Jan. 10, 1961 R. E. LINDEMANN 2,967,705

SHEET FEEDER

Filed Aug. 13, 1956 5 Sheets-Sheet 1

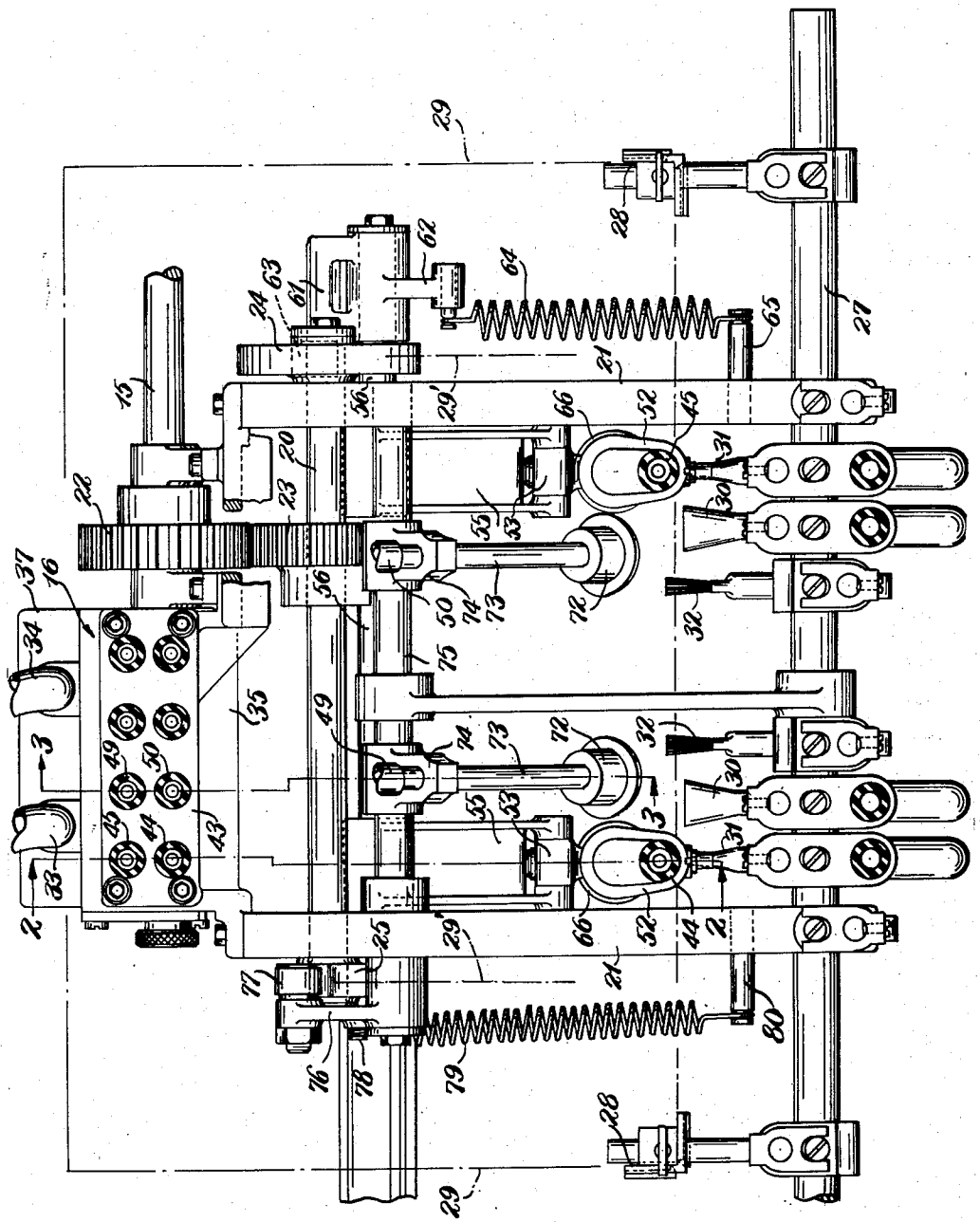

FIG. 1

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SHEET FEEDER

