United States Patent

[11] **3,552,741**

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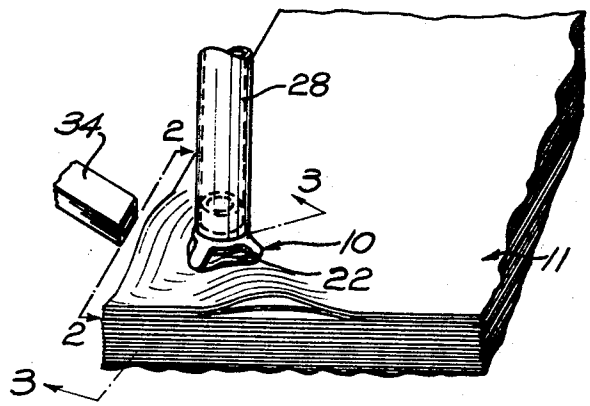
[54] **SHEET GRIPPING MEANS**
9 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **271/26**
[51] **Int. Cl.** **B65h 3/08**
[50] **Field of Search** ..... 271/511, 20, 26; 214/1BS2, 1BS3, 1BS4; 294/64—65

[56] **References Cited**
UNITED STATES PATENTS
957,804 5/1910 Schroeder 294/64X

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ABSTRACT: Sheet gripping suckers adapted to separate a sheet from the top of a pile preparatory to forwarding the sheet to a sheet-handling mechanism, the sucker having skirt portions which flex on gripping which alternate with skirt portions that do not have substantial flexing.



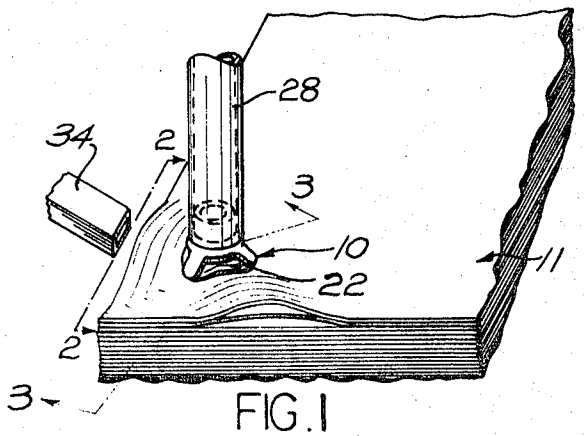


FIG. 1

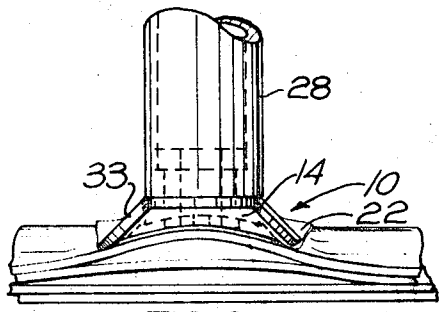


FIG. 2

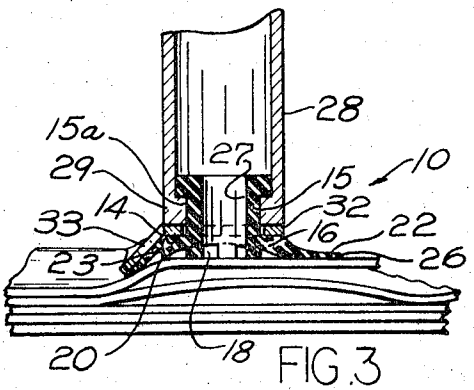


FIG. 3

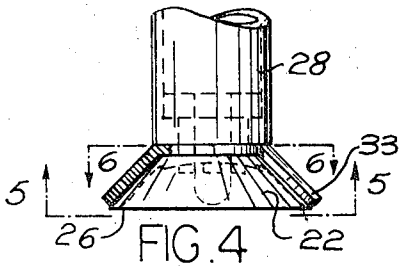


FIG. 4

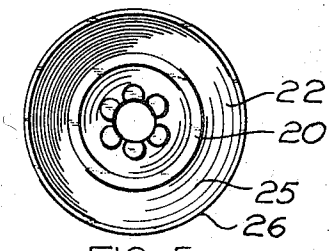


FIG. 5

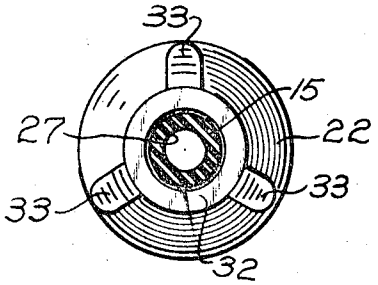


FIG. 6

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SHEET GRIPPING MEANS

Sheet gripping suckers for separating the top sheets of a pile are commonly utilized in sheet feeding and handling apparatus where sheets of paper are being fed from the top of a pile to a sheet processing machine, such as a printing press, by sheet separating and feeding mechanism. In such sheet separating and feeding mechanism, the separation of the top sheet of the pile may be aided by the use of combers and forwarding air (see U.S. Pat. No. 3,226,107 and U.S. Pat. No. 3,076,648) and presser feed are commonly moved into a position under the separated sheet to engage the next sheet of the pile to hold it in position and prevent it from being disarranged during the forwarding of the separated sheet from the pile. Such presser feet are moved into position after the sheet being separated is moved sufficiently to provide a clearance space above the top of the pile.

