United States Patent

Brown et al.

[15] **3,680,855**

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[54] **PICK-OFF HEAD FOR SORTING MACHINE**

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[52] **U.S. Cl.** **271/41**

[51] **Int. Cl.** **B65h 1/06**

[58] **Field of Search** ...271/26 E, 29, 41, 32, 27, 44 A

[56] **References Cited**

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[57] **ABSTRACT**

A pick-off head for a machine for sorting cards or the like which uses subatmospheric pressure to pull the bottom card from its adjacent card to effect a separation of the two cards, and a mechanical thickness gauging device to insure singular lateral movement of the bottom card relative to its adjacent card. The bottom card is distorted by the subatmospheric pressure to remove its central region from contact with the adjacent card, but if static or other conditions prevent such separation, the thickness gauging device physically bars the second card from moving with the first.

5 Claims, 6 Drawing Figures

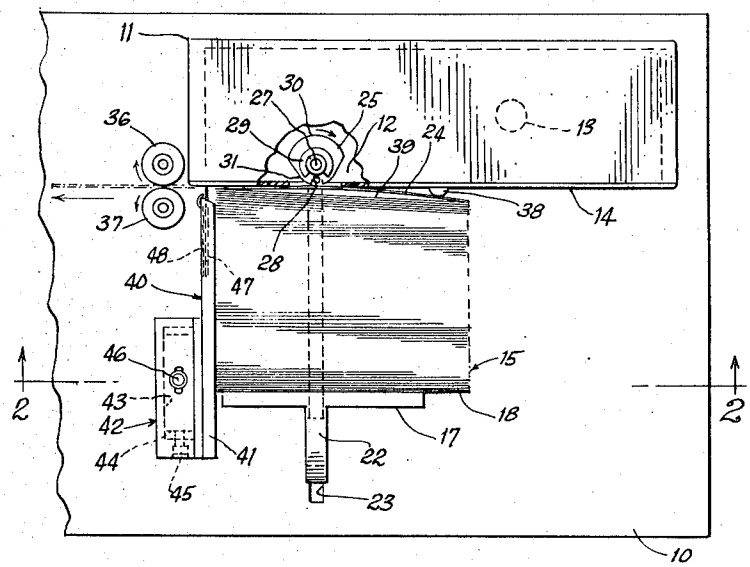


FIG. 1

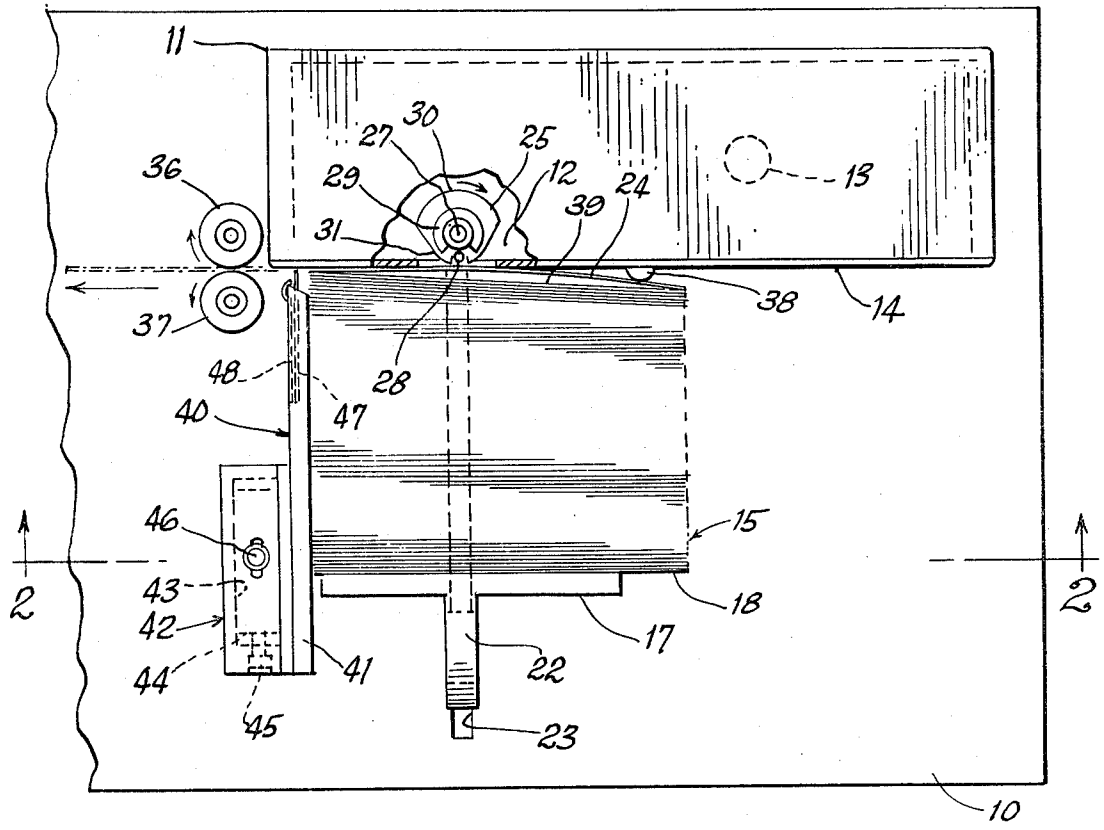
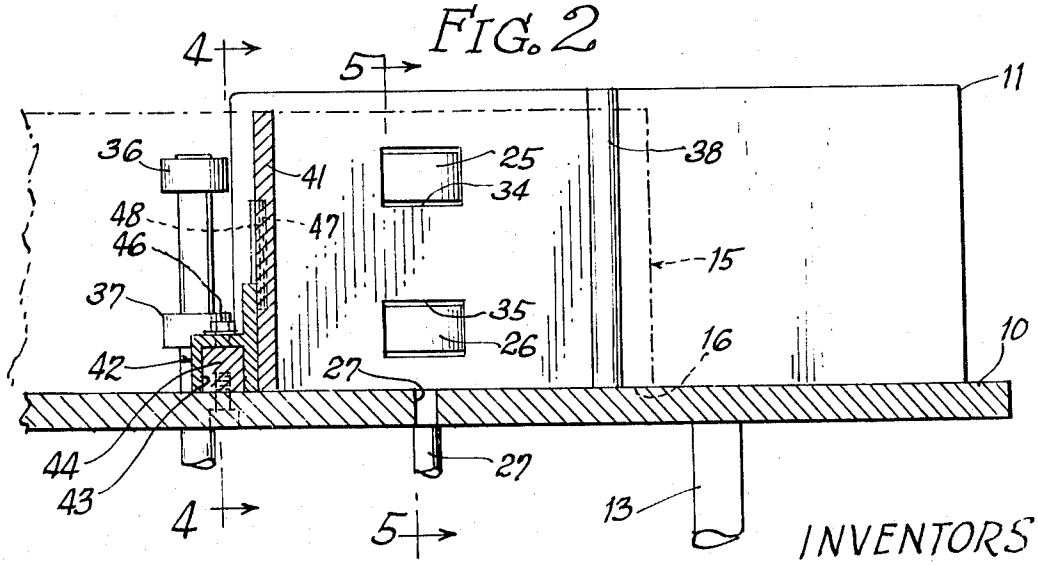


FIG. 2



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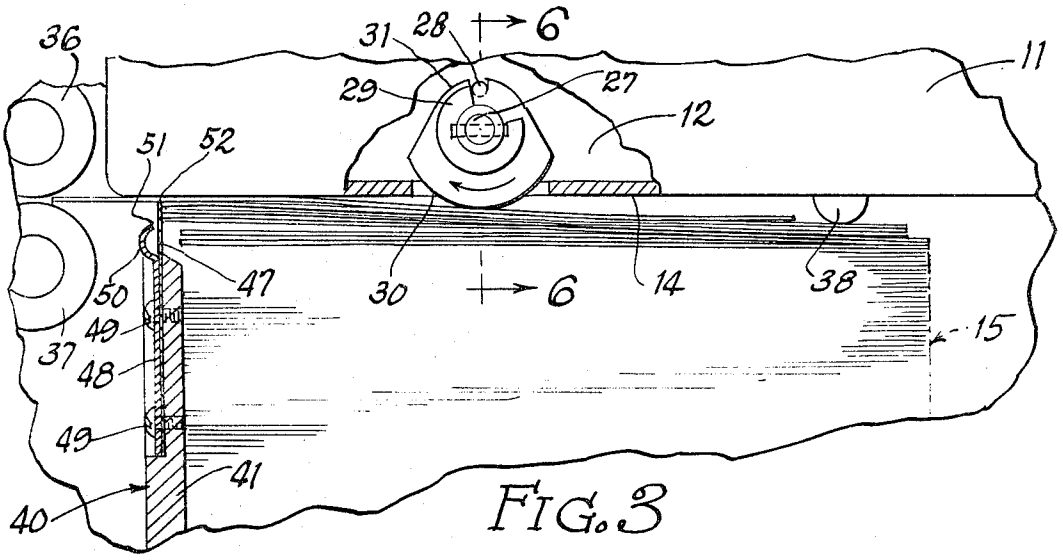


