

H. STEINMETZ.
SHEET LIFTING MECHANISM.
APPLICATION FILED SEPT. 3, 1915.

1,203,930.

Patented Nov. 7, 1916.

4 SHEETS—SHEET 1.

Fig. 1

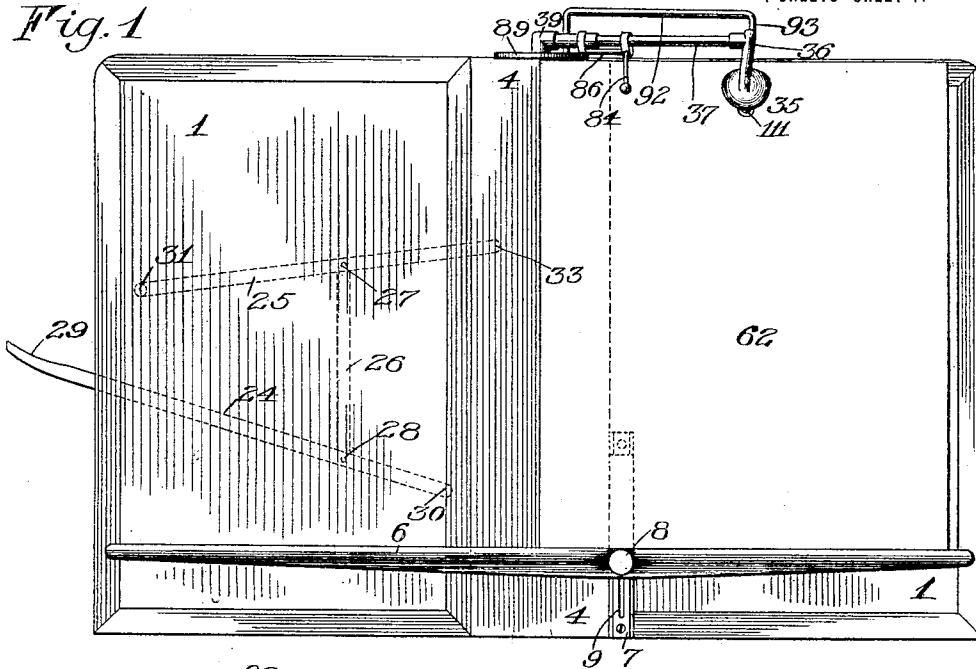


Fig. 4

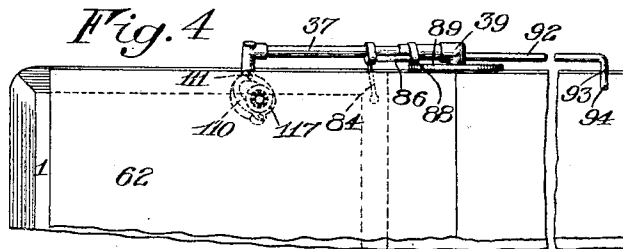


Fig. 2

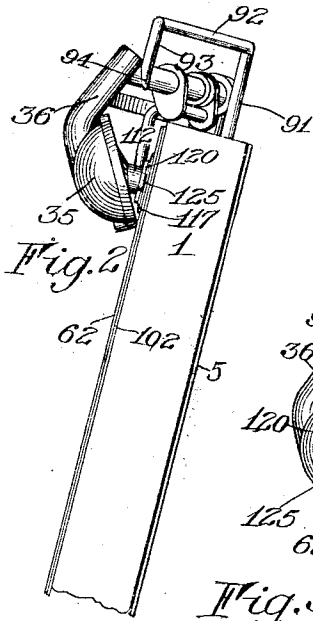


Fig. 3

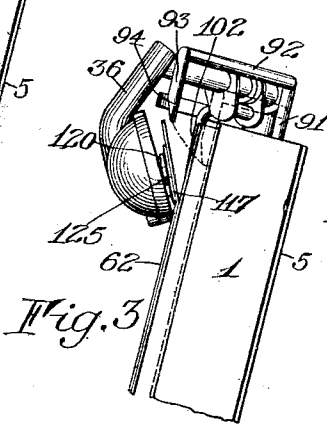
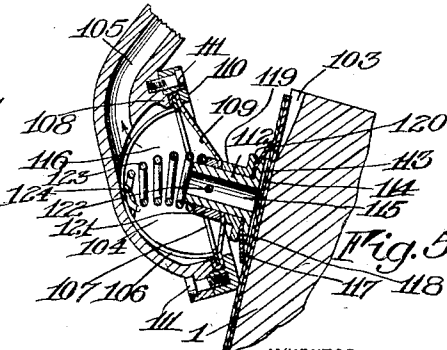


