

Sept. 3, 1946.

C. W. HARROLD

2,406,766

SHEET FEEDER

Filed May 5, 1944

2 Sheets-Sheet 1

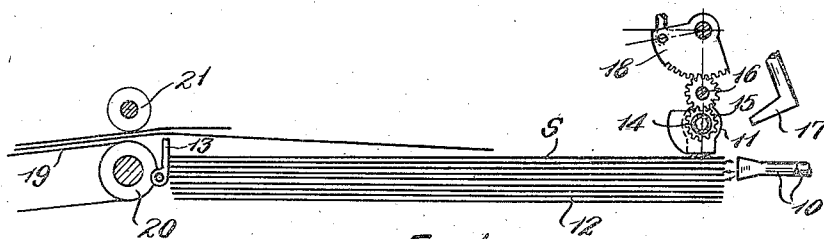


FIG. 1

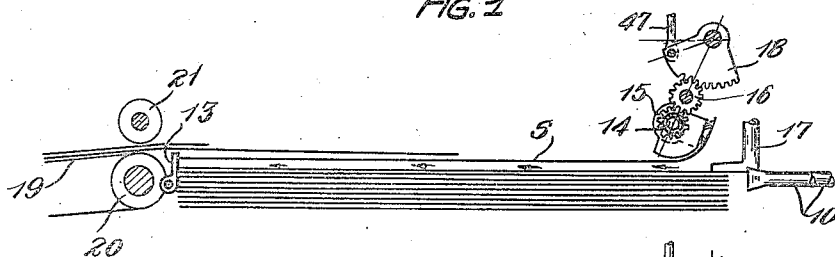


FIG. 2

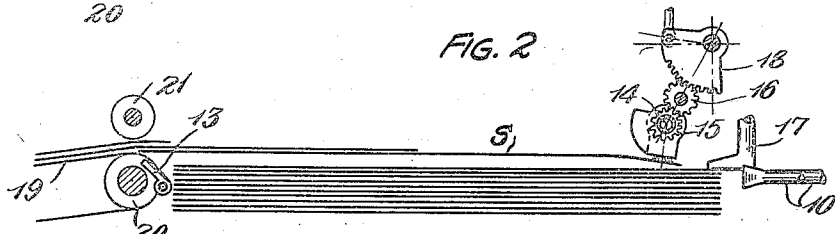


FIG. 3

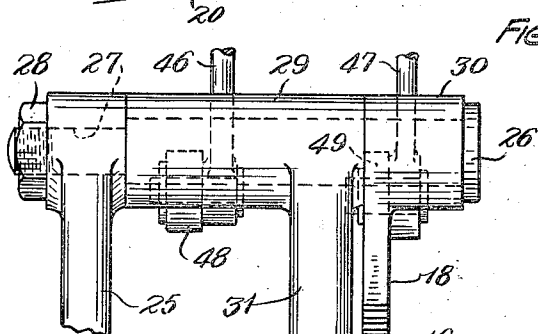


FIG. 4

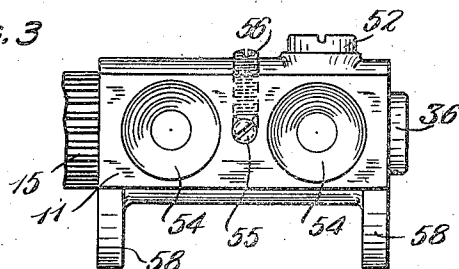


FIG. 5

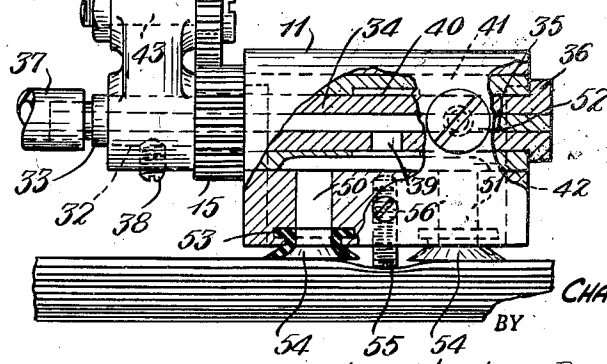


FIG. 6

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2 Sheets-Sheet 2

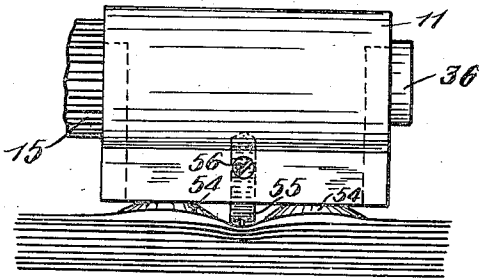


FIG. 6

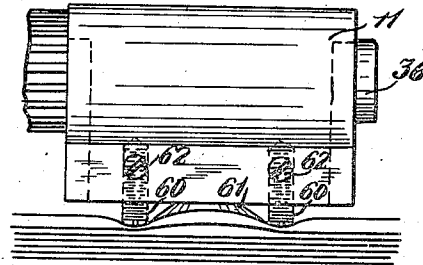


FIG. 9

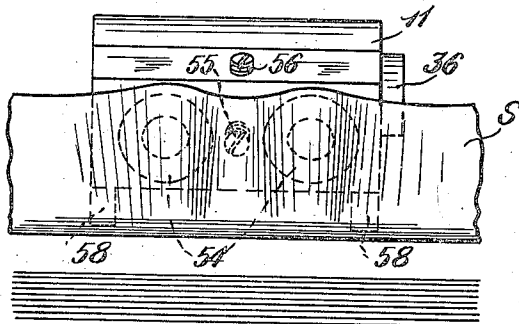


FIG. 7

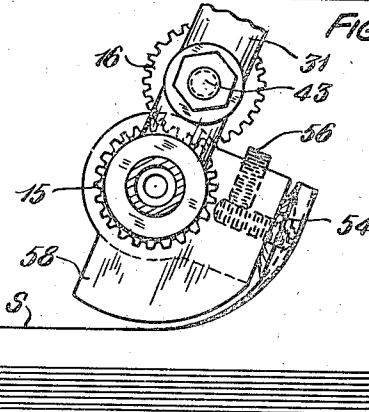


FIG. 8

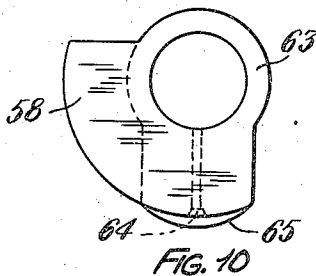


