed stitcher may equally be applied to a saddle stitcher.

Further, while in the apparatus described above the stitcher is fixed in position, it may be movable for varying the position of the stitch or for inserting more than one stitch in a set. Also, two or more stitchers according to the invention, which may themselves be movable, may be operated in tandem, in which case various of the drive elements may be common to avoid duplication.

It will also be understood that while in the embodiments described, the stitcher head is fixed, the clincher could be fixed and the clamping means be formed by the sheet receiving surface of the head itself.

It will further be understood that although the embodiments of stitcher described and illustrated show the stitcher head above the clincher, the stitcher may be arranged in any suitable orientation and specifically the clincher may be arranged over the stitcher head.

For clarity, it is to be noted that the term staple is used herein to mean either a wire-fastener which is pre-formed outside the stitching machine or one which is formed within the machine.



The ends of the staple or stitch legs may be turned over by an active clincher having guide surfaces which move with the ends as described above or by a passive clincher having fixed guide surfaces. The advantage of an active clincher is that the legs are wiped flat against the set.

While in the embodiment of Figures 6 and 7, the anvil pivot axis is ideally along the force plane of the driver, in order to accommodate tolerance variations it may be arranged slightly to the right as seen in Figures 6 and 7 of this plane.

Claims:

1. A stitcher including an anvil (104), a former (105) for forming a length of cut wire about the anvil (104) into a staple, and a driver (106) for driving the staple, said anvil (104) being retractable and acting as a support for the staple during driving, characterized in that the anvil (104) is locked against movement during forming, and movement of the former (105) acts to release the anvil (104) to permit it to move out of the path of the driver (106) during driving while supporting the staple.

2. A stitcher according to Claim 1 in which the anvil is pivotally mounted and spring-biassed to its forming position.

3. A stitcher according to Claim 1 or 2 in which the anvil is held against movement during forming by a latch which is acted upon to release the anvil by the former.

4. A stitcher according to Claim 3 in which the latch is spring-biassed to its latching position so that as the anvil returns to its forming position at the end of a stitching cycle, the latch re-engages automatically.

5. A stitcher according to Claim 1 in which the anvil is held against movement during forming by a geometric lock.

6. A stitcher according to Claim 5 in which the anvil has a support arm which is pivotally mounted for rotation about an axis spaced from the anvil in the plane of the force applied to the anvil by the driver during forming.

7. A stitcher according to Claim 6 in which the anvil is spring-biassed to its forming position and is released from said geometric lock by a projection on the former engaging the anvil support arm.



8. A stitcher according to any preceding claim in a finisher for a photocopier having a tray for compiling a series of sheets into a set.

