Sept. 18, 1951 C. W. DIDDE ET AL 2,568,224

PAPER GATHERING MACHINE

Filed Sept. 8, 1948 3 Sheets-Sheet 1

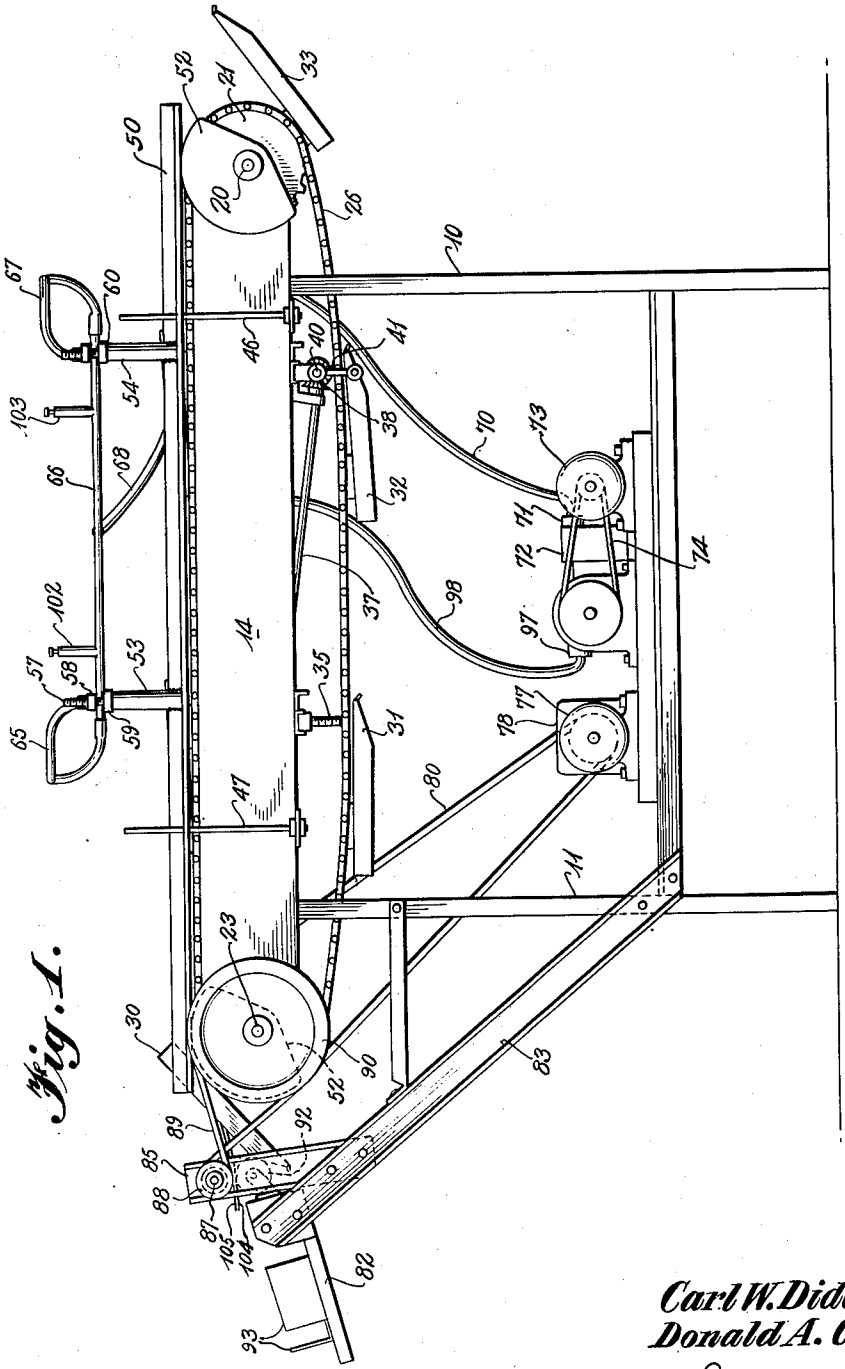


Fig. 1.

