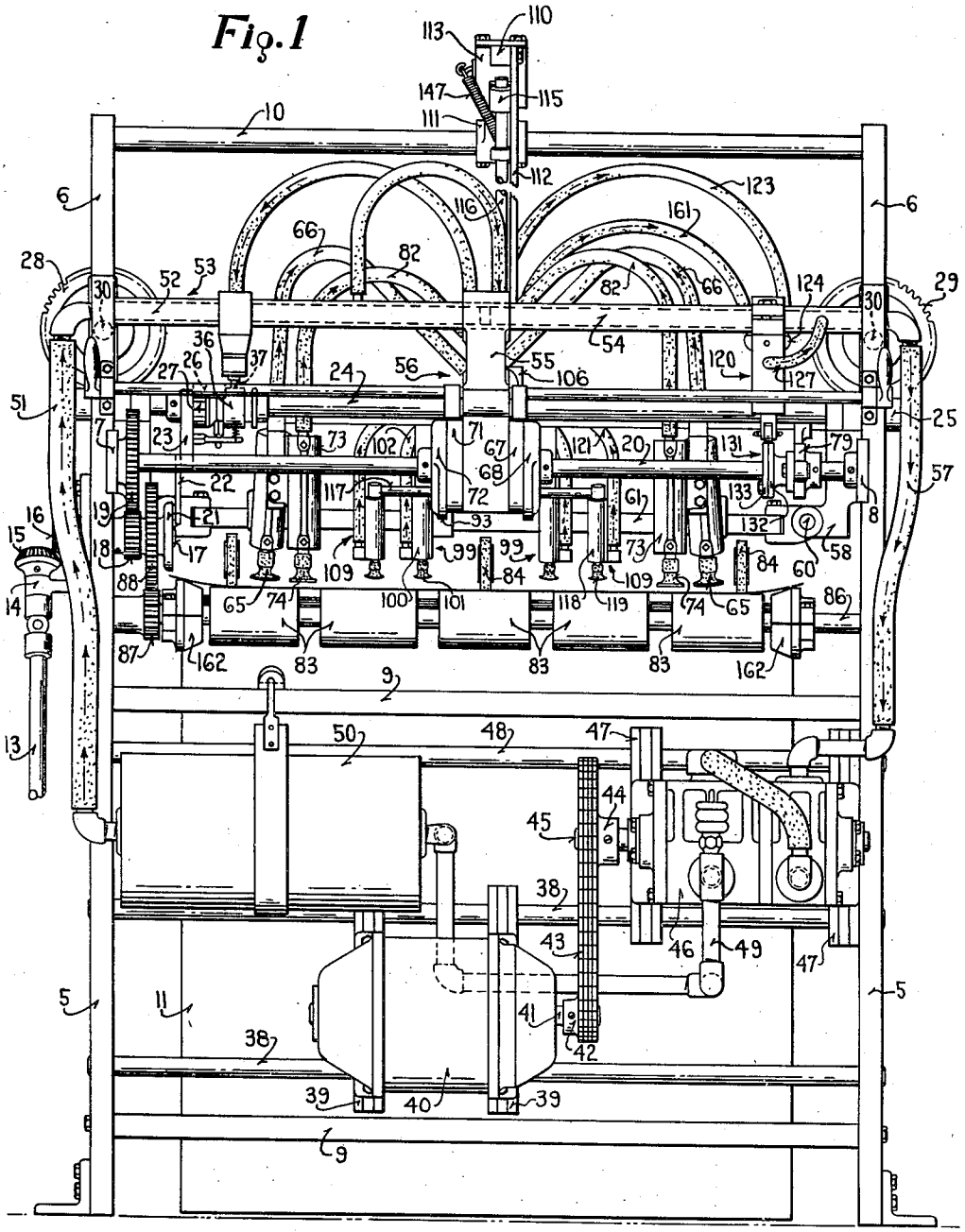
Nov. 19, 1940. G. A. MARTIN 2,221,981

SHEET FEEDER

Filed Jan. 17, 1939 3 Sheets-Sheet 1

Fig. 1



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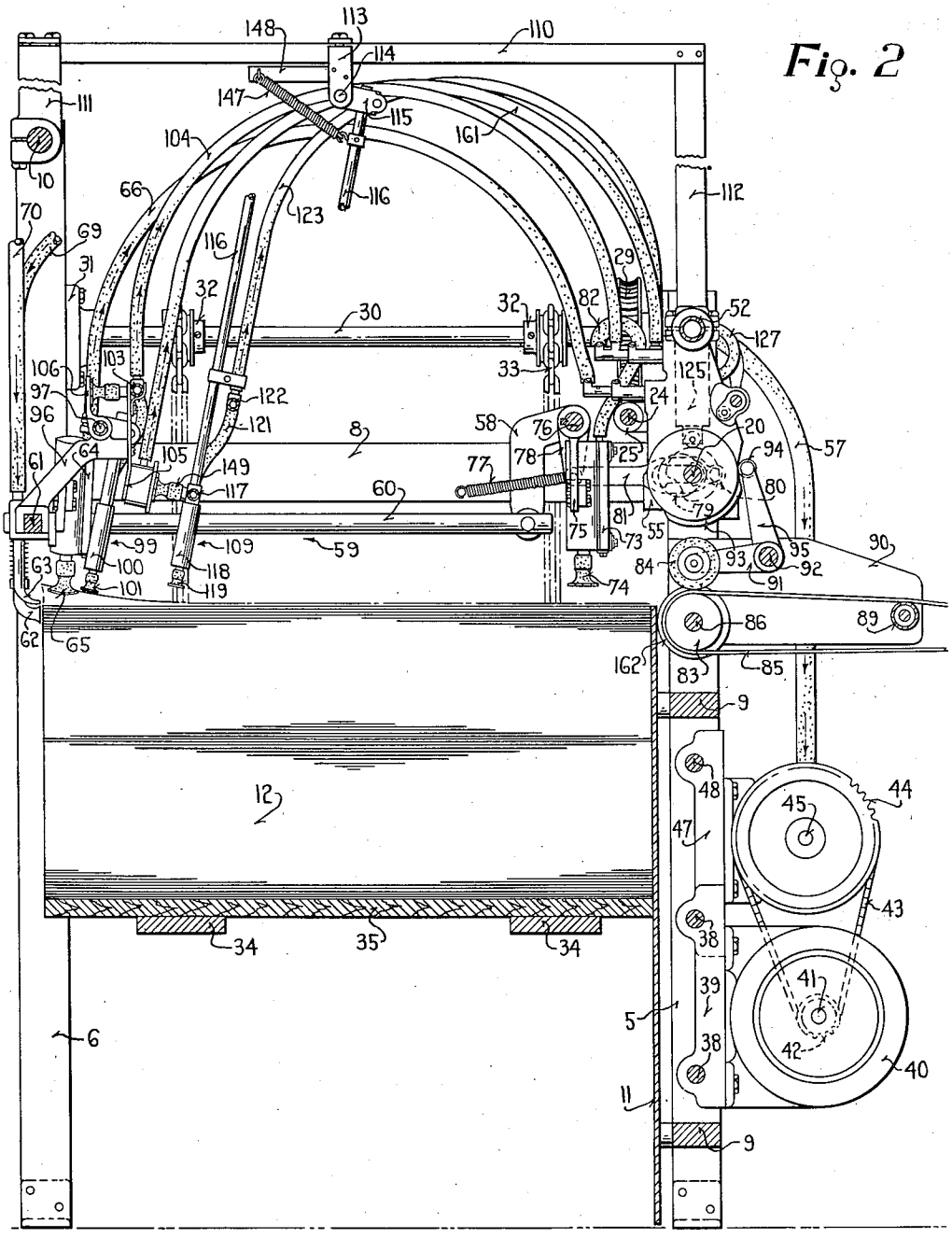
ATTORNEY

