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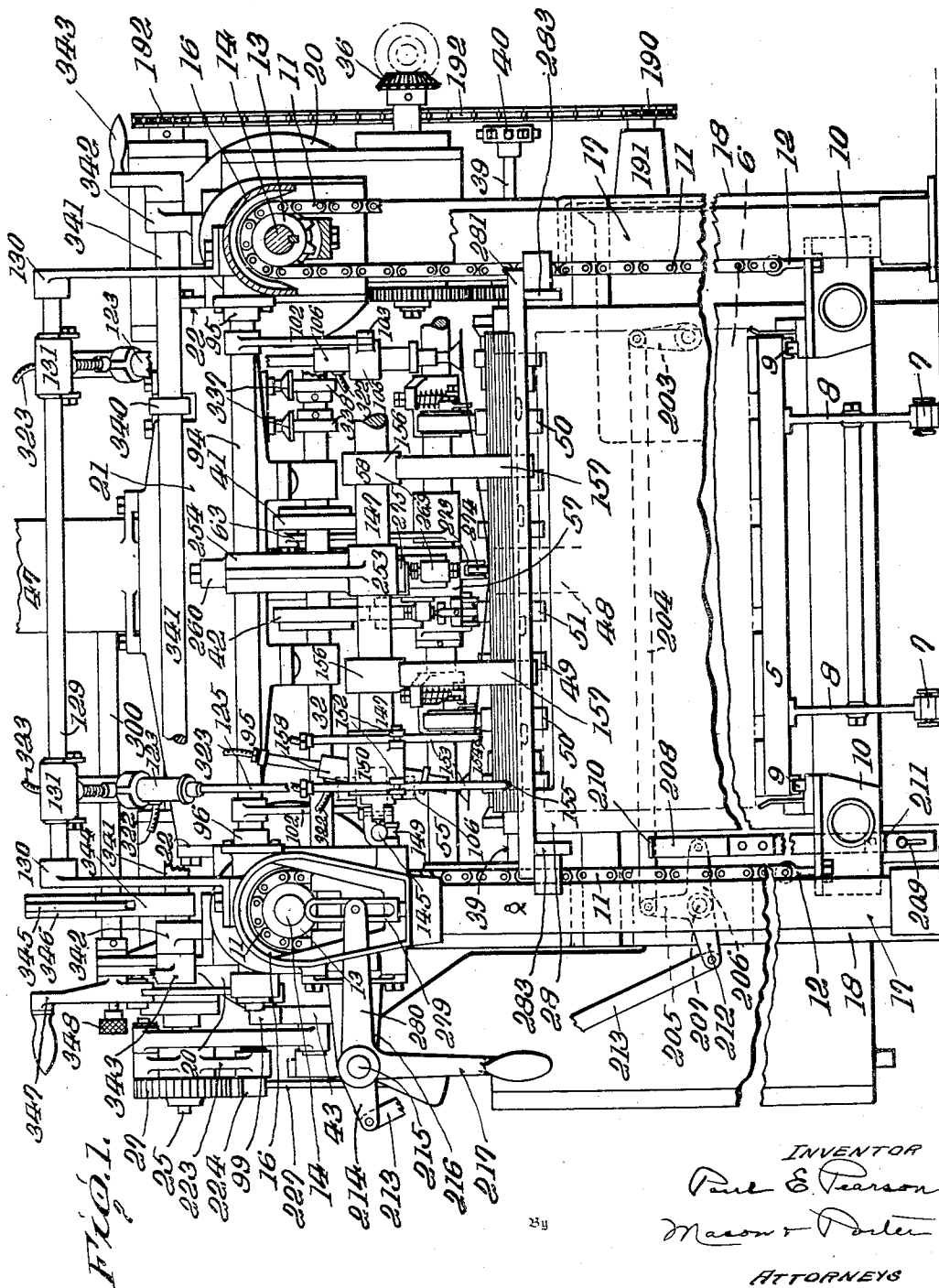
P. E. PEARSON

2,268,299

SHEET FEEDING MECHANISM

Filed May 11, 1940

18 Sheets-Sheet 1



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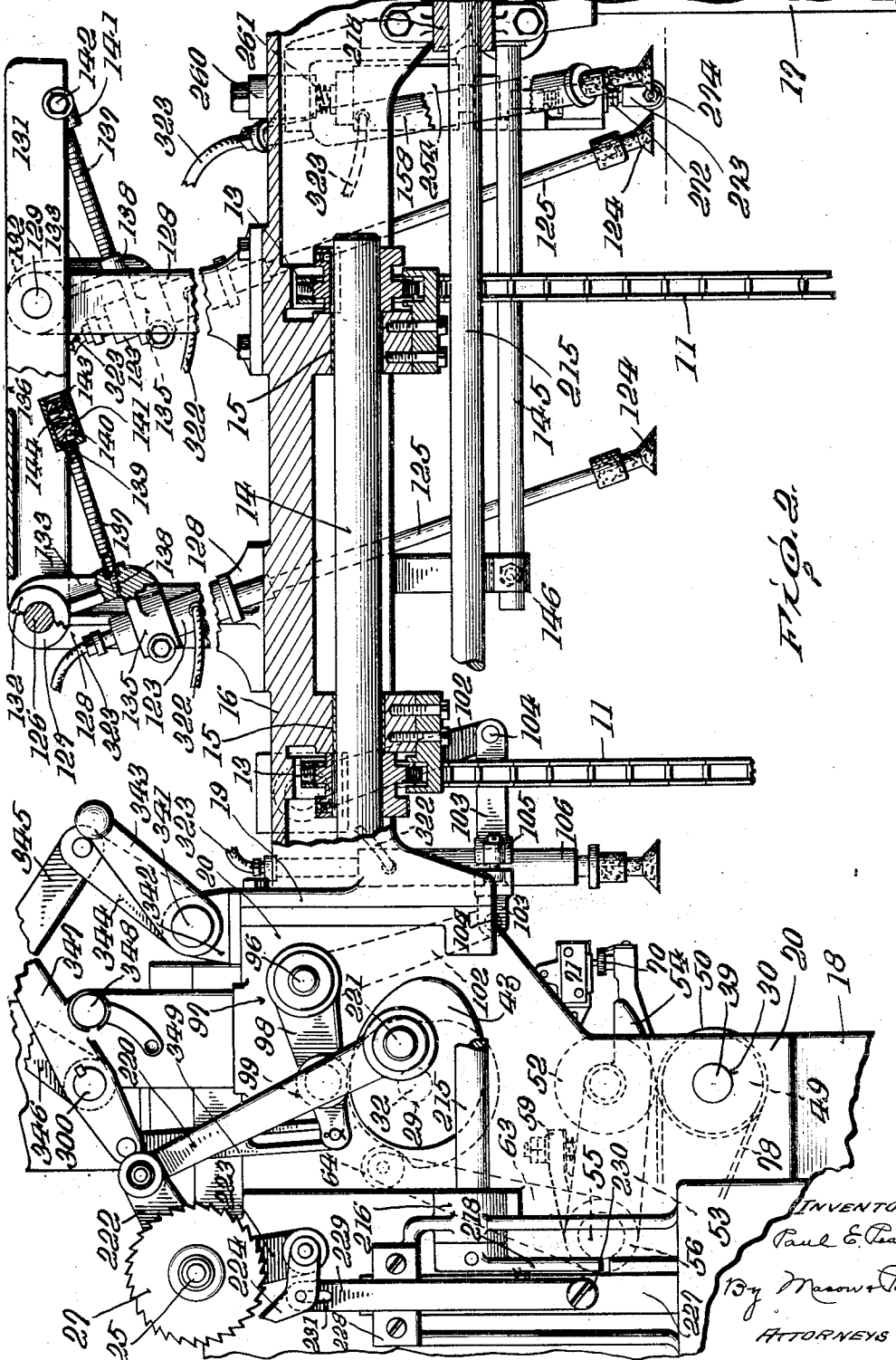
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SHEET FEEDING MECHANISM

Filed May 11, 1940

18 Sheets-Sheet 2



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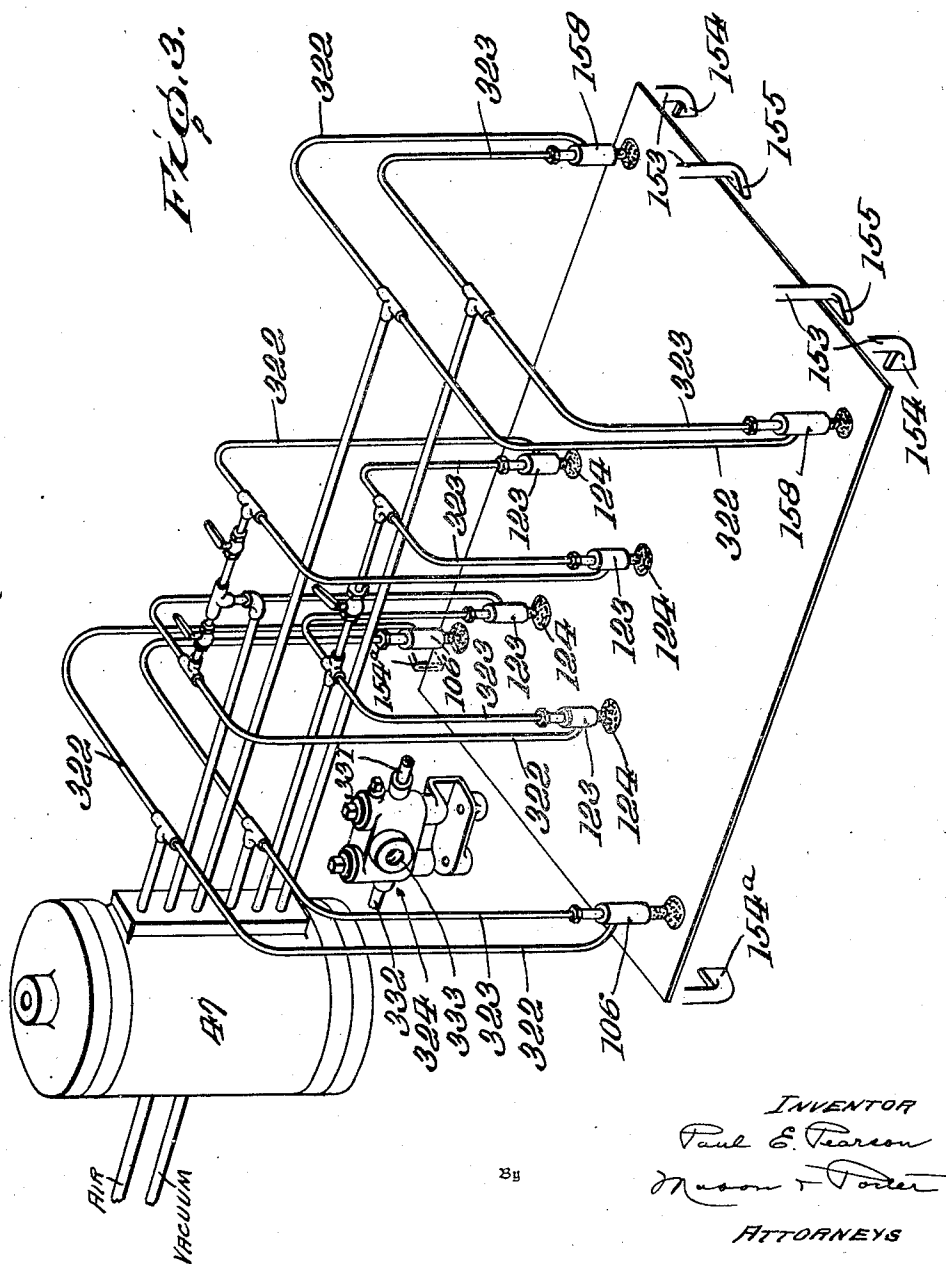
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SHEET FEEDING MECHANISM

Filed May 11, 1940

18 Sheets-Sheet 3



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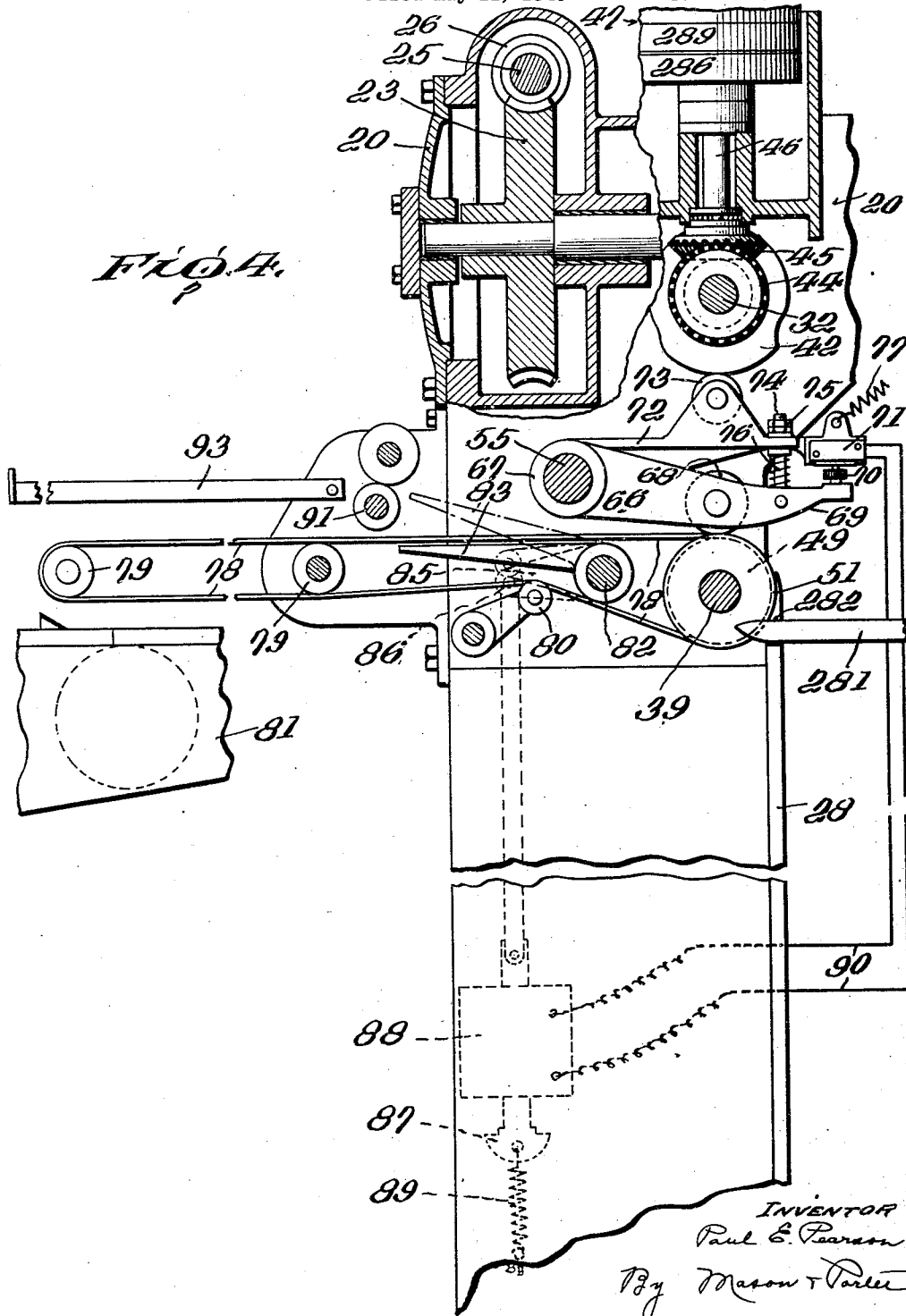
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SHEET FEEDING MECHANISM

