United States Patent

Holecek et al.

[15] **3,645,526**

[45] **Feb. 29, 1972**

[54] **NO-MOVING PARTS, PNEUMATIC HOPPER/SEPARATOR**

[72] Inventors: **Joseph J. Holecek**, Byron; **Larry D. Zolnosky**, Rochester, both of Minn.

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

[22] Filed: **Dec. 29, 1969**

[21] Appl. No.: **888,549**

[52] **U.S. Cl.** **271/32**

[51] **Int. Cl.** **B65h 3/08**

[58] **Field of Search** ..... 271/32, 61, 44 A, 26

[56] **References Cited**

UNITED STATES PATENTS

2,806,696	9/1957	Bishop	271/32
3,136,539	6/1964	Lyman	271/31 X
3,252,702	5/1966	Halbert	271/32
3,285,602	11/1966	Hartel	271/32
3,385,593	5/1968	Snellman	271/61 X

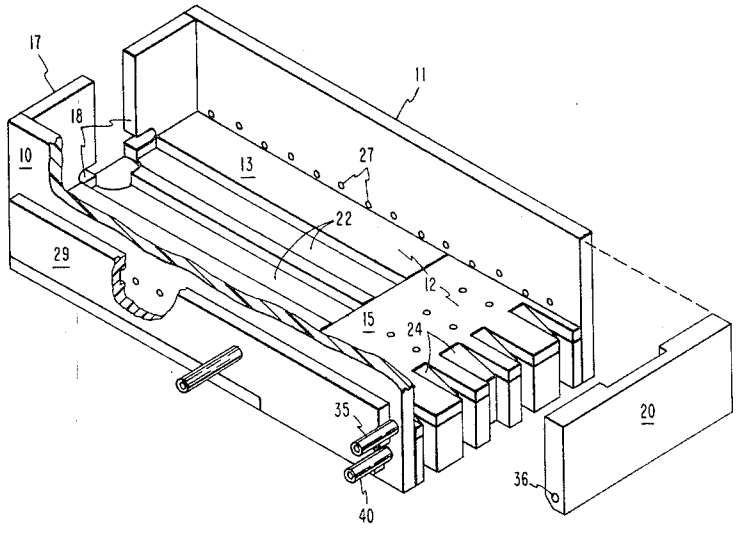
Primary Examiner—Joseph Wegbreit

Attorney—Hanifin and Jancin and Robert W. Lahtinen

[57] **ABSTRACT**

The disclosure pertains to a document hopper separator mechanism which is wholly pneumatically actuated to feed documents serially from the bottom of a document deck disposed therein. Riffle jets introduce air to support the deck and separate the lowermost documents from the document guide surface and one another while selectively operable eject jets function to eject the lowermost document from the hopper to a transport mechanism.

