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APPARATUS FOR PNEUMATICALLY SEPARATING FLAT ARTICLES ONE AT A TIME

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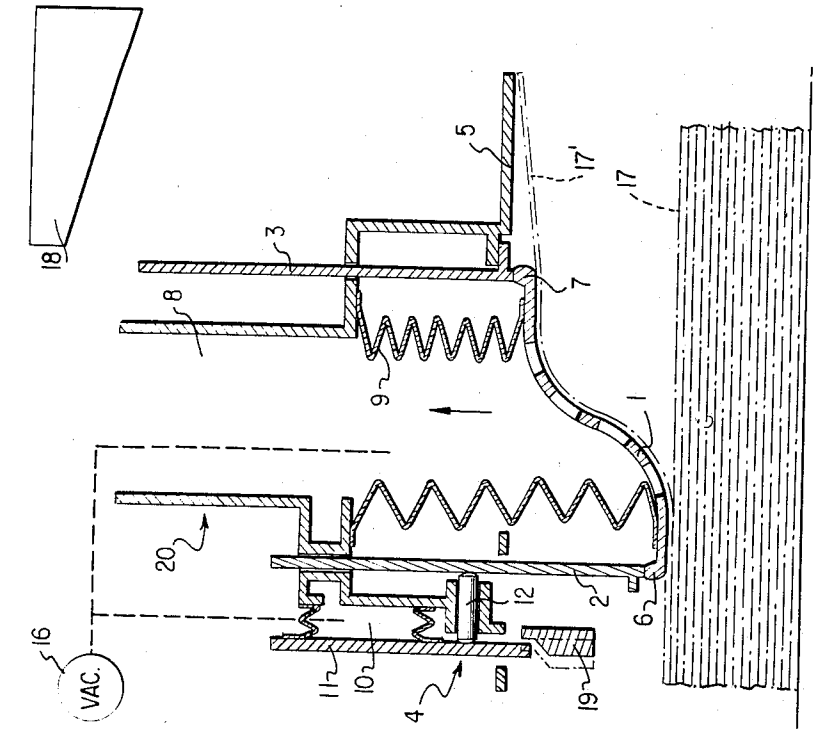


FIG. 2

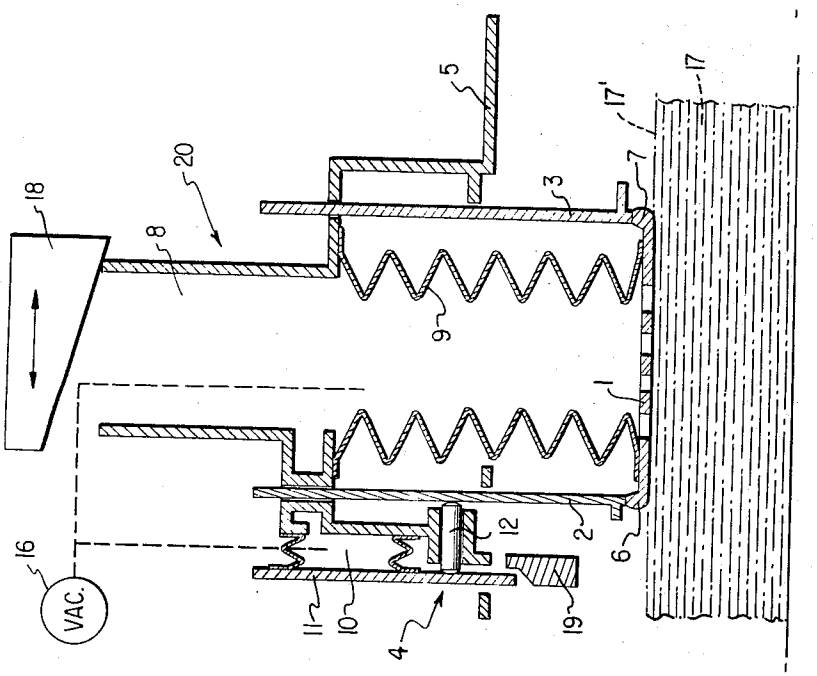


FIG. 1

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APPARATUS FOR PNEUMATICALLY SEPARATING FLAT ARTICLES ONE AT A TIME

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ABSTRACT OF THE DISCLOSURE

This invention relates to apparatus for separating flat articles one at a time, and, more particularly, to apparatus for pneumatically removing the top article of a stack of such articles and preventing double and multiple removals.

