Nov. 16, 1965 J. R. WICKLAND 3,218,062

SHEET FEEDING APPARATUS

Filed July 24, 1963 2 Sheets-Sheet 1

Fig. 1.

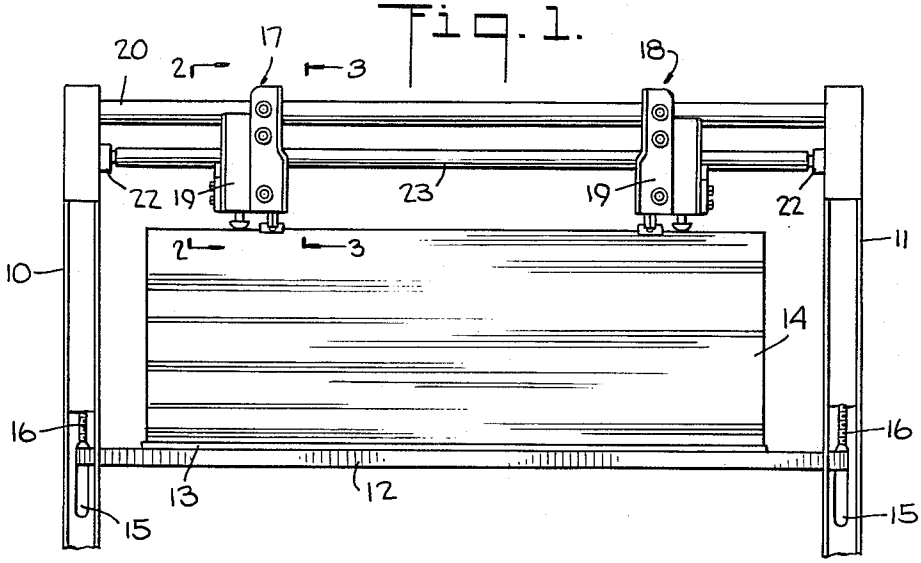
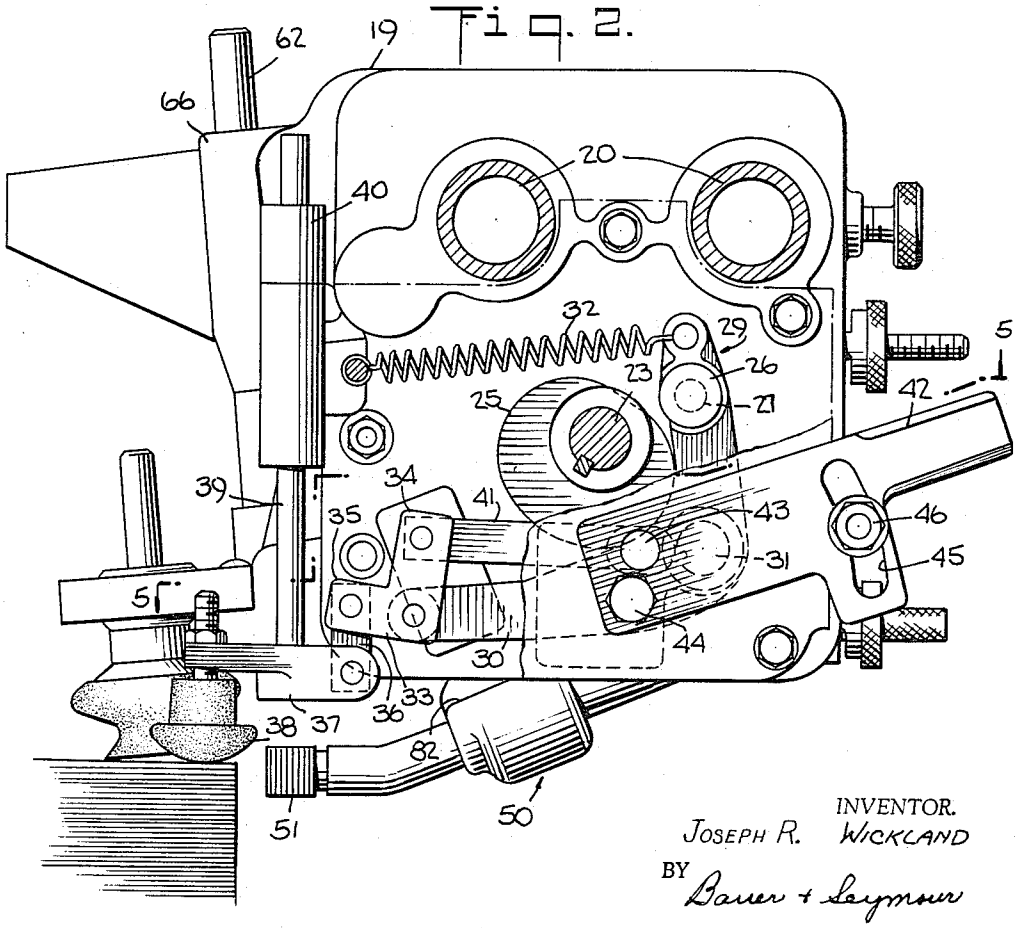


