Nov. 30, 1948. F. R. BELLUCHE 2,454,762

SHEET FEEDING METHOD AND APPARATUS THEREFOR

Filed May 24, 1946 4 Sheets-Sheet 1

Fig. 1.

180° INTO 1ST CYCLE

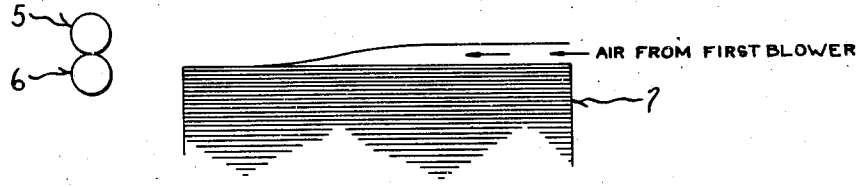


Fig. 2.

360° END OF 1ST CYCLE

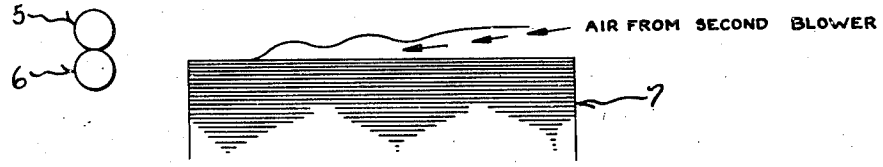


Fig. 3.

70° INTO 2ND CYCLE

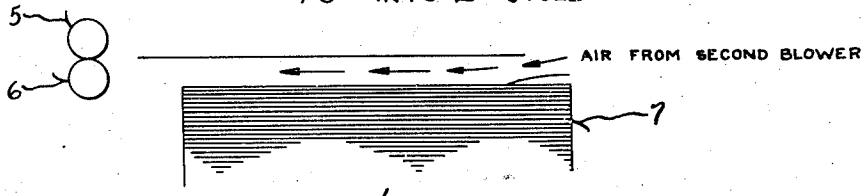
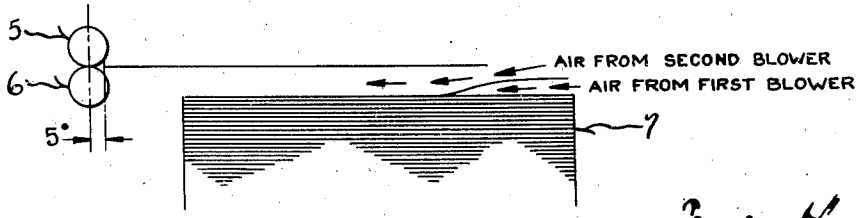


Fig. 4.

235° INTO 2ND CYCLE



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SHEET FEEDING METHOD AND APPARATUS THEREFOR

Filed May 24, 1946 4 Sheets-Sheet 2

Fig. 5.

(0° START OF CYCLE)

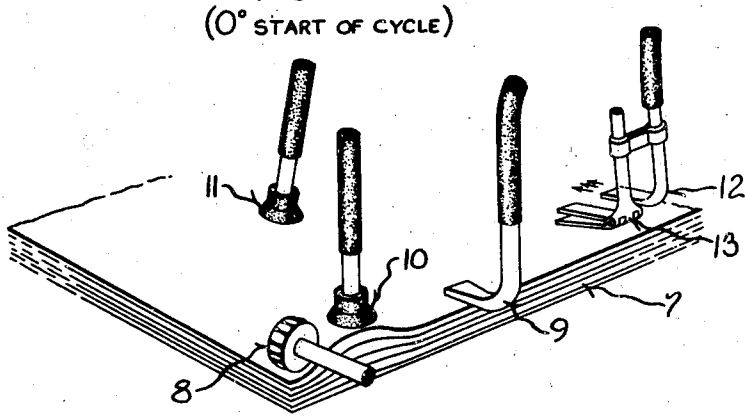


Fig. 6.

