

Aug. 18, 1942.

F. E. CURTIS

2,293,046

SHEET SEPARATING MECHANISM

Original Filed Feb. 8, 1941

3 Sheets-Sheet 1

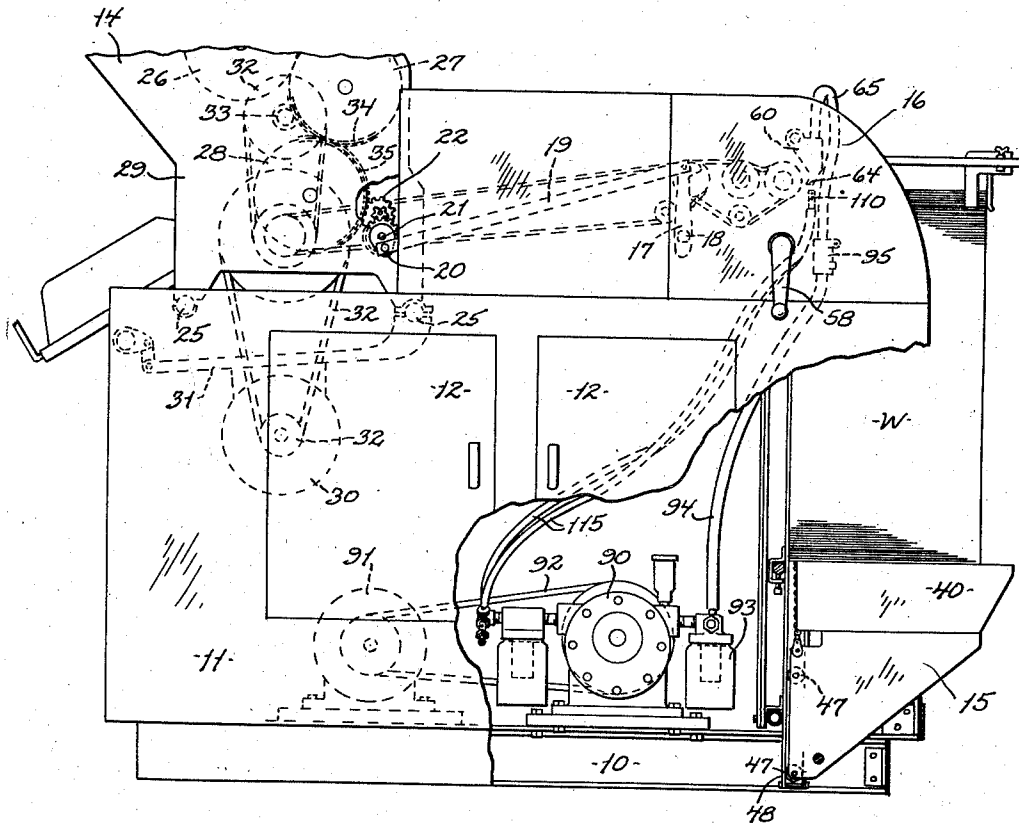


FIG. 1

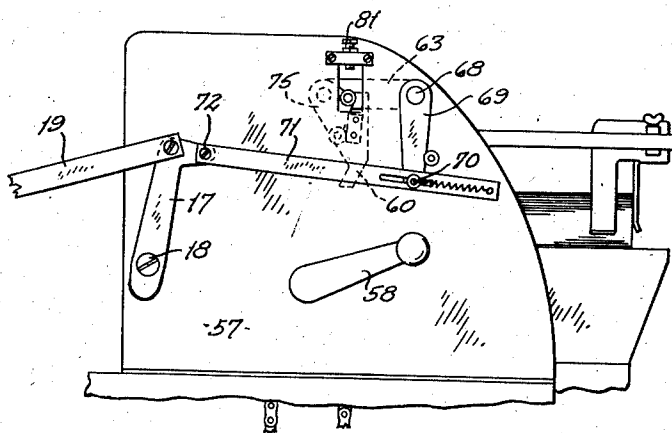


Fig. 2

INVENTOR.

FRANKLIN E. CURTIS

BY *Bates, Teare, & McBean*

ATTORNEYS

Aug. 18, 1942.

