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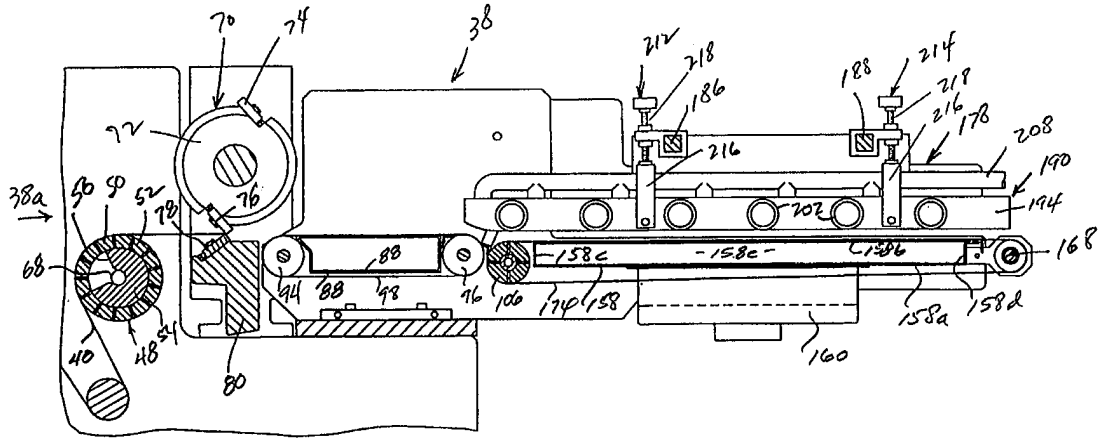

(57) Abstract

A sheeter (38) for sheeting and forming a shingled stream of the sheets (300, 400) from an elongated web (40) having a recently printed face is provided wherein a cutter (70) cuts the web into a plurality of individual sheets and the sheets are fed to a sheet shingling device (190) downstream of the cutter, this being accomplished without physical contact with the most recently printed face of the web to avoid marring of this face. The sheet shingling device includes a vacuum operated tail grabber assembly (104) which engages only the under surface of the tail of a severed sheet and functions to decelerate the sheet so that the next succeeding sheet is brought into shingled relationship to the decelerated sheet. First (88) and second (174) conveyors provided on opposite sides of the tail grabber assembly are both vacuum operated so that sheets may be moved along respective paths of travel without marring the freshly printed face.

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SHEETER HAVING NON-TOP SURFACE CONTACT SHEETING AND SHINGLING MECHANISM

Background of the Invention

1. Field of the Invention

This invention relates to the printing field and especially to a sheeter for cutting a printed web into a series of sequential sheets and to then form a shingled stream of the sheets which may be directed to a stacker, or other sheet handling apparatus. In particular, this invention concerns a sheeter that is operable to cut a web into sheets and to then shingle the sheets without contacting the recently printed face of the web, thereby avoiding any mechanical marking of the printed surface, allowing printing to the edge of the web and throughout its length, and permitting trimming of a web before sheeting if the printer elects to do so.

2. Description of the Prior Art

Offset lithographic presses have been available for many years for printing of sheets as well as webs of paper or other substrate. In the case of web fed offset presses, the web printing and processing train often is provided with a sheeter to cut the web into individual sheets which are then directed to a stacker or similar processing equipment. In order to maintain an accurate count of the sheets and to facilitate direction of the cut sheets into the stacker, it is conventional to form a shingled stream of sheets before they are introduced into the stacker. In the case of 8 1/2 X 11 inch printed sheets, for example, the shingling equipment generally is functional to form a stream of the sheets in shingled format with proximal sheets being in overlapped relationship leaving an unlapped leading edge spacing therebetween of about 2 inches.

Cutting of the web into individual printed sheets has for the most part been carried out using a rotary drum provided with a knife extending across the width of the drum which is cooperable with an anvil to sever the web into a series of sequential sheets. The knife on the cutting drum is configured in position such that a straight cut is formed in the web across the width thereof notwithstanding forward movement of the web during the severing operation.

Cooperable pull wheels have been used to direct the web between the rotary cutter and the anvil for the cutter blades. The cut sheets emerging from the cutter drum were supported by a table which directed the sheets into the nip between a full width roller and a series of overlying web-edge located snap wheels having rubber O-ring treads. The full width drive roller and associated edge drive snap wheels were normally

operated at about a 20% overspeed with respect to the circumferential speed of the knives of the cutter drum.

As the cut sheets were accelerated away from the cutter drum, they were sequentially directed to an underlying full width conveyor belt which was operated at a speed significantly less than the linear speed of the full width drive roller upstream therefrom, and usually of the order of about 2 inches of linear speed for each 11+ inch speed of the drive roller. A series of longitudinally extending, transversely spaced, cross-sectionally circular belts overlying the full width drive roller and the conveyor belt controlled the sheets as they were moved along their path of travel through the sheeter.

A pair of tail grabber nip rollers were positioned above the conveyor belt downstream of the main drive roller in locations to engage respective opposed side edge margins of the sheets. The tail grabber nip rollers oscillate between locations above the conveyor belt and positions directly above a backup roller beneath the conveyor belt. When the tail grabber nip rollers were shifted downwardly toward engagement with the conveyor belt, the tail grabber nip rollers served to decelerate the sheet engaged thereby to a speed approxi-mating that of the underlying conveyor belt. The timing of the oscillation of the tail grabber nip rollers was such that they engaged the tail portion of each cut sheet as that sheet was moved downstream from the main drive roller. In order to minimize interengagement of the tail of a sheet with the leading edge of a following sheet that was being moved into shingling relationship thereto, an air blast roller was positioned above the conveyor belt ahead of the tail grabber nip rollers for directing an air blast against the rearmost portion of the tail of each sheet to deflect the tail downwardly as an immediately preceding portion of the sheet was being gripped, decelerated and then moved forwardly at a slower speed while gripped by the tail grabber nip rollers. The sheets in shingled formation continued movement through the sheeter while being held in place between the underlying conveyor belt and the overlying series of cross-sectionally circular retainer belts.

From the foregoing, it can be seen that if ink had been applied to the surface of the web engaged by the snap drive wheels and/or the tail grabber nip rollers and the ink was not totally dry, undesirable marking of the freshly printed face of the sheets could occur as a result of interengagement of the snap wheels and the tail grabber nip rollers with the cut sheets. Although this marking was principally limited to the edges of the sheets, that marking or potential thereof prevented the printer from printing to the far side edges of the web, or printing continuously along the length of the web without any intervening unprinted areas. The sheeter construction described also

precluded the printer from optionally trimming the sides of the web before introducing the printed web to the cutting and sheeting operation.

Summary of the Invention

It is therefore the primary object of the present invention to provide a sheeter for sheeting and forming a shingled stream of the sheets from an elongated web having a recently printed face wherein cutting of the web into a series of sheets and shingling of such sheets is carried out without any direct physical contact of the shingling mechanism with the recently printed faces of the cut sheets.

It is a further important object of the invention to provide a sheeter as described which incorporates a combination tail grabber and cut sheet decelerator which engages only the underside of the sheet and there is no physical contact of the tail grabbing and decelerating structure with the printed surface of the sheet during shingling and transport of the shingled sheets.

Another important object of the invention is the provision of a sheeter having web pull structure which is operable to introduce the web to the rotary cutter without the necessity of the web feed mechanism being in physical engagement with the recently printed face of the web. In this respect, a further important object of the invention is to provide a sheeter wherein the components for directing the web to the rotary sheet cutter, and for forming a shingled line of the cut sheets is operated from a suitable vacuum source as for example the vacuum produced by a positive displacement pump that generates 6 to 8 inches of water.

Also an important object of the invention is the provision of a sheeter which does not occupy any greater space linearly of the press train than prior sheeters, that is positive in operation, and that may be directly connected to a conventional stacker which directly follows in the processing line path.

It is also an important object of the invention to provide a sheeter which will not mar or in anyway deface printing that is present on the face of the web being processed, even though that printing fully covers the printed face end to end and side to side of the sheets cut from the web, and that is competitive in manufacturing cost to prior sheeters that do not offer the non printed face marring properties of the present invention.

Another important object of the invention is to provide a sheeter that is readily adaptable to cutting and shingling sheets of different lengths, as for example 11 inches and 22 inches, by a simple and straightforward adjustment of the mechanism involving primarily the conventional step of mounting a single cutter blade or two cutter blades 180° apart on the cutter drum.

Brief Description of the Drawings

Figure 1 is a side elevational, schematic representation of a commercial modular offset lithographic printing unit including a roll support and splicer unit, a controlled web infeed, a plurality of offset units, an optional slitter-perforator, and a sheeter embodying the preferred concepts of the present invention.

Figure 2 is an enlarged fragmentary side elevational view of the sheeter of this invention;

Figure 3 is a fragmentary plan view of the sheeter as depicted in Figure 2, with the shingled stream air bar hold-down structure as shown in Figure 8 being removed;

Figure 4 is a fragmentary vertical cross-sectional view of the sheeter as shown in Figures 2 and 3;

Figure 5 is an enlarged fragmentary vertical partial cross-sectional view of the sheeter;

Figure 5A is a fragmentary cross-sectional view along the dashed line 5A-5A and looking in the direction of the arrows;

Figure 6 is a fragmentary partial cross-sectional view through the tail grabber cylinder of the present invention which is adapted to be connected to a vacuum source;

Figure 7 is a cross-sectional view along the dashed line 7-7 of Figure 6 and viewed in the direction of the arrows.

Figure 8 is a fragmentary plan view of the sheeter similar to Figure 3 but in this instance illustrating the shingled stream air bar hold-down structure in operative position above the shingled stream conveyor belt;

Figure 9 is an enlarged fragmentary, partially cross-sectional schematic representation of the tail grabber portion of the sheeter mechanism and also showing the air bar structure associated therewith, and in this instance illustrating the positions of respective parts where the tail portion of a cut sheet is approaching disposition to be grabbed by the vacuum operated tail grabber;

Figure 10 is an enlarged fragmentary, partially cross-sectional schematic representation similar to Figure 9 but illustrating the positions of respective parts in the locations thereof whereby the vacuum source has not yet been connected to the vacuum grabber cylinder to grab and deflect the tail portion of the sheet downwardly so as not to impede overlaying of the next following sheet in shingled relationship thereto;

Figure 11 is another enlarged fragmentary schematic representation similar to Figures 9 and 10 but illustrating grasping and deflection of the tail portion of

a sheet downwardly in response to connection of the tail grabber cylinder to a vacuum source, thus allowing the leading edge of a following cut sheet to move smoothly over the preceding cut sheet into shingled relationship thereto; and

Figures 12 through 17 respectively are plan view schematic representations of the sheeter illustrating in sequence, severing of an individual sheet from the web by a rotary cutter (Figure 12), movement of such cut sheet away from the cutter drum (Figure 13), cutting of a second sheet from the web by the rotary cutter accompanied by progressively increased spacing between the first sheet and the following sheet (Figure 14), gripping of the tail portion of the first sheet to decelerate the latter as the succeeding second sheet is caused to overlap the first cut sheet to commence formation of a shingled stream of sheets (Figure 15), commencement of the shingling of the cut sheets (Figure 16), and grabbing of the tail of the next sheet in line to continue sequential shingling of the sheets (Figure 17).