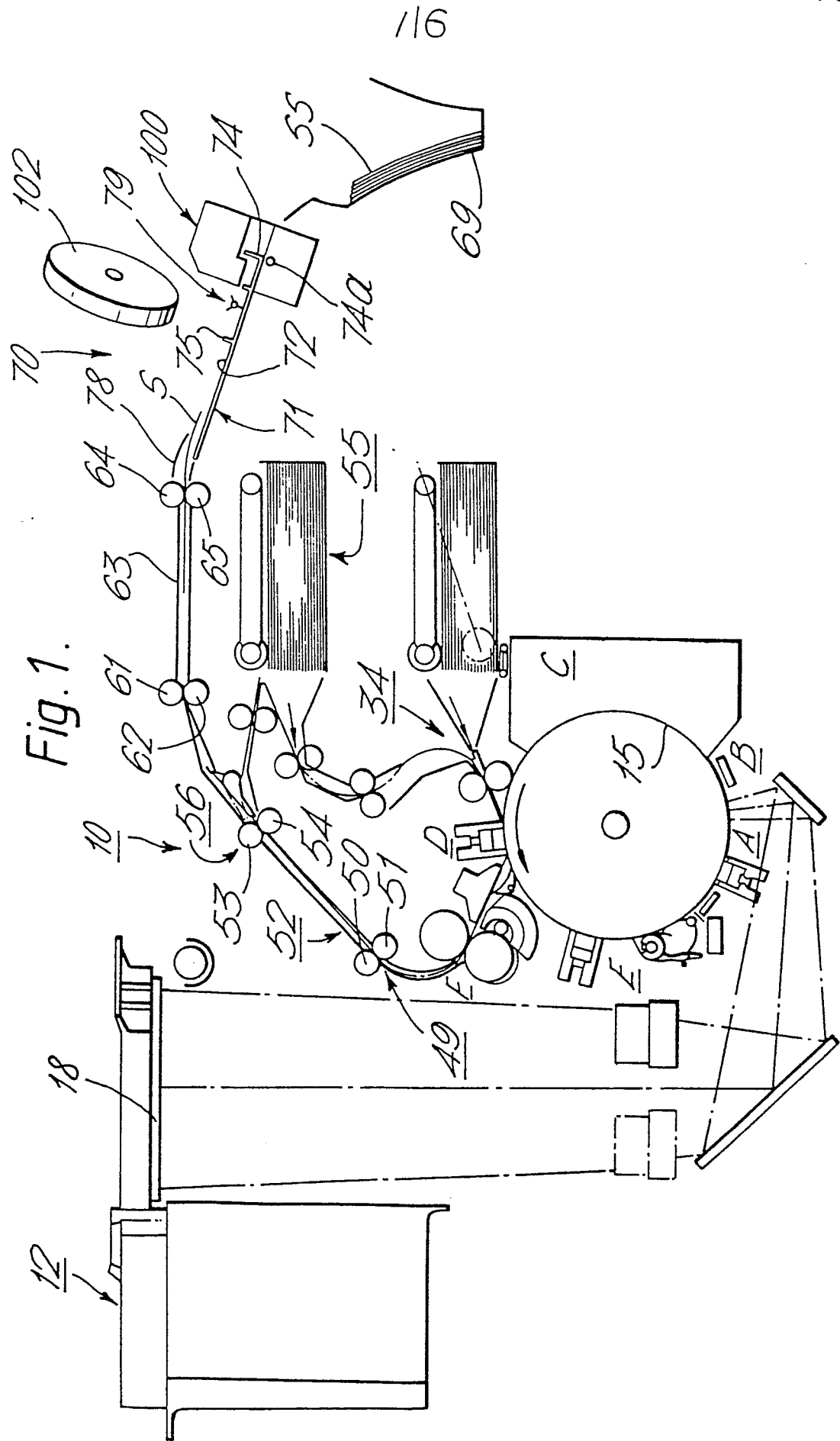


Fig. 1.

