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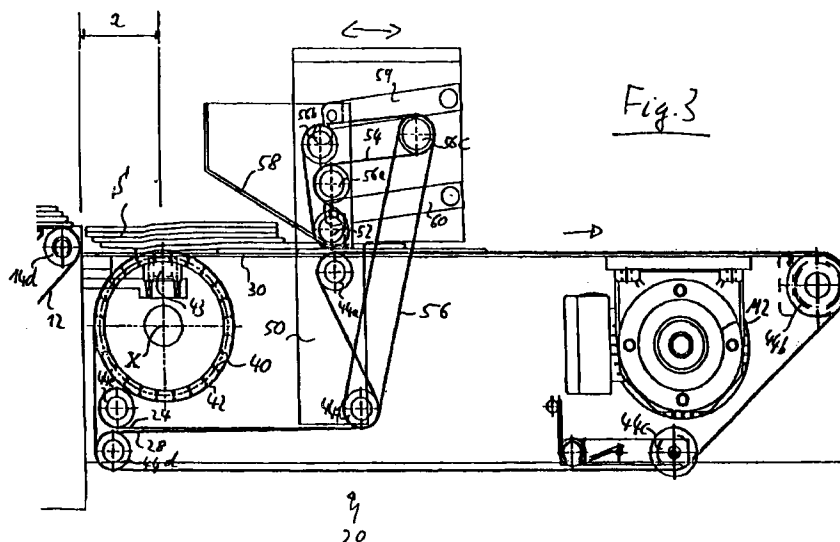
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**(54) Apparatus for forming a stream of uniformly overlapped printed products**

(57) A conveying apparatus has a receiving surface for a stack of printed products lying above one another, with a conveying device adjoining the receiving surface. A vacuum roll rotatable in the conveying direction can act by means of a reduced pressure on the lower side of the printed product in order to produce the desired overlap. The upper tangential plane of the vacuum roll thereby forms a part of the receiving surface. The apparatus herein generates a stream of overlapping signatures with the overlap between adjacent signatures in the stream being uniform. Such uniform overlap generally corresponds to the distance from the upstream end of the receiving surface or signature support portion of the apparatus to the vacuum roll, and more specifically to the upstream edge of a transverse manifold slot pro-

vided in the roll. Overlapped signatures are fed by the roll to a downstream nip and blower assembly for being pulled through the nip thereof. The nip is shiftably mounted so as to adjust the size of nip space during running of the apparatus to accommodate for changing thickness of the signature material drawn through the self-adjusting nip at any one time, such as due to varying numbers of signatures being in the nip space or when thicker folded over spines are therein. The precise location at which air from the blowers is directed back upstream against the signatures can be fine tuned and preset as determined by the thickness of the signatures to be run.



EP 0 857 674 A2

## Description

### Field of the Invention

The present invention relates to an apparatus for the production of a flow of printed products lying on top of one another with a uniform overlap. Such conveyor devices are fundamentally known and make it possible to clock printed products into an overlapping flow in which the individual printed products have a uniform overlap.

### Description of the Prior Art

An apparatus of this kind is shown in US-PS 4,771,896, wherein, for the production of the overlap, a belt conveyor equipped with holes is provided, which acts at the lower side of a printed product in order to produce the desired overlap.

### Objects of the Invention

It is an object of the present invention to provide an apparatus which generates a flow of printed products lying on top of one another and having a uniform overlap, with it being possible to set the overlap in a simple manner.

It is a further object of the present invention to provide an apparatus which produces a uniform overlapping flow and which can be adapted in simple manner to different product lengths.

Another object of the invention is to form a stream of overlapping printed products of signatures that is transferred onto a conveyor in a smooth manner with a uniform overlap between adjacent printed products. An additional object is to provide an apparatus that can be readily adjusted for running signatures of different thicknesses thereon.

### Summary of the Invention

This object is satisfied by an apparatus with the features of Claim 1.

In accordance with the invention a vacuum roll rotatable in the conveying direction is provided which engages by means of a reduced pressure on the underside of a printed product in order to produce the desired overlap relative to the preceding printed product. The upper tangential plane of the vacuum roll thereby forms a part of the receiving surface.

Through the apparatus of the invention the desired overlap can be varied in a simple manner in that the spacing which lies between the center point of the vacuum roll and the upstream start of the receiving surface is varied. For this purpose it is neither necessary to change the position of the vacuum roll nor to exchange the belt conveyors or the like.

Advantageous embodiments of the invention are

described in the description, the drawings and the subordinate claims.

In accordance with a first advantageous embodiment the vacuum roll has a circumferential region which is not provided with suction openings, with a conveyor belt of the belt conveyor being guided around this circumferential region. In this embodiment the vacuum roll is driven in synchronism with the belt conveyor. However, a coupling only takes place between the printed product and the roll, not, however, between the printed product and the conveyor belts of the belt conveyor. At the same time, conventional conveyor belts without suction openings can be used in this embodiment, which enables cost favorable manufacture.

In a further development of the invention the radius of the vacuum roll is as large as possible and corresponds, for example, substantially to the overlap. In this way it is ensured that that region of the vacuum roll which forms a part of the receiving surface has the smallest possible curvature in order to ensure a uniform transport of the printed products.

The vacuum roll can have many suction openings along its circumference, with a plurality of suction openings preferably being provided within a circumferential section corresponding to the overlap. In this embodiment the printed products are sucked on particularly well by the vacuum roll since the printed product adheres to a plurality of suction openings during its transport by the vacuum roll.

A vacuum shoe which provides a strip-like vacuum region which extends transversely to the conveying direction can be arranged within the suction roll at its upper side. In this way it is ensured that only a relatively narrow permanent vacuum region is provided - as seen in the conveying direction - and extends transverse to the conveying direction and thereby prevents the printed products to be conveyed from running askew.

A contact pressure roll can be provided above the belt conveyor and downstream of the vacuum roll and presses against a counter-pressure roller arranged beneath the belt conveyor. In this respect it is particularly advantageous when an upper belt conveyor driven by the belt conveyor is guided around the contact pressure roll, since in this case the printed products which already overlie one another in an overlapping manner are pressed and conveyed by two synchronously running belt conveyors.

In accordance with a further embodiment of the invention a guide funnel which extends at an acute angle to the plane of the belt conveyor can be arranged downstream of the vacuum roll. A guide funnel of this kind extending at an acute angle evens out the printed products which are still lying on one another in the stacked shape.

A passage opening for the product stream can be formed between the end of the guide funnel and the belt conveyor, and it is particularly advantageous when the upper contact pressure roll is arranged in the region of

this passage opening.

It is particularly advantageous when the guide funnel is mounted on a holder which is displaceable in the conveying direction. In this way the apparatus of the invention can be adapted in a simple manner to different product lengths in that the holder is respectively adjusted in or opposite to the conveying direction. The contact pressure roll and the counter-pressure roll are preferably secured to the holder since this can then be displaced simultaneously with the guide funnel.

In accordance with a further advantageous embodiment of the invention two deflection rollers, about which the conveyor belts of the belt conveyor are guided in S-shaped manner, are mounted on the holder. In this embodiment the holder can also be displaced in the conveying direction without the conveying belts having to be reset.

Finally, in accordance with a further embodiment of the invention, a conveying device can be provided upstream of the vacuum roll which guides the products onto the contact surface. A conveying device of this kind can be an inclined plane, a further conveying band or the like.

In one form of the invention, the vacuum roll has circumferentially spaced rows of axially aligned apertures for applying suction through the apertures to the printed product thereon with the rows having a predetermined circumferential spacing therebetween that is less than the predetermined overlap distance between adjacent printed products in the stream.

In another form of the invention, an apparatus is provided for moving products, such as folded over signatures with a spine at the fold, from upstream to downstream so that adjacent signatures are in overlapping relation to each other. The apparatus includes a frame, and a conveyor associated with the frame on which the signatures are supported for travel in the downstream travel direction. A vacuum mechanism applies suction to the signatures and feeds them downstream so that the signatures have a predetermined uniform overlap with respect to each other. A nip assembly including a nip is downstream of the vacuum mechanism for receiving the overlapping signatures from the vacuum mechanism and pulling them therethrough. The nip shifts relative to the frame as the apparatus is running to accommodate changing thicknesses of the signatures being pulled through the nip such as due to the overlap of the signatures and when the thicker folded-over spines of the signatures are in the nip so as to smoothly draw the stream of signatures therethrough for travel downstream on the conveyor. The shifting nip of the present invention thus is effective to keep the stream of signatures flowing therethrough without being adversely affected by the changing thicknesses of the material being pulled through the nip such as when two or more signatures are in the nip versus when a single signature is in the nip or when the thicker, folded-over spines of the signatures are traveling through the nip.

In a preferred form, the nip assembly includes an upper and lower roller with the lower roller being fixed relative to the frame when the apparatus is running and the upper roll being shiftably mounted relative to the frame for shifting when the apparatus is running so that the weight of the upper roller rests on the lower roller to form a self-adjusting nip space between the rollers as signatures are pulled therethrough with the upper roller shifting to change the size of the nip space as the apparatus is running to accommodate different thicknesses of the signatures pulled through the nip space.

Another aspect of the invention is a nip and blower assembly for a vacuum document feeder with the assembly being downstream of the vacuum mechanism and including a nip for pulling signatures from the vacuum mechanism therethrough, air blowers for directing thin streams of air upstream against the documents fed downstream to the nip by the vacuum mechanism, and an adjustable connection between the nip and air blowers to adjust the location at which air is blown against the signatures for different thicknesses of signatures. The air blowers are important to keep the overlap between adjacent signatures uniform as they come off the vacuum mechanism and to keep the flow smooth through the nip as the air streams provide air lubrication between the signatures to limit frictional movement of signatures on top of a signature gripped to the vacuum mechanism and to keep the leading edges of the signatures down so that they do not curl up before entering the nip. Depending on the thickness of the signatures being run on the feeder, the precise location at which the air hits the signatures is important to ensure smooth operation thereof. The adjustable connection provided herein allows for fine tuning of the air stream directed at and between the signatures so as to accommodate for the different thicknesses of signatures that are to be run on the feeder.

Preferably, the adjustable connection includes inner and outer frame portions with the outer portion having the air blowers mounted thereto and the inner portion having one of the nip blowers rotatably mounted thereto. An adjusting member interconnecting the outer and inner frame portions is provided and is operable to adjust the position of the frame portions with respect to each other to adjust the location of the blown air which respect to the nip.

### **Brief Description of the Figures**

The present invention will be described purely by way of example in the following with reference to an advantageous embodiment and with reference to the accompanying drawings. They show:

- FIG. 1 a plan view of an apparatus in accordance with the invention,
- FIG. 2 a side view of FIG. 1,
- FIG. 3 an enlarged section of the side view of FIG.

