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(54) **Improvements in sheet stackers.**

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Description

This invention relates to sheet stackers for compiling sheets delivered serially thereto into a stack.

Stacking apparatus typically act on sheets fed serially thereto to stack the sheets in registration with each other so as to provide an attractive and compact set or signature with uniform edges. The sheets may be registered against a single registration edge but for complete registration they are preferably aligned both laterally and longitudinally with respect to the direction of travel of the sheets. This may be achieved by registering two adjacent edges (one end and one side) of the sheet with respect to respective registration stops and this form of registration is termed corner registration. Stacking apparatus may be required in addition to compiling the sheets into sets to position the sheets with respect to a fixed finishing device such as a stitcher, stapler or punch. This is readily achieved by corner registration.

The invention is particularly concerned with sheet stackers in which the compiled set is fed off the support surface following the completion of compilation of the set and, if required, the binding thereof. Usually the completed sets are fed into an output tray or storage location for subsequent removal by an operator. It is known for example from GB-A-1 595 609 that a sheet stacker may comprise a support surface, a registration stop, means for registering sheets to form a registered stack against said registration stop and means for feeding the compiled stack of sheets off the support surface. Also, US-A-3 685 712 discloses a stapler having a sheet stacker comprising a support surface, a registration stop, means for registering sheets to form a registered stack against said registration stop prior to stapling and means for feeding the stapled stack of sheets off the support surface, wherein the feeding means comprises a drive roller and an idler roller between which the sheets are stacked, one of said rollers being movable between a first inactive position spaced from the other roller for compiling the stack and a second active position in which it presses the stack against the other roller and one of said rollers projects through the support surface. The pre-characterizing portion of claim 1 is based on the disclosure of this US patent.

Sometimes it is desirable to feed out or eject a compiled set from the compiling tray without binding the set. Rapid ejection of the set is desirable to avoid interrupting the delivery of sheets to the compiling tray. At the same time it is important that there be no set disturbance during ejection.

In accordance with this invention feeding means is proposed which is characterized in that the movable roller is the idler roller; in that the surface coefficient of friction of the drive roller is less than 0.5, and in that the drive roller has a hardness of less than 40 IBHD (International Rubber Hardness Degree) whereby, when the idler roller is moved to the active position, the drive roller is deformed so that the area of contact made by the drive roller with the stack extends over a peripheral distance of between 1.5 and 3.0 mm.

In one form the drive roller projects through said support surface and the idler roller is movable between an inactive position raised above the support surface and an active position in which it presses against the top of the stack. In one embodiment a roller about 25 mm wide and 30 mm in diameter suitably projects through the support surface by about 2 to 4 mm.

In another form, the drive roller is spaced above the support surface and the idler roller is movable between an inactive position below the support surface and an active position in which it projects through said support surface and presses the stack against the drive roller.

Preferably the drive roller is driven so that it is already rotating when the idler roller is moved into the active position; for this purpose the drive roller preferably rotates continuously during operation of the stacker.

It has been found that using a conventional hard plastics roller a relatively high coefficient of surface friction of about 0.8 is required in order for set ejection to be effective. This may not be suitable for unbound sets in particular since there is a tendency for premature ejection of the bottom sheet in the set. Conventional foam rollers are also not entirely satisfactory since they also tend to cause set disturbance of unbound sets. It is therefore preferred to use, in accordance with the invention, a drive roller having an outer surface with a low coefficient of friction and which is deformable by said idler roller pressing against a said stack to increase the area of contact with the stack.

In a preferred embodiment of the invention, the drive roller is formed as a composite of a hard outer skin of plastics material surrounding a soft rubber or foam inner core. The core suitably has a hardness of about 15 to 30 IRHD (International Rubber Hardness Degree) and the hard plastics skin around it suitably has a coefficient of friction of 0.1 - 0.3 and a thickness of between 125 and 250 microns.

The invention also provides a finishing apparatus incorporating a sheet stacker as described above and further including means for binding a stack compiled on the support surface.

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 front view of a photocopier incorporating a recirculating document handler and finisher according to the invention,

Figure 2 is a front view of the finisher shown in Figure 1,

Figure 3 is a rear view of the finisher,

Figure 4 is a perspective view from above of the finisher,

Figure 5 is a schematic rear view showing a bypass path for sheets,

Figure 6 is a perspective view from above of the compiler tray of the finisher,
Figure 7 is a perspective view of the stapler mechanism of the finisher,
Figures 8 to 10 show the operation of the stapler drive mechanism under varying conditions,
Figure 11 is a front view of the eject mechanism showing the positions of the elements during sheet compiling,
Figure 12 is a view like that of Figure 11 showing the positions of the elements during set ejection and also illustrating the eject path for the sets,
Figure 13 is a schematic perspective view of the mechanism as shown in Figure 11,
Figure 14 is a partly exploded view of the set offsetting stacking tray,
Figure 15 shows schematically the drives for the finisher,
Figure 16 is a schematic side elevation of another photocopier incorporating a second embodiment of sheet stacker according to this invention,
Figure 17 is a perspective view of the stacker, of Figure 16,
Figure 18 is a side elevation of the stacker, of Figure 16,
Figure 19 is a scrap view of the compiler tray of the sheet stacker of Figure 16 shown during stacking,
Figure 20 is a view like that of Figure 19 showing the apparatus during sheet ejection, and
Figure 21 is a section through the drive roller.

Referring first to Figure 1 there is shown a xerographic copying machine incorporating a recirculating document handler 40 and one embodiment of finisher 60 according to the present invention. The machine includes a photoreceptor drum 1 mounted for rotation (in the clockwise direction as seen in Figure 1) to carry the photoconductive imaging surface of the drum sequentially through a series of xerographic processing stations: a charging station 2, an imaging station 3, a development station 4, a transfer station 5, and a cleaning station 6.

The charging station 2 comprises a corotron which deposits a uniform electrostatic charge on the photoreceptor. A document to be reproduced is positioned on a platen 13 and scanned by means of a moving optical scanning system to produce a flowing light image on the drum at 3. The optical image selectively discharges the photoconductor in image configuration, whereby an electrostatic latent image of the object is laid down on the drum surface. At the development station 4, the electrostatic latent image is developed into visible form by bringing into contact with it toner particles which deposit on the charged areas of the photoreceptor. Cut sheets of paper are moved into the transfer station 5 in synchronous relation with the image on the drum surface and the developed image is transferred to a copy sheet at the transfer station 5, where a transfer corotron 7 provides an electric field to assist in the transfer of the toner particles thereto. The copy sheet is then stripped from the drum 1, the detachment being assisted by the electric field provided by an a.c. de-tack corotron 8. The copy sheet carrying the developed image is then carried by a transport belt system 9 to a fusing station 10.

After transfer of the developed image from the drum, some toner particles usually remain on the drum, and these are removed at the cleaning station 6. After cleaning, any electrostatic charges remaining on the drum are removed by an a.c. erase corotron 11. The photoreceptor is then ready to be charged again by the charging corotron 2, as the first step in the next copy cycle.

The optical image at imaging station 3 is formed by optical system 12. A document (not shown) to be copied is placed on platen 13 by the document handler 40, and is illuminated by a lamp 14 that is mounted on a scanning carriage which also carries a mirror 16. Mirror 16 is the full-rate scanning mirror of a full and half-rate scanning system. The full-rate mirror 16 reflects an image of a strip of the document to be copied onto the half-rate scanning mirror 17. The image is focussed by a lens 18 onto the drum 1, being deflected by a fixed mirror 19. In operation, the full-rate mirror 16 and lamp 14 are moved across the machine at a constant speed, while at the same time the half-rate mirrors 17 are moved in the same direction at half that speed. At the end of a scan, the mirros are in the position shown in a broken outline at the left hand side of Figure 1. These movements of the mirrors maintain a constant optical path length, so as to maintain the image on the drum in sharp focus throughout the scan. Alternatively the optical system 12 may be fixed in position and the document scanned by being advanced across it by the document handler 40 as described below.

At the development station 4, a magnetic brush developer system 20 develops the electrostatic latent image. Toner is dispensed from a hopper 21 by means of a rotating foam roll dispenser 22, into developer housing 23. Housing 23 contains a two-component developer mixture comprising a magnetically attractable carrier and the toner, which is brought into developing engagement with drum 1 by a two-roller magnetic brush developing arrangement 24.

The developed image is transferred, at transfer station 5, from the drum to a sheet of copy paper (not shown) which is delivered into contact with the drum be means of a paper supply system 25. Paper copy sheets are stored in two paper trays, an upper, main tray 26 and a lower, auxiliary tray 27. The top sheet of paper in either one of the trays is brought, as required into feeding engagement with a common, fixed position, sheet separator/feeder 28. Sheet feeder 28 feeds sheets around curved guide 29 for registration at a registration point 30. Once registered, the sheet is fed into contact with the drum in synchronous

relation to the image so as to receive the image at transfer station 5.

The copy sheet carrying the transferred image is transported, by means of vacuum transport belt 9, to fuser 10, which is a heated roll fuser. The image is fixed to the copy sheet by the heat and pressure in the nip between the two rolls of the fuser. The final copy is fed by the fuser rolls along output guides 31 to the input nip 65 of the finisher 60.

After transfer of the developed image from the drum to the copy sheet, the drum surface is cleaned at cleaning station 6. At the cleaning station, a housing 33 forms with the drum 1 an enclosed cavity, within which is mounted a doctor blade 34. Doctor blade 34 scrapes residual toner particles off the drum, and the scraped-off particles then fall into the bottom of the housing, from where they are removed by an auger.

As mentioned above, sheets 5 may be fed from either the main tray 26 or the auxiliary tray 27. The auxiliary tray is of larger size than the main tray, enabling a wide choice of paper sizes and types to be fed from it. The trays are physically located in the lower part of the machine below the photoreceptor drum 1.

As shown in Figure 1 a recirculation document handler 40 is provided for feeding documents to be copied to the platen 13 of the photocopier. The document handler includes a storage tray 41 for the documents to be copied and document circulating means for delivering the documents in turn to the platen from the storage tray and for returning the documents to the tray, whereby the documents may be circulated and recirculated in sequence past the platen for repeated copying (precollation mode). The documents may either be transported across the platen at a constant velocity past the optical system 12 of the photocopier which is held stationary in the solid line position shown, or instead the may be registered on the platen prior to copying and the stationary document exposed by scanning the optical system 12 across the document as described above. For this purpose a registration member or gate 39, which can be moved in and out of sheet blocking position at the registration edge of the platen by means of a conventional solenoid type actuator, is provided for registering the document in stationary position on the platen 13 while the optical system 12 is scanned across the document. When the document is registered on the platen, the document handler can be operated in so-called stacks mode wherein each document is copied a plural number of times during a single delivery to the platen.

The document handler comprises, in addition to the storage tray 41, a document separator/feeder 42, a pre-platen transport 43 for conveying documents to the platen, a platen transport 44 and a post-platen transport 45 by which documents are returned to the storage tray.

The document storage tray 41 is mounted over the platen 13 and slopes upwardly towards the separator/feeder 42; it is adjustable to accommodate different document sizes.

Sheet separation and acquisition is accomplished by a vacum belt corrugation feeder (VCF) 42 as for example in US-Patent No. 427 587 having transport belts 46 and an air knife 47.

The pre-platen and post-platen transports 43, 44 consist of pairs of nip rolls and inner and outer inversion guides as shown and the platen transport 45 comprises a single white, wide friction drive belt 48 entrained over input and output transport rollers 49. The document is transported across the platen 3 by the belt 48. Three gravity rolls apply a nip between the belt 48 and platen 13 and maintain drive across the platen.

The document handler may be operated as described above either in pre-collation (or sets) mode in which the pages of a document are copied one at a time in serial number order or in post-collation (or stacks) mode in which multiple copies of each document sheet are made before the next document sheet is copied. In accordance with the invention a copy sheet finishing apparatus 60 capable of handling output for the document handler in both these modes is shown in Figure 1.

The finisher 60 includes an offsetting catch tray or output tray 100 and may be operated to perform the following functions:

(a) to compile, register and corner staple sets of copies as they are produced and transport the stapled sets into the offsetting catch tray 100, and

(b) to deliver copies direct to the offsetting catch tray 100 where the sheets may be compiled in offset sets.

In a variation of (a) the stapling step may be omitted.

The finisher receives copy sheets from the processor at input nip 65 and conveys them to the offsetting catch tray 100 either directly along a path 61 or, via a compiler tray 62 in which they are registered and stapled, along a path 63. The direction of the sheets is determined by a diverter 64 located directly following the finisher input nip rolls 65a, 65b and which is operated in response to a signal from the processor initiated by the operator.

The path 63 comprises upper and lower guides 63a, 63b and includes two further sets of nip rolls 67, 68 which accelerate the sheets into the compiler tray 62. The sheets are corner registered against a retractable end registration gate 69 and a side registration gate 70 at the front of the machine by gravity and a paddle wheel 71, represented in Figure 1 by a broken ellipse. Sets compiled in the tray 62 are corner stapled by a stapler 72. Stapled sets are driven from the tray 62 by retracting the gate 69 and lifting the set against a pair of driven eject rolls 73 by means of a pair of idler rolls 74 mounted on one end of pivoted arm 75 which carries the gate 69 at its other end.

