No. 854,222. PATENTED MAY 21, 1907.

J. P. KNAPP.

MECHANISM FOR SEPARATING SHEETS.

APPLICATION FILED MAY 15, 1902.

3 SHEETS—SHEET 1.

Fig. 2.

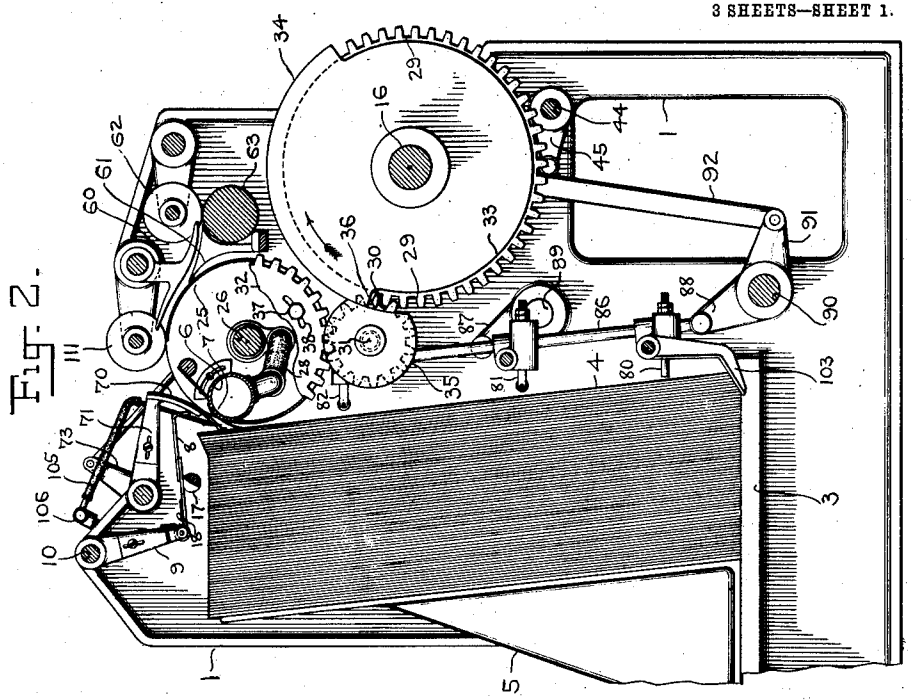
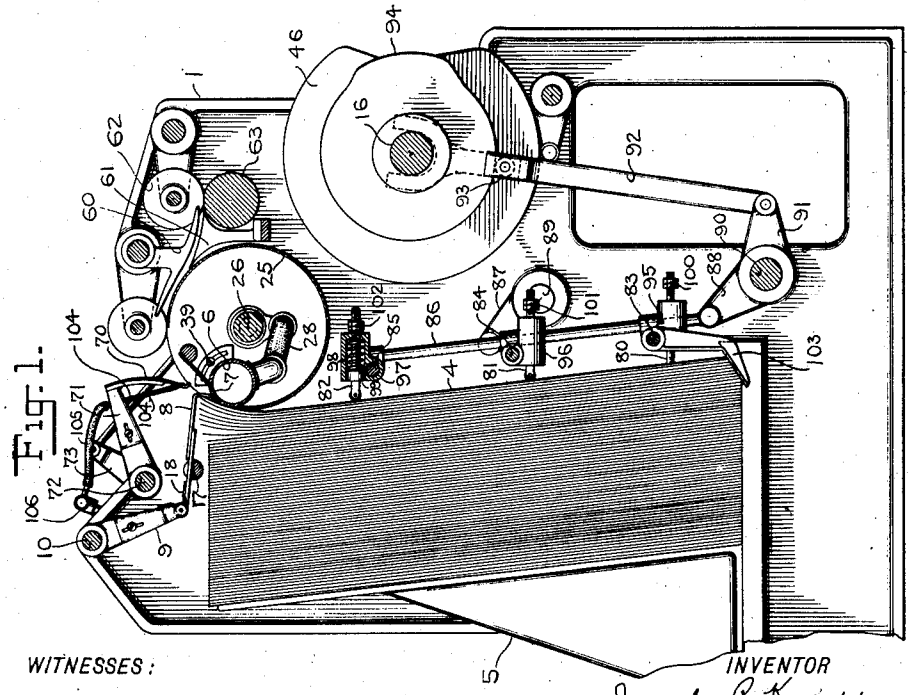


Fig. 1.



WITNESSES:

N. S. Everett.

John O. Kempler

INVENTOR

Joseph P. Knapp

BY

Kenyon & Kenyon

ATTORNEYS

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3 SHEETS—SHEET 2.

Fig. 4.