Detailed Description of the Preferred Embodiments

A modular printing press embodying the present improved sheeter is broadly designated by the numeral 20 and as depicted includes a roll support and splicer unit 22, a controlled web infeed 24, a plurality of offset units 26, 28, 30, 32 and 34, an optional slitter-perforator unit 36 and the sheeter 38 of this invention. A web 40 which is unrolled from the supply rolls 42 and 44 in desired sequence, first goes through the tension control dancer 46 and is fed into the infeed controller 24. Thereafter, the web is successively passed through the offset units 26-34 to imprint at least one face of the web. After emerging from the last offset unit 34, the web may be subjected to an optional slitting and/or perforating operation in unit 36 and thence directed to sheeter 38. It is to be understood in this respect that the printing press 20 made up of a number of modular units as depicted is set forth in the drawings for illustrative purposes only, and not intended to be limiting as to the specific modular components that may be operably associated with sheeter 38, including the type and number thereof.

Viewing Figs. 2, 3 and 4, sheeter 38 has a vacuum drum web infeed or pull assembly 48 at the inlet side 38a of sheeter 38. Assembly 48 includes a rotatable cylinder 50 provided with a series of radial vacuum ports 52 around the circumference thereof which intercommunicate the interior of the cylinder and the peripheral surface thereof. A fixed vacuum source divider 54 is received within the interior of cylinder 50 in sealing relationship to the inner surface thereof and as noted in Fig. 4, comprises a semi-cylindrical element having a cutout portion 56 of approximately 90° and that is oriented as shown in that figure. The vacuum drum cylinder 50 is supported on opposed

upright side walls 58 and 60 of the frame assembly 62 of sheeter 38 and is driven by gear means 64 operably connected to and rotated by the drive mechanism of press 20 such that the cylinder 50 is rotated at a speed such that the surface thereof is synchronized with and matches the speed of web 40 along the length of press 20. Vacuum source couplings 66 and 67 communicate with the bore 68 extending longitudinally of semi-circular divider 54 and provide means for a vacuum to continuously be drawn through the ports 52 of cylinder 50 which are in alignment with cutout portion 56 of divider 54.

Cutting means 70 for cutting the web 40 into a plurality of individual sheets may take the form of a rotatable cylinder 72 of conventional construction which may for example mount one or two cutter blades 74 and 76 which are spaced 180° apart. Each of the blades 74 and 76 are conventionally mounted on the rotatable cylinder 72 in disposition at an angle transversely of the cutter so that the blades successively operate in conjunction with the fixed anvil blade 78 mounted on cross-support 80 extending between side walls 58 and 60 to cut the web 40 along a line perpendicular to the longitudinal width of the web even though the web is being continuously fed to the sheeter 38, as is well understood by those skilled in this art. In an exemplary sheeter 38, mounting of a single cutter blade such as 74 or 76 on the cylinder 72 will result in cutting of individual sheets that are either 22 or 23 inches in length, or a selected increment therebetween, while use of two cutter blades 74 and 76 as depicted in Fig. 4 results in severing of individual sheets having a length of 11 to 11 1/2 inches as determined by the press operator, or any increment therebetween. It is to be understood in this respect that the sheet lengths described are exemplary only and that the length of sheets resulting from severing of the web by rotation of cylinder 72 with either one or two cutter blades thereon is a function of the diameter of cylinder 72 as used on a particular press.

Viewing Figs. 2, 3 and 8, it is to be observed that the shaft 82 for cylinder 72 extends outwardly from side wall 58 and is adapted to be driven by the press drive train in correlation with the speed of web 40. The opposite end of shaft 82 projects through end wall 60 and serves to mount a pulley 84 thereon which receives endless timing belt 86 trained around other pulleys to be hereinafter described. Rotatable cylinder 72 is driven by pulley 82 at a speed that remains correlated with the speed of advancement of web 40 toward and into sheeter 38.

As best shown in Figs. 3, 4 and 5, first conveyor means 87 includes a vacuum plenum 88 extending across the width of the sheeter 38 between side walls 58 and 60. Plenum 88 has a flat upper wall 88a and a lower wall 88b in spaced relationship therefrom. A dog leg front wall 88c and an upright rear wall 88d complete the enclosure of the plenum 88. It is to be observed from Fig. 5 for example that the upper wall 88a

of plenum 88 is generally aligned with the scissors line of engagement of each of the cutter blades 74 and 76 with anvil blade 78, but is spaced rearwardly therefrom in the direction of web travel or to the right of blade 78 as shown in such figure. A duct 90 communicating with the interior 88e of plenum 88 leads to a source of a continuous vacuum. In Fig. 3, it can be seen that the upper wall 88a of plenum 88 has a series of parallel, spaced, relatively narrow, elongated slots 92 therein which extend a substantial part of the extent of upper wall 88a in the direction of web travel. In the preferred exemplary embodiment of sheeter 38, there are eight slots 92 in upper wall 88a.

A pair of elongated, parallel, horizontal rollers 94 and 96 (Figs. 3, 4 and 5) rotatably carried by side walls 58 and 60 serve to support a wide, elongated endless conveyor belt 98 which has a portion 98a that continually overlies the upper wall 88a of plenum 88 as well as a portion 98b that underlies bottom wall 88b of plenum 88. From Fig. 5 it can be seen that roller 94 is proximal to front wall 88c of plenum 88 while roller 96 is adjacent upright wall 88d of plenum 88. The endless belt 98 has a series of perforation or holes 100 therein which define a series of elongated perforate paths which are directly aligned with and communicate with respective slots 92 in upper wall 88a of plenum 88. The diameter of each hole 100 is approximately equal to the width of a corresponding slot 92 and as is most evident from Fig. 3, there are eight rows 102 of holes 100 for the eight slots 92.

Gearing 103 operably coupled to drive shaft 96 is driven by the drive unit of press 20 to cause the endless belt 98 to preferably move at a linear speed about 8% faster than the existing speed of web 40 at any point in time as it is introduced into sheeter 38. Thus, if for a given unit of time the web 40 is advanced 11 inches, the linear speed of the endless belt 98 should preferably be about 11.88 inches in that interval of time.

A vacuum tail grabber assembly broadly designated 104 is operably associated with the conveyor belt 98 in proximal relationship to roller 96 supporting such conveyor belt. The assembly 104 includes an elongated rotatable cylindrical member or roller 106 extending between upright frame members 107 and 109 in parallelism with roller 96 and closely adjacent thereto. The cylinder 106 has a plurality of vacuum ports 108 extending radially between the outer cylindrical surface of cylinder 106 and the interior bore 110 of the cylinder. From Figs. 3, 5 and 6, it can be seen that there are a series of four ports 108 90° apart through each cross-sectional area of the cylinder 106 which is ported. Furthermore, from Figs. 3 and 6, it is to be observed that there are a plurality of sets of horizontally spaced vacuum ports along the longitudinal length of the cylinder 106. Preferably, there is a set 112a and a set 112b of ports at opposite ends of

the cylinder 106 each made up of two horizontally spaced series of four ports. Likewise, there are six sets 112c, 112d, 112e, 112f, 112h and 112j of vacuum ports made up of five horizontally spaced series of four circumferentially oriented ports. The horizontal spacing between adjacent sets of ports 112 is sufficient to accommodate respective endless tape belts 114, 116, 118, 120, 122, 124 and 126 respectively which are trained over and around the cylinder 106. As depicted in Fig. 6, it is to be seen that cylinder 106 is provided with a plurality of crowned, circumferentially-extending depressions 128 which receive corresponding tape belts 114-126 inclusive.

A ported fixed vacuum tube 130 within cylinder 106 and extending the full length of thereof has a plurality of vacuum ports 132 which are oriented as shown in Fig. 5 relative to the conveyor belt 98. Viewing Fig. 6, it can be seen that there is one port 132 for each longitundinal series of four ports 108. A vacuum coupling 134 adapted to be coupled to a vacuum source communicates directly with the interior of tube 130. It is preferred that a coupling 136 at the opposite end of tube 130 and communicating therewith also be connected to the continuous vacuum source so that an adequate vacuum is always available within the interior of tube 130 during operation of sheeter 38. An adjustment knob 138 on the outermost extremity of the end of vacuum tube 130 mounting coupling 134 serves to permit adjustment of the circumferential position of tube 30 so as to change permit selective change of the orientation of ports 132 from the position thereof shown in Fig. 5. For example, from the approximately 345° position of ports 132 as shown in Fig. 5, that angular position may be changed as desired by selective manipulation of adjustment knob 138.

An L-shaped sheet tail support bar 139 is located between the rearmost part of the first conveyor means 87 and cylinder 106, as illustrated in Figs. 5 and 9-11. The L-bar 139 has an inclined upwardly facing leg 139a located in disposition to serve as a support for the tail of a sheet as it is grabbed by tail grabber assembly 104. The bar 139 extends substantially the full width of the distance between upright frame members 107 and 109.

The gear 140 secured to the end of cylinder 106 outboard of upright frame member 107 and which is operable to effect rotation of cylinder 106 is in meshing relationship with a pinion 142 (Fig. 2) carried by shaft 144 on upright frame member 107. Pulley 146 secured to shaft 144 and rotatable with pinion 142 receives endless belt 86. It can therefore be seen that as shaft 82 is rotated by the drive unit of the press 20, pulley 84 is rotated to turn pulley 146 to rotate cylinder 106 in timed relationship to the cutter cylinder 72. A lever 148 pivotally mounted intermediate the ends thereof on frame member 107 between pulleys 84 and 146 on a pivot shaft 150 has an idler roller 150

which engages endless belt 86. Adjustment mechanism 154 allows selective pivoting of lever 148 to change the length of the stretch of belt 86 between pulleys 84 and 146 and thereby alter the timing of rotation of grabber cylinder 106 with respect to cutter cylinder 72.

Second conveyor means 156 is operably associated with first conveyor means 87 and includes a vacuum plenum 158 which extends across the width of sheeter 38 between frame members 107 and 109. Plenum 158 includes a rectangular bottom wall 158a, a similarly shaped and sized top wall 158b, and upright front and rear walls 158c and 158d. A duct 160 connected to an communicating with the interior of plenum 158 is also connected to the source of continuous vacuum that provides a vacuum for plenum 88, infeed pull assembly 48 and tail grabber assembly 104. It is to be seen from Fig. 3 that the plenum 158 extends substantially the full width of the distance between frame members 107 and 109, and also extends rearwardly from cylinder 106 to the rear extremities of frame members 107 and 109.