Thus the sheets are conveyed into the compil-

er tray in a first direction (from right to left in Figure 1) and their trail edges registered by being conveyed against the end registration gate 69 in the opposite direction from left in right in Figure 1). The path 63 extends over the paddle wheel 71 and the eject rolls 73 and the sheets drop by gravity towards the end registration gate 70 since the tray 62 slopes downwardly in that direction at an angle of between 35 and 45 degrees. In the embodiment of Figure 1 the angle is 38 to 42 degrees, preferably 40 degrees. Essentially the tray angle must be sufficient for the sheets to drop by gravity into the influence of the paddle wheel 71.

The sets are carried into the offsetting catch tray 100, which is arranged beneath the compiler tray 62, around a large driven, rigid sun roll 76 with the aid of three driven, compliant planet rolls 77, 78, 79 and outer guides 80, 81. Thus as the sets are conveyed to the offsetting catch tray 100 they are inverted and their direction reversed. The catch tray 100 itself slopes downwardly in the same direction as the compiler tray 62 suitably at an angle of 35 to 40 degrees, preferably 40 degrees.

In sets copying mode, a document set to be copied is placed face up in the document handler tray 41 so that the pages of the document are copied in reverse order. Thus, copy sheets are delivered to the compiler tray of the finisher in the order n - 1. The copy sheets are received face-aup so that the assembled set is in page number order and are fed through the copier long edge first so that the top of the page is at the front side of the machine. Accordingly the top left-hand corner of the set is arranged in the registration corner and is stapled. Thus sets stapled in the compiler tray 62 are received face-down in the catch tray 100 with the stapled corner at the upper front of the tray.

The above-described configuration provides a compact finisher in which the extent to which the finisher projects beyond the processor is kept to a minimum. At the same time it permits sheets which do not need to be stapled to be fed directly to the catch tray 100.

Thus, where stapling is not required sheets are directed along path 62 into engagement with the roller 76 and driven into the tray 100 with the aid of driven foam rolls 78, 79. The tray 100 may be offset sideways between sets to provide visual and physical separation between the sets.

The finisher 60 will now be described in greater detail.

Sheets from the fuser 10 of the processor enter the finisher through the input nip rolls 65 which comprise a lower steel roll 65b incorporating a one-way or overrun clutch with a pair of rubber bands thereon and a pair of upper idler acetal rolls 65a. Drive to the lower rolls 65b (and to all driven rolls of the finisher) is from the processor output spur gear (not shown). The rolls 65 assist in driving the copies to the diverter 64, and beyond. The diverter 64 extends across the paper path and has the cross-section shown in Figure 1.

It is operated by a solenoid 91 (Fig. 4) through a linkage 92. The solenoid is energised to direct sheets along path 63 into the compiler 62.

The upper transport path 63 comprises upper and lower sheet metal guides 63a, 63b and the two further sets of nip rolls 67, 68. These comprise upper idler acetal rolls 67a, 68a and lower driven polyurethane rolls 67b, 68b. In order to project the sheets positively onto the compiler tray 62, over the paddle wheel 71 and eject roll 73, the nip rolls 67, 68 are driven at a faster rate than the rolls 65. The one-way clutch in the lower roll 65b prevents the copies from being torn or scrubbed. The idler rolls 67a, 68a as well as the input idler rolls 65a are mounted on the upper guide plate 63a which is hinged from the back of the finisher for jam access. The nip roll sets 65, 67, 68 serve to corrugate the copy sheets and the idlers are fixed to the plate 63a by snap-on flexures.

On reaching the compiler tray 62 the copy sheets are reverse corner registered against end registration stops 69 and side registration plate 70 at the front of the machine by a driven 3-bladed paddle wheel 71 (Figures 2 and 6). The paddle wheel is straight-bladded and is made of polyurethane. For improved registration the blades flip down on to the sheets from a restraining plate 71a.

The stapler 72 ist arranged over the registration corner as shown in Figure 6 to insert a staple through that corner of the set. The stapler is actuated when the processor logic detects that a complete set has been delivered to the compiler tray 62. The stapler inserts staples at an angle of 20° to the long edge of the set.

Referring to Figures 7 to 10, the stapler 72 is a standard desk top stapler with a conventional head 101 and passive clincher (not shown). It has a capacity of 160 staples and can staple up to 25 x 80 gm. sheets. Drive to the stapler is by a motorised cam 103, a cam lever 104, a staple head lever 105 and a connecting shaft 106. This arrangement allows the cam drive to be positioned at the rear of the machine although the stapler is at the front. Adjustment for the staple head lever position is provided by a knuckle joint in the cam lever 104. The stapler is driven by a separate AC motor/gear-box 107 (Fig. 7).

A load limiting device is incorporated into the cam lever 104 to (a) accommodate varying set thicknesses presented to the stapler and (b) enable the cam 103 to rotate in the event of seizure or staple jam. This device comprises a bracket 108 pivoted to the cam lever 104 and connected to it through a compression spring 109. The cam follower 103a is mounted on the bracket 108 and relative movement of the bracket 108 and lever 104 limits the force applied by the staple head lever. Thus, if the staple head is closed before the cam 103 had completed its cycle, excess movement is absorbed by the cam lever bracket 108 as shown in Figure 10. The load limiting spring 109 prevents the bracket 108 from pivoting prematurely.

Located just above the back edge of the cam lever bracket 108 is a micro-switch 110. As the lever/bracket assembly moves up and down electrical continuity through the microswitch is interrupted. This signal is used to monitor cam rotation and may assist in staple jam detection.

Return of the stapler head to an open position after each stapling operation is assisted by a spring 111 attached between the bracket 108 and the finisher frame and a spring integral with the stapler head.

Staple levels in the magazine are monitored by a low staple sensor (not shown) activated when only twenty four staples remain. This sensor is an optical sensor consisting of an infra-red source and a detector aligned with holes through the staple rail. A signal from the sensor allows the processor logic to assess how many sets are outstanding against the on-going job and act accordingly.

A solenoid 114 (Fig. 3) mounted under the compiler tray 62 acts on pivoted arm 75 which as shown in Figures 11 to 13 comprises levers 112 and 113. Lever 112 is attached to gate 69 and through an intermediate lever 112a operates a lever 113 carrying the eject (knick-out) idler rolls 74. During compiling and stapling the rolls 74 and gate 69 are as shown in Fig. 11. Once the stapling operation has been completed, the solenoid 114 is energised to pivot the levers 112, 113 as shown in Fig. 12, retracting the gate 69 and lifting rolls 74 through a cut-out 62a in the compiler tray to nip the set against continuously driven rolls 73 and drive the set out of the compiler tray.

The rolls 73 and 74 each comprise a spaced pair of grooved rolls with O-ring inserts. The idlers 74 are spaced slightly further apart than the driven rolls 73.

Stapled sets are transported to the catch tray 100 around transport roll 76 which is 70 mm wide and 135 mm in diameter. It has a rigid hub of a thermoplastic resin material, suitably a modified polyphenylene oxide such as Noryl, with a high friction polyurethane coating. Suitably the surface of roll 76 has a hardness of 60 ± 5 IRHD. Transport of the sets around sun roll 76 is aided by the compliant rolls 77, 78, 79 and the guides 80, 81. The planet rolls 77, 78, 79 are foam rolls 30 mm in diameter and having a 10 mm thick layer of foam over a rigid hub. The foam material is a polyurethane ester suitably having a cell size of 18 cells per linear centimetre. The planet rolls 77, 78, 79 are driven at a slightly greater speed (about 10 % or more faster) than the sun roll 76 to compensate for the difference in speed between the inner and outer surfaces of a set being transported. In one embodiment in which the rolls have the dimensions above the sun roll 76 is driven at a surface speed of 307 mm/sec and the planet rolls 77, 78, 79 are respectively driven at surface speeds of 353 mm/sec (15 %), 402 mm/sec (31 %) and 335 mm/sec (9 %), the percentages in parenthesis indicating the amount by which the speed of the sun roll is exceeded. The guide 81 can be hinged down for jam access.

With the diverter solenoid 91 not energised, the diverter 64 is kept raised by a compression spring around the solenoid plunger and sheets are directed along the path 61 directly to the eject roll 76 and the catch tray 100.

The transport roll 76, like the nip rolls 67, 68, accelerates copies from the input rolls 65 to minimise set delivery time.

The offsetting catch tray 100 (Figure 14) provides physical and visual distinction between consecutive sets and this is achieved by reciprocating the tray through 35 mm. The tray is driven by a separate DC motor/gear-box through a cylindrical cam 121 and follower 121a. The tray slopes upwardly at a relatively sleep angle and has an upstanding rear registration edge 126. The tray is slideably mounted on stub shafts 122 carried on the finisher cover by means of brackets 123. Reaction studs 124 on the tray edge 126 ride on PTFE strips fixed to the outside of the cover. The catch tray is activated by a sensor switch 127 (Fig. 12) in the lower part of the set transport.

A spring loaded rib $1^1/_2$ - 2" wide extends downwardly along the tray to maintain uniform drop height into the tray as the sheets build up. Mylar control strips (not shown) hang from the cover above the tray to help guide paper onto the tray.

The finisher drives are shown in Figures 3 and 15. A spur gear 131 takes the drive from the processor and apart from the roll 65b which is driven directly from the spur gear 131 all driven rollers and the paddle wheel are driven via toothed belts 132, 133 and spur gears 134, 135. The latter are all arranged at the back of the finisher behind the rear frame 142 as shown in Figure 3. Front and rear frames 141, 142 moulded in plastic support all finisher components. The two frames are separated structurally by two steel tie bars, the lower plate 63b of upper transport guide 63 and the compiler tray (sheet steel).

The finisher and its covers are mounted separately. As shown in Figures 2 and 3, downwardly facing U-mountings of the frames 141, 142 sit on docking studs 143, 144 projecting from the processor frame and the assembly is held in position by gravity. The cover is held in place by four latch mechanisms, two front and two rear, which locate on docking studs fixed to the processor frames. The rear latches are secured by locking screws.

In operation sheets are either delivered to the compiler tray 62 along the upper path 63 or fed directly to the offsetting catch tray 100 along the path 61. In the latter case the sheets may be stacked in offsets sets by intermittently side-shifting the tray 100 under the control of the machine logic. Sheets delivered to the compiler tray 62 are reverse registered by gravity and the paddle wheel 71 against registration stops 69, 70. When all the sheets in a set have been received in the tray 62, the machine logic activates the motor 107 to cause the stapler 72 to insert a staple in the set and then activates the solenoid 114 to cause the gate 69 to retract and the eject

rolls 73, 74 to engage the set to drive the set out of the tray to the direction reversing transport formed by the transport roll 76 and its associated planet rolls and guides. The transport conveys the set into the offsetting catch tray 100 where successive sets are stacked for collection by an operator. The catch tray may be offset between sets.

The compiler tray will not accept more than 25 sheets. If the finisher is in binding mode and a sensor (not shown) in the path 63 has counted 25 sheets, it will direct the twenty-sixth and subsequent sheets directly to the catch tray 100 and also eject the stack of sheets in the tray 62 into the tray 100 without binding them.

Referring to Figure 16 there is shown an automatic xerographic reproducing machine 10 having another embodiment of finisher 70 incorporating sheet stacking apparatus 271 according to this invention including registration means 279 for aligning sheets as they are stacked in the finisher prior to being acted upon by a stitcher 299. 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 a recirculating document apparatus 212 described in US-Patent No. 3 556 512. Although the present invention is particularly well suited for use in automatic xerograph the apparatus generally designated 270 is equally well adapted for use with any number of devices in which out sheets of material are delivered or compiled in a set or stack.

The processor 10 includes a photosensitive drum 215 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 212 from the bottom of a stack to a platen 218 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 from sheet registering apparatus 234 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 F. Upon leaving the fuser the fixed copy sheet is passed through a curvilinear sheet guide system generally referred to as 249, incorporating advancing rollers 250 and 251. The advancing rollers forward the sheet through a linear sheet guide system 52 and to a second pair of advancing rolls 253 and 254. At this point, depending on whether simplex or duplex are desired the simplex copy sheet is either forwarded directly to the finisher 270 via pinch rills 261, 262, or, for making duplex copies, into upper supply tray 255, by means of a movable sheet guide 256. Movable sheet guide 256 and associated advancing rolls are pre-positioned by appropriate machine logic to direct the individual sheets into the desired path.

In this embodiment, the finisher 270 includes a stacking or compiling tray 271 having a base or support surface 272 inclined downwardly in the direction of sheet travel towards a registration corner 273 defined by registration members 274, 275 along the lower edge and one side of the tray. Along the upper end of the support surface is arranged a pair of co-acting sheet feed rolls 264, 265 arranged to receive sheets fed along passage 263 by pinch rolls 261, 262. From the feed rolls 264, 265 a sheet is directed by top guide 278 into the tray 271. A corner registration apparatus 279 is arranged over the surface 272 to urge the sheets into the registration corner to position them for receiving a stitch from the apparatus 300.

