

United States Patent

Arnell

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[54] SHEET FEEDING DEVICE

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[51] Int. Cl. B65h 3/10

[58] Field of Search 271/29, 32, 27

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[57] ABSTRACT

A high speed sheet feeding device which removes a single sheet of paper from the bottom of a stack by suction means and drives the sheet into transport rollers. Fully mechanical means are employed to substitute a blast of air for the suction means after the sheet has been grasped by the transport rollers. Freed of the influence of the suction means, the sheet is more positively and quickly drawn from the stack without danger of wrinkling, tearing, etc.

2 Claims, 6 Drawing Figures

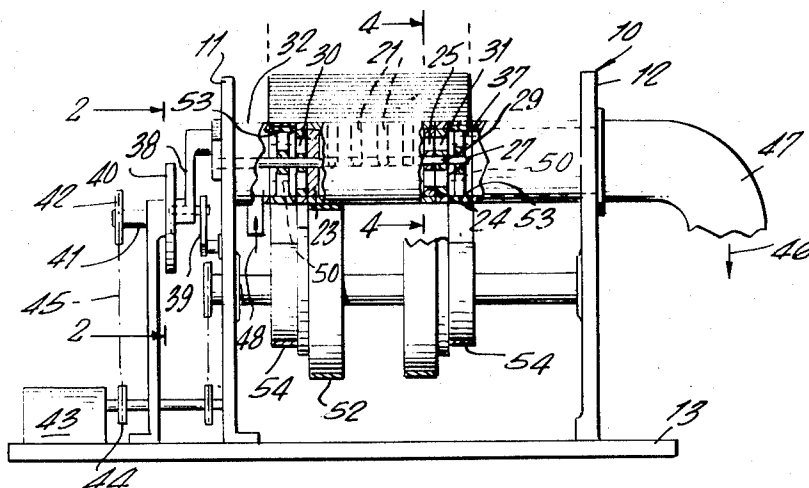


FIG. 1

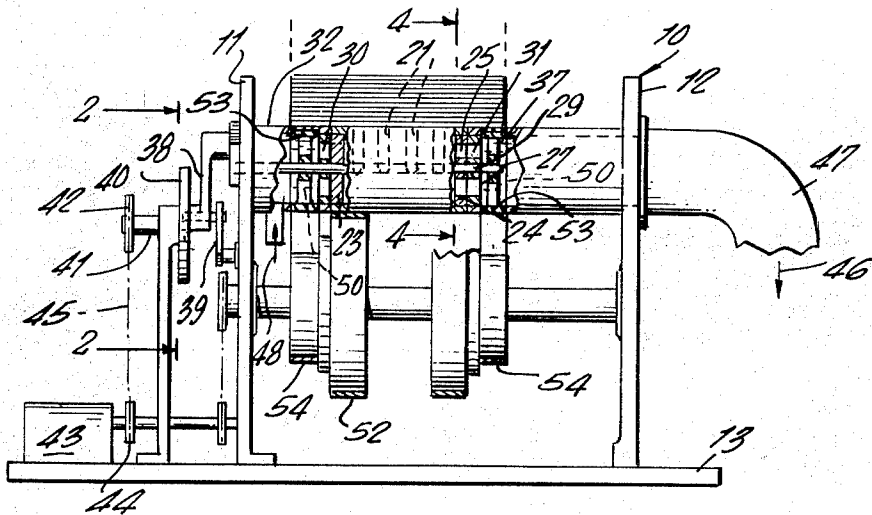


FIG. 2

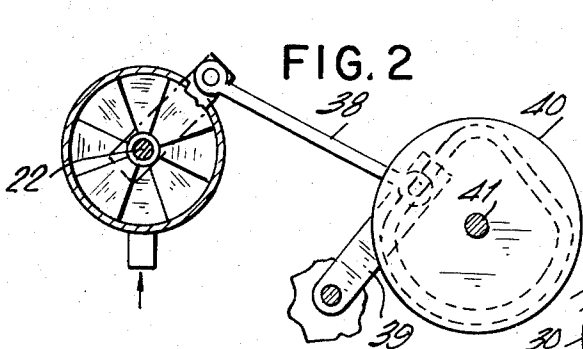


FIG. 3

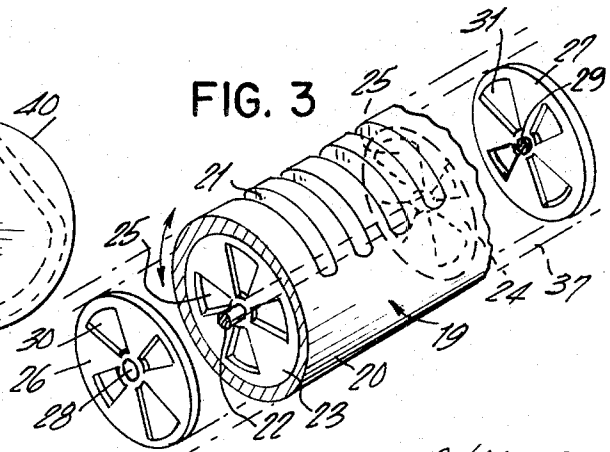


FIG. 4

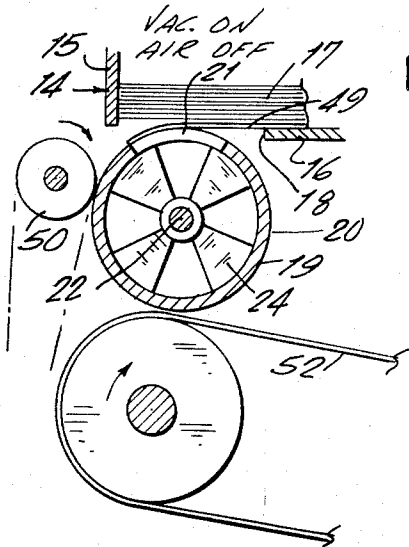


FIG. 5

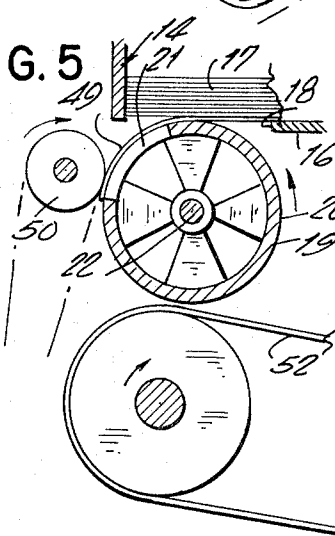