FIG. 3

FIG. 4

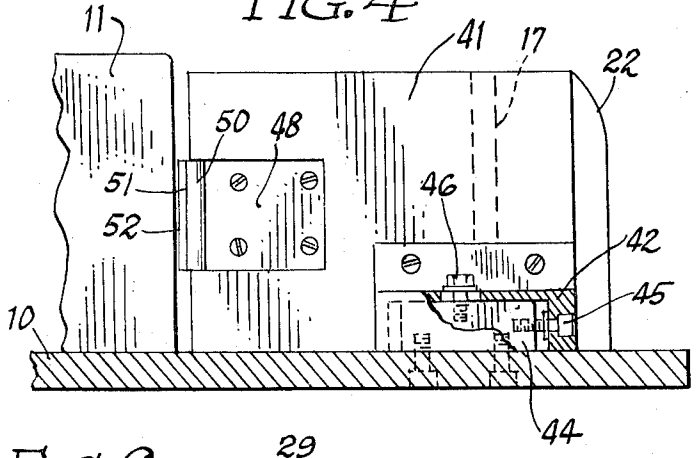


FIG. 5

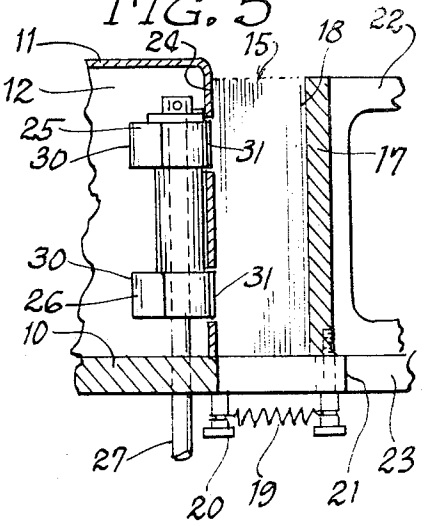
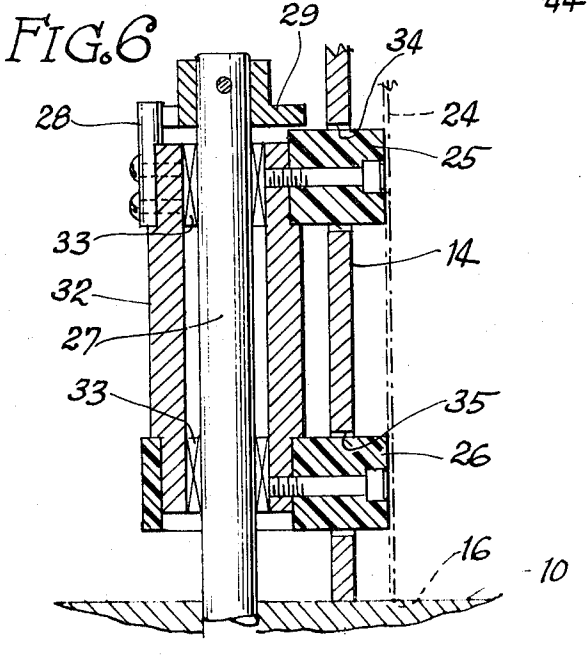


FIG. 6



PICK-OFF HEAD FOR SORTING MACHINE

This invention relates to a pick-off head for a sorting machine and particularly to an improvement in the singulation means used therein.

