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Grobman

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[54] **SHEET FEEDING APPARATUS**

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[52] **U.S. Cl.** .....**271/44 A**

[51] **Int. Cl.** **B65h 1/06**

[58] **Field of Search**.....271/44 A, 32

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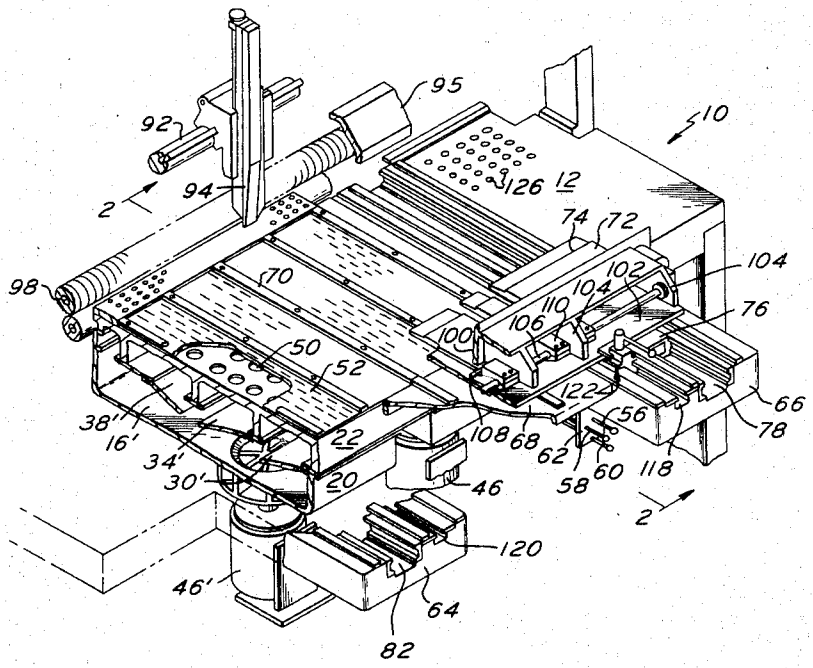
[57] **ABSTRACT**

Sheet feeding apparatus of the bottom feed type is disclosed. Stationary vacuum chambers are used to flatten out the sheets prior to feeding. Some of the vacuum chambers are provided with valve means to control the pressure effect on the juxtaposed portion of the sheet.

