M. A. DROITCOUR.

PAPER FEEDER.

APPLICATION FILED JAN. 8, 1912.

Patented Nov. 4, 1913.

1,077,399.

5 SHEETS—SHEET 1.

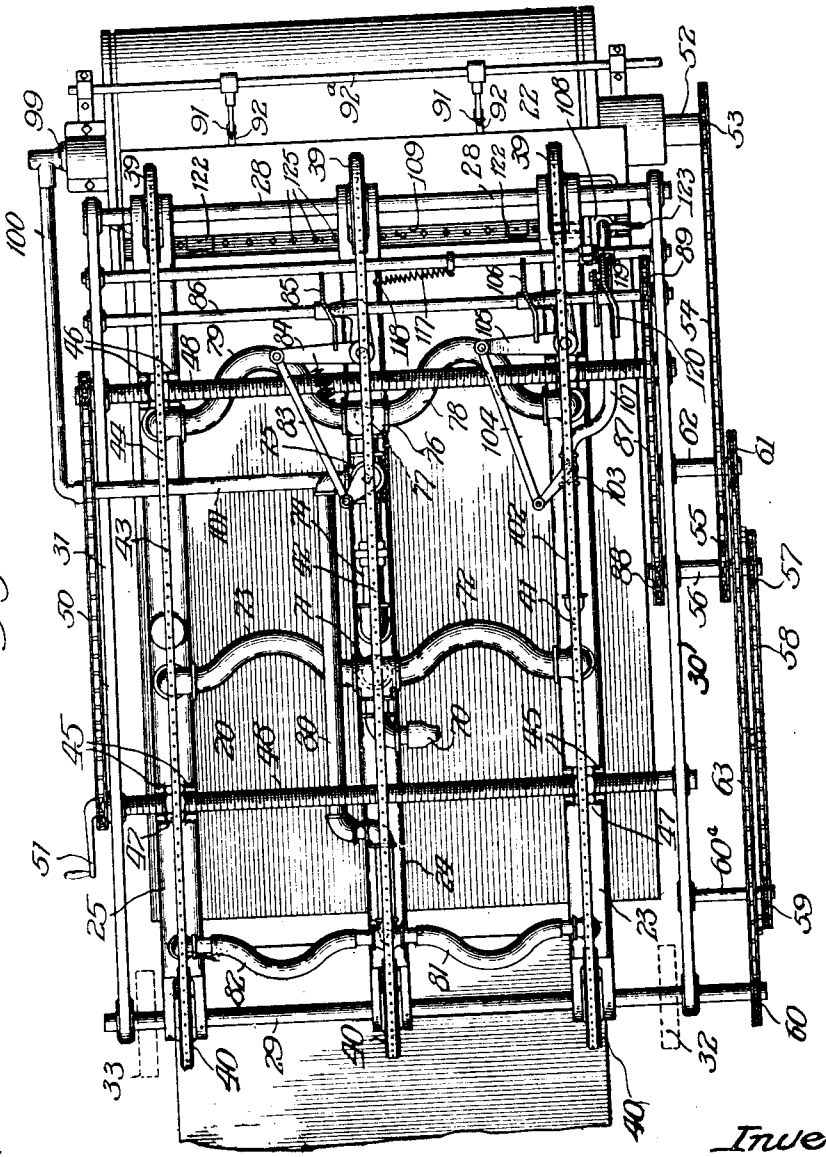


Fig. 1.

Witnesses

Fred C. Dorsey

H. G. Barrett

Inventor:

Michael A. Droitcour

By Lothrop & Gitt & Fuller

Attys

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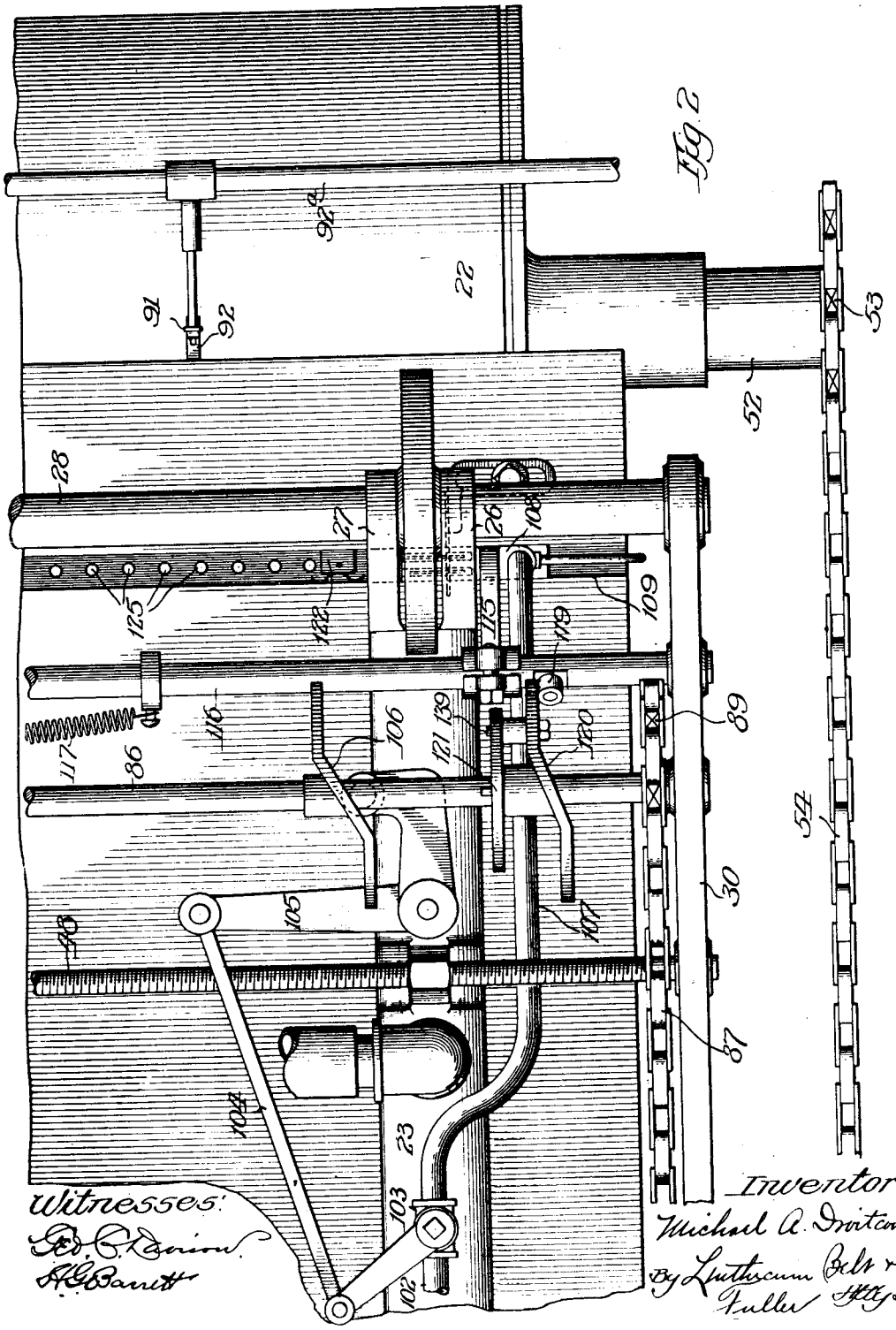
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5 SHEETS—SHEET 2.

