Oct. 28, 1952 H. T. BACKHOUSE 2,615,713

SHEET SEPARATING MACHINE

Filed April 21, 1949 5 Sheets-Sheet 1

Fig. 1.

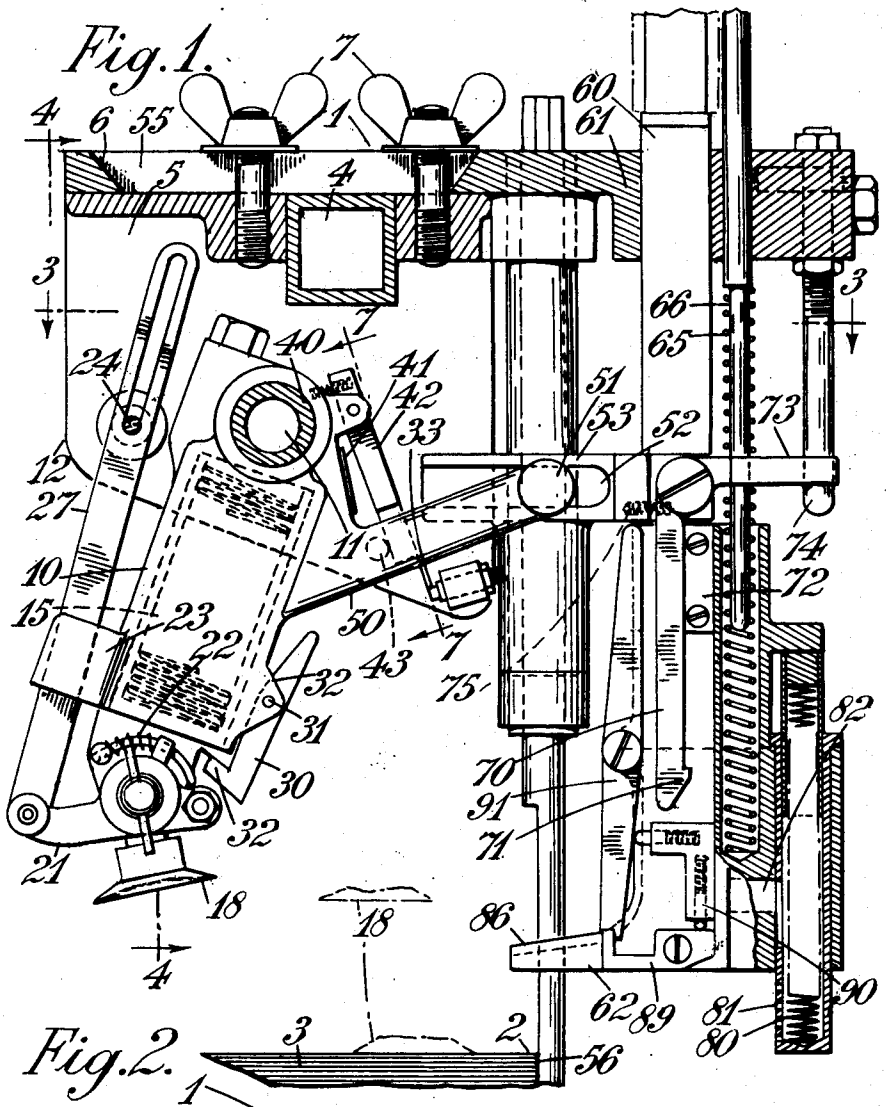
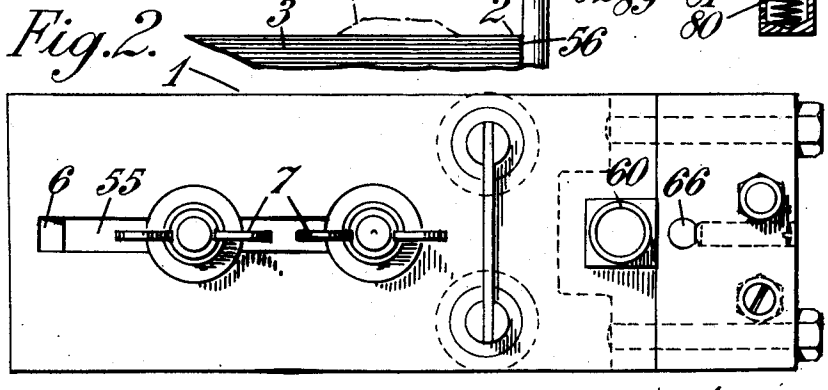


Fig. 2.



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SHEET SEPARATING MACHINE

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Fig. 3.

