Sept. 24, 1940. H. T. BACKHOUSE 2,215,458

SHEET SEPARATING AND LIFTING MEANS

Filed May 27, 1937 2 Sheets-Sheet 1

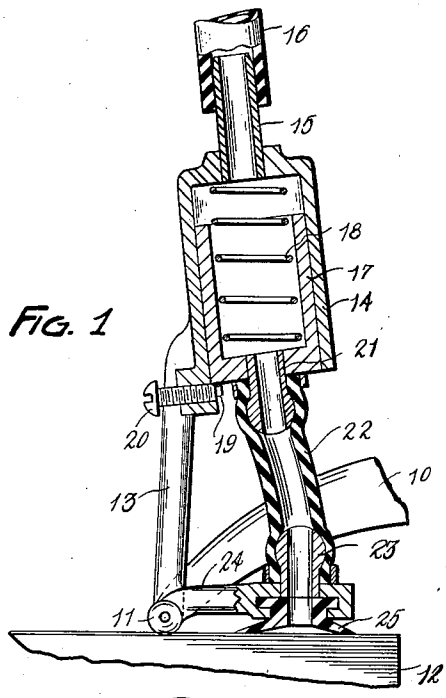


FIG. 1

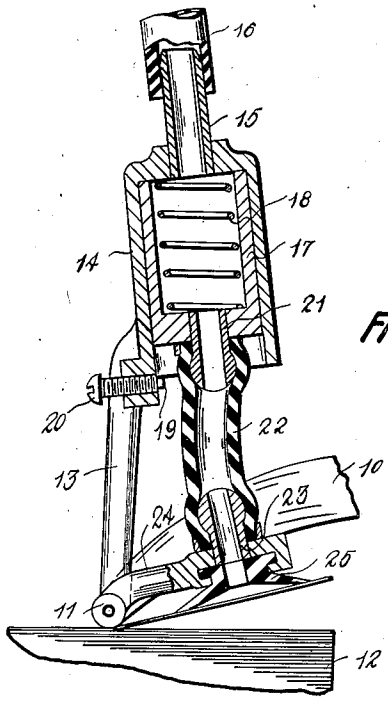


FIG. 2

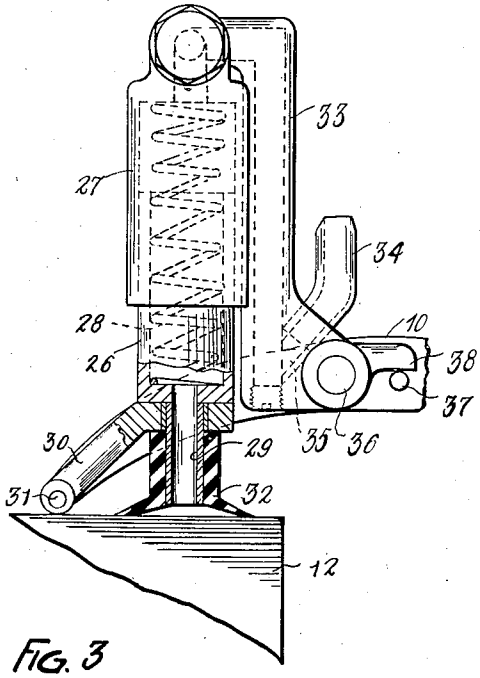


FIG. 3

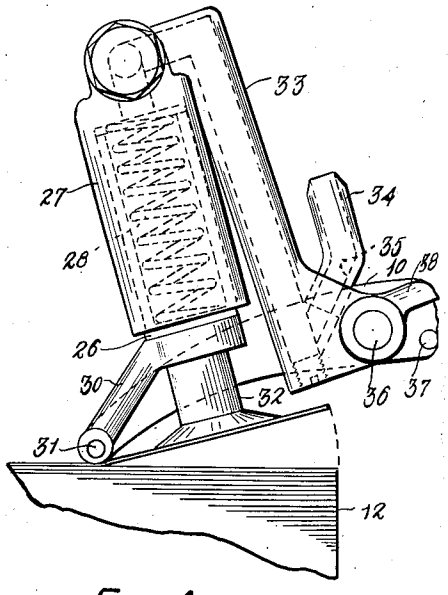


FIG. 4

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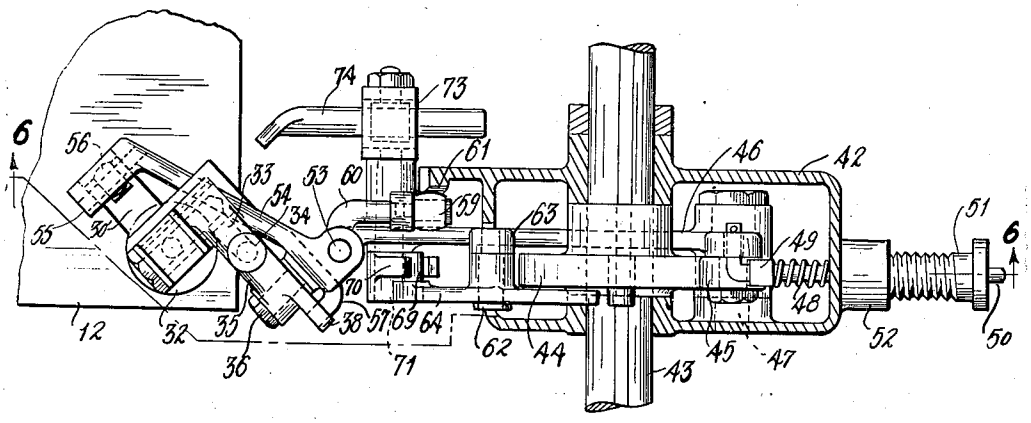


