United States Patent

Davis

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[45] **May 2, 1972**

[54] MATERIAL HANDLING DEVICE

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[52] **U.S. Cl.** **271/11**, 271/26

[51] **Int. Cl.** **B65h 3/08**, B65h 5/08

[58] **Field of Search** 271/11–12, 26

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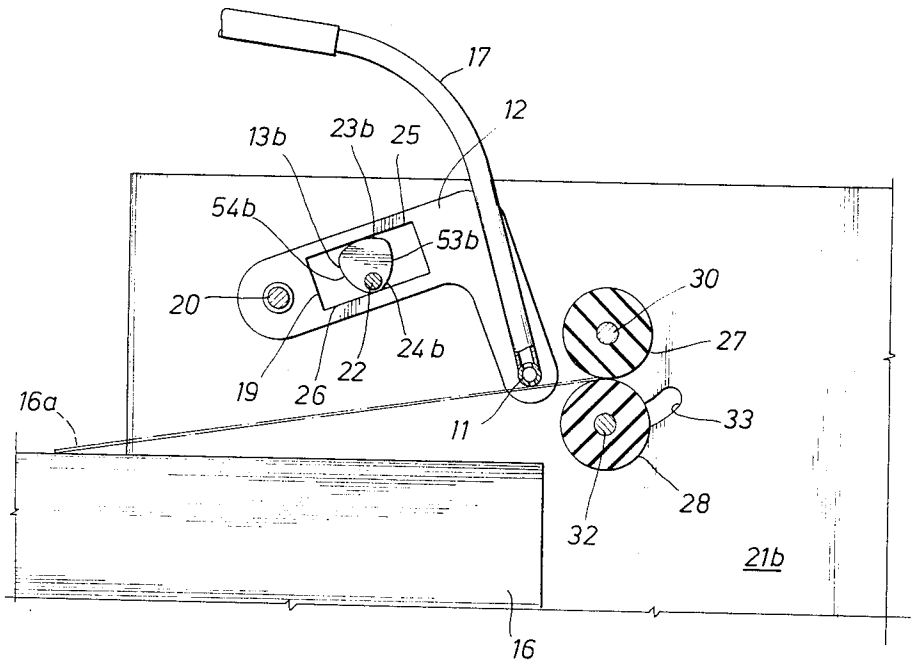
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[57] **ABSTRACT**

A pneumatic card pick-up member is moved between first and second positions. In the first position the member picks up a card. In the second position the card is removed from the member by two rollers that tilt the card as it travels through them. The card pick-up member is stopped long enough in the first position for it to pick up a card. It is also stopped long enough in the second position for the card to be engaged between the two rollers and removed from the pick-up member. In between these positions, the pick-up member is moved rapidly.