8 Claims, 6 Drawing Figures



Patented Feb. 29, 1972 3,645,526

2 Sheets-Sheet 1

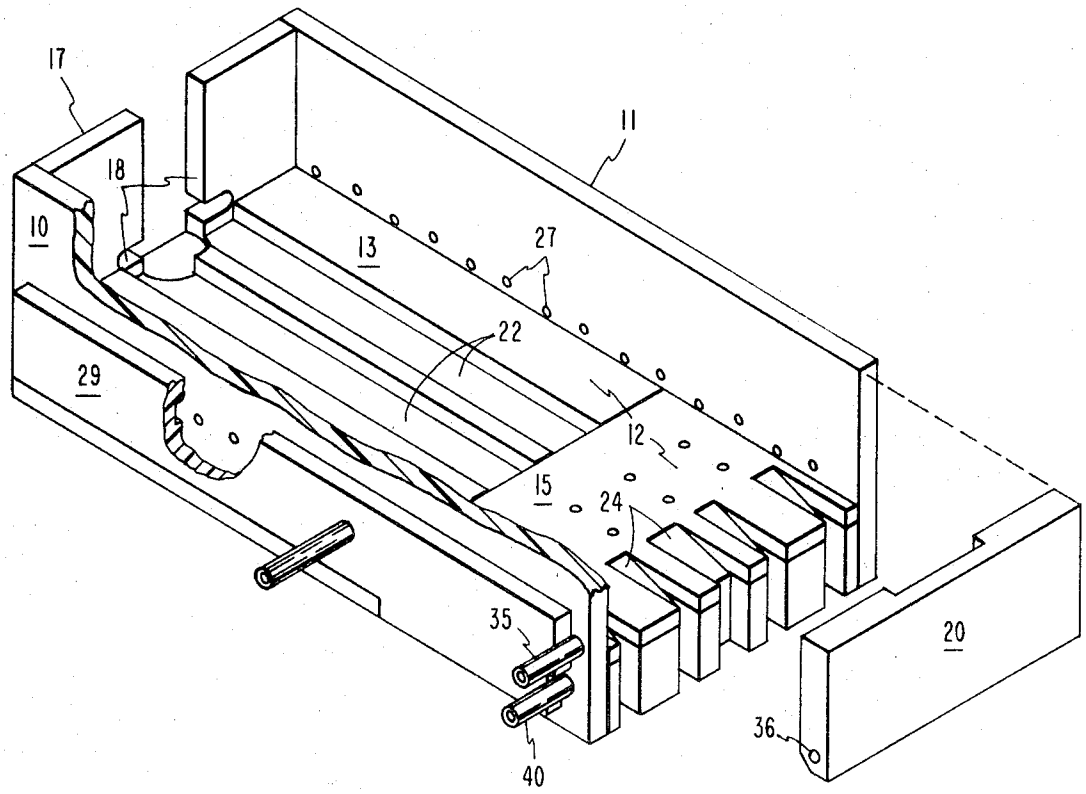


FIG. 1

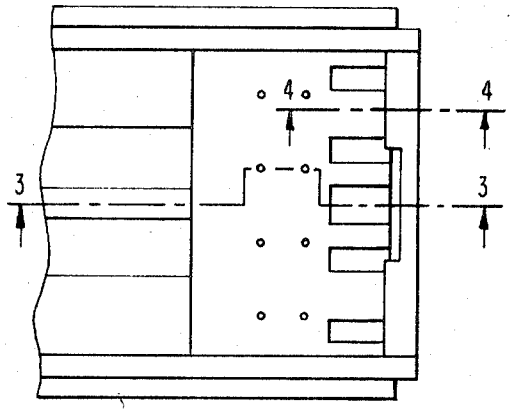


FIG. 2

INVENTORS.

