

Feb. 15, 1938.

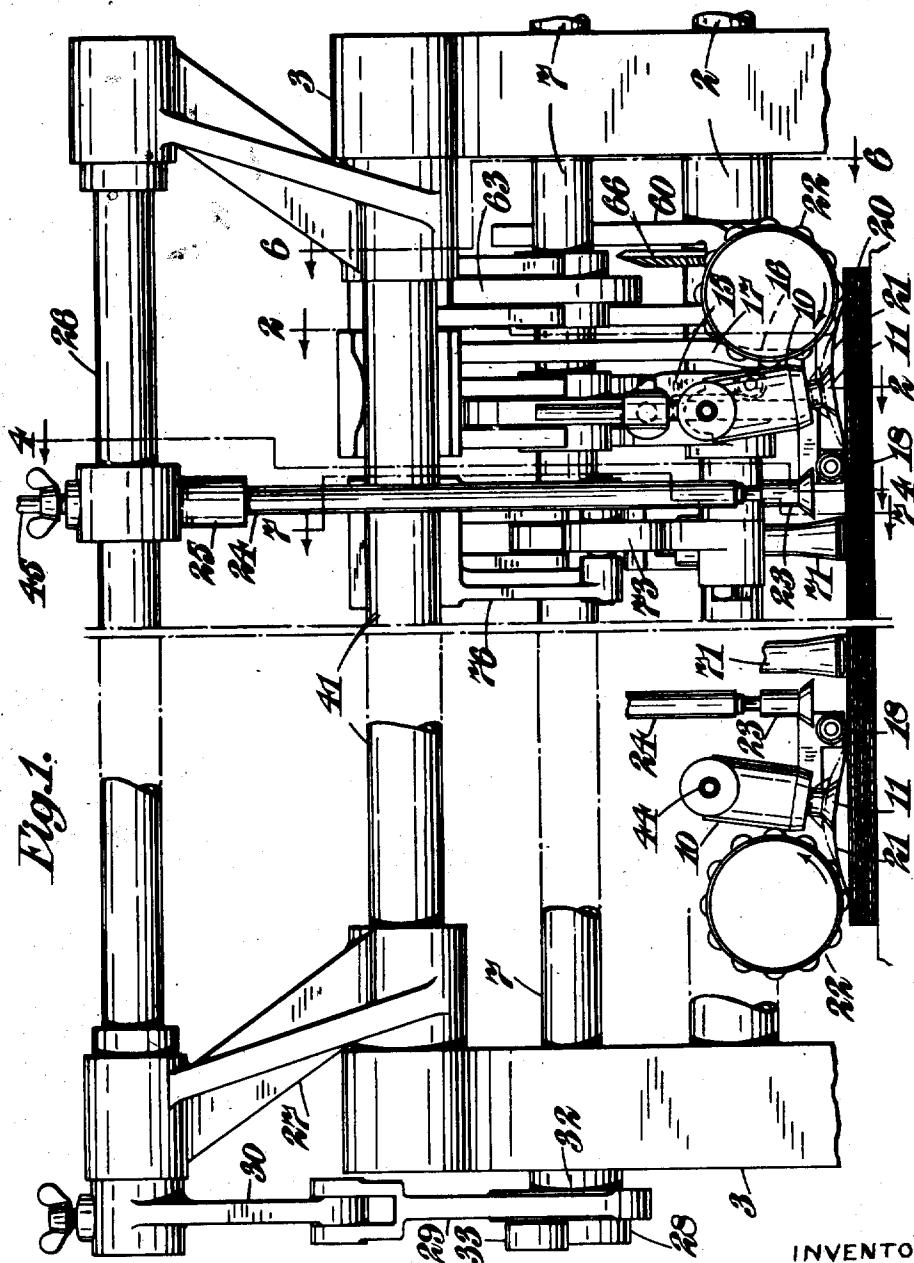
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2,108,702

AUTOMATIC SHEET FEEDING MACHINERY

Original Filed Aug. 4, 1934

6 Sheets-Sheet 1



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AUTOMATIC SHEET FEEDING MACHINERY

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6 Sheets-Sheet 2

Fig. 2.

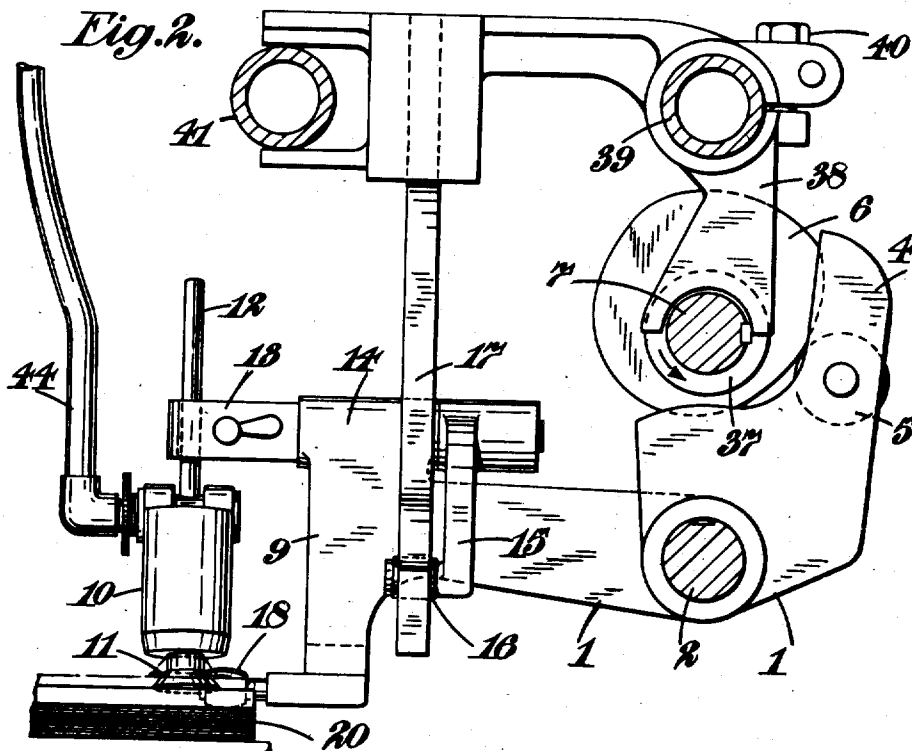
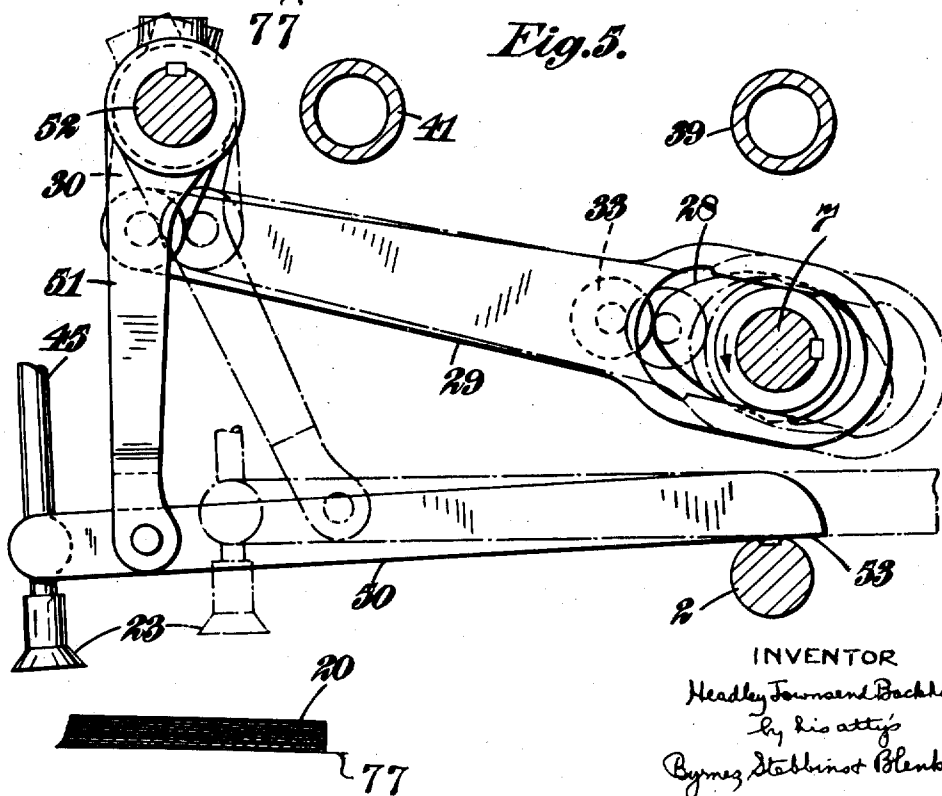


Fig. 5.



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6 Sheets-Sheet 3

Fig. 3.