Fig. 2.



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SHEET FEEDING APPARATUS

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Fig. 3.

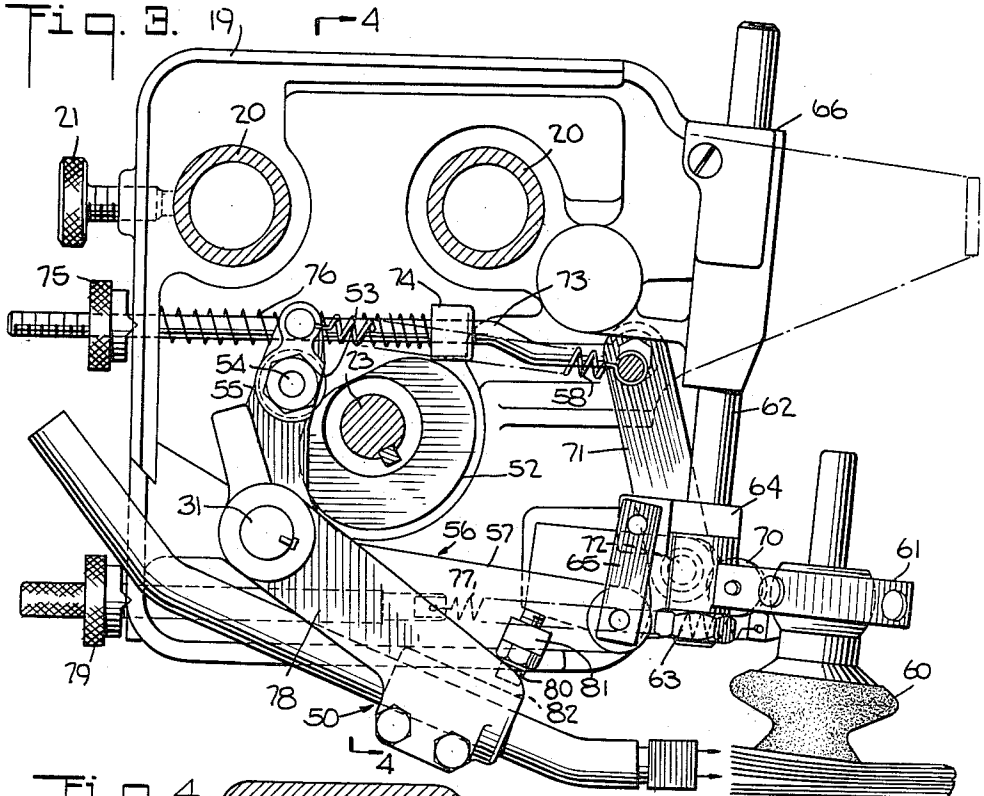
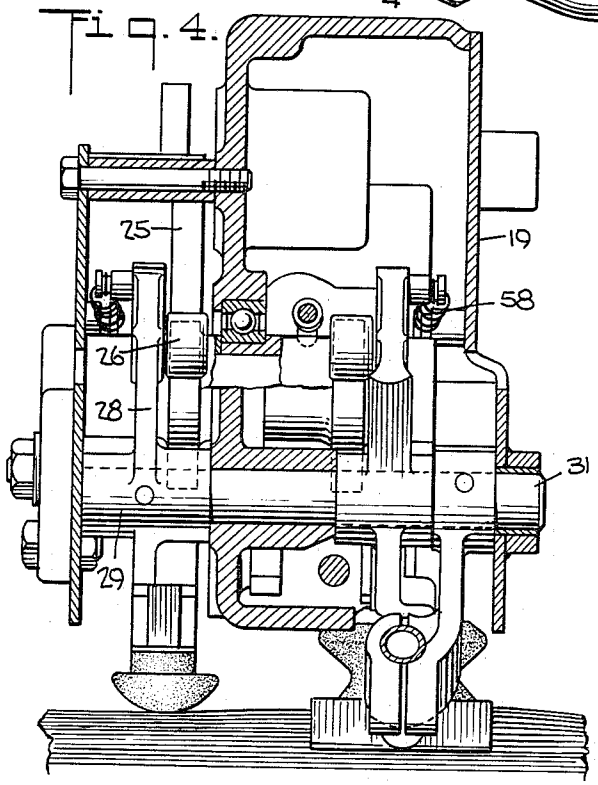