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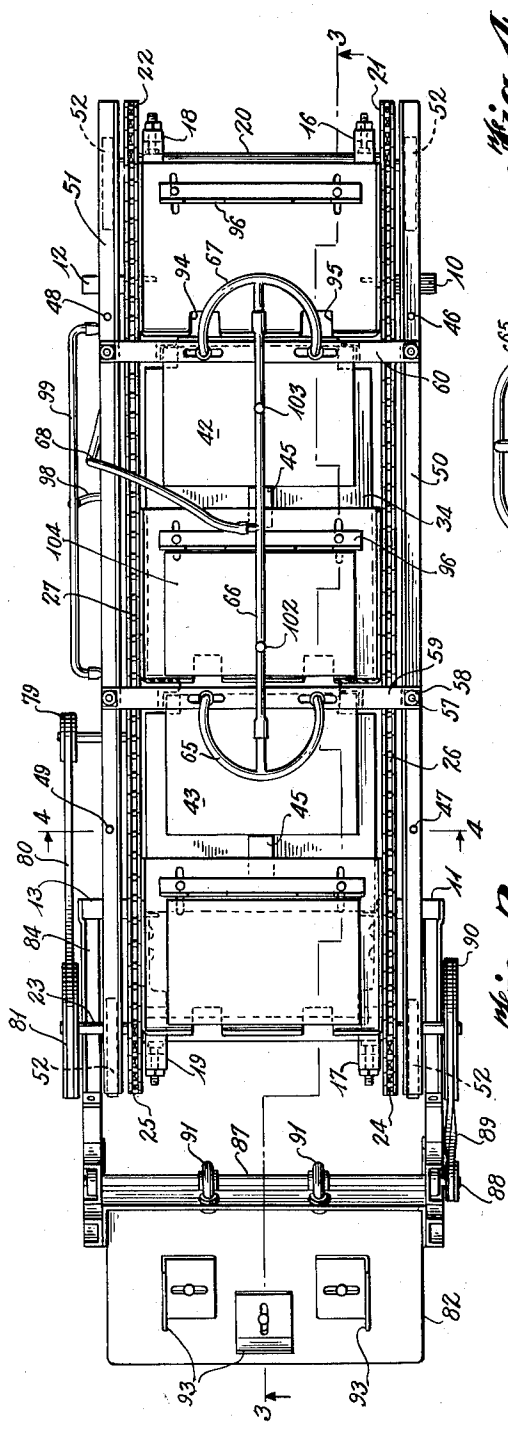


Fig. 2.

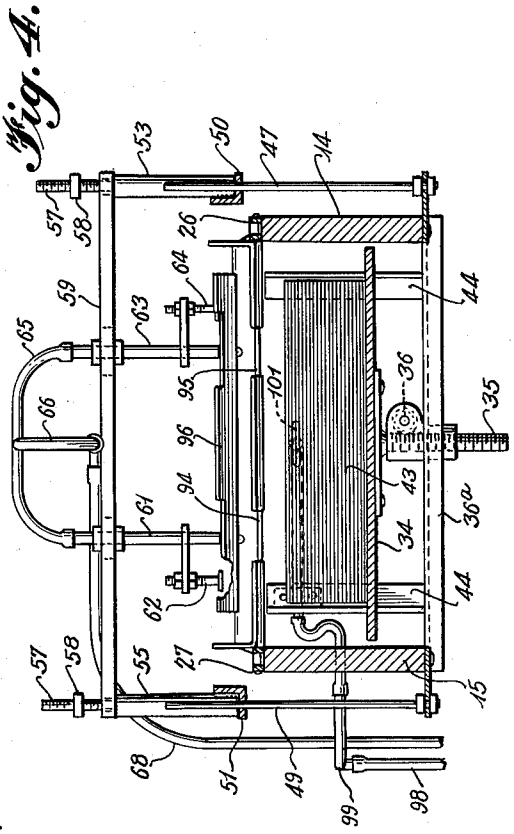


Fig. 4.

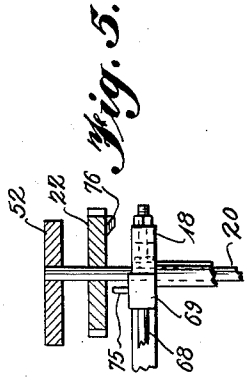


Fig. 5.