FIG. 5

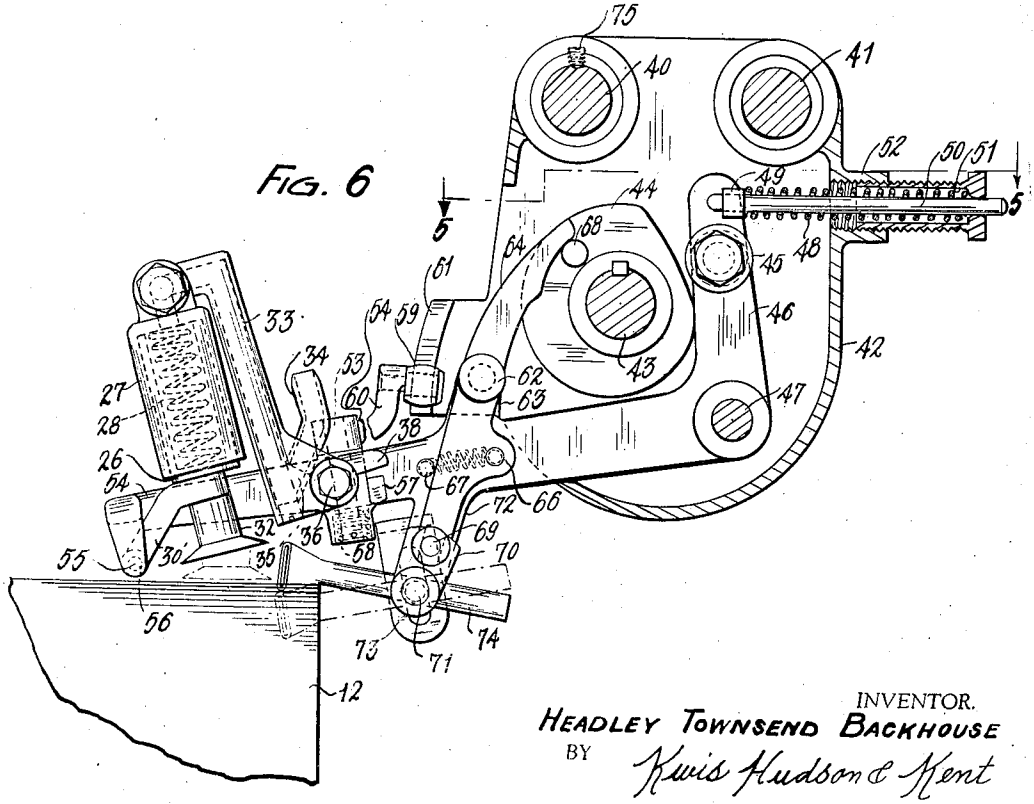


FIG. 6

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UNITED STATES PATENT OFFICE

2,215,458

SHEET SEPARATING AND LIFTING MEANS

Headley Townsend Backhouse, London, England

Application May 27, 1937, Serial No. 145,085
In Great Britain May 28, 1936

13 Claims. (Cl. 271—27)

This invention relates to improvements in sheet separating and lifting means.

