

May 2, 1939.

L. BAKER ET AL

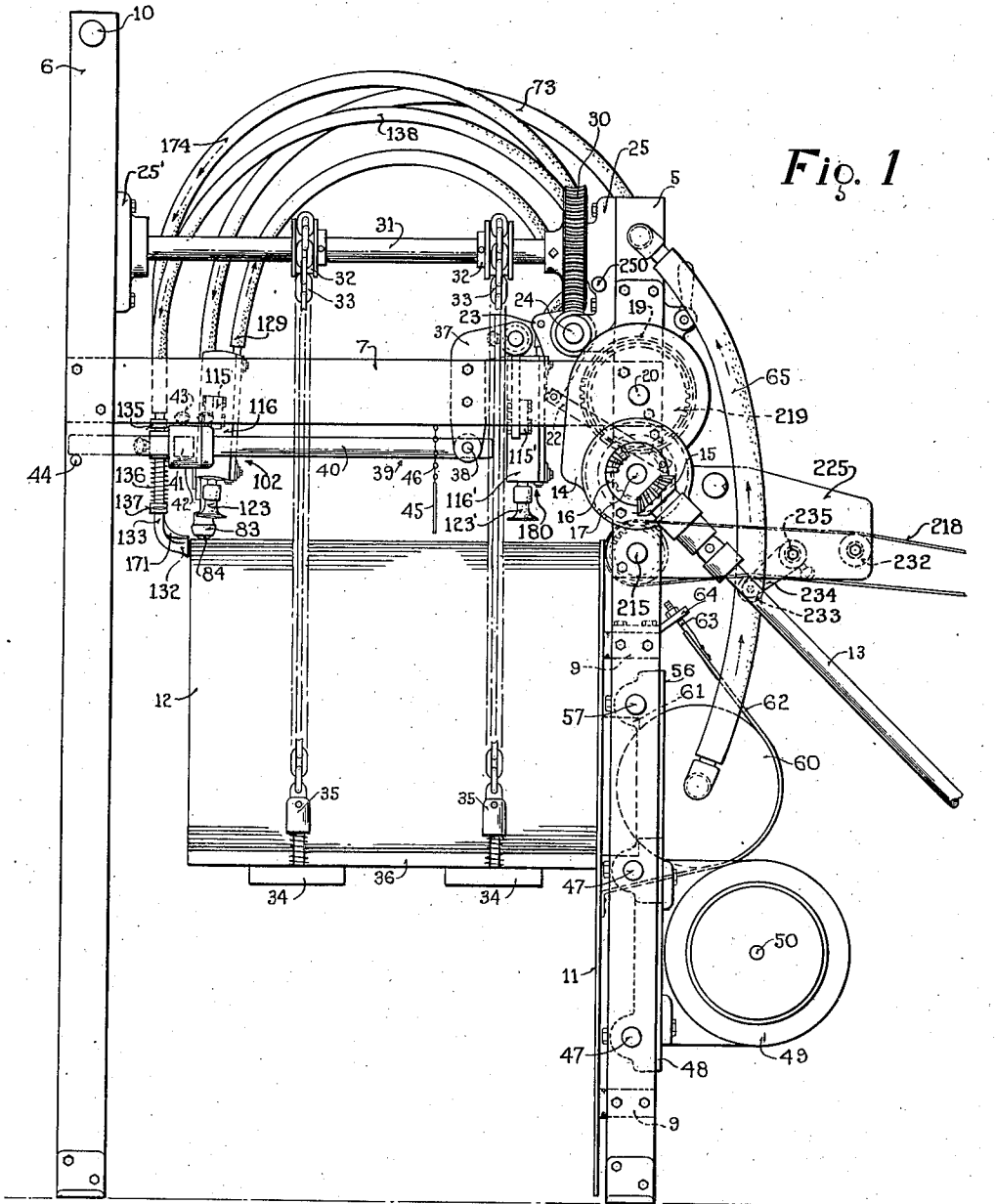
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SHEET FEEDER

Filed Dec. 19, 1936

8 Sheets-Sheet 1

Fig. 1



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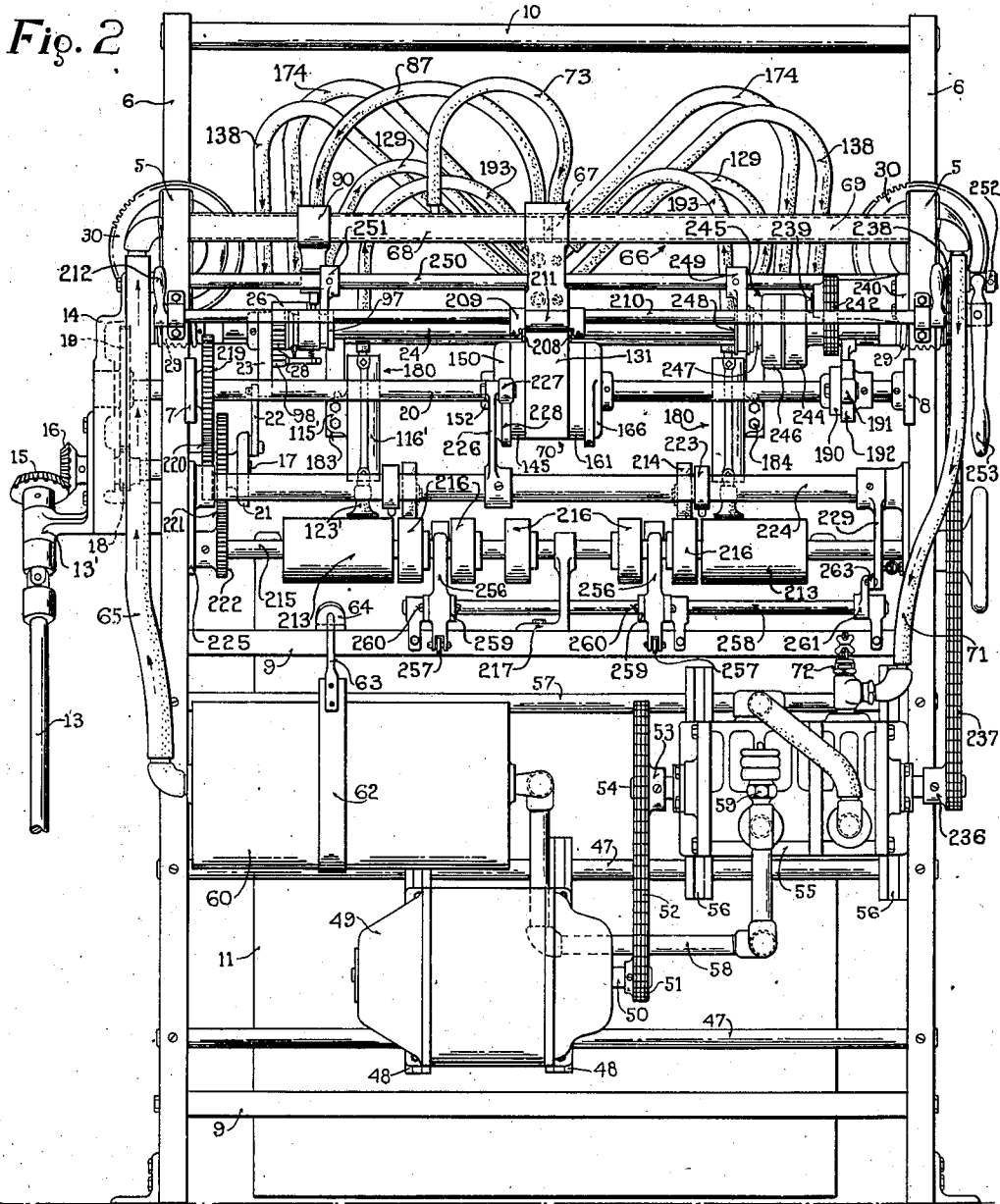
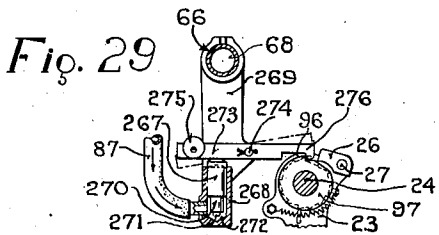
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SHEET FEEDER