In the preferred embodiment of sheeter 38 as depicted, the top wall 158b of plenum 158 has seven rows 164a, 164b, 164c, 164d, 164e, 164f and 164g respectively of slits 166. Each row 164a-164g of slits 166 preferably is made up of four elongated, aligned, spaced slits 166a, 166b, 166c and 166d. These slits 166 extend entirely through the thickness of top wall 158b and communicate with the interior 158e of plenum 158. As is most apparent from Fig. 3, the rows of slits 164a-164g inclusive are aligned with respective tape belts 114-126 inclusive which pass directly over corresponding rows of slits 166. A roller 168 rotatably carried by the rearmost extremities of frame members 107 and 109 has circumferentially extending depressions 170 therein complementally shaped with depressions 128 and receiving respective tape belts 114-126 therein. The tape belts 114-126 have portions 172 which ride across the upper surface of top wall 158b of plenum 158 in alignment with respective rows 164 of slits 166, while portions 174 of tape belts 114-126 pass in underlying relationship to bottom wall 158a of plenum 158. Each of the tape belts 114-126 has a series of spaced relatively small diameter openings 176 therein located in disposition to be aligned with slits 166 of corresponding rows 164a-164g inclusive. The openings 176 are preferably of a size approximately equal to the width of a respective slit 166.

An air bar assembly 178 is pivotally mounted on frame members 107 and 109 directly above plenum 158 and the associated tape belts 114-126. Assembly 178 includes two upright side plates 180 and 182 which are pivotally secured to and mounted on respective frame members 107 and 109 by corresponding pivotal connections 184. Two spaced, horizontal, transversely oriented mounting bars 186 and 188 extend between

opposed upright side plates 180 and 182 and serve to mount two air bar units 190 and 192 which are of identical construction. As shown in Figs. 4 and 8-11 inclusive, each of the air bars 190 and 192 includes an elongated, transversely rectangular, hollow core element 194 having an apertured, longitudinally extending upper wall 194a and an elongated apertured lower wall 194b. The sides and ends of each element 194 are also closed to present an elongated air chamber 194c therein.

Viewing Figs. 9-11, it is to be seen that the lower wall 194b of each element 194 has a series of apertures 196 therein which are formed by cross-drilling of the lower wall 194b using a drill which is passed transversely through bottom wall 194b on two separate centers which are spaced from one another, thereby creating arcuate wall surfaces 198 and 200 respectively with the surface 198 resulting from one drill operation, while arcuate surface 200 results from the second drilling operation offset from the first drilling step. Thus, by inserting a tubular member 202 in each of the apertures 196 and using a tubular member that has a radius equal to the radius of the drill used to form surface 198, the outer circumference of the tubular member 202 corresponds to and closely conforms with the arcuate surface 198 but is spaced from the corresponding opposed arcuate surface 200. The result is that a passage 204 is left between the outer face of tubular member 202 within each aperture 196 and the opposed arcuate wall surface 200. As depicted in Figs. 9-11 inclusive, it is to be observed that the passages 204 are each of a configuration such as they progressively increase in size as the outer extremity of each aperture 196 is approached. Although for purposes of explanation, the formation of surfaces 198 and 200 has been described as resulting from successive drilling operations, it is to be appreciated that the wall 194b of each element 194 may be molded to provide wall surfaces 198 and 200 as described, with the other wall components of element 194 being fabricated of suitable size and shape and then affixed to the molded wall component 194b. The upper wall 194a of element 194 has a series of openings 206 therein which serve as entrances for pressurized air that is delivered to the interior cavity 194c of element 194 via manifold 208 provided with branches 210 connected to each of the openings. Each of the manifolds 208 is adapted to be connected to a continuous source of pressurized air.

As shown in Fig. 4, adjustable mounting mechanisms 212 and 214 are provided on bars 186 and 188 respectively for suspending the air bar units 190 and 192 from the support bars. Each mechanism 212 and 214 includes a bracket member 216 connected to the side wall of a respective element 190 and having threaded bolt means 218 connected thereto so that as respective bolt means 218 are rotated in one direction or the opposite direction, the position of elements 190 above the tape belts 114-126 may

be selectively adjusted. It is to be noted in this respect that the air bar units 190 and 192 are located in horizontal spaced relationship and in the preferred relative disposition as shown in Fig. 8. Two air bar units 190 and 192 are preferably provided if sheeter 38 is employed to cut and shingle a single stream of sheets. If on the other hand sheeter 38 is set up to sheet and shingle two side-by-side rows of sheets, then best results are obtained by providing four air bar units such as the units designated by the numerals 190 and 192, with two of the air bar units being located above each of the side-by-side lines of shingled sheets. Furthermore, the entire air bar assembly 178 may be lifted from the rear thereof as the assembly pivots about the axes of pivotal connections 184 to provide access to the top surface of the second conveyor means. Adjustment means is provided to locate the air bar structure above the second conveyor means 156 in a desired position thereabove.

From Figs. 9-11 inclusive it can be seen that air introduced into the interior cavity 194c of each of the elements 194 flows outwardly through respective passages 204 and thence along the underside of respective wall components 194b in substantially laminar flow relationship thereto. As a result of the decreasing width of corresponding passages 204 as apertures 196 are approached each air stream increases in velocity before being discharged in substantial tangential relationship to the curved under surface of corresponding tubular members 202.

OPERATION

The operation of sheeter 38 in cutting individual sheets from web 40 and to effect shingling thereof for conveyance to another processing operation or station, which for example may be a stacker, will be best understood with reference to the schematic diagrams of Figs. 12-17 inclusive. Specifically, the web 40 is directed across anvil blade 78 by rotation of infeed pull assembly 48. As the cylinder 50 is rotated by gear means 64, the vacuum that exists within the cutout portion 56 of divider 54 produces a vacuum in the ports 52 exposed to cutout portion 56 and thus creating a vacuum condition against the underside of web 40 which causes the web to move at a linear speed equal to the circumferential speed of the outer surface of cylinder 50.

Cutting means 70 is rotated in timed relationship to web feed through the drive afforded by gearing connected to shaft 82 supporting cutter cylinder 72. During rotation of cylinder 72, the cutter blades 74 and 76 thereon are brought into successive shearing relationship to anvil blade 78 thus cutting the web 40 into successive sheets that are a function of the circumferential distance between the cutting margins of blades 74 and 76 respectively. It can be appreciated in this respect that if only one of the blades 74 or 76 is mounted on cylinder 72, the length of the sheets cut from web 40 will be twice

the length as is the case where two cutter blades are mounted on cylinder 72, as for example depicted in Figs. 4 and 5. Viewing Fig. 12, it is to be seen that upon severing of a first sheet from web 40 by cutting means 70 and that has been designated by the numeral 300, that first sheet rests on the portion 98a of conveyor belt 98 which is preferably being driven at a linear surface speed approximately 8% faster than the then web delivery speed. The drive for conveyor belt 98 is provided through gearing 103 connected to the drive train of the press. Sheet 300 is held firmly against the top surface of conveyor belt 98 by the vacuum within plenum 88 which creates a vacuum against the under surface of sheet 300 through the holes 100 in belt 98 which are exposed to slots 92 in the upper wall 88a of plenum 88. As a result of linear movement of the conveyor belt 98 at a speed in the order of 8% faster than the web delivery speed to cutting means 70, sheet 300 progressively moves away from the forward edge 40a of web 40 as illustrated schematically in Fig. 13. For example, Fig. 13 is intended to depict a spacing between first sheet 300 and the edge 40a of web 40 of about 7/16 of an inch when sheet 300 has progressed along the length of the first conveyor means 87 through a displacement as shown in the schematic representation of that figure.

Figure 14 schematically represents the sequence of operation at the time that a second sheet 400 has been severed from web 40 in trailing relationship to sheet 300. At that time, sheet 300 has progressed to a point where the spacing between the trailing edge 300a of first sheet 300 is about 7/8 of an inch away from the leading edge 400a of second sheet 400. The leading edge 300b of first sheet 300 has progressed to a point where it now overlies a part of second conveyor means 156. However, first sheet 300 continues to move at the speed of linear movement of belt 98 by virtue of the vacuum connection of the trailing portion 300a of sheet 300 to the first conveyor means 87.

Viewing Fig. 15, first sheet 300 is shown as having been moved to a position where that sheet no longer has contact with the upper surface portion 98a of belt 98. The timing of tail grabber assembly 104 is such that plurality of ports 108 in alignment longitudinally of the length of cylinder 106 align with ports 132 and vacuum tube 130 thus causing a momentary vacuum condition to exist in ports 108 and thereby creating a vacuum above the surface of cylinder 108 at the ports 108 which are aligned with ports 132. This vacuum condition causes the tail portion 300a of first sheet 300 to be pulled downwardly into engagement with outer circumferential surface of cylinder 106 as shown in Fig. 11. It is to be seen from that figure that the vacuum is imposed on the underside of the sheet 300 in spaced relationship from the trailing edge 300a of sheet 300

thereby causing the trailing portion of that sheet to be deflected downwardly until it comes to rest on the surface 139a of L-bar 139.

The tail grabber assembly 104 thus serves at least two significant functions. First, by grabbing the tail portion of a sheet that has been delivered to the second conveyor means 156 by the first conveyor means 87, the sheet that is grabbed by the tail grabber assembly 104 is thereby decelerated to a speed equivalent to the linear speed of the tape belts 114-126 of second conveyor means 156. Secondly, the tail grabber assembly 104, by deflecting the tail portion of the sheet 300 for example in a downward direction, moves the trailing edge 300a of sheet 300 to a position below the leading edge 400a of the next successive sheet 400 so that the leading edge 400a does not engage and the following sheet is not impeded in any way in its forward motion by the preceding sheet 300 which has been decelerated and is now moving forwardly at the much slower speed of second conveyor means 156.

It is to be explained in this respect that the relative timing of first conveyor means 87 and the second conveyor means 156 is such that a predetermined degree of shingled overlap of successive sheets is obtained. Exemplary in this respect is a timing arrangement such that for each 11 inches of linear movement of belt 98 and thereby a sheet laying thereon, the preceding sheet which has been delivered to second conveyor means 156, decelerated and then moved forwardly at the speed of tape belts 114-126 is preferably about 2 inches. This results in 2 inches of spacing between the leading edges of adjacent shingled sheets.

Returning to the schematic representation of Fig. 16, it is to be seen that the sheet 300 has been decelerated by tail grabber assembly 104 and is moving at the linear speed of tape belts 114-126. The sheet 300 as shown in Fig. 16 is held in position against the tape belts 114-126 by virtue of the vacuum condition that exists within plenum 158 and that creates a vacuum on the underside of the sheet 300 through respective slots 166 and the openings 176 that are aligned with corresponding openings 176 in belts 114-126. The sheet 400 at the same time is progressively moving away from the leading edge of web 40 in the same manner previously described with respect to the sheets 300 and 400.

Figure 17 shows the relationship of sheet 300 with respect to sheet 400 in fully shingled relationship thereto, while another sheet 500 has been severed from web 40 and is progressively moving away from the leading edge 40a thereof. Sheet 500 is moving at the speed of belt 96 in the schematic depiction of Fig. 17. Sheet 400 has been decelerated by grabbing of the tail portion thereof by tail grabber assembly 104, and sheets 300 and 400 are both moving forwardly at the linear speed of belts 114-126.