The apparatus includes a suction head which is connected to a vacuum source and which is comprised of at least two sections which are movable with respect to one another. The two sections of the suction head are advanced into engagement with the uppermost article of the stack. A partial vacuum is then applied to the suction head so that the uppermost article is held against the suction head. One of the sections is restrained while the other is retracted under the influence of atmospheric pressure. This causes the article to be bent around the edges of the sections of the suction head wheerupon any additional articles which might adhere to the uppermost article fall back into the stack.

Additionally, a limit stop may be provided which engages the edge of the uppermost article which is being lifted by the suction head to bend the article into a generally S-shaped configuration. The restraining device is then released so that the two sections become aligned, permitting the separated article to assume again a generally flat configuration.

State of the prior art

In the past, it has been known to use pneumatic or mechanical devices for separating stacked flat articles such as letters, postcards, money orders or blank forms. For simplicity, the articles hereinafter will be referred to as letters. As to the pneumatic devices, there have been utilized, for example, suction jets, the suction line of which is cylically opened and closed by a sliding member. At each opening of the suction line the uppermost letter of the stack is sucked up into engagement with the suction jet. When the suction line of the suction jet is closed, the letter falls onto a belt which advances the separated letter to another position.

It has also been known to draw the letters from a stack by the use of a perforated suction belt. Such a suction belt commonly has groups of openings which are spaced apart by a predetermined distance which corresponds to the desired conveying distance of the letters. The groups of suction openings are advanced over suction slits. Each group of openings sucks up one letter from the stack into contact with the belt and it is carried along by the belt to the end of the suction slit, whereupon the letter is released.

In the presently known apparatus for separating letters there exists the problem of the sticking together of two or more letters, thus preventing the assured separation of one letter at a time. However, the separation of the letters which are to be processed further in automatic letter sorting apparatus must be carried out in a very precise manner and an imperfection in separation immediately results in missorting. Therefore, it has been necessary in the past to provide facilities in addition to the actual separating device in order to correct for the separation errors which have occurred in this manner. This has been done, for example in the case of a suction belt separater, by providing a rotating pneumatic separator under the suction belt and adjacent the separation zone which, in the case of a double removal, separates the lower letter from the suction belt.

It has been shown from experience that the danger of double removal of letters is especially great when a horizontally positioned letter is lifted in a vertical direction. Even lifts from 20 to 30 millimeters afford no assured remedy.

Objects

Accordingly, it is a primary object of this invention to pneumatically separate a single letter from a stack of letters, while insuring against a double or multiple removal.

Another object of the invention is to remove the uppermost letter from a stack of letters and then bend the uppermost letter to insure the separation of any additional letters which might adhere thereto.

Description of the invention

The invention will now be more fully described in conjunction with an operative embodiment thereof shown in the accompanying drawing.

In the drawing, FIG. 1 is a schematic vertical sectional view of an operative embodiment of the invention in only the detail necessary to the understanding of the operation thereof; and

FIG. 2 is a similar view with portions removed indicating the relative position of parts when a letter has been lifted from the stack thereof.

The suction head, designated generally **20**, consists of a suction plate **1**, which is flexible or resilient in nature, and which has a plurality of apertures (unnumbered). The suction head **20** also includes sidewalls **2** and **3** which are connected to and which act to guide the vertical movement of the suction plate **1**. The sidewalls **2** and **3** may be constructed in a generally curved shape, rectangular shape, or many other variations. The sidewalls **2** and **3** are connected together by a resilient material or with any other conventional means which permits relative movement therebetween. Thus, the sidewalls **2** and **3** constitute individual sections of the suction head **20** which may be moved in unison or relative to one another.

