

[54] SHEET PICK-UP AND FEEDING DEVICE

[75] Inventors: Theodore H. Anderson, Pine Island;
George J. O'Konski; Michael N. Zell, both of Rochester, all of Minn.

[73] Assignee: International Business Machines Corporation, Armonk, N.Y.

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 155,969, June 23, 1971, abandoned.

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[51] Int. Cl. B65h 3/08

[58] Field of Search 271/103, 90, 95, 98, 104, 271/105, 11; 214/8.5 D

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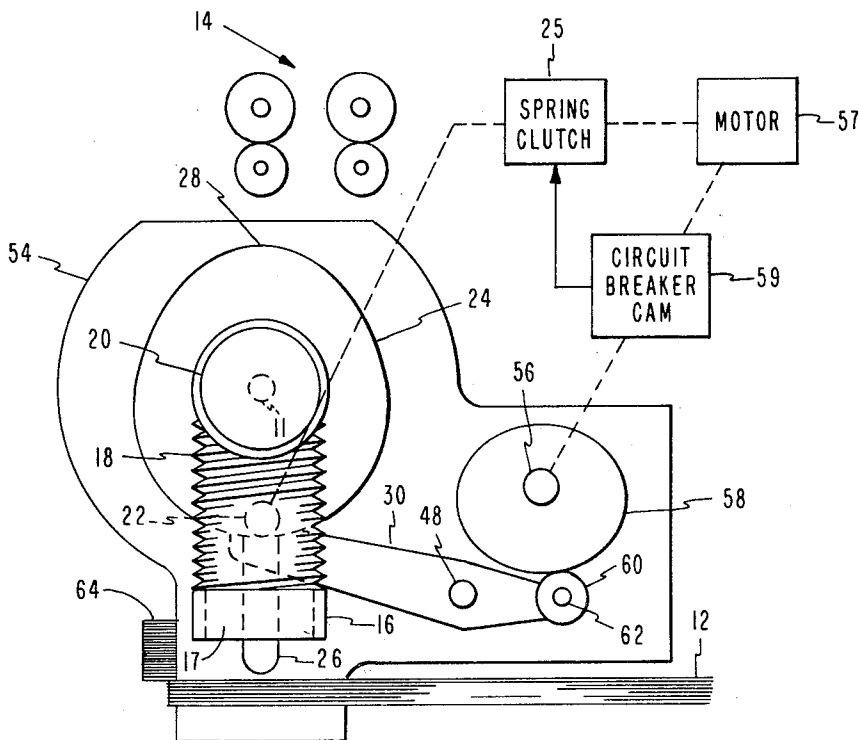
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Primary Examiner—James B. Marbert
Assistant Examiner—Bruce H. Stoner, Jr.
Attorney, Agent, or Firm—M. H. Klitzman; J. Jancin, Jr.; J. G. Cockburn

[57] ABSTRACT

A vacuum picking and feeding mechanism wherein the motion of the picker-foot is interrupted before actual contact with the upper most document of the stack by sensing the proximity of the foot to the upper most sheet in the stack and actuating a stopping means to stop the movement of the foot toward the stack at a position where the negative air pressure is strong enough to attract the upper most sheet. By doing this, air between the upper most sheets will not be forced out. A conventional fluffer is automatically valved by the picker foot.