2,

FIG. 4 is a perspective view of another version of an apparatus in accordance with the present invention with the frame thereof removed for clarity to show the belting and vacuum roller of the apparatus;

FIG. 5 is a schematic side elevation view of the apparatus of FIG. 4;

FIG. 6 is an enlarged perspective view of a nip and blower assembly of the apparatus of FIG. 4 including a holder and a pivot linkage for a self-adjusting nip of the assembly;

FIG. 7 is a side elevational view showing a signature supporting portion of the table of the apparatus immediately upstream from the vacuum roller with the nip assembly including the nip thereof downstream of the vacuum roller;

FIG. 8 is a schematic view of the path of an inner pair of belts of the belting of the apparatus around the various belt rollers and vacuum roller;

FIG. 9 is a schematic view showing the path of an outer pair of belts of the belting of the apparatus around the various belt rollers;

FIG. 10 is a plan view partially in section of the vacuum roller assembly including an apertured cylindrical roller and a vacuum manifold fixed inside the roller for applying suction force through the apertures of the roller;

FIG. 11 is a plan view of the vacuum roller assembly showing the circumferential grooves in the cylindrical roller for receiving the pair of inner belts therein;

FIG. 12 is a side sectional view of the vacuum roller assembly showing the top of the cylindrical roller projecting slightly above the table surface of the apparatus frame;

FIG. 13 is a front elevation view of a frame assembly of the nip blower assembly including an adjustment mechanism for varying the position of the blowers relative to the nip;

FIG. 14 is a side elevation view of the nip and blower frame assembly showing an inclined guide plate at the bottom thereof spaced upstream from the nip;

FIG. 15 is a plan view of the apparatus with the nip and blower assembly removed for clarity and showing shim rails provided on the table on which signatures ride from the vacuum roller to the nip; and

FIG. 16 is a perspective view of the signature supporting portion of the frame upstream from the vacuum roller and showing a strap for keeping the leading edges of the documents from curling and friction brushes to engage the underside of signatures.

#### **Detailed Description of the Preferred Embodiments**

The apparatus shown in the Figures for producing a flow of printed products with uniform overlap has a first

conveying device 10 and a second conveying device 20, which are arranged behind one another in the conveying direction. The first conveying device 10 has an endless recirculating belt conveyor 12 which is guided around a plurality of deflection rollers 14a to 14e.

As FIG. 1 shows, the belt conveyor 12 consists of a total of seven conveying belts which are arranged parallel to and alongside one another. FIG. 2 shows that a total of three conveyor sections of different gradients which reduce in the conveying direction are provided between the deflection rollers 14a, 14b, 14c and 14d. At the start of the conveyor path of the first conveyor 10, i.e. in the region of the deflection roller 14a, a shaft 16 is provided, which is not shown in more detail, in which the printed products are supplied to the belt conveyor 12 in stack-like manner. Individual stacks S consisting of a plurality of printed products lying on top of one another are formed by a separating device 18, which is likewise not shown in more detail. It is also possible to form an overlapping arrangement of printed products by the separating device 18. However, this overlapping arrangement is not yet regular and is relatively thick.

As FIG. 3 shows, a receiving surface 30 directly adjoins the first conveying device 10 and is vertically offset downwardly relative to the conveying plane of the first conveyor device 10. The receiving surface 30 serves to receive the printed products which still lie above one another with an irregular overlap. Beneath the receiving surface 30 there is arranged a vacuum roll 40, the upper tangential plane of which forms a part of the receiving surface 30. For this purpose a cut-out 32 (FIG. 1) is provided in the receiving surface 30 extending transverse to the conveying direction, through which the outer periphery of the vacuum roll 40 projects into the conveying plane.

The belt conveyor of the second conveying device 20 furthermore has two inner conveyor belts 22, 24 and two outer conveyor belts 26, 28, which are shown obliquely hatched in the plan view in FIG. 1. The two inner conveyor belts 22 and 24 are first guided around the vacuum roll 40 in an angular range of more than 270° and are then deflected by a deflection roller 44e, a deflection roller 44f and a deflection roller 44a, until the conveyor belts dip again into the conveying plane in the region of the deflection roller 44a.

The conveyor belts 22, 24 and 26, 28 extend in parallel in the conveying plane from the deflection roller 44a up to the downstream deflection roller 44b. The two outer conveyor belts 26, 28 are likewise deflected around the deflection roller 44a, at which they pass into the conveying plane again. From there, the conveying belts 26, 28 extend up to the downstream deflection roller 44b, from there to the deflection roller 44c, and further on to the deflection rollers 44d and 44f. The drive for all the conveyor belts 22 to 28 takes place via a second motor M2.

As FIG. 3 shows, the deflection rollers 44a and 44f are mounted on a holder 50, which also extends above

the conveying stream. The holder 50 is displaceable forwardly and rearwardly and has, above the conveying plane, a contact pressure roll 52 which is arranged substantially above the deflection roller 44a. An upper conveyor belt 54 which is driven via an auxiliary belt 56 from the deflection roller 44f is guided around the contact pressure roll 52. The upper conveyor belt 54 is thereby guided around the three further deflection rollers 56a, 56b and 56c, which are all secured to the holder 50.

A guide funnel 58 is secured to the upstream side of the holder 50 and extends at an acute angle to the conveying plane. A passage opening for the product stream is formed between the upstream end of the guide funnel and the upper apex point of the deflection roller 44a. An air nozzle arrangement can be provided in the region of this passage opening and generate an air flow against the conveying direction in order to reduce the friction between two printed products lying on one another. The unit consisting of the guide funnel 58 and the deflection rollers 52, 56a and 56b secured to the holder 50 is secured to pivot arms 59, 60 and can thus be displaced vertically upwardly or downwardly or rests with its weight on a product flow passing through beneath it.

As FIG. 3 shows in more detail, the vacuum roll 40 has a plurality of suction openings 42 distributed over its circumference. In this respect two circumferential regions free of suction openings 42 are provided at the outer periphery of the suction roll 40 and the conveyor belt 22 and the conveyor belt 24 are respectively guided around them (see FIG. 1). A vacuum shoe 43 is arranged within the suction roll 40 at its upper side and provides a relatively narrow permanent vacuum region, in which in each case two suction openings 42 come to lie during a rotation of the vacuum roll 40 about its axis X. Thus a strip-like vacuum region extending transverse to the conveying direction is provided as seen over the width of the printed products to be conveyed.

In the following the manner of operation of the apparatus illustrated in FIGS. 1 to 3 will be described.

In the region of the first conveying device 10 the printed products are distributed from the shaft 16 manually or by a separating device 18 onto the belt conveyor 12, with a thick and irregular overlapping arrangement being formed. The speed of the belt conveyor 12 is thereby controlled by a sensor attached to the motor M1, which detects the height of the stack S present on the receiving surface 30.

On the transition from the first conveying device 10 to the second conveying device 20, a product stack S falls from the belt conveyor 12 onto the receiving surface 30. There, the lowermost product is engaged by the suction roll 40 in that vacuum acts through the vacuum shoe 43 and the suction openings 42 located above it on the underside of a printed product. As the vacuum roll 40 rotates in the conveying direction, the printed product sticking to it is moved in the conveying direction until the trailing end of the printed product has released from the vacuum roll 40. Thus the size of the

overlap (or simply the overlap) is formed by the distance between the axis of rotation X of the vacuum roll 40 and the upstream start of the receiving surface 30. The overlap "a" can thus be set by lengthening the receiving surface 30 in the direction of its upstream end.

As soon as the leading edge of a printed product conveyed by the vacuum roll 40 has reached the region between the contact pressure roll 52 and the counter-pressure roll 44a, it is engaged between the upper recirculating belt conveyor 54 and the lower recirculating conveyor belts 22 to 28 and conveyed in the conveying direction.

The guide funnel 58 extending above the receiving surface 30 also contributes to distributing the printed products lying on top of one another in a stack S into a shallow and uniform overlapping formation. At the same time, an air nozzle which reduces the friction between the printed products can be arranged at the upstream end of the guide funnel 58.

As FIG. 3 shows well, the desired overlap a, which corresponds to the distance between the axis of rotation X of the vacuum roll and the upstream end of the receiving surface 30, can easily be changed by extending the receiving surface 30 opposite to the conveying direction. Since the vacuum roll 40 sucks on a new overlying product at the trailing end of each printed product and moves it on further in the conveying direction, a uniform overlap a is produced. Moreover, tilting or the like cannot arise, since in the region of the receiving surface 30 there is only the vacuum roll 40 but not, however, the conveyor belts 22 to 28 which drive the overlapping flow. I.e. the vacuum roll 40 only "sticks" the individual printed products to itself and not, however, to the conveyor belts, which do not therefore have to have any suction openings.

On conveying printed products with another product length, it is only necessary to adjust the holder 50 correspondingly in or contrary to the direction of conveying, and no further adaptations or settings are required as a result of the construction selected. In particular it is not necessary to swap or adjust any conveying belts.

FIGS. 4-16 are directed to an alternate feeder apparatus 100 which will next be described. The feeder apparatus 100 is similar to the apparatus of FIGS. 1-3 in that it utilizes a vacuum mechanism, generally designated 102, for taking printed products or signatures from a product or signature supporting portion 104 of the table 105 of the apparatus 100 and feeding them in overlapping relation to a nip and blower assembly, generally designated 106, downstream from the vacuum mechanism 102 and product supporting portion 104. As in the previously-described apparatus, the feeder apparatus 100 is effective to produce a stream of signatures which have a uniform overlap with the overlap corresponding to the distance between the upstream edge 104a and the product supporting portion 104 and the vacuum mechanism 102, as will be more fully described hereinafter. In addition, the nip and blower assembly

106 includes a holder 108 which is releasably clamped to the table 105 by clamps 109 to allow the entire assembly 106 to be repositioned along the frame 110 of the apparatus 100 so that the precise distance between the nip 112 of the nip and blower assembly 106 and the vacuum mechanism 102 can be coordinated to the length of the signatures as measured in the travel direction to be run on the feeder apparatus 100.

The vacuum mechanism 102, similar to the apparatus of FIGS. 1-3 is preferably a vacuum roller assembly 114 including an open-ended cylindrical roller 116 having rows of apertures 118 extending axially thereon with the rows of apertures 118 being circumferentially spaced along the cylindrical roller 116, as seen in FIGS. 10-12. The roller 116 is mounted on shaft 118 which is journaled for rotation at either end thereof to the side of apparatus frame 110. The vacuum manifold 120 is mounted through the open end of the cylindrical roller 116 in its interior in substantially fixed position therein by mounting bar 122 fastened to mounting block 124 fixed to the underside of the frame table 105, as shown in FIG. 12.

The vacuum manifold 120 includes an upper curved surface 126 having a radius of curvature substantially matching that of the roller cylindrical wall 116. The manifold upper surface 126 has a lateral slot 128 so that when the manifold 120 is mounted in the interior of the cylinder 116, the manifold slot 128 extends transverse to the travel direction of the signatures in the apparatus 100. The vacuum manifold 120 is spring biased as by spring 130 so that the manifold curved surface 126 is urged into substantially flush engagement with the inner curved surface 116a of the roller cylindrical wall 116. The vacuum roller wall 116 can be of a nickel plated steel material polished to a smooth finish with the vacuum manifold 120 being a low friction plastic such as Delrin or Teflon so as to minimize the wear due to friction generated at the interface of the manifold curved surface 126 with the inner polished surface 116a of the vacuum cylindrical wall 116.

The vacuum roller 116 is rotatably driven in the same fashion as the previously described vacuum roller 40. Accordingly, the cylindrical roller 116 includes circumferential grooves 130a and 130b in which belts 132 are trained. More specifically, the belts 132 include a pair of inner belts 132a and 132b and a pair of outer belts 132c and 132d with the inner pair of belts 132a and 132b being disposed in the recessed grooves 130a and 130b of the vacuum roll, as can be seen in FIG. 4. The belts 132a-d also serve as a conveyor for the stream of signatures as they exit the nip 112 forming a belt conveyor portion 133 downstream of the nip 112. The conveyor portion 133 includes four longitudinally extending cutout slots 135 formed in the table 105 in which the upper flights of the belts 132 forming the conveyor portion 133 run.

