June 11, 1963 D. A. GLASER ETAL 3,093,371

BOTTOM FEED APPARATUS FOR SHEET HANDLING EQUIPMENT

Filed Oct. 30, 1961 3 Sheets-Sheet 1

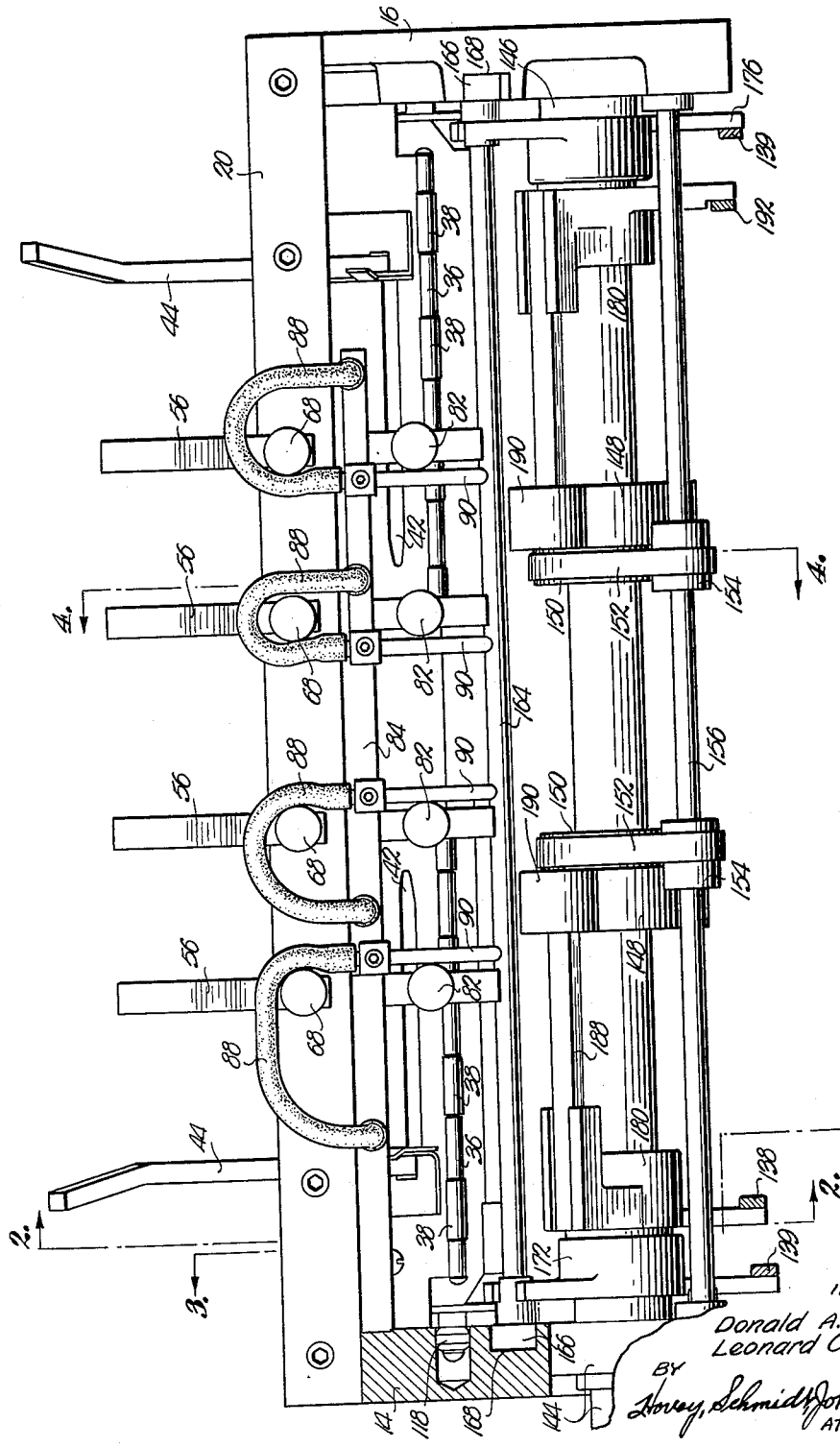


Fig. 1.