6 Claims, 6 Drawing Figures



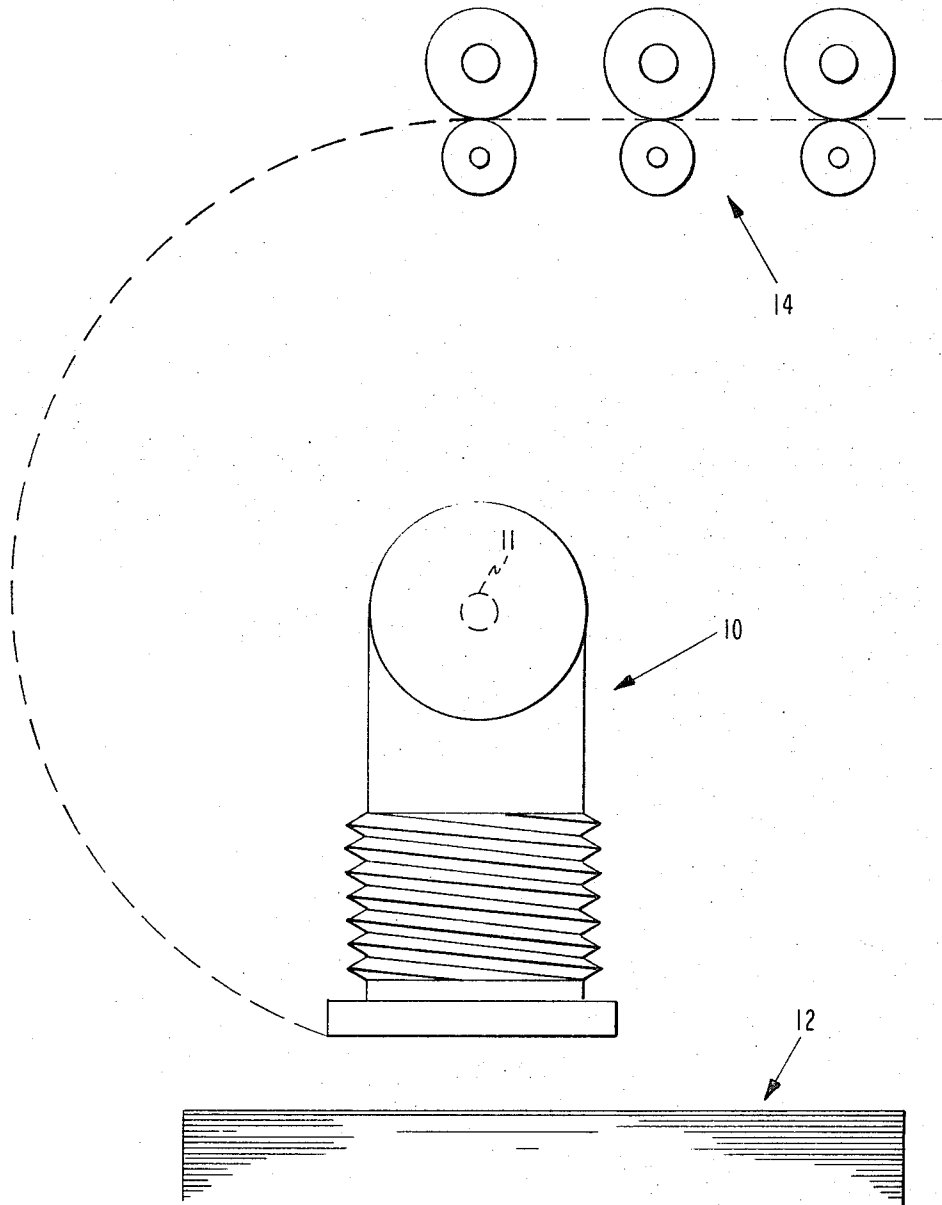


FIG. 1

INVENTORS.
THEODORE H. ANDERSON
GEORGE J. O'KONSKI
MICHAEL N. ZELL