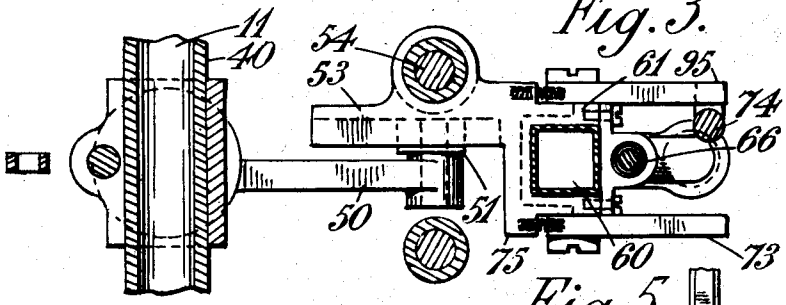


Fig. 4.

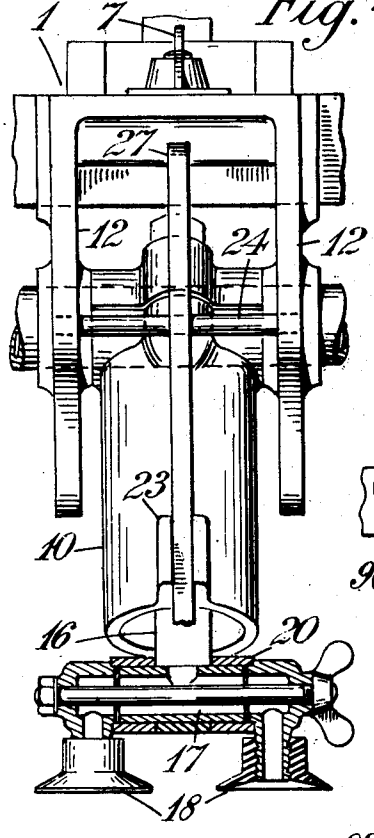


Fig. 5.

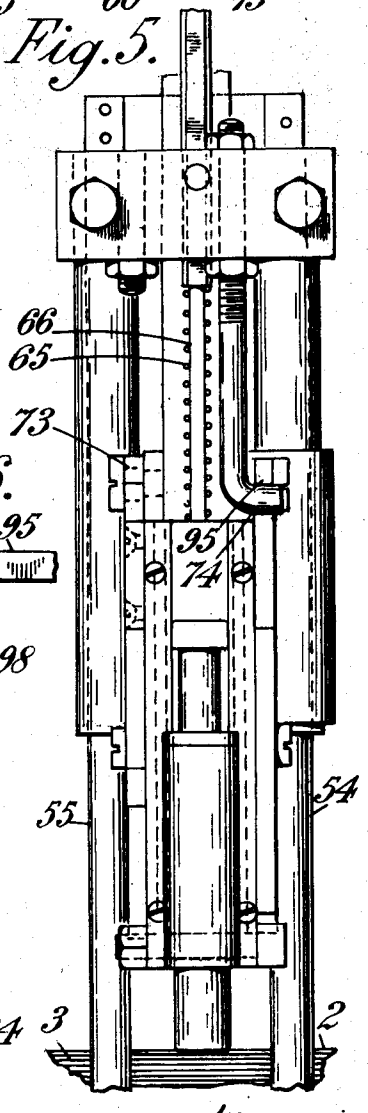
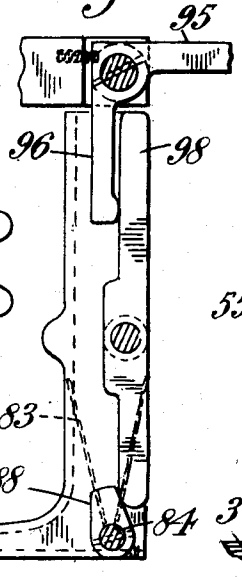


Fig. 6.