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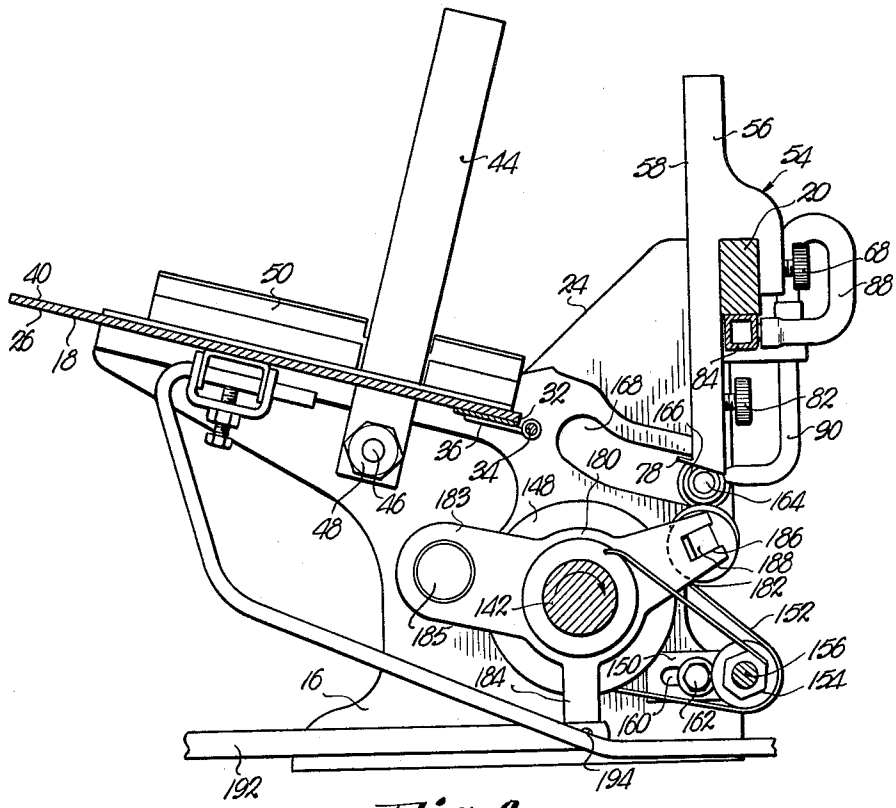


Fig. 2.

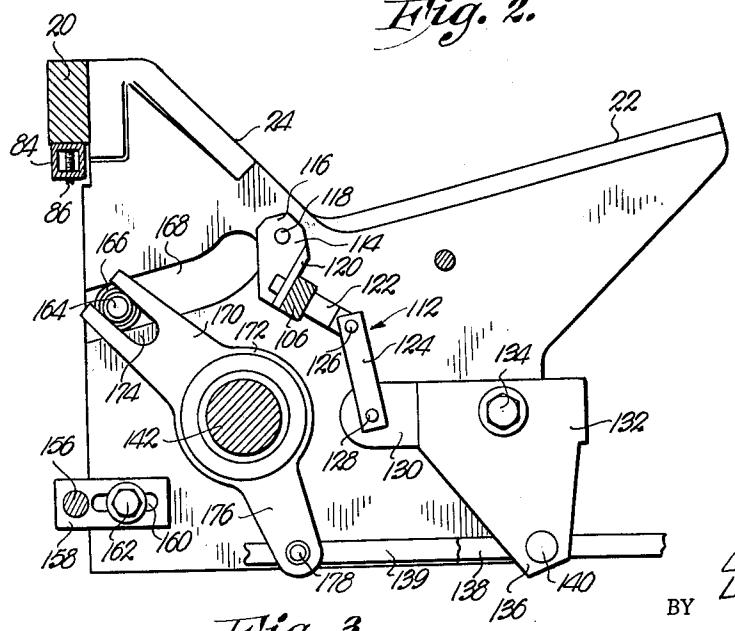


Fig. 3.