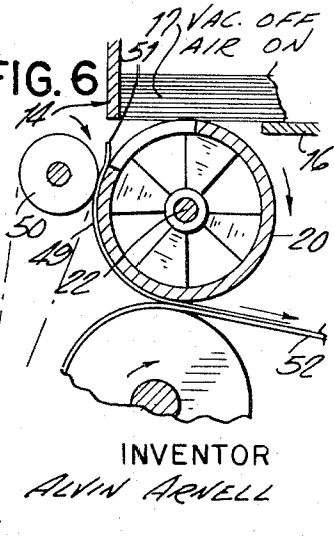


FIG. 6



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SHEET FEEDING DEVICE

BACKGROUND OF THE INVENTION

Sheet feeding devices which pick a single sheet from the bottom of a stack and feed the individual sheets into a machine for subsequent cutting, printing, or the like are well known and have been used for many years. However, such devices have several shortcomings particularly where thin sheets are used and fed at high speeds. Thin sheets tear, wrinkle, and become misaligned in devices which hold the sheet on a rocking cylinder by means of suction and then pull said sheet across the suction means while it is fed into the subsequent operations. Uneven feed of such sheets results in wrinkling skewing and other feeding problems. Some prior art devices have depended upon highly complicated electro-mechanical means incorporating valves for turning the vacuum off after the sheet has been fed into the nip of the first set of transport rollers. Such devices are complicated, relatively slow, and prone to frequent breakdowns.

