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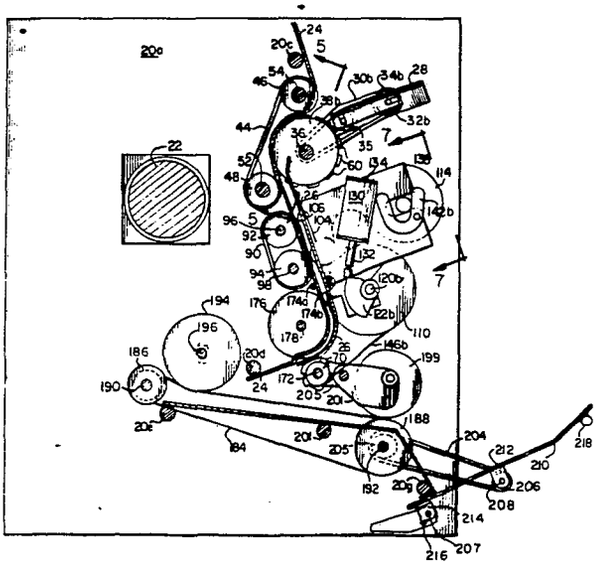
(54) Mechanism for sequentially separating documents.

(57) A machine for counting cheques or other documents is provided with an upper bin feed means (30b) feeding documents into a document separation means (38b, 44). A pair of opposed guide plates (24, 26) form a document feed path below the document separation means, one of the plates (24) being fixed in position between parallel support plates (20a) of the machine. The other guide plate (26) is pivotally supported relative to the parallel walls near one end and releasably latched relative thereto at the opposite end. The pivotally supported guide plate carries operative devices including the shafts of rotating devices. One such device is a printer roller (110). The guide means (26, 24) terminates above a generally horizontal conveyor (184) which runs counter to the direction of feed. The documents are fed successively onto the conveyor (184) beneath a floating roller (194) which allows documents which are driven to move as far as the drive urges them and then when drive ceases, moves the documents in the reverse direction toward a collection tray (210). A further roll (199) holds the documents in fanned out position so that they may be viewed as they come off the end of the conveyor and before they fall into the tray.



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Mechanism for sequentially separating documents

Specification

The present invention concerns an improved feed mechanism for sequentially separating documents including sheets, coupons, and other types of sheet material which may tend to be stuck together in the course of handling. The mechanism includes an input feed, a variable date drum, an endorsing system, and an output stacker system, each of which parts has features of novelty. The document separator system has a stripper or document separation mechanism, ensuring passage of only one document at a time, of the type covered by U.S. Patent No. 4,216,952 to George P. McInerny.

The output stacker system also provides a bill and document inspection capability as the bills and documents are preferably moved forward toward the front of the machine and neatly fall into the stacker. The output stacker is of a form which avoids the aggravation of document fly out experienced in some devices of the past. If desired, an alternative stacker can be provided in conjunction with conveyor belt reversal. However, if a single output stacker is employed, the convenience of an input bin across the top and output bin across the bottom is achieved.

Very high speeds have been achieved by the device of the present invention which permits operators to achieve much faster performance and greater production levels with highest possible accuracy in counting. There is improved performance with certain types of hard-to-handle documents, including limp paper documents, because of improvements to the paper separation device. The system permits date and dry ink cartridge changing by the operator with a minimum of problem and without the need to remove a back cover. The preferred structure is supported in such a way that a printing drum moves away from the document path defining wall and at the same time disengages from the inking system saving both ink and wear in the process. The ink cartridge or roller can be inserted and removed from the front without serious problems. The date can be quickly

adjusted and other changeable information can be quickly put in place, changing what is to be printed on the documents as they pass through the printing stage. The date drums have the advantage that they are universally applicable throughout the world without modification. Multiple utility is possible through use of six independently adjusted stable positioned ten-digit number belts whose member selection is easily accomplished by finger wheel adjustment by the operator.

The system is preferably microprocessor controlled and the control logic is accessed through a keyboard and pushbuttons located on a panel convenient to the operator. The machine is capable of counting and at the same time may endorse and date print on documents which pass through it. The control logic permits automatic cut off after a preset count. The logic, and sensor means sensing the removal of a counted batch, can initiate immediate automatic processing of the next batch. The control also allows selective use of the printer functions. Divided counter displays are preferably provided for ease in reading outputs and can be made to present batch counts or total counts as desired.

From a mechanical standpoint, the machine of the present invention functionally serves to separate documents and count them. Mechanically the machine consists of a frame having a pair of spaced generally parallel supporting walls and means extending between the walls to space them from one another. A pair of guide plates are arranged generally perpendicular to the supporting walls and provide portions which are closely spaced from one another and form a document guide path between them. At least one of the guide plates desirably has pivotal support means transverse to the parallel supporting walls adjacent one end of the guide plate whereby the pivoted guide plate can be rotated away from the other guide plate about the pivotal support to afford access to the guide path. Latch means can be provided to releasably hold the pivotal support plate in its path defining position. Operative means, such as rollers, belts, conveyors, printers, and the like, are

arranged to act upon the documents passing along the guide path and may be supported on the respective guide plates so that they have operative positions extending or extensible into the guide path.

The invention provides a compact vertically oriented machine which will fit into a very small space and provide a very high speed reaction through all phases, some of which need not be used at all times. The mechanism overall is compact and needs no material increase in size to accommodate its electric parts. A preferred systen handles documents as small as 38 mm (1.5 inch) wide to a maximum of 115 mm (4.5 inches) wide so that large commercial cheques will easily fit into the device which also provides a 225 mm (8.75 inches) document length feed bin.

The present invention also provides at least four major regions of improvement and numerous minor areas.

Improved Separating Means

In accordance with one aspect of the present invention, a machine for separating documents is provided with a frame supporting two friction members having opposed friction surfaces. One of the opposed friction surfaces is a friction drum means rotatably supported along its axis. The other friction surface is a resilient endless friction belt supported by at least two path-defining rotatable pulleys and deflected and resiliently deformed between said at least two pulleys by contact with a third pulley coaxial with, and of about the diameter of, the drum means. Drive means drives the friction members so that their friction surfaces move in opposite directions at the region of deflection, whereby they tend to move documents passing between them in opposite directions, the friction surface moving in a designated forward direction having the greater frictional effect. The structure so defined is essentially that of U.S. Patent No. 4,216,952 by George P. McInerny. One improvement in this structure comprises providing the drum surface with shallow grooves along elements of

the drum surface parallel to the axis of rotation to provide alternate shallow teeth-like and grooved areas around its periphery. At least two side-by-side drum parts have such patterns of grooves offset from one another. Another improvement in this structure is providing the friction-belt deflection pulley coaxial with the drum means with a groove cross-section different from that of the belt so that belt and pulley contact area is minimized.

Rotatable Print Member

In the sheet printer, the frame is provided to support a print member to rotate about an axis. The print member has spaced apart walls supported generally normal to said shaft and supports between the walls a plurality of rotatable shafts, each carrying at least one timing pulley fixed to each shaft and other pulleys rotatable about the shaft. A plurality of endless print belts in the form of timing belts engage at least the timing pulley fixed on one of said shafts and pulleys on other shafts. Manual means is provided for rotating each shaft. Indexing means is provided to engage each belt to hold the belt in a plurality of discrete positions representative of print positions.

Print Element Support Construction

A document handling device has a frame and a document guide path supported relative to the frame. A rotatable print device is supported on the frame and has alternative support positions, in one of which positions it contacts and prints on documents in said guide path and in the other of which positions it is removed from said path. Means on said frame selectively moves the rotary print device from one position to the other.

Document Feed and Inspection Means

In a machine for separating documents so that they may be individually inspected, a frame supports a generally horizontally oriented endless conveyor belt on rotatable pulleys. Means is provided to feed the documents onto the conveyor belt

and to orient the separated documents so that they assume a major directional component in a direction parallel to the endless belt conveyor. This means includes direction changing means and rotational trailing-edge-engaging means, the latter of which provides multiple shoulders transverse to the direction of document motion which engage the trailing edge of each document and direct it positively downward. Drive means drives the conveyor belt in opposition to the direction of document feed and moves the trailing-edge-engaging means faster than document motion as it leaves the direction changing means.

Drawings of the Preferred Embodiment of the Invention

The present invention is shown in a preferred embodiment in the accompanying drawings, in which:-

Figure 1 is a front elevational view of the preferred embodiment of the present invention,

Figure 2 is a side elevational view as viewed along line 2-2 of Figure 1,

Figure 3 is a side elevational view from the opposite side as viewed along line 3-3 of Figure 1,

Figure 4 is a sectional view taken along line 4-4 of Figure 1,

Figure 4A is a partial sectional view similar to Figure 4 but with operative structure removed and simply leaving the guide plates,

Figure 4B is a sectional view taken along line 4B-4B of Figure 4A,

Figure 5 is an enlarged front elevational view taken along line 5-5 of Figure 4 showing the document separation stripping structure of the present invention,

Figure 6 is a sectional view taken along line 6-6 of Figure 5,

Figure 7 is an enlarged front elevational view taken along line 7-7 of Figure 4 omitting part of the structure of the print drum,

Figure 8 is a side elevational view taken along line 8-8 of Figure 7,

Figure 9 is a side elevational view taken along line 9-9 of Figure 7,

Figure 10 is an exploded perspective view, somewhat enlarged, showing portions of the print drum of the present invention,

Figure 11 is an enlarged front elevational view partially cut away showing the print drum of the present invention removed from the structure;

Figure 12 is a sectional view taken along line 12-12 of Figure 11,

Figure 13 is a developed view showing the control structure of the print drum of Figure 11,

Figure 14 is an enlarged drawing of some of the structure shown in Figure 4 showing in greater detail the conveyor and the area of the print drum and a direction changing and positive feed element of the present invention,

Figure 15 is an enlargement of the lower portion of Figure 4 showing in greater detail the conveyor and collection means,

Figure 15A is a sectional view taken along line 15A-15A in Figure 15,

Figure 15B is an enlargement of a region of Figure 15 showing document directing mechanism,

Figure 16 is a view similar to Figure 15 on a somewhat reduced scale showing an alternative embodiment of the present invention having a bidirectional conveyor capable of feeding documents into two collection bins,

Figure 17 is a schematic drawing showing the drive structure and connections of the present invention, and

Figure 18 is a detailed view of the lower structure shown in Figure 1 showing some of the structure which is broken away or omitted from that Figure.

A Preferred Embodiment of the Present Invention

Referring first to Figures 1 through 4, the structure shown is a compact, generally vertically oriented document separation and counting device in which the documents are stacked at the top of the device in a feed bin. From the bin they are fed downwardly through friction separation means, an acceleration stage for spacing documents, past a printer of a rotary drum type, past a counter, and down to a document direction changing means and positive horizontal direction orientation means onto a horizontal conveyor and into a collection bin. The rotary printer can be engaged or disengaged by a specially designed operating structure. The conveyor spaces and separates documents so that they may be individually observed visually before being fed into a stack in the collection bin. Alternatively, two collection bins may be provided at opposite ends of a reversible horizontal conveyor.

Referring specifically to Figure 1, the structure consists of a frame 20 composed primarily of two parallel metal walls 20a and 20b between which extend various fixed and movable structures. Extending transversely of the two walls 20a and 20b are five support rods 20c-20g, (best seen in Figure 4)

which acts as a stabilizing and spacing structure for the walls and on which some of the structure may be supported. A single drive for the whole device is provided by a motor 22 which is mechanically supported on the wall 20b and is belt-connected in a drive system, as will be described hereafter.