Nov. 19, 1940. G. A. MARTIN 2,221,981

SHEET FEEDER

Filed Jan. 17, 1939 3 Sheets-Sheet 2

Fig. 2



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SHEET FEEDER

Filed Jan. 17, 1939 3 Sheets-Sheet 3

Fig. 3

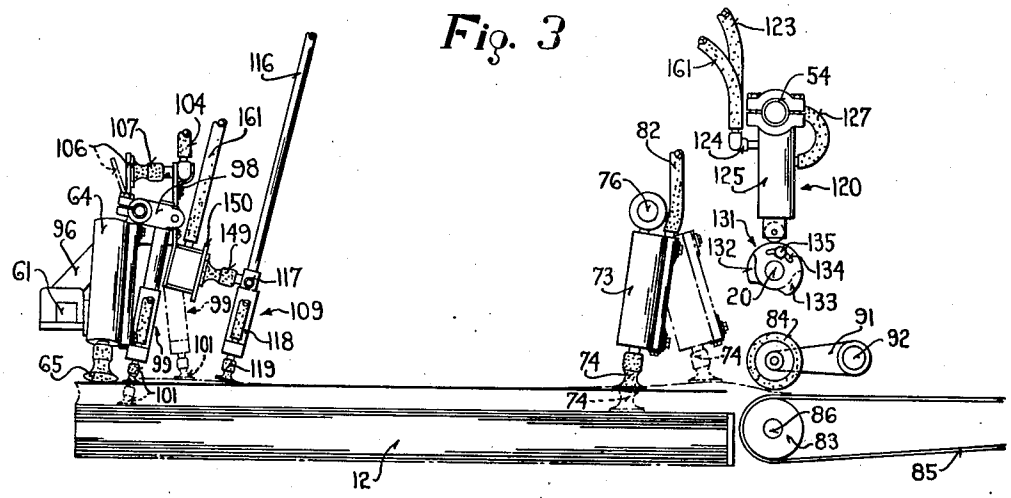


Fig. 4

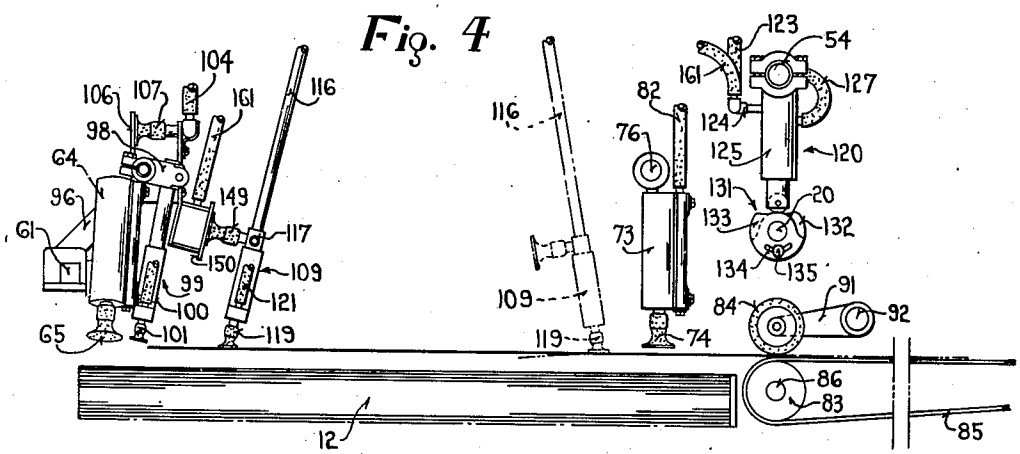


Fig. 5

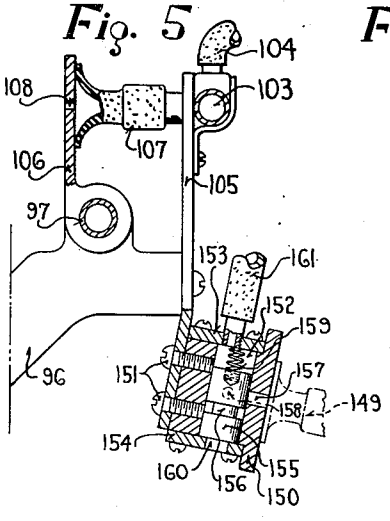


Fig. 6

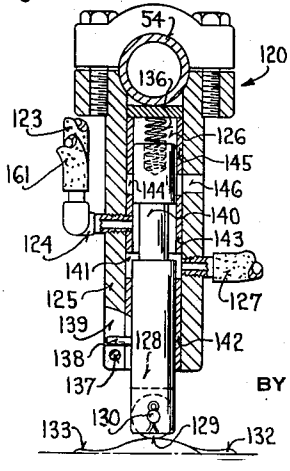
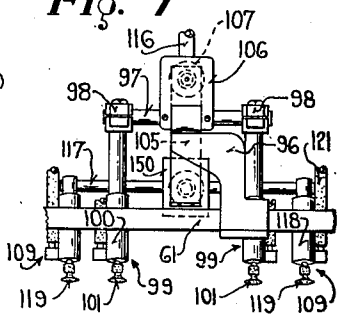


Fig. 7



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Patented Nov. 19, 1940 2,221,981

UNITED STATES PATENT OFFICE

2,221,981

SHEET FEEDER

George A. Martin, Pearl River, N. Y., assignor to Dexter Folder Company, Pearl River, N. Y., a corporation of New York

Application January 17, 1939, Serial No. 251,296

18 Claims. (Cl. 271—31)

This invention relates to sheet feeders and while capable of general use is more particularly adapted for embodiment in feeders for feeding sheets of tin, black iron, aluminum and the like to printing presses, punch presses, coating and varnishing machines, and various other instrumentalities employed in the processing or making of metal articles or containers.

One object of the present invention is to provide an improved sheet feeder which is capable of feeding metal sheets from a pile or supply without scratching or marking said sheets.

Another object of the present invention is to provide an improved sheet feeder which through the provision of novel means raises each sheet completely from a pile or supply and maintains it in raised condition until the entire sheet is fed from said pile or supply.