22 Claims, 7 Drawing Figures



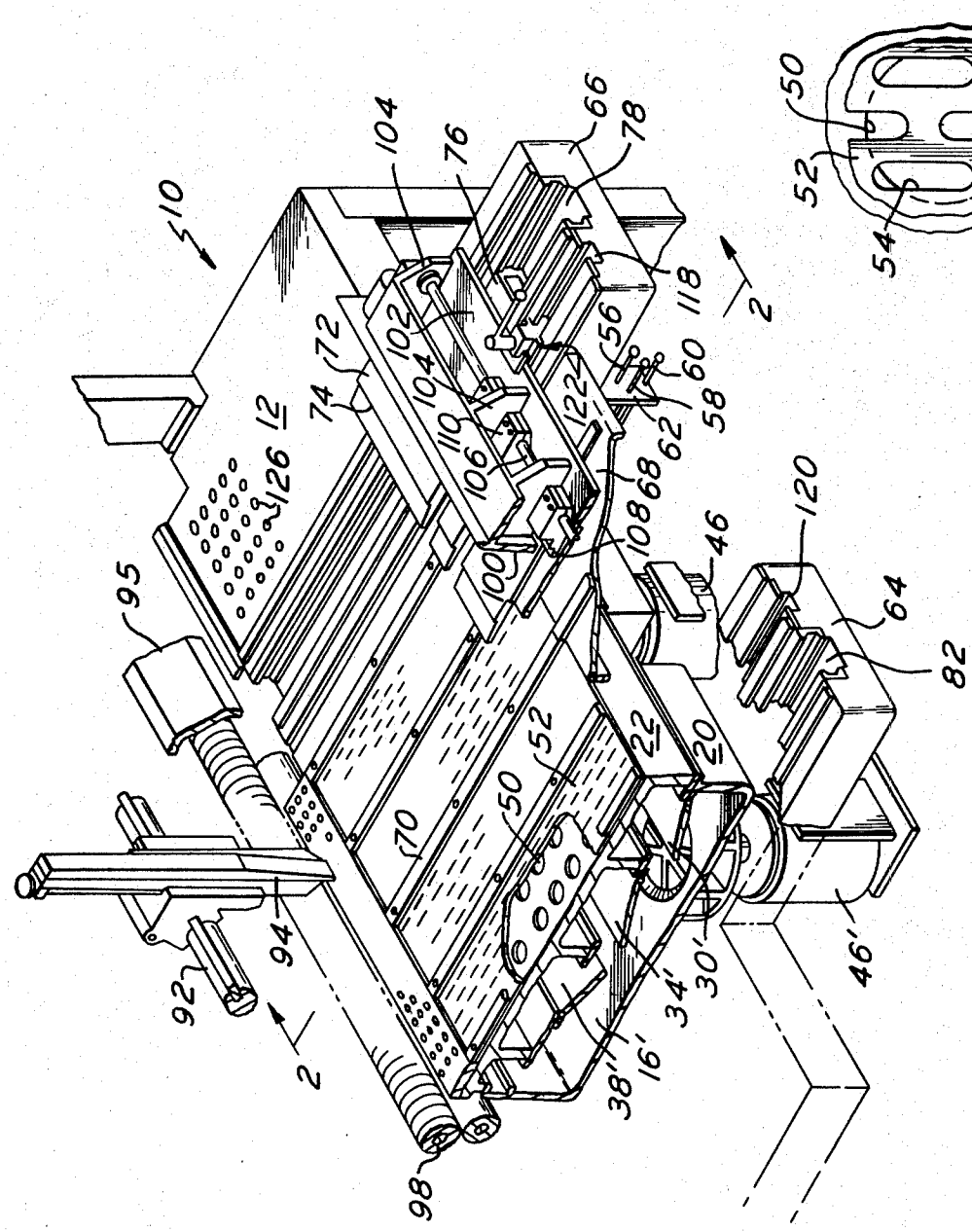


FIG. 1

FIG. 6

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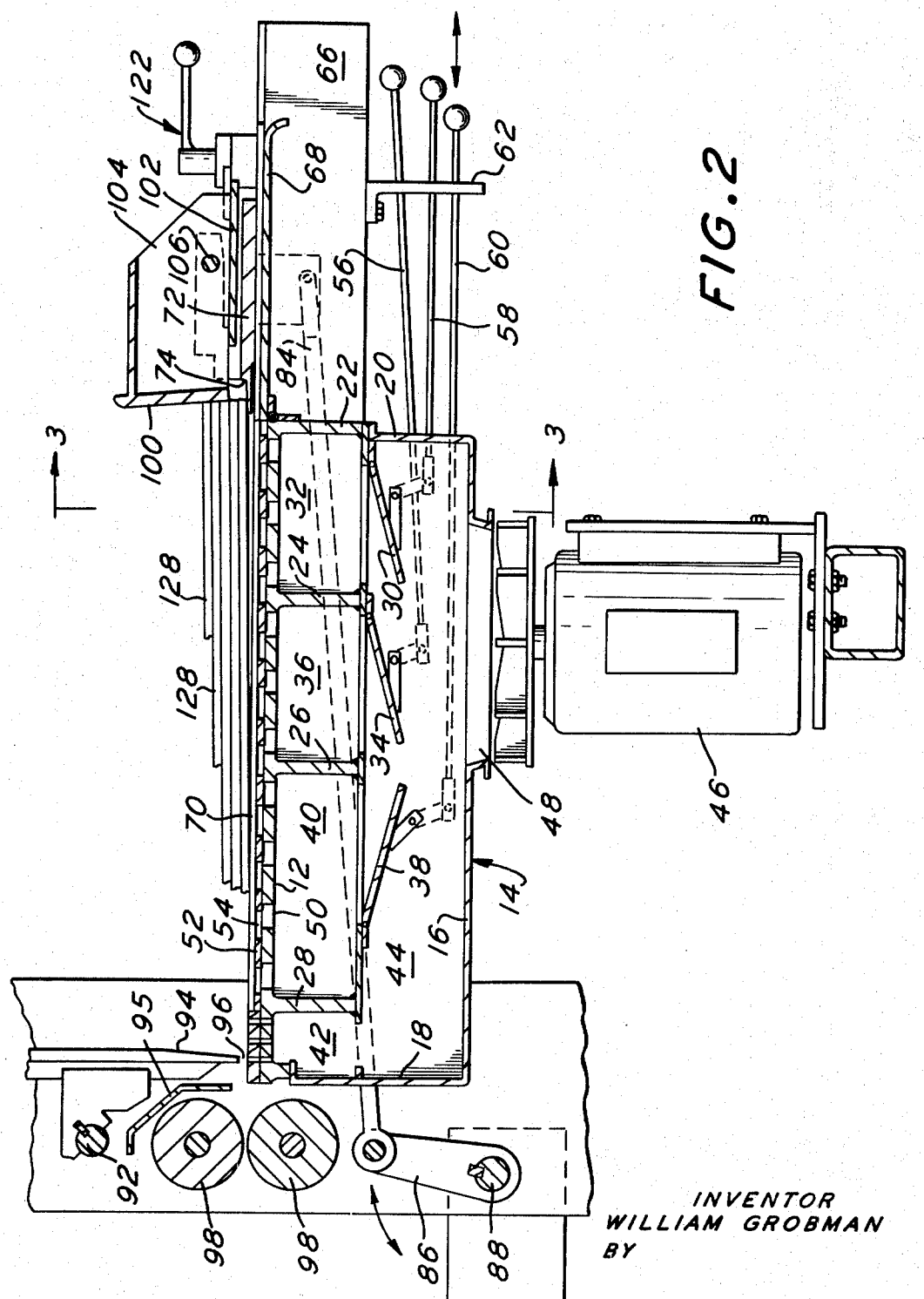