Fig. 4.



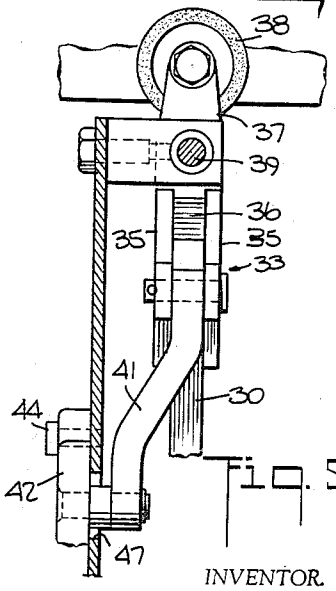


Fig. 5.

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SHEET FEEDING APPARATUS

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19 Claims. (Cl. 271—26)

This invention relates to a sheet handling apparatus for feeding sheets from a pile or supply of sheets to a printing press or other apparatus, and refers more particularly to a sheet feeding apparatus by which the topmost sheets of a pile or supply of sheets are separated and fed one at a time so that only single sheets are fed to the printing press.

One of the objects of the present invention is to provide an improved sheet feeding apparatus that will separate and feed single sheets of both paper and cardboard from a pile of sheets at a high rate of speed.

Another object is to provide an improved sheet feeding apparatus having cyclically operable means to separate the topmost sheet in a pile of sheets and means to engage each separated topmost sheet wherein the downward movement of said sheet separating means and said sheet engaging means is automatically compensated for pile height variations.

Another object is to provide an improved sheet feeding apparatus having a cyclically operable air blast means to separate the topmost sheet of a pile of sheets wherein the air blast means is automatically positioned at a predetermined position relative to the top of the pile of sheets regardless of the variations in the level of the top of said pile.

Anoher object is to provide an improved sheet feeding apparatus of the suction type wherein for each cycle of operation the air blast means is positioned at a predetermined lowermost position relative to the top of the pile of the sheets regardless of the variations in the level of the top of said pile and the suction sheet engaging means is automatically positioned a predetermined distance above said air blast means.

Another object is to provide an improved sheet feeding apparatus having cyclically operable means to separate the topmost sheet in a pile of sheets, means to engage each separated sheet and means for adjusting the amount of downward movement of said sheet separating and sheet engaging means.