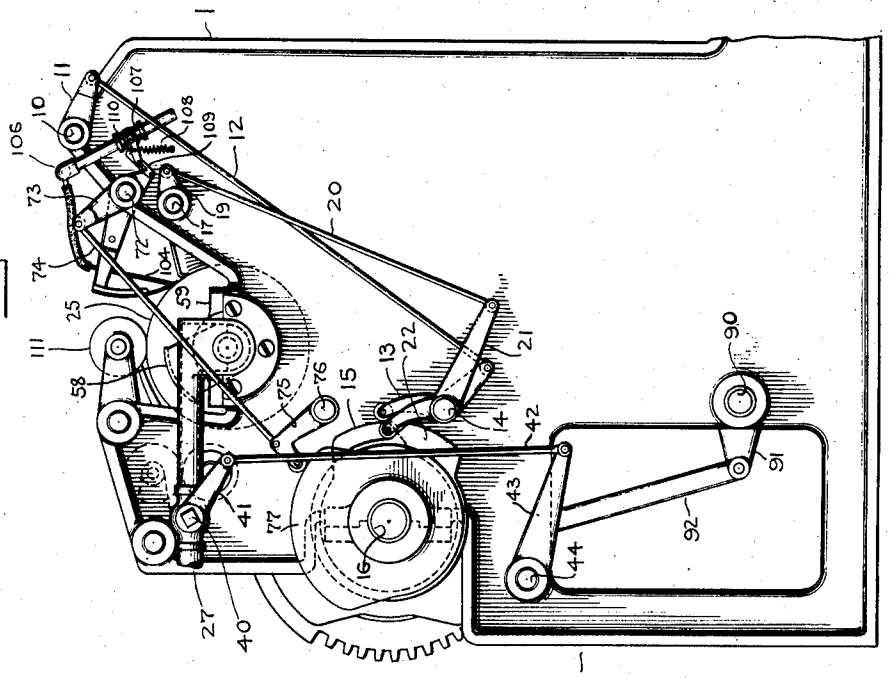
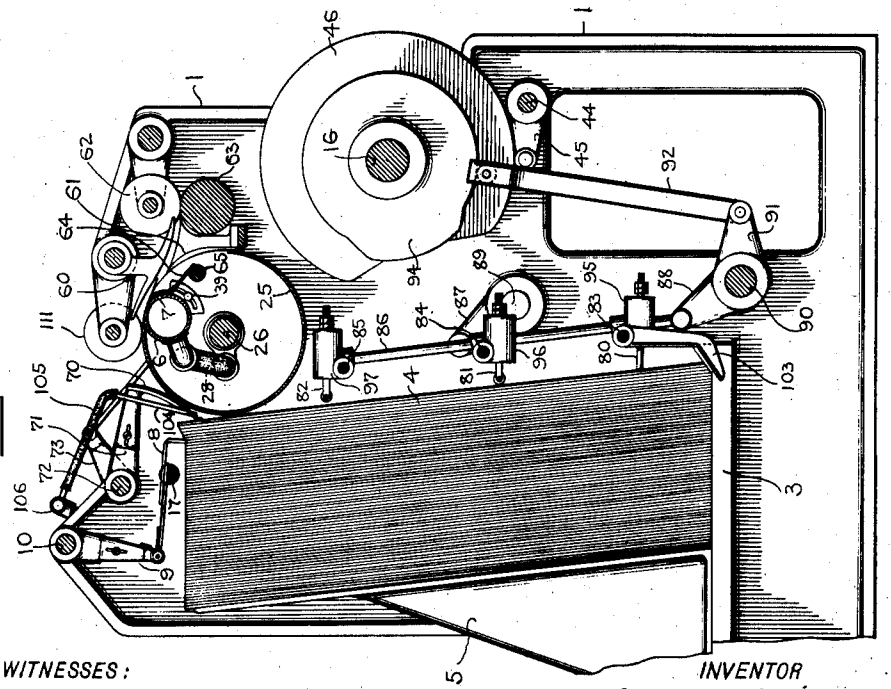


Fig. 7.



WITNESSES:

H. B. Everett.

John O Gempler

INVENTOR

Joseph P. Knapp

BY

Kenyon & Kenyon

ATTORNEYS

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J. P. KNAPP.

MECHANISM FOR SEPARATING SHEETS.

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3 SHEETS—SHEET 3.

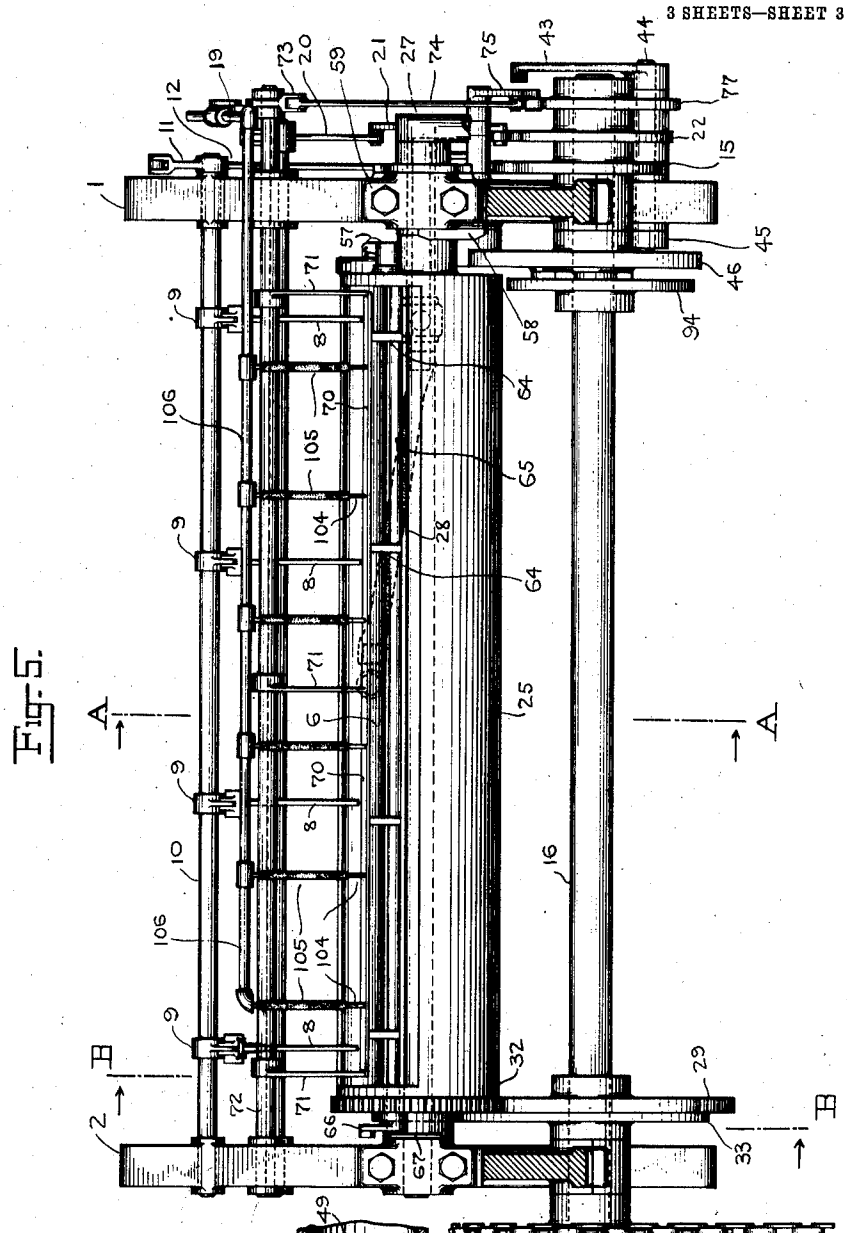


Fig. 5.

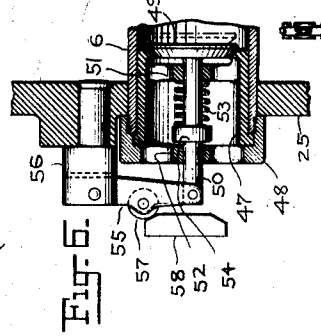


Fig. 6.

WITNESSES:

H. B. Beverett.

John O Gempler

INVENTOR

Joseph P. Knapp

BY

Kenyon & Kenyon

ATTORNEYS

UNITED STATES PATENT OFFICE.

JOSEPH P. KNAPP, OF BELLPORT, NEW YORK.

MECHANISM FOR SEPARATING SHEETS.

No. 854,222. Specification of Letters Patent. Patented May 21, 1907.