FIG. 2

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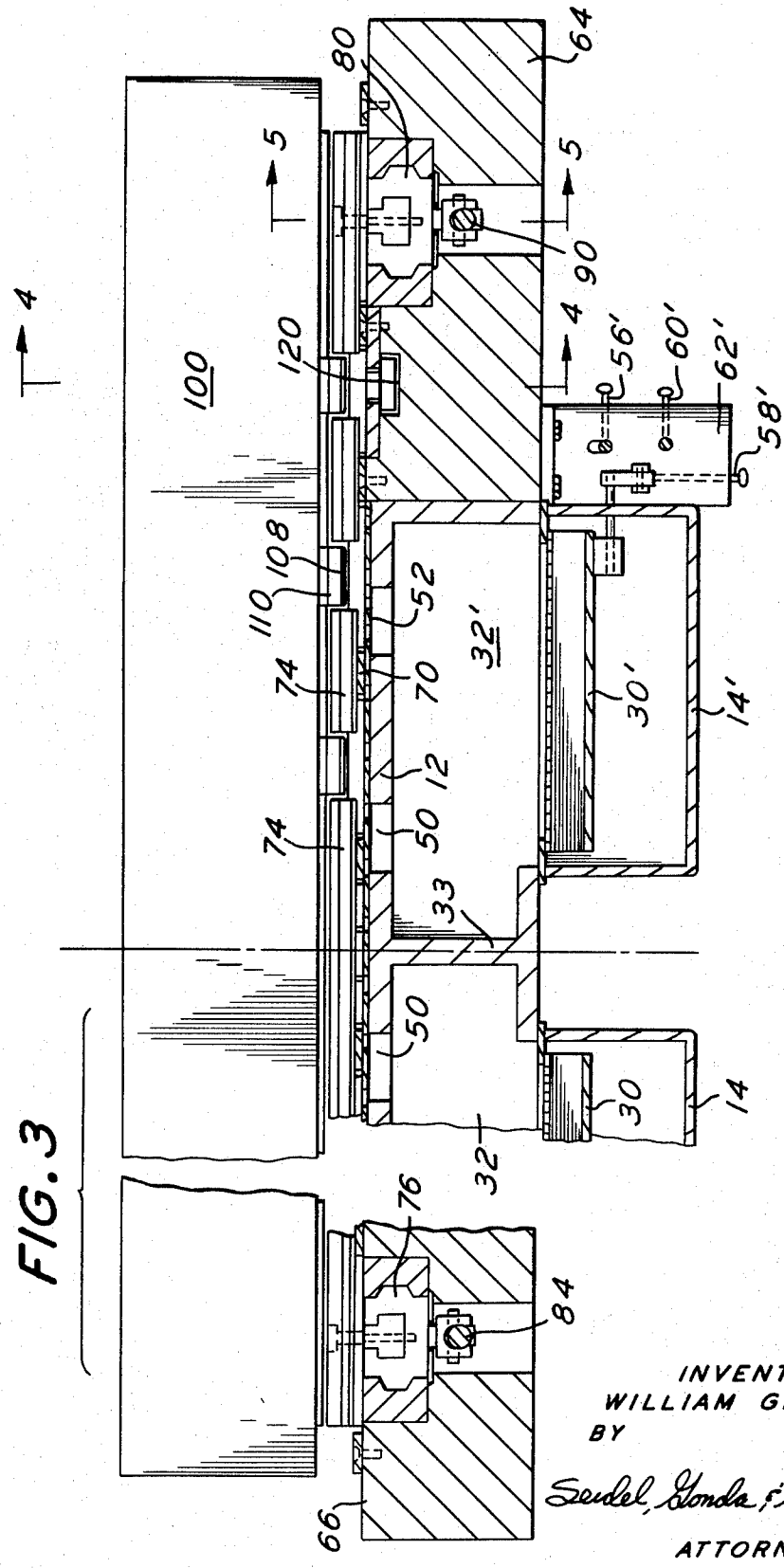