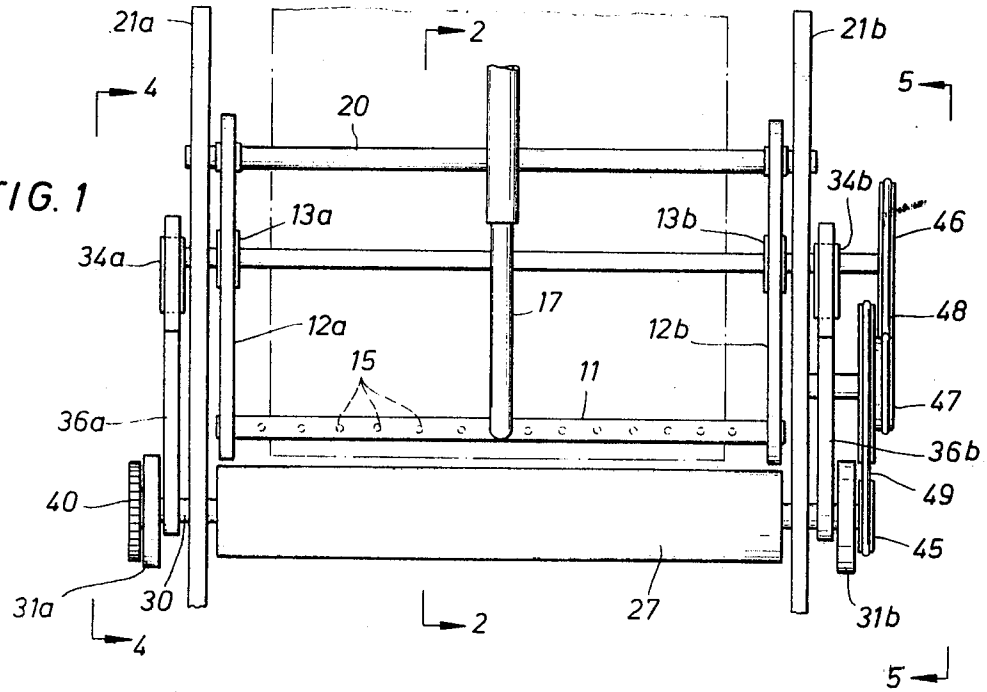
5 Claims, 5 Drawing Figures



Patented May 2, 1972 3,659,838

2 Sheets-Sheet 1

FIG. 1



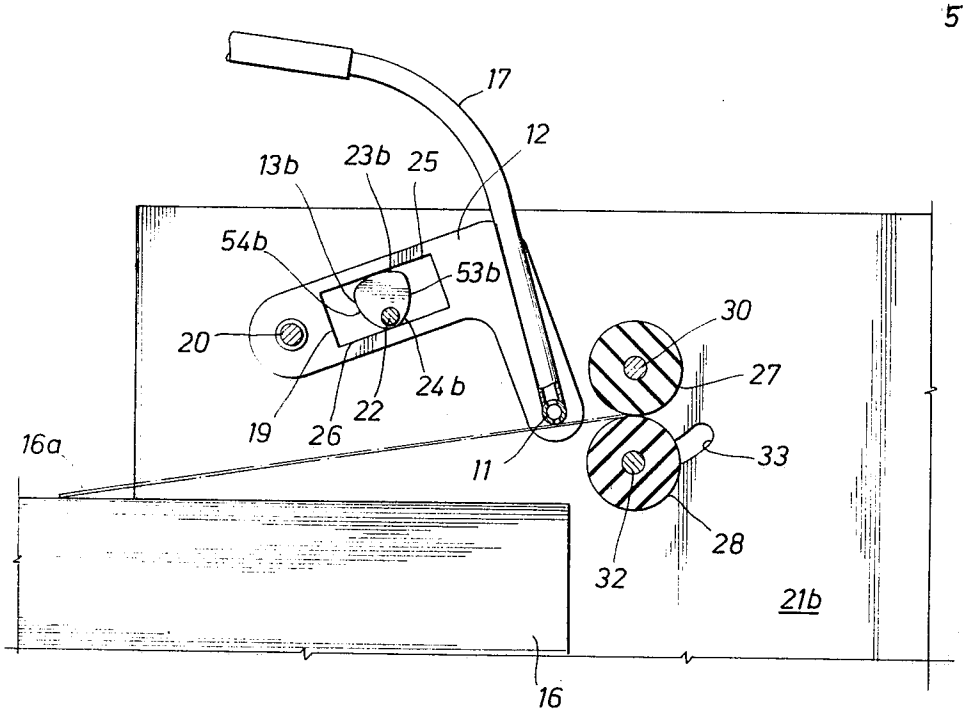


FIG. 2

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FIG. 3

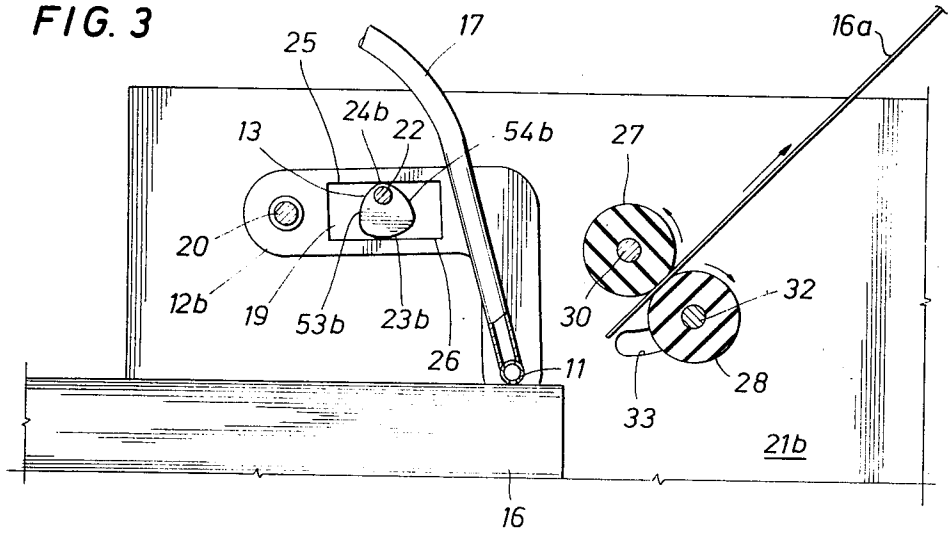
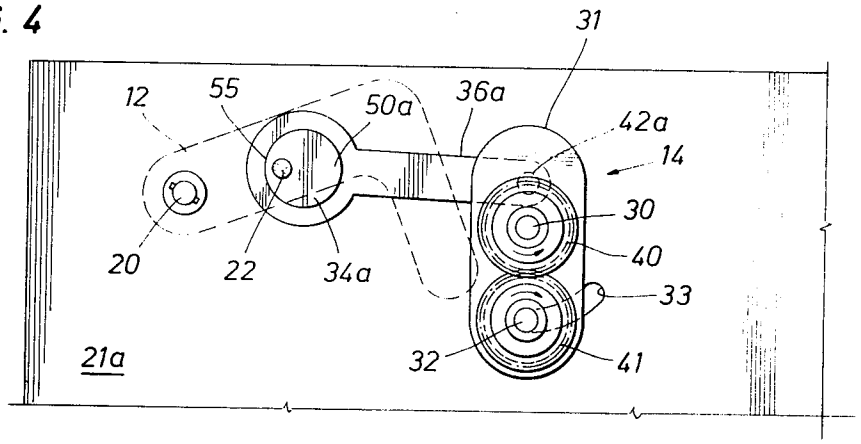