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18 Sheets-Sheet 4



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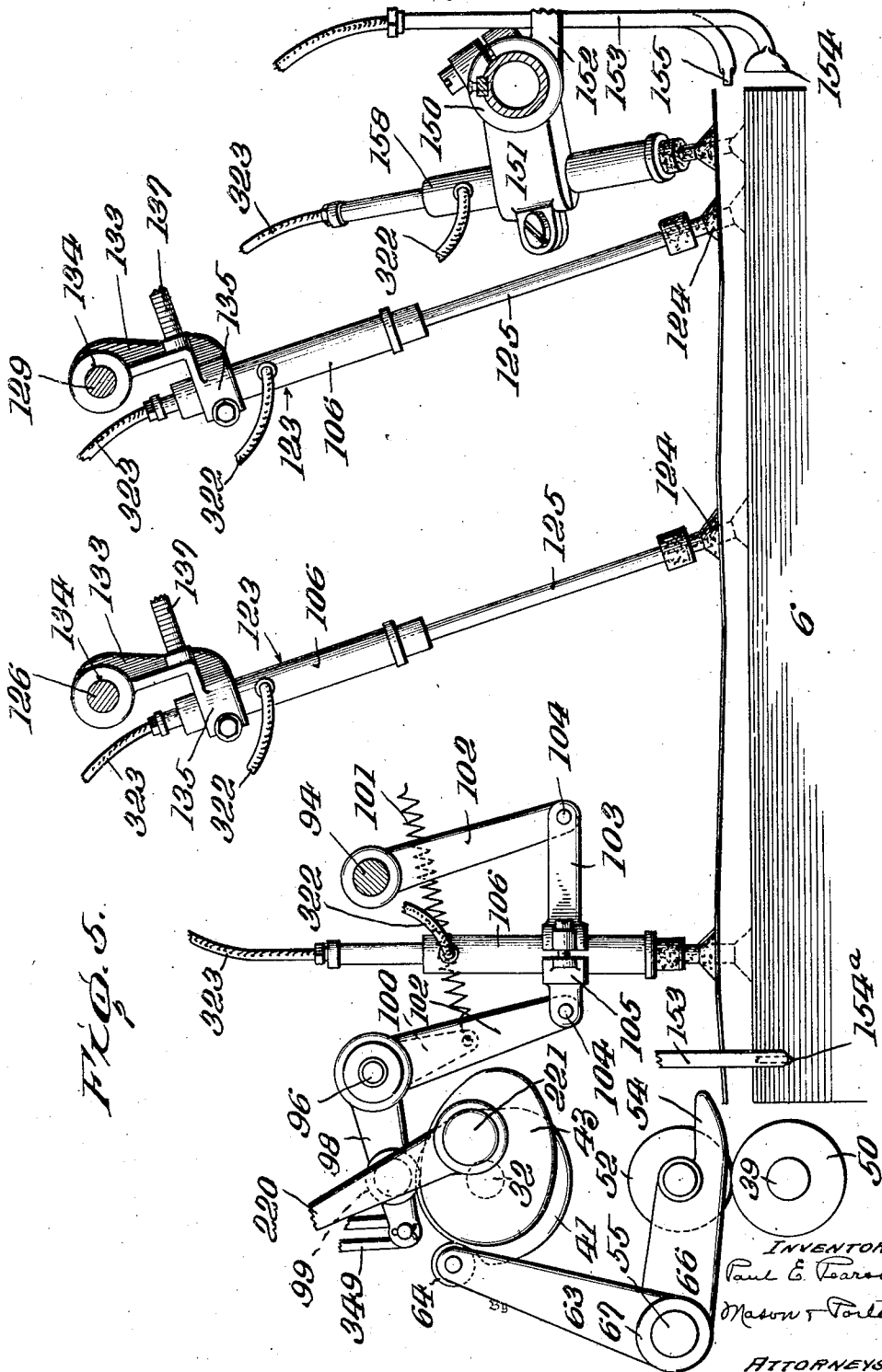
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SHEET FEEDING MECHANISM

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18 Sheets-Sheet 5



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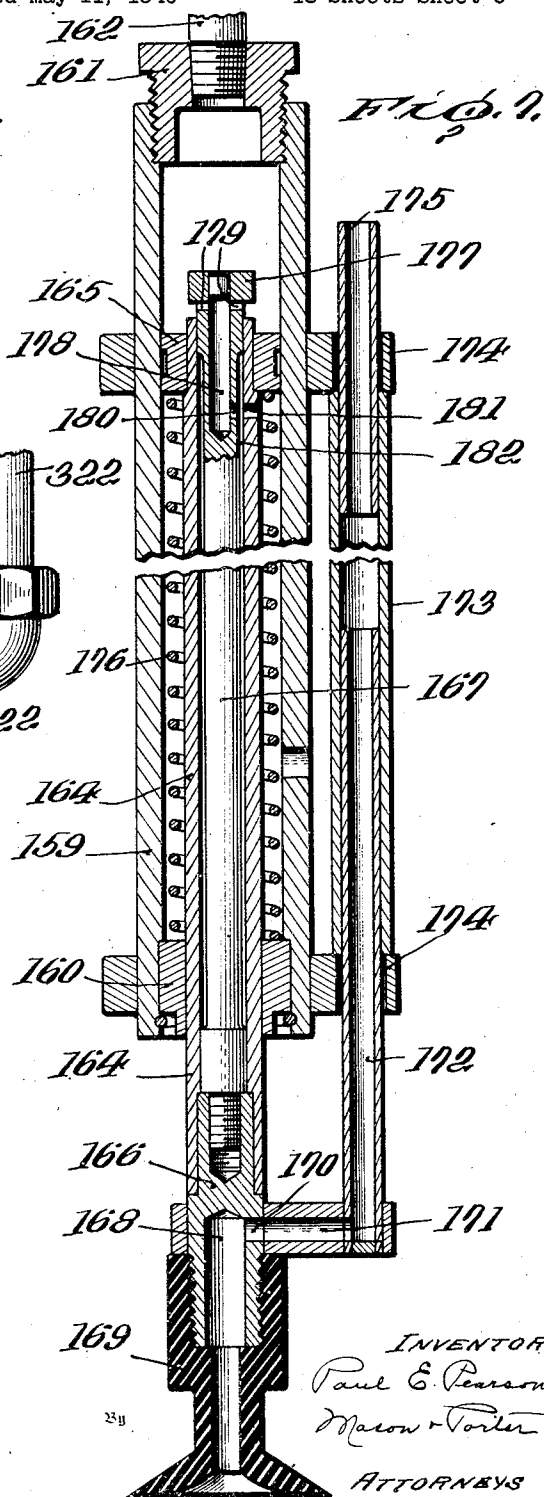
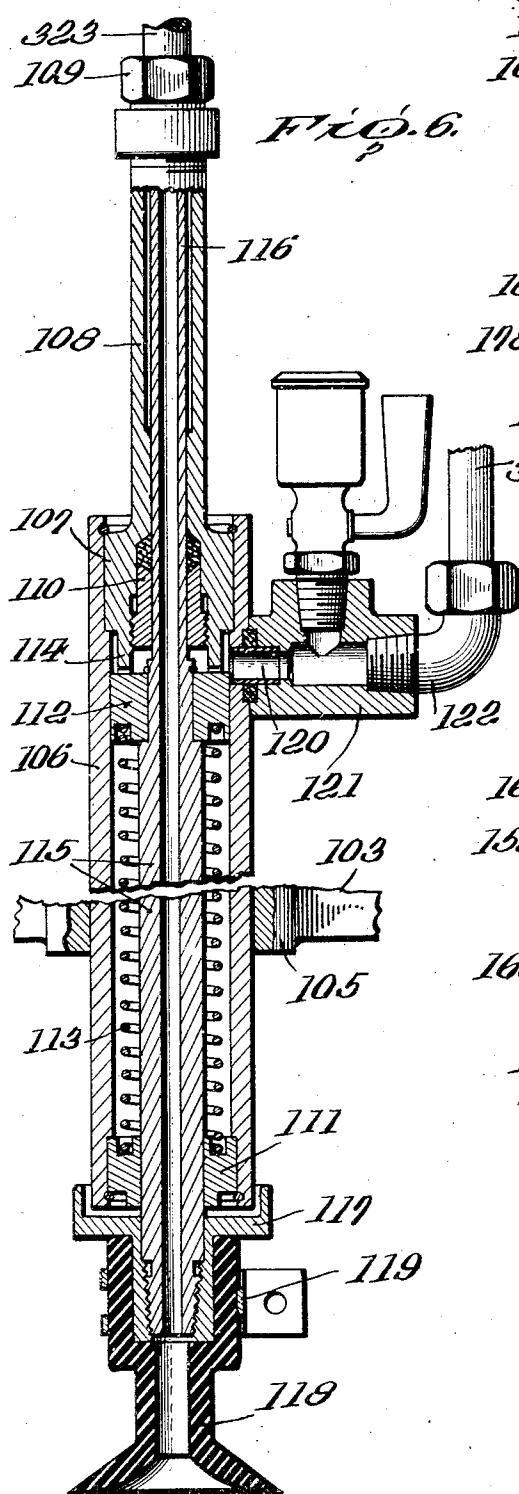
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SHEET FEEDING MECHANISM

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18 Sheets-Sheet 6



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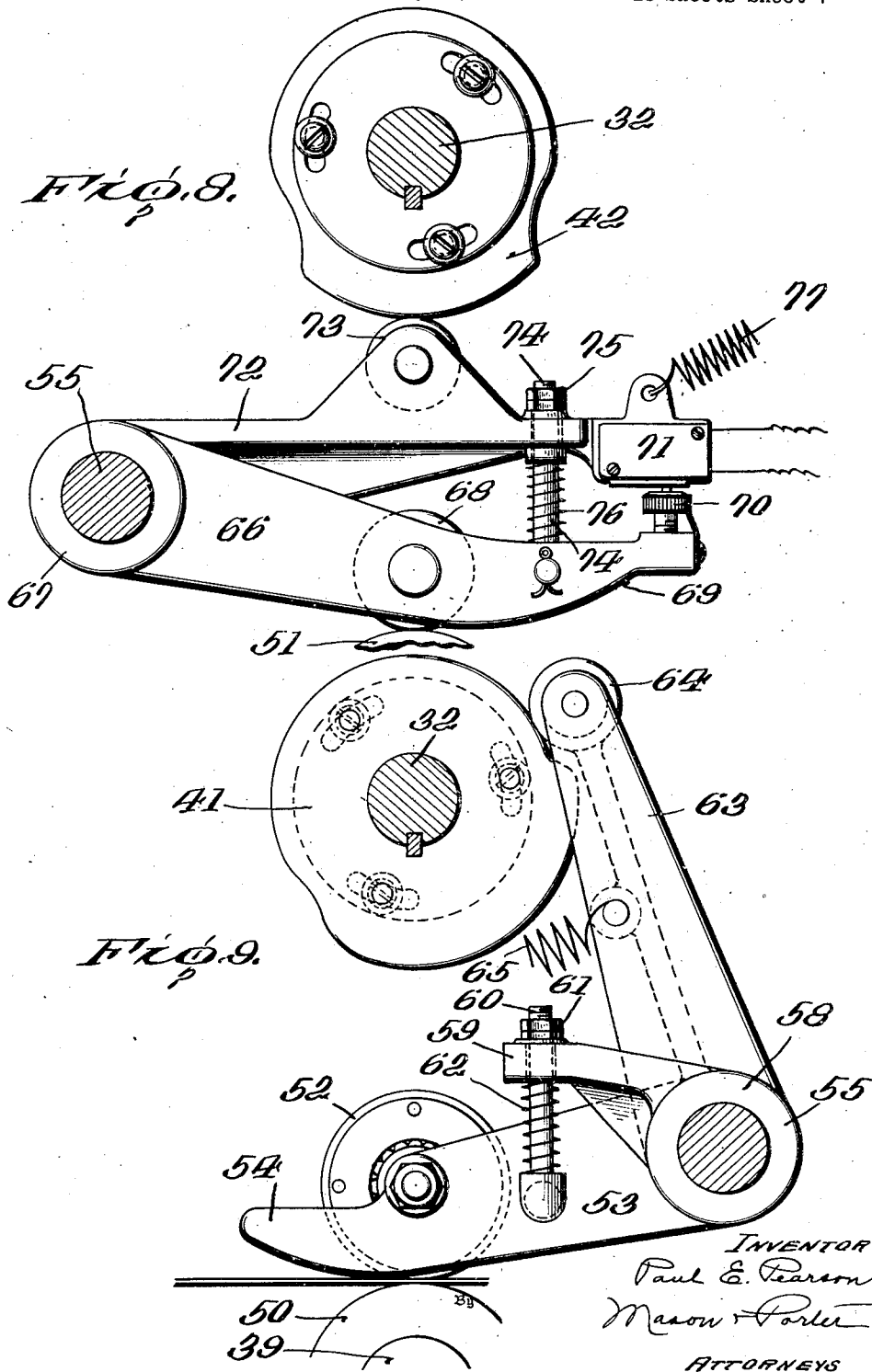
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SHEET FEEDING MECHANISM

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18 Sheets-Sheet 7



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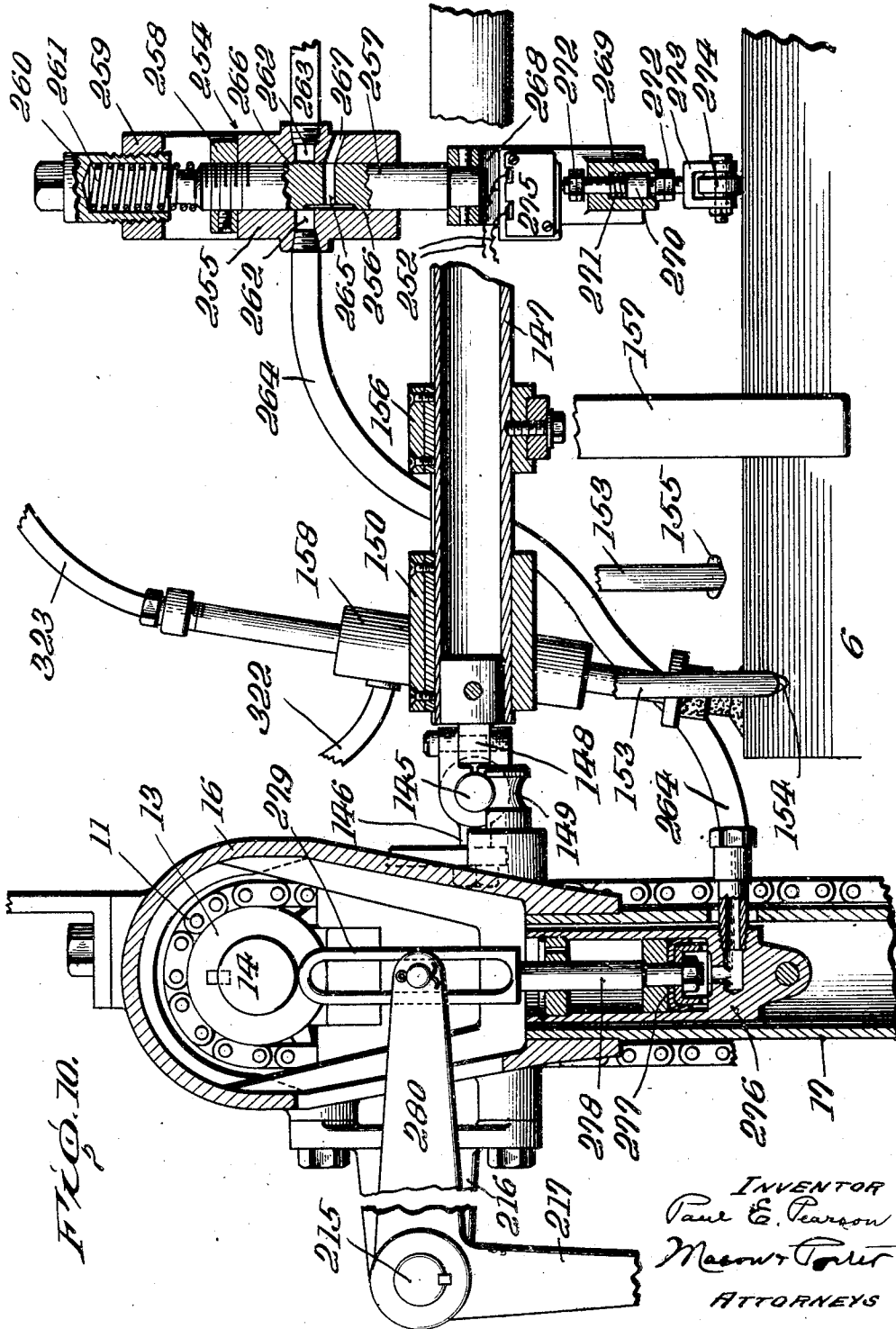
P. E. PEARSON