The registration apparatus 279 comprises a wiper 300 having four blades 301 arranged to wipe against the sheets being registered over a limited arc of rotation defined by a swash plate 302. The wiper has a backing plate 307 incorporating a hub 304 which is mounted for rotation about an axis 303 normal to the stack support surface. It is driven by a motor through a flexible drive 317 mounted on a bracket (not shown) at the side of the tray 271. The blades 301, which are made of a resilient elastomeric material, lie in radial planes passing through the axis 303 and depend from the backing plate 307, in the direction of the axis 303, towards sheet-engaging tips 306. The wipper 300 ist arranged over the stack support surface 272 so that the blades are in interference with the support surface and wipe against it. The swash plate 302 is arranged between the wipe 300 and the stack support surface 272, being spaced above and parallel to the latter, so that the blades 301 are held out of contact with the support surface by the swash plate except over limited arc of rotation defined by an arcuate opening 314 in the swash plate. The arcuate extent and position of this opening are chosen so that as the wiper 300 rotates the blades to urge the sheets into corner registration. The registration apparatus is described in greater detail in our copending UK Patent application No 8 219 712.

As shown in Figure 17, wire buckle control fingers 286 are arranged to engage the top sheet of the stack adjacent to the two registration fingers 274. One of these is carried on an arm 282 and the other on a bracket 287.

The registration fence 274 comprises two fingers 274 spaced to locate A4 and similar size paper with a third finger 274' to assist in locating wider sheets. The fingers 274, 274' are rotatable about an axis 274a so that they may be retracted for ejection of bound sets SS into a collection tray 269 or other suitable collective device, such as a stacker which may have an elevating mechanism to increase its capacity and may be operable to offset sets or stacks delivered thereto.

Set or stack ejection is effected by a set eject mechanism according to the invention which comprises a drive roller 280 mounted so as to have a small portion thereof projecting upwardly

through an aperture 88 in the base or stack support surface 272 of the tray 271, and a coacting idler roller 281 carried on a spring arm 282 mounted on a rail 283. The drive roller 280 is continuously driven during the operation of the stacker and when a set has been compiled the idler roller 281 is pressed down against the top of the stack (by a cam 290 acting on a lever 291 rigid with the rail 283), with sufficient pressure that the set is driven out of the compiler tray, the registration fingers 274, 274' having been retracted simultaneously with the movement of the idler roller 281. The eject rollers 280, 281 feed the stack or set into the nips of output rollers 284, 285 leading into the collection tray 269.

The drive roller 280 is suitably arranged on the centre-line of the intended or most commonly used paper size e.g. A4.

In accordance with the invention, the eject drive roller 280 has a peripheral surface of a low coefficient of friction (μ) of less than 0.5 and a hardness of less than 40 IRHD. Such a roller is able to deform when the idler roller 281 is pressed down on the set so that the surface contact with the set is increased and a lower surface coefficient of friction is required to effect transport. The area of contact between the drive roller and the stack, when the idler roller is pressed down, extends (with respect to the drive roller) over a peripheral distance of between 1.5 and 3.0 mm. By giving the surface of the roller a low coefficient of friction, the problem of bottom sheet separation (premature ejection) is alleviated.

Thus the resiliency of the roller is such that adequate frictional contact may be created between the periphery of the roller and the set despite the low of the roller surface by compressing the roller to increase the area of contact with the set.

The drive roller 280 shown in Figure 21 is a composite roller having an outer skin 280a of a hard, relatively incompressible plastics material surrounding an inner core 280b of soft, compressible material. The skin is formed of a heat-shrinkable plastics material, e.g. fluorinated ethylene propylene, heat shrunk on and bonded by glue to a core of natural or synthetic elastomeric material, such as phenyl silicone rubber. The skin, which is 125 to 250 microns thick, has a surface coefficient of friction of less than 0.4 and preferably 0.1 to 0.3. The core has a hardness of 15 to 30 IRHD. In a particular embodiment, a composite drive roller 30 mm in diameter and 25 mm wide has a surface coefficient of friction of 0.3 and a core hardness of 21 IRHD.

In use the drive roller 280 must project through the stack support surface 282 in its uncompressed condition sufficiently that when the idler roller 281 is pressed against the top of the set the drive roller will not be compressed below the level of the stack support surface 172. A projection of about 2 - 4 mm, preferable 2 mm, has been found satisfactory for a roller as described above.

The force applied against the stack and thus drive rollers 280 by the idler roller 281 will increase with increase in set thickness and for a roller as described above a force varying between 20 Newtons for a two-sheet set and 80 Newtons for a 7.5 mm thick set has been found satisfactory.

Although specific embodiments have been described, it will be understood that various modifications may be made without departing from the scope of the invention as defined in the appended claims. For example, while a paddle wheel registration device is described and illustrated any suitable form of sheet registration device may be employed.

Claims

1. A sheet stacker for compiling sheets delivered serially thereto into stack, comprising a support surface (62 or 271), a registration stop (69 or 274), means (71 or 300) for registering sheets to form a registered stack against said registration stop (69 or 274) and means (73, 74 or 280, 281) for feeding a compiled stack of sheets off the support surface, said feeding means comprising a drive roller (73, 280) and an idler roller (74, 281) between which the sheets are stacked, one of said rollers being movable between an inactive position spaced from the other roller for compiling the stack and an active position for feeding the stack off the support surface, in which active position the movable roller presses the stack against the other roller and one of said rollers (74 or 280) projects through said support surface (62 or 271), characterized in that the movable rollers is the idler roller; in that the surface coefficient of friction of the roller is less than 0.5, and in that the drive roller has a hardness of less than 40 IRHD (International Rubber Hardness Degree) whereby, when the idler roller is moved to the active position, the drive roller is deformed so that the area of contact made by the drive roller with the stack extends over a peripheral distance of between 1.5 and 3.0 mm.

2. A sheet stack according to claim 1, in which the drive roller (280) projects through said support surface (272) and the idler roller (281) is moveable between an inactive position raised above the support surface (272) and an active position in which it press against the top of the stack.

3. A sheet stacker according to claim 2, in which the drive roller (280) projects through the support surface by 2 - 4 mm.

4. A sheet stacker according to claim 1, in which the drive roller (73) is spaced above the support surface (62) and the idler roller (74) is movable between an inactive position below the support surface (62) and an active position in which it projects through said support surface (62) and press the stack against the drive roller (73).

5. A sheet stacker according to claim 1, 2, 3 or 4, including means for rotating said drive roller (73, 280) so that it is rotating at he time said idler roller (74, 281) is moved into the active position, said drive roller (73, 280) preferably being rotated continuously during operation of the stacker.

6. A sheet stacker according to any preceding claim, in which the force applied by the idler roller to the stack, when the idler roller is in the active position, is between 20 and 80 Newtons depending on the thickness of the stack.

7. A sheet stacker according to any preceding claim, in which said drive roller (73, 280) is composed of an outer skin of plastics material having a surface coefficient friction of less than 0.4, preferably 0.1 - 0.3, surrounding a soft inner core having a hardness of 10 - 40 IRHD, preferably 15 - 30 IRHD, the skin of said drive roller being for example 125 - 250 microns thick, and/or in which said skin is composed of a heat shrinkable plastics material, such as fluorinated ethylene propylene, and said core is composed of an elastomeric material, such as phenyl silicone rubber.

8. A sheet stacker according to any preceding claim, in which the registration stop (69 or 274) is arranged in the path of sheets conveyed on to the support surface (62 or 271) and the compiled stack is ejected in the same direction, said registration stop being retractable.

9. A sheet stacker according to claim 4, in which said idler roller (74, 281) and registration stop (69, 274) are mounted on a common lever mechanism for movement by a single actuator.

10. A finishing apparatus incorporating a sheet stacker according to any preceding claim and means for binding a stack compiled on the support surface.

Patentansprüche

1. Blatt-Stapelvorrichtung zum Zusammenstellen von ihr der Reihe nach zugeführten Blättern zu einem Stapel mit einer Auflagefläche (62 oder 271), einem Ausrichtanschlag (69 oder 274), einer Einrichtung (71 oder 300) zum Ausrichten von Blättern gegen den genannten Ausrichtanschlag (69 oder 274) zwecks Bildung eines ausgerichteten Stapels und einer Einrichtung (73, 74 oder 280, 281) zum Abführen eines ausgerichteten Stapels von der Auflagefläche, wobei die Abführungseinrichtung eine Antriebsrolle (73, 280) und eine Leerlaufrolle (74, 281), zwischen denen die Blätter gestapelt werden, umfaßt, eine der Rollen zwischen einer von der anderen Rolle entfernten inaktiven Position zum Zusammenstellen des Stapels und einer aktiven Position zur Abführung des Stapels von der Auflagefläche bewegbar ist, wobei in der aktiven Position die bewegbare Rolle den Stapel gegen die andere

Rolle preßt und eine der Rollen (74 oder 280) durch die genannte Auflagefläche (62 oder 271) hindurchragt, *dadurch gekennzeichnet*, daß die bewegliche Rolle die Leerlaufrolle ist; daß der Reibungskoeffizient der Oberfläche der Antriebsrolle kleiner als 0,5 ist, und daß die Antriebsrolle eine Härte von weniger als 40 IRHD (internationaler Gummihärtegrad) aufweist, wobei, wenn die Leerlaufrolle in die aktive Position bewegt wird, die Antriebsrolle derart deformiert wird, daß die zwischen der Antriebsrolle und dem Stapel erzeugte Kontaktfläche sich über eine periphere Distanz zwischen 1,5 und 3 mm erstreckt.

2. Blattstapelvorrichtung nach Anspruch 1, in der die Antriebsrolle (280) durch die Auflagefläche (272) hindurchragt und die Leerlaufrolle (281) sich zwischen einer inaktiven, über der Auflagefläche (272) angehobenen und einer aktiven Position, in der sie gegen die Oberseite des Stapels drückt, bewegt.

3. Blattstapelvorrichtung nach Anspruch 2, in welcher die Antriebsrolle (280) um etwa 2 bis 4 mm durch die Auflagefläche hindurchragt.

4. Blattstapelvorrichtung nach Anspruch 1, in welcher die Antriebsrolle (73) oberhalb der Auflagefläche (62) angeordnet und die Leerlaufrolle (74) zwischen einer inaktiven Position unterhalb der Auflagefläche (62) und einer aktiven Position, in welcher sie durch die Auflagefläche (62) hindurchragt und den Stapel gegen die Antriebsrolle (73) preßt, beweglich ist.

5. Blattstapelvorrichtung nach Anspruch 1, 2, 3 oder 4, mit einer Einrichtung zum Drehen der genannten Antriebsrolle (73, 280), so daß sie sich zu der Zeit dreht, in der die Leerlaufrolle (74, 281) in die aktive Position bewegt wird, wobei die Antriebsrolle (73, 280) vorzugsweise kontinuierlich während des Betriebs der Stapelvorrichtung gedreht wird.

6. Blattstapelvorrichtung nach wenigstens einem der vorangehenden Ansprüche, in welcher die von der Leerlaufrolle auf den Stapel ausgeübte Kraft, wenn sich die Leerlaufrolle in der aktiven Position befindet, abhängig von der Stapeldicke zwischen 20 und 80 Newton beträgt.

7. Blattstapelvorrichtung nach wenigstens einem der vorangehenden Ansprüche, in welcher die Antriebsrolle (73, 280) aus einer äußeren Haut aus einem Plastikmaterial, das einen Reibungskoeffiezienten kleiner als 0,4, vorzugsweise 0,1 bis 0,3, aufweist, zusammengesetzt ist, wobei die äußere Haut einen weichen inneren Kern mit einer Härte von 10 bis 40 IRHD, vorzugsweise 15 bis 30 IRHD, umgibt, die Haut der Antriebsrolle z. B. 125 bis 250 µm dick ist, und/oder in welcher die Haut aus einem durch Wärme einschrumpfbaren Plastikmaterial, wie fluoriertem Äthylenpropylen, und der Kern aus einem elastomeren Material, wie Phenylsilikongummi zusammengesetzt ist.

8. Blattstapelvorrichtung nach wenigstens einem der vorhergehenden Ansprüche, in welchem der Ausrichtanschlag (69 oder 274) im Weg der auf die Auflagefläche (62 oder 271) transportierten Blätter angeordnet ist und der zusammengestellte Stapel in derselben Richtung abgeführt wird, wobei der Ausrichtanschlag einziehbar ist.

9. Blattstapelvorrichtung nach Anspruch 4, in welcher die Leerlaufrolle (74, 281) und der Ausrichtanschlag (69, 274) an einem gemeinsamen Hebelmechanismus zur Bewegung durch einen einzigen Betätiger befestigt sind.

10. Fertigstellungsgerät mit einer Blattstapelvorrichtung nach irgendeine vorhergehenden Anspruch und mit einer Einrichtung zum Heften eines auf der Auflagefläche zusammengestellten Stapels.