In feeding sheets, it is important that the suckers only grip and separate one sheet at a time from the top of the pile. Problems have occurred, particularly in handling certain types of sheets, in limiting the separating and pick up to a single sheet. During separation of the top sheet, the sheet next to the top sheet of the pile will tend to move with the top sheet of the pile as the latter is picked up by the suckers. This tendency is caused in part by the fact that the air has been squeezed out between the sheets of the pile and when the top sheet of the pile is picked up, the following sheet tends to follow and move with the top sheet until sufficient air can be introduced between the sheets to break the "vacuum" produced by movement of the top sheet. The faster the rate at which the sheets are being separated from the top of the pile, the greater is the tendency of the second sheet to follow with and cling to the sheet being separated. This tendency of the second sheet to move with the top sheet is compounded when the sheets are being gripped by vacuum-type suckers, particularly when the stock is porous or is extremely thin, as in the case of gift wrap. In porous stock particularly, the vacuum tends to strike through the sheet being gripped to the next sheet to hold the second sheet against the underside of the sheet being separated. This problem is clearly delineated in The Printing Industry by Victor Strauss.

The lifting of two sheets at a time may cause several problems. If the two sheets which are separated simultaneously are fed to the sheet handling mechanism, double sheet detectors normally associated with such machines, will detect the presence of a double sheet and trip the sheet processing machine. In a situation where the second sheet is released before feeding so that the multiple sheet detectors are not tripped, the release of the second sheet before the feeding of it to the sheet handling machine may occur after the presser feet have engaged the top of the pile and in such a situation the released sheet will fall onto the top of the presser feet and will often be disarranged either by its falling or by the forwarding and separating air which is commonly used in the sheet separating and feeding mechanism. It is also possible that the second sheet might be gripped at one corner only and not at the other corner. In this situation, only one corner of the second sheet will be lifted and the other corner will be held down by the presser foot which moves in to engage the top of the pile at that corner. When the separated sheet is then forwarded by the sheet handling mechanism, the gripped corner of the second sheet will be moved forwardly with the top sheet but the other corner will be held by the presser foot thereby resulting in a disarrangement of the sheet. The foregoing examples are illustrations of the various situations and problems which may arise and it will be readily recognized by those skilled in the art that when double sheets are picked up or partially picked up, either the sheet handling machine will be tripped off if both sheets are fed or the second sheet will be disarranged so that on the next cycle of operation it will not be properly gripped and fed and the sheet feeding operation will have to be interrupted to properly orient and rearrange the sheet or to remove the sheet.

Further objects and advantages of the present invention will be apparent from the following detailed description thereof made with reference to the accompanying drawings and forming a part of the specification for all matter disclosed therein and in which:

It is an object of the present invention to provide a new and improved sheet gripping sucker which when it seals against the sheet tends to break the vacuum between the top sheet and the next sheet because of a corrugating effect produced when the sucker seals against the top sheet.

A further object of the present invention is to provide a new and improved sheet gripping sucker which has a skirt extending outwardly from the body portion of the sucker with the sucker being so constructed and arranged that spaced portions of the skirt flex in a flattening direction when vacuum is applied to the sucker with the latter in engagement with the sheet, and alternate portions of the skirt are constrained against substantial flexing so that a wavy effect is produced in the sucker skirt when the sucker grips a sheet.

FIG. 1 is a fragmentary perspective view of a sheet handling apparatus embodying a sucker of the present invention;

FIG. 2 is a fragmentary elevational view looking from line 2–2 of FIG. 1;

FIG. 3 is a sectional view taken along line 3–3 of FIG. 1;

FIG. 4 is an elevational view of the sucker;

FIG. 5 is a bottom view of the sucker; and

FIG. 6 is a top view of the sucker.

While the present invention is susceptible of embodiment in various types of sheet gripping suckers, it is herein shown as embodied in the general type of sucker disclosed in U.S. Pat. No. 3,154,306. Referring to FIG. 1, the sheet gripping sucker, designated by the reference numeral 10, is adapted to be moved by the sheet separating mechanism with which the sucker is associated toward and from the top of a pile 11 to separate the top sheet from the pile and to forward the latter to sheet feeding mechanism or to transfer the latter to the sheet forwarding suckers which, in turn, operate to forward the suckers to the sheet feeding mechanism. It will be understood that in operation the sucker 10 is moved downwardly to engage the top sheet of the pile, vacuum is applied to the sucker to cause it to grip the sheet, and the sucker is then moved upwardly to separate the sheet from the top of the pile and to either forward it or to transfer it to sheet forwarding suckers.