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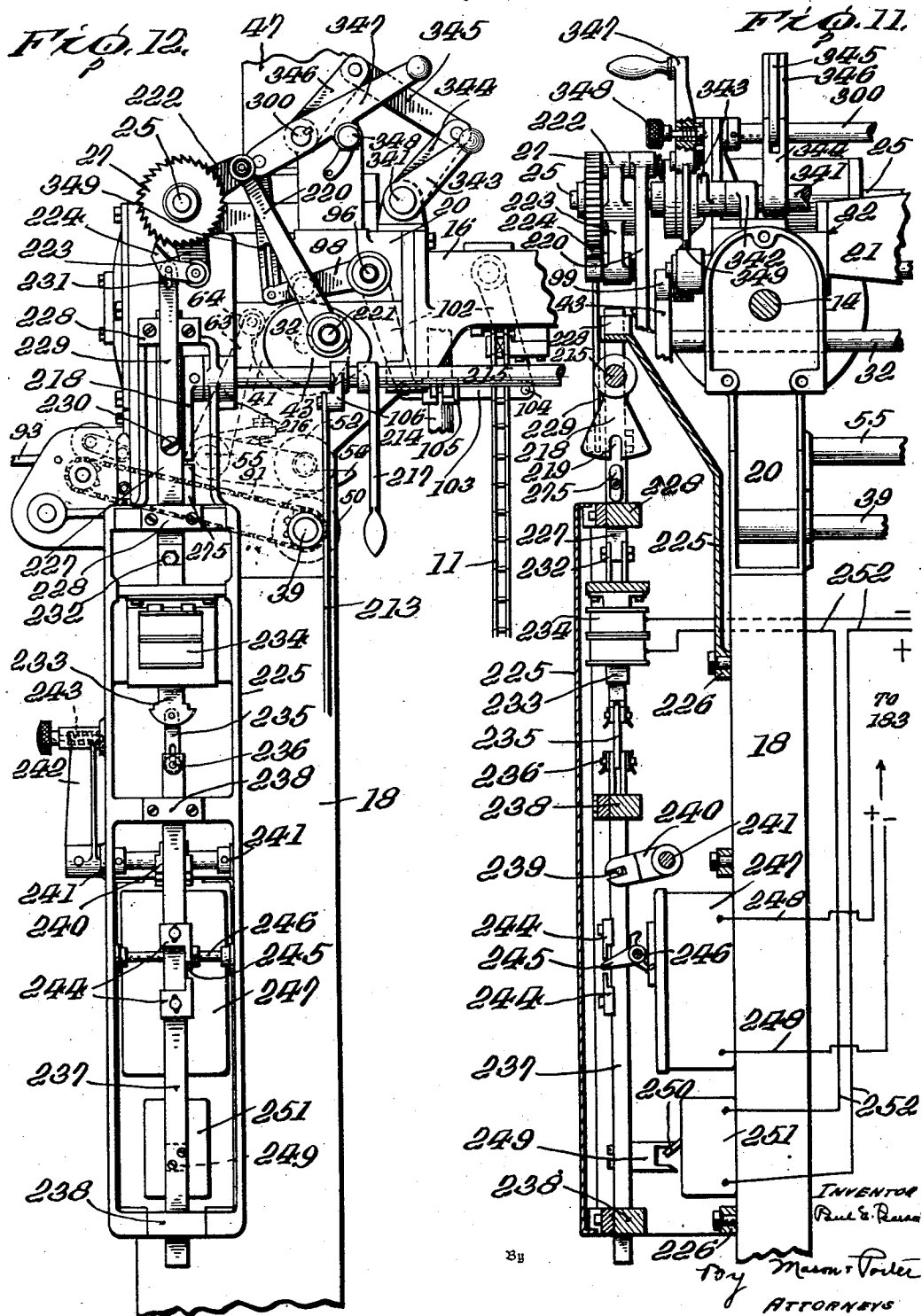
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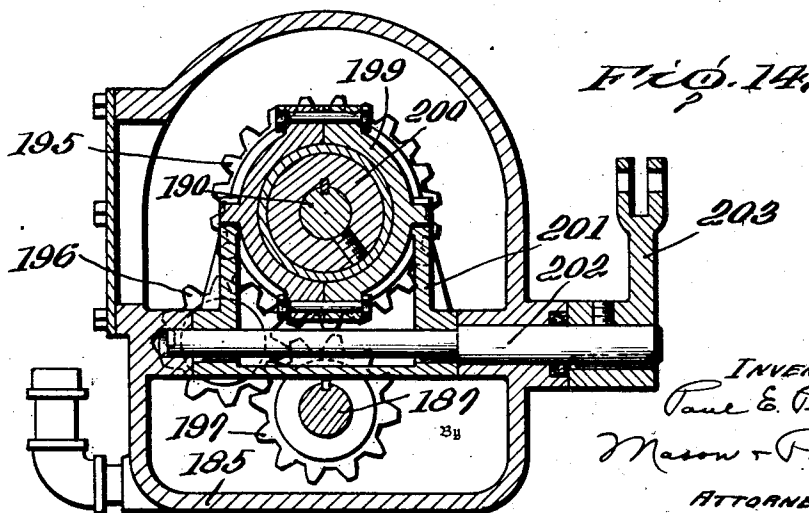
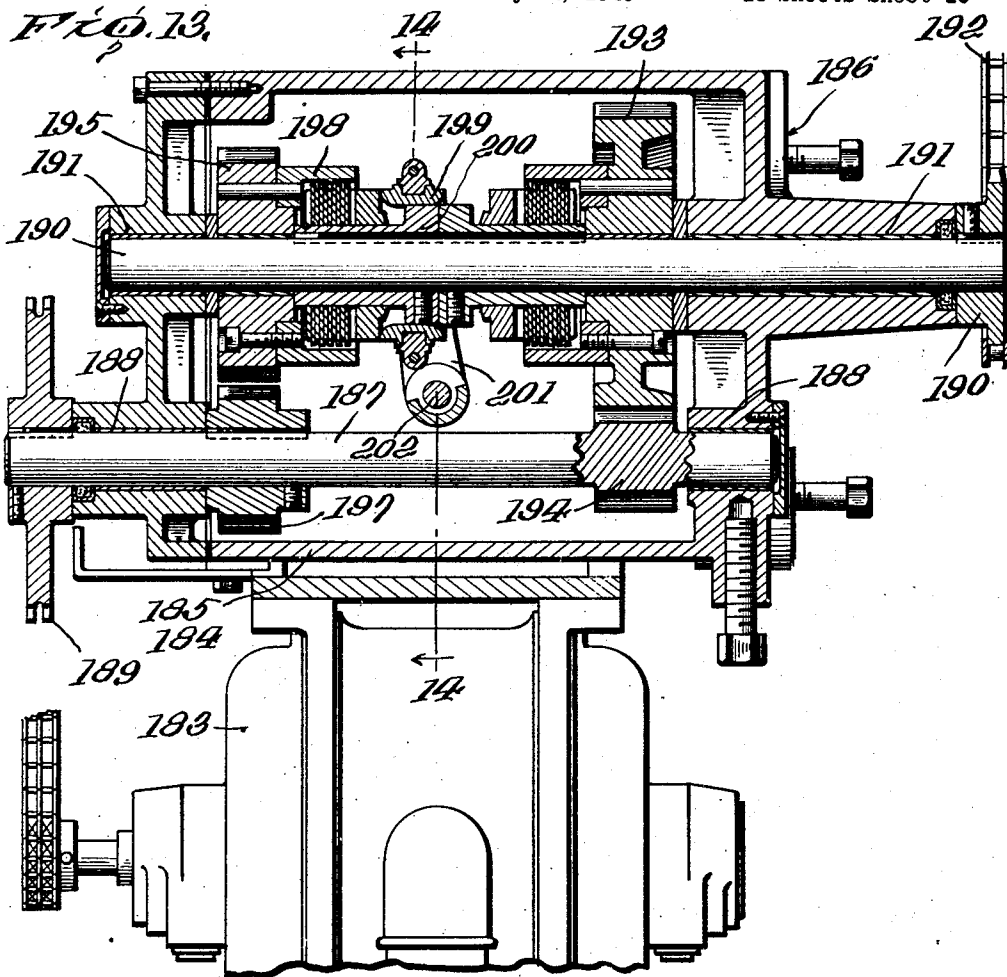
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18 Sheets-Sheet 10



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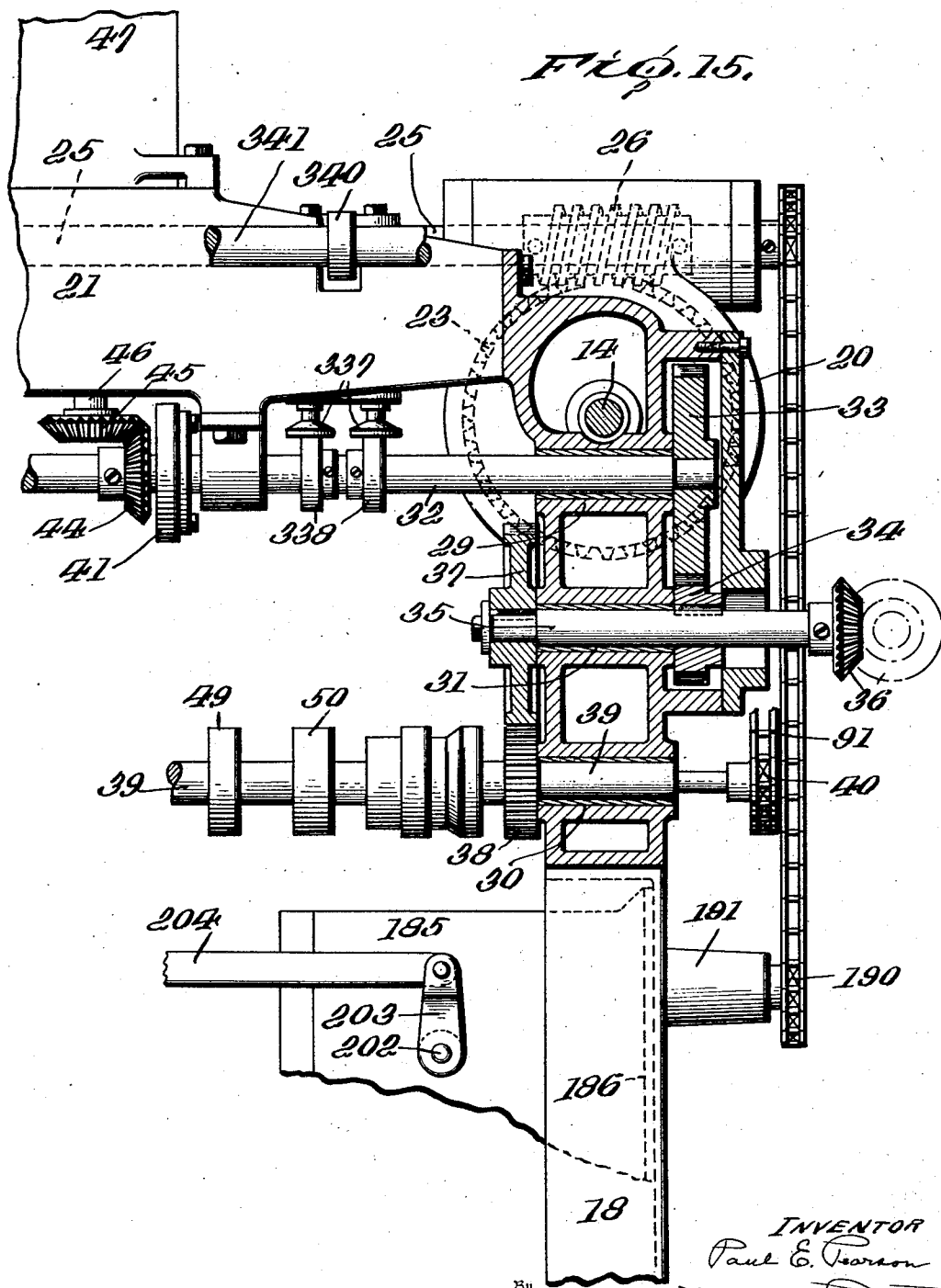
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SHEET FEEDING MECHANISM

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18 Sheets-Sheet 11 •



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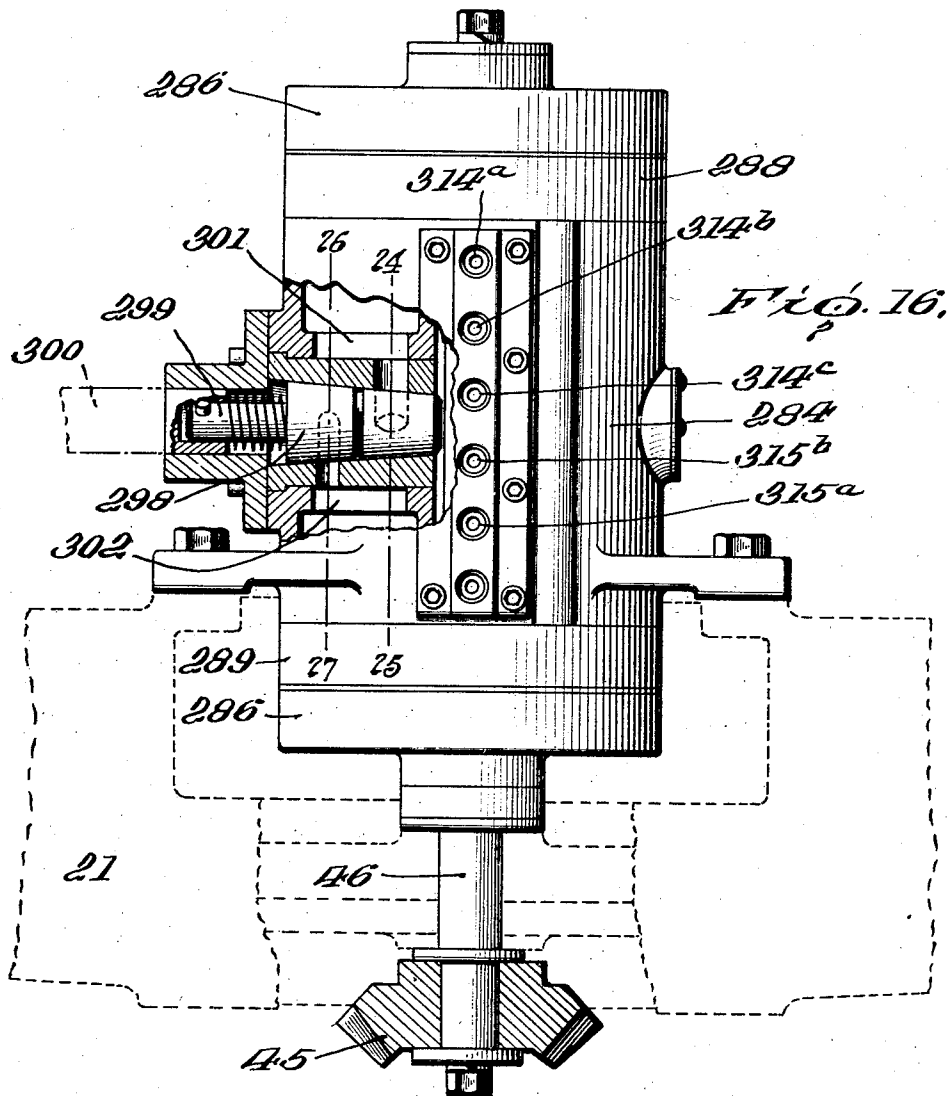
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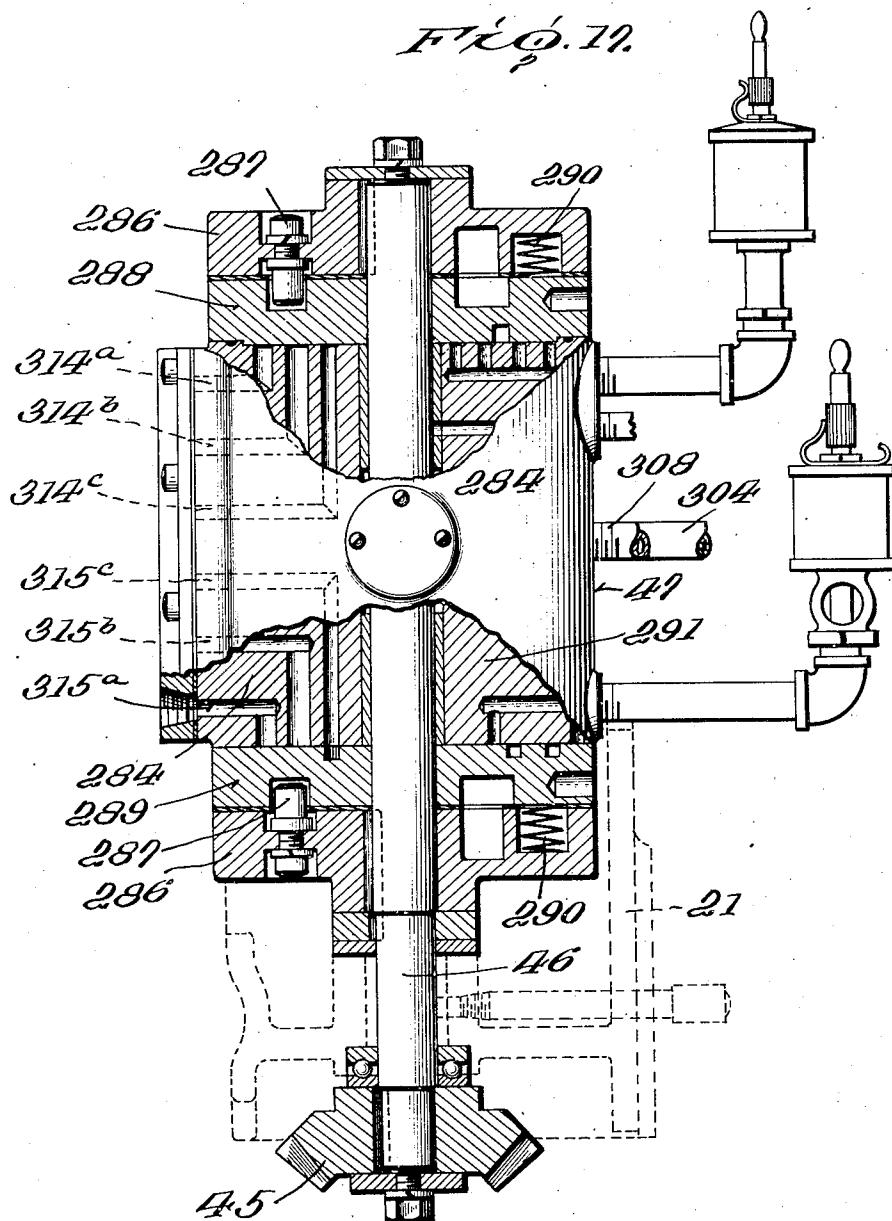
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FIG. 11.



