The invention relates to a device for raising the top sheet, or a portion thereof, of a pile of sheets so that secondary sheet handling means may operate or function, either to further separate the top sheet from the pile or to deliver the sheet to sheet feeding mechanism, or to perform both of these operations. The invention relates particularly to air jet and baffle means for projecting a stream of air towards the top edge of a pile of sheets and pocket the air under at least the top sheet, so that the swirling or eddying of the air underneath the top sheet separates a portion thereof such as a corner from the underlying sheet of the pile sufficiently so that the secondary sheet handling means may function.

It is an object of the invention to construct a sheet separating means which utilizes an elongated jet of air directed vertically or crosswise of the plane of the sheets and against an edge, or particularly against each edge at a corner, of the pile of sheets, and spaced a short distance therefrom, so that the air issuing from the jet or the pair of jets lifts at least the top sheet from the underlying sheet sufficiently so that a secondary sheet handling means may operate to grip the top sheet alone, to either further separate the top sheet from the other sheets, or to deliver the top sheet to a sheet feeding means or to perform both of these operations.

Another object is to construct a sheet separating means which utilizes at least one jet of air projected cross-wise of the plane of the sheets and particularly at a short distance from the corner of the pile, and at the top of the pile, and also utilizes baffle means to pocket the air, or obstruct the escape of air from, beneath the top sheet so that secondary sheet handling means may operate upon the top sheet alone.

Another object of the invention is to provide a new and novel method of initially separating the top sheet from a pile of sheets utilizing a jet or jets of air and obstructing the escape of air from between the sheet.

Another object of the invention is to construct a sheet separating device which utilizes a pair of elongated jets of air to secure initial separation of a corner of a top sheet from the pile of sheets and to pocket the air, or obstruct the escape of the air from, under the sheet so that effective initial separation of at least a portion of the top sheet, such as a corner, from the underlying sheet is obtained whereby a secondary sheet handling means may operate upon the top sheet alone.

Other objects of the invention will be more apparent from the following description taken in connection with the accompanying drawing, in which:

Figure 1 is a side elevation of the sheet separating means mounted upon a sheet delivering machine and in position relatively to a pile of sheets carried upon an elevator which forms a part of the sheet feeder or sheet delivering machine.

Figure 2 is a plan view of the sheet separating devices located at each rear corner of a pile of sheets and mounted upon a sheet feeder or sheet delivering machine.

Primary sheet separating devices of various kinds are used on sheet feeders or sheet delivering machines in order to obtain positive initial separation of the corners of sheets from the top of a pile of sheets. On such a device, a so-called comb is brought into contact with the corner of the top sheet and rotation of the comb forms a buckle in the sheet, and lesser buckles in a few of the underlying sheets, whereby initial or primary separation of the top sheet from the next or second sheet is obtained. This buckle in the top sheet provides sufficient initial separation to enable the secondary sheet handling means to function or operate. Although such combers are successful primary sheet separators, they involve considerable mechanism in order to rotate the comb and cam mechanism to bring the comb into contact with and away from contact with the top of the pile of sheets in timed relation with the other sheet handling devices upon the feeder or machine. The jet means to be described hereinafter functions highly satisfactorily and eliminates a great deal of the mechanism which is necessary with the comb type of primary separating devices.

The sheet separating means is shown in position with respect to a pile of sheets P carried upon a board B forming the platform of an elevator for a sheet feeding machine. As the sheets are removed from the top of the pile, the elevator rises so that a substantially constant level is maintained for the top of the pile.

The sheet separator at each corner of the pile is preferably a single unit and comprises an air box or chamber 10 which is hollow so that air under pressure may be fed therethrough. The box is angular in construction so that one arm and particularly its inner face or wall extends along one edge of the pile of sheets and the other arm extends along the other edge. Air jet means are carried by the box, that particularly illustrated being a thin slot 11 of about 7/8 of an inch wide, preferably through the wall of one arm of
the box facing the pile of sheets. The slot extends cross-wise or preferably vertically of the plane of the sheets in the pile and vertically in the face of the wall. A second slot 12, like slot 11, is provided through the wall of the other arm of the air box extending along and facing the other edge of the pile of sheets. The slots are thin enough so that sufficient pressure can be maintained in the air box to give a strong jet of air issuing from the slots. The slots provide a plurality of jets at each corner.

