

May 28, 1968

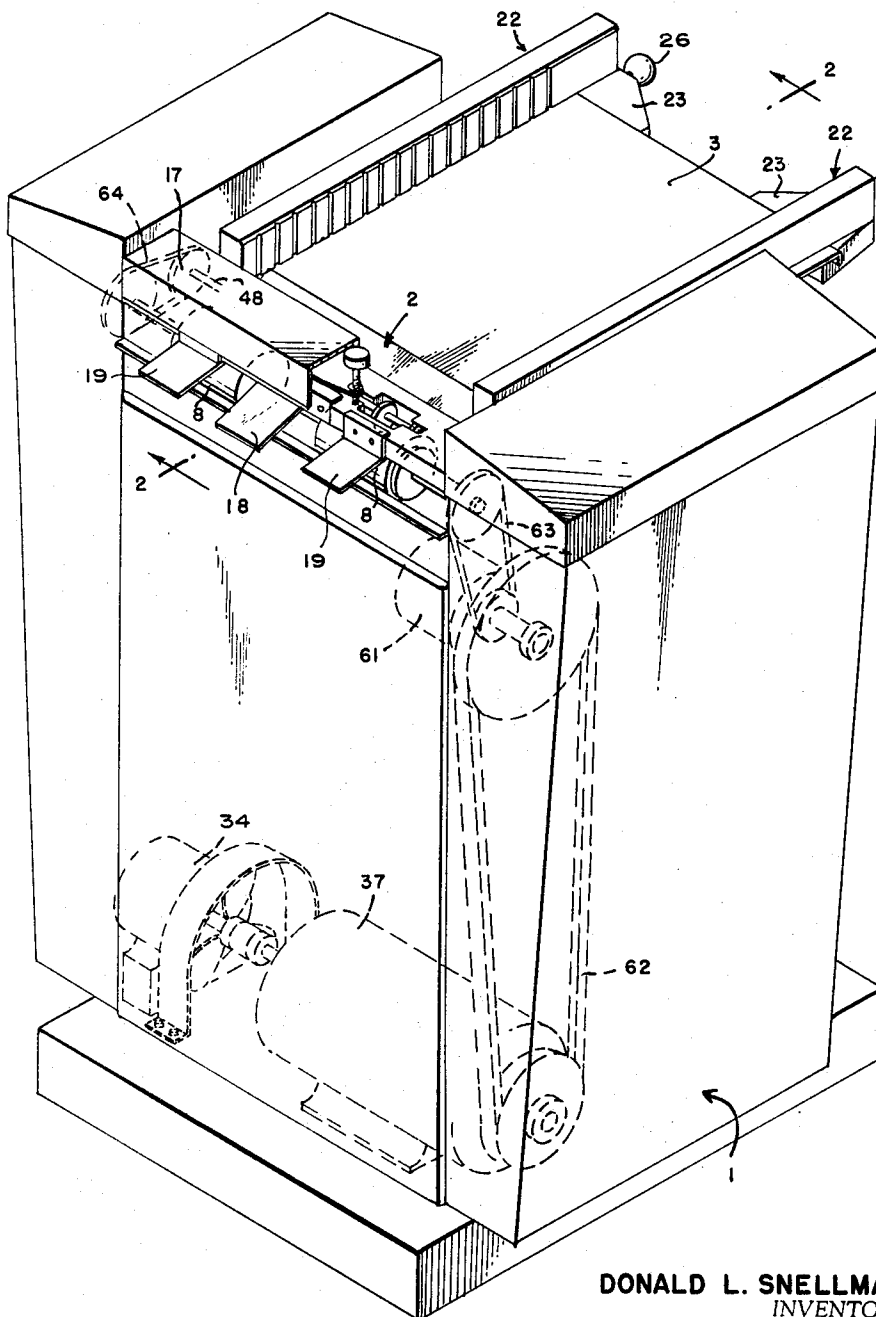
D. L. SNELLMAN
APPARATUS FOR FEEDING INDIVIDUAL SHEETS OF
PAPER OR THE LIKE FROM THE
BOTTOM OF A STACK