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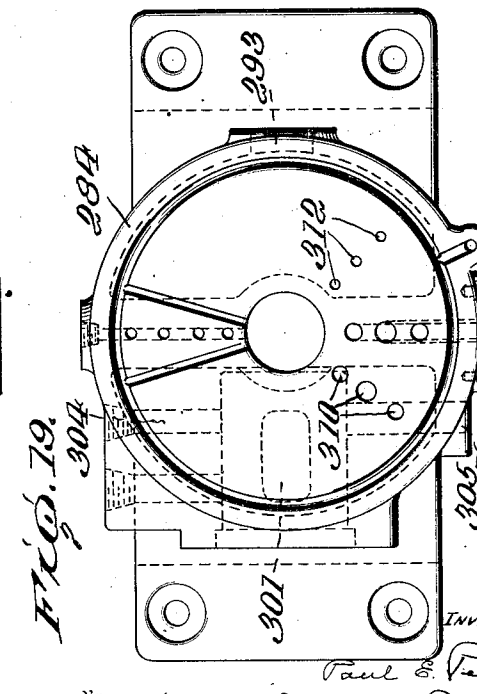
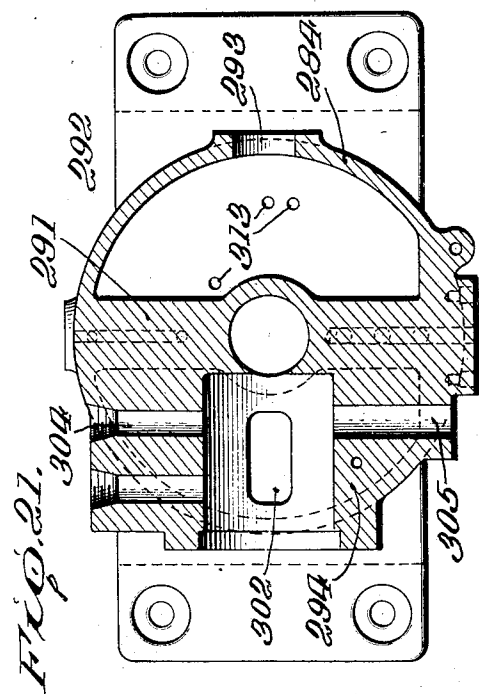
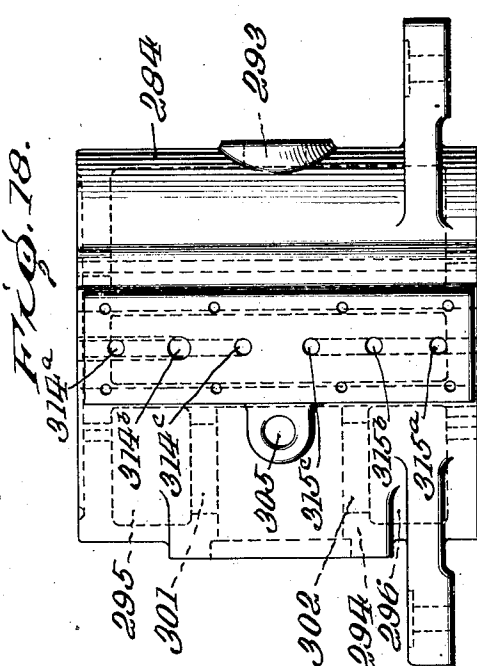
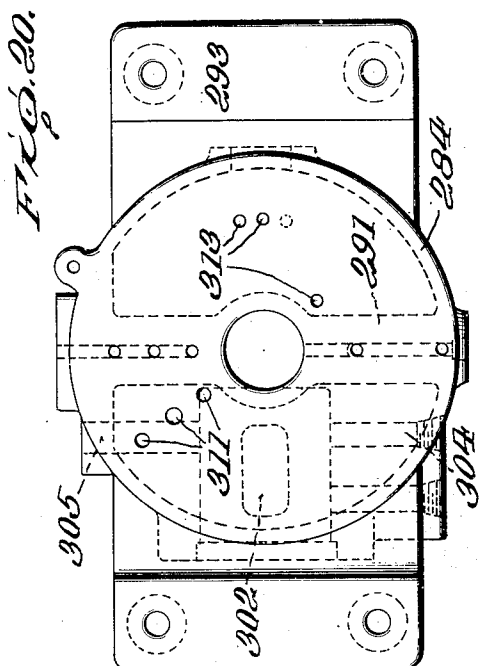
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SHEET FEEDING MECHANISM

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18 Sheets-Sheet 14



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SHEET FEEDING MECHANISM

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FIG. 22.

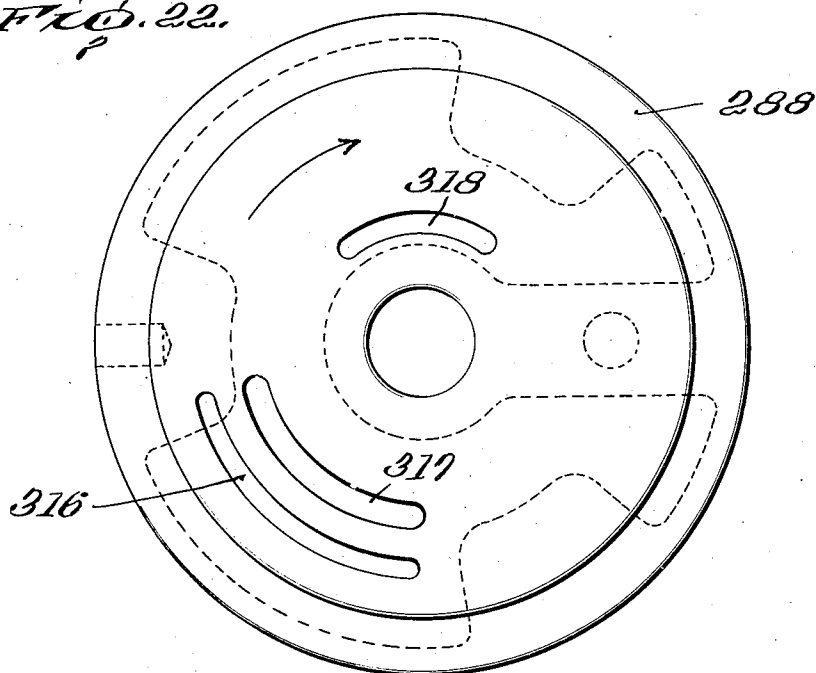
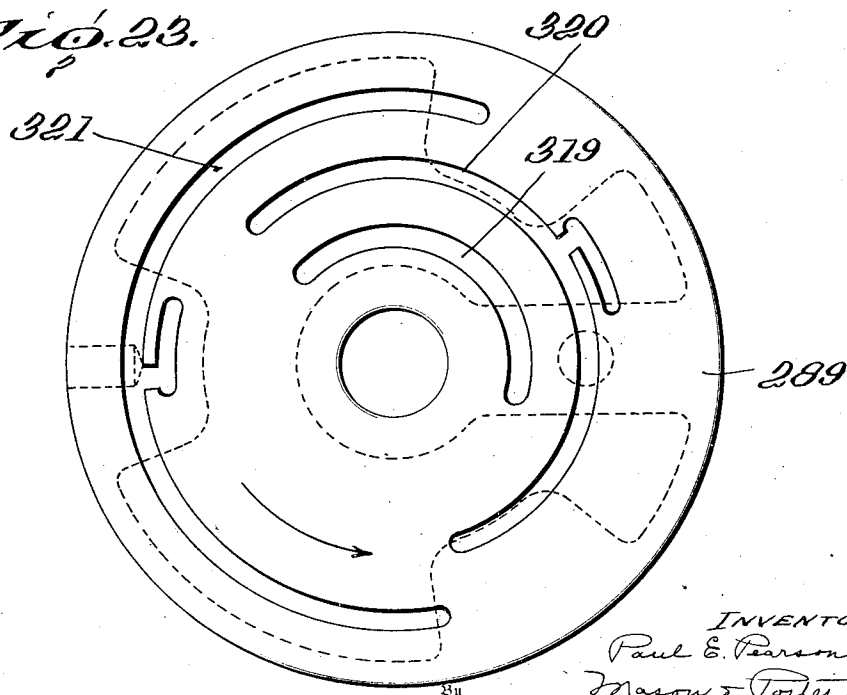


FIG. 23.



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FIG. 24.

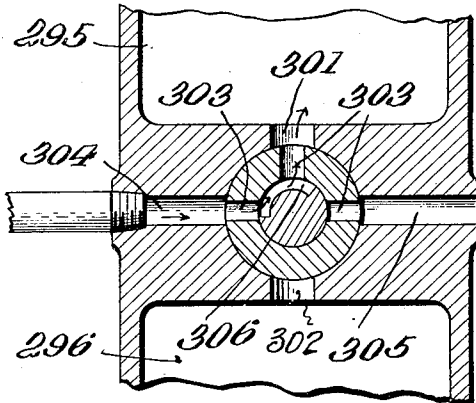


FIG. 26.

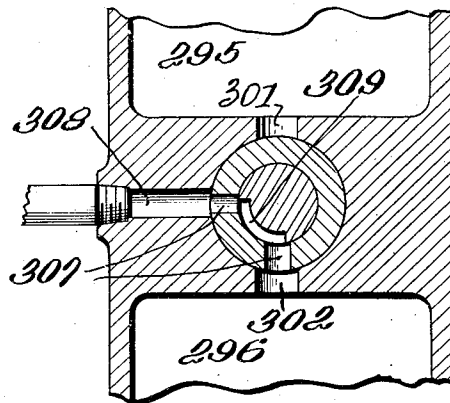


FIG. 25.

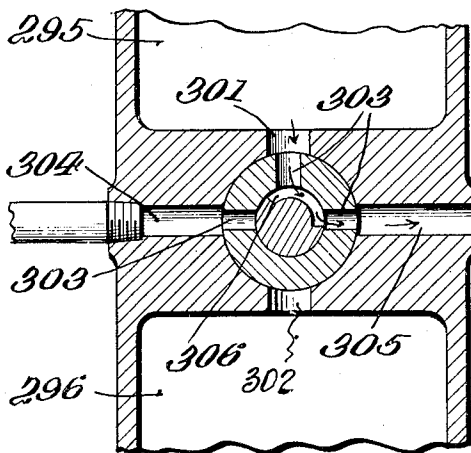
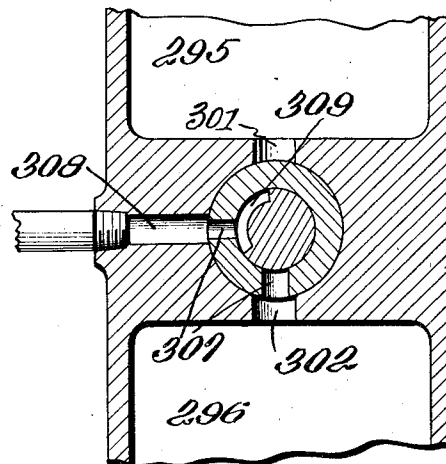


FIG. 27.



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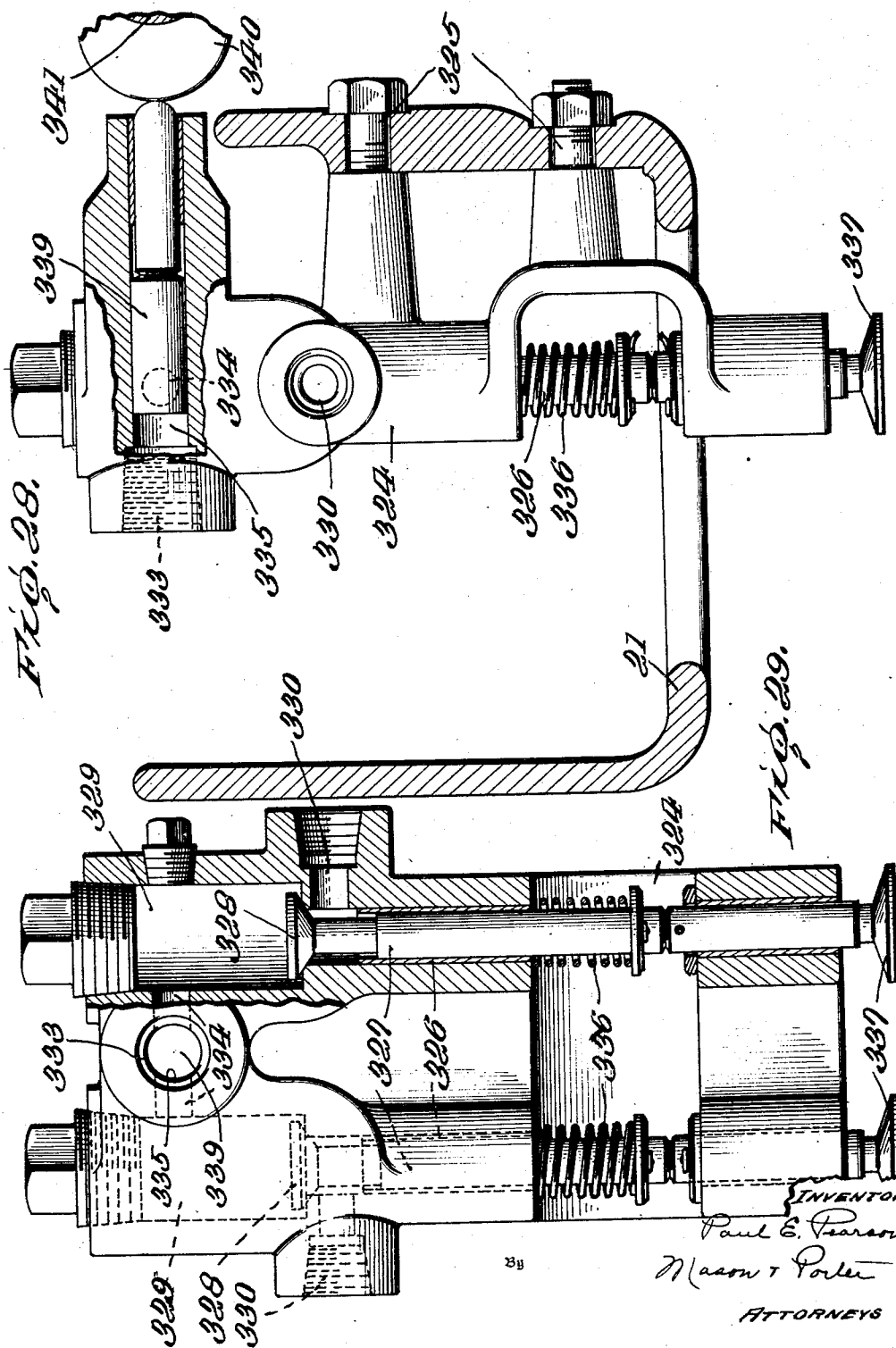
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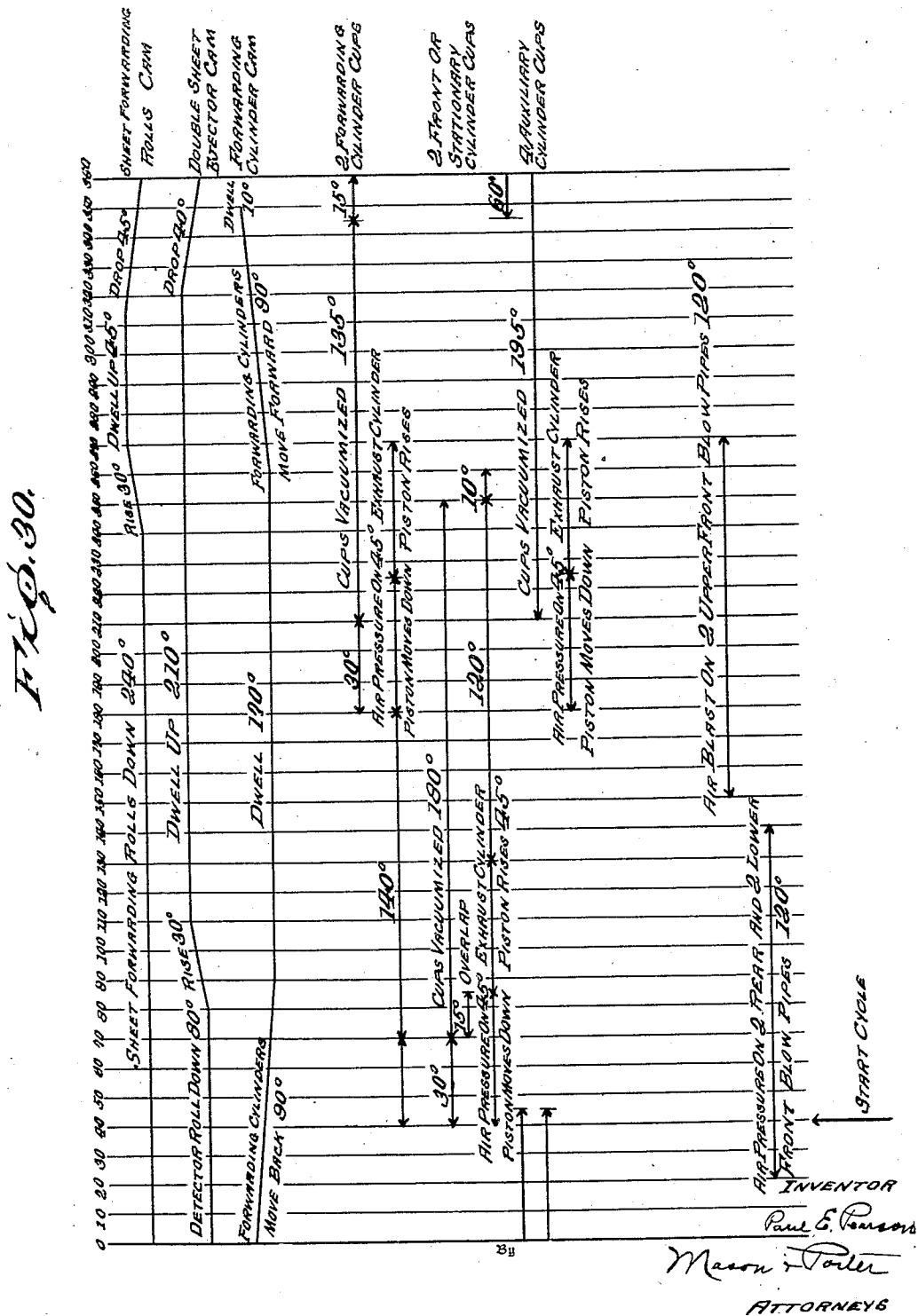
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SHEET FEEDING MECHANISM

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18 Sheets-Sheet 18



UNITED STATES PATENT OFFICE

2,268,299

SHEET FEEDING MECHANISM

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Application May 11, 1940, Serial No. 334,657

23 Claims. (Cl. 271—28)

The invention relates generally to sheet feeding mechanisms and primarily seeks to provide a novel machine structure embodying sheet feeding means for delivering sheets one at a time to machine structures such as lithographing or sheet slitting machines, and pneumatically actuated gripping devices for lifting the sheets one by one from a suitably positioned pack of sheets and presenting them to said feeding means.