(180°)

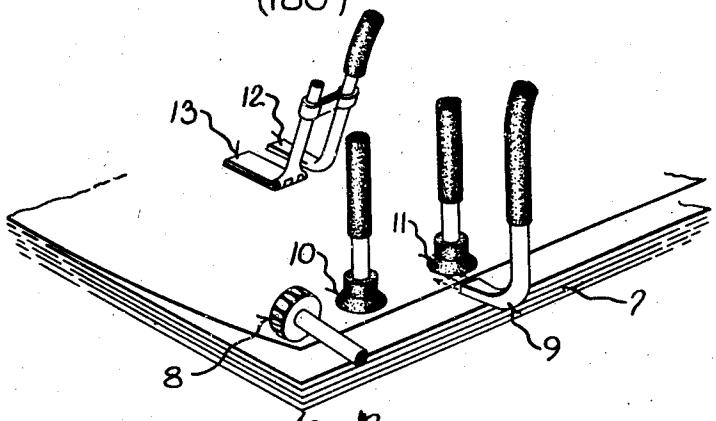
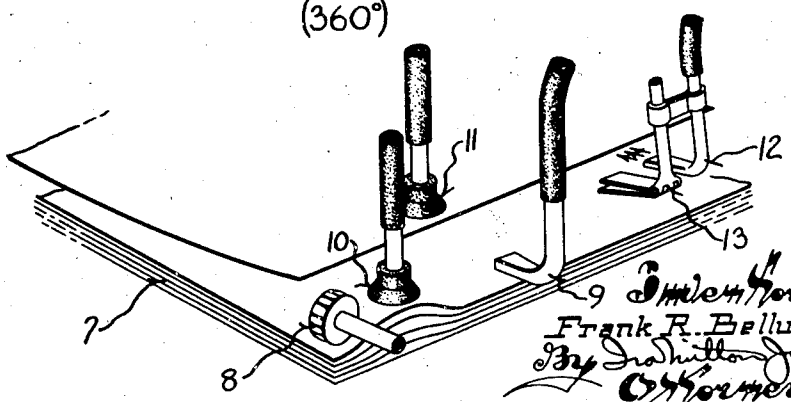


Fig. 7.

(360°)



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SHEET FEEDING METHOD AND APPARATUS THEREFOR

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Fig. 8.

(70° INTO 2ND CYCLE)

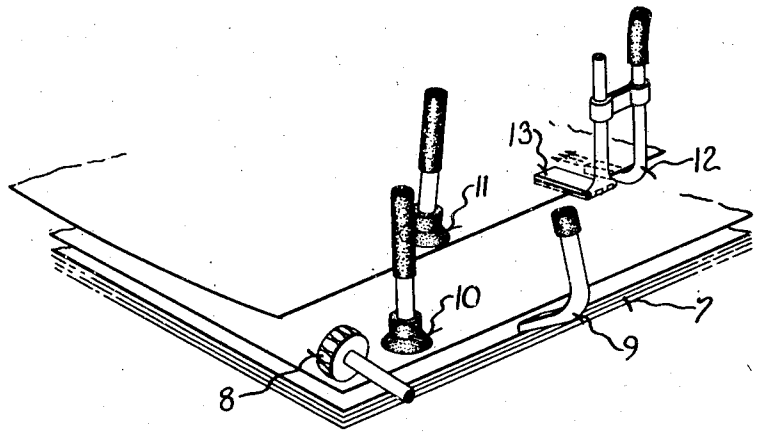
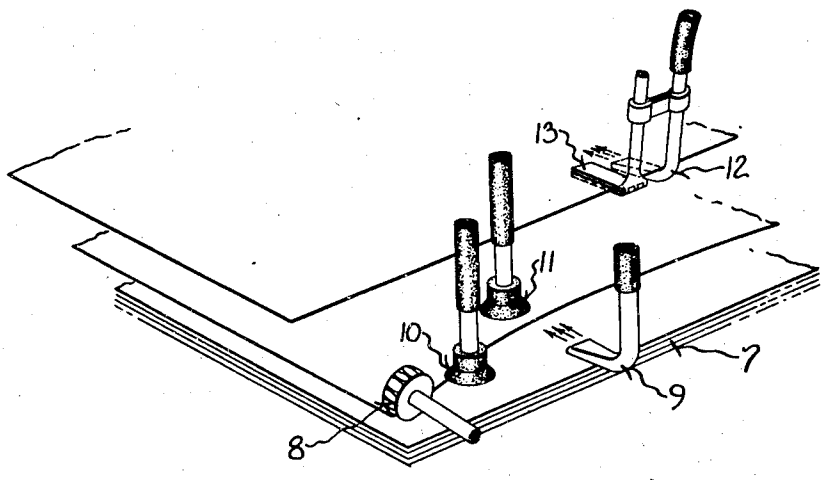


Fig. 9.