A sheet metal feed plate 24 extends in a sinuous path between the walls 20a and 20b between the support rods 20c and 20d (as best seen in Figure 4) and defines a document path. Generally parallel to the feed plate 24 is a second somewhat shorter sheet metal conveyor plate 26 which generally conforms to the shape of the feed plate 24 but is spaced somewhat therefrom. The conveyor plate 26 begins after the sheet separation means and ends shortly before the end of the feed plate 24. A tray 28 provides a feed bin in cooperation with the top of the feed plate 24.

The tray 28 receives and supports documents to be fed through the system. Friction conveyor belts 30a and 30b, arranged parallel to one another and transverse to the feed plate 24, move the bottom documents in the tray 28 into the separation means. The belts are supported on pulleys 32a and 32b having stub shafts supported in slots in an acetal block 40 fixed to the tray 28, which pulleys have friction wheel extensions 34a and 34b which project above the respective belt and aid the initiation of feed into the friction separation means. The belts are also directed over idler pulleys 35 supported on stub shafts which are also supported on the block 40 and around a shaft 36 which is provided with grooves to contain and provide drive to the respective friction belts 30a and 30b. The belts 30a and 30b preferably are of O-ring rubber construction or of other resilient frictional material, but alternatively may be of other shape. The friction drive belts 30a and 30b project through slots in the tray 28 and extend above the tray so that documents placed on the tray will contact the friction belts and be moved forward and slightly downward along the tray into the nip of the

friction separation means.

The friction separation means comprises a friction drum consisting of axially spaced apart friction drum members 38a and 38b of equal diameter having a high friction surface and intended to be driven in the forward direction of document movement from the bin. The orientation of the drum members is such that they advance documents through the system and downwardly. Opposed to the friction drum and extending through a slot 42 in the feed plate 24 is a friction belt 44 which is preferably of a non-circular cross-section, and preferably, for example, of a rectangular cross-section. The friction belt 44 is supported on rotatable pulleys 46 and 48 which together with a pulley 50 define the path of the friction belt 44. The pulley 50 is a freewheeling pulley of just slightly smaller diameter than the friction drum members 38a and 38b positioned between the drums and effectively deflecting and stretching the friction belt from its path between the pulleys 46 and 48 in such a way as to elastically deform the friction belt. The friction belt 44 is of elastic material such as rubber to permit it, when deformed, to apply a frictional force opposing normal flow of documents and also to deform further as documents pass between the friction drum and the friction belt. The pulleys 46 and 48 rotatably supporting the friction belt 44 are, in turn, supported on shafts 54 and 52, respectively. The shaft 54 also carries friction members 56a and 56b which are spaced laterally on each side of the friction belt 44 and carried on pulleys 58a and 58b, respectively.

The friction surfaces of the drum members 38a and 38b are provided with grooved surfaces as shown, wherein very shallow grooves, for example, on the order of 0.8 mm (1/32 inch) deep are provided in the high friction material which is of higher frictional effect than the belt 44 so as to tend to move the documents in opposition to the belt which is driven in the opposite direction by the driving pulley 46 on the shaft 54. Preferably these grooves are on the order of 2.5 mm

(100 mils) wide and are cut into the face of the drum members (or feed rolls) along elements thereof parallel to the axis and evenly spaced so as to result in alternate groove and teeth around the circumference of the drum members in the high friction material thereof. The drum members 38a and 38b are aligned on the shaft 36 so that the grooves in their friction surfaces 60 are alternated, and the grooves of one are aligned with the teeth of the other. The effect of this arrangement is to relieve the pinch on documents which tend to stick together, such as new currency, due to its coarse texture, upon entering the separation stripper area. The result of the improvement is that a considerably lower stripper force is required to separate coarse textured documents or bill currency. There is also less wear on the surfaces of the feed drum members and on the friction belt 44. A 40 percent higher speed of document throughput was made possible in one preferred embodiment of the invention using this improvement.

The advantage of making the belt 44 of non-conforming shape to the cross-sectional shape of the pulley 50 is to cause a reduction of friction. The cross-section of the friction belt 44 is such that it makes contact with the pulley 50 only at the outer edges assuming a convex shape to the pulley groove in cross-section. For example, a rectangular belt makes no contact with the centre of the idler pulley 50, thereby reducing the friction on the idler pulley in the counter-rotating direction. Furthermore, a rectangular or flat belt surface against certain types of documents improves results. An improved effect is achieved particularly on relatively limp documents which tend to conform to the belt 44 passing over the idler pulley 50 which has had the effect of making the documents tend to hesitate or skew. With the present invention there is essentially no skewing of documents, particularly on the limp conforming documents. Thus, there is no need for modifying the structure in ways which slow throughput so that the improved structure avoids this problem and, in fact, adds to the speed of throughput of the

documents with no adverse effect.

In other fundamental respects the structure of the friction separator is that of prior U.S. Patent No. 4,216,952 of George P. McInerny.

An important feature of the present invention is the provision of the high friction members 56a and 56b on the drive shaft 54 outboard of the friction belt pulley 46 and rotating in opposition to document flow. These friction members function across a wide space at the edges of the stack of documents on the feed tray 28 to hold back documents other than the bottom document and most importantly to shape the pile of documents so that the documents are fed into the friction separation means in sequence, from the bottom of the stack.

In addition to the friction drum members 38a and 38b, there is spaced outward of these drum members, respectively opposite the friction wheels 56a and 56b, a pair of wheels 64a and 64b on the shaft 36, producing a somewhat lesser frictional effect than the drum members but of the same diameter as the latter and arranged so that they rotate with the friction drum members to support the pack and hold the documents in the path of the friction wheels 56a and 56b, thereby preventing skew and providing stability across the document stack allowing off-centre stacking of documents. This is important to permit variation in the lateral position on cheques for example, when an endorsement is printed in order to select endorsement location. As a practical proposition, documents are fed by the belts 30a and 30b into the nip of the drum members 38a and 38b and the counter- rotating friction belt 44.

It should be noted in passing that, as described in the U.S. aforementioned patent, it is possible to reverse the functions of the friction drum and the friction belt by making suitable design changes and reversing the direction of both, although the arrangement shown is preferred.

Now giving consideration to the drive, as seen in Figures 1 through 4, the motor 22 is supported on the wall 20a and its shaft 22a extends through that wall to support a pulley 66. In connection with the drives, Figures 1, 2, 3, and 4 can be compared with Figure 17 to show the various drive belts, pulleys, and shafts involved. It should be noted that the shaft 22a carries not only a drive pulley 66, but also a timing disc 68 having photodetectable timing or clock marks 68a on the periphery thereof. As best seen in Figure 2, these timing marks are preferably equally spaced marks which are sensed by a photodector 70 and the pulses generated thereby may be used as timing pulses or a clock. The pulley 66 is preferably a timing belt pulley and is used with a timing belt 72 to drive, in turn, a dual sheave pulley 74 which, in turn, drives a shaft 76. The shaft 76 extends through the wall 20b, through the structure and out through the wall 20a, to carry a friction drive member 78. The friction drive member 78 is connected to the shaft 76 by a clutch-brake arrangement similar to the system described in the United States patent application of George P. McInerny, Serial No. 7,928, filed January 30, 1979. The friction drive member 78, in turn, engages a friction drive member 80 which has a friction portion 80a and a pulley portion 80b on a stubshaft 81 supported on the wall 20a. The pulley portion 80b, in turn, drives a belt 82 which drives a pulley 84 on the shaft 36, the shaft on which the friction drum members 38a and 38b are mounted which carries freewheeling pulley 50. The shaft 36 extends through the structure walls 20a and 20b and beyond the wall 20b carries a pulley 36a. The pulley 36a, as seen in Figure 2 is preferably the shaft itself which may be grooved or provided with flanges to support and guide a belt 86 which, in turn, drives a pulley 88 on the shaft 54. The shaft 54 carries the drive pulley 46 which, in turn, drives the counter-rotating friction belt 44. It will be observed by the nature of the belt connection 86 that the friction belt 44 will be driven in the opposite direction from the driving direction of the drum members 38a and 38b.

Referring now to Figure 4, it will be seen that as documents leave the friction separation means passing out over the drum formed by the drum members 38a, 38b and beyond the belt 44, they continue to move downwardly between the plates 24 and 26. They next contact drive belts 90 each extending between pulleys 92 and 94 on shafts 96 and 98, respectively. The belts 90 function as an accelerator and are driven faster than the drum members 38a and 38b, in order to accelerate succeeding documents as they leave the separation means and define a space between them so that they can be counted. Each belt 90 extends into the space between the plates 24 and 26 through slots provided for the belts. Because the documents will contact the belts 90 before they leave the slower separation means, it is necessary that belts 90 do not act upon documents, lest they tear the documents still in contact with the drum members 38a and 38b. However, some light pressure is applied through leaf spring members 89 attached to the document plate 26 by fastening means 93 and providing L-shaped extensions 91 which project through slots in the conveyor plate 26 to contact documents and urge them lightly against the respective conveyor belt 90. Each belt 90 is opposed by an idler roller 100 (best seen in the detail of Figure 14) where it is seen that it is rotatably supported on a shaft 102 by means of a spring arm 104 fixed to the document guide 26 by an appropriate fastener 106. The rollers 100 provide a greater pressure against the documents urging them against the drive belts 90. Documents passing the idler rollers 100 and the drive belts 90 are thus positively brought up to the accelerated speed of the belts 90.

A clutch 75 and a brake 77 (Figure 1), respectively provided between the pulley 74 and the shaft 76 and between the shaft 76 and the drive member 78, enable the feed drive preceding shaft 76 to be braked and the feed of documents stopped after a pre-selected count, without stopping drive of the lower part of the machine which is employed to finish processing documents already separated.

In this region, such as just below the drive belts 90, is located a light source 174a on the feed plate 24 and a photosensor 174b on the document plate 26. A light beam from the source 174a is interrupted by passage of a document and the resulting pulse, for example, at the leading edge, is counted by suitable counter means, not shown.

Below the counter is the printer, the printer may be engaged or disengaged depending upon whether the document passing through is to be printed. The printer actuating mechanism in Figures 7 through 9 is effective to print when a print drum 110 is in the position shown in solid lines in Figures 8 and 9 and will not print when moved to the dashed line position of those same Figures. As can be seen in Figures 8 and 9, the printer structure is supported between brackets 108a and 108b (e.g. supported on the document plate 26). These brackets, in turn, support the print drum 110, a transfer roller 112 and an ink roller 114. The nature of the system is such that the print drum 110 may be moved into and out of printing position upon demand by solenoid actuators as will be explained. When the print drum 110 is in the dashed line position, it is withdrawn behind the document plate 26 and cannot contact the documents moving through. In the dashed line position it will be observed that the print roller 110 does not contact the transfer roller 112. Since it is rotation of the print roller transferred to the transfer and inking rollers which causes ink to be applied, when the printer roller is moved into the dashed line position, no ink is applied since it is out of contact with transfer roller 112. Therefore, the ink roller 114 is not being exhausted and the transfer roller 112 is not being worn, nor are the other rollers being worn, in the situation where no printing is being accomplished.

A platen roller 176 for the print roller 110 is preferably provided with a cover over a cylindrical drum surface which is resilient and which will yield under pressure. The resilient cover, in turn, is coated with an ink resisting

cover so that the ink tends not to penetrate the cover and not to be wasted by absorption within the platen roller. When the print roller is in contact with the platen roller, the soft cover makes the printing operation of the structure smooth and quiet so that the structure is less noisy than prior art printers.

