Jan. 7, 1958 P. H. WENDT ET AL 2,819,076

PAPER-HANDLING APPARATUS

Filed April 29, 1955 3 Sheets-Sheet 1

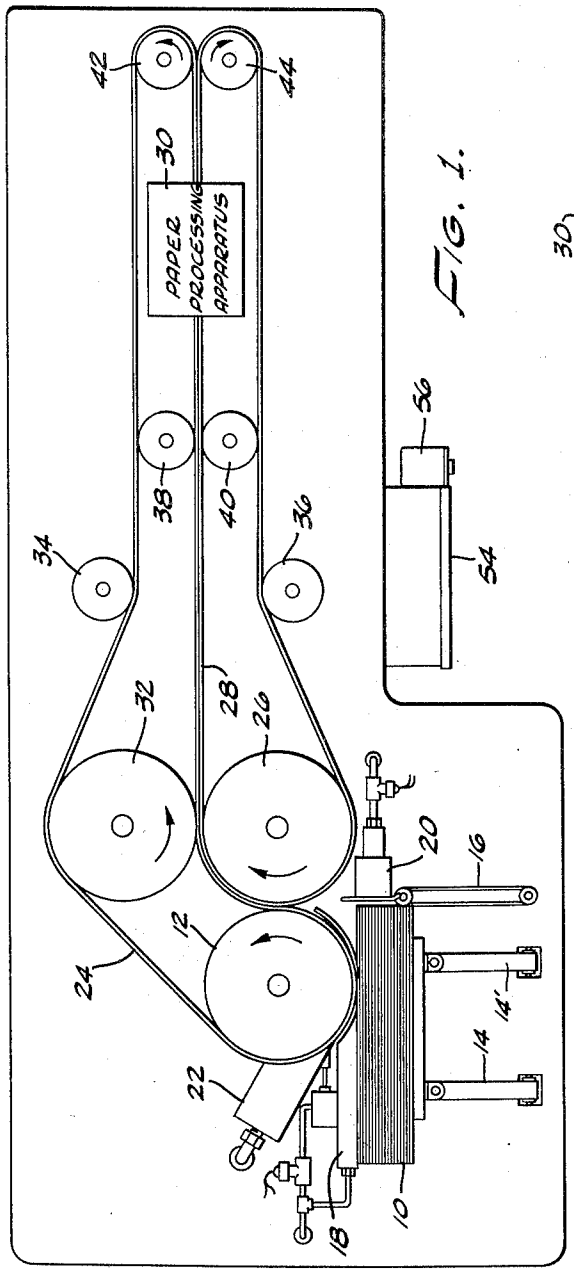


FIG. 1.

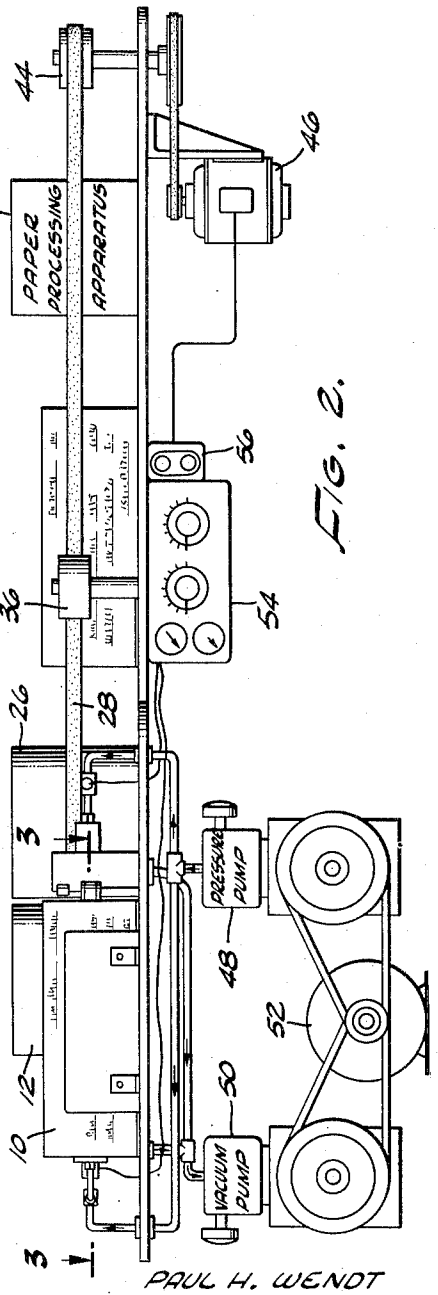


FIG. 2.