(235° INTO 2ND CYCLE)



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Nov. 30, 1948. F. R. BELLUCHE 2,454,762

SHEET FEEDING METHOD AND APPARATUS THEREFOR

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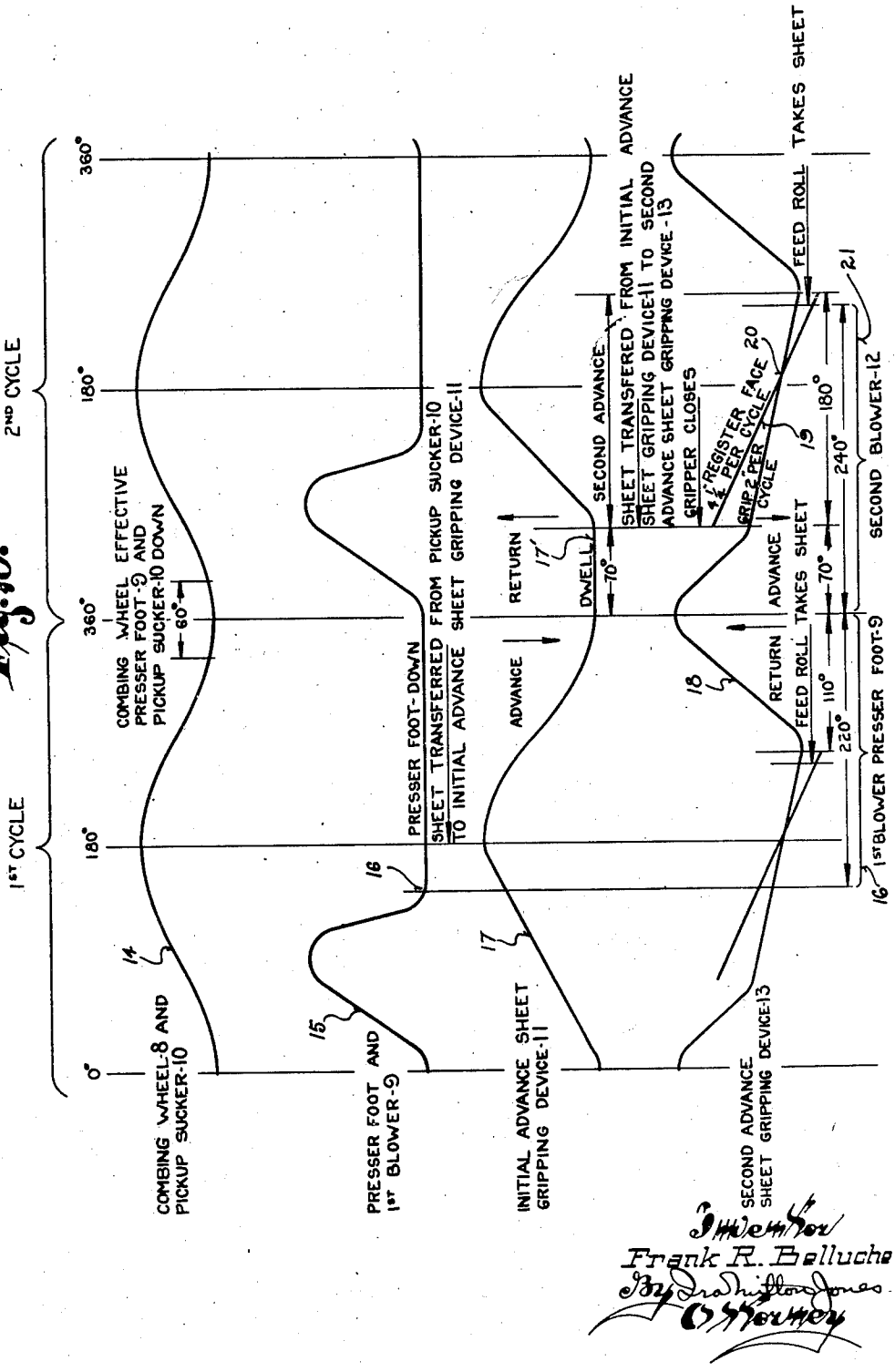


Fig. 10.