The sheet gripping sucker 10 has a body 14 which comprises a stem or tubular portion 15 and a frustoconical head 16 at the lower end of the tubular portion 15 as the sucker is viewed in FIG. 3. The head 16, in the illustrated embodiment, is circular in cross section and the underside thereof is disc-shaped or concave to provide a suction mouth 18 which is concentric with the axis of the stem 15 and which has a circular peripheral sealing edge or rim 20 provided by an annulus concentric with the axis of the stem and lying in a plane generally perpendicular to the axis of the tubular portion 15. The rim or edge 20 will seat and seal against the sheet being handled.

The sucker 10 also has, as an integrally molded part thereof, a thin flexible skirt 22, which extends from a line of juncture with the head 16 which is above the sealing edge 20 so as to provide a shoulder 23 extending upwardly of the sucker between the sealing edge 20 and the line of juncture of the skirt 22. This forms a groove in the sucker extending around the edge 20. The skirt 22 extends outwardly from the head 16 to form a continuation of the frustoconical configuration of the head and to define a second circular section mouth 25 concentric with the axis of the stem 15, the extended axis of which forms the axis of the skirt 22. The mouth 25 is of larger diameter than the suction mouth defined by the circular edge 20. The outer edge 26, i.e. the rim of the skirt 22, is essentially circular and normally lies in a plane generally perpendicular to the center line of the skirt 22.

The stem 15 has an axial or central passageway 27 therethrough which opens into the underside of the head 16 so that vacuum can be established in the suction mouths 18, 25 through the passageway 27. The stem 15 has an outer annular

groove 15*a* immediately adjacent the head **16** so that the sucker can be snapped into a tube **28** which is connected to a source of vacuum and which is reciprocated and translated in a conventional manner to effect the desired movements of the sucker. The tube **28** has an inwardly radially extending flange portion **29** at its lower end which is adapted to be received in the annular groove in the stem **15** to secure the sucker to the tube. The upper portion of the sucker stem **15** fits snugly within the tube **28** so that a seal is formed between the tube and the sucker.

The sucker **10** includes means for constraining spaced portions of the skirt **22** from flexing in a flattening direction when suction is applied to the sucker with the sucker in engagement with a sheet. This means in the preferred and illustrated embodiment comprises a sheet metal stamping having an annular portion **32** which encircles the stem **15** immediately below the tube **28** and constraining fingers **33** which extend outwardly from the annular portion **32** along the outer side of the skirt **22** to constrain spaced portions of the skirt from flexing in a flattening direction as vacuum is applied to the sucker with the sucker in engagement with the sheet. In the absence of the constraining means illustrated in the application or the equivalent thereof, the skirt **22** will normally tend to flex outwardly toward a flattened position, as shown in FIG. 3 of U.S. Pat. No. 3,154,306 in which the edge **20** forms the seal for holding the sheet, the initial seal between the sucker and the sheet being formed at the outer rim of the skirt. In the disclosed sucker, the portions intermediate the constraining fingers **33** will flex outwardly in a flattening direction while the portions immediately under the constraining fingers **33** will be constrained against such flattening and this will produce a corrugating effect in the sucker **10** when it is engaged with a sheet and vacuum is applied thereto. This corrugating effect will produce a waviness in the frustoconical skirt **22** and the rim of the skirt will be distorted out of a single plane. The "waves" or "corrugations"in the skirt itself will have crests and valleys extending lengthwise of the skirt between the body of the sucker and the outer rim of the skirt. Crests and valleys will also be formed in the sheet being handled as an extension of the crests and valleys in the skirt. I have found that when the annular skirt so flexes in a "corrugated" manner upon the application of vacuum, the tendency to pick up the sheet immediately below the top sheet is substantially reduced and the problems heretofore enumerated effectively and substantially minimized. This is also true at high speed operation.

Where double sheet pick ups present particular problems, the sucker is preferably disposed in the sheet handling apparatus so that the crest of a corrugation will extend along a line from the sucker generally perpendicular to the edge of the pile immediately adjacent the sucker. When the sucker is so oriented with respect to the pile, the sucker will produce a wave in the sheet which forms a passageway for air directly from the back edge where the separating air is being directed to the sucker location adjacent the underside of the sheet being separated. This tends to facilitate the breaking of any vacuum between the sheet being separated and the next sheet. A separating air nozzle **34** is illustrated in FIG. **1**.