Fig. 5



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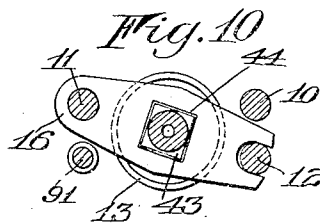
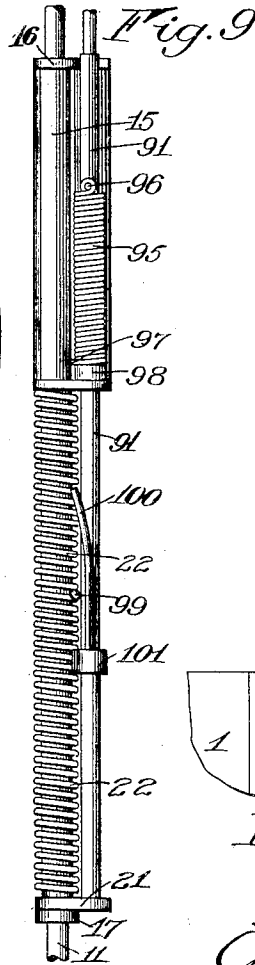
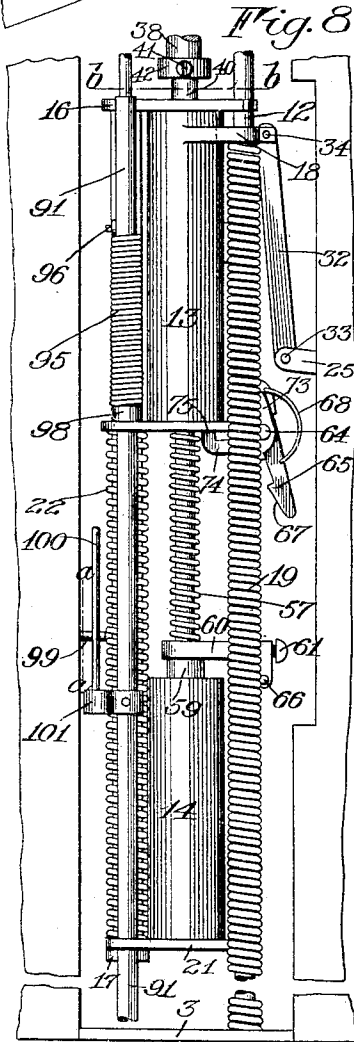
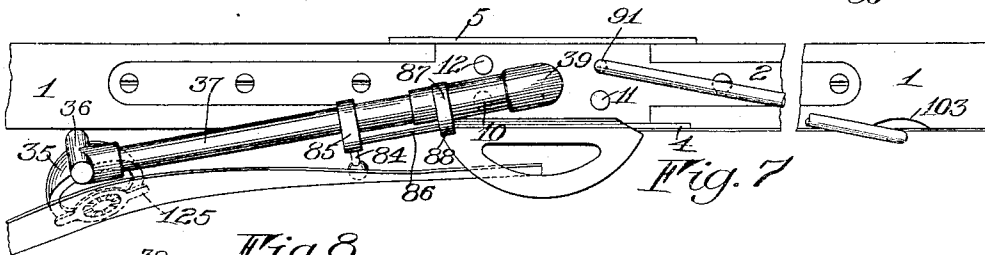
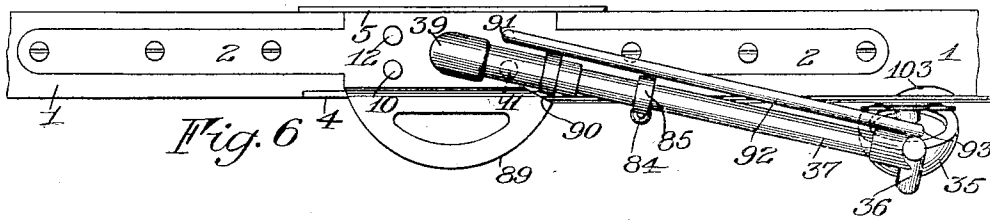
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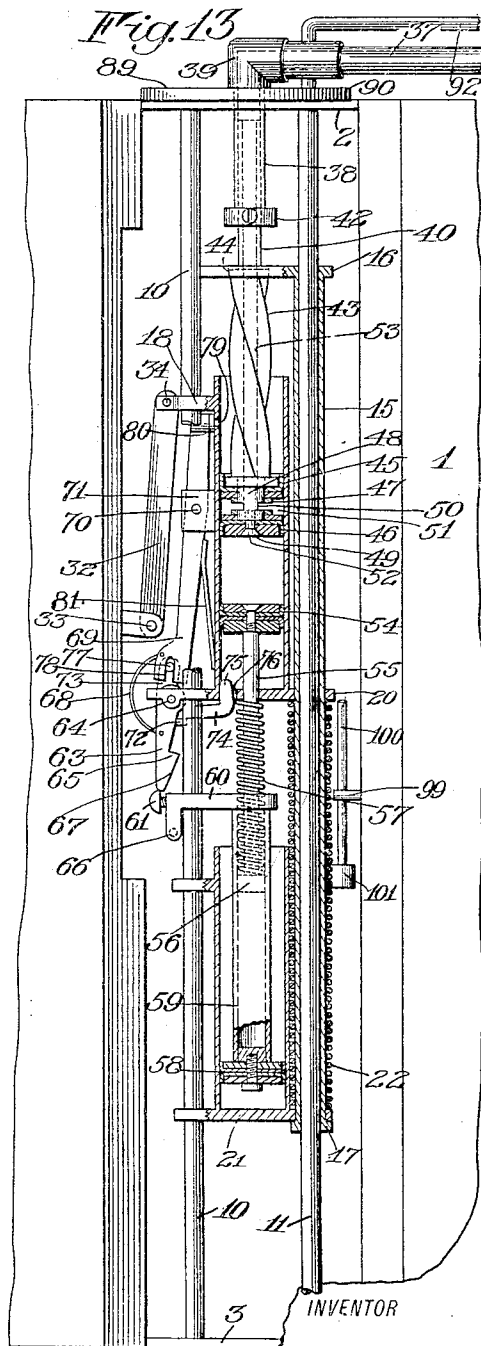
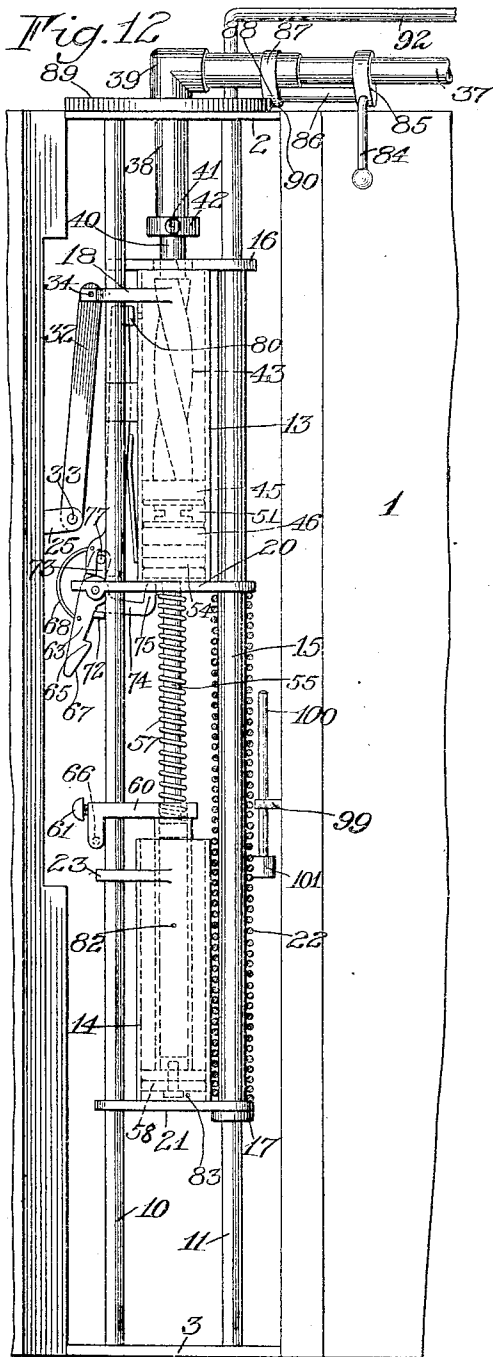
4 SHEETS—SHEET 2.