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PAPER-HANDLING APPARATUS

Filed April 29, 1955 3 Sheets-Sheet 2

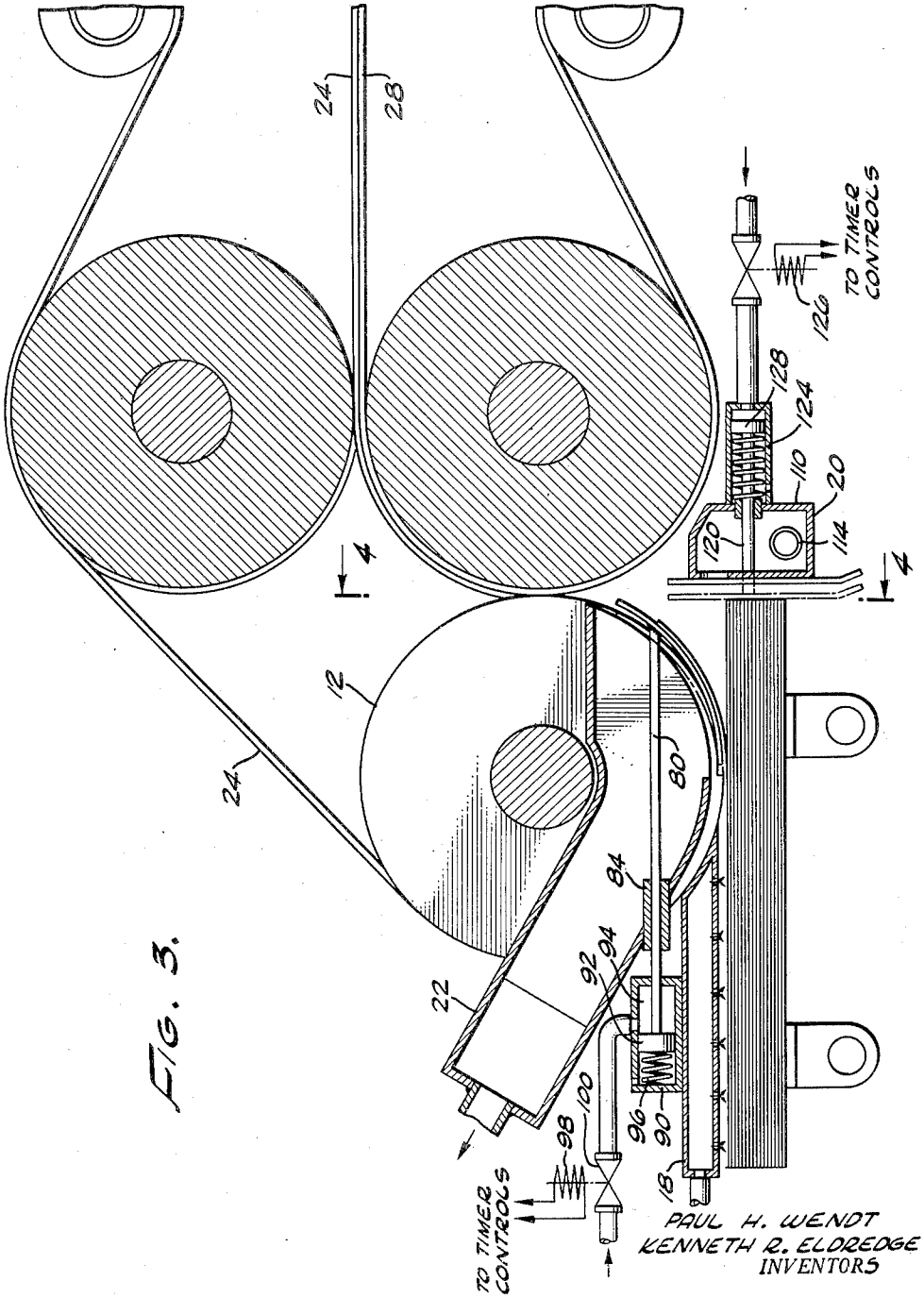


FIG. 3.

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Filed April 29, 1955 3 Sheets-Sheet 3

FIG. 4.