3,385,593

Filed Aug. 27, 1965

4 Sheets-Sheet 1

FIG. 1



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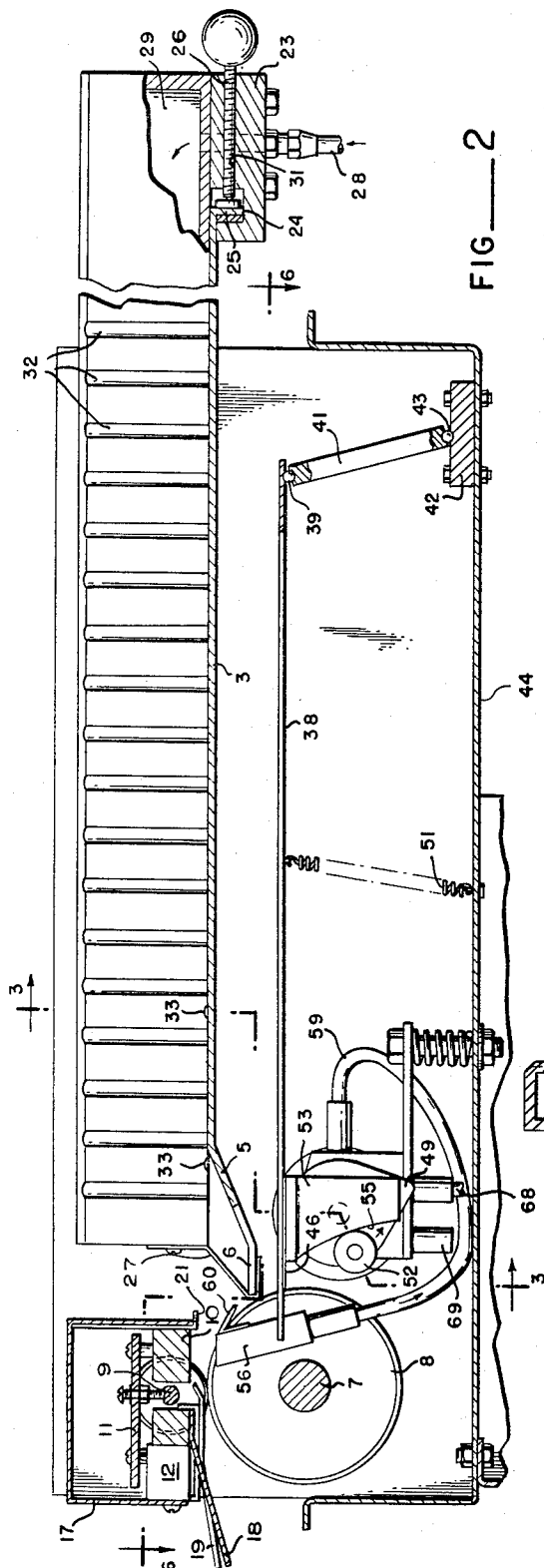


FIG. 2

FIG. 4

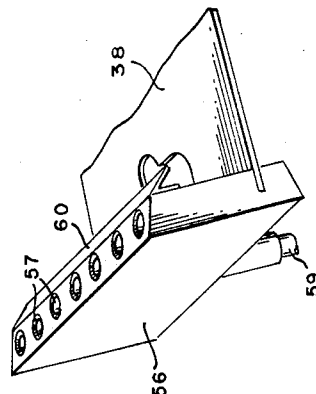
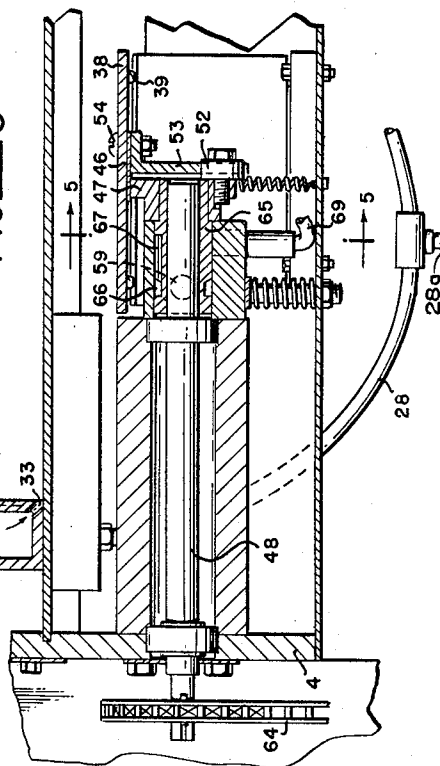