Filed Aug. 13, 1956 5 Sheets-Sheet 2

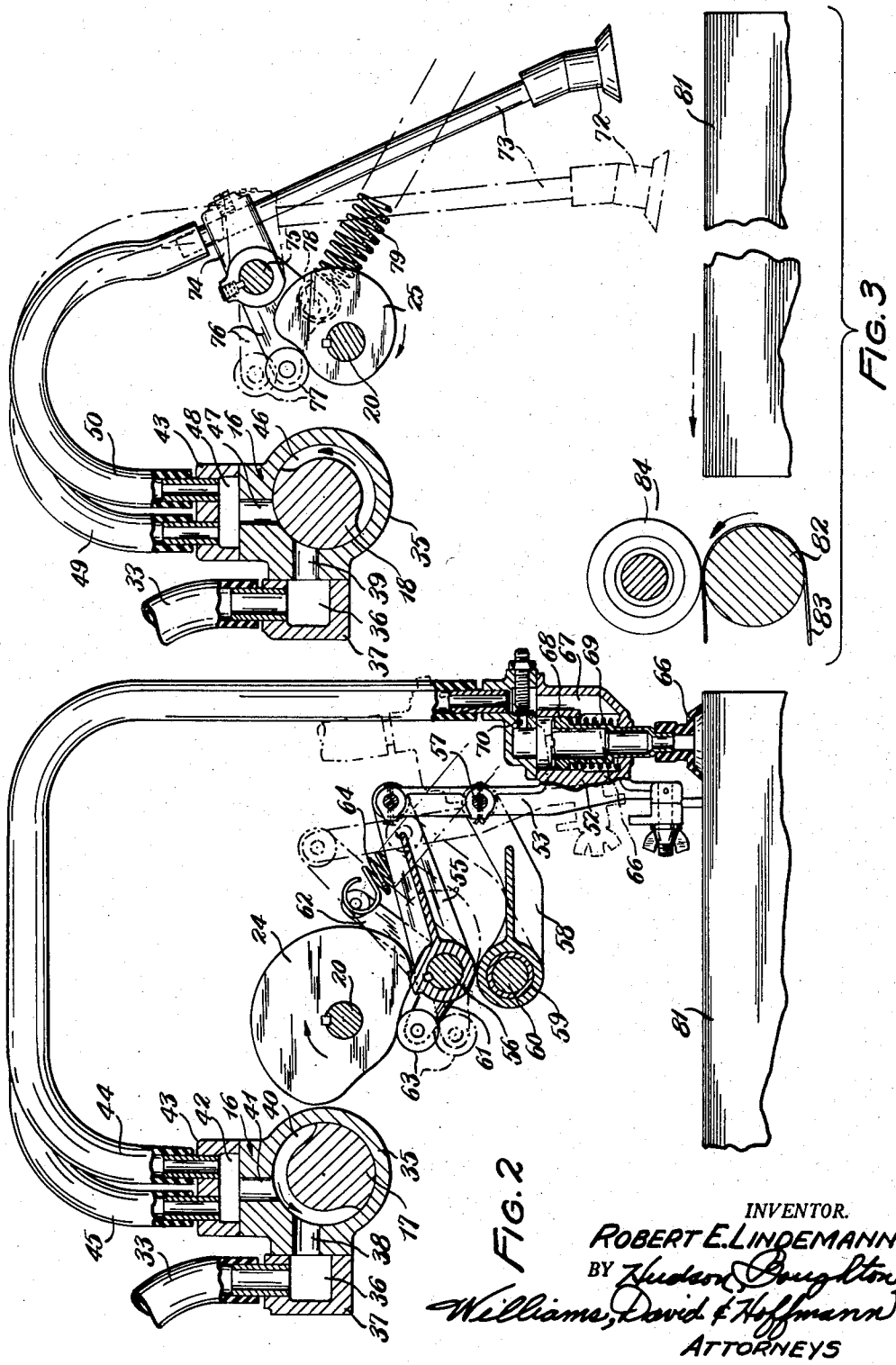

FIG. 2

FIG. 3

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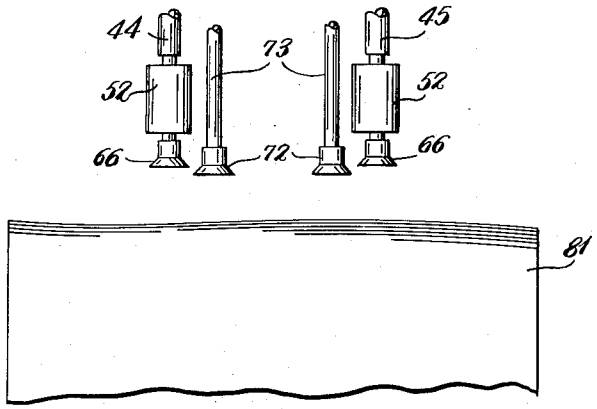
SHEET FEEDER