In the illustrated embodiment, the slot or issuing jet is as wide as the wall which is approximately an inch and one-quarter long and is spaced about an inch and three-quarters from the corner formed by the walls of the box, so that the slots are about an inch and a half from the corner of the pile of sheets. The jets probably fan out so that the jet at the edge of the pile is wider than at the slot. The air box with its elongated air jets is preferably positioned approximately three-eighths of an inch away from the edge of the pile of sheets. The slots and jets of air which issue therefrom extend cross-wise of the plane of the sheets and are preferably vertical with respect thereto. The air box 10, as illustrated, is located in a vertical position with respect to the top of the pile of sheets such that the lower end of the jet engages a plurality of the top sheets on the pile and the level of the upper end of the jet is above the pile depending upon the extent of the separation desired. In the illustrated construction approximately 1/8 of the jet of air extends below the top sheet and the balance of the jet is above the top sheet. The reason for this to provide a jet of ample length for all pile situations and sheet characteristics such as when the sheets are stiff and are raised by the secondary sheet handling means, the air jet underneath the sheet is increased as the sheet moves upward.

The spacing of the air box from the edges of the sheets, the velocity of the jet of air, the relative position of the jet below and above the top of the pile of sheets, and other factors are dependent largely upon the weight and character of the sheets in the pile. Heavy sheets ordinarily require a heavier blast of air than lighter sheets, which can be obtained by increasing the pressure in the air line and hence at the jets. The tendency of the sheets to stick together is also a factor which bears upon the air blast and the location of the jet or jets of air and because of the great number of different kinds of sheets handled by a sheet feeder, the strength of the jets and their location for best results can be determined only by trial.

The face of each wall of the air box 10 which is adjacent the edges of the pile of sheets, forms a wall or baffle which obstructs or restricts the escape of air from beneath the sheets or particularly the top sheet towards the raised corner thereof. This wall assures that enough air from the jet or jets will be pocketed between the sheets so that the sheets and particularly the top sheet will balloon or fly upwardly under the combined action of the force of the jet of air and the obstruction formed by the wall, tending to prevent or resisting the escape of the air towards the corner of the sheet. The air issuing from the two jets also engages or intermingles between the sheets to set up eddying or whirling currents of air which aid in separating particularly the top sheet from the underlying sheet in the pile. The walls of the air box and the sheet itself form an enclosure which obstructs the escape of air from beneath the same although if the air should, and it has been demonstrated that the air does, blow completely underneath the sheet that is not objectionable and in fact is an aid to sheet separation. The air jets also blow up at least a portion of one or more of the sheets, however, the top sheet is lifted upwardly from the top of the pile and particularly is lifted or separated from the second sheet.

Supporting means are provided for the air box 10 which includes a pipe 15 carried at the corner thereof to which is connected a flexible pipe or hose, 16 which is connected in turn to a suitable source of air pressure in any suitable fashion such as through an air shaft 17. The pipe 15 also serves to support the air jets or particularly, the air box with its jets and baffle 10. The pipe 15 extends vertically through another part of the supporting means or a bracket 18 and the elevation of the air box or the vertical position thereof with respect to the top of the pile P can be adjusted by means of the nuts 18. The pipe 15 is also freely adjustable upwardly in the bracket 18 so that if some part of the elevator should accidently engage the same, it can move upwardly as the elevator rises.

The bracket 18 also carries means for retaining the principal arm or in proper angular position with respect to the corner of the pile of sheets. Any suitable means may be utilized for this purpose and that particularly illustrated includes a pair of bars 20 and 21 extending downwardly from the bracket, which bars engage one end of the air box and thereby prevent angular displacement thereof with respect to the bracket and the corner of the pile of sheets. The bars 20 and 21 are suitably retained upon the bracket, the means particularly illustrated including a pin 22 extending through the upper end of each bar, which pin rests upon the bracket, and a nut 23 having a groove therein for each bar and being secured to the end of the bracket 18 by bolts 24. The bars are mounted so that they are freely movable upwardly.