FIG. 3



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FIG. 5

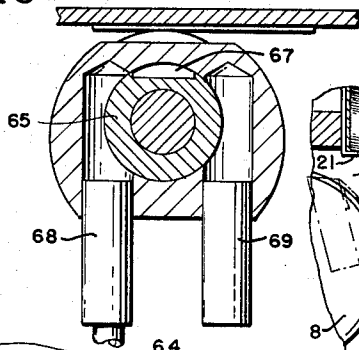


FIG. 7

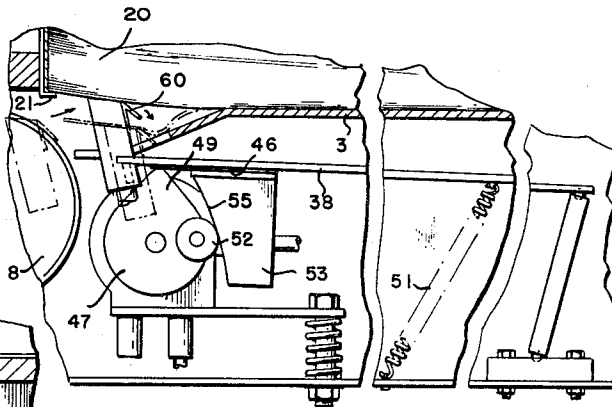
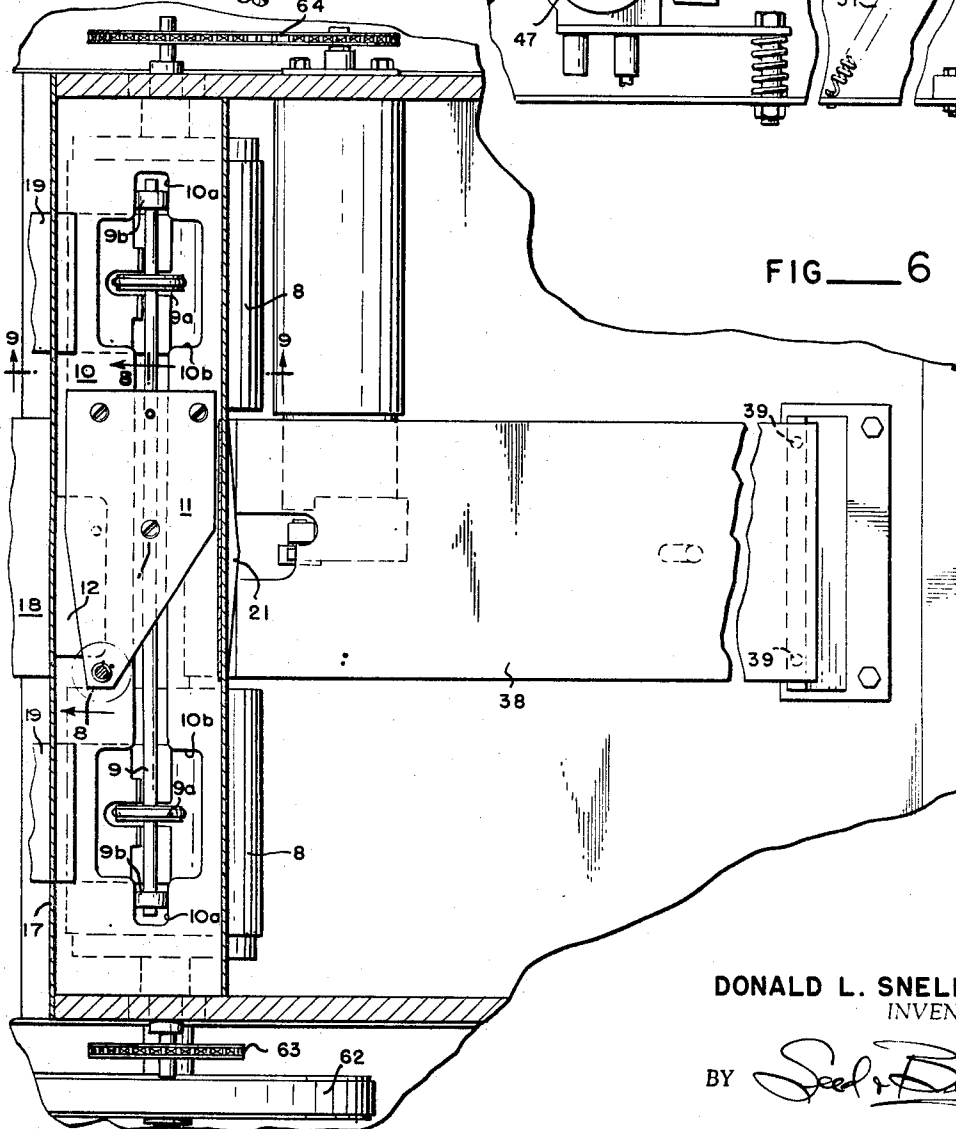