One of the objects of the invention is the simplification of sheet separating means employed in connection with mechanism for feeding sheets of paper or the like from the top of a pile.

Another object of the invention is the provision of means for utilizing a sucker to accomplish both the separation and the lifting of the rear edge of the sheet, thereby eliminating extra parts heretofore regarded as necessary in feeders of this character.

A further object is the provision of novel means for separating sheets by utilizing exclusively air blasting and exhausting means.

Another object is the provision of means for separating the rear corners of the uppermost sheet of a pile by means of air blast and suction and involving the bending up of the rear corners.

Still another object is the provision of mechanism for imparting to suckers three different kinds of motion, tilting, raising and side-wise movement for the purposes, respectively, of separating, lifting and tensioning the rear edge of the sheet.

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

Fig. 1 is a vertical sectional view of a sucker employed in connection with the invention.

Fig. 2 is a similar view showing the sucker in a tilted position for separating the rear corner of a sheet.

Fig. 3 is a view similar to Fig. 1, showing a modification of the invention.

Fig. 4 is an elevational view of the construction illustrated in Fig. 3, with the sucker in its tilted position.

Fig. 5 is a plan view, partly in section on the line 5—5 of Fig. 6, illustrating a sucker operating mechanism which may be employed at each rear corner of the pile.

Fig. 6 is an elevational view, partly in section, on the line 6—6 of Fig. 5, but showing some of the parts in a different position.

Referring first to Figs. 1 and 2, 10 represents a supporting element having at one end an abutment 11 which preferably takes the form of a hinge. This element 10 is intended to move up and down in the operation of a feeder with which it is connected. In its lowered position it rests upon the uppermost sheet of a pile of sheets 12. On the support 10 there is mounted an upwardly extending carrier bar 13 which may be formed integral with or be attached to a cylinder 14. A nipple 15 projects from the top of this cylinder, and by this means the cylinder is connected with a flexible tube 16 which leads to an air exhausting means, not shown. A hollow piston 17 fits within the cylinder 14 and is normally held in its lowered position, shown in Fig. 1, by a coil spring 18. A stop 19 on the end of a screw 20 limits the downward movement of the piston.

Depending from the piston 17 there is a nipple 21 over which the upper end of a flexible tube 22 is projected and to which the tube is secured. At its lower end tube 22 is attached to a similar nipple 23 that is mounted in the free end of an arm 24, the latter being mounted to swing upon the hinge 11. The arm 24 also carries at its outer end a soft rubber sucker head 25 having a central opening therethrough which is in communication through the nipple 23, the tube 22 and the nipple 21 with the space enclosed by the cylinder and piston 14 and 17. Soft rubber sucker heads of the nature of the head 25 are well known in the sheet feeding art, and require no further description here.

The operation of the sucker just described is as follows. The support 10 with its hinge 11 is lowered until the hinge engages the uppermost sheet of the pile near one edge thereof. At this time the parts are in the condition illustrated in Fig. 1. Now with the sucker head 25 in contact or substantially in contact with the uppermost sheet of the pile air is exhausted through the tube 16 from the nipple 15, the space enclosed by the cylinder 14 and piston 17, the nipple 21, the tube 22, the nipple 23 and the sucker head. As a consequence the mouth of the sucker head is sealed by the sheet of paper under it. Then, as the suction in the air connections builds up, external air pressure raises piston 17 from the position of Fig. 1 to that of Fig. 2, which in turn pulls up on the tube 22 causing the outer end of the arm 24 to swing upwardly to the position of Fig. 2, thereby bending the uppermost sheet of paper around the hinge 11, as indicated in the figure.