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4 SHEETS—SHEET 3.



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4 SHEETS—SHEET 4.

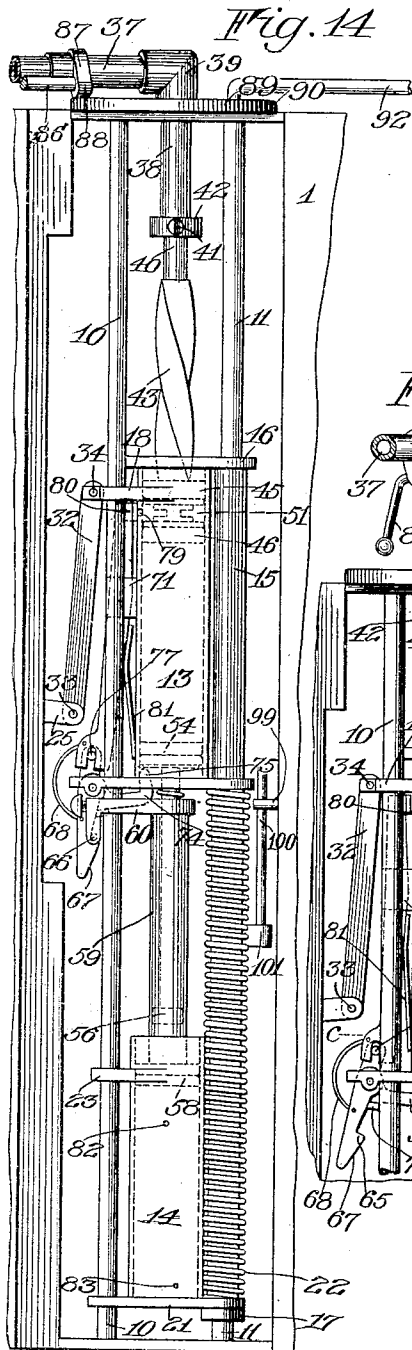


Fig. 14

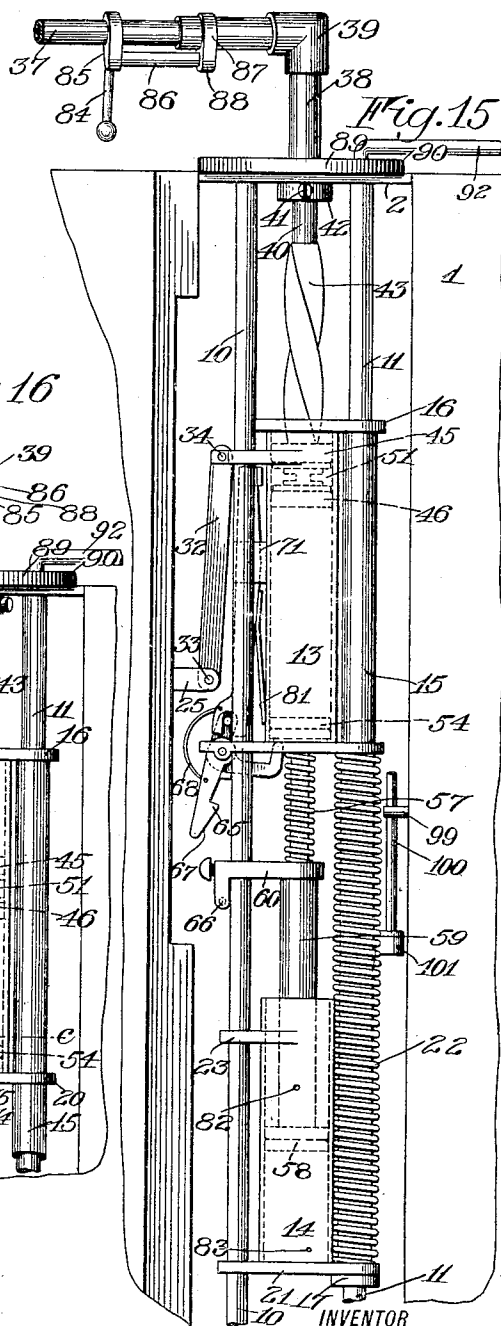


Fig. 15

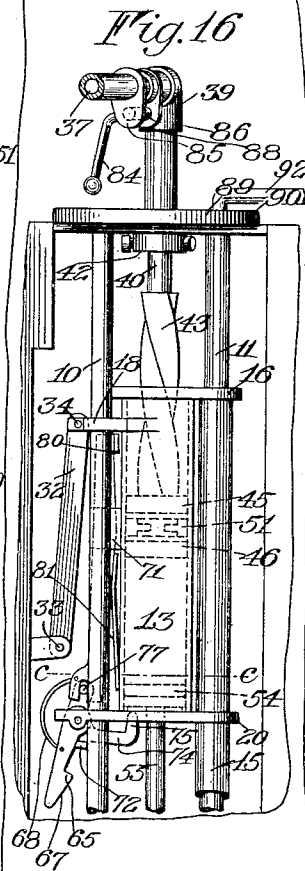


Fig. 16

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SHEET-LIFTING MECHANISM.

1,203,930.

Specification of Letters Patent.

Patented Nov. 7, 1916.

Application filed September 3, 1915. Serial No. 48,752.

To all whom it may concern:

Be it known that I, HERMAN STEINMETZ, of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Sheet-Lifting Mechanisms; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the reference-numerals marked thereon.

My present invention has for its object to provide improved mechanism adapted for lifting a sheet or leaf from a pile, in such a manner as to prevent feeding more than one sheet at a time and whereby a single sheet engaging member may be employed to operate successively on the different sheets.

Another purpose of the invention is to provide a sheet guard to engage and positively hold against movement the sheets under the one to be lifted.