In the present invention, after the leading edge of the sheet has been delivered to the nip of the first set of rollers of a conveyor system, the suction means is replaced by a blast of air which effectively freezes the remainder of the sheet from the suction roller without tearing it or applying any unnecessary mechanical stresses. The change from suction to air is accomplished by completely mechanical means operating cut-off valves built into the suction roller upon which the sheets are advanced into the transport mechanisms. In addition, successive sheets are not pulled downwardly prematurely as the result of suction remaining on at all times.

Accordingly, a feature of the present invention is the use of a highly simplified suction and air control valving system. Another feature of the invention is the sealing means for shutting off the suction system when air under pressure is used to separate the trailing portion of the sheet from the suction roller. Still another feature of the present invention is its rugged all mechanical valving structure.

For a better understanding of the present invention, together with other details and features thereof reference is made to the following description taken in connection with the accompanying drawings, in which drawings similar parts have been given identical reference numerals.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is an end view partly broken away, with some parts omitted for the sake of clarity of a sheet feeding device according to the present invention.

FIG. 2 is a cross-sectional view taken along line 2 — 2 of FIG. 1 looking in the direction of the arrows showing the valve actuating cam mechanism of the feeding device.

FIG. 3 is a somewhat exploded view of the suction feeding device and associated cut-off valves.

FIG. 4 is a somewhat diagrammatic view of a portion of the sheet feeding device taken generally along line 4—4 of FIG. 1 showing the start of the sheet feeding cycle.

FIG. 5 is a view similar to FIG. 4 showing the manner in which the sheet is carried into the nip of the first roller.

FIG. 6 is a view similar to FIGS. 4 and 5 showing the sheet being transported and the suction roller returning to its initial position, for feeding a succeeding sheet.

SUMMARY OF THE INVENTION

The present invention contemplates a device in which a stack of sheets is carried upon a table with the lower most sheet resting upon a suction roller. Cut-off valves are built into each end of the suction roller whereby a source of vacuum may be applied to the interior of the suction roller and upon movement of said valves the suction source can be cut off and air applied to the interior of the suction roller. Cam means attached to the valves alternately apply suction and air as required to enable the suction roller to draw down one sheet at a time and return to its starting position at the end of each cycle.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing and particularly to FIG. 1; 10 indicates a sheet feeding built between spaced side plates 11, 12 mounted upon a base 13. A support table 14 shown in FIGS. 4 through 6 consisting of upstanding side walls 15 and a bottom 16 retains a stack of sheets 17 within the feeding device. The bottom 16 is apertured as indicated at 18 so that a portion of the sheets 17 rest upon a suction roller 19. The suction roller 19 best shown in FIG. 3 includes a cylindrical member 20 having a plurality of slots 21 therein. It will be understood that the size, spacing and length of the slots 21 may be varied depending upon the nature of the sheets to be fed, without departing from the present invention.

The suction roller 19 is rockably supported on a shaft 22 which is slipped through two end plates 23 — 24 at each end of the roller 20. The end plates 23 — 24 are provided with spaced openings 25 for a here-in-after more fully described purpose. The end plates 23 — 24, the roller 20 and the shaft 22 moves as a single unit with a rocking motion during the operation of the device.

A valve plate 26 — 27 is disposed at each end of the suction roller 19 and is provided with a central bore 28 — 29 through which the shaft 22 extends. The valve plates 26 — 27 together with the end plates 23 — 24 form cut-off valves at each end of the suction roller 19. The valve plates 26 — 27 are provided with openings 30 — 31 which correspond in size and location to the openings 25 in the end plate 23 — 24 of the suction roller 19. The valve plates 26 — 27 are further secured at each end to conduits 32 — 37 (see FIG. 1) which conduits together with the suction roller 20 form a continuous path from one side of the frame 11 to the other side 12.

A crank arm 38 best shown in FIG. 2, is secured at one end of the shaft 22 and at the other end to the follower 39 of a cam 40. The cam 40 is driven by a shaft 41 having a pulley 42 at the outer end thereof. The pulley 42 in turn is driven by a motor 43 mounted upon the base 13 and having an output pulley 44 on the shaft thereof. A belt indicated by the dashed line 45 connects the pulleys 42, 44.