BY JOSEPH J. HOLECEK
LARRY D. ZOLNOSKY
Robert W. Lahtinen
ATTORNEY

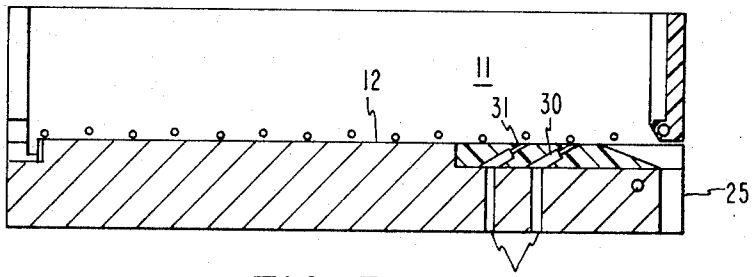


FIG. 3

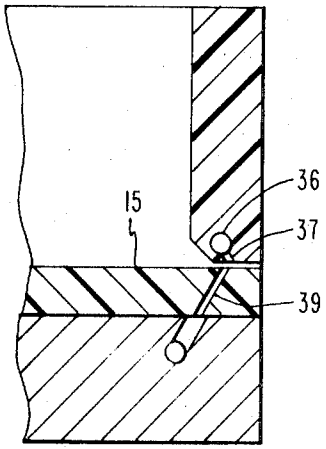


FIG. 4

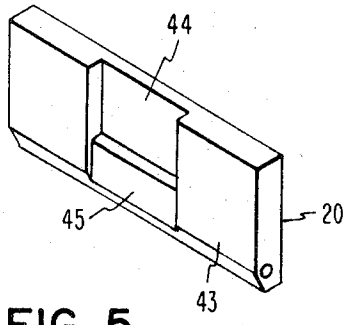


FIG. 5

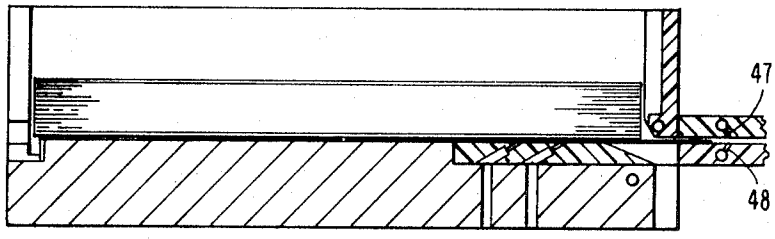


FIG. 6

NO-MOVING PARTS, PNEUMATIC HOPPER/SEPARATOR

BACKGROUND OF THE INVENTION

Document separation and delivery should be accomplished without damage to the document or the indicia thereon. The ideal method is to separate and serially transport documents without physical contact by any separating or transporting mechanism. A wholly pneumatic hopper separator avoids the use of picker knives, friction feed rolls or belts and restraint devices. Since it is frequently desirable to maintain document sequence, as in the case of card decks, it is necessary to utilize a hopper feed mechanism, transport and stacker which so cooperate as to maintain such document sequence. Accordingly it is preferable to feed documents from the bottom rather than the top of the document deck to avoid the necessity of turning the document during the transport or stacking operations either of which require space and increased machine cost.

In the pneumatic hopper separator of the present invention, documents are confined between longitudinally extending walls at each transverse side of a horizontal document guide surface. Air jets are directed toward the document deck from each side adjacent the horizontal guide surface to float the document deck and specifically separate the lowermost documents from one another by layers of films of air and particularly the bottom document from the remainder of the deck. A series of jets are positioned to deliver air along the horizontal guide surface in the longitudinal direction in which the lower most document is to be selectively moved from the remainder of the deck. These jets are positioned near the leading portion of the document deck and inclined in the direction of document transport to cause, upon actuation, a film of air to flow between the lowermost document and the guide surface, entraining the transversely flowing air and inducing a downward and forward motion of the document by the frictional drag force established with the document surface.

The hopper-separator has no moving parts which contact a document as compressed air separates the documents, selects the bottom document and propels the selected document through a wide throat gap to the transport system of the associated device.

It is an object of this invention to provide a wholly pneumatically actuated hopper and document feed mechanism. It is further object of this invention to provide a pneumatic hopper separator mechanism wherein documents are fed serially from the bottom of the document deck to facilitate the maintenance of document sequence. It is also an object of this invention to provide a pneumatically actuated hopper in which all documents including the final document of the deck may be fed without the use of a mechanical follower or weight.

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

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an isometric view partially exploded and partially broken away, illustrating the pneumatic hopper-separator mechanism of the present invention.

FIG. 2 is a partial plan view of the hopper separator of FIG. 1.

FIG. 3 is a vertical section of the device of FIG. 1 taken along the longitudinal axis except for the deviation shown by line 3—3 of FIG. 2.

FIG. 4 is a partial vertical section of the device of FIG. 1 taken along line 4—4 FIG. 2.

FIG. 5 is an isometric view of the throat bar showing the major surface which is hidden in FIG. 1.

FIG. 6 is similar to FIG. 3 with documents shown in the hopper, the lowermost of which is being serially fed therefrom.

DETAILED DESCRIPTION

Referring to FIGS. 1 through 3 the hopper has a pair of sidewalls 10 and 11 which extend from a guide surface 12 formed by the upper surfaces of bedplate 13 and insert 15. The rear wall is interrupted by a central exhaust slot defined by confronting wall surfaces 18. The throat bar 20 extends between sidewalls 10 and 11 and provides a transverse slotted opening between the lower surface thereof and the document guide surface 12. The transverse slotted opening between throat bar 20 and guide surface 12 is not used to restrain a second document that might be selected and accordingly is many document thicknesses wide rather than one and a fraction document thicknesses where a throat knife is used to preclude the simultaneous feeding of a second document. A pair of longitudinal recesses 22 in the bedplate 13 communicate with the rear vent slot. At the forward end of the hopper a series of inclined surface portions 24 terminate in a series of downwardly extending vent slots 25.