FIG. 10

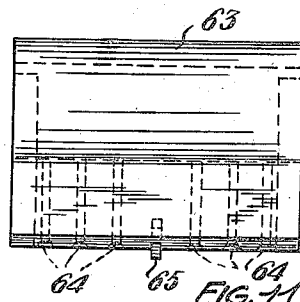


FIG. 11

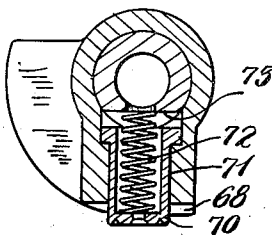


FIG. 12

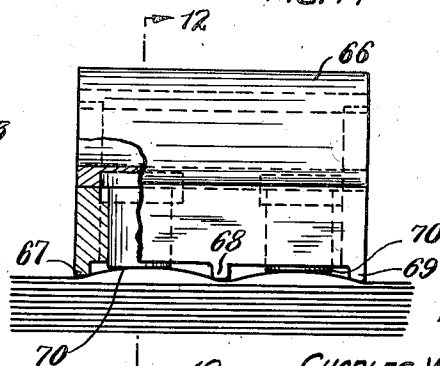


FIG. 13

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2,406,766

SHEET FEEDER

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Application May 5, 1944, Serial No. 534,264

24 Claims. (Cl. 271-27)

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This invention relates to improvements in sheet feeders, more particularly feeders for paper sheets embodying a suction head for gripping a transverse edge of each sheet and separating it from the supply, and in certain aspects of the invention advancing it by movement of the suction head.