The air bar units 190 and 192, which produce laminar air flow currents along the underside of wall components 194b serve to not only control the sheets as they are delivered to the second conveyor means until the vacuum condition is seen against the underside of the sheets through the openings 176 in tape belts 114-126, but also function to direct the sheets forwardly onto the second conveyor means 156. The sheet entering the opening that exists below the entrance to the second conveyor means is entrained to a certain extent in the laminar air flow pattern and is therefore not in any way impeded in its forward motion, notwithstanding the fact that the sheet therebelow is moving at the slower speed of the second conveyor means. It is to be understood in this respect that because there is some frictional engagement between a faster moving sheet and a slower moving sheet as sheets are transferred from the first conveyor means 87 to the second conveyor means 156, such friction might tend to retard forward movement of the next overlying sheet. This possible negative frictional effect is substantially neutralized by the laminar air flows emanating from air bar units 190 and 192 by virtue of the fact that such air flows tend to entrain a sheet as it moves forwardly thereunder and also produces a down pressure on the slower moving sheet over which the next succeeding sheet is progressively moving into overlying, shingled relationship thereto.

In addition, the air streams issuing from passages 104 of air bars 192 and 194 exert a down pressure on the shingled sheets on the second conveyor means to assist in stabilizing the sheets in that only the forwardmost sheet on the second conveyor means at any given time is fully exposed to the vacuum condition provided by plenum 158.

In addition to providing positive control over the sheets during cutting and shingling thereof on a continuous basis, the sheeter mechanism of this invention is especially useful by virtue of the fact that all contact with the sheets is on the under surface of the web and there is no mechanism contacting the upper face of the sheet which would mar or tend to mar freshly printed ink images thereon. Although it is not necessary that the under surface of the web be unprinted in that the web can be printed on one face, turned and then printed on the opposite face, a principal feature of this invention is the fact that the web can be sheeted without marring or deleteriously affecting in any way the most recently printed face of the sheet of the web which is emerging from the offset units 24-34 of an exemplary press 20.

Thus, and assuming that the upper face of web 40 is the last printed face, the surface of the web 40 opposite such recently printed face is the only portion of the web that engages the infeed pull assembly 48. Similarly, the freshly printed face of the sheet is not engaged by any conveying mechanism in the first conveyance stage after

severing of the sheets by virtue of the fact that the vacuum operated first conveying means contacts only the face of the severed sheet opposed to the freshly printed face.

Likewise, the tail grabber assembly 104 which decelerates the sheet delivered from the first conveying means is vacuum operated and contacts only the surface of the sheet opposed to the freshly printed face. As previously explained, the trail grabber assembly not only operates to decelerate a sheet by grabbing the tail and causing the latter to slow down to the speed of the second conveyor means 156, but also deflects the tail of that sheet so that it does not interfere with passage of the next succeeding sheet thereover as it is delivered to the slower moving second conveyor means by the faster first conveyor means which is also preferably moving about 8% faster than the linear speed of the web.

It is also notable that the second conveyor means, which effects shingling of the sheets by virtue of movment at a slower linear speed than that of the first conveyor means, physically contacts only the surfaces of the sheet opposed to the freshly or most recently printed faces of the sheets. The second conveyor means contacts only the undersides of the sheets while the air bars, which control and assist in forward movement of the sheets as explained, direct only air currents against the upper most recently printed faces of the sheets.

As a consequence, sheeter 38 may be used to sheet and shingle webs that are printed throughout the width thereof, as well as continuously printed along the length of the web. Similarly, sheeter 38 may be employed to sheet and shingle webs which have been trimmed prior to sheeting so that the image extends outwardly to one or both edges of the web.

Claims:

1. A sheeter for sheeting and forming a shingled stream of the sheets from an elongated web having a recently printed face and an opposed surface, said sheeter comprising:

structure defining an elongated path of travel for the web and a stream of shingled sheets formed therefrom;

means for introducing the web to said path and for directing the web along an initial portion of said path;

cutting means along said path for cutting the web into a plurality of individual sheets each having a leading head portion and an opposed trailing tail portion; and

sheet shingling means for receiving the cut sheets in sequential order from the cutting means and operable to form an overlapped shingled stream thereof along said path without direct physical contact of the shingling means with the recently printed faces thereof,

said shingling means including means engageable with only said surface of the tail portion of each sheet for decelerating a respective cut sheet and moving the tail portion thereof to a position clearing the head portion of the next following sheet as the latter is moved into shingled relationship with the directly underlying sheet.

2. A sheeter as set forth in claim 1, wherein said sheet shingling means includes first conveyor means disposed to receive the cut sheets from the cutting means and for conveying the cut sheets along said path in a direction away from the cutting means, and second conveyor means associated with said tail portion engaging means for receiving cut sheets from the first conveyor means, said second conveyor means being operable to move cut sheets thereon at a slower speed than the first conveyor means to effect shingling of the sheets conveyed to the second conveyor means by said first conveyor mean.

3. A sheeter as set forth in claim 2, wherein said sheet shingling means includes a vacuum tail grabber for momentarily grabbing the tail portion of each sheet and operable to shift such tail portion out of the path of travel of the head portion of the next oncoming cut sheet conveyed to the second conveyor means by said first conveyor means.

4. A sheeter as set forth in claim 3, wherein said cutting means includes a rotatable cylinder having a cutter blade thereon cooperable with an anvil to sever the web into said individual sheets, said first conveyor means being operable at a linear surface speed faster than the web feed speed to thereby cause the distance between sequential cut sheets to increase in a direction along said path of travel away from the cutting cylinder to permit the tail grabber to grab the tail ends of the cut sheets as they pass thereby without grabbing the head portion of a preceding adjacent cut sheet.

5. A sheeter as set forth in claim 3, wherein said first conveyor means has an exit end and the second conveyor means has an entrance end which are in generally proximal relationship with respect to one another, said vacuum tail grabber including an elongated rotatable member extending across the path of travel of the cut sheets adjacent said entrance end of the second conveyor means, said rotatable member being provided with a series of vacuum ports along the length thereof, and means for intermittently inducing a vacuum in said vacuum ports in timed relationship with the tail portion of each sheet moving into proximity to said rotatable member whereby said tail portion of each sheet is pulled down toward the rotatable member by the vacuum condition that exists in said ports.

6. A sheeter as set forth in claim 5, wherein said elongated rotatable member includes a cylindrical sleeve having said vacuum ports therein, and an inner vacuum tube within said cylinder having ports therein along the length thereof which intermittently communicate with the vacuum ports in the sleeve as the latter is rotated.

7. A sheeter as set forth in claim 6, wherein said sleeve is rotated as a circumferential surface speed approximately equal to the linear surface speed of the second conveyor means.

8. A sheeter as set forth in claim 7, wherein is provided an elongated support plate adjacent the rotatable sleeve member, extending across the path of travel of the cut sheets, and disposed to sequentially engage and support the tail portions of said cut sheets as the latter are shifted downwardly toward the sleeve member by the intermittent vacuum conditions existing in said vacuum ports of the sleeve member.

9. A sheeter as set forth in claim 2, wherein said first conveyor means includes a pair of spaced rollers extending transversely of said path of travel of the cut sheets, first belt means trained over said first rollers with a stretch thereof defining said path of travel of the cut sheets, said first belt means being provided with a series of openings therein, a first vacuum plenum underlying the stretch of the first belt means defining said path of travel of the cut sheets, said first plenum being in communication with the openings in said first belt means, and means for driving at least one of the first rollers to move said stretch of the belt in a direction away from said cutting means whereby the cut sheets resting on said stretch of the belt are moved along said path of travel without contact being made with the printed faces of the cut sheets.

10. A sheeter as set forth in claim 9, wherein said second conveyor means includes a pair of spaced second rollers extending transversely of said path of travel of the cut sheets, second belt means trained over said second rollers with a stretch thereof defining said path of travel of the shingled sheets, said second belt means being provided with a series of openings therein, a second vacuum plenum underlying the stretch of the second belt means defining said path of travel of the cut sheets as they are being shingled, said second plenum being in communication with the openings in said second belt means, and means for driving at least one of the second rollers to move said stretch of the belt in a direction away from said cutting means whereby the shingled sheets resting on said stretch of the belt are moved along said path of travel without contact being made with the printed faces of the shingled sheets.

11. A sheeter as set forth in claim 10, wherein is provided at least one elongated air bar positioned above said second conveyor means for directing a stream of air over the shingled sheets in the direction of movement thereof for controlling and maintaining the forward motion of the sheet until the tail grabber engages the tail of the sheet.

12. A sheeter as set forth in claim 11, wherein said air bar includes an elongated hollow element extending in the direction of the path of travel of the shingled sheets, said element being provided with at least one opening therein facing toward the second conveyor means, and a component having an arcuate surface positioned in said opening in a location causing air directed to the element and thence outwardly through said opening to be directed in substantially laminar flow along the length of the element in a direction generally parallel to the path of travel of the shingled sheets on said second conveyor means.

13. A sheeter as set forth in claim 12, wherein said element is provided with a plurality of said openings therein, each of said openings having a component therein causing a plurality of laminar air flows to be created from the air bar in the direction of movement of the shingled sheets on the second conveyor means.

14. A sheeter as set forth in claim 1, wherein said cutting means includes a rotatable cylinder having a cutter blade thereon cooperable with an anvil to sever the web into said individual sheets, said means for introducing the web to said path including a vacuum drum means disposed to engage said opposed surface of the web and operable to direct the web to said rotatable cylinder in timed relationship therewith.

15. A sheeter as set forth in claim 14, wherein said vacuum drum means includes a rotatable cylinder provided with a plurality of vacuum ports therein around the circumference of the same, and a fixed vacuum source divider within said cylinder for controlling exposure of the ports in said cylinder to the vacuum source during rotation of the cylinder in surface timed relationship with the circumferential movement of the cutter blade.

16. A sheeter for sheeting and forming a shingled stream of the sheets from an elongated web having a printed face and an opposed surface, said sheeter comprising:

structure defining an elongated path of travel for the web and a stream of shingled sheets formed therefrom;

means for introducing the web to said path and for directing the web along an initial portion of said path;

cutting means along said path for cutting the web into a plurality of individual sheets each having a leading head portion and an opposed trailing tail portion;

sheet shingling means for receiving the cut sheets in sequential order from the cutting means and operable to form an overlapped shingled stream thereof along said path without direct physical contact of the shingling means with the printed faces thereof,

said shingling means including means engageable with only said opposed surface of the tail portion of each sheet for decelerating a respective cut sheet and moving the tail portion thereof to a position clearing the head portion of the next following sheet as the latter is moved into shingled relationship with the directly underlying sheet; and

at least one elongated air bar positioned above the shingled sheets for directing a stream of laminar flow air over the shingled sheets as they are conveyed along said path of travel.