Referring to Figures 7, 8 and 9, the print roller 110 is rotatably supported on a shaft 116 so that when the shaft is fixed in non-rotating position relative to the frame, the print roller 110 can rotate relative to it. The print roller is not rotatably driven through the shaft, as will be later explained. The positioning of the print roller is determined by similar eccentrics 118a and 118b on opposite ends of the shaft 116. The print roller may be held in position by snap rings, or other conventional means. Shaft extensions 120a and 120b are off-centre and their rotation will cause the eccentrics to position the print roller 110 in the position shown at one extreme and in the dashed line position in the opposite extreme. In the position shown, a crank actuator 122a has been moved by a solenoid actuator 124 by the force of a plunger 126, with the winding of the solenoid 124 kept energized to maintain the crank actuator 122a in the position shown. The solenoid 124 is supported on the bracket 108a by standoffs 128a and 128b. Similarly, a crank actuator 122b is driven by a solenoid 130 through its plunger 132. The solenoid 130 is supported on the bracket 108b by standoffs 134a and 134b which are fixed thereto. The arrangement is such that when the solenoid 124 is actuated and energized, the solenoid 130 is deenergized. When the solenoid 130 is energized, the solenoid 124 is deenergized. In this way, a positive action occurs to move the print roller into printing position and out of printing position. It will be clear to those skilled in the art that other means of repositioning the print roller can be used and the device shown using crank arms, eccentrics and solenoid actuators is a matter of choice, but does provide a simple preferred construction.

Furthermore, the structure shown also provides a simple easily accessible arrangement whereby the whole printing system may be easily accessed for maintenance purposes. The transfer roller 112 is positioned such that it is behind the rest of the structure and is supported on an axle 136. It normally requires less attention that the ink roller 114 which is supported on C-shaped brackets 142a, 142b by a shaft 138. The shaft 138, as seen in Figures 8 and 9, slides within horizontal slots 140a and 140b, and it is held in that position by the C-shaped brackets 142a and 142b, urged into illustrated stable open or closed positions by overcentre springs 141a and 141b, respectively, each of which pivots about a pivot pin 144a or 144b relative to the respective support bracket 108a or 108b. When the C-shaped brackets are in the solid line positions, the shaft 138 is held in position, but when they are moved to the dashed line positions, the shaft 138 is easily removed from each of the slots 140a and 140b and the ink roller 114 may be removed for replacement. When the print roller 110 is moved to its dashed line position, the member belts can be very easily adjusted in that position without interference by the transfer roll. Thus, the support permitted by the brackets 108a and 108b places the print structure in the front of the machine where it is easily accessible and where it can be maintained without difficulty and great expense. The print roller 110 is held in support slots in the brackets 108a and 108b by drive belts 146a and 146b passing around the print roller and pulleys 170. The belts can easily be removed, allowing removal of the print roller 110 from the support brackets 108a and 108b for cleaning.

The print roller is very easily adjusted as will be apparent by reference to Figures 10, 11, 12, 13. Figure 10 shows how endwalls 148a and 148b and sidewall segments 150 of the structure of the print roller fit together. This can be seen as an assembly in Figure 11 where the walls 148a and 148b are held together, yet spaced apart, by the three sheet metal segments 150 and by a plurality of screws 147. Pins 149 serve the function of indexing members as will be described. As seen in Figure 10, each endwall provides a pulley or circum-

ferential groove 148b-1 and a circumferential groove 148b-2 which engages ends 150b of the sheet metal crylindrical segments 150. The sheet metal cylindrical segments are provided with fingers 150a which define slots between them through which print belts 161 protrude and are accessible for printing, as will appear hereafter. The broad areas of the segments may be provided with an ink stamp of rubber or other conventional material with a selected legend to be printed, such as "paid".

The endwalls 148a, 148b also act to support a plurality of shafts which act as drive shafts for pulleys secured to them and as shafts about which freewheeling pulleys freely rotate as well. As seen in Figure 12 where the relative arrangement of the parts is illustrated and in Figure 13 where a schematic or developed view is shown to give a better impression of the overall structure, there are three main shafts 154, 156 and 158, each of which carries a plurality of pulleys 160 each with its own hub 160a. The space between the pulleys and one endwall is filled by a spacer 162 and the hubs of the pulleys are designed so that the pulleys are properly spaced and positioned relative to one another to support six belts 161 required for the dates. Only one pulley is fixed to each of the shafts 154, 156 and 158. In the case of the shaft 154, it is the first pulley 160-1 fixed by a set screw, or other suitable means, through its hub. Pulley 160-3 is similarly fixed to the shaft 156 and pulley 160-5 to the shaft 158. As best seen in Figure 12, the so-called "pulleys" 160 are preferably timing belt pulleys, gear-like structures which engage and drive teeth-like protrusions on each of the timing belts 161 or case them to assume a fixed lateral belt path and track properly over the other freewheeling pulleys. Adjustment knobs 154a, 156a and 158a are fixed to their respective shafts and can then be seen to adjust the belts respectively positioned by their pulleys 160-1, 160-3 and 160-5.

The intermediate pulleys are driven in a somewhat different way by gear connections. Intermediate rotatable shafts 164, 166 and 168 each carries and is fixed to a gear 164a, 166a

and 168a which engages a further gear 164b, 166b and 168b attached to the pulleys 160-2, 160-4 and 160-6 on the shafts 154, 156 and 158, respectively. Thus, the shafts 164, 166 and 168 drive the gears and eventually the pulleys around these intermediate shafts through knobs 164c, 166c and 168c, respectively. It is therefore possible to position timing belts bearing printing numbers or other selected characters distributed around these pulleys and independent of the selected printing positions of the belts and most are attached to the shaft which merely provide the support and axis on which freewheeling pulleys, including the gear driven pulleys ride. In order to achieve some finite accurate positioning, therefore, indexing means is required. This is what is provided by the respective indexing pin 149, the function of which is best seen in Figure 12. In order to function as indexing means, however, the pins might engage the slots in the undersides of the timing belts members used for the printing belts. Preferably, however, the outer faces of the printing belts are also toothed, with the printing areas being raised and the regions between them being valleys into which the pins 149 snugly fit, urged outwardly by belt resiliency to thereby index and hold the belts when in proper position. Engagement of the outer surface of the belts proves to be advantageous as well, since it is effectively acting against the normal tendency of the belts to move outward as they are rotated and, therefore, a more positive engagement is achieved. Furthermore, the resiliency of the belts enables the driving force generated through each of the knobs 154a, 156a, 158a, 164c, 166c or 168c to dislodge the pins whenever it is necessary to reposition the selected belt in another selected position. Thus, using six belts arranged side-by-side in this way it is possible to give two digit representations of each of month, day and year with very simple manipulation which can be achieved from the front of the printer and the print roller is preferably moved to its forward position for this procedure.

As seen from Figures 1 and 4, the print roller is support-

ed from the brackets 108a and 108b by the eccentric shafts 120a and 120b simply by putting those shafts into forward opening slots. The print roller 110, itself, as previously mentioned, is rotatably supported on the shaft 116 and is rotatably driven by the belts 146a and 146b which as seen in Figure 4 extend around pulleys 170 and are partially deflected by the platen roller 176.

The platen roller 176 is shown in cross-section in Figure 15A and will be seen to be a generally spool-shaped roller having a soft resilient material 177 (such as polyurethane) filling out the roller in the region opposite to the print roller. Over this resilient material is a layer 179 of non-absorbent material which will not absorb ink from the print roller but which does yield under the pressure of the surface of the print roller and provides a soft yielding surface which performs more quietly in its position opposed to the print roller when the print roller is moved into such position for printing. The platen roller is driven by a shaft 178 and is provided with frictional drive means 181 which bears against the belts 146a and 146b to deflect these belts in their paths between the print roller 110 and the pulleys 170, as best seen in Figure 4. In this connection it should be noted that the drive belts 146a and 146b are resilient so that they stretch to permit the repositioning of the print roller out of its printing position. The belts are also removable from around the print roller and over the ends of the crank actuators 122a and 122b allowing the print roller to be withdrawn from the slot supports in the brackets 108a and 108b. In operation, it is the drive belts 146a and 146b which hold the print roller in its position in the slots. Thus, the arrangement permits very easy removal of the print roller for repair or changes in the subject matter to be printed.

In this regard another structural feature should be noted. It is possible to pivot the document plate 26 forward about pivot connections 61a and 61b, seen in Figure 1, which provide

pivot extensions through the sidewalls 20a and 20b, respectively. This effect is seen best in Figure 4A which corresponds to Figure 4 but has the structure supported on the brackets removed and much of the other operational structure omitted for the sake of clarity. As best seen in Figure 1, there are a pair of latch elements 63a and 63b attached to the plate 26. Their relative position is shown in Figure 4A and their function is seen best in Figure 4B. In that Figure, it is shown that the latch elements 63a provide circumferential grooves into which spring loaded pins are urged to hold the plate 26 in position. The spring loaded pins are part of detect means 65a and 65b which penetrate the sidewalls 20a and 20b and/or can be of various one of several commercially available types. Ring bumpers 67a and 67b are provided around the structure to keep the plate 26 out of actual contact with the sidewalls 20a and 20b and obviate a potential danger of scratching the sidewalls.

It should be noted also, that the structure at the printer level is driven by the same motor 22 as can be seen in Figure 17 (the drive diagram). More specifically, the pulley 74 is a two sheave pulley between the smaller diameter of which and the larger diameter of another two-diameter pulley 182 is placed a drive belt 184. The pulley 182 drives the shaft 178 of the platen roller 176 and aids in proper printing when the print roller 110 is in its printing position. As seen in the detailed drawings of Figure 14 and Figure 15, for example, a pair of saw-toothed wheels 180 on a shaft 172 provide successive shoulders 180a which contact the trailing edge of documents as shown in the inset drawing of Figure 15B. This is because the outside diameter of the saw-toothed wheels 180 is driven faster than the documents move. This occurs at the point where the documents are leaving the guide plates 24 and 26 which themseleves are curved to aid a direction changing device and which is further aided by the cooperation of the drive belts 146a, 146b which drive the print roller 110 from the surface of the platen roller 176. Thus, the documents leave the guide plates 24 and 26 with their direc-

tion changed from an essentially vertical direction to a direction having a substantial horizontal component. The saw-toothed wheels 180 are driven at a speed which is greater than the speed with which the documents pass out of the guide means 24, 26. The lower end of the feed plate 24 is shaped in such a way as to deflect the trailing edge of the documents into the path of the saw-tooth wheels. The shape of each saw-toothed wheel is such that the trailing edge of a document engaged by a saw tooth, as seen in Figure 15B, will be driven into a more horizontal position. When, the trailing edge of a document is in position to be contacted by a shoulder 180a of the wheel 180 seen in Figure 15B, the shoulder will tend to drive the trailing end of the document downwardly into a more horizontal orientation onto a pair of low friction conveyor belts 184.

The documents are accumulated on the conveyor belts 184 which are supported at opposite ends by drum pulleys 186 and 188. The pulleys are, in turn, rotatably supported, respectively, on shafts 190 and 192. The conveyor belts are arranged so that they are not completely horizontal in the particular embodiment but slope slightly downwards in the direction of forward motion of the belts. This slope, as shown, moves documents away from a low friction drum 194 which is supported to vertically float on an axle 196 within vertical slots 198 in the walls 20a and 20b to accommodate movements in the conveyor belts 184. The bottom surface of the drum 194 in contact with the belts 184 rotates and moves documents back in the same direction as the conveyor belts. Thus, documents moving into the nip between the drum 194 and the belts 184 will tend to be moved out of that position by both means thereby affecting the forward horizontal movement of the documents coming out of the guide plates 24, 26.

The lightweight low friction drum 194 will maintain a sufficient tension on the low friction belts 184 to instantly decelerate documents once they are out of the drive belts 146a and 146b. However, using the drum 194, while they are under

the influence of the drive, long documents are able to be driven between the drum and belt but immediately reverse direction when clear of the drive belts. This desirable arrangement allows a fixed distance between the last document drive member and the drum 194 to accommodate short and long documents without intervention by unskilled users to manually or otherwise adjust this common stacker space. As best seen in Figure 15B, in conventional stackers the document direction does not reverse, with the consequence that, particularly with curled edge documents, the documents tend to fan out into the path of succeeding documents causing undesirable jams and tears of original and negotiable documents. One feature of the stacker arrangement described is that the trailing document edge is systematically removed from the path of the succeeding documents by the conveyor belts 184.

