Jan. 7, 1958 L. C. WILLIAMS 2,819,074

SHEET SEPARATING MECHANISM

Filed May 10, 1954 2 Sheets-Sheet 1

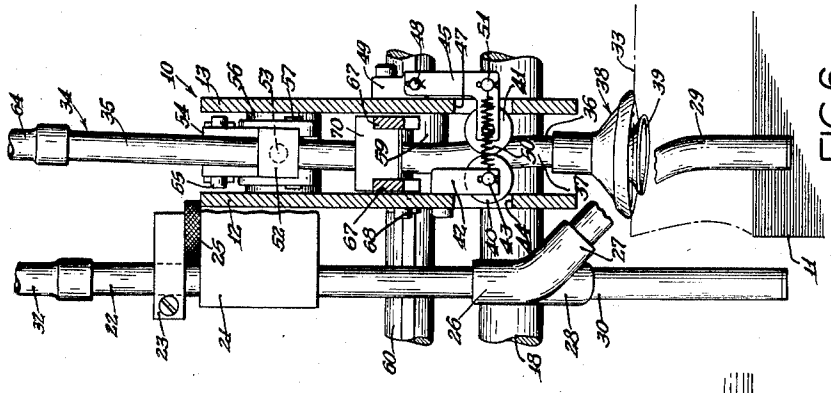


FIG. 6.

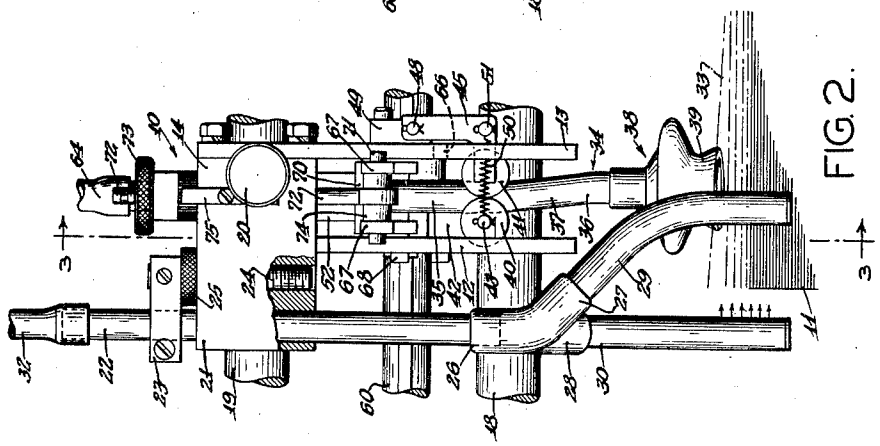


FIG. 2.

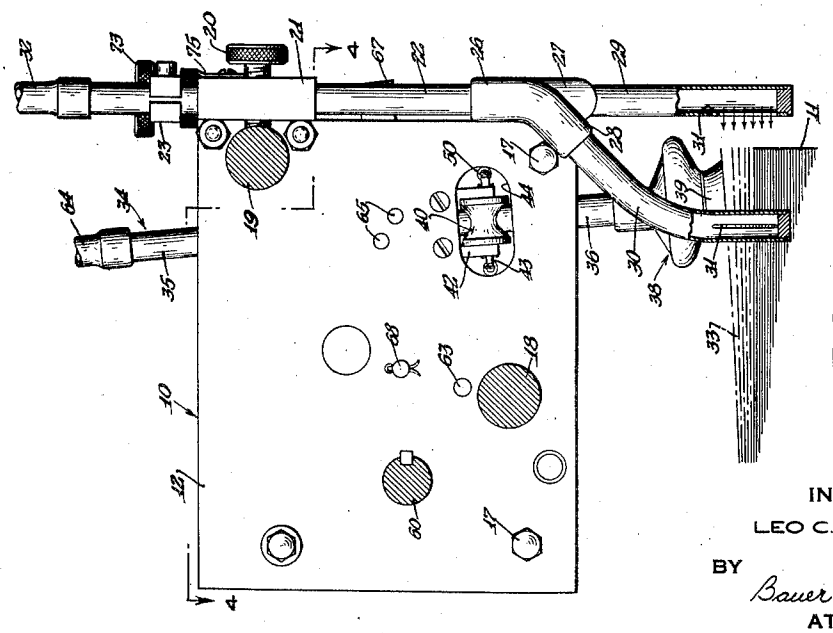


FIG. 1.

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SHEET SEPARATING MECHANISM

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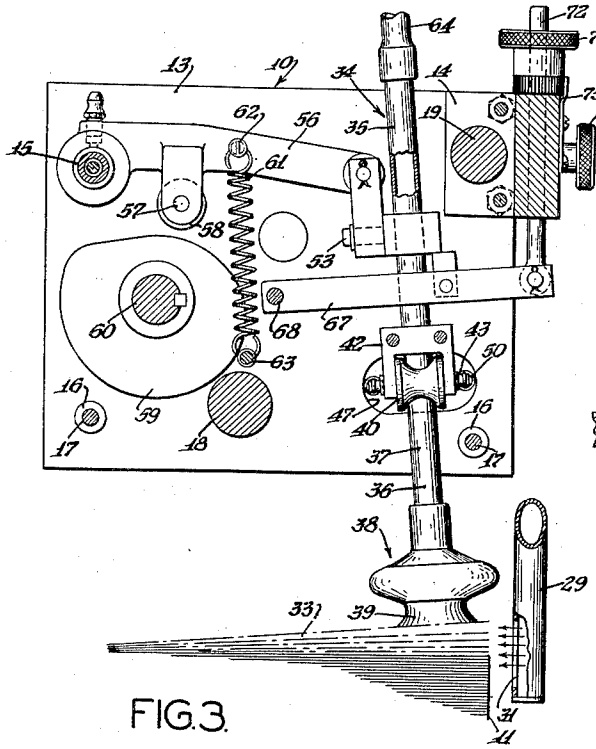


FIG. 3.