Fig 2



Witnesses:

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5 SHEETS—SHEET 3.

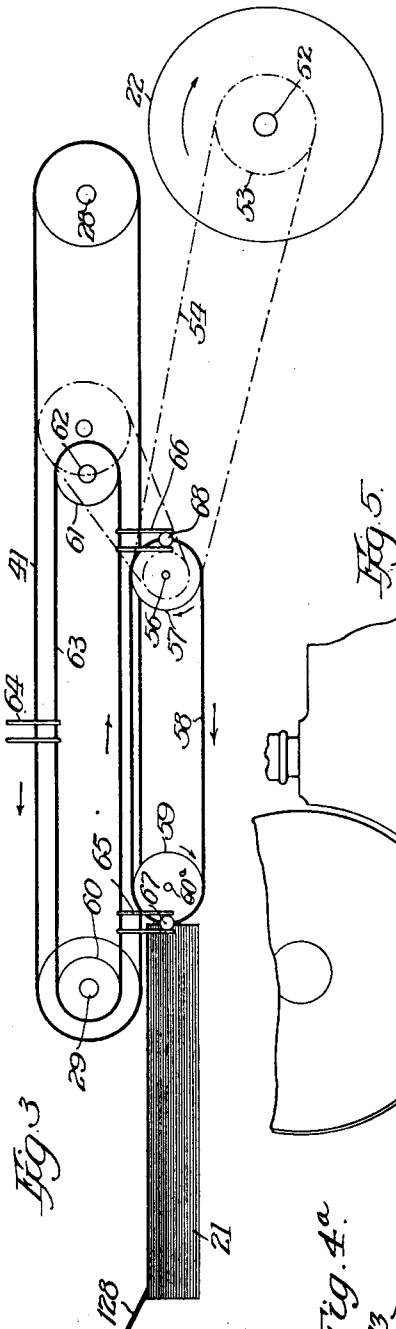


Fig. 3

Fig. 5.

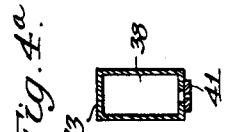


Fig. 4a.

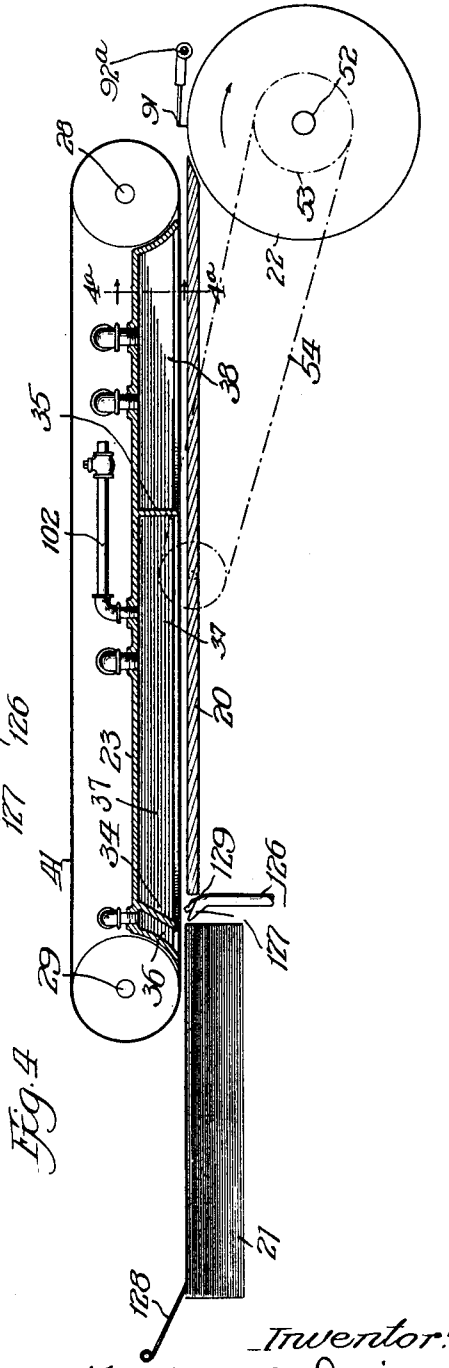


Fig. 4

Witnesses:

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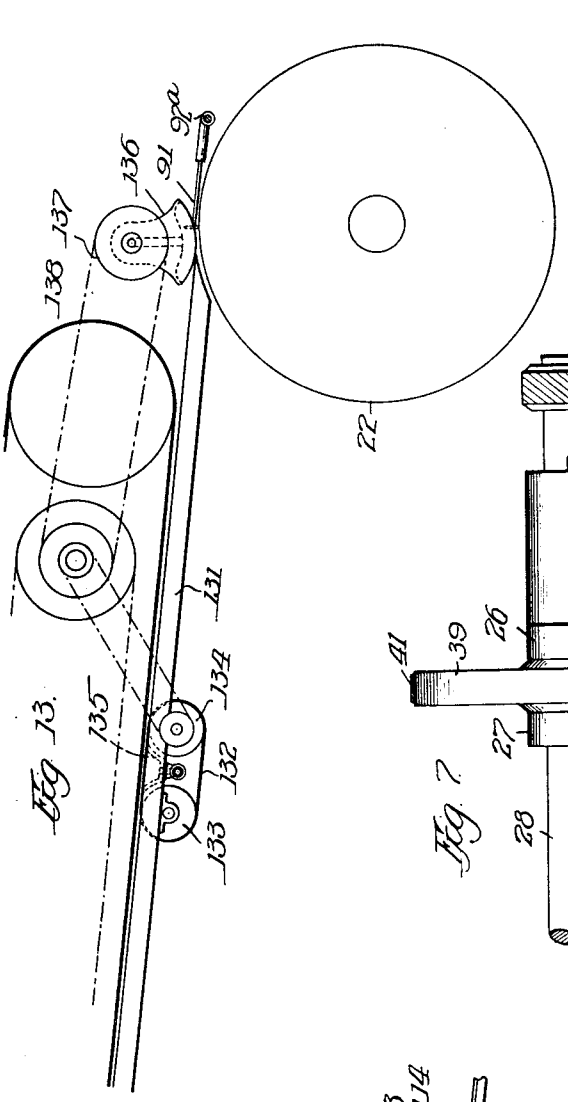


Fig. 13.