BY *Maurice H. Kitzman*
ATTORNEY

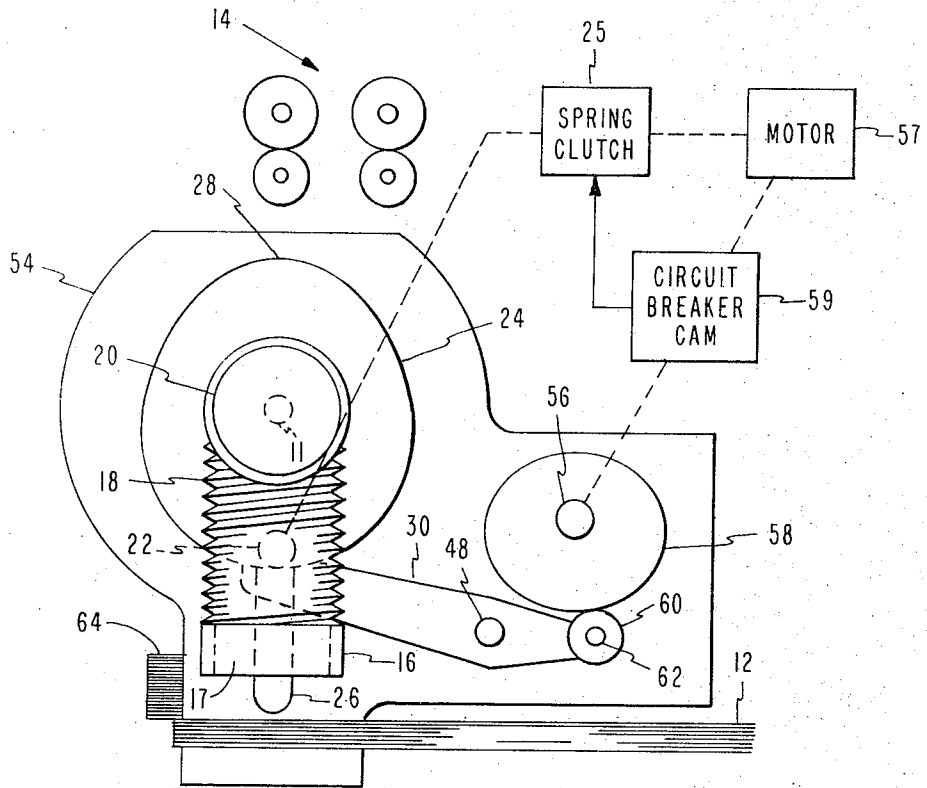
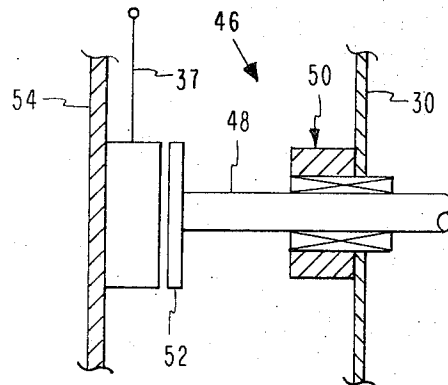
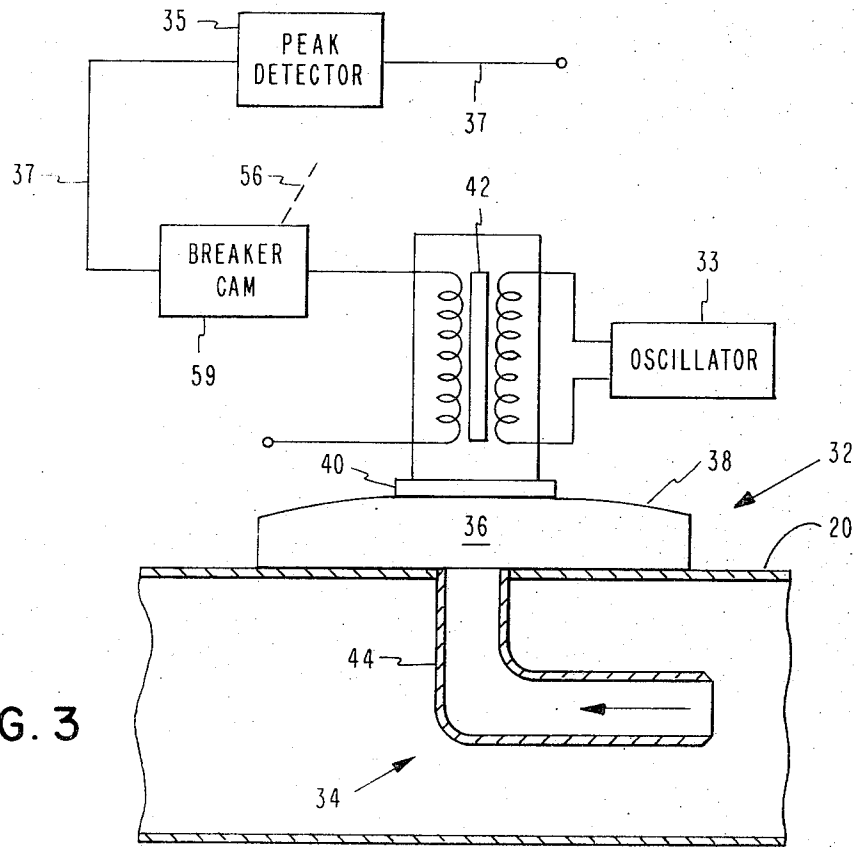