FIG. 4



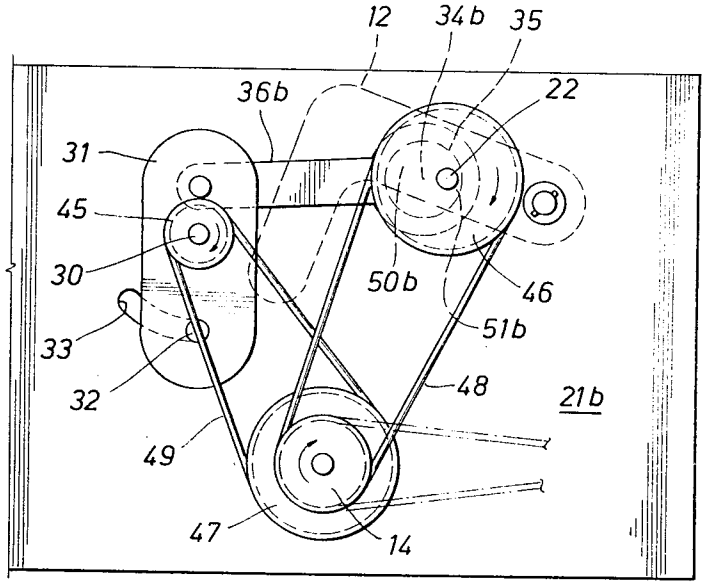


FIG. 5

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MATERIAL HANDLING DEVICE

This invention relates to pneumatic devices that move relatively thin, flat-sided objects, such as data processing cards, one at a time from one location to another.