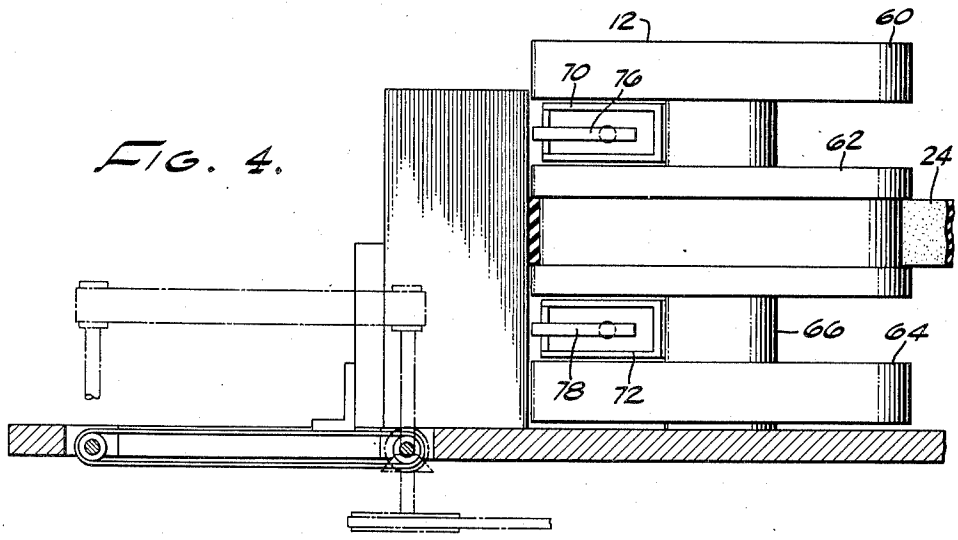
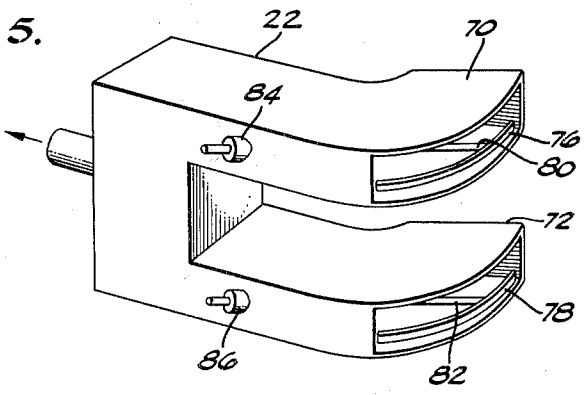


FIG. 5.



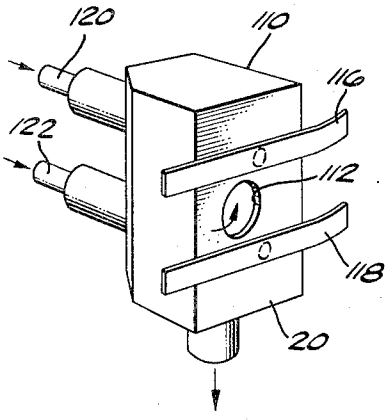


FIG. 6.

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United States Patent Office

2,819,076

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2,819,076

PAPER-HANDLING APPARATUS

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Application April 29, 1955, Serial No. 504,708

9 Claims. (Cl. 271—27)

This invention relates to paper-handling machinery and, more particularly, is an improved apparatus for separating single sheets from a stack.

An object of the present invention is to provide improved apparatus for separating single sheets from a stack.

A further object of the present invention is to provide apparatus which only picks up one sheet at a time.

Still another object of the present invention is to provide apparatus which can separate sheets from a stack singly and at a high speed.

The above and other features of the invention are achieved in apparatus wherein there is a shaft upon which three cylinders forming a separating drum are rotatably mounted spaced apart. In the space provided between the cylinders there is inserted a vacuum nozzle, the ends of which terminate within the periphery of the adjacent cylinders. This vacuum nozzle extends over an arc of the discs for a distance for which it is desired that the separated sheets be conveyed by the assembly. Extending from the opening of the nozzle are fingers which are arcuate to conform with the curve of the cylinders. These fingers are employed to prevent a sheet which adheres thereto, by virtue of the suction from the nozzle, from being brought in contact with the surface of the cylinders. One end of the suction nozzle is positioned adjacent the forward portion of a top sheet of a stack. The suction causes such forward portion of the top sheet to be drawn up toward the rotating cylinders. However, the fingers which extend beyond the periphery of the cylinders prevent such sheet from being moved by the rotating cylinders.