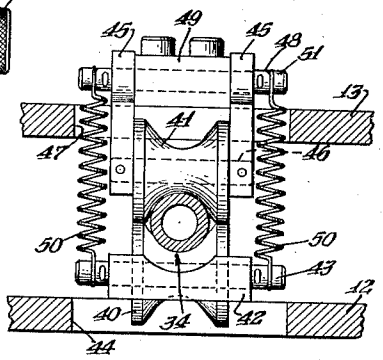


FIG. 5.

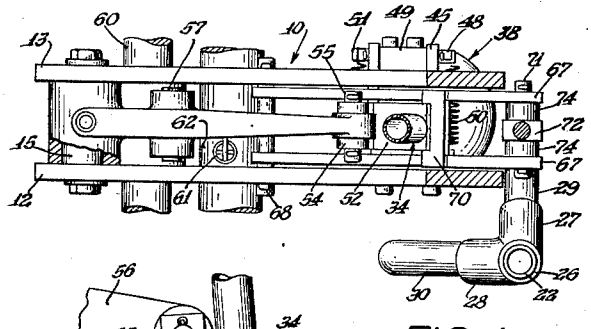


FIG. 4.

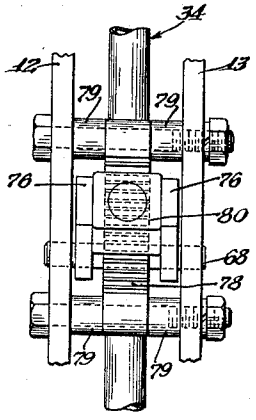


FIG. 8.

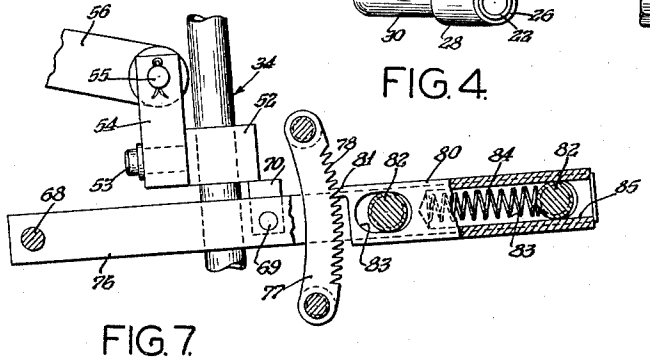


FIG. 7.

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SHEET SEPARATING MECHANISM

Leo C. Williams, Pearl River, N. Y., assignor, by mesne assignments, to Miehle-Goss-Dexter, Incorporated, a corporation of Delaware

Application May 10, 1954, Serial No. 428,520

19 Claims. (Cl. 271—26)

This invention relates generally to sheet feeders and more particularly to sheet separating mechanisms of the type which are employed in duplicate at opposite sides of the feeder and which function to separate and lift the sheets successively at opposite corner portions thereof from a pile or supply carried on said feeder and stretch said sheets in a direction transverse to the feeding direction. One sheet separating mechanism of the type specified is illustrated and described in the United States Patent No. 2,389,480, granted November 20, 1945, to Leonard Baker.

One object of the present invention is to provide for use in a sheet feeder of the type specified an improved and simplified mechanism for separating sheets one from another at a corner portion thereof and for moving the separated corner portion of each sheet in turn outwardly transverse to the feeding direction preparatory to forwarding the sheets to a printing press or other machine to be fed.

Another object of the invention is to provide an improved corner sheet separating mechanism having a relatively small number of parts novelly constructed, coordinated and operated to insure efficiency and low manufacturing, assembling and maintainance costs.

Another object is to provide a corner sheet separator having improved operating mechanism so constructed that certain of the elements serve more than one purpose and perform more than one function in effecting separation of a corner portion of a sheet and outward transverse movement of said sheet corner portion.

Another object is to provide a corner sheet separator wherein the sheet lifting sucker includes a rigid vacuum conduit movable therewith and guide means associated with said conduit, said conduit and guide means being so constructed and arranged that said sucker is caused to rock inwardly and outwardly with respect to the adjacent side edge of a supply of sheets upon movement thereof toward and away, respectively, from said supply to engage and lift the topmost sheet therefrom.

Another object is to provide a sheet separating mechanism having adjustable means of improved and simplified construction for varying the extent of downward movement of the sheet lifting sucker while the latter is in operation so as to obtain the best and most accurate separation of sheets thereby.

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.

