

June 13, 1939.

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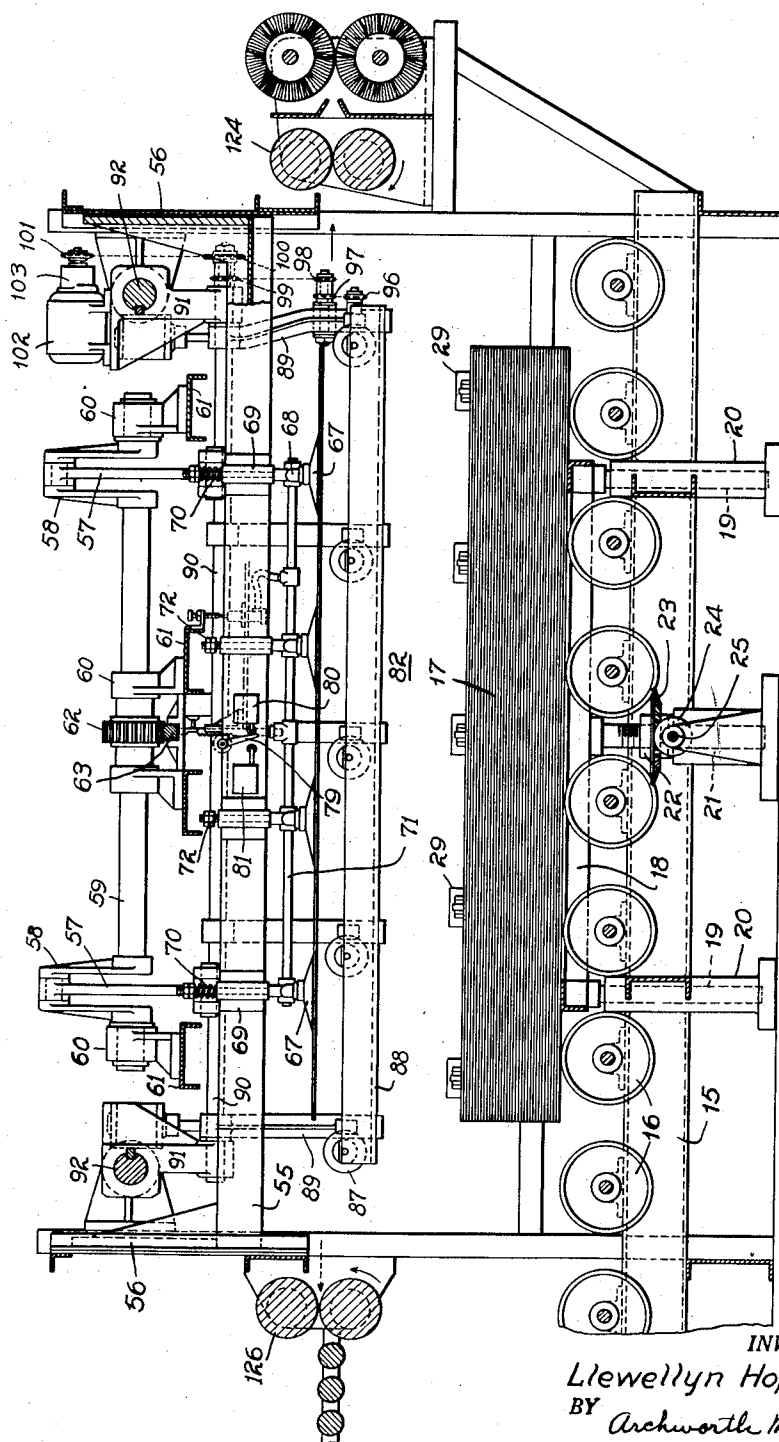
2,162,580

SHEET-HANDLING APPARATUS

Filed Aug. 27, 1938

5 Sheets-Sheet 1

Fig. 1.



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5 Sheets-Sheet 2

Fig. 2.