FIG. 2



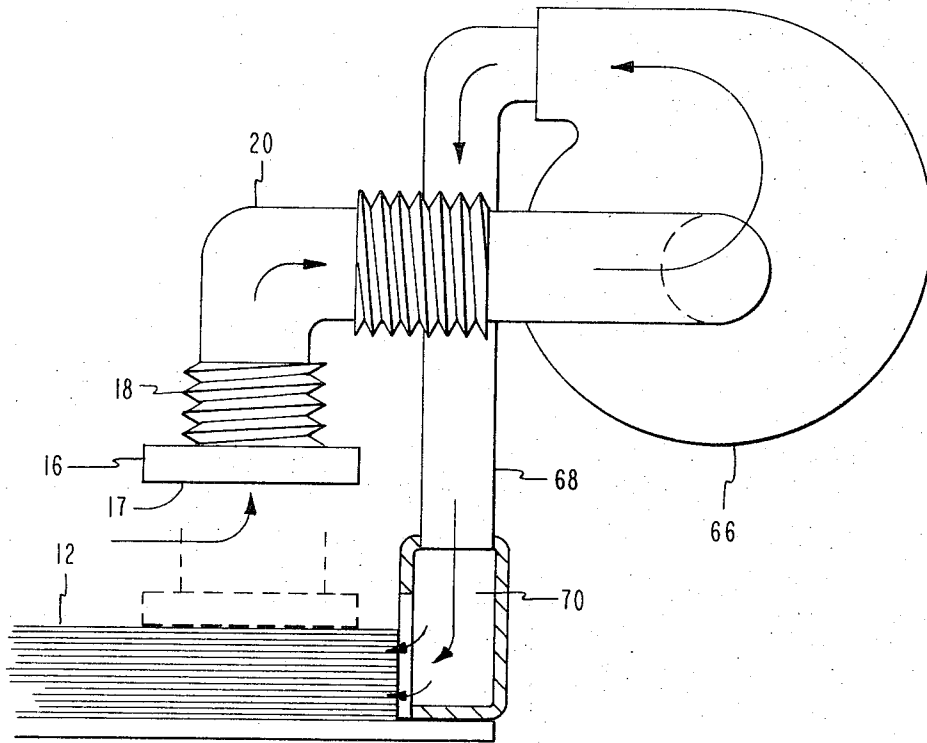


FIG. 5

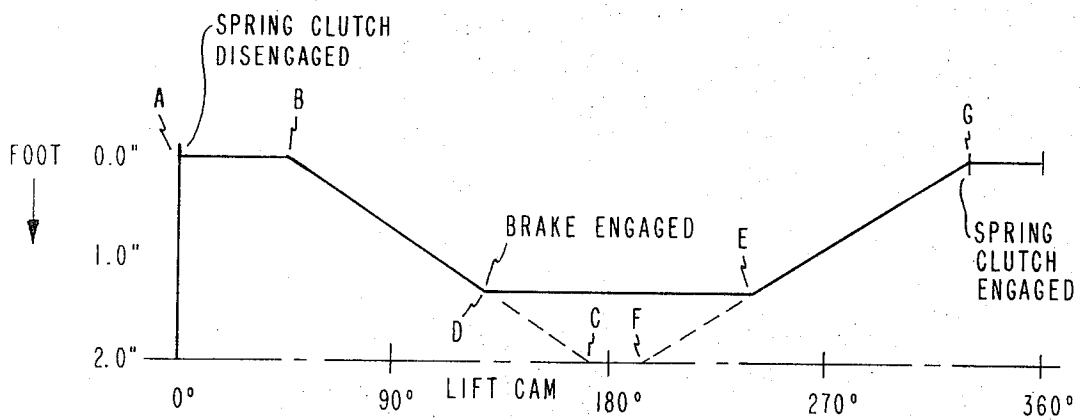


FIG. 6

SHEET PICK-UP AND FEEDING DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of copending application Ser. No. 155,969, filed June 23, 1971, and now abandoned by T. H. Anderson, G. J. O'Konski and M. N. Zell, and assigned to the assignee hereof.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an apparatus for removing an individual sheet from the position in a pack and also carrying it away from the pack.

2. Prior Art

It is common practice in sheet feeding devices to bring a suction cup or foot in to engagement with the upper-most sheet of a stack of sheets, leave the suction foot in contact with the sheets for a short interval of time and by suitable mechanical means move the suction foot and the sheet which it has contacted away from the stack of sheets so that thereafter the sheet may be completely removed from the stack by other means and transfer it by suitable means to some other part of the machine. It is also well-known to substitute the mechanical means for raising the suction foot with a pressure sensitive device which is actuated when the sheet adheres to the suction foot and cuts off the flow of air. Heretofore, when the upper-most document in the stack sealed itself to the suction port, the downward movement of the suction foot was interrupted and some means for raising the suction foot was actuated. To aid in preventing more than one sheet from being picked at the same time, fluffers have been used to blow air through the upper-most documents thus causing them to be separated. However, when the downward motion of the suction cup or foot is not stopped until the upper-most document sealed itself to the suction port, the air between the upper-most documents may be forced out of the stack by the suction foot contacting the upper-most document and thereby the stack. When this happens, the effect of the fluffer may be cancelled with the ultimate result being the picking of more than one sheet at the same time, or a failure to pick at all.

SUMMARY OF THE INVENTION

It is, therefore, an object of this invention to pick and feed documents from a stack in an improved manner.