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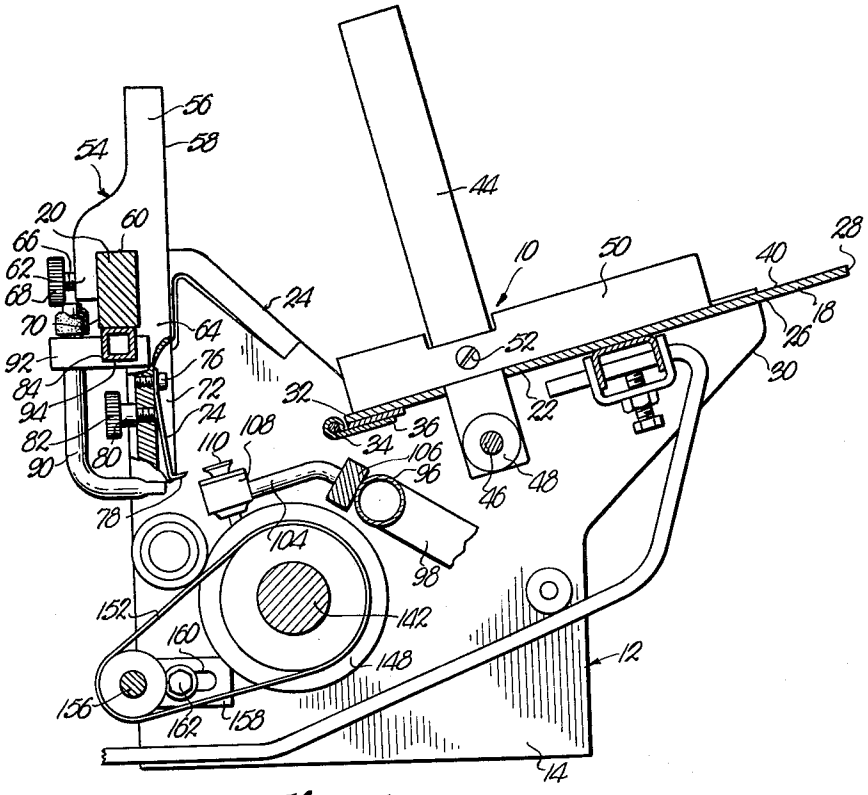


Fig. 4.

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3,093,371
BOTTOM FEED APPARATUS FOR SHEET HANDLING EQUIPMENT

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7 Claims. (Cl. 271—29)

This invention relates to sheet-handling apparatus and more particularly, to apparatus for feeding individual sheets from the bottom of a stack of such sheets to a sheet-handling machine.

It is the primary object of the present invention to provide apparatus for feeding individual sheets to a sheet-handling machine wherein the sheets are delivered from the bottom of a stack of such sheets placed upon the apparatus, whereby the apparatus may be disposed above the machine and the stack may be added to without having to cease operation of the machine in order to replenish the supply of sheets to be fed into the machine.

Another object of the present invention is the provision of means on the aforesaid apparatus for supporting only a portion of the sheets to be fed into the machine while the latter are stacked in position above the machine so that the unsupported portions of each sheet may be effectively grasped and drawn downwardly into the path of operation of the sheet-handling machine disposed below the apparatus.

A further object of the present invention is the provision of suction means on the aforesaid apparatus for grasping only the lowermost of said sheets to draw the latter toward the sheet-handling machine, whereby a single sheet only is removed from the stack and separated from the remaining sheets in the latter for delivery to the sheet-handling machine in a condition substantially free from damaging effects thereon since the delivered sheet is in no way creased, folded or mutilated by the effects of the reduced air pressure thereon.

Still another object of the present invention is the provision of sheet-handling apparatus of the character described which is provided with moving parts synchronized with the mechanism of the sheet-handling machine associated therewith so that the sheets delivered from the apparatus are positioned at precisely the right position on the sheet-handling machine and delivered to the latter at precisely the correct time in order to insure effective stacking of the sheets on the machine from successive feed apparatuses.

Other objects of the present invention relate to the provision of support structure including an inclined plate providing a surface for supporting the stack of sheets, the plate having a marginal edge underlying and spaced from the normally forwardmost margins of the sheets, whereby a portion of each of the sheets is effectively unsupported by the plate to be effectively grasped by the suction means heretofore set forth; to the provision of means movable into supporting relationship to the stack of sheets when the lowermost sheet is moved downwardly under the influence of the suction means, whereby the remaining sheets are prevented from moving downwardly with the aforesaid lowermost sheet; and to the provision of drum means engageable with the lowermost sheet when the latter is shifted downwardly under the influence of the suction means, whereby the lowermost sheet is advanced away from the stack and toward the sheet-handling machine under the influence of the drum means.