The sucker illustrated in Figs. 3 and 4 in operation resembles that shown in Figs. 1 and 2, but is somewhat different in construction. A hollow piston 26 slides in a cylinder 27, a coil spring 28 tending to hold the cylinder and piston in expanded position. At the lower end of piston 26 there is a tubular extension 29. An arm 30 similar to arm 24 of the first described form is mounted to swing around a hinge 31 carried by the sup-

port 10. The free end of this arm is provided with an eye which surrounds the tubular extension 29, and below this eye there is a soft rubber sucker head 32 with a relatively long hub which is made of a size to grip the tubular extension 29 firmly and serves to hold the arm 30 against the bottom surface of the piston. The upper end of the cylinder 27 has a pivotal connection with a Z-shaped carrier link 33, this link being hollow and having communication with the interior of the cylinder through the hollow pivotal connection. Suitable means is provided for making a connection with an exhaust line, and to this end I may mount a nipple 34 in the link 33 in communication with an inclined passage 35 which branches off from the main passage through the link. The lower end of the link is mounted to turn about a pivot 36 carried by the support 10. Movement of the link in one direction is limited by a stop pin 37 mounted in the support 10 and adapted to be engaged by an extending lip 38 on the link 33.

When the spring 28 is expanded the parts of the device occupy the relative positions illustrated in Fig. 3. In use the support 10 is lowered until the hinge 31 engages the uppermost sheet of the pile of sheets. At about the same time the sucker head 32 comes into contact with the sheet or approximately into contact therewith. Now, by suitable means, suction is applied through the nipple 34, passage 35, hollow link 33 and the space enclosed by cylinder 27 and piston 28 and the tubular extension 29. The uppermost sheet is thereby gripped by the sucker head 32. This seals the mouth of the sucker. Suction thereupon builds up in the chamber enclosed by the cylinder and piston elements, so that atmospheric pressure working upon the lower end of the piston moves the latter upward into the cylinder to the extent illustrated in Fig. 4 of the drawings. The hinge 31 and the pivot 36 are fixed upon the support 10, and the other parts are free to move. Consequently when the cylinder and piston elements are contracted the arm 30 swings up, the sucker head is tilted and raised slightly, the cylinder and piston are tilted and the supporting link 33 swings to tilted position, all as shown in Fig. 4. The corner of the uppermost sheet of the pile is thereby bent upwardly in substantially the same manner and to substantially the same extent as in the first described form of sucker.

In both forms thus far described it is to be understood that two or more of the suckers are used, generally along the rear edge of the pile, and that after the rear corners, with or without other portions of the rear edge, are bent up, the supports 10 are raised bodily thereby lifting the rear edge of the sheet. The sheet may then be forwarded either by these same suckers or by other suitable means.

In Figs. 5 and 6 of the drawings I have illustrated one form of mechanism by means of which the above described suckers may be operated to separate and lift the sheet. In these figures 40 and 41 represent transverse rods forming part of the framework of a sheet feeder. 42 is a casing adjustably mounted on the rods 40 and 41 so that the feeder may be made to accommodate itself to sheets of different widths. It will be understood that at least two casings 42 with their associated parts will be employed ordinarily, two being the usual number since the suckers are best adapted to operate upon the rear corners of the sheets. In the mechanism used at the other rear corner of the pile the arrangement of parts is reversed. Otherwise the construction is identical. The casing 42 has bearings for the accommodation of a shaft 43 which is parallel to rods 40 and 41 and is mounted at its ends in the frame of the machine. The shaft 43 is driven in synchronism with other moving parts of the feeder, being rotated once for each sheet fed. Within the casing this shaft has a cam 44 keyed thereto, the higher portions of the cam being adapted to contact with a follower 45 mounted on a bell crank lever 46 which is pivoted at 47 in the casing. The follower is urged toward the cam by means of a coil spring 48 which bears at one end against a collar 49 carried by a rod 50 which is surrounded by the spring. The inner end of the rod has a right angle bend which extends through a hole in the upper extremity of the bell crank lever. The opposite end of the rod protrudes through an opening in the end of a cap 51 which is threadably mounted in a hollow boss 52 on the casing. The outer end of the spring bears against the end wall of the cap 51, and by adjustment of the latter the force of the spring may be regulated.

The lower arm of the bell crank 46 projects forwardly through an opening in the casing 42, as shown in Fig. 6. At its forward extremity it carries a pintle 53 upon which there is supported to swing in a more or less horizontal direction a bracket 54. This bracket at its forward extremity carries a hinge 55 corresponding in function with the hinges 11 and 31 previously described. On the pintle or hinge 55 there may be mounted a small roller 56 which contacts the work when the bracket 54 is lowered. On the pintle or hinge 55 straddling the roller 56 there is pivoted the bifurcated end of an arm 30' similar to the arm 30 of Figs. 3 and 4. The other parts of the sucker construction are like those of Figs. 3 and 4 and are numbered accordingly. The extension 38 on the supporting link 33 in this case, however, engages a small projection 57 on the bracket 54.