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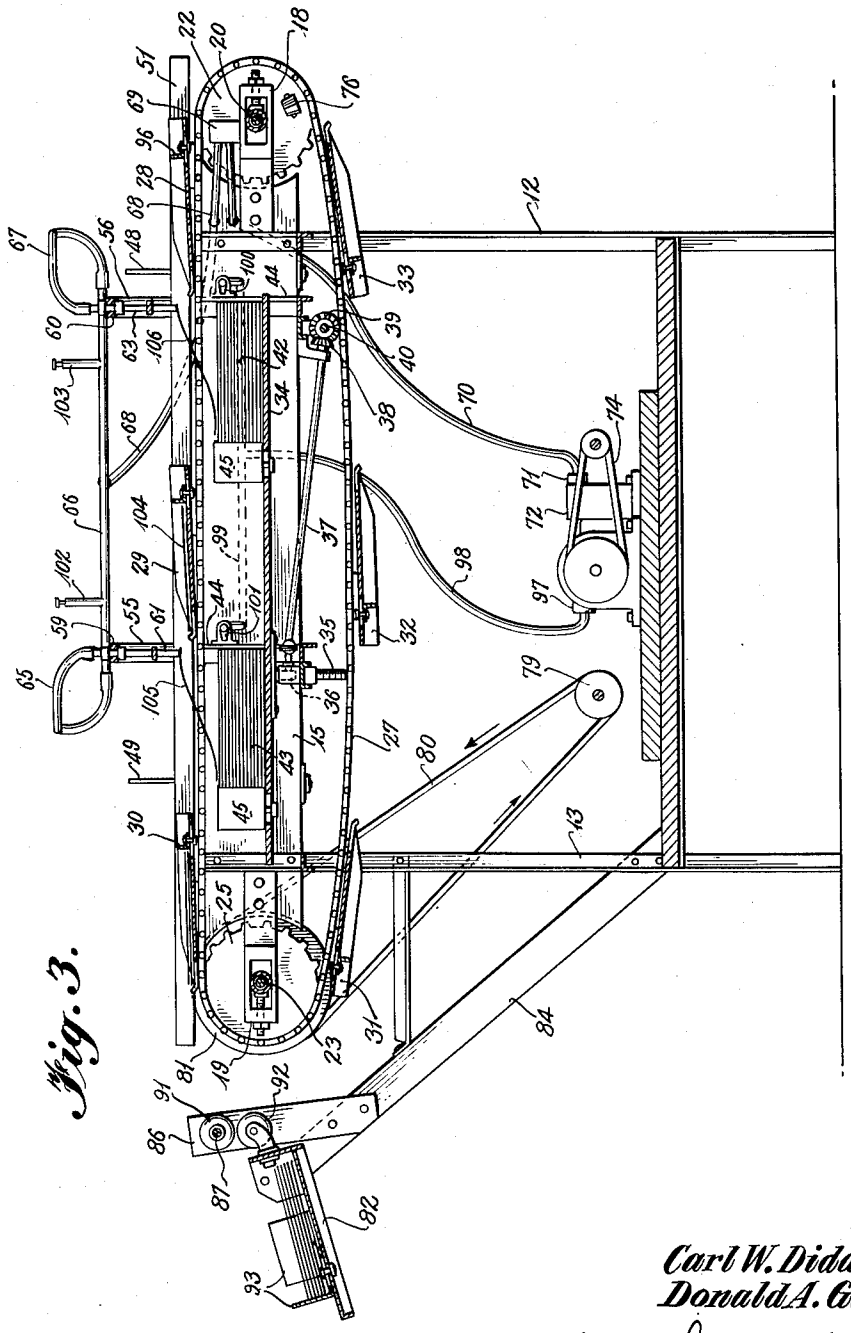


Fig. 3.

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UNITED STATES PATENT OFFICE

2,568,224

PAPER GATHERING MACHINE

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Application September 8, 1948, Serial No. 48,204

5 Claims. (Cl. 270—58)

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This invention relates to a machine for gathering sheets of paper from each of a plurality of stacks of sheets and delivering the sheets to a receiver in a predetermined order and arrangement.

The machine consists essentially of supporting means for a plurality of stacks of paper sheets, lift means for engaging and lifting the uppermost sheet from each stack and a plurality of trays on a conveyor which are arranged to move under the sheets being held by the lift means and to have the sheets deposited thereon. Mechanism is provided for removing the sheets from the consecutive trays and depositing those sheets in a receiver.

In the illustrated form of the invention the actuation of the lift means and the movement of the trays as well as the spacing of the stacks are so correlated that each tray receives a sheet from each stack. All of the sheets in any one stack are similar but differ from the sheets in other stacks. The stacks are arranged in proper order to cause the sheets to be deposited on the trays in predetermined order. All of the sheets on any one tray are discharged into the receiver simultaneously and in this way the sheets are arranged in the proper predetermined order in the receiver.