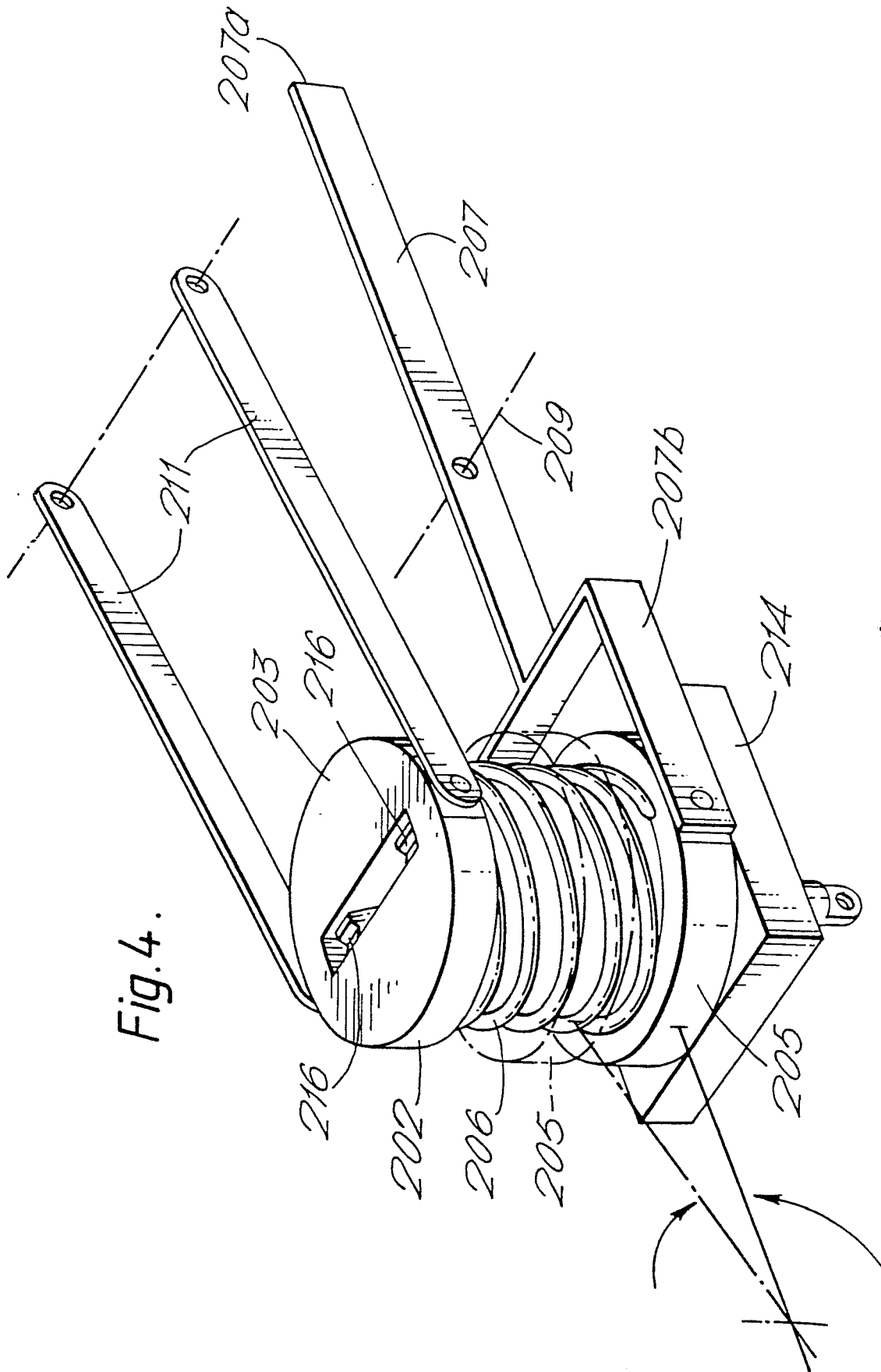
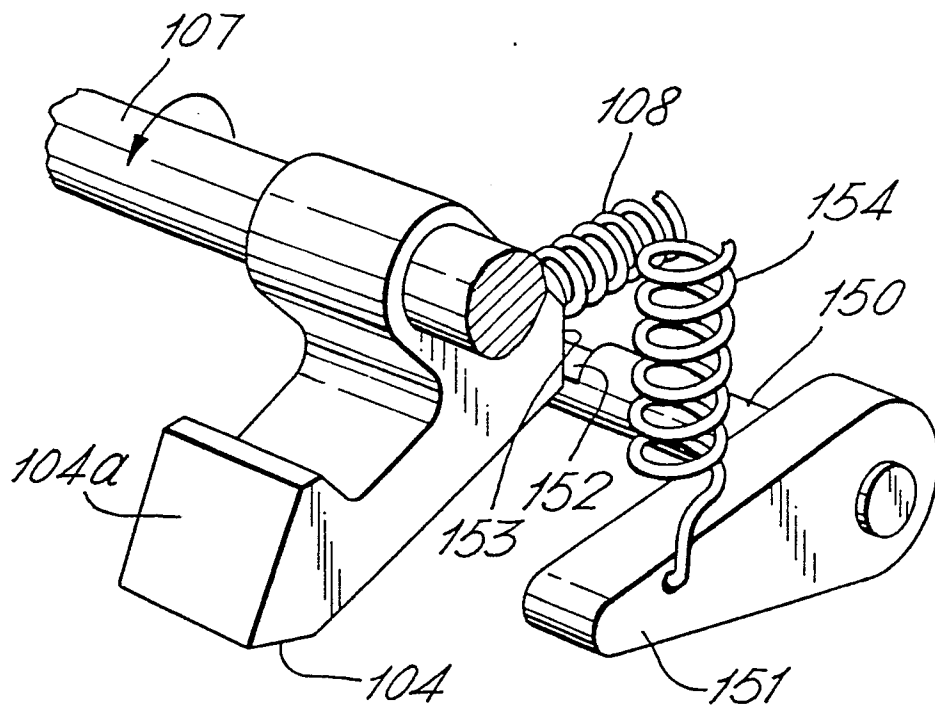


Fig. 4.

Fig. 5.