An object of the invention is to provide a machine of the character stated in which is included a novel arrangement of pneumatically actuated sheet gripper units, one such unit being disposed over each corner of the sheets to be fed and a plurality of such units being disposed intermediate said corner units and effective to lift and freely swing with intermediate portions of the sheets in a manner for preventing contact of such portions with the underlying sheet and the resultant scratching of engaging sheet surfaces.

Another object of the invention is to provide a machine of the character stated in which is provided gripper units of novel construction which lift the sheets individually by suction action and which are presented against the upper surface of the sheet pack by pneumatic pressure and withdrawn by spring action for the purpose of withdrawing sheets individually from the pack.

Another object of the invention is to provide novel means for actuating the gripper units which engage the advance corners of the individual sheets whereby said units will present said sheets individually to feed rolls disposed for feeding the individually presented sheets from the machine.

Another object of the invention is to provide novel means for automatically lifting the pack of sheets through small increments of movement so as to constantly present the uppermost sheet of the pack in position for being engaged by the gripping and lifting units.

Another object of the invention is to provide a machine of the character stated embodying novel means for controlling the pneumatic action of the gripper units and associated control mechanism.

Another object of the invention is to provide a machine of the character stated embodying novel means for supporting a pack of sheets and novel means for imparting rapid traverse movement to said supporting means upwardly to the effective, sheet presenting position, or downwardly, to a position for receiving a replenished pack supply, said last named means including a driving motor, a reversible clutch, and novel means for shifting the clutch to a neutral position each time said supporting means attains its upper effective or lower limit positions.

Another object of the invention is to provide

a machine embodying traverse movement imparting equipment including a reversible clutch and actuator means therefor, and means for automatically locking the actuator means against movement during automatic feeding of the pack for presenting the uppermost sheets successively in position for being engaged by the gripping units.

Another object of the invention is to provide novel sheet pack position controlling means and devices for rendering said means ineffective during the imparting of rapid traverse movement upwardly or downwardly to the pack or the pack supporting means.

Another object of the invention is to provide means for automatically presenting the uppermost sheets of the pack successively in position for being engaged by the gripper units and including novel ratchet and pawl devices and automatically operable means for releasing the pawl from the ratchet each time the proper height of the pack has been attained.

Another object of the invention is to provide a machine of the character stated in which is included pack supporting means, means including a motor for lifting and lowering the supporting means to and from pack presenting positions, novel means including ratchet and pawl devices for lifting the pack to successively present uppermost sheets thereof for engagement by lifting devices, and manually operable means for releasing said pawl and automatically starting said motor.

Another object of the invention is to provide novel automatically operable means for ejecting double or superposed sheets presented to the sheet feeding devices by the sheet lifting and presenting units.

With these and other objects in view which will more fully appear, the nature of the invention will be more clearly understood by following the description, the appended claims, and the several views illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a front elevation, parts being broken away and in section.

Figure 2 is a fragmentary upper left side elevation, parts being broken away and in section.

Figure 3 is a diagrammatic perspective view illustrating the relative arrangement of the gripper units and the connection thereof with the master valve.

Figure 4 is a fragmentary vertical longitudinal section of the rear portion of the machine.

Figure 5 is an enlarged, somewhat diagrammatic vertical longitudinal section illustrating the manner in which the sheets are lifted and presented to the feeding mechanism.

Figure 6 is an enlarged central vertical sec-

tion of one of the lifter units engageable with a sheet corner.

Figure 7 is a view similar to Figure 6 illustrating another form of lifter unit.

Figure 8 is an enlarged fragmentary vertical cross section illustrating the double sheet detector.

Figure 9 is an enlarged fragmentary vertical cross section illustrating the separable feeder rolls and the roll lifting cam.

Figure 10 is an enlarged fragmentary vertical cross section illustrating the positioning of the sheet pack lift controlling switch.

Figure 11 is a fragmentary vertical section illustrating the feeder pawl position controlling means.

Figure 12 is a left side elevation of the parts shown in Figure 11.

Figure 13 is a detail longitudinal section illustrating the reversible clutch structure.

Figure 14 is a detail vertical cross section taken on the line 14—14 on Figure 13.

Figure 15 is a fragmentary vertical cross section illustrating the driving connections for the cam shaft and the feed roll shaft.

Figure 16 is a front elevation of the master valve, parts being broken away and in section.

Figure 17 is a left side elevation of the master valve, parts being shown in central vertical section.

Figure 18 is a front elevation of the body of the master valve.

Figure 19 is a top plan view of the valve portion shown in Figure 18.

Figure 20 is a bottom plan view of the valve portion shown in Figure 18.

Figure 21 is a central horizontal section of the valve portion shown in Figure 18.

Figures 22 and 23 respectively illustrate in bottom and top plan view, the upper and lower rotary valve plates of the master valve.

Figures 24 and 25 are fragmentary vertical cross sections taken on the line 24—25 on Figure 16 and respectively illustrate the effective and cut-off positions of the manually operable rotary valve with relation to the air pressure chamber of the master valve.

Figures 26 and 27 are fragmentary vertical cross sections taken on the line 26—27 on Figure 16 and respectively illustrate the effective and cut-off positions of the manually operable rotary valve with relation to the vacuum chamber of the master valve.

Figure 28 is an enlarged fragmentary vertical cross section of the rear cross frame piece, the nozzle air control valve being shown in edge view and part longitudinal section.

Figure 29 is a rear face view of the control valve shown in Figure 28, parts being broken away and in section.

Figure 30 is a diagram chart depicting the operating cycle of the machine.

In the example of embodiment of the invention herein disclosed, 5 designates the skid platform on which the pack 6 of sheets to be fed are supported. In the mounting of these skids and sheet packs in proper cooperative relation with the feeding devices of the machine the individual skid platforms are rolled into place in the machine over rollways 7 which are engaged by the laterally spaced, longitudinally disposed supporting legs 8 depending from the skid platforms.

The lateral edges of the platforms 5 overlie rollways 9 which are disposed longitudinally on the C-shaped lifting and lowering frame 10 and

facilitate mounting and removal of said platforms, the frame 10 being open at the front in the manner best illustrated in Figure 1 of the drawings.

Four lifting and lowering chains 11 are provided and each is secured at its lower end as at 12 at one of the four corners of the frame 10. Each chain passes over a sprocket 13, two such sprockets being secured upon each of the two shafts 14 which are disposed in parallel spaced relation one along each upper side of the machine framing. Each shaft 14 is rotatable in bearings 15 provided therefor in a longitudinal end framing unit 16 and each of these frame units is supported at its front end on a corner post or standard 17 at the rear, indirectly, on framing generally designated 18, each said unit being secured as at 19 to a housing unit structure 20 which is in turn supported by said framing 18. The housing units 20 serve as supporting means for a rear cross frame member 21 which is secured as at 22 to said housing units.

Each shaft 14 has a worm wheel 23 secured thereon within the respective housing unit 20 and is rotatably supported in bearings 24 provided in said housing 20. A cross shaft 25 is rotatably supported at its ends in suitable bearings provided therefor in the housing units 20, and within each housing this cross shaft carries a worm gear 26 which meshes with the respective worm wheel 23. The shaft 25 extends beyond the housing unit 20 at the left side of the machine and has a ratchet wheel 27 affixed thereto. It will be obvious that as rotation is imparted to the ratchet wheel 27 it will be transmitted through the shaft 25 and the worm gears affixed thereon to the worm wheels 23 and the shafts 14 on which they are mounted. Rotation of the shafts 14 in one direction or the other will serve to lift or lower the chains 11 and the skid platform 5 and sheet pack 6 supported on the supporting frame 10. The power transmitting connections just referred to serve to impart rotation to the shaft 14 in a direction for lifting the chains only and the means for imparting movement to the ratchet wheel 27 and the means for imparting rotation to the shaft 25 in the opposite direction for effecting a lowering of the supporting frame 10 will be described in detail hereinafter.

At the rear of the machine there is mounted a sheet pack limiting wall generally designated 28 and best indicated in Figure 1 of the drawings.

Each housing unit 20 includes upper and lower shaft bearings 29 and 30, and the housing unit at the right side of the machine includes a shaft bearing 31 disposed between the bearings 29 and 30.

A cam shaft 32 is rotatably supported in the aligned bearings 29 in the housing units 20 and carries a gear 33 to which rotation is imparted by a smaller gear 34 secured upon a driver shaft 35 rotatably supported in the housing unit bearing 31, the shaft 35 being driven through a bevel gear couple 36 from any suitable power input source, preferably from the sheet slitting machine or a lithographing or other machine to which the sheet feeding machine is connected in cooperative relation.

The driver shaft 35 also carries a larger gear 37 which meshes with and drives a small gear 38 secured upon a sheet feed roll shaft 39 rotatably supported in the aligned housing unit bearings 30. The shaft 39 also carries a sprocket or pulley 40 forming a part of a roll driving couple which will be described later.

The cam shaft 32 carries an adjustably mounted timing or forwarding roll separator cam 41, an adjustably mounted double sheet detector cam 42, and a forwarding cam 43 which imparts oscillatory movement to the sheet feeding units which will be described hereinafter.

The cam shaft 32 also carries a bevel gear 45 which meshes with a similar gear 46 secured upon the lower end of a vertically disposed actuator shaft 46 forming a part of the master pneumatic control valve generally designated 47 and which is secured upon and centrally of the cross frame member 21 previously referred to. The details of construction and operation of this master valve will be described hereinafter.

The shaft 39 is disposed just behind the rear limit wall 23, and an intermediate bearing 48 is provided for centrally supporting this shaft. A plurality of pulleys 49 are secured to and spaced along the shaft 39 and the peripheries of these pulleys extend above the level of the upper edge of the wall 23. Two upper roll and guide supporting rolls 50 also are secured upon this shaft and one is disposed between the pulleys 49 at opposite sides of the center bearing 48. This shaft also carries a gage roll 51 which is secured adjacent the center of said shaft and close to the central supporting bearing 48.

The two roll and guide supporting rolls 50 are opposed by two rubber faced upper rolls 52 which are carried by arms 53 having guide portions 54 extending toward the sheet pack and freely pivoted on a cross shaft 55 rockably mounted as at 56 in the framing at the rear of the machine and having supporting bearing intermediate its ends as at 57. A collar 58 is fixed to the shaft 55 beside each arm 53 and has an apertured lug extension 59 through the aperture of which passes a vertically disposed plunger member 60 which is pivoted at its lower end to the respective arm 53 and has abutment nuts 61 secured at its upper end in position for contacting the respective lug 59. A compression spring is coiled about each plunger beneath the respective lug 59 and above the pivotal mounting of the plunger and serves to yieldably hold the respective roller 52 against the underlying supporting roll 50. A crank arm 63 is secured to the shaft 55 and carries a roller 64 at its free end. An anchored spring 65 yieldably holds the roller 50 against the rotary cam 41. As the cam rotates in suitably timed relation with the other mechanisms of the machine it imparts interval oscillations to the arm 63 for the purpose of rocking the shaft 55 at the proper time to effect separation of the opposed rolls 52 and 50 just long enough to receive the end of a sheet between them, after which these rolls are again permitted to yieldably contact and effect a feeding away of a sheet thus presented to them.

The shaft 55 also carries a detector arm 66 which is freely swingable thereon as at 67. The arm carries a gage roller 68 which rests upon the gage roll 51 and it also has a guide end 69 extended toward the sheet pack 6 and the individual sheets fed therefrom. The forwardly projected end of the arm carries an adjustably mounted tappet screw 70 engageable with the actuator button of a normally open switch 71 carried at the free end of an arm 72 which is freely swingable about the axis of the shaft 55. The arm 72 carries a roll 73 engaged by the detector cam 42 and is apertured to allow projection therethrough of a plunger 74 which is pivotally supported on the arm 66 and is

equipped with adjustable abutment nuts 75 above the arm 72. A compression spring 76 surrounds the plunger 74 between its pivotal mounting and the arm 72 and normally serves to separate from the arms 72 and 66 to the limit controlled by the adjustable abutment nuts 75, in which position the switch 71 will be in its normal, open position. An anchored spring 77 yieldably holds the combined arm structures in engagement with the cam 42. Thus the roller 68 will normally be spaced above the gage roll 51 which it opposes but will be presented in yielding contact with that roll by action of the cam 42 each time the leading end of a sheet is presented to the feeder rolls. Whenever single sheets are presented to these rolls the gage roller 68 is caused to yield upwardly a limited distance insufficient to alter the normally open, circuit breaking condition of the switch 71, but whenever superposed or double sheets are fed the roller 68 will be displaced an abnormal distance and the tappet 70 will close the switch 71 and complete a circuit therethrough for the purpose of actuating an ejecting means later to be described.

Feeder belts 78 pass over the pulleys 49 and over pulley rolls 79 so disposed that the upper flights of the belts form a feed-away table over which the sheets are individually fed from the machine, a suitably mounted and secured tightener idler 80 being provided for maintaining the desired tight condition of these belts. The belts 78 may deliver onto a feed-away conveyor generally designated 81 and which may be a part of the machine served by the feeding mechanism as hereinbefore described.

Between upper and lower flights of the belts 78 and just beyond the rolls 49 is mounted a cross shaft 82. The shaft is rockably mounted and carries a plurality of sheet deflector arms 83 which normally lie between the belts 78 and beneath the plane in which the upper flights of these belts travel. A crank 85 is fixed to the shaft 82 and is link-connected as at 86 to the core 87 of a solenoid 88 which is fixedly supported upon the machine framing, the core of the solenoid being normally held down by an anchored spring 89. The solenoid is connected as at 90 with a power line and with the switch 71, and it will be obvious that each time the switch 71 is closed so as to complete a circuit through the connecting lines 90 the solenoid will be energized and the core lifted against the tension of the spring 89. The upward movement of the core will be transmitted through the link and crank connections 86, 85 to the rock shaft 82 and the deflector arms 84 will be lifted to divert the double sheet which has effected an abnormal closing of the switch 71 upwardly between the opposed rolls of a feed roll couple 91 to which movement is imparted by chain and sprocket connections 92 with the sprocket 40 on the feed roll 39 so that double or superposed sheets will be fed onto an ejected sheet receiving table 93 instead of over the normal feed-away table provided by the upper flights of the belts 78.

A shaft 94 traverses the machine toward the rear and above the sheet pack and is rockably mounted in bearings 95 secured to the machine framing. Another shaft 96 is disposed parallel and to the rear of the shaft 94 at the same elevation and is rockably supported in frame bearings 97. The shaft 96 has one end extended and fitted with an actuator crank 98 which car-

ries a roller 99 engaged by the forwarding cam 43. Another crank arm 100 is secured to the shaft 96 and an anchored spring 101 attached to this crank serves to yieldably hold the roller 99 against the cam 43. Gripper unit supporting arms 102 depend in aligned pairs from the shafts 94 and 96 and are held in parallel relation by gripper unit carrying links 103 pivotally connected thereto as at 104. Each of the links 103 includes a split clamp collar 105 for removably securing and supporting a sheet gripping and lifting unit.

Each gripping unit engageable with the sheets at the rearmost corners thereof, or the corners nearest to the feeder belts 75, includes a cylindrical casing 106 having its upper end closed by a head 107 carrying an upwardly extended tubular extension 108 of reduced diameter and which is equipped at its upper end with means 109 for effecting connection with a vacuum line. A pack gland 110 is provided in the head 107. A similar closure head 111 is secured in the lower end of the casing and a piston 112 is slidably mounted in the chamber formed between the upper and lower heads and is urged toward the upper head by a compression spring 113 mounted in said chamber. Upward movement of the piston is limited by a depending flange 114 carried by the head 107 and which is notched or apertured to provide communication through the flange when the piston is in engagement therewith as illustrated in Figure 7 of the drawings.

The piston 112 is secured to a plunger sleeve 115 which includes a reduced extension 116 reciprocable in the head extension 108 through the gland 110, and the lower end of the holder sleeve 115 passes through the lower head 111 and is secured to a cup head 117 to which the rubber suction or gripper cup 118 is removably secured as at 119.