Revendications

1. Dispositif d'empilage de feuilles pour la compilation de feuilles qui lui sont fournies en série dans un empilage, comprenant une surface de support (62 ou 271), une butée de cadrage (69 ou 274), un moyen (71 ou 300) pour cadrer des feuilles afin de former un empilage cadré contre la butée de cadrage (69 ou 274) et un moyen (73, 74 ou 280, 281) pour procéder à une alimentation en jeu compilé de feuilles à partir de la surface de support, le moyen d'alimentation comprenant un rouleau moteur (73, 280) et un rouleau fou (74, 281) entre lesquels les feuilles sont empilées, l'un des rouleaux étant mobile entre une position inactive espacée de l'autre rouleau pour compiler l'empilage et une position active pour introduire l'empilage à partir de la surface de support, position active dans laquelle le rouleau mobile comprime l'empilage contre l'autre rouleau et l'un des rouleaux (74 ou 280) est en saillie dans la surface de support (62 ou 271), caractérisé en ce que le rouleau mobile est le rouleau fou; en ce que le le coefficient de frottement de la surface du rouleau moteur est inférieur à 0,5 et en ce que le rouleau moteur a une dureté inférieure à 40 IRHD (International Rubber Hardness Degree), d'où il résulte que lorsque le rouleau fou est amené à la position active, le rouleau moteur est déformé de sorte que la surface de contact réalisée par le rouleau moteur avec l'empilage s'étend sur une distance périphérique comprise entre 1,5 et 3,0 mm.

2. Dispositif d'empilage de feuilles selon la revendication 1, dans lequel le rouleau moteur (280) est en saillie dans la surface de support (272) et un rouleau fou (281) est mobile entre une position inactive en élévation au-dessus de la surface de support (272) et une position active dans laquelle il comprime la partie supérieure de l'empilage.

3. Dispositif d'empilage de feuilles selon la revendication 2, dans lequel le rouleau moteur (280) est en saillie dans la surface de support sur une distance de 2 à 4 mm.

4. Dispositif d'empilage de feuilles selon la revendication 1, dans lequel le rouleau moteur (73) est espacé du dessus de la surface de support (62) et le rouleau fou (74) est mobile entre une position inactive au-dessous de la surface de support (62) et une position active dans laquelle il est en saillie dans la surface de support (62) et comprime l'empilage contre le rouleau moteur (73).

5. Dispositif d'empilage de feuilles selon la revendication 1, la revendication 2, la revendication 3 ou la revendication 4, comprenant un moyen pour animer d'un mouvement de rotation le rouleau moteur (73, 280) de sorte qu'il tourne en même temps que le rouleau fou (74, 281) est amené à la position active, le rouleau moteur (73, 280) tournant de préférence continuellement pendant la marche du dispositif d'empilage.

6. Dispositif d'empilage de feuilles selon l'une quelconque des revendications précédentes, dans lequel la force appliquée par le rouleau fou à l'empilage, lorsque le rouleau fou se trouve dans la position active, est comprise entre 20 et 80 Newtons en fonction de l'épaisseur de l'empilage.

7. Dispositif d'empilage de feuilles selon l'une quelconque des revendications précédentes, dans lequel le rouleau moteur (73, 280) est constitué d'une enveloppe extérieure en matériau plastique ayant un coefficient de frottement en surface inférieur à 0,4, de préférence compris entre 0,1 et 0,3, entourant un noyau intérieur tendre ayant une dureté de 10 à 40 IRHD (International Rubber Harness Degree, degré international de dureté du caoutchouc), de préférence de 15 à 30 IRHD, l'enveloppe du rouleau moteur ayant par exemple une épaisseur de 125 - 250 microns, et/ou dans lequel l'enveloppe est constituée d'un matériau plastique rétrécissant à la chaleur tel que du propylène-éthylène fluoré, et le noyau est composé d'un matériau élastomère tel que le caoutchouc phénylsilicone.

8. Dispositif d'empilage de feuilles selon l'une quelconque des revendications précédentes, dans lequel la butée de cadrage (69 ou 274) est disposée dans le trajet des feuilles acheminées sur la surface de support (62 ou 271) et l'empilage compilé est éjecté dans la même direction, la butée de cadrage étant rétractable.

9. Dispositif d'empilage de feuilles selon la revendication 4, dans lequel le rouleau fou (74, 281) et la butée de cadrage (69, 274) sont montés sur un mécanisme commun à levier pour déplacement par un actionneur.

10. Appareil de finition incorporant un dispositif

d'empilage de feuilles selon l'une quelconque des revendications précédentes et un moyen pour lier un empilage compilé sur la surface de support.

Fig. 1.

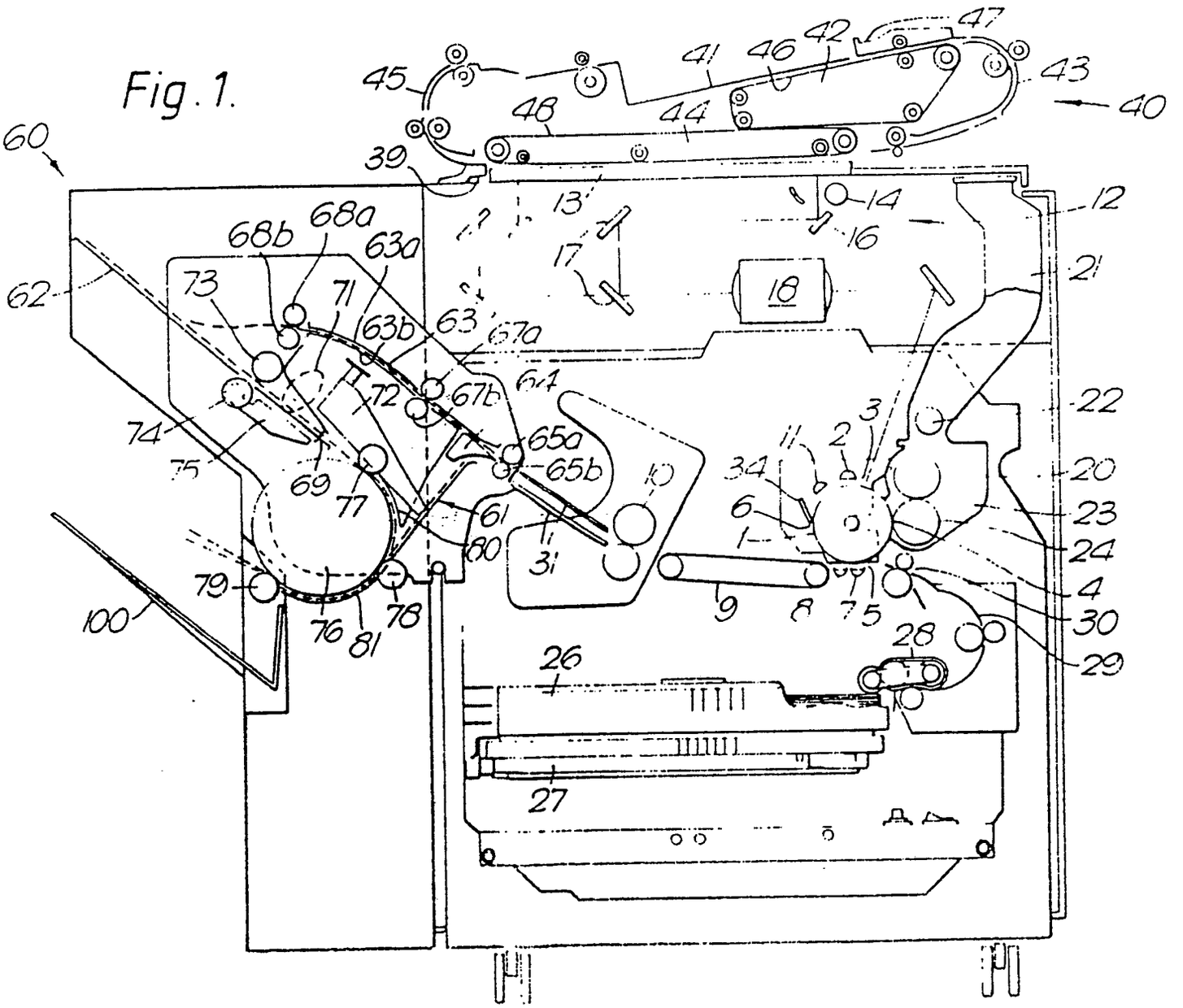
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Fig. 2.

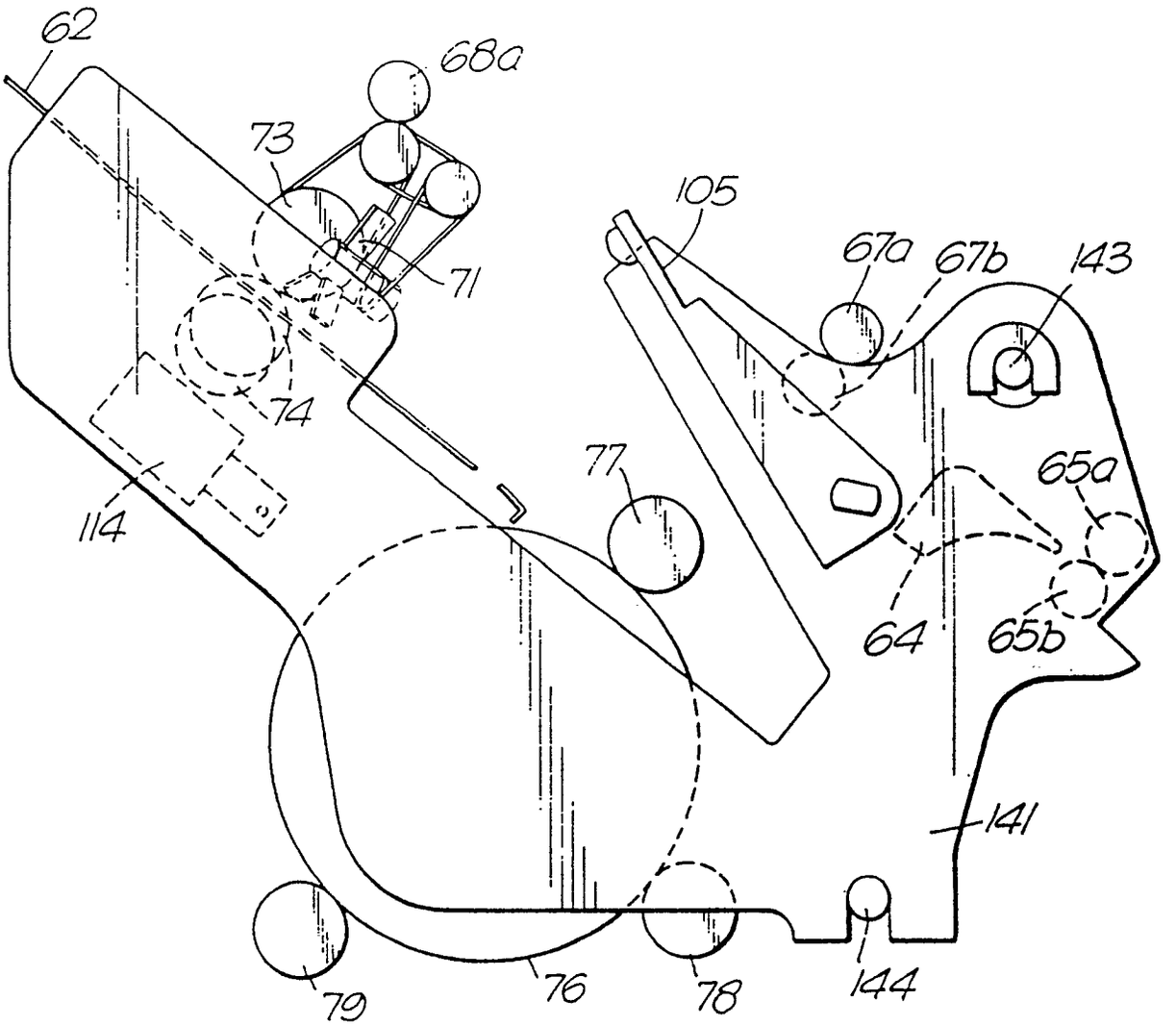

Fig. 3.