17. A sheeter as set forth in claim 16, wherein said sheet shingling means includes a vacuum tail grabber for momentarily grabbing the tail portion of each sheet and operable to shift such tail portion out of the path of travel of the head portion of the next oncoming cut sheet conveyed to the second conveyor means by said first conveyor means.

18. A sheeter for sheeting an elongated web having a top surface with printing thereon, said sheeter comprising:

an elongated frame defining a web travel path;

means for advancing the web through said frame along the web travel path;

a cut-off cylinder supported on said frame for cutting the elongated web into a plurality of individual sheets each having a top surface with printing thereon, a head end, and a tail end;

means for shingling the individual sheets without contacting the top surface of the sheets, said shingling means including a vacuum tail grabber cylinder operable for momentarily grabbing the tail end of one of the individual sheets while permitting the head end of the next subsequent sheet to pass partially thereover for shingling the sheets;

first conveyor means positioned between said cut-off cylinder and said vacuum tail grabber cylinder for advancing the sheets from said cut-off cylinder to said vacuum tail grabber assembly and for advancing the head end of each sheet over the tail end of the preceding sheet;

second conveyor means positioned after said vacuum tail grabber cylinder for advancing the shingled sheets away from said sheeter; and

at least one elongated air bar positioned above said second conveyor means for directing a stream of air over the individual sheets in a direction substantially parallel to the web travel path for controlling and maintaining the forward motion of the sheet until the tail grabber engages the tail of the sheet.

19. A sheeter as set forth in claim 18, said vacuum tail grabber cylinder including:

an inner, stationary, vacuum tube having a vacuum port connected with a vacuum source, and

an outer vacuum cylinder mounted for rotation about said inner vacuum tube, said outer vacuum cylinder including an outer circumferential surface and at least one radially extending vacuum port extending between the outer circumferential surface and said inner vacuum tube that momentarily aligns with the vacuum port on the inner vacuum tube during rotation of said outer vacuum cylinder for momentarily transferring vacuum pressure to its outer circumferential surface for grabbing the tail end of one of the sheets as it passes thereby.

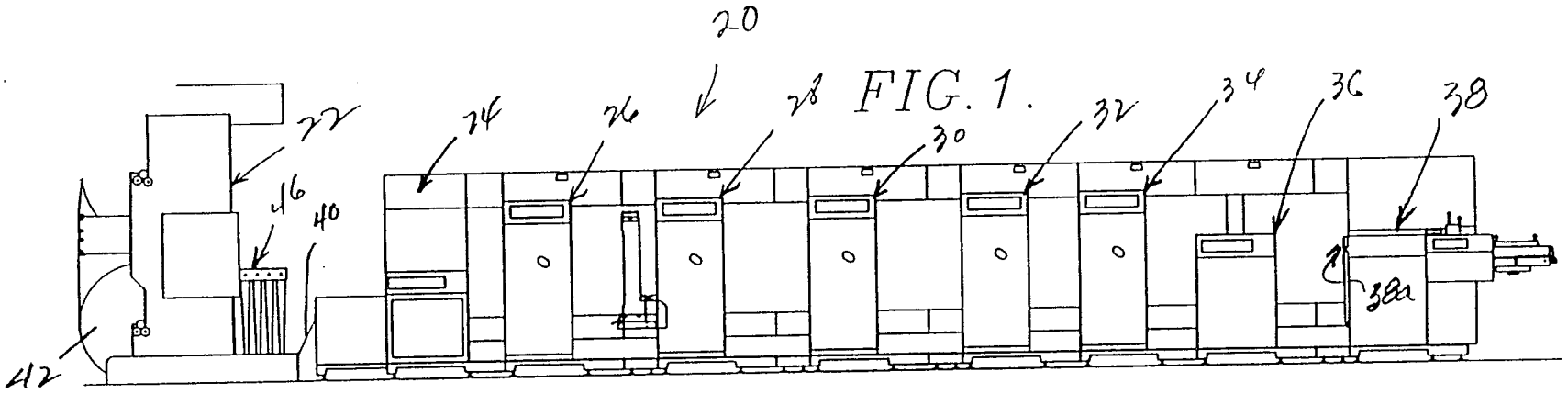

FIG. 1.

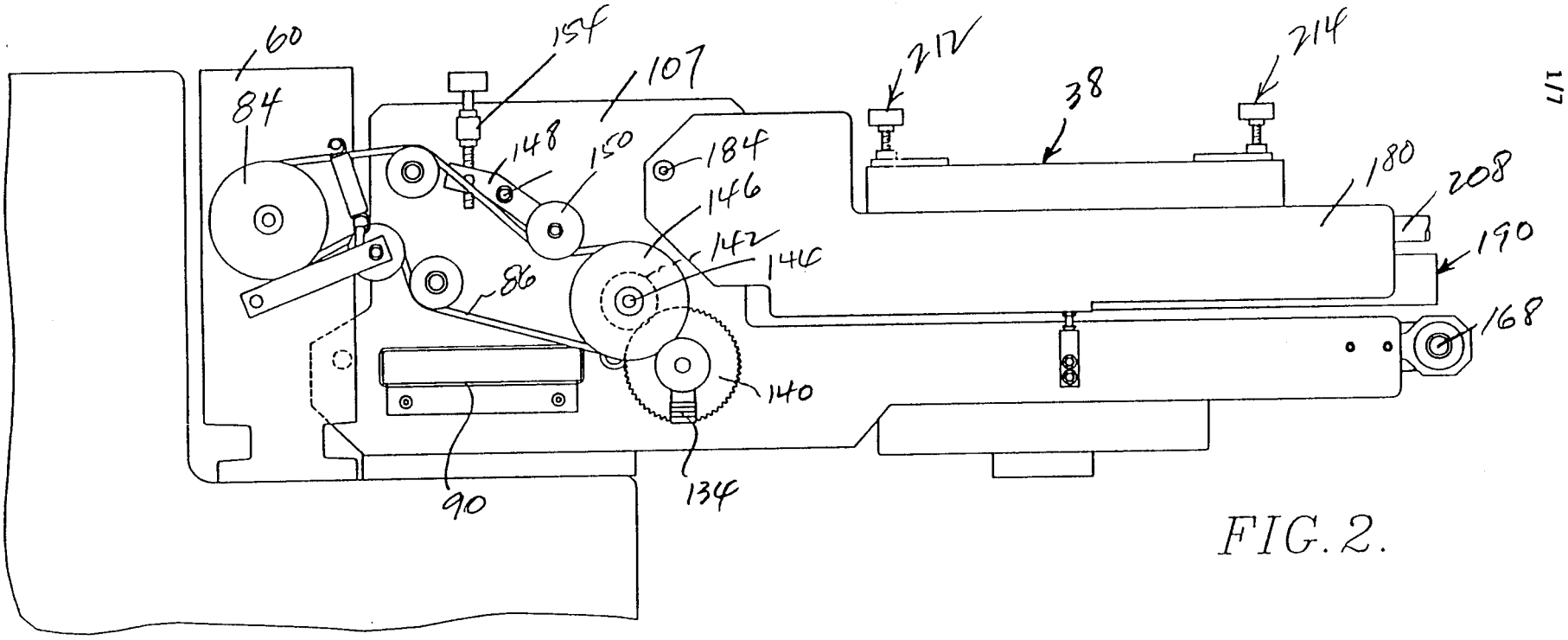

FIG. 2.

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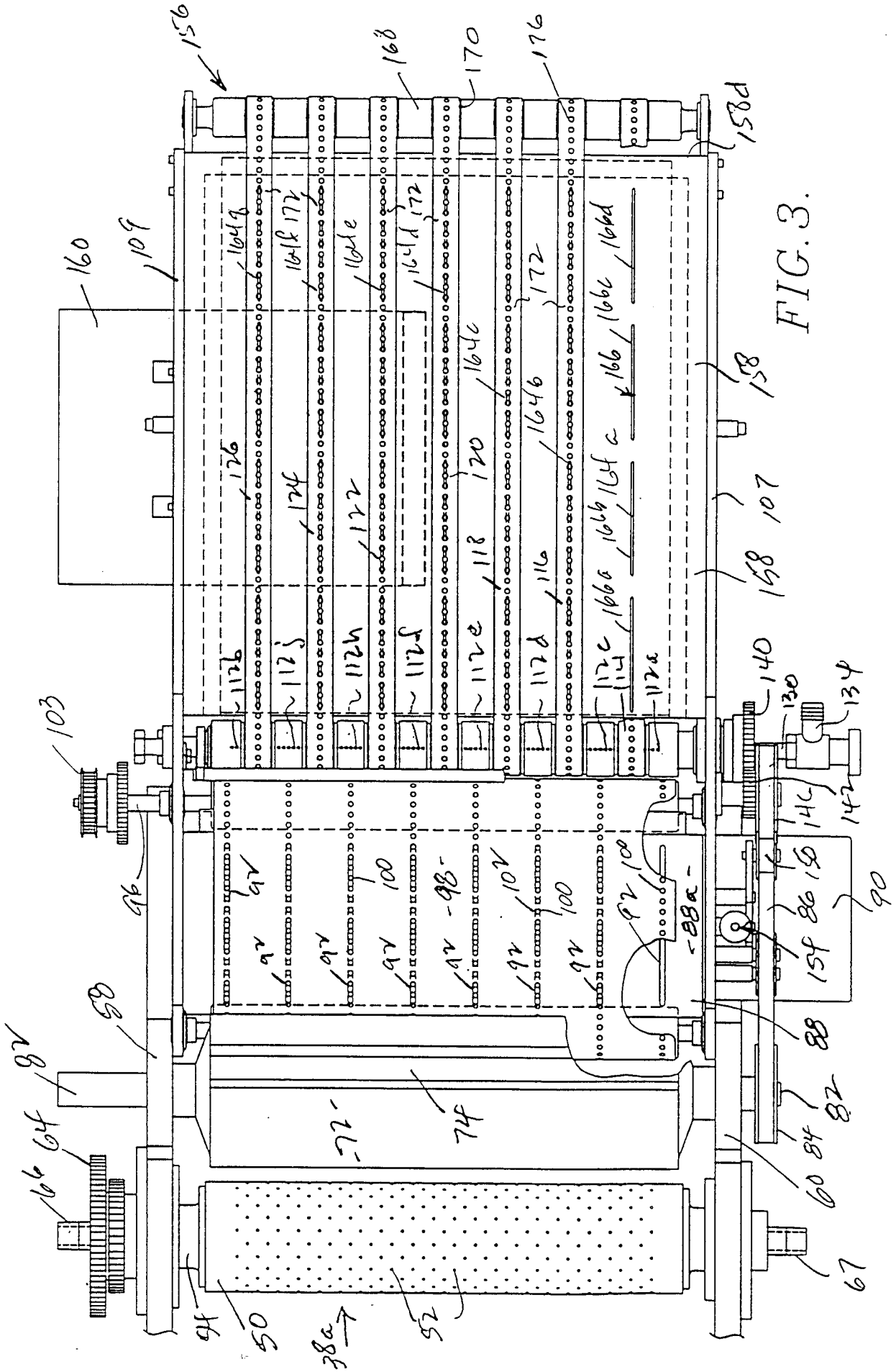

FIG. 3.