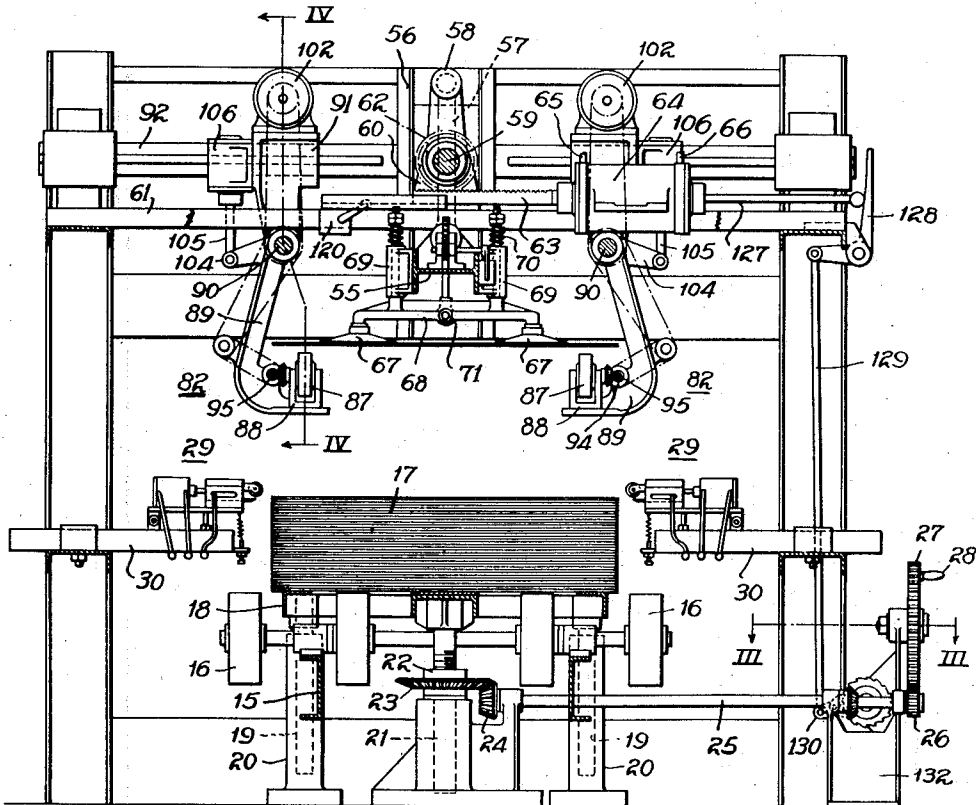
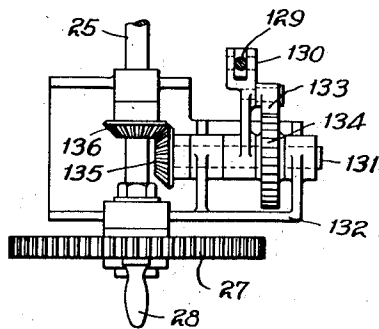


Fig. 3.

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5 Sheets-Sheet 4



Fig. 8.

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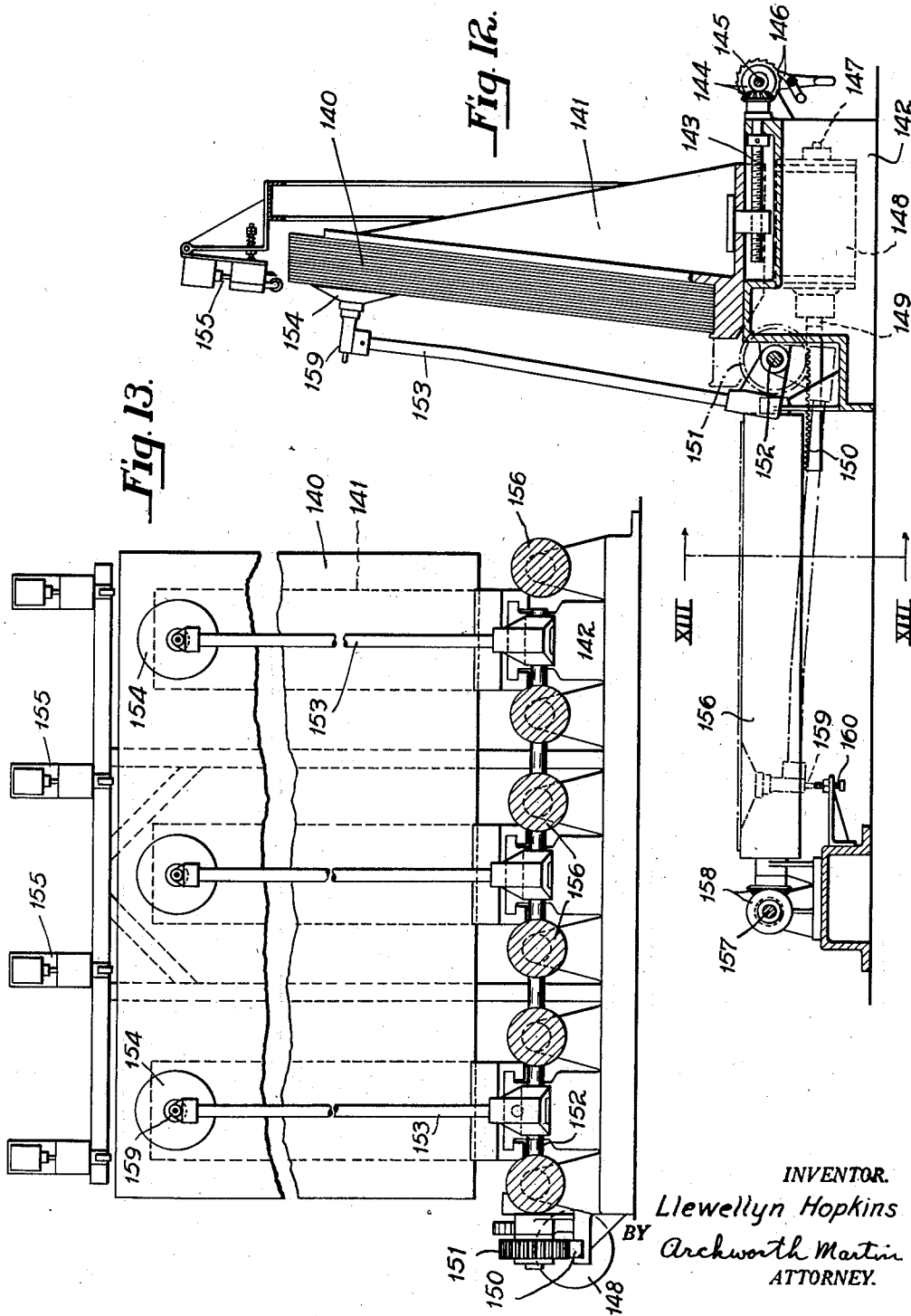
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5 Sheets-Sheet 5