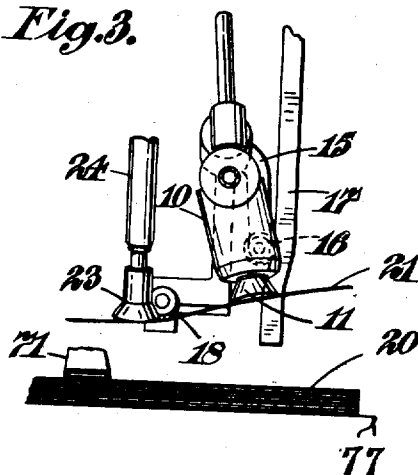
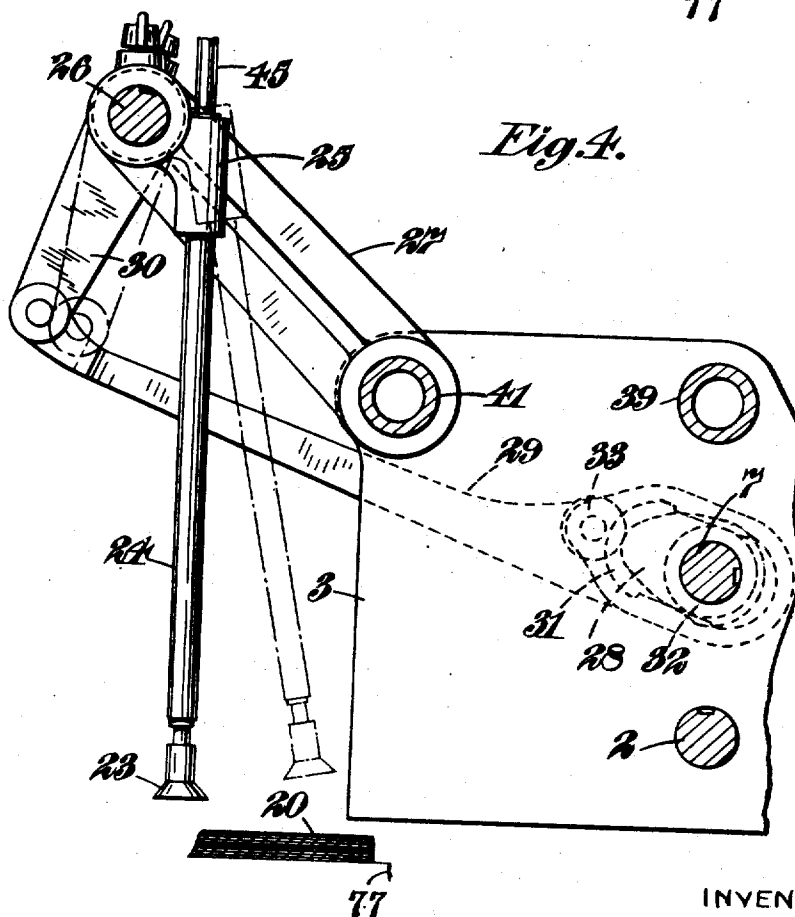


Fig. 4.



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AUTOMATIC SHEET FEEDING MACHINERY

Original Filed Aug. 4, 1934

6 Sheets-Sheet 4

Fig. 6.

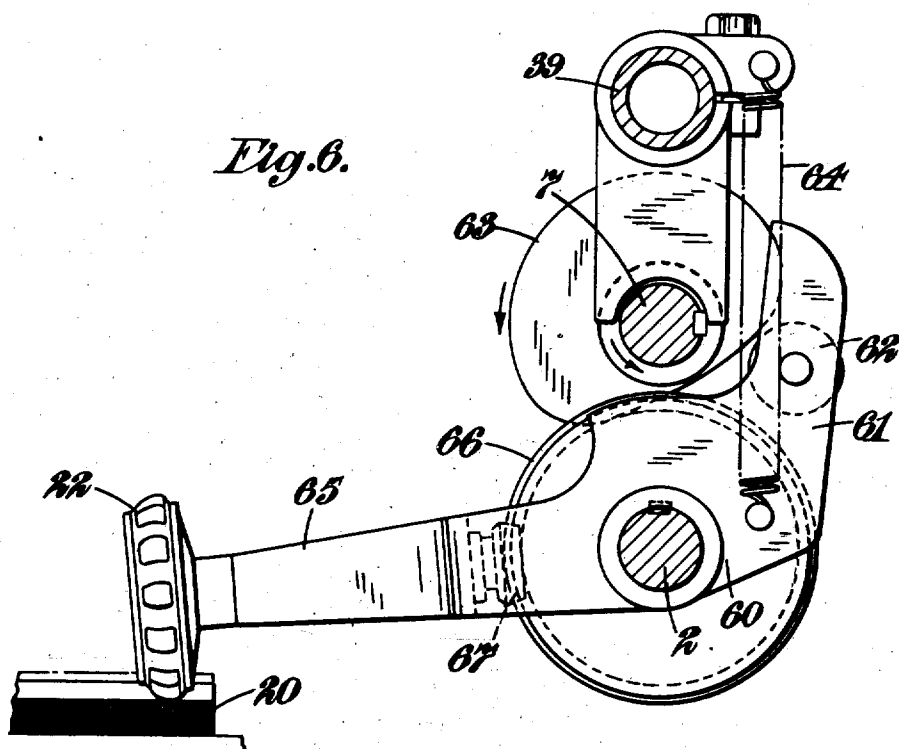
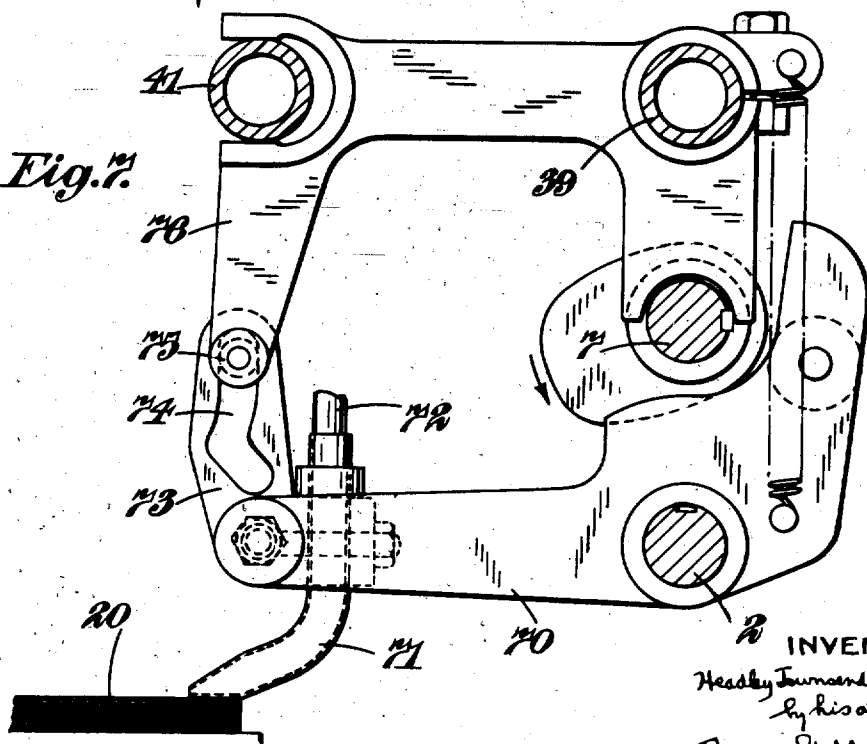


Fig. 7.



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AUTOMATIC SHEET FEEDING MACHINERY

Original Filed Aug. 4, 1934

6 Sheets-Sheet 6

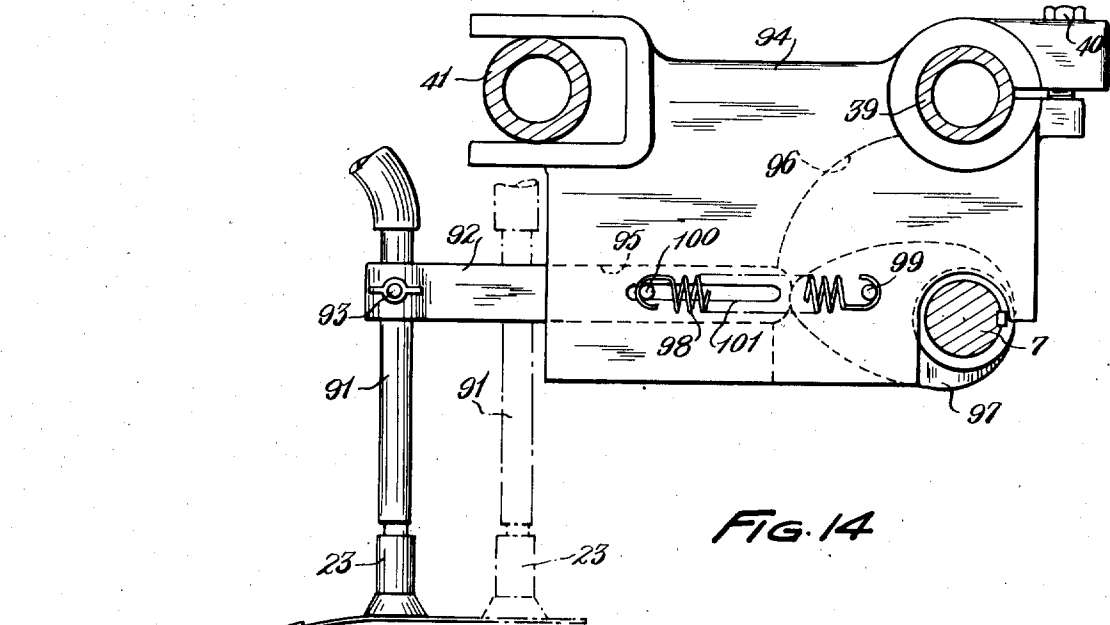


FIG. 14

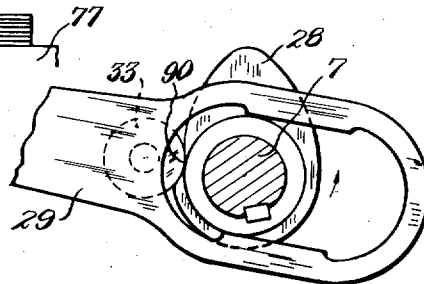


FIG. 13

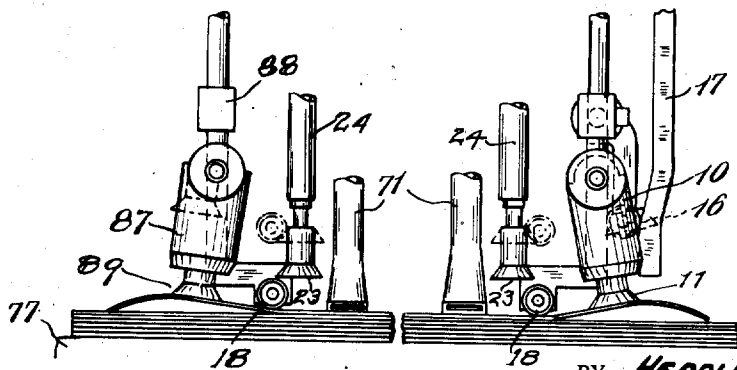


FIG. 12

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2,108,702

AUTOMATIC SHEET FEEDING MACHINERY

Headley Townsend Backhouse, St. John's Wood,
London, EnglandApplication August 4, 1934, Serial No. 738,500.
Renewed February 25, 1936. In Great Britain
October 26, 1933

72 Claims. (Cl. 271—20)

This invention consists in improvements in automatic sheet feeding machinery for feeding sheets of paper or similar material one at a time from the top of a pile and is particularly concerned with machinery of the type in which moving of the sheets from the top of the pile is effected by suction devices which are mounted above the top of the pile and are given appropriate movements while suction is applied and the sheet is engaged.