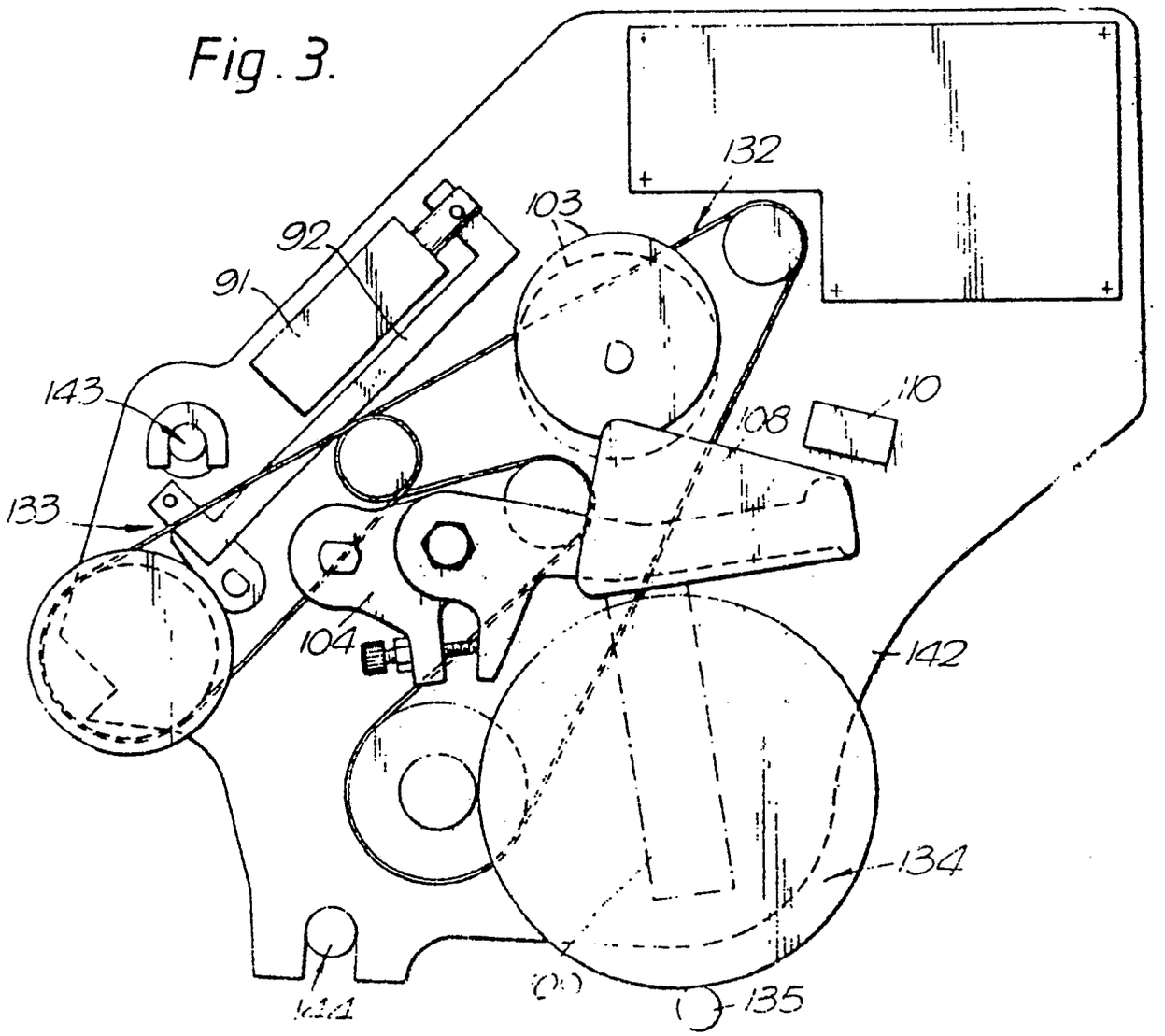

Fig. 4.

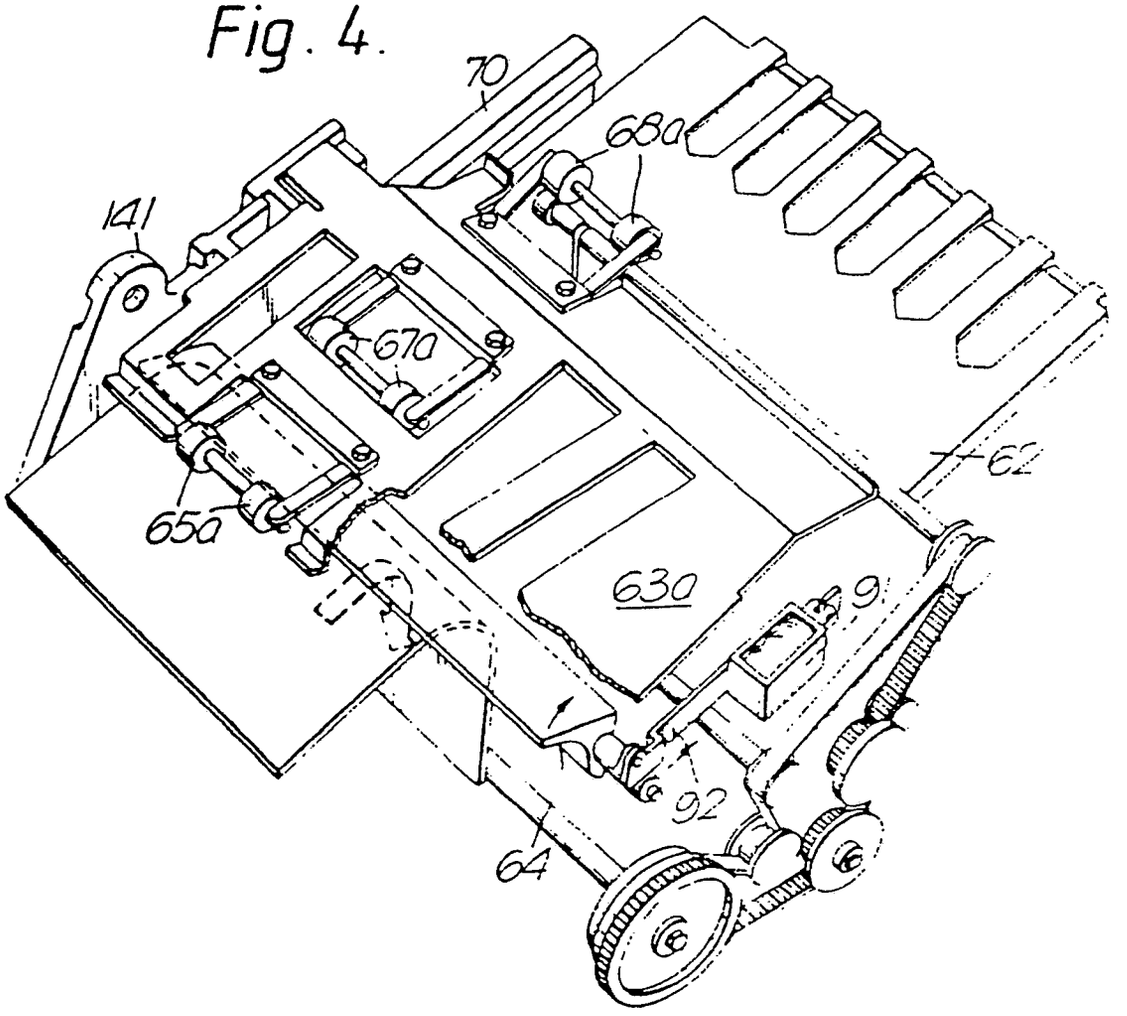

Fig. 5.

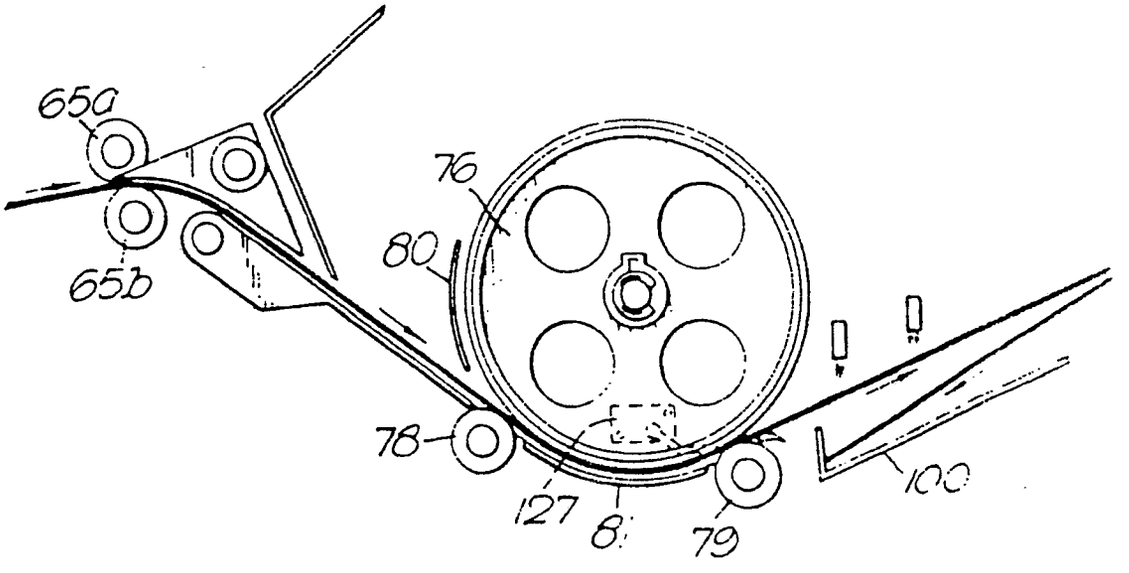

Fig. 6.

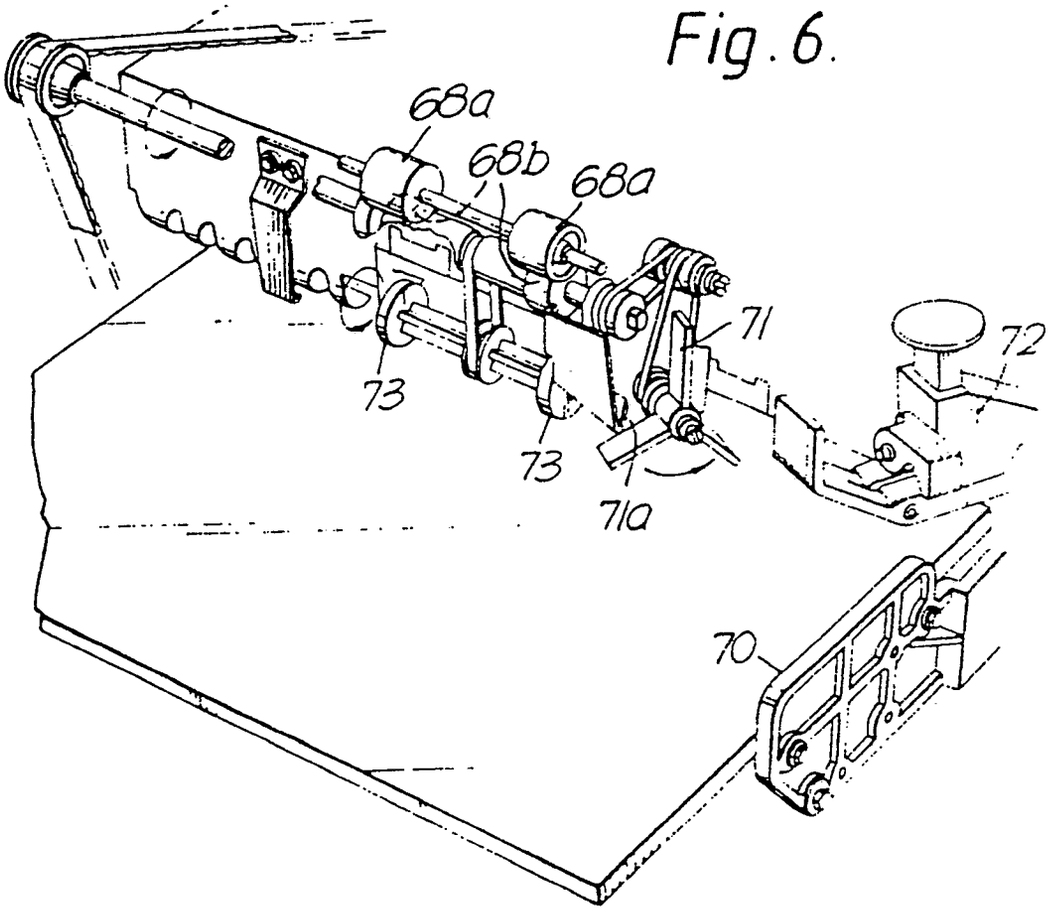
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Fig. 7.