The speed of the conveyor belts 184 is selected to cause the documents to overlap as shown and as the documents reach the end of the belts, they are contacted by a floating roller 199 having a shaft which is supported by a lever 201 which is pivotally mounted on a bracket 205 which, in turn, is supported on the document plate 26. Thus, gravity tends to hold the roller 199 in position on top of the documents as they move along the conveyor belts 184 so that they project outwardly in a sort of cantilever fashion and can be inspected before they drop upon a lower conveyor composed of a plurality of, and in the present instance three, belts 204. Pulley grooves on the drum pulley 188 support one end and effectively drive one end of the conveyor belts 204. The other ends of the belts 204 are supported on pulleys 206 about a shaft 208 which is supported from the bottom of a collection shelf 210 by a suitable support bracket means 212. The shelf 210 itself is pivotally mounted on a shaft 207 by suitable brackets so that it can fold up against the machine for shipping or when not in use. The conveyor belts 204 must pass through slots on the shelf 210.

The arrangement shown best in Figure 15 facilitates visa-

bility of the documents before they are stacked. Drive of the system is accomplished through the smaller diameter of the dual pulley 182 through a drive belt 197 to the larger diameter of dual pulleys 200. The smaller diameter of the dual pulley 200 also accommodates a drive belt 202 also engaging a pulley 203. The conveyor belt drive drum pulleys 188 drive the idler drum pulleys 186 through belts 184a and 184b. As can be seen, the belt is divided into two belts 184a and 184b and the shaft 192 drives the rear idler drum pulleys 186 mounted on the shaft 190 by the conveyor belts 184a and 184b. The drum pulleys 188 provide individual pulley grooves or channels to accommodate the belts 204 to drive the further idler pulleys 206 on the shaft 208.

Figure 16 shows an alternative conveyor and collection means arrangement in which the parts are shown to be very similar at the end of the feed through system and, therefore, parts having corresponding functions are given similar numbers with the additions of primes thereto. Thus, for example, guide plates 24' and 26', drum 176' and belt 146b' will coact on documents to change their direction from a largely vertical component to one having a substantial horizontal component. Again, saw-toothed wheels 180' will contact the trailing edge of the documents and cause them to be deflected downwardly into a predetermined position relative to previous documents. Rollers 194' act with conveyor 184' to limit the movement of the documents in an ordinary course. The conveyor is supported on drum pulleys 186' and 188'. In this case, the conveyor, however, is arranged generally horizontally. A floating roller 194' is again provided and will take its direction of rotation from the direction imposed upon it by the conveyor 184'.

The principal difference in the system of Figure 16 is that it has collection bins 210a and 210b at opposite ends of the conveyor belt and by running the conveyor one direction, one of the bins, say, 210a will be filled. By running it in the opposite direction from the direction of the Figure 15 construction, for example, bin, 210b will be filled. Thus

the structure of Figure 16 has a double-ended, or two bin, capacity. It will be noted that in most other respects this particular embodiment is similar to the one previously described.

Referring now to Figure 18 and Figures 4A and 4B, a feature of some advantage for use with the collection tray is illustrated in the form of a finger slot 210a extending inwardly backward from the forward edge of the collection tray 210 and enabling a user to pick up a pack of counted documents such as cheques or bills by placing one of his fingers or thumb beneath the pile and opposed fingers above the pile to remove it from the tray. Means to sense the passage of the finger or thumb through the slot 210a is provided on either side of the slot and is here shown as a light source 218 and a photopickup 220, although the sensor could be of any suitable type. In this case, the passage of the finger breaks the beam from the source 218 to the pickup 220 and causes a pulse which is particularly useful in the so-called batching function of the machine. In that function, repeated batches of a predetermined count are desired. The machine is set for that purpose, i.e. to count out that predetermined count and stop. Then, when the user picks up the batch and the senor 220 sends a pulse signal, the machine is turned on again to count a further batch and this process can be done repeatedly, thus, speeding up the batching process immeasurably over having to push suitable buttons at each operation.

Figure 18 together with Figure 4A also shows a feature which involves a pair of brackets 214 at opposite ends of the collection tray 210 by which the tray is pivotally supported on pivot members 207. Each pivot 207 rides in a slot 214a which allows the tray to be positioned along the length of the slot as well as being rotated. The bracket also has a tab 214b which is intended to engage a stop 216a. The stop 216a is formed by a lance in the otherwise planar sheet metal stop member 216 in which the lance is made. The stop member

216 is supported by adjustable screw means 218 which provides a pivot point and a locking means to lock the stop means and its stop tab 216a in a selected position. The position selected for the stop means determines how low or flat the tray 210 will be permitted to move about its pivot 207 so that a very simple adjustment of the attachment means 218, essentially loosening adjustment of the member 216 and tightening of the fastening means 218, is all that is required for readjustment. The tab 214b will strike the lance stop 216a when the slot 214a and bracket 216a has allowed the tray to move to the back or to the left in the drawing so that the pivot 207 is in the forward end of the slot as shown. If the tray is pulled forward relative to the slot, the tab becomes disengaged and the tray may be folded up against a cover or casing for the machine (not shown) for shipment of the tray to avoid damage of what would otherwise be a vulnerable piece of the equipment.

It should be understood by those skilled in the art that each section of the system of the present invention has certain features which are novel and this novelty is not limited to the specific structure shown. Thus, it is possible to modify the structure shown, modify the number and arrangement of parts and substitute various means to achieve similar results. All modifications within the scope of the claims are intended to be within the scope of the present invention.

CLAIMS

1. A machine for separating documents so that they may be individually inspected, comprising an endless conveyor belt (184) and means (175, 146) to feed documents to the conveyor belt (184) and orient the separated documents thereon, characterised in that there is provided direction changing means (24, 26) and rotational document-trailing edge-engaging means (180) providing multiple steps (180a) transverse to the direction of document motion, one of which steps (180a) engages the trailing edge of each document and directs it positively downward; and drive means (188) which drives the conveyor belt (184) in opposition to the direction of document feed thereto, and further drive means (146) to move the trailing-edge-engaging means (180) faster than the downward movement of each document as it leaves the direction changing means (24, 26).

2. A machine as claimed in claim 1, characterised in that roller means (194) is positioned to engage the conveyor belt (184) and provide a nip with that conveyor belt past which documents can be positively driven, but which stops the documents once positive drive thereto is removed, said roller (194) being provided with a shaft (196) supported to permit the roller (194) to ride up and down on the conveyor belt (184) and to be driven by the conveyor belt (184) in the direction of conveyor belt movement.

3. A machine as claimed in claim 1 or claim 2, characterised in that an additional floating roller (199) is provided at the discharge end of the conveyor (184) whereby documents tend not to fall off the end of the conveyor (184) but are cantilevered into a position above a collection means (210) before they fall thereonto, thus maintaining proper orientation and permitting examination of the documents in the process.

4. A machine as claimed in claim 3, characterised in that the second floating roller (199) is supported on a pivoted arm (201), the document trailing edge-engaging means being a saw-tooth surfaced drum (180) providing successive shoulders (180a)

against which the trailing edges of documents successively impinge.

5. A machine as claimed in any preceding claim, characterised in that documents leaving the end of the conveyor belt (184) fall onto a slower speed conveyor (204) which directs them to a collection means (210).

6. A machine as claimed in claim 1 or claim 2, characterised in that the conveyor belt (184') is reversable and a bin (210a, 210b) is provided at each end for collection of documents depending upon which direction the conveyor belt (184') is operated.

7. A machine for counting documents comprising, a frame having a pair of spaced generally parallel supporting walls (20a, 20b) and means (20c-20g) extending between the walls to support and space them from one another, and a pair of guide plates (24, 26) arranged generally perpendicular to the supporting walls (20a, 20b) and having portions which are closely spaced to one another and form a document guide path between them, characterised in that at least one of said guide plates (26) has pivotal support means (61a, 61b) transverse to the parallel supporting walls (20a, 20b) adjacent one end of the guide plate (26) whereby the pivoted guide plate (26) can be rotated away from the other guide plate (24) to afford access to the guide path, and latch means (63a, 63b) to hold said pivoted guide plate (26) in its guide path defining position, and operative means (60, 44, 90, 100, 176, 146) to act upon documents passing along the guide path, supported on the respective guide plates (24, 26) and having operative portions extending or extensible into the guide path.

8. A machine as claimed in claim 7, characterised in that the operative means include rotatable elements (38a, 38b, 176) rotatable about axes generally parallel to the guide path and perpendicular to the parallel supporting walls (20a, 20b) including a plurality of parallel driven shafts (36, 54, 76,

178, 192) which extend through the parallel supporting walls (20a, 20b) and drive interconnection means (66, 72, 74, 184, 197, 202) are provided outside of at least one of said walls, whereby rotatable shafts are interconnected with drive means (22); in which one (24) of the pair of guide plates (24, 26) is not pivotally supported from the parallel walls (20a, 20b) such that the operative means fixed to drive shafts extending through the parallel walls are at least in part supported thereby relative to the fixed guide plate (24); and, in which shafts of operative means extending through the pivotally supported guide plate (26) are supported on said pivotally supported guide plate (26).

9. A machine as claimed in claim 7 or claim 8, characterised in that generally parallel bracket means (108a, 108b) are supported on the pivotally supported guide plate (26), a print roller (110) being rotatably supported on said parallel bracket means (108a, 108b) and actuator means (124) which move the print roller (110) into and out of the guide path also supported from the pivotally supported guide plate (26).

10. A machine as claimed in claim 9, characterised in that the parallel bracket means (108a, 108b) also support an ink roller (114) and a transfer roller (112) in contact with the ink roller (114) so located that, when the actuator means (124) moves the print roller (110) out of the guide path, the print roller (110) is out of contact with the transfer roller (112) and, when the actuator means (124) moves the print roller (110) into the guide path, it also moves the print roller (110) into contact with the transfer roller (112).

11. A machine for separating documents having a frame supporting two friction members having opposed surfaces, a friction drum (38a, 38b) driven rotatably about the axis by which it is supported and a resilient endless friction belt (44), said belt (44) being supported on at least two path defining rotatable pulleys (46, 48) and deflected and resiliently deformed between said at least two pulleys by contact with a third pulley (50) coaxial with, and of about the diam-

eter of, the friction drum (38a, 38b), and drive means (22) driving the friction members so that their friction surfaces (60, 44) move in opposite directions at the region of deflection, whereby they tend to move documents passing between them in opposite directions, the friction surface moving in a designated forward direction having the greater frictional effect, characterised in that the surface (60) of the friction drum (38a, 38b) is provided with shallow grooves along elements of the drum surface parallel to the axis of rotation to provide a pattern of alternate shallow teeth-like and grooved areas around the periphery, at least two parts of the drum having patterns out of alignment with one another.