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8 Sheets-Sheet 2



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8 Sheets-Sheet 3

Fig. 3

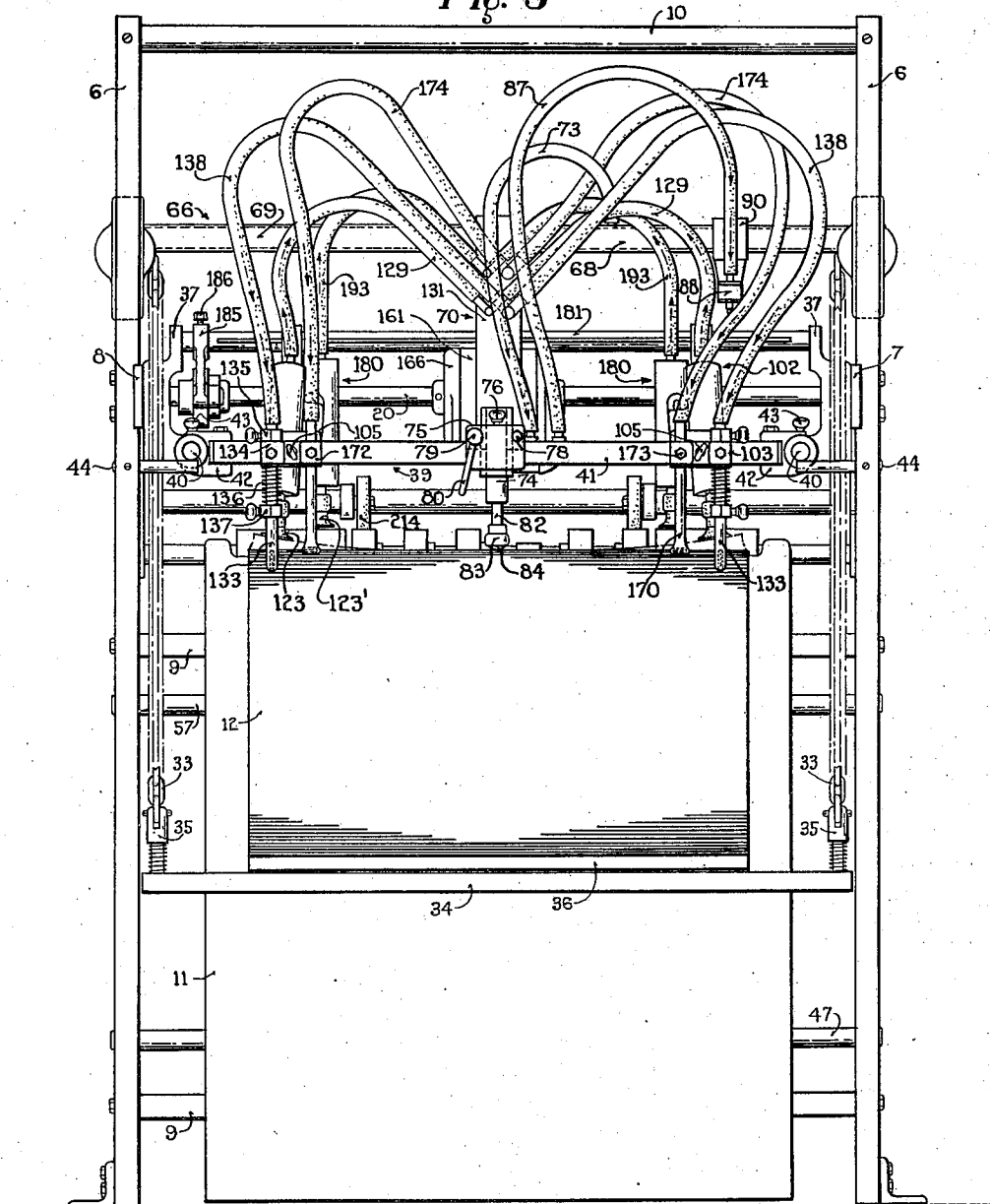
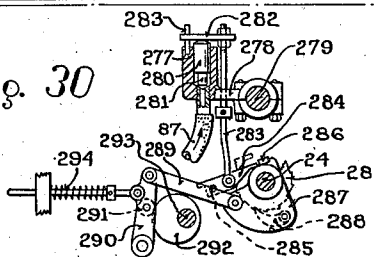


Fig. 30



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8 Sheets-Sheet 4

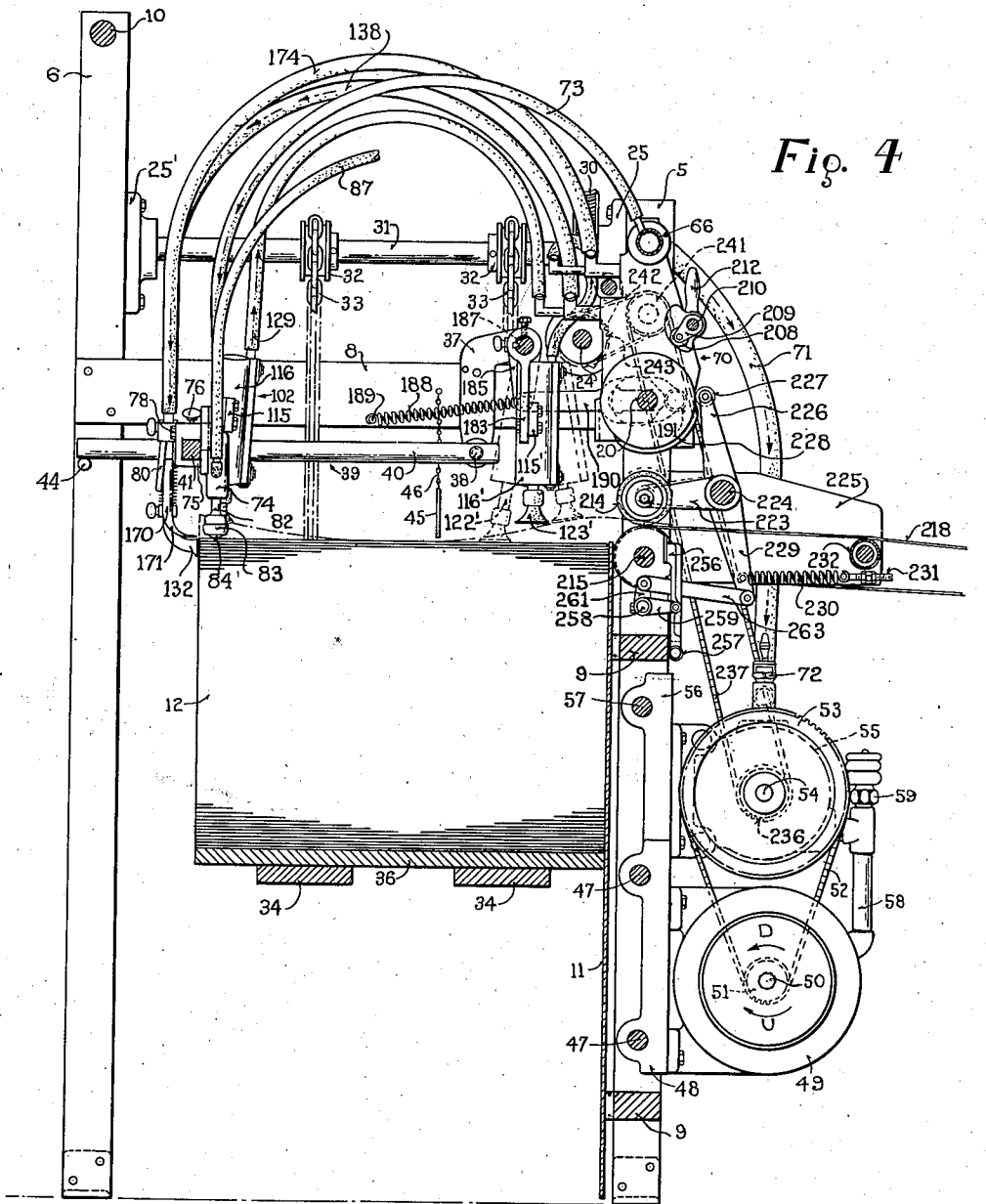
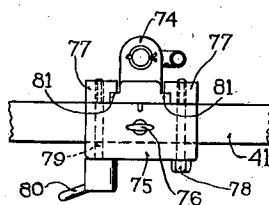