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Patented Nov. 30, 1948 2,454,762

UNITED STATES PATENT OFFICE

2,454,762

SHEET FEEDING METHOD AND APPARATUS THEREFOR

Frank R. Belluche, Racine, Wis., assignor to The Christensen Machine Company, Racine, Wis., a corporation of Wisconsin

Application May 24, 1946, Serial No. 672,095

9 Claims. (Cl. 271—20)

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This invention relates to a method and apparatus for feeding sheets of paper and the like off a pile or fanned out bank to a printing press or other machine in which work is to be performed upon the sheets.

Great strides have been made in sheet feeding and speeds of five thousand sheets per hour are not uncommon even in instances where the sheets being handled are more than twice as large as the average desk top. These high speeds have been possible largely because of so-called stream feeding in which the sheets move from the pile or fanned out bank as a continuous seriated stream; but even stream feeding with all its advantages has not satisfactorily met the problem of feeding previously printed sheets, as in multi-color work where the sheets are run through the press once to have one color printed, restacked and fed through the press again to have another color printed.

In multi-color work, the sheets inevitably adhere to each other to a greater extent than in ordinary single run printing, as good results in multi-color printing require that the succeeding colors be applied before the previously applied ink is entirely dry. Consequently, in such work, the problems are far greater than those resulting from the normal tendency of the sheets to stick together.

In stream feeding, the sheets must be fed from the rear edge, that is, the sheet separating and forwarding control mechanism acts upon the rear edge portion of the sheet. Each sheet is actually forwarded or advanced by the air projected forwardly under it. The so-called forwarding suckers or other suitable sheet grasping means by which it is held at its rear edge merely control its advance into the feed-off rolls.

Under ordinary circumstances, the air blown forwardly under each sheet as its rear edge portion is picked off the pile or bank, quickly separates the entire sheet from the next adjacent one, but where the adhesion is exceptional, as in multi-color work, difficulty was experienced in the past in securing quick separation of the sheets throughout their entire area.

Experience has demonstrated that the best medium to effect separation of the sheets is air blown under the topmost sheet, but where the adhesion between the sheets is great, the air that could be

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blown under the sheet within the time available was insufficient to effect separation. Increasing the velocity of the air did not suffice. In some instances where this was tried, the air streams actually blew holes into the paper. Increasing the volume of the air was also unsatisfactory as this necessitated extremely large blowers and in other ways complicated the feeders.

The present invention, therefore, has as its object to provide an improved method and apparatus for feeding sheets of paper and the like off a pile or fanned out bank which retains the advantage of effecting separation of the sheets by air but which assures complete separation by increasing the duration for which the air is under the sheet.

As is well known to those skilled in this art, the mechanism of sheet feeders is cyclically operated. The time allotted for each cycle is extremely short especially in high speed printing. Part of the cycle has to be devoted to preliminary separation of the sheets, as for instance, by combing the rear corners to enable the topmost sheet to be grasped to the exclusion of those beneath it. Also part of the cycle must be devoted to the return stroke of the sheet forwarding or control suckers or their equivalent. Consequently, in the conventional sheet feeder, the sheet-separating-and-forwarding-air can be on for only part of one cycle.

With a view toward increasing the time for which the sheet-separating-and-forwarding-air is effective, the present invention more specifically has as its object the provision of an improved method and apparatus whereby the sheet-separating-and-forwarding-air is on for a substantial part of two cycles and in fact for longer than one complete cycle and wherein the separation of the topmost sheet and its advance to the feed-off rolls does not have to occur within one cycle but extends over two complete cycles.

With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel method, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate one complete example of the physical embodiment of the invention constructed in accordance with the best mode so far devised for the practical application of the principles thereof, and in which:

Figures 1 to 4 inclusive are similar diagrammatic views to illustrate the manner in which sheets are separated from and fed off a pile to the feed-off rolls of a sheet feeder in accordance with this invention;

Figure 5 is a perspective view illustrating the mechanism at one side of the pile or bank for separating and controlling the feeding of the sheets in the manner illustrated in Figures 1 to 4 inclusive, said view showing the parts in their relative positions at the start of the cycle;

Figure 6 is a view similar to Figure 5 but showing the various parts in their respective positions at 180° into the first cycle, thus corresponding with Figure 1;

Figure 7 is a view similar to Figure 5 showing the parts in their respective positions at the end of the first cycle, thus corresponding with the condition shown in Figure 2;

Figure 8 is a perspective view similar to Figure 5 illustrating the parts in their respective positions 70° into the second cycle, thus corresponding with Figure 3.