Another object of the present invention is to provide an improved sheet feeder which through the provision of novel means raises and holds the rear portion of each sheet in process of being fed from a pile or supply to prevent said portion from dragging on and scratching or marking the next or underlying sheet of said pile or supply.

These and other objects of the present invention will appear as the following description thereof proceeds, and in order to more clearly understand said invention reference may be had to the accompanying drawings which illustrate one embodiment thereof.

In said drawings:

Fig. 1 is a front elevation of a feeder embodying the present invention and particularly adapted for feeding metal sheets;

Fig. 2 is a vertical longitudinal sectional view of the feeder shown in Fig. 1;

Figs. 3 and 4 are diagrammatic side views of suction sheet hold-up devices showing the positions they occupy while a sheet is being fed;

Fig. 5 is an enlarged vertical longitudinal sectional view of a device for checking the rearward movement of the suction sheet hold-up devices and preventing rebounding of said devices;

Fig. 6 is an enlarged vertical longitudinal sectional view of a valve for controlling the operation of one of the suction sheet hold-up devices; and

Fig. 7 is a fragmentary rear elevation of the suction sheet hold-up devices.

Referring to the drawings, wherein like reference characters designate like parts throughout the several views, the various movable parts of the feeder as well as certain stationary parts thereof may be mounted on a frame of any suitable construction and the movable parts employed during normal operation of the feeder may be actuated or driven by any suitable means. As hereinafter shown, said frame and driving means are preferably constructed as follows.

The feeder frame is comprised by front uprights 5 and rear uprights 6 which are bolted or otherwise suitably secured to the machine foundation and connected together by side members 7 and 8 (Figs. 1 and 2). The front uprights 5 are connected together by cross members 9 bolted or otherwise suitably secured thereto, and the rear uprights 6 are connected together at the tops thereof by a stay shaft 10. The cross members 9 have bolted or otherwise suitably secured thereto a metal apron or plate 11 against which the front side of a pile or supply of metal or other sheets 12 bears during elevation of the same by mechanisms to be hereinafter described.

Referring now more particularly to Fig. 1, the drive for the feeder is preferably comprised by an inclined driven jack shaft 13 which, in turn, is driven from a suitable source of power (not shown). The upper end of this jack shaft is journalled in a suitable bearing provided by a bracket 14 that is bolted or otherwise suitably secured on one of the front uprights 5.

Fixed on the upper end of jack shaft 13 is a bevel gear 15 which meshes with a similar gear 16 that is fixed on a short shaft 17 journalled in suitable bearings in the bracket 14 and the adjacent front upright 5. Fixed on the short shaft 17 is a spur pinion 18 which meshes with a spur gear 19 that is fixed on a cam shaft 20. This cam shaft 20 is journalled in suitable bearings in the front uprights 5 and is utilized to operate various parts of the feeder to be hereinafter described. The feeder includes a pile elevator and operating mechanism therefor preferably constructed as follows.

The short shaft 17 has fixed thereon a crank disk 21 pivotally connected with one end of a link 22 the opposite end of which is pivotally connected with a pawl carrier 23 that is loosely mounted on a shaft 24 (Fig. 1). This shaft 24 extends transversely of the feeder and is journalled in suitable bearings in brackets 25 (Figs. 1 and 2) that are bolted or otherwise suitably secured to the front uprights 5 at the upper ends thereof. Shaft 24 is operated at suitable intervals to raise the pile elevator hereinafter described and said operation of said shaft is preferably effected by pawl and ratchet mechanism of the general type disclosed in the application Serial No. 33,002 of Leonard Baker filed July 25, 1935.

This pawl and ratchet mechanism includes the pawl carrier 23 and a pawl 26 pivoted thereon and adapted, under certain conditions, to engage a ratchet 27 fixed on the shaft 24. It will thus appear that through oscillation of the pawl carrier 23 by the described driving connections therefor with jack shaft 13 and through engagement of the oscillating pawl 26 with the ratchet 27, the shaft 24 will be intermittently rotated. Under these conditions right and left hand worm gears 28 and 29 (Figs. 1 and 2) fixed on shafts 30 will likewise be rotated through right and left hand worms (not shown) that are fixed on opposite ends of the shaft 24. The shafts 30 are journalled in suitable bearings in the brackets 25 and in brackets 31 which are bolted or otherwise suitably secured to the rear uprights 6 (Fig. 2).

Fixed on shafts 30 are toothed sheaves 32 (Fig. 2) in the teeth of which are engaged links of chains 33 so that when the shafts 30 are rotated in the proper direction by the described means therefor, said chains will be raised and thus raise an elevator comprising cross beams 34 to which the lower ends of said chains 33 are secured in any suitable manner. The elevator 34 has placed thereon a pile board 35 which, together with the pile of metal or other sheets 12, is positioned on said elevator through the rear of the feeder when the elevator is lowered.

The elevator 34 and pile of sheets 12 thereon are raised intermittently as the sheets are fed off the top of the pile by sheet separating and forwarding devices hereinafter described, and to keep the top of said pile at a predetermined level for the operation of said devices the elevator and its operating mechanism are preferably controlled by pneumatic means including a mask 36 and a mask detent 37 (Fig. 1) preferably mounted, constructed and operated as disclosed in the application Serial No. 116,692 of Leonard Baker, George A. Martin and Leo C. Williams, filed December 19, 1936, and needing no detail description herein.

The feeder embodies means for supplying compressed air to pile and sheet winding devices, and means for creating vacuum in the sheet separating and forwarding devices, and said means are preferably mounted, constructed and operated as follows. Extending across the feeder frame and secured in any suitable manner to the front uprights 5 thereof are cross shafts 38 (Figs. 1 and 2). These cross shafts 38 have bolted or otherwise suitably secured thereto brackets 39 which, in turn, have bolted or otherwise suitably secured thereto an electric motor 40. Fixed on the armature shaft 41 of motor 40 is a sprocket 42 around which passes a chain 43 that also passes around a sprocket 44. This sprocket 44 is fixed on the shaft 45 of a pump 46 suitably constructed to supply air under pressure from one part thereof and to create vacuum in another part thereof.

This air and vacuum pump 46 is bolted or otherwise suitably secured above, and to one side of, the motor 40 on brackets 47. These brackets 47 are bolted or otherwise suitably secured on one of the cross shafts 38 and a third cross shaft 48 located thereabove and secured in any suitable manner to the front uprights 5. Connected with the exhaust or air pressure side of pump 46 is one end of a conduit 49 the opposite end of which is connected with a compressed air tank 50 (Fig. 1) secured in any suitable manner on the feeder frame above and to one side of the motor 40.