More specifically the invention relates to the provision of a method and means for preliminarily separating the upper sheets of the pile, preferably by a fluffing air blast, gripping the topmost sheet while it is thus elevated and without permitting the sucker head to descend to or rest upon the pile, forming in the gripped edge of the sheet simultaneously with the gripping action a localized corrugation or corrugations, and thereafter curving the sheet transversely to the corrugations and advancing it by movement of the sucker head. The formation of the corrugations provides one or more paths for the flow of air from the fluffing blast or blasts, thereby furthering the separation of the topmost sheet from the one next beneath, and also imparts added stiffness to the sheet, especially when a rolling up sucker head is employed.

One of the objects of the invention is the provision of improved sheet separating means.

Another object is the formation of corrugations in the sheet by the use of flexible suckers spaced transversely a distance less than the width of one of them.

Still another object is the provision of one or more fixed abutments cooperating with one or more suckers for imparting localized corrugations to the sheets.

Other objects and features of novelty will appear as I proceed with the description of those embodiments of the invention which, for the purposes of the present application, I have illustrated in the accompanying drawings, in which

Figs. 1, 2 and 3 are diagrammatic views of the invention showing the parts in a series of three positions, that is (1) where the sheet is first taken by the sucker head, (2) where it is rolled up by the sucker head without disturbing the forward edge of the sheet, and (3) where it is being advanced by the unrolling of its rolled up rear edge.

Fig. 4 is a rear elevational view of the sucker head and its mounting, shown in position above a pile of sheets which have been fluffed, the sucker head being in a position for taking a sheet but the suction being not yet applied.

Fig. 5 is a bottom plan view of the sucker head.

Fig. 6 is a fragmental, elevational view, corre-

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sponding to Fig. 4, after the suction has been applied.

Fig. 7 is a rear elevational view after the sheet has been rolled up.

Fig. 8 is a side elevational view corresponding to Fig. 7.

Fig. 9 is a view corresponding to Fig. 6, showing a modified form of sucker head.

Figs. 10 and 11 are side and rear views, respectively, of another modification of the sucker head.

Figs. 12 and 13 are side and rear views, respectively, of still another form of sucker head, Fig. 12 being shown largely in section on the line 12-12 of Fig. 13.

The present application is a continuation in part of my co-pending application, Serial No. 446,477, filed June 10, 1942, to which reference may be had for a complete disclosure of the operating mechanism and general features of the machine.

The sequence of operations illustrated in Figs. 1, 2 and 3 is somewhat as follows:

A pair of fluffing air blast nozzles 10 with vertical slot mouths disposed on opposite sides of the sucker head 11 are caused to discharge air which preliminarily separates the uppermost sheets at the rear edge of the pile 12 and raises them. While this fluffing action is going on the front edges of the sheet are held against forward displacement by front pile guides 13. The sucker head 11, either before or after the blast from nozzles 10 is turned on, comes into the position illustrated in Fig. 1 where it is in contact with the topmost fluffed sheet. Suction is then exerted and the topmost sheet is gripped, after which the fluffing blasts are turned off. Next the axis 14 of the sucker head swings forward, and at the same time gears 15 and 16 turn to rotate the sucker head on its axis, so that the sheet gripping means will travel in a substantially epicycloidal path. The parts may be so dimensioned that this is accomplished without disturbing the forward portion of the sheet. Alternatively the dimensions may be such as to produce a small rearward motion of the sheet during the rolling up action.

While the sucker head is moving from the position of Fig. 1 to that of Fig. 2 a combination presser foot and air blast nozzle 17 disposed behind the middle of the sucker head, moves diagonally forward and downward to a position above the rear edge of the pile and then vertically downward onto the pile, compressing the previously fluffed sheets beneath the topmost one, S. The blast through presser foot 17 is then turned on to float the sheet S, as indicated in Fig. 2.