Figure 9 is a perspective view similar to Figure 5 illustrating the parts in their respective positions 235° into the second cycle, thus corresponding with Figure 4; and

Figure 10 is a cam chart depicting the cam produced motions of the various instrumentalities.

Referring now to the accompanying drawings, the numerals 5 and 6 designate a pair of feed-off rolls to which sheets are fed from a stacked source of supply 7. The rolls 5 and 6 may be specifically the feed-off rolls of a sheet feeder, but they can be considered, for the purpose of this invention, the receiving rolls for a press or other machine to which the sheets are to be fed, and thus are representative of any sheet receiving device.

Where the rolls 5 and 6 constitute the feed-off rolls of a feeder, the distance between them and the front of the pile or bank ordinarily is but a matter of a few inches, and in that case other conveyor means (not shown) take the sheets in overlapped relation and feed them to the press or other machine being served.

The stacked source of supply indicated by the numeral 7 may be a pile as depicted in the drawings or it may be a fanned out bank. The problem of separating the topmost sheet and moving it into the bite of the rolls 5 and 6 within the extremely short time available is substantially the same in either case.

For the practice of this invention, preliminary separation of the rear edge portion of the topmost sheet is effected in any conventional manner as by means of a combing wheel 8 acting upon each rear corner of the pile or bank and buckling the sheets against a presser foot 9. It is, of course, understood that the mechanism illustrated in Figures 5 to 9 inclusive, is duplicated at the opposite sides of the pile or bank. The action of the combing wheel brings the topmost sheet into the range of a sheet grasping and lifting means preferably in the form of a sucker 10. During the time the sucker 10 lifts the topmost sheet, the presser foot 9 quickly moves off its rear edge portion and back onto the next adjacent sheet as shown in Figure 6. This action requires 180° of the first cycle of the mechanism.

A cycle, as referred to herein, is one revolution of the cam shaft (not shown) upon which all the cams for actuating the various elements of the sheet separating and forwarding mechanism are mounted to revolve in unison. The specific form of the mechanism is no part of this invention and may be of any suitable design, as for instance, that shown in Patent No. 2,267,784, issued to Frank R. Belluche.

At the time the sucker 10 reaches its top position (180° into the first cycle) a forwarding or control sucker or other suitable sheet grasping means 11 is in position opposite the sucker 10 to take over control of the topmost sheet. This sucker 11 is cam actuated by suitable mechanism to have either a direct horizontal back and forth movement or a swinging movement, whereas the sucker or sheet grasping member 10 merely has an up and down movement.

By means of the sucker 11 (one at each side of the pile or bank) the rear edge portion of the topmost sheet is advanced a short distance sufficient to allow the combing wheel 8 to descend onto the next adjacent sheet. This short forward movement of the rear edge portion of the sheet constitutes a first step or stage in the total movement required to enable the leading edge of the sheet to enter between the feed-off rolls 5 and 6, and takes another 180° of the first cycle. Thus at the end of the first cycle, as depicted in Figures 2 and 7, the rear edge portion of the topmost sheet has been moved forward an initial amount or through its first step.

During this initial forward movement of the rear edge portion of the sheet, separating and forwarding air is discharged from the presser foot 9 which is hollow and serves as an air blast nozzle. However, as experience has demonstrated, the separating and forwarding air blown under the topmost sheet at this time is generally insufficient to assure complete separation of the topmost sheet. Thus in the diagrammatic illustration of Figure 2, the forward portion of the topmost sheet is shown adhered to the next adjacent sheet.

At the end of the first cycle (Figures 2 and 7), the forwarding control sucker 11 comes to rest and remains stationary for a short interval, 70° in the specific embodiment of the invention illustrated. Throughout this 70° period, sheet-separating-and-forwarding-air is blown under the topmost sheet by an air blast nozzle 12 which is connected to a sheet gripper 13. This sheet gripper 13 may be of the type illustrated in the aforesaid Patent No. 2,267,784 issued to Frank R. Belluche, or a conventional suction cup might be used. In any event it is a sheet grasping means and is adapted to take over control of the sheet after its rear edge portion has been brought to the position depicted in Figures 2 and 7.