The compressed air tank 50 has connected therewith one end of a conduit 51 the opposite end of which is connected with one part 52 of a transversely extending tubular shaft indicated broadly at 53 that is secured in any suitable manner in the front uprights 5. This tubular shaft 53 is divided centrally in any suitable manner and the other part of the shaft is indicated at 54. Part 52 provides an air supply conduit and part 54 provides a vacuum conduit and both of these parts are connected with the housing 55 of a valve mechanism 56 supported on the feeder in any suitable manner and through which the cam shaft 20 extends. The construction and operation of this valve mechanism is the same as the valve mechanism disclosed in application Serial No. 116,692 above referred to and needs no further detail description herein. The vacuum part or conduit 54 of tubular shaft 53 has connected therewith one end of a conduit 57 the opposite end of which is connected with the vacuum side or part of pump 46. The valve mechanism 56, through the described connections therefor with the pump 46, controls the delivery of air under pressure to pile and sheet winding devices, and the making and breaking of vacuum in the sheet separating and forwarding devices hereinafter referred to.

Bolted or otherwise suitably secured on the side members 7 and 8 are brackets 58 (Figs. 1 and 2) to which is pivoted an auxiliary frame 59 comprised by side members 60 and a rear cross member 61 mounted on said side members and adjustable therealong to various positions. The cross member 61 has mounted thereon, at opposite sides thereof, pile and sheet winding devices indicated at 62 and 63 respectively, and vacuum sheet separating devices comprised by cylinders 64 and suction cups 65 that are raised and lowered through the making and breaking of vacuum in said cylinders. These sheet separating devices are constructed and operated in the same manner as the sheet separating devices disclosed in application Serial No. 116,692 and need no detail description herein. It might be pointed out, however, that the cylinders 64 are connected by flexible hose 66 with the vacuum side of valve housing 55 and that the making and breaking of vacuum in the sheet separating devices at predetermined intervals is effected by the rotary valve 67 connected with the driving disk 68 that is fixed on the cam shaft 20. The rotary valve 67, during rotation of the same, connects and disconnects the cylinders 64 with the vacuum side of pump 46 through the described connections therefor with the valve housing 55. Also, the pile and sheet winding devices 62, 63 are connected by flexible hose 69 and 70 with the air side of valve housing 55, and delivery of compressed air to said pile and sheet winding devices at predetermined intervals is effected by the rotary valve 71 connected with the driving disk 72 that is fixed on the cam shaft 20. The rotary valve 71, during rotation of the same, connects and disconnects the pile and sheet winding devices 62, 63 with the compressed air tank 50 through the described connections therefor with the valve housing 55.

The sheet forwarding devices are comprised by cylinders 73 and suction cups 74 that are raised up and down relative to the cylinders through making and breaking of vacuum therein. These sheet forwarding devices are also constructed and operated in the same manner as the sheet forwarding devices disclosed in the ap-

plication Serial No. 116,692 and need no detail description herein. It is pointed out, however, that the sheet forwarding devices have swinging movement to advance the sheets that have been separated from the pile 12 by the sheet separating devices, and for this purpose cylinders 73 are secured on arms 75 (Fig. 2) which, in turn, are fixed on a rock shaft 76 that extends transversely of the feeder frame and is journalled in suitable bearings in the brackets 58. The sheet forwarding devices are rocked rearwardly by a spring 77 having one end connected with an arm 78 (Fig. 2) fixed on rock shaft 76, the opposite end of said spring being connected with the side member 8 in any suitable manner. The sheet forwarding devices are rocked forwardly by a cam 79 (Figs. 1 and 2) fixed on and rotated by cam shaft 20. This cam 79 engages a cam roller 80 journalled on a cam strap 81 extending over cam shaft 20 and connected with the arm 78.

The making and breaking of vacuum in the cylinders 73 is also effected by the valve 67 at proper intervals, and for this purpose the cylinders 73 are connected by flexible hose 82 with the vacuum side of the valve housing 55. It might be pointed out, however, that the operation of the valve 67 is so timed that vacuum is established in the cylinders 73 to move the suction cups 74 into engagement with the top sheet of the pile when the sheet forwarding devices have been swung rearwardly, as illustrated in full lines in Fig. 3, and is maintained therein until said devices have completed their forward movement and delivered the sheet engaged thereby in proper position on a conveyor hereinafter described.

The sheets separated from the pile 12 by the sheet separating devices are taken by the sheet forwarding devices and delivered thereby to a sheet conveyor that advances the sheets to the machine with which the feeder is associated. As herein shown, this conveyor includes feed and drop rollers 83 and 84 respectively, and a plurality of conveyor tapes 85 passing around the feed rollers 83. The feed rollers 83 are fixed in spaced relation on a shaft 86 extending transversely of the feeder and journalled in suitable bearings in the front uprights 5. The shaft 86, the feed rollers 83 fixed thereon, and the conveyor tapes 85 passing around said rollers are driven by suitable gearing including a gear 87 (Fig. 1) fixed on said shaft, and a gear 88 which meshes with the gear 87 and is fixed on and rotated by the short shaft 17. The front portions of tapes 85 pass around other rollers (not shown) and said tapes travel over a roller 89 that extends transversely of the feeder and is journalled in suitable bearings in side plates 90 which are bolted or otherwise suitably secured to the front uprights 5.

The drop rollers 84 are journalled on arms 91 (Fig. 2) fixed on a rock shaft 92 which extends transversely of the feeder and is journalled in suitable bearings in the side plates 90. The drop rollers 84 are raised and lowered by a cam 93 secured or formed integrally with the valve driving disk 72 and which engages a roller 94 journalled on an arm 95 that is fixed on the rock shaft 92.

In accordance with the present invention the feeder is provided with novel means by which the rear or trailing portion of each sheet in process of being fed from the pile by the sheet forwarding devices and the feed and drop rollers is raised above the pile and held in raised position until the entire sheet is fed from the pile. In this manner scratching or marking of the next or underlying sheet of the pile by the rear or trailing portion of the forwardly moving sheet is entirely eliminated.

Fixed on the cross member 61 approximately in the center of the feeder is a bracket 96 (Figs. 2 and 7). Journalled in a suitable bearing in the upper end of bracket 96 is a hollow shaft 97 which projects beyond each side of said bracket. Clamped or otherwise suitably secured to the hollow shaft 97 at opposite ends thereof are arms 98 (Figs. 3, 4 and 7) which, in turn, support for swinging movement suction sheet hold-up devices indicated broadly at 99. These suction sheet hold-up devices 99, except for being smaller in size, are constructed and operated in the same manner as the suction sheet separating and forwarding devices disclosed in the aforementioned application Serial No. 116,692 and include cylinders 100 and suction cups 101 that are raised and lowered through the making and breaking of vacuum in said cylinders.

The making and breaking of vacuum in the cylinders 100 is effected by the valve 67 at the same time that vacuum is created and broken by said valve in the cylinders 73 of the sheet forwarding devices. For this purpose the cylinders 100 are connected by flexible hose 102 (Fig. 1) with opposite ends of a conduit 103 (Fig. 2) which, in turn, is connected by a flexible hose 104 with the part of the valve housing 55 that is connected with the cylinders 73 of the sheet forwarding devices. The conduit 103 is supported in any suitable manner on a vertically extending plate 105 (Figs. 2 and 5) which is bolted or otherwise suitably secured on the inner end of the bracket 96.