It is another object of the present invention to eliminate the picking of more than one sheet at the same time in an improved manner.

The present invention features a separator device wherein a vacuum picker foot travels downward by gravity (or with the aid of a spring) toward the fluffed stack of documents. As the foot approaches the upper-most document, a pressure-change detector senses the proximity. The detector actuates a means to stop downward travel of the foot before the top document is contacted so that the effect of the fluffer will not be negated thus tending to cause multiple or no sheets to be picked. The vacuum at this time is strong enough, however, to pull the document upward into sealing engagement with the vacuum port of the foot. Then, a rocker

or lift arm raises the foot to feed the document, and the stopping means is released.

The present device further features means to rotate the separator device with the document attached thereto, so as to feed the document to another mechanism and thereupon return the separator device to pick the next document in the stack.

Finally, the apparatus features an automatic document fluffing valve where the input of the vacuum pump is piped through the picker foot and the output of the pump is piped directly to the slotted fluffing chamber.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of the preferred embodiment of the invention, as illustrated in the accompanying drawings.

IN THE DRAWINGS

FIG. 1 shows a schematic diagram of the sheet separator and feeder mechanism shown with the sheets being fed by the separator to an aligning station.

FIG. 2 shows the separator and feeding mechanism along with the means needed to raise the picker foot after the document is picked and to thereupon rotate the separator mechanism to feed the document to the next station.

FIG. 3 shows a pressure change detector for sensing the proximity of the picker foot to the upper-most document.

FIG. 4 shows a section view of the one way clutch and electric brake mechanism used to stop and then raise the separator mechanism.

FIG. 5 shows a schematic view of the automatic document fluffing valve.

FIG. 6 shows the preferred cycle of operation as the degree of rotation of the lift arm cam versus the height of the foot.