In a number of industries it is necessary to provide some type of device that can move relatively thin, flat-sided members one at a time from one location to another location very rapidly. Data processing cards, statements, checks, receipts, paper money, and mail are examples of flat-sided, card-shape objects that are frequently so moved between processing points. The flat-sided member need not be paper or cardboard, however. For instance, in the tinning process, sheets of metal are fed into the tinning process one at a time from stacks of the sheet.

In the data processing industry there is one particular problem to which this invention is particularly well adapted. Data processing cards are usually returned by the data processing machine in reverse order after being run through the machine. These cards must be restacked into their original order before they can be used again. Previously, the restacking of punch cards has been accomplished by using a thin blade moving at high speeds to physically knock the cards one at a time into a new stack. This type of restacking device has one important disadvantage: The punch cards may be damaged by the blade.

Pneumatic suction devices have also been used for restacking punch cards. These pneumatic devices included a pneumatic suction head for picking up one card at a time from the reverse order stack. The suction head with the card attached was then moved to a second position where the card was disposed. The suction head was rapidly oscillated between a pick-up position and a card removal position. The device had no means to slow down the suction head at the pick-up position so that the suction head continued its rapid speed even when in a position to pick up a card from the stack. Therefore, the suction head would be in engagement with the stack only momentarily. This meant that the suction force of the suction head had to be strong enough to pick up a card while the suction head moved rapidly during engagement of the head with the card. The strong suction forces created problems. The cards have perforations in them as well as some permeability and the suction head would on occasion pick up two cards instead of one. One solution was to reduce the suction force of the pick-up member, but then it would not be able to consistently pick up a card due to the short time it was in engagement therewith.

It is an object of this invention to provide a device having pneumatic means for picking up flat-sided members one at a time from a stack without disturbing the next member in the stack.

It is a further object of this invention to provide a pneumatic material handling device that is of simple construction and that can be economically built.

It is a further object of this invention to provide a device that can restack data processing cards rapidly without damaging the cards.

It is a further object of this invention to provide a card pneumatic moving device wherein the pneumatic suction head of the device pauses when in engagement with the stack of data processing cards to be restacked for a sufficient time for the top card to be firmly attached to the pneumatic suction head before moving the head, thereby allowing a suction force to be used that has less tendency to pick up more than one card.

It is a further object of this invention to provide a pneumatic card handling device that includes rotating rollers that are positioned to receive a card between the rollers from the pick-up means of the device and to discharge the card from between the rollers in a direction at an angle to the direction of travel of the card when it was first engaged by the rollers.

This invention has utility in moving any flat-sided member, as explained above; however, the embodiment shown in the drawings will be described in detail below in connection with the restacking or moving of flat, thin, relatively stiff cards, such as data processing cards.

In the drawings:

FIG. 1 is a top plan view of the preferred embodiment of a card handling device constructed in accordance with this invention;

FIG. 2 is a cross-sectional view of the card handling device of FIG. 1 as seen along line 2—2 of FIG. 1 with the pneumatic pick-up means of the device in its card delivering or second position;

FIG. 3 is the same view as FIG. 2 with the pick-up means in its first or card pick-up position;

FIG. 4 is a side view in elevation, as seen along line 4—4 of FIG. 1; and

FIG. 5 is a side view in elevation, as seen along line 5—5 of FIG. 1.