UNITED STATES PATENT OFFICE

2,162,580

SHEET-HANDLING APPARATUS

Llewellyn Hopkins, Butler, Pa.

Application August 27, 1938, Serial No. 227,145

17 Claims. (Cl. 271-11)

My invention relates to apparatus whereby metal sheets or the like can be removed one-by-one from a stack and sorted, the invention being useful in the feeding of sheets one-by-one to rolls, or simply as a sorting device whereby sheets which are stuck together can be discarded and the other sheets deposited on conveyors or the like.

One object of my invention is to provide means for effectively removing sheets one-by-one from a stack, even though there is tendency of the sheets to adhere together through atmospheric pressure or otherwise.

Another object of my invention is to provide an improved means for feeding sheets one-by-one from a stack.

A further object of my invention is to provide means for automatically throwing out or discarding sheets which adhere together during the removal of the sheets from a stack.

Still another object of my invention is to provide an apparatus of generally simplified and improved form which will operate rapidly and effectively in the feeding or sorting of sheets.

Some of the forms which my invention may take are shown in the accompanying drawings wherein Figure 1 is a longitudinal sectional view through the apparatus; Fig. 2 is a cross-sectional view thereof; Fig. 3 is a view on an enlarged scale taken on the line III—III of Fig. 2; Fig. 4 is an enlarged view taken on the line IV—IV of Fig. 2; Fig. 5 is a view taken on the line V—V of Fig. 4; Fig. 6 is a sectional detailed view of a portion of the apparatus of Fig. 1; Fig. 7 is a longitudinal view through one of the separating devices for the marginal edges of the sheets; Fig. 8 is a view taken on the line VIII—VIII of Fig. 7; Fig. 9 is a view showing the device of Fig. 7 in operating position; Fig. 10 is a plan view of the separating blade of Fig. 7; Fig. 11 is a schematic view showing the arrangement of the control mechanism for various operating parts of the machine; Fig. 12 is an elevational sectional view of a modified form of sheet-separating apparatus, and Fig. 13 is a view taken on the line XIII—XIII of Fig. 12.

As shown in Fig. 1, a framework 15 has journaled thereon idler rollers 16 along which packs of sheets 17 are moved to bring the pack into position above a table 18. The table 18 at its corners carries depending posts 19 which telescopically fit within upright guide members 20. A screw jack 21 engages the underside of the table at its central portion, so that the table and the pack carried thereby can be raised step-by-step during removal of the sheet from the pack, as hereinafter

described. The nut 22 which engages with a jack screw carries a bevel gear wheel 23 with which a pinion 24 meshes. The pinion 24 is mounted on a shaft 25 which carries at its outer end a pinion 26 that meshes with a gear wheel 27, the gear wheel being provided with a handle 28 by which it may be manually turned to initially raise the table and thereby slightly lift the pack 17 from the rollers 16.

A series of blades or edge separating devices are provided alongside each edge of the pack, in position to operate on the topmost sheet of the pack. These separating devices are designated generally by the numeral 29 and are shown more clearly in detail in Figs. 7 to 10. Each of the separating devices 29 is mounted upon a bar 30 which in turn is adjustably secured to the framework of the machine for adjustment toward and away from the edges of the pack, as shown more clearly in Fig. 2. Each device is mounted upon a supporting plate 31 which is pivotally connected at 32 to the bar 30. An adjustable stop screw 33 is provided for effecting proper alignment between the device and a pack, a spring 34 serving to yieldably hold the separating device against the stop screw.

The members 29 are all of similar construction and a detailed description of one will suffice for all. A hollow block 35 is secured to the plate 31 and is provided with a removable cap plate 36. A slide block 37 is movable longitudinally within the block 35 and carries a blade 38 having a sharpened nose portion or knife edge 39, that is adapted to be moved beneath the topmost sheet of a pack. A roller 40 is journaled in an arm 41 carried by the block 37 and which is pivotally mounted at 42. The roller 40 is positioned slightly in advance of the knife 39 so that when the block 37 is moved from the position shown in Fig. 7 toward that shown in Fig. 9, the roller will first engage the top of the pack and thereafter the blade 39 will pass beneath the top sheet, moving the same to the position shown in Fig. 9.