FIGS. 8 and 9 schematically illustrate the manner in which the belts 132 travel about the various rollers of the

feeder apparatus 100 with FIG. 8 illustrating the path of travel of the inner pair of belts 132a and 132b and FIG. 9 illustrating the path of travel of the outer belts 132c and 132d. As shown, the feeder apparatus 100 has several belt roller shafts about which belts rollers 132 are trained. It should be noted that the various roller shafts described herein are generally machined with enlarged cylindrical portions about which the belts are trained for rotating the shafts. Accordingly, for the majority of their length, the shafts have a smaller diameter than at the location of the enlarged portions for the belts. Herein, when the term roller or roller shaft is used to describe the travel of the belts therearound, it will be understood that these terms refer to the larger diameter roller portions of the shafts that have the belts thereon.

Referring to FIG. 8, the inner pair of belts 132a and 132b extend around the cylindrical vacuum roller 116 in the grooves 130 thereof for approximately 270° so that they enter the grooves 130 on the upstream side of the roller 116 and come off the roller 116 at the bottom thereof moving in an upstream direction to a belt roller 134e substantially aligned with the upstream edge of the vacuum roller 116. The belts 132a and 132b extend 180° around the roller 134e so as to move back downstream to belt roller 134f which is rotatably mounted to the bottom of the lower portion 108a of the holder 108 which projects below the apparatus table 105, as will be more fully described hereinafter. The belts 132a and 132b extend around the bottom of the belt roller 134f and back upstream to belt roller 134a also rotatably mounted on the holder lower portion 108a above and slightly upstream from the belt roller 134f. The belts 132a and 132b extend around the front upstream side of the belt roller 134a and move back downstream to roller 134b in the table slots 135 so that as the belts 132a and 132b travel between the rollers 134a and 134b they cooperate to form the inner part of the conveyor section 133, as previously discussed. The belts 132a and 132b move around the top of roller 134b and come off of the roller 134b at its downstream side for travel back upstream to the roller 134c, which is positioned below and upstream from roller 134b. Belts 132a and 132b travel around downstream side of the roller 134c and come off at the bottom thereof and move upstream to roller 134d which is below roller 134e slightly displaced upstream therefrom. The belts 132a and 132b move around the bottom of the roller 134d and come off the upstream side thereof for travel to the vacuum roller 116 where they enter into the grooves 130 thereof, as previously described. Accordingly, the inner pair of belts 132a and 132b form an endless path around the belt rollers 134a-e and around the vacuum roller 116 to drive it for rotation. Motor 136 positioned below the table 105 is operable to drive the belts 132 about the rollers 134.

Similar to the inner pair of belts 132a and 132b, the outer pair of belts 132c and 132d are driven in an endless path, as shown in FIG. 9. However, the outer pair of

belts 132c and 132d do not serve to drive the vacuum roller 116 for rotation. Instead of being trained around the roller 116, the belts 132c and 132d travel around the upstream side of the roller 134d and move back downstream directly to roller 134f bypassing the vacuum roller 116 and the roller 134e therebelow. The belts 132c and 132d travel around the roller 134f up to the roller 134a, downstream to the roller 134b and down to the rollers 134c and 134d, similar to the inner pair of belts 132a and 132b. Accordingly, the belts 132c and 132d travel in parallel relation in table slots 135 on the outside of the inner pair of belts 132a and 132b between the rollers 134a and 134b to cooperate with the inner pair of belts 132a and 132b to form the conveyor section 133.

In the vacuum feeder apparatus 100, the vacuum roller 116 is mounted so that it projects slightly above the table 105 through a transverse cut-out-slot 137 formed therein, as best seen in FIG. 16. In this manner, the crown of the curved exterior surface 116b of the cylindrical roller wall 116 will be slightly above the table 105 as the roller 116 is rotatably driven by the belts 132a and 132b. By way of example and not limitation, the cylindrical roller 116 can have one inch thick wall with a 16 inch outer diameter and a 15 inch inner diameter with the axis of the shaft 118 being spaced below the table 105 somewhat less than 8 inches so that the roller exterior surface 116b projects above the table 105 through the slot 137, such as by approximately 3 mm. Thus, when the signatures exit the hopper area 138 upstream of the product supporting portion 104 of the table 105, the bottommost signature will lie on the roller exterior surface 116b. Laterally spaced guides plates 140 can be provided on the sides of the product support portion 104 extending in the travel direction and perpendicular up from the table 105 so as to keep the signatures from becoming skewed with respect to the travel direction as they are feed onto the table support portion 104 from the hopper 138. The guide plates 140 can be adjusted to accommodate different widths of signatures.

In the preferred form with a 16 inch outer diameter vacuum roller 116, the rows of apertures 118 in the cylindrical roller 116 are each circumferentially spaced 18 or 19 mm from adjacent rows about the exterior surface 116b with the vacuum manifold slot 108 having a width of approximately 20 mm. In this manner, there will always be at least one row of apertures 118 aligned over the manifold slot 108 for always applying suction through the apertures to draw the bottommost signature into engagement with the exterior surface 116b of the roller 116. Because of the closer spacing of the aperture rows relative to the width of the slot 128, at certain times there will be two rows of apertures 118 aligned with the vacuum slot 108, as can be seen in FIG. 12.

In operation, the vacuum roller assembly 114 will drive the lowermost signature in the downstream direction gripping the signature at various positions therealong until its trailing portion moves past the vacuum

slot opening 108. At that point, the leading portion of the signature will be gripped in the nip 112 for being affirmatively pulled therethrough. The signature immediately above the lower most signature will be masked from the vacuum coming from the manifold slot 128 through the apertures 118 until the trailing portion of the upper most signature travels past the leading or upstream edge 128a of the manifold slot 128 and a row of apertures 118 comes into vertical alignment therewith. Once this occurs, the signature above the lowermost signature will be gripped on to the roller 116 for being driven downstream thereby. Thus, the overlap of the signatures produced by the vacuum feeder apparatus 100 herein corresponds to the distance between the upstream end 104a of the product supporting portion 104 and the upstream side or edge 128a of the vacuum manifold slot 128. As is apparent, this overlap distance will generally be preset in the machine 100 and will always be much larger than the relatively small spacing between the rows of apertures 118 in the vacuum roller. It should also be noted that similar to the apparatus of FIGS. 1-3, because the belts 132a and 132b are trained in recessed grooves 130 of the vacuum roller 116, when the signatures are drawn into engagement therewith, they will engage the roller exterior surface 116b and not the belts 132a and 132b.

As described earlier, after signatures have been gripped by the vacuum roller 116 for producing the uniform overlap between adjacent signatures, the signatures are fed to the nip 112 for being pulled therethrough and onto conveyor section 133 downstream thereof for smoothly forming a stream of uniformly overlapped signatures. The nip 112 is formed in the nip and blower assembly 106 which is of slightly different construction with respect to the previously-described apparatus of FIGS. 1-3.

As previously mentioned, the nip and blower assembly 106 includes the holder 108 having a top 142 which extends across and over the machine table 105 with depending sides 144 which extend down towards the frame table 105 and therebelow for rotatably mounting the roller shafts 134a and 134f thereto between the opposite lower portions 108a of the holder 108 below the table, one such holder side 108a being shown in FIGS. 8 and 9. Rigidly extending between the holder sides 144 above the table 105 are upper and lower link mounting rods 146 and a rotatable roller shaft 148, as best seen in FIG. 6. The roller shaft 148 is for an upper belting system 150 for the nip and blower assembly 106, as shown partially in ghost in FIG. 7. The roller shaft 148 is driven for rotation by an auxiliary belt 152 which is trained around roller shaft 134f below the table 105. Rotation of the roller shaft 148 drives a pair of belts 153a and 153b of the nip and blower assembly belt system 150. In this manner, the belts 153a and 153b are driven in a synchronous fashion with the belts 132.

The belts 153 are trained about various upper rollers 154 journaled for rotation in a frame assembly 156

therefor. The roller shaft 148 is driven in a counter-clockwise direction as viewed in FIG. 7 by the auxiliary belt 152 so that the pairs of belts 153a and 153b trained around the roller shaft 148 will be fed into engagement with bottom of the roller shaft 148 and move around its downstream side and come off at the top thereof in the upstream direction to roller shaft 154a. The belts 153 travel along the top of the roller shaft 154a and down its upstream side where they come off and move to the upstream side of the roller shaft 154b. The belts 152 travel around the upstream side the roller shaft 154b along its bottom in the nip 112 and around the downstream side of the roller shaft 154b where it is directed back upstream to the upstream side of roller shaft 154c. Thus, the belts 152 travel substantially 270° around the roller shaft 154b. The belts 152 travel along the upstream side of the roller 154c and come off the top thereof in the downstream direction back to the roller shaft 148 to form an endless path for the upper belting system 150 of the nip and blower assembly 106.

The frame assembly 156 for the roller shafts 154a-c is pivotally connected to the holder 128 by way of the rods 126a and 126b which pivotally mount pivot links 158a and 158b which are, in turn, pivotally attached to the frame assembly 156, as best seen in FIGS. 6 and 7. Thus, before the feeder apparatus 100 is running, the pivot linkage formed between the holder 108 and the frame assembly 156 allows the frame assembly 156 including the roller shafts 154 thereof to have its weight freely resting on the roller 134a therebelow so that the enlarged portions of the roller shafts 154b and 134a, including the respective belts 153 and 132, form the nip 112 therebetween with the respective belts 152 and 132 moving in the downstream direction in the nip area 112 when the machine 100 is run.

When the machine 100 is running, the pivot linkage allows for shifting of the nip 112, and particularly upper roller shaft 154b thereof so as to change the size of the nip space 112 thus accommodating for the changing thicknesses of the signatures being pulled through the nip 112 such as due to the overlap of the signatures, and if the signatures are folded over, the thicker spines at the folded over portions of these signatures. Thus, depending on the length of the signatures in the travel direction and the overlap provided between adjacent signatures, the thickness of the conveyed material in the nip 112 can vary at any particular time depending on if there is one, two or three, etc. signatures passing through the nip 112. In addition, the thicker spines of folded over signatures will change the thickness of the material in the nip 112. The shifting of the frame assembly 156 including the roller shaft 154b up and down during running of the apparatus 100 to accommodate changing thicknesses of material passing through the nip 112, provides the nip 112 with a self-adjusting feature that allows for smoother running of the apparatus 100 herein. In this manner, if the signature thickness increases during running of the apparatus 100 such as

due to the aforementioned reasons, the nip roller shaft 154b can shift upwardly so as to increase the space in the nip 112 as the thicker material is drawn therethrough so as to minimize destruction of signatures as by crumpling and stoppages of production runs precipitated thereby which could occur if the nip 112 did not self-adjust. Conversely, when the thickness decreases, the nip 112 shifts down so that the roller shaft 154b and its belts 153a and 153b still firmly press the signatures against the roller shaft 134a and its belts 132a and 132b to ensure a smooth flow of uniformly overlapping signatures exiting from the nip 112 to the conveyor section 133 of the apparatus 100 herein.