To these and other ends the invention consists in certain improvements and combinations of parts all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

In the drawings: Figure 1 is a view in front elevation of one embodiment of my invention as applied to a music sheet mechanism, or the like, and showing the normal position of the sheet engaging device; Fig. 2 is a side elevation showing the sheet engaging device in normal position and the relative position of a guard for engaging the sheets under the uppermost one; Fig. 3 is a similar view showing the position of the sheet engaging device and guard member after their initial operative movement; Fig. 4 is a view in front elevation, showing the relative positions of the sheet engaging device and guard member after a sheet has been turned, and before the engaging device has released its hold upon the sheet and begun to return to its normal position; Fig. 5 is an enlarged sectional view through the sheet engaging device when the same is in normal position upon the sheets, which are held by the supporting stand; Fig. 6 is a top plan view showing the sheet engaging device and guard members in their normal

positions with respect to the sheets; Fig. 7 is a similar top plan view showing the position of the sheet engaging device after the same has moved one of the sheets from the position shown in Fig. 6, or a right hand position, to a left hand position, and just previous to the releasing of the sheet by the engaging device; Fig. 8 is a fragmentary rear elevational view of a portion of the operating and releasing mechanism controlling the sheet engaging device and guard member; Fig. 9 is a sectional elevation taken on line *a-a* of Fig. 8; Fig. 10 is a sectional view taken on line *b-b* of Fig. 8; Fig. 11 is a sectional view taken through the support for the sheet engaging device, when the same has reached a position substantially at right-angles to the sheet supporting stand; Fig. 12 is a front elevation with the cover plates removed to show the operating mechanism in its normal position; Fig. 13 is an elevational view partly in section, showing the position of the cylinders and other movable parts upon the initial operative movement of the sheet engaging device; Fig. 14 is a view in elevation showing the position of the cylinders and other movable parts after the sheet engaging device has reached substantially its extreme operative position, and before the cylinders have been released to return the sheet engaging device to its normal position; Fig. 15 is an elevational view showing the position of the cylinders after they have been released, and have raised the support for the sheet engaging device to its highest elevation, at which point it begins to rotate back to its normal position; Fig. 16 is a similar view showing the support for the sheet engaging device, after it has partially returned to normal position, and Fig. 17 is a sectional view taken on line *c-c* of Fig. 16.

Similar reference numerals throughout the several views indicate the same parts.

The invention is susceptible of any application, where there is a requirement to grip one of a series of sheets and remove it from the pile on which it rests, and the present embodiment will serve as an illustration of one manner of adapting the improvements to a particular mechanism. The structure shown comprises a sheet music

stand or rack preferably consisting of the frames 1 spaced apart and connected at the top and bottom by means of the straps 2 and 3 respectively. Front and back cover plates 4 and 5 are provided for inclosing between the frames 1, the parts of the operating mechanism which will be hereinafter described. Near the bottom of the stand is positioned a sheet or book support 6 adjustably secured to a bracket 7 preferably by means of a clamping screw 8 carried by the support and arranged to move up and down in a slot 9 formed in the bracket 7. A pair of front guides 10 and 11 are secured at their ends to the top and bottom straps 2 and 3 and a guide 12 in the rear of the guide 10 is also secured at its ends to the straps 2 and 3. A pair of cylinders 13 and 14 are mounted between the guides 10 and 11 and are arranged to move up and down thereon in a manner which will be hereinafter described. A sleeve 15 is slidably mounted on the guide 11 and is rigidly connected at its top with a cross-head 16 which extends diagonally across the top of the cylinder 13 to slidably engage the guide 12, and at the bottom of the sleeve 15 is a rigidly connected stop 17. The cylinder 13 is provided near its top with a projecting member 18 slidably engaging the guides 10 and 12. A spring 19 is mounted on the guide 12 with one end seated against the under side of the projecting member 18 and the other on the strap 3 as shown in Fig. 8. The spring 19 holds the cylinder 13 against the bottom of the cross-head 16 when the parts are in their normal position. The bottom of the cylinder 13 is provided with a cylinder head 20 which extends laterally for sliding engagement with the guide 10 and sleeve 15. The cylinder 14 is also provided with a head 21 which likewise extends laterally for sliding engagement with the guide 10 and sleeve 15. A spring 22 is mounted on the sleeve 15 between the heads 20 and 21 and serves to normally hold the cylinders apart as shown in Fig. 12; the head 21 being held against downward movement by the stop 17 on the bottom of the sleeve 15. The cylinder 14 is also provided with a projecting member 23 in sliding engagement with the guide 10 for holding the cylinder in proper alignment between the guides 10 and 11. As a means for moving the cylinders from the position shown in Fig. 12 to the position shown in Fig. 14, which is the extreme lowermost position of the parts, I provide a pair of levers 24 and 25 pivotally connected by a link 26 at 27 and 28. The lever 24 is adapted to extend beyond the frame 1 as shown at 29 to provide a handle for operating the cylinders in a manner which will presently be described. The lever 24 is pivoted to the frame at 30 and the lever 25 at 31. A link 32 is pivotally connected at 33 to the inner end

of the lever 25 and at 34 to the projection 18 carried by the cylinder 13. By depressing the handle 29 of lever 24, the link 32 will cause the cylinders 13 and 14 to move down upon the guides 10 and 11 to the position shown in Fig. 14, and upon releasing the lever 24 the spring 19 will return the cylinders to their normal position. The sheet engaging device includes a suction head 35 which carries a hollow extension 36 mounted on a hollow support 37. The latter extends to the center of the stand, and connects with a hollow shaft 38, preferably by means of a joint 39, while shaft 38 is slidably mounted in the strap 2.

The shaft 38 is connected with a tube 40 preferably by means of a screw 41 passing through a collar 42 mounted on the shaft 38. The tube 40 carries a spiral 43 which is adapted to move up and down through an opening 44 formed in the crosshead 16. On the bottom of the spiral and within the cylinder 13 are secured pistons 45 and 46 spaced apart by a thimble 47 through which a hollow extension 48 on the spiral is carried to connect with the piston 46 by means of the screw 49. The hollow extension 48 is provided with cuts 50 through its walls registering with cuts through the side walls of the thimble to form openings leading into the chamber 51 formed between the pistons 45 and 46. An opening 52 is formed through the screw 49 to connect the cylinder below the piston 46 with the opening through the hollow extension 48 and the registering openings formed by the cuts 50 in the side walls of the hollow extension 48 and thimble 47. An opening 53 is formed through the spiral 43 and tube 40 to connect the hollow extension 48 with the openings through the shaft 38, joint 39, support 37 and extension 36 leading to the suction head 35. Mounted in the cylinder 13 below the piston 46 is a piston 54 provided with a stem 55 extending through the piston head 20 and having on its lower extremity a head 56. Mounted on the stem 55 between the head 56 and the piston head 20 is a spring 57 normally serving to hold the piston 54 at the bottom of the cylinder 13, as shown in Fig. 12. A stationary piston 58 is mounted in the cylinder 14 and is supported by a hollow stem 59 rigidly connected with a bracket 60 mounted on the guide 10 and held thereon preferably by a set screw 61. An opening is formed through the inner end of the bracket 60 large enough to permit the spring 57 and head 56 of the stem 55 to extend therethrough into the hollow stem 59 which is adapted to guide the spring and head 56 loosely therein during their up and down movement. After the cylinders have been moved to their lowermost position at which time the suction head has reached the position shown in Figs.