In the position shown in Fig. 7, the roller is rigidly held against raising movement on its pivot, by means of the cap 36. If the vertical position of the roller is such with respect to the top of the pack that there will be tendency for the roller to be raised slightly as it moves onto the pack, the bracket 31 will be tilted slightly upwardly about its pivot 32 and against the tension of spring 34. There need not therefore be very precise initial alignment of the separating device with the top sheet. The spacing between the roller and the knife edge 39 is equal to the thickness of one sheet. In the position shown in Fig. 9, the

arm 41 that carries the roller is clear of the cover plate 36, so that when the top sheet is raised, as hereinafter explained, the roller can swing upwardly around its pivot 42 to be thereby disengaged from the sheet.

The vertical spacing between the roller 40 and the knife edge 39 is adjusted to correspond with the different sheet gauges, by an eccentric 43 upon which the roller 40 is mounted. Rotative adjustment of the eccentric 43 will, of course, raise or lower the roller relative to the knife blade. An extended hub of the cam is threaded to receive a nut 44 to clamp it in adjusted positions, the other end of the hub having a squared shank 45 which can be turned by a wrench.

When the blades are entering beneath the top sheet of a pack, blasts of air are introduced through the blades and beneath the sheet to assist in separating the sheets and to eliminate suction which may result when the top sheet is lifted as will be hereinafter described. To this end, the knives are provided with passageways 46 that discharge at the forward edges of the knives and at their rear ends communicate with ports 47 that have constant communication with passageways 48 formed in the slide blocks 37. A pipe 49, to which air under pressure is supplied, communicates with each passageway 48, the side walls of the hollow blocks 35 having longitudinal slots formed to permit movement of the pipes 49 with the slide blocks 37. Each slide 37 is reciprocated by a piston contained within an air cylinder 50, fluid pressure being admitted and exhausted at the opposite sides of the piston through pipe connections 51 and 52.

A cross head 55 is provided at each end with slide blocks which are vertically movable in guide ways 56 carried by the stationary framework. The cross head is vertically supported by a pair of connecting rods 57 that are hung from crank arms 58 which are formed on a crank shaft 59, the crank shaft 59 being journaled in bearings 60 that are mounted upon cross beams 61. The crank shaft carries a gear wheel 62 that has meshed engagement with a rack bar 63 formed on the end of a piston rod, that is connected to a piston within a cylinder 64, fluid pressure being admitted through pipes 65 and 66 to the opposite ends of the cylinder to effect actuation of the crank shaft 59. The cranks 58 are moved downwardly, thereby moving the cross head 55 downwardly, while admission of fluid pressure to the opposite end of the cylinder will effect raising movement of the cross head.

Four pairs of vacuum cups 67 are provided. Each pair of cups is mounted on extensions of a yoke 68 which has its legs extending upwardly through guide brackets 69 that are secured to the sides of the cross head. Springs 70 surround the legs of the endmost yokes and rest upon the tops of the brackets 69 that are carried by the cross head, the springs engaging nuts on said legs, so that the yokes are yieldably urged upwardly. The yokes are all connected in unitary relation by a pipe 71, so that they move as a unit and the intermediate yokes have gauge nuts 72 threaded thereon to positively limit downward movements of the yokes relative to the cross head 55. Those extensions of the yokes that carry the cups 67 are hollow and communicate with the cups and the pipe 71.

When the cross head 55 is moved downwardly to bring the cups 67 into engagement with the top sheet of a pack, compressive movement of the cups will cause the air to be forced therefrom

beneath the edges of the cups. A check valve 73 (Fig. 6) is provided in the base of the cups to prevent the air within the cups from being forced back into the bores of the yoke in the pipe 71, during application of the cups to the top sheet.

After the cups have been applied to a sheet, as above described, the cranks 58 are actuated to raise the cross head 55 and the top sheet which will adhere to the cups 67 by atmospheric pressure. Owing to the inertia of the sheet and the vacuum cups, together with their yokes, springs 70 will be compressed somewhat during the initial stages of upward movement, the limit nuts 72 on the top of the intermediate yoke legs serving to positively limit the extent to which the springs 70 will be compressed. After the sheet has been completely lifted or pulled away from the pack and the inertia of the parts overcome, the cups and the sheet will be supported entirely by the springs 70, the stop nuts 72 then being clear of the cross head 55.