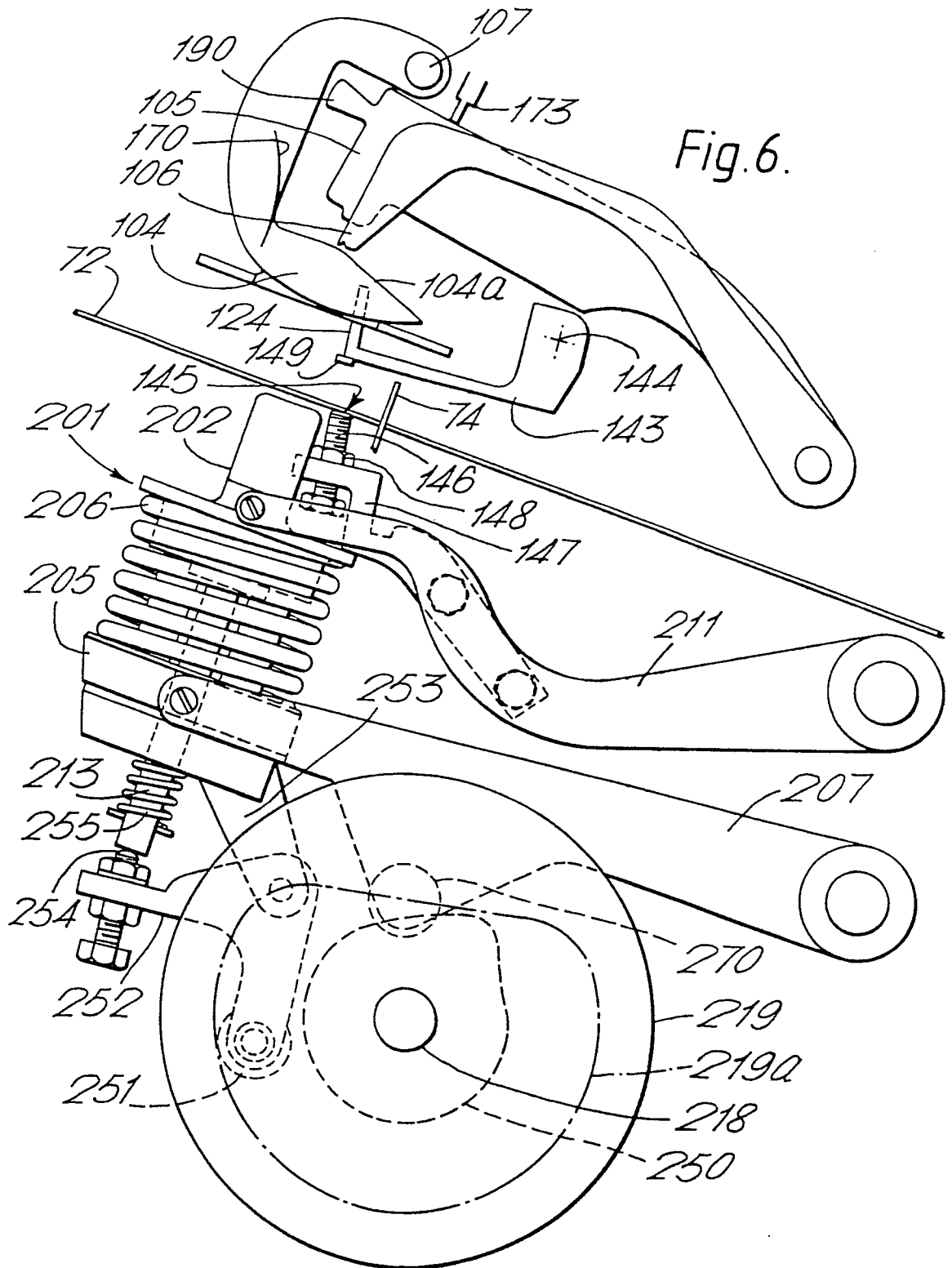
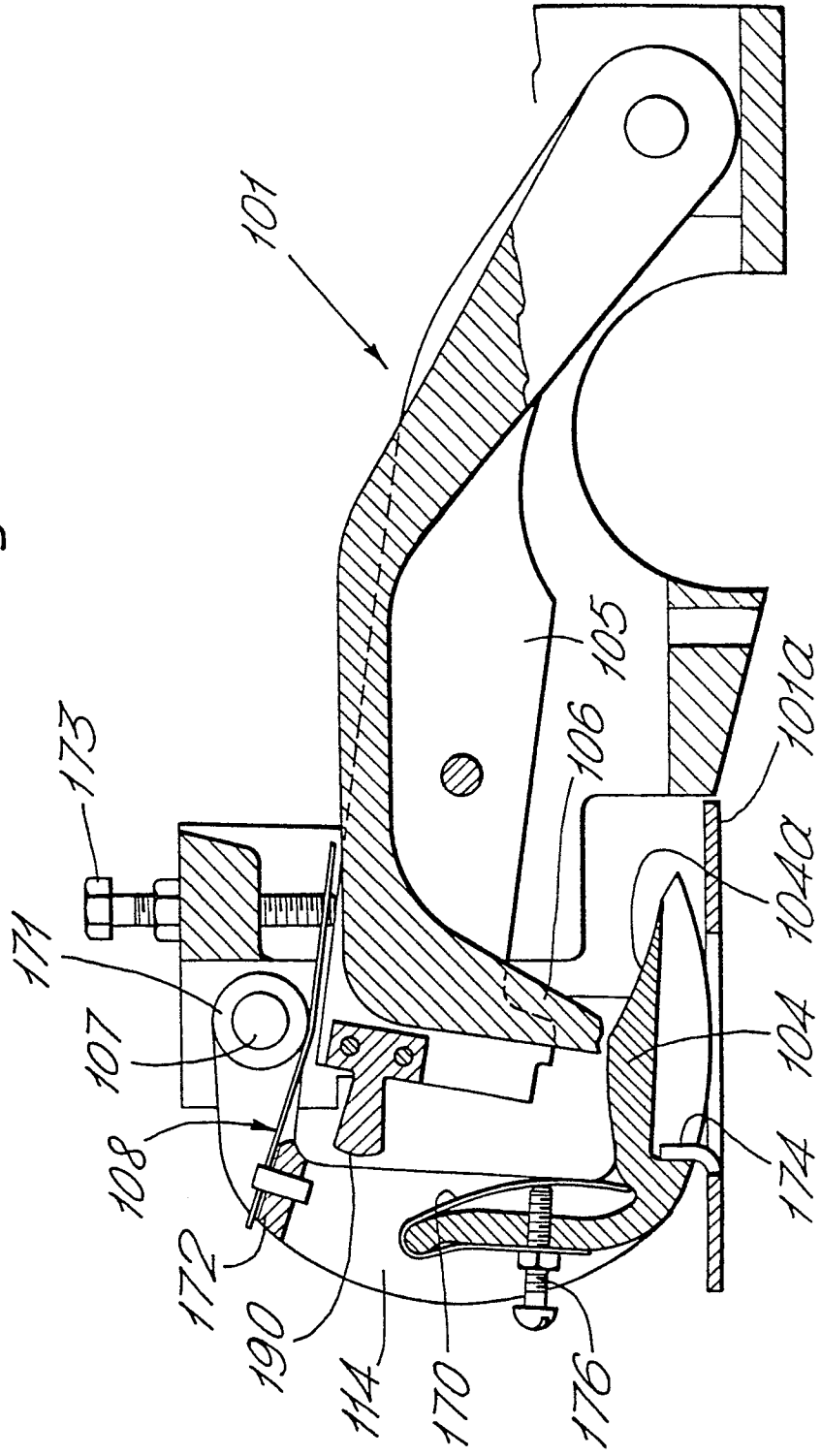