The device includes a frame means that comprises parallel, spaced sides **21***a* and **21***b*. In accordance with the invention, means are provided for picking up a relatively thin, flat-sided member, such as a data processing card. In the embodiment shown, such means comprise horizontally disposed pneumatic suction bar **11**. The bar is a hollow tube closed at both ends. Openings **15** (shown dotted in FIG. 1) are spaced along the underside of the bar. Tube **17** connects the inside of the bar with a pump (not shown) that pulls air from the inside of the tube when openings **15** are blocked, as by card **16***a* in FIG. 2. When tube **17** is in contact with card **16***a*, such that openings **15** are blocked, the pressure in the bar will be reduced below atmospheric pressure and this pressure differential will cause card **16***a* to be attached to the bar by a force greater than its own weight. Preferably, openings **15** and the capacity of the pump are designed to provide a pressure differential during the time that the suction head is in engagement with the stack that will pick up only one card. As will be explained below, it is one of the features of this invention to hold the suction head in engagement with the stack for sufficient period of time for such a relatively low suction force to be used and thereby reduce the tendency of the head to pick up more than one card. As the data processing card is picked up, means are provided (not shown) to push the new top card in the stack to the position of the previous card so that the top card in the stack will always be in the proper position to be contacted by suction bar **11**.

Means are provided for moving the pick-up means between a first position to pick up a data processing card, such as **16***a*, from the reversed order stack **16** of data processing cards and a second position to deliver card **16***a* with a pause at each position, the pause being sufficient to allow the card to be attached to the pneumatic pick-up means in the first position and to allow the card to be removed from the pick-up means in the second position. In the embodiment shown, such moving means includes L-shaped arms **12***a* and **12***b*. The arms are in spaced, parallel relationship. One end of each arm is attached to one end of suction bar **11** to support the suction bar between sides **21***a* and **21***b* of the frame means. The other ends of arms **12***a* and **12***b* are mounted on rod **20** that extends transversely between frame sides **21***a* and **21***b* for pivotal movement of the arms about the longitudinal axis of the rod to oscillate suction bar **11** between the first and second positions shown in FIGS. 3 and 2, respectively.

To oscillate the arms, first shaft **22** is mounted on the frame means for rotation around its longitudinal axis. Shaft **22** extends between frame sides **21***a* and **21***b* and through openings in arms **12***a* and **12***b*. Only opening **19** in arm **12***b* is shown; however, it should be understood that arm **12***a* has an opening identical to that in **12***b*. A first set of cams **13***a* and **13***b* are mounted on shaft **22** for rotation with the shaft. Cams **13***a* and **13***b* are positioned in the openings in arms **12***a* and **12***b* for engagement with side **25** or **26** of openings **19** in arm **12***b* and the opening in arm **12***a*. Cams **13***a* and **13***b* are identical in operation, just as arms **12***a* and **12***b* are identical in operation. Therefore, only one cam and only one arm, cam **13***b* and arm **12***b*, respectively, will be hereinafter discussed, since any discussion of this particular cam or arm applies to the cam and arm on the other side of the device.

First, cam **13***b* is known in the art as a cylindrical arm. The cam has arcuate peripheral surface **23***b* having a relatively

long radius of curvature and arcuate peripheral surface **24***b* having a relatively short radius of curvature with respect to shaft **22**. Relatively straight sections **53***b* and **54***b* are on each side of and connect the long and short radius surfaces of each cam. Cam **13***b* is provided with this cylindrical cam shape so that the pick-up means will pause when curved peripheral surface **23***b* is in engagement with side **25** or **26** of opening **19** and arm **12***b* and move rapidly between positions when peripheral section **23***b* is moving from engagement with a side of opening **19**.

The duration of the pause with respect to the time required for a complete rotation of cam **13***b* is determined by the angle of arcuate surface **23***b* having the long radius of curvature. Therefore, the pause per revolution time of the cam may be adjusted for pneumatically picking up flat-sided members other than cards if a longer or shorter length of time is required by choosing a first cam having a longer or shorter length of the peripheral surface **23***b*. Surface **24***b* is designed to contact or be in immediate proximity to the opposite side of opening **19** at the same time that longer radius of curvature surface **23***b* is in contact with a side of opening **19**. The proximity of cam surface **24***a* to the opposite side of opening **19** prevents arm **12***a* from lurching when cam surface **24***a* first contacts side **25** or **26** of opening **19** as shaft **22** rotates the cam.