Next the front guides 13 are swung forward and downward out of the way, as indicated in Fig. 3, and gear sector 18 is turned while axis 14 of the sucker head remains in the same position as in Fig. 2, with the result that the gears 15 and 16 rotate the sucker head about its axis from the position of Fig. 2 to one slightly in advance of that of Fig. 3, thereby forwarding the front edge of the sheet on to an endless carrier belt 19 and between pull-out rolls 20 and 21. As soon as the forward edge of the sheet is thus controlled and it becomes a part of the stream of sheets on the conveyor, suction in the sucker head is interrupted and the latter moves rearwardly to the position of Fig. 1 for operation upon the next sheet.

Describing now the particular mechanism illustrated for imparting to the sucker head the movements above described, 25 is a bracket in which is carried a stud 26 having a reduced threaded part 27 extending through a hole in the bracket and held in position by a nut 28. On this stud two hubs 29 and 30 are mounted for oscillation independently of each other. Hub 29 carries an arm 31 in the extremity of which there is bored a hole 32 for the reception of a hollow stud 33, the bore 34 of which is closed at one end by a plug 35 in a head 36. The opposite end of hollow stud 33 may have a flexible hose 37 connected therewith leading to the vacuum side of an air pump, not shown. When the stud is in place it is held against motion in arm 31 by means of a set screw 38 or the like.

Stud 33 has a lateral port 39 which communicates with an annular recess 40 in a sleeve 41 which surrounds stud 33 and is rotatable thereupon. A longitudinal pocket 42 in the sleeve intersects annular recess 40, so that this pocket is constantly in communication with the bore 34. Sleeve 41 carries the spur gear 15, previously mentioned, which meshes with gear 16, also previously mentioned. Gear 16 is carried by arm 31, having a fixed bearing upon that arm. For example, it may turn freely upon a stud 43 having a head 44 engaging one face of the gear, and a nut 45 for locking the stud in position. Gear 16 in turn meshes with gear sector 18 previously mentioned, which is rigid with hub 30.

Suitable means are provided for oscillating hubs 29 and 30 upon their bearing stud 26 in properly timed sequence, this means comprising cams, not shown, rotating once for each sheet fed, as fully disclosed in the above mentioned depending application. Motion from the said cams may be communicated by suitable levers to links 46 and 47 that are pivotally connected with arm 48 and sector 18 projecting from hubs 29 and 30 respectively.

The sucker head 11 has a bore therethrough fitting over sleeve 41. It also has radial passages 50 and 51 communicating with its central bore. It is held in proper position both longitudinally and angularly, to cause passages 50 and 51 to communicate with pocket 42, by means of a screw 52 which extends through a threaded hole in the head and into a socket in sleeve 41. The head may be removed and interchanged with another one by merely loosening screw 52. The head is counterbored around passages 50 and 51 and an annular recess 53 is formed in the head inwardly of each counterbore. Rubber or other resilient suckers 54 are formed with annular flanges to snap into the recess 53, by which means the suckers are held against accidental displacement but are readily removed and replaced when

necessary. The passages 50 and 51 are so spaced apart that when the suckers 54 are in place they are separated from each other by a distance no greater than the diameter of the suckers, this relationship having an important bearing upon the functioning of the device.

Midway between the passages 50 and 51 and in the same plane therewith I provide a threaded opening for the reception of a roundheaded screw 55, hereinafter sometimes called an abutment. This screw is adjusted so as to project any required distance from the periphery of the sucker head, and is held in position by means of a set screw 56. Ordinarily, screw 55 is set to project from the head as far as, or slightly further than, the suckers 54 before suction is made effective. After suction is applied the suckers contract axially, increasing the distance which the screw 55 projects beyond them. A pair of cheeks 53 having circular curvature on approximately the same radius as the effective radius of the suckers, together constitute a body for imparting a predetermined curvature to the rear portion of the sheet as it is rolled up.