A lateral port 120 opens into the casing above the piston 112 through a fitting 121 having provision at 122 for connection with a pressure line. Each of the gripper units just described, that is the casing 106 thereof, is securely clamped in one of the carrier links 103 and is oscillated back and forth by the actuator arms 102 with the axis of the unit always vertical. The operation of these units and the manner of connecting and utilizing the suction and pressure lines which control the operation of the unit will be described later.

The two gripper units which engage and lift the front corners of the sheets, or the portions of the sheets adjacent the frame standards 17, are identical with those just above described but are mounted and operate in a slightly different manner later to be described.

As previously stated, there are four intermediate lift gripper units disposed in two front and rear pairs intermediately of the four corner units, and each of these intermediate units is generally designated 123 and is identical with the units above described except for the fact that the plunger carried cup head 124 is indirectly connected with the suction cup through the medium of a long tube extension 125. The means for mounting the four intermediate gripper units will now be described. A cross shaft 126 traverses the machine above the sheet pack 6 and is secured in bearings 127 formed on standards 128 affixed to the machine framing. Another shaft 129 is similarly mounted as at 130 in parallel spaced relation and frame pieces 131 formed in inverted channel shape are mounted on the

shafts 126 and 129 in parallel spaced relation, said frame pieces having bearing portions 132 encircling said shafts. A crank hanger 133 is rockably mounted as at 134 on each shaft 126, 129 between the depending webs of each frame piece 131 and each crank handle carries a split clamp collar 135 adapted to securely grip one of the intermediate units 123, and each frame piece 131 includes an opening 136 for permitting movement of the upwardly extended portion of the respective foremost unit 123. A closely wound tension spring 137 is secured at its rear end as at 138 to each crank hanger 133 and is anchored at its front end as at 139 to a block 140 slidable in a casing member 141 pivotally secured as at 142 to the particular frame piece 131. An adjustable end plug 143 is mounted in each casing member 141 and a spring 144 is interposed between each plug and the block 140 which opposes it. Thus as each crank hanger and the carried unit is drawn rearwardly with the sheet its movement will be resisted by the respective spring 137 so that when the gripper suction which causes the unit to retain its engagement with the sheet being fed is released the spring will return the crank hanger to its normal, forward position. On this return movement, the respective closely wound spring 137 acts as a relatively solid thrust member and at the limit of its forward movement displaces the block 140 and compresses the spring to cushion the return movement.

Upon the free ends of side hanger rods 145 pivotally mounted as at 146 on the framing is supported a cross shaft or tube 147, the latter being secured as at 148 to the free ends of said rods. Suitable rigid supporting means 149 serves to hold the U-shaped frame formed by the members 145 and 147 a definite distance above the pack of sheets.

The shaft or tube 147 carries a clamp sleeve 150 near each end and each sleeve includes a rearwardly extending clamp collar 151 having a gripper unit receiving bore therein disposed at a slight angle with respect to the vertical so that the axis of the units clamped in the collars 151 converge inwardly and rearwardly, or inwardly and in the direction in which the sheets are fed. Each sleeve 150 also includes a pair of forwardly directed clamp collars 152 having bores therein for receiving and securely clamping a pair of air blast tubes 153. One tube of each pair terminates in a vertically disposed nozzle 154 positioned for directing a blast of air against the sheets at the upper portion of the pack, and the other tube of each pair terminates at a slightly higher level in a horizontally disposed air blast nozzle 155 similarly directed toward the upper extremity of the pack. In addition to those just described, a pair of air blast nozzles 154a are suitably supported at the rear upper side portion of the pack for directing blasts of air against the uppermost sheets of the pack at that portion also.

The tube or shaft 147 also supports two or more intermediately disposed clamp sleeves 156 from each of which a guide plate 157 depends in position for engaging the edges of the sheets at the upper portion of the pack and retaining the desired spaced relation between said sheet edge portion and the nozzles 154, 155.

Two gripper units adapted to engage and lift the front corners of the sheets are secured in and depend from the clamp collars 151 and these units are generally designated 158 and are identi-

cal in construction with the units engageable with the rear corners of the sheets and which include the casings 106.

The sheet gripping or suction cups of all of the sheet gripper units hereinbefore referred to are projected against the uppermost sheet of the pack and withdrawn therefrom for sheet lifting and feeding purposes in the same manner. The springs 113 normally hold the suction cups at their uppermost limits and gripping suction in the cups is provided through the hollow centers of the cups and the bore extending through the whole of the unit in the plunger 115 and the extension 116 thereof. Air pressure is directed through the port 120 into the casing chamber above the piston 112 and forces the piston downwardly, against the compression of the spring 113, to force the suction cup 118 into gripping relation with the uppermost sheet of the pack. It is to be understood, of course, that at the time of contact between each suction cup and the pack the interior of the cup is evacuated through the vacuum line. It will be obvious that when the pressure above the piston 112 is released the spring will return the piston to the normal position illustrated in Figure 7 and the suction cups thus lifted draw the foremost sheet upwardly with them. The cups engaging the rear corners of the sheets are lifted truly vertically whereas those at the front corners of the sheets, because of the incline positioning of the unit axes, will lift the corners upwardly, inwardly, and rearwardly thereby tending to bow the sheet downwardly. The air blasts discharged by the nozzles 154, 154a, 155 enters the space formed below the uplifted corners of the uppermost sheet and aids in freeing that sheet from the remainder of the pack and in preventing a drawing up of the underlying sheet.

The suction cups of the four intermediate units 123 lift the intermediate portion of the sheet so that when feeding motion is imparted to the sheet this intermediate portion thereof will not drag against and scratch the underlying sheet. Actual feeding movement or presentation of the sheets to the feeding rolls is effected by a rearward swinging of the rear unit supporting arms 102 in the manner hereinbefore described, and during this movement the intermediate units 123 swing freely backwardly with the sheet. It is to be understood that the foremost sheet engaging units serve merely to lift the sheet and take no part in the feeding movement. For this reason the suction in the gripping cups of these foremost units 150 is released just prior to the forward movement of presentation of the sheets in a manner later to be described. The suction in the cups of the intermediate and rearmost units is released just after the foremost edge of the sheet has been presented between the feeder rolls which have been separated by operation of the cam 41. Upon release of the suction in the intermediate units 123, these units are returned to their normal, forwardly and downwardly inclined position by the return springs 137. The units which engage the rearmost corners of the sheets are returned by movement of the arms 102, by action of the spring 101 and under control of the forwarding cam 43. As previously stated, the manner of controlling the suction and pressure action in the various units will be described later.

In Figure 7 of the drawings there is illustrated an optional modified form of gripper unit. This unit includes a cylindrical casing 159 closed at

its lower end by a plug 160 and at its upper end by a threadably mounted head or plug 161 carrying a tubular extension 162 adapted to be connected with a pressure duct. A tubular plunger 164 is slidable in the casing and extends downwardly through the bottom plug 160 and has a piston 165 affixed to its upper end slidably engaging in the chamber formed in the casing 159. A plug 166 is slidably mounted in and closes the lower end of the plunger 164 and a rod 167 is secured to said plug and extends upwardly through the plunger 164. The plug 166 has a central duct 168 which opens through the bottom of the plug into the removably mounted suction cup 169. The plug 166 also includes a lateral duct 170 communicating through a fitting 171 with a tube 172 which is movable with the plunger 164 and the fitting 171 and telescopes in a tube 173 fixedly secured as at 174 to the casing 159 and having provision at 175 for connection with a vacuum line. A spring 176 normally forces the piston 165 to the upper position illustrated in Figure 7.

A stop head 177 closes the upper end of the central duct 178 formed in the rod 167, suitable lateral openings 179 communicating between the central duct 178 and the casing chamber above the piston 165 and surrounding the head 177. It will be observed that the lateral openings 179 are small and are disposed intermediately beneath the head 177 so that by telescoping the rod 167 downwardly in the plunger sleeve 164, the ports 179 will be closed by the extended upper end of the sleeve 164 which also serves as a means for limiting the degree of movement of the rod 167 downwardly with relation to the sleeve 164.

The rod 167 is provided with a lateral port 180 which communicates between the center duct 178, a lateral port 161 in the plunger sleeve 164, and the friction reducing clearance or space 162 surrounding the rod 167 within the sleeve 164 and provided by reducing the diameter of the rod intermediate its upper and lower ends.

When this form of unit is employed, air pressure directed through the extension 162 will cause the rod head 177 to move down and close the lateral ports 179 and then cause the rod and piston to move in unison to present the suction cup 169 into engagement with the uppermost sheet of a pack. It is to be understood that at the time the suction cup contacts the sheet, the space within the cup is evacuated through the ducts 168, 170, 172 and 175 so as to effect a gripping of the sheet. As soon as the cup contacts the uppermost sheet the rod 167 will be caused to move upwardly relative to the plunger sleeve 164 the limited distance permitted by the space intervening the lower end of the plunger sleeve 164 and the shoulder of the plug 166 provided by the initial downward movement of the rod 167 relative to said plunger sleeve. This movement of the rod opens the lateral ports 179, to overcome the dominant air pressure condition above the piston 165 and permit the spring 176 to return the plunger 164 to the initial position above described.

During the operation of the machine the pack of sheets is automatically lifted through small increments of movement to constantly present the uppermost sheet of the pack at a proper elevation for being engaged by the gripper unit. When almost all of the sheets of a pack have been fed one by one therefrom, it becomes desirable to mount a new pack in the machine, and

in order to accomplish this it is necessary to provide a temporary support for the small number of sheets yet remaining in the pack and to lower the pack skid supporting frame to a position for receiving a fresh skid and pack and, to return the supporting frame to an elevated position for presenting the newly supplied pack in cooperative relation with the gripping elements.

In the machine herein disclosed, means is employed for accomplishing this lowering and lifting of the skid and pack supporting frame by rapid traverse movements. The normal lifting of a pack through small increments of movement is accomplished by rotation of the cam shaft 32 and the cross shaft 25, power being applied to these shafts from an outside source. The means for imparting the rapid traverse movements just referred to include an individual motor and reversible clutch equipment which will now be described.

A motor 183 is secured as at 184 to depend from a reversible clutch unit generally designated 185 which is in turn mounted as at 186 on the machine framing.

Any suitable reversible clutch unit may be employed and the one herein illustrated includes a driver shaft 187 rotatable in bearings 188 in the casing or housing and driven by sprocket and chain connections 189 from the shaft of the motor 183. The unit also includes a driven shaft 190 rotatable in bearings 191 provided therefor in the casing, and this shaft has sprocket and chain connection 192 with the worm shaft 25 hereinbefore referred to so that the rotation imparted in one direction or the other to the shaft 190 will be transmitted to the shaft 25 for effecting a relatively rapid lifting or lowering of the chains 11 which pass over the sprockets 13 secured upon the shafts 14 hereinbefore described.

A large spur gear 193 is loosely mounted on the shaft 190 and is constantly driven by a small pinion 194 on the driver shaft 187. A smaller spur gear 195 is loosely mounted on the shaft 190 and is constantly driven in a direction opposite the direction of rotation of the gear 193 by an idler gear 196 supported on the unit housing and enmeshed with the gear 195 and with the gear 197 secured upon the shaft 187.

Each of the gears 195 and 193 carries a clutch head portion 198 and these head portions are selectively engaged by a clutch element 199 splined at 200 on the shaft 190. The clutch head 199 is shifted in one direction or the other on the shaft 190 by a shifter fork 201 secured to a shaft 202 rockably mounted in the unit casing and which is extended outside the casing and equipped with an actuator crank 203. The crank 203 is link-connected as at 204 with the central vertical arm 205 of a 3-arm actuator lever. The lever includes two arms extended in opposite, generally horizontal directions and one of these arms 206 is pivotally connected as at 207 with a vertically disposed slidable control bar 208 which is slide-guided as at 209 and includes an outwardly extended top lug 210 and a similarly extended bottom lug 211. The lugs 210 and 211 are presented for engagement by the pack supporting skid at upper and lower limits of its travel.

The other generally horizontal arm 212 of the lever is link-connected as at 213 with a crank member 214 secured upon an actuator shaft 215 rockably supported as at 216 on the machine frame along the left side of the machine. The

shaft 215 also carries two vertically depending manually operable actuator handles 217. The shaft 215 also has a large plate 218 affixed thereto, and this plate is provided with a vertically disposed latching recess 219 which is vertically, centrally disposed and open at the bottom.

A thrust link 220 having crank connection with the shaft 32, as by connection with the forwarding cam 43 as at 221, is connected to one arm 222 of a bell crank lever which is oscillatable about the shaft 25 on which the ratchet wheel 27 is affixed. The other arm 223 of the bell crank lever has a ratchet wheel engaging pawl 224 pivoted at its free end, and it will be obvious that when the bell crank lever 222, 223 is oscillated with the pawl in engagement with the ratchet wheel 27, increments of movement will be imparted to the shaft 25, and from it to the pack lifting chains 13 in the manner hereinbefore described.

A housing 225 is secured as at 226 to the machine framing, and a pawl position controlling rod 227 is vertically reciprocable in bearings 228 provided in said housing. The rod is connected with the pawl 224 by a link 229 which is pivoted to the rod as at 230 and slot and pin connected as at 231 to said pawl.

The rod 227 is secured as at 232 to the upper end of the core 233 of a solenoid 234, the lower end of said core being connected to a link 235 which is slot and pin connected as at 236 to a switch actuator rod 237.

The switch actuator rod 237 is vertically slidable in bearings 238 provided in the housing and has a pin 239 projected therefrom for engagement in the fork end of a crank member 240 rockably mounted as at 241 on the housing and having an actuator handle 242 secured thereto. The handle 242 is equipped with a spring detent 243 releasably insertable in receiving recesses provided in the housing for the purpose of securing the rod in its raised or lowered position, the lowered position of the rod being illustrated in Figure 12 of the drawings. The rod 237 also carries a pair of adjustably spaced switch actuator fingers 244 engageable with a switch actuator 245 rockably mounted at 246 and engageable with stop and start buttons of a switch 247 connected in the power circuit 248 serving the motor 183. Thus each time the rod 237 is lowered to the position illustrated in Figure 12 of the drawings, it will close the switch 247 and start operation of the motor 183, and when this rod is raised the operation of this motor will be automatically stopped.

The rod 237 also carries a switch actuator fork 249 engageable with the actuator lever 250 of a switch 251 connected in the circuit connections 252 serving the solenoid 234.

A collar 253 is secured centrally of the cross shaft or tube 147 and carries a bracket 254 equipped with a cylinder 255 having a bore 256 in which a valve plunger 257 is vertically slidable. The plunger is threaded at its upper end and carries a stop collar 258. The bracket also includes a lug portion 259 vertically spaced from and overlying the upper end of the cylinder and which has a threaded bore in which a socket plug 260 is adjustably mounted. A compression spring 261 is interposed between the plug 260 and the upper end of the plunger and normally holds the plunger down at the lower limit of its movement determined by the stop collar 258.

The cylinder includes a pair of aligned cross ports 262 one of which connects at one side with

a pressure line 263 from a suitable source of air pressure and the other of which connects with a pressure line 264 leading to a control mechanism, the construction and purpose of which will be described later. The plunger also includes a cross duct 265 and a longitudinal side recess 266 which normally communicates between the pressure line 264 and a venting duct 267 opening laterally through the cylinder wall. It will be obvious that when the plunger is lifted against the action of the spring 261 the cross port 265 will open communication between the cross ducts 262 of the cylinder and allow air pressure to flow from the line 263 into the line 264.

At its lower end the plunger 257 carries a bracket member 268 having a cylinder 269 at its lower end in the axial bore of which a plunger 270 is vertically slidable. The plunger 270 has a limited amount of vertical movement in the bore of the cylinder 269 and movement in the upward direction is resisted by a compression spring 271 surrounding the plunger within the cylinder, and the amount of movement of the plunger in both directions is limited by abutment heads 272 threadably mounted on the plunger. The plunger terminates at its lower end in a stirrup 273 which carries a roller 274 adapted to be engaged by the uppermost sheet of the sheet pack 6.

A switch 275 in which the contacts are held separated or in circuit breaking relation is mounted on the bracket 268 directly above the plunger 270. The contacts of this switch are normally held separated by engagement of the plunger 270. This switch is connected in the power circuit lines 252 which serve the solenoid 234 and, as stated, the circuit is normally broken through this switch except when the plunger 270 is lowered by reduction of the predetermined top level of the sheet pack by feeding of individual sheets therefrom. When the plunger is thus lowered it will permit the switch contacts to engage and complete the solenoid energizing circuit. Each time the top level of the pack is reduced below the predetermined level by the feeding of individual sheets therefrom, the plunger 270 will be lowered a sufficient distance to permit the switch contacts to close and complete the circuit which energizes the solenoid 234 and thereby effect a re-engagement of the pawl with the ratchet wheel 27 so that the pack will be fed upwardly a sufficient distance to again effect a breaking of the solenoid energizing circuit and another retraction of the pawl, it being understood that each time the solenoid energizing circuit is broken the rod 227 will fall by gravity and effect a retraction of the pawl.