The face of the inner sheet of the air box is wide enough to substantially close the space between the arm of the box and the side of the pile of sheets. This bar therefore also serves as an additional barricade or baffle to the escape of air and tends to direct at least some of the escaping air in an upward stream, which further aids separation of the sheets. A similar side baffle may be used upon the other arm if desired. If greater lifting or separating power of the air is desired, other baffles may be provided, further restricting or obstructing the escape of air from beneath the sheet or sheets and also the length of the walls or arms of the air box may be increased.

Means may be provided to prevent the top sheet from being raised too high. This means or stop may take any suitable form, and that particularly illustrated is a bolt 27 extending through a hole in the bracket 18 over the corner of the pile of sheets as illustrated in Figure 2. A nut 28 carried by the bolt 27 permits adjustment of the level of the head or lower end of the bolt. It will be observed that the air box, the bolt 27 and bars 20 and 21 merely rest upon the bracket 18 and consequently are freely movable upwardly in the event something should engage the bottom of these parts. It is necessary, too, that the stop 27 be movable upwardly if the sheets are stiff, such as cardboard, because when the sheet han-
5 Means of gripping the sheet it raises it farther and pushes the bolt upwardly. The stop otherwise might resist the further separation and forwarding of the sheet. This yielding of the stop is of only minor importance once when the sheets being separated bend easily.

6 The bracket 18 is suitably mounted upon the sheet feeder such as upon the cross bars 17 and 30. A complete air jet means and bracket is provided for each rear corner of the pile of sheets 18 and are carried upon its bracket 18. Each bracket is adjustable along the cross bars towards and away from each other. A screw 31 may be used to fix the brackets in adjusted position.

When the jets of air contiguous the corners of the pile of sheets have lifted or separated the corners of the top sheet or particularly the top sheet from the underlying sheets in the pile, a sheet handling means 32 is utilized to forward the sheet, or to further separate the top sheet from the pile of sheets in which case other devices may perform the forwarding operation, or the sheet handling means may perform both of these operations. The sheet handling means illustrated is a suction cup type, although any other type of jet or air current may be used along with other jets of air which aid in separating the whole of the top sheet from the pile of sheets. The air separating means described obtains sufficient separation of the top sheet from the underlying sheets in the pile so that the sheet handling means may operate to grip the corners of the top sheet and continue the separation or the forwarding of the sheet from the pile.

The construction described herein provides at least one jet of air of a substantial length which is directed towards the edge of the top sheets of a pile of sheets and contiguous the corner thereof. Baffle or wall means cooperate with the jet in that it obstructs the escape of air towards the opened or spaced edge of the separated sheet. Preferably two jets are provided which are directed so that they intersect their paths intersect and this creates a swirling action under the sheet or sheets which aids separation. With two jets the baffle extends between the jets and may extend upon either side of each jet. The baffle wall is at least as wide as the jets. The jets may be positioned along the edge of the sheet but a jet at each edge adjacent or contiguous a rear corner is the illustrated construction. Each rear corner of the pile is provided with a pair of jets and a baffle wall between the jets.

The invention includes the method by which initial separation of at least a portion of the top sheet from the underlying sheet is obtained by a jet, or particularly a plurality of jets of air, and obliterating the escape of air from between the sheets and particularly the top sheet so that the entrapped air separates the sheets sufficiently so that a secondary sheet handling means may operate upon the top sheet alone. Several of the top sheets are separated from each other, however, the secondary sheet handling means picks up or grips the top sheet only which is enabled to do because of the initial separation of the top sheet from the underlying sheet. Where a plurality of jets are used, it is desirable to have a pair of jets intermingle or intersect so that a swirling or eddying of the air is obtained underneath the sheet or sheets. Where a plurality of jets are used, a jet may be provided at each edge of each rear corner of the pile of sheets.