Along each of the transverse sidewalls 10 and 11 are a series of horizontal apertures 27 located adjacent to guide surface 12, which are supplied from a pair of manifolds 29 secured at the outer surface of the respective sidewall. Air under pressure from manifolds 29 is delivered through apertures 27 as a series of horizontal riffle jets in close proximity to the guide surface 12.

A series of inclined passages 30 in insert 15 each terminate in an apertured passageway 31 to supply a jet of air through the guide surface 12. Jets 31 are supplied with air under pressure through bedplate passage 33 with the horizontal component of the output being directed toward the opening between throat bar 20 and guide surface 12.

As also seen in FIG. 4, the conduit 35 leads through a passage in sidewall to a passage 36 in throat bar 20 to supply a series of transport jets 37 inclined toward the document guide path 12 in the direction of document transport. Cooperating therewith are a series of lower transport jets 39 formed as apertures in insert plate 15 and supplied by conduit 40 through passages 41 in the sidewall 10 and bedplate 13. Throat bar 20 has formed in the surface 43 (FIG. 5) which defines the forward wall of the hopper, a vent slot 44. Also formed in the lower portion of the surface 43 to extend between the vent slot 44 and the lower inclined surface is a shallow recess 45.

In operation, with a stack of documents within the hopper as viewed in FIG. 6, air is continuously supplied through the series of transversely opposed riffle jets 27 directing air inwardly from each sidewall closely adjacent the guide surface 12. The document deck is thus supported by introducing a film of air between the lowermost card and the guide surface 12 and intermediate the adjoining documents at the lower portion of the deck to continuously separate the lowermost card or document both from the guide surface 12 and from the next adjacent document on films of air. The number of documents that may be accepted by the hopper is a function of document weight and the support capacity of air introduced through the riffle jets as dictated by hopper configuration and volume of air supplied. The air introduced into the hopper through riffle jets 27, is exhausted through the rear exhaust opening, the throat or the vent slots 25 underlying the throat bar 20. Most of such air is exhausted through the rear vent slot with the result that the friction force of the moving air film is largely exerted toward the rear of the hopper to function as a restraint which provides a net force on the documents directed toward the hopper rear wall 17.

When it is desired to feed a document, air is supplied through eject jets 31, directing a flow of air along the guide surface 12 which is permitted to escape through vent openings 25. When the film of air introduced by the eject jets passes along the guide surface 12 the riffle jet air introduced at that location and confined between the sidewalls 10 and 11 is entrained and the lowermost document is drawn down toward

the guide surface as a negative pressure is generated. The boundary layer buildup or frictional component of the air introduced by the eject jets **31** causes the lowermost document to be propelled forward into the throat area between the throat bar **20** and guide surface **12**. When the document progresses to a position beneath the throat bar, accelerated toward motion is induced by the cooperating jets **37** and **39**. Jets **37** and **39** may be either continuously operating or may be selectively operated in conjunction with the eject jets **31** (being initiated either simultaneously or sequentially) to provide further control and assurance that an accidental feed cycle will not occur. When the document projects beyond the throat bar it becomes subject to the action of transport jets **47** and **48** which are continuously ejecting air to accelerate the document to a transport velocity in cooperation with successive transport jets disposed along the transport path.

Eject jets **31** may be operated continuously to supply documents serially and continuously to the transport or may be selectively pulsed on command to supply single documents serially in accordance with the requirements indicated by a logic circuit or control mechanism.

To facilitate the feeding of the last document or the last few documents of a stack or deck, recess **45** is provided in the surface **43** of throat bar **20** which allow venting of air from beneath the leading portion of the card. The relief provided by the recess allows the leading edge of the final document or documents to drop toward the guide surface and enter the throat upon actuation of the eject jets, thereby avoiding the occasional tendency of the last few documents to have the leading edge engage throat bar surface **43** and fail to feed. The hopper-separator characteristics permit variable length documents to be selected and ejected without any mechanical adjustments. Further variable length documents can be intermixed and selected for feeding. The absence of moving parts and the protective layers of air about the document enable the hopper to handle sensitive surface documents, including those composed of film materials or having magnetic surfacing materials, without damage.