A torsion spring 58 tends to swing the bracket 54 in an anti-clockwise direction, as viewed in Fig. 5. Such a movement produces a transversely outward or sidewise movement of the suckers. This movement is permitted to occur when the sucker is raised, and the purpose of the movement is to straighten or stretch the rear edge of the sheet in order that it may be presented with accuracy to suitable forwarding means. For a more detailed explanation of the purposes and advantages of this rear edge straightening action reference should be had to my copending application, Serial No. 738,500, filed August 4, 1934. In the present construction, when the sucker head 32 is in the position indicated in Figs. 5 and 6, the bracket 54 is held against outward swinging movement by a cam follower 59 on the end of an arm 60 which is carried by and is rigid with the bracket 54. The follower is shown in Fig. 6 as bearing against the high spot on the lower end of a cam 61 formed in a projecting part of the casing 42. When the bell crank lever 46 and the bracket 54 carried thereby move upward, that is in the clockwise direction, follower 59 rolls toward the low spot at the upper end of cam 61, whereupon the spring 58 is free to swing the bracket 54 and the parts carried thereby in the anti-clockwise direction, thus tensioning the sheet which is gripped by the sucker head 32 and the corresponding sucker head at the opposite rear corner of the pile.

62 is a headed stud which is mounted in an upwardly extending lip 63 formed integral with the bell crank 46 and pivotally supporting a lever 64 which is normally urged clockwise by a coil spring 65 attached at 66 to the lever 64 and at 67 to the lever 46. The upper end of lever 64 is arranged to be contacted once during each revolution of shaft 43 by a pin 68 which is mounted in and projects from the face of cam 44. The lower extremity of lever 64 carries a pin 69 which is received in the bifurcated upper end of a short crank 70 that is fixed upon and turns with a shaft 71 which is journaled in the lower extremity of an extension 72 depending from the bell crank lever 46. On its opposite end this shaft 71 carries a slotted bracket 73 in which is adjustably mounted an air blast nozzle 74. This nozzle is so directed as to blow a blast of air across the corner of the pile beneath the position of the sucker head, it being understood that a suitable connection, by means of a flexible tube, is made from the nozzle to a supply of air under pressure.

When the two sucker units, built as rights and lefts, have been so adjusted longitudinally of the shaft 43 as to bring the sucker heads 32 into positions above the rear corners of the pile, substantially corresponding to that illustrated in Fig. 5, the casings 42 are secured in some suitable manner against bodily movement, as for instance by threading down set screws 75. Assuming that when the machine starts the bell crank lever 46 is in the lowered position illustrated in Fig. 6 and that the sucker head 32 is in the dotted line position of that figure, in other words in a position corresponding to that of Fig. 3, a blast of air is caused to emerge from nozzle 74, then in the dotted line position of Fig. 6. This air blast fluffs up the rear corners of the sheets near the top of the pile, that is those portions to the rear of the hinge 55. By this means any sheets whose edges tend to adhere to each other are separated, thus accomplishing the result usually obtained by the use of the well known comber. Then suction is caused to act upon the sucker. This results first in moving the corner of the uppermost sheet into sealing relation with the sucker head. Thereafter vacuum builds up rapidly in the air connections to the sucker, causing the collapse or contraction of the cylinder and piston elements. This produces the tilting of the sucker head and its movement to the position illustrated in full lines in Fig. 6, together with the corresponding movement of the cylinder and piston and supporting link 33. The rear corners of the sheet are thereby bent up. At about the time the sucker head moves to the tilted position illustrated the air blast nozzle moves up also from its dotted line position to its full line position, this movement being effected by the action of pin 68 upon lever 64 working against spring 65. This movement of the lever 64 swings pin 69 to the right which turns bifurcated crank 70 in the same direction, rocking shaft 71 and tilting the nozzle. The nozzle thus follows the sucker head up and directs the blast of air against the lower surface of the sheet gripped by the sucker, thereby serving to separate the next adjacent sheet from the uppermost sheet in the event that they tend to stick together when the corner of the uppermost sheet is bent upwardly. The parts have now all reached the full line position of Fig. 6. The suction and the air blast continue while the cam 44 turns as indicated by the arrow, moving the low spot of the cam out from under the follower 45, contacting the follower and shifting it to the right and swinging the bell crank lever clockwise. All of the apparatus supported by the bell crank is thereby raised bodily. In the course of this raising movement follower 59 travels upwardly on fixed cam 61, and torsion spring 58 swings bracket 54 transversely outward. This action upon the two suckers at opposite ends of the rear edge of the sheet straightens the sheet, preferably placing it under slight tension, so that its entire rear edge between the suckers is accurately presented to whatever forwarding means may be provided for taking the sheet and imparting to it the desired forward travel. As soon as the transfer is made to the forwarding means the vacuum in the sucker connections is broken by suitable means. The cylinder and piston elements of the sucker then expand by the action of spring 28, again assuming their relative positions illustrated in Fig. 3. The sucker now returns to the top of the pile, the bell crank 46 being urged in the anti-clockwise direction by the spring 48, while the follower 45 runs down from the high spot of cam 44 toward the low spot. The downward movement of the sucker is terminated, not by the cam, but by the contact of hinge 55 with the pile. The apparatus is then ready for the beginning of the next cycle.