FIG. 6



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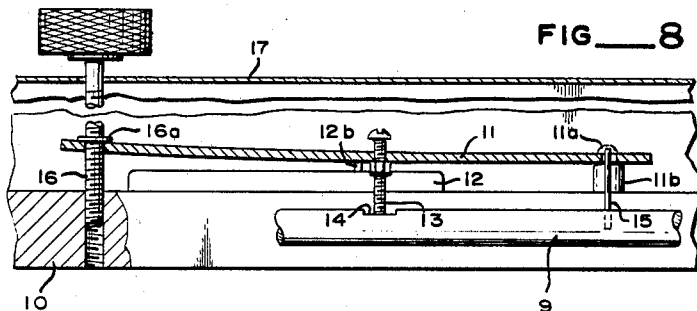


FIG. 8

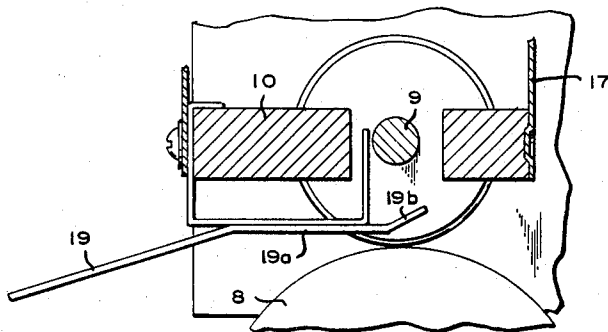


FIG. 9

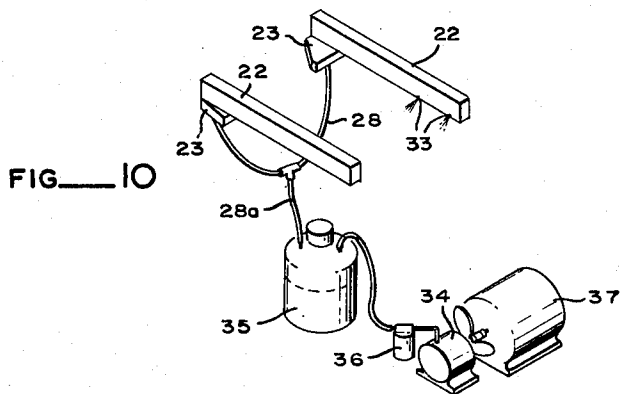


FIG. 10

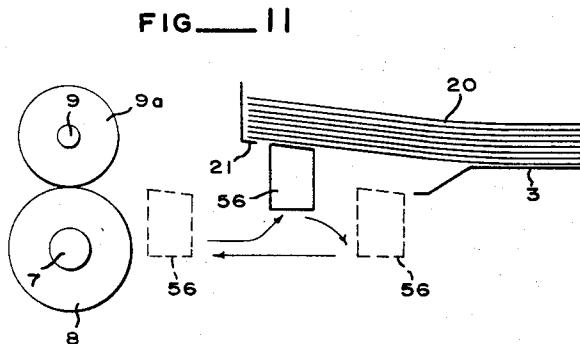


FIG. 11

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3,385,593

APPARATUS FOR FEEDING INDIVIDUAL SHEETS OF PAPER OR THE LIKE FROM THE BOTTOM OF A STACK

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8 Claims. (Cl. 271-11)

ABSTRACT OF THE DISCLOSURE

A device for removing a sheet of paper or the like from the bottom of a stack which is partially supported by an air cushion. One end of the bottom of the stack is exposed except for support thereof provided by a narrow angularly shaped bracket which contacts the edge portion of the stack. A movable contact member which comprises a vacuum head is operated so as to move against the bottom sheet in the area of the exposed end and to adhere to the bottom sheet and remove it in one direction from the supporting bracket structure and then feed it in the opposite direction into a set of feed rolls. The supply of vacuum pressure to the vacuum head of the moveable contact member is controlled by a rotary valve, the movement of which is timed so as to apply vacuum pressure when the vacuum head moves into contact with the sheet and to release the vacuum pressure at the instant the sheet is picked up by the feed rolls.