Application filed May 15, 1902. Serial No. 107,503.

To all whom it may concern:

Be it known that I, JOSEPH P. KNAPP, a citizen of the United States, and a resident of the city of Bellport, county of Suffolk, and State of New York, have invented certain new and useful Improvements in Mechanism for Separating Sheets, of which the following is a specification.

My invention relates to mechanism for separating sheets of paper or similar material.

The special objects of my inventions are to provide mechanism whereby the sheets may be separated from a pile rapidly and with great precision and advanced to a paper manipulating machine, such as a printing press, folding machine and the like, uniformly and accurately at a predetermined period in the operation of the machine and always one at a time without any skip or intermission in the succession of sheets; also to provide a machine which is simple in construction and operation and durable and not apt to get out of order. These and other objects of my invention will more fully appear from the following description.

My invention consist in the novel parts, improvements and combinations herein shown and described.

The accompanying drawings, which are referred to herein and form a part hereof, illustrate one embodiment of my invention, and serve, in connection with the description herein, to explain the principles of the invention and the best mode in which I have contemplated applying those principles.

Of the drawings Figure 1 is a vertical section taken on the line A A on Fig. 5 and looking in the direction of the arrows; Fig. 2 is a similar view taken on the line B B on Fig. 5, looking in the direction of the arrows; Fig. 3 is a view similar to that shown in Fig. 1 but illustrating the positions the parts occupy at a different period of the operation of the machine; Fig. 4 is a side elevation of the machine as seen from the right in Fig. 5; Fig. 5 is a plan view of the machine certain parts being removed to more clearly show the construction; and Fig. 6 is a sectional view illustrating a detail.

Like reference numerals refer to like parts wherever they occur throughout the drawings.

In accordance with my invention a number of the sheets of a pile of paper or similar resilient material are bent or flexed and then released successively, one of the sheets from which the others are partly separated by their elasticity, being retained and withdrawn from the pile. Preferably the sheets at or near the surface of the pile are flexed and the surface sheet is retained and removed after being separated from the other sheets by a suitable blast of air. In accordance with the best mode of carrying the method of separating sheets into effect, the sheets are engaged at their edges and each sheet is alternately flexed and released a number of times before it is finally retained and withdrawn.

A mechanism constructed in accordance with my invention comprises, in combination, means for flexing a number of sheets and releasing them successively and means for retaining one of the sheets from which the others are partly separated by their elasticity. Means are also provided for withdrawing the retained sheet. A pneumatic suction device is preferably used for retaining the sheets and the means for withdrawing the retained sheet preferably acts on the said retaining means so that the sheet is not transferred from one holding device to another before it is withdrawn from the pile. In the best embodiment of the machine the pneumatic suction device has a convex surface arranged in front of the pile near one edge thereof and the means for flexing the sheets engages the edges of the sheets near the surface of the pile and bends them toward and around the convex surface of the retaining device, and then permits them to spring back successively and thus separate themselves from the surface sheet which adheres to the retaining device. When the machine is to be used for separating large sheets of paper means are provided for directing a blast of air between the surface sheet and the other sheets and mechanism is provided for holding the adjacent sheets while the surface sheet is withdrawn, said mechanism preferably including holding devices for both the rearward and forward edges of the pile.

While, in the embodiment of the invention illustrated in the drawings, the pile from which the sheets are separated is arranged with the sheets resting on edge in a nearly vertical position, it is to be understood that the machine will operate equally as well when the pile is arranged with the sheets in a horizontal position or at an intermediate angle. Where large sheets or very thin sheets

are being manipulated, a horizontal or nearly horizontal position is preferable.

Referring now to the drawings in detail: Numerals 1 and 2 represent a pair of side frames in which the various parts of the mechanism are mounted, said side frames being connected by suitable cross girders or by tie rods not shown.

3 represents a support for a pile 4 of paper which, in the embodiment of my invention illustrated, is arranged on edge, 5 being a suitable follower to support the back of the pile.

Any suitable form of sheet retaining device may be used. In the machine shown the retaining device consists of a pneumatic suction tube 6 which, when in position to receive the sheet, is horizontally arranged in front of the pile near the forward edge thereof and preferably extends from one side of the pile to the other. The tube is connected as hereinafter described to a suitable air exhausting apparatus and it is provided with one or more rows of perforations 7 on the side which is adjacent to the pile.

Any suitable means may be provided for bending or flexing a number of sheets near the suface of the pile around the surface of the tube 6 so as to cover the perforations therein. As shown, the means for thus flexing the sheets consists of a series of fingers 8 which are pivotally connected at their rear ends to a corresponding series of arms 9 fixed at intervals along the shaft 10 which is located in a horizontal position above the pile, the same being journaled at its opposite ends in the said frames 1 and 2. The shaft is given an intermittent rocking motion so as to move the fingers 8 across the forward edge of the pile to and from the tube 6 by any suitable means, those shown consisting of an arm 11 fixed to one end of the shaft 10 which is connected by means of a link 12 with one arm of a lever 13. See Fig. 4. As shown the lever 13 is pivoted on a stud 14 carried by the side frame 1 and its opposite end is provided with an anti-friction roller adapted to engage a suitable cam 15 carried by the main shaft 16. For the purpose of lifting the fingers 8 when at the inner limit of their movement, as required to release the sheets and allow them to successively spring back away from the curved surface of the tube 6, a movable support is provided for the fingers. In the structure shown this support consists of a shaft 17 horizontally arranged above the pile and provided with a series of eccentric surfaces on which the fingers 8 are adapted to rest. The fingers are preferably held in contact with the eccentric surfaces of the shaft 17 by the springs 18 which surround the pivots of the fingers 8 and bear at their opposite ends on said fingers and the arms 9, as shown. The shaft 17 is rocked at the right instant to lift the fingers 8 by means of an arm 19 affixed to one end of the shaft 17 and connected by means of a link 20 with one end of a lever 21 which, as shown in Fig. 4, is pivotally mounted on the stud 14 and is provided at its opposite end with an anti-friction roller adapted to engage a cam 22 affixed to the shaft 16.