F. E. CURTIS

2,293,046

SHEET SEPARATING MECHANISM

Original Filed Feb. 8, 1941

3 Sheets-Sheet 2

Fig. 4

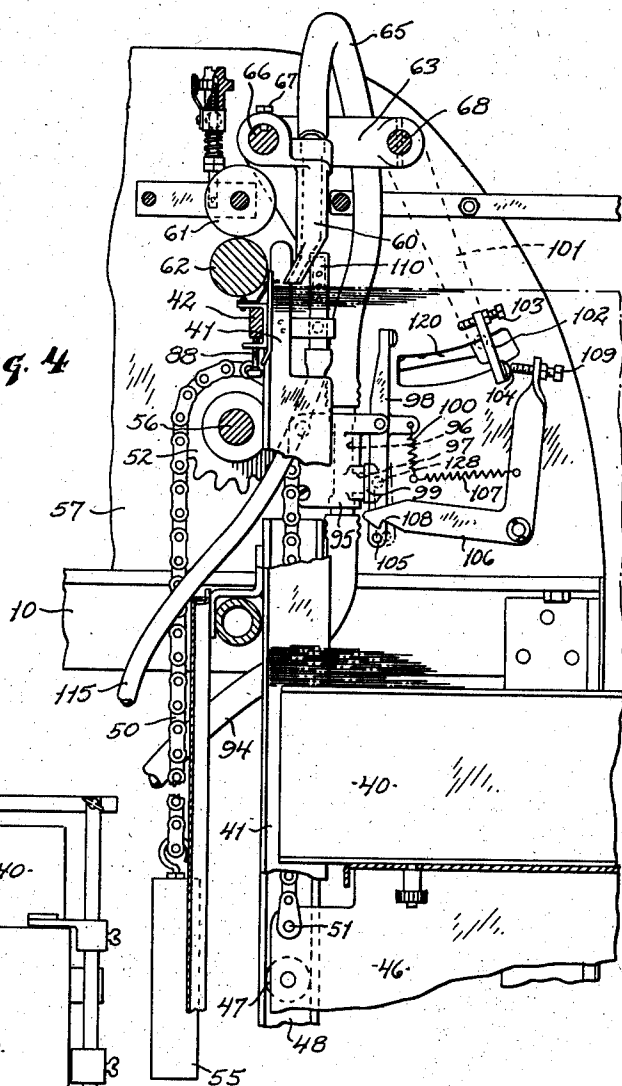
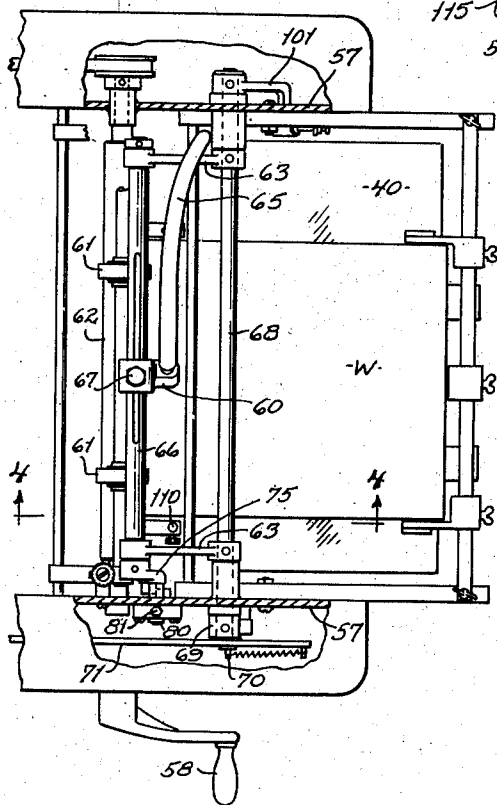


Fig. 3



INVENTOR.

FRANKLIN E. CURTIS

BY

Bates, Teare, & McBean

ATTORNEYS

Aug. 18, 1942.