Filed Aug. 13, 1956 5 Sheets-Sheet 3

FIG. 8



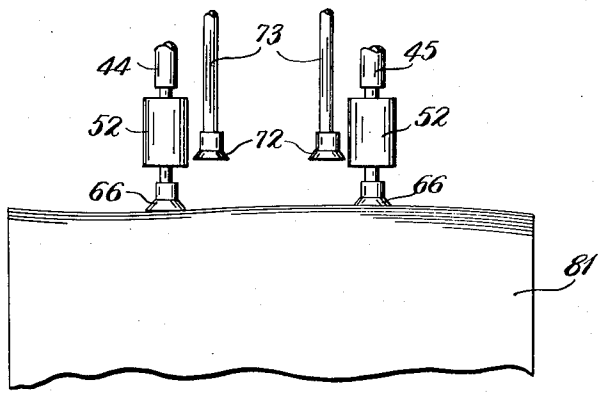


FIG. 4

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SHEET FEEDER

Filed Aug. 13, 1956 5 Sheets-Sheet 5

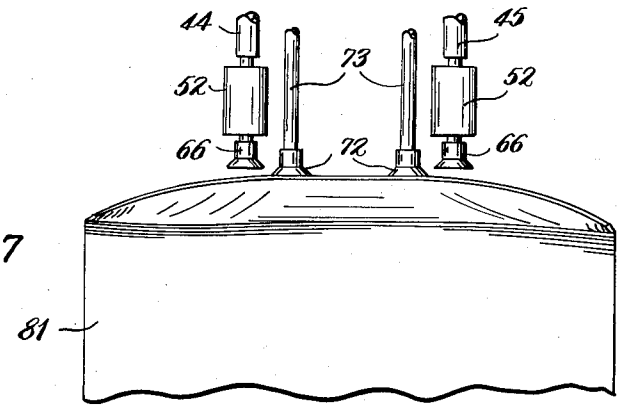

FIG. 7

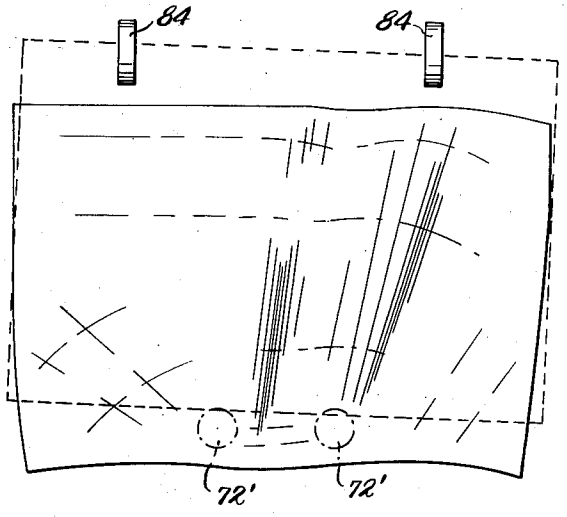

FIG. 9

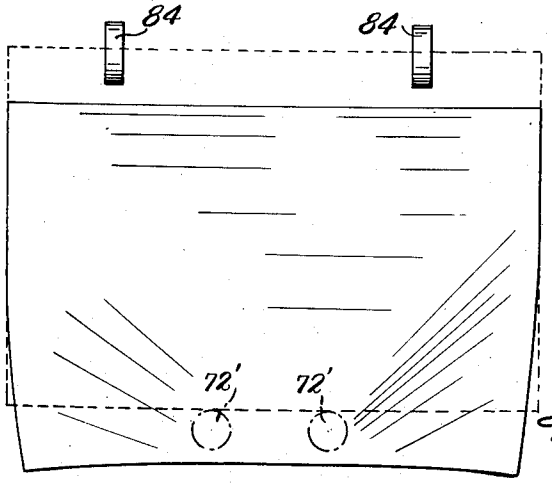

FIG. 10

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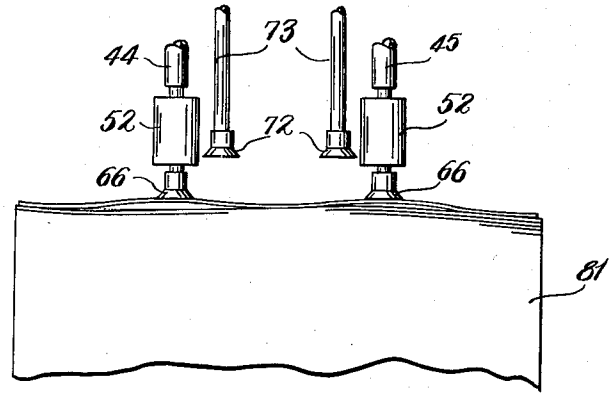
SHEET FEEDER

Filed Aug. 13, 1956 5 Sheets-Sheet 4

FIG. 5



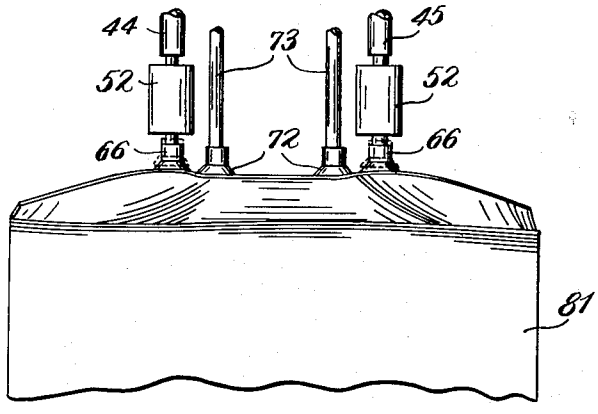


FIG. 6

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2,967,705

SHEET FEEDER

Robert E. Lindemann, Le Roy, Ohio, assignor to Harris-Intertype Corporation, a corporation of Delaware

Filed Aug. 13, 1956, Ser. No. 603,488

16 Claims. (Cl. 271—26)

This invention relates to improvements in sheet feeders, more particularly means for feeding sheets in a stream or sheet by sheet from a pile of sheets through a pair of pull-in rolls onto a feed board by which the sheets are carried forward to a sheet handling machine such as a printing press.