Fig. 28



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8 Sheets-Sheet 5

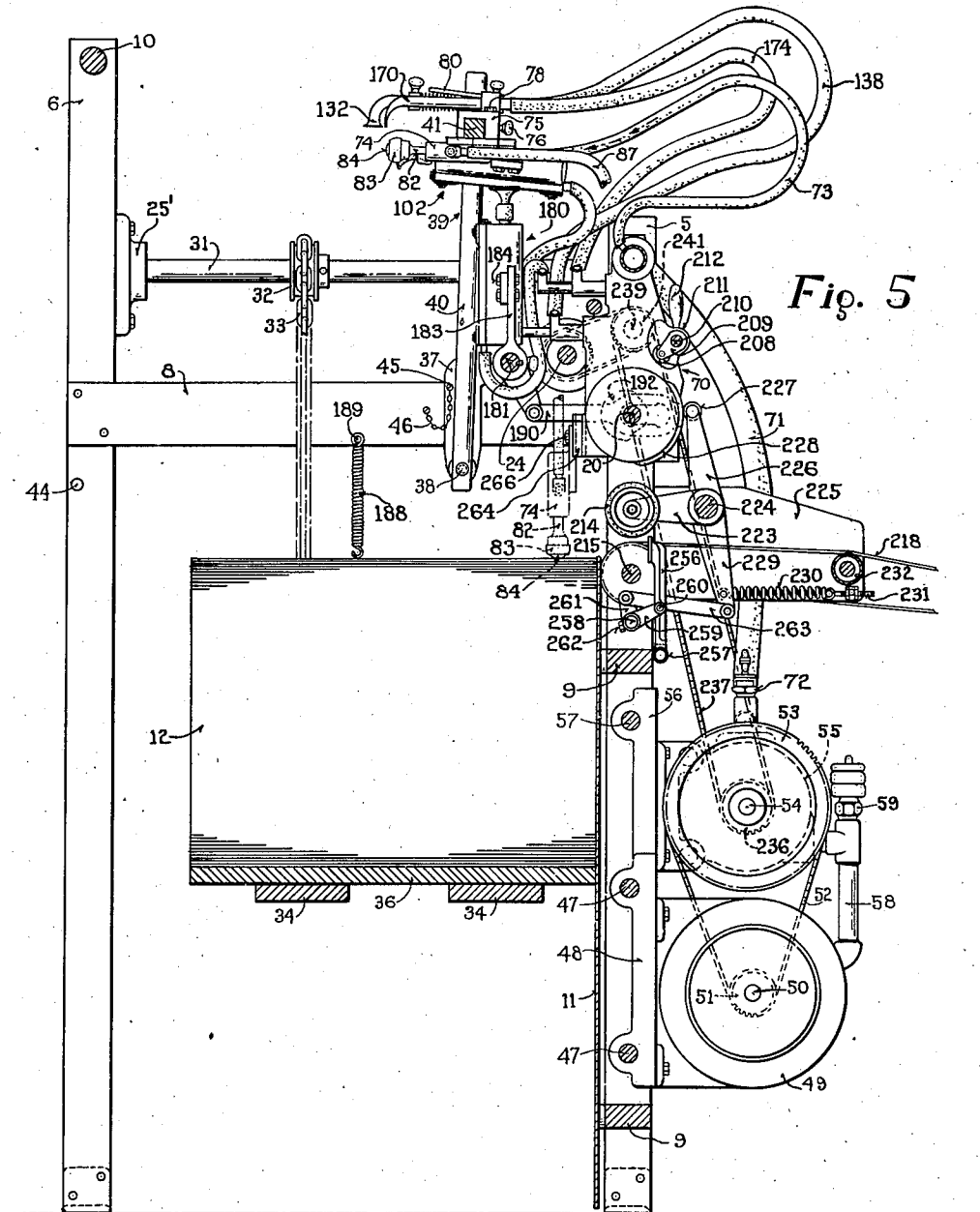


Fig. 5

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8 Sheets-Sheet 6

Fig. 6

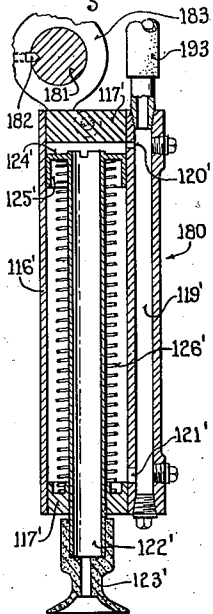


Fig. 7

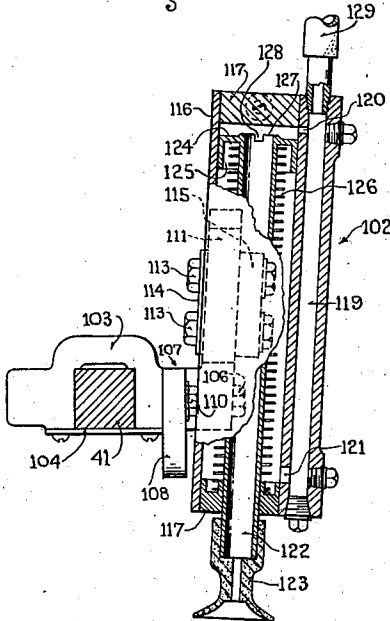


Fig. 8

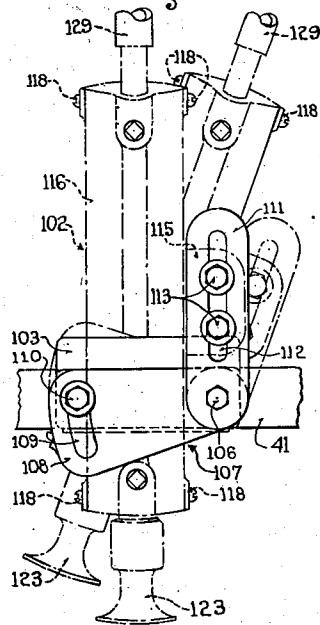


Fig. 26

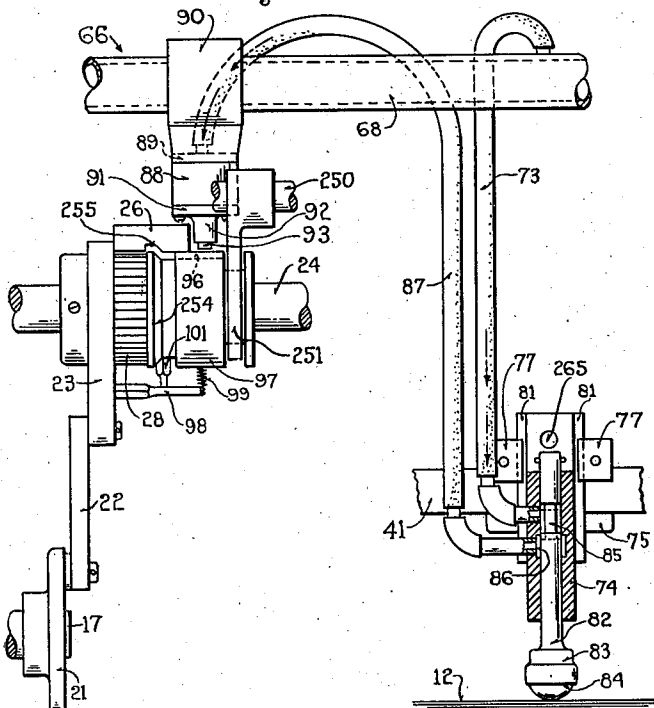
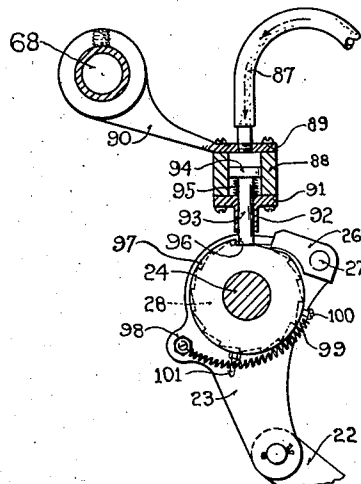


Fig. 27



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8 Sheets-Sheet 7

Fig. 9

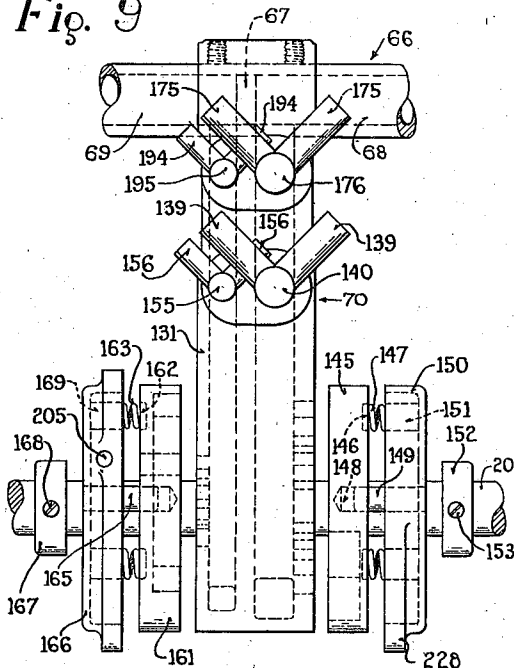


Fig. 10

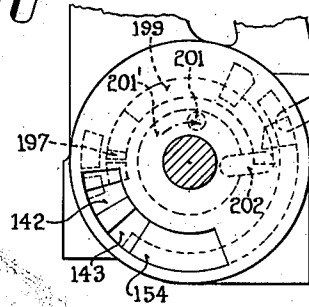


Fig. 11

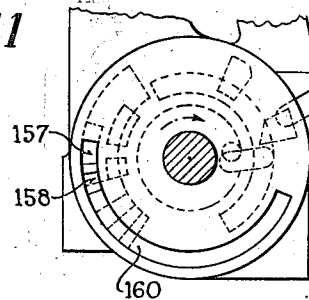


Fig. 12

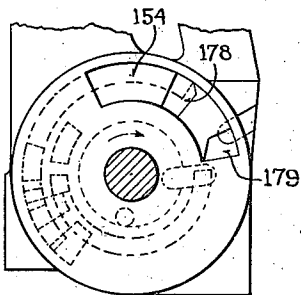


Fig. 13

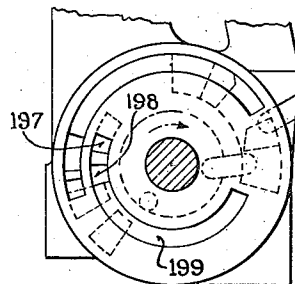


Fig. 14

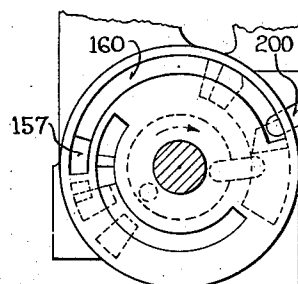
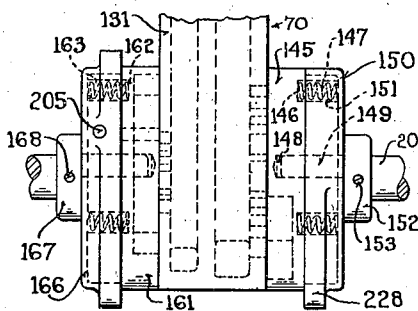