Background of the invention

The present invention relates in general to devices for feeding individual sheets of paper or the like in rapid succession from a stack and more particularly to an improved mechanism wherein individual sheets are fed from the bottom of a stack with the aid of both mechanical and pneumatic means.

Although many different types of sheet feeders are available in the prior art and are widely used in conjunction with devices such as Multigraph machines, printing machines and collators etc., such devices usually feed the sheets from the top of a stack which requires a shut-down to enable the operator to replenish the supply of sheets. The prior art devices also are subject to other mechanical failures and malfunctions which the present invention seeks to eliminate in order to provide a more rapid and efficient feeding mechanism.

Accordingly, the primary object of the present invention is to provide a sheet feeder having capabilities of increased speed and efficiency and wherein individual sheets are fed from the bottom of a supply stack.

Another object of the present invention is to provide a sheet feeder of the character described wherein combined mechanical and pneumatic means are provided for separating the individual sheets from the bottom of a stack and feeding the same from the device.

Another object of the present invention is to provide a sheet feeder of the character described having novel pneumatic pressure means for supplying an air blast to aid in separating the bottom sheets in the stack and to maintain a cushion of air to support the stack.

A further object of the present invention is to provide a sheet feeder of the character described which is adaptable for use with any size sheet and wherein the supply stack of sheets is replenished from the top.

The means by which the foregoing objects and other advantages, which will be apparent to those skilled in the art, are accomplished, are set forth in the following specification and claims and are illustrated in the accompanying drawings dealing with a preferred embodiment. Refer-

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ence is now made to the accompanying drawings in which:

FIG. 1 is a perspective view of the overall device;

FIG. 2 is a cross sectional view taken along lines 2-2 of FIG. 1;

FIG. 3 is a cross sectional view taken along lines 3-3 of FIG. 2;

FIG. 4 is a detailed perspective of the vacuum feeder head of the device;

FIG. 5 is a cross sectional detail taken along lines 5-5 of FIG. 3;

FIG. 6 is a cross sectional view taken along lines 6-6 of FIG. 2;

FIG. 7 is an elevational detail similar to FIG. 2 showing various positions of the feeder mechanism;

FIG. 8 is a cross sectional view taken along lines 8-8 of FIG. 6;

FIG. 9 is a cross sectional view taken along lines 9-9 of FIG. 6;

FIG. 10 is a perspective of the air pressure supply system; and

FIG. 11 is a schematic illustration of the movable sheet contact member.

Referring now to the drawings wherein like reference numerals indicate identical parts in the various views, FIG. 1 illustrates the overall device which comprises a cabinet or housing structure 1 which serves to house the various drive components including an electrical motor and pneumatic pumps as illustrated. The sheet feeder mechanism indicated generally at 2 is mounted on the top portion of the cabinet 1 so as to present a stack supporting table 3 which is freely accessible for top loading.

The support table 3 is a stationary metal plate which extends across the top of the cabinet 1 and may be supported along its side edges by the cabinet wall 4 as shown in FIG. 3. The plate 3 has a sloping front end portion 5 which is cut away as at 6 to permit operation of the movable feed mechanism as will be described. The housing 1 also mounts a rotatable shaft 7, powered by means presently to be described, which carries the rollers 8 located on opposite sides of the support table 3 and which constitutes the outfeed rollers for the device. A floating shaft 9 carries two freely rotatable rollers 9a which ride on top of the outfeed rollers 8 and serve the purpose of contacting the sheet of paper and holding it against the rollers. The shaft 9 is also provided with centering wheels 9b which maintain the shaft ends in position within the slots 10a of a transverse plate 10 secured to the frame of the cabinet as illustrated in FIG. 2. The rollers 9a are located within the enlarged slotted portions 10b of the plate 10 with the weight of the shaft and rollers carried thereby normally holding the rollers 9a against the rollers 8.