In accordance with those embodiments of the invention which are herein illustrated and described, one set of suckers is employed for raising the sheet from the pile, and a second set is arranged to grip the sheet at or towards the end of the lifting movement and then to transport it in a forward direction towards a printing press or other sheet handling machine.

A feature of the invention provides, in a machine of the kind described means, operable while the lifting suckers are gripping a sheet, to effect relative movement between the suckers in a direction away from one another so as to stretch the sheet and straighten out that portion of it which is between the suckers. Preferably the relative movement between the suckers to stretch the sheet is effected during the lifting movement of the suckers.

In one embodiment of the invention the forwarding suckers are carried by levers pivoted to arms arranged to oscillate about a fixed axis to cause the forwarding and return movements of the suckers, and, during the swinging movement of the arms, the levers slide on a fixed frame member remote from their connection to the arms so as to maintain the suckers substantially vertical.

Preferably the lifting and forwarding suckers are both arranged to operate near the rear edge of the sheet, whereby the invention lends itself particularly to what is known in the art as stream feeding, that is feeding in which several sheets are traveling forward in stepped relation, the last sheet fed underlapping the previously fed sheet, that sheet underlapping the one which went before it, etc.

One of the objects of the invention is the provision of a pair of stops always moving up and down to the same extent above the rear edge of the pack, and a pair of suckers arranged outwardly of the stops and moving vertically to an extent different from that of the stops, whereby the rear edge of the sheet may be stretched across said stops and may be thereby presented with accuracy to the forwarding suckers.

One of the objects of the invention therefore is the provision of novel means for separating sheets from a pile, and forwarding them.

Another object is the provision of means for presenting to the forwarding suckers a transversely straightened portion of the sheet.

Another object is the provision of means for imparting a forwarding impulse to the rear edge of a sheet by causing the gripping suckers to move downwardly and forwardly in a curved path, producing the effect of stiffening the sheet.

Still another object is the provision of means for stretching the sheet transversely in engagement with the lower surfaces of a pair of spaced stops which are arranged to have a predetermined movement up and down.

A further object is the provision of sheet feeding means which shall be particularly adaptable to the stream feeding of sheets.

Other objects and features of novelty will appear as I proceed with the description of those embodiments of the invention which, for the purposes of the present application, I have illustrated in the accompanying drawings, in which—

Figure 1 represents a front elevation of a sheet feeding machine according to the invention with the centre portion and details unnecessary for the understanding of the invention omitted, and with the parts in the position corresponding to the commencement of the lifting operation;

Figure 2 is a view in the direction of the arrows 2—2 in Figure 1 showing details of the sheet lifting mechanism;

Figure 3 is a front elevation of one of the sheet lifting mechanisms and associated forwarding sucker, with the parts in the position corresponding to the completion of the lifting operation;

Figure 4 is a section on the line 4—4 in Figure 1 showing details of the sheet forwarding mechanism in the position corresponding to the end of the forwarding stroke and to the commencement of the lifting movement of the lifting suckers;

Figure 5 is a view similar to Figure 4, but showing an alternative form of the sheet forwarding mechanism;

Figure 6 is a section on the line 6—6 in Figure 1 showing details of the sheet combing mechanism with the comb resting on the paper, and

Figure 7 is a section on the line 7—7 in Figure 1 showing details of the second sheet stop mechanism with the stop resting on the paper.

Figs. 8 and 9 are diagrammatic plan and elevational views respectively of an embodiment of the invention wherein an intermediate set of

lifting and forwarding suckers is employed between the outer sets.

Fig. 10 is a view similar to Fig. 8, wherein two sets of lifting and forwarding suckers are arranged intermediate the outer sets.

Fig. 11 is a detail view similar to Fig. 2 showing the mounting and operating mechanism for the intermediate lifting suckers illustrated in Figs. 8, 9 and 10.

Fig. 12 is an elevational view in the same plane as Fig. 1, illustrating another embodiment of the invention wherein one lifting sucker only is swung laterally for the purpose of tensioning the sheet.

Fig. 13 is an enlarged detail view of another embodiment of the invention including cam means for swinging the forwarding suckers, the cam being constructed to move the forwarding sucker rearwardly a short distance to break the sheet loose from the pile before the sucker is moved forwardly by said cam to advance or forward the sheet.

Fig. 14 is a view similar to Figs. 4 and 5, illustrating another embodiment of the invention including operating means for any of the sheet forwarding suckers shown in Figs. 1, 3 to 5 inclusive, 8 to 10 inclusive and 12.

Like reference numerals refer to like parts throughout the several figures of the drawings.

Referring first to Figures 1, 2 and 3 the lifting mechanism at each end of the machine comprises a bell-crank 1 mounted for partial rotation on a shaft 2 extending right across the machine and supported at each end in frame members 3. One arm 4 of this bell-crank is forked and carries between the arms of the fork a roller 5 which runs, as a follower, on a cam 6 mounted on a rotatable driving shaft 7 parallel to the shaft 2 and supported in bearings in the frame members 3. The roller 5 is kept in contact with the cam by means of a spring (not shown) suitably attached to the bell crank and to member 3 in a manner similar to the arrangement shown in Figure 6 and later described. The other arm 9 of the bell-crank carries a suction head 10 provided with a rubber sucker 11 of known type. The suction head 10 is formed with an extension in the form of a rod 12 which may be slid through a hole in a substantially horizontal shaft 13 to adjust the height of the sucker 11 and may then be secured in position in the shaft. The shaft 13 is rotatably mounted in a bearing 14 on the bell-crank arm 9 about a substantially horizontal axis in a plane at right angles to the shaft 2 and is provided, on the side of the bearing 14 remote from the suction head, with a dependent arm 15 secured to the shaft and having at its end a roller 16 which co-operates with a fixed cam 17 during the rise and fall of the suction head under the action of the cam 6. This cam 17 has a short vertical portion at the bottom, above this a short portion inclined outwardly towards the adjacent frame member 3 and then a second vertical portion. The roller 16 is kept in contact with the cam by means of a spring 102 Fig. 8 acting on the arm 15.

The arm 9 also carries a roller 18 which, in the position shown in Figure 1, rests on the top of the pack of paper 20 and constitutes a stop which limits the extent of the hump 21 produced in the top sheet by the rotatable comb 22.

It will be seen that this stop 18 is not adjustable on the bell crank arm 9 and that in consequence it invariably lifts to the same height on rotation of the cam 6 and that, therefore, the

transfer of the sheet to the forwarding sucker as shown in Figure 3 always occurs at the same position of the forwarding sucker. Any relative adjustment required between the lifting suckers and the stops 18 is obtained by adjustment at the suction head 10.

Turning now to Figures 1 and 4, the forwarding mechanism consists of a sucker 23 attached to one end of a rigid tube 24, the other end of which is adjustably secured in a bracket 25 mounted on a shaft 26, carried on brackets 27 and arranged for oscillation therein. The brackets could, if desired, be incorporated in the main side frames 3. The tube 24 is arranged to be so long that, as indicated in Figure 4, there is only a small change of height in the sucker as the tube swings between the limits of its travel and also the change of angle between the face of the sucker and the sheet is negligible. As in the case of the lifting mechanism a sucker is arranged at each end of the machine but in this case only one operating cam 28 is employed. This cam is carried on, and keyed to, the shaft 7 outside the frames. A link 29 connects the cam to an arm 30 keyed to the shaft 26 and has a slotted end 31 which rides on a boss 32 on the cam 28. The link also carries a roller 33 which acts as a follower to the cam 28, a suitable spring, not shown, being provided to keep the follower in contact with the cam.

An alternative way of mounting the forwarding suckers is shown in Figure 5 in which the mechanism consists of a sucker 23 fixed to one end of a lever 50 pivoted to an arm 51 mounted on shaft 52 which is supported and arranged for oscillation in the frame members 3 and is parallel to the shafts 2 and 7. The lever 50 has an extension 53 which slides on the fixed shaft 2 and the extension is kept in contact with the shaft 2 by a spring (not shown). It will be seen that if the arm 51 is oscillated about the shaft 52 from the forward position shown in full lines in Figure 5 to the back position shown in chain lines, the inclination (e. g. vertical) between the axis of the sucker 23 and the paper remains very much more nearly constant than it would do if the sucker were mounted directly upon the arm since the lever is, in effect, rotating at any instant about a point a considerable distance from the sucker. If desired, the lever can be curved in such manner that as the sucker moves away from the shaft 2 and drops towards the paper the body of the lever drops an equal amount thus ensuring that the angle of the axis of the sucker to the paper remains exactly constant. Oscillations of the shaft 52 to cause the forwarding and return movements of the suckers is effected in similar manner to the oscillation of the shaft 26 previously described.