If the sheet grasping means 13 is in the form of a sucker, it will be readily apparent to those skilled in the art that it is not necessary to incorporate the 70° period of dwell, but instead the sucker 11 must move in unison with the sheet grasping means 13 for a short period of time sufficient to enable transfer of the sheet from the sucker 11 to the sheet grasping means 13. Where the sheet grasping means 13 is a gripper of the type shown in Patent No. 2,267,784, the sheet comes to rest for a brief interval to enable the gripper to grasp it regardless of possible variations in the location of its rear edge with respect to the range of travel of the gripper. With the rear edge portion of the topmost sheet

held in the bite of the gripper 13 or its equivalent sheet grasping means, and with the sheet-separating-and-forwarding-air issuing from the nozzle 12, separation of the topmost sheet from the next adjacent sheet is completed as indicated in Figure 3 so that the sheet can be moved forwardly by the air under control of the gripper 13.

At 240° into the second cycle, the leading edge of the sheet being fed enters the bite of the rolls 5 and 6. Thus just before the sheet enters the rolls 5 and 6, as for instance 235° into the second cycle, the sheet is still being winded by air issuing from the nozzle 12 and is under the control of the gripper 13. At this point, as diagrammatically illustrated in Figures 4 and 9, the next sheet has already had its rear edge portion moved forward a short distance and air is blowing under it from the presser foot 9.

The relationship of these various motions and the sequence of the several stages in the operation is clearly depicted in the cam chart of Figure 10. This chart covers two cycles of the operation. The upper curve 14 represents the rise and fall of the combing wheel and the pick-up sucker 10. These elements move up and down in unison. As depicted by the curve 14, the combing wheel and the sucker 10 are down at the beginning of the cycle. The combing wheel acts upon the sheets for a period of about 60°. Hence, at a point approximately 30° into the cycle the combing wheel is no longer effective, but the sheet just acted upon is held by the lifting sucker 10 which reaches its topmost position at 180°. From that point the combing wheel and the pick-up sucker begin their descent to again become active, on the next sheet, approximately 30° before the end of the cycle.

The second curve 15 depicts the functioning of the presser foot and first blower 9. As shown by this curve the presser foot 9 is down during the time the combing wheel is operative, lifts off the topmost sheet abruptly after the pick-up sucker has hold of it and "ducks" down behind it to again engage the top of the pile or bank approximately 140° after the beginning of the cycle where it remains until the beginning of the next cycle. As the presser foot returns to its operative position, the first air blast comes on as depicted at 16.

By the time the pick-up sucker 10 reaches its top position, the forwarding control sucker 11 reaches its rear-most positon as depicted by the rise in the curve 17. The sheet is thus transferred at 180° into the first cycle, from the pick-up sucker 10 to the first control sucker 11 which then starts its advance as depicted by the descent of the curve 17, reaching its farthest advance position at 360°. Throughout this entire time, air is of course, blown under the sheet from the presser foot.

Inasmuch as the specific location of the rear edge of the sheet may vary, the control sucker 11 has a period of dwell; in the present instance 70° as shown at 17' on the curve 17. During this time the gripper 13 is advancing rapidly from its rear-most position indicated by the major elevation in the curve 18, and sometime during the 70° dwell of the sucker 11, the gripper overtakes the rear edge of the sheet. At the end of the 70° dwell, the gripper closes on the sheet so that the sheet is in effect transferred from the sucker 11 to the gripper. The advance of the gripper then progresses at a lesser rate of speed until at a point just before it reaches its farthest advanced position of 240° into the second cycle, the leading edge of the sheet is taken over by the feed-off rolls 5 and 6.

Where the gripper or sheet grasping means 13 is of the type embodied in the aforesaid Patent No. 2,267,784, it incorporates a register face (not shown but fully explained in said patent) which has motion relative to the gripper to engage the rear edge of the sheet and thereby straighten the sheet. The motion of the register face is depicted on the chart by curve 19 which as shown intersects the curve 18 at point 20. As shown by the curve 19, the forward travel of the rear edge portion of the sheet is accelerated during its final stages.

