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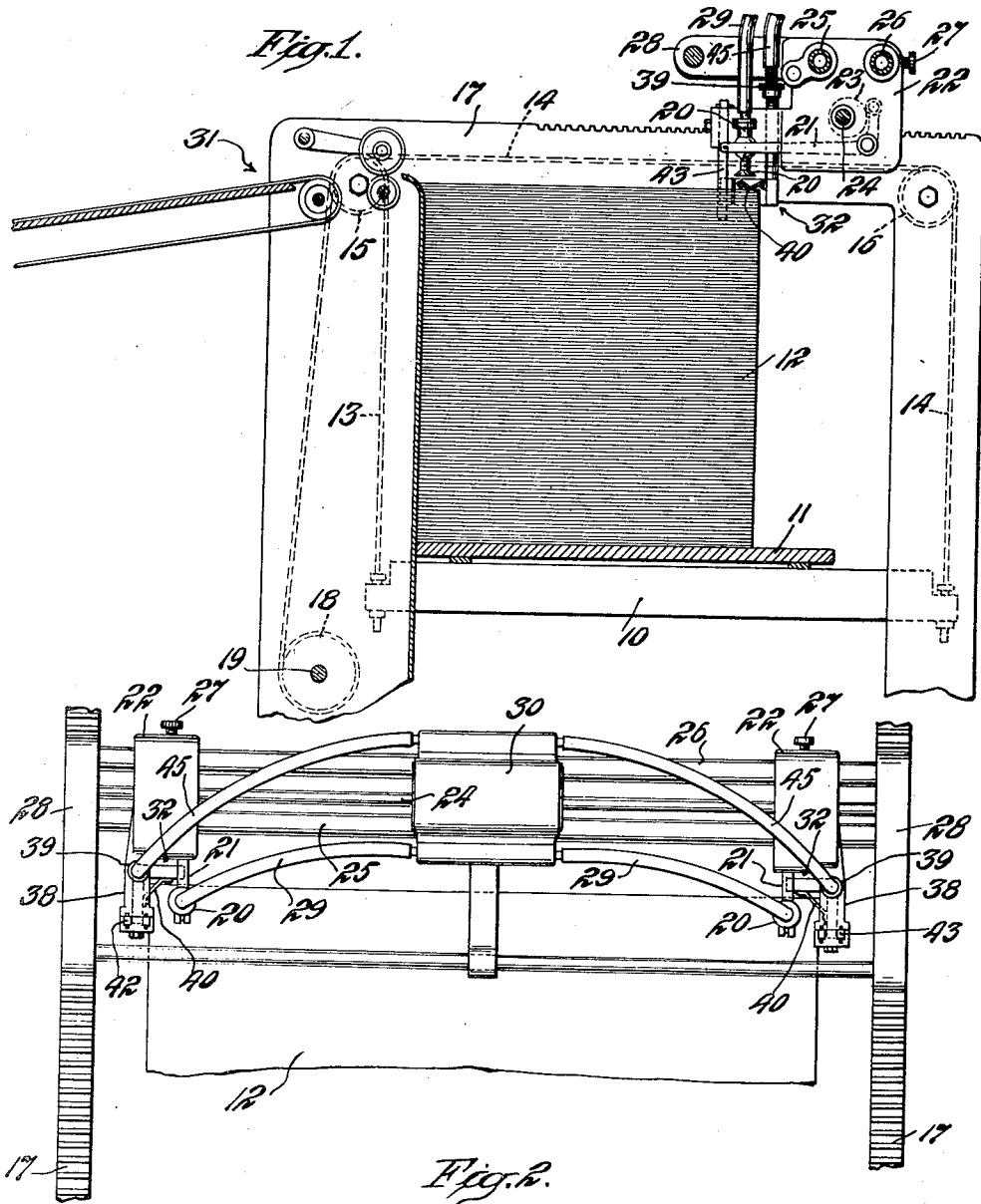
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SHEET FEEDING APPARATUS

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SHEET FEEDING APPARATUS

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This invention relates to sheet feeders for feeding sheets to printing presses or other machines, and more particularly to sheet separating devices thereof employed to separate the sheets one after another from a pile of said sheets preparatory to forwarding of the sheets from said pile.