FIG. 3

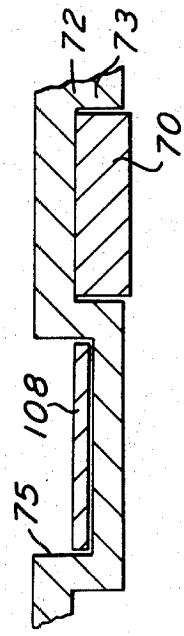

FIG. 7

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FIG. 4

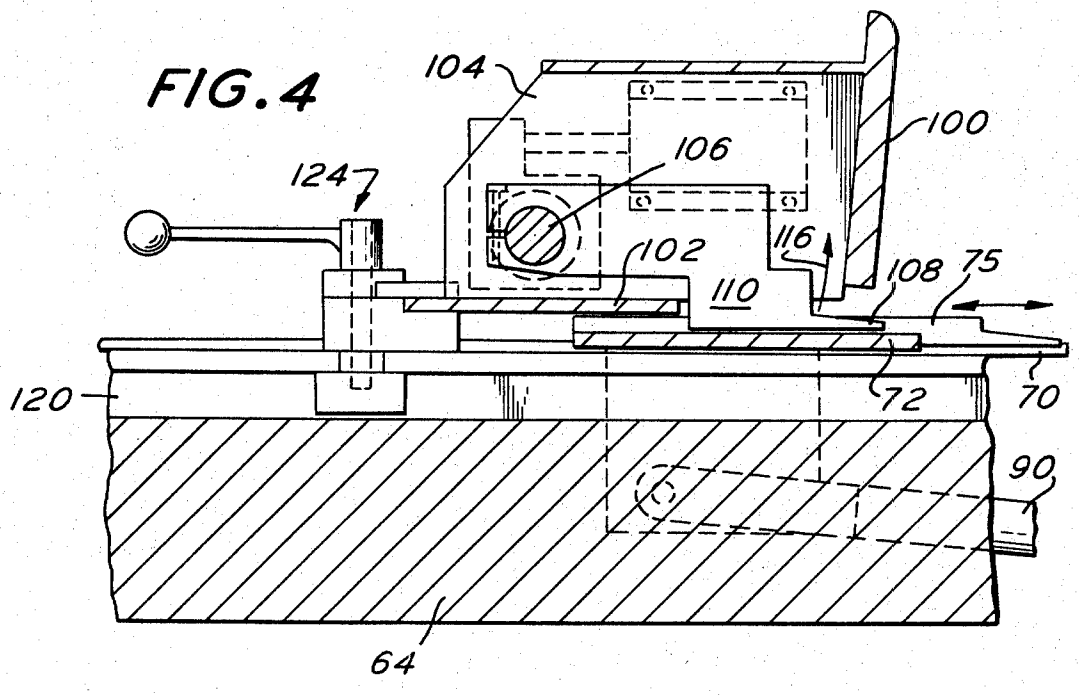
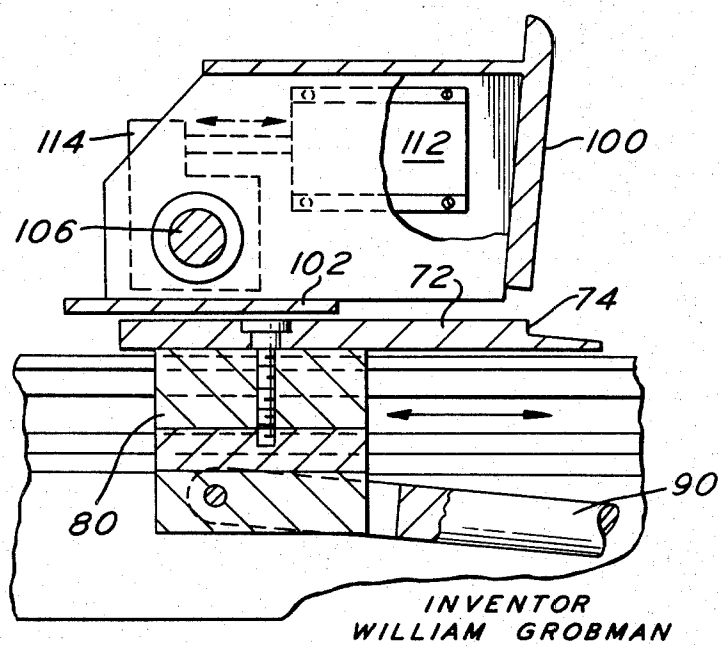


FIG. 5



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SHEET FEEDING APPARATUS

The present invention is directed to apparatus for feeding sheets such as sheets of corrugated paperboard. The paperboard sheets may be in a hopper and are adapted to be fed to a machine such as a printer-slotter. The stack of sheets in the hopper rests on a table. The lowermost sheet is fed on support strips by means of a kicker plate which contacts one end of the sheet.

A stack of sheets to be fed is supported by the stationary table. Vacuum chambers are provided below the table. The table is provided with air holes communicating with the vacuum chambers. At least some of the vacuum chambers selectively communicate with a manifold chamber which in turn is connected to a pump means for evacuating the manifold chamber. The ability to control or vary the pressure in one chamber with respect to another has the advantage of tailoring the vacuum effect to the particular size of the sheet being processed and to a particular zone of a warped sheet.

The vacuum chambers are utilized to flatten out the sheet against support strips on the table. The support strips minimize frictional contact with the sheets so that the flattened sheet may be fed notwithstanding that it is the bottommost sheet of the stack.

While vacuum type feeders have been proposed heretofore, they have primarily been of the movable type. In the present invention, the vacuum chambers and the table are stationary. This minimizes the need to move large masses, simplifies construction and maintenance, and permits large sheets to be fed with minimum friction by means of support strips.

The use of a plurality of vacuum chambers provides the advantage of flattening out the leading and trailing edges of the sheet. The primary purpose of tailoring the use of only certain vacuum chambers depending upon the size of the sheet being run is to prevent damage to the trailing edge at maximum feeding speed.

An unexpected result of the present invention is the minimum down-time required for maintenance. When a conventional sheet feeder is used with a printer-slotter, in actual practice the entire apparatus must be stopped periodically to clean dust that collects on the printing dies. The present invention, due to the vacuum effect, cleanses the surrounding air so that a lesser amount of dust collects on the printing dies, whereby the apparatus may be run for approximately twice the production time associated with previous equipment before cleaning is necessary.

It is an object of the present invention to provide a feeder apparatus of the vacuum type which can feed warped sheets.

It is another object of the present invention to provide a feeder apparatus of the vacuum type which can feed sheets with minimum friction.

It is another object of the present invention to provide a feeder apparatus of the vacuum type which permits the vacuum effect in various zones to be selectively varied depending on sheet size.

It is another object of the present invention to provide a feeder apparatus having a novel kicker plate which is supported on its bottom by support strips on the feed table and is notched on its top to receive feed interrupter tabs.

It is another object of the present invention to provide a feeder apparatus which permits associated equipment to be run for longer periods of time without stopping for cleaning and maintenance.

Other objects will appear hereinafter.

For the purpose of illustrating the invention, there is shown in the drawings a form which is presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIG. **1** is a partial perspective view of apparatus in accordance with the present invention.

FIG. **2** is a sectional view taken along the line **2—2** in FIG. **1**.