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SHEET SEPARATING MACHINE

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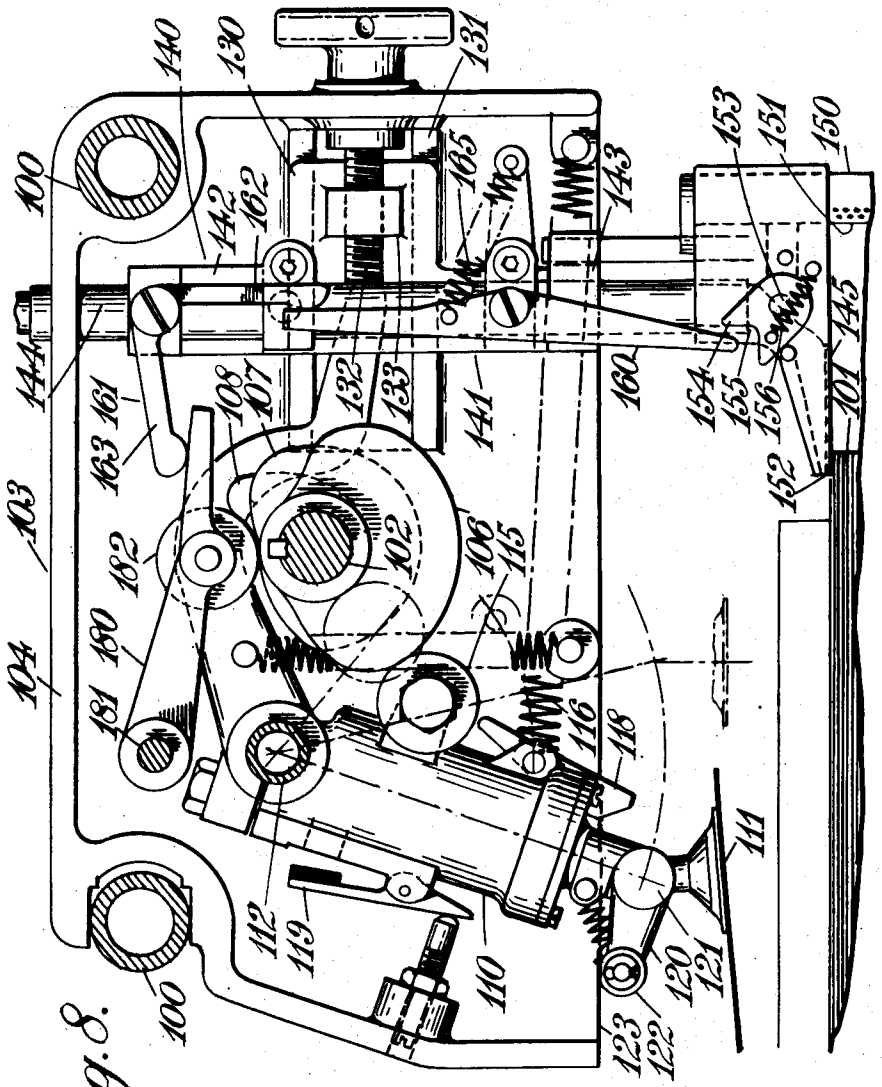


Fig. 8.

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SHEET SEPARATING MACHINE

Filed April 21, 1949 5 Sheets-Sheet 4

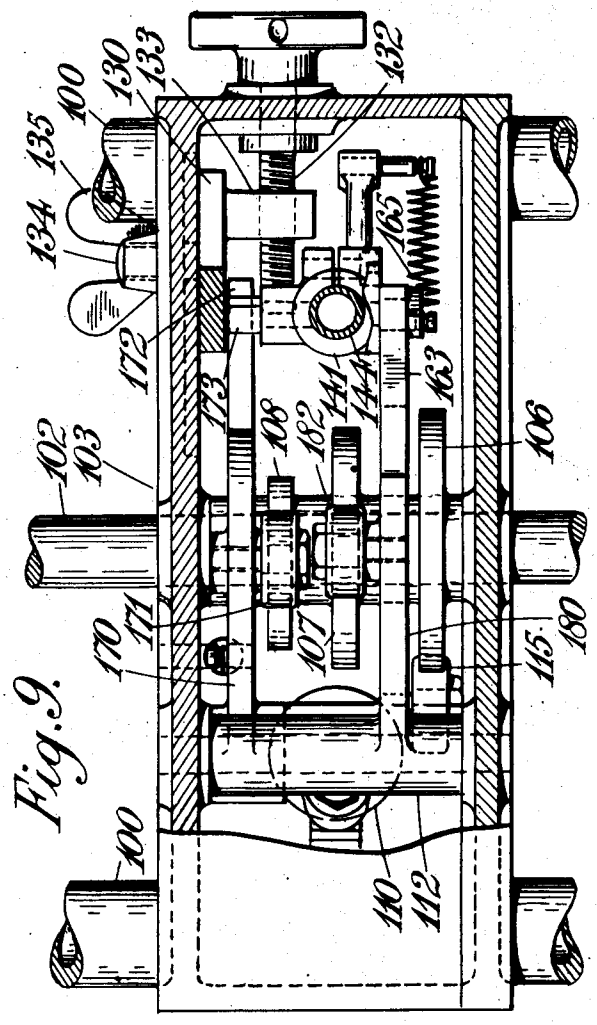


Fig. 9.

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SHEET SEPARATING MACHINE

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Fig. 7.