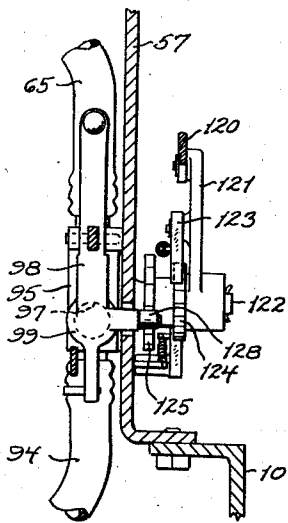
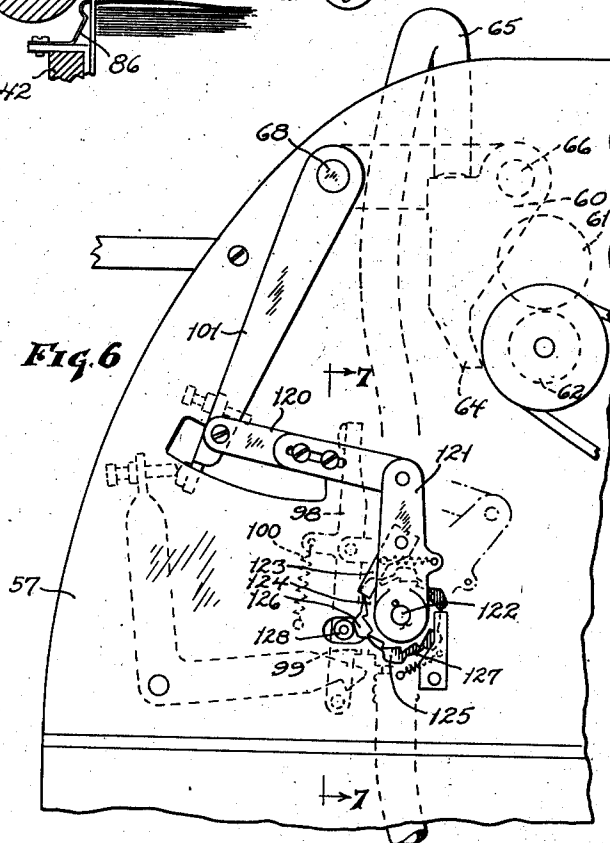
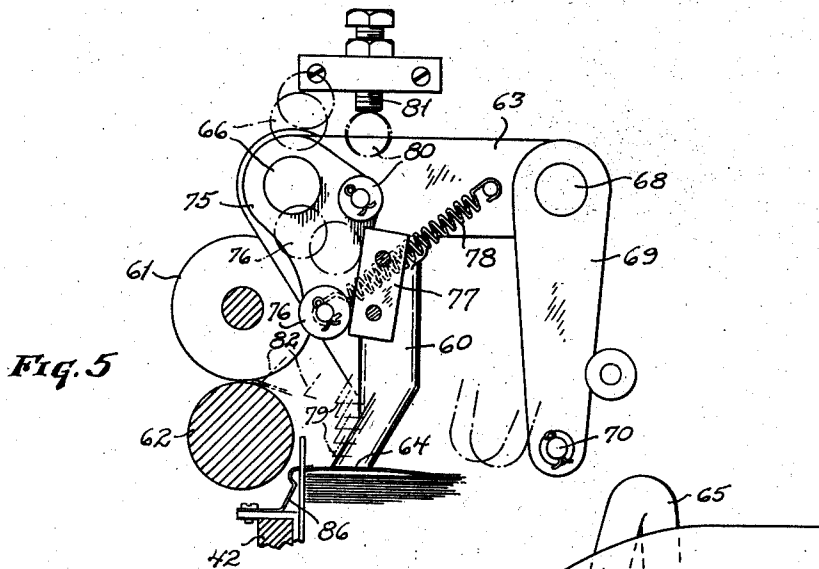
F. E. CURTIS

2,293,046

SHEET SEPARATING MECHANISM

Original Filed Feb. 8, 1941

3 Sheets-Sheet 3



INVENTOR
FRANKLIN E. CURTIS
BY *Bates, Teare, & McBean*
ATTORNEYS

Patented Aug. 18, 1942

UNITED STATES PATENT OFFICE

2,293,046

2,293,046

SHEET SEPARATING MECHANISM

Franklin E. Curtis, Willoughby, Ohio, assignor to
Addressograph-Multigraph Corporation, Cleve-
land, Ohio, a corporation of Delaware

Original application February 8, 1941, Serial No.
370,834. Divided and this application May 13,
1941, Serial No. 393,209

13 Claims. (Cl. 271-28)

This invention relates to improvements in sheet separating and feeding mechanisms and is a division of my copending application for Sheet feeding mechanism, filed February 8, 1941, and assigned Serial No. 370,834. The present invention is particularly concerned with a sheet separating and feeding mechanism which withdraws sheets one at a time from the top of a stack or pile of sheets and feeds them to another mechanism.