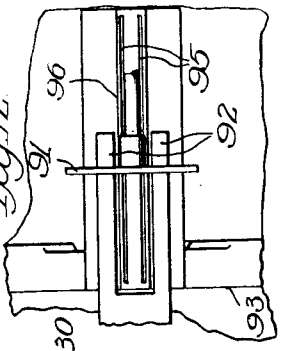


Fig. 12.

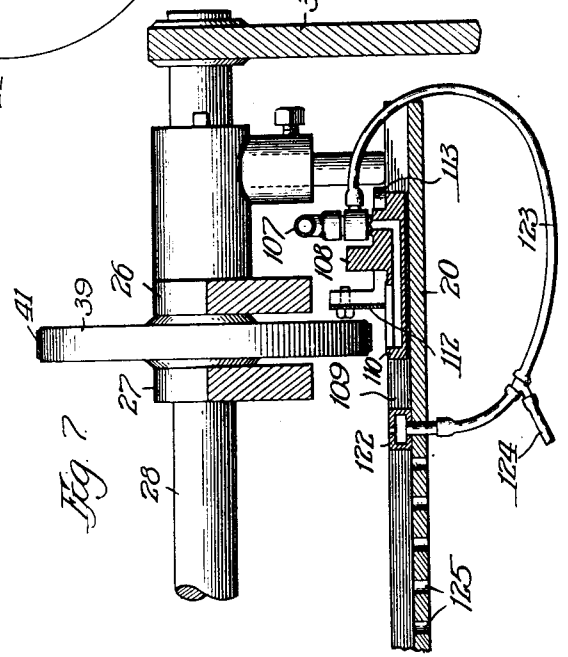


Fig. 7.

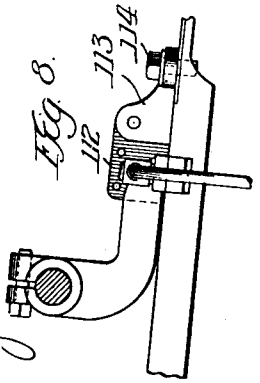


Fig. 8.

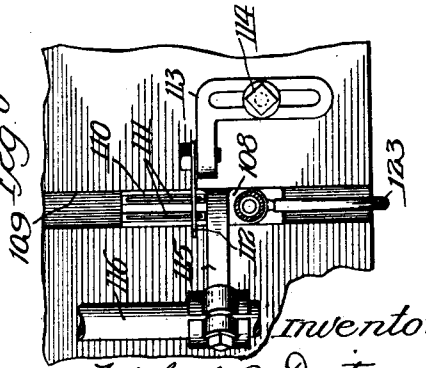


Fig. 6.

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PAPER FEEDER.

APPLICATION FILED JAN. 8, 1912.

1,077,399.

Patented Nov. 4, 1913.

5 SHEETS—SHEET 5.

Fig. 9

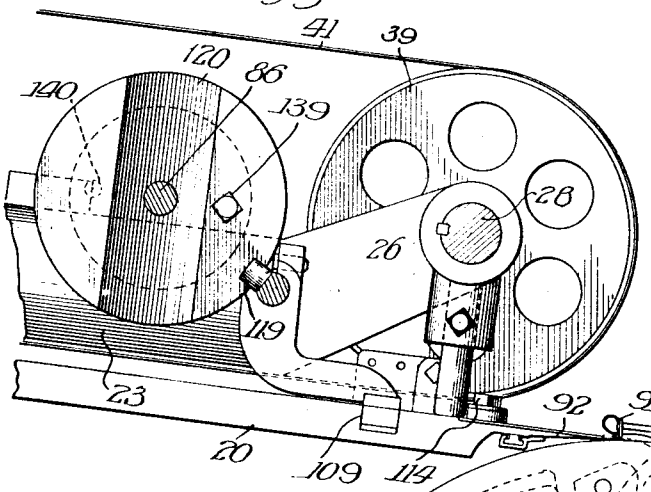


Fig. 11

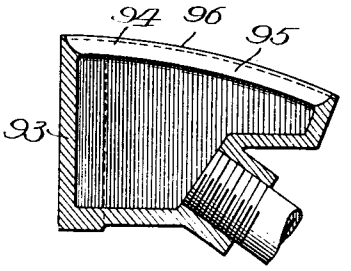
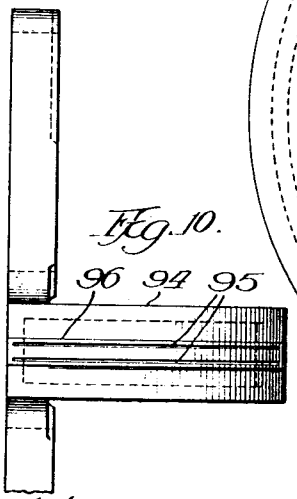


Fig. 10.



Witnesses:

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UNITED STATES PATENT OFFICE.

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PAPER-FEEDER.

1,077,399. Specification of Letters Patent. Patented Nov. 4, 1913.

Application filed January 8, 1912. Serial No. 670,039.

To all whom it may concern:

Be it known that I, MICHAEL A. DROITCOUR, a citizen of the United States, residing at Oak Park, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Paper-Feeders, of which the following is a specification.

My invention pertains to improvements in pneumatic means for transporting sheets of paper, and more particularly relates to suction feeders for printing presses, although the invention is in no way limited to this particular use.