The present invention provides feed apparatus for delivering individual sheets to a sheet-handling machine, and includes support structure in the nature of a plate having a surface adapted for supporting a plurality of

sheets in a vertical stack. The sheets project outwardly from one marginal edge of the plate so as to provide unsupported portions to be grasped by shiftable suction means positioned below the plate and engageable with the lowermost sheet of the stack. Structure is included for shifting the suction means from a position spaced from the lowermost sheet to a position wherein the suction means engages the lowermost sheet and applies a negative pressure thereto. By virtue of the aforesaid negative pressure, the lowermost sheet is urged downwardly and simultaneously therewith the same is directed into engagement with a rotating drum therebelow, the latter being sufficient to draw the lowermost sheet from the stack and away from the supporting plate for movement toward the sheet-handling machine normally positioned below the drum means.

In addition, means are provided for supporting the remaining sheets in the stack when the lowermost sheet has been urged downwardly under the influence of the suction means to prevent the remaining sheets from moving downwardly with the aforesaid lowermost sheet. Means are also provided for applying a positive air pressure between the lowermost sheet and the sheet adjacent thereto so that the lowermost sheet is effectively separated from the stack as the same is urged downwardly by the suction means. A plurality of rods shift the stack-supporting means as the downward movement of the suction means carrying the lowermost sheet therewith is being completed, the rod means adapted to be operably coupled to cam means forming a part of the sheet-handling machine.

In the drawings:

FIGURE 1 is a front elevational view of the feed apparatus which forms the subject of the present invention, parts being in section to illustrate details of construction;

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

FIG. 3 is a cross-sectional view taken along irregular line 3—3 of FIG. 1; and

FIG. 4 is a cross-sectional view taken along line 4—4 of FIG. 1.

The feed apparatus which forms the subject of the present invention is broadly denoted by the numeral **10** and includes support structure **12**, having a pair of sides **14** and **16**, an elongated plate **18** secured to the uppermost margins of the sides **14** and **16** adjacent the rearmost edges thereof, and an elongated length **20** secured to sides **14** and **16** adjacent the forwardmost margins thereof and spanning the distance therebetween.

Sides **14** and **16** are adapted to be positioned on a sheet-handling machine so that plate **18** and length **20** are positioned above the sheet-handling machine. Apparatus **10** is adapted for delivering individual sheets to the aforesaid sheet-handling machine by removing the sheets from the bottom of a vertical stack in a manner to be described.

Each of sides **14** and **16** is provided with a first inclined, uppermost margin **22**, and a second inclined, uppermost margin **24** joined with margin **22**, margins **22** and **24** converging as the center of each of the sides **14** or **16** is approached.

Plate **18** is provided with a flat bottom surface **26** which rests on and engages the first margin **22** of each of sides **14** and **16** so that plate **18** effectively spans the distance between sides **14** and **16**. Plate **18** has a normally rearmost edge **28** spaced outwardly from the rearmost marginal edge **30** of each of sides **14** and **16** and plate **18** is further provided with a normally forwardmost edge **32** spaced forwardly of the junction between margins **22** and **24**. Edge **32** effectively spans the distance between sides **14** and **16** and is rearwardly spaced from and below length **20**. An elongated hinge pin **34** is secured to edge **32** by J-shaped hinge brackets **36** secured to the lower

surface 26 of plate 18. Pin 34 is substantially parallel with edge 32 and mounts, at spaced intervals alternately with sections of the hinge brackets 36, a plurality of sleeves 38 in the nature of short tubes having an outermost periphery flush with the upper surface 40 of plate 18. Sleeves 38 are rotatable on pin 34 by virtue of being spaced outwardly from edge 32 of plate 18.

Plate 18 is provided with a pair of opposed, elongated slots 42 therein which serve as guides for a pair of upright members 44 which project through slots 42 and terminate below the same. Members 44 are carried by an elongated shaft 46 disposed below plate 18 and secured at the ends thereof to sides 14 and 16. Fastening means 48 in the nature of shiftable, threaded nuts, releasably maintain members 44 in fixed positions so as to provide predetermined distance therebetween.

Each member 44 is provided with an elongated stretch 50 secured thereto by screw means 52 and engageable with the upper surface 40 of plate 18. Stretches 50 are substantially perpendicular to the corresponding members 44 and, with the latter, provide sheet guides for a stack of sheets placed on the upper surface 40 of plate 18. By shifting members 44 relative to plate 18, the distance between members 44 may be varied so as to accommodate sheets of varying sizes for delivery to the sheet-handling machine associated with apparatus 10.