In known types of sheet feeders there is employed sheet separating mechanism including friction devices such as, for example, a pair of comber wheels which are moved into engagement with the rear opposite corners of the topmost sheet of a pile of sheets, and rotated in opposite directions to effect a preliminary separation of the sheet for further action thereon by suction sheet lifting devices. These comber wheels require considerable mechanism to rotate the same, and to move them into and out of engagement with the pile of sheets in timed relation with the sheet lifting devices. Also, in some cases, particularly with reference to certain grades of paper, the comber wheels would mark or otherwise disfigure the sheets, which is objectionable, due to the pressure of said comber wheels on said sheets necessary to effect separation thereof.

In addition, because of the high speeds at which present sheet feeders are required to operate, the interval of time that the comber wheels are in contact with the pile of sheets is barely sufficient to effect separation of the sheets, with the result that the sheets are improperly separated.

It is accordingly one object of the present invention to provide novel means for effecting preliminary separation of a corner portion or portions of the topmost sheet of a pile of sheets without having any movement imparted thereto and thus requires no mechanism to operate the same.

Another object is to provide novel sheet separating means for effecting preliminary separation of a corner portion or portions of the topmost sheet of a pile of sheets without in any way marking or disfiguring the sheet, and wherein the sheet separating action thereof is in no way affected by the speed at which the sheet feeder is operated.

A further object is to provide novel sheet separating means which utilizes compressed air for effecting preliminary separation of a corner portion or portions of the topmost sheet of a pile of sheets.

A still further object is to provide a novel sheet separating device which utilizes compressed air for effecting preliminary separation of a corner portion of the topmost sheet of a pile of sheets, and which is automatically maintained in a predetermined relation to the top of said pile regard-

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less of variations in the height or unevenness in the top surface of the same.

Another object is to provide a sheet separating device of novel construction which utilizes air under pressure for preliminarily separating a corner portion of the topmost sheet of a pile of sheets so that a secondary sheet handling means may operate to grip and lift said sheet, in combination with means engaged with the pile for maintaining said device in a predetermined relation to the top of the pile and at the same time acting through such engagement to hold the sheets in separated condition and to further ensure that the top sheet alone is lifted by said means.

The above and further objects and novel features of the present invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and are not intended as a definition of the limits of the invention, reference for this latter purpose being had primarily to the appended claims.

In the drawings, wherein like reference characters refer to like parts throughout the several views,

Fig. 1 is a vertical longitudinal sectional view of a sheet feeder embodying the present invention;

Fig. 2 is a fragmentary top plan view of the sheet feeder illustrated in Fig. 1;

Fig. 3 is an enlarged top plan view, partly in section of one of the sheet separating devices in operative position;

Fig. 4 is a vertical sectional view on the line 4—4 of Fig. 3;

Fig. 5 is an enlarged detail perspective view of the sheet separating device;

Fig. 6 is a perspective view illustrating diagrammatically the resultant action of the sheet separating device on the sheets of the pile at one corner thereof; and

Fig. 7 is an enlarged side elevation of one of the sheet separating and lifting units illustrated in Figs. 1 and 2.

Referring to the drawings, the novel sheet separating means of the present invention are shown as embodied in a sheet feeder of general construction and which includes a pile elevator comprising two side bars 10, one only being shown, adapted to support a pile board 11 and pile of sheets 12 (Fig. 1). Pile board 11 and pile of sheets 12 thereon are raised intermittently in the usual manner, to keep the top of said pile at a

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predetermined level, by cables 13 and 14 at opposite sides of the feeder, which are secured to each bar 10 and pass over grooved sheaves 15 and 16 journaled on the feeder side frames 17. Cables 13 and 14 extend downwardly from sheaves 15 to winding drums 18 fixed on a transverse shaft 19 journaled in suitable bearings in frames 17. Shaft 19 and drums 18 are intermittently rotated from any suitable source of power and by any suitable mechanism connected with said shaft to raise bars 10, pile board 11 and pile of sheets 12.

The sheets of pile 12 are acted upon one after another by suction devices 20 (Figs. 1, 2 and 7) which are adapted to engage opposite rear corner portions of each successive sheet and lift the rear edge thereof above the level of the pile. These suction devices are carried on arms 21 pivotally mounted in casings 22 for rocking movement toward and away from the top of the pile by suitable cams 23 (Fig. 1) fixed on a driven cam shaft 24. Casings 22 are mounted on and adjustable along hollow cross shafts 25 and 26 to locate the suction devices 20 for operation on sheets of different widths, each casing being secured in its desired position of adjustment by a clamp screw 27. Shafts 25 and 26 are closed at their opposite ends, and are secured in brackets 28 which are supported by, and adjustable along, the side frames 17 so that the suction devices 20 may be moved longitudinally of the feeder as a unit for operation on sheets of different lengths. Cam shaft 24 extends through casings 22 and is journaled in suitable bearings in said casings and in the brackets 28.