When it is desired to advance the top sheet the fingers are withdrawn into the suction nozzle. This enables the sheet to be pulled against the surface of the cylinders. The cylinder surfaces are ridged to increase the friction between the sheet and the surface. Accordingly, the sheet is moved away from the stack by the rotating cylinders to other handling apparatus which can then process it as desired. Means are provided to prevent more than one sheet from being conveyed by the drum. Further means are provided to facilitate the removal of the top sheet of the stack from the remainder of the stack.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

Figure 1 is a plan view of the apparatus employing this invention;

Figure 2 is a side view of the drawing shown in Figure 1;

Figure 3 is a section along the line 3—3 of Figure 2 and shows details of an embodiment of the invention;

Figure 4 is a section along the line 4—4 of Figure 3

showing the placement of the vacuum nozzle between the cylinders;

Figure 5 shows the vacuum nozzles which are employed in the present invention; and

Figure 6 illustrates the apparatus employed to insure that only a single sheet is removed at a time from the stack.

Referring now to Figures 1 and 2, a stack of sheets **10** which are to be separated in a sequence of one sheet at a time are placed upward against what can be considered as a separating drum **12** which is comprised of three spaced cylinders. The stack is urged against the drum by virtue of two vibrator belts **14**, **14'** and a rotating belt **16**. A box **18** having perforations therein which open onto the top sheet of the stack **10** is employed to facilitate the removal of the top sheet. Compressed air is fed into the box from a source, not shown, which passes through and around the top sheet to literally float it on a cushion of air away from the sheet beneath it. A mechanism **20** is provided on one side of the sheets which prevents more than one sheet from being drawn upward by the vacuum provided by the nozzles **22** which extend into slots in the drum **12**. A belt **24** passes over the removing drum and in combination with another drum **26** and belt **28** supports the top sheet of the stack which has been removed and conveys it to paper-processing apparatus **30**. The drum **32** and rollers **34**, **36**, **38**, **40**, **42**, and **44** all serve to maintain the two belts **24** and **28** tightly pressed against one another so that the sheets are firmly held therebetween. As may be seen in Figure 2, an electric motor **46** drives the cylinders which help to maintain the belt stretched and the apparatus moving. A pressure pump **48** and a vacuum pump **50** are required and are driven from a suitable motor **52**. Control apparatus **54** for varying the speed of operation to a desired value are represented by the panel and controls **54**. Also shown are the stop-start buttons **56** for the entire apparatus.

Referring now to Figures 3 and 4, a cross section of an embodiment of the invention may be seen. A drum **12** may either be considered as being made up of three spaced apart discs or cylinders **60**, **62**, **64** which are mounted on a shaft **66** to be rotatable therewith or alternatively this may be considered as a cylindrical drum which has had diametrical grooves machined therein. A vacuum nozzle **22** has a double terminal portion **70**, **72**, each of which is inserted in the space between the cylinders **60**, **62**, **64**, in the manner shown in Figure 4. The vacuum is applied to the suction nozzles of the vacuum pump **50**. The terminations of the nozzle are just below the periphery of the cylinders. Accordingly, as a sheet is drawn to the drum by virtue of the suction from the nozzles, it is prevented from contacting the nozzles themselves by the periphery of the three cylinders. The openings of the nozzles extend over an arc which equals the desired arc of travel of a sheet from the stack.

As may be seen in Figure 3, the vacuum nozzle is positioned with one end over the portion of the stack at which it is desired to pick up a sheet. The nozzle terminates at a point where the leading edge of the sheet has already been grasped between the two belts **28**, **24**. Extending through the openings in the suction nozzle are two fingers **76**, **78**. These fingers are movable and are supported from push rods **80**, **82**. These push rods are supported in a bearing **84**, **86**, which extends through one side of each nozzle. The push rods each terminate in a motor member **90**. The end of each push rod has a piston head **92**.

In the absence of air inside the chamber **94**, a spring **96** urges the fingers to extend beyond the periphery of the cylinders. This prevents the top sheet of a stack, which

is caused to adhere to these fingers by reason of the suction from the nozzles, from being moved with the rotating cylinders. When it is desired to move this sheet, a solenoid **98** opens a valve **100** which permits air under pressure to enter into the chamber **94** and compress the spring **96**. Thus, the push rods **80**, **82** withdraw the fingers **76**, **78** into the vacuum nozzles. The top sheet of the stack is thus permitted to engage the rotating cylinders and is moved up until the leading edge is engaged engaged between the two belts. As soon as the leading edge of the sheet has been grasped by the belts the air pressure on the air motor is removed and the fingers are moved back into position to prevent a second sheet from being picked up and moved by the drum. As previously pointed out, a box **18** has air under pressure fed therein. This air is emitted through a plurality of openings in one wall of a box and serves to flow this air around the top of a top sheet and therethrough, so that it is literally floated above the sheet in the stack which is underneath. The operation of this device has been described in detail and claimed by Alonzo W. Noon in an application filed December 20, 1954, Ser. No. 476,444, for a Sheet-Separating Device, and assigned to this assignee.