DETAILED DESCRIPTION

The preferred embodiment of this invention is shown generally in FIG. 1. The sheet separator 10 is located above a stack of sheets 12. After the upper-most sheet of stack 12 is picked and raised by separator 10, the separator is rotated about shaft 11 to carry the upper-most sheet to a sheet aligner station 14. Here, the upper-most sheet will be stripped from separator 10 and fed along for further processing. Any other processing station could replace aligner 14. The separator 10 continues to be rotated after the upper-most sheet is picked from it until it is again in position to be lowered to pick the next sheet from the stack.

As shown in the more detailed drawing, FIG. 2, picker foot 16 is attached to bellows 18 to allow the picker foot to be raised and lowered. Vacuum supply line 20 is attached to bellows 18 and to a constantly running vacuum pump (not shown) to supply a high-volume but low-pressure vacuum through at least one vacuum port 17 formed in the picker foot.

Vertical cam slot 26 is provided to force the picker foot to move in a straight vertical movement when the picker foot is raised and lowered. Vertical cam slot 26 is part of internal cam surface 24 which is in turn formed in frame 54. By attaching picker foot roller 22 to foot 16 or to bellows 18, the vertical movement of the picker foot and bellows will be guided as the picker foot roller 22 is guided by cam slot 26. To aid the force

of gravity in lowering the picker foot, picker roller 22 may if necessary be outwardly biased against the surface of the cam by a radial spring (not shown).

Once the separator has picked the upper most sheet from the stack and has lifted it to a proper height, spring clutch 25 connects to continuously driven motor 57 which in turn causes rotation of picker foot roller 22. Since picker foot roller 22 is attached to bellows 18, shaft 11 will rotate the separator 10 as the picker foot roller 22 rotates about fixed internal cam 24. Internal cam 24 is formed in frame 54 and guides the roller in a substantially circular path to rotate the sheet to the angular station 14 to rotate the separator back to a position above the vertical cam slot 26. At this point, the separator 10 can again be lowered to pick the next sheet from the stack. Provided the upper-most portion of internal cam 24 is a cam configuration 28 which guides the document into aligner station 14 and then cams roller 22 away from the aligning station 14, stripping the document away from the foot 16.

A braking means is provided to interrupt the picker foot motion when it moves toward the stack. The braking means of the preferred embodiment of this invention consists generally of a detection means 32 and a stopping means 46.

As shown in FIG. 3, detection means 32, connected by any suitable piping means to the vacuum air line 20, is provided to sense the proximity of the picker foot to the upper-most sheet in the stack. Detection means 32 consists of an outer chamber 34 and an inner chamber 36. A flexible diaphragm 38 is attached to the inner chamber with a metal slug 40 attached thereto. Diaphragm 38 is located such that slug 40 is in contact with probe 42 when no document is near foot 16. Metal sensing probe 42 is attached to the frame, whereby a signal from oscillator 33 can be detected by detector 35 as the metal slug moves relative to the sensing probe. Tube 44 is pointed into the air flow in the vacuum line to avoid a spurious partial vacuum in chamber 36 which might otherwise occur. As the topmost sheet is attracted toward the picker foot and begins to seal thereto, the vacuum increases inside chamber 36, so that atmospheric pressure on the other side of diaphragm 38 pushes slug 40 away from probe 42. This motion then produces a pressure-change signal on line 37. Other types of detectors are also adaptable to provide such a pressure-change signal. Another specific detector, for example, is shown in Boras et al., "Pneumatic-to-Electrical Transducers", *IBM Technical Disclosure Bulletin*, March 1966, pp. 1377-1378.