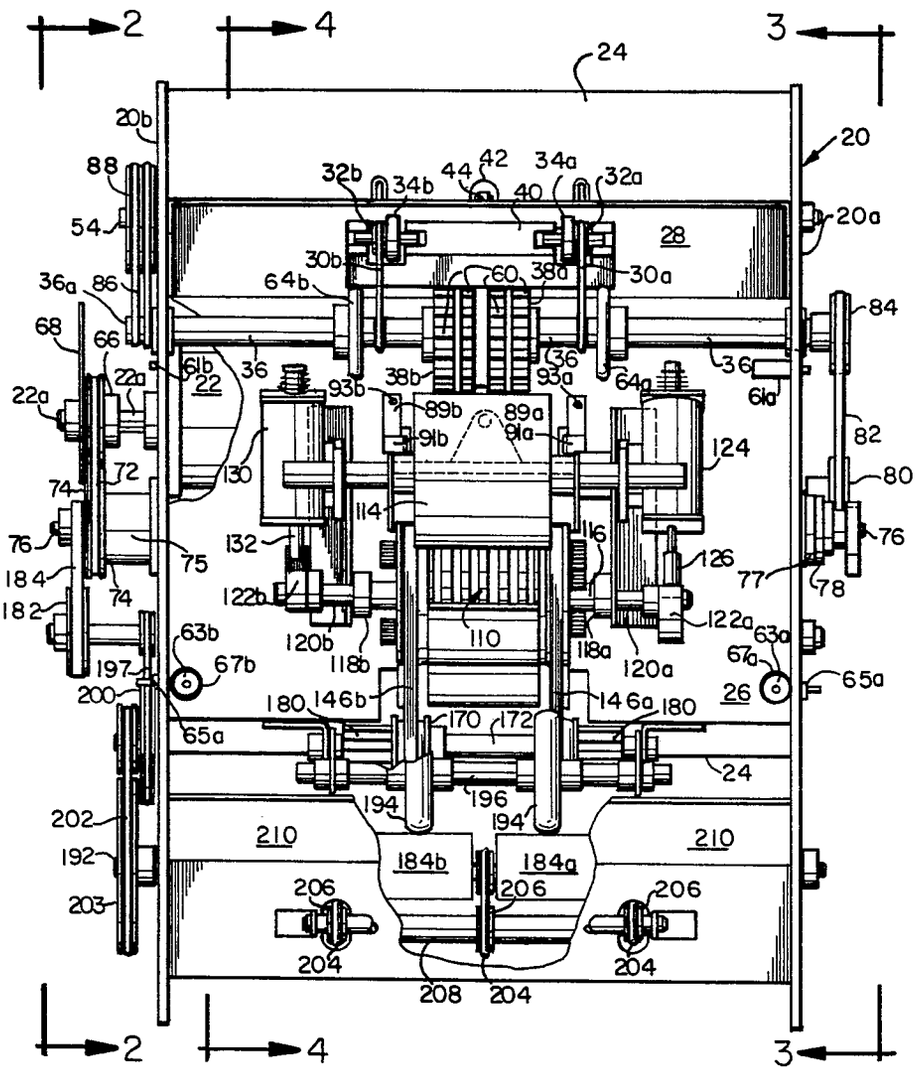
12. In a sheet printer comprising a frame, a print member rotatably supported relative to the frame about a shaft and having spaced apart walls supported generally normal to said shaft and supporting between those walls a plurality of rotatable shafts each carrying at least one timing gear, a plurality of endless print belts in the form of belts having a repetitive pattern on a timing belt having segments engaging a mating pulley having a pattern on the order of a timing belt, manual means for moving each shaft, and indexing means engaging each belt to tend to hold the belt in discrete printing positions.

13. A print element for a document handling device comprising a frame, a document guide path supported relative to the frame, a rotary print device supported on said frame and having alternative support positions between which it can be moved whereby in one position it contacts and prints on documents in said guide path and in the other position it is removed from said guide path, and means on said frame to selectively move the rotary print device from one position to the other and back again.

14. A machine for counting documents comprising a support structure, feed means for receiving the documents on the support structure, separation means for separating documents

from one another as they are fed from the feed means on the support structure, counting means on the support structure, stop means acting upon the separation means in response to a signal on a preset count from the counting means to stop the separation means and associated feed means, a collection tray for collecting counted documents on a top surface having a slot through the tray from a front edge which permits a finger or thumb of the user to move upward, from beneath the tray to pick up the documents on the tray, detection means so mounted on the collection tray to detect any opaque object passing through the finger slot to pick up documents and produce a signal, and restart means responsive to the signal from the detection means to restart the drive means as the counted batch is removed from the tray.

15. A collection tray for a document handling machine having a support frame with generally parallel walls between which the support shelf can extend and a housing having an opening to the support shelf when it is in its operative generally horizontal position and closed by the shelf upon rotation thereof wherein rotation is permitted by mounting the shelf on support brackets generally parallel to the sidewalls and close spaced therefrom and providing a slot in the brackets generally parallel to the shelf, providing a pivot means coaxial with one another through said slots and into the generally parallel sidewalls to permit rotation of the aforesaid shelf, a stop shoulder being provided on at least one of said support brackets for said shelf and stop means supported on at least one of the sidewalls in position to be engaged by the stop shoulder to hold the shelf in a selected horizontal position when the shelf, in lower position places the slot back toward the machine relative to the pivot pin which permits engagement of the bracket with the stop.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60
38a
30a
36a
86
84
68
66
61b
22
36
38b
93b
89b
89a
91b
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130
80
74
114
116
76
132
75
126
76
184
77
74
78
182
122b
120b
118b
110
118a
120a
122a
63b
63a
67b
67a
197
65a
200
180
146b
146a
180
26
65a
170
172
24
194
196
194
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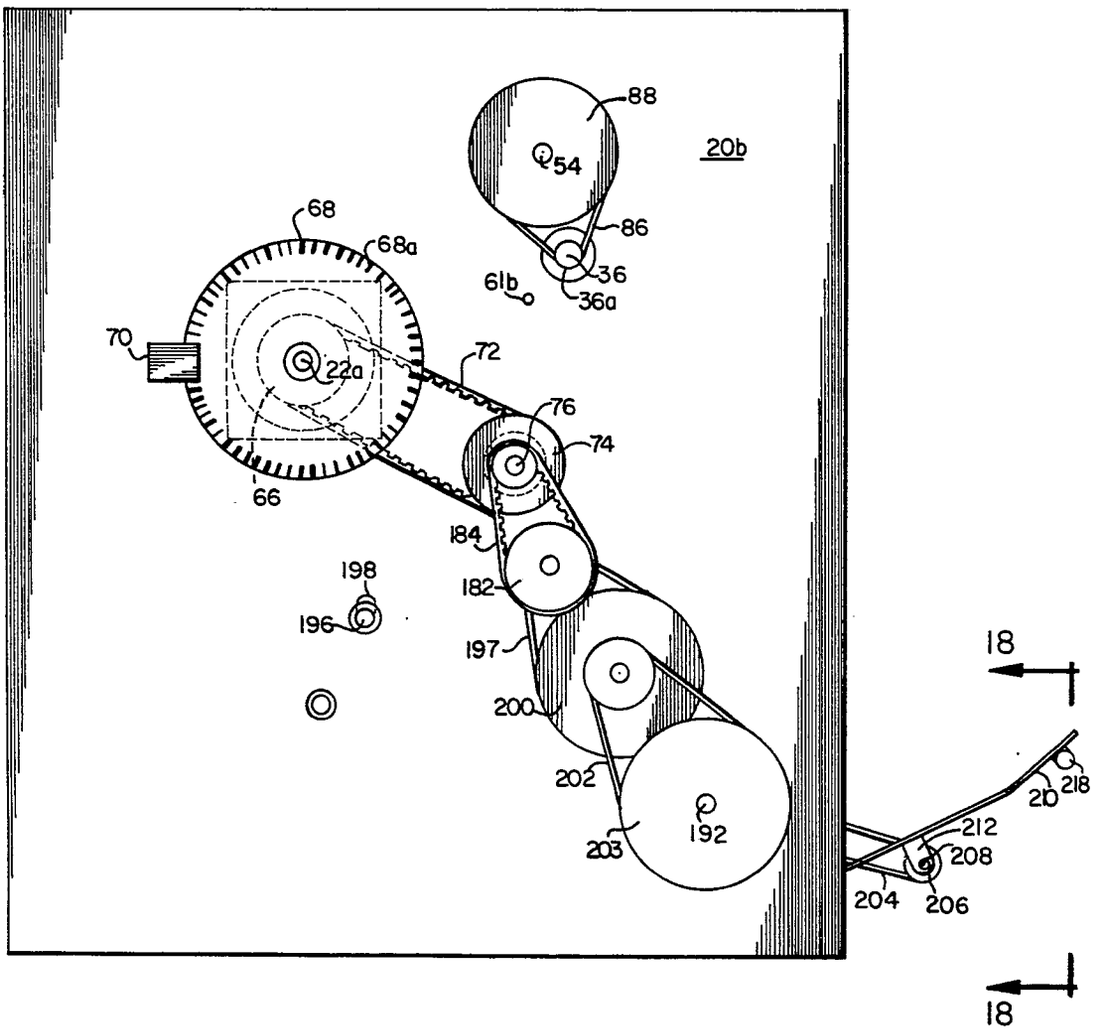
3