The main and leading objects of the invention are to effectively and efficiently separate the sheets of paper from the pile by use of air, and to transport such sheets by suction to the gages of the press, including the registration of the sheets with the gages and the smoothing or straightening of the sheets to render them free from wrinkles or bulges. Mechanical devices which have heretofore been used for this general purpose tend to cause an offsetting of the ink on the sheets and to crumple or mar the paper sheets during their manipulation.

Consequently, one of the principal features of this invention is to provide a device whereby the sheets of paper will be handled more gently and carefully than can be accomplished with mechanical means, and yet positively feed, register, and control the travel of the sheets of paper; in other words, maintain complete control of the movement of the paper.

In order that a full understanding of this invention may be had, I have illustrated preferred embodiments of the same in the accompanying drawings, which form a part of this specification and to which reference should be had in connection with the following detailed description.

In these drawings—Figure 1 is a plan view of one embodiment of the invention; Fig. 2 is a fragmentary plan of the construction on an enlarged scale, in order that the details of the structure may be more fully comprehended; Fig. 3 is a more or less conventional or diagrammatic view illustrating the driving mechanism for the apertured metal bands; Fig. 4 is a longitudinal section through the device taken through one of the suction shoes, and illustrates its plurality of interior compartments; Fig. 4ª is a sectional view through one of the shoes taken on the line 4ª—4ª of Fig. 4; Fig. 5 is a fragmentary view illustrating in detail the paper fluffing or blast separating part of the mechanism; Fig. 6 is a fragmentary plan view illustrating the mechanism employed for shifting the paper into register with the side gage; Fig. 7 is a vertical section illustrating the mechanism shown in Fig. 6, and in addition, one of the paper straightening or smoothing devices; Fig. 8 is a plan view of the mechanism shown in Fig. 6; Fig. 9 illustrates the part of the appliance adjacent to the cylinder on which the sheets are adapted to be gripped; Fig. 10 shows in plan one of the suction shoes on the rotary cylinder which is adapted to register the sheets of paper with the bottom gages; Fig. 11 is a section through the suction shoe shown in Fig. 10; Fig. 12 is a fragmentary plan illustrating the relation of the paper-supporting tongues and one of the shoes illustrated in Figs. 10 and 11, and Fig. 13 shows a modification of the bottom gage registering mechanism, which structure, however, if desired, may be used in conjunction with the mechanism illustrated in the other figures.

By reference to these drawings it will be observed that the appliance is provided with a suitably supported feed-table 20 located adjacent to the pile of sheets of paper 21, the table 20 being disposed between the pile 21 and a rotary cylinder 22. Disposed longitudinally above the table 20 are a plurality of suction-shoes 23, 24 and 25. At each end each of these shoes is provided with a pair of apertured arms 26 and 27 through the holes of which pass the two cross-shafts 28 and 29, these shafts acting as supports for the shoes, the shafts in turn being rotatably supported at their opposite end portions in two side-frames 30 and 31. The shaft 29 which acts as the main support for the entire suction-feeding device is rotatably mounted in suitable bearings 32 and 33 whereby the side frames 30 and 31 and all the parts hereinafter described which they carry, may be swung out of position around the axis of the shaft 29 if desired, permitting the table 20 to be unobstructed for the feeding of the sheets by hand. Each of these suction shoes 23, 24 and 25 is divided by partition walls 34 and 35 into three chambers or compartments 36, 37 and 38 of which the one characterized 36 is comparatively small. Each of these shoes is in reality in the form of a

shell, having on its under surface three alined slots each slot connecting with one of the three chambers 36, 37 and 38, each slot being of substantially the same length as the chamber with which it connects. On the shafts 28 and 29 in alinement with the axes of the slots through the bottom walls of the three shoes, I fasten the pulleys or drums 39 and 40 around which pass the three endless belts or bands, 41, 42 and 43, preferably metallic, and apertured at intervals at 44 whereby the suction in the shoe chambers, the slots of which are covered by these belts or bands, is made applicable to the sheets of paper as explained hereinafter, through the perforations of the bands.

In order that the positions of the two outside suction shoes 23 and 25 may be adjustable for proper action on sheets of paper of different widths, I have provided each of these outside shoes with two pairs of apertured or slotted lugs 45, 45 and 46, 46, the lugs of each pair being spaced apart for the accommodation between them of a nut 47. The mechanism is provided with two comparatively long screws 48 and 48 rotatably mounted in the side frames 30 and 31 and each having its halves provided with right and left hand screw threads passing through the nuts 47 of the shoes. In order to bring about a simultaneous and equal rotation of these two screws 48 and 48, I equip each with a sprocket wheel coöperating with both of which is a sprocket chain 50, one of the screws 48 having an operating handle 51. As will be apparent, the simultaneous approach or separation of the two outside suction-shoes 23 and 25 may be readily brought about by simply turning the handle 51, and, owing to the fact that the various pulleys or drums 39 and 40, splined but longitudinally movable on the two shafts 28 and 29 are straddled by the arms 26 and 27 of these outside shoes, these pulleys and the apertured metallic belts passing around them will be simultaneously and equally shifted with their corresponding suction-shoes so that under all circumstances these belts or bands 41 and 43 will be maintained in register with the slots of the shoes.

The shaft 29 is given a variable rotation causing a variable travel of the perforated steel bands or belts by means of the following instrumentalities. The shaft 52 of the cylinder 22 has fixed thereto a sprocket wheel 53 around which passes a sprocket chain 54 encircling another sprocket wheel 55 on a shaft 56 rotatably mounted, as is clearly shown in Fig. 1, in the side frame 30. Shaft 56 also has fixed thereto a sprocket wheel 57 passing around which is a sprocket chain 58 encircling another sprocket wheel 59, loosely or rotatably mounted on a stud shaft 60^a carried by the side frame 30. Shaft 29 has fixed to one end thereof a sprocket wheel 60, a similar sprocket wheel 61 being rotatably mounted on a stud shaft 62 carried by the side frame 30, and passing around these companion wheels 60 and 61 is a sprocket chain 63 having securely fastened thereto three yokes 64, 65 and 66, each consisting as is shown in Fig. 3, of a pair of parallel arms spaced apart. These yokes are separated from one another lineally along the sprocket chain 63 a distance substantially equal to that between the remotest points of the sprocket wheels 57 and 59. Cooperating with these yokes I employ a pair of rollers 67 and 68 secured at diametrically opposite points on the chain 58, the construction being such that as the roller 67 passes into the yoke 65 the roller 68 will leave the yoke 66. This operating mechanism for the shaft 29 gives to such shaft a variable or changing rotation. While either roller 67 or 68 is traveling on the upper left hand quadrant of the wheel 59 or on the upper right hand quadrant of the wheel 57, the motion transmitted from the chain 58 to the chain 63 will be varying, that is, the speed will be gradually increasing in the first instance and gradually decreasing in the second instance. There will be one point, as shown in Fig. 3, where the chain 63 will be momentarily or theoretically stopped, and the rotation of the shaft 29 will temporarily or theoretically cease. Advantage is taken of this construction for the picking up and delivery of the sheets of paper, as explained hereinafter.