In machines for processing card-like sheets supplied to the machines in stacks, it is necessary to handle the sheets from the stack one at a time. One such means is disclosed in U. S. Pat. No. 3,420,368 to Rosenberg et al., dated Jan. 7, 1969. In the Rosenberg et al., form, the means comprises a table on which the material to be sorted is stacked on edge, with a spring-pressed plate urging the stack continuously against a vertical abutment. An intermittent drive is imparted to the material by a rotating cam-shaped wheel which frictionally engages the end piece of the material and moves it sideways from the stack into the first stage of the material processing machine. The spring-pressed plate is disposed parallel with the end piece and hence the latter piece is in complete surface-to-surface contact with the next piece in the stack.

It has been found, in the Rosenberg et al., form, that several factors are present which decrease the effectiveness of such mechanisms to pick off cards or the like, one at a time, from a stack of cards. Thus static electricity may cause two cards to stick together and move as one through the subsequent processing of the cards. At times a sticky substance may find its way between two cards and again cause two cards to be processed simultaneously instead of singly. It may also be found that if sufficient pressure is exerted upon the stack to ensure the proper placement of the bottom card against the reference plane or vertical abutment from which it is to be picked off for processing, such pressure creates too much friction between the foremost card and its adjacent card for the pick-off mechanism to slide the bottom card laterally off the stack.

It is an object of this invention to provide a means for facilitating the separation of the foremast card from a stack of cards to promote easy movement of the foremost card sideways from the stack for subsequent processing.

Another object of this invention is to provide a singulation device for cards which are to be separated from a stack of such cards, said device providing a gate large enough for only one card to pass therethrough, with means ahead of the gate for effecting a physical separation between the said one card and its adjacent card.

As a more specific object this invention has within its purview the provision of a means for producing a shape in the foremost card of a stack of such cards which is different from the shape of the card adjacent to the foremost card to effect a separation between said cards, whereby to facilitate subsequent relative lateral movement between the foremost and adjacent cards.

These and other objects of this invention will become apparent from the following detailed description of a preferred embodiment of the invention when taken together with the accompanying drawings in which:

FIG. 1 is a plan view of the pick-off mechanism of this invention;

FIG. 2 is a front elevational view in section of the mechanism of FIG. 1, the section being taken along line 2—2 of FIG. 1;

FIG. 3 is an enlarged, fragmentary plan view of the mechanism of FIG. 1 showing the shape and position of a card moved by the mechanism;

FIG. 4 is a side elevational view of the mechanism taken along line 4—4 of FIG. 2;

FIG. 5 is a side elevational view, in section, of the mechanism taken along line 5—5 of FIG. 2; and

FIG. 6 is a still further enlarged and fragmentary side elevational view, in section, of the drive portion of the mechanism taken along line 6—6 of FIG. 3.

The pick-off means of this invention is best adapted for use with stacks of relatively stiff material such as cardboard or the like. It is especially well suited for use in singulating covers for paperback books, wherein such covers are torn off the books and returned, in lieu of the entire book, to the publisher for determination of refunds to the bookseller, or other data processing. Essentially, the present pick-off means provides a chamber behind the pick-off reference plane in which chamber is located the friction drive for moving the covers singly laterally of the stack. The drive is comprised of a pair of cams which periodically protrude through openings in the plate defining the reference plane to engage and impel sideways the foremost cover of the stack. The chamber is subjected to subatmospheric pressure so that the foremost cover is pushed against the openings by the external atmospheric pressure. However, an abutment is provided on the reference plane plate to one side of the openings so that the cover is bowed when it is pushed against the openings. The cover immediately adjacent the foremost cover, however, is not bowed because it is shielded from the subatmospheric pressure by the foremost cover. Thus the foremost cover is separated from its adjacent cover despite any static electrical charge that may tend to hold them together, or the presence of a small quantity of adhesive accidentally placed between them. An adjustable resilient gate then provides a final singulation means through which only one cover can pass at a time. The resilient gate has two rates of resilience, a soft rate for yielding under the pressure of cards considered acceptable, and a stiff rate for resisting the lateral movement of a second card which may be adhered to the first.