It will be noted by reference to Figure 12 of the drawings that the rod 227 carries a latch lug 275 which engages the lower bearing 228 and limits downward movement of the rod whenever the solenoid 234 is not energized, and when the rod is lifted by the energized solenoid to operable position the pawl this lug engages in the latch notch 219 in the latch plate 218 affixed to the rock shaft 215 and serves to lock the shaft against movement so that the clutch is held in neutral, thus making it impossible to apply power to the devices for lifting and lowering the pack in rapid traverse movement while the normal lifting of the pack by small increments and the feeding of sheets therefrom is proceeding.

The pressure line 264 connects with the lower end of a pivotally mounted cylinder 276 secured

upon the frame adjacent the shaft 215. A piston 277 is vertically reciprocable in the cylinder and is attached to a plunger 278 which extends upwardly from the cylinder and has slot and pin connection at 279 with a crank 280 secured upon the clutch control shaft 215. Whenever the pack is lifted high enough to cause the plunger port 265 to register with the cross ports 262 in the control cylinder 255, as by initial lifting of the pack by the rapid traverse lifting equipments, air pressure flowing through the lines 263 and 264 will force the piston 277 upwardly, and the upward movement of the plunger 278 will actuate the crank 280 to rock the shaft 215 and shift the clutch to neutral.

In operation, in the initial loading of the machine, a skid 5 having a sheet pack thereon is rolled over the rollways 7 into position over the C-shaped supporting frame 10 and with the pack 6 against the rear limiting wall 28. By adjusting the handle 242 the machine attendant can depress the rods 227 and 237. It will be understood that when these rods are depressed the pawl 224 will be moved out of engagement with the ratchet wheel 27. Depression of the rod 237 actuates the switch 251 to break the circuit through the solenoid energizing circuit 252 and will also actuate the switch 247 for automatically closing the motor control circuit 248 and setting the motor 183 into operation.

By now manually actuating one of the control handles 217 toward the left, as viewed in Figure 1 of the drawings, the rock shaft 215 and the crank and link connections 214, 213, 212, 205, 204, 203 and 201 will be actuated so as to properly shift the clutch to impart rapid upward movement to the pack supporting frame and the pack thereon by rotation of the chain actuating shafts 25 through the transmission connections 192.

As the skid and pack thereon reach the intended upper limit the skid will engage the bar projection 210 and mechanically rock the lever 206, 205, 212 and thereby effect a shifting of the clutch to the neutral position. This skid effected automatic upward rapid traverse control is supplemented by the pack effected control equipment including the cylinder 255 and roller 274. As the pack top attains the desired level for proper cooperation with the sheet gripping and feeding devices, it will engage the roller 274 and force the plunger 257 upwardly so as to effect cross communication between the air pressure lines 263 and 264 through the cross duct 265 in said plunger. This pressure communication will effect a lifting of the piston 277 and an actuation of the crank 280 effective to shift the clutch to the neutral condition in the manner hereinbefore described.

With the sheet pack thus presented with its top portion in proper cooperative relation with the gripping and feeding units, the sheets are successively lifted one by one from the top of the pack and presented to the feeding-away equipments hereinbefore described. Each time double or superposed sheets are lifted and presented to the feed rollers they are ejected by the ejector mechanism hereinbefore described in detail and, as the level of the pack is lowered, the pack is automatically raised by small increments so as to maintain the desired spaced relation between the sheet gripping and lifting units and the uppermost sheet of the pack. The master valve 47 controls the flow of air through and the evacuation of the lines leading to the gripping units in a manner later to be described so that

the pressure introduced into the units is effective to force the suction cups against the uppermost sheet as the arms 102 reach the limit of their swing forwardly or in the sheet receiving direction. As previously described, the gripper cups are evacuated at the time they contact the sheet and the pressure effective to present the cups is released just after the suction gripping of the sheet has been effected so that the cups are lifted to the positions illustrated in Figures 1 and 5 of the drawings.

As previously stated, the cups of the units 150 at the front corners of the sheets are lifted and lowered only, and the units are not movable in the sheet presenting or feeding direction. The suction gripping action of these cups is discontinued immediately after gripping of the front end of the sheet has been effected, and as previously stated the sheet corners are turned upwardly, as indicated in Figure 1, so that the air blasts delivered through the nozzles 154, 155 will serve to overcome any tendency of the underlying sheet to adhere to and be lifted with the uppermost sheet. As the arms 102 are swung forwardly, the units 106 present the rear edge of the lifted sheet between the feeder rolls, which are separated in the manner hereinbefore described at the moment at which the presentation is effected, and are thereafter permitted to move together so that the feeding of the sheet out of the machine can be effected. During the rearward movement of the units 106, the intermediate units generally designated 123 swing rearwardly with the gripped sheet and serve to hold it elevated out of contact with the underlying sheet, thereby preventing dragging and scratching of the sheets. The suction within the cups of the units 106 and 123 is released just before the arms 102 start their return swing and after the feeder rollers have gripped the presented end of the sheet.

This individual feeding of sheets continues, and each time the top level of the pack falls below the predetermined level the circuit 252, effective to energize the solenoid 234, is energized by a lowering of the plunger 270 and the rod 227 is lifted to cause the pawl 224 which is being constantly oscillated to engage and impart increments of movement to the ratchet wheel 27 effective to again lift the pack to the desired elevation. When this desired elevation is attained the circuit 252 will be again broken by lifting of the plunger 270 in the manner hereinbefore described.

Whenever the sheet pack has been reduced to approximately two inches in height, a pack supporting fork 281 is slipped under the pack through openings provided for that purpose in the skid and will serve to temporarily support the remaining sheets of the pack while the supporting frame is being lowered to receive a new skid and pack supply. The rear end of the fork 281 rests upon the rear wall 28, as at 282, and the front end thereof is supported upon brackets 283 secured to and projecting from the frame standards 17.

By now moving the rod 227 downwardly by actuation of the hand crank 242, the operator can disconnect the pawl 224 and render ineffective the solenoid 234 and the control equipments therefor in the manner hereinbefore described, and also actuate the switch 247 for energizing the motor circuit and starting operation of the motor 183. By now shifting one of the control levers 217 to the right, as viewed in Figure 1 of the drawings, the clutch can be set to effect a

rapid traverse movement downwardly of the pack supporting frame. As the frame reaches its lower limit the skid will engage the bottom lug 211 on the bar 208 and shift the lever 206, 205 to again shift the clutch to the neutral position, thereby discontinuing downward movement of the supporting chains 13. After a new pack has been mounted on the support the control devices can be actuated to lift the pack to the proper elevation in the manner hereinbefore described.

In Figure 3 of the drawings the general arrangement of the master valve, the pressure control valve, the gripper units, the pressure nozzles, and the various connecting lines or ducts are shown, and in Figure 30 an attempt has been made to diagrammatically illustrate the whole operating cycle of the machine. In the said Figure 3 no attempt has been made to indicate the angular relation of the gripper units, for to do so would result in confusion, and the actual positioning of these parts is clearly shown in the remaining views of the drawings.

The master valve, hereinbefore generally designated 47, includes a vertically disposed cylindrical body 284 equipped with mounting lugs 285 through the medium of which it is rigidly secured upon the cross frame member 21. The driver shaft 46 is rotatably supported axially of the body and this shaft depends through the cross frame member 21 and carries the bevel gear 45 hereinbefore referred to and through which rotation is transmitted to the valve shaft from the cam shaft 32. Both below and above the valve body 284 driver heads 286 are keyed onto the shaft and impart rotation to valve plates through the medium of driving pin and socket connections 287. The upper or air pressure controlling plate is designated 288, and the lower or vacuum controlling plate is designated 289, and both are held in tight sealing contact with the opposing surface of the valve body by compression spring equipments 290. See Figures 16 to 21.

The master valve body includes a vertical centrally disposed solid wall portion 291 extending in the forward-rearward direction. This wall divides the body to form two side portions, one forming a pressure and vacuum relieving or exhaust chamber 292 which communicates with the atmosphere through a wall port 293. The other side portion is horizontally divided by a horizontal wall portion 294 to form an upper pressure chamber 295 and a lower vacuum chamber 296.

A valve casing 297 is mounted in a bore formed in the horizontal wall portion 294, and a rotary valve 298, removably coupled as at 299 with an actuator shaft 300, is operable in the casing 297. A port 301 communicates between the valve bore and the pressure chamber 295, and a port 302 communicates between the valve bore and the vacuum chamber 296.

It will be obvious by reference to Figures 24 and 25 that the valve casing 292 is provided, in one vertical plane, with three ports 303, one communicating with the pressure chamber 295, one with a pressure inlet duct 304, and the other with a pressure exhausting duct 305. It is to be understood that the pressure duct 304 is connected with any suitable source of air under pressure. The valve rotor 298 is provided with a peripheral cutout 306 for communicating with selected pairs of the ports 303 in the manner illustrated in Figures 24 and 25 for affording communication between the pressure inlet duct 304 and the pressure chamber 295, or between the pressure duct 295 and the exhaust duct 305.

By reference to Figures 26 and 27 of the drawings it will be observed that the valve casing is provided in another vertical plane with two ports 307, one communicating with the vacuum chamber 296 and the other with the vacuum duct 308 which is connected with a source of negative pressure such as a pump or the like. The valve rotor 298 includes a peripheral cutout 309 which may be adjusted in the manner illustrated in Figures 26 and 27 to open or close communication between the suction duct 308 and the vacuum chamber 296.

Ports 310 open through the top of the valve body into the pressure chamber 295 in the manner illustrated in Figure 19 of the drawings, and ports 311 similarly open through the bottom of the valve body into the vacuum chamber 296 in the manner shown in Figure 20. Figures 19 and 20 also illustrate ports 312 and 313 respectively communicating through the top and bottom of the valve body into the exhaust chamber 292.

It will be observed by reference to Figures 16 and 17 of the drawings that sets of ducts or ports 314^a, 314^b, 314^c, and 315^a, 315^b, 315^c, open in vertical alignment through the front wall of the valve body, and in upper and lower radially spaced sets at the top and bottom of said valve body. The three ducts designated 314 are pressure ducts and the three ports designated 315 are vacuum or suction ducts. The duct 314^a is adapted for cooperation with the sheet forwarding or rear gripper units 106. The duct 314^b is adapted for cooperation with the four intermediate gripper units 123, and the duct 314^c is adapted for cooperation with the front or lift gripper units 158. The duct 315^a is adapted for communication with the front or lift gripper units 158, the duct 315^b is adapted for communication with the four intermediate gripper units 123, and the duct 315^c is adapted for communication with the rear or sheet forwarding gripper units 106.

It will be observed by reference to Figure 22 of the drawings that the master valve plate 288 is provided with a bottom face cutout 316 for controlling the flow of pressure to the two rear or sheet forwarding grippers 106, with a cutout 317 for controlling pressure communication with the four intermediate grippers 123, and with a cutout 318 for controlling pressure communication with the front or lift grippers 158.

It will be observed by reference to Figure 23 of the drawings that the lower valve plate 289 is provided with an upper face cutout 319 for controlling vacuum or suction communication with the rear or sheet forwarding grippers 106, a cutout 320 for controlling vacuum communication with the four intermediate grippers 123, and a cutout 321 for controlling vacuum communication with the front or lift grippers 158.

The upper set of pressure ducts 314^a, 314^b, and 314^c are connected by pressure lines 322 respectively with the rear or sheet forwarding gripper units 106, the four intermediate gripper units 123, and the front or lift gripper units 158. The lower set of ducts 315^a, 315^b, and 315^c are respectively connected by suction lines 323 with the front or lift gripper units 158, the four intermediate gripper units 123, and the rear or sheet forwarding gripper units 106.

It will be obvious that with the rotary valve positioned in the manner illustrated in Figures

24 and 26 of the drawings, the rotating plates 288 and 289 of the master valve will control communication between the vacuum and pressure chambers 295 and 296 of the master valve with the vacuum units to cause them to function in the manner hereinbefore described in detail and diagrammatically illustrated in Figure 30 of the drawings. When the rotary valve is adjusted to the position illustrated in Figures 25 and 27 of the drawings the communication from the pressure line 304 is cut off and pressure is bled out of the chamber 295 through the duct 305, and the vacuum source 308 is cut off in the manner illustrated in Figure 27.

For controlling the flow of air pressure to the various nozzles 154, 154^a and 155, there is provided a control valve generally designated 324. This valve is mounted as at 325 on the frame cross piece 21 and includes a pair of parallel spaced vertical guides 326 in each of which a valve stem 328 is vertically reciprocable. Each stem carrying valve 328 is adapted to control passage of air under pressure from the chamber 329 above the valve through an outlet port 330 disposed below the valve. One of the ports is connected through a pipe line 331 with the two upper nozzles 155 at the front of the sheet pack 6 and the other is connected by a pipe line 332 with the four lower nozzles disposed in pairs 154 and 154^a at the front and rear of the sheet pack. Air under pressure is supplied to the chambers 329 through a common supply connection 333 and axially aligned lateral ducts 334 which traverse a valve bore 335.

The valves 328 are held seated by springs 336 and are lifted from their seats by tappets 337 engaged by cams 338 mounted on the cam shaft 32.

A pressure opened, cam closed valve plunger 339 is mounted in the valve bore 335 and this valve may be manually shifted to the position illustrated in Figure 28 of the drawings to close off air pressure communication with the lateral ducts 334 and the chambers 329 by a cam 340 mounted upon a rock shaft 341.

The shaft 341 is rockably mounted as at 342 on the machine framing and carries a hand crank 343 at each end. At the left hand end the shaft 341 also carries a crank 344 which is interconnected as at 345 with a crank 346 mounted on the rotary valve actuator shaft 300. The valve shaft 300 also carries a hand crank 347 which is held in its elevated or active position, or in a lowered inactive position by a spring detent 348.

The crank lever 347 is connected by a slotted link 349 with an extension from the crank member 98 which is actuated by the forwarding cam 43 for imparting sheet presenting movement to the arm 102 and the gripper units 106 carried thereby. It will be observed that the slot in the link 349 will permit normal operation of the crank 98, but when the lever 347 is swung downwardly the link 349 will lift the roller 99 out of contact with the cam 43 for silencing the sheet grippers and discontinuing the sheet forwarding operation. This movement of the lever also shifts the rotary valve 298 to the cut off position illustrated in Figures 25 and 27 of the drawings, and, through the medium of the crank and link connections 346, 345 and 344, the shaft 341 is rocked to move the cam 340 to the position for closing the valve 339 and cutting off pressure communication in the manner hereinbefore described.

This manipulation of the pilot valve 298 cuts off both the pressure air and the vacuum supply, and stops the feeding of sheets without stopping the machine. By this manipulation of the pilot valve 298 the pressure chamber 295 is suitably bled so that the grippers will not tend to partially operate on the next cycle.

It is of course to be understood that the details of structure and arrangement of parts may be variously changed and modified without departing from the spirit and scope of my invention.

I claim:

1. In a sheet feeding means, feeder rolls, means for lifting sheets serially from a pack top maintained at a constant level and presenting them to the rolls to be fed thereby and including a gripper unit disposed over each corner of the pack and at least one intermediate gripper unit for engaging the sheets between the corners to prevent dragging of the central portion of the sheet being lifted over the underlying sheet, said intermediate gripper unit being mounted independently of the corner mounted gripper units and freely swingable with the sheets in the direction of presentation thereof, spring means for returning said intermediate gripper unit after each presentation of a sheet to the feeder rolls, and spring means for cushioning the return movement of the intermediate gripper unit.

2. In a sheet feeding means, feeder rolls, means for lifting sheets serially from a pack top maintained at a constant level and presenting them to the rolls to be fed thereby and including a gripper unit disposed over each corner of the pack and at least one intermediate gripper unit for engaging the sheets between the corners to prevent dragging of the central portion of the sheet being lifted over the underlying sheet, said intermediate gripper unit being freely swingable with the sheets in the direction of presentation thereof, spring means for returning said intermediate gripper unit after each presentation of a sheet to the feeder rolls, and spring means for cushioning the return movement of the intermediate gripper unit, said last named means comprising an anchor cup, a plunger slidable through a limited distance in said cup and opposed by a cushion spring, and a close coiled tension spring anchored to said intermediate unit and to said plunger and active as a thrust member upon return movement of said intermediate unit.

3. In a sheet feeding means, feeder rolls, means for lifting sheets serially from a pack top maintained at a constant level and presenting them to the rolls to be fed thereby and including a gripper unit disposed over each corner of the pack and a plurality of longitudinally and laterally spaced intermediate gripper units disposed for engagement with the sheets between the corners to prevent drag contact of a sheet being lifted with the underlying sheet, means for imparting lifting and lowering movement to all said units, means for imparting movement to the units disposed over the sheet corners adjacent the feeder rolls only for moving sheets toward said rolls, and means for mounting the intermediate units for free swinging movement with a sheet being presented.

4. In a sheet feeding means, feeder rolls, means for lifting sheets serially from a pack top maintained at a constant level and presenting them to the rolls to be fed thereby and including a gripper unit disposed over each corner of the pack and a plurality of intermediate gripper units

disposed for engagement with the sheets between the corners to prevent drag contact of a sheet being lifted with the underlying sheet, means for imparting lifting and lowering movement to all said units, means for swingably mounting the units disposed over the sheet corners adjacent the feeder rolls and for imparting movement to these particular units toward and from the rolls with the axes of these units always vertical, and means for mounting the intermediate units for free swinging movement with a sheet being presented.