The combing mechanism is shown in Figures 1 and 6 and consists of a bell-crank 60 mounted for partial rotation on the shaft 2. One arm 61 of this bell-crank is forked and carries between the arms of the fork a roller 62, which runs as a follower, on a cam 63 mounted on, and keyed to, the shaft 7. The roller 62 is kept in contact with the cam by means of a spring 64. The other arm 65 of the bell-crank carries a rotatable comb 22 of known kind which is driven from a bevel wheel 66 keyed on the shaft 2 engaging with a bevel wheel 67 on one end of a short shaft carried in bearings in the arm 65—the comb being secured to the other end of the shaft.

The second sheet stop mechanism is shown in Figures 1 and 7 and also comprises a bell-crank

rotatable on the shaft 2 under the action of a cam on the shaft 7 in similar manner to the lifting and combing mechanisms. The arm 70 of the bell-crank in this case carries a nozzle in the form of a foot 71 adjustable for position on the arm and intermittently supplied with compressed air through a pipe 72. This foot is carried on a second bell-crank 73 pivoted to the arm 70 and having in one arm a cam slot 74 co-operating with a roller 75 carried by a fixed member 76. The shape of the slot 74 is such that as the foot is raised under the action of the cam on the bell-crank the foot is moved backwards clear of the pile of paper and is then returned over the pile between it and the lifted sheet as the foot is lowered.

It will be appreciated that the combing, lifting, forwarding and second sheet stop mechanisms as described above are arranged one at each side of the machine near the rear edge of the pile of paper as shown and that in order to accommodate paper of varying width, it is necessary that the distance between the mechanisms should be adjustable. For this purpose the mechanisms are mounted on shafts extending across the machine as described and are so arranged that they may easily be moved along these shafts. Thus in the case of the lifting mechanism the cam 6, which is keyed to, and slidable on, the shaft 7, is closely embraced at the sides by the forked end of the arm 4 and the bell-crank 1 is slidably mounted on the shaft 2. Closely embracing bosses 37 formed on the cam 6 is a forked member 38 slidably mounted on a shaft 39 extending across the machine and provided with a bolt as shown at 40 which may be tightened to cause the member to grip the shaft. The member 38 also carries the cam 17 and is further supported by a shaft 41 as shown. To adjust the lifting mechanism across the machine it is only necessary to loosen the bolt 40 when the member 38, the cam 6 and the bell-crank 1 with its associated parts may all be moved along their respective shafts while retaining their relative positions since the cam 6 is closely embraced by both the member 38 and the bell-crank. The combing and second sheet stop mechanisms may also be adjusted across the machine in similar manner while the forwarding suckers are simply adjusted by sliding along the shaft 26.

Vacuum may be applied to the lifting and forwarding suckers through flexible tubes 44, 45 connected to a vacuum pump (not shown) through suitable valve mechanism (also not shown) which may if desired be operated from cams on the main shaft 2.

In the operation of the mechanism the comb 22 is first rotated in the direction of the arrow and in contact with the paper—the level of which is kept constant by raising the table 77 on which it is supported as the paper is removed—so as to form a small hump in the top sheet bringing it into contact with the lifting sucker to which suction is then applied, causing it to attach itself to this sheet and also causing in usual manner a small movement of the sucker into its associated head as indicated in chain lines in Figure 1. The sucker is then raised together with the roller 18 under the action of the cam 6, which is rotated by the shaft 7, on the bell-crank 1 and the sheet is lifted. As the sucker moves upward the roller 16 runs up the sloping part of the cam 17 and the suction head tilts outwardly under the action of its associated spring (which is so pro-

portioned as not to be strong enough to tear the paper) as shown in Figure 3 and the paper is stretched taking up any droop caused by the weight of the paper and the straightening of the hump 21. Towards the end of the lifting movement the second sheet stop moves under the lifted sheet, blows air between it and the pile and rests on top of the pile to prevent movement thereof and the lifted sheet is brought by the lifting suckers into contact with the forwarding suckers as shown in Figure 3 and suction is then applied to these suckers and released from the lifting suckers. The forwarding suckers then move forwardly under the action of the cam 28 and slightly downwardly as the tube 24 approaches the vertical, and the lifting suckers simultaneously move downward to operate on the underlying sheet. Towards the end of the forwarding movement of the sheet its front edge is transferred to a conveyor of any usual construction which conveys the sheets in continuous partly overlapped formation or singly (one at a time) to the printing or other operating machine, and the suction is released from the suckers, which are then returned to their original position to receive a further sheet from the lifting mechanism.

It is to be understood that the invention is not restricted to the precise constructional details shown in Figs. 1 to 7 inclusive of the drawings. In a modified form of the invention, for example, an intermediate set of lifting and/or forwarding mechanisms are arranged between the outside sets described and the lifting mechanism in this intermediate set moves vertically without itself having any movement towards or away from either of the other sets. Accordingly, in Figs. 8 to 11 inclusive I have illustrated two embodiments of the invention wherein the lifting and forwarding suckers at the rear corners of the pile are supplemented by lifting and/or forwarding suckers. The set or sets just mentioned are useful particularly where the sheets being fed are relatively wide. In Figs. 8 and 9 I have shown just one intermediate forwarding sucker 78 mounted above the pile at a point approximately midway between the outer forwarding suckers 23. This intermediate sucker may be mounted and operated like the forwarding sucker 23 in Fig. 4, or like the forwarding sucker illustrated in Figs. 5 and 14.

I have also shown in Figs. 8 and 9 one intermediate lifting and sheet supporting sucker 79 which is constructed and mounted like the outer lifting suckers 10 except that it has no movement towards or away from either of the outer lifting suckers. That is to say its movement is in a longitudinal vertical plane only. Sucker 79 may be mounted and operated by means such as illustrated in Fig. 11, wherein said sucker is shown adjustably fixed in the forward end of a bell crank 80 that is oscillatably supported by shaft 2 and has an upwardly extending rear arm that is bifurcated to straddle to some extent cam 81 slidably keyed to shaft 7 and arranged between arms 82 that are adjustable along shaft 39 and may be clamped in a desired position on that shaft by set screw 40. Between the bifurcations of the rear arm of bell crank 80 there is a cam follower 83 which is held up against cam 81 by a coil spring 84, as clearly illustrated in the drawings. The sucker 79 when engaged with and lifting a sheet has slight upward or telescoping movement in its casing 85, as in the case of the suckers 11, and said sucker 79 is connected with a suitable

source of vacuum by a flexible tube 86, which permits adjustment of the sucker mechanism transversely of the machine upon the shafts 2, 7 and 39.

In the embodiment of the invention shown in Fig. 10, where two sets of intermediate lifting and forwarding suckers are employed, the lifting suckers 79 and the operating mechanisms therefor are the same as shown in Figs. 8 and 11. The forwarding suckers 78 are the same as those shown in preceding views and may be operated by any one of the three types of forwarder operating mechanisms herein illustrated and described. As shown in Fig. 10, the forwarding suckers are preferably spaced evenly across the sheet and the lifting suckers 79 are arranged adjacent to and on one side or the other of the intermediate forwarding suckers 78, as may be convenient. In some cases it is only necessary for one lifting mechanism to move along the top plane of the pile away from the other set which may have a vertical movement only. Accordingly, in the embodiment of the invention shown in Fig. 12, only one of the lifting suckers is swung outwardly, on upward movement thereof, to tension or stretch the sheet. In this case the lifting sucker 87 at one side of the machine has reciprocating motion in a vertical plane only, it being carried in bracket 88 at the front end of a shaft corresponding to shaft 13 in Fig. 2, and said reciprocating motion of sucker 87 being imparted thereto by the same mechanism employed to impart such motion to the suckers 11. The shaft that carries sucker 87 is fixedly mounted in bearing 14 (Fig. 2) however, and it does not carry a dependent arm 15 nor a roller 16. The cam 17 is also omitted at this side of the machine. The sucker 87 therefore swings up and down about the shaft 2 only, and has no transverse swinging movement. The lifting sucker 10 at the opposite side of the machine however is identical with and operated in the same manner as the sucker 10 of Figs. 2 and 3. Accordingly, when the uppermost sheet of the pile has been combed and is taken from the pile by suckers 87 and 10 the sucker mouth 89 of sucker 87 moves upwardly to its dotted line position, while the sucker mouth 11 of sucker 10 moves both upwardly and outwardly to its dotted line position. As a consequence, that part of the sheet which is between the lifting suckers is stretched or tensioned exclusively by the sidewise swinging movement of sucker 10. Otherwise, the construction and operation of the embodiment of the invention shown in Fig. 12 is the same as that of the embodiment shown in Fig. 1.

In a still further modification, the cam 28 is also made to cause the sheet to move backwards before going forward and so greatly to assist the separation of the sheets. Accordingly, in the embodiment of the invention shown in Fig. 13, cam 28 has a short depression 90 which comes into operative relation with roller 33 directly following the dwell or circular part of the cam surface. This depression 90 serves to cause a brief rearward movement of the forwarding suckers just prior to their forward travel, and this brief rearward movement of the forwarding suckers pulls the sheet backward slightly so as to break it loose from the pile prior to forward movement of said suckers to advance the sheet relative to the pile. A cam 28 formed with a recess 90 therein, as described, could of course be employed in any of the other suction forwarding operating mechanisms herein illustrated and described.

According to another modification the forward-

ing suckers are carried on substantially horizontal rods slidable in fixed guides and sliding of the rods is effected by the direct action of cams on the ends of the rods. Accordingly, in the embodiment of the invention illustrated in Fig. 14, each of the forwarding suckers 23 is carried at the lower end of a metal tube 91, which is vertically adjustable in the forward extremity of a slide bar 92, and is adapted to be clamped in adjusted position by a set screw 93 or the like. A housing 94, slidable along shaft 39 for adjustment purposes, is provided with a guiding passage 95 for slide bar 92. The guide passage 95 communicates with a cavity 96 formed between the walls of the housing 94 at the rear thereof. Within this cavity 96 there revolves a cam 97 which is slidably keyed to shaft 7 and bears on the rear end of slide bar 92. The slide bar 92 is held against and made to follow cam 97 by a spring or springs 98. One end of spring 98 is attached to a pin 99 on housing 94 and the other end of said spring is attached to a pin 100 carried by slide bar 92 and extending through a slot 101 in the housing. In this embodiment of the invention travel of the forwarding suckers is in a horizontal direction only.