4 and 7 it is necessary to lock them in such a position until the suction head releases the sheet 62 which it has carried over from the position shown in Fig. 1. The locking means for this purpose consists in the catch or lock 63 pivotally mounted on the pin 64 through the end of the cylinder head 20. The catch or lock 63 is provided with a shoulder 65 which is adapted to engage the pin 66 carried by the bracket 60 on the guide 10 as shown in Fig. 14, the catch being provided with a beveled face 67 adapted to ride over the pin and to be forced into locking engagement therewith by a spring 68, one end of which is connected to the catch and the other to a lever 69 pivotally mounted at 15 to a fulcrum 71 carried by the cylinder 13 as shown in Fig. 12. The catch is normally held in the position shown in Fig. 12 by a stop 72 extending from a lever having arms 73 and 74 positioned substantially at right-angles to each other, the lever being pivotally mounted on the pin 64 independently of the catch 63. The arm 74 is provided with an upturned end 75, adapted to extend through an opening 76 formed in the bottom of the cylinder head 20 and is adapted to be normally held in the position shown in Fig. 12 by the piston 54. The arm 73 of the lever is provided with a pin 30 77 projecting therefrom and extending into a slot 78 formed in the end of the lever 69. A port 79 is formed through the wall of the cylinder 13 near the top thereof, which is adapted to normally remain open as shown in Fig. 12 and is arranged to be closed by a cap 80 on the upper end of the lever 69 as soon as the piston 54 releases the lever arm 74. Upon the releasing of the arm by 40 the piston 54 a spring 81 forces the bottom of the lever 69 outwardly, thereby causing the pin 77 to move the lever arm 73 outwardly and the arm 74 upwardly to the position shown in Fig. 13. The moving of 45 the bottom of the lever 69 outwardly causes the cap 80 on the top of the lever to close the port 79. The spring 81 is connected at its top to the lever 69 while the bottom of the spring is arranged to bear against the cylinder 13. The movement of the arm 74 upwardly through the opening 76 allows the spring 68 to force the beveled face 67 of the catch in position to ride over the pin 66, as the cylinder 13 is being moved down to the position shown in Fig. 14, at which position 55 the shoulder 65 is forced into locking engagement with the pin 66 by the action of the spring. The catch is not released nor the port 79 opened until the piston 54 has moved to the bottom of the cylinder to engage and force the lever arm 74 down to its normal position, the stop 72 then forcing the catch outwardly to disengage the pin 66, thereby operating the lever 69 to uncover 65 the port 79. Through the wall of the cylin-

der 14 are provided air ports 82 and 83, the latter being positioned near the bottom of the cylinder below the piston 58 and the former higher up on the cylinder at a point not far below the highest position reached 70 by the piston within the cylinder as the latter is moved down. The purpose of the ports and the function of the several pistons within the cylinders will presently be explained.

In the turning of the sheet music published in book form, only the sheet engaging suction head 35 is necessary for the operation of engaging and turning a leaf from one side of the stand to the other, but in the case of loose sheets I have found it necessary to provide additional means for supporting the sheets during said turning operation. This means consists in a depending arm 84 connected with a support 85 rotatably mounted upon the tube 37. The support 85 is connected by a bar 86 to a controlling member 87 which is also rotatably mounted on the tube 37. The controlling member 87 is provided with a rounded 80 bottom 88, adapted during the movement of the suction head 35 from one side of the stand to the other to ride over a forwardly extending semicircular projection 89 carried by the strap 2. During the initial movement of the suction head the rounded bottom 88 of the controlling member 87 engages the beveled edge 90 on the semicircular member 89 and is rotated backwardly a short distance, thereby moving the arm 84 rearwardly at the time the suction member begins to turn the sheet. This movement of the arm tends to hold the inner edge of the sheet, causing it to turn about the center of the stand, while the suction head is carrying the sheet around to the position shown in Fig. 7. When the sheet has been released by the suction head and the supporting tube 37 raised to the position shown in Fig. 15, the arm 84 assumes its normal position 110 upon the tube, and is carried by the rotation of the shaft 38 to the position shown in Fig. 12 in front of the sheet to be turned.

In the turning of the sheets carried by the stand, whether the same are loose or in book form, it is necessary to provide means to positively prevent the turning of more than one sheet at a time and to this end I have provided a sheet guard which comprises a rod 91 rotatably mounted in the ends of the cylinder heads 20 and 21 and extending through the strap 2 connecting the frames 1. The rod at a point slightly above the tube or suction head support 37 is bent at a right-angle to the portion 91 to form the horizontal arm 92 which terminates in a downwardly extending finger 93 positioned immediately behind the extension 36 carrying the suction head 35 as shown in Figs. 1, 2 and 3. The downwardly extending finger 130

93 is pointed at 94 to facilitate its entrance under the uppermost sheet as it is pulled away from the stand in the manner indicated in Fig. 3. The sheet guard is normally held against the back of the extension 36 carrying the suction head 35 by means of a spring 95 mounted on the rod 91. The top end of the spring is secured to the rod by means of a pin 96 and the bottom end bears against the sleeve 15 as clearly shown in Fig. 17. The spring is applied with sufficient tension to cause the sheet guard to normally take the position indicated in Figs. 2 and 6 and the position shown in Fig. 3 when the suction head is moved forwardly. The sheet guard is held at the height shown in Figs. 1 and 2 by means of a stop 98 on the rod 91 which rests on and is held by the piston head 20. The stop 98 also serves to support the bottom end of the spring 95 as indicated in Figs. 8 and 9. In operating the parts, it is necessary to move the sheet guard both forwardly and downwardly and then rearwardly and downwardly at the same time from the normal position shown in Fig. 2 to the position indicated by dotted lines in Fig. 3. The downward movement of the guard is accomplished simultaneously with the downward movement of the cylinders as will be readily seen, while the forward movement is accomplished by the action of the spring 95, but the rearward movement requires additional means which comprises preferably a pin projection 99 carried by the frame, spaced slightly from and in rear of which is provided a movable, forwardly inclined finger 100 seated on a support 101 rigidly mounted on the rod 91 of the sheet guard. In the first instance the pin 99 serves as a stop to prevent the sheet guard from moving forwardly of the position shown in Fig. 3 other than a limited amount. In the second instance it causes the forwardly extending finger 100 to rotate the rod 91 rearwardly and consequently moving the arm 92 and finger 93 at the same time this being accomplished as previously stated, by the downward movement of the cylinders, the forwardly inclined finger moving downwardly with considerable speed quickly places the guard in the position shown in Fig. 3 between the first and second sheets as the top of the first sheet is drawn out by the initial movement of the suction head 35. It has been assumed that the second sheet shown at 102, may in some instances be drawn out from the stand, as indicated in Fig. 3, possibly by frictional engagement with the first sheet. The suction member is therefore so arranged that in case the sheets should stick along certain portions of their contacting surfaces the suction is applied in such a manner as to insure the complete separation of the first sheet from those under it, and to permit the sheet

guard finger to move to take a position in front of the second sheet to insure manipulating the latter upon the stand as the first sheet is carried over by the suction member.