Another important feature of the present feeder apparatus 100 is the construction of the frame assembly 156 of the nip and blower assembly 106. As mentioned with respect to the apparatus of FIGS. 1-3, blowers 160 can be provided on either side of the nip 112 for lessening the friction between signatures and to keep the signature immediately above the signature clutched to and driven by the vacuum roller 116 from being pulled by frictional forces therewith until that signature is drawn by suction into engagement with the roller 116. In this regard, the frame assembly 156 has an adjustable connection 162 between the nip 112 and blowers 160 to allow for the streams of air blown towards the signature to be adjusted so that they are maintained at a consistent location relative to the signatures for different thicknesses of signatures. More specifically, the frame assembly 166 is formed by an outer frame portion 164 and an inner frame portion 166 with the outer frame portion 164 having the air blowers 160 and the inner frame portion 156 rotatably carrying the roller shafts 154. An adjustment member 168 interconnects the outer and inner frame portions 164 and 166, as best seen in FIGS. 13 and 14. Operation of the adjustment member 168 varies the relative position between the inner and outer frame portions 164 and 166 thus adjusting the positions of the blowers 160 with the roller shaft 154b resting on roller shaft 134a therebelow. In this manner, the adjustable connection 162 allows fine tuning as to exactly where the air will hit relative to the signatures so that this location can be preset and maintained at the proper point for a specific thickness of signatures to be run.

Preferably, the outer and inner frame portions 164 and 166 have flat bottom inverted U-shapes with the inner frame portion 166 nested within the outer frame portion 164. The outer frame portion 164 includes laterally spaced side members 170 interconnected by an upper cross member 172. The inner frame portion 166 is similarly formed and includes laterally spaced guide plates 174 interconnected by a lower cross member 176 with the lateral spacing between the side plates 174 substantially corresponding to the distance between the inner surfaces of the side members 170 of the outer frame portion 164 so that the respective side members 170 and plates 174 are in sliding engagement with each other. The adjustment member 168 preferably is an

adjustment screw 178 having a shank 180 and a top knob 182 with the shank being threaded through the upper cross member 172 of the outer frame portion 164 and fixed longitudinally with respect to the lower cross member 176 are being rotatable relative thereto. Accordingly, turning of the adjustment screw knob 182 rotates the shank 180 so as to either increase or decrease the space 184 between the upper and lower cross members 172 and 176. The side plates 174 include guide pins 181 received in corresponding guide slots 183 of the side members 170 to guide sliding movement of the side members 170 along the plates 174. In addition, shoulder bolts 176 extend between the cross members 172 and 176 through the space 184 therebetween to assist in keeping the alignment between the inner and outer portions 164 and 166.

The side members 170 each having air passageways 186 formed therein. Foot portions 185 of the side members 170 each have a forward section 185a that projects upstream and a rearward section 185b that projects downstream with passageways 186 formed in both the upstream and downstream projecting sections 185a and 185b, as best seen in FIG. 14. An inclined surface 192 extends from the upstream sections 185a to the respective downstream sections 185b of the side member foot portions 185. A plate 194 having air-nozzle openings 196 formed along either side thereof is attached to the foot portion 185 at respective short vertical walls 198 of foot upstream sections 185a above the inclined surface 192. The nozzle openings 196 serve to direct thin streams of pressurized air, e.g., 1½ to 1 mm thick, back upstream toward signatures. More particularly, the sides of the plate 194 extending over the inclined surfaces 192 have downwardly directing nozzle openings 196a which assist in keeping the leading edges of the signatures from curling up, especially as they hit the signature guide 200 which serves to direct signatures towards the nip 12 formed between the rollers 134a and 154b, as will be described in more detail hereinafter. The plate 194 includes a flat section that fits against the bottom flat surface 202 of the foot rear or downstream section 185b and has a front nozzle opening 196b for directing a flat horizontal stream of air between adjacent signatures to lessen the friction therebetween so that premature movement of signatures that are not gripped to the vacuum roller 116 is minimized. Pressurized air is supplied to the passageways 186 by air hook-ups attached to the top of the foot front section 195a and the back of the foot rear section 195b with the front hook up 204 and corresponding air lines 206 being shown in FIG. 6.

Continuing reference to FIG. 6, it can be seen that the foot portions 185 of the side members 170 are interconnected by front portion 208 including the vertical surface 198 and guide 200. The guide depends from the bottom of the vertical surface 198 at an incline from upstream to downstream with its incline being slightly less than that of the inclined surface 192, as best seen

in FIGS. 6 and 14. Accordingly, the downstream lower end of the guide 200 terminates approximately level with or slightly above the flat bottom 202 of the side member foot portions 185 and upstream therefrom. The upper nip roller shaft 154b is mounted between the plates 174 so that its bottom is approximately level with the side member flat bottoms 202. This arrangement is maintained during shifting of the frame assembly 156 as the feeder machine 100 herein is run so that roller shaft 154b and the air blowers 160 and guide 200 shift up and down together. Thus, leading edges of signatures that are gripped to the vacuum roller 116 will be guided by the guide 200 downstream with air from the nozzle openings 196a hitting the sides of the signatures to keep them down so that the signatures are substantially level with the nip 212 in proper alignment for being pulled therethrough even as nip 112 shifts during running of the apparatus 100.

The guide 200 preferably has a central lower cutout 210 therein. To further assist in keeping the stream of overlapping signatures down flat on top of each other, an elongate strip 212 preferably formed of spring steel, extends from adjacent the hopper area 138, over the product supporting portion 104 of the table 105 and the vacuum mechanism 102 and through the cut-out 210 in the guide 200 and downstream past the nip 112 in between the enlarged portions of the nip forming roller shafts 154b and 134a. A thumb screw 214 is threaded through fixed block 216 so that the distal end of the screw shank 218 is in engagement with the spring steel strip 212 to adjust the downward tension applied by the strip 212 on the stream of signatures.

As previously mentioned, the vacuum roller 116 projects slightly above the table surface 105. To assist the flow of signatures from the vacuum roller 116 to the nip 112, low profile shims 220 can be attached on the table 105 in the area between the vacuum mechanism 102 and nip 112, as best seen in FIGS. 6, 7, and 15. The upper surfaces of the shims 220 are preferably raised approximately three millimeters over the surface of the table 105 similar to the vacuum roller 116 so as to serve as rails on which the signatures ride downstream from the vacuum mechanism 102. In addition, the enlarged diameter portions of the roller shaft 134a also preferably project approximately 3mm. above the table surface through the slots 135 so that the nip space and the upper flights of the belts 132 in the conveyor section 133 are slightly elevated over the table 105. By keeping the signatures slightly above the table 105 on the raised vacuum roller 116, shims 220 and conveyor 133, frictional drag on the signatures by engagement with the table 105 is substantially obviated producing better results in terms of generating a smooth uniformly overlapping flow or stream of signatures.

As stated above, the signatures are kept slightly over the table surface, e.g. approximately 3 mm, so to reduce the amount of frictional drag thereon as they are fed into the nip 112. The spring steel strap 212 along

with air blown from nozzles 196a ensures that the signatures lie flat and that the leading edges do not curl up such as when hit with the air from the air blown horizontally from nozzles 196b. The signatures are to remain substantially flat at all times during running of the apparatus 100 herein for proper flow characteristics and are not dimpled or bent between shims 220 as they are fed to the nip 112. In addition, brushes 222 are provided in the product support portion 104 of the table 105 with their bristles 222a projecting slightly above the table surface. When the vacuum roller 116 tightly grips a signature thereto, it will be pulled over the brush bristles 222a; however, the bristles 222a will prevent air from the blowers 160 from blowing the signatures back into the hopper area 138.

Returning more specifically to the construction of the nip and blower assembly 106, the pivot links 158 are pivotally attached to the side plates 174 as by shoulder bolts 222 with the other ends of the links 158 pivotally attached on link rods 146. The pivot links 158 can include an upper pair of laterally spaced pivot links 158a and a lower pair of laterally spaced pivot links 158b. Pivot links 158 each have an enlarged end 226 with a through bore 226a extending therethrough. The upper pair of pivot links 158a receive the upper link rod 146a through their bores 226a, and the enlarged ends of the lower pair of pivot links 158b receive the lower link rod 146b therethrough so that the links are capable of pivoting about the rods 146 fixed to the sides 144 of the holder 108. In this manner, the rods 146 serve as a fixed pivot point for the links 158. At the link ends 228 opposite the enlarged ends 226, the pivot links 158 are attached by the shoulder bolts 224 to the side plates 174, as described above. The links 158 are of sufficient length such that the radius of movement of the links 158 is substantially flat at their distal ends 228. With the flat radius, shifting of the inner frame portion 166, and particularly the nip roller shaft 154b thereof is substantially vertical up and down relative to the table surface 105. Thus, as overlapping signatures and spines thereof are drawn through the nip 112, the inner frame portion 166 along with the interconnected outer frame portion 164 can shift upwardly to accommodate for the greater amounts or thicker material being drawn through the nip 112.

An additional advantage of the present apparatus 100 is that the precise location at which the thin air streams from the air blowers 160 hit relative to the signatures can be fine-tuned to the thickness of the signatures that are to be run on the apparatus 100. Thus, if thicker signatures are run, the adjusting screw 178 can be turned to raise the outer frame portion 164 relative to the inner frame portion 166 to increase the space 184 between the respective cross members 172 and 176 thereof so as to correspondingly raise the side members 170 relative to the side plates 174. Such raising of the side members 170 relative to the side plates 174 causes the blowers 160 to be moved higher relative to

the nip roller shaft 154b resting on roller shaft 134a so that the air streams coming from the blowers 160 are adjusted upwardly for the thicker signatures. In this manner, air from the blowers 160, and particularly the horizontal nozzles 196b will hit the right level for providing air lubrication between the thicker signatures while minimizing any curl-up effects caused by such inter-signature horizontal air lubricating stream. On the other hand, if thinner signatures are being run, the adjustment screw 178 can be turned to decrease the space 184 between the cross members 172 and 176 thus lowering the air blowers 160 relative to the nip roller shaft 154b so that the air streams, and particularly the horizontal stream from nozzles 196b hit the signature stream at the proper point to provide air lubrication between the adjacent signatures.

While there have been illustrated and described particular embodiments of the present invention, it will be appreciated that numerous changes and modifications will occur to those skilled in the art, and it is intended in the appended claims to cover all those changes and modifications which fall within the true spirit and scope of the present invention.

## Claims

1. Apparatus for producing a stream of printed products lying on top of one another with a uniform overlap, comprising:
  - a receiving surface (30) for a stack (S) of at least two printed products lying on top of one another;
  - a belt conveyor (22-28) adjoining the receiving surface (30); and
  - a vacuum roll (40) rotatable in the conveying direction which engages by means of a reduced pressure on the underside of a printed product in order to produce the desired overlap (a) relative to the preceding printed product, with the upper tangential plane of the vacuum roll (40) forming a part of the receiving surface (30).
2. Apparatus in accordance with Claim 1, characterized in that the vacuum roll (40) is driven in synchronism with the belt conveyor (22-28).
3. Apparatus in accordance with Claim 1, characterized in that the vacuum roll (40) has a circumferential region free from suction openings (42), about which at least one conveyor belt (22, 24) of the belt conveyor is guided.
4. Apparatus in accordance with Claim 1, characterized in that the radius of the vacuum roll (40) corresponds substantially to the overlap (a).