It will thus appear that when the cylinders 73 of the sheet forwarding devices are swung rearwardly by the described means for this purpose and vacuum is established therein to cause the suction cups 74 to engage and lift the front portion of the separated sheet, vacuum is also established in the cylinders 100 of the sheet hold-up devices 99 to cause the suction cups 101 to engage and lift the rear portion of said sheet thus lifting the entire sheet from the top of the pile as shown in full lines in Fig. 3 of the drawings. When the sheet is lifted at the front and rear thereof as aforesaid, the cylinders 73 and 100 are moved forward and bodily carry the sheet between the feed rollers 83 and the raised drop rollers 84 as shown in dotted lines in Fig. 3 of the drawings, the forward movement of the cylinders 73 being effected by the described means for this purpose, and the forward movement of the cylinders 100 being effected by the forwardly moving sheet through engagement of the suction cups 101 therewith.

After the front edge of the sheet is delivered between the feed rollers 83 and raised drop rollers 84, vacuum is simultaneously broken in the sheet forwarding devices and in the sheet hold-up devices to release the sheet whereupon the drop rollers 84 are lowered by the described means for this purpose to engage said sheet and assist feeding of the same forwardly from the pile by the feed rollers 83 and conveyor tapes 85. When vacuum is broken in the sheet hold-up devices 99 and the sheet is released thereby said devices return by gravity to their original full-line positions shown in Figs. 2, 3 and 4 in readiness to act on the next sheet of the pile.

In order to limit the rearward movement of the sheet hold-up devices 99 and to prevent rebound-

ing of said devices when they return by gravity to their original positions, the tubular shaft 97 has fixed thereon to rock therewith a plate-like arm 106 (Figs. 5 and 7) which engages a suction cup 107 secured in any suitable manner on the upper end of the plate 105. This arm 106 is bifurcated at its lower end to engage opposite sides of the bracket 96 and prevent endwise displacement of the tubular shaft 97 in said bracket. The arm 106 is provided with a restricted opening 108 (Fig. 5) in line with the interior of the suction cup 107, said opening being of a size small enough to enable vacuum to be created in the cup 107 when the latter is engaged by the arm 106. It will thus appear that when the sheet hold-up devices 99 swing rearwardly by gravity the arm 106 will swing forwardly, engage the suction cup 107, and exert sufficient pressure thereon to cause said cup to adhere to the arm 106 and thereby hold said sheet hold-up devices against further rearward movement and also against rebounding until such time that sufficient air enters through the restricted opening 108 to release the cup 107 from the arm 106. The sheet hold-up devices 99 then hang free in readiness to be drawn forward by the next sheet to be acted upon.

Prior to the release of the forwarded sheet by the sheet forwarding and hold-up devices, and lowering of the drop rollers 84 on the sheet, the rear or trailing portion of said forwarded sheet is, in accordance with the present invention, engaged by a second set of sheet hold-up devices indicated broadly at 109. These sheet hold-up devices 109 maintain the rear or trailing portion of the sheet in raised position until a major portion of said sheet is fed from the pile by the feed and pressure rollers 83 and 84, and are preferably mounted, constructed and operated as follows. Extending longitudinally of the feeder at the top thereof is a bar 110 (Figs. 1 and 2). This bar 110 is clamped or otherwise suitably secured at the rear end thereof in a bracket 111 which is clamped or otherwise suitably secured to the stay shaft 10. The front end of the bar 110 is bolted or otherwise suitably secured to the upper end of a bar 112 the lower end of which rests on the tubular shaft 53. Clamped to the bar 110 and movable therealong to various positions is a bracket 113 which has journalled in the lower bifurcated end thereof a short shaft 114.

Fixed on the short shaft 114 between the arms of the bracket 113 is one end of an arm 115 (Fig. 2) which has clamped or otherwise suitably secured in the opposite end thereof a vertically extending tubular rod 116. Secured to or formed integrally with the tubular rod 116 at the lower end thereof is a laterally extending tubular rod 117 which supports at its opposite ends the sheet hold-up devices 109. The construction and operation of the sheet hold-up devices 109 is the same as the construction and operation of the sheet hold-up devices 99 and said devices include cylinders 118 and suction cups 119 that are raised and lowered through the making and breaking of vacuum in said cylinders.

The making and breaking of vacuum in the cylinders 118 at proper intervals is effected by a separate valve mechanism indicated broadly at 120 (Figs. 1 and 6). For this purpose the cylinders 118 are connected by flexible hose 121 with opposite ends of a conduit 122 (Fig. 2) which is supported in any suitable manner on the tubular rod 116. The conduit 122 has connected therewith one end of a flexible hose 123 the opposite end of which is connected with one side of a tubular T-fitting 124 (Fig. 6) that is secured in one side of the housing 125 of valve mechanism 120 and communicates with a bore 126 formed in said housing. This housing 125 is mounted at one side of the feeder on the tubular shaft 53 and secured thereto in any suitable manner. Connected with the opposite side of the housing 125 and communicating with the bore 126 therein below the T-fitting 124 is one end of a flexible hose 127 (Figs. 1 and 6) the opposite end of which is connected with the vacuum side 54 of the tubular shaft 53.

Slidably mounted in the bore 126 of housing 125 is a valve 128 (Fig. 6) which projects downwardly through the housing and is provided on the lower end thereof with a roller 129 journalled on a pin 130. The roller 129 engages a cam 131 (Figs. 1, 3 and 4) fixed on and rotated by the cam shaft 20. To accommodate sheets of various lengths the cam 131 consists of an outer member 132 and an inner member 133 which is rotatably adjustable on the outer member 132 by a curved slot 134 and bolt 135 to vary the cam dwell and thereby the duration of suction in the cylinders 118 in accordance with the length of sheet being fed. The roller 129 is held in engagement with the cam 131 by a spring 136 (Fig. 6) interposed between the upper closed end of the bore 126 and the upper end of the valve 128. It will thus appear that the valve 128 is cam operated in one direction and spring operated in the opposite direction to make and break vacuum in the sheet hold-up devices 109. Accidental displacement of the valve 128 from the housing 125 is prevented by a pin 137 (Fig. 6) secured in the lower end of the housing and located in the path of a pin 138 that is secured in said valve and projects through a slot 139 formed in said housing.

The valve 128 is provided with a reduced portion 140 (Fig. 6) and the housing 125 is provided in the bore 126 thereof with a chamber 141 formed by the upper and lower ends of spaced bushings 142 and 143 and communicating with flexible hose 127. The housing 125 is also provided in the bore 126 thereof with a second chamber 144 formed by the upper end of the bushing 143 and the lower end of a third bushing 145. This chamber 144 communicates with a relief port 146 formed in the housing 125 and opening outwardly to atmosphere through one side thereof. When the roller 129 of valve 128 is in the low part of cam 131 the valve 128 will be in the position shown in Fig. 6 wherein it will be noted that the reduced portion 140 of the valve is in communication with the flexible hose 127, the chamber 141 and the T-fitting 124. Under these conditions, vacuum is created in the cylinders 118 through the described connections therefor to cause the suction cups 119 to engage and hold up the rear or trailing portion of the sheet when it is released by the first set of hold-up devices 99 as shown in full lines in Fig. 4 of the drawings.