This invention is presented to fill a need for improvements in a sheet separator. It is understood that various modifications in structure, as well as changes in mode of operation, assembly, and manner of use, may and often do occur to those skilled in the art, especially from the teachings of an invention. Hence, it will be understood that this disclosure is illustrative of preferred means of embodying the invention in useful form by explaining the construction, operation, and advantages thereof.

What is claimed is:

1. A sheet separator for initially separating at least a portion of the top sheet of a pile of sheets so that a secondary sheet handling means may operate upon the top sheet comprising means providing a thin jet of air of substantial length extending crosswise of the plane of the sheets and directed towards the edges of the sheets in the pile to raise an edge portion thereof above the underlying sheet, an air connection to the jet means, baffle means at least as wide as the jet and extending on each side thereof to obstruct the lateral escape of air from between the sheets at the raised edge portion thereof, the baffle means at or adjacent at least one end thereof extending inwardly thereby spacing the baffle means from the pile of sheets and substantially closing the escape of air at the ends of the baffle means, and means supporting the jet means so that the lower end of the jet of air is a plurality of sheets below the top of the pile of sheets and supporting the jet means and baffle means in position with respect to their distance from the edge of the pile of sheets.

2. A sheet separator for initially separating a portion of at least the top sheet of a pile of sheets so that a secondary sheet handling means may operate upon the top sheet comprising means providing a jet of air of substantial length extending crosswise of the plane of the sheets and directed towards the edges of the sheets in the pile, a second means providing a jet of air of substantial length extending crosswise of the plane of the sheets and directed towards the edges of the sheets in the pile, the two jets being projected in a direction to intermingle at a point spaced from the edge of the sheet, an air connection to each jet means, a baffle wall extending between the two jet means and spaced from the edge of the pile of sheets but near enough to obstruct the lateral escape of air from between the sheets, baffle means at least at one end of the baffle wall substantially closing the space between the baffle wall and the edge of the pile, and means supporting the jet means so that the lower end of each jet of air is a plurality of sheets below the top of the pile of sheets and extends a distance above the pile of sheets depending upon the separation desired and supporting the jet means and baffle means in position with respect to the distance from the edge of the pile of sheets.

3. A sheet separator for initially separating the corner of the top sheet of a pile of sheets so that a secondary sheet handling means may operate upon the top sheet comprising an air box having a pair of faces extending crosswise of the plane of the sheets, vertical baffle means spaced from the corner of the pair of faces and spaced from the end of its respective face, the slots providing a pair of thin intermingling jets of air of substantial length adapted to extend crosswise of the plane of the sheets, vertical baffle means at the end of at least one face substan-
initially closing the space between the air box and the pile of sheets, an air connection to the box, and means supporting the air box so that the lower end of each jet of air is a plurality of sheets below the top of the pile of sheets and extends a distance above the pile of sheets depending upon the separation desired.

4. A sheet separator for initially separating the corner of the top sheet of a pile of sheets so that a secondary sheet handling means may operate upon the top sheet comprising an air box having a pair of faces extending substantially at right angles to each other, an elongated vertical slot in each face of the air box, each slot being spaced from the corner of the pair of faces and spaced from the end of its respective face, the slots providing a pair of thin intermingling jets of air of substantial length adapted to extend cross-wise of the plane of the sheets, vertical baffle means at the end of at least one face substantially closing the space between the end of the air box and the pile of sheets, an air connection to the air box, means supporting the air box so that the lower end of each jet of air is a plurality of sheets below the top of the pile of sheets and extends a distance above the pile of sheets depending upon the separation desired and the supporting means being freely slidable upwardly.

5. A sheet separator for initially separating the corner of the top sheet of a pile of sheets so that a secondary sheet handling means may operate upon the top sheet comprising an air box having a pair of faces extending substantially at right angles to each other, an elongated vertical slot in each face of the air box, each slot being spaced from the corner of the pair of faces and spaced from the end of its respective face, the slots providing a pair of thin intermingling jets of air of substantial length adapted to extend cross-wise of the plane of the sheets, vertical baffle means at the end of at least one face substantially closing the space between the end of the air box and the pile of sheets, means retaining the vertical baffles means in position for free movement upwardly, and means supporting the air box so that the lower end of each jet of air is a plurality of sheets below the top of the pile of sheets and extends a distance above the pile of sheets depending upon the separation desired.