Vacuum is created and broken at predetermined intervals in the suction devices 20 to cause the latter to grip and release each sheet, and for this purpose said devices have connected therewith corresponding ends of flexible conduits 29, the opposite ends of which are connected with the vacuum side of a rotary valve mechanism 30 (Fig. 2) supported on the hollow shafts 25 and 26. Valve mechanism 30 is of the type disclosed in the United States Patent No. 2,233,934, granted March 4, 1941, to Headley Townsend Backhouse, and needs no detail description herein. The valve mechanism is connected with an air and vacuum pump (not shown) through the hollow shafts 25 and 26 which are in communication with said mechanism and connected in any suitable manner with the vacuum side and air pressure side, respectively, of said pump, and said mechanism is driven from the cam shaft 24 by suitable gearing (not shown) to control the making and breaking of vacuum in the suction devices 20, and the delivery of air under pressure to sheet separating devices to be hereinafter described.

Prior to release of the lifted sheets by the suction devices 20, said sheets are engaged by sheet forwarding devices (not shown) which forward the sheets, when released by the suction devices, a short distance from the pile to conveying means indicated generally at 31 (Fig. 1) that advance the sheets to a printing press or other instrumentality with which the feeder is associated.

Novel means are provided for effecting preliminary separation of the topmost sheet on the pile from the next or underlying sheet prior to action thereon by the suction devices 20, to ensure that the top sheet alone is lifted from the pile by said devices, and that the sheets are forwarded singly from the pile to the conveyor. As herein shown, said sheet separating means are arranged at opposite rear corners and adjacent the top of the

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pile of sheets 12, and each preferably comprises a hollow air box 32 (Figs. 3, 4, 5 and 7) having interconnected arms 33 and 34 which are disposed at right angles to each other so that said box extends along the side and rear edges of the pile of sheets. Box 32 is provided with air jet means in the form of a thin slot or orifice 35 directed laterally through the wall of arm 33 facing the side edge of the pile of sheets, and a thin slot or orifice 36 directed forwardly through the wall of arm 34 facing the rear edge of the pile of sheets. Slots 35 and 36 extend vertically of the air box 32 and crosswise or vertically of the plane of the sheets in the pile, and are preferably spaced approximately an inch and three quarters from the corner formed by the walls of said box. The slots provide strong, thin elongated jets of air issuing from said slots, and the latter are preferably of a length such that, when the air box is in proper position to effectively separate the sheets, the lower ends of the slots are approximately three-quarters of an inch below the top of the pile of sheets, and the upper ends of said slots are approximately three-eighths of an inch above the level of the pile.

Each corner sheet separating device is arranged in the feeder in a novel manner for automatic adjustment in a vertical direction to compensate for variations in the height of the pile of sheets or unevenness in the top surface of the pile. In this manner the sheet separating devices are independently maintained in proper relation with respect to the top of the pile regardless whether the pile is high or low, or the surface thereof is uneven, thus ensuring accurate preliminary separation of the rear corner portions of the sheets at all times and under all conditions. As shown, each air box 32 is supported and guided for floating movement in a vertical direction and parallel with the side and rear edges of the pile, by a rigid conduit 37 (Fig. 7) that is welded to the box at the corner and extends upwardly through a suitable opening formed in an extension 38 of casing 22. Conduit 37 communicates with the interior of box 32 and is provided on its upper end with a nut 39 threaded thereon to retain said box on casing 22 during loading and reloading of the feeder with a pile of sheets.

Each air box 32 is provided with pile engaging means which, as illustrated, is preferably in the form of a rod or wire 40 (Figs. 3, 4 and 7) that extends diagonally across the corner of said box and is secured at its opposite ends, as by bolts 41, to the inner walls of arms 33, 34 at points between the slots 35, 36. Rod 40 is preferably bent intermediate its ends in the form of a V so as to provide point contact of said rod with the top of the pile directly at the corner thereof, and said rod so located vertically on box 32 that when engaged with the top of the pile, the slots 35, 36 will be disposed in proper position above and below the level of the pile as hereinbefore described to effect accurate separation of the sheets. Air boxes 32, through the hereinbefore described floating arrangement therefor, and through engagement of rods 40 with the pile, will thus move independently of each other upwardly and downwardly with the pile of sheets as the level thereof varies, and are thereby automatically maintained in predetermined relation to the top of the pile regardless of the height or unevenness of the same.