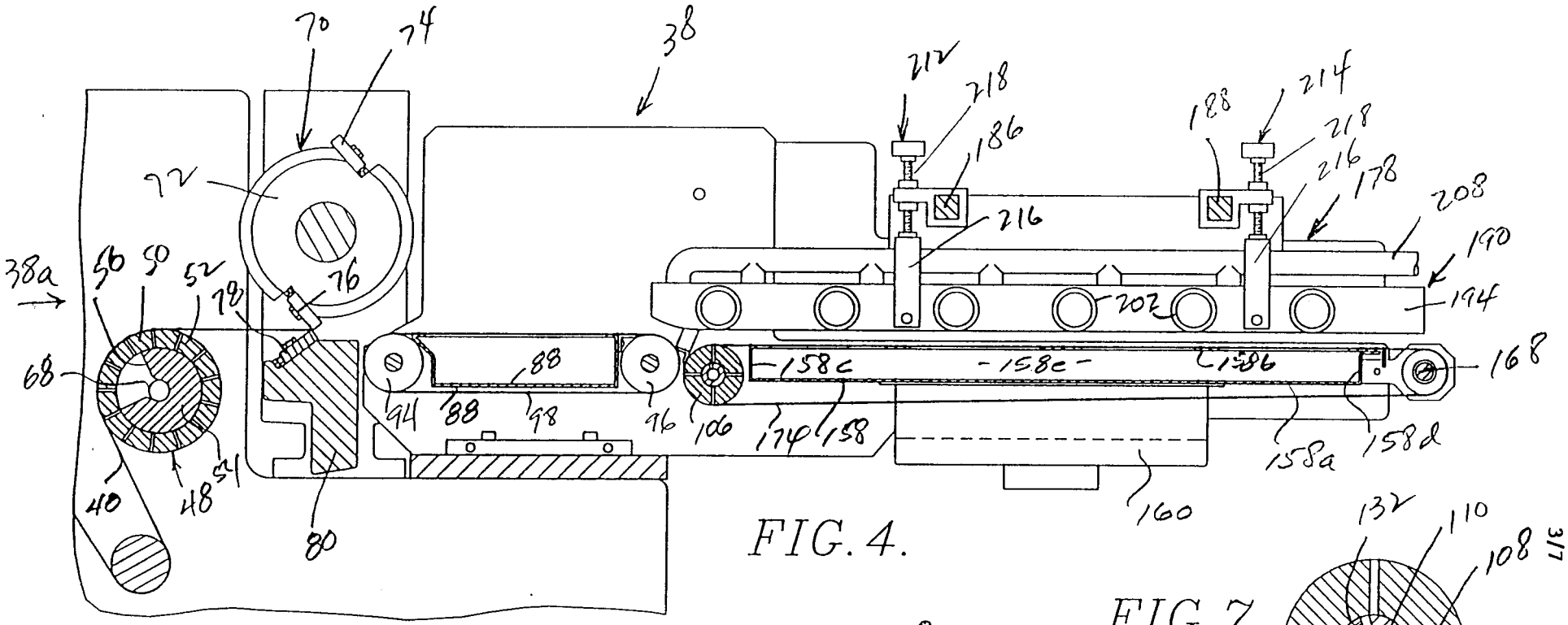

FIG. 4.

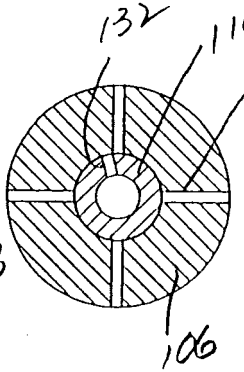

FIG. 7.

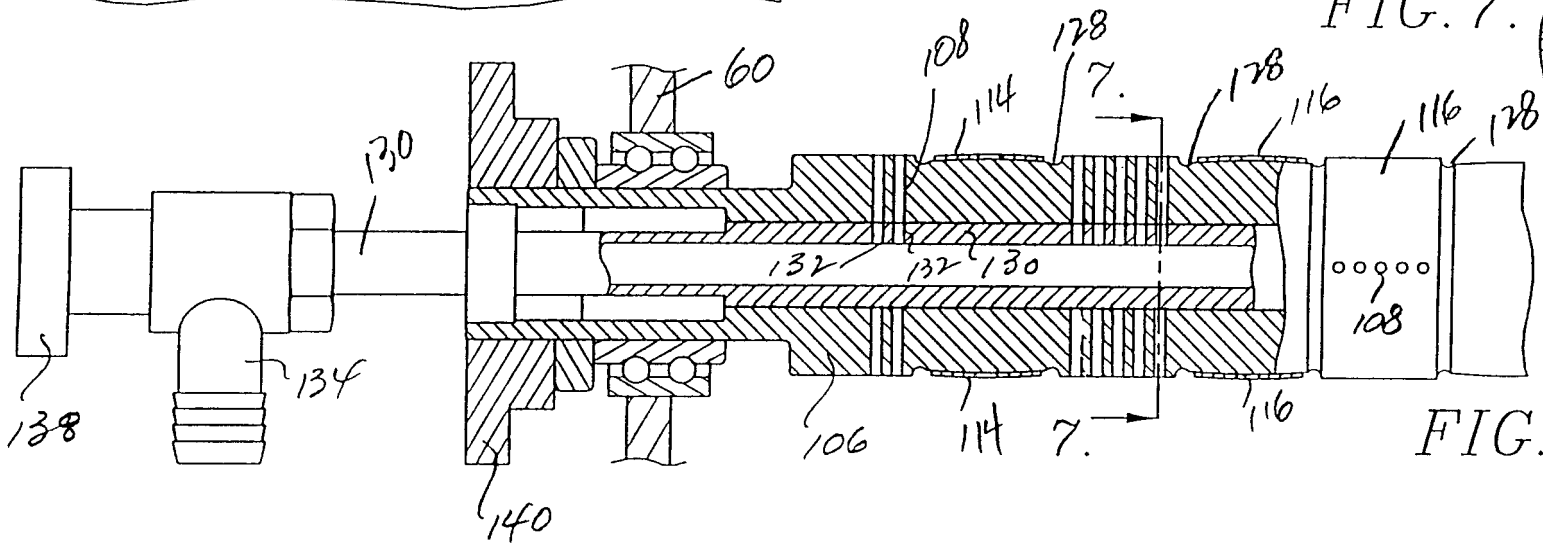

FIG. 6.

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FIG. 5.

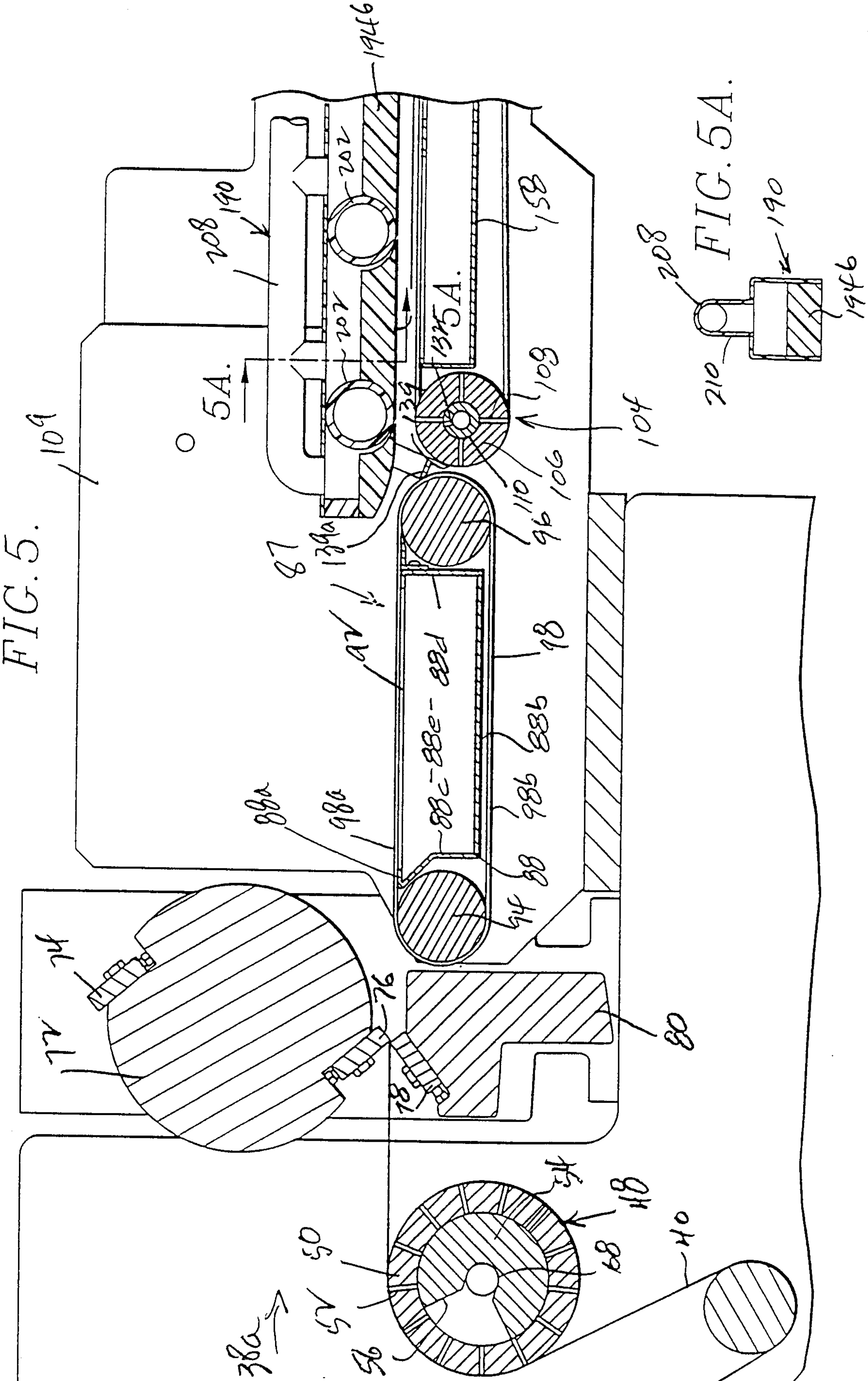

5A.
5A.
109
190
208
202
138
104
106
110
108
96
98
88
88a
88b
98a
98b
94
80
76
78
72
74
48
68
40
50
52
56
38a
194b
210

FIG. 5A.