The general object of the present invention is to provide an improved sheet separating and feeding mechanism which will separate and withdraw sheets one at a time from a stack or pile of sheets and deliver them to and in timed relationship with another mechanism, such as a printing machine.

A more specific object of the present invention is to provide an improved pneumatic sheet separating mechanism for removing sheets one at a time from the top of a stack of sheets and feeding the separated sheet into another mechanism, as for instance, a pair of coating feed rolls which complete the removal of the sheet from the stack.

Another object of the present invention is to provide an improved sheet separating mechanism, which will effectively separate and remove sheets one at a time from the top of a stack of sheets at a relatively high rate of speed.

Other objects and features of this invention will become more apparent from the following description, reference being had to the accompanying drawings in which there is illustrated a preferred embodiment of the invention. The essential features of the invention will be summarized in the claims.

In the drawings, Fig. 1 is a side elevation of a duplicating machine in which the sheet separating and feeding mechanism of the present invention is incorporated, the entire mechanism being mounted in a common cabinet, a part of which has been broken away to illustrate certain power operating mechanism; Fig. 2 is an enlarged side elevation of the sheet separating and feeding mechanism with certain cover plates removed; Fig. 3 is a plan view of the mechanism shown in Fig. 2; Fig. 4 is an enlarged sectional view of the sheet separating and feeding mechanism, the plane of the section being indicated by the lines 4-4 on Fig. 3; Fig. 5 is an enlarged detail of the pneumatic sheet separating member and certain associated mechanism; Fig. 6 is a fragmentary elevation of the separating unit as viewed from the far side of Fig. 1, and Fig. 7 is a sectional detail as indicated by the lines 7-7 on Fig. 6.

Referring now to the drawings, wherein there is illustrated a preferred form of the invention, and particularly to Fig. 1, there is shown a frame 10 enclosed by a cabinet 11 which is provided with

doors 12 to permit access to the interior thereof. Mounted on the frame at the upper left hand end as viewed in Fig. 1, is a printing machine 14. At the right hand end of the cabinet there is a stack or pile support 15, which supports a stack of work sheets W to be separated and fed one at a time to the printing machine. Atop the cabinet, adjacent the pile support, is the sheet separating device 16 with which the present invention is particularly concerned and which separates the top sheet from the pile and progresses it to a delivery table and sheet feeding mechanism interposed between the separating device and the printing mechanism. The delivery table and feeding mechanism is not illustrated in detail. However, reference may be had to my copending application heretofore mentioned, for a complete description of such mechanism.

The printing machine shown in the drawings is a planographic duplicating machine. It is supported on a pair of cross bars 25 of the frame 10, and comprises a pattern roll 26, an offset roll 27, a platen roll 28, and an inking mechanism (not shown). The various rolls of the printing machine are journaled in suitable side plates, one of which is shown at 29 in Fig. 1.

The printing mechanism is driven by a motor 30 mounted on a bracket 31 disposed within the cabinet 11. Suitable driving elements, including belts and pulleys 32 interconnect the motor 30 with a gear 33, which meshes with a gear 34 carried by the offset roll 27, thus driving the latter. The pattern roll 26 is driven by frictional engagement with the offset roll in the usual manner. The platen roll is driven by a gear 35 carried thereby and which meshes with the gear 34.

The paper table 15 which supports the pile or stack of sheets W to be fed, is best illustrated in Figs. 1, 3, and 4. As there shown, the stack of sheets W is supported on a table 40, with its forward corners seated in vertically extending guides 41, which are adjustable transversely of frame members 42. The paper table 40 is slidably mounted for vertical movement in the frame 10. The table 40 may be raised at periodic intervals to maintain the uppermost sheet in the stack substantially in a predetermined plane where it may be conveniently engaged by the sheet separating mechanism 16 hereinafter to be more fully described.