Means are provided for retaining each air box 32 in proper angular position with respect to the corner of the pile of sheets, and as herein shown,

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preferably comprise a pair of bars 42 and 43 (Figs. 3 and 7) which are slidably carried by the extension 38 of casing 22, and extend downwardly therefrom in spaced relation to receive therebetween the free end of arm 33 of the air box, thereby preventing angular displacement of the latter with respect to said casing and the corner of the pile of sheets. Bars 42 and 43 are retained upon casing 22 by pins 44 extending through the upper ends of said bars and resting on the extension 38. The space between bars 42 and 43 is slightly greater than the thickness of arm 33 so as to enable free floating movement of the air box in a vertical direction.

The preferred position of each air box with respect to the side and rear edges of the pile of sheets is approximately three-eighths of an inch away from said edges. This position is automatically determined with respect to the sides of the pile by the bars 43, each casing 22 and air box carried thereby being adjusted separately along shafts 25 and 26 until the bar lightly engages the adjacent side edge of the pile. After the casings and air boxes are adjusted as described, they are adjusted longitudinally of the feeder as a unit until the rods 40 engage the top of the pile of short distance diagonally inward of the corners thereof, said adjustment automatically determining the position of the air boxes with respect to the rear edge of the pile.

Air under pressure is delivered to the air boxes 32 at predetermined intervals in timed relation with the operation of the suction devices 20, and for this purpose, the conduits 37 have connected therewith corresponding ends of flexible conduits 45 which are connected in turn with the air pressure side of valve mechanism 30. When air under pressure is delivered to each air box 32 and issues therefrom through the slots 35, 36 as strong, thin elongated jets of air, said jets impinge against the side and rear edges of the pile at points spaced from the corner thereof and tend to rebound and if permitted to escape will lose much of their effectiveness. However, the walls of arms 33, 34 facing the pile form baffle means which obstruct or restrict the escape of air, thereby causing the air to penetrate the pile and enter between a plurality of the uppermost sheets. The air projected into the pile from the two angularly related points engages or intermingles between the sheets at a point spaced inwardly from the corners thereof and sets up eddying or whirling currents of air which turbinate toward the outer edges of the sheets, the escape of the air from between the sheets being obstructed or restricted by the arms 33, 34. The corner portions of the sheets thus acted upon will raise or "fluff up" and become separated one from another in a progressive manner beginning with the lowermost sheet and ending with the uppermost or top sheet, with the maximum amount of separation being between the top sheet and the next or underlying sheet, as shown in Figs. 4 and 6, at the same time assuming a humped condition, as indicated at 46 (Figs. 4 and 6), due to engagement of rod 40 with the top of the pile, the corner of the top sheet and of a few of the underlying sheets sliding slightly relative to said rod during said separation, but not sufficiently to become disengaged therefrom.

When the jets of air have separated the opposite rear corner portions of the top sheet as described, the suction devices 20 are operated to grip said sheet at the raised humped corner portions and further lift the sheet from the pile,

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whereupon the air to the boxes 32 is discontinued through continued rotation of valve mechanism 30 until the next cycle of operation of the feeder at which time the next and underlying sheets are again subjected to the two jets of air. When the top sheet is lifted from the pile by the suction devices 20, the corners of said sheet are drawn from beneath rods 40 which then engage the underlying sheet and hold or strip the latter from the top sheet should there be a tendency of the underlying sheet to stick to the top sheet. Due to engagement of rod 40 with the top of the pile, the corner portions of the sheets as separated during the initial cycle of operation of the feeder are maintained in such separated condition by said rod, and in this manner little effort is required of the jets of air to complete the separation of the next and succeeding sheets during the next and succeeding cycles of operation of the feeder.

The bars 43 substantially close the space between arms 33 and the sides of the pile and thus serve as additional baffles to obstruct the escape of air. It will be understood that similar baffles may be used upon the arms 34 if desired, and that other baffles may also be used on both arms if it is desired to further obstruct the escape of air. Further, the relative positions of the slots 35 and 36 above and below the top of the pile may be varied by relocating or bending the rod 40.