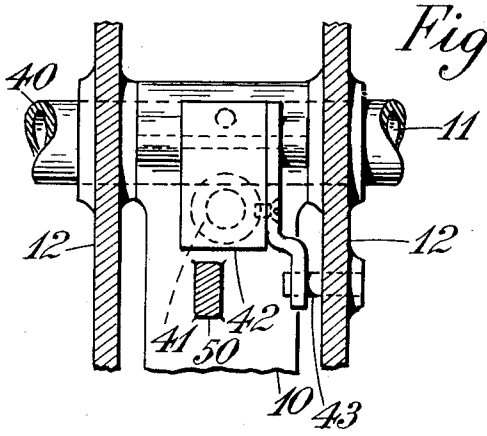
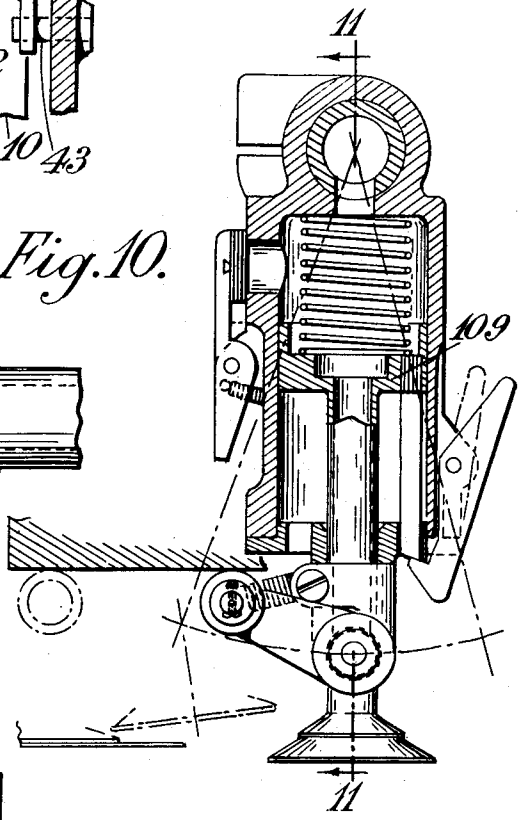


Fig. 10.



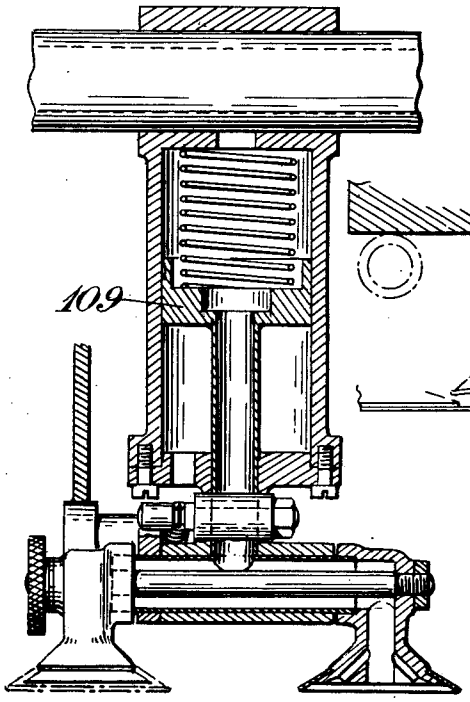


Fig. 11.

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Patented Oct. 28, 1952 2,615,713

UNITED STATES PATENT OFFICE

2,615,713

SHEET SEPARATING MACHINE

Headley Townsend Backhouse, Sunningdale, England

Application April 21, 1949, Serial No. 88,863
In Great Britain April 22, 1948

1 Claim. (Cl. 271—26)

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The invention relates to machines for separating individual sheets one by one from the top or bottom of a pile and of the kind (herein referred to as the kind described) in which one edge of each sheet in turn is gripped (e. g. by a suction gripper) and bent away from the body of the pile, and a nozzle is employed to direct a short blast of air between the separated edge and the reminder of the pile to assist in, or to complete, the separation of the remainder of the sheet. In machines of the kind described the nozzle conveniently consists of a foot adapted to rest on the remainder of the pile and to apply pressure thereto to prevent movement of the remaining sheets by the air blast. Such a foot is usually raised to release the pressure on the pile between the separation of successive sheets. The machines may include means for forwarding the sheets in a direction transverse to the height of the pile and the arrangement may be such that the sheets are fed individually or as a stream of partly overlapped or partly underlapped sheets. The aforesaid air blast may be employed to assist the forwarding of the sheets or it may effect the forwarding while the sheets are being controlled by the gripping means. In the case in which the machine is arranged to operate on the uppermost sheet of the pile it is usually convenient that the edge which is bent is at the rear of the pile in relation to the subsequent forwarding of the sheet. The sheets may be forwarded to a printing or other machine operating on individual sheets.

It is an object of the present invention to provide improved means for controlling the air blast in a machine of the kind described.

The invention provides a sheet separating machine of the kind described characterised by a valve for controlling the air blast which is positioned closely adjacent to the nozzle outlet in the path of the air to the outlet. This position for the control valve reduces the time lag between the operation of the valve and the starting or stopping of the blast.