The invention has to do more particularly with means for lifting the top sheet of the pile by a pair of transversely spaced sheet lifters which carry the sheet upwardly to a position somewhat above the level of a pair of sheet forwarders that are disposed inwardly of the sheet lifters, by means of which action the sheet is tensioned or tautened (sometimes referred to as stretched) beneath the sheet forwarders preparatory to being advanced by the latter. This tensioning of the sheet is particularly beneficial where the sheet feeding unit is located at the center of the machine, as is sometimes the case in machines for handling sheets of relatively narrow width. I have discovered that in such machines if the sheet is permitted to sag between the forwarding suckers the front edge of the sheet tends to assume a slightly bowed line instead of a straight line at right angles to the direction of feed. When the front edge of a sheet thus bowed enters the bite of the feed-in rolls the sheet is wrinkled or angularly disarranged and may cause a misfeed. The tensioning of the sheet between the forwarding suckers however results in maintaining the forward edge of the sheet straight to enter the feed-in rolls properly, and the difficulty is overcome.

One of the objects of the invention therefore is to prevent the misfeeding of sheets into the feed-in rolls.

Another object is the provision of means for tensioning each sheet between the forwarding suckers.

Still another object is the tensioning of the rear edge of the sheet by disposing a pair of sheet lifters outwardly of the sheet forwarders and causing them to rise to a level above that of the sheet forwarders while the latter are at the rearmost point of their forward travel, whereby the sheet is tensioned beneath the sheet forwarding suckers before a vacuum is created in them to grasp the sheet.

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

Fig. 1 is a plan view of a feeding unit embodying the invention;

Fig. 2 is a side view partly in vertical section through one of the sheet lifting suckers and through a valve controlling the vacuum in one of the lifting suckers;

Fig. 3 is a similar view showing a forwarding sucker in elevation and its control valve in vertical section, and illustrating also the pull-in rolls;

Fig. 4 is a rear elevational view showing digrammatically the positions of the two sets of suckers just as the lifting suckers with vacuum on are about to lift a sheet;

Fig. 5 is a similar view with the lifting suckers in lowered position with vacuum on and the lifting suckers sealed by the top sheet of the pile and telescoped;

Fig. 6 is a similar view with the lifting suckers moved bodily upward to an elevation above that of the forwarding suckers and in transverse alignment therewith, thereby tensioning the sheet beneath the then stationary forwarding suckers in which at the time there is no vacuum;

Fig. 7 is a similar view wherein vacuum has been induced in the forwarding suckers and released in the lifting suckers, the forwarding suckers being about to advance the sheet into the pull-in rolls;

Fig. 8 is a similar view after the forwarding suckers have been returned to their rearmost position and before the lifting suckers have been lowered toward the pile;

Fig. 9 is a plan view showing diagrammatically an aggravated condition encountered in prior art feeders wherein the rear edge of the sheet is raised but not tensioned, and

Fig. 10 is a similar plan view wherein the middle portion of the sheet is tensioned in accordance with the present invention.

The principal parts of that portion of a sheet feeder embodying the present invention are shown in plan in Fig. 1 of the drawing. A shaft **15** driven in 1 to 1 relation from the press served by the feeder operates the moving parts with which we are here concerned. This shaft runs into a valve casing **16** and drives a rotary valve having sections **17** and **18** for controlling the application of vacuum to the suckers presently to be described.

20 is a cam shaft journaled in frame members **21** which also support the valve casing **16**. Gears **22** and **23** of equal diameter cause shaft **20** to turn at the same speed as shaft **15** or in 1 to 1 relation with the press. Shaft **20** at its opposite ends carries a cam **24** which operates the lifting suckers and a cam **25** which operates the forwarding suckers.

Figs. 2 and 3 show one of the two lifting suckers and one of the two forwarding suckers and their operating mechanism at the same instant, that is at the time the lifting suckers have descended into contact with the top sheet of the pile while the forwarding suckers are poised in their rearmost position awaiting the action of the lifting suckers. The corresponding suckers of each pair are identical and work together, and hence the description of one sucker of each pair will suffice.