During the remainder of upward travel of the cross head 55, the sheet is "weighed", so that if two sheets stick together, the weight will be such as to automatically discharge the sheet in one direction, while if a single sheet of proper weight is being raised by the cups, it will be automatically discharged in a direction to be fed to rolls. This weighing mechanism, as shown more clearly in Figs. 1, 2 and 6, comprises a rack bar 75 which is secured to the pipe 71 and extends upwardly through the cross head 55, and is vertically guided in a bracket 76 carried by the cross head. A pinion 77 is secured to a shaft 78 which is journaled on the bracket 76, and the shaft 78 carries a switch-operating arm 79 that during movement of the shaft will actuate control switches 80 and 81. Normally the arm 79 maintains the switch 80 in closed position. Upon starting of raising movement by the crank arms 58, the cross head 55 will first move upward slightly without corresponding upward movement by the cups, with the result that the rack 75 rotates the pinion 77 to cause the arm 79 to release the switch 80 and close the switch 81. If but one sheet is being raised by the cups at this time, the springs 70 will have sufficient force to raise the vacuum cups and the single sheet toward the cross head 55, whereby the rack 75 is shifted upwardly relative to the cross head, thus rotating the pinion 75 and swinging the arm back to its normal position where it closes the switch 80. Upon further movement of the cross head in its upward travel, the sheet is raised above the plane of take-out conveyors 82, which as hereinafter described, are swung into position beneath the sheet to receive it when it is released from the cups.

Near the end of the upper travel of the cross head, the stem of a valve 84 carried by the cross head, engages a stop 85, which opens the valve and admits atmospheric air through a pipe 86 that is connected to the pipe 71 and thus relieves the vacuum within the cups and permits the sheet to drop upon the conveyors.

The conveyors 82 are disposed adjacent to the path of vertical travel of the sheet. Each conveyor comprises a series of rollers 87 journaled in a channel bar 88, the bars 88 being carried on swinging arms 89 that are hung on rods 90; the rods in turn, at their ends, are supported in brackets 91, the brackets being slidably supported on cross rods 92 that are secured to the framework of the machine. The brackets 91 are keyed against rotating movement on the rods 92, as

shown in Fig. 4, and are adjustable longitudinally of the rods 92, being fastened at set positions thereon by set screws 93. The shafts of the rollers 87 have drive connection through bevel gear wheels 94 with a shaft 95, which shaft is journaled in the bearings formed in the bracket 89. The shafts 95 carry sprocket wheels 96 which are driven from a sprocket 97 that is formed unitarily with a sprocket 98. The sprocket 98 has drive-chain connection with a sprocket 99 that is formed unitarily with a sprocket 100, the sprocket 100 having drive-chain connection with a sprocket 101 on the shaft of a motor 102. The motor 102 is provided with an internal gear-reducing unit at 103. The unitarily-formed sprocket 99-100 is journaled on the rod 90. The end brackets 89 have a crank arm extension 104 that is connected with a piston rod 105 which is operated by a cylinder 106. It will be seen that as fluid pressure is admitted to the opposite ends of the cylinder 106 alternately, the brackets 89 will be oscillated to move the rollers 87 into and out of position beneath a sheet. Before the valve 84 is actuated through raising movement of the cross head, fluid pressure is admitted to the upper ends of the cylinders 106 to cause the brackets 89 to be swung to the position shown in Fig. 1, with the rollers in position to receive the sheet when it is dropped from the cups. This movement of the conveyor 82 to sheet-receiving position is effected by means of timing mechanism which controls raising of the cross head 55 and which also controls operation of the knife devices 38.

The timing mechanism is shown in Fig. 11 and comprises a motor-driven timer having a plurality of cams which operate fluid pressure control valves 107 to 113 inclusive. When the parts are in position for descending movement of the cross head to effect engagement by the vacuum cups with the top sheet of a pack, the valve 107 will be in open position admitting fluid pressure from the line 114 through a pipe 115 to the lower sides of the cylinders 106, thus holding the arms 89 and the conveyor rollers 87 in their outermost positions. Similarly, the knife members 38 are held in their retracted positions, because the valve 108 is in open position, admitting fluid pressure from the line 114 through the pipe 52 to the outer end of the cylinder 50, the air supply for the blast orifices of the knives being closed at valve 109. At this time the valve 110 is open to atmosphere and the valve 111 opened by its cam to pressure line 114, thus admitting pressure through the pipe 66 to the cylinder 64 and causing the rack and pinion to be actuated to rock the crank shaft 59 so as to lower the cross head and the vacuum cups, the exhaust from the cylinder occurring at this time through the pipe 65. At about the time that the cross head has reached the limit of its downward movement, the valve 108 is closed, by its cam, to line pressure and opened to atmosphere, while the valve 112 is opened by its timer cam to the line pressure from 114 so that the pistons within the cylinders 50 are actuated to move the rollers 40 and the knives 38 toward the pack. As the knives begin to penetrate beneath the top sheet, the valve 109 is actuated by its cam to establish communication from the line 114 to the pipe leading to the line 49 and to the interior of the knives, so as to provide the separating blast of air beneath the top sheet, as heretofore referred to.