The spring 95 on the rod 91 is so tensioned as to cause the sheet guard to move outwardly a short distance with the suction head, during its initial movement, approximately the maximum outward movement of the guard being shown in Fig. 3, the guard in this figure being in advance of the guard shown in Fig. 2. Obviously the spring 95 may be so tensioned and the projection 99 so positioned as to permit further outward movement of the guard than that shown if it is desired to increase said movement. The purposes of such outward movement are twofold. In the first instance, as already stated, it is necessary to insure the keeping of the guard in front of the sheets under the uppermost one, which may tend to move outwardly during the operation of the machine. Secondly, when the sheets are in book form, they constitute a greater thickness than in the case of a few loose sheets placed on the stand and therefore, it is necessary to provide means for moving the sheet guard outwardly a sufficient distance to accommodate such books and this has been done in the present embodiment. The complete operation of the sheet guard comprises a slight downward movement, followed by a forward movement and thence downwardly and rearwardly to the position shown by dotted lines in Fig. 3. A recess in the top of the right hand frame is indicated at 103 which is provided for receiving the finger 93 of the sheet guard when there are no sheets positioned upon the stand.

In the construction of the sheet engaging suction head 35, an enlarged section of which is shown in Fig. 5, I have provided a bowl 104 with which communicates a passage 105 leading through the extension 36, support 37, shaft 38 and tube 40, into the opening 53 through the spiral 43 and pistons carried thereon within the cylinder 13. Positioned within the bowl 104 is a yoke 106 carried by a ring 107 supported by a shoulder 108 formed on the bowl. A flexible member or diaphragm 109, preferably formed of soft thin rubber, is mounted on the ring 107, and extending around the periphery thereof and terminating behind the ring so as to rest upon the shoulder 108 as shown in Fig. 5. The diaphragm and ring are held upon the shoulder 108 by means of an annular clamping member 110 through which the diaphragm extends, and which is secured to the bowl by means of suitable screws 111. Extending through the diaphragm at a point eccentrically thereof, is a tubular member 112 provided with a circular flange 113, having a series

of radial grooves 114 formed on its outer face, and leading into an opening 115 through the tubular member, said opening communicating with a suction chamber 116 formed between the bowl and the diaphragm 109. Positioned on the tubular member at the back of the flange 113 is a flexible sheet engaging member 117 preferably cup shaped, and of greater diameter than the circular flange, the same being arranged to extend into engagement with the sheet 102, and formed preferably of flexible material suitable for the purpose. The back of the circular flange is beveled as shown at 118 to give the proper concavity to the cup shaped member. The cup shaped member is held upon the flange 113 by means of a sleeve 119 mounted on the tubular member and provided with an annular flange 120 for engaging the back of the said member. The outer end of the sleeve is angular with respect to its axis to receive the diaphragm 109 and to position the tubular member at the proper angle with respect to the bowl to permit the latter to be supported in the position shown in Fig. 5 while the tubular member stands at a right-angle to the sheet 102. The diaphragm is held upon the sleeve by means of a correspondingly formed clamping member 121 mounted on the tubular member and arranged to be held thereon by means of a pin 122 passing through both the clamping and tubular members. The tubular member is made to extend beyond the clamping member in order to provide means for holding seated upon the clamping member one end of a light wire spring in the manner shown. The other end of the spring is held preferably by being extended behind a projecting member 124 carried by the yoke 106. The action of gravity will hold the bowl of the suction head in the position shown in Fig. 5 and the spring 123 normally holds the cup shaped member 117 against the sheet 102. The suction produced by the pistons in the cylinder 13 will, when the machine is being operated, draw into the bowl the diaphragm or flexible member 109 and certain parts connected therewith until the cup shaped member reaches the position shown in Fig. 3. In order to prevent the cup shaped member from being drawn entirely into the bowl, I have provided on the flange 120 of the sleeve 119, projecting arms 125 as shown in Figs. 3 and 7, which engage the clamping member 110 after suction in the bowl has caused the diaphragm 109 to be drawn inwardly until the leaf engaging surface of cup shaped member assumes a position substantially parallel with the face of the clamping member 110. Any further inward movement of the cup shaped member is thus prevented by the contacting of the arms 125

with the clamping member 110. If the cup were allowed to be drawn entirely into the bowl, such action would tend to cause the release of the sheet by the cup before the operation of turning the sheet was completed.

The bowl of the suction head is arranged at an angle to the frame, with the bottom edge of the clamping member thereon bearing against the sheet 102 as shown in Fig. 5, for the purpose of providing a pivot point about which the top of the leaf, or that portion in front of the suction head, may pivot in moving outwardly during the period of time in which the diaphragm is being sucked into the bowl. This operation is for the purpose of separating the first sheet from those underneath during the initial movement of the parts after which the sheet guard moves in front of the second sheet and holds the same upon the frame. By disposing the tubular member 112 eccentrically of the flexible diaphragm, or so that its longitudinal axis, when in normal position, is at some angle other than a right-angle to the plane in which the diaphragm is supported, I obtain a swinging movement of the sheet engaging member or cup 117, relatively to the sheet and to the bowl. The result is that the sheet engaging member moves into the bowl in a curved path, one edge traveling faster than the other, and thus moving one portion of the sheet faster than another, so that a pivotal movement of the edge portion of the sheet is obtained, while the body of the sheet is held fixed, until the cup has moved within the bowl and the entire arm or support for the sheet engaging member commences to move.

It will be apparent that the novel form of suction heads and cup which I have just described possesses advantages and features that make it adaptable for other uses and types of apparatus than that herein set forth, as for instance, it can be employed with great success for feeding sheets in printing machinery, and other apparatus that require successively lifting single sheets from a pack.