There is thus provided a novel, simple and inexpensive sheet separating device for effecting positive and accurate preliminary separation of a corner portion of the topmost sheet of a pile of sheets, which utilizes air under pressure for this purpose, and thus requires no movement to be imparted thereto and consequently no mechanism to operate the same. Additionally, the sheet separating device is automatically maintained in a predetermined relation to the top of the pile regardless of variations in the height or unevenness in the surface of the pile, thus requiring no further handling of the device after once set in operative position. Also, the sheet separating device will effectively separate the sheets without in any way marking or disfiguring the sheets, and the action thereof is in no way affected by the speed at which the feeder is operated.

Although only a single embodiment of the invention has been illustrated and described in the foregoing specification, it is to be expressly understood that changes may be made therein particularly in the design and arrangement of the parts illustrated, without departing from the spirit and scope of the invention, as will now be clear to those skilled in the art. For a definition of the limits of the invention, reference is had primarily to the appended claims.

What is claimed is:

1. A sheet separator for preliminarily separating a corner portion of a sheet from a pile of sheets for action of other sheet handling means thereon and comprising means providing two jets of air of substantial length extending crosswise of the plane of the sheets and directed toward adjacent sides of the pile at points spaced from a corner thereof, baffle means extending between the two jets, means for guiding said jet means for floating movement in a vertical direction and parallel to said sides of the pile, and means engaged with the top of the pile for automatically maintaining said jet means in a predetermined relation to the top of the pile regardless of variations in the height or unevenness in the surface of the same.

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2. In a sheet feeder, a sheet separating device for preliminarily separating a corner portion of a sheet from a pile of sheets for action thereon of other sheet handling means and comprising means providing two jets of air of substantial length extending crosswise of the plane of the sheets and directed toward adjacent sides of the pile at points spaced from a corner thereof, baffle means extending between the two jets, means for guiding said jet means and said baffle means for floating movement in a vertical direction and parallel to said sides of the pile, and means engaged with the top of the pile at the corner thereof for automatically maintaining said jet means and said baffle means in a predetermined relation to the top of the pile and such that each jet of air extends above and below the level of the pile.

3. In apparatus of the class described, air blast means for simultaneously separating corner portions of a plurality of sheets from a pile of sheets, means for rendering said air blast means operative and inoperative at predetermined intervals, and means engaged with the pile at the corner thereof for causing said separated portions of the sheets to assume a humped condition upon separation thereof by said air blast means and for holding said portions in said condition when said air blast means is rendered inoperative.

4. In a sheet feeder, air blast means for directing two elongated jets of air at an angle with respect to each other against the edges of a pile of sheets contiguous a corner thereof to separate a corner portion of the top sheet from said pile of sheets, baffle means associated with said air blast means and extending between said air jets, means for yieldably holding the corner of said sheet engaged with the pile to cause said portion of the sheet to assume a humped condition upon separation thereof by said air blast means, and suction means for engaging said separated humped corner portion of the sheet and lifting said sheet from the pile.

5. In sheet feeding apparatus of the type having means for supporting a pile of sheets, the combination of air blast means for separating a plurality of said sheets simultaneously one from another adjacent a corner thereof, means for controlling the delivery of air under pressure to said air blast means at predetermined intervals, and means for holding the sheets in separated condition when the air to said air blast means is discontinued.

6. In apparatus of the class described having suction means adapted to engage the top sheet of a pile of sheets and lift said sheet from said pile, the combination therewith of air blast means for separating a corner portion of said sheet from the next or underlying sheet, and means for yieldably holding the corner of the top sheet engaged with the pile to cause the separated portion to assume a humped condition for engagement by said suction means, said holding means also serving to prevent movement of the underlying sheet with the top sheet when the corner of the latter is drawn from beneath said means and lifted by said suction means.

7. A sheet separator for preliminarily separating a corner portion of a sheet from a pile of sheets for action of other sheet handling means thereon and comprising an air box having a pair of walls disposed at right angles to each other, means in each of said walls and spaced from the corner of the pair of walls for providing a thin jet of air of substantial length extending crosswise of the plane of the sheets, means for sup-

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porting said air box adjacent a corner of the pile of sheets and for floating movement in a vertical direction parallel to adjacent sides of said pile, and means carried by said air box and engaged with the top of the pile of sheets for automatically maintaining the air box in a predetermined relation with respect to the top of said pile.