Any suitable means may be provided for withdrawing the sheet which is retained by the suction tube 6 and from which the other sheets are partly separated by their elasticity. Preferably and in accordance with the structure shown, the sheet is withdrawn by moving the tube 6 away from the pile and then releasing the sheet and delivering it to a suitable sheet forwarding mechanism. To this end the tube 6 is mounted near the circumference of a suitable carrying cylinder 25, mounted on a shaft 26, horizontally journaled in front of the forward portion of the pile 4. One end of the shaft 26 is bored out to form a passage between the pipe 27 which is connected to a suitable exhausting apparatus and the pipe 28 which communicates at one end with the bore of the shaft 26 and at the other end with the tube 6. In order that the tube 6 may be at rest when the sheets are bent into contact therewith the cylinder 25 is given intermittent rotation. This rotation may be produced by any suitable mechanism, that shown consisting of a segment gear 29 carried by the shaft 16 which is adapted to mesh with a pinion 30 mounted on a stud 31 in position to mesh with a gear 32 affixed to one end of the cylinder 25. For the purpose of locking the cylinder in a fixed position while the blank portion of the gear 29 is passing the pinion 30, a disk 33 having a high concentric portion 34 corresponding in length to the blank portion of the gear 29 is provided, said disk being secured in a fixed relation to the segment gear 29, and the pinion 30 is provided with a disk 35 having a recessed portion 36 adapted to be engaged by the high portion 34 of the disk 33, the said two disks forming in effect the mechanical movement known as the Geneva stop motion.

In order that the position of the tube 6 when at rest may be adjusted with relation to the forward edge of the pile, the gear 32 is preferably adjustably connected to the cylinder 25, as by means of a bolt 37 tapped into the cylinder head and adapted to engage a slot 38 in the gear. The tube 6 may be further adjusted so as to vary the relative arrangement of the perforations 7 and the forward edge of the pile 4, by so mounting the tube 6 in the cylinder that it may be adjusted in a circumferential direction around its own axis. In accordance with the construction shown the tube is journaled in the opposite heads of the cylinder and is provided with a slotted segment by means of which and a screw 39 the tube may be

clamped in various positions. To permit of this latter adjustment the pipe 28, hereinbefore referred to, is made of flexible material.

With the end in view of enabling the air to be exhausted from the tube 6 at the proper instant to retain the sheet thereon, a valve 40 is provided in the pipe 27 and the operating arm 41 of the valve is connected by a link 42 to an arm 43. The arm 43 is journaled on a stub shaft 44 which is journaled in the side frame 1 and is provided at its opposite end with an arm 45 having at its free end an anti-friction roller adapted to engage a cam 46 carried by the shaft 16.

The vacuum in the tube may be broken at the proper instant to release the sheet in any suitable way. As shown, the tube 6 is carried through one of the heads of the cylinder 25 and is provided with a valve mechanism shown in Fig. 6. This mechanism as shown consists of a sleeve 47 which is clamped within the end of the tube by a collar 48 which is threaded on the end of the tube, as shown. A puppet valve 49 is seated on the inner end of the sleeve 47, the stem 50 of the valve being mounted in suitable guides 51 and 52 carried by the sleeve 47 and the collar 48, respectively. The valve is normally held to its seat by means of a compression spring 53 which is arranged between the guide 51 and a collar 54 on the stem 50. For the purpose of opening the valve to release the sheet at the desired point in the revolution of the cylinder 25, a lever 55 is pivoted at one end to the stem 50 and at the opposite end to a stud 56 carried by the head of the cylinder 25, said lever being provided at an intermediate point with a friction roller 57 which is adapted to engage a suitable stationary cam 58. In order that the point at which the vacuum is released may be adjusted, the cam 58 is preferably adjustably mounted concentrically with the shaft 26 of the cylinder 25. This is accomplished in the construction shown by mounting the cam 58 on a sleeve which is clamped on the frame 1 by the cap 59 and forms one of the journals of the shaft 26. As the sheet is released from the tube 6 it may be received and advanced by any suitable mechanism. As shown, the forward edge of the sheet is delivered between the upper and lower guides 60 and 61 respectively, which act to direct it between a pair of suitable forwarding rollers 62 and 63, the latter being mounted and operated in any suitable way. To insure the proper entrance of the sheet between the guides 60 and 61 a series of sheet lifting fingers 64 are preferably provided, the same being mounted on a rock shaft 65 which is journaled in the opposite ends of the cylinder 25 and is provided at one end with an arm 66 adapted to engage a stationary cam 67 carried on the frame 2 as shown in Fig. 5. The free ends of the fingers 64 are preferably curved to adapt them to rest in suitable recess formed in the tube 6 between adjacent perforations therein, and thus normally form a continuation of the surface of said tube. When the sheet has reached the forward edge of the guide 61 the fingers 64 are slightly lifted so as to release the sheet from the tube 6 and direct it above the guide 61.

Any suitable mechanism may be provided for holding the adjacent sheet or sheets while the surface sheet is being withdrawn from the pile. Means are preferably provided however for holding both the forward and rearward edges of the pile and the means for holding the rearward edge of the pile are preferably arranged to engage the pile at successive points beginning at the rearward edge of the pile after the surface sheet has been partly withdrawn and advancing toward the forward edge of the pile as the surface sheet recedes. As shown, the device for holding the forward edge of the pile consist of a blade 70 mounted on a series of arms 71 fixed on the shaft 72 which is horizontally arranged above the pile 4, the same being journaled at its opposite ends in the frames 1 and 2. The blade 70 is preferably curved concentrically with the shaft 72 so that it may be moved as closely as possible to the surface of the cylinder 25, and in order that the blade 70 may be intermittently moved out of contact with the paper, so as not to interfere with the operation of the fingers 8, the shaft 72 is provided at one end with an arm 73 which is connected by a link 74 to an arm 75 pivoted at one end to a stud 76 on the frame 1, and provided at its free end with an anti-friction roller adapted to engage a cam 77 carried by the shaft 16.

The mechanism for holding the rearward edge and the front of the pile consists, in the machine shown, of a series of fingers 80, 81 and 82, which are carried by a series of transverse bars 83, 84 and 85 respectively. These bars are supported by a pair of upright bars or links one at each side of the machine, one of these bars being numbered 86 in the drawings. The bars 86 are carried by upper and lower pairs of arms 87 and 88, only one of each pair being shown. The pair of arms 87 are pivotally mounted on the studs 89 carried by the side frames 1 and 2, and the lower pair of arms are fixed to the opposite ends of a rock shaft 90 journaled in the opposite side frames. The shaft 90 is provided with an arm 91 to the free end of which is pivoted a link 92 which is bifurcated at its upper end so as to embrace and be guided by the shaft 16 and it is provided with an anti-friction roller 93 adapted to engage a suitable cam 94 carried by the shaft 16.