Referring now to the means for applying suction to the shoes, and controlling the action of the air, it will be observed that the suction pump (not shown) is connected to the interior of the middle chamber of the shoe 24 by means of a connecting pipe 70 communicating with the interior of the compartment 37 through a suitable connection 71, such connection having lateral extensions 72 and 73 communicating with the middle chambers 37 of the two outside shoes 23 and 25, and owing to the fact that these shoes are adjustable in and out, these connections 72 and 73 are made flexible and yielding. Consequently, the central chambers of all three shoes are subjected to suction continuously.

The chamber 37 of shoe 24 is also connected by means of a pipe 74 with a valve 75 communicating by means of a pipe connection 76 and a nipple 77 with the chamber 38 of shoe 24, this pipe connection 76 being also connected by the flexible pipe or hose 78 and 79 with the corresponding chambers or compartments 38 of the two outside shoes. Valve 75, by means of the pipe and flexible connections 80, 81 and 82, is in communication with the small chambers or compartments 36 of all three shoes. Valve 75 is operated by means of a connecting rod 83 and

a spring-actuated bell-crank 84, the end roller of which bears against the side operative face of a cam 85 fixed on a shaft 86 rotatably mounted in the side frames 30 and 31 and revolved by means of a sprocket chain 87 passing around sprocket wheels 88 and 89 and fixed respectively on shafts 56 and 86.

Above the cylinder 22, which may be the impression cylinder, a transfer cylinder, or any other sort of cylinder provided with the usual grippers 90 and their operating mechanism (not shown), I employ a plurality of bottom gages 91, 91 supported on a cross-rod 92^a in the usual manner, the sheet in its forward travel being adapted to engage such gages to properly register for transmission to the cylinder 22, to which it is subsequently gripped. The table 20 has at its cylinder end a plurality of slotted or divided tongues 92 adapted to support the paper, and also to support the free ends of the gages 91.

Cylinder 22 is equipped with a plurality, (in the present instance two) of hollow suction-shoes 93, 93, the outer curved faces 94 of which are each provided with a plurality of narrow slots 95 communicating with the interior of the shoes, the slotted portions 96 of the latter, as is shown in Fig. 9, extending outwardly from the surface of the cylinder 22 a sufficient amount to bring their curved faces in register with the top surfaces of the tongues 92, as the shoes pass through the slots or spaces of such tongues. Each of these curved, suction, cylinder shoes is in communication with the hollow shaft 52 of the cylinder through a pipe connection 98 and one end 99 of the shaft 52, as shown in Fig. 1 is connected to the valve 75 through the pipes 100 and 101, whereby the valve controls the application of the suction of these shoes as well as controls its application in the compartments 36 and 38 of the long shoes 23, 24 and 25. The connections or pipes 98 may be made flexible or expansible if desired, so as to permit adjustment of the curved shoes 93 longitudinally of the cylinder 22 to conform to sheets of varying widths and to compensate for such adjustment of the shoes the tongues 92 are also made adjustable.

This improved mechanism is also equipped with a suction device for registering the sheets of paper with the side gage, and this part of the mechanism includes the following elements. The middle, or constant-suction chamber 37 of the shoe 23 is connected by a pipe 102 with a valve 103 operated through a link 104, bell-crank 105, and a cam 106, mounted on shaft 86. Valve 103 by means of a pipe 107 is in communication with a hollow sliding suction-shoe 108 (Figs. 6 and 7) reciprocable in a slot 109 of table 20. This side-gage suction-shoe has an extended portion 110 supplied in its top with a pair of parallel slots 111 communicating with its hollow interior, this part 110 of the shoe being reciprocated beneath a suitably-supported adjustable side-gage 112. In Figs. 6 and 8 I have illustrated such gage as bolted to a slotted support 113, adapted to be adjustably clamped in position on table 20 by a screw or bolt 114. In order to effect the desired reciprocation of this side-gage suction-shoe, I clamp a laterally-extended arm 115 of the shoe to a rod 116 slidably mounted in the side frames 30 and 31, such rod having attached thereto a spring 117 the other end of which is secured to lug 118 on the middle longitudinal shoe 24. The desired sliding movement of this rod is effected by means of a roller 119 mounted thereon, which coöperates with the face of a suitably shaped cam 120 adjustably associated with a disk 121 on shaft 86.

In mechanisms of this character it is desirable to provide some means for maintaining the sheets of paper flat and free from wrinkles or bulges at the time that the grippers of the cylinder grasp them and carry them away from the table, and to bring about this result, I provide in the cross-slot 109 of the table 20, a pair of hollow apertured suction pieces 122, both in communication with the suction pipe 107 by means of the flexible connections 123 and 124. These shoes or suction pieces 122 are adjustable in the slot 109 to conform to the varying width of paper employed by the feeder mechanism, and this is conveniently and desirably brought about by equipping the table 20 at the bottom of the slot 109 with a plurality of properly spaced apertures 125, through which the depending pipe connections of the suction pieces 122 may pass. It will be observed therefore, that the valve 103 controls the application of the suction not only to the reciprocating shoe 108, which brings the paper against the side-guide 112, but also simultaneously to the two suction pieces 122 so as to hold the paper flat during its registration with the gages, and during its transfer from the feed-table to the grippers of the cylinder. In order that this suction paper-conveying and registering mechanism may be rendered properly operative, it is desirable or necessary to act upon the top sheet of the pile 21 so as to bring its forward edge portion into operative association with the perforated bands or belts 41, 42 and 43 while they are passing beneath the slots of the chambers 36 of the three longitudinal shoes, so as to render the suction capable of grasping the sheet and carrying it forwardly with the perforated bands or tapes. To bring about this result, I position near the forward edge of the paper pile and near its top, a double-nozzle air-blast pipe 126 for each of the three perfo-

rated bands, each of which nozzles is suitably connected to any desirable source of compressed air, (not shown). As is clearly shown in Figs. 4 and 5, one of each of these double nozzles 127 is directed against the forward edges of the top sheets of the pile, and the discharge of air therefrom acts to fluff or separate these sheets and carry the uppermost one into contact with or sufficiently close to the perforated bands to enable the suction acting through them to grasp the top sheet and carry it forwardly. As the sheet is pulled from the pile by this traveling suction operation, the successive portions of the sheet pass from these nozzles 127 and are blown by the emitted blasts of air up against the tapes so as to permit the latter to engage and hold the sheets the entire length of the latter. As is customary in paper-feeding devices, one or more finger retainers 128 is used at the rear of the pile to prevent displacement of the under sheets while the top sheet is being removed.