In order to stop the movement of the foot toward the stack of sheets when line 37 in the detection means is activated, stopping means 46 is provided as shown in FIG. 4. Stopping means 46 consists of a one way clutch assembly 50 mounted on arm 30 about shaft 48 with an electric brake 52 fixed to frame 54 on the end of shaft 48. The operation of this preferred embodiment of the stopping means will now be described. When picker foot roller 22 has been completely rotated to feed the sheet to the next feeding station and has returned to its position above cam slot 26, it is then resting atop picker lift arm 30. As picker foot 16 begins to descend toward the stack of sheets, picker foot roller 22 forces picker lift arm 30 to descend about pivot point and shaft 48. At this time, one way clutch 50 locks arm 30 to shaft 48, so that shaft 48 will rotate counterclockwise as the picker lift arm is lowered. When line 37 is activated by

detection means 32, electric brake 52 locks shaft 48 to the frame 54 thereby preventing any further counter clockwise rotation of picker arm 30, thereby preventing any further downward movement of the picker foot.

After the sheet of paper has been drawn against the picker foot, a lifting means is needed to raise the foot before it can be rotated to feed the sheet to the next feeding station. In order to accomplish this, shaft 56 is constantly rotated by motor 57 to rotate picker arm cam 58. While stopping means 46 has shaft 48 locked, cam 58 comes into contact with cam follower 60 which is rotatable about the shaft 62 which is in turn connected to picker arm 30. Picker lift arm 30 will be allowed to rotate in a clockwise direction even though shaft 48 is locked to frame 54 by the electric brake 52, because the one way clutch 50 is freely rotatable in the clockwise direction. At a predetermined point in the raising of the picker foot, another circuit breaker cam 60, also located on shaft 56, disconnects the electric brake 52 by opening line 37.

As also shown in FIG. 2, brushes 64 can be fixed to the frame and positioned to the side and above the stack of sheet 12 to help prevent more than one sheet from being picked at the same time. Other means well-known in the art could also be used to help prevent more than one sheet from being picked at the same time, such as multiple fingers either replacing or in combination with brushes.

Document fluffers have commonly been used in vacuum separating devices such as the present invention. In devices of this type, it has been necessary to valve the document fluffers when the sheet becomes attached to the picker foot in order to prevent blowing the documents out of the hopper at certain points in a picking cycle. Apparatus for carrying out this operation is shown in FIG. 5. FIG. 5 shows air being drawn through centrifugal vacuum pump 66 (which may also be driven by motor 57) with its output going to output line 68 which has fixed at its end a slotted fluffing chamber 70. When the picker foot is in the up position without a document attached, air is pumped through picker foot 16 and exhausted through fluffing chamber 70 into the stack of documents 12 (as indicated by the arrows). This causes the stack of sheets to separate and to generally improve conditions for vacuum picking of single sheets. As the topmost document is attracted to and becomes sealed to the picker foot, the flow of air in line 68 is decreased and ultimately completely blocked, thus automatically valving document fluffer 70. Therefore, at the same time that the top sheet is being attracted toward foot 16, the remaining sheets in the stack are allowed to fall away from the foot, an effect which enhances the sheet-separating ability of the present picker, without adding any mechanically operated valves to its structure.

OPERATION

The operation of the preferred embodiment will be described beginning with the picker foot 16 in home position, i.e., where picker roller 22 is at the top of slot 26 resting upon arm 30, as shown in FIG. 2. At this point, the forces of gravity (along with the force of a radial spring, not shown) acting against picker roller 22 causes picker foot roller 22 to descend through slot 26, causing picker lift arm 30 to rotate counterclockwise. Shaft 48 is locked through the operation of one way

clutch 50 so that it rotates also. When the picker foot comes to a position just above the stack of sheets 12, detection means 32, here being a pressure switch, senses this action and activates electric brake 52 to prevent shaft 48 from further counterclockwise rotation, thus, preventing picker foot 16 from any further downward motion. Continuously rotating cam 58 then contacts cam follower 60 to cause picker lift arm 30 to be rotated in a clockwise direction through the action of one way clutch 50 which does not lock shaft 48 in the clockwise direction. When the picker foot roller 22 reaches its home position, circuit breaker cam 59 closes spring clutch 25, which causes the picker foot roller 22 and foot 16 to begin rotating counterclockwise around the inner surface of internal cam 24. The attached sheet is picked off the picker foot at aligning station 14 and the picker foot 16 continues its rotation until it reaches its home position and cam 58 is in the up position as shown in FIG. 6; electric brake 52 may then be released to allow another feed cycle.