I claim:—

1. A sheet-feeding machine comprising means for supporting a pile of sheets, a set of suction devices mounted above the pile, means to cause the suction devices first to move downwardly towards the pile and to grip the uppermost sheet and then, while gripping the sheet, to move upwardly from the pile to lift the sheet, a set of arms pivoted for oscillation about an axis remote from the pile, a set of levers pivoted to the arms remote from the axis aforesaid, a frame member on which the levers slide and a second set of suction devices carried on the levers, above the pile, and arranged to receive and grip the sheet lifted by the first set towards the end of the lifting movement, and means to oscillate the arms about the axis aforesaid to cause forwarding movement of the suction devices while gripping the sheet and return movement after the sheet has been released, the frame member being remote from the connections of the levers to the arms so as to maintain the axes of the suction devices at a substantially constant angle to the plane of the pile.

2. In sheet-feeding apparatus for forwarding sheets from the top of a pile the combination of a set of lifting suckers operable at separated points near the rear edge of the pile on each sheet in turn to lift it, means operable while the lifting suckers maintain their grip upon the sheet to effect a relative separating movement between them to stretch the sheet transversely across a major portion of the width thereof, and a set of sheet-forwarding suckers operable near the rear edge of the pile to take each sheet in turn from the lifting suckers and to move it forwardly in a direction towards the front edge of the pile.

3. A sheet-feeding machine comprising means for supporting a pile of sheets, a set of at least two suction devices mounted at separated points above the rear portion of the pile, means to cause the suction devices first to move downwardly towards the pile and to grip the uppermost sheet and then, while gripping the sheet, to move upwardly from the pile to lift the sheet, means operable while the suction devices are gripping the sheet to effect relative movement between the devices in a direction away from one another so as to stretch the sheet transversely across a major portion of the width thereof, a second set

of suction devices mounted above the pile, and arranged between the suction devices of the first set to receive and grip the sheet lifted by the first set and means to cause forward movement of the second set of suction devices while gripping the sheet and return movement of the suction devices after releasing the sheet.

4. A sheet-feeding machine comprising means for supporting a pile of sheets, a set of at least two suction devices mounted at separated points above the pile at the rear thereof, means to cause the suction devices first to move downwardly towards the pile and to grip the uppermost sheet and then, while gripping the sheet to move upwardly from the pile to lift the sheet, means operable while the suction devices maintain their grip upon the sheet to effect relative movement between them in a direction away from one another so as to stretch the sheet transversely across a major portion of the width thereof, a second set of suction devices mounted above the pile at the rear thereof and arranged to grip the sheet lifted by the first set, and means to cause forward movement of the second set of suction devices while gripping the sheet and return movement of the suction devices after releasing the sheet.

5. A sheet-feeding machine comprising means for supporting a pile of sheets, a set of at least two suction devices mounted above the pile at the rear thereof, means to cause the suction devices first to move downwardly towards the pile and to grip the uppermost sheet and then, while gripping the sheet, to move upwardly from the pile to lift the sheet, a second set of suction devices mounted above the pile at the rear thereof and arranged to receive and grip the portion of the sheet lifted by the first set towards the end of the lifting movement, means to cause forward movement of the second set of suction devices while gripping the sheet, and return movement of the devices after releasing the sheet, and sheet-combing devices associated with the lifting suction devices and arranged to comb inwardly towards the suction devices so as to produce small humps in the sheet under the suction devices before they grip the sheet.

6. A sheet-feeding machine comprising means for supporting a pile of sheets, a set of at least two suction devices mounted above the pile, means to cause the suction devices first to move downwardly towards the pile and to grip the uppermost sheet and then, while gripping the sheet, to move upwardly from the pile to lift the sheet, a second set of suction devices mounted above the pile and arranged to receive and grip the portion of the sheet lifted by the first set, means to cause forward movement of the second set of suction devices while gripping the sheet and return movement of the devices after releasing the sheet, sheet-combing devices associated with the suction devices of the first set and arranged to comb inwardly towards these suction devices so as to produce small humps on the sheet under the suction devices before they grip the sheet and stops associated with the suction devices on the sides thereof remote from their associated combers and arranged to press on the pile adjacent to the suction devices during the combing operation so as to restrict the humps to the portions of the sheet adjacent to the suction devices.

7. A sheet-feeding machine comprising a platform for a pile of sheets, a set of at least two suction devices mounted above the pile, supporting means for the suction devices, means to cause the supporting means to move the suction devices

first downwardly towards the pile to grip the uppermost sheet and then, while gripping the sheet, to move upwardly from the pile to lift the sheet, means permitting relative adjustment between the supporting means and the suction devices, a second set of suction devices mounted above the pile and arranged to grip the sheet lifted by the first set, means to cause forward movement of the second set of suction devices while gripping the sheet and return movement of the devices after releasing the sheet, sheet-combing devices associated with the suction devices of the first set and arranged to comb inwardly towards these suction devices so as to produce small humps on the sheet under the suction devices before they grip the sheet and stops associated with the suction devices on the sides thereof remote from their associated combers and also carried on the said supporting means and fixed in relation thereto so that they rise with the supporting means always to the same height, the stops being arranged to press on the pile adjacent to the suction devices during the combing operation so as to restrict the humps to the portions of the sheet adjacent to the suction devices.

8. A sheet-feeding machine comprising means for supporting a pile of sheets, a set of suction devices mounted above the pile means for adjusting the devices across the width of the pile, means to cause the suction devices first to move downwardly towards the pile and to grip the uppermost sheet and then, while gripping the sheet to move upwardly from the pile to lift the sheet, a second set of suction devices mounted above the pile, means for adjusting the devices of this set across the width of the pile, the devices being arranged to receive and grip the portion of the sheet lifted by the first set towards the end of the lifting movement, means to cause forward movement of the second set of suction devices while gripping the sheet and return movement of the devices after releasing the sheet, and sheet-combing devices associated with the lifting suction devices, means for adjusting the sheet-combing devices across the width of the pile the combing devices being arranged to comb inwardly towards the suction devices, so as to produce small humps in the sheet under the suction devices before they grip the sheet.

9. A sheet feeding machine comprising means for supporting a pile of sheets, a supporting shaft extending in a direction across the pile, a set of bell cranks mounted for oscillation on the supporting shaft and spaced apart across the width of the pile a corresponding set of lifting suckers each carried on one arm of its respective bell crank, a rotatable shaft, a set of cams mounted on the rotatable shaft and co-operating with followers on the other arms of the bell cranks to oscillate, on rotation of the shaft, the bell cranks to cause the suckers first to move downwardly towards the pile to grip the uppermost sheet and then, while they are gripping the sheet, to move upwardly away from the pile, a set of arms pivoted for oscillation about an axis extending across, and remote from, the pile a cam on the rotatable shaft aforesaid, means connecting the arms to a follower co-operating with the cam and so arranged that rotation of the shaft produces oscillation of the arms, a second set of suckers each carried on an arm and each adjacent to a lifting sucker and arranged to receive the sheet from the lifting sucker, and so arranged that oscillation of the arms as aforesaid effects a forwarding and return movement

of the suckers in a direction substantially parallel to the plane of the pile, a further set of cams on the rotatable shaft aforesaid, a set of combing devices associated with the lifting suckers and arranged to be moved towards and away from the pile by the last named set of cams on rotation of the shaft, a still further set of cams on the rotatable shaft and sheet-stop devices arranged to be moved between the lifted sheet and the pile by the cams on rotation of the shaft.

10. For forwarding sheets of paper or the like from the top of a pile, sheet feeding mechanism comprising in combination means for stretching and lifting a major portion of the rear edge of each sheet in turn and forwarding suction means located above the pile and arranged to grip the sheet in the region of the stretched portion and while the grip is maintained to impart to it a movement whereof at least a component is in a direction parallel to the plane of the pile to advance the sheet.

11. For forwarding sheets of paper or the like from the top of a pile, sheet-feeding mechanism operable near the rear edge of each sheet and comprising in combination two or more lifting suckers arranged above the pile along a major transverse portion thereof for reciprocation in a direction perpendicular to the plane of the top of the pile and adapted to grip and lift the top sheet, means to effect relative movement of the lifting suckers, while they are gripping the sheet, so as to stretch the rear edge of the sheet, forwarding suction means arranged to grip and take the lifted and stretched sheet at its stretched edge from the lifting suckers and means to move the forwarding suction means in the direction of sheet feed while gripping the sheet.

12. For forwarding sheets of paper or the like from the top of a pile, sheet feeding mechanism comprising means for stretching and lifting a major portion of the rear edge of each sheet in turn, said means comprising two suckers spaced apart transversely, forwarding means comprising a plurality of suckers movable into position between the first named suckers for gripping and taking the raised and stretched sheet from the first named suckers, and means for imparting to said forwarding suckers after the sheet is transferred thereto a movement whereof at least a component is in a direction parallel to the plane of the pile to advance the sheet.

13. For forwarding sheets of paper or the like from the top of a pile, sheet separating, raising and forwarding mechanism comprising means for buckling spaced portions of the rear edge of the top sheet, a pair of suckers arranged for up and down movement above the rear edge of the pile adapted to grip the buckled portions of the sheet, means to effect relative movement between the suckers while they are gripping the sheet so as to stretch the rear edge of the sheet between them, forwarding means comprising a plurality of suckers movable into position between the first named suckers for gripping and taking the raised and stretched sheet from the first named suckers, and means for imparting to said forwarding suckers after the sheet is transferred thereto a movement whereof at least a component is in a direction parallel to the plane of the pile to advance the sheet.