FIG. 1

2/11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18

FIG. 2

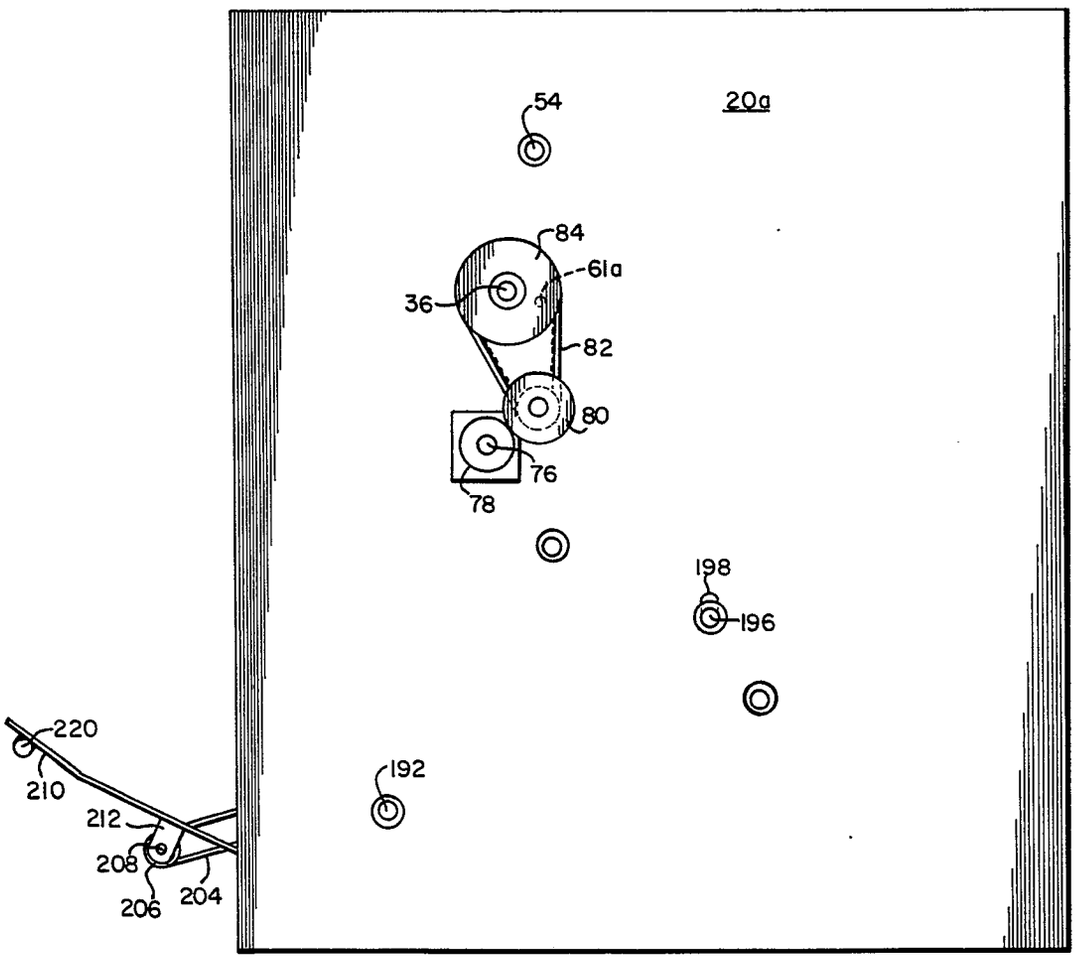
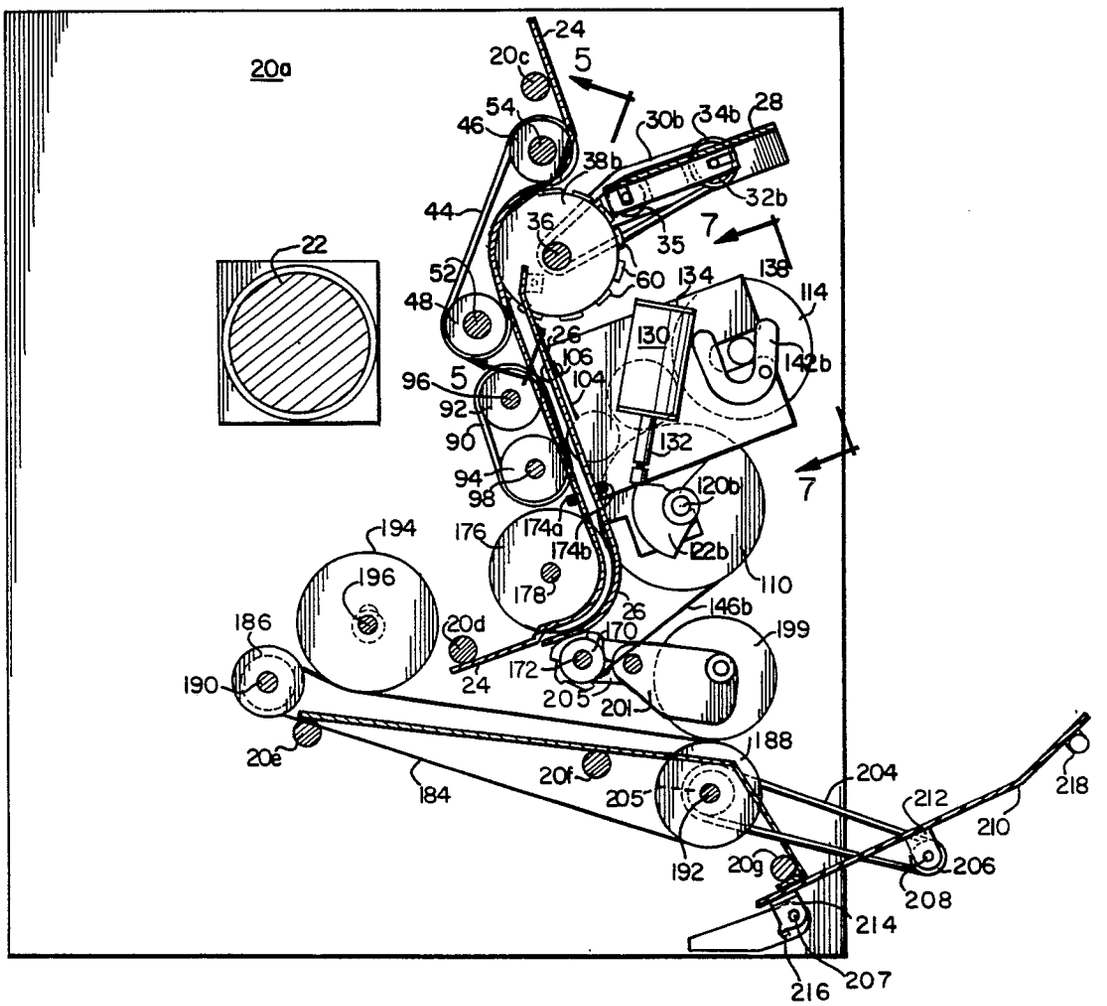


FIG. 3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20c
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46
30b
34b
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32b
44
36
35
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138
114
48
26
130
106
142b
96
5
104
92
90
132
94
98
120b
7
194
176
174a
174b
122b
196
178
110
26
146b
186
20d
170
199
190
24
172
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210
192
20g
206
208
214
216
207