FIG. 6 shows the preferred cycle of operation showing the degree of rotation of the lift arm cam as a picker foot 22 is in its home position at the top of slot 26. The picker foot begins to descend at point B in the cycle. The foot descends toward point C. At some variable intermediate point D, the electric brake 52 is engaged by the detection means 32 sensing the proximity of the stack of sheets. With the electric brake preventing the further downward movement of the picker foot, the top sheet is attracted from the stack. At some point E, the lift arm 30, having begun to move clockwise at point F engages the follower 58 to cause lift arm 30 to pivot about shaft 48. Thus the picker foot roller 22 is raised to its home position, point G, at which time cam 59 will cause spring clutch 25 to engage, causing foot 16 to be rotated about the internal cam to feed the sheet to another station. Brake 52 may be released for the next cycle at any point after point E and before point B, although it is preferably released near point A.

Although the preferred embodiment shows the picker foot being rotated to carry the sheet to a further feeding station, other mechanical means could be provided to move the entire picking mechanism horizontally to move the sheet into the aligning station and then move the picking mechanism back horizontally into position to pick the next sheet.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and detail may be made therein without departing from the spirit and scope of the invention.

We claim:

1. A sheet separator and feeding device for picking and feeding one sheet from a stack comprising:
 - a vacuum picker foot which can be raised and lowered toward a stack of sheets against which a sheet can be attracted;
 - fluffing means for blowing air through the uppermost sheets in said stack thus causing separation of said sheets;
 - detection means for sensing a pressure change within said foot resulting from the proximity of said sheet towards the picker foot;
 - braking means for interrupting the picker foot mo-

tion towards the stack of sheets before contacting the topmost sheet when said pressure change is detected while maintaining the fluffing means effective to keep the uppermost sheets separated;

lifting means for raising said foot away from the stack after the topmost sheet has been attracted; and

means for moving the sheet attracted to said foot to a further feed means.

2. A sheet separator and feeding device according to claim 1 wherein said rotating means includes:

- a picker foot roller attached to a bellows which is in turn fixed to the picker foot;
- an internal cam fixed to a frame to provide a traveling surface for said roller; and
- means for rotating said roller after a sheet has been lifted from the stack so that said roller follows said internal cam, thereby causing the picker foot and sheet to rotate to feed the sheet to the further feeding device.

3. A sheet separator and feeding device according to claim 1 further including an automatic sheet fluffing valve comprising:

- a vacuum pump which receives input from the picker foot as long as no sheet blocks the flow of air; and
- a fluffing chamber which receives its input from an output pipe from said pump to cause air to be blown through the stack of sheets at all times except when the sheet is attached to the foot.

4. A method of feeding a sheet from a stack, comprising the steps of:

- a. introducing a partial vacuum into a picker foot having a port capable of engaging one sheet from said stack;
- b. moving said picker foot toward said stack;
- c. detecting a predetermined pressure change within said foot, said pressure change resulting from the attraction of a sheet to said port;
- d. stopping the movement of said foot toward said stack when said predetermined pressure change is detected before contacting said sheet;
- e. attracting said sheet to said port by means of said partial vacuum;
- f. moving said picker foot away from said stack so as to remove said one sheet therefrom; and
- g. rotating said picker foot so as to feed said sheet to a processing station.

5. The method of claim 4, wherein step (d) comprises the steps of:

- h. braking a member coupled to said foot, so as to prevent further movement of said foot toward said sheet; and
- i. simultaneously clutching said member so as to allow movement of said foot away from said sheet.

6. The method of claim 4, comprising:

- i. pumping air from said picker foot to an outlet so as to introduce said partial vacuum into said foot and to produce a positive pressure at said outlet; and
- j. introducing said positive pressure into a fluffer adjacent said stack of sheets so as to separate said sheets from each other at all times except when said one sheet has been attracted to said picker foot port.

* * * * *