Means for detecting the feeding of more than one sheet at a time between the outfeed rollers 8 and the hold down rollers 9a is provided by a "double detector" which includes a sensing plate 11 and an electric switch 12. The plate 11 is anchored to the plate 10 by means of the screws 11a and spacers 11b and comprises a flexible spring member for a purpose to be described. The sensing plate 11 is provided with an adjustable screw threaded contact member 13 which extends downwardly through the plate and contacts the bottom of a slot 14 in the shaft 9. As illustrated in FIG. 8, the shaft 9 is also provided with an upstanding pin 15 which passes through a suitable hole in the plate 11 to prevent rotation of the shaft. With this arrangement the contact member 13 may be adjusted so as to be contacted by the shaft 9 in the event the shaft is lifted by the passage of more than one sheet of paper between the rollers. The plate 11 also contacts the switch operator 12b in such a manner that lifting of the plate 11 will cause actuation of the switch to give a signal which may be

used as either an indicator means or as a means to halt the operation of the device. An adjustment of the sensitivity of the plate 11 is provided by the adjusting screw 16 which is threaded into the plate 10 and which includes a fixed stop washer or the like 16a. The stop member 16a bears against the top of the plate 11 and thus the tension or downward pressure exerted by the plate may be adjusted by turning the member 16. A guard or the like 17 may be provided as a cover for the shaft, rollers and doubles detector.

A central guide plate 18 is located beneath the guard or cover 17 in order to guide the sheets issuing from the rollers 8 and 9a. Additional guide plates 19 are located on either side of the guide plate 18 and include horizontal portions 19a and upturned ends 19b overlying the rollers 8 to insure proper feeding of the sheets. The major portion of the stack of sheets 20 rests on the flat top portion of the plate 3, as shown in FIGS. 7 and 11. The central portion of the forward edge of the stack, however, is supported on a plate or bracket 21 fixed to the cover member 17 and located in the center of the device between the rollers 8 as illustrated in FIG. 6. The plate 21 forms a ledge or lip which is especially designed to have the free edge thereof angled in both directions from the center of the plate forwardly. This configuration insures that the last contact between the support 21 and the bottom sheet is at the middle of the sheet as it is removed from the bottom of the stack.

According to the present invention, the support of the stack of papers is aided by pneumatic means associated with the adjustably positioned truncated guide units 22 mounted on top of the plate 3 as illustrated in FIG. 1. The units 22 may be identical in structure and are mirror images of each other. Each of the units 22 comprises a closed hollow frame structure which is rectangular in cross section and which may be made of plastic, metal or any other suitable material. Each of the units 22 rests directly on top of the flat plate 3 and includes a block 23 having a groove 24 for receiving the downwardly bent rear edge 25 of the plate 3. Mounted within the block 23 is a clamp screw 26 for adjustably fixing the guide units to the plate 3. The forward ends of the units 22 are held down by the slidable clips 27 which engage the end of the table 3. In this manner, the device may be adapted for receiving any size paper. An air pressure inlet hose or conduit 28 is fitted to each of the blocks 23 to permit air under pressure to be delivered to the interior portion of the guide unit which constitutes an air pressure chamber 29. A suitable passage 31 is provided in each of the blocks 23 to allow for passage of air from the conduit 28 to the chamber 29. As seen most clearly in FIGS. 2 and 3, the inside vertical wall of each of the units 22 is provided with a plurality of longitudinally spaced vertical grooves 32. The grooves 32 are preferably rounded in cross section and will extend the complete height of the wall. In the present embodiment, outlet means for the air within the chamber 29 is provided by two passages or bores 33 through the bottom inside corner of the guide members. With this arrangement, air under pressure issues from the openings 33 and provides a cushion support for the bottom sheets 19 in the stack with the air passing out of the openings 33, about the sheets and then escaping through the vertical grooves 32. This arrangement relieves a substantial portion of the weight of the stack from the bottom sheets which are to be fed and provides for easy separation of the sheets during feeding. The air under pressure is supplied from a single supply conduit 28a connected to both of the conduits 28 and to an air pump 34 located in the housing 1. The air pump 34 may be provided with a cooling fan as illustrated and a water container 35 is located in the conduit 28a for the purpose of slightly humidifying the air to minimize the effect of the static electrical charge normally present during the feeding of sheets of paper. The air line 28a may

also be provided with a conventional filter unit 36 located between the pump and the water container 35. The pump 34 is driven by an electrical motor 37 which is also used to provide power for the outfeed rollers and the sheet feeder mechanism presently to be described.