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 details may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. A hopper-separator device for separating and feeding documents serially from the bottom of a document deck disposed therein comprising;

a base member presenting a generally horizontal document guide surface;

transversely spaced sidewalls extending upwardly from said guide surface;

a rear wall extending between said sidewalls and upwardly from said guide surface at the rear end of said hopper;

a throat bar extending between said sidewalls and vertically spaced from a guide surface to define a slotted throat opening therebetween;

a series of riffle jets along each sidewall emitting air under pressure transversely inward, closely adjacent said guide surface for isolating the bottom document from the remainder of the deck; and

selectively operable eject jet means for creating a moving layer of air intermediate said bottom document and guide surface which creates a drag force on said bottom document to propel said document aerodynamically through said slotted throat opening,

said eject jet means including a series of passageways terminating in apertured openings in said base member guide surface disposed intermediate said rear wall and said throat bar, said passageways being inclined at an acute angle toward said throat bar to establish said moving layer of air between said guide surface and lowermost document progressing toward said throat opening.

2. A hopper-separator device for separating and feeding documents serially from the bottom of a document deck disposed therein comprising;

a base member presenting a generally horizontal document guide surface;

transversely spaced sidewalls extending upwardly from said guide surface;

a rear wall extending between said sidewalls and upwardly from said guide surface at the rear end of said hopper;

a throat bar extending between said sidewalls and vertically spaced from a guide surface to define a slotted throat opening therebetween;

a slotted opening in said throat bar wall surface which defines the hopper end wall,

said slotted opening extending upward from said slotted throat opening;

a series of riffle jets along each sidewall emitting air under pressure transversely inward closely adjacent said guide surface for isolating the bottom document from the remainder of the deck;

selectively operable eject jet means for creating a moving layer of air intermediate said bottom document and guide surface which creates a drag force on said bottom document to propel said document aerodynamically through said slotted throat opening.

3. A hopper-separator device for separating and feeding documents serially from the bottom of a document deck disposed therein comprising;

a base member presenting a generally horizontal document guide surface;

transversely spaced sidewalls extending upwardly from said guide surface;

a rear wall extending between said sidewalls and upwardly from said guide surface at the rear end of said hopper;

a longitudinal recess in said base member guide surface extending from said rear wall;

an upwardly extending vent slot in said rear wall communicating with said longitudinal recess;

a throat bar extending between said sidewalls and vertically spaced from a guide surface to define a slotted throat opening therebetween;

a series of riffle jets along each sidewall emitting air under pressure transversely inward closely adjacent said guide surface for isolating the bottom document from the remainder of the deck; and

selectively operable eject jet means for creating a moving layer of air intermediate said bottom document and guide surface which creates a drag force on said bottom document to propel said document aerodynamically through said slotted throat opening.

4. The hopper-separator of claim **2**, wherein;

said eject jet means includes a series of apertured openings in said base member guide surface disposed longitudinally intermediate the forward end of said longitudinal recess and said throat opening and inclined toward said throat opening.

5. A device for pneumatically separating and feeding documents in sequence from the bottom of a document deck comprising:

a guide member presenting a generally horizontal guide surface above which said document deck is supported;

air inlet means disposed at each transverse side of said document deck adjacent said guide surface for supporting said deck and separating the lowermost document from the balance of said deck;

pneumatic eject means for selectively delivering a layer of moving air over said guide surface in the longitudinal direction in which documents are to be fed and imparting a longitudinal force to the lowermost document;

said pneumatic eject means including passage means inclined at an acute angle with the document supporting surface of said guide member in the direction of document travel from said deck; and

sidewall means extending along each transverse side of said deck adjacent said guide surface with said pneumatic eject means air delivery effected therebetween.

6. The device of claim 5, further comprising a rear wall member extending between said sidewall means with an exhaust opening formed therein and a longitudinally extending relief slot formed in said guide surface and communicating with said rear wall exhaust opening.

7. The device of claim 6 further comprising a throat bar extending between sidewalls at the hopper end opposite said rear wall and defining with said sidewalls and said guide surface a throat through which documents are fed from said device and pneumatic outlet passageways inclined in the direction of document travel at an acute angle to the document path and terminating adjacent said document path at said throat, whereby a propelling force along the document path is imparted to a document delivered into said throat opening.

8. The device of claim 7, comprising;

a shallow recess in the throat bar surface which defines the forward boundary of said hopper, said recess extending upwardly from the lower edge of said throat bar surface.

* * * * *