As illustrated in Figs. 1 and 4, the paper table 40 is provided with a pair of side flanges 45, each of which carries a pair of rollers 47. These rollers project outwardly from the sides of the table 40 and engage the flanges of vertically extending channels 48 carried by the frame 10 thus guiding the table for vertical movement.

The table 40 is supported by a pair of chains, one of which is shown at 49 in Fig. 4. These chains are attached to respective side flanges 46

of the table 40 as at 51, and extend upward to respective sprocket wheels 52 and thence downward. Counterweights 55 are secured to the depending free ends of each chain. The sprocket wheels 52 are secured to a cross shaft 56 which is journaled in the side plates 57 supported by the frame 10. This shaft extends through the near side plate 57 (Fig. 2) and is provided with a crank 58 of which the shaft may be rotated to raise and lower the table 40. If desired, the stack supporting table 40 may be automatically raised whenever the top of the stack drops below a predetermined level. A preferred form of power operated mechanism and a control therefor to periodically raise the table 40 is shown and described in my copending application heretofore referred to.

The sheet separating mechanism with which the present invention is particularly concerned will now be described. The top sheet in the stack W is separated from the rest of the stack and fed to a pair of feed members 61 and 62 by a suction foot 60. This foot is first moved into contact with the uppermost sheet in the stack. Suction is then applied to the foot causing the contacted sheet to adhere thereto. The foot is then raised to separate the forward portion of the top sheet from the remaining sheets in the stack. The foot is then moved forward completing the separation of the sheet and carrying it forward into the bite of the feed rolls 60 and 61 which are disposed forward of the stack as indicated in Fig. 5. As the foot inserts the sheet in the bite of the rolls 61, 62, the suction is removed releasing the sheet, whereupon the rolls complete the removal of the sheet from the stack. As the rolls withdraw the sheet, the suction foot moves rearwardly and begins to move toward the top of the stack to start another cycle of operation.

The suction foot 60 comprises a hollow casting, the lower end 64 of which is open, and the upper end of which is connected by a flexible conduit 65 and other means hereinafter to be described to a vacuum pump 90. The foot 60 is adjustably secured to a shaft 66 by a set screw 67 to facilitate adjustment transversely of the feeding mechanism.

The suction foot is operated in timed relation with the printing machine. As illustrated in Figs. 3 and 4, the shaft 66 carrying the suction foot is journaled at its ends in a pair of arms 63 which are secured to a cross shaft 68 rotatably mounted in the side plates 57. As illustrated in Figs. 2 and 3, the shaft 68 has secured to its outer end a lever 69, the lower end of which has a pin and slot connection 70 with a bar 71 pivotally connected, as at 72, to the upper end of a lever 17. This lever is pivoted at 18 to a frame plate 57 of the separating mechanism, and is connected by a link 19 with a crank arm 20 of the printing machine. The crank 20, as illustrated in Fig. 1, is mounted on a shaft 21 of the printing machine and is drivingly connected by gearing 22 with the platen roll gear 35 heretofore described. Thus the lever 17 is rocked in timed relation to the rotation of the platen roll. The relationship illustrated is such that the lever 17 operates once during each revolution of the platen roll.

The periodic rocking of the lever 17 above described results in the rocking of the shaft 68 and imparts an up-and-down movement to the foot-carrying shaft 66. As heretofore mentioned, the suction foot first raises, and then swings

forward to move the sheet to the bite of the feed rolls 61 and 62. This operation and movement is best illustrated in Fig. 5. As there shown, an arm 75 is secured to the foot-carrying shaft 66 and is provided at its lower end with a roller 76 which is drawn by a spring 78 into engagement with a guide block 77 secured to a side plate 57. This guide block (Fig. 5) inclines upwardly and rearwardly so that as the shaft 68 and arms 63 rock in a clockwise direction (Fig. 5), the lower end of the suction foot moves upward, substantially vertically, as indicated by the progressive series of dotted lines 79. When the foot 60 reaches the position indicated by the uppermost of these lines, a second roller 80, carried by the arm 75 is engaged by an adjustable but relatively stationary abutment 81. Continued rocking of the parts about the axis of the shaft 68 then causes the suction foot 60 to swing in a clockwise direction about the moving axis of the shaft 66, moving the foot toward the bite of the feeding rolls as indicated by the series of dotted lines 82. This movement of the suction foot has been found to be highly efficient in separating the top sheet from the stack and enables the feeding of sheets of various thicknesses at relatively high speeds.