In some cases the top sheet may not register accurately with the sheets below it, that is, its forward edge may be somewhat back of the other sheets, and in order to raise or separate such a misplaced top sheet from the remainder of the pile and carry it into the field of action of the suction of the traveling tapes, I use the other nozzles 129 of the three duplex nozzles referred to, blasts from which are directed against deflectors 130 attached to the corresponding stationary longitudinal suction-shoes, which deflectors act to carry the blast of air around the edge of the pile and downwardly against the edge of the rearwardly disposed top sheet, whereby such sheet is lifted by the blast against the suction tapes which engage it and carry it off over the feeder-board, as will be readily understood.

The operation of this improved mechanism takes place substantially as follows. Assuming that the pile of sheets of paper 21 is properly supported and is gradually raised in the ordinary manner to compensate for the delivery of the sheets therefrom, it will be readily understood that the sheet-fluffing or separating blasts of air from the nozzles 127 and 129 operate to raise the top sheets of the pile individually and in succession, so as to permit the suction-conveying part of the mechanism to carry the sheets one by one to the cylinder. When the two rollers 67 and 68 reach the opposite positions or dead center positions shown in Fig. 3, the three traveling perforated metal bands have their movement momentarily stopped, and at this time the valve 75, through the agency of its manipulating cam 85 and connecting mechanism, is opened, bringing about the application of suction to the three chambers 36 of the three shoes 23, 24 and 25 so that the three perforated bands or belts are enabled by reason of the action of the suction through their perforations beneath these chambers 36 to draw to them and hold the forward portion of the top sheet raised from the pile by the air blasts. At the same time, the suction previously present in the three chambers 38 of the three shoes is cut off by the movement of the valve 75, and the previously transported sheet is dropped on the table adjacent to the cylinder, as will be described hereinafter. As the sprocket wheels 57 and 59 continue their rotation, roller 68 leaves its yoke 66 and roller 67 gradually increases the speed of movement of the chain 63, which brings about a corresponding increasing rate of travel of the three perforated suction bands or belts 41, 42 and 43 until the maximum speed is obtained, and maintained during the travel of the roller 67 along the top stretch of the chain 58. This results in a careful and gentle extraction of the top sheet from the pile, much more so than would be brought about if the speed of the perforated suction bands was not modified. As the sheet of paper is conveyed forwardly and as its successive portions pass over the air blast nozzles 127 and 129, these various parts are raised by the air blast into operative engagement with the under faces of these three traveling perforated bands so that each sheet is supported throughout its entire length at three different points as it is carried along by these bands. As has been mentioned above, the suction in the middle chambers 37 of the three shoes is constant, that is, not intermittent, as takes place in the two end chambers of each shoe, so that the sheets receive the proper supporting suction as they pass beneath these middle chambers. When the sheet reaches a position closely adjacent to the bottom gages 91 and the side gage 112, the suction in the three end chambers 38 is cut off by the movement of the valve 75, which, at the same time applies the suction to the three chambers 36 as explained above. The suction having been removed from the chambers 38, the sheet drops from its three supporting perforated bands on to the table 20 adjacent to the various gages. As the forward portion of the paper passes beyond the chambers 38, even before the suction in such chambers is removed, the supporting-suction on such part of the paper is eliminated because the perforated bands pass beyond the chambers 38, so that the front edge of the paper drops or bends downwardly to the table, possibly slightly in advance of the action of the valve 75. It should therefore, be apparent that the sheets of paper are conveyed or carried individually from the pile to that part of the feed-table adjacent to the cylinder, and that approximately at the same time that the

sheet is being delivered to the table near the gages, another sheet is being picked up from the pile.

After the sheet has been dropped on to the feed table and tongues 92 as explained, the rotating suction-shoes 93 pass beneath or enter the slots of the tongues and act to pull the sheet of paper forwardly accurately into register with the bottom gages 91, which arrest the sheet in the desired position, preventing further forward travel even though the rotary shoes attempt to pull the sheet farther in that direction. As has been fully explained above, the shutting off of the suction in the three chambers 38 occurs substantially simultaneously with the application of the suction to the rotary shoes 93, the valve 75 controlling the reduced air pressure or suction in all of these parts.

The sheet having been properly and accurately registered with the bottom guides 91 the valve 103 is opened by the action of its controlling cam 106, whereby suction is applied to the sliding shoe 108 and the two recessed members 122. At about the same time the shoe 108 is slid outwardly by the action of cam 120 on roller 119 of rod 116, the result being that the relatively fixed shoe 122 at the farther side of the printing press acts to restrain the sidewise movement of the paper by the outward moving of the shoe 108 and its extension 110 sliding under the side gage 112, but the sidewise pull of the suction-action of the sliding shoe 108 is greater than the restraining influence of the two fixed shoes 122 so that the sheet is slid laterally into proper engagement and register with the side-gage 112, and at the same time, any wrinkles or bulges in the paper are straightened out by the restraining influence of the two shoes 122, and the paper is held straight by the action of such pair of shoes, at least, until the grippers 90 of the cylinder grasp the sheet and carry it away properly held on the cylinder. It should therefore, be apparent that the sheets are individually taken from the pile, transported to the other end of the feed-table by the perforated suction bands, and properly brought into engagement with the gages and in flat condition for transfer to the gripper-equipped cylinder.