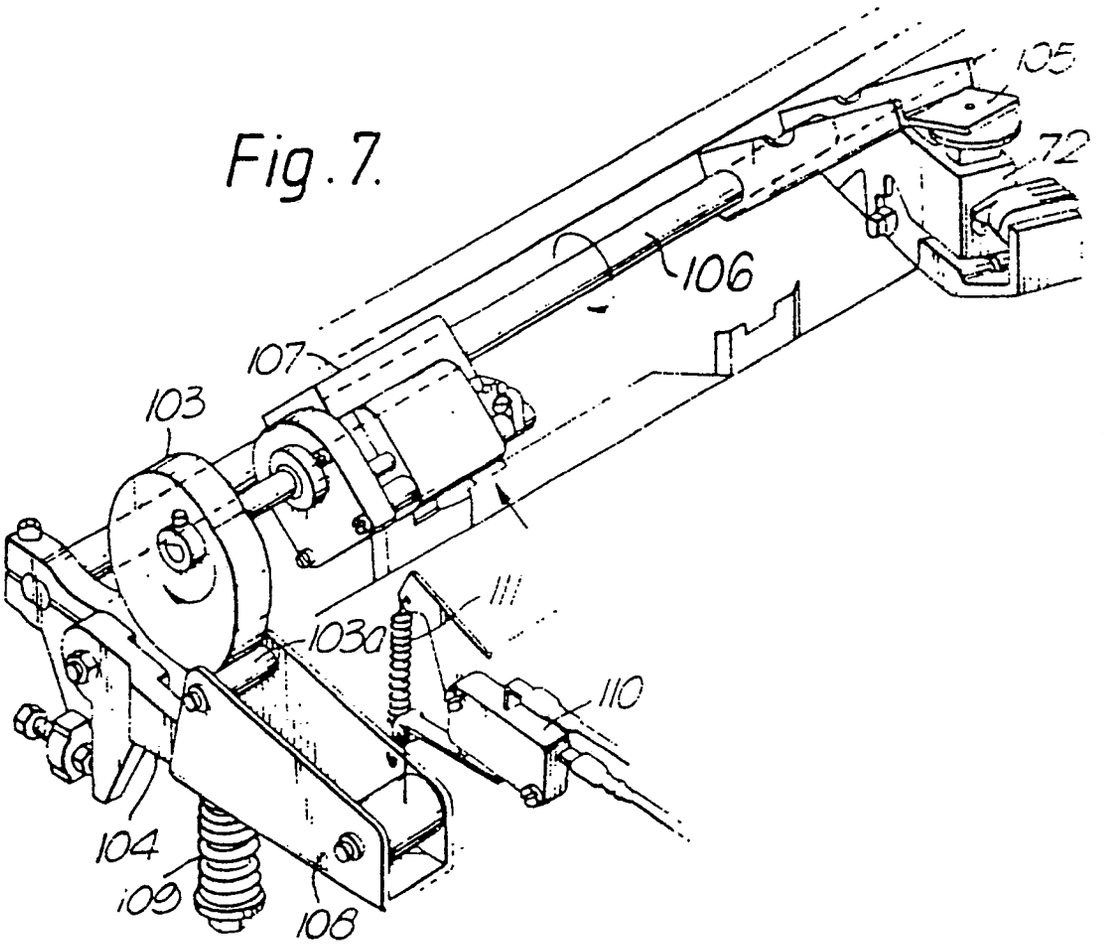
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Fig. 8.

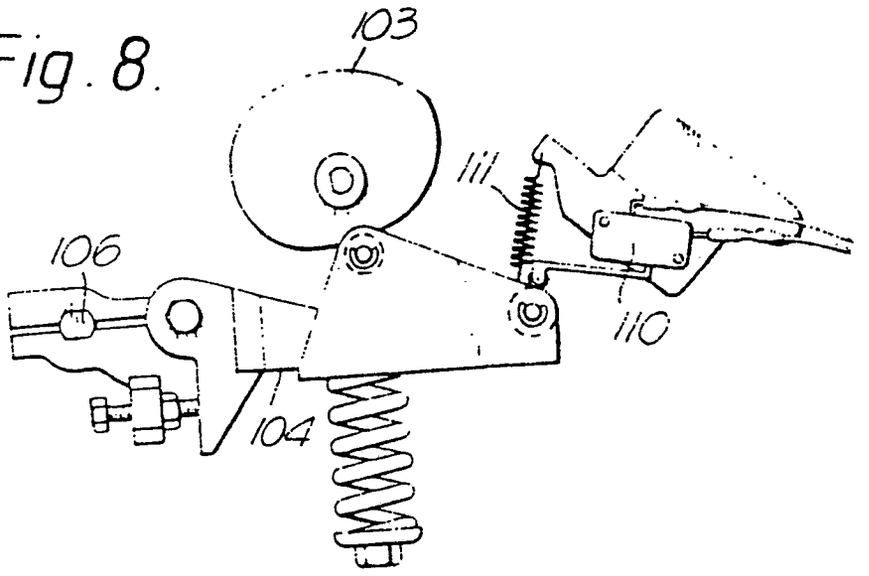

Fig. 9.

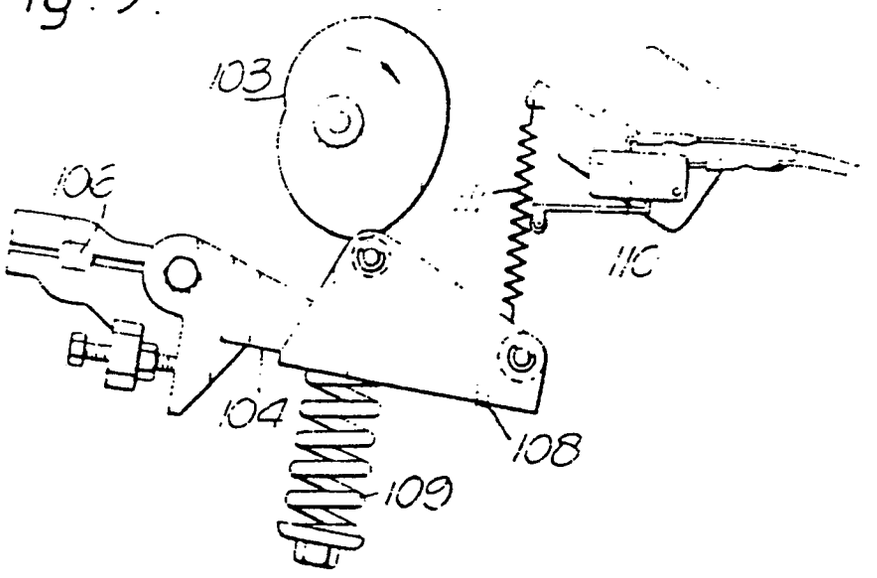

Fig. 10.

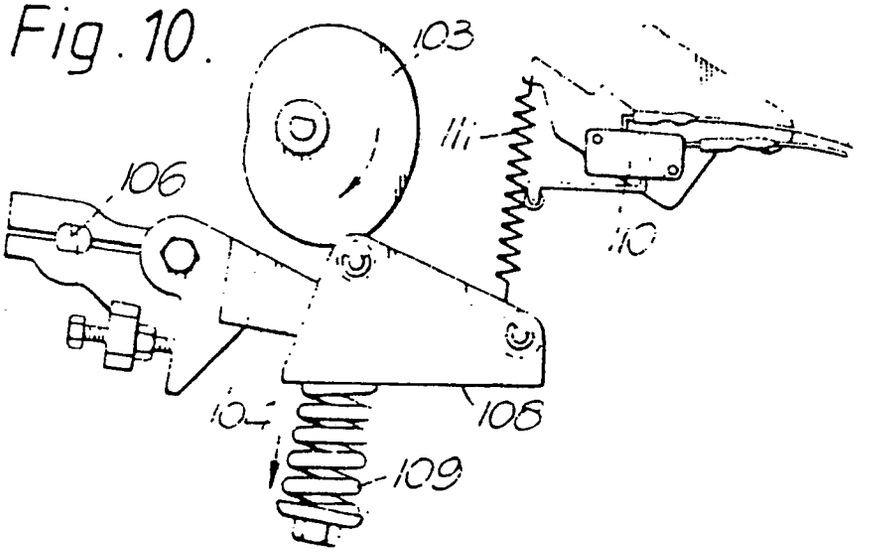

Fig. 11.

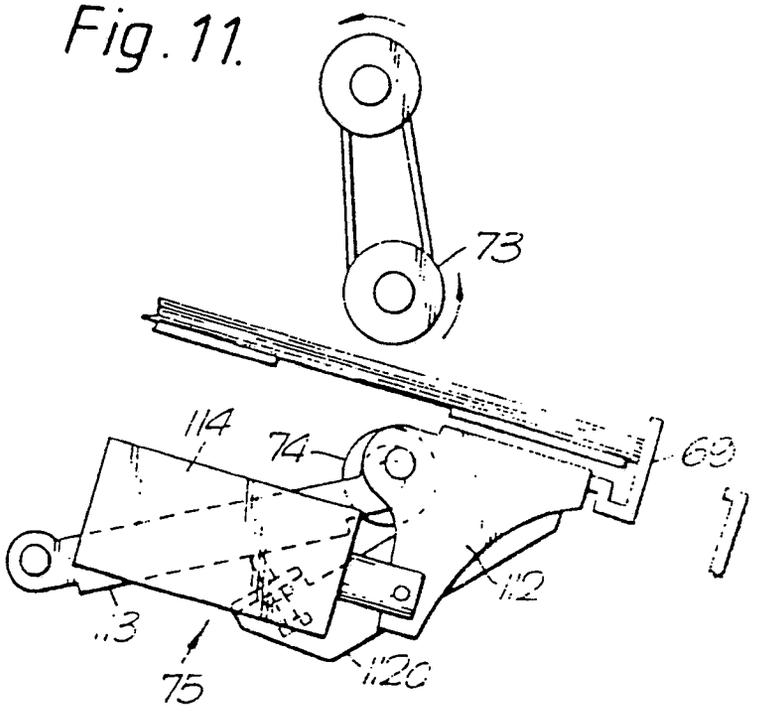
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Fig. 12.

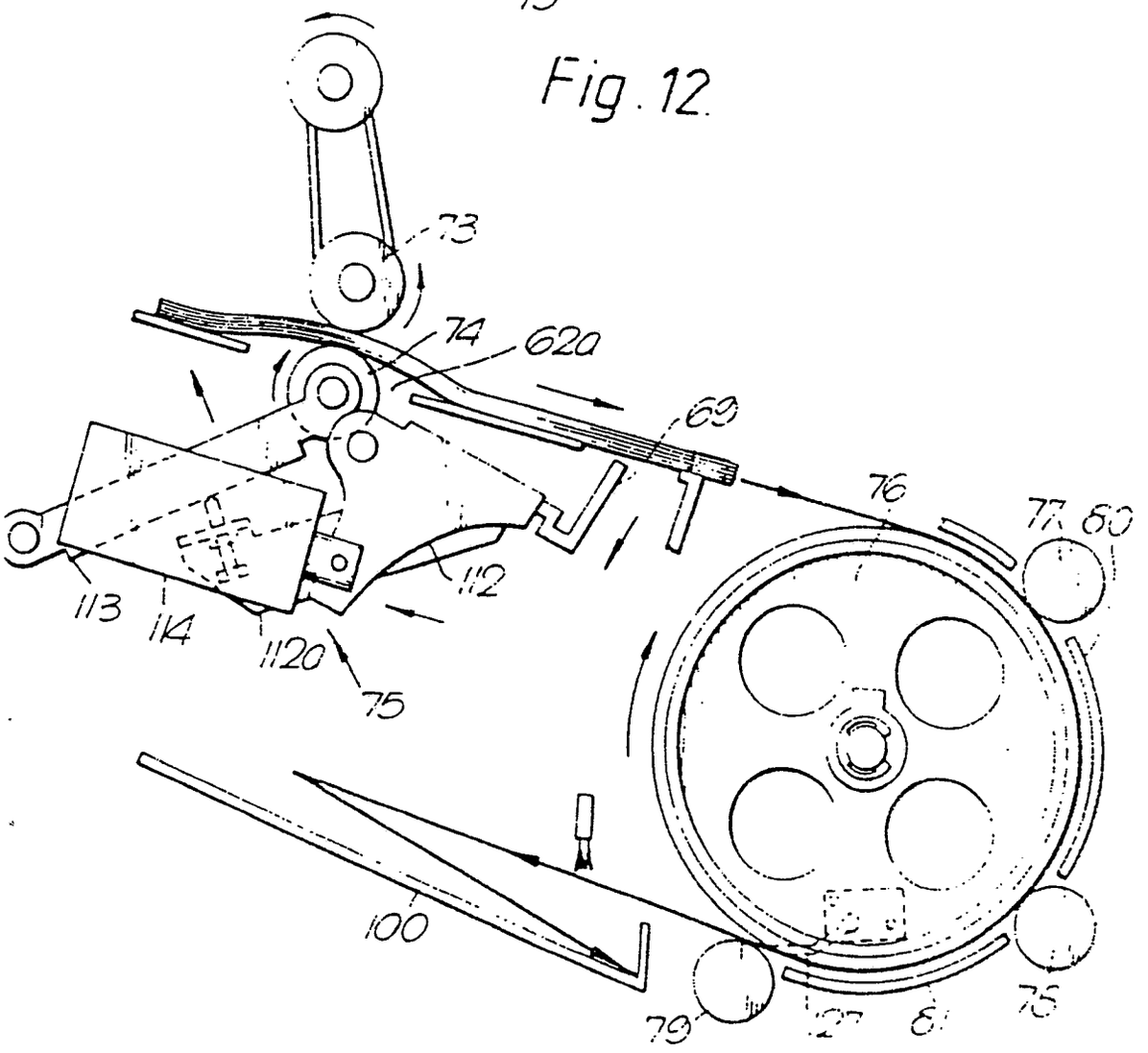
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Fig. 13.