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

Fig. 1 is a side elevational view, partly in section, illustrating one sheet separating mechanism constructed in accordance with the present invention, showing the sheet lifting sucker in the lowered position which it occupies

when a sheet is about to be gripped and lifted thereby from a supply, certain of the parts having portions thereof broken away for purposes of clearer illustration;

Fig. 2 is a rear elevational view of said sheet separating mechanism, looking from the right of Fig. 1, certain of the parts having portions thereof broken away for purposes of clearer illustration;

Fig. 3 is a vertical longitudinal sectional view taken substantially on the line 3—3 of Fig. 2;

Fig. 4 is a top plan view, partly in section, of said sheet separating mechanism as viewed from the position indicated by the irregular line 4—4 of Fig. 1;

Fig. 5 is an enlarged detail top plan view, partly in section, of guide means for the sheet lifting sucker;

Fig. 6 is a rear elevational view of the sheet separating mechanism, with parts broken away and in section, showing the sheet lifting sucker in the position it occupies after a sheet is gripped and lifted thereby from the supply;

Fig. 7 is a fragmentary side elevational view, partly in section, showing a modified form of stop for the sheet lifting sucker, certain of the parts having portions thereof broken away for purposes of clearer illustration; and

Fig. 8 is an end elevational view of the modified stop, looking from the right of Fig. 7.

Referring to the drawings, the improved and simplified sheet separating mechanism, indicated generally at 10, herein shown is located above and adjacent to one rear upper corner of a supply pile of sheets 11. It will be understood that in actual practice two of said sheet separating mechanisms are employed in the sheet feeder, the other being of opposite hand and located above and adjacent to the opposite rear upper corner of the pile of sheets 11, whereby the topmost sheet is separated and lifted at both rear corner portions from said pile, and through outward movement of said corner portions, said sheet is transversely stretched to straighten and raise the rear edge portion thereof for accurate presentation to and engagement by sheet forwarding devices, said devices acting to take the sheet in the region of the stretched portion and impart to said sheet a forward movement relative to the pile 11. With this understanding that two of the sheet separating mechanisms 10 are ordinarily employed, and that said mechanisms are identical in construction and operation, except that they are of opposite hands, the description of the single mechanism herein shown will now proceed.

As herein shown, the sheet separating mechanism 10 comprises two spaced parallel side plates 12 and 13 which are bolted or otherwise suitably secured at their upper rear corners to a spacer-block 14 (Figs. 2 and 3), and adjacent their upper front corners to opposite ends of a spacer-stud 15 (Figs. 3 and 4). Other spacers 16 and bolts 17 located adjacent the lower opposite corners of the side plates 12, 13 serve to further hold said plates together in spaced parallel relation. The side plates 12, 13 are slidably mounted on two parallel cross shafts 18 and 19 to enable lateral adjustment of the entire sheet separating mechanism 10 to accommodate sheets of different widths. The cross shaft 18 extends through suitable axially aligned clearance openings in the plates 12 and 13, and the cross shaft 19 extends through suitable axially aligned clearance openings in said plates and in the spacer-block 14. The sheet separating mechanism 10 is secured in the desired position of adjustment thereof along the cross shafts 18, 19 by a jam screw 20 threaded in the spacer-block 14 and engaging the shaft 19. The cross shafts 18, 19 are suitably supported at their opposite ends on the feeder frame to enable longitudinal adjustment of the entire sheet separating mechanism 10 to accommodate sheets of different lengths.

The spacer-block 14 is formed so that a portion 21 thereof (Figs. 1, 2 and 3) projects outwardly beyond the outer side plate 12, and slidably mounted in said block portion is a vertically disposed open-ended rigid tubular conduit 22. The conduit 22 projects above the spacer-block 14 and has clamped to the upper end thereof a block 23 provided with a threaded pin 24 which projects downwardly into a suitable clearance opening formed in the portion 21 of said spaced-block. Disposed between the blocks 14 and 23 and threaded on the pin 24 is an adjusting nut 25 by means of which the conduit 22 and parts carried thereby to be presently described may be vertically adjusted with respect to the top of the pile of sheets 11. By virtue of the described arrangement of the adjusting means comprising the pin 24 and nut 25, the conduit 22 and parts carried thereby are free to move upwardly in the event something should engage the bottom of said parts, and said pin also serves to hold said conduit and said parts against turning movement relative to the spacer-block 14. Upon rotation of the nut 25 in one direction, the conduit 22 is raised by said nut through engagement thereof with the spacer-block 14, and upon rotation of the nut in the opposite direction, said conduit is lowered by gravity assisted by a light spring if deemed necessary or desirable. Engagement of the nut 25 with the spacer-block 14 holds the conduit 22 and parts carried thereby in adjusted positions and against downward sliding movement beyond said positions.

Secured to the lower end of the conduit 22 and communicating with said conduit is an inverted Y-shaped tubular fitting 26 (Figs. 1, 2 and 4) having a laterally and inwardly directed branch 27 and a forwardly directed branch 28. Secured in and communicating with the branch 27 of the fitting 26 is a rear blow pipe 29. This blow pipe 29 is so shaped and is of such length that the lower end portion thereof is vertically disposed and extends below the normal feeding level of the top of the pile of sheets 11, and when the sheet separating mechanism 10 is in its proper operating position as herein shown, said blow pipe portion is positioned a desired distance away from the rear face and in from the rear corner of the pile. Secured in and communicating with the branch 28 of the fitting 26 is a side blow pipe 30 which is of the same shape and length as that of the rear blow pipe 29 so that the lower end portion thereof is likewise vertically disposed and extends below the top of the pile of sheets 11, and is correspondingly spaced from the side face and rear corner of said pile. The blow pipes 29 and 30 are closed at their lower ends, and each is provided in the vertical portion thereof with air jet means in the form of a relatively thin vertically extending slot or orifice 31 facing the pile of sheets 11.