Throughout that portion of the second cycle before the sheet is taken over by the feed-off rollers, air is blown forwardly under it by the nozzle 12. The start and duration of this second air blast is indicated on the chart by the time line 21 which obtains for 240°. Thus the total time in cycle degrees during which sheet-separating-and-forwarding-air is blown under the sheet is 220° from the first blower (presser foot 9) plus 240° from the second blower (nozzle 12) or a total of 460°.

From this it will be readily apparent to those skilled in the art that the present invention readily achieves complete separation of sheets from the pile or fanned out bank without the aid of complicated instrumentalities, and that inasmuch as the lineal speed of the sheets is in nowise altered, the advantages of this invention are realized without entailing reduction in the number of sheets fed per hour. On the contrary, the assurance of sheet separation which this invention provides enables materially increasing the feeding rate.

It will also be apparent that this invention achieves its objective with no structural change in the conventional mechanism now employed in sheet feeders, and inasmuch as all the mechanism employed may be of conventional design and construction, disclosure more elaborate than that made herein is unnecessary.

What I claim as my invention is:

1. A method of feeding sheets of paper off a stacked supply which comprises the steps of: lifting and forwarding the rear edge portion of the topmost sheet far enough to uncover the rear edge portion of the next sheet sufficiently to be acted upon; blowing sheet-separating-and-forwarding-air under the topmost sheet as its rear edge portion is moved forward to uncover the rear edge portion of the next sheet; continuing forward motion of the lifted rear edge portion of the topmost sheet and simultaneously lifting and forwarding the rear edge portion of the next sheet; and simultaneously blowing sheet-separating-and-forwarding-air under the topmost sheet as the forwarding motion of its rear edge portion is continued, and under the next sheet as its rear edge portion is forwarded to uncover the rear edge portion of the following sheet.

2. The hereindescribed method of feeding sheets off a stacked supply, which comprises: successively separating the rear edge portion of each sheet as it becomes the topmost, from the sheets therebeneath; positively moving the separated rear edge portion of each sucecssive sheet forward in two steps, the first step being far enough to uncover the rear edge portion of the next sheet sufficiently to be acted upon, and the second step in the moyement occuring while the rear edge portion of the next sheet is undergoing the first

step of its forward movement; and blowing sheet-separating-and-forwarding-air simultaneously under the topmost sheet as its rear edge portion undergoes the second step of its forward movement and under the next sheet as its rear edge portion undergoes the first step of its forward movement.

3. The hereindescribed method of forwarding sheets of paper off a stacked supply and to sheet receiving instrumentalities by means of mechanism actuated by cams revolving in unison, which method comprises: grasping the rear edge portion of the topmost sheet by a first sheet grasping means each cycle of revolution of the cams; imparting an initial forwarding movement to the rear edge portion of the topmost sheet thus grasped during said cycle; transferring the rear edge portion of the initially forwarded sheet to a second sheet grasping means; grasping and initially forwarding the rear edge portion of the next sheet during the next cycle of revolution of the cams; continuing forwarding motion of the rear edge portion of the topmost sheet by said second sheet grasping means during said next cycle; and blowing sheet-separating-and-forwarding-air under each sheet during said initial and continued forwarding motion of its rear edge portion so that such air acts upon each sheet for longer than one cycle of revolution of the cams.

4. The hereindescribed method of feeding sheets of paper and the like off piles and fanned out banks, which comprises: lifting the rear edge portion of the topmost sheet; grasping the lifted rear edge portion of the topmost sheet by suitable means and thereby initially moving the rear edge portion of the topmost sheet forwardly to expose the rear edge portion of the next adjacent sheet sufficiently to be acted upon; blowing sheet-separating-and-forwarding-air under the grasped lifted rear edge of the topmost sheet as it is initially moved forward; transferring the rear edge portion of the topmost sheet from the grasp of the means by which it was initially moved forward to other suitable sheet grasping means; continuing the forward movement of the rear edge portion of the topmost sheet by such other sheet grasping means; blowing sheet-separating-and-forwarding-air under the topmost sheet as its rear edge continues its forward movement and by means other than that by which air was blown under the sheet during the initial forward movement of its rear edge portion to thereby assure separation of the topmost sheet from the next adjacent sheet and carry the topmost sheet forwardly under the control of the means by which its rear edge is grasped; and acting upon the rear edge portion of the next adjacent sheet to separate the same from the pile or bank and start its forward motion while forwardly moving air is still being blown under the topmost sheet.