Mounted in the frame of the machine there is a fixed shaft or brace **27**. This shaft may carry vertical pile guides **28** that are adjustable transversely of the machine to accommodate sheets of different widths. The top sheet of the maximum width pile is indicated by the broken lines **29** in Fig. 1. The minimum width sheet is indicated at **29'**. Shaft **27** may carry horizontal and vertical blast nozzles **30** and **31** and brushes **32**, which parts have the usual well known functions of assisting in sheet separation. In setting up the mechanism, most of the parts are arranged to properly handle minimum sheets, and this same arrangement is used to handle maximum width sheets. The entire assembly is movable as a unit forwardly and rearwardly however to compensate for sheets of different lengths. The drive to shaft **15** may be flexible for this purpose.

The machine includes a vacuum pump, not shown, the intake or vacuum side of which is connected with a conductor **33**, while the discharge or pressure side is connected with a conductor **34**. In the present instance we are concerned only with the vacuum side. The rotating valve which has the sections **17** and **18** is carried within a cylinder **35** that forms part of the valve casing **16**. Conductor **33** communicates with a cavity **36** in a block **37** attached to the rear of the casing **16**, and from this cavity there extend two ports **38** and **39** leading to the cylinder.

Valve section **17** has a groove **40** extending partially around its periphery which groove is adapted during a

portion of a revolution to connect port 38 with a port 41 in the casing. Port 41 leads to a space 42 formed in the underside of a cover 43 of the casing, and from this space there extend two flexible conductors 44 and 45 which communicate with the lifting suckers. Similarly a peripheral groove 46 in the valve section 18 is adapted to put port 39 into communication with a port 47 which opens into a space 48 in the cover 43. From the latter space two flexible conductors 49 and 50 lead to the two forwarding suckers.

Each of the lifting suckers comprises a housing 52 having an upwardly extending bracket arm 53. This arm is pivotally connected with the bifurcated outer end of a lever 55 that is keyed to an oscillatable shaft 56. The bracket 53 also is pivotally connected with the outer end of a lever 58, the inner end of which is free to oscillate over a bushing 59 surrounding a stationary shaft 60. Near one end of shaft 56 there is also keyed a bell crank lever having arms 61 and 62. Arm 61 carries a roller follower 63 which runs upon the under side of cam 24, while to the other arm 62 there is connected a tension spring 64 the opposite end of which is anchored to a post 65 mounted in the frame. Follower 63 working through shaft 56 swings levers 55 and 58 upwardly so that the sucker 66 at the top of its lifting motion assumes the position shown in broken lines in Fig. 2.

The sucker 52, 66 is a telescoping sucker of a type known in the art, but it has a particularly advantageous function in the present combination. As shown it comprises a vacuum passage 67 which, when the sucker 66 is open, exerts suction on the outer annular surface of the piston 68 and pulls it down against the action of spring 69. As soon as the sucker is closed by contact with the top sheet of the pile the suction exerted through the port 70 becomes effective upon a larger surface and draws the piston upwardly, assisted somewhat by the spring 69. This has an important function as will be explained hereinafter.

The forwarding suckers 72 which may be ordinary suckers as distinguished from telescoping suckers, are each carried upon the lower ends of hollow tubes 73, the upper ends of which connect with the flexible conductors 49 and 50 previously mentioned. These tubes 73 are each mounted in arms 74 that are keyed to an oscillatable shaft 75 which is journaled in frame members 21. An arm 76 mounted at one end of shaft 75 carries a roller follower 77 which runs upon the periphery of cam 25 to control the movement forwardly and backwardly of suckers 72 between the full and broken line positions illustrated in Fig. 3. Arm 76 is of somewhat triangular shape and carries a pin 78 over which one end of a coil spring 79 bears, the opposite end being anchored in a post 80 mounted in the frame.

The pile of sheets is shown at 81 in Figs. 2 and 3. Beyond the forward edge of the pile as illustrated in Fig. 3, there is a roller 82 over which run feeding tapes 83, while wheels or rollers 84 bear upon the tapes to insure traction as the sheets travel forward over the tapes. The rollers 82, 84 constitute the pull-in rolls of the machine that take the sheets one after another as they leave the pile and travel down the feed board, not shown.

Operation.—We turn now to Figs. 4 to 10 inclusive for a description of the operation of the invention. The positions of the parts in Fig. 4 correspond with their positions in Figs. 2 and 3. The suckers 66 are contacting the top sheet of the pile with vacuum on and are about to telescope upwardly. In Fig. 5 the telescoping has occurred and the top sheet has been grasped and raised slightly while the suckers 72 remain in the same position as before. In Fig. 6 the parts are shown in the positions they take after the cam shaft 20 has revolved through approximately one-quarter revolution. There is still no suction available in suckers 72, and they have not changed their position. Suckers 66 still firmly grasp the top sheet and they have moved bodily upward to an elevation slightly above that of suckers 72. That part of the sheet between the suckers 72 is stretched beneath the latter suckers by the upward pull exerted by suckers 66 as they rise somewhat above the level of suckers 72. While the sucker housings 52 are still being bodily moved upwardly, the tension in the sheet reaches a value which balances the pull of the vacuum on the piston 68. At this point, the suckers 66 remain still, but the housings 52 continue their upward movement. If the suckers 66 were not telescoping suckers but were movable bodily only like the suckers 72 and there was no sag in the sheet between the suckers 72, the suckers 66 would have to slip upon the sheet as they rose above the level of suckers 72 and they would suffer consequent wear necessitating frequent replacement, but instead of such slippage occurring, the pistons 68 slide in their cylinders and the springs 69 yield slightly.