Fig. 15



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SHEET FEEDER

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8 Sheets-Sheet 8

Fig. 16

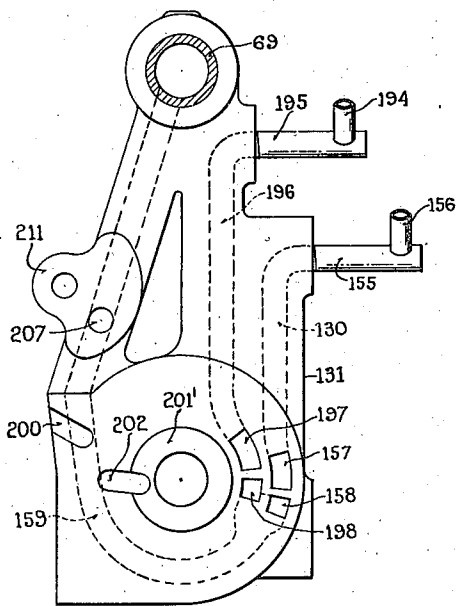


Fig. 17

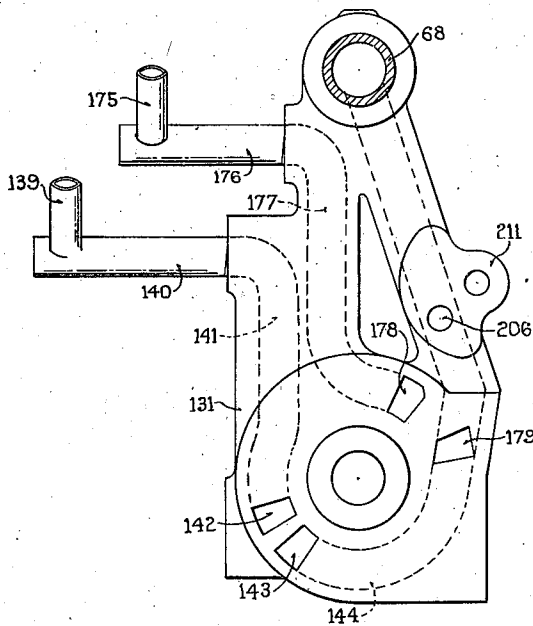


Fig. 18

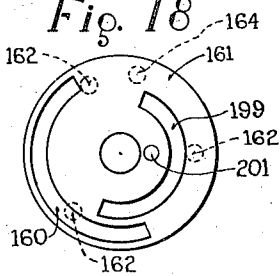


Fig. 20

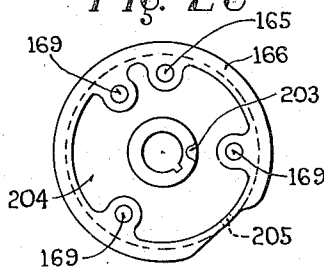


Fig. 22

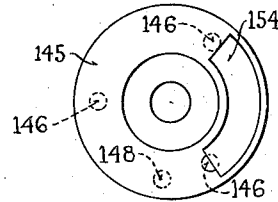


Fig. 19

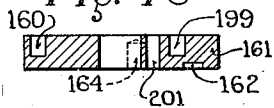


Fig. 21

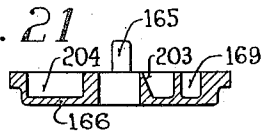


Fig. 23

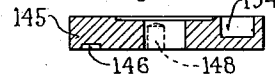


Fig. 24

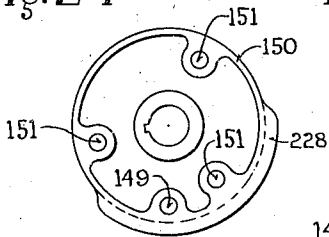
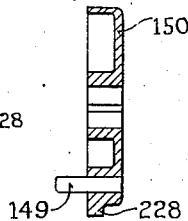


Fig. 25



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UNITED STATES PATENT OFFICE

2,156,648

SHEET FEEDER

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Application December 19, 1936, Serial No. 116,692

39 Claims. (Cl. 271—31)

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

One object of the present invention is to provide an improved method of separating and feeding metal or other relatively heavy sheets from a pile or supply thereof.

Another object of the present invention is to provide an improved feeder of novel, simple, and durable construction that will rapidly and efficiently feed sheets of metal to various types of equipment such as mentioned above.

Another object of the present invention is to provide an improved feeder having a relatively small number of parts novelly constructed, coordinated and operated to insure efficiency, low manufacturing, installation and maintenance costs, and "fool-proof" operation.

Another object of the present invention is to provide a feeder having as many of the operating parts as possible actuated or controlled by vacuum or air so that various expensive and complicated mechanical devices heretofore employed are eliminated and a more efficient, compact and economical feeder is produced.

Another object of the present invention is to provide a feeder having improved sheet separating devices angularly arranged in such manner that they positively separate metal sheets singly in succession from a pile or supply and prevent them from sliding relatively and marring or scratching each other.

Another object of the present invention is to provide a feeder having improved means for separately operating the elevator to load it.

Another object of the present invention is to provide a feeder having improved valve mechanism for making and breaking vacuum in the sheet separating and forwardly devices of the feeder and for controlling delivery of compressed air to the pile corner and individual sheet winding devices.

Another object of the present invention is to provide a feeder with pile elevating mechanism and control means therefor so constructed that compressed air may be utilized in the operation of said means and control thereby of said pile elevating mechanism.

Another object of the present invention is to

provide a feeder having sheet separating and forwarding devices arranged as units independently movable to operative and inoperative positions so that sheets may be fed automatically or by hand from a pile or supply thereof as desired.

Another object of the present invention is to provide a feeder having pile lifting means and control means therefor which can be employed to automatically elevate the pile or supply of sheets either when automatically or hand feeding the same from said pile or supply.

Another object of the present invention is to provide a feeder having automatically operated pile elevating means and control means therefor that may be actuated by the pile to elevate it when hand feeding or may be moved to the inoperative position of certain of the pneumatic units and there manually actuated to control automatic elevation of the pile during such feeding.

Another object of the present invention is to provide a feeder having drop rollers automatically operated toward and away from the feed rollers either when automatically feeding sheets from a pile or a supply or when hand feeding them therefrom and which rollers, during hand feeding, may be employed to actuate stops or gages against which the sheets are hand fed preparatory to operation of the feed and drop rollers upon said sheets.

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

In said drawings:

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

Figs. 2 and 3 are front and rear elevations respectively of the feeder shown in Fig. 1;

Fig. 4 is a vertical longitudinal sectional view of the feeder shown in Figs. 1 to 3, the sheet separating and forwarding devices and the control means for the pile elevating mechanism appearing in their lowered operative positions for automatic feeding;

Fig. 5 is a view similar to Fig. 4, the sheet separating and forwarding devices being shown in their raised inoperative positions for hand feeding and the control means for the pile elevating mechanism being shown in different operative positions for such feeding as indicated by full and dotted lines;

Fig. 6 is an enlarged vertical longitudinal sectional view of one of the pneumatic sheet forwarding devices;

Fig. 7 is a side elevation, partly in section, of one of the pneumatic sheet separating devices and supporting means therefor;

Fig. 8 is a front elevation of the supporting means illustrated in Fig. 7, showing diagrammatically different positions of adjustment of said means and the pneumatic sheet separating device carried thereby;

Fig. 9 is an enlarged rear elevation of improved valve mechanism embodying the present invention, certain parts of said mechanism being separated for purposes of clearer illustration;

Figs. 10 to 14 inclusive are side elevations showing diagrammatically different positions occupied by parts of the valve mechanism during one cycle of operation thereof;

Fig. 15 is a view similar to Fig. 9 on a smaller scale, showing the parts of the valve mechanism in engaged, operative relation;

Fig. 16 is an elevation of one side of a ported casting forming part of the valve mechanism illustrated in Figs. 9 and 15;

Fig. 17 is an elevation of the opposite side of said casting;

Fig. 18 is a side elevation of the vacuum valve shown in Figs. 9 to 15, and Fig. 19 is a horizontal sectional view of said valve;

Fig. 20 is a side elevation of the vacuum valve driving disc shown in Figs. 9 and 15, and Fig. 21 is a horizontal sectional view of said disc;

Fig. 22 is a side elevation of the air valve shown in Figs. 9 and 15, and Fig. 23 is a horizontal sectional view of said valve;

Fig. 24 is a side elevation of the air valve driving disc shown in Figs. 9 and 15, and Fig. 25 is a vertical sectional view of said disc;

Fig. 26 is an enlarged front elevation, partly in section, of the pile elevating mechanism and pneumatic control means therefor;

Fig. 27 is a side elevation, partly in section, of the mechanism and means shown in Fig. 26;

Fig. 28 is a top plan view of the valve supporting bracket shown in Fig. 26;

Fig. 29 is a view similar to Fig. 27 of another pneumatic control means embodying the present invention; and

Fig. 30 is a view similar to Fig. 29 of another pneumatic control means embodying the present invention.