5. Apparatus in accordance with Claim 1, characterized in that the vacuum roll (40) has a plurality of suction openings (42) along its circumference, with preferably a plurality of suction openings (42) being provided within a peripheral section corresponding to the overlap (a). 5
6. Apparatus in accordance with Claim 1, characterized in that a vacuum shoe (43) is arranged within the suction roll (40) and at its upper side and provides a strip-like vacuum region extending transversely to the conveying direction. 10
7. Apparatus in accordance with Claim 1, characterized in that the receiving surface (30) has an outlet opening (32) extending transversely to the conveying direction for the vacuum roll (40). 15
8. Apparatus in accordance with Claim 1, characterized in that at least one contact pressure roll (52) is provided above the belt conveyor (22-28) and downstream of the vacuum roll (40) and presses against a counter-pressure roller (44a) arranged beneath the belt conveyor (22-28). 20
9. Apparatus in accordance with Claim 8, characterized in that an upper belt conveyor (54) driven by the belt conveyor (22-28) is guided around the contact pressure roll (52). 25
10. Apparatus in accordance with Claim 1, characterized in that a guide funnel (58) is arranged downstream of the vacuum roll (40) and extends at an acute angle to the conveying plane. 30
11. Apparatus in accordance with Claim 10, characterized in that a passage opening for the product flow is formed between the end of the guide funnel (58) and the belt conveyor (22-28). 35
12. Apparatus in accordance with Claim 10, characterized in that the guide funnel (58) is secured on a holder (50) which is displaceable in the conveying direction. 40
13. Apparatus in accordance with Claim 12, characterized in that a contact pressure roll (52) and preferably also a counter-pressure roll (44a) is secured to the holder (50). 45
14. Apparatus in accordance with Claim 12, characterized in that two deflection rollers (44a, 44f), about which a conveyor belt (22, 24, 26, 28) of the belt conveyor is guided in S-shaped manner, are provided on the holder (50). 50
15. Apparatus in accordance with Claim 1, characterized in that a conveyor device (10) is provided upstream of the vacuum roll (40) and guides the products onto the receiving surface (30). 55
16. An apparatus for forming a stream of printed products with adjacent printed products having a uniform overlap between each other in the stream, the apparatus comprising:
  - a conveyor for moving products in a downstream direction;
  - a vacuum mechanism for applying a suction force to printed products to feed them to the conveyor in a stream so that adjacent printed products are in overlapping relation; and
  - a product supporting portion upstream from the vacuum mechanism and in which the conveyor is absent with the products pulled from the supporting portion by the vacuum mechanism for feeding them in the downstream direction towards the conveyor, the product supporting portion having an upstream end that is spaced at a predetermined distance along the product travel direction from the vacuum mechanism and cooperating with the vacuum mechanism to produce a predetermined uniform overlap between adjacent printed products in the stream that substantially corresponds to said predetermined distance.
17. The apparatus of Claim 16 wherein the vacuum mechanism includes an apertured vacuum roll for drawing products into tight engagement therewith and feeding the products downstream to the conveyor as a consequence of rotation of the roll. 30
18. The apparatus of Claim 17 wherein the conveyor comprises belts for moving the products in the downstream direction, and the vacuum roll includes recessed grooves having at least one of the belts therein for rotatably driving the roll without engaging the printed product that is drawn into tight engagement with the roll for feeding it downstream. 35
19. The apparatus of Claim 17 wherein the vacuum roll has circumferentially spaced rows of axially aligned apertures for applying suction through the apertures to the printed product thereon with the rows having a predetermined circumferential spacing therebetween that is less than the predetermined overlap distance between adjacent printed products in the stream. 40
20. The apparatus of Claim 16 including a nip assembly downstream from the vacuum mechanism and having a nip for pulling the printed products there-through onto the conveyor. 45
21. The apparatus of Claim 20 wherein the nip assem-

bly includes a holder which allows for shifting of the nip during running of the apparatus to accommodate varying thicknesses of printed product material drawn therethrough to provide a self-adjusting nip as the apparatus is running.

22. The apparatus of Claim 20 wherein the nip assembly includes a guide having a surface extending at an incline from upstream and above the nip back downstream towards the nip to smoothly guide printed products into the nip without bending or dimpling of the printed products.
23. The apparatus of Claim 20 wherein the nip assembly includes a holder to which the nip is mounted with the holder being movable along the frame for repositioning of the nip so that the distance between the nip and vacuum mechanism can be correlated to the length of the printed products in the travel direction that are to be run on the apparatus.
24. An apparatus for moving products, such as folded over signatures with a spine at the fold, from upstream to downstream so that adjacent signatures are in overlapping relation to each other, the apparatus comprising:
- a frame;
  - a conveyor associated with the frame on which the signatures are supported for travel in the downstream travel direction;
  - a vacuum mechanism to apply suction to the signatures and feed them downstream so that the signatures have a predetermined uniform overlap with respect to each other; and
  - a nip assembly including a nip downstream of the vacuum mechanism for receiving the overlapping signatures from the vacuum mechanism and pulling them therethrough with the nip shifting relative to the frame as the apparatus is running to accommodate changing thicknesses of the signatures being pulled through the nip due to the overlap of the signatures and the thicker spines thereof for smoothly drawing the stream of signatures therethrough for travel downstream on the conveyor.
25. The apparatus of Claim 24 wherein the vacuum mechanism includes an apertured cylindrical roller having axial rows of circumferentially spaced apertures therein, and a vacuum manifold mounted in the roller having a transverse slot therein with an upstream edge and a downstream edge for applying a vacuum through rows of openings as the roller rotates and the rows pass over the upstream edge of the vacuum slot and to the downstream edge thereof; and

a signature support portion of the frame separate from the conveyor with the vacuum roller pulling signatures of from the support portion for feeding downstream in overlapping relation, the support portion having an upstream end spaced from the upstream edge of the vacuum slot by a predetermined distance that equals the predetermined uniform overlap between adjacent overlapping signatures.

26. The apparatus of Claim 24 wherein the nip assembly includes an upper roller and a lower roller with the lower roller being fixed relative to the frame and the upper roller being shiftably mounted relative to the frame so that the weight of the upper roller rests on the lower roller to form a self-adjusting nip space between the rollers as signatures are pulled therethrough with the upper roller shifting to change the size of the nip space as the apparatus is running to accommodate different thicknesses of the signatures pulled through the nip space.
27. The apparatus of Claim 26 including air blowers on either side of the nip for directing air generally in an upstream direction against the flow of signatures coming from the vacuum mechanism to the nip; and an adjustable connection between the blowers and upper roller to allow the relative position between the air blowers and upper roller to be changed to coordinate the location at which the air is blown for different thicknesses of signatures.
28. The apparatus of Claim 24 wherein the nip assembly includes a holder which is movable along the frame to allow the nip assembly to be repositioned relative to the vacuum mechanism and fixed in place so that the distance between the vacuum mechanism and the nip substantially corresponds to the length of the signatures in the travel direction.
29. In a vacuum document feeder having a vacuum mechanism for taking signatures from an upstream location and feeding them downstream, a nip and blower assembly downstream of the vacuum mechanism, the assembly comprising:
- a nip for pulling signatures from the vacuum mechanism therethrough;
  - air blowers for directing thin streams of air upstream against the documents fed downstream to the nip by the vacuum mechanism; and
  - an adjustable connection between the nip and air blowers to adjust the location at which air is blown towards the signatures for adjusting said location for different thicknesses of signatures to be run on the feeder.

30. The assembly of Claim 29 wherein the nip includes an upper roller and a lower roller, and the adjustable connection includes outer and inner frame portions with the outer portion having the air blowers mounted thereto and the inner portion having one of the nip rollers rotatably mounted thereto; and  
an adjusting member interconnecting the outer and inner frame portions and being operable to adjust the position of the frame portions with respect to each other for adjusting the location of the blown air with respect to the nip.
31. The assembly of Claim 30 wherein the nip roller mounted to the inner frame portion is the upper nip roller.
32. The assembly of Claim 30 wherein the outer frame portion includes a first pair of spaced side members having air discharge ports thereon and a first upper cross member interconnected between the first pair of side members, the inner frame portion includes a second pair of spaced side members disposed between and adjacent the first pair of side members with the nip roller mounted between the second pair of side members and a second lower cross member interconnected between the second pair of side members and below the first upper cross member, and the adjusting member is an adjustment screw with turning of the screw adjusting the distance between the cross members for changing the position of the discharge ports relative to the nip roller.
33. The assembly of Claim 29 wherein the nip has a nip space formed when the signatures are pulled through the nip, and  
a pivot linkage which allows the size of the nip space to adjust as the thickness of the signatures pulled therethrough varies for self-adjustment of the nip during running of the feeder.
34. The assembly of Claim 33 including a holder for supporting the pivot linkage and nip with the holder being moveable along the frame to reposition the nip with respect to the vacuum mechanism so that the distance therebetween substantially corresponds to the length of the signatures in the travel direction.