At this stage in the cycle groove 46 in the suction valve section 18 will have revolved to place ports 39 and 47 in communication to provide suction in the suckers 72. Immediately thereafter suction valve section 17 will close off communication between ports 38 and 41 to interrupt suction in suckers 66 and the condition illustrated in Fig. 7 will obtain. The suckers 72 now in control of the sheet will then advance to the broken line position of Fig. 3 and will feed the sheet forward into the bite of the pull-in rolls 82, 84.

The long radius circular part of cam 24 will maintain the suckers 66 in their uppermost position illustrated in broken lines in Fig. 2 through a considerable part of a cycle. In the meantime the follower 77 will have ridden up the rising portion of cam 25 to swing the suckers 72 forward and then down off the high portion of the cam to swing the tubular arms 73 upward rapidly to the full line position in Fig. 3. This latter condition is illustrated in Fig. 8 where all of the suckers are in transverse alignment. Now while the suckers 72 remain in the full line position of Fig. 3, follower 77 then riding upon the short radius circular part of cam 25, the suckers 66 descend from the dotted line position of Fig. 2 to the full line position of that figure and the parts will again be in the positions of Fig. 4 to begin another cycle.

In Fig. 9 of the drawing there is illustrated a condition which could prevail if forwarding suckers 72 were used without the lifting suckers or with lifting suckers having no stretching effect. The points of gripping the sheet would be at 72'. In case the pile of sheets was level and there was no sag between the two grasped points 72', the feeding action would be satisfactory, but if the sheet sagged more or less between the grasped points at the time the suckers 72 were raised, the sheet instead of being drawn in evenly on both sides as in Fig. 10, might take a position somewhat as indicated in Fig. 9. In other words the sag between the gripped points 72' may extend forward toward the front edge of the sheet but not necessarily in a central direction. The front edge of the sheet would then be presented to the pull-in rolls somewhat as indicated in Fig. 9, which might result in the sheet being wrinkled or angularly misfed as it passed through the pull-in rolls. If the sag between the gripped points 72' would run in the same direction each time, the pile could be moved to assure that the sheet's forward edges entered the bite of the rolls properly. However, the sag may run in the direction shown in Fig. 9 for one sheet, may then run to the left forward corner for the next sheet, then down the right side for the following sheet, and so on. The condition illustrated in Fig. 10 where the sheet as it moves forward has been stretched between the suckers 72, overcomes this difficulty and causes the front edge of the sheet to extend in a straight transverse line as it enters the bite of the pull-in rolls, thereby eliminating wrinkling or angular misfeed.

Having thus described my invention, I claim:

1. The method of feeding sheets from a pile to a sheet

handling machine, comprising the steps of grasping the top sheet of the pile at two points spaced apart near the rear edge of the sheet on opposite sides of the center line of the machine, raising the sheet thus grasped past two transversely spaced forwarding means disposed between said grasped points until the portion of the sheet between the forwarding means is tautened against the same, and thereafter grasping the sheet with the forwarding means and forwarding it independently of said first named grasping means toward the sheet handling machine.

2. A method of feeding sheets from a pile to a sheet handling machine by means of a pair of spaced sheet lifting suckers disposed for movement that is substantially vertical only above the rear of the pile and a pair of interposed forwarding suckers disposed above the pile for movement forward from and return to the plane of movement of said lifting suckers, comprising the steps of lowering the lifting suckers, creating vacuum therein for grasping the top sheet of the pile, raising the lifting suckers with the sheet grasped thereby past the level of the forwarding suckers while the latter suckers are stationary and in said plane, whereby the raised sheet is tautened against the forwarding suckers transversely between the forwarding suckers, creating a vacuum in the forwarding suckers, breaking the vacuum in the lifting suckers, moving the forwarding suckers to advance the tautened sheet toward the sheet handling machine, breaking the vacuum in the forwarding suckers and returning the lifting and forwarding suckers to positions above the rear of the pile.

3. In a pile sheet feeder, a pair of transversely spaced forwarding suckers movable back and forth in the direction of sheet feed, a pair of lifting suckers movable independently of said forwarding suckers down and up from a position in a transverse vertical plane aligned with the rearmost position of said forwarding suckers, vacuum control means for each pair of suckers, means for causing the lifting suckers to descend to a position closely adjacent the top sheet of the pile, said vacuum control means then functioning to create a vacuum in the lifting suckers to grasp the top sheet, means for causing the lifting suckers to rise above the level of the forwarding suckers while the latter suckers are in their rearward position, thereby tautening against the forwarding suckers that portion of the lifted sheet between the then stationary forwarding suckers, said vacuum control means then functioning to create a vacuum in the forwarding suckers to cause them to grasp the sheet, and functioning thereafter to break the vacuum in the lifting suckers, means for advancing the forwarding suckers to feed the sheet forward, said vacuum control means then functioning to break the vacuum in the forwarding suckers to release the forwarded sheet, and means for returning the forwarding suckers to their rearmost positions.