Another feature of the present invention which assists in the separation of the sheets is shown in Figs. 4 and 5. At the front of the stack of sheets W, there is a transversely extending frame bar 42 heretofore mentioned. Adjustably mounted on this bar and extending over the front edge of the stack is one or more flat spring fingers 86. These fingers are each adjustably positioned on the bar 42 by adjusting screw 88 and are normally spaced a predetermined distance above the uppermost sheet W of the stack and above the lowermost position of the sheet engaging surface 61 of the suction foot. It will be noted from Fig. 5, that these spring fingers project inwardly above the stack a comparatively short distance, hence, as the suction foot raises a sheet W from the stack, the innermost end of the sheet is drawn with a wiping motion past the end of the finger. Should two or more sheets tend to raise with the suction foot, this wiping movement generally causes all but the top sheet to return to the stack.

A combined motor driven pump 90 provides the suction supply for the foot 60. This pump is best illustrated in Fig. 1, and as there shown, is mounted within the cabinet 11 on a cross frame member of the frame 10. A motor 91, also mounted within the cabinet 11, is drivingly connected with the pump by a driving belt 92. The suction side of the pump 90 is connected with a filter 93 which in turn is connected with a valve 95 by a conduit 94. The valve is connected with the suction foot by a flexible conduit 65 heretofore described.

The pressure side of the pump 90 is connected by a pair of conduits 115 to respective jets 110 disposed at opposite sides of the stack of sheets. As shown in Figs. 1, 3, and 4, these jets direct air under pressure toward the sides of the uppermost sheets in the stack. The jets are positioned adjacent the forward edges of the stack and direct blasts of air beneath the forward portion of each sheet while it is being lifted by the suction foot.

The suction to the foot 60 is controlled by opening the valve 95 to atmospheric pressure. The valve 95 is best shown in Fig. 4, and com-

prises a valve body having a through passage-way 96, the opposite ends of which are in communication with the conduits 65 and 94, respectively. Intermediate its ends the valve body is provided with a port 97, which when closed, brings the suction side of the pump into direct communication with the suction foot 60. However, when this port is opened, the suction to the foot is broken by atmospheric pressure entering the port.

The valve port 97 is opened and closed in timed relationship with the operation of the suction foot 60. Pivoted to the body of the valve 95 is a lever 98 which carries a closure 99 for the port 97. A spring 100 normally retains the closure seated against the valve port. In Fig. 4, the parts are shown in the positions they assume immediately after the closing of the valve port to apply suction to the foot 60. It will be remembered that the foot is raised and swung forward by the clockwise rotation of the shaft 68. Secured to this shaft is a lever 101 having an inwardly extending portion 102 which carries an adjustable screw 103 and a contactor 104. As the shaft 68 swings to cause a sheet to be fed, the lever 101 swings toward the upper end of the valve lever 98 and as the feed rolls 61 and 62 are about to grip the sheet, the screw 103 contacts the lever 98 opening the port 97 and causing the sheet to be released from the suction foot.

When the valve closure lever 98 moves to open the valve port, a pin 105 carried thereby engages and cams upward one arm of a bell crank 106. A spring 107, interposed between the bell crank and a frame plate 57 then causes a latch portion 108 of the bell crank to engage the pin 105 and retain the valve closure 99 in an open position. On the return stroke of the foot 60, the swinging of the shaft 68 in a counterclockwise direction causes the contactor 104 of the lever 101 to engage an adjustable screw 109 on the upper arm of the bell crank 106 and move the latch portion thereof out of engagement with the port closure lever 98, closing the port and returning the parts to the position illustrated in Fig. 4.

The adjustability of the screw 103 which contacts with the lever 98 to open the port 97 of the valve 95 to relieve the pressure in the vacuum line 65 enables the release of the sheet W from the foot 60 to be accurately timed. By adjusting the timing of this releasing action and by controlling the forward limit of movement of the suction foot through the adjustment of the abutment 81 heretofore described, the mechanism may be adjusted to feed sheets at a relatively high rate of speed.