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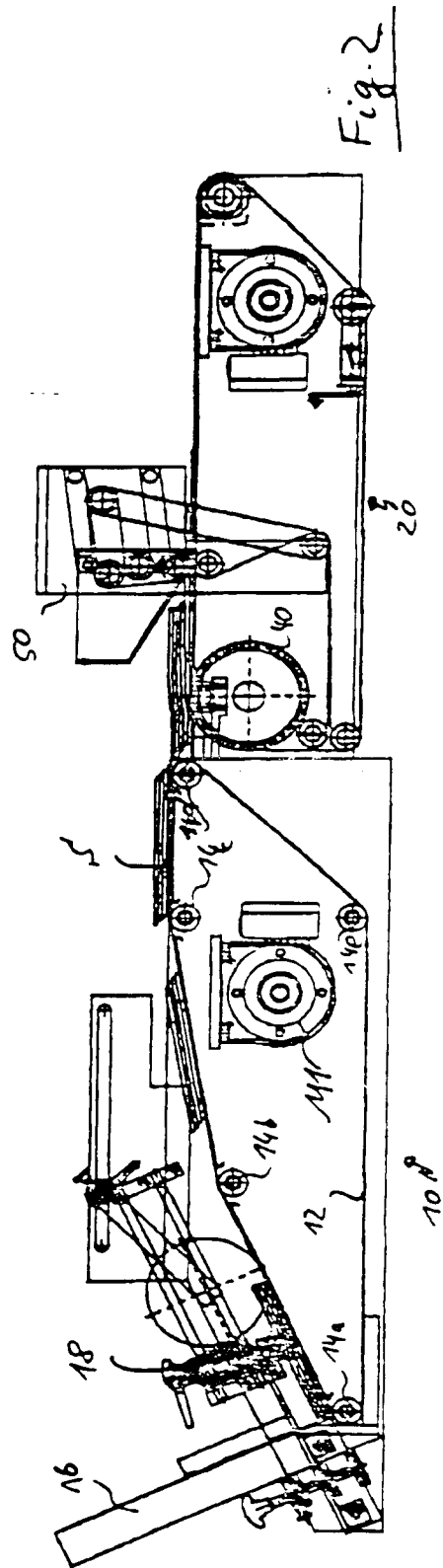
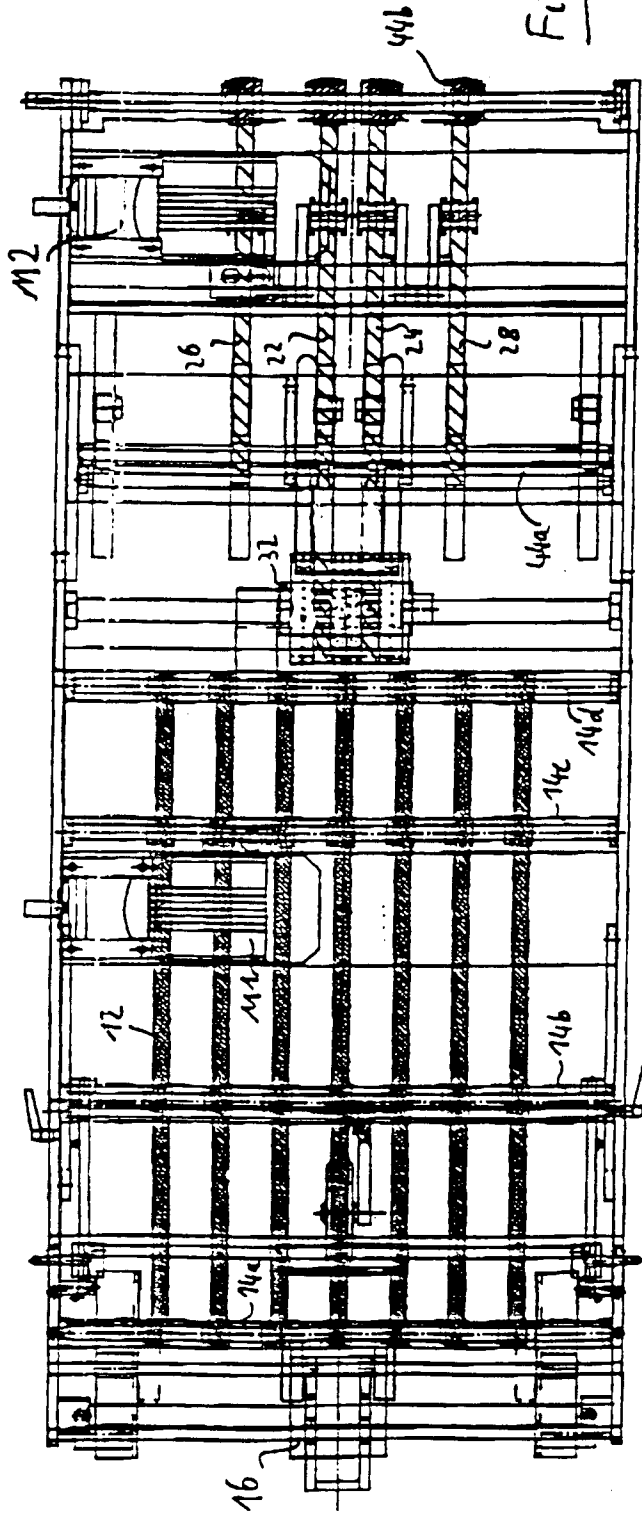
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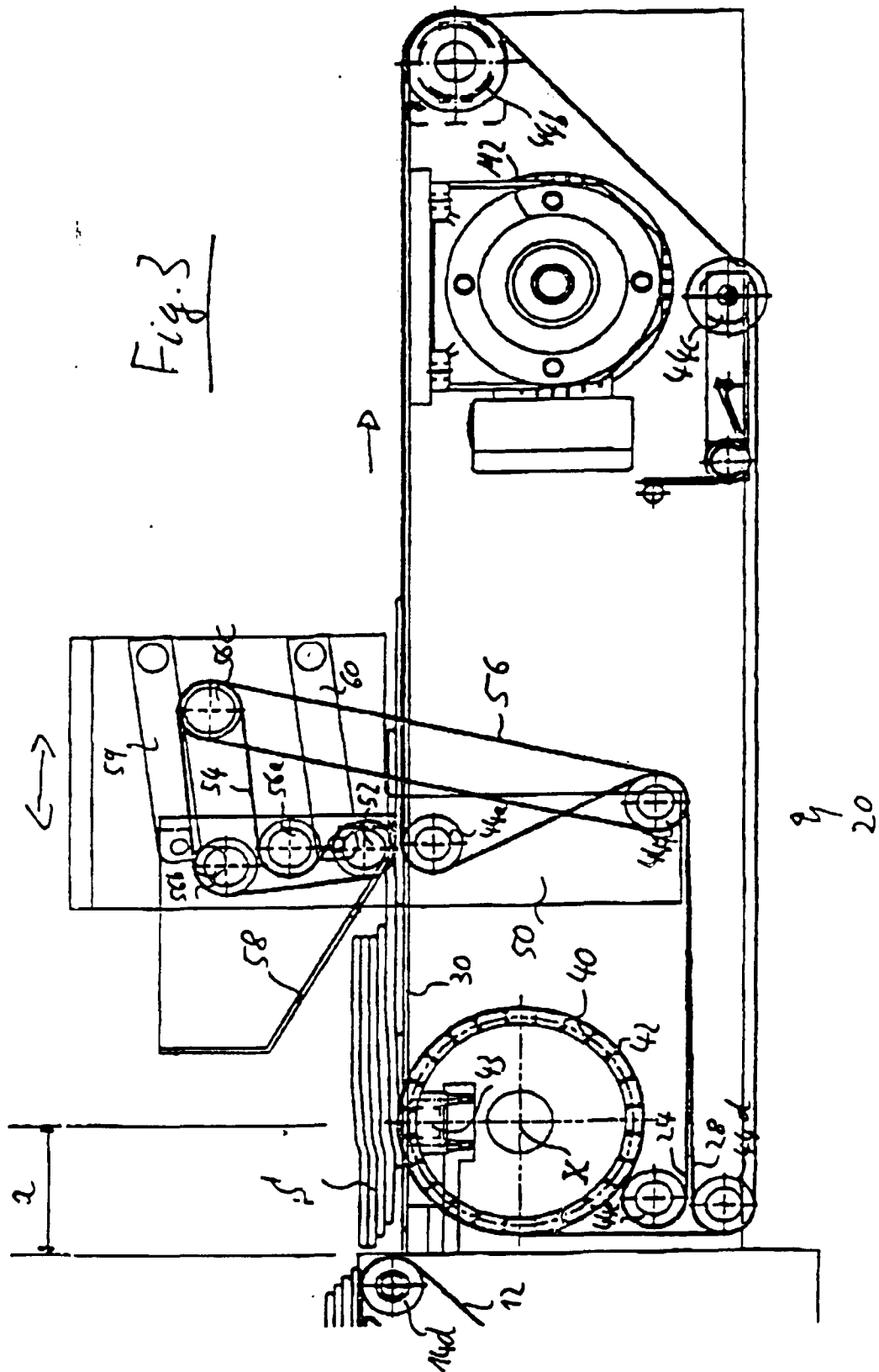
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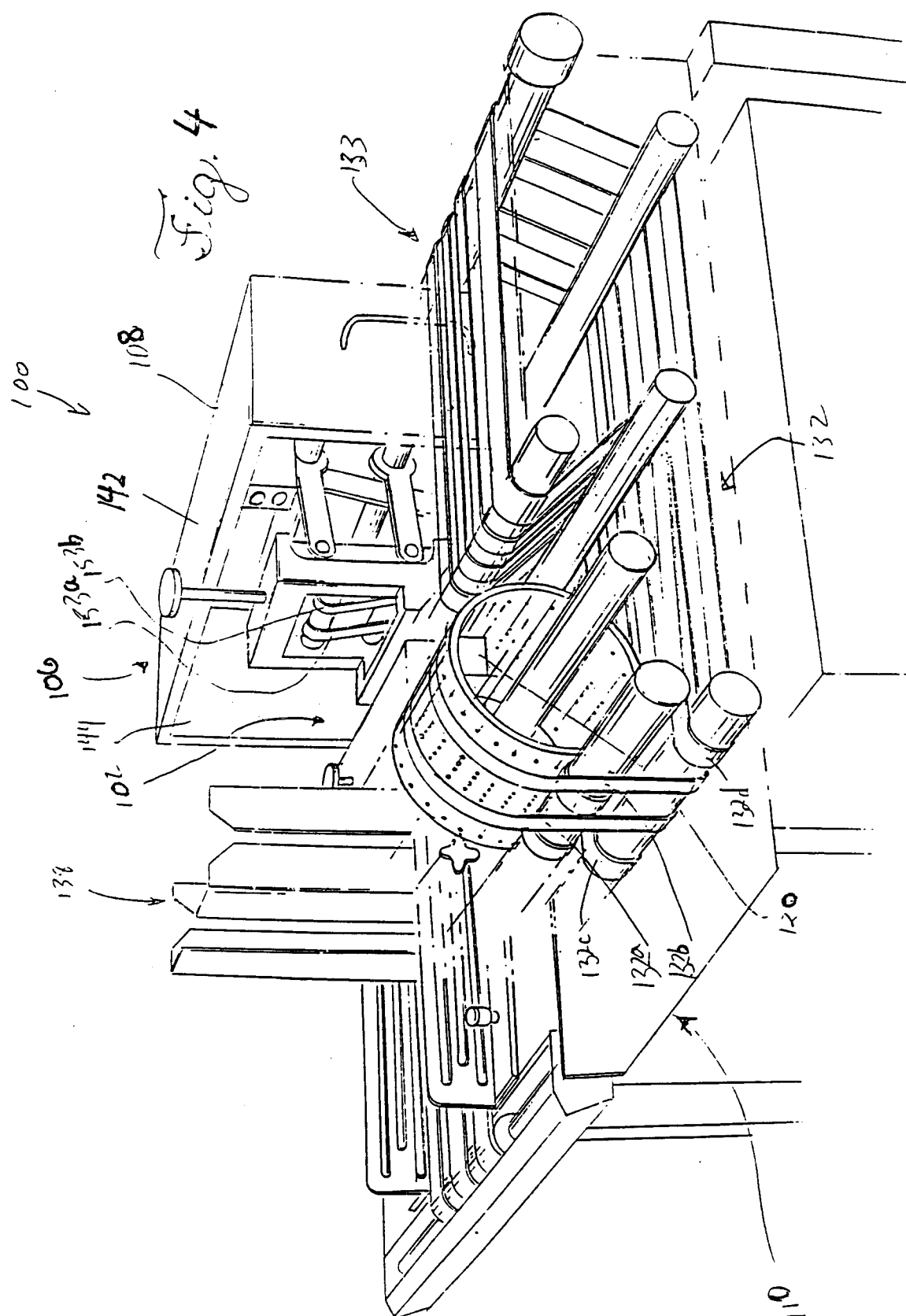