In Fig. 4 the uppermost sheets of the pile are shown fluffed up and contacting suckers 54 and abutment 55 before the vacuum is on. In Fig. 6 the vacuum is on and the suckers are contracted axially and expanded laterally. Also, because of their high degree of resilience they have adjusted themselves to the curvature of the top sheet produced by suction on either side of the abutment. As herein indicated there are distinct corrugations in the sheet, running in the fore and aft direction, that is to say, at right angles to the axis of the sucker head, and as illustrated at right angles to the rear edge of the sheet. These corrugations are localized, that is they occupy relatively small portions of the length of that edge of the sheet in which they are formed. When the sheet has been thus gripped, as in Figs. 1 and 6, hub 29 is turned clockwise from the position of Fig. 1 to that of Fig. 2, hub 30 remaining fixed. Pinion 16, running upon sector 18, is thereby turned on its stud 43 in the clockwise direction and gear 15 is turned in the counter-clockwise direction, so that the sheet is rolled up as shown in Fig. 2. The parts may be so designed, that the body of the sheet, including its front edge, is undisturbed, or so that the sheet is pulled back slightly. This rolled up condition of the sheet is illustrated in Figs. 7 and 8.

A modified form of sucker head is illustrated in Fig. 9, wherein the head 11 instead of having two suckers disposed upon opposite sides of an abutment, has two abutment screws 60 disposed on opposite sides of a sucker 61. Screws 60 are held in adjusted position by set screws 62. In this case also a corrugation or corrugations are formed in the top sheet when the vacuum comes on.

Another modified form is shown in Figs. 10 and 11, where the sucker head 63 is an all metal head having two sets of ports 64, three in each set, with an abutment 65 between the sets. Here the effect, when suction is on, is similar to that illustrated in Fig. 6.

Still another form of head is illustrated in Figs. 12 and 13. In this case also the head 66 is all metal. It has three equally spaced abutments 67, 68 and 69 with a sucker 70 between the center abutment 68 and each of the side abutments 67 and 69. The suckers 70 are telescoping suckers and comprise cylindrical plungers 71 biased outwardly by means of springs 72. Be-

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fore suction is applied, the suckers 70 may extend outwardly further than the abutments 67, 68 and 69, but as soon as suction is applied, and the sucker ports are closed by contact with a sheet, the plungers move inwardly against the action of springs 72 until stopped by contact with end wall 73, at which time they will be in the position illustrated in Fig. 13. Here the effect is substantially double that in Fig. 9.

When a pair of flexible suckers is spaced substantially as illustrated herein, that is, by a distance no greater than the diameter of one of them, the vacuum exerted through each sucker tends to form in the sheet at that point what may be termed a circular blister, but if the suckers are close enough together the flexing of each one is modified by the flexing of the other, with the result that these blisters are converted into a corrugation or corrugations extending at right angles to the adjacent edge of the sheet. While a corrugated contour formed in this way is very beneficial, the effect is considerably accentuated by the interposition between the suckers of a fixed abutment in accordance with the preferred forms of the invention, or by the use of two fixed abutments, one on either side of a sucker.

As previously explained, the corrugations provide definite paths for flow of fluffing air under the top sheet and well into the body of the sheet, which improves the preliminary separation of the top sheet from the one next below, but the corrugations also contribute stiffness to the rear edge of the sheet and do not interfere with the rolling up of that edge. In fact, the combined effect of corrugating and rolling up results in superior separation of sheets and gives great stability to the gripped edge of the sheet, so that the sucker head maintains excellent control of the sheet while the sheet is being unrolled for forwarding purposes, and while the forwarding blast is effective.

A single sucker head of the type herein disclosed is very efficient for the separation and feeding of small and medium sized sheets, but for large sheets it is desirable to employ two or more sucker heads with accompanying air blasts, suitably distributed across the width of the pile.

Having thus described my invention, I claim:

1. The method of separating sheets from the top of a supply comprising gripping the topmost sheet by suction near an edge thereof, forming localized corrugations perpendicular to the edge portion of the sheet in the region of said gripped portion, and moving the gripped portion to form a curved contour in the sheet extending in a direction parallel to said edge.

2. The method of separating sheets from the top of a supply comprising gripping the topmost sheet by suction near its rear edge, forming localized corrugations perpendicular to the edge of the sheet in the region of the gripped portion, raising and tilting the gripped portion to form in the portion of the sheet directly in front of said gripped portion an upwardly curved contour extending in a direction parallel to said rear edge, and blowing air forwardly under the curved up sheet.