FIG. **3** is a sectional view taken along the line **3—3** in FIG. **2**.

FIG. **4** is a sectional view taken along the line **4—4** in FIG. **3**.

FIG. **5** is a sectional view taken along the line **5—5** in FIG. **3**.

FIG. **6** is a plan view of a small portion of the table on an enlarged scale.

FIG. **7** is a sectional view of a small portion of the kicker plate on an enlarged scale showing the relationship with the support strips and tabs.

Referring to the drawing in detail, wherein like numerals indicate like elements, there is shown in FIG. **1** a partial perspective view of the sheet feeding apparatus in accordance with the present invention designated generally as **10**. The apparatus **10** includes a table **12** cooperating with a housing **14** therebelow. The housing **14** includes a bottom wall **16**, a front wall **18** and a rear wall **20**. Housing **14** also includes side walls.

The table **12** is provided with depending flanges **22**, **24**, **26**, and **28** as shown more clearly in FIG. **2**. Flange **22** coincides generally with the rear wall **20**. Housing **14** is secured to table **12** at flanges **22** and **28**.

A valve member **30** is pivotably secured to a ledge on flange **22** and cooperates with the flanges **22** and **24** to define a chamber **32**. A valve member **34** is pivotably connected to the flange **24** and cooperates with flanges **24** and **26** to define a chamber **36**. Chamber **36** is parallel to chamber **32**.

A valve member **38** is pivotably secured to a horizontal platform extending from flange **28**. Valve member **38** cooperates with the flanges **26** and **28** to define a chamber **40**. Flange **28** cooperates with the front wall **18** on the housing **14** to define a chamber **42**. Table **12** defines the top of each of the chambers **32, 36, 40, 42**.

A manifold chamber **44** is provided in the housing **14** beneath each of the chambers **32, 36, 40** and **42**. Chamber **42** is always in open communication with the manifold chamber **44**. Chambers **32, 36** and **40** are selectively communicating with the manifold chamber **44** whereby the pressure in chambers **32, 36** and **40** may be varied with respect to the pressure in any of the chambers.

A means is provided for creating a negative air pressure in each of the above-mentioned chambers. Such means is preferably supported below the housing **14** and is an integral part of the apparatus **10** rather than being an accessory which must be separately attached during installation. The suction means is identified as **46** and is preferably a motor-operated blower communicating with manifold chamber **44** by way of opening **48** in the bottom wall **16**.

The table 12 is provided with a plurality of holes 50 communicating with each of the chambers. A perforated screen 52 overlies the table 12. Screen 52 is provided with a plurality of elongated perforations 54 of smaller size than the hole 50 whereby a plurality of perforations 54 overlies each hole 50. See FIG. 6.

The holes 50 may have a diameter of three-fourths of an inch so as to provide for a large air flow-through passage into the chambers 32, 36, etc. The perforations 54 may have a length of approximately one-half inch and a width of one-eighth inch. In this manner, the perforations 54 are small enough so as to prevent an operator from inserting his finger into one of the holes 50. In this regard, the screen 52 performs a safety function.

Manipulation of the valve member 30 is selectively accomplished by means of a rod 58. Manipulation of valve member 34 is accomplished by means of a rod 56. Manipulation of valve member 38 is accomplished by means of a rod 60. These actuating rods extend through and are guided by a depending flange 62 on the lower surface of projection 66. The table includes projections 64 and 66 on opposite sides of a dropleaf 68. The dropleaf 68 is pivotably connected to the flange 22.

The table 12 is provided with two independent systems of chambers with suction means associated therewith. The structural interrelationship as shown in FIG. 2 appears on the righthand side of the table shown in FIG. 1. A completely independent but identical system is present on the lefthand side of FIG. 1 and partially shown in section. The lefthand system of chambers and valve members is identified with corresponding primed numerals.

Thus, the vacuum chambers are in the form of rows of transversely extending chambers. For example, chambers 32 and 32' are aligned with one another and extend transversely across the table 12 while being separated from each other by a web 33. The web 33 is centrally disposed along the table 12.

A plurality of parallel support strips 70 is removably secured to the table 12 overlying the perforated screen 52. Sheets to be fed will be supported by and be in frictional contact with the strips 70. The strips 70 minimize frictional contact with the sheets to be fed as compared with supporting the sheets on the perforated screen 52 or directly on the table 12. The sheets are fed along the upper surface of the strips 70 by means of a kicker plate 72. The kicker plate 72 has a pushing surface 74 which engages the trailing edge of the lowermost sheet of a stack of sheets and pushes it. The kicker plate 72 is mounted for reciprocation in the direction of the strips 70. Plate 72 is sometimes referred to in the trade as a feed plate and may be referred to as such hereinafter.

In order to accommodate the strips 70, the kicker plate 72 is provided with grooves or notches 73 on the bottom surface. Each of the support strips 70 extends into one of said grooves or notches. The kicker plate 72 is also provided with notches 75 on its top surface for a purpose to be made clear hereinafter. Thus, it should be apparent that the sheet engaging face 74 on the kicker plate 72 is a series of spaced contact surfaces lying in a plane immediately above the top surface of the strips 70.

The kicker plate 72 is guided for reciprocatory movement parallel to the strip 70 by means of guide bars 76 and 80. Guide bar 76 is disposed in a longitudinally extending slot 78. Guide bar 80 is disposed in a longitudinally extending slot 82. The slots 78 and 82 are disposed in both the main portion of the table and in that portion of the table which contains the projections 64 and 66.