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

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

ing elevation of the same by mechanism to be hereinafter described.

Referring now more particularly to Figs. 1 and 2, the drive for the feeder is preferably comprised by an inclined driven jack shaft 13 which, in turn, is driven from any suitable source of power (not shown). The upper end of this jack shaft 13 is journaled in a suitable bearing 13' bolted or otherwise suitably secured on a gear guard 14 that is likewise secured on one of the front uprights 5.

Fixed on the upper end of jack shaft 13 is a bevel gear 15 which meshes with a similar gear 16 fixed on a short shaft 17 journaled in suitable bearings in the gear guard 14 and the adjacent front upright 5. Disposed within the gear guard 14 and fixed on the short shaft 17 is a spur pinion 18 which meshes with a spur gear 19 also disposed within said guard and fixed on a cam shaft 20 projecting therein. This cam shaft 20 is journaled in suitable bearings in the front uprights 5 and also has a bearing in the gear guard 14 through which it projects into said guard to receive the gear 19. The cam shaft 20 is utilized to operate various parts of the feeder to be hereinafter described. The feeder includes a pile elevator and operating mechanism therefor preferably constructed as follows.

The short shaft 17 has fixed thereon a crank disc 21 pivotally connected with one end of a link 22 the opposite end of which is pivotally connected with a pawl carrier 23 that is loosely mounted on a shaft 24 (Figs. 2, 26 and 27). This shaft 24 extends transversely of the feeder and is journaled in suitable bearings in brackets 25 (Figs. 1 and 4) that are bolted or otherwise suitably secured to the front uprights 5 at the upper ends thereof. The shaft 24 is operated at suitable intervals to raise the pile elevator hereinafter described and said operation of said shaft is preferably effected by pawl and ratchet mechanism of the general type disclosed in the application Serial No. 33,002 of Leonard Baker filed July 25, 1935.

This pawl and ratchet mechanism includes a pawl carrier such as indicated at 23 (Figs. 2, 26 and 27) having a pawl 26 pivoted thereon at 27 and adapted, under certain conditions, to engage a ratchet 28 fixed on the shaft 24. It will thus appear that through oscillation of the pawl carrier 23 by the described driving connections therefor with the jack shaft 13 and engagement of the oscillating pawl 26 with the ratchet 28, the shaft 24 will be intermittently rotated. Under these conditions right and left hand worms 29 (Fig. 2) fixed on shaft 24 will likewise be rotated. These worms 29 mesh with right and left hand worm gears 30 that are fixed on shafts 31 (Figs. 1 and 4) journaled in suitable bearings provided by the brackets 25 on the front uprights 5 and 25' on the rear uprights 6. Fixed on shafts 31 are toothed sheaves 32 in the teeth of which are engaged links of chains 33 so that when the shafts 31 are rotated in the proper direction by the described driving means therefor, said chains will be raised and thus raise an elevator comprising cross beams 34 to which the lower ends of said chains are secured as by suitable couplings or connections 35. The elevator 34 has placed thereon a pile board 36 which, together with the pile of metal or other sheets 12, is positioned on said elevator through the rear of the feeder when the elevator is lowered by means for this purpose hereinafter described.

The elevator 34 and pile of sheets 12 thereon are raised intermittently as the sheets are fed off the top of said pile by separating and forwarding means hereinafter described, and to keep the top of said pile at a predetermined level for the operation of said means the elevator and its operating mechanism are, in accordance with the present invention, controlled by pneumatic means preferably mounted, constructed and operated as follows.

Bolted or otherwise suitably secured on the side members 7, 8 are brackets 37 to which are pivoted, as at 38, a frame indicated broadly at 39 (Figs. 1 to 5). This frame 39 comprises side members 40 and a rear cross member 41. This cross member 41 is bolted or otherwise suitably secured to brackets 42 slidably mounted on the side members 40. The cross member 41 and parts carried thereby are therefore adjustable forwardly and rearwardly along said side members and may be secured in any desired position of adjustment thereon by thumb screws 43 or the like.

During automatic feeding of sheets from the top of pile 12, in a manner hereinafter described, the frame 39 and parts carried thereby are positioned as shown more clearly in Fig. 4 wherein it will be noted that the rear of said frame is supported by pins 44 secured on the rear uprights 6. When sheets are being hand fed from the top of the pile the frame 39 and parts carried thereby are swung upward and positioned as more clearly shown in Fig. 5 of the drawings where they are held against accidental displacement by a pin 45 removably secured in a suitable opening in one of the brackets 37. This pin 45 is secured to one end of a small chain 46 the opposite end of which is connected in any suitable manner to the side member 8.

As before stated, pneumatic means are employed to control the operation of the elevator and in accordance with the present invention compressed air is employed to actuate said means. The source of compressed air and the driving means therefor are preferably mounted, constructed and operated as follows. Extending across the feeder frame and secured in any suitable manner to the front uprights 5 thereof are cross shafts 47 (Fig. 2). These cross shafts 47 have bolted or otherwise suitably secured thereto brackets 48 which, in turn, have bolted or otherwise suitably secured thereto an electric motor 49 connected with a suitable source of current and controlled for starting, stopping and reversing purposes by suitable switch means (not shown). Fixed on the armature shaft 50 of motor 49 is a sprocket 51 around which passes a chain 52 that also passes around a sprocket 53 that is fixed on the shaft 54 of a pump 55 suitably constructed to supply air under pressure from one part thereof and to create vacuum in another part thereof.

This air and vacuum pump 55 is bolted or otherwise suitably secured above and to one side of the motor 49 on brackets 56 which, in turn, are bolted or otherwise suitably secured on one of the cross shafts 47 and a third cross shaft 57 located thereabove and secured in any suitable manner on the front uprights 5. Connected with the exhaust or air pressure side or part of pump 55 is one end of a conduit 58 in which is located a valve 59 for controlling the pressure of air delivered from the pump through said conduit to the parts hereinafter described and connected therewith. The opposite end of this conduit 58 is connected with a compressed air tank 60. A block 61 (Fig. 1) is provided with an arcuate face to receive a por-

tion of tank 60 and said tank and said block are clamped against the pile guiding plate 11 by a strap 62 passing around the tank and having its lower end secured to said plate. The upper end of the strap 62 is adjustably secured, as by an adjusting bolt 63 thereon, to a bracket 64 that is bolted or otherwise suitably secured to the upper cross member 9.

The compressed air tank 60 has connected therewith one end of a conduit 65 the opposite end of which is connected with a tubular shaft indicated broadly at 66 (Figs. 2 and 3) extending transversely of the feeder and secured in any suitable manner in the front uprights 5. This tubular shaft 66 is divided, as by a plug 67 therein, into an air supply conduit 68 and a vacuum conduit 69 both connected with a valve mechanism indicated broadly at 70. This valve mechanism, hereinafter described in detail, controls both the air pressure actuated and vacuum actuated parts of the feeder that will be later described. The vacuum conduit 69 has connected therewith one end of a conduit 71 the opposite end of which is connected with the vacuum side or part of the pump 55. The conduit 71 has disposed therein adjacent the pump 55 a vacuum regulating valve 72 of any suitable construction.

Air under pressure will, through the described connections between pump 55 and tank 60, be continuously maintained in the latter and in the conduits 65 and 68. The conduit 68 has connected therewith one end of a flexible conduit 73 the opposite end of which is connected with a valve housing 74 (Figs. 3 to 5 and 26). This valve housing 74 is removably and adjustably mounted in a bracket 75 (Figs. 26 and 28) secured to, and adjustable along, the rear cross bar 41 of the frame 39 as by a thumb screw 76 or the like. This bracket 75 is provided on the front thereof with a pair of clamps 77 one of which is secured to the bracket by a machine screw 78. The other clamp is secured to bracket 75 by an adjusting screw 79 provided with a handle 80. The valve housing 74 is provided with a tenon 81 engaged by the clamps 77. By manipulation of the handle 80 the clamp connected therewith may be loosened or tightened to provide for vertical adjustment of the valve housing 74 and mounting and removal of the same on and from the bracket 75 respectively, as desired.

Slidably mounted in the housing 74 is a valve 82 the stem of which, in the position of the parts shown in Figs. 4 and 26, projects downwardly through the housing and is provided on the lower end with a socket 83 in which is freely mounted a ball 84 that rests on the top of the pile of sheets 12. The valve 82 is provided with a reduced portion 85 and the valve housing 74 is provided in the bore thereof with a chamber 86. When the top of the pile of sheets 12 is at proper height the valve 82 through engagement of ball 84 with the pile will be positioned as shown in Fig. 26 wherein it will be noted that the reduced portion 85 of the valve is disposed slightly above chamber 86 so that air under pressure supplied in the valve housing and around the reduced portion of the valve by conduit 73 cannot reach the chamber 86.