Referring now to the drawings for a detailed description of the invention, the pick-off device of this invention may be mounted on a base-plate **10** which may be the top of a table or a cabinet. The pick-off device itself, in the form illustrated, is comprised of a housing **11** mounted on plate **10** and defining a chamber **12** which is in communication with a conduit **13** connected to a device of known construction (not shown) designed to produce subatmospheric pressure in said conduit **13** and chamber **12**. The front vertical wall **14** of housing **11** is disposed substantially at right angles to the surface of base plate **10** and is designed to act as an abutment for a stack **15** of the cardboard sheets, such as paperback covers, to be processed one at a time by sorting and data processing equipment located to the left of housing **11** as viewed in FIG. 1, but not shown herein since it forms no part of the present invention.

The cardboard sheets making up stack **15** may be substantially rectangular in form having at least one straight reference edge **16** for data processing by which it is supported upon the surface of base plate **10**. The stack is urged against front vertical wall **14** by a pressure plate **17** bearing against the front end cover **18** of the stack **15**. Pressure plate **17**, in turn, is urged continuously toward front vertical wall **14** by any suitable

resilient means such as a tension spring **19** (FIG. **5**) preferably disposed below plate **10** and connected between an abutment **20** secured to a plate **10** and to a guide **21** secured to a handle **22** on a pressure plate **17**. Said guide **21** extends through a slot **23** in plate **10** and is guided thereby.

Plate **17** is maintained in a predetermined vertical plane by guide **21**, said plane being substantially at right angles to the longitudinal center line of the stack such that plate **17** exerts a substantially uniform pressure along the entire front cover **18** contacted thereby. Plate **17** also is disposed substantially parallel with the front vertical wall **14** of housing **11** so that substantially uniform pressure is transmitted through the stack **15** to the rearmost or foremost cover **24** of the stack.

Lateral movement of the foremost cover **24** is effected by a pair of spaced cams **25, 26** which are driven from a central continuously rotating shaft **27** through a lost motion drive comprising a pin **28** disposed between the ends of a sector **29** secured to said shaft **27**. The reason for the lost motion connection will be made apparent hereinafter.

As shown more clearly in FIG. **6**, cams **25** and **26** are preferable made from an elastomeric material such as polyurethane appropriately molded to have a sector **30** or cylindrical contour adapted frictionally to engage and propel the foremost cover **24** laterally of the stack **15**, and a relief or dwell sector **31** opposite the drive sector **30**. The two sectors in the form illustrated may each encompass approximately 180° of the periphery of a cam. Said cams **25** and **26** are mounted on a hub **32** freely rotable on shaft **27** through antifriction bearings **33**. Although shaft **27** is disposed within housing **11**, contact between cams **25** and **26** on the one hand and the foremost cover **24** on the other is established through openings **34** and **35** formed in front vertical wall **14** of housing **11** which are aligned with cams **25** and **26** so that the cylindrical drive sector **30** of each cam may protrude through its adjacent opening **34** or **35**, as the case may be, into contact with said cover **24**.

When a cover **24** is moved by the drive cam sectors **30** laterally to the left as viewed in FIG. **1**, it is brought between a pair of drive rollers **36, 37**, the peripheral speed of which is greater than the linear velocity of the cover **24** when moved by sectors **30**, such that said cams **25** and **26** are accelerated by the cover **24** to the speed dictated by the drive rollers **35, 35**. The lost motion connection between the cams and their drive shaft **27**, however, permits the cams to be accelerated for the length of time that the cams are in contact with a cover **24**. Once the cover passes the cams, said cams are free to decelerate to the speed of said shaft **27**.

As stated previously, the interior of housing **11** is at subatmospheric pressure such that card **24**, which is adjacent to the openings **34** and **35**, is pushed against said openings by the atmospheric pressure outside housing **11** and effectively covers said openings during the time the dwell sector **31** is rotating past said openings. This differential pressure across the foremost card **24** is utilized to establish a separation between it and its adjacent card in the following manner:

A vertical abutment **38**, preferable made of low friction material such as nylon or polytetrafluoroethylene is secured to front vertical wall **14** a short distance to the left, as viewed in FIG. **1**, from the right hand edge of the stack **15**. Abutment **38** preferably has a rounded contour to provide, in effect, a line contact with card **24**. Said abutment, as may be apparent from FIG. **1**, causes the covers in the stack to assume an angular relation with respect to the surface of wall **14**. This position is shown in connection with the penultimate cover **39**, and, inasmuch as the foremost cover **24** extends over the openings **34** and **35** in wall **14** so as to, in effect, close said openings, said penultimate cover **39** is not subjected to any differential pressure on its opposite sides. Cover **39**, therefore, assumes a flat planar position. The foremost cover **24**, however, being drawn against the openings **34, 35** by the differential pressure acting on the cover, is bowed toward wall **14** by the presence of abutment **38**, thereby establishing a separation between cover **24** and its adjacent cover **39**. This separation is effective to reduce the forces of friction, or adhesion, between foremost cover **24** and its adjacent cover **39** and thus promotes the sliding of foremost cover **24** relative to said adjacent cover **39**.

Despite the fact that abutment **38**, combined with the differential in atmospheric pressure across the foremost cover **24**, causes a separation between the foremost cover and its adjacent cover **39**, there is still sufficient friction between the contacting ends of the said two covers to make it possible for both to be moved laterally by the cams **25, 26** when the movement of only the foremost cover **24** is desired. To insure proper singulation of the covers as they move off the foremost of the stack, the device shown generally at **40** is provided. Said device is comprised of a vertical plate **41** disposed at right angles to pressure plate **17** and adapted to function as an abutment for the left hand edges, as viewed in FIG. **1**, of the covers in stack **15**. Said plate **41** is secured to a slide **42** which has a rectangular groove **43** formed in the under surface thereof in which is received a guide **44** fixed to the upper surface of base plate **10**. Plate **41** may be moved toward or away from front vertical wall **14** by an adjustment screw **45**, and its position, once determined, may be fixed by a set screw **46**.

The end of plate **41** nearest the front vertical wall **14** is provided with a substantially rectangular flat spring **47** which is held against plate **41** by a rigid back-up plate and the rectangular flat spring **47**. The end of back-up plate **48** adjacent to front vertical wall **14** is curved as at **50** and the edge **51** of the curved end **50** is spaced from the rectangular flat spring **47** a distance which is such that the latter may flex to a limited extent in the direction of edge **51**. The edge **52** of rectangular spring **47** is parallel to the outer surface of front vertical wall **14** and is spaced from there a distance slightly greater than the thickness of a cover in stack **15** to form a gate for individual covers. Thus one cover may be moved to the left as viewed in FIGS. **1** and **3** by the cams **25** and **26** through the space or gate formed between rectangular spring **47** and front vertical wall **14**, but if two such covers tend to move through said space, the second will strike rectangular spring **47** and will be restrained from moving with the foremost cover in this stack. The width of the opening or gate between spring **47** and wall **14** may be adjusted by appropriately manipulating adjustment screw **45** after said screw **46** has been loosened. Minor differences in thickness of the covers are accommodated by a flexing of spring **47** until said spring strikes back-up plate **48**.

In the event that the adhesion between the foremost cover **24** and its adjacent cover **39** is such that neither the differential in atmospheric pressure on the foremost cover nor the rectangular spring **47** can break it, said rectangular spring **47** will yield sufficiently to allow the double cover to pass through, but in the process the second cover, that is, the adjacent cover **39**, will be visibly cut or scarred by the spring and the double cover may later be visually detected and manually separated from those processed. The passage of a double thickness cover, or a double cover, causes a deflection of both spring **47** and its back-up plate **48**, but the deflection rate of the two is less per unit force than that of spring **47**. Thus the combination of spring **47** and back-up plate **48** constitutes a double rate spring.