The fingers 80, 81 and 82 are preferably so mounted with relation to the bars 83, 84 and 85 that they will bear upon the surface of the pile with a yielding pressure. In the construction shown this is accomplished by

mounting the fingers in suitable housings 95, 96 and 97 so that they can slide therein in directions substantially at right angles to the surface of the pile, a suitable compression spring being arranged between a shoulder in each of the housings and a collar 99 on each of the fingers so as to hold the fingers toward the outer limits of their movements with a yielding pressure. Pairs of jam nuts 100, 101 and 102 are preferably provided on rearward extensions of the fingers so that their movement in the direction of the pile may be adjusted. The fingers may be provided with anti-friction rollers at their free ends, if desired. The upper pair of arms 87 are preferably made somewhat shorter than the lower arms 88 and the two pairs of arms are so connected to the bars 86 that when the fingers are moved toward the surface of the pile the lower set of fingers 80 will be brought into contact with the pile first and the upper set of fingers 82 last.

For the purpose of advancing the sheets near the front of the pile slightly with relation to the other sheets in the pile, so that they may be acted upon with greater certainty by the fingers 8, a series of fingers 103 are fixed to the lower horizontal bar 83 and the ends of these fingers are bent forwardly so as to lie to the rear of the rearward edge of the pile. When the frame formed by the bars 83, 84, 85 and 86 is moved forwardly and outwardly by the action of the cam 94, the fingers 103 will engage the rearward edge of the pile and advance the sheets slightly, as shown in Figs. 1 and 2.

With the object in view of enabling the surface sheet to be readily withdrawn from the surface of the pile by the pneumatic suction tube 6, means are preferably provided for directing a blast of air between the surface sheet and the adjacent sheets to complete the partial separation of the sheets affected by the fingers 8. In the construction shown this is accomplished by means of a series of blast tubes 104 which are carried by the arms 71 and arranged to discharge through suitable openings near the lower edge of the blade 70. The blast tubes 104 are connected by a series of flexible pipes 105 to an air supply pipe 106 arranged horizontally in a fixed position above the shaft 72. In order that the blast of air may be delivered intermittently and only at the instant required, the supply pipe 106 is provided with a valve 107 which is normally closed by a tension spring 108. For the purpose of intermittently opening the valve 107, a link 109 is connected by a slot in one end to the operating arm of the valve and is pivoted at the other end to an arm 110 carried by the shaft 72.

The operation of the machine is as follows: The main shaft 16 is set in motion in any suitable way, as by means of a chain and sprocket connection with the machine to be supplied with sheets; such a chain and sprocket connection being shown at the left in Fig. 5. During the period of rest of the cylinder 25, the fingers 8 are moved inwardly so as to move the forward edges of the sheets near the surface of the pile toward the suction tube 6 and force them around the curved surface of said tube. The shaft 17 is then operated so as to lift the fingers 8 forwardly away from the sheets and permit the latter to spring back successively away from the surface sheet which will be retained on the surface of the tube by the partial vacuum therein, the valve 40 in the suction pipe 27 having been opened during the time that the sheets are held on the surface of the suction tube. The blade 70 will now be moved inwardly between the surface sheet and the other sheets, the fingers 8 during this movement being returned to their normal position. At this instant the holding fingers 80, 81 and 82 will be moved away from the surface of the pile and a blast of air will be admitted through the tubes 104. This position of the parts is illustrated in Fig. 2. The segment gear 29 then co-operates with the pinion 30 to give the cylinder 25 a complete revolution. As the tube 6 approaches the lower guides 61 the valve 40 will be closed and the valve 49 will be opened so as to break the partial vacuum in the tube 6. The lifting fingers 64 will then be operated to direct the forward edge of the sheet between the guides 60 and 61 and as the cylinder 25 continues to revolve the sheet will be delivered between the forwarding rollers 62 and 63. For the purpose of insuring the advancing movement of the sheet from the time it is released by the suction tube 6 till it reaches the forwarding rollers 62 and 63, a series of rollers 111 may be arranged to bind the sheet on the surface of the cylinder 25. As the rear end of the surface sheet is advanced along the surface of the pile 4, the holding fingers 80, 81 and 82 are brought into operation successively, said fingers thus acting to prevent the adjacent sheets from being advanced with the surface sheet, and where the pile is arranged in an upright position as shown, the fingers also prevent the sheets near the surface of the pile from buckling and dropping away from the pile. When the cylinder 25 has completed its revolution the blade 70 is moved outwardly to release the upper edge of the pile and the blast of air is cut off from the tubes 104. The machine is then in position to repeat the above cycle of operations.

It will be seen that, by reason of the described action of fingers 8, each of the sheets will be repeatedly flexed and released before it reaches the surface of the pile and is separated and withdrawn from the other sheets. In this way the sheets are thoroughly loosened from each other and are certain to have between them when they reach the surface of

the pile, a sufficient quantity of air to permit the sheets near the surface sheet to freely separate themselves from the surface sheet by their elasticity, the withdrawal of two or more sheets at a time being thus prevented. When heavy, stiff paper is being manipulated the tube 6 is so adjusted with relation to the forward edge of the pile that the paper is bent a less distance around the surface of the tube by the fingers 8. While when a thinner and less resilient paper is used, the operative position of the tube 6 will be further from the forward edge of the pile and the perforations 7 will be set further around away from the surface of the pile, so that the sheets will be flexed to a greater extent and thus given more power to separate themselves from the surface sheet. The fingers 8 may also require adjustment in this connection. This adjustment may be effected either by resetting the arms on the shaft 10 or by varying the length of the fingers or the arms or both, the fingers and arms, to this end, preferably being made in two sections which are adjustably secured together, as indicated. When small sheets are used the means for supplying the blast of air for separating the surface sheet from the other sheets may not be necessary. On the other hand, where very large sheets are to be separated, it may be desirable to arrange the machine so that the surface of the pile will be horizontal, or nearly horizontal.

My invention, in its broad aspects, is not limited to the precise construction shown, nor to the particular construction by which it may be carried into effect, as many changes other than those herein suggested may be made in the construction without departing from the main principles of the invention and without sacrificing its chief advantages.

What I claim as new and desire to secure by Letters Patent is:

1. A sheet separating mechanism comprising, in combination, means for flexing a number of sheets and releasing them successively, and means for retaining one of the sheets from which the others are partly separated by their elasticity.

2. A sheet separating mechanism comprising, in combination, means for flexing a number of sheets and releasing them successively, means for retaining one of the sheets from which the others are partly separated by their elasticity, and means for withdrawing the retained sheet.

3. A sheet separating mechanism comprising, in combination, means for flexing a number of sheets and releasing them successively, means for retaining one of the sheets from which the others are partly separated by their elasticity, and means acting on said retaining means for withdrawing the retained sheet.

4. A sheet separating mechanism comprising in combination, means for flexing a number of sheets and releasing them successively, means for retaining one of the sheets from which the others are partly separated by their elasticity, means acting on said retaining means for withdrawing the retained sheet, and mechanism for receiving and forwarding the separated sheets.