As sheets are fed one after another from the top of the pile, and with the ball 84 engaged therewith, the valve 82 will lower by gravity so that when a sufficient number of sheets have been so fed, the reduced portion of the valve will extend or drop into the chamber 86 thus establishing communication between the latter and the conduit 73. Under these conditions, air

under pressure will be delivered into a conduit 87 having one end connected with the chamber 86 and the opposite end connected with a plunger housing 88 (Figs. 26 and 27). This housing 88 has a cover plate 89 bolted or otherwise suitably secured thereto and provided by an arm 90 which, in turn, is bolted or otherwise suitably secured to the tubular shaft 66 at a point adjacent the previously described pawl 26 and ratchet 28.

The plunger housing 88 is provided at the bottom thereof with a cover plate 91 bolted or otherwise suitably secured to said housing and having a tubular guide 92 for the stem 93 of a plunger 94 disposed within said housing as clearly shown in Fig. 27. A spring 95 encircling the stem 93 and interposed between the bottom cover plate 91 and the plunger 94 normally tends to lift the plunger and the stem so that the latter is removed from the path of travel of a shoulder 96 formed on a pawl mask 97 freely mounted on, and slidable along, the shaft 24.

When air under pressure is admitted in conduit 87, however, as previously described, said air enters the plunger housing 88 and exerts downward pressure on the plunger 94, thus forcing the stem 93 downwardly into the path of the shoulder 96 on the pawl mask 97 as clearly shown in Fig. 27. This pawl mask is connected with the oscillating pawl carrier 23 by means of a pin 98 on the latter and a spring 99 having one end connected with said pin and the opposite end connected with the pawl mask 97 as by a machine screw 100.

Under operating conditions and when the pile elevator is at rest, the spring 99 holds a pin 101 on mask 97 in engagement with the pin 98 on the oscillating pawl carrier 23 and said carrier and mask are rotated together and the latter holds the pawl 26 out of engagement with the ratchet 28. When the mask 97 is stopped through engagement of plunger stem 93 with shoulder 96 as previously described, the pawl 26 through continued oscillation of the pawl carrier 23 will ride off a high part of the mask on to a low part thereof and engage the ratchet 28. The shaft 24 will thus be actuated intermittently by the pawl and ratchet mechanism, and through the described connections for said shaft with the elevator, the latter and the pile of sheets will be raised until the top of the pile is at the proper height.

As the pile thus raises, the valve 82 is lifted, thus raising the reduced part 85 out of the chamber 86 and disconnecting the source of air under pressure from the plunger housing 88. The spring 95 then lifts the plunger 94 and stem 93 so that the latter is disengaged from shoulder 96 on the mask 97. The spring 99, which enables continued oscillation of the pawl carrier when the mask is stopped, now acts on the mask to turn the latter and engage the pins 98 and 101. The high part of the mask is thus brought under the pawl 26 to lift the latter out of engagement with the ratchet 28, and the pawl and its carrier, together with the mask, again oscillate idly until further elevation of the pile is necessary at which time said pile will again be elevated as previously described.

The sheets of pile 12 are separated one after another at the rear by separating devices located adjacent the rear corners of the pile and actuated in one direction by vacuum or suction and in the opposite direction by vacuum or suction assisted, if desired, by spring means. These

separating devices, indicated broadly at 102 in Figs. 1, 3, 7 and 8, are identical as respects their mounting, construction and operation and a description of one of said devices will therefore be sufficient for both of the same. Each separating device 102 is mounted on a bracket 103 (Figs. 7 and 8) engaged over the rear cross bar 41 of the pivoted frame 39 and held against displacement therefrom by a bottom plate 104 that is bolted or otherwise suitably secured to said bracket. Each bracket 103 and the separator 102 carried thereby is adjustable along the bar 41 so that the separators 102 may be moved toward and away from each other in accordance with various sizes of sheets being handled and to locate said devices at the desired points with reference to their operation upon rear corner portions of the sheets at the top of the pile.

Each bracket 103 is secured in the desired position of adjustment thereof by a set screw 105 (Fig. 3) and carries a stud 106 (Figs. 7 and 8) on which is pivotally mounted a bell crank lever indicated broadly at 107. One arm 108 of this bell crank lever is parallel with the bar 41 and provided with an arcuate slot 109 through which extends a lock screw 110 carried by the bracket 103 and threaded in a suitable opening therein. The other arm 111 of the bell crank 107 is inclined upwardly and forwardly from the arm 108 and the bracket 103 and is provided longitudinally with a vertical slot 112. Extending through the slot 112 of arm 111 are adjusting and locking bolts 113 that also extend through suitable openings in a washer 114 and through suitable openings in an ear 115 that is secured to or formed integrally with a cylinder 116.

This cylinder 116, through mounting of the same on the arm 111, is inclined upwardly and forwardly from the top of the pile of sheets 12 and toward the front of the feeder and when the bell crank lever 107 and cylinder 116 are moved to the inclined dotted line positions thereof shown in Fig. 8 of the drawings the cylinder is inclined transversely of the feeder upwardly and inwardly from the top of the pile 12. In other words, each cylinder 116 and the parts carried thereby are inclined upwardly and forwardly in the direction of feed of the sheets from the pile 12, and both cylinders are disposed in angular relation as shown in Fig. 3 transversely of said direction so that they extend upwardly and inwardly toward each other from the top of said pile. Angular adjustment of the cylinders 116 and parts carried thereby relative to each other transversely of the direction of feed of sheets from the feeder may be effected by swinging the bell cranks 107 and locking them in desired positions of adjustment by the locking screws 110. The upward and forward inclination of the cylinders 116 and parts carried thereby is preferably maintained constant by the angular bell crank arms 111 and slots 112 and bolts 113 of which, however, provide for vertical adjustment of the cylinders 116 and said parts, as desired.

Each cylinder 116 is closed at its opposite ends by caps 117 held in position by machine screws 118 or the like. Each cylinder 116 is provided longitudinally thereof with a chamber 119 the upper end of which has a small port 120 for establishing communication between said chamber and said cylinder. The lower end of the chamber 119 is provided with a somewhat larger port 121 also for establishing communication between said chamber and the cylinder 116. Slidably mounted in the lower cap of each cylinder

116 is a piston the rod or stem of which is comprised by a relatively large thin walled tube 122 open at both ends and projecting through said cap downwardly beyond the same. Fixed on the lower projecting end of tube 122 exteriorly of cylinder 116 is a rubber suction cup 123 provided with a duct in communication with said cup and said tube through the lower open end of the latter. The upper end of tube 122 is provided with a relatively thin piston head 124 and skirt 125. The diameter of tube 122 is preferably not less than approximately three quarters of an inch so that when vacuum or suction is applied on the under side of head 124 to lower tube 127 and engage cup 123 with the top sheet of the pile, a vacuum or suction effect is created on the upper side of the piston head 124 sufficient to lift the piston and a metal or other relatively heavy sheet engaged by vacuum with the cup 123.

Surrounding the relatively large, thin walled tube 122 and interposed between the head 124 and the bottom cap of cylinder 116 is a spring 126. This spring 126 may be of sufficient strength to also exert a lifting force on the head 124, the tube 122 and the metal sheet adhering to cup 123. In this case, the spring 126 may be readily compressed by the head 124 on downward movement thereof as said head is of adequate size and strength for this purpose. In order to prevent the piston head 124 from becoming "air-bound" at the top of the cylinder 116, the piston tube 122 extends slightly above said head, as at 127, and is provided with slots 128 or the like.

The upper ends of the chambers 119 of cylinders 116 have connected therewith corresponding ends of flexible conduits 129 the opposite ends of which are connected with a conduit 130 formed in a stationary valve body 131 mounted centrally of the machine on the tubular shaft 66 and secured thereto in any suitable manner (Figs. 2 to 5). This valve body 131 forms part of the valve mechanism 70 that controls the making and breaking of vacuum in the sheet separators 102 in a manner hereinafter described.

Before the pistons of separators 102 are actuated to engage and lift the rear corners of the top sheet of the pile, the rear corners of the pile are winded by compressed air that is blown through the vertically disposed elongated nozzles 132 of blow pipes 133 (Figs. 1 and 3). These blow pipes 133 are loosely mounted in suitable openings of bosses 134 formed on the brackets 103 and said pipes are therefore adjustable transversely of the feeder at the rear thereof with said brackets and the sheet separating devices 102. Blow pipes 133 are provided on the tops thereof above the brackets 103 with locking and adjusting devices 135 by means of which the pipes may be adjusted vertically to desired positions for action on the upper rear corner portions of the pile of sheets 12. In order to maintain the blow pipes 133 in the desired positions of adjustment, they have mounted thereon below the brackets 103 springs 136 the upper ends of which bear against the brackets and the lower ends of which bear against adjusting devices 137 which are secured to the blow pipes and may be adjusted to regulate the tension of said springs.

The upper rear corner portions of the pile of sheets 12 are winded to provide preliminary separation of the sheets. This occurs once during each cycle of operation of the feeder and prior to and during a portion of the time when the sheet separating devices 102 engage and lift the

top sheet from the pile. Winding of the rear corners of the pile, as aforesaid, is preferably effected by means constructed and operated as follows.