3. The method of separating sheets from the top of a supply comprising preliminarily separating an edge portion of the upper sheets of the supply, thereby elevating the topmost sheet of the supply, gripping the topmost sheet by suction near its preliminary separated and raised edge while said edge remains thus raised, pressing on

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the topmost sheet at a point adjacent to the gripped portion thereby forming localized corrugations in the topmost sheet perpendicular to said edge and holding the second sheet away from the sheet gripper, and moving the gripped portion to form a curved contour in the sheet extending in a direction parallel to said edge.

4. The method of separating sheets from the top of a supply comprising preliminarily separating an edge portion of the upper sheets of the supply, thereby elevating a plurality of the upper sheets of the supply, pressing on the topmost sheet with force insufficient to fully compress the preliminarily separated sheets, gripping the topmost sheet by suction adjacent to the pressing point and lifting the gripped portion above the level of the pressing point while said preliminary separating action continues, and simultaneously raising and tilting the gripped portion in a direction perpendicular to said edge.

5. The method of separating and feeding sheets from the top of a pile comprising pneumatically fluffing a rear edge portion of the upper sheets of the pile, gripping the topmost sheet by suction near its rear edge while the pile is fluffed and simultaneously forming localized corrugations in said topmost sheet in the region of its gripped portion, raising and tilting said gripped portion and simultaneously rolling up the portion of the sheet while thus corrugated directly in front of said gripped portion around a curved body, blowing air forwardly under the rolled up sheet, holding the next sheet against forward movement, and moving the topmost sheet forwardly along the top of said pile.

6. The method of separating and feeding sheets from the top of a pile comprising pneumatically fluffing the rear edge portion of the upper sheets of the pile, gripping the topmost sheet by suction near its rear edge while the pile is fluffed and simultaneously forming localized corrugations in said topmost sheet in the region of the gripped portion, raising and tilting said gripped portion and simultaneously rolling up the portion of the sheet directly in front of said gripped portion around a curved body, maintaining said corrugations in the sheet during at least a part of said raising and tilting movement, blowing air forwardly under the rolled up sheet, holding the next sheet against forward movement, and moving the topmost sheet forward along the top of said pile.

7. The method of separating and feeding sheets from the top of a pile comprising pneumatically fluffing a rear edge portion of the upper sheets of the pile, gripping the topmost sheet by suction near its rear edge while the pile is fluffed and simultaneously forming localized corrugations in said topmost sheet in the region of the gripped portion, raising and tilting said gripped portion and simultaneously rolling up the portion of the sheet directly in front of said gripped portion around a curved body, blowing air forwardly under the rolled up sheet, holding the next sheet against forward movement, and unrolling the rolled up portion of the sheet to move the sheet forwardly along the top of the pile.

8. The method claimed in the preceding claim, characterized by the fact that said corrugations are maintained in the sheet during said rolling up and unrolling movements.

9. In mechanism for separating the topmost sheet of a supply, a pair of movable flexible suckers spaced apart less than the width of one of them, and adapted simultaneously to grip said

topmost sheet along an edge thereof and impart a localized wavy contour thereto, and means for raising and tilting said pair of suckers while gripping a sheet to roll up a portion of the sheet adjacent said suckers while retaining said wavy contour, and carry said edge upward and toward the opposite edge of the sheet.

10. In sheet separating mechanism a pair of closely spaced movable flexible suckers arranged in transverse alignment to grip a sheet near its edge and impart a wavy contour thereto, means for causing said suckers to grip a sheet and to move the gripped portion thereof, and a curved body adjacent said suckers and movable therewith, adapted to contact a gripped sheet to form a curve therein.

11. A sheet separating suction device comprising a suction head having a plurality of sheet corrugating elements mounted therein, including suction gripper means and rigid abutment means, a means of one kind being arranged on each side of a means of the other kind, whereby corrugations in a sheet are positively formed said suction head presenting a clear path for air at right angles to the adjacent edge of the sheet and in line with said suction gripper means.