Another object is to provide an improved sheet feeding apparatus having cyclically operable means to separate the topmost sheet in a pile of sheets and cyclically operated means to engage each separated sheet wherein the predetermined lowermost position of the sheet separating means relative to the top of the pile of sheets and the predetermined lowermost position of the sheet engaging means relative to the top of the pile of sheets and to the sheet separating means are constant regardless of the variations in the level of the top of said pile.

A still further object is to provide an improved sheet feeding apparatus having sequentially downwardly operated sheet separating means and sheet engaging means and simultaneously upwardly operated sheet separating and sheet engaging means.

The above and further objects and novel features of the present invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only, and are not intended as a definition of the limits of the invention.

In the drawings, wherein like reference characters refer to like parts throughout the several views,

FIG. 1 is a fragmentary rear elevational view of a sheet feeder embodying the present invention;

FIG. 2 is an enlarged side elevational view, partly in section, of one of the sheet separator mechanisms taken along line 2—2 of FIG. 1 and showing the feeler mechanism;

FIG. 3 is an enlarged side elevational view, partly in section, of one of the sheet separator mechanisms, taken along line 3—3 of FIG. 1 and showing the air blast and suction sheet lifting mechanisms;

FIG. 4 is an enlarged rear elevational view of the improved sheet separator mechanism; and

FIG. 5 is an enlarged fragmentary top plan view taken along line 5—5 of FIG. 2 showing the operating mechanism for the pile height feeler means.

Referring to the drawings, **10** and **11** of FIG. 1 indicate in rear elevation the side frames of an existing sheet feeder which includes a pile elevator comprising front and rear cross beams **12** adapted to support a pile board **13** and a pile of sheets **14** thereon. The cross beams **12** are supported by side bars **15** which are connected adjacent their front and rear ends to cables **16** that pass over suitable sheaves and around suitable winding drums (not shown) for raising and lowering the pile. Since the pile elevator which carries the pile of sheets **14** is of a well-known construction and operation, further description thereof is considered unnecessary except to say that as the sheets are fed from the top of the pile the elevator is automatically raised step-by-step by the described drums to maintain the top of said pile at a predetermined elevation and thus insure continued and accurate separation and feeding of the sheets from the top of the pile.

The sheets of pile **14** are lifted from said pile one after another along the rear edge at spaced apart positions thereof by a sheet lifting mechanism of the suction type. The sheet lifting mechanism has incorporated therein air blast devices which function to raise or fluff up the rear edge of the sheet, whereby said sheets become separated one from another in a progressive manner, with the maximum amount of separation being between the topmost sheet and the next underlying sheet.

After preliminary separation of the uppermost sheets, and particularly the topmost sheet, has been effected along the rear edge thereof, the topmost sheet is lifted from the rear of the pile **14** and thus further separated from said pile by sheet separator mechanisms of substantially the same construction and operation as those disclosed in U.S. Patent No. 2,850,279. These sheet separator mechanisms are of the type wherein as soon as the sucker strikes the sheet of paper it collapses thus quickly drawing the sheet a still further distance away from the adjacent sheet on the top of the pile. The suction type sheet separator may also be of the type shown in U.S. Patent No. 2,799,499 wherein the suction head descends until it contacts the sheet which seals the opening in the sucker and the suction head is raised. Alternatively the separator mechanism may be a combination of both of the above described combinations. The sheet separator mechanisms comprising this invention are indicated generally at **17** and **18** (FIG. 1) and are constructed one left-hand and the other right-hand and are each arranged at opposite sides of the feeder. Since the construction of said mechanisms are otherwise identical, a description of one will be sufficient for an understanding of both.

As shown in FIGS. 2 and 3, each sheet separator mechanism comprises a housing **19** slidably mounted on a pair of tubular shafts **20** and secured by a clamp screw **21** to one of said shafts in various positions of adjustment along said shafts. Movement of each housing **19** along the shafts **20** provides for adjustment of the sheet separator mechanisms **17** and **18** independently of each other transversely of the feeder to accommodate sheets of dif-

ferent widths. The shafts 20 are suitably secured at their opposite ends in brackets 22 which are in turn slidably mounted on the side frames 10 and 11 to enable adjustment of the sheet separator mechanisms 17 and 18 as a unit longitudinally of the feeder to accommodate sheets of different lengths.