14. For forwarding sheets of paper or the like from the top of a pile, sheet separating, raising and forwarding mechanism comprising means for buckling spaced portions of the rear edge of the top sheet, a pair of suckers arranged for

up and down movement, above the rear edge of the pile adapted to grip the buckled portions of the sheet, means to effect relative movement between the suckers while they are gripping the sheet so as to stretch the rear edge of the sheet between them, the raising and stretching actions taking place simultaneously, forwarding means comprising a plurality of suckers movable into position between the first named suckers for gripping and taking the raised and stretched sheet from the first named suckers, and means for imparting to said forwarding suckers after the sheet is transferred thereto a movement whereof at least a component is in a direction parallel to the plane of the pile to advance the sheet.

15. In a machine for feeding sheets from the top of a pile, means for transversely stretching a major portion of the rear edge of the top sheet, lifting the sheet, and holding it in raised stretched condition momentarily, and a plurality of suckers mounted to swing in the direction of feed adapted to grip the sheet at separated points near its rear edge and to take the raised stretched sheet and move it forward, the axis of swinging motion of said suckers being such as to impart arcuate movement to the suckers downwardly and forwardly.

16. In a machine of the class described, means for supporting a paper pile, sheet separating, raising and forwarding mechanism arranged above the rear end of the pile, comprising a pair of sheet gripping suckers, means for producing movement of the suckers bodily up and down, means for swinging the suckers upwardly and outwardly during their bodily upward movement to stretch the sheet, a pair of stops arranged inwardly of the suckers having bodily movement up and down and between which the sheet is stretched, and forwarding means adapted to take the stretched sheet from between said stops.

17. In a machine of the class described, a support for a paper pile, means located at the rear of the pile for separating the rear edge of the top sheet from the pile, stretching the rear edge of that sheet and lifting it to a definite predetermined elevation where sheet feeding mechanism may take it, said means including vertically movable elements spaced transversely of the machine, suckers on said elements vertically adjustable thereon, stops mounted on the vertically movable elements adapted to rest upon the top of the pile at the rear edge thereof, and means for moving said elements upwardly and swinging said suckers outwardly in a transverse direction, whereby the rear edge of the top sheet is raised and stretched between said stops at the same height regardless of the adjustment of the suckers.

18. In a machine of the class described, a support for a paper pile, means located at the rear of the pile for separating the rear edge of the top sheet from the pile, stretching the rear edge transversely and lifting it to a definite predetermined elevation, said means including a pair of stops, means for causing said stops to engage the top of the pile during one part of the feeding cycle and to rise above the pile a predetermined distance during another part of the cycle, a pair of suckers arranged outwardly of said stops and moving up and down to grip the top sheet and lift it off the pile, said suckers having a movement different in vertical extent from that of the stops, whereby the lifted sheet is stretched across the said stops and between the same.

19. In a machine of the class described, means for supporting a paper pile, sheet separating, raising and forwarding mechanism arranged above the rear end of the pile, comprising a pair of suckers, means for producing movement of the suckers bodily up and down, a pair of stops arranged inwardly of the suckers occupying positions at a certain definite height above the pile, the said suckers moving upwardly beyond that height, whereby the sheet is stretched beneath and between said stops, and forwarding means adapted to take the stretched sheet from between said stops.

20. For forwarding sheets from the top of a pile, sheet feeding mechanism comprising in combination means for stretching and lifting a major portion of the rear edge of each sheet in turn and forwarding suction means located above the pile and arranged to grip the sheet in the region of the stretched portion and while the grip is maintained to impart to it a movement whereof at least a component is in a direction parallel to the plane of the pile to advance the sheet, and a foot movable into position beneath the stretched sheet to press upon the rear edge of the pile and hold it down while the raised sheet is being advanced.

21. For forwarding sheets from the top of a pile, sheet feeding mechanism comprising in combination, suction means for separating and straightening a major portion of the rear edge of the top sheet of the pile, and means located above the pile and arranged to grip the sheet in the region of the straightened portion and to impart a forwarding movement to the sheet while the grip is maintained.

22. For forwarding sheets from the top of a supply, sheet feeding mechanism comprising in combination, means for separating and tensioning a major portion of the rear edge of the top sheet of the supply, and suction means located above the supply and arranged to grip the sheet in the tensioned portion and to impart a forwarding movement to the sheet while the grip is maintained.

23. For forwarding sheets from the top of a supply, sheet feeding mechanism comprising in combination suction means for separating the top sheet of the supply and bringing a rear portion thereof into a straightened condition transversely across a major portion of the width of the sheet, means for gripping said sheet in the region of the rear straightened portion, and means for imparting a forward motion to the said gripping means.

24. For forwarding sheets from the top of a pile, sheet feeding mechanism comprising in combination means for separating and tensioning a major transverse portion of the rear part of the top sheet of the pile, and suckers arranged to grip the sheet in the region of the tensioned portion and to move forwardly therewith.

25. For forwarding sheets from the top of a pile, sheet feeding mechanism comprising in combination means for separating the top sheet from the pile and removing unevenness from a major transverse portion of the rear part thereof so as to bring said portion into a straight line, suckers for gripping the sheet in the region of said straight line, and means for imparting a forwarding movement to said suckers.

26. For forwarding sheets from the top of a pile, sheet feeding mechanism comprising rotary means for separating from the pile the rear corners of the uppermost sheet, means cooperat-

ing with said first named means for engaging said uppermost sheet near the rear corners and tensioning the sheet transversely, and, forwardly movable suckers adapted to grip said tensioned portion of the sheet.

27. For forwarding sheets from the top of a pile, sheet feeding mechanism comprising rotary means for raising above the general level of the pile portions of the top sheet of the pile in the region of the rear corners thereof, means cooperating with said first named means for engaging the uppermost sheet at the said raised portions and tensioning the sheet between said raised portions, and forwarding suckers adapted to grip said sheet in the region of the tensioned portion.

28. For forwarding sheets from the top of a pile, sheet feeding mechanism comprising rotary means working in a direction transversely of the pile for raising above the general level of the pile portions of the top sheet in the region of the rear corners thereof, means acting upon the thus raised portions of the uppermost sheet for engaging that sheet and tensioning the same transversely, and forwarding suckers adapted to grip said uppermost sheet in the region of the tensioned portion and to impart to it a forwarding motion.

29. For forwarding sheets from the top of a pile, sheet feeding mechanism comprising rotary means working in a direction transversely of the pile for raising above the general level of the pile portions of the top sheet in the region of the rear corners thereof, means mounted to turn upon longitudinal axes for engaging the thus raised portions of the uppermost sheet and tensioning the sheet transversely, and forwarding suckers adapted to grip said uppermost sheet in the region of the tensioned portion and to impart to it a forwarding motion.

30. For forwarding sheets from the top of a pile, sheet feeding mechanism comprising means for separating and tensioning the rear edge of the uppermost sheet, suckers for gripping the sheet in the thus tensioned area, means for moving said suckers rearwardly a short distance for breaking away the front part of the sheet from the pile and for thereafter moving the suckers forwardly to advance the sheet in the feeding direction by an impetus applied to the rear edge exclusively.

31. For forwarding sheets from the top of a pile, sheet feeding mechanism comprising means for lifting and tensioning at least the middle portion of the rear edge of the uppermost sheet, means for forcing air beneath the sheet while tensioned, suckers for gripping the sheet in the region of the tensioned portion, means for moving said suckers rearwardly a short distance for breaking away the front part of the sheet from the pile and for thereafter moving the suckers forwardly to advance the sheet in the feeding direction by force applied exclusively at its rear edge.

32. For forwarding sheets of paper or the like from the top of a pile, sheet feeding mechanism comprising in combination two combers arranged to operate at the rear edge of the top sheet and to comb towards each other to produce humps in the sheet, a pair of lifting suckers arranged to grip the combed sheet at the humps and to move in a direction substantially perpendicular to the plane of the pile to lift the sheet, means to move the lifting suckers away from one another above the pile and in directions approximately parallel to the rear edge of the pile so as to stretch the

rear portion of the sheet, and forwarding suckers arranged to grip the sheet in the region of the stretched portion and while the grip is maintained, to give a forwarding movement to the sheet.

33. For forwarding sheets of paper or the like from the top of a pile, sheet feeding mechanism comprising in combination two combers arranged to operate at the rear edge of the top sheet and to comb towards each other to produce humps in the sheet, a pair of lifting suckers arranged to grip the combed sheet at the humps and to move in a direction substantially perpendicular to the plane of the pile to lift the sheet, stops associated with the lifting suckers on the sides remote from their associated combers arranged to press on the pile adjacent the lifting suckers during the combing operation so as to restrict the humps to the portions of the sheet adjacent the lifting suckers, means to move the lifting suckers away from one another above the pile and in directions approximately parallel to the rear edge of the pile so as to stretch the rear portion of the sheet, and forwarding suckers arranged to grip the sheet in the region of the stretched portion and while the grip is maintained, to give a forwarding movement to the sheet.

34. For forwarding sheets from the top of a pile, sheet feeding mechanism comprising in combination means for raising the outer portions of the rear edge of the uppermost sheet of the pile and for moving said raised outer portions outwardly to bring the intermediate portion of the rear edge to a predetermined elevation, and forwarding suction means located above the pile and arranged to grip the sheet at said predetermined elevation along the raised rear edge and to impart to it a sheet forwarding motion.

35. For forwarding sheets from the top of a pile, sheet feeding mechanism comprising in combination means for raising the outer portions of the rear edge of the uppermost sheet of the pile, means for subsequently raising the intermediate portion of the rear edge, and forwardly movable suction means located above the pile and arranged to grip the sheet along its raised rear edge.

36. In a machine of the class described, means for supporting a paper pile, sheet separating, raising and forwarding mechanism arranged transversely of the pile, comprising a pair of suckers adapted to grip the sheet near its opposite side edges, a pair of stops arranged inwardly of the suckers, means for producing relative movement between said suckers and stops for tensioning the sheet between the stops while gripped by the suckers, and forwarding means adapted to take the tensioned sheet from between said stops.