In the operation of my improved sheet turner, after the sheets have been placed on the stand with the sheet engaging suction head in the position shown in Fig. 1, the operator forces down the lever 24 by pressing on the extension 29 until the cylinders 13 and 14 reach the position shown in Fig. 14, at which time the shoulder 65 on the catch 63 has engaged the pin 66 to lock the cylinders until the sheet is released by the suction head. The catch 63 is tripped automatically with the releasing of the sheet by the suction head, and the cylinders are then returned to their normal position by the action of the spring 19. In the downward movement of the cylinder 13 the

same will reach approximately the position shown in Fig. 13 before the sleeve 15 forces the cross-head 16 into engagement with the spiral 43 sufficiently to move the suction head any appreciable distance from its normal position. By the time the cylinder has reached this position enough suction will have been created through the hollow members leading to the suction head, by the separation of the pistons 46 and 54 to cause the sheet engaging cup to take the position shown in Fig. 3.

The holding of the cross-head 16 in its approximate normal position during the initial downward movement of the cylinder 13 is due to the retarding of the sleeve 15 by suction in the cylinder 14 between the head thereof and the piston 58, the port 83 in the bottom of the cylinder being extremely small it admits air to the cylinder very slowly and consequently if the cylinder is moved down the tendency is to produce therein a partial vacuum, thus retarding the cylinder enough to allow the diaphragm to be drawn into the bowl to move the top of the sheet outwardly before the suction head proper begins to move. It will be understood of course that the piston 58 is held stationary by the stem 59 while the cylinder 14 moves up and down thereon. The initial downward movement of the cylinder 13 will however, through the compression of the spring 22, cause a slight downward movement of the cylinder 14, which is momentarily arrested by the suction in the cylinder, long enough at least to allow the diaphragm to pull out the top of the main or body portion.

The initial downward movement of the cylinder 14 as just described, will of course pull down the cross-head 16 and if the same came immediately into contact with the spiral 43 the suction head proper would begin to rotate before the diaphragm could be drawn into the bowl. In order to overcome this objection the cross-head in its normal position has been placed a little above the top of the spiral 43 as shown in Fig. 12 so that the initial downward movement of the cylinder 14 may take place without rotating the support 37 or moving the suction head proper. In the operation of rotating the suction head and its support from the position shown in Fig. 6 to that shown in Fig. 7 it is desirable that the first half of the movement be relatively slower than the last half. For the first half of said rotating movement the speed at which the suction head moves is controlled by the suction in the cylinder 14 during the movement of the cylinder from its normal position to a position where the port 82 passes the bottom of the piston 58. At this point the speed at which the rotating

parts are moving is increased by the additional intake of air in the cylinder through the port 82, as well as by reason of the fact that as soon as the suction head and its support pass to the left of the center of the machine the action of gravity will tend to assist in carrying them over. From this time on, these parts are descending, as they move to the position shown in Fig. 7, it being obvious that the suction head will be at a higher point in the center of the machine than at either side, due to the angular position of the stand. In the normal position of the cylinders, the piston 54 held down against the cylinder head 20 and the upturned end 75 of the arm 74 will cause the lever 69 to prevent the cap 80 from closing the port 79 near the top of the cylinder 13. After the cylinder 13 and piston 54 have begun to move downwardly and consequently to produce suction between the pistons 49 and 54, atmospheric pressure in the cylinder below the piston 54 will to a certain extent, overcome the tension of the spring 57 and will elevate the piston 54 to the approximate position shown in Fig. 13. As soon as the piston head 54 has released the lever arm 74 the spring 81 operates to move the top of the lever 69 inwardly to cause the cap 80 to close the port 79. At the same time the catch 63 is forced into position, by the spring 68, to ride over the pin 66 when the shoulder 63 engages the pin at the end of the downward stroke of the cylinders. By this time the chamber 51 between the pistons 45 and 46 is opposite the port 79, as shown in Fig. 14, with the suction head in the position shown in Fig. 7. Under normal conditions with the parts in the positions just described, the releasing of the sheet by the suction head is caused by the gradual leaking of air until the suction in the cylinder is overcome and the pressure therein equalized with the outside pressure at which time the piston 54 is forced down to the bottom of the cylinder to engage the top of the lever arm 74 for the purpose of releasing the catch 63, thus allowing the spring 19 to return the cylinders to their normal position. As the cylinder 13 moves up the cross-head carries the spiral with it and without turning the same until the collar 40 strikes the underside of the strap 2 as shown in Fig. 15, after which time the continued upward movement of the cross-head causes the spiral to rotate the suction head and support to the right of the center of the machine a short distance until gravity begins to carry the suction head back to its normal position, the pistons 45 and 46 rotating and descending in the cylinder 13 at the same time. In some instances it is possible for enough leakage of air into the cylinder 13 between the pistons 46 and 54

to cause the latter, with the aid of the spring 57, to move down and operate the lever arm 74 to release the catch 63 before the sheet itself has been released by the suction head. In this case the elevating of the parts to the position shown in Fig. 15 would cause the suction member to carry the sheet with it about the stand instead of releasing and depositing the same upon the stand. Such displacement of the sheet is prevented by the simultaneous opening of the port 79 with the releasing of the catch 63 by the projection 72 on the lever arm 74, whereby air is admitted through the port 79 to the chamber 51, the extension 48 and the other hollow members intervening between the extension and the suction head. By this means the sheet, if not previously released by the suction head as intended, will be automatically discharged with the beginning of the upward movement of the cylinders and spiral 43 and other parts supported thereon.

I claim as my invention:

1. The combination with a member for engaging one of a series of sheets, of a guard, means for operating said engaging member to lift the sheet engaged thereby, and means for causing the guard to move downwardly and forwardly during the initial operation of the leaf engaging member and thence rearwardly and downwardly to prevent the turning of the adjacent sheet.

2. The combination with a sheet engaging member, of a guard normally positioned above and in front of said sheets, an inclined member movable with the guard, means for operating the sheet engaging member to lift the sheet engaged thereby and to move the guard downwardly, and stationary means coöperating with the inclined member for moving the guard rearwardly during its downward movement, whereby said adjacent sheet is prevented from being turned.

3. The combination with a suction member for engaging a leaf, of a hollow rotary support for the suction member, mechanism in engagement with the rotary support for exhausting air from the suction member and rotating the support, and means for locking said mechanism when the support has reached the limit of its rotating movement.

4. The combination with a suction member for engaging a leaf, of a hollow rotary support for the suction member, operating mechanism in engagement with the rotary support for exhausting air from the suction member and rotating the support, locking mechanism for retaining the operating mechanism in position to hold the rotary support at the limit of its rotating movement, and means controlled by leakage of air for releasing said locking mechanism.