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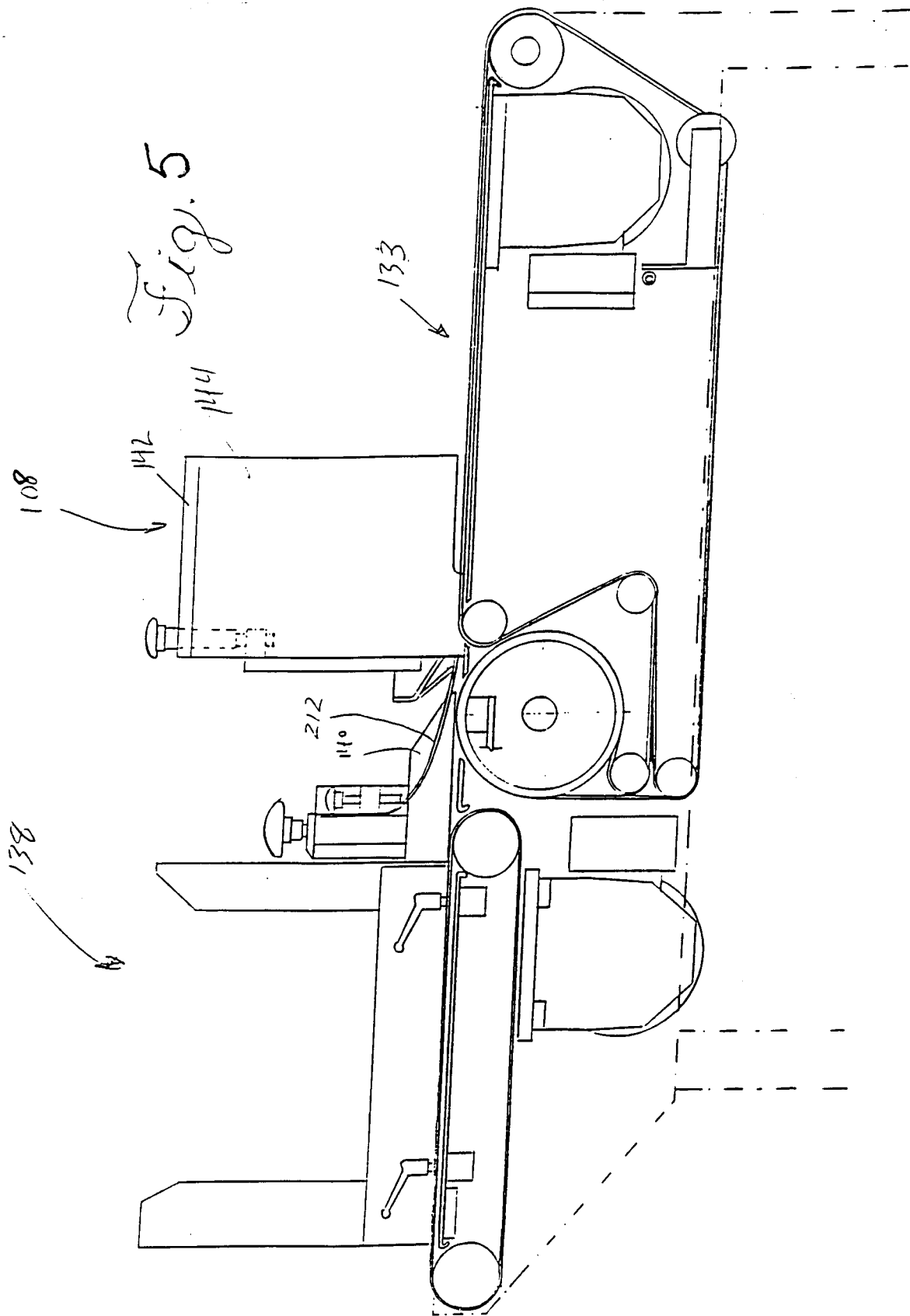
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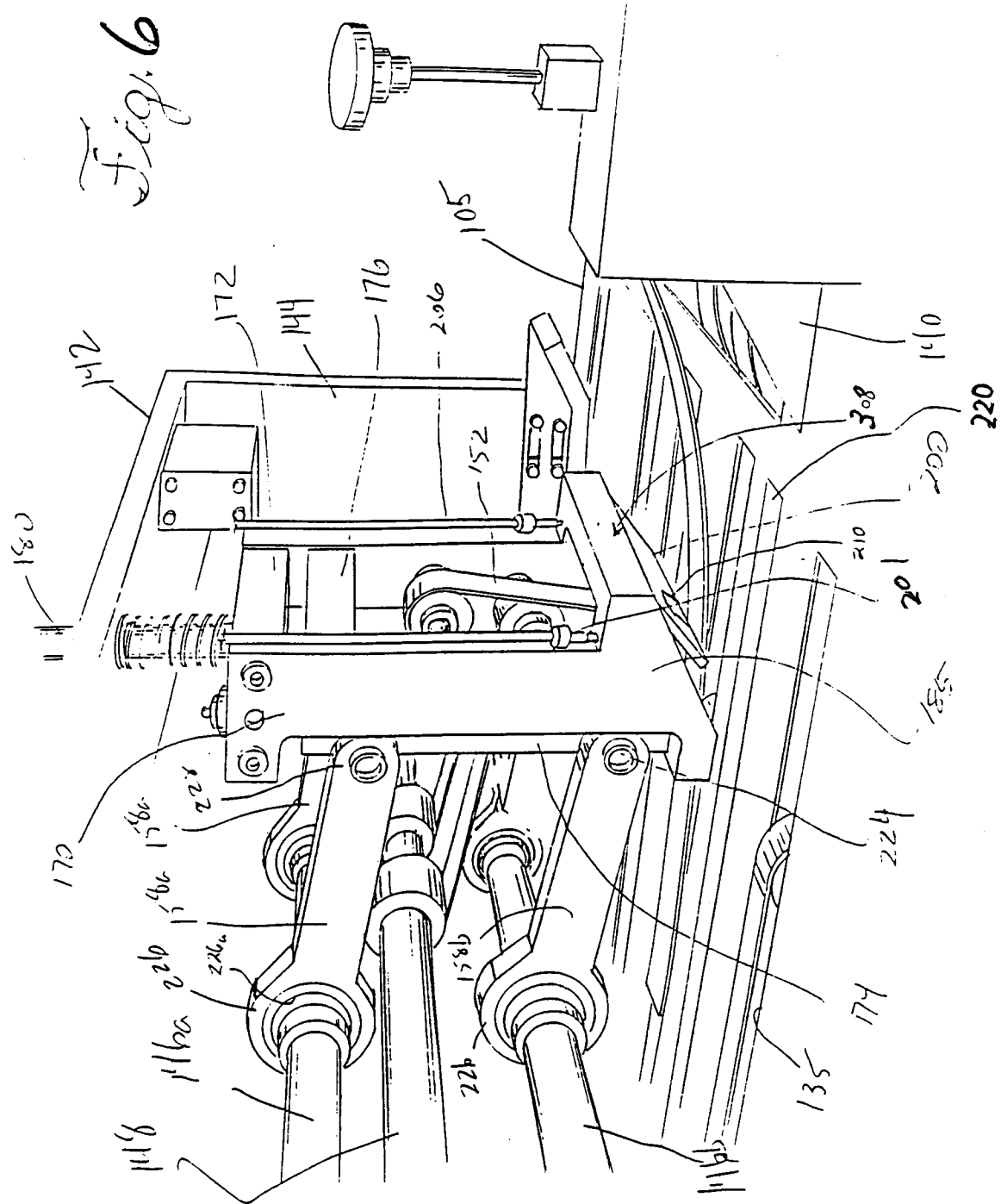
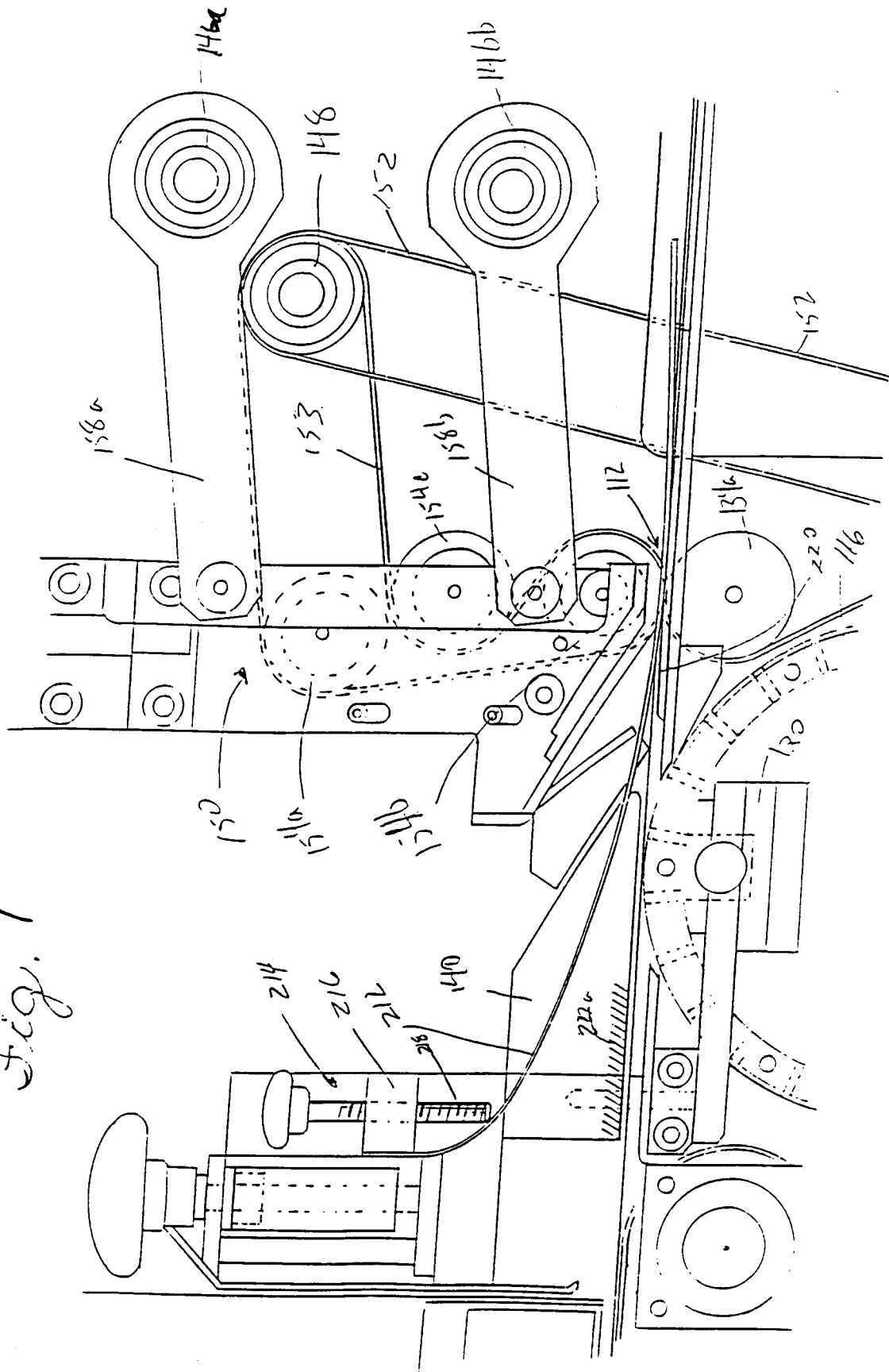
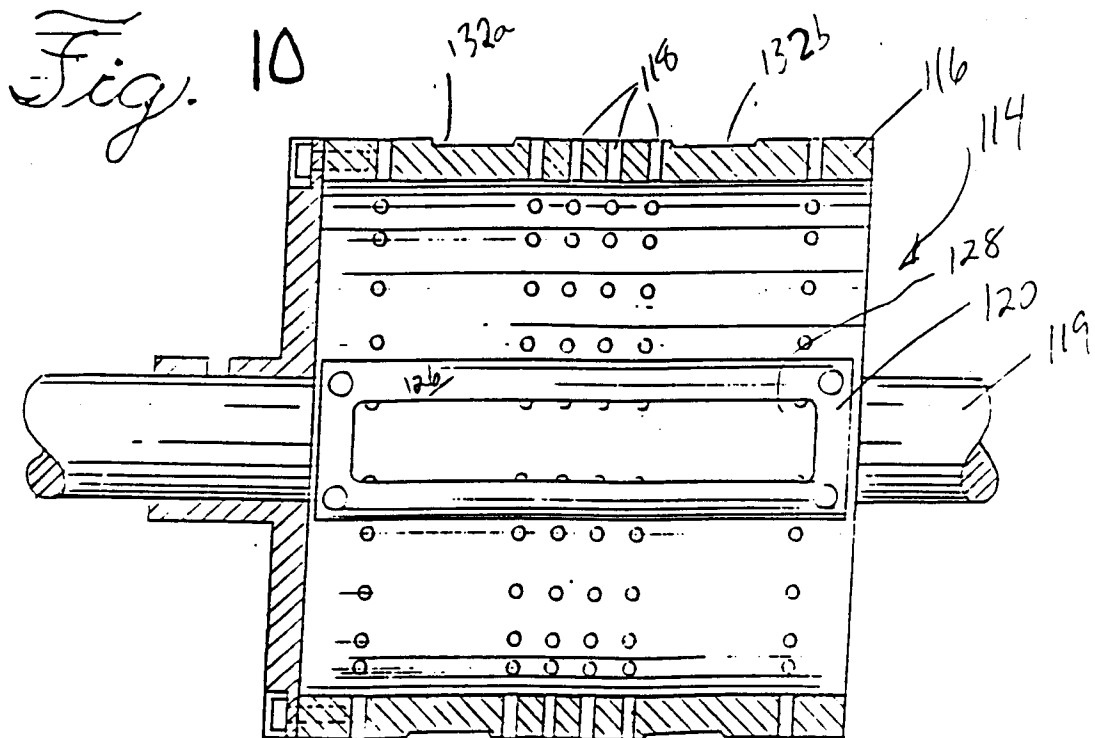
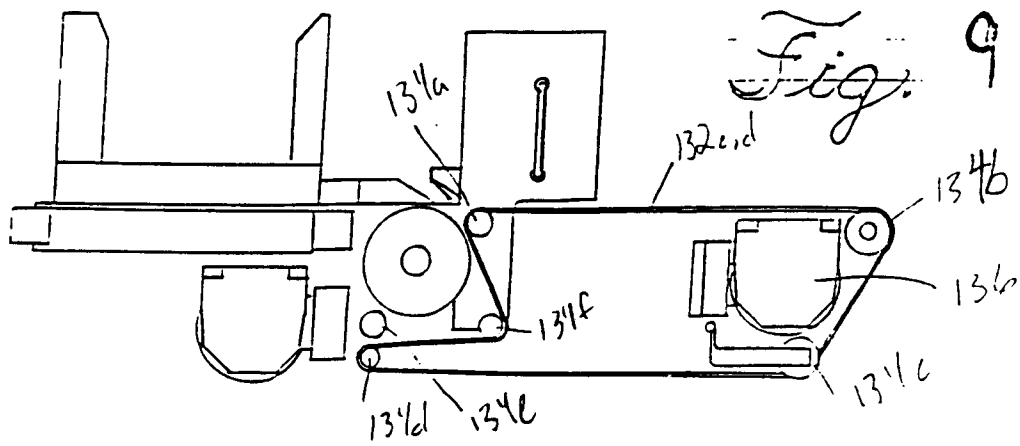
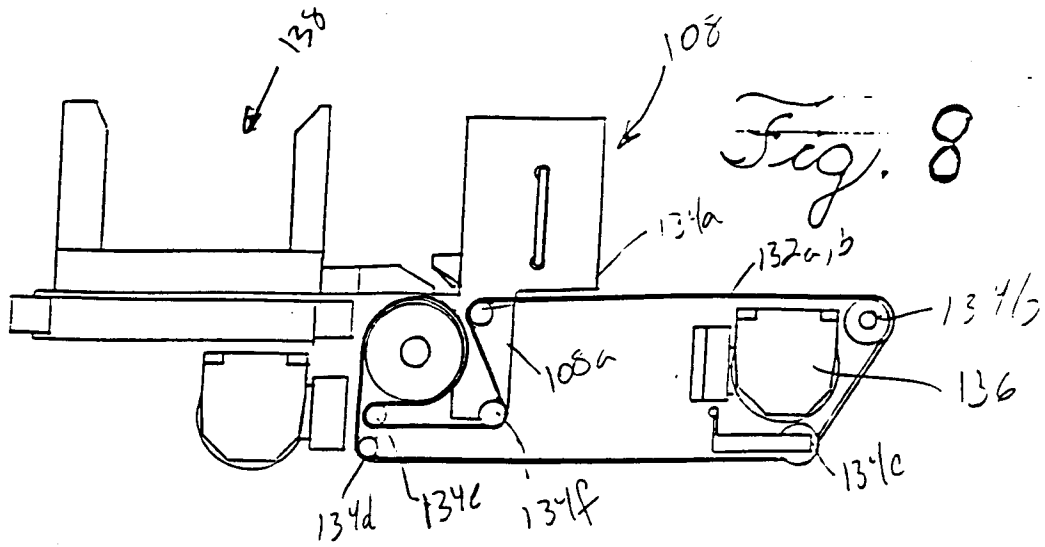