37. For forwarding sheets from the top of a pile, sheet feeding mechanism comprising in combination means for separating the rear corners of the top sheet from the pile and tensioning the sheet transversely across a major portion of the width thereof between said corners, means for injecting air under the top sheet, and means for gripping the top sheet between the corners near its rear edge and forwarding the sheet.

38. For forwarding sheets from the top of a pile, sheet feeding mechanism comprising in combination means for raising spaced portions of the top sheet above the general level of the top of the pile, means effective to separate said portions for raising the entire intermediate portion be-

tween them, and means for gripping the top sheet in the region of the raised intermediate portion and forwarding the sheet.

39. For forwarding sheets from the top of a pile, sheet feeding mechanism comprising in combination means for raising the rear corners of the top sheet, means for tensioning a major portion of the sheet between said corners, and means engaging the sheet near its rear edge for forwarding the sheet.

40. For forwarding sheets from the top of a supply, sheet separating, tensioning and forwarding mechanism, comprising means for separating and tensioning a major transverse portion of the rear part of the uppermost sheet and for gripping the top of said sheet in the rear tensioned portion, and means for imparting a forwarding motion to said sheet gripping means.

41. For forwarding sheets from the top of a pile, means for separating the uppermost sheet of the pile, means including a pair of spaced suckers for tensioning a major transverse portion of the rear part of the uppermost sheet transversely, forwarding suckers arranged to engage the top of the sheet in the region of the rear tensioned portion, means for making the forwarding suckers effective for gripping the sheet after it is tensioned, and means for moving the forwarding suckers in a sheet forwarding direction.

42. For forwarding sheets from the top of a pile, a pair of transversely aligned raising suckers for lifting the uppermost sheet of the pile, a pair of forwarding suckers interposed between said raising suckers, means for tensioning the sheet transversely across a major portion of the width thereof comprising means for producing relative vertical movement between said raising suckers and forwarding suckers, means for making the forwarding suckers effective for gripping the sheet after it is tensioned, and means for moving the forwarding suckers in a sheet forwarding direction.

43. For forwarding sheets from the top of a pile, sheet feeding mechanism comprising in combination, means acting on each sheet in turn to raise its rear edge above the pile and to bring each point of a major portion of the rear edge to a predetermined elevation, and means transversely adjustable for engaging each sheet in the region of said raised portion and forwarding the sheet, whereby said forwarding means may take each sheet at the same predetermined elevation for any given transverse adjustment of the forwarding means.

44. In a machine for feeding sheets from the top of a pile, sheet separating and forwarding mechanism comprising in combination, combing means for separating the rear corner portions of the top sheet from the sheets below, suction means for gripping the top sheet in said separated portions and raising the sheet, means adapted to press on the pile for holding the remaining sheets in position while the top sheet is being forwarded and to inject air beneath the top sheet, and means arranged between said combing means for gripping the sheet near its rear edge and forwarding the sheet.

45. In a machine adapted to feed sheets from the top of a pile for delivery in lapped relation to a printing or other machine, sheet separating and forwarding means comprising combing means for preliminarily separating the rear corner portions of the top sheet from the sheets below, suckers arranged to grip said separated portions and lift the sheet, blowing means ar-

ranged at the rear of the pile for injecting air forwardly beneath the lifted sheet, and suckers for forwarding the sheet arranged to grip the rear portion of the sheet and thereby control any forward impetus imparted thereto by the forwardly directed air.

46. In a machine adapted to feed sheets from the top of a pile for delivery in lapped relation to a printing or other machine, sheet separating and forwarding means comprising combing means for preliminarily separating the rear corner portions of the top sheet from the sheets below, suckers arranged to grip said separated portions and lift the sheet to further separate the same, pivotally mounted forwarding suckers arranged to swing in the direction of feed, grip the exposed rear portion of the sheet, and control the forward movement thereof, and blowers at the rear of the forwarding suckers arranged to inject forwardly directed streams of air beneath the portion of the sheet in front of the forwarding suckers.

47. The method of feeding sheets from the top of a pile to a printing or other machine, which comprises preliminarily combing the rear corner portions of the top sheet of the pile, lifting the rear portion of the topmost sheet above the pile by means of its combed corners sufficiently to permit the injection of forwardly directed streams of air therebeneath, injecting forwardly directed streams of air beneath said sheet to substantially separate same from the sheet below by a layer of forwardly moving air, controlling the forward movement of the sheet by suction means engaging only the rear portion of the sheet, and conveying the forwarded sheets in lapped relation to said machine.

48. The method of feeding sheets from the top of a pile to a printing or other machine, comprising preliminarily combing the rear corner portions of the top sheet of the pile, lifting the rear portion of said sheet above the pile by means of its combed corners sufficiently to permit the injection of forwardly directed streams of air therebeneath, injecting forwardly directed streams of air beneath the sheet to substantially separate the same from the sheet below by a layer of forwardly moving air, drawing said sheet backward slightly to effect separation of any unseparated portions of the sheet, controlling the forward and backward movement of the sheet by suction means engaging only the rear portion of the sheet, and conveying the forwarded sheets in lapped relation to said machine.

49. In a machine of the class described, means for supporting a paper pile, sheet separating, raising and forwarding mechanism arranged above the rear end of the pile, comprising a pair of sheet raising suckers, a pair of stops arranged inwardly of the suckers above the top sheet of the pile, means effective after the raising suckers have moved upward a predetermined distance for producing relative vertical movement between the suckers and said stops to tension the sheet between said stops, and forwarding means arranged to take the tensioned sheet from between said stops.

50. The method of feeding sheets from a supply thereof to a printing or other machine, which comprises combing the sheets of the supply at the rear corners thereof, gripping by suction each uppermost sheet of the supply in turn at the rear combed corners thereof, transversely stretching and separating the rear portion of each sheet in turn while it is gripped, engaging a rear portion

of each stretched and separated sheet in turn and forwarding the same, and conveying the forwarded sheets in lapped relation to said machine.

51. The method of feeding sheets from a supply thereof to a printing or other machine, which comprises combing the rear corners of the sheets, stretching and separating the rear portion of each uppermost sheet in turn, gripping rear portions of each stretched and separated sheet in turn by suction, moving each sheet forward in turn by its rear gripped portion, and conveying the forwarded sheets in lapped relation to said machine.

52. The method of feeding sheets from a supply thereof to a printing or other machine, which comprises preliminarily separating the sheets one at a time from the rear of the supply, gripping the rear of the uppermost sheet by suction, moving the sheet rearwardly by its gripped rear portion to further separate the same from the supply, and then forwardly to advance the sheet relative to the supply, and conveying the advanced sheets in lapped relation to said machine.

53. In apparatus for feeding sheets one after another from a supply thereof, means for preliminarily separating rear portions of the sheets from the supply, suction means for further separating the sheets from the rear of the supply, suction means for engaging rear portions of the separated sheets and forwarding them relative to said supply, one of said suction means acting to stretch the sheets transversely thereof, and mechanism for operating said means in proper timed relation with each other.

54. In apparatus for feeding sheets one after another from a supply thereof, means for preliminarily separating rear portions of the sheets from the supply including rotating combers, suction means for engaging the combed rear portions of the sheets and lifting them from the supply to further separate the sheets therefrom, suction means for engaging rear portions of the further separated sheets and forwarding said sheets relative to the supply, one of said suction means acting to stretch the rear portions of the sheets transversely thereof prior to the forward travel of the sheets, and mechanism for operating the three aforesaid means in proper timed relation with each other.

55. In apparatus for feeding sheets from the top of a supply thereof, the combination of a set of lifting suckers operable near the rear upper corners of the supply on each sheet in turn to lift it, means operable while the lifting suckers maintain their grip upon the sheet to effect a relative separating movement between them to stretch the entire portion of the sheet between the lifting suckers, and a set of sheet forwarding suckers operable over a rear portion of the supply to grip each sheet and move it forwardly relative to said supply.

56. A machine for feeding sheets one after another from a supply thereof and comprising a set of at least two suction devices mounted above the supply at the rear thereof, means for moving the suction devices downwardly towards the supply to grip the uppermost sheet and then upwardly from the supply to lift said sheet, a second set of suction devices mounted above the supply at the rear thereof for gripping the sheet lifted by the first set of suction devices, means for imparting sheet forwarding movement to the second set of suction devices while they grip the sheet and return movement of said second set of suction devices after they release the forwarded sheet, and sheet combing devices adja-

cent the suction sheet gripping and lifting devices and acting to comb inwardly towards the same so as to produce small humps in the sheet under said suction sheet gripping and lifting devices before they grip said sheet.

57. A machine for feeding sheets one after another from a supply thereof comprising a set of suction devices mounted above the supply at the rear thereof, means for adjusting the suction devices transversely of the supply, means for moving the suction devices downwardly to grip the uppermost sheet of the supply and then upwardly to lift said sheet therefrom, a second set of suction devices mounted above a rear portion of the supply for gripping a rear portion of the sheet lifted by the first set and forwarding said sheet relative to the supply, means for adjusting the sheet gripping and forwarding devices transversely of the supply, means for imparting sheet forwarding movement to the sheet gripping and forwarding devices while they grip the sheet and for imparting return movement to said sheet gripping and forwarding devices after they have forwarded and released the sheet, sheet combing devices adjacent the lifting suction devices and acting to comb inwardly so as to produce small humps in the sheet under said lifting suction devices before they grip the sheet, and means for adjusting said sheet combing devices transversely of said supply.

58. For feeding sheets from the top of a supply thereof, suction means for lifting and stretching a rear portion of each sheet of the supply in turn across a major portion of the width thereof, suction means for gripping a rear portion of each sheet in turn and for forwarding the sheet relative to said supply, and means for operating said sheet lifting and stretching means and said suction sheet gripping and forwarding means in proper timed relation.