A suction tube **8** is slidably mounted between the sidewalls **2** and **3** and is provided with a bellows **9** which is positioned between the bottom of the suction tube **8** and the inner, upper surface of the suction plate **1**. The suction tube **8** (shown in its DOWN position in FIG. 1) is connected to a conventional source of vacuum **16**. The partial vacuum created by vacuum source **16** is confined in the suction tube **8** and the bellows **9** so as to provide a suction through the apertures of the suction plate **1**. The vacuum which is drawn through the apertures is sufficient to lift at least one letter from the stack of letters, shown in phantom at **17**. A curved disc or cam **18** is provided for urging suction tube **8** downwardly so that the suction plate **1** is in engagement with the stack of letters **17**. After the uppermost letter **17'** is in contact with the suction plate **1**, and the vacuum source **16** is turned ON the cam **18** is moved out of engagement with suction tube **8**. Under these conditions, wherein there is a partial vacuum on the inside of the bellows **9**, the atmospheric pressure presses from the under side of the upper letter **17'** against the suction plate **1** and attempts to push the suction head **20** upward.

A braking device **4** is mounted adjacent the sidewall **2** for restraining or holding the sidewall **2**, during the initial upward movement of the suction plate **1** and the sidewall **3**. The brake **4** includes a bellows **10** which is connected to the vacuum source **16** by a suitable means (unnumbered). The brake **4** further includes a fixed wall or plate **11** the outward surface of which is exposed to the atmos-

phere and the inner surface of which is in engagement with a detent or peg 12. When the vacuum source 16 is turned ON, a partial vacuum is created inside the bellows 10. The differential pressure which is so created on the plate 11 causes the plate 11 to move to the right and urge the peg 12 into holding engagement with the sidewall 2. Thus, during the retraction cycle of the suction plate 1 (FIG. 2) the sidewall 2 is held in its lowermost position while the sidewall 3 and the suction plate 1 are urged upwardly by atmospheric pressure acting against the outer surface thereof. This results in a bending of the uppermost letter which is in contact with the suction plate 1; whereas any additional letter which adheres to the uppermost letter remains in an undeformed condition since such a letter has atmospheric pressure acting on both of its sides. Subsequently, the brake 4 is mechanically released by a cam 19 which engages and moves the plate 11 to the left (FIG. 1). The sidewall 2 is then allowed to rise under the force created by atmospheric pressure and align itself with the sidewall 3 in order to return the uppermost letter 17' to a flat condition.

A limit stop 5 is provided adjacent the sidewall 3 in order to effect further bending of the uppermost letter 17'. Thus, during the retraction cycle of the suction head 1 and while the brake 4 is engaged, the righthand edge of the uppermost letter 17' strikes the limit stop 5 (FIG. 2). As the sidewall 3 is further raised the uppermost letter assumes a generally S-shaped configuration. In this manner the letter 17' is bent or pivoted around a point 6 on the sidewall 2, a point 7 on the sidewall 3 and some portion of the limit stop 5. This bending of the uppermost letter 17' has been found to be very successful in separating any additional letters which are inadvertently carried along by the uppermost letter 17'.

Preferably, the suction tube 8 is pivotally suspended at its upper end by means not shown. In one position, the suction tube 8 and the suction plate 1 are positioned over the center of the letter stack 17. They may be driven by a conventional crank drive through an arc in order to transfer the uppermost separated letter 17' to a forwarding transporting device, such as rollers. The crank drive is designed so that during approximately one-quarter of a revolution the suction head 20 is swung out toward the rollers and then swung back during the next one-quarter revolution. This leaves approximately one-half of a revolution for the lowering of the suction head 20, the sucking up of the uppermost letter 17', and the lifting of the suction head 20, by means of atmospheric pressure. During the latter one-quarter of a revolution the uppermost letter 17' is separated from the stack 17 and any additional letters are allowed to drop back into the stack 17. It is during the time when the suction plate 1 is at its lowest position (FIG. 1) that the vacuum source 16 is turned on in order to attract the uppermost letter 17'.