Mounted directly beneath the support table 3 is a reciprocable motion-transmitting carrier member in the form of a flat plate 38. As seen in FIG. 6, the plate 38 is generally rectangular in plan view and is supported at one end by means of the ball bearings 39 engaging suitable recesses in the bottom side of the plate and the top edge of a swingable bar 41. The bar 41 is pivotally supported on the block 42 by means of a second set of ball bearings 43. The housing panel 44 provides the support for the feeding mechanism including the block 42. The forward end of the plate 38 is provided with a wear plate 46 on the under side thereof which contacts the surface of a rotatable cam 47 mounted for rotation by the drive shaft 48. The cam 47 thus provides a movable vertical support for the forward end of the plate 38. The drive shaft 48 is driven constantly throughout the operation of the device as will be presently described thus giving a vertical reciprocating motion to the plate 38 due to the high point 49 of the cam 47 which contacts the plate once for each revolution of the cam as illustrated in FIG. 7. The plate 38 is biased downwardly against the cam 47 by means of a tension spring 51 attached to the bottom of the plate 38 and to the top of a housing frame member 44, as shown most clearly in FIG. 2.

Horizontal reciprocation of the plate 38 is accomplished by means of the roller 52 carried by the cam 47 which contacts a cam follower 53 fixed to the bottom of the plate by bolts or the like 54. The cam follower 53 includes a curved cam surface 55 which cooperates with the roller 52 to produce a particular type of motion presently to be described in detail. It will also be noted that the tension spring 51 is disposed so as to exert a downward and forward thrust on the plate 38 to thus hold the plate against the cam 47 and the follower 53 against the roller 52.

Mounted on the forward end of the plate 38 is a contact member 56 which is generally rectangular in cross section and extends substantially across the width of the front end of the plate 38 as shown in detail in FIG. 4. The contact member 56 is fixedly connected to the end of the plate 38 as shown in FIG. 4, and includes a plurality of bores or passages 57 opening into the top surface thereof and connected to a manifold which, in turn, is connected to a flexible vacuum conduit 59. The contact member 56 may also include a lip member 60 which insures proper contact between the member 56 and the bottom of the sheets being fed.

Briefly stated, the contact head 56 is moved rearwardly by the roller 52 and upwardly by the high point 49 of the cam 47 to contact the bottom side of the forward end of the bottom sheet on the stack 20. The head then continues rearwardly and downwardly and finally forward again to advance the sheet from beneath the stack. This may be understood more clearly by reference to FIGS. 2 and 7 illustrating different positions of the rotatable cam and by various positions of the head illustrated schematically in FIG. 11. As indicated by the arrows in FIGS. 2, 7 and 11, the cam rotates in a counter clockwise direction. Beginning from a position shown in FIG. 2, wherein the plate 38 is at its extreme forward position, continued rotation of the cam 47 and the roller 52 starts the plate 38 and consequently the contact member 56 in a rearward direction by virtue of the contact between the roller 52 and the cam surface 55. As the rotation continues, the high point 49 of the cam carries the plate 38 upwardly and the roller 52 moves the plate rearwardly to the position shown in FIG. 7 wherein the contact member 56 has contacted the bottom surface of the bottom sheet on the stack. The vacuum pressure within the contact member 56 causes the bottom sheet to adhere to the

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member which pulls this sheet rearwardly and off of the support 21 as the cam continues to rotate. This action is illustrated in the dotted line portions of FIGS. 7 and 11. As the high point 49 of the cam passes from the plate, the spring 51 pulls the plate, the member 56 and the sheet, downwardly and further movement of the roller 52 allows the spring to move the plate forwardly toward the rolls 8. When the contact member 56 moves to the forward position as shown in FIG. 2, the sheet is picked up by the rollers 8 and 9a and fed out of the device.