Stop means broadly denoted by the numeral 54 is secured to length 20 and includes a plurality of upright stretches 56, each having a rearwardly facing surface 58 for engaging the forwardmost margins of the sheets in the stack disposed on the upper surface 40 of plate 18. Each stretch 56 is provided with a downwardly facing, U-shaped recess 60 therein formed by downwardly extending, separated portions 62 and 64. Portion 62 terminates above the lowermost end of portion 64, and an elongated screw 66 having a head 68 is threadably mounted in portion 62 and bears against the front face 70 of length 20 when the latter is positioned within recess 60 of each of the stretches 56.

Rear surface 58 of each of the stretches 56 extends to the lowermost end of portion 64 of the latter, and an elongated groove 72 is provided in surface 58 extending from the lowermost end of portion 64 to a point adjacent to a point spaced thereabove. A spring clip 74 is carried within each of the grooves 72 and is secured to the corresponding portion 64 by means of a screw 76 passing through one end of clip 74 and into portion 64. The opposite end of clip 74 is provided with a projection 78 extending at right angles to the remaining part of the clip 74 and toward the edge 32 of plate 18. A screw 80 having a head 82 is threadably mounted within portion 64 and emerges into groove 72 and bears against the inner face of clip 74. Screw 80 serves to vary the separation of clip 74 relative to portion 64 so as to move projection 78 toward and away from edge 32.

Secured to the lowermost face of length 20 is a first transversely rectangular manifold 84, the latter being secured to length 20 by a plurality of screws 86 as illustrated in FIG. 3. Manifold 84 is adapted to be operably coupled to a source of air under pressure and is provided with a plurality of openings (not shown) to which a plurality of flexible tubes 88 are coupled. Tubes 88 are connected to ducts 90 which are substantially J-shaped as shown in FIG. 4 and which are mounted on manifold 84 by virtue of blocks 92 having depressions 94, the manifold 84 being fitted and suitably held in the depressions 94 of blocks 92. The lowermost end of each of the ducts 90 is disposed below and adjacent the projection 78 on clip 74 of a corresponding stretch 56, and the lowermost end of duct 90 is flattened so as to permit air issuing therefrom to pass outwardly in a flat pattern below projection 78 and toward edge 32.

A second transversely circular manifold 96 which is preferably of flexible tubular material is carried on a bar 106 and is adapted to be operably coupled to a source of reduced air pressure by means of a flexible extension thereof indicated at 98 leading outwardly therefrom.

There are a plurality of rigid tubes 104 coupled with manifold 96 and extending forwardly therefrom. A head 108 having a fluid inlet and sucker fitting 110 is secured to the forwardmost end of each tube 104 and is thus placed in fluid communication with manifold 96.

Linkage means, broadly denoted by the numeral 112, is secured to the ends of bar 106 and shiftably mounted on sides 14 and 16 respectively. Linkage means 112 includes an L-shaped bracket 114, having a vertically disposed section 116 pivotally mounted on the corresponding side 14 or 16 by means of a pivot pin 118 for movement about a horizontal axis. It is significant that the axis of pivot for the sucker fittings 110 is aligned with the line along which the lowermost sheet of the stack is bent by the action of the fittings 110. This avoids any tendency of the fittings 110 to shift along the sheet, which might destroy the vacuum coupling required for positive operation. A section 120 of bracket 114 is disposed at right angles to section 116 and is secured to the corresponding end of bar 106.

A first link 122 is secured rigidly to the corresponding end of bar 106 and also to the proximal end of a second link 124 by means of a pivot pin 126. Link 124 is secured by means of a pivot pin 128 to an ear 130 of a polygonal element 132, the latter being pivotally mounted on side 14 by means of a pivot pin 134.

Element 132 is provided with an extension 136 extending below pivot pin 134 and is connected to an elongated first rod 138 by means of a pivot pin 140. It is evident that, by reciprocating rod 138 along a line substantially parallel with the longitudinal axis of first rod 138, element 132 pivots about pivot pin 134 and bracket 114 pivots about pin 118 to shift bar 106 toward and away from edge 32 of plate 18. In effect, head 108 is moved into and away from the region between edge 32 and projection 78 when bar 106 is shifted toward and away from edge 32.

An elongated first shaft 142 is journalled at the ends thereof in sides 14 and 16 by virtue of bearing means 144 and 146 respectively. First shaft 142 is positioned below the region between edge 32 and projection 78 and carries therewith a pair of drums 148 in spaced relationship thereto. Drums 148 are centrally located between sides 14 and 16 and are substantially at equal distances on opposed sides of the center line of apparatus 10.