At this time valve 110 is open to line pressure so that such pressure is admitted to the front

end of cylinder 64 to effect reverse movement to the crank shaft 59 and raising of the cross head 55. At the time the sheet has been thus lifted completely off the stack, the valve 109 is closed to cut off flow of air to the interior of the knives. The knives during the early stages of raising movement of the sheet, are retained in their projected position to hold the next succeeding sheet of the pack down. After the top sheet has been lifted clear of the stack, the valve 112 is opened to atmosphere and the valve 108 is opened to line pressure, so as to direct fluid pressure to the front side of the cylinders 50 and retract the knives.

During this raising movement of the cross head 55 and after the sheet has been raised above the plane of the conveyors 82, valve 107 is opened to atmosphere and valve 113 opened to line pressure, so as to admit fluid pressure to the upper sides of the cylinders 106 and thereby rock the shafts 90, thus swinging the arms 89 and the rollers 87 to the position shown in Fig. 2 where they can receive the sheet which is released, as heretofore described.

A switch 120 is supported in the path of movement of the rack bar 63, whereupon during lowering movement of the cross head, the switch will be engaged by the rack bar and held in open position. During raising movement of the cross head, the switch 120 is released by the rack bar 63 and thereupon closes under spring pressure, thus establishing a point in the circuit for the motors 102. At this time if there is only a single sheet held by the cups, the arm 79 will maintain the switch 80 in closed position, as above explained (because the springs 70 will have sufficient expansive force to support the sheet), and the circuit being completed through the switch 120 will cause energization of the coil 121 of a reversing switch 122, whereupon the circuit for the motors 102 is completed and the said motors will, through the drive connections, as shown more clearly in Fig. 4, effect rotation of the rollers 87 and discharge of the sheet through take-out rollers 124. Upon beginning of the next downward movement of the cross head, the switch 120 will be opened, thus causing stopping of the motors 102. If there are two sheets held by the suction cups during upward movement of the cross head, the weight thereof will hold the springs 70 compressed and the arm 79 consequently held in position to maintain the switch 81 closed (the switch 120 being closed during this upward movement, as above explained). A circuit will consequently be completed through the coil 125 of the reversing switch 122, whereupon the motors 102 will be driven in the opposite direction and the conveyor rollers 87 therefore operated in a direction to discard the sheets to take-out rolls 126.

Upon each operation of the piston within the cylinder 64, an extension 127 which has connection with the piston in the cylinder 64, engages a bell crank 128 to rock said bell crank and lift a link 129 whose lower end 121 is connected to a pawl arm 130 which is pivoted on a shaft 131 that is journaled in a bracket 132. The pawl arm 130 carries a pawl 133 which engages a ratchet wheel 134 secured to the shaft 131. The shaft 131 carries a bevel gear 135 which drives a bevel gear wheel 136, that is secured to the shaft 25. Upon each retractive movement of the piston in the cylinder 64 and the rack bar 63, the bell crank 128 is swung to effect slight rotative movement of the shaft 25 through the con-

nections just described, and hence rotation of the nut 22 of the screw jack, thereby raising the pack slightly so that the underside of the top sheet will be brought to the plane in which the knives 38 operate. After removal of all of the sheets of a pack, the table can be quickly returned to its lower position by unlatching the pawl 133 and turning the gear wheel 27 to lower the jack.

The apparatus can be adjusted to stacks of various widths, by longitudinal adjustment of the bars 30 on their supports, toward and away from the edges of the pack, and by similarly adjusting the brackets 91 on the rods 92.

From the foregoing it will be seen that with the motor-driven timer in constant operation, the apparatus will automatically move through repeated cycles of operation, and during each cycle of operation will effect separation and lifting of the top sheets from the packs, and when a sheet has been fully raised, the discharge conveyor 82 will be brought into position beneath the sheet, whereupon the sheet will be released and the conveyor set in motion to discharge the sheet. If two sheets are stuck together, the additional weight on the lifting elements will be such as to cause the conveyor to discard such sheets in the opposite direction. Upon discharging of either one sheet or two sheets which are stuck together, the cycle of operations will be automatically repeated. The properly separated sheets which are discharged between the rolls 124 can be advanced by other rolls or conveyor mechanism to rolls where a cold rolling operation is performed thereon, the apparatus thus serving not only as a sheet separating and sorting device, but as a feeder for cold rolls.

Referring now to Figs. 12 and 13, I show an apparatus for feeding sheets one-by-one from a pack mounted in approximately an upright position instead of in a horizontal position. In this instance the pack of sheets is represented by the numeral 140, and is supported in an inclined position by brackets 141 that are slidably mounted on a base 142. Each bracket has threaded connection with an indexing screw 143 that is journaled in an upstanding boss on the base 142. The screws 143 have bevel connection at 144 with a shaft 145. The shaft 145 is actuated by a pawl and ratchet mechanism 146, the ratchet arm thereof depending into position where it is engaged by a piston rod extension 147 of a piston contained within an operating cylinder 148.

The piston within the cylinder 148 is provided with a piston rod 149 on which is formed rack teeth 150 which engage a gear wheel 151, that is fixed on a shaft 152, which is journaled on the base 142. Arms 153 are secured to the rock shaft 152 and at their upper ends carry vacuum cups 154 in position to be forced against the outermost sheet of the pack 140 at points adjacent to the upper edge thereof.