5. In a machine for separating sheets from a pile, the combination with mechanism for flexing a number of sheets, said mechanism being constructed to engage the sheets at their edges and to release them successively, of mechanism for retaining the surface sheet from which the others are partly separated by their elasticity, said sheet retaining mechanism being constructed and operated to withdraw the sheet so separated.

6. A sheet separating mechanism comprising, in combination, means for flexing a number of sheets and releasing them successively, and a pneumatic suction device for retaining one of the sheets from which the others are partly separated by their elasticity.

7. A sheet separating mechanism comprising, in combination, means for flexing a number of sheets and releasing them successively, a pneumatic suction device for retaining one of the sheets from which the others are partly separated by their elasticity, and means acting on said pneumatic suction device for withdrawing the retained sheet.

8. In a machine for separating sheets from a pile, the combination with mechanism for flexing a number of sheets, the said mechanism being constructed to engage the sheets at their edges and to release them successively, of a pneumatic suction device for retaining the surface sheet from which the others are partly separated by their elasticity, and means for withdrawing the sheet retained by the pneumatic suction device.

9. In a machine for separating sheets from a pile, the combination with mechanism for flexing a number of sheets, the said mechanism being constructed to engage the sheets at their edges and to release them successively, of a pneumatic suction device for retaining the surface sheet from which the others are partly separated by their elasticity, said pneumatic suction device being constructed and operated to withdraw the sheets so separated.

10. A sheet separating device comprising, in combination, mechanism for retaining the sheets and withdrawing them singly, and means whereby each sheet is flexed and released before it is separated and is brought into co-operative relation with the retaining mechanism while in a flexed condition.

11. A sheet retaining device comprising, in combination, means for repeatedly flexing a number of sheets and releasing them successively, and means for retaining one of the sheets during each releasing operation.

12. A sheet separating device comprising, in combination, means for repeatedly flexing a number of sheets and releasing them successively, means for retaining one of the sheets during each releasing operation, and means acting on said retaining means for withdrawing the retained sheet.

13. A sheet separating device comprising, in combination, a pneumatic suction device whereby each sheet is flexed and released before it is separated and is brought into co-operative relation with the retaining mechanism while in a flexed condition.

14. A sheet separating device comprising, in combination, a pneumatic suction device for retaining the sheets and withdrawing them singly and means whereby each sheet is repeatedly flexed and released before it is separated and is brought into co-operative relation with the retaining mechanism while in a flexed condition, said means being constructed to engage the sheets at their edges and to release them successively.

15. A sheet separating device comprising, in combination, means for repeatedly flexing a number of sheets, said means being constructed to engage the sheets at their edges and to release them successively, and means for retaining one of the sheets during each releasing operation.

16. A sheet separating device comprising, in combination, means for repeatedly flexing a number of sheets, said means being constructed to engage the sheets at their edges and to release them successively, means for retaining one of the sheets during each releasing operation, and means acting on said retaining means for withdrawing the retained sheet.

17. A sheet retaining device comprising, in combination, means for repeatedly flexing a number of sheets and releasing them successively, and pneumatic suction means for retaining one of the sheets during each releasing operation.

18. A sheet separating device comprising, in combination, means for repeatedly flexing a number of sheets and releasing them successively, and pneumatic suction means for retaining one of the sheets during each releasing operation, and means acting on said retaining means for withdrawing the retained sheets.

19. A sheet separating device comprising, in combination, means for repeatedly flexing a number of sheets, said means being constructed to engage the sheets at their edges and to release them successively, and pneumatic suction means for retaining one of the sheets during each releasing operation.

20. A sheet separating device comprising, in combination, means for repeatedly flexing a number of sheets, said means being constructed to engage the sheets at their edges and to release them successively, pneumatic suction means for retaining one of the sheets during each releasing operation, and means acting on said retaining means for withdrawing the retained sheet.

21. A mechanism for separating sheets comprising, in combination, a sheet retaining device, and means for bending a number of sheets so as to bring one of the sheets into co-operative relation with the retaining device and permitting them to spring back successively.

22. A mechanism for separating sheets comprising, in combination, a sheet retaining device, and means for bending a number of sheets so as to bring one of the sheets into co-operative relation with said retaining device, said means being constructed to engage the edges of the sheets and to permit them to spring back successively.

23. A mechanism for separating sheets comprising, in combination, a sheet retaining device having a curved surface, and means for bending a number of sheets around said surface and permitting them to spring back successively.

24. A mechanism for separating sheets comprising, in combination, a sheet retaining device having a curved surface, and means for bending a number of sheets around said surface, said means being constructed to engage the edges of the sheets and to permit them to spring back successively.

25. A mechanism for separating sheets comprising, in combination, a pneumatic suction sheet retaining device, and means for bending a number of sheets so as to bring one of the sheets into co-operative relation with the retaining device and permitting them to spring back successively.

26. A machine for separating sheets comprising, in combination, a pneumatic sheet retaining device having a curved suction surface, and means for bending a number of sheets around said surface and permitting them to spring back successively.

27. A machine for separating sheets comprising, in combination, a pneumatic retaining device having a curved suction surface, and means for bending a number of sheets around said surface, said means being constructed to engage the edges of the sheets and to permit them to spring back successively.

28. A mechanism for separating sheets comprising, in combination, a sheet retaining device, and means for bending a number of sheets toward the retaining device and permitting them to spring back successively, said sheet retaining device being constructed and operated to withdraw the sheet retained thereby.

29. A mechanism for separating sheets comprising, in combination, a sheet retaining device, means for bending a number of sheets toward the retaining device and permitting them to spring back successively, a device

for holding the sheets thus separated by their elasticity from the sheet on the retaining device, and means for withdrawing the retained sheet.

30. A mechanism for separating sheets comprising, in combination, a sheet retaining device, means for bending a number of sheets toward the retaining device, said means being constructed to engage the edges of the sheets and to permit them to spring back successively, a device for holding the sheets thus separated by their elasticity from the sheet on the retaining device, and means for withdrawing the retained sheet.

31. A mechanism for separating sheets comprising, in combination, a pneumatic sheet retaining device having a curved suction surface, means for bending a number of sheets around said surface and permitting them to spring back successively, a device for holding the sheets thus separated by their elasticity from the sheet on the retaining device, and means for withdrawing the retained sheet.

32. In a machine for separating sheets from a pile, the combination with mechanism for flexing a number of sheets, said mechanism being constructed to engage the sheets at their edges and to release them successively, of mechanism for retaining the surface sheet from which the others are partly separated by their elasticity, means for withdrawing the surface sheet and mechanism for holding the other sheets while the surface sheet is being withdrawn.