Extending transversely of the feeder and through the housings 19 is a cam shaft 23 which is driven in any suitable manner from the printing press or any other suitable source of power to make one revolution for each cycle of operation of the feeder. Keyed to the cam shaft 23 and disposed within the housing 19 of each sheet separator mechanism is a feeler cam 25 which engages a roller 26 journalled at 27 on the upwardly projecting arm 28 of a bell crank lever 29 which has a forwardly extending arm 30. The bell crank lever 29 is keyed to a shaft 31 which extends through the housing 19 and has its ends mounted in suitable bearings in said housing. Shaft 31 is rotated in response to the movement of bell crank 29. The roller 26 is continuously biased toward the cam 25 by a coil extension spring 32 having one end connected to the arm 28 and the other end secured to the housing 19. Mounted to the outer end of arm 30 are a pair of spaced apart bell cranks 33 each having arms 34 and 35. The bell cranks 33 are pivotally mounted to the end of arm 30 by suitable pin means. A link 36 is pivotally connected at one end between arms 35 of bell cranks 33 by suitable pin means. The lower end of link 36 is pivotally connected to a feeler plate 37. The feeler 38 is threadedly secured to the other end of the plate 37. A guide rod 39 is secured at one end to the plate 37 and its other end is slidably retained in a guide 40 which is fixed to the housing 19. The guide rod 39 and the guide 40 enable the feeler to maintain a substantially vertical path of movement in relation to the pile of sheets upon movement of the bell crank 29. A horizontally extending link 41 is pivotally connected at one end between the arms 34 of bell cranks 33. The opposite end of link 41 is pivotally connected to a plate 42 by means of a stud 43. The plate 42 is pivotally mounted at 44 to the outer surface of the housing 19. The other end of plate 42 has an arcuately shaped slot 45. A nut and bolt arrangement 46 is positioned in the slot 45 and threadedly engages the housing 19 whereby plate 42 is secured to the housing in any desired angular position. An opening 47 in the housing 19 permits the free passage of stud 43. Since the pivot point 44 of the plate 42 is offset from the pivot point 43 for the link 41, the up and down movement of the plate 42 will permit adjustment of the position of the feeler 38 in relation to the blow pipe nozzle hereinafter described. As shown in FIG. 5 the rear portion of the link 41 is offset toward the housing 19 in order to accommodate the movement of arm 30 of the bell crank 29.

Secured to one end of the shaft 31 is the blow pipe housing 50 and a blow pipe nozzle 51. Since the nozzle 51 is secured to the shaft 31 it will pivot with shaft 31 in response to the movement of the feeler 38. Thus the nozzle 51 will move cyclically with feeler 38 and always come to rest in its lowermost position at a predetermined vertical position relative to the plane of the top of the pile of sheets regardless of the variations in the height of the pile of sheets. Additionally, there is obtained a much more uniform preliminary separation of the topmost sheets in the pile by having the blow pipe nozzle moving into and out of position with each feed cycle.