At this time the drop rollers 84 are lowered through the described means for this purpose and the sheet is engaged by said rollers and the feed rollers 83 and advanced from the pile while its rear or trailing portion is maintained in raised position above the pile by the sheet hold-up devices 109 as shown in dotted lines in Fig. 4 of the drawings. It is to be noted that the for-

ward movement of the sheet hold-up devices 109 is effected by the sheet as it is advanced from the pile by the feed and drop rollers 83 and 84 through engagement of the suction cups 119 therewith.

After a major portion of the sheet is advanced from the pile by the feed and drop rollers 83, 84 as shown in dotted lines in Fig. 4 of the drawings, vacuum is broken in the housing 125 and the cylinders 118 of the sheet hold-up devices 109 are opened to atmosphere to cause the suction cups 119 to release the sheet. This is effected by the valve 128 which through continuous rotation of the cam 131 is raised so that the reduced portion 140 of the valve moves out of communication with the chamber 141 and into communication with the chamber 144 thereby breaking vacuum in the housing 125 and opening the cylinders 118 to atmosphere through the T-fitting 124, the chamber 144 and the relief port 145. When the sheet is released by the sheet hold-up devices 109, said devices are returned to their original position by a spring 147 (Fig. 2) having one end connected with the tubular rod 116 and the opposite end connected with a rearwardly extending arm 148 that is bolted or otherwise suitably secured to the bracket 113.

In order to limit the rearward movement of the sheet hold-up devices 109 and to prevent rebounding of said devices when they are returned to their original position by the spring 147, the tubular rod 117 has secured thereto in any suitable manner a suction cup 149 (Figs. 2 to 4, inclusive). This suction cup 149 engages the flat front side of a housing 150 (Fig. 5) with sufficient pressure to cause said cup to adhere to said housing and thereby hold the sheet hold-up devices 109 against further rearward movement and also against rebounding. The housing 150 is secured as by bolts 151 to the lower end of the plate 105. This housing 150 is provided with a bore 152 (Fig. 5) which is closed at its upper and lower ends by plates 153 and 154, respectively, that are bolted or otherwise suitably secured to said housing. Slidably mounted in the bore 152 is a plunger 155 provided with a reduced portion 156 which, under certain conditions, communicates with a port 157 formed in the front side of the housing 150 in line with the interior of the suction cup 149 and a port 158 opening outwardly to atmosphere through another side of said housing. The plunger 155 is normally held in its lowermost position by a spring 159 interposed between said plunger and the plate 153.

When the plunger 155 is in the lowermost position as shown in Fig. 5 the reduced portion 156 thereof will be disposed slightly below the ports 157 and 158 so that the port 157 is closed to atmosphere to enable the suction cup 149 to adhere to the front side of the housing 150. When the plunger 155 is raised, however, to move reduced portion 156 thereof in line with the ports 157 and 158, air enters into the suction cup 149 through the port 158, reduced portion 156 and port 157 to break the vacuum grip of said cup on the housing 150 so that the sheet hold-up devices 109 are free to be drawn forward by the sheet engaged thereby. To prevent the plunger 155 from becoming "air bound" at the bottom of the housing 150, the plate 154 is provided with a port 160.

Raising of the plunger 155, as previously described, is effected by vacuum and at the same time that vacuum is created in the cylinders 118 of the sheet hold-up devices 109. For this purpose the plate 153 has connected therewith one end of a flexible hose 161 (Figs. 1, 2 and 5) the opposite end of which is connected with the opposite side of the tubular T-fitting 124. It will thus appear that when vacuum is established in the cylinders 118 of the sheet hold-up devices 109 by the valve mechanism 120 to cause the suction cups 119 thereof to engage and hold up the rear or trailing portion of the sheet, vacuum is simultaneously established in the housing 150 above the plunger 155 to raise said plunger and release said sheet hold-up devices for forward movement as previously described. Likewise, when vacuum is broken in the cylinders 118 to cause the suction cups 119 to release the advancing sheet, vacuum is simultaneously broken in the housing 150 whereupon the plunger 155 is moved to its lowermost position by the spring 159 and the port 157 is again closed to atmosphere to enable the suction cup 149 to adhere to the housing when the sheet hold-up devices 109 are returned to their original position by the spring 147.

The operation of the drop rollers 84 is so timed that said drop rollers remain down on the sheet until approximately the entire sheet is advanced from the pile. In order to hold up the rear or trailing portion of the advancing sheet still extending over the pile when released by the sheet hold-up devices 109 additional devices are, in accordance with the present invention, provided which stiffen said remaining portion of the sheet in a longitudinal direction so that it is self-supporting and prevented from sagging and dragging on the next sheet of the pile. These additional devices consist of truncated cone-shaped rollers 162 (Fig. 1) which are fixed at opposite sides of the feed roll shaft 86 and driven thereby. These cone-shaped rollers 162 are each made in two parts bolted together so that they may be readily removed from the shaft 86 and placed thereon in various positions to accommodate sheets of various widths. It will thus appear that when the rear or trailing portion of the sheet is released by the sheet hold-up devices 109, the cone-shaped rollers 162 through cooperation of the drop rollers 84 will bow up opposite sides of the advancing sheet as shown in Fig. 1 so that the trailing portion thereof is stiffened in a longitudinal direction. In this manner the trailing portion of the sheet is made self-supporting and prevented from curving downwardly and dragging on the next sheet of the pile until approximately the entire sheet is fed therefrom at which time the drop rollers 84 are raised and the previously described operations are repeated on the next sheet of the pile.

During each cycle of operation of the feeder the pile of sheets 12 is winded at the top and rear thereof by the devices 62 whereupon the separators 65 descend and engage the top sheet near the rear corners thereof and the air blasts from the devices 62 are discontinued. The separators 65 then raise to lift said corners of the top sheet upwardly and inwardly at which time blasts of air are directed between the pile and the top sheet by the devices 63.

In the meantime the hold-up devices 99 have returned to their rearmost positions and when the sheet has been separated by the devices 65 and winded by the devices 63 said hold-up devices 99 engage the center rear portion of the separated and winded sheet and lift it clear of the pile. The sheet forwarding devices 74 which have also returned to their rearmost positions

engage the sheet at the time the hold-up devices 99 engage it, the sheet separating devices 65 at this time being released from the sheet and the latter being in the full line position thereof shown in Fig. 3 of the drawings. At this time the air blasts from devices 63 are discontinued.