6. A sheet separator for initially separating the corner of the top sheet of a pile of sheets so that a secondary sheet handling means may operate upon the top sheet comprising an air box having a pair of faces extending substantially at right angles to each other, an elongated vertical slot in each face of the air box, each slot being spaced from the corner of the pair of faces and spaced from the end of its respective face, the slots providing a pair of thin intermingling jets of air of substantial length adapted to extend cross-wise of the plane of the sheets, vertical baffle means at the end of at least one face substantially closing the space between the end of the air box and the pile of sheets, means retaining the vertical baffles means in position for free movement upwardly, and means supporting the air box so that the lower end of each jet of air is a plurality of sheets below the top of the pile of sheets and extends a distance above the pile of sheets depending upon the separation desired and the supporting means being freely slidable upwardly.

7. A sheet separator for initially separating at least a portion of the top sheet of a pile of sheets so that a secondary sheet handling means may operate upon the top sheet comprising means providing a thin jet of air of substantial length extending crosswise of the plane of the sheets and directed towards the edges of the sheets in the pile, a second jet means providing a thin jet of air substantially above the underlying sheet, an air connection to the jet means, baffle means at least as wide as the jet and extending on each side thereof to obstruct the lateral escape of air from between the sheets at the edges of the sheet and the jet means being angular to extend along both edges of the corner of a pile of sheets, additional baffle means extending inwardly adjacent the ends of the next aforesaid baffle means to substantially close the escape of air at the ends of the baffle means, and means supporting the jet means so that the lower end of the jet of air is a plurality of sheets below the top of the pile of sheets and supporting the jet means and baffle means in position with respect to their distance from the edge of the pile of sheets.

8. A sheet separator for initially separating a corner portion of the top sheet of a pile of sheets so that a secondary sheet handling means may operate upon the top sheet comprising means providing a jet of air of substantial length extending crosswise of the plane of the sheets and directed towards the edges of the sheets in the pile, a jet means providing an air of substantial length extending crosswise of the plane of the sheets and directed towards the edges of the sheets in the pile, the jet means being adjacent to each other and both located contiguous to one corner of the pile of sheets to separate the corner portion of the sheets, and projected at an angle with respect to each other to intermingle, the two jets being close enough so that they do intermingle between the sheets at a point spaced from the edge of the sheet, an air connection to each jet means, baffle means extending between the two jet means and obstructing the lateral escape of air from between the sheets, and means supporting the jet means so that the lower end of each jet of air is a plurality of sheets below the top of the pile of sheets and supporting the jet means and baffle means in position with respect to their distance from the edge of the pile of sheets.

9. A sheet separator for initially separating a corner portion of the top sheet of a pile of sheets so that a secondary sheet handling means may operate upon the top sheet comprising a corner baffle having walls extending continuously from end to end thereof and at or substantially at right angles to extend along each edge of the corner of a pile of sheets, jet means in one wall providing a jet of air of substantial length extending crosswise of the plane of the sheets and directed towards the edges of the sheets in the pile, a second jet means in the other wall providing another jet of air of substantial length extending crosswise of the plane of the sheets and directed towards the edges of the sheets in the pile, the two jet means being contiguous to one corner of the pile of sheets to separate the corner portion of the sheets, and an air connection to the jet means, the walls of the baffle extending at least between the two jet means and obstructing the lateral escape of air from between the sheets, and means supporting the jet means so that the lower end of each jet of air is a plurality of sheets below the top of the pile of sheets and extending a distance above the pile of sheets and supporting the baffle in position with
A sheet separator for initially separating a corner portion of at least the top sheet of a pile of sheets so that a secondary sheet handling means may operate upon the top sheet comprising an air box having a wall, jet means through the wall providing a jet of air of substantial length extending crosswise of the plane of the sheets and directed towards the edges of the sheets in the pile, a second jet means through the wall providing another jet of air of substantial length extending crosswise of the plane of the sheets and directed towards the edges of the sheets in the pile, the two jet means being adjacent to each other and both located contiguous to one corner of the pile of sheets to separate the corner portion only of the sheets and projected at an angle with respect to each other and between the two jet means, the jet means also retaining the baffle means in position with respect to the distance of the wall from the edge of the pile of sheets.