Variations from the described structure may be employed. Accordingly, I desire it to be understood that the scope of the invention is to be regarded as defined exclusively by the appended claims rather than by the foregoing description or the accompanying illustration.

Having thus described my invention I claim:

1. Sheet separating means for sheet feeders, comprising a pile engaging hinge, an arm mounted to swing on said hinge, a sucker head carried at the free end of said arm, an oscillating support, a carrier on said oscillating support projecting upwardly therefrom, and air connections leading to said sucker head comprising a compartment mounted on said carrier and adapted to contract, whereby when air is exhausted from said connections the uppermost sheet of the pile is gripped by said sucker after which said compartment contracts swinging the arm upwardly around its hinge.

2. Sucker apparatus comprising cylinder and piston elements, a sucker head depending from and supported by the lower one of said elements, said sucker head being in communication with the space enclosed by said cylinder and piston elements, a support for the apparatus, a hinge carried thereby adapted to contact with the top of a pile of sheets, an arm mounted on said hinge, said sucker head being mounted in the free end of said arm, and means projecting from said support for carrying the upper one of said cylinder and piston elements, said means being pivotally connected with said support whereby the contraction of said cylinder and piston elements swings said sucker about said hinge.

3. Sucker apparatus comprising cylinder and piston elements, a flexible tube attached to the lower one of said cylinder and piston elements, said tube being in communication with the space enclosed by said elements, a sucker head supported by the lower end of said tube and in communication with the interior thereof, a support for the apparatus, a hinge carried thereby adapted to contact with the top of a pile of sheets, an arm mounted on said hinge, said sucker head being attached to the free end of said arm, means extending upwardly from said support for carry-

ing the upper one of said cylinder and piston elements, and means for exhausting air from the space enclosed by said elements.

4. Sucker apparatus comprising cylinder and piston elements, a sucker head depending from and supported by the lower one of said elements, said sucker head being in communication with the space enclosed by said cylinder and piston elements, a support for the apparatus, a hinge carried thereby adapted to contact with the top of a pile of sheets, an arm mounted on said hinge, said sucker head being attached to the free end of said arm, and a link pivotally connected between the support and the upper one of said cylinder and piston elements, whereby the exhaustion of air from the space within the cylinder and piston will cause the sucker head and arm to swing upwardly around said hinge tilting the cylinder and piston and the said link.

5. In a sheet feeder, a bracket mounted at its rear end to swing about an upright axis, the forward end of said bracket having a hinge adapted to engage the top of a pile of sheets, an arm mounted on said hinge, a sucker head carried at the free end of said arm, means for exhausting air from said sucker head and swinging the arm upwardly around said hinge, means for raising said bracket bodily, and means set in motion by said bodily upward movement for swinging said bracket on its axis.