FIG. 4

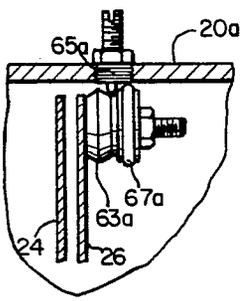


FIG. 4B

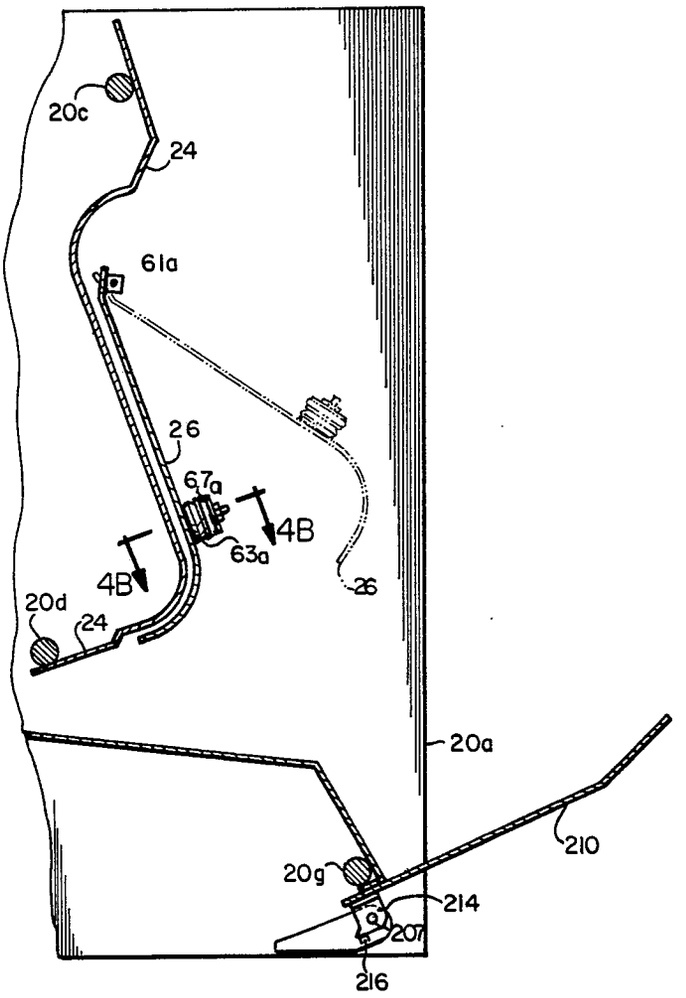


FIG. 4A

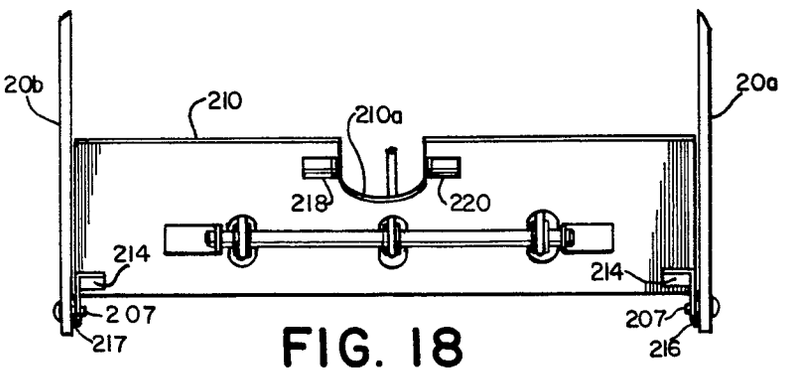


FIG. 18

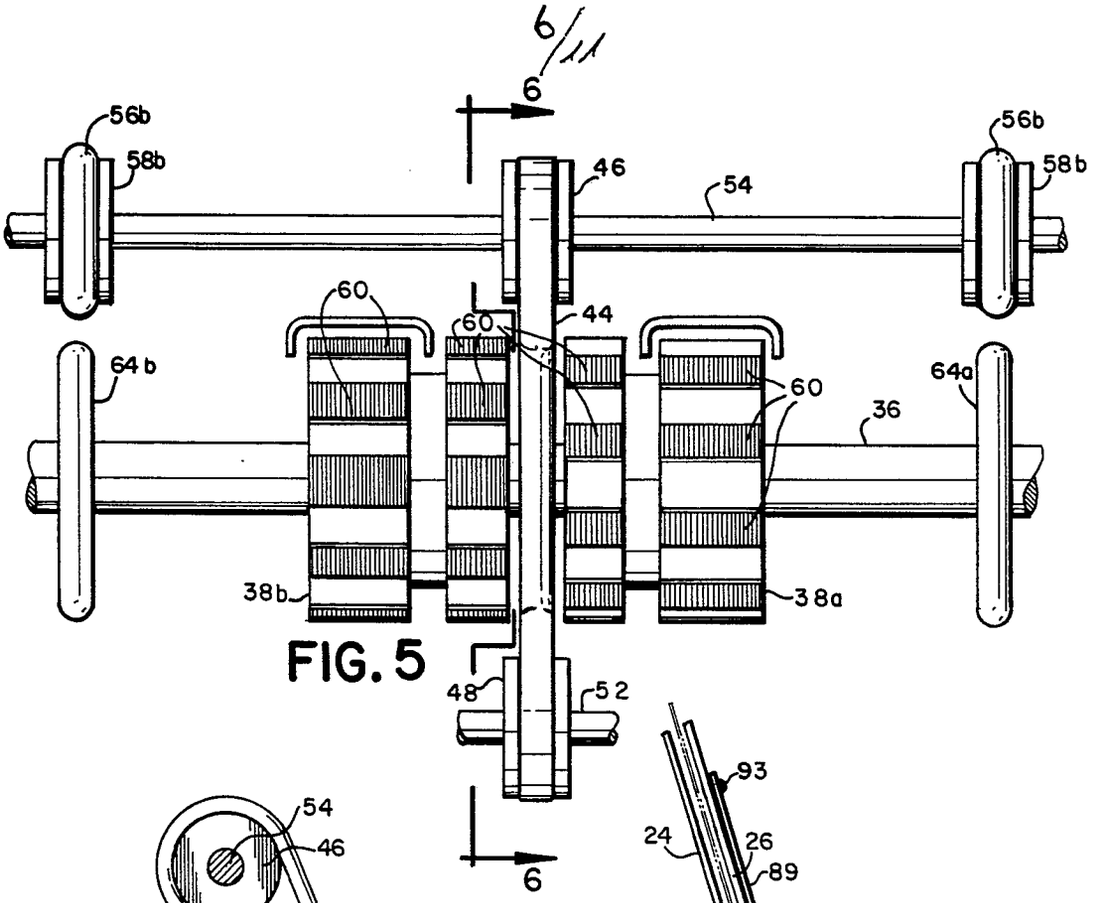


FIG. 5

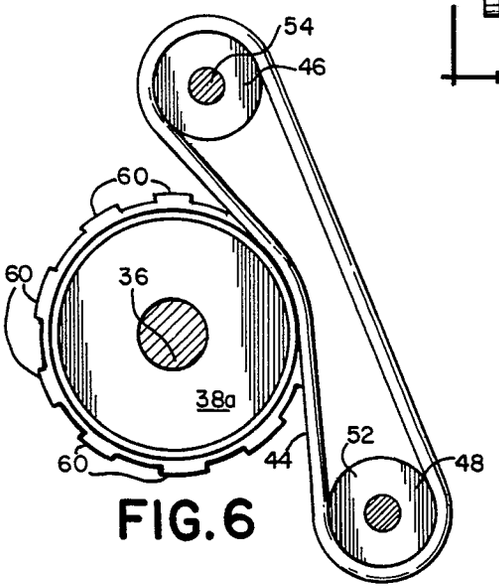


FIG. 6

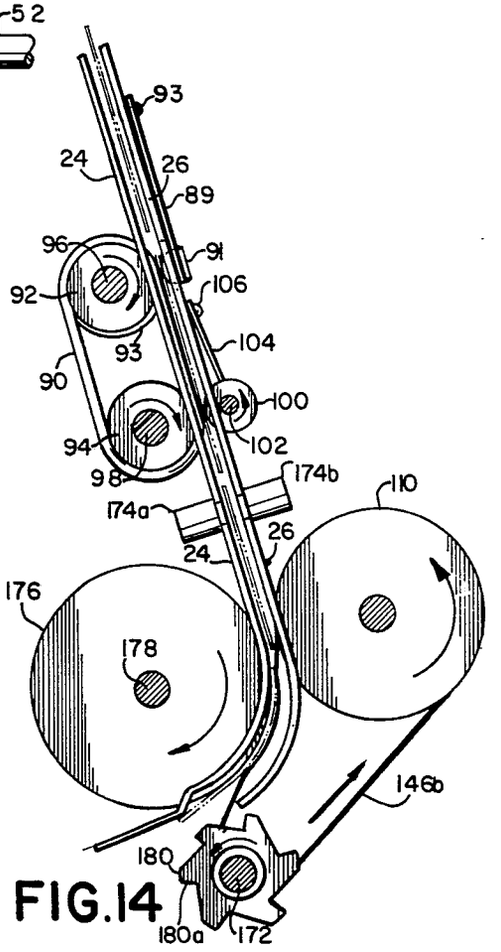


FIG. 14

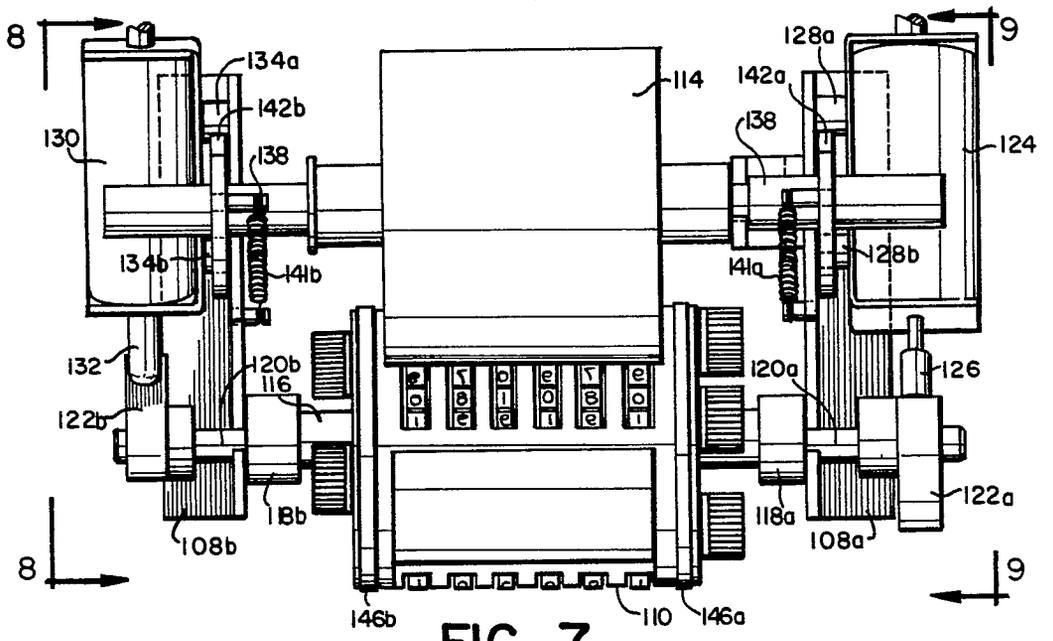


FIG. 7

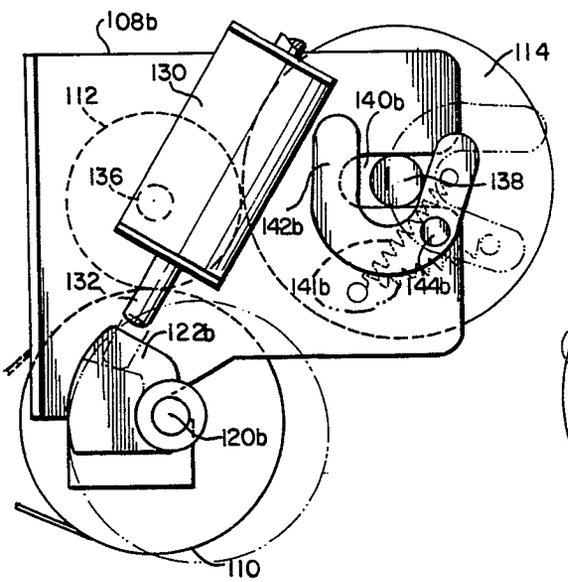


FIG. 8

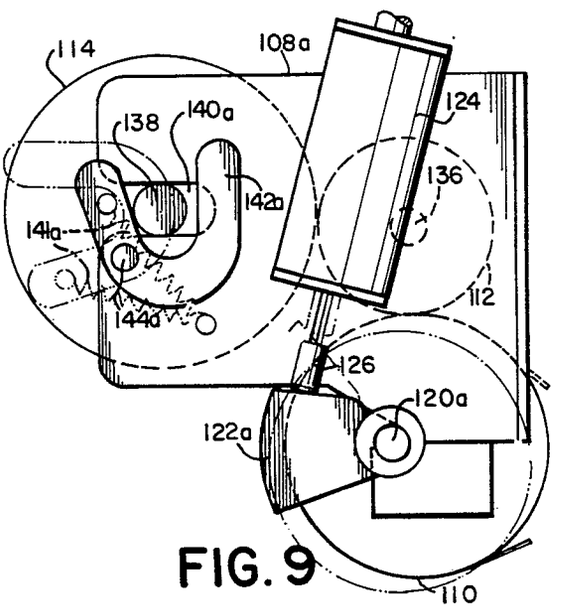
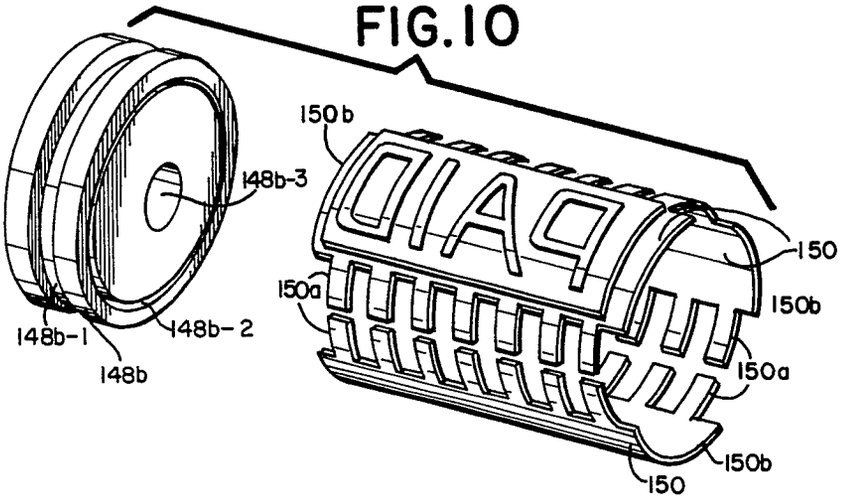