12. A device as claimed in the preceding claim including means for adjusting the relative level of said gripper means and said abutment means.

13. A sheet separating suction device comprising a revoluble suction head, a pair of flexible suckers mounted therein, and an abutment mounted in said head between said suckers arranged to contact and displace a portion of a sheet held by said suckers, thereby forming corrugations in the sheet which remain therein while the head is being revolved.

14. A device as claimed in the preceding claim, wherein said flexible suckers are spaced apart less than the width of one of them.

15. A sheet separating suction device comprising a suction head, a flexible sucker mounted therein, and two abutments mounted in said head, one on each of the opposite sides of said sucker, arranged to contact and displace a portion of a sheet held by said sucker said suction head presenting a clear path for air in line with said sucker at right angles to the line connecting said abutments whereby a corrugation is formed in the sheet through which fluffing air may be blown.

16. In mechanism for separating and feeding sheets from the top of a supply, a revoluble suction head mounted for movement in the direction of feed, a flexible sucker mounted therein adapted to grip a sheet near its rear edge, an abutment arranged adjacent said sucker laterally of said direction of feed and adapted in conjunction with said sucker to form in a gripped sheet a localized corrugation extending in the direction of feed, the axis of revolution of said suction head being disposed above the said sucker at the time suction becomes effective to grip the sheet and means for moving said suction head to simultaneously raise, tilt and advance said sucker.

17. The method of separating paper sheets from the top of a pile, which comprises pneumatically fluffing an edge portion of the upper sheets of the pile, thereby introducing air between adjacent sheets and elevating the same, gripping the top

sheet by suction near said edge while it remains thus elevated, and simultaneously forming in that sheet localized corrugations substantially perpendicular to said edge providing a clear path for air toward the body of the sheet, thereby providing space for the entry of additional air between the top sheet and the next sheet of the pile for further separating the top sheet, and lifting the gripped corrugated portion of the top sheet to still further separate the same from the next sheet.

18. The method of separating paper sheets from the top of a pile, which comprises pneumatically fluffing an edge portion of the upper sheets of the pile, thereby introducing air between adjacent sheets and elevating the same, gripping the top sheet by suction near said edge while it remains thus elevated, and simultaneously forming in that sheet localized corrugations substantially perpendicular to said edge, thereby providing space for the entry of additional air between the top sheet and the next sheet of the pile for further separating the top sheet, lifting the gripped corrugated portion of the top sheet to still further separate the same from the next sheet, blowing air beneath said portion and advancing the sheet by movement of said portion.

19. A sheet separating device comprising a suction head, a pair of flexible suckers mounted therein and spaced apart a distance less than the width of one of them, and an abutment mounted in said head between said suckers arranged to contact and displace a portion of a sheet held by said suckers, thereby forming localized corrugations in the sheet.

20. A sheet separating suction device as defined in claim 11, comprising means for applying a combined raising and tilting movement to the said sheet corrugating elements in a direction to form a curve in the sheet extending transversely to said corrugations.

21. The method of separating sheets from the top of a supply, comprising gripping the top sheet by suction near an edge thereof, forming localized corrugations at an angle to said edge in the region of the gripped portion, and tilting the gripped portion to form a curve in the sheet extending transversely to the direction of said corrugations.

22. A sheet separating suction device as defined in claim 11, comprising means for applying a combined raising and tilting movement to the said sheet corrugating elements in a direction to form a curve in a gripped sheet extending transversely to said corrugations, and a body associated with said corrugating elements adapted to assist in forming said curve.

23. A sheet separating suction device as defined in claim 13, comprising a body revoluble with said suction head adapted to assist in curving a sheet when said head is revolved, the curve in the sheet extending transversely of said corrugations.

24. A sheet separating suction device as defined in claim 19 comprising means for applying a combined raising and tilting movement to said suckers and said abutment in a direction to form a curve in a sheet extending transversely to said corrugations, and a body associated with said suckers and said abutment adapted to assist in forming said curve.

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