5. In a sheet feeding means, feeder rolls, means for intermittently separating the rolls to receive a sheet between them and then restore them to feeding relation, pressure projected and spring returned suction grippers engageable with sheets of a pack top maintained at a constant level for lifting them serially from the pack, means for moving the grippers with a gripped sheet to present it to the rolls while separated, and rotary valve means for controlling pressure flow to the grippers to control projection and retraction thereof and for evacuating said grippers at the time they initially contact a sheet and for relieving the evacuation as the rolls take over the feeding of said sheet.

6. In a sheet feeding means, feeder rolls, means for intermittently separating the rolls to receive a sheet between them and then restore them to feeding relation, pressure projected and spring returned suction grippers engageable with sheets of a pack top maintained at a constant level for lifting them serially from the pack, means for moving the grippers with a gripped sheet to present it to the rolls while separated, and rotary valve means for controlling pressure flow to the grippers to control projection and retraction thereof and for evacuating said grippers at the time they initially contact a sheet and for relieving the evacuation as the rolls take over the feeding of said sheet, said valve means including a master valve having a vacuum chamber and a pressure chamber and control members for controlling communication between said chambers and said units, and a pilot valve manually operable to close off pressure and vacuum source communications with the chambers and for bleeding the pressure chamber.

7. In a sheet feeding means, feeder rolls, means for intermittently separating the rolls to receive a sheet between them and then restore them to feeding relation, pressure projected and spring returned suction grippers engageable with sheets of the pack for lifting them serially from a pack top maintained at a constant level, means for moving the grippers with a gripped sheet to present it to the rolls while separated, rotary valve means for controlling pressure flow to the grippers to control projection and retraction thereof and for evacuating said grippers at the time they initially contact a sheet and for relieving the evacuation as the rolls take over the feeding of said sheet, said valve means including a master valve having a vacuum chamber and a pressure chamber and control members for controlling communication between said chambers and said units, a pilot valve manually operable to close off pressure and vacuum source communications with the chambers and for bleeding the pressure chamber, pressure nozzles effective at the corners of the pack to prevent sticking of sheets, means including a pressure control and cutoff valve for supplying air under pressure to said nozzles, and means for simultaneously actuating said pilot valve and said cutoff valve.

8. In a sheet feeding means, feeder rolls, means for intermittently separating the rolls to receive a sheet between them and then restore them to feeding relation, pressure projected and spring returned suction grippers engageable with sheets of a pack top maintained at a constant level for lifting them serially from the pack, means for moving the grippers with a gripped sheet to present it to the rolls while separated, rotary valve means for controlling pressure flow to the grippers to control projection and retraction thereof and for evacuating said grippers at the time they initially contact a sheet and for relieving the evacuation as the rolls take over the feeding of said sheet, said valve means including a master valve having a vacuum chamber and a pressure chamber and control members for controlling communication between said chambers and said units, a pilot valve manually operable to close off pressure and vacuum source communications with the chambers and for bleeding the pressure chamber, pressure nozzles effective at the corners of the pack to prevent sticking of sheets, means including a pressure control and cutoff valve for supplying air under pressure to said nozzles, and a common manually operable means for simultaneously actuating the pilot valve and the cutoff valve and for discontinuing operation of said gripper movement imparting means.

9. In a machine of the character described, a pair of support arms swingable about axes occupying the same substantially horizontal plane, said arms being disposed in parallel spaced relation and connected at their free ends by a link composed of two parts clamped together intermediately of said arms, and a sheet gripper unit clamped uprightly between said link parts.

10. In a machine of the character described, a pair of support shafts disposed in horizontal parallel spaced relation, a pair of arms swingably suspended in parallel relation adjacent each end of said shafts, each pair being connected at their lower ends by a spacer device, a sheet gripper unit supported upright by each device, and means for swinging said arms back and forth about the axes of said shafts and including a continuously rotated cam and a crank arm secured to one of said shafts and engaging said cam, and means for moving said crank arm out of the effective path and movement of said cam for rendering said arms and unit inoperative.

11. In a machine of the character described, a pair of support shafts disposed in horizontal parallel spaced relation, a pair of arms swingably suspended in parallel relation adjacent each end of said shafts, each pair being connected at their lower ends by a spacer link, a sheet gripper unit secured uprightly to each link, a sheet gripper freely swingable in position for engaging an intermediate part of a sheet, means yieldably holding the freely swingable gripper unit in a normal non-feeding position, means for swinging said arms to impart sheet feeding movement thereto, means for controlling flow of pressure to and for effecting evacuation of said grippers for alternately forcing them against and attaching them to a sheet to be fed and then releasing said attachment to free the sheet, whereby said freely swingable gripper will move with said arms and then swing freely back to normal upon release of the sheet.

12. In a machine of the character described, a pair of support shafts disposed in horizontal parallel spaced relation, a pair of arms swingably suspended in parallel relation adjacent each

end of said shafts, each pair being connected at their lower ends by a spacer link, a sheet gripper unit secured uprightly to each link, a sheet gripper freely swingable in position for engaging an intermediate part of a sheet, means yieldably holding the freely swingable gripper unit in a normal non-feeding position, means for swinging said arms to impart sheet feeding movement thereto, means for controlling flow of pressure to and for effecting evacuation of said grippers for alternately forcing them against and attaching them to a sheet to be fed and then releasing said attachment to free the sheet, whereby said freely swingable gripper will move with said arms and then swing freely back to normal upon release of the sheet, and manually operable means for simultaneously discontinuing operation of the movement imparting means and said flow controlling and evacuation effecting means for silencing said grippers.

13. In a sheet feeding means, feeder rolls, means for lifting sheets serially from a pack top maintained at a constant level and presenting them to the rolls to be fed thereby and including a gripper unit disposed over each corner of the pack and a plurality of intermediate gripper units disposed for engagement with the sheets between the corners to prevent drag contact of a sheet being lifted with the underlying sheet, air pressure lowering and spring lifting means for imparting lifting and lowering movement to all said units, means for imparting movement to the units disposed over the sheet corners adjacent the feeder rolls only for moving sheets toward said rolls, and means for mounting the intermediate units for free swinging movement with a sheet being presented, the units disposed over the sheet corners remote from the feeder rolls being disposed with their axes converging upwardly-rearwardly so that the front edge of each sheet will be bowed downwardly as it is lifted by said converged-axis units.

14. In a machine of the character described, a pressure projected spring retracted gripper unit comprising, an upright cylindrical casing, a head closing the upper end of the casing and having an axial tubular extension, a head ring closing the lower end of the casing, a tubular plunger reciprocable in the casing and through the head ring and having a tubular extension movable in and terminating in the head extension, a suction cup secured on the lower end of the plunger and adapted to be evacuated through said plunger, its extension and the head extension, a piston reciprocable in the casing and secured to said plunger, spring means normally forcing the piston upwardly, said head having provision for engaging the piston and limiting its upward movement, and a pressure fitting including a lateral port communicating with the interior of the casing above the piston for admitting fluid pressure effective to project the plunger against the urge of the spring.

15. In a machine of the character described, a pressure projected spring retracted gripper unit comprising, an upright cylindrical casing, a head closing the upper end of the casing, a head ring closing the lower end of the casing, a tubular plunger reciprocable in the casing and through the head ring and having a piston affixed to its upper end, a second plunger having limited telescopic movement in the tubular plunger and extending below and slightly above said tubular plunger and having a central port at its upper end and lateral wall ports above and below the

piston, said tubular plunger having a wall port positioned for communicating with said central port below the piston, spring means normally urging the piston upwardly, means on the second plunger above and below the tubular plunger for limiting telescoping movement of said second plunger, said second plunger being hollow at its lower end and having a lateral vacuum duct connection, and a suction cup attached to said hollow end, fluid pressure applied above the piston initially serving to depress the second plunger and close its upper wall ports and then depress the piston and tubular plunger, and contact with a sheet to be lifted serving to lift the second plunger and hold open the upper wall ports to allow fluid pressure to escape from above the piston and permit the spring to return upwardly.

16. In a machine of the character described, a plurality of sets of sheet separating blower nozzles, and means for controlling the flow of pressure fluid to said nozzles comprising a valve casing having a valve chamber therein for each set of nozzles, a pressure inlet bore common to all chambers and ducts leading individually to the chambers from the common bore, an individual outlet leading from each chamber to a set of nozzles, a valve seat between each chamber and each outlet leading therefrom, a valve controlling passage through each seat, cam means for actuating the valves, and a plunger movable in the common bore for at times closing off said ducts.

17. In a sheet feeding means, feeder rolls, and means for lifting sheets serially from a pack top maintained at a constant level and presenting them to the rolls to be fed thereby and including a gripper unit disposed over each corner of the pack and at least one intermediate gripper unit for engaging the sheets between the corners to prevent dragging of the central portion of the sheet being lifted over the underlying sheet, each said gripper unit including a reciprocable plunger and a suction gripper carried thereby and communicating with said hollow portion, said plungers being projectible by fluid pressure greater than atmospheric pressure, spring means for retracting said plungers, and valve means for controlling application of fluid pressure to said plungers for alternately projecting them and then releasing said pressure to permit said spring means to retract them, and also for evacuating said suction grippers at times to cause them to grip sheets to be fed.

18. In a sheet feeding means, feeder rolls, and means for lifting sheets serially from a pack top maintained at a constant level and presenting them to the rolls to be fed thereby and including a gripper unit disposed over each corner of the pack and at least one intermediate gripper unit for engaging the sheets between the corners to prevent dragging of the central portion of the sheet being lifted over the underlying sheet, each said gripper unit including a reciprocable plunger and a suction gripper carried thereby and communicating with said hollow portion, said plungers being projectible by fluid pressure greater than atmospheric pressure, spring means for retracting said plungers, and a single rotary valve for controlling application of fluid pressure to said plungers for alternately projecting them and then releasing said pressure to permit said spring means to retract them, and also for evacuating said suction grippers at times to cause them to grip sheets to be fed.

19. In a sheet feeding means, feeder rolls, and means for lifting sheets serially from a pack top maintained at a constant level and presenting them to the rolls to be fed thereby and including a gripper unit disposed over each corner of the pack and at least one intermediate gripper unit for engaging the sheets between the corners to prevent dragging of the central portion of the sheet being lifted over the underlying sheet, each said gripper unit including a reciprocable plunger and a suction gripper carried thereby and communicating with said hollow portion, said plungers being projectible by fluid pressure greater than atmospheric pressure, spring means for retracting said plungers, means including a horizontally disposed cam shaft for imparting sheet feeding movement to certain of said gripper units, a single rotary valve rotatable about a vertical axis and effective for controlling application of fluid pressure to said plungers for alternately projecting them and then releasing said pressure to permit said spring means to retract them, and also for evacuating said suction grippers at times to cause them to grip sheets to be fed, and means for driving said valve from said cam shaft.

20. In a sheet feeding means, feeder rolls, and means for lifting sheets serially from a pack top maintained at a constant level and presenting them to the rolls to be fed thereby and including a gripper unit disposed over each corner of the pack and at least one intermediate gripper unit for engaging the sheets between the corners to prevent dragging of the central portion of the sheet being lifted over the underlying sheet, each said gripper unit including a reciprocable plunger and a suction gripper carried thereby and communicating with said hollow portion, said plungers being projectible by fluid pressure greater than atmospheric pressure, spring means for retracting said plungers, means including a horizontally disposed cam shaft for imparting sheet feeding movement to certain of said gripper units, a single rotary valve rotatable about a vertical axis and effective for controlling application of fluid pressure to said plungers for alternately projecting them and then releasing said pressure to permit said spring means to retract them, and also for evacuating said suction grippers at times to cause them to grip sheets to be fed, sheet winding devices, means including a control valve for directing fluid under pressure to said winding devices, and means for actuating both said valves from said cam shaft.

21. In a machine of the character described, a pressure projected spring retracted sheet gripper equipment comprising, an upright cylindrical casing, a plunger reciprocable in and projecting from the lower end of said casing, a suction gripper carried by the lower end of said plunger, spring means alone effective for forcing said plunger to a retracted position in said cylinder, means for directing fluid pressure at greater than atmospheric pressure against said plunger for at times projecting the same from the cylinder to engage a sheet to be fed, and means for evacuating said suction gripper to cause it to grip an engaged sheet and lift the same when the pressure on the plunger is released and the spring retracts the plunger.

22. In a machine of the character described, a pressure projected spring retracted sheet gripper equipment comprising, an upright cylindrical casing, a plunger reciprocable in and projecting

from the lower end of said casing, a suction gripper carried by the lower end of said plunger, spring means alone effective for forcing said plunger to a retracted position in said cylinder, means for directing fluid pressure at greater than atmospheric pressure against said plunger for at times projecting the same from the cylinder to engage a sheet to be fed, means for evacuating said suction gripper to cause it to grip an engaged sheet and lift the same when the pressure on the plunger is released and the spring retracts the plunger, and a single valve for controlling the application of fluid pressure to said plunger and the evacuation of said suction gripper.

23. In a sheet feeding means, feeder rolls, means for intermittently separating the rolls to receive a sheet between them and then restore them to feeding relation, pressure projected and spring returned suction grippers engageable with sheets of a pack top maintained at a constant level for lifting them serially from the pack, means for moving the grippers with a gripped sheet to present it to the rolls while separated, and valve means for controlling pressure flow to the grippers to control projection and retraction thereof and for evacuating said grippers at the time they initially contact a sheet and for relieving the evacuation as the rolls take over the feeding of said sheet, said valve means including a master valve having a vacuum chamber and a pressure chamber and control members for controlling communication between said chambers and said units, and a pilot valve manually operable to close off pressure and vacuum source communications with the chambers and for bleeding the pressure chamber.

24. In a sheet feeding means, feeder rolls, means for intermittently separating the rolls to receive a sheet between them and then restore them to feeding relation, reciprocable suction grippers engageable with sheets of a pack top maintained at a constant level for lifting them serially from the pack, compressed air and spring actuated means for reciprocating said grippers, means for moving the grippers with a gripped sheet to present it to the rolls while separated, devices including valve means for controlling reciprocation of said grippers and for evacuating said grippers at the time they initially contact a sheet and for relieving the evacuation as the rolls take over the feeding of said sheet, a pilot valve operable to render said valve means ineffective to control reciprocation of said grippers, pressure nozzles effective at the corners of the pack to prevent sticking of sheets, means including a pressure control and cutoff valve for supplying air under pressure to said nozzles, and means for simultaneously actuating said pilot valve and said cutoff valve.

25. In a sheet feeding means, feeder rolls, means for intermittently separating the rolls to receive a sheet between them and then restore them to feeding relation, reciprocable suction grippers engageable with sheets of a pack top maintained at a constant level for lifting them serially from the pack, compressed air and spring actuated means for reciprocating said grippers, means including a rotary cam shaft for moving the grippers with a gripped sheet to present it to the rolls while separated, devices including valve means for controlling reciprocation of said grippers and for evacuating said grippers at the time they initially contact a sheet and for relieving

the evacuation as the rolls take over the feeding of said sheet, a pilot valve operable to render said valve means ineffective to control reciprocation of said grippers, pressure nozzles effective at the corners of the pack to prevent sticking of sheets, means including a pressure control and cutoff valve for supplying air under pressure to said nozzles, means for simultaneously actuating said pilot valve and said cutoff valve, and means for disabling said gripper moving means without discontinuing rotation of said cam shaft.

26. In a sheet feeding means, feeder rolls, means for intermittently separating the rolls to receive a sheet between them and then restore them to feeding relation, reciprocable suction grippers engageable with sheets of a pack top maintained at a constant level for lifting them serially from the pack, compressed air and spring actuated means for reciprocating said grippers, means including a rotary cam shaft for moving the grippers with a gripped sheet to present it to the rolls while separated, devices including valve means for controlling reciprocation of said grippers and for evacuating said grippers at the time they initially contact a sheet and for relieving the evacuation as the rolls take over the feeding of said sheet, a pilot valve operable to render said valve means ineffective to control reciprocation of said grippers, pressure nozzles effective at the corners of the pack to prevent sticking of sheets, means including a pressure control and cutoff valve for supplying air under pressure to said nozzles, and a single means operable to actuate said pilot valve and said cutoff valve and for disabling said gripper moving means without discontinuing rotation of said cam shaft.

27. In a machine of the character described, a pair of support shafts disposed in horizontal parallel spaced relation, a pair of arms swingably suspended in parallel relation adjacent each end of said shafts, each pair being connected at their lower ends by a spacer device, a sheet gripper unit supported upright by each device, means for swinging said arms back and forth about the axes of said shafts and including a continuously rotated cam and a crank arm secured to one of said shafts and engaging said cam, said crank arm being movable out of the effective path of movement of said cam for rendering said arms and unit inoperative, and means for moving the crank arm to and holding it in said inoperative position and including a lever pin and slot connected with said crank arm.

28. In a machine of the character described, a pressure projected spring retracted sheet gripper equipment comprising, an upright cylindrical casing, a plunger reciprocable in and projecting from the lower end of said casing, a suction gripper carried by the lower end of said plunger, spring means for forcing said plunger to a retracted position in said cylinder, means for directing fluid pressure at greater than atmospheric pressure against said plunger for at times projecting the same from the cylinder to engage a sheet to be fed, means controlled through engagement of the suction gripper with the sheet for releasing said fluid pressure to enable said spring means to retract said plunger, and means for evacuating said suction gripper to cause it to grip an engaged sheet and lift the same when the pressure on the plunger is released and the spring retracts the plunger.

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