Bar 76 has an adapter pivotably connected to one end of a connecting rod 84. The other end of connecting rod 84 is pivotably connected to a crank throw 86. See FIG. 2. Crank throw 86 is fixedly connected to shaft 88 for rotation therewith. Guide bar 80 has an adapter pivotably connected to one end of a connecting rod 90. The other end of connecting rod 90 is pivotably connected to a crank throw (not shown) which is fixedly secured to shaft 88. Shaft 88 may be oscillated in the manner as shown in U.S. Pat. No. 2,181,211 or in any other conventional manner so as to cause the kicker plate to reciprocate back and forth above the support strips 70.

The table 12 constitutes the bottom of a hopper. Removable side guide plates define portions of the hopper which are adjustable along support member 92. A pair of gates 94 is likewise adjustably supported along the length of member 92. The lower end of the gates 94 is spaced from the upper surface of a perforated plate at the front end of the table 12 to define a gap 96 which is sufficient to permit the feeding of one sheet at a time to the feed rolls 98 which feed the sheet to a printing roll of a printer-slotter, a die cutting roll of a die cutter, etc. The nip of the feed rolls 98 is horizontally aligned with the gap 96 and closely adjacent thereto so that the extent of feed of the lowermost sheet by the kicker plate 72 is a short distance. In order that the leading edge of the sheet be maintained flat, chamber 42 is always in communication with the manifold chamber 44. If the leading edge of the sheet is slightly warped upwardly, the suction effect from chamber 42 will maintain the leading edge of the sheet flat so that it may pass through the gap 96.

The rear end of the hopper is defined by the backstop 100. The backstop 100 is a generally upright plate which engages the rear end of a stack of sheets and has its lower edge spaced from the table by a distance corresponding to the thickness of several sheets.

The backstop 100 is supported on a base 102 by means of brackets 104 extending therebetween at spaced points therealong. A shaft 106 is supported by the brackets 104 for rotation about its longitudinal axis. Interrupter body structures 110 are secured to the shaft 106 at spaced points therealong. Each of the body structures 110 terminates at its free end in a thin tab 108 which is recessed in the notch 75 on the top surface of the kicker plate 72. The upper surface of the tab 108 lies in a plane which is slightly below the plane of the sheet engaging faces 74 on the kicker plate 72 whereby the tabs 108 lie in a plane which is slightly below the bottom surface on the lowermost sheet.

A means is provided for rotating the shaft 106 through a limited arc about its longitudinal axis. Such means may include a manual lever, a solenoid, etc. Such means in the illustrated preferred embodiment is a pneumatic cylinder 112 having its piston rod connected to a bell crank 114 which is connected to the shaft 106. Actuation of the cylinder 112 causes the

body structures **110** to rotate in the direction of arrow **116**, see FIG. **4**, lifting the sheets above the pusher face **74**.

The position of the backstop **100** may be selectively located where desired depending upon the size of the sheet to be fed. Adjustment of the backstop **100** toward and away from the gates **94** is preferably attained as follows. Guide slots **118** and **120** are also provided in that portion of the table **12** containing the projections **64** and **66**. A first manually operable friction lock **122** is connected to the base **102** and extends into the slot **118**. A similar manually operable friction lock **124** is connected to the base **102** and extends into the slot **120**. When these locks are turned to a released position, the backstop and components associated therewith may be manually moved forwardly or rearwardly to the desired position. Per se, the friction locks are old and need not be described in detail.

The drop leaf **68** is provided with support strips comparable to strips **70** and aligned therewith. Since the dropleaf **68** is imperforate, the dropleaf and the support strips will form a channel with the sheet to be fed through which air may flow to the holes **50** when the backstop **100** is positioned sufficiently far to the rear whereby the sheets will overlie a part of the dropleaf **68**. When small sheets are being run, the dropleaf may be pivoted downwardly so as to provide access space for the operator. At the forward end of the table **12**, and beyond the area containing the projections **64** and **66**, the table is provided with a plurality of holes **126** corresponding to the holes **50**. A discrete vacuum chamber is provided therebelow and either communicates with the chamber **44** or is provided with a separate suction means. The holes **126** are positioned so as to assure that the leading edge at the corner of long sheets will be maintained flat. The sheets to be fed are identified by the numeral **128** in FIG. **2**.

The apparatus **10** is utilized as follows:

The elements adjustably supported by member **92** will be manipulated so as to define the ends of a hopper as needed for a particular size sheet **128**. Gates **94** define the front end of the hopper. A backstop **100** will be adjusted so as to define the rear end of the hopper depending on the size of the sheets **128**. The plate **72** is adjusted with respect to the guide bars **76** and **80** so as to position the kicker plate **72** whereby its sheet engaging face **74** will be beneath or slightly to the rear of the backstop **100** and have a stroke sufficient to move the sheets into the nip between the feed rolls **98**.

Thereafter, the actuating rods **56**, **58**, and **60**, **56'**, **58'**, and **60'** are manipulated to properly position the various valve members **30**, **34**, etc. This will result in a tailoring of the suction effect as a function of a size of the sheet to be fed. For example, if the size of the sheets extends from flange **24** to the gate **94**, valve members **30** and **30'** will be manipulated to a closed disposition since they will be outside the peripheral contour of the sheets. If the length of the sheets is shorter than the distance between the holes **126** in each corner at the forward end of the table **12**, the suction means for the holes **126** or a valve member in a conduit between holes **126** and the adjacent manifold chamber **44** or **44'** will be moved to a closed or inoperative disposition. It is assumed that the gates **94** have been adjusted to a position whereby the gap **96** is slightly greater than the thickness of a single sheet.