The operation of the card pick-up means during one rotation of first cam **13***b* is as follows. As shaft **22** rotates clockwise, suction bar **11** is disposed in contact with top card **16***a* of reverse order stack **16** and remains in that first position for sufficient time to pick up single card **16***a*. This hesitation period is accomplished by engagement of the peripheral surface **23***b*, having the long radius of curvature, of first cam **13***b* with side **26** of opening **19** of L-shaped arm **12***b*, as shown in FIG. **3**, thereby maintaining suction bar **11** in the first position. If it is desired that suction bar **11** be maintained immediately adjacent rather than in contact with the top card in stack **16**, then peripheral surfaces **23***b* and **24***b* of cam **13***b* may contact both sides **25** and **26**, respectively, of opening **19** in arm **13**b during the hesitation period. As shaft **22** rotates clockwise, peripheral surfaces **23***b* of first cam **13***b* moves out of engagement with side **25** of opening **19** causing rapid movement of arm **12** and suction bar **11** with attached card **16***a* to a second position for the suction bar. Continuing the rotation of shaft **22** and cam **13***b*, peripheral surfaces **23***b* engages side **25** of opening **19**, as shown in FIG. **2**, causing suction bar **11** to pause in the second position so that card **16***a* is removed. Rotating shaft **22** then moves peripheral surface **23***b* out of contact with side **26**, thereby causing suction bar **11** to return to its first position immediately above reverse order stack **16**.

Means are provided to remove the punch card from suction bar **11** when suction bar **11** is in the second position as shown in FIG. **2**. In the preferred embodiment, the member removal means includes first roller **27** and second roller **28**. Means are provided for mounting the rollers on the frame means for rotation around their longitudinal axis, including means mounting at least one of the rollers, roller **28**, for pivotal movement of its longitudinal axis around the longitudinal axis of the other roller **27**. The means for mounting the rollers on the frame means includes second shaft **30** that extends through frame sides **21** and **22** that support the shaft for rotation, thereby providing a longitudinal axis of rotation for roller **27** mounted on the shaft.

Arcuate slots **33** are cut into frame sides **21** and **22**. Roller **28** is mounted upon shaft **32** that extends through slots **33**. Means are provided to mount roller **28** for pivotal movement of its longitudinal axis, shaft **32**, about the longitudinal axis, shaft **30**, of roller **27**. The means include a pivotal link **31***a* through which roller shafts **30** and **32** extend. Since the longitudinal axis of shaft **30** is supported by frame sides **21** and **22**, roller **28** is pivotable about shafts of roller **27** through the path of slots **33** by the pivoting of link **31** about shaft **30**.

Means for rotating rollers **27** and **28** in opposite directions around their longitudinal axes are provided by gears **40** and **41**. Gears **40** and **41** are mounted in a meshed relationship for rotating upon shafts **30** and **32** of the rollers adjacent link **31***a* as shown in FIG. **4** in such a manner that rotation of gear **40** causes rotation in the opposite direction of shaft **32**, gear **41** and roller **28**.

Means are provided for moving pivotally mounted roller **28** within slots **33** between a first roller position as shown in FIG. **2** where the rollers are positioned to receive between the rollers a member, such as a data processing card, from the pick-up means when the pick-up means is in its second position and a second roller position as shown in FIG. **3** to discharge the member from between the rollers at an angle to the direction of travel of the member when it was first engaged by the rollers. In the embodiment shown such moving means includes follower members **36***a* and **36***b* for causing roller **28** to move between its first and second positions as cam **34***a* and **34***b* are rotated. Follower arm **36***a* is operatively engaged with roller **28** by connection on one end by pin **42***a* to link **31***a* so that horizontal movement of the follower arm **36***a* will cause pivoting of second roller **28** about the axis of shaft **30** of first roller **27**. The other end of follower arm **36***a* has a circular opening therein that fits over second cam **34***a*. Second cam **34***a* is mounted eccentrically on shaft **22** so that rotation of second cam **34***a* with shaft **22** provides follower member **36***a* with alternate periods of fast and slow movement causing oscillation of roller **28** between the first and second roller positions.