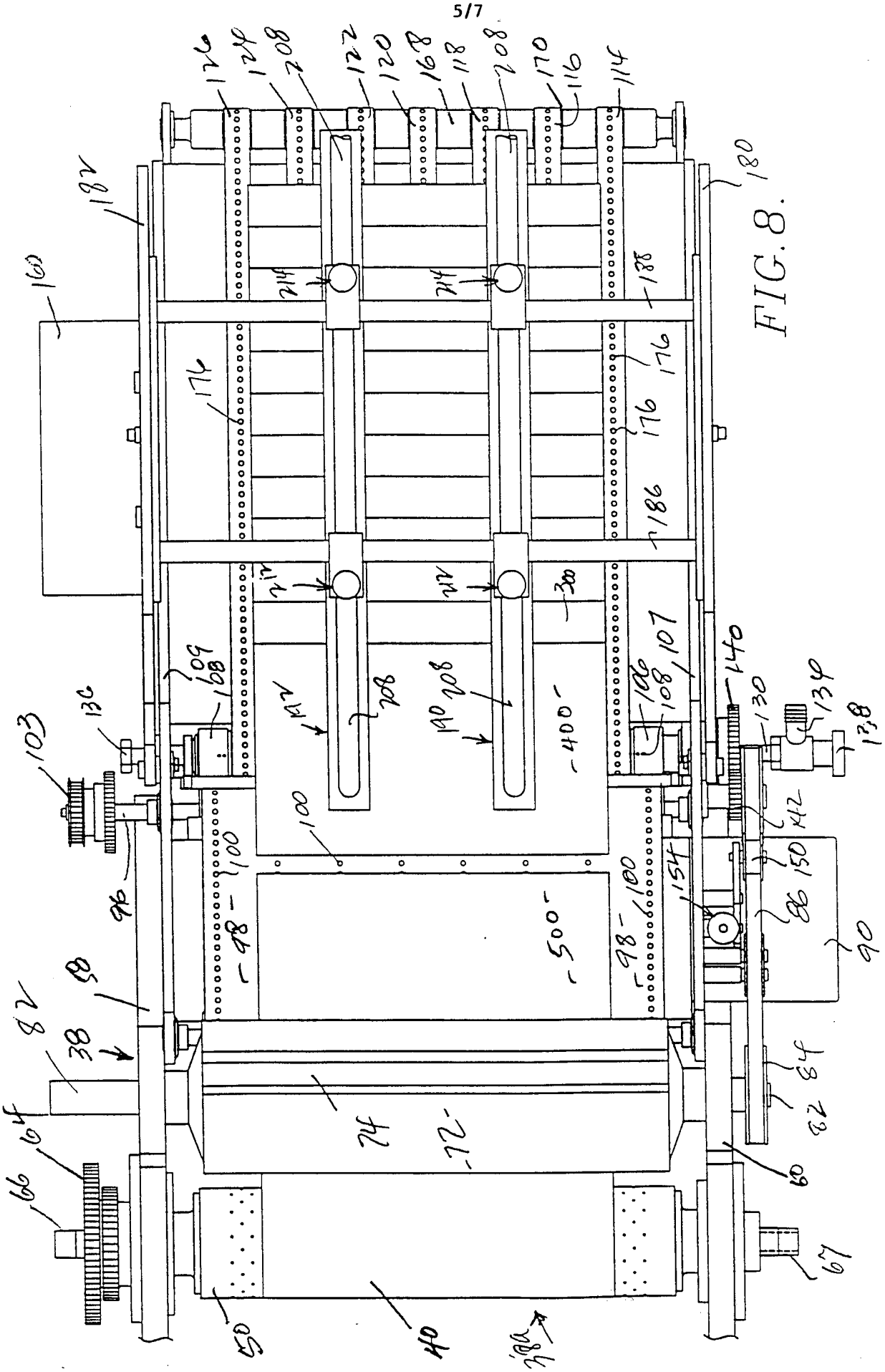


FIG. 8.

FIG. 9.

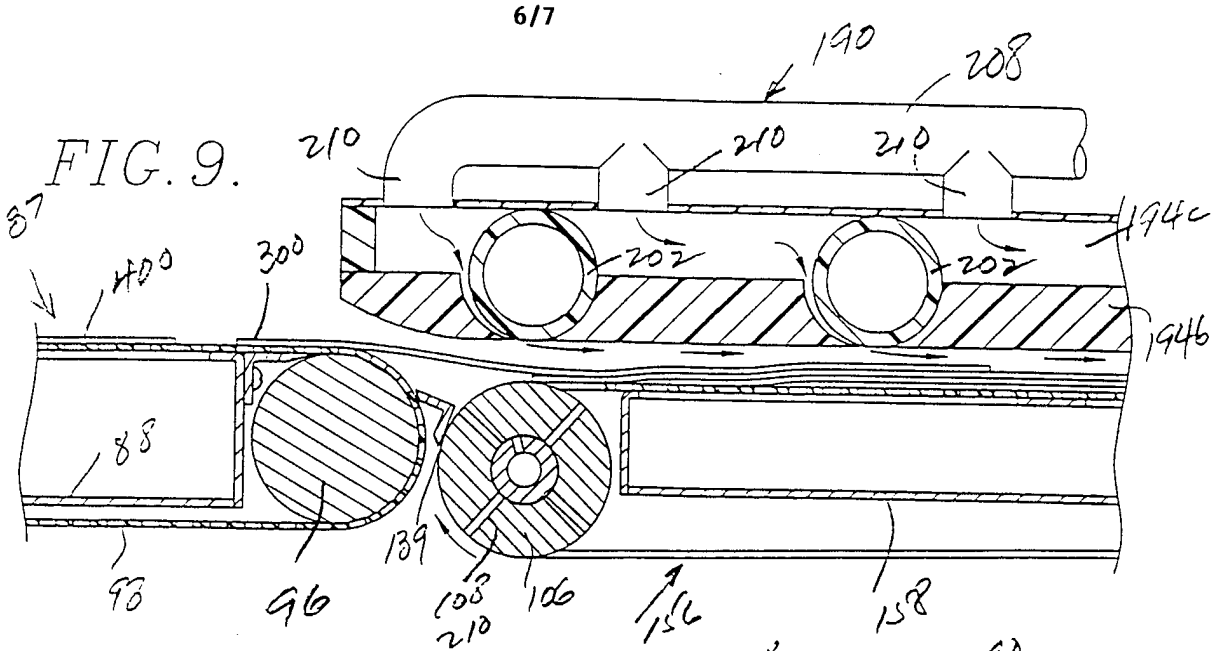


FIG. 10.

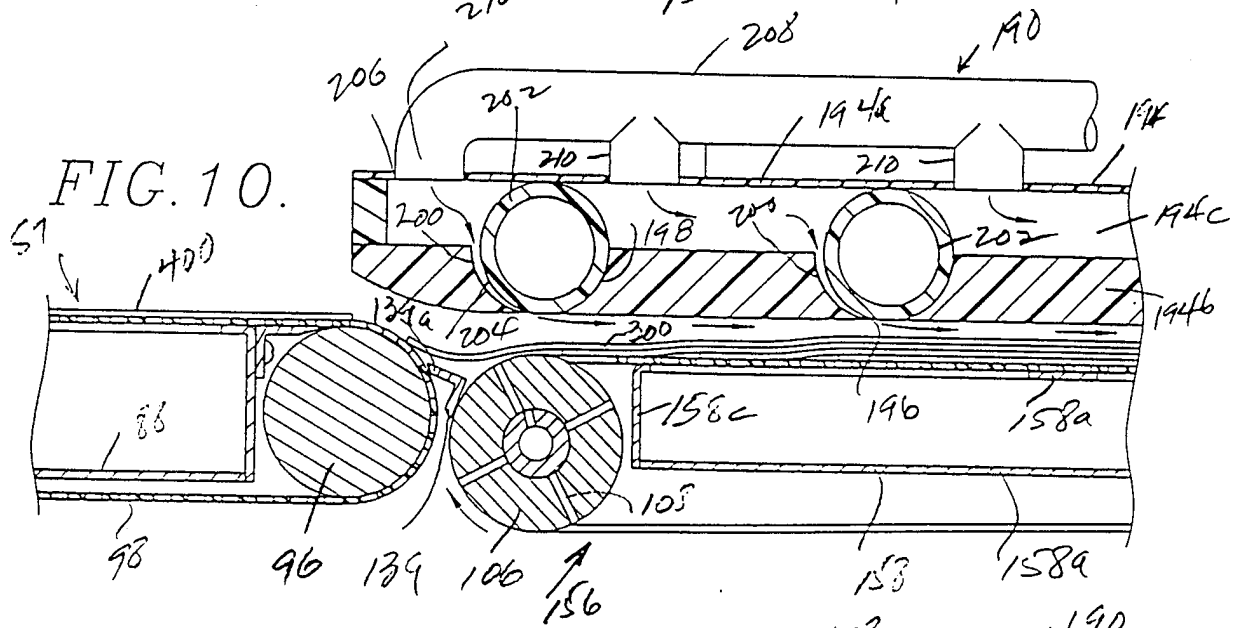
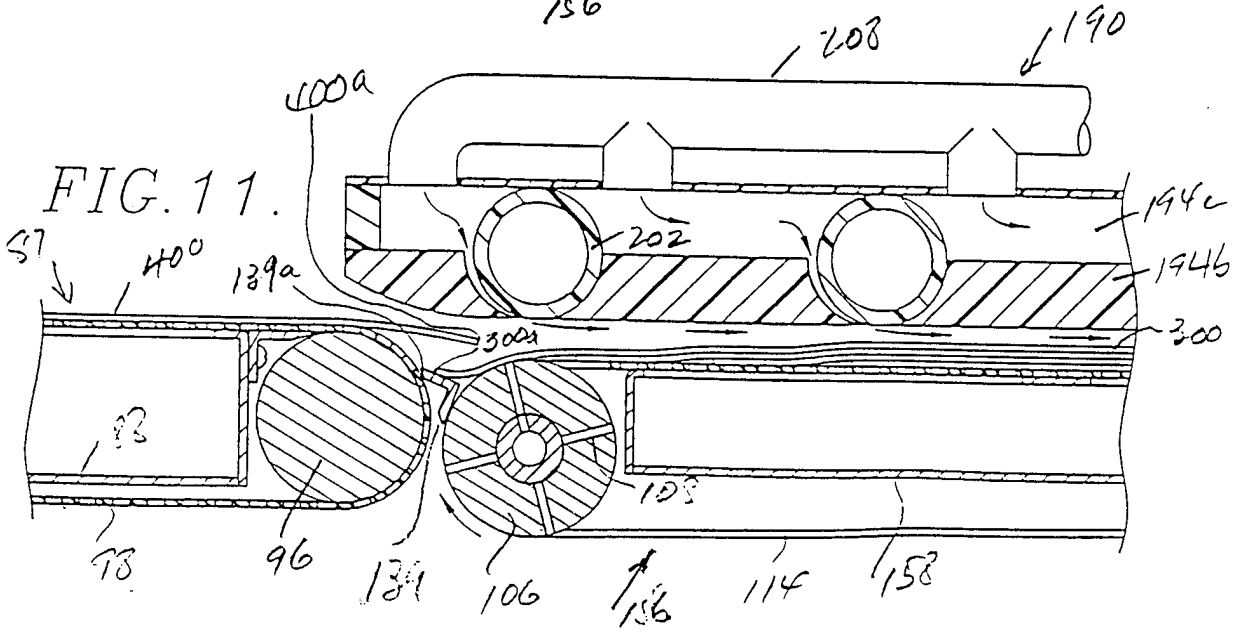


FIG. 11.