The sheet forwarding devices 74 are then swung forwardly by the described means for this purpose and through engagement of the sheet therewith and with the suction cups 101 of the hold-up devices 99 swing the latter forward so that during advance of the sheet they hold the rear edge thereof above the pile clear of the same to prevent the advancing sheet from scratching or marking the one below. At this time the drop rollers 84 are raised and the front edge portion of the sheet is delivered between said rollers and the feed rollers 83. About this time the sheet hold-up devices 109, which have been returned to their rearmost positions by the spring 147, grip the rear portion of the sheet. The sheet forwarding devices 74 and the cups 101 of the rear hold-up devices 99 are then released from the sheet at which time the drop rollers 84 descend and with the feed rollers 83 feed the sheet forwardly. The sheet forwarding devices 74 and the sheet hold-up devices 99 then return to their rearmost positions for action on the next sheet, the preceding sheet in the meantime being fed forwardly by the feed and drop rollers 83, 84 and the rear portion of said sheet being held up above the pile by sheet hold-up devices 109.

The sheet hold-up devices 109 continue to grip and hold up the rear of the advancing sheet until the major portion thereof has been moved forwardly of the pile by the feed rollers 83 and the drop rollers 84. This is illustrated by the dotted line positions of the advancing sheet and the sheet hold-up devices 109 in Fig. 4 of the drawings. When the sheet and said devices 109 have reached the aforesaid dotted line positions, said devices are released from the sheet and return to their full line positions shown in Figs. 2 and 3 of the drawings. At this time the small rearward portion of the advancing sheet remaining over the pile is stiffened by the conical rollers 162 so that said portion cannot descend and scratch or mark the underneath sheet. It will thus appear, that through the provision of the sheet hold-up devices 99 and 109, the advancing sheet is positively held up during travel thereof and prevented from dropping on and marking or scratching the underneath sheet. This is further facilitated and accomplished through the stiffening action produced on the remaining outgoing portion of the sheet by the conical feed rollers 162. When the sheet has been completely advanced by the feed rollers 83 and the drop rollers 84 onto the tapes 85, said drop rollers are raised by the disclosed means for this purpose and the described cycle of operation of the parts is repeated in connection with the succeeding sheets to separate and advance them one after another from the pile.

The operation of a feeder constructed in accordance with the present invention will be clearly understood from the foregoing description and while said description and the accompanying drawings set forth with more or less particularity one embodiment of the invention, it is to be expressly understood that said invention is not limited to said embodiment or otherwise than by the terms of the appended claims.

What I claim is:

1. In a sheet feeder, suction devices for gripping and forwarding sheets one after another from a pile or supply thereof, pivoted suction sheet hold-up devices arranged to swing forwardly and rearwardly and adapted to grip and hold the rear or trailing portion of each sheet raised from the pile or supply while the sheet is being forwarded by said first named suction devices, forward movement being imparted to said sheet hold-up devices by said first named suction devices through gripping of the sheet by both of the same, means for making and breaking vacuum in the sheet forwarding devices and the sheet hold-up devices at proper intervals, and means for limiting the rearward movement of the sheet hold-up devices when they swing rearwardly to their original positions and for holding said devices against rebounding.

2. In a sheet feeder, a conveyor comprising a feed roller and drop rollers cooperating therewith for gripping and advancing sheets delivered therebetween from a pile or supply of sheets, means for driving said feed roller, mechanism for raising and lowering said drop rollers, reciprocating suction sheet hold-up devices engaging the rear or trailing portion of each sheet and actuated forwardly through such engagement by said feed and drop rollers, means for moving the sheet hold-up devices rearwardly, and means for limiting the rearward movement of the sheet hold-up devices and for preventing said devices from rebounding.

3. In a sheet feeder, conveying means for gripping and advancing sheets from a pile or supply of sheets toward a machine to be fed, suction means for gripping and holding the rear or trailing portion of each sheet out of contact with the pile or supply until a major portion of the sheet is advanced therefrom by said conveying means, valve means for making and breaking vacuum in said suction means at predetermined intervals, and adjustable means for operating said valve means and for varying the time of operation thereof in accordance with the length of sheet acted on by said suction means.

4. In a sheet feeder, conveying means for gripping and advancing sheets delivered thereto from a pile or supply of sheets, means for driving said conveying means, reciprocating suction sheet hold-up means engaging the rear or trailing portion of each sheet and actuated forwardly through said engagement by said conveying means, means for moving the sheet hold-up means rearwardly, and means for limiting the rearward movement of the sheet hold-up means and for holding the same against rebounding comprising a suction cup mounted on the sheet hold-up means, a stationary housing adapted to be engaged and adhered to by said suction cup, said housing having two normally closed ports one of which is covered by the suction cup when engaged with the housing, and a plunger in the housing normally closing the ports thereof and actuated pneumatically to open said ports, release said cup from the housing, and free the sheet hold-up means for forward movement thereof.

5. In a sheet feeder, the combination with sheet separating means arranged to act on opposite rear corner portions of a sheet to separate it from a pile or supply of sheets, and positively actuated sheet forwarding means for advancing the separated sheet relative to the pile or supply, of sheet hold-up means arranged between and in spaced relation with said sheet separating means, the sheet hold-up means acting to engage

and hold the rear portion of the separated sheet raised from the pile or supply while the sheet is being advanced by the positively actuated sheet forwarding means and said sheet hold-up means having forward movement imparted thereto through the sheet by said positively actuated sheet forwarding means.

6. In a sheet feeder, the combination with suction sheet separating means arranged to grip opposite rear corner portions of a sheet to separate it from a pile or supply of sheets, and positively actuated suction sheet forwarding means arranged to grip and advance the separated sheet relative to the pile or supply, of suction sheet hold-up means arranged between and in spaced relation with said suction sheet separating means, the suction sheet hold-up means acting to grip and hold the rear portion of the separated sheet raised from the pile or supply while the sheet is being advanced by the positively actuated suction sheet forwarding means and said suction sheet hold-up means having forward movement imparted thereto through the sheet by said positively actuated suction sheet forwarding means.

7. In a sheet feeder, the combination with suction sheet separating means arranged to grip opposite rear corner portions of a sheet to separate said corner portions from a pile or supply of sheets, and suction sheet forwarding means arranged to grip the front portion of the separated sheet to lift and advance said sheet relative to the pile or supply, of suction sheet hold-up means arranged between and in spaced relation with said suction sheet separating means and being movable toward and away from the pile or supply to grip and lift the intermediate rear portion of the sheet, the suction sheet hold-up means being movable forwardly to hold the rear portion of the sheet in raised position while the sheet is being advanced by the suction sheet forwarding means and said suction sheet hold-up means having forward movement imparted thereto through the sheet by said suction sheet forwarding means.

8. In a sheet feeder, the combination with pneumatic sheet separting means arranged to act on opposite rear corner portions of a sheet to separate said corner portions from a pile or supply of sheets, and pneumatic sheet forwarding means arranged to act on the front portion of the separated sheet to lift and advance said sheet relative to the pile or supply, of pneumatic sheet hold-up means arranged between and in spaced relation with said pneumatic sheet separating means, the pneumatic sheet hold-up means being movable pneumatically toward and away from the pile or supply to lift the intermediate rear portion of the sheet and said pneumatic sheet hold-up means being movable forwardly to hold the rear portion of the sheet in raised position while said sheet is being advanced by said pneumatic sheet forwarding means.