8. In a sheet feeder, means for preliminarily separating a corner portion of a sheet from a pile of sheets for action thereon by other sheet handling means and comprising an air box having a pair of walls disposed at right angles to each other, an elongated vertical slot in each of said walls and spaced from the corner of said pair of walls, said slots providing thin jets of air of substantial length extending crosswise of the plane of the sheets, means supporting said air box adjacent a corner of the pile of sheets and for floating movement in a vertical direction parallel to adjacent sides of said pile, and means engaged with the top of the pile for automatically maintaining the air box in a predetermined relation to the top of said pile, said last-named means comprising a member secured to said air box and extending diagonally of the corner of the latter and the corner of the pile of sheets.

9. In apparatus of the class described, means for preliminarily separating opposite corner portions of a sheet from a pile of sheets for action thereon by other sheet handling means and comprising two laterally spaced air boxes each having a pair of walls disposed at right angles to each other, an elongated vertical slot in each of said walls and spaced from the corner of the respective pair of walls, said slots providing thin jets of air of substantial length extending crosswise of the plane of the sheets, means supporting said air boxes adjacent opposite corners of the pile of sheets and for floating movement independent of each other in a vertical direction and parallel to adjacent sides of the pile, and means engaged with the top of the pile for automatically adjusting the air boxes independently of each other to accommodate variations in the height and irregularities in the surface of the pile at said corners.

10. In apparatus of the class described, means for directing a thin vertical jet of air against one side of a pile of sheets and adjacent one corner thereof, whereby a corner portion of the top sheet of said pile is separated from the sheets therebeneath, means engaged with the top of the pile directly at said corner for yieldingly resisting the separating movement of said corner portion of the top sheet, and suction means for engaging the separated corner portion of the sheet and lifting said sheet from the pile.

11. In combination, means for directing at least two thin vertical air jets against the edges of a pile of sheets adjacent to the corners thereof that lie in a single line, means engaged with the top of the pile directly at the corner for yieldingly resisting upward movement of the corner portion of the top sheet from the pile by said air jets, and suction means for engaging said corner portion of the sheet and lifting said sheet from the pile.

12. In a sheet feeder, means for intermittently directing two air jets at substantially right angles to each other against the sides of a pile of sheets adjacent one corner of the pile, means engaged with the top of the pile at said corner for resisting the movement upward from said pile of the corner portion of the top sheet, and means for

engaging said corner portion after it has been moved from the pile by said air jets.

13. In a sheet feeder, a sheet separating device for separating a corner portion of a sheet from a pile of sheets comprising means providing at least one jet of air of substantial length extending crosswise of the plane of the sheets adjacent one corner thereof, baffle means associated with said jet means, means guiding said jet means for vertical movement in a plane parallel to but spaced from the adjacent side of the pile, and means engaged with the top of the pile for automatically maintaining said jet means in a predetermined relation to the top of the pile regardless of variations in the height or unevenness in the surface of the same.

14. A sheet separator for separating a corner portion of a sheet from a pile of sheets for action thereon of other sheet handling means comprising means providing at least one jet of air of substantial length extending crosswise of the plane of the sheets adjacent one corner thereof, baffle means associated with said jet means, means for guiding said jet means and said baffle means for vertical movement in a plane parallel to but spaced from the adjacent side of the pile, and means engaged with the top of the pile for automatically maintaining said jet means and said baffle means in a predetermined relation to the top of the pile and such that the jet of air extends above and below the level of the pile.

15. In a sheet feeder, a sheet separating device for separating a corner portion of a sheet from a pile of sheets comprising means providing at least one jet of air of substantial length extending crosswise of the plane of the sheets adjacent one corner thereof, baffle means associated with said jet means and extending along adjacent sides of the pile at said corner, means guiding said jet means and said baffle means for vertical movement in a plane parallel to but spaced from the adjacent sides of the pile, and means engaged with the top of the pile at said corner for automatically maintaining said jet means and said baffle means in a predetermined relation to the top of the pile and such that the jet of air extends above and below the level of the pile.

16. In apparatus of the class described, air blast

means for separating a corner portion of the top sheet from a pile of sheets, means mounted for floating movement in a vertical plane for yieldably holding the corner of said sheet in engagement with the pile to cause said portion of the sheet to assume a humped condition upon separation thereof by said air blast means, and suction means for engaging said separated humped corner portion of the sheet and lifting said sheet from the pile.

17. In apparatus of the class described, air blast means for separating a corner portion of the top sheet from a pile of sheets, means mounting said air blast means for floating movement in a vertical plane and parallel with the vertical projection of the pile, and means engaged with the top of the pile at the corner for maintaining said air blast means in a predetermined relation with respect to the top of the pile and for causing said corner portion of the sheet to assume a humped condition upon separation thereof by said air blast means.

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