Adjacent to the upper edge of the pack are a series of sheet-separating devices 155 which are of the same structure as the separating devices of Figs. 7 to 10 except that they operate in approximately a vertical direction instead of horizontally. These devices serve to split the foremost sheet from the next of the pack and to direct a blast of air behind it.

A series of conveyor rolls 156 are provided for receiving the sheets that are stripped from the pack and carried downwardly by the arms 153 into position just above the rolls, at which point the vacuum in the cups is relieved. Each roll 156

has bevel gear connection 158 with a shaft 157 that is constantly driven from a suitable source of power.

Timing mechanism similar to that shown in Fig. 11 may be employed for controlling the supply of fluid pressure to the cylinder 148 that operates the swinging arms 153, the cylinders of the separating devices 155, and the air blast through the separating knives. When the cups 154 have been swung to their lower positions indicated by dotted lines in Fig. 12, the stems of valves 159 thereof will engage stop screws 160 to open the valves and admit atmospheric air to the cups, thus relieving the pressure and releasing the sheets to be carried away by the conveyor rolls 156. During lowering movement of a sheet, the extension rod 147 of the piston of the cylinder 148 which actuates the swinging arms 153, will strike the arm of the ratchet device and turn the screw 143 slightly so as to advance the pack-supporting brackets a distance approximately equal to the thickness of a sheet.

It will be seen that since the vacuum cups all engage the pack at points near only the upper edge thereof, downward swinging movement of the cups causes removal of the foremost sheet by a peeling or stripping action, so that if the sheets are stuck together somewhat at points below where they are initially separated by the knife devices 155, considerable separating force will thereafter be exerted simply through the arcuate movement of the cups, such separating force being, of course, much greater and more effective than where a sheet is bodily lifted by suctional force applied simultaneously at various points throughout the area thereof.

I claim as my invention:

1. Sheet handling apparatus comprising vacuum cups reciprocable vertically above a sheet pack, the cups being movable into engagement with successive top sheets of the pack and arranged to lift sheets vertically from the pack, means for relieving the vacuum in the cups when they have reached their upper limit of travel, a conveyor, means operable during upward travel of the cups, for shifting the conveyor into position to receive sheets released from the cups, and means operable upon further movement of the cups for removing the conveyor.

2. Sheet handling apparatus comprising vacuum cups arranged to engage the topmost sheet of a pack and to support the same in a horizontal plane when raised, means for vertically reciprocating said cups, means for automatically relieving the vacuum within the cups when they are adjacent to their upward limit of movement, conveyor devices movable laterally of the path of vertical movement by the cups, and means actuated through said movement of the cups for moving the conveyors into and out of position to receive sheets released by the cups.

3. Sheet handling apparatus comprising a vacuum cup device for removing the outermost sheets successively from a pack, a knife member, and means for moving the knife member behind the outermost sheet of a pack, in advance of sheet removing movement of the vacuum cup, for assisting in separating said outermost sheet from the rest of the pack.

4. Sheet handling apparatus comprising a vacuum cup device for removing the outermost sheets successively from a pack, a knife member, and means for moving the knife member behind the outermost sheet of a pack, in advance of sheet removing movement of the vacuum cup, 75

for assisting in separating said outermost sheet from the rest of the pack, and means for directing a blast of air behind the sheet thus separated by the knife.

5 5. Sheet handling apparatus comprising a vacuum cup device for removing the outermost sheets successively from a pack, a knife member, and means for moving the knife member behind the outermost sheet of a pack, in advance of sheet removing movement of the vacuum cup, for assisting in separating said outermost sheet from the rest of the pack, and means for directing a blast of air through the edge of the knife which enters behind a sheet.

10 6. Sheet handling apparatus comprising a vacuum cup device for removing the outermost sheets successively from a pack, a knife member movable behind the outermost sheet of a pack, in timed relation to movement of the vacuum cup, for assisting in separating said outermost sheet from the rest of the pack, and a guide device positioned outwardly of the knife, for engaging the face of the outermost sheet of the pack and serving to guide the knife blade into position behind the rear side of said sheet.

15 7. The combination with means for removing sheets one-by-one from the exposed side of a pack, of a knife device, a slide block carrying said device, means for reciprocating said block toward and from the edges of the sheets in a pack, and a guide member carried by said slide and positioned in advance of the knife and to be moved upon the outermost sheet, whereby the knife will be caused to penetrate the pack immediately behind the said sheet.

20 8. The combination with means for removing sheets one-by-one from the exposed side of a pack, of a knife device, a slide block carrying said device, means for reciprocating said block toward and from the edges of the sheets in a pack, a guide roller carried by said slide and having its axis positioned in advance of the knife and to be moved upon the outermost sheet, whereby the knife will be caused to penetrate the pack immediately behind the said sheet, means for maintaining the roller against displacement relative to the slide block when it is moving into position against the face of the sheet, and means effective when the roller has completed its movement on a sheet for releasing the roller to permit it to be swung aside when the sheet is being removed from the pack.