As under normal conditions it is desirable to feed a sheet with each revolution of the printing machine rolls, an arrangement is provided to cause the sheet separating mechanism to become effective to separate a sheet from the stack either every revolution of the printing rolls or alternate revolutions as desired. This is preferably accomplished by controlling the operation of the suction relief valve 99.

As illustrated in Figs. 6 and 7, the suction relief valve 99 is controlled to render the feeding mechanism effective on alternate cycles of operation only, by a device which latches the valve open every other cycle of operation of the mechanism and thus permits the removal of a sheet W from the stack of sheets only on alternate cycles of operation of the suction foot 60.

As heretofore described, the arm 101 makes one complete oscillation in each cycle of operation of the feeding mechanism. A link 120 is pivotally interconnected between the arm 101 and a pawl carrier 121 which is pivoted on a shaft 122 carried by the adjacent frame plate 57. A pawl 123, pivoted to the carrier 121 in the usual manner, engages a ratchet wheel 124 and advances the latter a distance of one tooth during each cycle of operation.

The intermittent advancement of the ratchet wheel controls the movement of the valve lever 98. Secured to the ratchet wheel 124 is a cam disc 125 having high points 126 and low points 127. Secured to the valve lever is a roller 128 which is drawn toward the cam disc by the valve lever closing spring 100 heretofore described. The cam disc is so arranged that when a high point 126 contacts the roller 128, the valve lever will be retained in an open position, and when a low point 127 lies opposite the roller 128, the spring 100 will move the lever into a valve closing position. In the embodiment illustrated, the high and low points of the cam are alternately arranged and are of such a nature as to permit the valve 99 to be closed only on alternate cycles of operation. This renders the sheet feed ineffective without disturbing the movement of the parts.

I claim:

1. In a sheet feeding mechanism, a frame, a pair of feeding rolls carried by said frame, a support for a stack of sheets to be fed, a sheet separator, a member pivoted at one end relative to said frame and pivotally supporting said separator at its other end, means to oscillate said member to move said separator upward away from the top of a stack, and means acting on said separator after it has moved upward a predetermined distance to swing said separator toward said rolls.

2. In a sheet feeding mechanism, a frame, a pair of feeding rolls carried by said frame, a support for a stack of sheets to be fed, a sheet separator, an oscillatable member pivoted at one end relative to said frame and pivotally supporting said separator at its other end, means to resiliently retain said separator in a predetermined position relative to said member, means to swing said member to move said separator substantially upward away from the top of a stack, and means acting on said separator after it has moved upward a predetermined distance to swing said separator toward said rolls.

3. In a blank separating mechanism, a frame, a pair of coacting feed rolls mounted in said frame, means to support a stack of superposed sheets, a member oscillatable about a fixed axis relative to said frame, a sheet separator pivotally connected at one end to said member at a point spaced from said axis, resilient means to normally retain said separator in a position depending toward the stack of sheets, means to swing said member, and an adjustable abutment adapted and arranged in the path of said separator to swing the separator about its pivotal connection with said member.

4. In a blank separating mechanism, a frame, a pair of coacting feed rolls mounted in said frame, means to support a stack of superposed sheets, a member oscillatable about a fixed axis relative to said frame, a sheet separator pivotally connected at one end to said member at a point spaced from said axis, resilient means to retain said separator normally in a position depending

toward the stack of sheets, means to swing said member to move said separator toward and away from said stack, means coacting with said separator to cause it to move substantially vertically during the first portion of the raising movement, and an adjustable abutment adapted and arranged to coact with said separator during a subsequent portion of its raising movement to swing the separator toward said rolls.

5. In a sheet feeding mechanism, a frame, a pair of feeding rolls carried by said frame, a support for a stack of sheets to be fed, a pivoted arm, a sheet separating member pivotally mounted on said arm, means to rock said arm and member as a unit to move said separating member substantially upward away from said stack, and means acting on said member after it has been moved upward a predetermined distance to swing said member about its pivotal connection with said arm consequent upon the continued rocking of said arm and thereby move said member forward toward said feeding rolls.