In operation, the suction tube 8, while it is positioned over the letter stack 17, is lowered a sufficient distance by the cam plate 18 to contact the letter stack 17. After the source of vacuum 16 is turned ON, the cam 18 is moved out of engagement with the suction tube 8. At the lowermost position of the suction plate 1, the plate is positioned on top of the letter stack 17. The suction plate 1 is designed to come to rest on the uppermost letter and is yieldable by a few millimeters depending on the height of the stack. During this time the vacuum source 16 is turned ON, thus closing the apertures in suction plate 1. The atmospheric pressure presses from the underside of the upper letter 17' against the suction plate 1 and attempts to push it upward. Since the sidewall 2 is restrained by the brake 4, only the sidewall 3 and the suction plate 1 move upward. This results in a bending or tilting motion of the suction plate 1 about the point 6 of the sidewall 2, and the letter is correspondingly bent about point 6. The right hand free edge of the letter strikes the limit stop 5, and, therefore the letter is bent in the area 7 so that it assumes a generally S-shaped configuration. It should be clear that the vacuum in the bellows 9 acts only on the uppermost letter 17' but is prevented by the shielding action of that letter from acting upon any succeeding letters. Thus, if another letter adheres to the uppermost letter 17', it will not be bent during the retraction cycle and will fall back into the stack 17.

As the suction head 20 rises upwardly, the cam 19 is advanced to engage the plate 11 in order to release the brake 4 and the sidewall 2. Thereupon, the lifted letter 17' and the suction plate 1 rotate around the point 7 into a generally horizontal position. Following this the suction head 20 is swung outwardly to transfer the letter, for example, to the transporting rollers.

In the preferred embodiment, the tilting axes 6 and 7 are suitably chosen so that the letters are bent around relatively short axes because less force is required. This is also preferred in that short letters, if they lie on one side or the other of the stack 17, may otherwise only be engaged at one end of the suction plate 1.

After one stack 17 of letters is exhausted, an additional stack of letters may be indexed into alignment beneath the suction head by means of a hoist which has a plurality of nests (not shown). In such a case each nest would be provided with an individual stack of letters which are to be separated by the apparatus of this invention. The nests are indexed into position as the letters on each preceding nest are exhausted.

A continuous indexing of the nest after each cycle of the suction head 20 would only be possible if the stacked objects being separated were of equal thickness. As this is not so in the case of letters, the indexing of the letter hoist is controlled by a secondary control which includes two electrical contacts (not shown). One of the contacts is affixed to the suction head 1 in the area of the sidewall 3 and is closed in the lowermost position of the suction plate 1. It is designed to open after the suction plate 1 has been lifted approximately 2 millimeters above that lowermost position. The other contact is in the nature of a innerlock contact which is operated by a cam mounted on the drive shaft of the crank drive. At a predetermined time during the operation of the second apparatus, the second contact tests whether the contact mounted on the suction plate 1 is closed or not. If the letter stack 17 has become too low in the meantime, then the contact on the suction plate 1 is closed at the time of the testing operation and this condition is effective through a secondary control circuit to give the letter hoist a further control operation.

Preferably, the letter hoist is constructed in such a way that it may be advanced in steps of a few millimeters by the secondary control. The secondary control is intended as a fine control for the indexing of the nest depending on the height of letters remaining in that particular nest. Thus, it is possible to maintain the uppermost letters 17' at approximately the same vertical position after repeated cycles of the suction plate 1. In order to index the hoist from one nest to the next, there is provided a suitable photocell which scans the letter stack 17 at a point close to the lower position of the suction plate 1.

The letter hoist can be driven through a direct current shunt motor (not shown) directly without coupling and thereby providing a rather favorable fine control. If a very fine control of the hoist advancement is desired, it is possible to place another brake (not shown) in the vicinity of the suction head which, for example, mechanically pushes a stop into the path of the sidewall 3 at the beginning of the upward lift so that it is held firmly in the same position under all operating conditions. In such a case this stop must again be removed shortly before the termination of the upward lift of the suction means.