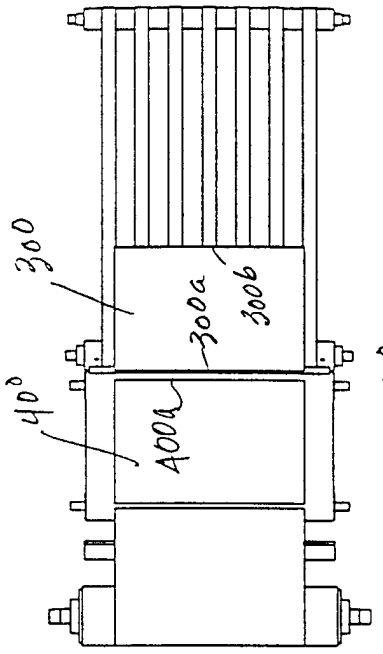


FIG. 12.

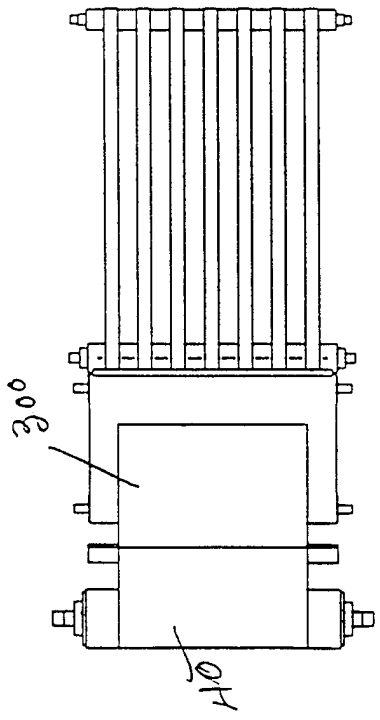


FIG. 15.

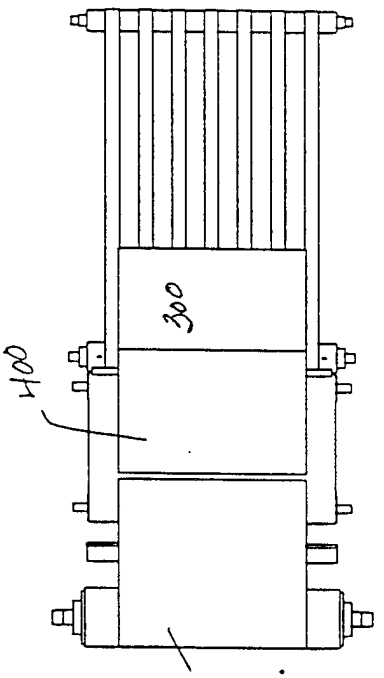


FIG. 13.

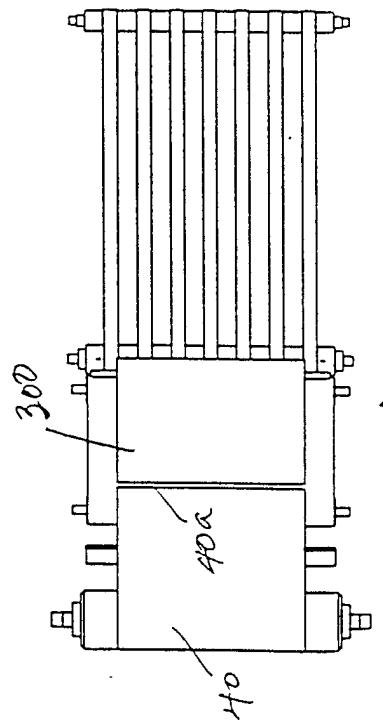


FIG. 16.

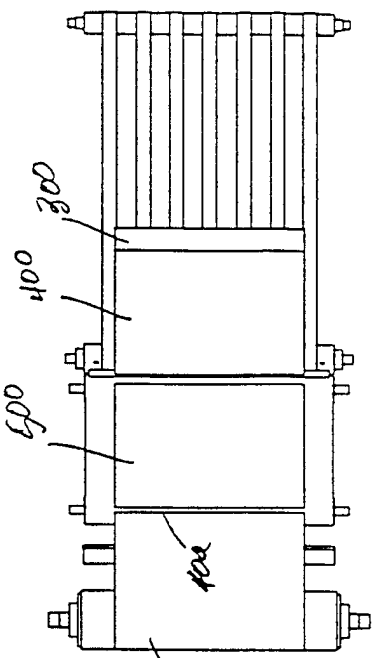


FIG. 14.

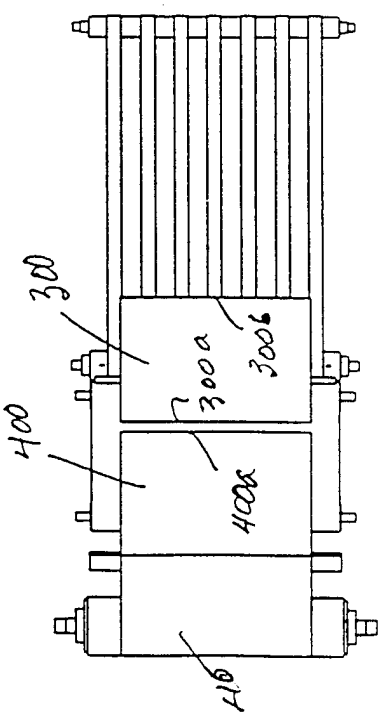


FIG. 17.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/03073

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :B65H 29/16, 29/24, 29/66; B26D 1/62
US CL :83/88, 98, 152, 154, 155, 349; 271/69, 197
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 83/24, 88, 98, 152, 154, 155, 331, 343, 349; 271/69, 182, 183, 196, 197, 202, 203, 216

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

None

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

None

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,667,953 A (HIRAKAWA et al.) 26 May 1987, see Fig. 1.	1, 2
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A		3-19
A	US 2,261,972 A (MATTHEWS) 11 November 1941, see Fig. 1.	1-19
A	US 2,632,510 A (DOPPLEB) 24 March 1953, see Fig. 2.	1-19
A	US 3,198,046 A (DE ANGELO) 03 August 1965, see Fig. 2.	1-19
A	US 3,595,564 A (DE YOUNG) 27 July 1971, see Fig. 1.	1-19
A	US 3,889,801 A (BOYER) 17 June 1975, see Fig. 1.	1-19

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search
02 JUNE 1998

Date of mailing of the international search report
23 JUN 1998

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For CLARK F. DEXTER
Sheila Veney
Paralegal Specialist
Group 3200/3700
Telephone No. (703) 308-1404

Form PCT/ISA/210 (second sheet)(July 1992)★

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/03073

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,114,355 A (DAVIES et al.) 19 September 1978, see Fig. 1.	1-19
A	US 4,200,016 A (HELMIG et al.) 29 April 1980, see Fig. 3.	1-19
A	US 5,193,423 A (BAKKER) 16 March 1993, see Fig. 1.	1-19

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/03073

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Please See Extra Sheet.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING
This ISA found multiple inventions as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group I, claims 1-4, 16 and 17, drawn to a sheeter having specific sheet shingling means combined with a specific cutting means.
Group II, claims 1-3, 5-8, 16 and 17, drawn to a sheeter having specific sheet shingling means including a specific vacuum tail grabber.
Group III, claims 1, 2 and 9-13, drawn to a sheeter having specific conveyor means.
Group IV, claims 1, 14 and 15, drawn to a sheeter having a specific cutting means combined with a vacuum drum means.
Group V, claims 18 and 19, drawn to a sheeter having a specific cutting means combined with a specific vacuum tail grabber.

The inventions listed as Groups I-V do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The inventions are distinct, each from the other because of the following reasons:

Inventions of groups I and II are separate inventions. They are distinct because the invention of group I does not require the specific technical feature of the means for intermittently inducing vacuum of group II for patentability as evidenced by the omission thereof from group I, and the invention of group II does not require the special technical feature of the rotatable cylinder and cutter blade of group I for patentability as evidenced by the omission thereof from group II.

Inventions of groups I and III are separate inventions. They are distinct because the invention of group I does not require the special technical feature of the first belt means of group III for patentability as evidenced by the omission thereof from group I, and the invention of group III does not require the special technical feature of the rotatable cylinder means and cutter blade of group I for patentability as evidenced by the omission thereof from group III.

Inventions of groups I and IV are separate inventions. They are distinct because the invention of group I does not require the special technical feature of the vacuum drum means of group IV for patentability as evidenced by the omission thereof from group I, and the invention of group IV does not require the special technical feature of the first conveyor means of group I for patentability as evidenced by the omission thereof from group IV.

Inventions of groups I and V are separate inventions. They are distinct because the invention of group I does not require the special technical feature of the means for intermittently inducing vacuum of group V for patentability as evidenced by the omission thereof from group I, and the invention of group V does not require the special technical feature of the means engageable with the tail portion of group I for patentability as evidenced by the omission thereof from group V.

Inventions of groups II and III are separate inventions. They are distinct because the invention of group II does not require the special technical feature of the first belt means of group III for patentability as evidenced by the omission thereof from group II, and the invention of group III does not require the special technical feature of the means for intermittently inducing a vacuum of group II for patentability as evidenced by the omission thereof from group III.

Inventions of groups II and IV are separate inventions. They are distinct because the invention of group II does not require the special technical feature of the vacuum drum means of group IV for patentability as evidenced by the omission thereof from group II, and the invention of group IV does not require the special technical feature of the means for intermittently inducing a vacuum of group II for patentability as evidenced by the omission thereof from group IV.

Inventions of groups II and V are separate inventions. They are distinct because the invention of group II does not require the special technical of the rotatable cylinder and cutter blade of group V for patentability as evidenced by the omission thereof from group II, and the invention of group V does not require the special technical feature of the means engageable with the tail portion of group II for patentability as evidenced by the omission thereof from group V.

Inventions of groups III and IV are separate inventions. They are distinct because the invention of group III does not require the special technical feature of the vacuum drum means of group IV for patentability as evidenced by the omission thereof from group III, and the invention of group IV does not require the special technical feature of the first belt means of group III for patentability as evidenced by the omission thereof from group IV.

Inventions of groups III and V are separate inventions. They are distinct because the invention of group III does not require the special technical feature of the rotatable cylinder and cutter blade of group V for patentability as

evidenced by the omission thereof from group III, and the invention of group V does not require the special technical feature of the first belt means of group III for patentability as evidenced by the omission thereof from group V.

Inventions of groups IV and V are separate inventions. They are distinct because the invention of group IV does not require the special technical feature of the elongate air bar of group V for patentability as evidenced by the omission thereof from group IV, and the invention of group V does not require the special technical feature of the vacuum drum means of group IV for patentability as evidenced by the omission thereof from group V.