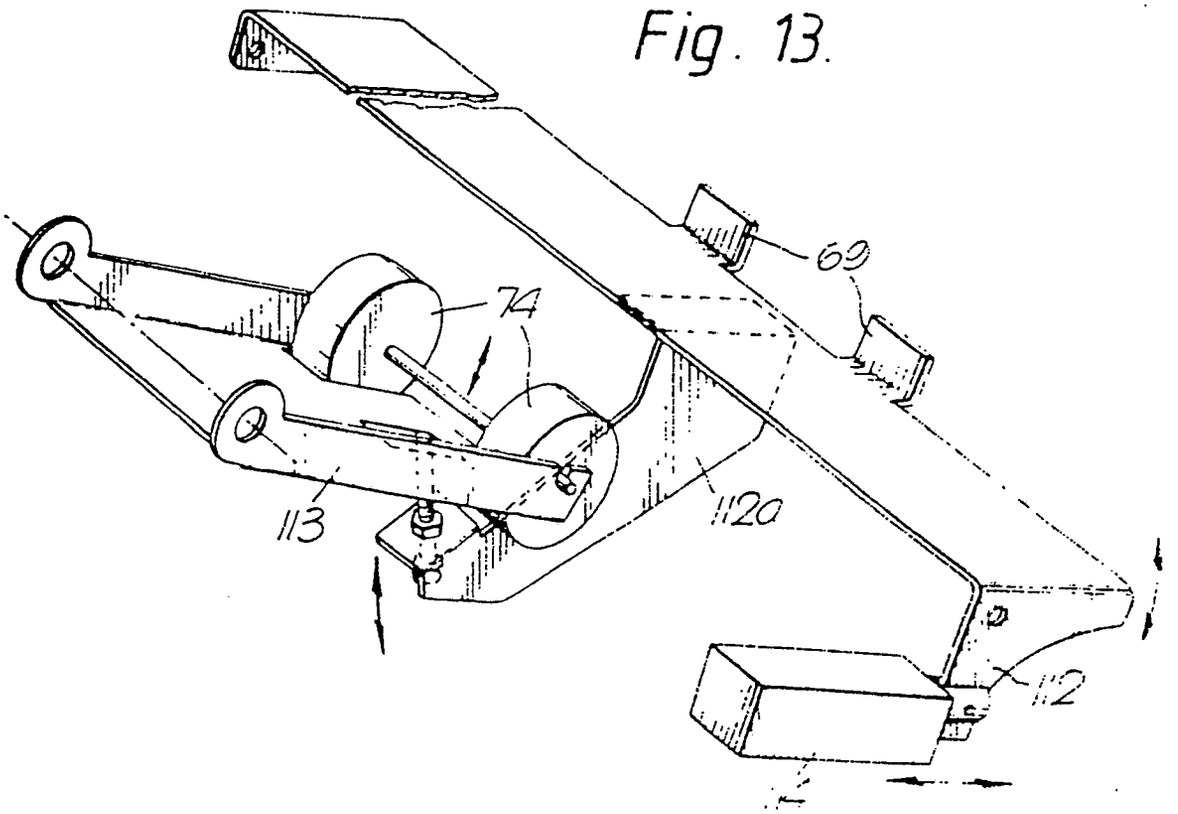


Fig. 14.

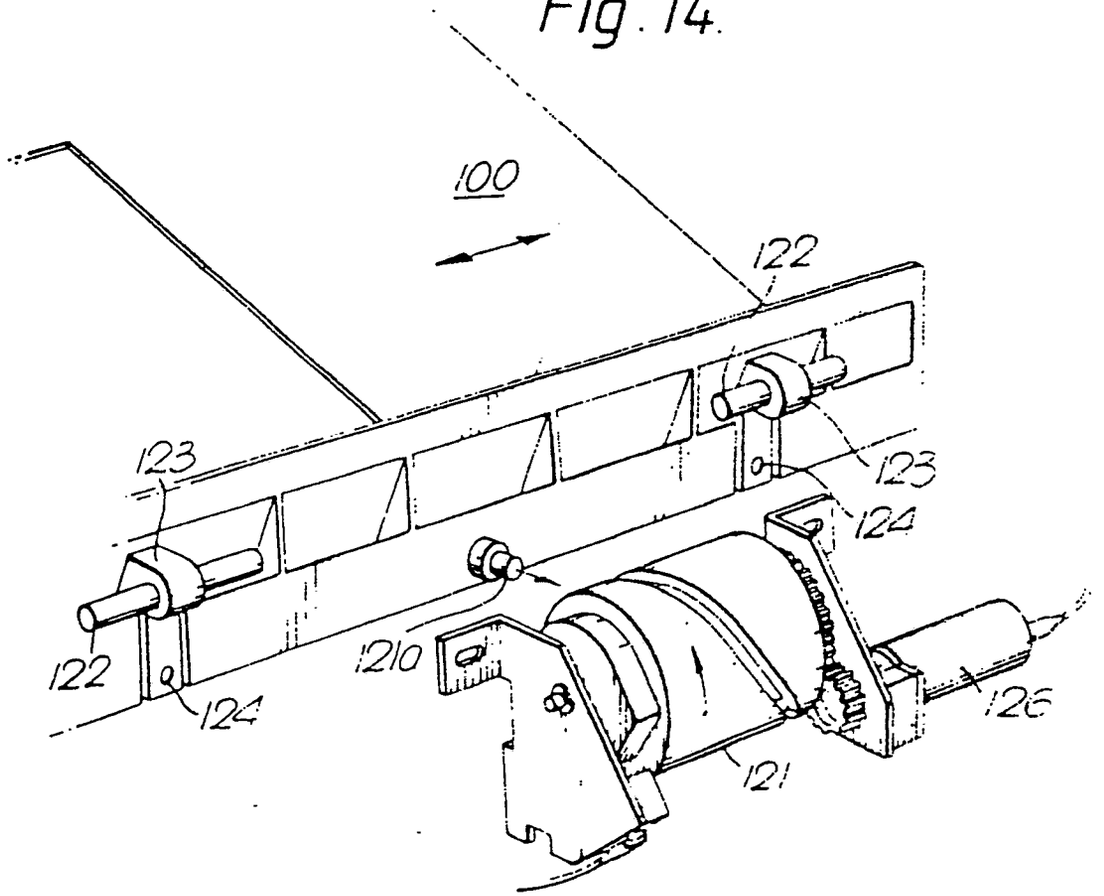


Fig. 15.

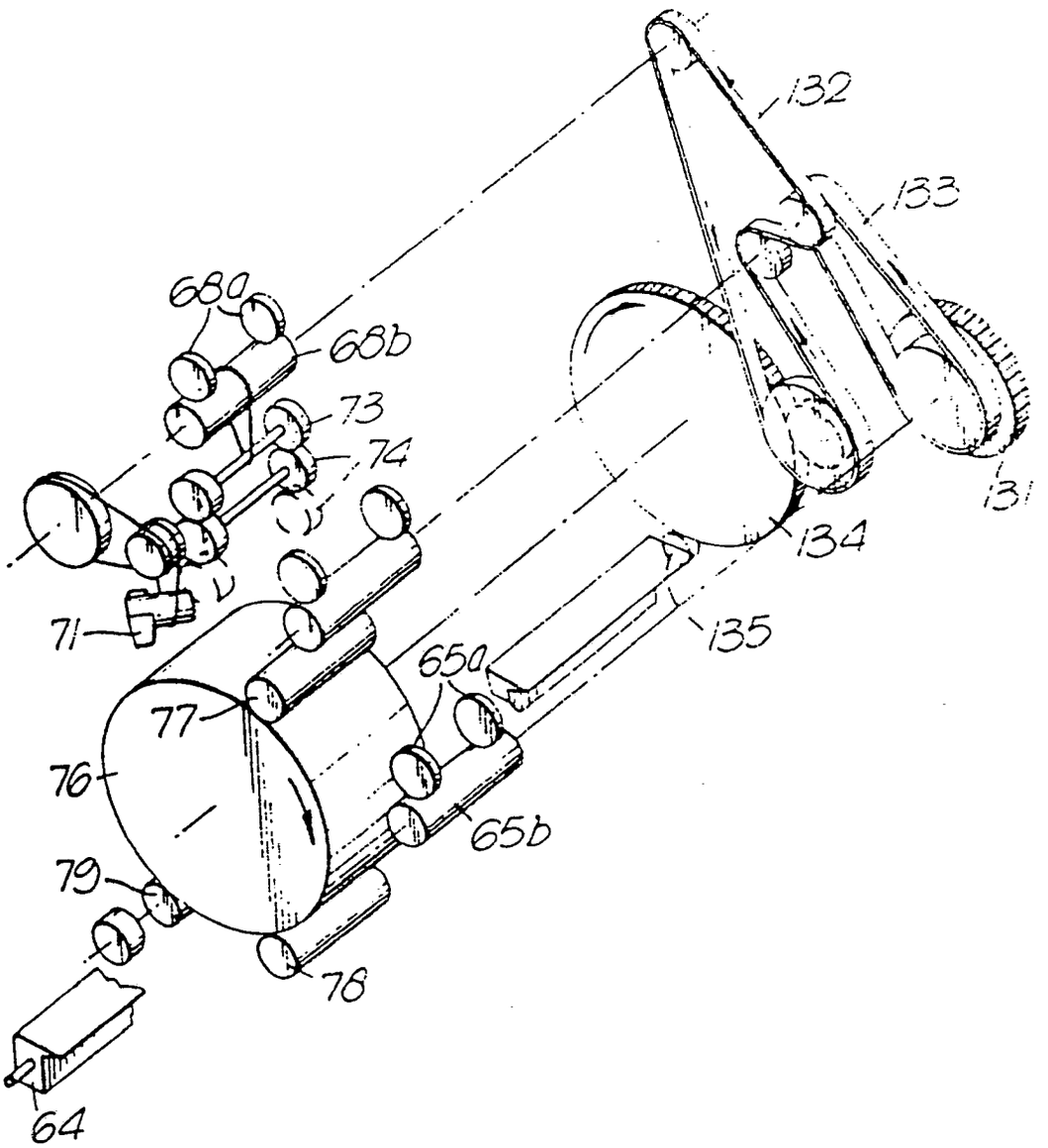
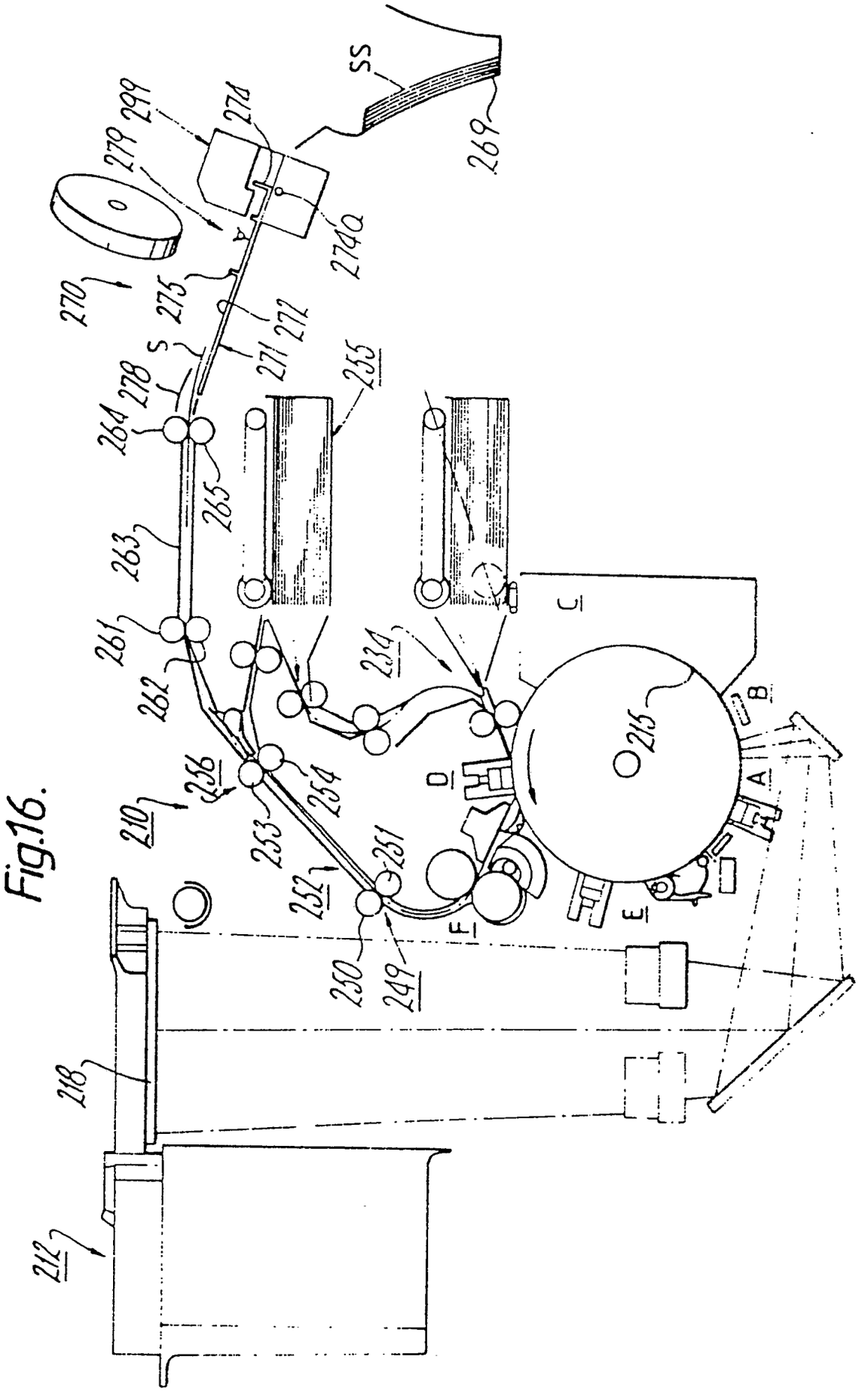