It will be evident that many changes can be made in the apparatus of the invention without departure from the scope thereof. Accordingly, the invention is not to

be considered limited to the particular embodiment described herein, but rather only by the scope of the appended claims.

I claim:

1. Apparatus for pneumatically separating a single flat bendable article from a stack of such articles and preventing the separation of more than one article which comprises:

a suction head (20) having two sections (2, 3) which are movable toward and away from the stack of articles (17);

means (18) for advancing the suction head into engagement with the uppermost article (17') of the stack;

means (16) for forming a partial vacuum in the suction head after it engages the uppermost article to hold the article thereagainst and thereby create a differential force on the suction head due to atmospheric pressure to urge the suctionhead away from the stack;

means (4) operable during the retraction of the head for restraining the movement of one of the sections (2) of the suction head as the other is retracted to bend the uppermost article around the sections and thereby cause release of any additional articles adhering thereto.

2. Apparatus as recited in claim 1 which further includes:

means (19) for subsequently releasing the restraining means so that the two sections become aligned and the separated article assumes an unbent configuration.

3. Apparatus as recited in claim 1 wherein said restraining means includes a detent (12) operated by the partial vacuum means for engaging and temporarily holding one of the sections (2) of the suction head during the retraction of the suction head.

4. Apparatus as recited in claim 1 wherein said restraining means comprises:

a detent (12) positioned adjacent one of the sections (2) of the suction head;

a plate (11) which is movable into and out of contact with the detent to engage or disengage the detent with the section (2);

a bellows (10) which is closed at one end and attached to the plate at the other end; and

means for connecting the bellows to the partial vacuum means (16) to create a differential pressure on the plate, so that actuation of the partial vacuum means after the suction head engages the uppermost article advances the plate (11) into operative engagement with the detent to hold the detent against the section (2) of the suction head thereby causing bending of the article.

5. Apparatus as recited in claim 4 which further includes:

means (19) operable after the article has been bent for overriding the force created by the differential pressure on the plate (11) to release the detent so that the two sections become aligned and the article assumes an unbent configuration.

6. Apparatus as recited in claim 1 which further includes:

a limit stop (5) positioned adjacent the suction head for engaging an edge of the article, while it is bent, to bend the article further into an approximate S-shape.

7. Apparatus for separating one flat article from a stack of such articles, which comprises:

pickup means (20) having a passageway (8, 9) extending therethrough adapted to be connected to a vacuum source for picking up the uppermost article in the stack, said pickup means including at least two sections (2, 3) which are movable relative to one another;

means (18) for advancing the pickup means against the uppermost article of the stack;

means (16) for pulling a partial vacuum through the passageway of the pickup means to hold the uppermost article thereagainst, said vacuum causing a differential pressure on the pickup means thereby urging said pickup means away from the stack; and

means for causing relative movement between the two sections during the retraction to bend the uppermost article around the edges of the two sections so that any article which is stuck to the uppermost article is separated therefrom.

8. Apparatus as recited in claim 7 which further includes:

means (19) for subsequently releasing the last mentioned means in claim 7 so that the two sections become aligned and the separated article assumes an unbent configuration.

9. Apparatus as recited in claim 7 wherein said means for causing relative movement comprises:

a detent (12) positioned adjacent one of the sections (2) of the suction head;

a plate (11) which is movable into and out of contact with the detent to engage or disengage the detent with the section (2);

a bellows (10) which is closed at one end and attached to the plate at the other end; and

means for connecting the bellows to the partial vacuum means (16) to create a differential pressure on the plate, so that actuation of the partial vacuum means after the suction head engages the uppermost article advances the plate (11) into operative engagement with the detent to hold the detent against the section (2) of the suction head thereby bending the article.

10. Apparatus as recited in claim 9 which further includes:

means (19) operable after the article has been bent for overriding the force created by the differential pressure on the plate (11) to release the detent so that the two sections become aligned and the sheet assumes an unbent configuration.

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