In the illustrated embodiment, the angularly related blow pipes 29 and 30 are located approximately one and one-quarter inches in from the rear corner of the pile of sheets 11, and approximately one-half inch away from the rear and side faces, respectively, of said pile. The blow pipes 29 and 30 are vertically adjusted by means of the adjusting nut 25 with respect to the top of the pile of sheets 11 such that the lower ends of the air jets issuing from the slots 31 engage a plurality of the top sheets on said pile and the level of the upper ends of said air jets is above the pile depending upon the extent of sheet separation desired. Air under pressure is delivered to the blow pipes 29 and 30 at the required predetermined intervals through a flexible conduit 32 which is connected with the upper end of the conduit 22 and with a suitable valve mechanism (not shown) that is, in turn, connected with an air pump (not shown) or other suitable source of compressed air.

When air under pressure is delivered through the conduits 32 and 22 and fitting 26 to the blow pipes 29 and 30 and issues from said pipes through the slots 31 as strong thin elongated jets of air, said jets impinge against the rear and side edges of the sheets on the pile 11 and the air enters under pressure from two angularly related directions between the corner portions of a plurality of the uppermost sheets on said pile. The air from the jets so projected intermingles at a point inwardly from the rear and side edges of the sheets and thus produces between the sheets eddying or whirling currents of air which turbinate toward said sheet edges. Under these conditions, the rear corner portions of the sheets are caused to raise or "fluff-up," as shown in broken lines in Figs. 1, 2 and 3, and become separated one from another in a progressive manner beginning with the lowermost sheet and ending with the uppermost sheet, with the maximum amount of separation being between the top sheet and the next underlying sheet.

When the rear corner portion of the top sheet 33 is preliminarily separated by the jets of air as above described, and while said jets of air continue to act on said sheet, the separated corner portion of the sheet is gripped by a sucker, to be hereinafter described, lifted from the pile and moved laterally outward at which time the delivery of compressed air to and through the blow pipes 29 and 30 is discontinued. Since in actual practice two suckers are employed at the opposite rear corners of the pile of sheets 11 as above explained, it will be apparent that the top sheet will be stretched transversely of said pile when said sheet is gripped by the suckers at both separated rear corner portions thereof and one or both of said corner portions are moved outwardly by said suckers. The purpose of this stretching of the sheet is to raise and straighten the rear edge thereof so that said sheet may be effectively and accurately presented to and engaged by suitable sheet forwarding devices at said edge.

As herein shown, the sheet lifting and stretching sucker is disposed between the side plates 12 and 13 and comprises an open-ended hollow rod or tubular conduit 34 which, as shown in Figs. 2 and 6, is formed to provide a long upper vertical portion 35, a short lower vertical portion 36 which is offset inwardly from said upper portion, and a short intermediate portion 37 which is inclined downwardly and inwardly from said upper portion to said lower portion. While the conduit 34 may assume a straight up and down position with respect to the upper surface of the pile of sheets 11, it is preferably inclined at a slight angle forwardly from the vertical, as shown in Fig. 3, so that when the top sheet 33 is lifted at the rear thereof from said pile a forward pushing action will be exerted thereon to maintain the front edge thereof in its initial position on said pile.

The conduit 34 has suitably attached to the lower offset portion 36 thereof a sheet engaging suction device 38 which is preferably, but not necessarily, of the type disclosed in the application of Stanley T. Stoothoff and Leo C. Williams, Serial No. 419,378, filed March 29, 1954, needing no detail description herein. Suffice to say that the suction device 38 includes a sheet gripping rubber suction cup 39 which is carried by and communicates with the conduit 34 and is so formed that it is automatically flexed upwardly a short distance toward and relative to said conduit, as shown in Fig. 6, by atmospheric pressure when vacuum is created therein and it has gripped and is sealed by the corner portion of the top sheet 13 on the pile 11. This initial movement of the suction cup 39 compensates for a slight overtravel of the sucker 38 in the movement thereof toward the pile of sheets 11, whereby gripping engagement of said suction cup with the top sheet 13 is assured without depressing the separated corner portion of said sheet back onto said pile. It will be understood that the well-known cylinder and piston type of suction device, as well as any one of the many well-known types of suction cups, may be employed and attached to the conduit 34 in lieu of the suction device 38 illustrated herein.

The suction device 38 is guided for straight-line up and down movement by two opposed spool-like rollers 40 and 41 (Figs. 2, 3, 5 and 6) which receive the conduit

34 therebetween and are so located that they are disposed in the path of upward movement of the inclined portion 37 of said conduit. The roller 40 which may be termed the fixed roller, is disposed outwardly of the conduit 34 and between the furcations of a bifurcated bracket 42, and is journalled on a pin 43 which is carried at its opposite ends by said furcations. The bracket 42 is bolted or otherwise suitably secured to the inner surface of the outer side plate 12, and said plate is provided with a suitable window 44 therein to afford a clearance space for the roller 40. The roller 41, which may be termed the movable roller, is disposed inwardly or at the offset side of the conduit 34 and between the horizontal portions of a pair of angular-shaped links 45, and is journalled on a pin 46 carried at opposite ends thereof by said link portions. The links 45 project through a suitable clearance window 47 formed in the inner side plate 13 and are pivotally mounted exteriorly of said plate at the upper ends of the upwardly projecting portions thereof on opposite ends of a pin 48. The pin 48 is carried by a bracket 49 which is disposed between the links 45 and is bolted or otherwise suitably secured to the inner side plate 13. The roller 41 is yieldingly urged toward and into continuous engagement with the conduit 34, and said conduit is, in turn, yieldingly urged toward and into continuous engagement with the fixed roller 40 by a pair of coil extension springs 50 having corresponding ends thereof connected to opposite ends of a pin 51 carried by the links 45. The opposite ends of the springs 50 are connected to suitable fixed means, such as the opposite ends of the pin 43 in the bracket 42.