In Fig. 13 I have illustrated some supplemental devices which may be employed if found to be desirable or necessary. In that case the feed-table 131 is equipped with a plurality of perforated belts or bands 132 passing around suitable pulleys or drums 133 and 134, the latter being rotated by any approved means. Each one of these endless tapes passes through a slot or recess in the table 131 and beneath the top stretches of each of such bands 132 is a suction chamber 135 slotted on its top, the slot being closed by the perforated band so that when the sheets drop upon the table and these series of perforated bands or belts 132, the sheets are carried forwardly against the bottom gages 91 by the forward travel of the bands and the suction exerted on the paper through the bands.

In addition, as I have illustrated in Fig. 13, a secondary or supplemental rotary suction-shoe, slotted as is required, may be provided for acting on the top of the forward portion of the sheet of paper to advance it or assist in advancing it to the bottom gages 91. Such shoes 136 may be rotated or oscillated by any improved mechanism, but in the present instance, in Fig. 13, I have shown the shoe as being rotated by means of a pulley or sprocket wheel 137 coöperating with which is a belt or sprocket chain 138, suitably driven. These various means for bringing the paper down into register with the bottom gages may be used individually or any two or more used jointly.

In some instances it may be desirable to pull the sheet laterally against the side gage at the opposite side of the press than that which has been illustrated, and the construction is such that the shoe 108 and its associated parts may be readily employed at the opposite side of the press, but in order to make such shoe reciprocate in proper relation to the action of the other parts, the cam 120 must be reversed. In the device as shown in Figs. 2 and 9 this reversal is made possible, since the disk 121 is not only provided with a hole for accommodating the pin or bolt 139, but is also equipped with another hole 140 in which the bolt or pin 139 may be inserted to retain the cam 120 in a position at 180 degrees to that shown in Fig. 2. In other words, the position of the cam 120 is adjustable about the axis of shaft 86, being capable of assuming two positions 180 degrees apart, the position employed for the cam depending upon which side gage is to be used for registering the paper.

If it is found that the paper does not readily drop from the plurality of perforated tapes 41, 42 and 43 when the suction is cut off from the three chambers 38, by a slight modification of the device atmospheric air or even compressed air may be readily admitted to such chambers to assist in the separation of such sheet from the bands, to facilitate its dropping upon the feed-board.

While I have herein illustrated and shown a few embodiments of this invention, it is to be understood that the latter is in no way restricted and limited to the precise and exact details of construction described and shown, because the invention is susceptible of a variety of embodiments without departure from its substance and with-

out the sacrifice of any of its substantial benefits and advantages.

I claim:

1. In a paper transporting device, the combination of a plurality of suction shoes, each having an opening in the bottom wall thereof, a plurality of bands each encircling one of said shoes and arranged to travel over the opening therein, said bands being provided with perforations adapted to coincide with said shoe openings whereby suction is exerted through said perforations, means for imposing a sheet of paper against the lower faces of the bands so that the sheet is supported on the bands by suction, and means for moving the bands along the shoes to transport the sheet of paper, substantially as described.

2. In a paper transporting device, the combination of a suction shoe comprising a plurality of non-communicating compartments each having an opening in one wall thereof, a band arranged to encircle said shoe with one travel thereof disposed over the openings of said compartments, said band being provided with perforations adapted to coincide with the openings in said compartments whereby suction may be exerted through said perforations, means for imposing a sheet of paper against the lower face of said band, and means for moving the band along the shoe to transport the sheet of paper, substantially as described.

3. In a paper transporting device, the combination of a suction shoe provided with a longitudinally extending opening in the bottom wall thereof, a band provided with perforations adapted to coincide with said shoe opening, said band being arranged to travel outside of and adjacent to the bottom wall of the shoe, means for elevating one edge of a sheet of paper into coöperative relation with said band, and means for moving the band along the shoe to transport the sheet of paper, substantially as described.

4. In a paper transporting device, the combination of a suction shoe provided with a longitudinally extending opening in the bottom wall thereof, a band provided with perforations adapted to coincide with said shoe opening, said band being arranged to travel adjacent to the outer face of the bottom wall of the shoe, an air-blast for imposing a sheet of paper against said band, and means for moving the band along the shoe to transport the sheet of paper, substantially as described.

5. In a paper transporting device, the combination of a suction shoe provided with an opening in its bottom wall, a flexible band arranged to travel longitudinally of the shoe and across the mouth of the said opening therein, means for intermittently applying suction to said shoe to produce a suction through said band, means for imposing a sheet of paper against the band, and means for moving the band along the shoe to transport the sheet of paper held to the band by suction, substantially as described.

6. In a paper transporting device, the combination of a hollow suction shoe having an opening through a wall thereof, a perforated flexible traveling member adapted to travel in contact with the outer face of said wall and over the opening of said shoe whereby the suction is applied to a sheet of paper through the perforations of said member, an air-blast adapted to impose a sheet of paper against said member, and means to cause said member to travel along said shoe opening at a variable speed, substantially as described.

7. In a paper-transporting device, the combination of a hollow suction-chamber open through its continuous bottom wall, a perforated endless band positioned to have a portion thereof underlying the opening of said chamber to close the opening, whereby the suction is applied to the sheet of paper through the perforations of the band, means to cause said endless band to travel along said opening, and air-blast means to raise a portion of the top sheet of a pile of sheets of paper initially into operative relation to the band, whereby the latter by means of the suction may remove such top sheet from the pile, substantially as described.

8. In a paper-transporting device, the combination of a hollow suction-shoe having a continuous bottom wall with a slot therein, a perforated endless band having a portion thereof underlying and closing the opening of said shoe, whereby the suction is applied to the sheets of paper through the perforations of the band, means to cause said band to travel along said opening, and means to apply an air blast to the sheet of paper to be transported by said band to bring said sheet initially into the field of action of the suction of such band, substantially as described.

9. In a paper transporting device, the combination of a hollow suction shoe divided into a plurality of chambers each having an opening in one wall thereof, a perforated member adapted to cover the openings of said shoe whereby suction is applied to the sheet of paper through the perforations of said member, means for varying the suction in one or more of said chambers, and means to cause said perforated member to travel along said shoe opening and carry a sheet of paper therewith, substantially as described.

10. In a paper-transporting device, the combination of a hollow suction-shoe open through its continuous bottom wall, an endless perforated band having a portion there-

of underlying the bottom of said shoe, whereby the suction is applied to the sheet of paper through the perforations of the band, means to cause said perforated band to travel along the opening of the shoe, and means to modify automatically in timed relation to the travel of the sheet the degree of suction in said shoe, substantially as described.