In the preferred form of the machine provided by the invention the nozzle is formed in a foot as described above, and the valve is positioned in the foot.

The machine may be provided with a second nozzle, directed against the face of the pile to assist separation of the sheets by a preliminary "fluffing" of the sheets and the valve may be arranged to change the air supply from one nozzle to the other in timed relation with the separation of the sheets. In one form of this arrangement the "fluffing" nozzle is carried by the foot for movement therewith.

Two specific examples of sheet separating machines embodying the invention will now be described with reference to the accompanying drawings in which:

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Figure 1 is a side view, partly in section, of one embodiment of the machine,

Figure 2 is a plan view of one of the lifting and forwarding units,

Figure 3 is a part section on the line 3—3 in Figure 2,

Figure 4 is a sectional view on the line 4—4 in Figure 1,

Figure 5 is a rear view of one of the lifting and forwarding units,

Figure 6 is a detail view of the operating means for the nozzle valve,

Figure 7 is a detail view on the line 7—7 in Figure 1,

Figure 8 is a side view, with one cover plate removed, of the second embodiment,

Figure 9 is a plan, partly broken away, of one of the units employed in the machine shown in Figure 8,

Figure 10 is a sectional view of the gripper operating means shown in Figure 8, and

Figure 11 is a section on the line 11—11 in Figure 10.

The machine forming the subject of the first example and shown in Figures 1 to 7 has two lifting and forwarding units 1 positioned in spaced relation above the rear edge 2 of the pile 3 of sheets and supported from a common bar 4 of square section extending transversely across the pile. The two units are of similar construction and for the sake of clarity the following description relates to only one of the units.

Depending from the above-mentioned square section bar 4 there is a bracket 5 which is adjustably clamped (by plate 6 and screws 7) to the bar for sliding adjustment along the length of the bar. The depending portion of the bracket is forked and embraced within the arms of the fork there is a cylinder 10 having its mouth directed downwardly and supported at its upper end by a rocker shaft 11 below and extending parallel to the square section bar. The shaft is supported in the two arms 12 of the bracket and in operation has oscillatory movements imparted to it by means forming no part of the present invention.

The cylinder contains a piston 15 which is spring-urged in the downwards direction and carries, by means of a tubular piston rod 16 guided on the lower end of the cylinder, a transverse bar 17 on which are mounted two suction grippers 18 having their mouths directed downwardly towards the top of the pile. The two grippers are spaced apart in a line parallel to the rear edge of the pile. The transverse bar 17 is hollow and there is open communication through the bar and the piston rod between the

gripper mouths and the interior of the cylinder above the piston. Further, the bar is rotatable in the supporting means **20** by which it is attached to the piston rod to vary the angular relation between the axes of the grippers and the top of the pile. This angle may also be adjusted by rotation of the grippers in relation to the bar. A short arm **21** extends substantially horizontally from the bar in the direction from the rear edge of the pile and there is a link **27** pivoted to the free end of this arm. The link extends upwardly between the arms of a guide fork **23** on the cylinder and makes a pivotal-sliding connection at its upper end with a pin **24** attached to the aforesaid bracket **5**. The pin is in substantially the same horizontal plane as the aforesaid rocket shaft **11** and is spaced therefrom by an amount substantially equal to the length of the arm **21** on the gripper supporting bar. The cylinder, the arm, the link and the supporting bracket consequently constitute a parallel link system, as described above, and maintain the axes of the grippers at a substantially constant angle to the plane of the pile during the oscillatory movement of the cylinder derived from the rocker shaft. A spring **22** urges the gripper supporting bar for rotation up to a stop in a direction to hold the link at the upper limit of its sliding movement on the pin **24**. The anchor pin of the spring engaging the arm **21** constitutes the stop.

The cylinder carries an external latch **30** which is pivoted to the cylinder at the rear thereof. The latch is in the form of an upwardly extending lever pivoted to the cylinder for rotation about a horizontal axis **31** at approximately the centre in the length of the lever. At its lower end the lever has a lateral abutment **32** forming the latch which is arranged to engage under the lower face of the piston when the piston is at the upper limit of its travel in the cylinder (i. e. as shown in Figure 1). A spring **32** urges the lever into the latching position. The upper end of the latch is arranged to engage, as later described, with an adjustable stop screw **33** secured to the bracket which engagement effects the release of the latch from the piston.

The rocker shaft **11** supporting the cylinder is hollow and has a port **40** communicating with the upper end of the cylinder. The cylinder has a further port **41** in its side leading to the atmosphere and closed by an external flap valve **42** arranged to co-operate with a stop pin **43** on the bracket.