Pulleys 150 are secured to the innermost face of each of drums 148 for rotation therewith, and an endless, flexible belt 152 interconnects each pulley 150 with a pulley 154 mounted on an elongated second shaft 156 journalled at the ends thereof in sides 14 and 16. Shaft 156 is adapted to be rotated in a counterclockwise sense when viewing FIG. 4, so that drum 148 and thereby, shaft 142, are driven in the same direction. A bracket 158 (FIG. 4) is secured at each end of shaft 156 and is provided with an elongated slot 160 therein for receiving screw means 162 connected to the corresponding side 14 or 16. By virtue of this construction, shaft 156 may be pushed toward or away from shaft 142 so as to vary the tension on belt 152.

An elongated third shaft 164 is disposed above shafts 142 and 156 and is provided with bearing means 166 at each end thereof receivable within an elongated groove 168 disposed on the inner face of a corresponding side 14 or 16.

An elongated arm 170 is secured to each of a pair of collars 172 rotatably mounted on shaft 142 at opposite sides of the machine. Each arm 170 extends upwardly and forwardly from shaft 142 and is provided with a U-shaped slot 174 therein. The slots 174 receive therein shaft 164 for moving the latter rearwardly when collars 172 are rotated relative to shaft 142. Shaft 164 thereby is moved into a position between projection 78 and edge 32 of plate 18 for supporting the stack of sheets posi-

tioned on the upper surface 40 of plate 18. A second arm 176 is secured to each collar 172 at a substantially diametrically opposed position on the latter relative to its arm 170. The arms 176 extend below and rearwardly of shaft 142, and are connected to a pair of second rods 139 by means of pivot pins 178. By reciprocation of rods 139, collars 172 are rotated relative to shaft 142 and shaft 164 is movable toward and away from the region between edge 32 and projection 78.

A pair of spaced sleeves 180 are rotatably carried at the ends of shaft 142 and are inwardly spaced from collars 172 adjacent thereto. Each sleeve 180 is provided with an elongated leg 182 extending upwardly and forwardly therefrom, and a second leg 183 extending rearwardly therefrom. One only of the sleeves 180 is provided with a downwardly extending leg 184. Legs 182 are provided with a U-shaped slot 186 therein at the outermost end thereof for receiving a transversely polygonal shaft 188, the latter extending toward and terminating adjacent drum 148. An idler roller 190 is journalled at the innermost end of the corresponding shaft 188 and normally engages the outer periphery of the corresponding drum 148. By virtue of the interconnection of shaft 188 with leg 182, roller 190 may shift away from drum 148 to permit a sheet to be disposed between the latter and roller 190.

The leg 184 is secured at the normally lowermost end thereof to a third rod 192 by means of a pivot pin 194. Legs 183 are interconnected by a rod 185 for simultaneously rotating sleeves 180. Rod 192, like rods 138 and 139, is adapted to be operably coupled to cam means carried by the sheet-handling machine associated with apparatus 10 for reciprocating rod 192 and thereby rotating sleeves 180 about shaft 142. As rod 192 is reciprocated, legs 182 are shifted so as to move each shaft 188 and thereby the corresponding roller 190, toward and away from edge 32 of plate 18.

In operation, a stack of sheets to be delivered to a sheet-handling machine, is positioned on the upper surface 40 of plate 18 with the lowermost sheet of the stack being positioned over sleeves 38 and in engagement with projection 78. The remaining sheets above the lowermost sheet engage the rearmost surfaces 58 of stretches 56 and extend rearwardly therefrom, terminating in the vicinity of the rearmost edge 28 of plate 18. The sheets are positioned between members 44 and stretches 50 and are substantially inclined relative to the vertical by virtue of the inclination of plate 18.

In the initial condition, shaft 164 is in a position between projection 78 and edge 32 and supports the portions of the stack of sheets which overlie the aforesaid region. Furthermore, the heads 108 of the suction means, are in the lowermost positions thereof since rods 138 are in their normally forwardmost positions. In addition, shafts 188 are in their normally forwardmost positions since rods 192 are in their normally rearmost positions.

Upon actuation of rod 138, bar 106 is shifted toward edge 32 of plate 18 so as to shift heads 108 into the region between edge 32 and projection 78. Inlets 110 thereby engage the lower face of the lowermost sheet of the stack disposed on the upper surface 40 of plate 18 and cause the lowermost sheet to adhere to heads 108 by virtue of the reduced pressure within the latter. Simultaneously with the upward movements of heads 108, shaft 164 moves forwardly out of supporting relationship to the stack to thereby permit heads 108 to be positioned so that the inlets 110 engage the lowermost sheet. While shaft 164 is out of supporting relationship to the stack of sheets, the lowermost sheet is temporarily supported by projection 78 and the inlets 110 of heads 108.