A primary object of the invention is to provide a machine for the purpose described which is of simple construction, which has relatively few moving parts and which can be operated for long periods of time with a minimum of care and maintenance.

Another object of the invention is to provide lift means for the uppermost sheet on each stack of such construction that no sheets will be lifted in the event any one of the lift means fails.

Still another object of the invention is to provide improved air blast and suction means for separating the uppermost sheet on each stack and lifting such sheets so that they may be deposited on the trays.

Other objects and advantages of the invention will be referred to in the following detailed description of an exemplary form of the invention. This detailed description has reference to the accompanying drawings wherein:

Figure 1 is a side elevation view of the machine;

Figure 2 is a top plan view thereof;

Figure 3 is a longitudinal sectional view taken in the direction of the arrows along the line 3—3 of Figure 2;

Figure 4 is a transverse sectional view taken

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in the direction of the arrows along the line 4—4 of Figure 2; and

Figure 5 is a fragmentary view partly in plan and partly in section illustrating the mechanism for controlling the suction in the vacuum line leading to the lift means.

The illustrated form of the machine is designed to gather and assemble sheets from two stacks. It will be understood however that the principles of operation of the machine permit its use with a greater number of stacks and we contemplate that the machines can be constructed to accommodate any desired number of stacks.

Four supporting legs 10, 11, 12 and 13 support the frame of the machine which includes a pair of spaced parallel side frame members 14 and 15. These side frame members have adjustable bearing supports 16, 17, 18 and 19 at their ends. The adjustable bearing supports 16 and 18 have an axle 20 journaled therein and sprockets 21 and 22 are mounted on the ends of this axle. A similar axle 23 journaled in the bearing supports 17 and 19 and sprockets 24 and 25 are mounted on the ends of the axle 23. A conveyor chain 26 runs on the sprockets 21 and 24 and a similar conveyor chain 27 runs on the sprockets 22 and 25. The tension on the conveyor chains 26 and 27 can be adjusted by means of the adjustable bearing supports 16 to 19, inclusive.

A plurality of identical trays are secured in spaced relationship along the length of the conveyor chains 26 and 27. Six such trays are shown in the drawings, although it will be understood that a greater or lesser number of trays may be used and that the number of trays will be appreciably increased in machines which are designed to accommodate a greater number of stacks of sheets. The trays are designated in the drawings by the reference numerals 28, 29, 30, 31, 32 and 33. Each of the trays is loosely secured near its rear edge to the conveyor chains 26 and 27 by any suitable means which does not interfere with the running of the chains over the sprockets.

Supporting means is provided for a plurality of stacks of sheets (two such stacks are illustrated in the drawings). This supporting means is illustrated as a table 34 of adjustable height. The adjustment of the table 34 is accomplished by means of a rack 35 extending vertically downwardly from the table, a gear 36 mounted on a cross bar 36a, a flexible shaft 37, meshing gears 38 and 39 and a shaft 40 which carries a crank 41 positioned at one side of the machine. We contemplate that individual tables having separate adjustments may be provided for each stack

of sheets and this may be desirable in some instances.

One of the stacks of sheets is designated by the reference numeral 42 and the other stack is designated by the reference numeral 43. Channel irons 44 are provided at the corners of one edge of each stack and adjustable stop members 45 are positioned near the center of the opposite edges of the stacks.

Upwardly extending pins 46, 47, 48, and 49 are secured to the side frame members 14 and 15 and parallel bars 50 and 51 are mounted for vertical reciprocation on these pins. The vertical reciprocation of the parallel bars 50 and 51 is caused by cams 52 which are mounted on the ends of the axles 20 and 23. The cams 52 are so arranged that both ends of each of the parallel bars 50 and 51 are raised simultaneously and permitted to descend simultaneously so that the parallel bars always remain in parallel relationship.

Posts 53 and 54 extend upwardly from the bar 50 and similar posts 55 and 56 extend upwardly from the bar 51. Each of these upright posts is provided at its upper end with a threaded pin 57 having a nut 58 thereon. A cross bar 59 having apertures in its ends extends from the pin 57 on the post 53 to the pin at the upper end of the post 55. The similar cross bar 60 extends between the pins 57 on the upper ends of the posts 54 and 56.