The operation of the mechanism as so far described is as follows: Starting from the position in the cycle when the grippers have been lowered on to the top of the pile the engagement of the gripper mouths with the uppermost sheet serves to seal the mouths and consequently the open communication to the cylinder through the mouths. Suction which is continuously applied to the cylinder through the hollow rocker shaft and the connecting port between the shaft and the cylinder then builds up in the cylinder and causes the piston to rise carrying with it the grippers and the rear portion of the uppermost sheet adhering thereto. At the upper limit of the movement of the piston the latch engages underneath the piston to retain it in the uppermost position. The cylinder then oscillates in the forwards direction moving the grippers and the rear portion of the sheet with it, while at the same time the link system maintains the axes of the grippers at a substantially constant angle to the surface of the pile. Immediately before the cylinder reaches the end of its forward movement the flap valve carried by the cylinder is engaged by the stop pin on the bracket which opens the valve end and admits air to the cylinder. The air admission port is of substantial size and admits sufficient air substantially to destroy the partial vacuum built up in the cylinder and thereby releases the hold of the grippers on the sheet enabling the sheet to be withdrawn by rollers or other forwarding means operating at the front edge of the pile. The destruction of the partial vacuum in the cylinder also release the piston but this is, as already explained, retained in its uppermost position by the latch. The direction of movement of the cylinder is then reversed and the piston is swung back to its initial position. There is a short "dwell" intermediate in the backward stroke of the cylinder for the purpose later described. Just before the end of the rearward movement of the cylinder the upper end of the latch lever comes into contact with the stop screw so that continued movement of the cylinder swings the latch lever about its pivot and disengages the latch from the piston allowing the piston to fall and thereby to bring the grippers into engagement with a new sheet on top of the pile. The flap valve closes during the first part of the rearward movement of the cylinder but the admission of air to the cylinder through the gripper mouths prevents suction being built up in the cylinder until the mouths engage the new sheet. The engagement of the grippers with the new sheet initiates the next cycle of operations.

Extending rearwardly from the cylinder towards the upper end thereof there is an arm **50** bearing at its end a roller **51** having a pivotal-sliding engagement in a horizontal slot **52** formed in a cross-head **53** which is supported for vertical sliding movement on a rod **54** forming one of two fixed rods **54, 55** depending vertically from the plate **6** attached to the aforesaid bracket. The lower ends **56** of these rods serve as gauges to engage the rear face of the pile and thereby to locate the mechanism in relation to the pile. The oscillatory movements of the cylinder impart through the arm vertical movements to the cross-head **53**. The slot in the cross-head is of sufficient length to permit adjustment of the cylinder towards and away from the rear edge of the pile and the supporting plate **6** has a slot **55** arranged to provide such adjustment in relation to the square rod to which the bracket is clamped. Adjustments of this nature may be employed to adapt the mechanism to sheets of different characteristics (e. g., thickness and stiffness).

Behind the vertical rods above described there is a square tube **60** which is also vertically dependent from the plate **6**. This tube is embraced by a fork **61** projecting from the rear of the cross-head about its supporting rod **54**. A hollow foot **62** is slidable on the tube and extends in the forwards direction to engage the top of the pile. A compression spring **65** surrounding a guide rod **66** dependent from the plate **6** and received within a vertical socket in the foot is, in this example, employed to develop clamping pressure of the foot on the pile. This spring may be omitted in cases where sufficient pressure is obtained by the weight of the foot, or other means.

Pivotally supported from one of the arms of the fork **61** of the cross-head there is a bell-crank

latch lever 70 of which one leg extends downwardly from the pivot and is shaped at 71 to constitute a latch to engage with a catch-piece 72 on the foot. The other leg 73 of the bell-crank extends rearwardly from the pivot to engage with an adjustable stop 74 on the support plate 6. A spring 75 urges the downwardly projecting leg of the bell-crank in the rearward direction to engage with the catchpiece on the foot.

The foot carries a blower tube 80 which depends from the lower face of the foot behind the rear face of the pile and has nozzle outlets 81 directed towards the pile. A throughway 82 in the foot connects the nozzle outlets with the interior of the hollow foot and thence to the throughway of the aforesaid square guide tube 60. A flap valve 83 contained within the foot and rotatable about a horizontal axis 84 is arranged to divert compressed air admitted to the guide tube either to the nozzle outlets 81 depending from the rear of the foot—which constitute the "fluffing nozzle"—or to a nozzle outlet 86 formed in the foot itself. The supporting spindle for the flap valve extends outwardly from the foot and has a short re-set lever arm 87 on one end. On the other end it has a forwardly directed catch 89. A spring and plunger 90 pressing against the rear of the catch urges the valve into the position in which the air is directed to the nozzle in the foot. A vertically extending lever 91 pivoted to the foot serves as a latch engaging the catch to retain the flap valve, against the spring, in the position in which the air is diverted to the "fluffing nozzle." Pivoted from the second arm of the cross-head fork there is a further bell-crank 95 having a downwardly extending leg 96 and a rearwardly extending leg 97. The downwardly extending leg co-operates with a further lever 98 pivoted to the foot of which the lower end engages the vertically extending re-set arm 88 on the valve spindle. The hook-like stop 74 depending from the plate 6 is arranged to engage the underside of the rearwardly projecting leg 95 of the bell-crank towards the lower limit of the sliding movement of the cross-head.