4. In a pile sheet feeder, a feeding unit disposed above the rear of the pile at the middle thereof, said unit comprising a pair of transversely spaced forwarding suckers closer to each other than to the sides of a pile of maximum width, a pair of lifting suckers mounted independently of said forwarding suckers and disposed outwardly of said forwarding suckers, vacuum control means for each pair of suckers, said vacuum control means for the lifting suckers causing them to grasp the top sheet of the pile, means for causing the lifting suckers while the sheet is thus grasped to rise above the level of the forwarding suckers in substantially the same vertical plane, thereby tautening against the forwarding suckers that portion of the sheet between the forwarding suckers, the vacuum control for the forwarding suckers then functioning to grasp the sheet, the vacuum control then functioning to release the tautened sheet from the lifting suckers, means for advancing the forwarding suckers to feed the sheet forward, said vacuum control means then functioning to break the vacuum in the forwarding suckers, whereby the lifted and advanced sheet shall have a forward edge that is straight and at right angles to its path of travel, and means for returning both sets of suckers to positions above the rear of the pile.

5. In a pile sheet feeder, means for tautening a sheet being fed comprising transversely spaced abutments for engagement with a lifted sheet, telescoping suckers outwardly of said abutments, and means for operating the suckers to lift the sheet higher than said abutments to thereby tauten the sheet between the abutments, each of said telescoping suckers embodying a spring tending to hold the sucker upwardly in telescoped position, whereby the suckers may yield slightly if when they approach their highest elevation the sheet is already tautened to some extent, thereby eliminating slippage of the sheet on the lifting suckers and consequent wear on those suckers.

6. In a pile sheet feeder, a pair of pull-in rolls at the front end of the pile to which sheets are to be fed, a feeding unit disposed above the rear of the pile at the middle thereof, said unit comprising a pair of transversely spaced forwarding suckers closer to each other than to the sides of a maximum width pile, a pair of lifting suckers disposed outwardly of said forwarding suckers, vacuum control means for both pairs of suckers, said control means functioning to produce vacuum in the lifting suckers and cause them to grasp the top sheet of the pile, means for causing the lifting suckers with the grasped sheet to rise above the level of the forwarding suckers in substantially the same vertical plane, thereby tautening against the forwarding suckers that portion of the sheet between the forwarding suckers and maintaining the forward edge of the sheet in a straight line parallel to the bite of said pull-in rolls, said vacuum control means then functioning to create a vacuum in the forwarding suckers and to break the vacuum in the lifting suckers, and means for advancing the forwarding suckers until the sheet is within the grasp of the pull-in rolls, and the said vacuum control then functioning to break the vacuum to the forwarding suckers.

7. In a machine for forwarding sheets from a pile to a pair of pull-in rolls which forward the sheet onto a feed board, a pair of transversely spaced sheet lifters comprising suckers disposed for vertical movement above the rear of the pile, a pair of spaced forwardly suckers between said sheet lifters disposed above the pile for movement forward and backward from the plane of movement of said sheet lifters, vacuum control means for both pairs of suckers, means for lowering said sheet lifters, said vacuum control means then functioning to set up vacuum in said lifting suckers, means for raising the sheet lifters with the sheet grasped thereby upward above the level of said forwarding suckers while the latter suckers are stationary in their rearmost position to thereby tauten against the forwarding suckers that portion of the sheet between the forwarding suckers, said vacuum control means then functioning to create a vacuum in the forwarding suckers and to break the vacuum in the suckers of the sheet lifters, and means for moving the forwarding suckers forwardly to advance the tautened sheet into said pull-in rolls, said vacuum control means then functioning to break the vacuum in the sheet forwarding suckers.

8. The method of feeding sheets from a pile to a sheet handling machine, comprising the steps of grasping the top sheet of the pile at two points spaced apart near the rear edge of the sheet on opposite sides of the center line of the machine, moving the sheet thus grasped and a pair of intermediately disposed transversely spaced forwarding means relatively to each other vertically until the portion of the sheet between the forwarding means is tautened against the forwarding means and thereafter grasping the sheet with the forwarding means and forwarding it toward the sheet handling machine.

9. The method of feeding sheets from a pile to pull-in rolls of a sheet handling machine, comprising the steps of grasping the top sheet of the pile at two points spaced

apart near the rear edge of the sheet on opposite sides of the center line of the machine, moving the sheet thus grasped and a pair of intermediately disposed transversely spaced forwarding means relatively to each other vertically until the portion of the sheet between the forwarding means is tautened against the forwarding means, thereafter grasping the sheet with the forwarding means, and forwarding the sheet to the pull-in rolls of the sheet handling machine.