The cross bars 59 and 60 support suction pick-up members which are arranged to descend and pick up the uppermost sheet from each of the stacks 42 and 43 and to elevate those sheets so that the trays may pass under the sheets. A tube 61 extends downwardly from the cross bar 59 and is provided adjacent its lower end with an adjustable foot 62. A similar tube 63 also extends downwardly from the cross bar 59 and is provided with an adjustable foot 64 near its lower end. The adjustable feet 62 and 64 engage the uppermost sheet of the stack 43 and thereby limit the downward movement of the tubes 61 and 63 and the cross bar 59. It will be noted that the nuts 58 on the threaded pins 57 are positioned some distance above the ends of the cross bar 59 so that the parallel bars 50 and 51 and the posts 53 and 55 may descend to a greater extent than the cross bar 59. This feature has been found advisable to compensate for any irregularities in the stacks and also to eliminate the necessity for frequent adjustments of the table 34.

The upper ends of the tubes 61 and 63 are joined by a conduit 65 which communicates with a suction manifold 66. The suction manifold 66 also communicates with a conduit 67 which is attached to the upper ends of tubes attached to the cross bar 60 and which are in all respects similar to the tubes 61 and 63.

A suction line 68 leads from the manifold 66 to a valve 69 mounted on the bearing support 18. A suction line 70 extends from the valve 69 to the intake 71 of a vacuum pump 72 which is driven by means of a motor 73 through a belt 74. The valve 69 is normally open to permit the vacuum pump 72 to draw air through the suction lines 68 and 70, the suction manifold 66, the conduits 65 and 67 and the tubes secured to the cross bars 59 and 60. This valve is arranged to be closed by inward movement of a plunger 75. The plunger 75 is intermittently moved inwardly by means of the camming surface of a projection 76 on the sprocket 22. The valve is of the type which will automatically reopen after the projection 76 has passed beyond the plunger 75. The closing of the valve 69 in this manner permits the sheets to be dropped on the trays in the manner hereinafter described.

The axle 23 is driven by means of a motor 77 through a gear reduction unit 78, a pulley 79 and a belt 80 which runs over a pulley 81 secured to the end of the axle 23.

A receiver 82 in the form of a rack for accommodating a stack of assembled sheets is supported by struts 83 and 84 which extend upwardly and outwardly from the supporting legs 11 and 13. Standards 85 and 86 are secured to the struts 83 and 84, respectively, and a shaft 87 is journaled in the upper ends of these standards. A pulley 88 is fixed to one end of the shaft 87. This shaft is rotated by means of a crossed belt 89 which runs on the pulley 88 and a pulley 90 secured to the end of the axle 23. The shaft 87 has secured thereto friction rollers 91 of rubber or other suitable material. Similar rollers 92 are secured to the front wall of the receiver 82 and are positioned adjacent the peripheries of the rollers 91. The receiver 82 is provided with a plurality of adjustable stop members 93 to enable the receiver to properly stack sheets which are received therein.

The forward edges of the trays 28 to 33 inclusive are notched as indicated at 94 and 95 and these notches are positioned in alignment with the discharging rollers 91 and 92. The trays are provided with adjustable abutment members 96 which can be adjusted for sheets of different sizes to make certain that the forward edge of each sheet overlies the notches 94 and 95 so that the forward edges of the sheets are capable of being received in the bite of the discharging rollers 91 and 92.

The discharge 97 of the vacuum pump 72 is connected to a pressure line 98 which leads to a pressure manifold 99. The pressure manifold 99 is connected to a discharge nozzle 100 which discharges a jet of air against the upper portion of that stack of sheets which is designated by the reference numeral 42. The pressure manifold is also connected to a similar discharge nozzle 101 which discharges a jet of air against the upper portion of the stack 43. The jets of air discharged by the nozzles 100 and 101 assist in separating the uppermost sheet from each of the stacks in a manner which will be more clearly understood from the description of the operation of the machine.

The vacuum manifold 66 is provided with an adjustable aperture 102 adjacent the suction tubes descending from the cross bar 59 and with a similar adjustable aperture 103 adjacent the suction tubes descending from the cross bar 60. Adjustment of the apertures 101 and 103 permits variations in the amount of air drawn into the suction manifold 66 and permits the operator to control the extent of suction at each pair of suction pick-up tubes.