9. In a sheet feeder, the combination with suction sheet separating devices arranged to lift opposite rear corner portions of a sheet from a pile or supply of sheets, and pivoted suction sheet forwarding devices arranged to lift the front portion of the sheet and advance said sheet relative to the pile or supply, of pivoted suction sheet hold-up devices arranged between and in spaced relation with said suction sheet separating devices, the pivoted suction sheet hold-up devices acting to lift the intermediate rear portion of the sheet and hold the rear portion thereof raised from the pile or supply while said sheet is being advanced by the suction sheet forwarding devices and said pivoted suction sheet hold-up devices having forward swinging movement imparted thereto through the sheet by said suction sheet forwarding devices.

10. In a sheet feeder, the combination with suction sheet separating devices arranged to lift opposite rear corner portions of a sheet from a pile or supply of sheets, and reciprocating suction sheet forwarding devices for gripping and lifting the front portion of the sheet and advancing said sheet relative to the pile or supply, of reciprocating suction sheet hold-up devices arranged between and in spaced relation with said suction sheet separating devices, the suction sheet hold-up devices acting to lift the intermediate rear portion of the sheet and hold the rear portion thereof raised from the pile or supply while said sheet is being advanced by the suction sheet forwarding devices and said suction sheet hold-up devices having forward movement imparted thereto through the sheet by said suction sheet forwarding devices, means for limiting rearward movement of the sheet hold-up devices, and means for making and breaking vacuum in the sheet separating devices, the sheet forwarding devices and the sheet hold-up devices at proper intervals.

11. In a sheet feeder, the combination with conveying means for advancing a sheet forwardly of a pile or supply of sheets, and suction means for lifting the sheet from the pile or supply and forwarding the sheet to the conveying means, of suction sheet hold-up means engageable with the rear of the lifted sheet adapted to travel therewith over the top front portion of the pile or supply and thereby prevent the lifted sheet from dragging on said pile or supply while said sheet is being advanced therefrom by said conveying means.

12. In a sheet feeder, the combination with conveying means adjacent the front thereof and adapted to grip a sheet and advance it forwardly of a pile or supply of sheets, and suction means for lifting the sheet from the pile or supply and forwarding the sheet to the conveying means, of suction sheet hold-up means acting to grip the rear of the lifted sheet and travel therewith over the top front portion of the pile or supply to thereby prevent the sheet from dragging on said pile or supply while the sheet is being advanced therefrom by said conveying means, said suction sheet hold-up means having forward movement imparted thereto through the sheet by the conveying means, and means for driving said conveying means.

13. In a sheet feeder, the combination with a conveyor comprising a driven feed roller and pressure rollers cooperating therewith for advancing a sheet forwardly of a pile or supply of sheets, and suction means for lifting the sheet from the pile or supply and forwarding the sheet between said feed and pressure rollers, of pivoted suction sheet hold-up devices engageable with the rear of the lifted sheet, said pivoted suction sheet hold-up devices being arranged to swing forwardly over the top front portion of the pile or supply and thereby prevent the lifted sheet from dragging on said pile or supply while said sheet is being advanced therefrom by said feed and pressure rollers.

14. In a sheet feeder, the combination with conveying means for advancing sheets successively from a pile or supply thereof, and sheet

forwarding means for advancing lifted sheets from said pile or supply to said sheet conveying means, of sheet hold-up means engageable and movable with a lifted sheet to hold said sheet raised while it is being advanced by the sheet forwarding means, and sheet hold-up means adapted to take the advancing lifted sheet from said first named hold-up means and move with and hold said sheet raised while it is being advanced from the pile or supply by said sheet conveying means.

15. In a sheet feeder, the combination with conveying means for advancing sheets successively from a pile or supply thereof, and sheet forwarding means for advancing lifted sheets from said pile or supply to said sheet conveying means, of sheet hold-up means engageable and movable with a lifted sheet to hold said sheet raised while it is being advanced by the sheet forwarding means, sheet hold-up means adapted to take the advancing lifted sheet from said first named hold-up means and move with and hold said sheet raised while it is being advanced from the pile or supply by said sheet conveying means, and means for controlling the operation of both of said sheet hold-up means so that one acts to engage and hold up a sheet advanced by the conveying means and the other acts to engage and hold up a succeeding sheet advanced by said sheet forwarding means.

16. In a sheet feeder, the combination with rear sheet separating means, front sheet forwarding means for lifting sheets successively from a pile or supply and forwarding them in like manner relative thereto, and sheet conveying means to which the lifted sheets are advanced successively by the sheet forwarding means, of sheet hold-up means movable rearwardly to engage a lifted sheet and movable forwardly to hold said sheet lifted from the pile or supply while the sheet is being advanced thereover by the conveying means, and sheet hold-up means movable rearwardly to engage a succeeding lifted sheet and movable forwardly to hold the same raised from the pile or supply while being forwarded by said front sheet forwarding means and until said first named hold-up means moves rearwardly to engage and hold up said succeeding sheet.

17. In a sheet feeder, the combination with conveying means for advancing a sheet forwardly from a pile or supply of sheets, and suction sheet forwarding devices for lifting the front portion of the sheet from the pile or supply and forwarding the sheet to the conveying means, of means for holding the sheet raised above the pile or supply while said sheet is being forwarded by the suction sheet forwarding devices and advanced from the pile or supply by the conveying means, said holding means comprising two sets of rearwardly disposed suction devices, one set of suction devices being adapted to lift the rear portion of the sheet from the pile or supply and travel therewith over the top rear portion of the pile or supply while the sheet is being forwarded by said suction sheet forwarding devices, and the other set of suction devices being adapted to take the lifted sheet at the rear thereof from the first set of suction devices and travel therewith over the rear and front portions of the pile or supply while the sheet is being advanced by said conveying means, and valve means for controlling the operation of said two sets of suction devices in proper timed relation with each other.

18. In a sheet feeder, the combination with conveying means for advancing a sheet forwardly of a pile or supply of sheets, and suction sheet forwarding devices for lifting the front portion of the sheet from the pile or supply and forwarding the sheet to the conveying means, of means for holding the sheet raised above the pile or supply while said sheet is being forwarded by the suction sheet forwarding devices and advanced from the pile or supply by the conveying means, said holding means comprising two sets of rearwardly disposed suction devices, one set of suction devices being adapted to lift the rear portion of the sheet from the pile or supply and travel therewith over the top rear portion of the pile or supply while the sheet is being forwarded by said suction sheet forwarding devices, said set of suction devices having forward movement imparted thereto through the sheet by said suction forwarding devices, and the other set of suction devices being adapted to take the lifted sheet at the rear thereof from the first set of suction devices and travel therewith over the rear and front portions of the pile or supply while the sheet is being advanced by said conveying means, said last named set of suction devices having forward movement imparted thereto through the sheet by said conveying means, and valve means for controlling the operation of said two sets of suction devices in proper timed relation with each other.

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