10. In a pile feeder for a sheet handling machine, a pair of transversely spaced forwarding suckers, means moving said forwarding suckers back and forth in the direction of sheet feed, a pair of lifting suckers disposed laterally outward of the forwarding suckers, means moving said lifting suckers down and up from a position in a transverse vertical plane aligned with the rearmost position of said forwarding suckers, a source of vacuum, conductors from said source to said lifting and forwarding suckers, valve means in one of said conductors for making and breaking vacuum to the forwarding suckers, and valve means in the other conductor for making and breaking vacuum to the lifting suckers, said moving means and said valve means operating first to lower the lifting suckers, grasp a sheet, and raise the lifting suckers above the level of the forwarding suckers while vacuum to the forwarding suckers is off to tauten the sheet against the forwarding suckers, next to grip the sheet with the forwarding suckers and thereafter release it from the lifting suckers, and finally to forward the sheet to the sheet handling machine and thereupon release it from the forwarding suckers.

11. Mechanism according to claim 10 including pull-in rolls to which the forwarding suckers present the forward edge of the sheet while the edge is parallel to the bite of the rolls.

12. In a pile sheet feeder, a pair of transversely spaced forwarding suckers movable back and forth in the direction of sheet feed, a pair of lifting suckers disposed laterally outward of the forwarding suckers movable down and up from a position in a transverse vertical plane generally aligned with the rearmost position of said forwarding suckers, each lifting sucker comprising a cylinder, a piston reciprocable therein, and spring means urging the piston upwardly in the cylinder, vacuum creating means, conductors for communicating vacuum to said lifting and said forwarding suckers, valve means in said conductors, said valve means controlling vacuum in the lifting suckers and acting on the underside of the pistons to telescope the pistons and suckers downwardly in opposition to the spring means, means bodily lowering said lifting suckers to the top sheet of the pile, the pistons of said lifting suckers telescoping upwardly upon sealing of the suckers on a sheet, means bodily raising the lifting suckers above the level of the forwarding suckers while the latter are in their rearward position thereby tautening that portion of the sheet between the forwarding suckers, said spring means being compressible during the tautening of the sheet to compensate for the difference in the amount one sheet is required to be stretched as compared to the next, said valve means operating after the sheet has been tautened to apply vacuum to the forwarding suckers and thereafter discontinue its application to the lifting suckers, means for advancing the forwarding suckers to feed the sheet forward, said valve means causing the forwarding suckers to thereupon release the sheet, and means returning the forwarding suckers to their rearmost positions.

13. In a machine for feeding sheets from a pile to the pull-in rolls of a sheet feeding machine, a pair of transversely spaced lifting suckers disposed for vertical movement above the rear of the pile from and to a sheet pick-up position at the top of the pile, a pair of spaced abutments above the pile at a level beneath the lifting suckers when the latter are at the upper end of their vertical movement, said abutments each comprising a second sucker, vacuum control means for both pairs of suckers, feed vacuum control means including means to create a vacuum in said lifting suckers, and means for raising said lifting suckers vertically from said pickup position to tauten a sheet gripped thereby against said abutments, said vacuum control means including means to create a vacuum in said second suckers and to break the vacuum in said lifting suckers only after said lifting suckers have been raised to a position where the sheet gripped thereby is tautened against said abutments.

14. The method of picking up the top sheet of a pile and transferring it in a tautened condition to a pair of suckers disposed above the pile and inwardly of the sides thereof, said method comprising the steps of grasping the top sheet of the pile at a point outwardly of each sucker so that the suckers are disposed between the grasped points, raising the grasped sheet until the sheet engages the suckers and tautens thereagainst to remove sag from the portion of the sheet between the suckers, and then applying vacuum to the suckers to render them effective to grasp the sheet.

15. In a pile sheet feeder, the structure as defined in claim 5 wherein said abutments are suckers and means is provided for rendering the latter effective to grip a sheet being lifted only after the sheet has been lifted by said telescoping suckers and tautened against said suckers providing said abutments.

16. In a machine for feeding sheets from a pile to the pull-in rolls of a sheet feeding machine, a pair of transversely spaced sheet gripping elements disposed for vertical movement above the rear of the pile from and to a sheet pickup position adjacent to the top of the pile, a pair of spaced abutments above the pile at a level beneath the sheet gripping elements when the latter are at the upper end of their vertical movement, said abutments each comprising a sucker, vacuum control means for said suckers, and means for raising said sheet gripping elements vertically from said sheet pickup position to tauten a sheet gripped thereby against said abutments, said vacuum control means including means for creating a vacuum in said suckers after said gripping elements have been raised to a position where a sheet gripped thereby has been tautened against said abutments.

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