The sprockets 21, 22, 24 and 25 are of such diameter that the conveyor chains 26 and 27 will move a distance equal to the spacing of the trays for each revolution of the sprockets. These sprockets and the cams 52 rotate at the same rate and the parallel bars 50 and 51 and the elements carried thereby will rise and descend once for each revolution of the sprockets. The cams 52 are positioned to raise the parallel bars 50 and 51 when a tray is approaching a stack of sheets, to hold those parallel bars elevated until

the tray passes beyond the stack, and to permit the parallel bars to descend after the tray has passed beyond the stacks.

The stacks 42 and 43 are spaced apart a distance equal to the spacing of the trays on the conveyor chain. This relationship may be more clearly understood by reference to Figure 3 of the drawings. The tray 28 is shown approaching the stack 42 and the tray 29 is approaching the stack 43. The parallel bars 50 and 51 are elevated and the uppermost sheet on each stack has been lifted by the suction pick-up tubes. The parallel bars 50 and 51 will remain elevated and the trays 28 and 29 will continue to move until they underlie the sheets which have been picked up from the stacks 42 and 43. The camming surface of the projection 76 on the sprocket 22 will, at this time, depress the plunger 75 of the valve 69 which will discontinue the suction in the pick-up tubes and the sheets will be released onto the trays 28 and 29. The cams 52 will permit the parallel bars 50 and 51 to descend as soon as the trailing edges of the trays have passed from beneath the pick-up tubes. This permits the pick-up tubes to descend to pick up additional sheets from the stacks and the cycle of operation is then repeated.

It will be seen by reference to Figure 3 that sheet 104 is lying on the tray 29. This sheet 104 was obtained from the stack 42. The tray 29 is illustrated as being in position to pick up the sheet 105 from the stack 43. The tray 28 is about to pick up the sheet 106 from the stack 42. This tray 28 will eventually also pick up the sheet immediately underlying sheet 105 on stack 43. It will be seen that there are two sheets on the tray 30. The lower sheet on this tray has been obtained from the stack 42 while the upper sheet has been obtained from the stack 43. It will thus be apparent that each tray will pick up one sheet from each stack and it will also be apparent that the sheets are always arranged in the same order on the trays. As is best shown in Figure 3, the connections of the trays to the chains are such that the trailing edges of the trays are positioned slightly above their forward edges as the trays travel along the upper reach of the conveyor. This slight tilting of the trays causes sheets positioned thereon to be pressed against the upper surfaces of the trays by the relative movement between the sheets and the surrounding air. In other words the air currents tend to cause the paper sheets to remain on the trays rather than to be lifted and blown off the trays as would be the case if the trays were horizontal or tilted in the opposite direction.

By referring again to Figure 3 it will be seen that the tray 30 is approaching the discharge rollers 91 and 92. As this tray moves to the left the portions of the sheets overlying the notches 94 and 95 will enter the bite of the rollers 91 and 92 and the rotation of these rollers will draw the sheets from the tray and discharge those sheets into the receiver 82.

The crossbars 59 and 60 are so positioned that the pick-up tubes depending therefrom engage the edges of the uppermost sheets on the stacks 42 and 43. The air jets from the discharge nozzles 100 and 101 play on the same edge of the uppermost sheet on each stack. These jets thus assist the pick-up tubes in separating the uppermost sheets from the stacks. We have detected that these air jets cause a slight buckle in the uppermost sheet on each stack and this is apparently responsible for the greater ease with which the pick-up tubes function to accomplish their purpose. It will be seen by reference to Figure 3 that the pick-up tubes elevate only the edges of the sheets which they engage and that the opposite edge of each sheet continues to rest on its respective stack. Such lifting of the sheets is sufficient for the reason that the trays will lift the remaining portions of these sheets as the trays pass beneath the sheets. This is an advantageous feature of our machine in that it eliminates the necessity for lifting the entire weight of the sheets by suction.

All of the pick-up tubes are connected to a common suction manifold. If for any reason a pair of pick-up tubes fails to pick up a sheet, there will be insufficient vacuum in the manifold to permit other pairs of pick-up tubes to retain their sheets. This is an advantageous feature of the machine as it decreases the possibility of obtaining an erroneous arrangement of sheets in the receiver.

The machine which has been illustrated and described is a small machine adapted to accommodate only two stacks of sheets. This machine does, however, embody the mechanical features and principles of operation of our invention and it serves to illustrate those features and principles in a manner which is perhaps more clearly understandable than would be the case if we were to illustrate and describe a machine designed to accommodate a greater number of stacks. Various alterations and modifications may be resorted to without departing from the scope of the invention as defined by the following claims.