Thus a method of moving a plurality of relatively thin, flat-sided members, such as a data processing card, from a first stack comprises the steps of holding a card pick-up means adjacent or in contact with top card **16***a* of stack **16**, stopping the movement of the pick-up means for sufficient time to pick up a card, moving the card pick-up means to a second position, stopping the card pick-up means in said second position for sufficient time for the card to be removed, conveying the card to a disposal point, and returning the card pick-up means to the first stack in order to pick up another card The operation of the card removal means is as follows. As shaft **22** rotates eccentric **34***a* through the first roller position shown in FIGS. **2** and **4**, follower arm **36***a* is moved very slowly thereby causing link **31***a* and roller **28** to slow down allowing the rotating rollers to remove card **16***a* from pneumatic suction head **11**. The slower movement of the rollers pivotally attached to the follower arm **36***a* is caused by section **50***a* rotating through a horizontal position with respect to shaft **22** thereby causing follower arm **36***a* to move very slowly. As eccentric cam **34***a* rotates clockwise with shaft **22**, section **50***a* of eccentric **34***a* causes follower member **36** to accelerate causing second roller **28** to pivot upward to the second roller position of FIG. **3** so that card **16***a* may be released at an angle with respect to reversed order stack of cards **16**. As second cam **34***a* continues to rotate clockwise, section **50***a* causes follower arm **36***a*, rigid member **31***a*, and thus second roller **28** to slow down at the second roller position while card **16***a* is released. The pivoting upward of roller **28** and the releasing of the data processing card at an angle combines with the rotation of the rollers to break the card away from the forces of pneumatic suction of suction bar **11**. Second roller **28** is then returned to the first roller position to remove another card from suction bar **11**. Eccentric **34**a causes slow horizontal movement of follower arm **36***a* when section **50***a* is substantially horizontal with respect to shaft **22** and rapid horizontal movement of follower arm **36**a when surface **50***a* is substantially vertical with respect to shaft **22**.

Driving means are provided for mounting first cams **13***a* and **13***b* and second cams **34***a* and **34***b* for rotation so that the pick-up means and the rollers may oscillate as herein described. In the preferred embodiment of FIG. **5**, the rotating means includes driving gear **47** linked to driving gears **45** and **46** by belts **47** and **48** in order to provide the proper speed of rotation for first cams **13***a* and **13***b* and second cams **34***a* and **34***b* mounted on shaft **22** and for roller **27** mounted on shaft **30**. Of course, any type of power may be used to drive shafts **22** and **30**, as is well known to those of ordinary skill in the art.

First cams 13*a* and 13*b* and second cams 34*a* and 34*b* must be positioned on shaft 20 so that suction bar 11 will stop in its second position during the precise period that the rollers have slowed down in the first roller position shown in FIG. 2. Also, the speed of rotation of the first roller shaft 30 and cam shaft 20 must be properly synchronized. This synchronization is accomplished by using gears having the proper diameter with respect to the diameter of main driving gear 47.

From the foregoing, it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the apparatus.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

The invention having been described, what is claimed is:

1. A pneumatic handling device comprising frame means, pneumatic means for picking up a relatively thin flat-sided member, such as punch cards, means mounted on the frame means for moving the pick-up means between a first position to pick up such a member and a second position to deliver the member with a pause at each position, said moving means including an arm attached to the pick-up means and pivotally attached to the frame for moving the pick-up means between the first and second position as it oscillates about its pivotal axis, said arm having an opening therein spaced from said pivot point, a first cam mounted on the frame for rotation with its peripheral surface to engage opposite sides of the opening in the arm to cause the arm to oscillate and the pick-up means to move between said first and second positions with a pause at each position, as the cam is rotated, means for rotating the cam, and means to remove the member from the pick-up means when the pick-up means is in said second position.