While the present disclosure illustrates a particular type of means for introducing a waviness or corrugation in the sucker skirt on the application of vacuum, it is to be understood that other constructions may be utilized to provide a sucker skirt where portions which flex outwardly in a flattening direction alternate with portions which have limited or no flexing on the application of a vacuum. For example, the fingers **33** might be molded inside the sucker body or the sucker may be formed with an increased thickness which would provide ribs that form the function of the constraining fingers **33**. However, it should be recognized that the fingers **33** should be located and extend sufficiently close to the outer rim of the sucker so that a corrugating effect will be produced. While ribs have heretofore been embodied in the portion of the skirt adjacent the upper end for strengthening purposes, none of these ribs have extended into the portion of the skirt which would normally be deflected by the application of suction and in any case have not produced the type of corrugating action described herein.

It will be noted that the corrugating effect provided by constraining spaced portions of the skirt may be simulated by an operator pressing the flexible skirt of a sucker at spaced locations after the sealing of the sucker against the skirt to corrugate the skirt during the transfer operation.

The sucker in which the invention is embodied need not be a double mouth sucker as described but is applicable to other sheet gripping suckers, e.g. the sealing edge **20** could be formed with openings therein so that the skirt forms the seal during the handling of the sheet.

I claim:

1. A vacuum sheet gripping sucker having a body portion, skirt means extending from one side thereof and terminating in an outer edge which leads said sucker into engagement with a sheet to be gripped, and a vacuum passageway in said body portion opening into said skirt means, said skirt means having spaced first portions extending inwardly from the outer edge thereof which flex in a flattening direction away from the center line of the skirt means when the sucker grips a sheet and second portions at and extending inwardly from said outer edge and alternating with said first portions and constrained against flexing in a flattening direction on the application of vacuum to said sucker to effect the gripping of a sheet.

2. A sheet gripping sucker as defined in claim **1** wherein said second portions include metal members extending between said body portion and said outer edge to engage and constrain said second portions against flexing.

3. A sheet gripping sucker as defined in claim **2** wherein said metal members comprise spaced fingers extending along the outer side of said skirt means between said body portion and said outer edge and said skirt means is of a substantially uniform thickness which is such that the sucker flattens between said fingers and engages the sheet a substantial distance inwardly of the outer edge.

4. In a sheet separating mechanism, a sheet gripping sucker adapted to grip the top sheet of a pile of sheets adjacent one side of the sheet to separate the sheet from the pile, separating air means located outwardly of said one side and directing air toward said one side, said sheet gripping suckers having skirt means for engaging the sheet which comprises first and second portions which alternate with each other, said first portions having substantial flexing in a flattening direction upon the application of a vacuum to grip a sheet and said second portions having substantially no flexing to establish crests and valleys radiating from said sucker, a said first portion of said sucker being disposed along a line normal to said side to provide a crest in said skirt means and the sheet gripped by the sucker which extends along said line when the sucker grips a sheet.

5. A method of gripping the top sheet of a pile to separate the latter comprising moving a vacuum sucker having flexible skirt means for leading the sucker into engagement with the top sheet, applying a vacuum to the sucker to grip the sheet preparatory to separation, and corrugating the skirt means along lines extending inwardly from the outer edge of the skirt while separating the sheet from the pile.

6. A method of gripping the top sheet of a pile to separate the latter comprising moving a vacuum sucker having flexible skirt means for leading the sucker into engagement with the top sheet, applying a vacuum to the sucker to grip the sheet preparatory to separation, corrugating the skirt means along lines extending inwardly from the outer edge of the skirt while separating the sheet from the pile to establish crests and valleys in the sheet being gripped with a crest extending from said sucker toward one side of said pile, and directing air along said crest extending from said sucker toward one side of said pile and under the sheet being gripped by the sucker.

7. A method of gripping the top sheet of a pile to separate the latter comprising the steps of moving a sheet gripping sucker device having flexible skirt means for leading the sucker device into engagement with the top sheet, engaging the skirt means with the top sheet, gripping the sheet with the

sucker device by applying a vacuum to establish a vacuum between the sucker and the top sheet, and corrugating the top sheet with the sucker device to thereby form crests and valleys in the sheet.

8. A method as defined in claim 7 and further including the steps of directing air under at least one of said crests in the sheet while separating the sheet from the pile of sheets.

9. In a sheet gripping apparatus, a vacuum sheet gripping sucker having a body portion, skirt means extending from one side thereof and terminating in an outer edge which leads said sucker into engagement with a sheet to be gripped, and a vacuum passageway in said body portion opening into said skirt means, said skirt means having alternating first and second portions which cooperate to corrugate the sheet upon gripping of the sheet, said first portions constraining the sheet against flexing on the application of vacuum to said sucker to effect the gripping of a sheet and said second portions providing for flexing of the sheet in an upwardly direction relative to said first portions on the application of vacuum to said sucker to effect the gripping of a sheet.