Brazed or otherwise suitably secured to the portion 35 of the conduit 34 at a point above the rollers 40 and 41 is a block or collar 52 (Figs. 2, 3, 4 and 6) having secured therein or formed integrally therewith a pin 53 which projects forwardly at right angles to said conduit. Pivotally connected to the pin 53 is the lower end of a vertically extending link 54 the upper end of which is pivotally connected at 55 to the rear end of a cam lever 56 which is disposed between the side plates 12 and 13 and is pivotally mounted at the forward end thereof on the spacer stud 15. The hub of the lever 56 spans the distance between the side plates 12, 13 so that said lever is held against endwise movement with respect to said plates. Journalled as at 57 on the lever 56 is a cam follower roller 58 which is engaged by a cam 59 that is disposed between the side plates 12, 13 and is slidably keyed to a transverse cam shaft 60 journalled in suitable bearings in said side plates. The hub of the cam 59 spans the distance between the side plates 12, 13 so as to prevent sidewise movement of said cam with respect to said plates, and to provide for sidewise adjustment of the cam in unison with the plates. The lever 56 is biased by a coil extension spring 61 toward the cam 59 to cause the roller 58 to follow said cam, said spring having one end thereof connected as at 62 to said lever and the opposite end connected as at 63 to the outer side plate 12. The cam shaft 60 is driven in a suitable manner to make one revolution for each cycle of operation of the sheet feeder with which the sheet separating mechanism 10 is associated.

The cam 59 being fixed to the shaft 60 rotates continuously and thus periodically raises the lever 56 through engagement of the high part of said cam with the roller 58, and enables lowering of said lever by the spring 61 through engagement of said roller with the low part of said cam. It will thus follow that when the lever 56 is lowered, the conduit 34 and the suction device 38 carried thereby are, through the described connections therefor with said lever, also lowered to substantially the position thereof shown in Figs. 1, 2 and 3 to engage the suction cup 39 with the separated corner portion of the top sheet 33, and when said lever is thereafter raised, said conduit and said suction device are also raised to the position thereof shown in Fig. 6 to lift said sheet corner portion gripped by said suction cup to a predetermined position. In the lowered position of the suction device 38, shown in Fig. 2, the upper straight portion 35 of the conduit 34 is disposed between and engaged by the rollers 40 and 41, and in the raised position of said suction device, shown in Fig. 6, the inclined portion 37 of said conduit is disposed between and engaged by said rollers. The upper end of the conduit 34 has a flexible conduit 64 attached thereto which is connected with a vacuum pump (not shown) or other suitable source of vacuum through suitable valve means (not shown) which controls the making of vacuum in the suction device 38 through the conduit 34 when said device is lowered, and the breaking of vacuum in the suction device after the latter has been raised and the sheet gripped thereby is transferred to and taken by the sheet forwarding devices hereinbefore referred to.

It is important to note that the described connections for the conduit 34 with the lever 56 provide for pivotal movement of said conduit and the suction device 38 about the axis of the pin 53 transversely of the pile of sheets 11 and parallel to the rear edge of said pile. It is also important to note that the inclined portion 37 of the conduit 34 constitutes, in effect, a bar-cam. It will thus be apparent that by virtue of the described pivotal mounting of the conduit 34 and suction device 38, and the described shape of said conduit, when the suction device is lowered from the position thereof shown in Fig. 4 to the position thereof shown in Figs. 1, 2 and 3 to engage the separated corner portion of the top sheet 33, said suction device and the conduit will be swung inwardly about the pivot 53 through downward movement of the inclined portion 37 of said conduit and engagement of the same with the fixed roller 40. Such inward movement of the suction device 38 continues until the upper straight portion 35 of the conduit 34 passes into contact with the fixed roller 40 at which time said suction device will be disposed in its innermost position, shown in Fig. 2, and substantially parallel to the side edge of the pile of sheets 11 for gripping of the separated corner portion of the top sheet 33 by the suction cup 39. When the separated corner portion of the top sheet 33 is gripped by the suction cup 39 and the suction device 38 and conduit 34 are thereafter raised to the positions thereof shown in Fig. 4 to lift said sheet, said suction device and conduit will be swung outwardly through upward movement of the inclined portion 37 of said conduit and engagement of the same with the fixed roller 40 under the influence of the spring biased roller 41. Under these conditions, the corner portion of the top sheet 33 gripped by the suction device 38 is moved outwardly by a yielding action and an extent depending on the slack or sag in said sheet. When such slack or sag in the sheet is less than the full outward stroke of the suction device 38 determined by the inclination of the portion 37 of the conduit 34, the spring biased roller 41 will yield inwardly upon continued upward movement of said conduit and engagement of said conduit portion with said roller, thus effectively stretching the rear edge portion of the sheet without tearing said sheet or causing the suction cup 39 to slip thereon.