The upper ends of the blow pipes 133 have connected therewith corresponding ends of flexible conduits 138 the opposite ends of which are connected with angularly related tubular arms 139 of a tubular fitting 140 (Figs. 9 and 17) closed at its outer end and having an inner open end secured in and communicating with a conduit 141 formed in the valve body 131. This conduit 141 communicates with a port 142 formed in the valve body and opening outwardly therefrom through one side thereof. Spaced from the port 142 is another port 143 formed in the valve body 131 and opening outwardly through the same side thereof as the port 142. This port 143 communicates with a conduit 144 formed in the valve body and communicating with the air conduit 68 of the tubular shaft 66. This conduit 68 and the conduit 144 are continuously supplied with compressed air from the tank 60 (Fig. 2) by the conduit 65 that connects said tank with the conduit 68.

Delivery of compressed air at the required predetermined intervals to the blow pipes 133 is effected by a rotary valve 145 (Figs. 9, 15, 22 and 23) that is loosely mounted on the cam shaft 20 which extends loosely through the valve body 131. This valve 145 is provided with pockets 146 for the inner ends of springs 147 and with a pocket 148 for the inner end of a pin 149. The pin 149 is fixed on a valve driving disc 150 (Figs. 24 and 25) provided with pockets 151 for the outer ends of springs 147. This valve driving disc 150 is fixed on cam shaft 20 in any suitable manner and said disc and the valve 145 are maintained closely against each other and the adjacent side of valve housing 131 respectively, by a collar 152 secured, as by a machine screw 153, to the cam shaft 20.

The valve 145 is provided on the inner side thereof near its periphery with an arcuate shaped port 154. The valve 145 through the described connections therefor with cam shaft 20 is rotated continuously by the latter and once during each cycle of operation of the feeder the port 154 passes over the ports 142, 143 of valve body 131 (Fig. 10). This establishes communication between conduits 144, 141 (Fig. 17) and through the described connections for the conduit 141 with the blow pipes 133 compressed air is delivered through said pipes and their nozzles 132 against the upper rear corner portions of the pile of sheets 12 to partially separate the top sheets so that the separators 102 can more readily pick up the uppermost sheet. When, through continued rotation of the valve 145, the port 154 has passed over the port 143 and no longer communicates therewith, the air under pressure is prevented from entering the blow pipes 133 until the valve, in the next cycle of operation of the feeder, again rotates to bring port 154 into communication with ports 142, 143.

While the upper rear corner portions of the pile are being winded as just described, the sheet separators 102 act to engage the top sheet of the pile and lift and bend the rear corner portions of said sheet inwardly toward each other and toward the front apron or plate 11 with which the front of the pile is engaged. The top sheet is thus prevented from sliding rearwardly on and marring or scratching the next sheet therebelow. These sheet separating devices 102, as previous-

ly pointed out, are vacuum operated and the means for effecting such operation of said devices is preferably constructed and operated as follows. Said means includes the flexible conduits 129 which are connected with the conduit 130 of valve body 131 by a tubular fitting 155 (Figs. 9 and 16) provided with angularly related tubular extensions 156 to which corresponding ends of the conduits 129 are attached. The conduit 130 communicates with a port 157 opening outwardly through the side of the valve body 131 opposite that having the previously described air ports 142, 143. Spaced from the port 157 and opening outwardly through the same side of the valve body as said port, is another port 158 which communicates with a conduit 159 formed in the valve body 131 and communicating with the vacuum conduit 69 of the tubular shaft 66. The conduit 69, as previously described, is connected with the vacuum side or part of pump 55 by the conduit 71 (Fig. 2).

Making and breaking of vacuum in the sheet separating devices 102 is controlled by an arcuate shaped port 160 formed in a rotary valve 161 (Figs. 9, 15, 18 and 19). This valve is loosely mounted on cam shaft 20 at the side of valve body 131 that has the ports 157, 158 therein. Valve 161 is provided in the outer face thereof with pockets 162 for springs 163 and with a pocket 164 for a pin 165. Pin 165 forms a driving connection for valve 161 with a driving disc 166 which carries said pin (Figs. 9, 15, 20 and 21). This driving disc 166 is keyed or otherwise suitably secured on cam shaft 20. Driving disc 166 and valve 161 are maintained closely engaged with each other and with the valve body 131 respectively by a collar 167 which is rigidly secured to cam shaft 20, as by a machine screw 168. The driving disc 166 is provided with pockets 169 for the springs 163 and these springs, as well as the springs 147, are maintained under compression by the collars 152, 167 and thereby hold the valves 145, 161 tightly against the valve body 131 to prevent leakage therebetween.

During rotation of cam shaft 20 the valve 161 through the described driving connection therefor with the driving disc 166 is continuously rotated so that the port 160 passes over the ports 157, 158 once during each cycle of operation of the feeder (Fig. 11). Just prior to operation of the sheet separating devices 102 no vacuum is being created therein and the springs 126 are acting to hold the vacuum cups 123 in their uppermost position through expansion of said springs and action of the same against the piston heads 124. As the valve 161 is rotated, port 160 passes over the ports 157, 158 thus connecting the conduits 130, 159, 69 and 129 with the vacuum side of pump 55 and the vacuum chambers 119 of cylinders 116. Vacuum is thus created in said cylinders through the lowermost ports 121 thereof and acting on the under side of the piston heads 124 draws said heads, the tubes 122 and the cups 123 downwardly and outwardly until the latter engage the top sheet of the pile near the rear corners thereof.

This closes the cups 123 so that the vacuum effect on the underside of the piston heads 124 is less than the vacuum which is now created above said heads through the upper ports 120. Through the relatively large diameters of tubes 122 there is now a relatively large differential in vacuum effect on the top and bottom sides of the piston heads 124 and said heads, the tubes 122, the cups 123, and the rear corner portions of the sheet

engaged by vacuum with said cups are lifted upwardly and inwardly by vacuum regardless of the strength of the springs 126. This separates the top sheet from the one thereunder and since the cylinders 116 and parts carried thereby are inclined upwardly and inwardly toward each other as previously described, the rear corner portions of the sheet are lifted and bent upwardly and inwardly toward each other. Due to the upward and forward inclinations of the sheet separating devices, said corner portions are also bent toward the front of the pile and a forward pushing action is exerted on the sheet so that it is held against the apron or plate 11 and prevented from moving rearwardly and scratching or marring the next sheet below. Through the described inclinations of the sheet separating devices and resulting action thereof on the sheets as described, the major portion of the sheet is separated from the next sheet and the separated and lifted sheet is stiffened from the rear to the front thereof.

After the top sheet has been lifted, and stiffened, as aforesaid, it may, through stiffening of the same, be more readily winded and completely lifted from the next sheet therebelow. Wind- ing of the lifted separated sheet is preferably accomplished by means constructed and operated as follows and including blow pipes 170 provided with nozzles 171 located at the top and rear of the pile (Figs. 3 and 4). These blow pipes 170 are adjustably mounted in suitable openings of bosses 172 formed in the brackets 103, and said pipes are adjustably held in position in said bosses, as by machine screws 173 or the like.

The upper ends of the blow pipes 170 have connected therewith corresponding ends of flexible conduits 174 the opposite ends of which are connected with angularly related tubular extensions 175 of a tubular fitting 176 (Figs. 9 and 17) that is closed at its outer end. The inner end of fitting 176 is open and secured in the end of a conduit 177 formed in the valve body 131. This conduit communicates with a port 178 opening outwardly through the side of the valve body 131 in which the air ports 142, 143 are formed. Spaced from the port 178 is another port 179 which opens outwardly through the same side of valve body 131. The ports 178, 179 are disposed substantially 180 degrees apart from the ports 142, 143 and the port 179 communicates with the conduit 144 the end of which terminates in the port 143. The conduit 144 through the previously described connections therefor with the tank 60 is continuously supplied with compressed air from the latter, and while the ports 142, 143 are covered by the port 154 of valve 145 (Fig. 10) to supply air to the blow pipes 133 as previously described, the port 179 is closed by the valve 145 so that the air can pass through conduit 144 to the port 143.

After the upper rear corners of the pile have been winded, and the top sheet of the pile has been separated and lifted, as previously described, the port 154, through continued rotation of valve 145 passes over the ports 178, 179 (Fig. 12) so that air under pressure is delivered from the pump 55 to the port 179 by the described means for this purpose. The compressed air then passes through the ports 179, 154, 178, the conduit 177, and described connections therefor with the blow pipes 170. The compressed air is thus delivered through the blow pipes 170 and nozzles 171 between the separated, lifted and stiffened uppermost sheet and the one therebelow so that said uppermost sheet is completely lifted 71

from the pile by the compressed air and without sagging of the front edge of the sheet.

When the separated and lifted sheet has been wound it is forwarded from the pile by forwarding devices that are indicated broadly at 180 (Figs. 1, 2, 4 and 6). These forwarding devices are oscillated and have sheet engaging and releasing means which, when the forwarding devices are swung rearwardly, are moved by vacuum into engagement with the separated sheet on the top of the pile and then lifted by vacuum to raise the sheet and hold it up during forward movement of the sheet by said device to feed and drop rollers hereinafter described.