In the operation of the device, a stack **15** of the material to be sorted, such as the covers heretofore illustrated, is placed between pressure plate **17** and wall **14** against the side plate **41** of singulation device **40**, pressure plate **17** being pulled back manually against the tension of spring **19** to permit the insertion of the stack into the area just described. Subatmospheric pressure, that is, vacuum, is established in conduit **13** and in the space **12** in housing **11** by the means provided for that purpose, said means being continuously operative so that it is unnecessary to provide any periodic valving in synchronism with the rotation of the cams **25** and **26**. With pressure plate **17** released, the drive for the rollers **36, 37** is rendered effective and the drive for the shaft **27** is likewise rendered effective to commence the singulation of the covers in stack **15**. The foremost cover **14** will be held against the openings **34, 35** by the differential atmospheric pressure across the openings, and when the drive sectors **30** of the cams **25, 26** strike the foremost cover **24**, the latter will be moved to the left, as viewed in FIGS. **1** and **3**, through the space established by the singulation device **40** and between rollers **36** and **37**. The latter then grip the cover and accelerate it in the said left hand direction, accelerating the cams **25** and **26** as well in the process. For as long as cover **24** is over the openings **34** and **35**, the adjacent cover **39** will not be subjected to the differential pressure between the interior and exterior of housing **11**. When cover **24** is moved sufficiently to the left to uncover openings **34, 35**, the previously adjacent cover **39** becomes the foremost cover of the stack and is then subjected to the differential pressure across openings **34, 35** and separated from its immediately adjacent cover. The movement of the cams **25, 26** and of the rollers **36, 37** is such that cams **25, 26** do not contact a cover in the stack until after the preceding cover has passed through the gate established by the singulation device **40**.

Although in the form described above the abutment against which the foremost cover **24** bears is a flat wall **14** forming part of a substantially rectangular housing **11**, it may be apparent that the desired bending effect in the foremost cover can be achieved by other forms of abutment. All that is required is that two laterally spaced abutments be provided such as the left hand region (FIG. **1**) of wall **14** and an abutment spaced laterally therefrom such as abutment **38**, and an intermediate abutment incorporating the openings **34, 35** located between the two aforesaid abutments, but to the rear of a flat plane connecting the aforesaid abutments. The intermediate abutment may be a tube (not shown) instead of the rectangular housing shown, the tube containing the cams **25, 26** and their associated drive as well as a connection to an evacuation device.

Other modifications of the singulation device will suggest themselves to those skilled in the art, and it is therefore understood that the scope of the invention is not to be limited to the form described above, but is to be determined by the appended claims.

We claim:

1. A pick-off head for a machine for handling singly the cards of a stack of cards, said head comprising a base plate for supporting such stack of cards on edge, means for drawing the central region of the foremost card of said stack of cards away from the card immediately adjacent the foremost card to effect a separation of a major portion of said foremost card and the card immediately adjacent thereto, and means for imparting lateral motion to the separated foremost card while restraining the immediately adjacent card from said lateral movement, said means for drawing the central region of the foremost card away from the card immediately adjacent the foremost card comprising a pair of laterally spaced abutments, means urging the stack against said abutments, a third abutment disposed between said laterally spaced abutments and in proximity to the said foremost card, an opening in said third abutment, means establishing a pressure differential across said opening, said third abutment being removed from a flat plane connecting said pair of laterally spaced abutments such that said differential in pressure causes the foremost card to be moved against the opening to assume a curved shape while said adjacent card retains a substantially flat shape.

2. A pick-off head as described in claim **1**, said laterally spaced abutments comprising a substantially flat transverse wall extending vertically across the foremost card of a stack and a vertical rib on said wall projecting outward from the surface of said wall.

3. A pick-off head as described in claim **1**, and said lateral motion imparting means for the foremost card extending intermittently through said opening.

4. A pick-off head as described in claim **1**, and comprising further, means for establishing a gate slightly wider than the thickness of one card, but narrower than the thickness of two cards, through which the foremost card is driven by the lateral motion imparting means, said gate establishing means comprising a vertical abutment on the base plate disposed along the side of a stack of cards, a flat spring extending toward one of said abutments into the path of movement of a laterally moving card, and means for establishing a dual rate of deflection of said spring.

5. A pick-off head for a machine for handling singly the cards of a stack of cards, said head comprising a base plate for supporting such stack of cards on edge, means for drawing the central region of the foremost card of said stack of cards away from the card immediately adjacent the foremost card to effect a separation of a major portion of said foremost card and the card immediately adjacent thereto, and means for imparting lateral motion to the separated foremost card while restraining the immediately adjacent card from said lateral movement, and comprising further, means for establishing a gate slightly wider than the thickness

of one card but narrower than the thickness of two cards, through which the foremost card is driven by the lateral motion imparting means, said gate establishing means comprising a vertical abutment on the base plate disposed along the side of a stack of cards, a flat spring extending into the path of movement of a laterally moving card, and means for establishing a dual rate of deflection of said spring.

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