With the illustrated and described construction, the stretching of the sheets is accomplished by a yielding action which is particularly advantageous when handling paper and other similar flexible and relatively light and thin sheets. In the event it is deemed necessary or desirable to effect the sheet stretching operation by a positive action, as when handling cardboard and other stiff, thick and relatively heavy sheets, this may be accomplished with the illustrated and described structure by simply reversing the rollers 40 and 41 such that the fixed roller 40 is disposed at the inner or offset side of the conduit 34, and the spring biased roller 41 is disposed at the opposite or outer side of said conduit. Under these conditions, when the conduit 34 and suction device 38 are

raised, said conduit and suction device will be forced outwardly against the opposition of the spring biased roller 41 through upward movement of the inclined portion 37 of the conduit and engagement of the same with the fixed roller 40. When the conduit 34 and suction device 38 are lowered, said conduit and suction device will be moved inwardly by the yielding action of the spring biased roller 41 thereon as the inclined portion 37 of the conduit travels downwardly relative to the fixed roller 40. To enable reversal of the rollers 40 and 41 as above described, and stretching of sheets effectively by a positive action, the outer side plate 12 is provided with suitable bolt holes 65 for mounting the spring biased roller unit 41, 45, 46, 48, 49, 51 on said side plate, and the inner side plate 13 is provided with suitable bolt holes 66 for mounting the fixed roller unit 40, 42, 43 thereon.

Simplified stop means are provided for controlling the extent of downward movement of the suction device 38 in accordance with the kind of sheet material being handled and the extent of preliminary separation effected by the air jet means on the rear corner portions of the uppermost sheets on the pile 11, so that said suction device will be stopped after the suction cup 39 has contacted the separated corner portion of the top sheet 33 and before said separated corner portion of the sheet is depressed by the suction device back onto the pile. In this manner, the corner portion of the top sheet 33 will be gripped in separated condition by the suction cup 39, and lifting of said sheet only and only single sheets from the pile is assured. The extent of downward movement of the suction device 38 may be varied while said device is in operation, thus avoiding loss of time and production, and the simplified stop means for this purpose in the first form thereof shown particularly in Figs. 2, 3, 4 and 6, comprises the following elements constructed, mounted and adjusted as follows.

Disposed between and in close proximity to the side plates 12 and 13 and located between the block 52 on the conduit 34 and the guide rollers 40 and 41 are two arms 67 which are pivotally mounted at the front ends thereof on a pin 68 carried by said side plates. The arms 67 receive the conduit 34 therebetween and they extend rearwardly beyond the rear edges of the side plates 12, 13. Disposed between and carried, as at 69, by the arms 67 is an abutment-block 70 which is located in the path of downward movement of the block 52 on the conduit 34. The abutment-block 70 projects above the arms 67 for engagement by the block 52, and is formed of a suitable shock and noise absorbing material, such as nylon. The arms 67 carry at the rear ends thereof a pin 71 to which is pivotally connected a threaded rod 72 which extends upwardly through a suitable clearance opening in the spacer-block 14 and has an adjusting nut 73 threaded on the upper end thereof above said block. The abutment or bumper-block 70 also serves to hold the arms 67 in spaced relation, and spacer-collars 74 are engaged over the pin 71 and located at opposite sides of the rod 72 to hold the latter against sidewise movement. The adjusting nut 73 is held against accidental rotation by a leaf-spring detent 75 which is secured to the spacer-block 14 and engages the lower knurled portion of the hub of said nut. The suction device 38 is shown in Fig. 3 in its lowered position with the block 52 engaged with the abutment-block 70, thus preventing the cam follower roller 58 from following the full drop of the cam 59 and holding the suction device against further downward movement beyond said position. It will thus be apparent that upon rotation of the adjusting nut 73 in opposite directions, the arms 67 and abutment-block 70 thereon will be raised and lowered about the pivot 68 relative to the conduit 34 and, hence, the suction device 38 may be stopped in any desired downward position through relative adjustment of the abutment-block 70 by the adjusting nut 73 and engagement thereof by the block 52 on the conduit 34.

In the second form of stop means shown in Figs. 7 and 8 for the suction device 38, the previously described rod 72, adjusting nut 73, spacer-collars 74 and detent 75 are eliminated, and longer arms 76 are employed in lieu of the previously described arms 67 and pivotally mounted on the pin 68 to carry the abutment-block 70 at 69 thereon. Disposed rearwardly of the abutment-block 70 and extending between the arms 76 is an arcuate-shaped rack 77 which is provided in the rear surface thereof with a plurality of upwardly facing ratchet-like teeth 78. The rack 77 is concentrically disposed with respect to the pivot 68 of the arms 76 and is bolted or otherwise suitably secured to the side plates 12 and 13, spacer-collars 79 being provided on opposite sides of said rack to locate the same centrally between said side plates and said arms and to hold said rack against sidewise movement. Disposed between the rear end portions of the arms 76 is a spring-pressed latch-block 80 provided at the front end thereof with a tooth 81 which is adapted to engage the teeth 78 of the rack 77. The latch-block 80 is slidably mounted on two pins 82 which are carried by the arms 76 and extend through elongated clearance openings 83 in said block. The spring for the latch-block 80 is indicated at 84 and is of the coil compression type and is disposed within a socket 85 formed in said block, one end of said spring engaging against the bottom wall of said socket and the opposite end engaging against the rearmost pin 82, whereby the latch-block is continuously urged toward and into engagement with the teeth 78 of the rack 77. The tooth 81 of the latch-block 80 may be engaged selectively with any tooth 78 of the rack 77 through retraction of said block and swinging movement of the same and the arms 76 about the pivot 68. Such swinging movement of the arms 76 imparts corresponding movement to the abutment-block 70, thus positioning said block for engagement by the block 52 when the suction device 38 reaches the desired position in the downward movement thereof. The abutment-block 70 is then locked in position through release of the latch-block 80 and action of the spring 84 which causes the tooth 81 on said latch-block to engage the adjacent tooth of the rack 77. The latch-block 80 may be disengaged from the rack 77 and the abutment-block 70 may be adjusted as and for the purpose above described while the suction device 38 is in operation.