Fig. 6.

Fig. 7.





DOCUMENTS CONSIDERED TO BE RELEVANT		CLASSIFICATION OF THE APPLICATION (Int. Cl.)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	<p><u>FR - A - 705 668 (MAGNAT)</u> * Complete description *</p> <p>--</p> <p><u>DE - C - 130 213 (BRIGGS)</u> * Page 3, right-hand column, line 17 - page 4, left-hand column, line 37; figures *</p> <p>--</p> <p><u>DE - C - 42 280 (HARPER)</u> * Page 2, left-hand column, lines 13-57; figures *</p> <p>--</p> <p><u>US - A - 1 855 162 (ZENUREITH)</u> * Page 5, lines 103-129; figures *</p> <p>--</p> <p><u>DE - C - 29 782 (LASH)</u> * Complete description *</p> <p>--</p> <p><u>FR - A - 779 198 (GASTE)</u> * Page 4, line 84 - page 5, line 43; figures *</p> <p>-----</p>	<p>1-4</p> <p>1</p> <p>6</p> <p>1</p> <p>1,3</p> <p>1</p>
		B 27 F 7/21
		TECHNICAL FIELDS SEARCHED (Int. Cl.)
		B 42 B B 25 C B 25 B B 27 F
		CATEGORY OF CITED DOCUMENTS
		X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
<input checked="" type="checkbox"/> The present search report has been drawn up for all claims		<input type="checkbox"/> member of the same patent family, corresponding document
Place of search	Date of completion of the search	Examiner
The Hague	14-03-1980	LONCKE