FIG. 9

FIG.10



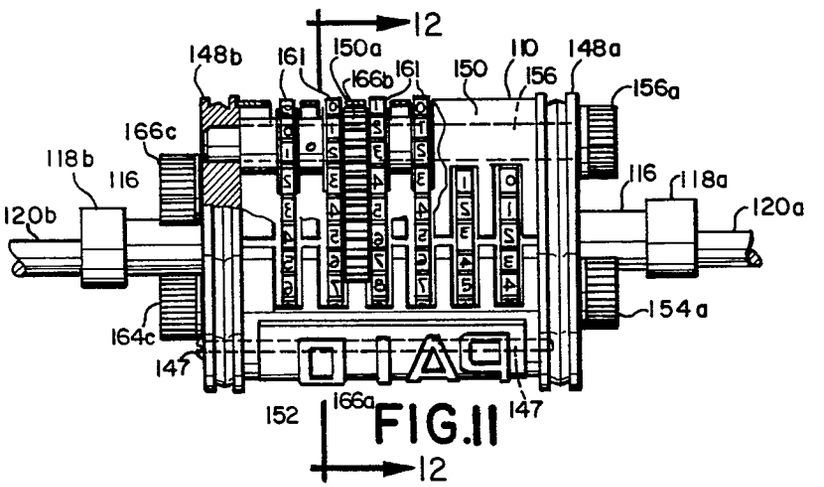


FIG.11

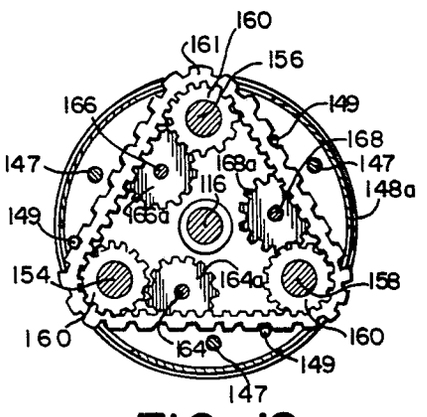


FIG. 12

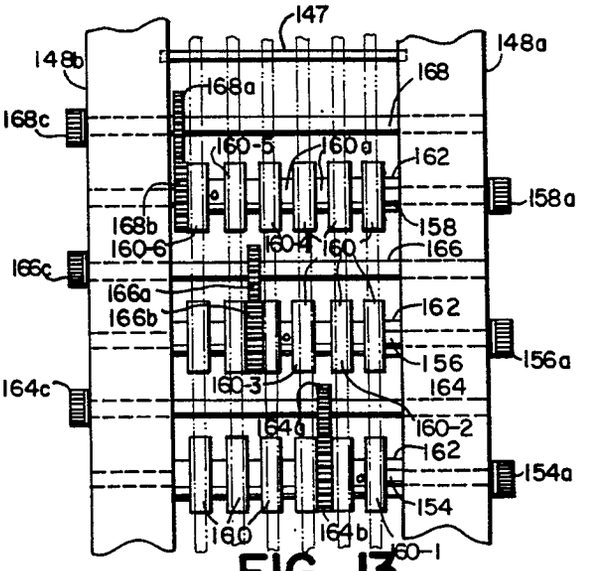
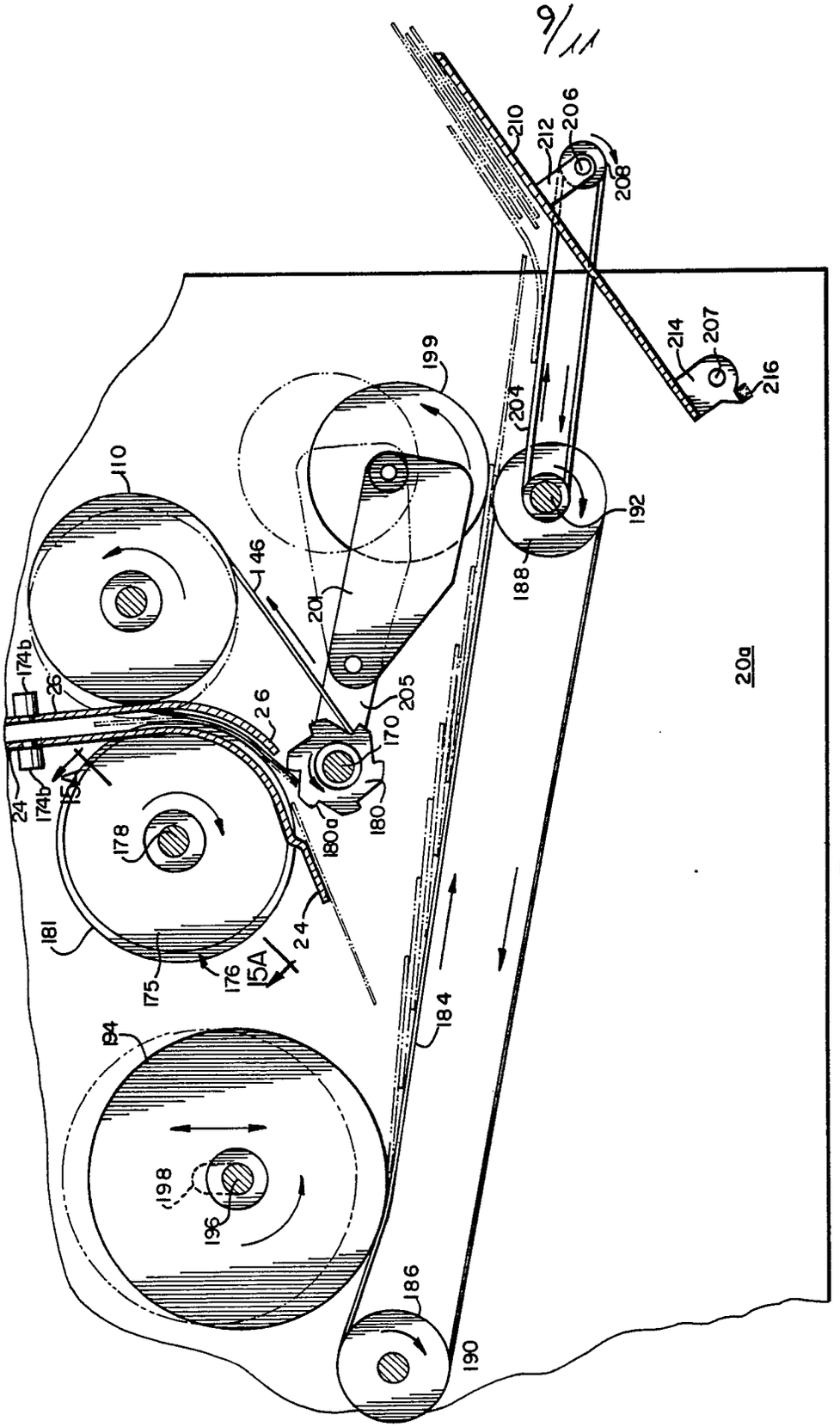


FIG. 13


9/11
210
212
206
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214
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174b
26
205
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154
180a
180
178
181
175
176
15A
24
184
84
198
196
186
190
20a

FIG. 15

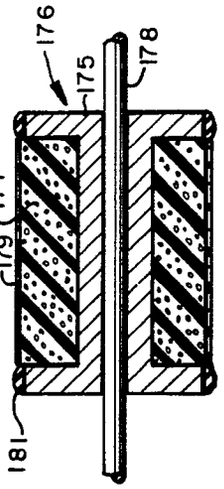


FIG. 15A

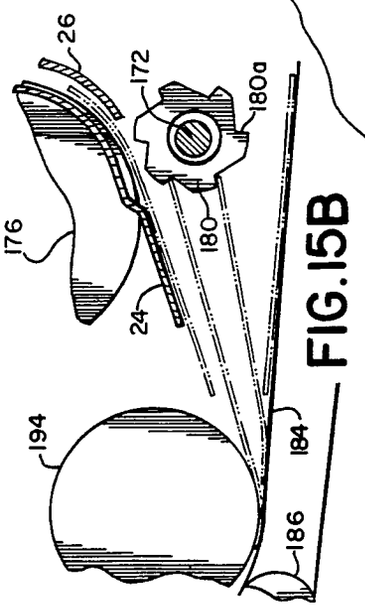


FIG. 15B

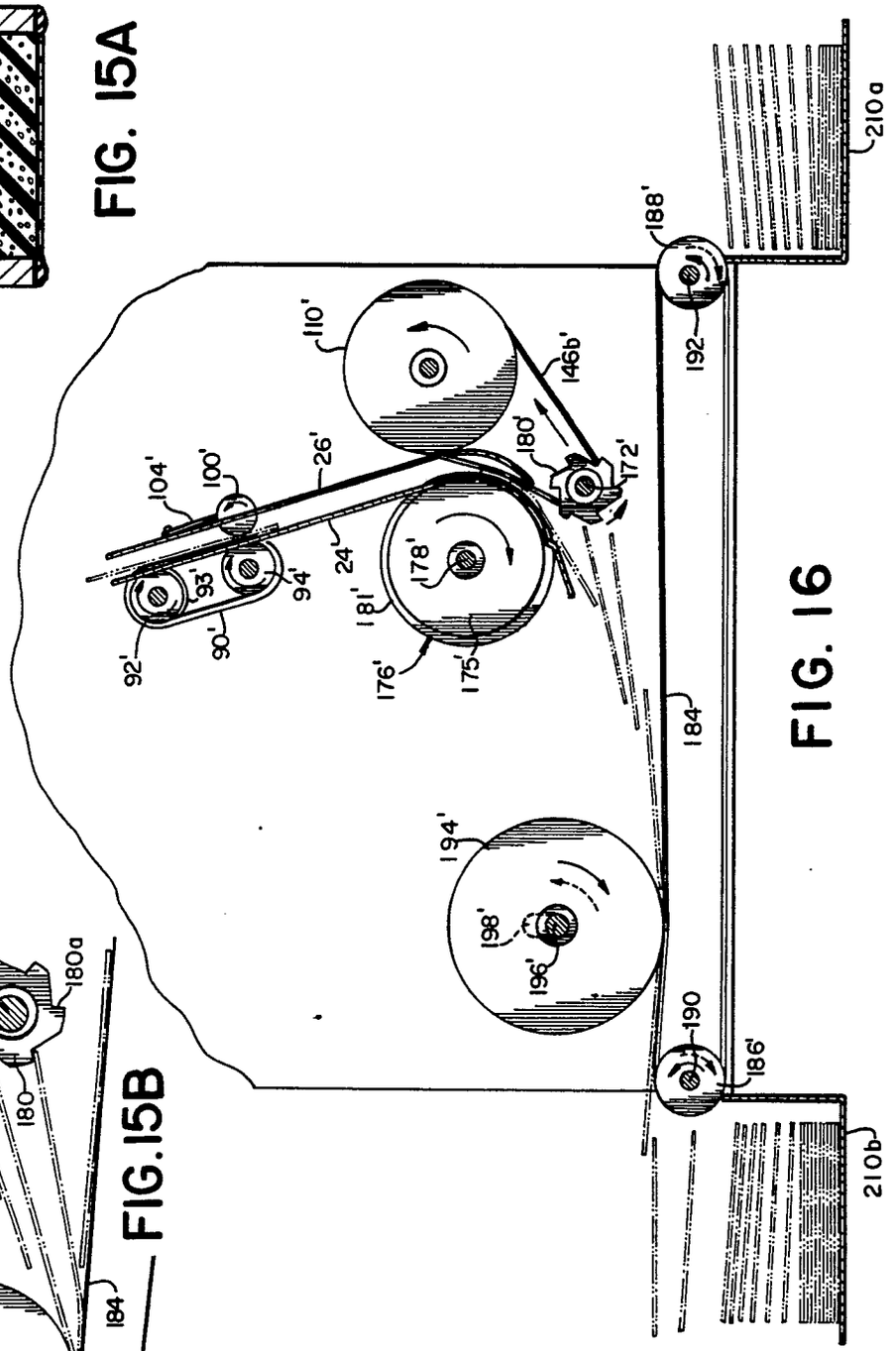
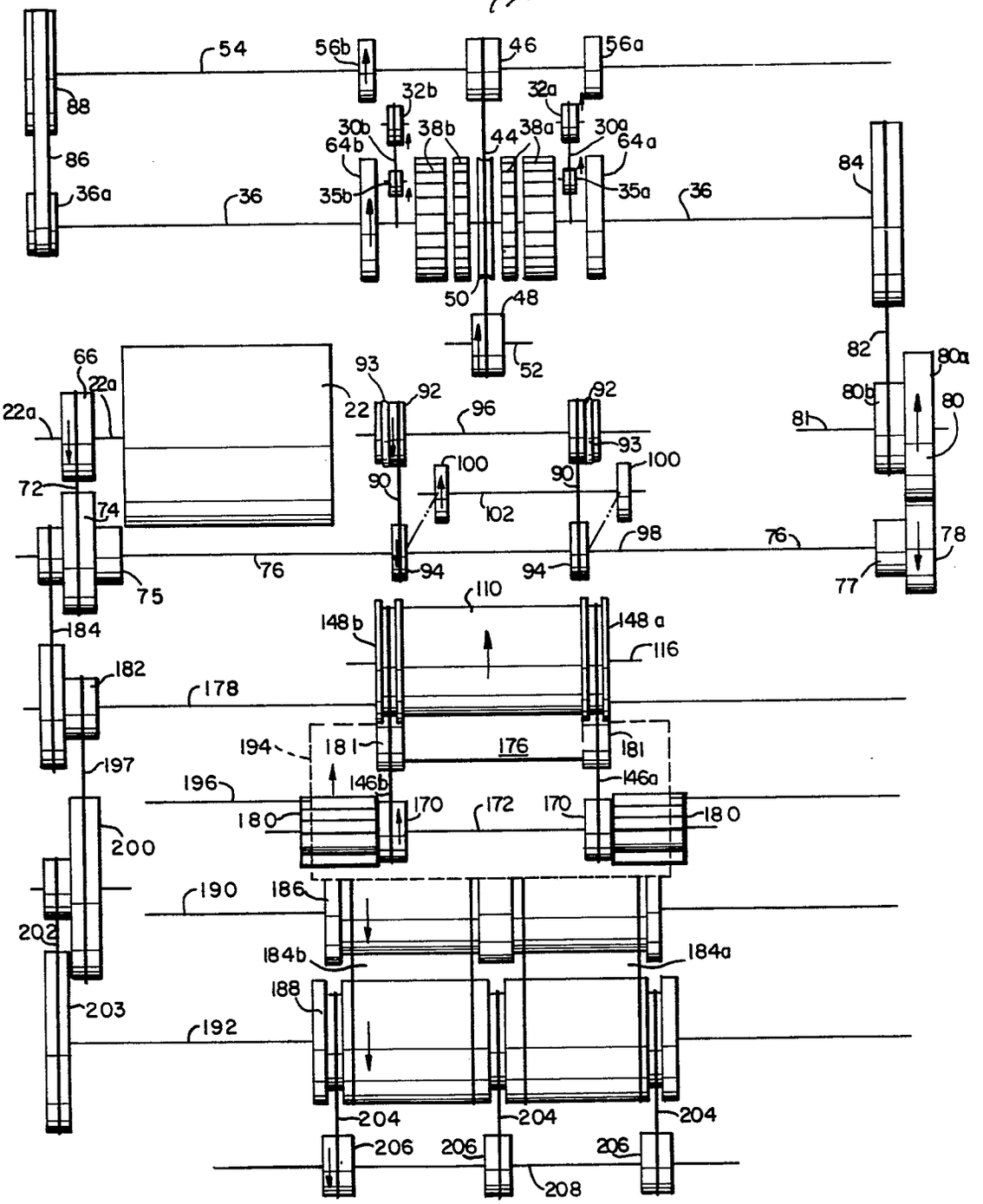


FIG. 16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84
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80a
66
22a
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80b
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22a
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148b
148a
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146b
146a
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184b
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FIG. 17