As the cam 40 rotates, it drives the crank arm 38 in a reciprocating manner. The crank arm 38 thereupon rocks the shaft 22 which in turn causes the suction roller 19 to oscillate back and forth in the manner shown in FIGS. 4, 5, 6.

A source of vacuum indicated by the arrow 46 is connected by means of a conduit 47 to the outer end of the conduit 37 as shown in FIG. 1. A source of air under pressure indicated by the arrow 48 is in communication with the interior of the conduit 32. The cut-off valves at each end of the suction roller 20 are so disposed, that when the source of suction is in communication with the interior of the roller 19, the air supply is cut off. When the roller 19 is rocked as the result of the feeding operation, the suction source 46 is cut off and the air supply can enter the roller 20 through the cut off valve on the opposite side.

Spaced rollers 53 are freely carried upon the conduits 32, 37 beneath the stack of sheets 17 as shown in FIG. 1. The spaced rollers are in tangential contact with a roller 50 driven by belt 54. Referring to FIGS. 4, 5 and 6, the operation of the sheet feeding device will become apparent. At the beginning of the cycle (shown in FIG. 4) the cut off valves are in a position where the source of suction can evacuate the roller 19 whereupon the bottom sheet 49 is pulled down upon the surface of the roller 19. The cam 40 rotates causing the suction roller 19 to move in a counter-clockwise direction and pull the sheet 49 into the nip formed by the roller 50 and the spaced rollers 53 on the suction roller 19. At this juncture, the continued motion of the cam 40 reverses the direction of the roller 19, thereby closing the cut-off valve to the suction source and opening the valve admitting air under pressure to the interior of the roller 19. The trailing edge 51 of the bottom sheet 49, is thus floated off the surface of the roller 20 and the sheet proceeds onto the transport belt 52 and then into the succeeding operation station as required.

It will be noted that as the result of the alternate application of air and suction, the suction has an opportunity to build up during the time when the cut-off valve controlling the suction is closed. As the cut-off valve for the suction is opened a sudden substantial amount of suction is available to pull the leading edge of the sheet 49 down upon the roller 19 for the next feeding operation.

As a result of the simplified cut-off valve mechanism complicated seals are not required at each end of the roller 19 and friction can be substantially eliminated by the application of a thin coating of some anti-friction material such as Teflon between the plates forming the cut-off valves. Since the device is completely mechanical, delicate and complicated electrical apparatus such as solenoids, switches, etc. are unnecessary, which leads to greater dependability of the device.

Having thus fully described the invention, what is claimed as new and desired to be secured by Letters Patent of the United States, is:

1. A sheet feeding device for removing and transporting individual sheets from the bottom of a stack comprising a base, spaced upstanding side plates on said base, a first conduit secured to one of the side plates, a second conduit secured to the other side plate, a suction roller assembly rockably carried between the first and second conduits to form a continuous passage therebetween, said roller assembly comprising a hol-

low cylindrical member having a plurality of elongated spaced openings therein, spaced end plates disposed at each end of the cylindrical member, spaced openings in each of the end plates, said cylindrical member being positioned against the bottom sheet of the stack, a first and second valve plate having openings therein carried by the first and second conduits in frictional contact with the end plate adjacent thereto, said valve plate openings being of a size and disposition such that the combined valve plates and end plates form cut-off valves at each end of the roller assembly, a source of air under pressure connected to the first conduit, a source of vacuum connected to the second conduit, spaced rollers freely carried by the conduits beneath the stack, a driven roller in tangential contact with the spaced rollers, means to rock the roller assembly to alternately open and close the cut-off valves to draw down the leading edge of the bottom sheet of the stack by suction, carry the sheet into the nip of the spaced and driven rollers, and free the trailing edge of the sheet after the sheet has entered the nip, and means to transport the sheet after it leaves said nip.

2. A device according to claim 1 in which the cut off valve of the first conduit opens after the sheet has entered the nip of the rollers and remains open until the roller assembly returns to the opposite limit of travel.

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