33. In a machine for separating sheets from a pile, the combination with mechanism for flexing a number of sheets said mechanism being constructed to engage the sheets at their edges and to release them successively, of mechanism for retaining the surface sheet from which the others are partly separated by their elasticity, means for withdrawing the surface sheet and mechanism for holding the other sheets while the surface sheet is being withdrawn, said holding mechanism including means constructed and arranged to engage the rearward portion of the pile after the surface sheet has been partly withdrawn.

34. In a machine for separating sheets from a pile, the combination with mechanism for flexing a number of sheets, said mechanism being constructed to engage the sheets at their edges and to release them successively, of mechanism for retaining the surface sheet from which the others are partly separated by their elasticity, means for withdrawing the surface sheet and mechanism for holding the other sheets while the surface sheet is being withdrawn, said holding mechanism including means constructed and arranged to engage the pile at successive points beginning at the rearward portion of the pile after the surface sheet has been partly withdrawn and advancing toward the forward portion of the pile as the surface sheet recedes.

35. In a machine for separating sheets from a pile, the combination with mechanism for flexing a number of sheets, said mechanism being constructed to engage the sheets at their edges and to release them successively, of mechanism for retaining the surface sheet from which the others are partly separated by their elasticity, means for withdrawing the surface sheet and mechanism for holding the other sheets while the surface sheet is being withdrawn, said holding mechanism being constructed and arranged to engage both the forward and rearward portions of the pile.

36. In a machine for separating sheets from a pile, the combination with mechanism for flexing a number of sheets, said mechanism being constructed to engage the sheets at their edges and to release them successively, of mechanism for retaining the surface sheet from which the others are partly separated by their elasticity, means for withdrawing the surface sheet and mechanism for holding the other sheets while the surface sheet is being withdrawn, said holding mechanism including a device for holding the forward portion of the pile and means constructed and arranged to engage the rearward portion of the pile after the surface sheet has been partly withdrawn.

37. In a machine for separating sheets from a pile, the combination with mechanism for separating and withdrawing the surface sheet of the pile, of mechanism for holding the other sheets while the surface sheet is being withdrawn, said mechanism being constructed and arranged to engage the forward end of the pile before the sheet is withdrawn and to engage the rearward portion of the pile after the surface sheet has been partly withdrawn.

38. In a machine for separating sheets from a pile, the combination with mechanism for separating and withdrawing the surface sheet from the pile, of mechanism for holding the other sheets while the surface sheet is being withdrawn, said mechanism being constructed and arranged to engage the pile at successive points beginning at the rearward portion of the pile after the surface sheet has been partly withdrawn and advancing toward the forward portion of the pile as the surface sheet recedes.

39. In a machine for separating sheets from a pile, the combination with mechanism for separating and withdrawing the surface sheet of the pile, of mechanism for holding the other sheets while the surface sheet is being withdrawn, said mechanism being constructed and arranged to engage both the forward and the rearward edges of the pile and to engage the pile at an intermediate

point after the sheet has been further withdrawn.

40. In a machine for separating sheets from a pile, the combination with mechanism for separating and withdrawing the surface sheet of the pile, of mechanism for holding the other sheets while the surface sheet is being withdrawn, said mechanism including a device for holding the forward edge of the pile and means constructed and arranged to engage the rearward edge of the pile after the surface sheet has been partly withdrawn and to engage the pile at an intermediate point after the sheet has been further withdrawn.

41. A sheet separating mechanism comprising, in combination, means for flexing a number of sheets and releasing them successively, means for retaining one of the sheets from which the others are partly separated by their elasticity, and means for directing a blast of air between the retained sheet and the other sheets.

42. A sheet separating mechanism comprising, in combination, means for flexing a number of sheets and releasing them successively, means for retaining one of the sheets from which the others are partly separated by their elasticity, means for directing a blast of air between the retained sheet and the other sheets, and means for withdrawing the retained sheet.

43. In a machine for separating sheets from a pile, the combination with mechanism for flexing a number of sheets, said means being constructed to engage the sheets at their edges and to release them successively, of mechanism for retaining the surface sheet from which the others are partly separated by their elasticity, and means for directing a blast of air between the retained sheet and the other sheets, said sheet retaining mechanism being constructed and operated to withdraw the sheets when separated.

44. A sheet separating mechanism comprising, in combination, means for flexing a number of sheets and releasing them successively, a pneumatic suction device for retaining one of the sheets from which the others are partly separated by their elasticity, and means for directing a blast of air between the retained sheets and the other sheets.

45. In a machine for separating sheets from a pile, the combination of mechanism for flexing a number of the sheets, said mechanism being constructed to engage the sheets at their edges and to release them successively, a pneumatic suction device for retaining the surface sheet from which the others are partly separated by their elasticity, means for directing a blast of air between the retained sheet and the other sheets, and means for withdrawing the sheet retained by the pneumatic suction device.

46. A sheet separating device comprising, in combination, means for repeatedly flexing a number of sheets and releasing them successively, means for retaining one of the sheets during each releasing operation, means for directing a blast of air between the retained sheet and the other sheets, and means for withdrawing the retained sheet.

47. A mechanism for separating sheets comprising, in combination, a sheet retaining device, means for bending a number of sheets toward the retaining device and permitting them to spring back successively, a device for holding the sheets thus separated by their elasticity from the sheet on the retaining device, means for directing a blast of air between the retained sheet and the other sheets, and means for withdrawing the retained sheet.

48. A mechanism for separating sheets comprising, in combination, a pneumatic sheet retaining device having a curved suction surface, means for bending a number of sheets around the said surface and permitting them to spring back successively, a device for holding the sheets thus separated by their elasticity from the sheet on the retaining device, means for directing a blast of air between the retained sheet and the other sheets, and means for withdrawing the retained sheet.

49. In a machine for separating sheets from a pile, the combination with mechanism for flexing a number of sheets, said mechanism being constructed to engage the sheets at their edges and to release them successively, of mechanism for retaining the surface sheet from which the others are partly separated by their elasticity, means for directing a blast of air between the retained sheet and the other sheets, means for withdrawing the surface sheet, and mechanism for holding the other sheets while the surface sheet is being withdrawn.

50. In a machine for separating sheets from a pile, the combination with means for supporting the pile, of means for slightly advancing a number of the sheets near the surface of the pile, means for flexing a number of sheets, said means being constructed to engage the advanced sheets at their forward edges and to release them successively, of mechanism for retaining the surface sheet from which the others are partly separated by their elasticity, and means for withdrawing the retained sheet.