The operation of the foot and associated parts will now be described. When the grippers are lowered into gripping engagement with the top of the pile the foot is resting with light pressure on the uppermost sheet and remains in that position during the raising of the rear edge of the sheet by the grippers which withdraw this portion of the sheet from between the foot and the remainder of the pile. The cylinder then makes a slight rearward movement which lifts the cross-head, by engagement of the arm on the cylinder with the slot in the cross-head, and by engagement with its associated stop of the horizontal arm of the first-mentioned bell-crank lever on the cross-head (i. e. the bell-crank lever which has the latch for engagement with the catch on the foot) causes the lower arm of the bell-crank to move forwardly into engagement with the latch lever holding the flap valve in the foot, thereby releasing the valve which is rotated by the spring to divert the air into the foot which directs a blast of air between the lifted rear edge of the sheet and the remainder of the pile. The cylinder now reverses its movement and the lifted sheet is moved in the forward direction by the action of the air blast and by the suction grippers. This forward movement of the cylinder causes the cross-head to be lowered and towards the end of the downward movement of the cross-head the latch engages under the catch of the foot. In addition, and immediately before the limit of the downward movement of the cross-head is reached, the second bell-crank lever comes into contact with the hook-like stop so that the final movement of the cross-head rotates the bell-crank which through the associated lever rotates the reset arm of the flap valve to restore the valve to its initial position where it is held by the latch and in which the air is diverted to the "fluffing" nozzles. On the return movement of the cylinder the cross-head rises and the foot is raised by its latching engagement with the bell-crank lever until the bell-crank lever comes into abutment with its stop which then releases the foot to fall back on to the pile. The above-mentioned "dwell" in the movements of the cylinder now occurs to allow the foot time to seat itself on the pile. Back movement of the cylinder is then continued and the piston is released by the catch and lowered to engage the grippers with the pile.

Briefly summarising the cycle of operations of the apparatus the grippers are first lowered on to the uppermost sheet, the engagement of the grippers with the sheet seals the air inlet to the cylinder causing the grippers to be lifted and thereby to withdraw the sheet from underneath the foot, an air blast is directed from the foot between the lifted sheet and the pile, and the grippers move forwardly with the sheet. The sheet is released by admission of air to the cylinder, the cylinder returns while the piston is held in the elevated position, the foot is raised, the air is diverted to the "fluffing" nozzles, the foot is lowered on to the pile and the piston is then released to lower the grippers ready to commence a new cycle.

The machine forming the subject of the second example is shown in Figures 8 to 11 and comprises a frame, means for supporting and elevating a pile of sheets and means of well-known kind for controlling the elevating means to maintain the top of the pile at a substantially constant height as the sheets are removed. Extending crosswise of the pile and supported at each end in the frame there are two fixed parallel cross-bars 100 of which one lies above the pile 101 a little in front of the rear face thereof and the other lies a corresponding amount above and behind the rear face. A shaft 102 supported for rotation in bearings in the frame extends crosswise and centrally between the two cross-bars.

Supported on the cross-bars and adjustable along them there are two separating and forwarding units 103. These two units are of similar construction and for the sake of simplicity only one of them will be described in detail. In use the two units are spaced apart towards the side faces of the pile.

Each unit comprises an inverted rectangular box-like frame member 104. The longer dimension of the member extends in the fore and aft direction of the pile and the member is supported along its upper front and rear edges by the cross-bars. The rotatable operating shaft 102 passes through the sides of the frame member and carries within the member three cams 106, 107, 108 which are splined to the shaft. In front of the shaft there is a piston 109 and cylinder 110 for raising and lowering the suction gripper 111 and for moving the gripper in the fore and aft direction as described in the previous example. This cylinder is pivotally supported on a short shaft 112 extending between the sides of the frame member and is dependent from the shaft. A roller 115 secured to the back of the cylinder co-operates with the cam 106 to effect, in com-

bination with a return spring 116, an oscillatory movement of the cylinder to move the gripper forwardly and backwardly. The arrangement includes a latch 118 for holding the gripper in the elevated position and valve 119 for admitting air to the cylinder as described in the previous example. The parallel link construction described in the above example is omitted and is replaced by an arm 120 extending forwardly from a shaft 121 from which the gripper is dependent and having a roller 122 which runs along the bottom edge 123 of the frame member or any other convenient suitably fixed part to maintain the axis of the gripper in the desired relation to the top of the pile. The frame member or the equivalent part may be suitably shaped to provide this result.