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jets of air of substantial length crosswise of the plane of the sheets and so that the lower portion of each jet engages a plurality of the top sheets of the pile, locating the jets adjacent to each other and contiguous a corner of the pile of sheets to separate the corner portion only of the sheets, the air for the jets having a pressure to separate and retain separated the top sheets from each other, directing the jets at an angle to each other so that they intermingle at a point over and between the sheets.

17. A method for initially separating a corner portion of the top sheet from the underlying sheets in a pile so that the top sheet alone can be operated upon comprising blowing a pair of jets of air of substantial length crosswise of the plane of the sheets and so that the lower portion of each jet engages a plurality of the top sheets of the pile, directing one jet at each edge of the pile contiguous a corner thereof to separate the corner portion only of the sheets, the air for the jets having a pressure to separate and retain separated the corner portions only of the top sheets from each other, directing the jets at an angle to each other so that they intermingle at a point over and between the sheets, and obstructing the escape of air from between the sheets and at each edge of the corner of the pile of sheets.

18. A method for pneumatically separating a corner portion of at least the top sheet from a pile of sheets which includes discharging an elongated jet of air through an opening having its major dimension disposed substantially parallel to but laterally spaced from the adjacent side of said pile of sheets, directing the jet at the pile spaced from but contiguous the corner of said pile of sheets to separate the corner portions only of the sheets, the air for the jet having a pressure sufficient to separate and retain separated the corner portions of the top sheets from each other, and obstructing the escape of air from between the sheets at the corner of the pile and continuously along each edge at least to the jet and create a turbulence of air between two or more of the topmost sheets of said pile at the corner only thereof.

19. A method for initially separating corner portions of a pair of corners of the top sheet from the underlying sheets in a pile so that the top sheet alone can be operated upon comprising blowing a plurality of jets of air of substantial length crosswise of the plane of the sheets and so that the lower portion of each jet engages a plurality of the top sheets of the pile, directing one jet at each side edge of the pile contiguous a corner thereof to separate the corner portions of the top sheets, directing a jet at the adjacent transverse edge of the pile of sheets and contiguous each corner thereof, the air for the jets having a pressure to separate and retain separated the corner portions only of the top sheets from each other, and obstructing the escape of air from between the sheets in at least the space between the adjacent jets.

20. A method for initially separating corner portions of a pair of corners of the top sheet from the underlying sheets in a pile so that the top sheet alone can be operated upon comprising blowing a plurality of jets of air of substantial length crosswise of the plane of the sheets and so that the lower portion of each jet engages a plurality of the top sheets of the pile, directing one jet at each side edge of the pile contiguous a corner thereof, directing a jet at the adjacent transverse edge of the top sheet of the pile, directing one jet at each side edge of the top sheet contiguous a corner thereof, directing a jet at the adjacent transverse edge contiguous each corner thereof to separate the corner portions only of the sheets, the air for the jets having a pressure to separate and retain separated the corner portions of the top sheets from each other, directing adjacent jets at an angle to each other so that they intermingle at a point over and between the sheets, and obstructing the escape of air from between the sheets at least between the adjacent jets.

21. A method for initially separating corner portions of a pair of corners of the top sheet from the underlying sheets in a pile so that the top sheet alone can be operated upon comprising blowing a plurality of jets of air of substantial length crosswise of the plane of the sheets and so that the lower portion of each jet engages a plurality of the top sheets of the pile, directing one jet at each side edge of the pile contiguous a corner thereof, directing a jet at the adjacent transverse edge contiguous each corner thereof, directing adjacent jets at an angle to each other so that they intermingle at a point over and between the sheets to create turbulence therebetween, and the air supplied to the jets having a pressure to separate and retain separated the corner portions only of the top sheets from each other.

JOHN R. PERRY.