Turning now to the means for applying the vacuum to the contact member 56, it will be noted that the vacuum pump 61 is driven by the motor 37 through the drive belt 62 and the drive is transferred by means of the chain 63 to rotate the shaft 7 for constantly rotating the rolls 8. The opposite end of the shaft 7 is provided with a sprocket about which is trained a second chain 64 for driving the shaft 48 which rotates the cam 47. Fixed to the shaft 48 is a rotatable spool valve body 65 shown most clearly in FIGS. 3 and 5. The valve body 65 is provided with an annular passage 66 which is in constant communication with the conduit 59 leading to the contact member 56. An elongated longitudinal passage 67 extends along the valve body 65 and, as the valve body rotates, will be either blocked, in registry with the vacuum pressure conduit 68 or the passage 69 communicating with atmosphere. The rotation of the shaft 48 and positioning and extent of the passage 67 will be so coordinated that the passage 67 communicates with vacuum conduit 68 as soon as the sheet is contacted and is moved into registry with the conduit 69 to allow atmospheric pressure to release the sheet once it is moved to the rollers 8. In this manner, the bottom sheets on the stack are continuously and rapidly removed from the bottom of the stack and fed to the outfeed rollers 8 with the rotatable shaft 48 providing rotation for the cam 47 and roller 52 as well as controlling the rotation of the valve 66 to apply vacuum pressure to the contact member 56 and to release the same in proper timed relationship. The air pressure provided by the chamber 29 and passages 32 and 33 insures that only one sheet at a time will be separated from the bottom of the stack and serves to provide an air cushion on which the stack is supported.

From the foregoing, it will be understood by those skilled in the art that the sheet feeder according to the present invention provides significant advantages over known prior art devices of the character under consideration. The arrangement and types of structural components utilized within the invention may be subjected to numerous modifications well within the purview of this invention and applicant intends only to be limited to a liberal interpretation of the specification and appended claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. A sheet feeder comprising in combination; means to support a stack of sheets on an air cushion extending over the major portion of the bottom area of the stack and leaving one end portion of the bottom sheet exposed, a narrow angled support plate supporting the mid portion of the exposed end portion of said stack, feed rolls mounted adjacent the end of the stack, a movable contact member, means to support said contact member beneath the exposed portion of the bottom sheet for movement upwardly into contact with said sheet and then rearwardly and downwardly to remove the sheet from said angled support and forwardly to advance the sheet to the feed rolls, and means to apply vacuum pressure to said contact member upon contact with said sheet and to apply atmospheric pressure to release the sheet as it is fed to the rolls.

2. A sheet feeder mechanism comprising; a first rigid support plate for supporting a stack of sheets, said plate extending under the major portion of said stack, an an-

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gularly shaped support plate spaced from said first plate for supporting the mid portion only of one end of the stack and leaving a portion of the bottom sheet exposed, air pressure means for providing an air cushion beneath said stack, outfeed rolls positioned to receive a sheet from the bottom of said stack, a movable contact member, means to support said contact member beneath the exposed portion of the bottom sheet for movement upwardly into contact with said sheet and then rearwardly and downwardly to remove the sheet from said angled support and forwardly to separate the sheet and remove the same from said stack, and means to apply vacuum pressure to said contact member upon contact with said sheet and to connect the member to atmosphere to release the sheet as it is fed to the rolls.

3. The device according to claim 2 including means associated with said air pressure means for humidifying the air supply.

4. The device according to claim 2 including signal means cooperating with said outfeed rolls for detecting and indicating the passage of plural sheets therebetween.

5. The device according to claim 2 wherein said air pressure means comprises; elongated hollow guides mounted on said first support plate and extending along the bottom edges of said stack, a source of air pressure, conduit means for connecting said source to the interior of each of said guides, first passage means in the walls of said guides for directing air under pressure beneath said stack and a plurality of vertical longitudinally spaced passages in the surface of the wall of each guide adjacent the stack to permit controlled escape of air along the sides of the stack.

6. The device according to claim 5 including, means connected in said conduit means for humidifying the air passing therethrough.

7. The device according to claim 2 wherein said contact member is mounted on an elongated movable carrier member, said carrier member being pivotally mounted at one end and including a downwardly extending cam surface beneath said contact member, means supporting the pivoted end of said carrier member to permit horizontal reciprocation, a first rotating cam means for contacting the bottom surface of said carrier member to cyclically raise and lower said contact member, a second cam means carried on said first cam means for contacting said cam surface to simultaneously reciprocate said member longitudinally, and means to bias said carrier member into contact with said cams.

8. The combination according to claim 7 wherein said first cam means is carried on a rotating shaft, and wherein said means to apply vacuum pressure and atmospheric pressure to said contact member comprises, a valve member mounted on said shaft, said valve member including means to alternately connect said contact member to a source of vacuum pressure and to atmospheric pressure in timed relation to the movement of said contact member, whereby said sheet is caused to adhere to said contact member for removal from the stack and is released as it is fed to the outfeed rolls.

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