5. The combination with a suction mem-

ber for engaging a leaf, of a hollow rotary support for the suction member, operating mechanism in engagement with the rotary support for exhausting air from the suction member and rotating the support, locking mechanism for retaining the operating mechanism in position to hold the rotary support at the limit of its rotating movement, means controlled by leaking of air into the suction member for releasing said locking mechanism, and means for returning the operating mechanism and rotary support to their normal positions upon releasing of the locking mechanism.

6. The combination with a suction member for engaging a leaf, of a hollow rotary support for the suction member, operating mechanism in engagement with the support for exhausting air from the suction member and rotating the support, locking mechanism for retaining the operating mechanism in position to hold the rotary support at the limit of its rotating movement, means controlled by leaking of air into the suction member for releasing said locking mechanism, and means for causing the operating mechanism to first elevate the rotary support and then return the same to its normal position.

7. The combination with a suction head, of a sheet engaging member, a flexible member connected with and supporting said sheet engaging member bodily, means for supporting the flexible member, and means connected therewith for producing suction upon the flexible member to operate the leaf engaging member for the purpose of lifting a portion of a sheet.

8. The combination with a sheet engaging member, of a diaphragm connected with and supporting said sheet engaging member bodily, and means for moving the diaphragm to cause the sheet engaging member to be operated and the sheet to be lifted.

9. The combination with a suction head normally in engagement with a sheet, of a cylinder, a piston mounted in the cylinder, a hollow member connecting the cylinder and the piston with the suction head, a second piston mounted in the cylinder normally in proximity to the first mentioned piston, means for yieldingly holding the last mentioned piston in the cylinder, mechanism for depressing the cylinder for the purpose of increasing the distance between the pistons in order to create suction upon the sheet through the hollow member and the suction head, means for moving the hollow member and suction head simultaneously upon depressing the cylinder whereby said sheet is lifted, and means controlled by the yieldingly mounted piston for locking the cylinder after the same has been depressed.

10. The combination with a suction head

- normally in engagement with a sheet, of a cylinder, a piston mounted in the cylinder, a hollow member connecting the cylinder and the piston with the suction head, a second piston mounted in the cylinder normally in proximity to the first mentioned piston, means for yieldingly holding the last mentioned piston in the cylinder, mechanism for depressing the cylinder to increase the distance between the pistons in order to create suction upon the sheet through the hollow member and the suction head, means for moving the hollow member and suction head simultaneously upon depressing the cylinder whereby said sheet is lifted, and means controlled by the yieldingly mounted piston for both locking and releasing the cylinder at the end of its downward movement.
11. The combination with a suction head normally in engagement with a sheet, of a cylinder, a piston mounted in the cylinder, a hollow member connecting the cylinder and the piston with the suction head, a second piston movably mounted in the cylinder normally in proximity to the first mentioned piston, means for yieldingly controlling the movement of said last mentioned piston, mechanism for depressing the cylinder to increase the distance between the pistons in order to create suction upon the sheet through the hollow member and the suction head, means for moving the hollow member and suction head simultaneously upon depressing the cylinder whereby said sheet is lifted, means controlled by the yieldingly mounted piston for both locking and releasing the cylinder at the end of its downward movement, and means for returning the cylinder and the suction head to their normal positions.
12. The combination with a suction head adapted to engage a sheet, a movable cylinder, means for supporting the same, a piston mounted in the cylinder, a hollow member connecting the piston and the suction head, a second piston mounted in the cylinder, a locking member carried by the cylinder supporting means, means for moving the cylinder upon its support and upon the first mentioned piston for the purpose of producing a partial vacuum between said pistons and suction upon said sheet, a head for the cylinder provided with an opening therethrough for admitting atmospheric pressure to the second mentioned piston, means carried by the second mentioned piston for yieldingly limiting the movement of the piston caused by said atmospheric pressure acting thereon in opposition to said partial vacuum, locking mechanism controlled by the movement of the second mentioned piston and released thereby to engage said locking member as the cylinder reaches the end of its stroke, and means connected with the hollow member and with the cylinder for moving the suction head to lift said sheet when the cylinder is moved.
13. A sheet lifting device comprising a hollow head for connection with suction producing means, a flexible diaphragm mounted on the head, and a sheet engaging member supported bodily upon said flexible diaphragm.
14. A sheet lifting device comprising a hollow head for connection with suction producing means, a flexible diaphragm mounted on the head, and a sheet engaging member carried by said flexible diaphragm and arranged eccentrically thereof.
15. A sheet lifting device comprising a hollow head for connection with suction producing means, a flexible diaphragm mounted on the head, and a sheet engaging member carried by said flexible diaphragm, and having its engaging face normally at an angle to the plane in which the diaphragm is supported and adapted to be moved into parallel relation to said plane after the sheet is engaged.
16. A sheet lifting device comprising a hollow head for connection with suction producing means, a flexible diaphragm mounted on the head, a sleeve carried by the diaphragm and having its longitudinal axis normally inclined to the plane in which the diaphragm is supported, and a sheet engaging member carried by said sleeve.
17. A sheet lifting device comprising a hollow head for connection with suction producing means, a flexible diaphragm mounted on the head, a sheet engaging member carried by said flexible diaphragm, and means on the head having engagement with the sheet during the initial movement of the sheet engaging member and before the latter is entirely engaged with the sheet.
18. A sheet lifting device comprising a hollow head for connection with suction producing means, a flexible diaphragm mounted on the head, a sheet engaging member carried by said flexible diaphragm and arranged eccentrically thereof, and means on the head having engagement with the sheet during the initial movement of the sheet engaging member and before the latter is entirely engaged with the sheet.
19. A sheet lifting device comprising a hollow head for connection with suction producing means, a flexible diaphragm mounted on the head, a sheet engaging member carried by said flexible diaphragm and having its engaging face normally at an angle to the plane in which the diaphragm is supported and adapted to be moved into parallel relation to said plane after the sheet is engaged, and means on the head having engagement with the sheet during the initial movement

of the sheet engaging member and before the latter is entirely engaged with the sheet.

20. A sheet lifting device comprising a hollow head for connection with suction producing means, a flexible diaphragm mounted on the head, a sleeve carried by the diaphragm and having its longitudinal axis normally inclined to the plane in which the diaphragm is supported, a sheet engaging

member carried by said sleeve, and means on the head having engagement with the sheet during the initial movement of the sheet engaging member and before the latter is entirely engaged with the sheet.

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."