6. In a sheet feeder, sheet separating means comprising a sucker head, an abutment adapted to engage the top of a pile of sheets, means for swinging said sucker head upwardly around said abutment whereby a corner of the uppermost sheet when gripped by the sucker may be bent upwardly, means for blowing a blast of air against the corner of the pile before said sucker grips the sheet and thereafter against the underside of said raised corner to assist in the separation of the said corner from the sheets below, and means to raise said abutment and sucker head bodily while the blast of air continues.

7. In a sheet feeder, sheet separating means comprising an abutment adapted to engage the top of a pile of sheets near one corner, means for blowing a blast of air against the corner of the pile to fluff up the corners of the sheets near the top of the pile, a sucker head mounted to swing around said abutment from a horizontal position to a tilted position, whereby a corner of the uppermost sheet when gripped by the sucker may be bent upwardly, and means to move said air blast upwardly following the upward swinging of the sucker head whereby a blast of air is blown against the underside of the raised corner of the uppermost sheet.

8. In a sheet feeder, sheet separating means comprising an abutment adapted to engage the top of a pile of sheets near one corner, means for blowing a blast of air against the corner of the pile to fluff up the corners of the sheets near the top of the pile, a sucker head mounted to swing around said abutment from a horizontal position to a tilted position, whereby a corner of the uppermost sheet when gripped by the sucker may be bent upwardly, means to move said air blast upwardly following the upward swinging of the sucker head whereby a blast of air is blown against the underside of the raised corner of the uppermost sheet, and means for raising said abutment, sucker head and blower bodily.

9. In a sheet feeder, sheet separating means comprising an abutment adapted to engage the top of a pile of sheets near one corner, means for blowing a blast of air against the corner of the pile to fluff up the corners of the sheets near the top of the pile, a sucker head mounted to swing around said abutment from a horizontal position to a tilted position, whereby a corner of the uppermost sheet when gripped by the sucker may be bent upwardly, means to move said air blast upwardly following the upward swinging of the sucker head whereby a blast of air is blown against the underside of the raised corner of the uppermost sheet, means for raising said abutment, sucker head and blower bodily, and means set in motion by the bodily raising of the sucker head and abutment for moving the sucker head transversely outward.

10. In a sheet feeder, sheet separating means comprising a sucker head, a hinge adapted to press on the top of the pile of sheets near a rear corner thereof and inwardly of said sucker head, means for swinging said sucker head inwardly and upwardly around said hinge, whereby a corner of the uppermost sheet when gripped by the sucker may be bent upwardly and inwardly, and means for blowing a blast of air against the corner of the pile outwardly of said hinge to assist in the preliminary separation of that portion of the corner of the uppermost sheet extending outwardly beyond said hinge.

11. In a sheet feeder, sheet separating means comprising a support, a hinge carried thereby adapted to press on the top of a pile of sheets along a diagonal across a rear corner of the pile, a sucker head arranged between said hinge and the corner of the pile, means for swinging said sucker head inwardly and upwardly around said hinge, whereby a corner of the uppermost sheet when gripped by the sucker may be bent upwardly and inwardly, and means for blowing a blast of air against the corner of the pile outwardly of the hinge to assist in the preliminary separation of that portion of the corner of said uppermost sheet extending outwardly beyond said hinge.

12. In a sheet feeder, sheet separating means comprising an abutment adapted to press on the top of a pile of sheets near a rear corner thereof, a sucker head arranged between said abutment and the corner of the pile and mounted to swing around said abutment to bend the corner of the uppermost sheet upwardly and inwardly, a blower arranged to blow air diagonally across the corner of the pile outwardly of said abutment to fluff up the corners of the sheets at the top of the pile beneath said sucker head before the latter grips the uppermost sheet, and means for moving the blower and the sucker head upward while suction on the sucker head and the blast of air through the blower continue, whereby in the uppermost position of the blower the blast tends to force the corners of the remaining sheets away from the lifted corner of the uppermost sheet.

13. In a sheet feeder, sheet separating means comprising a support arranged to move toward and away from a pile of sheets and to contact the pile in its lowered position, a hinge on said support near said contacting point, an arm carried by said hinge, a sucker head mounted in the free end of said arm, cylinder and piston elements connected with said sucker head, and means pivotally mounted on said support connected with said cylinder element, and functioning when air is exhausted from the space within said cylinder to tilt the cylinder, swing said arm around said hinge, and thereby tilt said sucker head upwardly.

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