It will be noted that one of the belts **24** fits into a groove in the middle cylinder. This is done for two reasons: first, to rotate the assembly by reason of the drive applied to the belt, and, second, to enable the removal of a sheet from the suction nozzle.

Prevention of more than one sheet being picked up at a time is insured further by the mechanism **20**, which is shown in cross section in Figure 3 and in further detail in Figure 6. This consists of a box **110**, which has an opening **112** in the face opposite the edges of the top sheets of the stack. Suction is applied to the box through a second opening **114**. When the top sheet of a stack is drawn against the fingers and/or the drum, the sheet serves to effectively block the suction nozzle portals from which the suction is provided. The suction through the opening **112**, accordingly, is free to act on any sheet which adheres or follows the top sheet. Thereby, only the top sheet is held against the separating drum. The remaining sheets are held back by suction in the stack.

It has been determined, however, that occasionally when a top sheet is being pulled up to the removing drum, a following sheet will move upward part-way and then by virtue of the suction from the opening **112** will be drawn to block such opening and will adhere to the box **110**. In order to prevent the blocking and thus the disabling of the mechanism, two members **116**, **118** are employed which are positioned to extend in the direction of the stack of sheets. These members are separately mounted on push rods **120**, **122**. Each push rod is held by means of a spring **124**, so that the members **116**, **118** are flat against the face of the box. When a top sheet is drawn up toward the separating drum, the solenoid **126** is operated to permit air to push against the piston head **128** to the top of the push rod **120**. This serves to jog the stack of sheets away from the opening **112** a slight distance. Such rapid jogging prevents the following sheet from clogging the opening **112** but is not sufficient to cause a loss of the effect of the suction through the opening **112**, whereby such following sheet is prevented from also being drawn up to the separating drum.

The speed of operation of the device may be easily adjusted by controlling the speed of driving the belts from the electric motor **46**. The movement of the fingers and the members for moving the top sheet and preventing the following sheets from clogging the opening **112** where desired, may be timed electronically with the speed of the operation of the apparatus. Both solenoids **98** and **126** are excited simultaneously to remove a sheet from the drum and to permit the top sheet on the stack to take its place. It should also be noted that this invention may be employed to provide a "demand feed" type of operation by exciting the two solenoids whenever it is desired to feed the next sheet. The length of the documents which can be handled by this machine is limited only by the speed at which the machine runs and by the frequency at which it is desired to feed such documents or pieces of paper. For example, if the belt conveyor travels at a speed of 100 inches per second, one sheet or document slightly less than 100 inches long or 20 documents slightly less than five inches long may be fed by the machine each second. As pointed out previously, the variations in feeding speed can be accomplished simply by varying the time intervals at which the solenoids **98** and **126** are excited.

To summarize its operation, the stack of sheets is urged against the separating drum or cylinders. The top sheet of the stack is first floated by air from the box **18** and then is sucked up against the cylinders but is held from frictional contact therewith by reason of the fingers. This blocks suction from being applied to the following sheet. The following sheet is also held by the suction from the device **20**. Clogging of the device **20** at the time of pick-up of the top sheet is prevented by a slight jog received by the remaining stack from the members **116**, **118**. The fingers **76**, **78** are retracted into the vacuum nozzle, thus enabling the top sheet to adhere to the surface of the rotating cylinders and be moved between the two belts **24**, **28** to further processing apparatus. At this time the fingers are allowed to extend from the suction nozzle again. The next sheet is then picked up. Thus, high-speed separation of a stack into single, sequential sheets can be attained. A further feature of this invention is that the succeeding sheets are not picked up at one end but rather are pulled or bent upward in a folding-unfolding or peeling type of movement as the sheet on the drum is pulled away therefrom. This further assists the separation of the two top sheets.

There has been shown and described hereinabove new, novel and useful apparatus for separating sheets singly from a stack.

We claim:

1. Apparatus for separating sheets from a stack comprising a drum having a groove, means to rotatably support said drum with its periphery in proximity to said stack of sheets, stationary suction means in and extending along a portion of said groove, a movable finger extending outward from said suction means and away from said drum surface, and means to retract said finger into said suction means to permit a sheet from said stack to be drawn against said drum surface to be movable therewith.