If the sheets to be fed are particularly warped in a central portion thereof, the valve members **34** and **38** may be manipulated to a wider position to get maximum suction effect in chambers **36** and **40**. If the sheets are flat in the area of these chambers **36** and **40**, a minimal suction effect may be attained by manipulating valve members **38** and **42** in partially closed position.

Thereafter, the apparatus **10** may be started by appropriate switches to turn on the suction means **46**, **46'**, etc. and effect oscillation of shaft **88**. As the kicker plate **72** moves toward and away from the feed rolls **98**, the sheets **128** will be fed one at a time from the bottom of the stack. If at any time it is desired to skip feed, cylinder **112** will be actuated to cause the tabs **108** to lift up the rear end of the stack for a distance which is greater than the thickness of the kicker plate **72** whereby no sheet will be fed on that stroke or any subsequent strokes of the kicker plate **72** until the tabs are permitted to descend to their normal position as shown in FIG. **7** wherein the tabs are slightly below the upper edge of the support strips **70**. As the sheets are fed, they are supported by the strips **70** which define channels through which air may be sucked to the holes **50**.

Operation of the apparatus **10** has resulted in the substantial minimizing of the maintenance required on the equipment to which the sheets are fed. Thus, downtime for cleaning of printing plates or the like is substantially minimized and provides an unexpected advantage of the apparatus **10**. When the sheets **128** are of a sufficient size so that the backstop **100** must be moved rearwardly away from the feed rolls **98** to a position wherein the trailing edge of the sheets **128** overlies the dropleaf **68**, it has been found that the trailing edge is maintained flat against the support strips **70** even though there are no holes **50** in this area of the table. Air being sucked through the channel defined by the sheet **128** at the top, the dropleaf **68** at the bottom, and at the sides by support strips **70** unexpectedly maintains the trailing edge of the sheet flat against the support strips **70**.

As shown in the drawings, each notch **75** on plate **72** is aligned with a suction channel. Each suction channel is between adjacent strips **70**. Each notch **75** communicates with one of the suction channels by way of one of the interruptions in the pushing face **74**. As the lowermost sheet is being fed to the rolls **98** by the pushing face **74**, the trailing edge of the next sheet in the hopper is sucked downwardly by the vacuum in notches **75**. This has the advantage of using the next sheet as a means for preventing the trailing edge of the sheet being fed from moving upwardly away from the pushing face **74**.

Due to the fact that a vacuum effect is provided on the table **12** across the full length of the largest size sheet which can be fed. The gap at the nip guard **95** (see FIG. **2**) may be minimized for increased safety of workers. On commercially available equipment supplied heretofore, the lack of a suction effect across the full length of the sheets has required the gap at the nip guard **95** to be large enough to accommodate warped sheets which was too much for safety. The kicker plate **72** is preferably provided with wear buttons which contact the top surface of the support rails **70** to provide reliable and trouble free performance and to minimize replacement of the kicker plate. Since the interrupter

tabs **108** move with the backstop **100**, they may be effectively used on all size sheets. Due to the vacuum effect of the feed table of the present invention, high running speeds may be attained even with warped sheets. the vacuum hold-down effect also provides for better sheet register into the feed rolls **98**.

Each of the valve members **30**, **34**, etc. is biased downwardly by gravity and the suction effect in the manifold chambers. The downward bias on the valve members is opposed by a link pivoted to the side of the housing. The valve members rest on one end of the link while the other end of the link is pivoted to one end of the rods **56**, **58**, etc. See FIGS. **2** and **3**.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

I claim:

1. Apparatus for feeding generally flat sheets comprising a stationary table, a plurality of chambers below said table, said table having air holes communicating with said chambers, pump means communicating with said chambers for reducing the pressure in the chambers below atmospheric pressure, selectively operable means for varying the pressure in one of the chambers with respect to the pressure in another of the chambers, a hopper on said table, a reciprocal feed plate on the table for feeding a sheet from the bottom of a stack of sheets in the hopper, means for selectively lifting up one end of a stack in the hopper sufficiently high so that the feed plate cannot feed the lowermost sheet, and spaced stationary support strips on said table above said air holes, said strips defining channels therebetween which communicate with said air holes, notches on the bottom surface of said feed plate, each feed plate notch receiving and providing clearance for one of said support strips.

2. Apparatus in accordance with Claim **1** including a perforated screen on top of said table, the perforations in said screen being smaller than the holes in said table.

3. Apparatus in accordance with Claim **1** wherein said feed plate has notches on the top surface thereof, each notch being aligned with and communicating with one of said channels.

4. Apparatus in accordance with Claim **3** wherein said lifting means has interrupter tabs, each interrupter tab being disposed in one of said notches on the top surface of said feed plate in one position of the feed plate.

5. Apparatus in accordance with claim **1** including a manifold chamber, at least one of said vacuum chambers being in open communication with said manifold chamber, and said selectively operable means being a valve controlling communication with the manifold chamber.

6. Apparatus in accordance with claim **1** including a dropleaf pivoted on one end of said table, said dropleaf having support strips aligned with the support strips on said table, said dropleaf being imperforate between the support strips thereon so as to define an air channel through which air may flow to said holes.