2. The device of claim 1 which the peripheral surface of said first cam has a section with a relatively long radius of curvature and relatively straight sections on each side thereof so the pick-up means will pause at said first and second positions for the pick-up and removal of the member when the curved section is in engagement with one of the sides of the opening in the arm and will move rapidly to another of said positions when the curved section is moving from engagement with one side of the opening and into engagement with the opposite side.

3. A pneumatic handling device comprising frame means, pneumatic means for picking up a relatively thin flat-sided member, such as punch cards, means mounted on the frame means for moving the pick-up means between a first position to pick up such a member and a second position to deliver the member with a pause at each position, and means to remove the member from the pick-up means when the pick-up means is in said second position, said member removal means including first and second rollers, means mounting the rollers on the frame means for rotation around their longitudinal axes, means for rotating the rollers in opposite directions around their respective longitudinal axes, said mounting means including means mounting at least one of the rollers for pivotal movement of its longitudinal axis around the longitudinal axis of the other roller, means for moving the pivotally mounted roller between a first roller position where the rollers are positioned to receive between the two rollers a member from the pick-up means when the pick-up means is in its second position and a second roller position to discharge the member from between the rollers in a direction at an angle to the direction of travel of the member when it was first engaged by the rollers.

4. The device of claim 3 in which said roller moving means includes a second cam, means mounting the second cam for rotation, a follower member operatively engaged with the movable roller and the second cam for causing the roller to move between its first and second positions as the cam is rotated, and means for rotating the second cam to so move the movable roller.

5. A card handling device for moving cards, such as data processing cards, one at a time from a stack of such cards, comprising two frame sides, a cam shaft mounted on said frame sides for rotation relative thereto around its longitudinal axis, a cam mounted on and rotating with said cam shaft, said cam having a peripheral surface with an arcuate portion having a relatively long radius of curvature with respect to the longitudinal axis of the shaft, an arcuate portion having a relatively short radius of curvature with respect to the longitudinal axis of the shaft, and generally straight portions connecting said two arcuate portions, an L-shaped arm positioned between the frame sides with one end mounted to pivot around an axis generally parallel to the longitudinal axis of said cam shaft, said arm having an opening in which said cam is positioned for its peripheral surface to engage the sides of the opening, a suction bar attached to said L-shaped arm at a location spaced from its pivotal axis to pick up one card from the top of the stack of such cards, means for rotating the shaft in order to rotate said cam and oscillate the arm around its pivotal axis to move the suction bar between a first position in engagement with a stack of such cards with a pause in the movement of such arm when in such position that is sufficient to allow the top card to become attached to the suction bar and a second position where the card is removed from the suction bar with a pause in the movement of the bar at said second position, and means for so removing the card, said means comprising a first roller shaft mounted on said frame sides for rotation about its longitudinal axis, said first roller mounted on said first roller shaft for rotation about the longitudinal axis of said first roller shaft, a pivotal link mounted on said first roller shaft in such a manner that said link is pivotal about said first roller shaft longitudinal axis, said frame sides having arcuate slots, a second roller shaft extending through said arcuate slots and through said pivotal link in such a manner that said second roller is pivotal through said arcuate slots about the longitudinal axis of said first roller shaft, a gear mounted on each of said first and second roller shafts in such a manner that rotation of said one of said gears causes the other of said gears to rotate and thereby causes said rollers to rotate, means moving said pivotally mounted second roller between a first roller position where said rollers are positioned to receive between the rollers a card when said suction bar is in its second position, comprising an eccentric mounted for rotation on said cam shaft, a follower arm connected on one end to said pivotal link and on the other end having a circular opening therein fitting over said eccentric such that rotation of said eccentric causes oscillation of said second roller between a first roller position where said rotating rollers remove said card from said suction bar in said second suction bar position and a second roller position where the card is released at an angle with respect to the position of the cards in said stack.

* * * * *