Disposed within housing 19 and positioned adjacent the blow pipe housing is a sucker cam 52 keyed to the cam shaft 23. A roller 53 is journalled at 54 on the upwardly projecting arm 55 of a bell crank lever 56. The bell crank lever 56 has a forwardly extending arm 57. Bell crank 56 is mounted for free pivotal movement about shaft 31. Roller 53 is continuously biased toward the cam 52 by a coil extension spring 58 having one end connected to the end of arms 55 and the other end secured to the housing 19. The suckers 60 of each of the sheet separator mechanisms 17, 18 are mounted for horizontal rotational movement away from each other to effect a stretching of the engaged sheet such as is shown in U.S. Patent No. 2,389,480. As shown in FIG. 3, sucker 60 is mounted in one end of a frame 61. The other end of frame 61 is mounted for free rotational movement about the lower end of a guide rod 62. A conventional nut threadedly engages the lower end of the guide rod 62 and holds the frame 61 in position on said rod. A block 64 is fixedly secured to the guide rod 62 and serves as a means of lifting the guide rod and the sucker 60 as well as confining the frame 61 on the rod 62. A link 65 pivotally connects one end of the block 64 with the outer end of the arm 57 of bell crank 56. The upper end of guide rod 62 is slidably received in the guide 66. Thus as the arm 57 of the bell crank 56 is moved up and down the sucker 60 is moved in a substantially vertical path as determined by the position of guide rod 62 and guide 66. In addition to the vertical movement of the sucker 60 it is desirable to move the sucker in an arcuate horizontal path simultaneous with the vertical movement to effect the above-mentioned stretching of the lifted sheet. As shown in FIG. 1, the sucker associated with feeding mechanism 17 would rotate in a counterclockwise direction about guide rod 62 in the horizontal plane and the sucker associated with the feeding mechanism 18 would move in a clockwise direction about its guide rod in the horizontal plane. This would effect the stretching of the rear edge of the sheet simultaneously with the lifting of the sheet. In order to produce the horizontal arcuate movement of each sucker there is provided a roller 70 rotatably secured on the inside surface of the frame 61. Roller 70 rides along the cam surface 71 as the sucker is raised from its lowermost position to its highest position. The cam 71 is pivotally mounted to the housing 19 at 72. A rod 73 is secured to one end to the upper end of the cam 71 and its other end extends outwardly through a suitable opening in housing 19. A collar 74 is secured to rod 73. An adjustment nut 75 is threadedly secured to the outer end of rod 73. A spring 76 is telescopically compressed over the rod 73 between the housing 19 and the collar 74 whereby the cam 71 is constantly maintained in a predetermined position as set by the adjustment nut 75. The roller 70 is continuously biased toward the cam 71 by means of a coil extension spring 77 having one end secured to one end of the frame 61 and the other end secured to a rod 78. Rod 78 extends outwardly through the housing 19 and has an adjustment nut 79 threadedly engaged thereto whereby the tension on spring 77 may be adjusted. A bolt 80 is threadedly engaged in a bracket 81 which is secured to one side of arm 57 of the sucker bell crank 56. Bolt 80 is in vertical alignment with a horizontal ledge 82 on the blow pipe housing 50. Consequently as the bell crank arm 57 is rotated downwardly the bolt 80 will engage the ledge 82 and stop such downward movement of sucker 60 at a predetermined position relative to the blow pipe. Bolt 80 can be threaded into and out of the bracket 81 to determine the proper distance that the sucker 60 will be stopped above the blow pipe nozzle 51. Any conventional compressor supplies compressed air to the blow nozzle through suitable tubing or piping (not shown) and any conventional vacuum pump supplies vacuum to the suckers through suitable tubing or piping (not shown). The distribution and timing of the compressed air and vacuum is effective through a suitable valve structure such as that shown and described in U.S. Patent No. 2,898,937.

In operation the feeler 38 descends under control of cam 25 until it comes to rest on the rear edge of the top of the pile of sheets. The descent of the feeler is so timed that the rear edge of the preceding fed sheet has been moved away from the rear edge of the pile so that the descending feeler does not contact it. Since the operating mechanisms for the feeler and for the blow pipe nozzle are keyed to the same shaft 31 both descend simul-