The operation of the sheet separating mechanism embodying the present invention will be clearly understood from the foregoing description, and while said description and the accompanying drawings set forth with more or less particularity one embodiment of the invention, it is to be expressly understood that said invention is not limited to said embodiment. Various changes may be made in the mechanical details, some of which have been suggested in the foregoing specification, and in the design and arrangement of the parts illustrated without departing from the spirit and scope of the invention, as will now be apparent 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. In a sheet separator for separating sheets one at a time from the top of a supply thereof, a hollow upwardly extending elongated element having a cam surface thereon facing a side edge of said supply, a sheet gripping sucker pneumatically and mechanically connected to said element, an operating member for said sucker connected with said element, the connection between said element and said member being a pivot permitting swinging movement of said element and said sucker in opposite directions laterally of said supply, means for operating said member to move said element and said sucker vertically toward and away from said supply, a fixed follower arranged for engagement by said cam surface, said cam surface acting to swing said element and said sucker in one of said lateral directions upon vertical movement of said element and said sucker in one direction, and yieldable means acting to swing said element and said

sucker in the other of said lateral directions upon vertical movement of said element and said sucker in the opposite direction.

2. In a mechanism of the class described, a hollow upwardly extending elongated element arranged above a supply of sheets and having a cam surface thereon facing a side edge of said supply, a sheet gripping sucker pneumatically and mechanically connected to said element, an operating member for said sucker connected with said element, the connection between said element and said member being a pivot permitting swinging movement of said element and said sucker inwardly and outwardly laterally of said supply, means for operating said member to move said element and said sucker toward and away from said supply, a fixed follower arranged for engagement by said cam surface, said cam surface being formed so as to impart said inward lateral movement to said element and said sucker upon movement of the latter and said element toward said supply, and biasing means continuously applying a yieldable force upon said element in the direction of said follower so as to impart said outward lateral movement to said element and said sucker upon movement of the latter and said element away from said supply.

3. In a sheet separator for separating sheets one at a time from the top of a supply thereof, an upwardly extending rod having a cam surface thereon facing a side edge of said supply, a sheet gripping sucker carried by said rod, an operating member for said sucker connected with said rod, means for operating said member to move said rod and said sucker toward and away from said supply, the connection between said rod and said member being a pivot permitting swinging movement of said rod and said sucker inwardly and outwardly laterally of said supply during movement of the same toward and away, respectively, from said supply, a fixed roller arranged for sliding engagement by said cam surface to swing said rod and said sucker about said pivot in one direction, a movable roller arranged opposite said fixed roller, and a spring acting upon said movable roller and at all times urging the same toward said fixed roller to thus engage said rod and swing the same and said sucker about said pivot in the opposite direction.

4. Apparatus as defined in claim 3 wherein said rod is hollow and communicates with said sucker, and said rollers are flanged to confine said rod.

5. Apparatus as defined in claim 3 wherein said rod is shaped to provide an upper vertical portion, a lower vertical portion offset laterally from said upper portion, and an intermediate portion connecting said upper and lower portions and inclined downwardly from said upper portion to said lower portion, said inclined intermediate portion providing said cam surface on said rod.

6. In a sheet separator for separating sheets one at a time from the top of a supply thereof, a rigid tubular conduit shaped to provide an upper vertical portion, a lower vertical portion offset from said upper portion toward a side edge of said supply, and an intermediate portion connecting said upper and lower portions and inclined downwardly from said upper portion to said lower portion, a sheet gripping sucker carried by said lower conduit portion and communicating with said conduit, a lever mounted for pivotal movement about a horizontal transverse axis, a link mounted on said lever for pivotal movement about a horizontal transverse axis and connected with said upper conduit portion, the connection between said link and said conduit being a pivot permitting swinging movement of said conduit and said sucker inwardly and outwardly laterally of said supply, a pair of flanged rollers positioned at opposite sides of said conduit and in the path traversed by said inclined portion of the conduit, means mounting one of said rollers in fixed position, means mounting the other of said rollers for movement toward and away from the fixed roller, a spring operatively connected with said movable roller to continuously urge the same toward said fixed roller and means for swinging said lever to raise and lower said conduit and said sucker, said rollers cooperating to guide said conduit for straight-line upward and downward movements, and said rollers and said inclined portion of the conduit cooperating to effect said inward and outward movements of said conduit and said sucker upon downward and upward movements, respectively, of said conduit and said sucker.

7. Apparatus as defined in claim 6 wherein the inward lateral movement of the conduit and sucker is effected by the fixed roller, and the outward lateral movement is effected by the movable spring-biased roller.

8. Apparatus as defined in claim 6, comprising means on said conduit providing a downwardly facing shoulder, an abutment arranged for engagement by said shoulder to limit the downward movement of said conduit and the sucker, and means connected with said abutment and movable to different positions to adjust said abutment to various operative positions and thereby vary the extent of downward movement of said conduit and said sucker.