Fig.16.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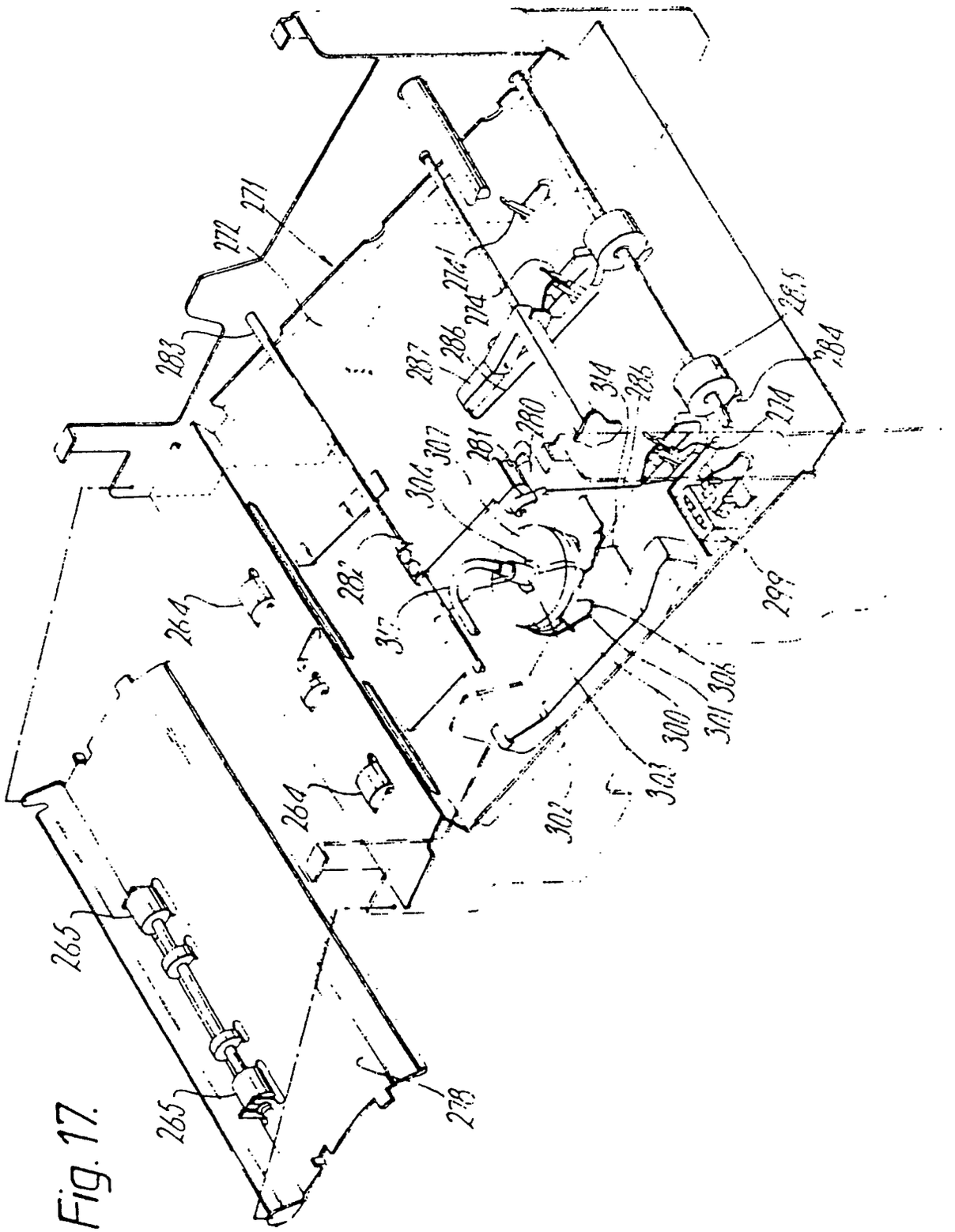
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Fig. 17.

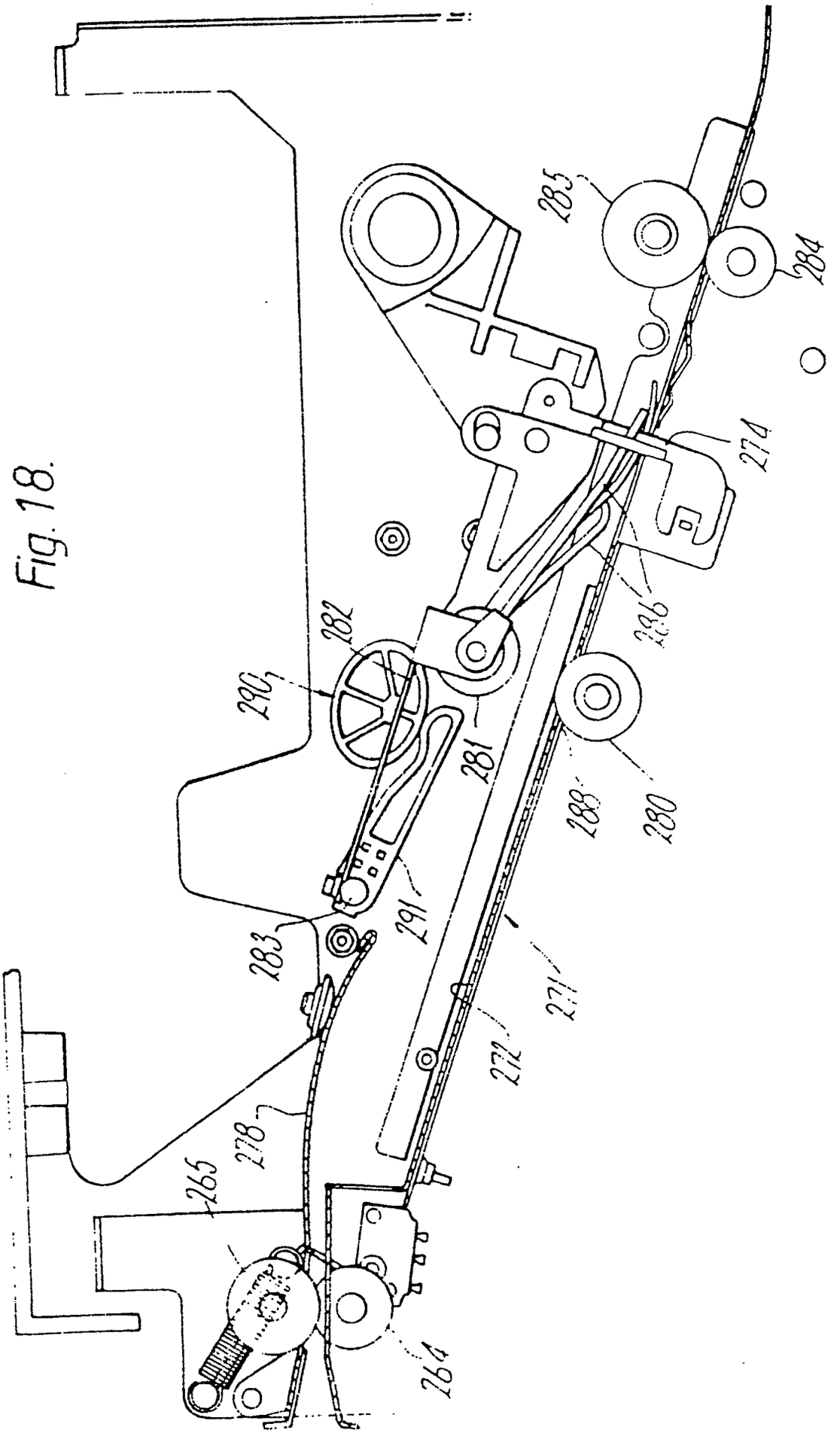

Fig. 18.

Fig. 19.

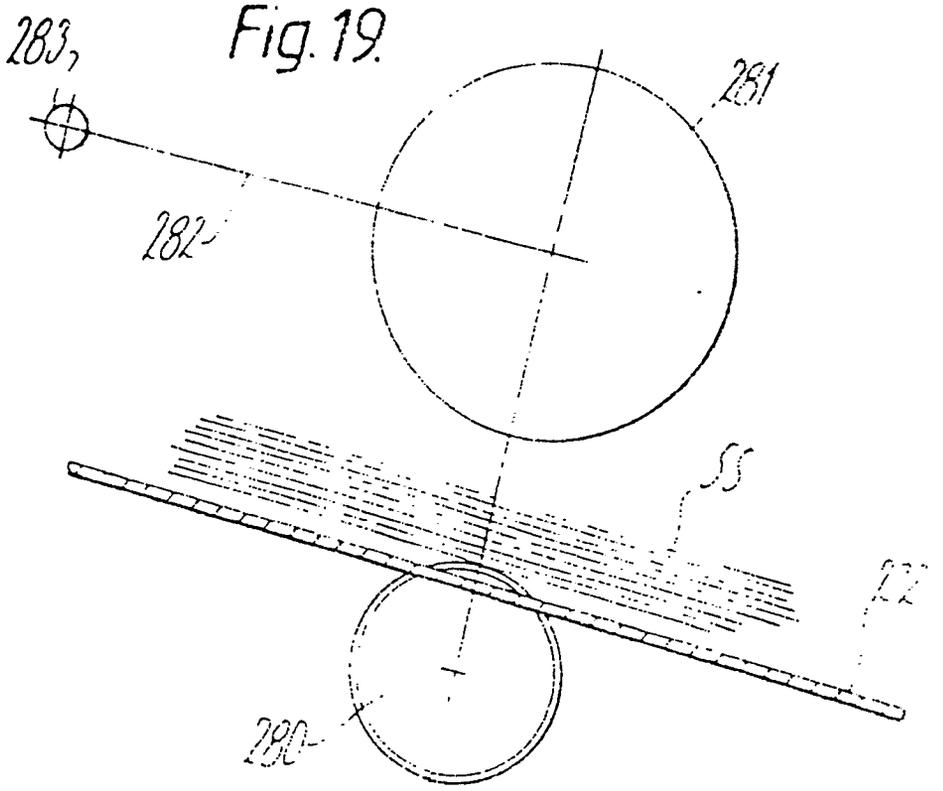

Fig. 20.

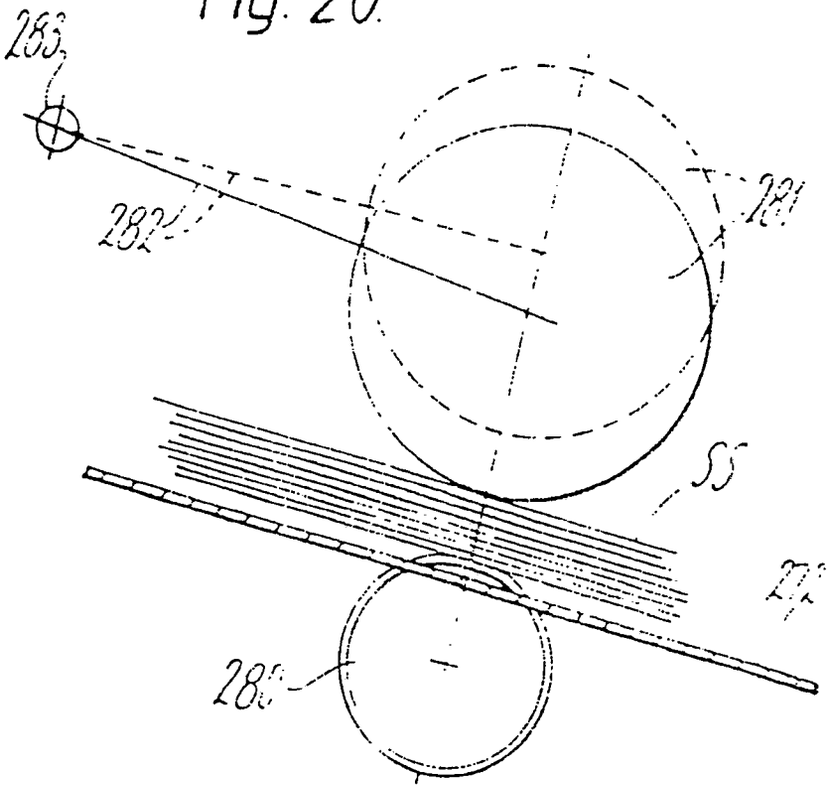

Fig. 21.