taneously. Through the timing and operating valve structure (not shown) compressed air is discharged through the blow pipe nozzle as it descends and after it has reached its predetermined level relative to the top of the pile of sheets as regulated by the descent of the feeler. The feeler is spaced horizontally from the blow pipe nozzle, as shown in FIG. 4, so that it does not interfere with the efficient preliminary separation of the topmost sheet. The sucker **60** is timed to start its descent under control of cam **52** after the blow pipe nozzle starts its descent and it continues downward under the control of cam **52** until bolt **80** engages ledge **82** on the blow pipe housing **50**. In such position the sucker is always stopped a predetermined vertical distance above the blow pipe nozzle and since, for each cycle of operation, the blow pipe nozzle always stops at a predetermined position relative to the top of the pile regardless of variations in the height of the pile, efficient single sheet feeding is assured through a wide range of pile height. Sucker **60**, the blow pipe nozzle **51**, and feeler **38** are simultaneously carried upward by the movement of the blow pipe nozzle housing **50** which is operated by the feeler cam **25** through bell crank **29** and shaft **31**. Sucker cam **52** continues its normal operation and controls the sucker's downward movement on the next cycle of operation.

While only a single embodiment of the invention has been illustrated in the accompanying drawings and described in the foregoing specification, it is to be expressly understood that said invention is not limited to said embodiment, and that various changes may be made therein without departing from the spirit and scope of the invention, as will now be clear to those skilled in the art.

What is claimed is:

1. In a sheet feeder, a sheet lifting means arranged above a supply of sheets and movable downwardly toward and upwardly away from said sheet supply to grip the topmost sheet and lift at least a portion of said sheet from said sheet supply, a mechanism for periodically operating said sheet lifting means downwardly and upwardly, sheet separating means positioned adjacent said sheet supply, a mechanism for periodically operating said separating means toward and away from one edge of said sheet supply, means for determining the location of the top of said sheet supply, means operable by said last named means for actuating said separating means operating mechanism and for limiting movement thereof toward said supply to a predetermined position in relation to the top of said sheet supply, and means for engaging said separating means operating mechanism in its lowermost position with said lifting means operating mechanism upon the downward movement of said lifting means whereby the downward movement of said lifting means is limited to a predetermined position above the separated topmost sheet of said supply relative to the separating means.

2. In a sheet feeder as defined in claim **1** wherein said sheet separating means and said sheet lifting means are operable in timed relation to each other and said separating means is timed to begin movement toward said supply before said sheet lifting means, and said operating mechanisms are operable to raise said lifting means simultaneously with the raising of said separating means.

3. In a sheet feeder as defined in claim **1** wherein said means for engaging said separating means operating mechanism with said sheet lifting means operating mechanism comprises adjustable means to selectively predetermine the distance between the lowermost position of said lifting means and the lowermost position of said separating means.

4. In a sheet feeder the combination of means to detect the vertical position of the top of a pile of sheets, means to move said detecting means into and out of contact with the topmost sheet of said pile, means for separating the topmost sheet from the rest of the pile, means responsive to the movement of said detecting means for moving said separating means from a position above said pile to a predetermined position relative to the topmost sheet on said pile and adjacent an edge of said pile, a sheet lifting means positioned above said pile, means for moving said lifting means toward and away from said pile and timed relative to the movement of said separating means to cause said lifting means to start to move toward said pile after said separating means starts its movement toward said pile, and means on said separating means to stop the downward movement of said lifting means and to move said lifting means upwardly simultaneously with the upward movement of said separating means.

5. In a sheet feeder as defined in claim **4** wherein said sheet separating means comprises a blow nozzle, a source of compressed air for said blow nozzle, and means to connect said compressed air source with said blow nozzle when said nozzle starts its downward movement.

6. In a sheet feeder, the combination of means to detect the position of the top of a pile of sheets to be fed, means to move said detecting means in an operative stroke into and out of contact with the topmost sheet of said pile, means for separating the topmost sheet from the rest of said pile, means responsive to the movement of said detecting means for moving said separating means from a position above said pile to a predetermined position relative to the topmost sheet on said pile and adjacent an edge of said pile, sheet lifting means positioned above said pile, means for moving said lifting means toward and away from said pile and timed relative to the operation of said separating means to cause said lifting means to start to move toward said pile after said separating means starts its movement toward said pile, means on the separating means to stop the downward movement of said lifting means and to move said lifting means upwardly simultaneously with the upward movement of said separating means, and means for adjusting said detecting means relative to said means for moving the same comprising a movable arm for moving said detecting means toward and away from the top of said pile, a bell crank pivotally secured to one end of said arm, said detecting means being pivotally connected to said bell crank, and means to pivotally move said bell crank about the end of said arm.