7. Apparatus in accordance with claim **1** wherein said chambers are generally parallel and extend transverse with respect to the direction of movement of the feed plate.

8. Apparatus for feeding generally flat sheets comprising a stationary support table, a plurality of suction chambers below said table, said table having air holes communicating with said suction chambers, a reciprocating feed plate for feeding sheets across said table, a plurality of parallel guide strips on said table for supporting and contacting the bottom surface of sheets to be fed by the feed plate, said feed plate having a pushing surface immediately adjacent to and extending across a portion of the upper surface of said guide strips, adjacent ones of said support strips defining channels above the table and communicating with some of said air holes, and suction means communicating with said suction chambers for effecting a negative atmospheric pressure in said suction chambers and channels.

9. Apparatus in accordance with claim **8** wherein said feed plate is provided with notches on its bottom surface, each of said plate notches receiving one of said support strips, and said plurality of chambers extending transversely with respect to said support strips.

10. Apparatus in accordance with claim **8** including notches on the top surface of said feed plate, a lifting tab disposed within each notch on the top surface of said feed plate with the uppermost surface of the tab being below the uppermost surface of the feed plate, and means for selectively raising each tab above the uppermost surface of the feed plate.

11. Apparatus in accordance with claim **8** wherein said table is provided with two guide slots, said vacuum chambers being disposed between vertical planes containing said guide slots, a guide bar in each guide slot, means connecting each guide bar to said feed plate, and means for reciprocating said guide bars.

12. Apparatus in accordance with claim **8** wherein said suction chambers extend generally perpendicular to said support strips, a manifold chamber communication with each suction chamber, and selectively operable means for varying the extent of communication between some of said suction chambers and said manifold chamber.

13. Apparatus in accordance with claim **12** wherein the suction chamber which is the furthest from said plate is in open communication with said manifold chamber at all times.

14. Apparatus in accordance with claim **12** wherein two independent discrete sets of said chambers and associated suction means are provided below said table.

15. Apparatus in accordance with claim **8** including feed rolls for receiving sheets fed by said plate, said table having a zone adjacent said feed rolls containing a multiplicity of holes, a suction chamber therebelow, means for providing a lower atmospheric pressure in said last-mentioned chamber as compared with the pressure in said plurality of chambers so that the leading edge of the sheet being fed is subjected to a lower atmospheric pressure than the remaining portion of the sheet being fed.

16. Apparatus for feeding generally flat sheets comprising a stationary table, a plurality of chambers below said table, said table having air holes communicating with said chambers, pump means communicating with said chambers for reducing the pressure in the cham-

bers below atmospheric pressure, a perforated screen on top of said table, several of said perforations overlying each of said holes in the table, selectively operable means for varying the pressure in one of the chambers with respect to the pressure in another of the chambers, an reciprocable feed plate on the table for feeding sheets from the bottom of a stack of sheets on said table, and means for selectively lifting up one end of a stack on said table sufficiently high so that the plate cannot feed the lowermost sheet, support strips on said table, notches on the bottom of said plate, each plate notch receiving and providing clearance for one of said support strips, said plate having notches on the top surface thereof, said lifting means including interrupter tabs, each interrupter tab being disposed in one of said notches on the top surface of said plate, each tab lying within one of said notches on the top surface.

17. Apparatus for feeding generally flat sheets comprising a stationary support table, a plurality of spaced parallel support strips on said table for supporting and contacting the bottom surface of sheets to be fed, a reciprocating feed plate for feeding sheets across the upper surface of said strips, said feed plate having a pushing surface immediately adjacent to and extending across a portion of the upper surface of said strips, means mounting said feed plate for reciprocation in a direction parallel to said strips, and suction means communicating with the channels between adjacent strips for effecting a negative atmospheric pressure in the channels so that the sheet being fed by said feed plate is subjected to spaced zones of negative pressure parallel to the direction of feed.

18. Apparatus for feeding generally flat sheets of paperboard comprising a stationary support table, a plurality of parallel support strips on said table for supporting and contacting the bottom surface of sheets to be fed, a reciprocating feed plate for feeding sheets across the upper surface of said strips, said feed plate having a pushing surface immediately adjacent to and extending across a portion of the upper surface of said strips, means mounting said feed plate for reciprocation in a direction parallel to said strips, and suction means communicating with the channels between adjacent strips for effecting a negative atmospheric pressure in the channels.

19. Apparatus in accordance with claim **18** wherein the space between adjacent strips is greater than the height of the strips.

20. Apparatus in accordance with claim **18** including notches in said feed plate for receiving a lifting tab when the feed plate is in its rearmost position, said feed plate having an opening for communicating each notch with a channel therebelow, and each notch being aligned with one of said channels, whereby said negative pressure may hold the next sheet to be fed downwardly against the upper surface of the sheet being fed to effect positive engagement between said pushing surface and the sheet being fed.

21. Apparatus in accordance with claim **20** wherein said feed plate opening includes notches which extend through said pushing surface on the feed plate.

22. Apparatus in accordance with claim **18** including a pair of nip rollers extending transversely with respect to said strips, said feed plate having a stroke sufficient to feed a leading edge of a paperboard sheet into a nip of said rollers, the nip of said rollers being aligned with the upper surface on said strips, the upper surface of said table being below the nip of said rollers.

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