5. In a sheet feeder of the character described, the combination of: cyclically operating sheet separating and forwarding control instrumentalities adapted to grasp and advance the rear edge portion of the topmost sheet so as to expose the rear edge portion of the next adjacent sheet sufficiently to be acted upon by said instrumentalities during the next cycle of operation of said instrumentalities; cyclically operating sheet grasping means adapted to grasp the rear edge portion of a sheet advanced by said instrumentalities, during said next cycle and to control further advance of the sheet; and means for blowing sheet-separating-and-forwarding-air under the topmost sheet while its rear edge portion is in the grasp of said sheet grasping means and while it is in the grasp of said instrumentalities to thus provide sheet-separating-and-forwarding-air under the sheet during part of each of the two cycles whereby the air may be on for longer than one cycle.

6. A sheet feeder of the type wherein cyclically operating instrumentalities separate the rear edge portion of each sheet as it becomes the topmost of a stacked supply, from the sheets therebeneath, positively move the rear edge portion of the sheet forwardly to expose the rear edge portion of the succeeding sheet and blow air forwardly under the sheet as its rear edge portion is positively moved forwardly, characterized by the provision of: means for grasping and continuing the positive forward movement of the rear edge portion of the topmost sheet beyond the point to which it is brought by said cyclically operating instrumentalities at the same time that said cyclically operating instrumentalities are operating upon the next successive sheet; and means for simultaneously blowing sheet-separating-and-forwarding-air under both the topmost sheet and the next successive sheet during a portion of each cycle.

7. In a sheet feeder of the character described: a pair of sequentially acting sheet grasping means each movable back and forth over the rear portion of the stacked sheets to be fed, the forward movement of the second acting sheet grasping means encompassing the forepart of and extending beyond the foremost position of the first acting sheet gasping means so that said two sheet grasping means are adapted to sequentially grasp and forward the rear edge portions of the sheets; means for blowing sheet-separating-and-forwarding-air under a sheet while its rear edge portion is in the grasp of the first acting sheet grasping means; and other means for blowing sheet-separating-and-forwarding-air under the sheet while its rear edge portion is in the grasp of the second acting sheet grasping means, said other blowing means operating simultaneously with said first named blowing means during a portion of each sequence.

8. In a sheet feeder for feeding sheets off a stacked supply and to a sheet receiving means in front of the stacked supply: a first sheet grasping means for grasping and positively moving the rear edge portion of the topmost sheet part of the distance it must move to have the front edge of the sheet reach the sheet receiving means; a second sheet grasping means for grasping and positively moving the rear edge portion of the topmost sheet the rest of the distance it must move to have the front edge of said sheet reach the sheet receiving means; while said first sheet grasping means is operating upon the rear edge portion of the next sheet; and means for blowing sheet-separating-and-forwarding-air under the topmost sheet and the next sheet while their rear edges are in the grasp of said sheet grasping means.

9. In a sheet feeder for feeding sheets off a stacked supply and to a sheet receiving means in front of the stacked supply: a first sheet grasping means for grasping and positively moving the rear edge portion of the topmost sheet part of the distance it must move to have the front edge of the sheet reach the sheet receiving means; a second sheet grasping means for grasping and positively moving the rear edge portion of the topmost sheet the rest of the dis-

tance it must move to have the front edge of said sheet reach the sheet receiving means; means for blowing sheet-separating-and-forwarding-air under the topmost sheet while its rear edge is in the grasp of the first sheet grasping means; and other means for blowing sheet-separating-and-forwarding-air under said sheet while its rear edge portion is in the grasp of the second sheet grasping means.

FRANK R. BELLUCHE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,112,609	Harris	Oct. 16, 1914
1,498,965	Henderson	June 24, 1924
2,156,139	Backhouse	Apr. 25, 1939
2,159,147	Gumbel	May 23, 1939
2,236,363	Backhouse	Mar. 25, 1941
2,284,429	Jirousek	May 26, 1942