2. Apparatus for separating sheets from a stack comprising a drum having a circumferential groove, means to rotatably support said drum with its periphery in proximity to the top sheet of said stack of sheets, means to apply air under pressure to the top sheet of said stack of sheets adjacent one side of said drum, means to apply suction to the edges of sheets near the top of said stack which edges are extending at the other side of said drum, stationary suction means in and extending along a portion of said circumferential groove over said top sheet of said stack, a movable finger extending outward from said vacuum means and away from said drum surface, and means to retract said finger into said suction means to permit the top sheet from said stack to be drawn against said drum surface to be movable therewith.

3. Apparatus for separating sheets from a stack comprising a drum having a circumferential groove, means to rotatably support said drum with its periphery in proximity to the top sheet of said stack of sheets, means to apply air under pressure to the top sheet of said stack of sheets adjacent one side of said drum, means to apply suction to the edges of sheets near the top of said stack located furthest away from where said air under pressure is applied, stationary suction means in and extending along a portion of said circumferential groove over said top sheet of said stack, a movable finger extending out-

ward from said stationary suction means and away from said drum surface, means to retract said finger into said suction means to permit the top sheet from said stack to be drawn against said drum surface to be movable therewith, a push rod positioned within said means to apply suction to the edges of sheets, and means to actuate said push rod to move said sheets near the top of said stack away from said means to apply suction to the edges of sheets and to be retracted while said top sheet is drawn against said drum by said stationary suction means.

4. Apparatus for separating sheets from a stack comprising a rotatably supported shaft, three cylinders mounted on said shaft spaced from one another, a pair of vacuum nozzles respectively inserted in the spaces between said cylinders, said nozzles terminating in the space between and below the peripheries of said cylinders, said nozzles extending over a desired arc of carry of sheets by said apparatus, a pair of movable fingers extending through said pair of vacuum nozzles and beyond the periphery of said cylinders, and means to retract said fingers into said nozzles and within the periphery of said cylinders when it is desired to separate a sheet from a stack.

5. In apparatus as recited in claim 4 wherein each of said cylinders has axial ridging to prevent sheet slippage and the cylinder in the center has a peripheral groove to permit insertion of a conveyor belt therein.

6. In apparatus as recited in claim 4 wherein said pair of movable fingers includes a pair of arcuate members supported by a pair of rods, said pair of rods extending within said pair of vacuum nozzles.

7. In apparatus for separating sheets from a stack, a rotatably supported shaft, three cylinders mounted on said shaft spaced from one another, a pair of vacuum nozzles respectively inserted in the spaces between said cylinders, said nozzles each having an arcuate opening which is below the periphery of the cylinders and which extends over a desired arc of carry of said sheets by said apparatus, means to urge a stack of sheets toward the

portion of said cylinders wherein one end of said vacuum nozzles occur to position a portion of the top sheet of said stack adjacent the arcuate opening of said nozzles, means to apply suction to the edges of said stack of sheets which are adjacent to the openings of said nozzles, means to apply air under pressure to the remaining portion of a top sheet of said stack which is not adjacent the nozzle openings, a pair of arcuate movable fingers extending through said pair of vacuum nozzles and beyond the periphery of said cylinders, and means to retract said fingers into said nozzles and within the periphery of said cylinders when it is desired to separate a sheet from a stack.

8. In apparatus as recited in claim 7 wherein said means to apply suction to the edges of said stack includes a box having an opening through which said suction is applied, a flat member mounted on either side of said opening, said flat members extending in the direction of the thickness of said stack of sheets for a plurality of sheets, and means to arcuate said flat members to deliver a push away from said box nozzle opening whenever said fingers are retracted within said nozzles.

9. In apparatus as recited in claim 7 wherein the one of the three cylinders which is in the center is grooved, a first moving conveyor belt passes into and out of said groove to rotate said three cylinders, and a second conveyor belt is positioned adjacent said first conveyor belt substantially where said suction nozzle terminates, said second conveyor belt moving in pressing contact with said first belt carrying therebetween a sheet which has been removed from the top of said stack.

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U. S. DEPARTMENT OF COMMERCE

PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,819,076 Paul H. Wendt et al. January 7, 1958

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 10, strike out "engaged"; line 36, after "drawn" insert --up--; column 6, line 20, for "arcuate" read --actuate--.

Signed and sealed this 10th day of June 1958.

(SEAL)
Attest:
KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON
Commissioner of Patents