Within the housing member 104 and to the rear of the operating shaft 102 there is a slide 130 engaging co-operating guides 131 on the frame member for movement in the fore and aft direction. There is a screwed spindle 132 passing through the rear wall of the frame member and engaging a nut 133 on the slide for effecting the movements thereof. The guides are formed on one of the longer side walls of the frame member and the slide is held against that wall by a screw 134 passing through the wall and by a wing-nut 135 on the outside of the frame member. This nut may be tightened to lock the slide in a desired position of adjustment. The slide has two arms 140, 141 which extend upwardly and downwardly from the slide respectively and which, at their free ends, 142, 143 are turned inwardly towards the centre of the frame member. These two inward extensions are provided with vertically aligned holes within which a compressed air tube 144 is slidable. This tube has at its lower end a forwardly directed foot 145 of which the toe is positioned to rest on a rear edge portion of the top of the pile 101. Dependent from the heel of the foot there is a short tube 150 having perforations 151 in its walls directed towards the rear face of the pile. Within the foot there is a flap valve (not shown) arranged to divert compressed air from the tube 144 either into the toe of the foot which is provided with a nozzle 152 directed forwardly or into the tube 150 at the heel of the foot which constitutes a "fluffing" nozzle. The valve is mounted on a spindle 153 which extends outwardly through the side of the foot and has outside of the foot a short radial arm 154 with a notch 155 in its end face and a toggle spring 156 arranged to retain the valve in either of its two positions. A lever 160 is pivoted to the tube above the foot and centrally of the length of the lever. The lower end of the lever engages in the notch 155 in the end of the operating arm for the flap valve so that a rocking movement applied to the lever moves the valve from one position to the other and vice versa. A bell-crank 161 is pivoted to the upper extension 140 from the arms of the slide and one arm 162 of the bell-crank extends downwardly to engage the rear edge of the upper end of the lever 160. The other arm 163 of the bell-crank extends forward and the arrangement is that an upwardly movement imparted to this arm causes the other arm to engage and rock the lever in the direction to move the valve into the position in which it directs air to the toe of the foot. Return movement is effected by a spring 165. Rising and falling movements of the foot and the air tube cause relative movement between the lever 141 and the arm 162 of the bell-crank. However, as these

two parts both extend in a vertical direction this does not affect the operation of the valve.

There is a lever 170 which is pivoted to the cross shaft 112 supporting the piston and cylinder and extending rearwardly therefrom. This lever passes over the operating shaft 102 and has a roller 171 engaging the cam 108 on that shaft. The rear end 172 of the lever extends substantially horizontal and engages under an abutment 173 on the air tube. A rising movement imparted to the lever by the cam accordingly lifts the foot from the pile. Fore and aft adjustment of the slide carrying the foot has little effect on the operation of this lever since the lever extends in the horizontal direction and the abutment is free to move along the lever.

A further lever 180 is pivoted to a cross shaft 181 on the frame member above the cylinder and extends rearwardly over the operating shaft. This lever also has a roller 182 which co-operates with the cam 107 on the shaft 102. The rear end of the lever extends horizontally beneath the horizontal arm 163 of the bell-crank so that rising movement imparted to the lever by the cam lifts the arm of the bell-crank to move the valve as aforesaid. In this case also since the lever extends in a horizontal direction adjustment of the slide has little effect on the operation of the valve.

The several cams are shaped and positioned to effect the movements of the cylinder, the rising and falling movements of the foot and the operation of the valve in the timed relationship described in the previous example.

I claim:

In a machine having a gripper for separating individual sheets one by one from a pile, the gripper being arranged to grip one edge portion of each sheet in turn and to bend the edge portion away from the body of the pile and an air nozzle in the form of a foot which is arranged to rest on the body of the pile between the said body and the bent edge portion of the sheet and to direct a blast of air between the bent sheet and the body of the pile and then to be removed from engagement with the pile, a second air nozzle movable with the foot as a unit and arranged to direct a blast of air against a face of the pile to assist separation of the sheets by a preliminary "fluffing" of the sheets, and an air conduit leading to the two nozzles and movable therewith, the provision of a control valve for the air supply to the nozzles which valve is located in the movable air conduit adjacent the nozzles, and means for operating the control valve in timed sequence with the operations of the gripper and movements of the foot such that the air is turned on to the separating nozzle after the sheet has been bent as aforesaid and is diverted from the separating nozzle to the fluffing nozzle during the period when the foot is removed from the pile.

HEADLEY TOWNSEND BACKHOUSE.

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