25 9. Sheet handling apparatus comprising a vertically-movable lifter for sheets, holding elements on the lifter for supporting the sheets in horizontal position when raised, laterally-spaced sheet-receiving members at two opposite sides of the path of lifting movement, and means operating in timed relation to lifting movements for moving the said members into and from sheet-receiving position.

30 10. Sheet handling apparatus comprising a vertically-movable lifter for sheets, holding elements on the lifter for supporting the sheets in horizontal position when raised, laterally-spaced sheet-receiving members at two opposite sides of the path of lifting movement, means operating in timed relation to lifting movements for moving the said members into and from sheet-receiving position, and conveyor elements on said members for discharging sheets laterally of said path.

35 11. Sheet handling apparatus comprising a vertically-movable lifter for sheets, holding elements on the lifter for supporting the sheets in

horizontal position when raised, sheet-receiving means normally positioned out of the path of lifting movement, and means automatically operable when the lifter is adjacent to its upper limit of movement, for moving the sheet-receiving means into position beneath a lifted sheet.

40 12. Sheet handling apparatus comprising a vertically-movable lifter for sheets, holding elements on the lifter for supporting the sheets in horizontal position when raised, sheet-receiving means normally positioned out of the path of lifting movement, means automatically operable when the lifter is adjacent to its upper limit of movement, for moving the sheet-receiving means into position beneath a lifted sheet, and means automatically operable to release a lifted sheet from said holding elements.

45 13. Apparatus for separating sheets from a pack, comprising a knife member movable behind the outermost sheet of pack, a guide device positioned outwardly of the knife, for engaging the face of the outermost sheet of the pack, and serving to guide the knife member into position behind the rear side of said sheet, mechanism for removing the outermost sheet after entrance of the knife behind the same, and means for effecting movement of the said guide device away from the path of movement of the sheet during operation of said mechanism.

50 14. Sheet handling apparatus for removing the outermost sheets successively from a pack, comprising a guide member for engaging the exposed face of the pack, a knife device operatively associated with the guide member, the knife device being so positioned that it will enter behind the outermost sheet when the guide member moves against the exposed face thereof, means for moving the guide member and the knife device toward the pack, means for directing the guide member toward the pack in such path that the sheet-engaging area thereof is disposed rearwardly of the plane of the outermost sheet, and means for deflecting the guide member against the outermost face of said sheet, to thereby move the knife device to the rearmost plane of the sheet, when the guide member encounters the pack, whereby continued movement in a direction toward the pack will cause the blade to penetrate behind the outermost sheet.

55 15. Sheet handling apparatus for removing the outermost sheets successively from a pack, comprising a guide member for engaging the exposed face of the pack, a knife device operatively associated with the guide member, the knife device being so positioned that it will enter behind the outermost sheet when the guide member moves against the exposed face thereof, means for moving the guide member and the knife device toward the pack, means for yieldably maintaining the guide member in such path that the sheet-engaging area thereof is disposed rearwardly of the plane of the outermost sheet, means for deflecting the guide member forwardly and against the outermost face of said sheet, to thereby move the knife device to the rearmost plane of the sheet, when the guide member encounters the pack, whereby continued movement in a direction toward the pack will cause the blade to penetrate behind the outermost sheet, mechanism for removing the outermost sheet after entrance of the knife behind the same, and means for effecting movement of the guide member out of the path of movement of the sheet during operation of said mechanism.

60 16. Sheet handling apparatus for removing the

outermost sheets successively from a pack, comprising a guide member for engaging the exposed face of the pack, a knife device operatively associated with the guide member, the knife device being so positioned that it will enter behind the outermost sheet when the guide member moves against the exposed face thereof, means for moving the guide member and the knife device toward the pack, and means for yieldably maintaining the guide member in such path that the sheet-receiving area thereof is disposed rearwardly of the plane of the outermost sheet, the forward end of the guide member being of such form that engagement thereof with the pack will deflect it forwardly of the outermost face of said sheet, to thereby move the knife device into the rearmost plane of the sheet, when the guide member encounters the pack, whereby continued movement in a direction toward the pack will cause the blade to penetrate behind the outermost sheet.

17. Sheet handling apparatus for removing the outermost sheets successively from a pack, comprising a carrier movable in a plane approximately parallel to the plane of the pack, a knife device on said carrier, a guide member on said carrier, the said carrier being so arranged that the guide member will engage the exposed face of the pack and the knife device enter behind the outermost sheet thereof when the carrier is moved toward the pack, and means for yieldably maintaining the said carrier in such a path that the sheet-contacting surface of the guide device and the knife device lie in planes inwardly of the plane of sheet separation, during movement toward the pack, the guide device being of such form that the said member will be deflected outwardly to the plane of the said face, when the guide device enters upon a pack.

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