Having thus described our invention, we claim:

1. A paper gathering machine comprising means for supporting a plurality of stacks of flat sheets of paper with the stacks arranged in alignment longitudinally of the machine in equally spaced relationship, an endless conveyor having an upper reach extending over the tops of the stacks and a lower reach extending beneath the stack supporting means, a plurality of trays equally spaced along said conveyor by distances equal to the spacing of the stacks, lift means operative while the trays on the upper reach of said conveyor are between stacks for lifting a single sheet from each stack and for releasing such sheets onto the trays when such trays have moved between the lifted sheets and the tops of the stacks, each of said trays being provided with an abutment member on its upper surface for engaging the trailing edges of the sheets superposed on the tray and for pushing such sheets forwardly with the tray, said abutment member being positioned relative to the leading edge of the tray to cause at least portions of the leading edges of the superposed sheets to project from the tray, and cooperating discharge members positioned adjacent the end of the upper reach of said conveyor for gripping the projecting portions of the superposed sheets and pulling such sheets from the trays.

2. In a paper gathering machine, means for supporting a plurality of stacks of flat sheets of paper, a tray movable over the stacks, said tray having a smooth upper surface which is inclined downwardly from its trailing edge to its leading edge, means for lifting a single sheet from the top of each stack as the tray moves over the stacks and for depositing the sheets in sequential superposed relation on said upper surface of the tray, said tray being provided with an abutment member on the upper surface thereof for engaging the trailing edges of the sheets and pushing

the superposed sheets forwardly with the tray, said abutment member being positioned relative to the leading edge of the tray to cause at least portions of the leading edges of the superposed sheets to project from the tray, and cooperating movable discharge members for gripping the projecting portions of the superposed sheets and pulling such sheets from the tray.

3. A machine for gathering sheets from each of a plurality of stacks of sheets and delivering the sheets to a receiver in predetermined order and arrangement, comprising means for supporting a plurality of stacks arranged in equally spaced relationship longitudinally of the machine, a conveyor movable longitudinally of the machine and provided with trays equally spaced along its length by distances equal to the spacing of said stacks in such manner that when one of the trays is above one of the stacks other trays are above other stacks, lift means operative when the trays are between stacks for lifting the uppermost sheet from each stack and for releasing such sheets when the trays are above the stacks, each of said trays being provided with an abutment member on its upper surface for engaging the trailing edges of the superposed sheets on the tray and for pushing such sheets forwardly with the tray, said abutment member being positioned relative to the leading edge of the tray to cause at least portions of the leading edges of the superposed sheets to project from the tray, and means for grasping the projecting portions of the superposed sheets and pulling such sheets from the trays and discharging the superposed sheets into a receiver.

4. In a paper gathering machine, the combination of: supports for a plurality of stacks of paper sheets; a device for gripping the leading margin of a group of superposed sheets presented thereto and delivering such group to a receiver; and mechanism for forming groups of superposed sheets and presenting such groups successively to said gripping and delivering device, said mechanism including a movable sheet collecting and group forming member having an upper surface which is downwardly inclined in the direction of movement of the member and which is arranged to underlie and support the major portion of the area of a plurality of superposed paper sheets successively deposited thereon with a leading marginal portion of the group thus formed exposed for engagement by said gripping and delivering device, means for moving said member successively over said stack supports and into position to present the exposed leading margin of the group of sheets supported thereon to said gripping and delivering device, and a sheet separating means disposed above each stack support for removing a sheet from the top of the stack resting upon that stack support and depositing the same upon said member as it passes said means.

5. In a paper gathering machine, a movable tray having a flat upper surface for supporting a plurality of paper sheets in superposed relation thereon, means for moving said tray first in one direction, and immediately thereafter in a second direction at an angle to said first direction, an abutment member on said upper surface adjacent the trailing edge of said tray for engaging the trailing edges of paper sheets on said tray, said abutment member being so positioned relative to the leading edge of the tray as to cause the leading edges of paper sheets on said tray to be positioned on said flat surface adjacent the leading edge of said tray, a pair of cooperating discharge rolls rotatable on axes generally parallel to the leading edge of said tray, said first direction being such as to direct the leading edge of said tray into the bite of the rolls, and a notch in the leading edge of said tray in position to underlie portions of the paper sheets on the tray, said notch being aligned with said discharge rolls to cause the portions of the paper sheets which overlie said notch to be discharged by said rolls while said tray moves in said second direction.

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