When rod 138 moves, heads 108 shift downwardly to draw therewith the lowermost sheet of the stack and shaft 164 once again moves rearwardly into the region between edge 32 and projection 78 to support the stack of sheets remaining on plate 18. Then, the actuation of rod 192 causes rollers 190 to move rearwardly about the outer periphery of the corresponding drums 148. As rollers 190 are moving rearwardly, the forwardmost portion of the lowermost sheet is moved into engagement with the peripheries of drums 148, and rollers 190 thereby roll over the lowermost sheet to press the latter into frictional engagement with the peripheries of the drums 148. In effect, the frictional engagement with drums 148 causes the sheets to be moved in the direction of movement of belts 152, namely, away from the stack of sheets and forwardly of apparatus 10. The lowermost sheet is separated from the sheet adjacent thereto, and the lowermost sheet follows the contour of belts 152 as the same moves downwardly. After passing pulleys 154, the lowermost sheet continues downwardly and into operational relationship with the sheet-handling machine disposed below apparatus 10.

It is to be noted that air is continuously delivered to ducts 90 through first manifold 84 to continuously direct air in a flat pattern rearwardly to facilitate the separation of the lowermost sheet of the stack from the sheet adjacent thereto. In addition, air is intermittently removed from tubes 96 and 104 to maintain the air pressure at inlet 110 at a value below that of the atmosphere surrounding apparatus 10.

By virtue of the aforesaid construction, apparatus 10 provides means for delivering individual sheets to a sheet-handling machine by removing the lowermost sheet from a vertical stack. This permits the replenishing of the sheets without having to halt the operation of the sheet-handling machine, and further, permits the apparatus 10 to be positioned above the sheet-handling machine.

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

1. Feed apparatus for sheet handling equipment comprising structure provided with an inclined surface having a lower marginal edge and adapted for supporting a stack of sheets with portions of said sheets projecting outwardly therefrom; means having a lateral projection thereon spaced from said marginal edge and disposed with the projection beneath and in supporting relationship to the portion of the lowermost sheet of the stack for supporting the portions of the stack; suction means shiftably carried by said structure for engaging the lowermost of said sheets and for shifting the portion of the latter downwardly; means carried by said structure and movable into the space between said marginal edge and said projection for augmenting the supporting action of said projection after the portion of the lowermost sheet is shifted downwardly under the influence of said shifting means; and means adjacent said edge and engageable with the downwardly shifted portion of said lowermost sheet for advancing the latter away from said edge and said stack.

2. Feed apparatus as set forth in claim 1, wherein said suction means comprises a conduit, a head secured to and in fluid communication with said conduit, and bracket means coupled with said structure and said conduit for mounting the latter on the structure for swinging movement toward and away from said space.

3. Feed apparatus as set forth in claim 1, wherein said means for advancing the lowermost sheet comprises drum means rotatably mounted on said support structure below the path of movement of said augmenting means, means carried by said support structure for rotating said drum means, and bearing means adjacent said drum means for forcing said portion of the lowermost sheet into frictional engagement with said drum means when said portion is moved downwardly under the influence of said suction means.

4. Feed apparatus as set forth in claim 3, wherein is included a shaft journalled at the ends thereof for rotation about an axis spaced below said marginal edge, said drum means comprising a drum secured to said shaft for rotation therewith, and arm means carried by

said shaft and coupled with said augmenting means for mounting the latter for rotation through a limited arc about said shaft toward and away from the space between said marginal edge and said projection.

5. Feed apparatus as set forth in claim 1, wherein said augmenting means includes a rod engageable with and spanning the distance across the lowermost of a stack of sheets carried on said surface.

6. Feed apparatus as set forth in claim 1, wherein said augmenting means includes a rod, and arm means swingably carried by said structure and coupled with said rod adjacent the ends thereof for swinging the latter into and out of the space between said marginal edge and said projection.

7. Feed apparatus as set forth in claim 6, said structure having a pair of opposed sides each provided with a rod-receiving guide slot therein, there being means on said arm means to permit limited shifting movement of the rod relative to said arm means as the rod moves in said slots into and out of said space.

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