6. In a sheet feeding mechanism, a frame, a pair of sheet feeding rolls carried by the frame, a support for a stack of sheets to be fed, a suction sheet separating foot adapted to engage and raise the top sheet of said stack, a movable member to which said foot is pivoted, a roller on an axis rigid with said foot, a guide engaged by said roller, a spring tending to keep the roller in contact with the guide, and an abutment adapted to be engaged by means rigid with the foot and back of the pivot thereof, whereby as said member moves upwardly the foot may move upwardly under the control of said guide until said abutment is engaged after which the continued upward movement of the member swings the foot toward the pair of sheet feeding rolls.

7. In a sheet feeding mechanism, a frame, a pair of feeding rolls carried by said frame, a support for a stack of sheets to be fed, a sheet separating member, a bar on which said separating member is secured, a pair of arms each of which is pivotally connected at one end to said frame, said bar being journaled in the other end of said arms, a crank arm secured to said bar, a guide carried by said frame, means to resiliently retain the crank arm in contact with said guide and cause said separating member to move upward away from said stack consequent upon the rocking of said arms about their pivotal connection, and means acting on said crank arm after said foot has moved upward a predetermined distance to swing said crank arm and separating member about the axis of said bar consequent upon the continued rocking of said arms.

8. In a sheet feeding mechanism, a frame, a pair of sheet feeding rolls carried by said frame, a support for a stack of sheets to be fed, a suction sheet separating foot adapted to engage and raise the top sheet of said stack, a bar to which said foot is secured, a shaft journaled in said frame, a pair of spaced arms each of which is secured at one end to said shaft, said bar being journaled in the other end of said arms, a plate secured to said bar, a roller carried by said plate, a cam carried by said frame, a resilient means to retain the roller in contact with said cam to cause said foot to move substantially upward away from said stack consequent upon the rock-

ing of said shaft, and an abutment adapted and arranged to engage said plate after said foot has moved upward a predetermined distance to swing said plate and foot about the axis of said bar against the action of said resilient means and consequent upon continued rocking of said shaft to move the raised sheet forward into the bite of said rolls.

9. In a sheet separating mechanism, a pair of feed rolls, a support for a stack of sheets, a suction device movable between said stack and said rolls, a source of vacuum pressure, a connection between said source and said suction device, means to adjustably control the time of application and release of vacuum to said device, and adjustable means to limit the movement of said device toward said rolls.

10. In a sheet separating mechanism, a pair of feed rolls, disposed one above the other, means to support a stack of sheets with the uppermost sheet in a plane normal to a plane passing through the axes of said rolls and below the bite thereof, a suction device movable in a substantially vertical direction to and from said stack and in a transverse direction toward and away from said rolls, a source of vacuum pressure, a connection between said source and said suction device, a valve to control the application and release of vacuum to said device, and adjustable means to operate said valve and means to adjustably limit the movement of said device toward said rolls.

11. In a sheet feeding mechanism, a support for a stack of sheets, a suction foot suspended above the stack, means to move said foot into contact with the top sheet in the stack, suction producing means, a suction relief valve, means to move said foot and a sheet adhering thereto away from said stack, means connected with said foot to open said relief valve when the sheet reaches a predetermined distance from said stack, releasable means to hold said valve open while said foot returns to contact the next succeeding sheet in the stack, and means operated by said foot to release said last named means to cause the next succeeding sheet to adhere to said foot.

12. In a sheet feeding mechanism, a frame, a pair of feeding rolls carried by said frame, a support for a stack of sheets to be fed, a sheet separator, a rod on which the separator is adjustably mounted, an oscillatable shaft, a pair of rock arms thereon carrying said rod, means to rock the shaft to lift the separator from the stack, and means acting on said separator after it has moved upward a predetermined distance to swing said separator toward said rolls.

13. In a sheet feeding mechanism, a frame, a pair of sheet feeding rolls carried by the frame, a support for a stack of sheets to be fed, a suction sheet separating foot adapted to engage and raise the top sheet of said stack, a pivotally mounted member to which the foot is pivoted, a guide acting on the foot between its pivot to said member and its free end, to control the position of the mouth of the foot in the first part of its upward movement, and means for swinging the foot away from the guide and toward the feed rolls in the latter part of the upward movement of the foot.

FRANKLIN E. CURTIS.