7. In a sheet feeder as defined in claim **6**, means to confine the movement of said detecting means to a substantially vertical path of movement relative to the top of said pile.

8. In a sheet feeder as defined in claim **7**, means for confining the up and down movement of said sheet lifting means to a straight line path of movement above the top of the pile.

9. In apparatus for feeding sheets from the top of a pile of sheets, means for detecting the position of the top of the pile comprising feeler means engageable with the top of the pile, means for guiding movement of said feeler means toward and away from said pile, and means for reciprocating said feeler means including a pivoted lever, a bell crank pivotally mounted adjacent the free end of said lever, a link pivotally connected at one end to said feeler means and at its other end to one arm of said bell crank, a second link pivotally mounted at one end and pivotally connected at its other end to the other arm of said bell crank, resilient means biasing said lever in one direction to move said feeler means downwardly toward the pile and means for actuating said lever in the other direction to lift the feeler means away from the pile and for controlling the downward movement of the feeler means by said resilient means.

10. Apparatus for feeding sheets as defined in claim **9**, wherein said lever is a bell crank lever and said means for actuating the lever comprises a rotatable cam engageable with an arm of the lever.

11. Apparatus for feeding sheets as defined in claim **9**, comprising means for adjusting the position of said second link relative to said lever to thereby adjust the verti-

cal position of said feeler means without interrupting the operation of the apparatus.

12. Apparatus for feeding sheets as defined in claim 11, wherein said means for adjusting comprises a pivoted element pivotally supporting said one end of the second link eccentrically of the pivotal axis of said element, and means for releasably securing said element in adjusted position.

13. Apparatus for feeding sheets as defined in claim 9, comprising means for adjusting the pivotal axis for said one end of the second link relative to the pivotal axis of the lever to thereby adjust the position of the feeler means relative to the free end of said lever.

14. In apparatus for feeding sheets from the top of a pile of sheets, means including a blow pipe nozzle adjacent a side of the pile for separating an edge portion of the topmost sheet from the pile, said nozzle being movable generally upwardly and downwardly across the plane of the top of the pile, feeler means engageable with the top of the pile for limiting downward movement of said nozzle into lapped relation with said pile and relative to the top of the pile, a suction sheet pick-up means movable generally upwardly and downwardly above the pile for picking up and lifting the topmost sheet from the pile, means for limiting the downward movement of said pick-up means relative to the blow pipe nozzle, means for periodically moving said nozzle downwardly, means for periodically moving said pick-up means downwardly in retarded timed relation to the downward movement of said nozzle, and means for periodically simultaneously moving said nozzle and pick-up means upwardly in unison.

15. Apparatus for feeding sheets as defined in claim 14, wherein the means for moving said nozzle downwardly comprises resilient means and the means for moving said nozzle upwardly comprises rotatable cam means, the latter being operable to control downward movement of the nozzle by said resilient means.

16. Apparatus for feeding sheets as defined in claim 15, wherein said cam means are operable also to move said sheet pick-up means upwardly.

17. Apparatus for feeding sheets as defined in claim 14, wherein the means for moving said sheet pick-up means downwardly comprises resilient means and rotatable cam means for controlling downward movement of said pick-up means by said resilient means.

18. Apparatus for feeding sheets as defined in claim 14, wherein the feeler means and the blow pipe nozzle are movable upwardly and downwardly in unison by common means.

19. Apparatus for feeding sheets as defined in claim 14, wherein said feeler means are movable upwardly and downwardly by the means for moving said nozzle, and comprising guide means for limiting said feeler means to straight line movement, and guide means for limiting the up and down movement of said pick-up means to straight line movement.

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