9. Apparatus as defined in claim 8 wherein said abutment adjusting means comprises an arm mounted for pivotal up and down movement about a fixed horizontal axis and having the abutment attached thereto, a vertically extending threaded rod pivotally connected with said arm, a fixed guide for said threaded rod, and an adjusting nut on said threaded rod and engaging said guide, said adjusting nut upon rotation thereof effecting pivotal movement of said arm and said abutment.

10. Apparatus as defined in claim 8 wherein said abutment adjusting means comprises an arm mounted for pivotal up and down movement about a fixed horizontal axis to different positions and having the abutment attached thereto, a latch element carried by said arm, and a fixed rack having teeth with which said latch element may be selectively engaged for releasably holding said arm in any of said positions.

11. Apparatus as defined in claim 10 wherein said latch element is slidably mounted on said arm for movement into and out of engagement with said rack, and comprising a spring for releasably holding said latch element engaged with the selected teeth of said rack.

12. In a sheet separator, an upwardly extending rod, a sheet gripping sucker carried by said rod, means for lowering and raising said rod to move said sucker into and out of engagement with the top of a supply of sheets, and means for limiting the downward movement of said sucker and for stopping the latter in a desired operating position with respect to the top of said supply comprising, an abutment on said rod, an arm mounted for pivotal up and down movement about a fixed horizontal axis to various positions, and an abutment attached to and movable with said arm to said positions and arranged for engagement by the abutment on said rod.

13. In a sheet separator, a sheet gripping sucker, means for lowering and raising said sucker into and out of engagement with the top of a supply of sheets, pivoted stop means for limiting the downward movement of said sucker and movable to different operative positions to thereby stop said sucker in different operating positions with respect to the top of said supply, and latch means for releasably holding said stop means in any of its said positions.

14. In a sheet separator, a sheet gripping sucker, means for lowering and raising said sucker into and out of engagement with the top of a supply of sheets, and means for limiting the downward movement of said sucker and for stopping the latter in a desired operating position with respect to the top of said supply and comprising, an abutment movable with said sucker, an arm mounted for pivotal up and down movement about a fixed horizontal axis to different positions, an abutment attached to and movable with said arm to said positions and arranged for engagement by said first-named abut-

ment, a latch element, a rack element having teeth with which said latch element may be selectively engaged, means for mounting one of said elements in fixed position, and means for mounting the other of said elements on said arm, said elements cooperating to releasably hold said arm in any of its said positions.

15. Apparatus as defined in claim 14 wherein the rack element is fixed, and the latch element is mounted on the arm for sliding movement into and out of engagement with said rack, and comprising a spring for releasably holding said latch element engaged with the selected teeth of said rack.

16. A sheet separating mechanism arranged for operation on a corner portion of the top sheet of a supply of sheets, comprising two side plates, spacer means including a stub-shaft rigidly connecting said side plates in spaced parallel relation, a tubular conduit disposed between said side plates and shaped to provide an upper vertical portion, a lower vertical portion laterally offset inwardly from said upper portion, and an intermediate portion inclined downwardly from said upper portion to said lower portion, a sheet gripping sucker carried by said lower conduit portion and communicating with said conduit, a lever pivotally mounted on said stub-shaft, a link connected with said lever for pivotal movement about an axis parallel to the axis of said stub-shaft, a block secured to said upper conduit portion and connected with said link, the connection between said block and said link being a pivot permitting swinging movement of said conduit and said sucker inwardly and outwardly laterally of said supply, a pair of flanged rollers positioned in opposed relation at opposite sides of said conduit and in the path traversed by said inclined portion of the conduit, means mounting one of said rollers on one of said side plates in fixed position, means mounting the other of said rollers on the other of said side plates for pivotal movement toward and away from the fixed roller, a spring operatively connected with the movable roller to continuously urge the same toward the fixed roller, a driven cam shaft along which said side plates are movable, a cam disposed between said plates and slidably keyed to said cam shaft, said cam acting to positively lift said lever and thereby raise said conduit and said sucker, and yieldable means operatively connected to said lever and to one of said side plates to cause said lever to follow said cam and thereby lower said conduit and said sucker, said rollers cooperating to guide said conduit for straight-line upward and downward movements, and said rollers and said inclined portion of said conduit cooperating to effect said inward and outward lateral movements of said conduit and said sucker upon downward and upward movements, respectively, thereof.

17. Apparatus as defined in claim 16 wherein the movable roller is disposed at the offset side of said conduit, whereby the conduit and the sucker upon upward movement thereof are caused to swing outwardly by the yielding action of said roller.

18. Apparatus as defined in claim 16 comprising a pair of arms disposed between the side plates and at opposite sides of the upper portion of the conduit, means mounting said arms at corresponding ends thereof on the side plates for pivotal up and down adjustment below the block on said conduit, and an abutment member attached to said arms and positioned for engagement by said block to thereby limit the downward movement of said conduit and consequently the sucker.

19. Apparatus as defined in claim 18, comprising a latch element slidably mounted on said arms and disposed between the latter at the opposite ends thereof, an arcuate-shaped rack extending between said arms and secured to said side plates in concentric relation with the pivotal mounting for said arms, said rack having teeth with which said latch element may be selectively engaged for holding said arms in any position of adjustment thereof, and a spring for releasably holding said latch element engaged with the selected teeth of said rack.

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