51. In a machine for separating sheets, the combination of a sheet retaining device consisting of a pneumatic suction tube, a rotary carrier for said tube, and means for bending a number of sheets toward the retaining device while it is in position to receive them and permitting them to spring back successively.

52. In a machine for separating sheets, the combination of a sheet retaining device consisting of a pneumatic suction tube, a rotary

carrier for said tube, means for intermittently rotating said carrier, a series of fingers for bending a number of sheets toward the retaining device while it is at rest, said means being constructed to engage the sheets at their edges and to permit them to spring back successively.

53. In a machine for separating sheets, the combination of a sheet retaining device consisting of a pneumatic suction tube, a rotary carrier for said tube, means for intermittently rotating said carrier, a series of fingers for bending a number of sheets toward the retaining device while it is at rest, said means being constructed to engage the sheets at their edges and to permit them to spring back successively, means for creating a partial vacuum in the suction tube while the sheets are in contact therewith and means for releasing the vacuum during the rotation of said carrier.

54. In a machine for separating sheets, the combination of a sheet retaining device consisting of a pneumatic suction tube, a rotary carrier for said tube, means for intermittently rotating said carrier, a series of reciprocating fingers for bending a number of sheets around said tube while it is stationary and permitting them to spring back successively, means for creating a partial vacuum in said tube while the sheets are in contact therewith, and means for breaking the vacuum in said tube during the rotation of the carrier.

55. In a machine for separating sheets, the combination of a sheet retaining device consisting of a pneumatic suction tube, a rotary carrier for said tube, and means for intermittently rotating said carrier.

56. In a machine for separating sheets, the combination of a sheet retaining device consisting of a pneumatic suction tube, a rotary carrier for said tube, and means for intermittently rotating said carrier, said pneumatic suction tube being adjustable circumferentially around its own axis on said carrier.

57. In a machine for separating sheets, the combination of a sheet retaining device consisting of a pneumatic suction tube, a rotary carrier for said tube, means for intermittently rotating said carrier, said pneumatic suction tube being adjustable circumferentially around its own axis on said carrier, means for creating a partial vacuum in said tube while it is stationary, and means for breaking said vacuum during the rotation of the carrier.

58. In a machine for separating sheets, the combination of a sheet retaining device, means for bending a number of sheets toward said retaining device while it is in position to receive them and permitting them to spring back successively, a sheet holding blade, and means for moving said blade between the retained sheet and the other sheets.

59. In a machine for separating sheets, the combination of a sheet retaining device, means for bending a number of sheets toward said retaining device while it is in position to receive them and permitting them to spring back successively, a sheet holding blade, means for moving said blade between the retained sheet and the other sheets and a series of blast nozzles carried with said blade.

60. In a machine for separating sheets, the combination of a sheet retaining device, means for bending a number of sheets toward said retaining device and permitting them to spring back successively, a sheet holding blade and means for moving said blade between the retained sheet and the other sheets, a series of blast nozzles carried with said blade, and means for admitting air to said nozzles when the blade is in its operative position.

61. In a machine for separating sheets from a pile, the combination with means for supporting the pile on edge, of a sheet retaining device located in front of said pile near its upper edge, means for bending a number of sheets toward the retaining device while it is in position to receive them, said means being constructed to engage the sheets at their upper edges and to permit them to spring back successively.

62. In a machine for separating sheets from a pile, the combination with means for supporting the pile on edge, of a sheet retaining device located in front of said pile near its upper edge, means for bending a number of sheets toward the retaining device while it is in position to receive them, said means being constructed to engage the sheets at their upper edges and to permit them to spring back successively, and means for withdrawing the retained sheet.

63. In a machine for separating sheets from a pile, the combination with means for supporting the pile on edge, of a sheet retaining device located in front of said pile near its upper edge, said retaining device consisting of a pneumatic suction tube and rotary carrier for said tube, means for bending a number of sheets toward the retaining device, said means being constructed to engage the sheets at their upper edges and to permit them to spring back successively.

64. In a machine for separating sheets from a pile, the combination with means for supporting the pile on edge of a sheet retaining device located in front of said pile near its upper edge, said sheet retaining device consisting of a pneumatic suction tube, a rotary carrier for said tube, means for intermittently rotating said carrier, and means for bending a number of sheets around said suction tube while it is stationary, said means being constructed to engage the sheets at their upper edges and to permit them to spring back successively.

65. In a machine for separating sheets from a pile, the combination with means for supporting the pile on edge of a sheet retaining device located in front of said pile near its upper edge, said sheet retaining device consisting of a pneumatic suction tube, a rotary carrier for said tube, means for intermittently rotating said carrier, means for bending a number of sheets around said suction tube while it is stationary, said means being constructed to engage the sheets at their upper edges and to permit them to spring back successively, means for creating a partial vacuum in said suction tube while it is stationary, and means for breaking said vacuum during the rotation of said carrier.

66. In a machine for separating sheets from a pile, the combination with means for supporting the pile on edge of a sheet retaining device located in front of said pile near its upper edge, said sheet retaining device consisting of a pneumatic suction tube, a rotary carrier for said tube, means for intermittently rotating said carrier, means for bending a number of sheets around said suction tube while it is stationary, said means being constructed to engage the sheets at their upper edges and to permit them to spring back successively, and means for holding the upper edge of the pile during the rotation of said carrier.

67. In a machine for separating sheets from a pile, the combination with means for supporting the pile on edge of a sheet retaining device located in front of said pile near its upper edge, said sheet retaining device consisting of a pneumatic suction tube, a rotary carrier for said tube, means for intermittently rotating said carrier, means for bending a number of sheets around said suction tube while it is stationary, said means being constructed to engage the sheets at their upper edges and to permit them to spring back successively, means for holding the upper edge of the pile during the rotation of said carrier, and means for directing a blast of air between the surface sheet and the other sheets.

68. In a machine for separating sheets from a pile, the combination with means for supporting the pile on edge of a sheet retaining device located in front of said pile near its upper edge, said sheet retaining device consisting of a pneumatic suction tube, a rotary carrier for said tube, means for intermittently rotating said carrier, means for bending a number of sheets around said suction tube while it is stationary, said means being constructed to engage the sheets at their upper edges and to permit them to spring back successively, means for creating a partial vacuum in said suction tube while it is stationary, means for breaking said vacuum during the rotation of said carrier, and means for directing a blast of air between the surface sheet and the other sheets.

In testimony whereof. I have signed my name to this specification, in the presence of two subscribing witnesses.

JOSEPH P. KNAPP.

Witnesses:

GEO. H. BARNES,

W. P. TEN EYCK.