11. In a paper-transporting device, the combination of a hollow suction-shoe open through a wall thereof, a perforated traveling member adapted to cover the opening of said shoe, whereby the suction is applied to the sheet of paper through the perforations of said member, and means to cause said perforated member to travel along said shoe opening at a variable speed, substantially as described.

12. In a paper-transporting device, the combination of a hollow suction-shoe divided into a plurality of non-communicating chambers each open through a wall thereof, a perforated traveling member adapted to close the openings of said chambers, whereby the suction is applied to the sheet of paper through the perforations of said member, means to vary the degree of suction in one or more of said chambers, and means to cause said perforated member to travel along the openings of said shoe, substantially as described.

13. In a paper-transporting device, the combination of a hollow suction-shoe divided into a plurality of chambers each having an opening through a wall thereof, a perforated traveling member covering said openings, whereby the suction is applied to the paper through the perforations of said member, means to vary the degree of suction in one or more of said chambers, and means to move said perforated member at a variable speed, substantially as described.

14. In a paper-transporting device, the combination of a hollow suction-shoe divided into a plurality of chambers each having an opening through a wall thereof, a traveling perforated member covering said openings, whereby the suction is applied to the paper through the perforations of said member, means to cause said perforated member to travel, and means to apply the suction to one of the chambers and remove the suction from another of said chambers, substantially simultaneously, substantially as described.

15. In a paper-transporting device, the combination of a hollow suction-shoe divided into a plurality of chambers, each having an opening through a wall thereof, a traveling perforated member covering said openings, whereby the suction is applied to the paper through the perforations of said member, means to cause said perforated member to travel at a variable speed, and means to apply the suction to one of said chambers and remove the suction from another of said chambers substantially simultaneously and while said member is substantially stationary, substantially as described.

16. In a paper-transporting device, the combination of a hollow suction-shoe divided into a plurality of independent chambers each having an opening through a wall thereof, a traveling perforated member closing said openings, whereby the suction is applied to the paper through the openings of said member, means to cause said perforated member to travel, means to apply a substantially constant suction to one or more of said chambers of said shoe, and means to vary the degree of suction in one or more of the chambers of said shoe, substantially as described.

17. In a paper-transporting device, the combination of a plurality of hollow suction-shoes each having an opening in its continuous bottom wall, a plurality of endless perforated bands each having a portion thereof underlying the bottom opening of one of said shoes, whereby the suction is applied to the sheets of paper through the perforations of the bands, and means to cause said perforated bands to travel along the openings of their shoes, the bottom walls of said shoes constituting guides for said bands respectively, substantially as described.

18. In a paper-transporting device, the combination of a hinged frame, a plurality of hollow suction-shoes mounted on said frame and open through their bottom walls, pulleys mounted on said frame, endless perforated bands passing around said pulleys and each having a portion thereof underlying the bottom opening of one of said shoes, whereby the suction is applied to the sheet of paper through the perforations of the bands, and means to rotate said pulleys to cause said perforated bands to travel along the openings of their shoes, substantially as described.

19. In a paper-transporting device, the combination of a pair of shafts, a suction shoe mounted on said shafts, means to adjust said shoe along said shafts, said shoe having an opening through the bottom wall thereof, pulleys on said shaft, an endless perforated band passing around said pulleys outside of said shoe and covering the opening of said shoe, whereby suction is applied to the sheet of paper through the perforations of said band, and means to cause said pulleys and band to be shifted along said shafts simultaneously with the adjustment movement of said shoe, substantially as described.

20. In a device of the character described, the combination with a support adapted to hold a plurality of sheets of an air-blast nozzle, and a deflector above and against which the air-blast is discharged, whereby the edge portion of the top sheet may be

raised by the blast, substantially as described.

21. In a device of the character described, the combination of a pair of air-blast nozzles, and a deflector above and against which the air-blast from one of said nozzles is discharged, whereby the edge portion of the top displaced sheet of a pile of sheets may be raised by the blast directed against the deflector, the other nozzle discharging against the sheets of the pile to fluff or separate the same, substantially as described.

22. In a paper transporting device, the combination of an endless band; means for applying suction through the lower stretch of said band, means for feeding a sheet of paper into operative relation with the band, and means for intermittently actuating said band co-related with the operation of said feeding means so that the band is stationary when a sheet of paper is fed thereto but is subsequently actuated to withdraw said sheet from a pile, substantially as described.

23. In a paper transporting device, the combination of an endless band, means for applying suction through the lower stretch of said band, means for periodically forwarding said band, and means for decreasing the suction at one end of the band between the successive forwarding periods, substantially as described.

24. In a paper transporting device, the combination of an endless band, means for applying suction through the lower stretch of said band, means for periodically forwarding said band, and means for increasing the suction at one end of the band between the successive forwarding periods, substantially as described.

25. In a paper transporting device, the combination of an endless band, means for applying suction through the lower stretch of said band, means for periodically forwarding said band, and means for decreasing the suction at one end of the band and increasing the suction at the other end of the band between successive forwarding periods, substantially as described.

26. In a paper transporting device, the combination of a sheet conveyer, means for causing said conveyer to travel periodically with a varying speed in one direction on means for bringing a sheet of paper in carrying relation with said conveyer wh said conveyer is substantially at rest, a means for discharging said sheet out of carrying relation with said conveyer when the conveyer is substantially at rest at the end of a travel period, substantially as described.

27. In a paper transporting device, the combination of an endless band, means for applying suction through the lower stretch of said band, means for periodically forwarding said band, and means for controlling the suction at the ends of said band synchronously with the movement of the band, substantially as described.

28. In a paper transporting device, the combination of an endless band, means for applying suction through said band, means for periodically forwarding said band, and controlling means for alternately inducing and discontinuing the suction adjacent the ends of the band and synchronously w the movement of said band, substantiall described.

29. In a device of the character describ the combination of a belt conveyer, means for periodically actuating said conveyer, intermittently operated suction means for attaching a sheet of paper to the conveyer while the conveyer is substantially at rest, and intermittently operated means for releasing the sheet while the conveyer is substantially at rest at the end of a periodic actuation, substantially as described.

30. In a paper transporting mechanism, the combination of an elongated suction shoe divided by transversely disposed partitions into a plurality of compartments, drums mounted at the ends of said shoe, a perforated tape adjusted to travel around said drums in proximity to one wall of said shoe, and a device for automatically and periodically introducing and discontinuing suction in said compartments in succession, substantially as described.

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