59. For feeding sheets from the top of a supply thereof, a plurality of suction devices arranged above the supply at separated points along the rear thereof for gripping and lifting each sheet in turn, means for imparting relative lateral movement to said devices while they grip a sheet so as to stretch a rear portion of said sheet transversely thereof along a major portion of its width, suction means located above a rear portion of the supply for gripping each sheet in turn in a rear portion thereof and forwarding the same relative to said supply, and means for operating said suction devices and said suction means in proper timed relation.

60. For feeding sheets from the top of a supply thereof, sheet separating, raising and forwarding mechanism comprising means for buckling rear portions of the top sheet, a plurality of suckers movable up and down above the supply at the rear thereof for gripping the buckled portions of the sheet and raising said sheet from said supply, means for imparting relative lateral movement to said suckers while they grip the sheet so as to stretch a rear portion of the same transversely thereof, a plurality of suckers located above a rear portion of the supply for gripping and forwarding the sheet relative thereto when it has been acted upon by the gripping and raising suckers, and means for operating the aforesaid elements of said sheet separating, raising and forwarding mechanism in proper timed relation.

61. In a machine for feeding sheets from the top of a supply thereof, suction means for lifting the rear end of the top sheet, stretching a major portion of said rear end transversely of the

sheet, and holding it in raised stretched condition momentarily, a plurality of suckers located above a rear portion of the supply for gripping the sheet at points separated transversely thereof and for forwarding said sheet relative to said supply, and means for operating said first named means and said suckers in proper timed relation.

62. In a machine for feeding sheets from the top of a supply thereof, suction means for raising the rear end of the top sheet and for stretching a major portion of said rear end transversely thereof, a plurality of suckers pivoted above a rear portion of the supply for gripping the top sheet in rear portions thereof and swinging in the direction of feed to forward said sheet relative to said supply, and means for operating said first named means and swinging said suckers in proper timed relation.

63. In a machine for feeding sheets from a supply thereof, a plurality of suckers movable toward and away from the supply for gripping a sheet and separating it from the supply, means for moving the suckers toward and away from the supply, means for imparting relative movement to the suckers while gripping the sheet to thereby stretch the same, and means intermediate said suckers and arranged at a level nearer the supply than the extreme position of said suckers and between which said sheet is stretched.

64. For feeding sheets from the top of a supply thereof, means for lifting and stretching a rear portion of each sheet in turn across a major part of the width of the sheet, suction means located above a rear portion of the supply for gripping a rear portion or portions of each sheet in turn and forwarding the same relative to the supply, means movable into position between each lifted and stretched sheet and the supply for pressing upon the latter at the top and rear thereof while the lifted and stretched sheet is being forwarded, and means for operating said first named means, said suction means, and said pressing means in proper timed relation.

65. For feeding sheets from a supply thereof, means for separating and tensioning a rear transverse portion of each sheet of the supply in turn across a major part of the width of the sheet, suction means for engaging a rear portion of each sheet of the supply in turn and for forwarding the sheets in turn relative to said supply, and means for operating said sheet separating and tensioning means and said suction sheet engaging and forwarding means in proper timed relation.

66. For feeding sheets from a supply thereof, suction means for lifting a major transverse portion of the rear part of the uppermost sheet from the supply and stretching said portion transversely of said supply, means for directing air under pressure between the supply and the sheet lifted relative thereto, and suction means located above a rear portion of the supply for engaging the uppermost sheet in a rear portion or portions thereof and forwarding said sheet relative to said supply.

67. The method of feeding sheets from a supply thereof, which comprises rotatably applying separating action on rear corner portions of the uppermost sheet of the supply to preliminarily separate said rear corner portions of the uppermost sheet, gripping a rear portion or portions of the uppermost sheet by suction and lifting said sheet while gripped to further separate it from the supply, directing air under pressure between the supply and the uppermost lifted sheet, and gripping

the uppermost lifted sheet by suction in a rear portion or portions thereof and forwarding said gripped sheet relative to said supply.

5 68. The method of feeding sheets from a supply thereof to a printing or other machine, which comprises rotatably applying separating action on rear corner portions of the uppermost sheet or sheets of the supply to preliminarily separate said rear corner portions of the uppermost sheet, grip-
10 ping the uppermost sheets in turn by suction on a rear portion or portions thereof and lifting each gripped sheet in turn to further separate it from the supply, directing air under pressure between the supply and each sheet in turn lifted there-
15 from, gripping the lifted sheets in turn by suction on a rear portion or portions thereof and forwarding each gripped sheet in turn relative to said supply, and conveying the separated and forward sheets in lapped relation to said machine.

20 69. In apparatus for feeding sheets one at a time from the top of a supply thereof, the combination of a pair of lifting suckers arranged on opposite sides of the longitudinal center line of the supply and operable near the rear of the
25 supply on each sheet in turn to lift it, means operable after the lifting movement has begun and while the lifting suckers maintain their grip upon the sheet to move one of said lifting suckers laterally outward while the other remains fixed laterally to stretch the sheet between said suckers,
30 and a set of sheet forwarding suckers operable over the rear portion of the supply to grip each sheet and move it forwardly relative to said supply.

35 70. In a machine for feeding sheets from a supply thereof, a pair of suckers arranged on opposite sides of the longitudinal center line of the supply and movable toward and away from the

supply for engaging a sheet and separating it therefrom, means for moving the suckers toward and away from the supply, means for imparting outward movement to one of the suckers relative to the other while the suckers are engaged with the sheet to thereby stretch the same, and means
5 between said suckers and cooperating therewith to stretch the entire portion of the sheet therebetween.

71. The method of feeding sheets from the top
10 of a supply which comprises preliminarily separating the rear corner portions of the uppermost sheet from the sheets below, lifting the separated corner portions of the sheet, lifting the rear edge of said sheet between said corner portions subse-
15 quent to initiation of the corner lifting operation, directing air under pressure forwardly beneath the sheet, supporting said lifted rear edge at one or more intermediate points along the same, and forwarding the sheet with its rear edge thus sup-
20 ported.

72. For forwarding sheets from a supply there-
of, means for preliminarily separating rear corner portions of the uppermost sheet from the
25 supply, means located above the supply at the rear thereof for further separating the uppermost sheet therefrom, means for blowing air forwardly under the separated sheet to still further separate it from the supply, suction means pivotally
30 mounted above the supply at the rear thereof for gripping the separated sheet in a rear portion or portions thereof and advancing said sheet relative to said supply through swinging movement of said pivotally mounted suction means,
35 and means for operating the aforesaid separating means and swinging said suction forwarding means in proper timed relation.

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Disclaimer

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AUTOMATIC SHEET FEEDING MACHINERY. Patent dated Feb. 15, 1938.

Disclaimer filed Jan. 10, 1948, by the inventor.

Hereby enters this disclaimer to claim 52 of said patent.

[Official Gazette February 10, 1948.]

the uppermost lifted sheet by suction in a rear portion or portions thereof and forwarding said gripped sheet relative to said supply.

- 5 68. The method of feeding sheets from a supply thereof to a printing or other machine, which comprises rotatably applying separating action on rear corner portions of the uppermost sheet or sheets of the supply to preliminarily separate said rear corner portions of the uppermost sheet, gripping the uppermost sheets in turn by suction on a rear portion or portions thereof and lifting each gripped sheet in turn to further separate it from the supply, directing air under pressure between the supply and each sheet in turn lifted therefrom, gripping the lifted sheets in turn by suction on a rear portion or portions thereof and forwarding each gripped sheet in turn relative to said supply, and conveying the separated and forwarded sheets in lapped relation to said machine.
- 20 69. In apparatus for feeding sheets one at a time from the top of a supply thereof, the combination of a pair of lifting suckers arranged on opposite sides of the longitudinal center line of the supply and operable near the rear of the supply on each sheet in turn to lift it, means operable after the lifting movement has begun and while the lifting suckers maintain their grip upon the sheet to move one of said lifting suckers laterally outward while the other remains fixed laterally to stretch the sheet between said suckers, and a set of sheet forwarding suckers operable over the rear portion of the supply to grip each sheet and move it forwardly relative to said supply.
- 30 70. In a machine for feeding sheets from a supply thereof, a pair of suckers arranged on opposite sides of the longitudinal center line of the supply and movable toward and away from the

supply for engaging a sheet and separating it therefrom, means for moving the suckers toward and away from the supply, means for imparting outward movement to one of the suckers relative to the other while the suckers are engaged with the sheet to thereby stretch the same, and means between said suckers and cooperating therewith to stretch the entire portion of the sheet therebetween.

71. The method of feeding sheets from the top of a supply which comprises preliminarily separating the rear corner portions of the uppermost sheet from the sheets below, lifting the separated corner portions of the sheet, lifting the rear edge of said sheet between said corner portions subsequent to initiation of the corner lifting operation, directing air under pressure forwardly beneath the sheet, supporting said lifted rear edge at one or more intermediate points along the same, and forwarding the sheet with its rear edge thus supported.

72. For forwarding sheets from a supply thereof, means for preliminarily separating rear corner portions of the uppermost sheet from the supply, means located above the supply at the rear thereof for further separating the uppermost sheet therefrom, means for blowing air forwardly under the separated sheet to still further separate it from the supply, suction means pivotally mounted above the supply at the rear thereof for gripping the separated sheet in a rear portion or portions thereof and advancing said sheet relative to said supply through swinging movement of said pivotally mounted suction means, and means for operating the aforesaid separating means and swinging said suction forwarding means in proper timed relation.

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Disclaimer

2,108,702.—Headley Townsend Backhouse, St. John's Wood, London, England.
AUTOMATIC SHEET FEEDING MACHINERY. Patent dated Feb. 15, 1938.
Disclaimer filed Jan. 10, 1948, by the inventor.

Hereby enters this disclaimer to claim 52 of said patent.

[Official Gazette February 10, 1948.]