Fig. 7





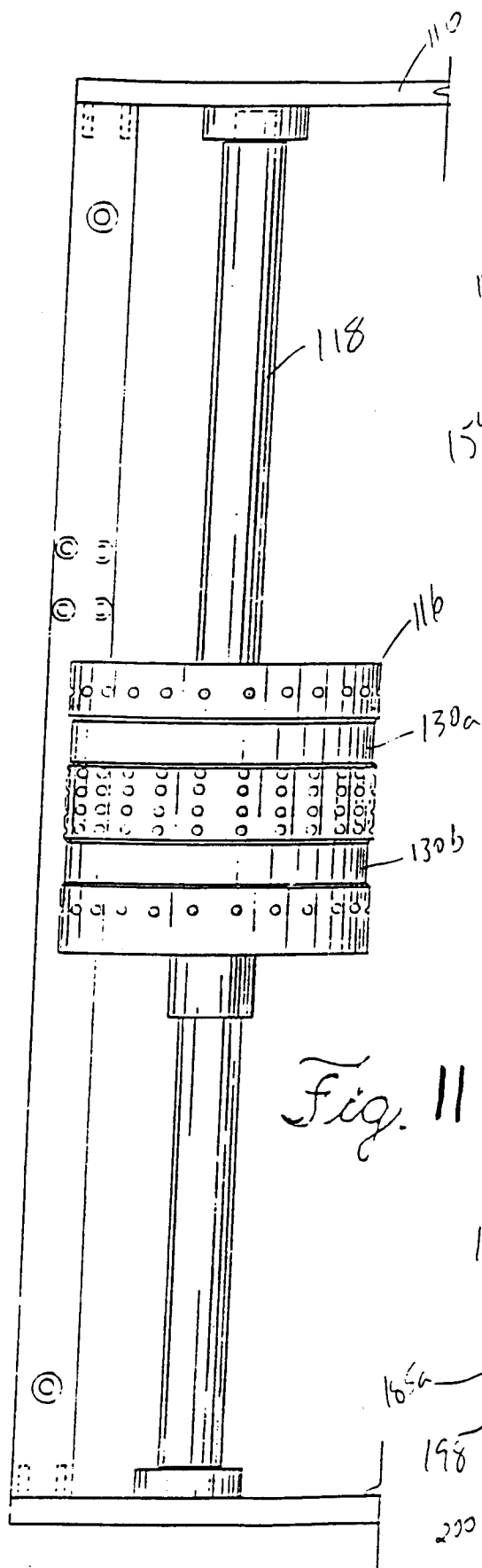


Fig. 11

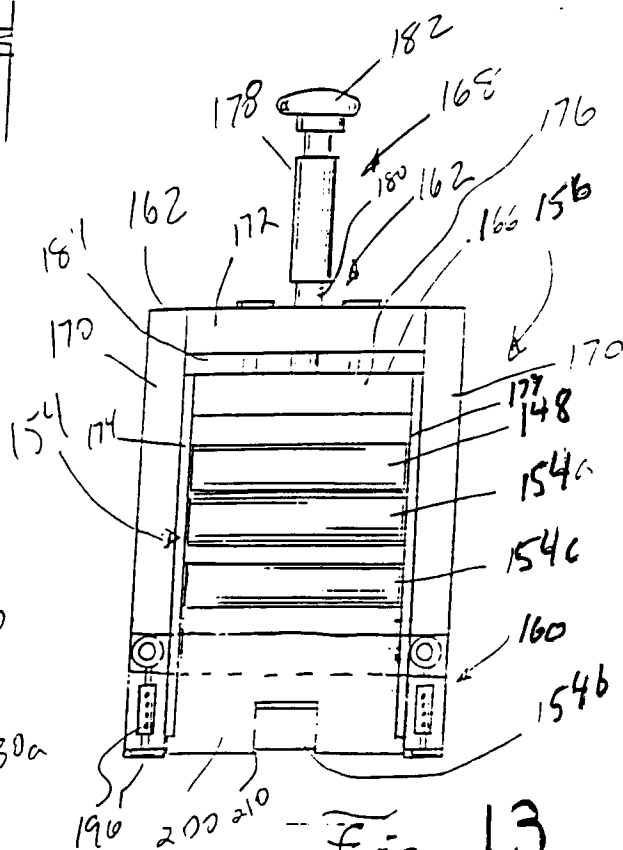


Fig. 13

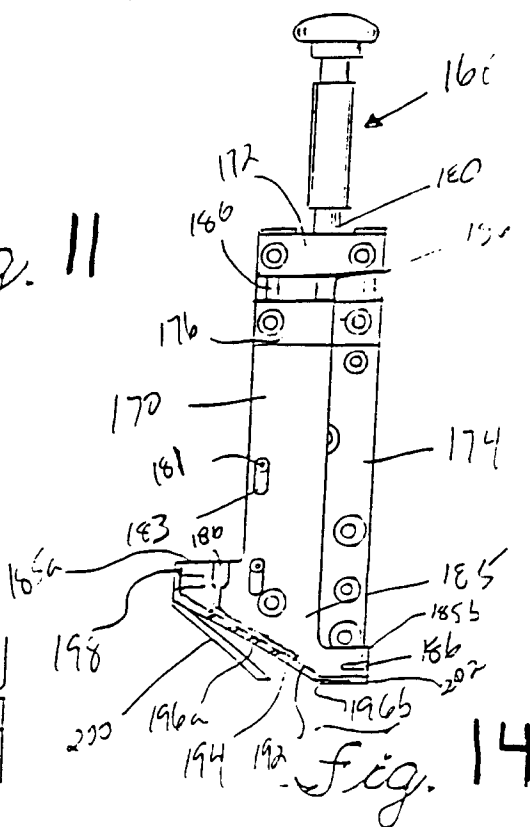


Fig. 14