The sheet forwarding devices 180 are located at the front of the feeder, are identical in construction with the previously described sheet separating devices 102, and have the same reference characters, except that in the case of the parts of the sheet forwarding devices the reference characters are primed. A detail description of the sheet forwarding devices is, under these circumstances, therefore unnecessary.

The sheet forwarding devices 180 are preferably mounted and operated as follows: Journalled in suitable bearings in the brackets 37 and extending transversely of the feeder is a rock shaft 181 (Figs. 2, 3, 5 and 6). Keyed to said rock shaft, as at 182, and slidable along the same to various positions of adjustment are arms 183 provided therein with vertical slots (not shown). These arms have secured thereto as by bolts 184, the cylinders 116' of the sheet forwarding devices 180. For this purpose, the bolts 184 pass through the slots in the arms 183 and openings in the ears 115' of cylinders 116' and provide for adjustment of said cylinders and the parts carried thereby vertically to the required or desired positions therefor.

Oscillating movement is imparted to the rock shaft 181 and the sheet forwarding devices 180 carried thereby through the medium of an arm 185 (Figs. 3 and 4) that is spring operated in one direction. This arm 185 is preferably secured to the rock shaft 181 by a machine screw 186 which engages in a recess 187 formed in said shaft, so that by loosening said screw the shaft 181, the arms 183 and the sheet forwarding devices 180 may be swung up to their inoperative positions shown in Fig. 5 in order to facilitate feeding of the sheets by hand from the top of the pile, if so desired.

Connected with the lower end of the arm 185 is one extremity of a spring 188 the opposite extremity of which is connected at 189 with the adjacent side member 8 of the feeder frame. The arm 185 has pivotally connected therewith one end of cam strap 190 through an opening in the opposite end of which the cam shaft 20 extends. Journalled in any suitable manner on the last named end of cam strap 190 is a roller 191 which engages a cam 192 that is fixed on shaft 20 and rotated thereby. It will thus appear that as shaft 20 is rotated, the cam 192 and the spring 188 will rock the arm 185 and the shaft 181 and thus impart oscillating movement to the sheet forwarding devices 180.

As the sheet forwarding devices 180 are oscillated the suction cups 123', the tubes 122' the piston heads 124' are moved up and down in the cylinders 116' by vacuum. This vacuum reciprocation of said cups, tubes, and heads is effected through the medium of the following devices. Connected with the chambers 119' of the cylinders 116' at the upper ends thereof are corre-

sponding ends of flexible conduits 193 (Figs. 2 and 6) the opposite ends of which are connected with angularly related tubular extensions 194 of a tubular fitting 195 that is closed at its outer end (Figs. 9 and 16). This fitting 195 is open at its inner end and secured in the adjacent end of a conduit 196 formed in the valve body 131. The conduit 196 communicates with a port 197 opening outwardly through said valve body at the same side thereof having the ports 157, 158. This side of the valve body is also provided with a port 198 opening therethrough and which communicates with the conduit 159 of said valve body.

The making and breaking of vacuum in the sheet forwarding devices 180 is controlled by an arcuate shaped port 199 in valve 161 and which port, after the top sheet has been separated, lifted and wound, passes over the ports 197, 198 through rotation of said valve (Fig. 13). At this time the sheet forwarding devices 180 have been swung rearwardly by the described means for this purpose. Vacuum is then established in the chambers 119' of cylinders 116' through the ports 197, 198, 199 and the described connections for the ports 197 and 198 with said chambers and the suction side or part of pump 55. The vacuum thus created, in the chambers 119' of the cylinders 116' acts through the lower ports 121' against the under sides of the piston heads 124' thus drawing the latter downwardly, compressing the springs 126', and engaging the suction cups 123' with the top sheet that has been separated, lifted and wound as before described.

Upon engagement of the suction cups 123' with said sheet the vacuum in the sheet forwarding devices acts through the upper ports 120' and the tubes or pistons 122', causing the sheet to adhere to said cups. Due to the unequal effect of the vacuum on opposite sides of the piston heads 124' and because of the relatively large diameter of the tubes 122' the vacuum in the cylinders 116' now acts on the upper sides of the piston heads 124' and lifts said heads, the tubes 122', the cups 123' and the metal or other sheet engaged by vacuum with said cups.

About this time, the sheet forwarding devices 180, are swung forward by the described means for this purpose and carry the sheet adhering to the suction cups 123' forwardly to conveying means that will be hereinafter described. As before pointed out, the sheet forwarding devices 180 engage the uppermost sheet after it has been separated and wound by the described means for this purpose. Accordingly, vacuum at about this time is broken in the sheet separating devices 102 by opening the connections therefor with the vacuum conduit 69 to atmosphere. This is preferably effected in the following manner. The port 160 of valve 161 after passing over ports 157, 158 to create vacuum in the sheet separating devices 102, passes over a port 200 (Fig. 16) that is formed in the valve body 131 and opens outwardly therefrom to atmosphere. At the time the leading end of the port 160 reaches port 200 the opposite end of port 160 is passing over port 157 (Fig. 14). Under these conditions the sheet separating devices 102 and all the described conduits connecting them with the vacuum conduit 69 are open to atmosphere, thus breaking vacuum in said sheet separating devices. Obviously, continued rotation of the valve 161 closes said conduits and devices to atmosphere so that the latter can be again operated by vacuum, as described, during the next cycle of operation of the feeder.

Likewise when the sheet forwarding devices 180 have swung forward and carried the top sheet to the above mentioned conveying means, vacuum is broken in said devices to release the sheet for further forwarding of the same by said means. This is preferably accomplished in the following manner. Valve 161 is provided therein adjacent the port 199 with an open ended port 201. During rotation of valve 161 the port 201 is in constant communication with an annular port 201' formed in valve body 131 (Fig. 16). After vacuum has been created in the sheet forwarding devices 180, as described, and while port 199 is passing over port 197, the leading end of port 199 also passes over a port 202 (Figs. 10 and 16) formed in the valve body 131 and communicating with the annular port 201'. Port 201 communicates with a port 203 that is formed in the hub of driving disc 166 and port 203 communicates with a chamber 204 (Figs. 9, 20 and 21) formed in the disc 166 and open to atmosphere through a port 205 formed in the outer wall thereof. It is therefore obvious, that when the port 199 is in register with the ports 197 and 202 the sheet forwarding devices 180 will be open to atmosphere through conduits 193 and 196, the ports 197, 199, 202, 201', 201, 203, the chamber 204, and the port 205. After the port 199 has passed over the port 197 the connections therewith for the sheet forwarding devices 180 will be closed to atmosphere so that vacuum may again be established in the sheet forwarding devices as previously described, during the next cycle of operation of the feeder.

If, for any reason, it is desired to temporarily interrupt automatic separation and forwarding of the sheets from the top of the pile 12 during the operation of the feeder, this can be accomplished by disconnecting the sheet separating and forwarding devices as well as the sheet winding devices, from their source of vacuum and air, respectively. For this purpose, the valve body 131 is provided at opposite sides thereof with ports 206, 207 (Figs. 16 and 17) communicating with the conduits 144 and 159 respectively and opening outwardly through said sides of said body. Normally, these ports 206, 207 are closed by small disc valves 208 (Figs. 2 and 4) mounted on arms 209 disposed at opposite sides of the valve body 131 and fixed on a rock shaft 210. This rock shaft 210 extends transversely of the machine and is journaled in suitable bearings provided on the front uprights 5 and in a lug 211 (Figs. 2, 16 and 17) formed on the valve body 131. The rock shaft 210 has fixed on the ends thereof handles 212 and by turning either of these in one direction the shaft 210, arms 209, and disc valves 208 may be swung to uncover the ports 206, 207 thus opening the sheet separating devices 102, the sheet forwarding devices 180 and the sheet winding devices 133 and 170 to atmosphere and preventing operation of said devices. Obviously when the rock shaft 210 is swung in the opposite direction by either of the handles 212, the disc valves 208 will cover the ports 206, 207 so that the sheet separating, forwarding and winding devices may be operated as previously described.

After the uppermost sheet has been separated and forwarded from the pile, it is received by conveying means for carrying said sheet into the machine or instrumentality with which the feeder is associated. As herein shown, this conveying means is preferably operated and constructed as follows. A lifted and forwarded sheet is delivered

by the sheet forwarding devices 180 between feed and drop rollers 213 and 214 respectively (Figs. 2, 4 and 5). The feed rollers 213 are fixed in spaced relation on a shaft 215 extending transversely of the feeder and journaled in suitable bearings on the front uprights 5 thereof. This shaft 215 also has fixed thereon between the feed rollers 213, auxiliary feed rollers 216 (Fig. 2) that are disposed along said shaft in spaced relation for a purpose hereinafter pointed out. An additional bearing for the feed roller shaft 215 is provided by a bracket 217 located intermediate the ends of said shaft and bolted or otherwise suitably secured to the upper cross member 9.

The shaft 215, the feed rollers fixed thereon, and conveyor tapes 218 passing around said rollers are driven from the continuously rotated cam shaft 20 as follows. This cam shaft has fixed thereon a large gear 219 (Figs. 1 and 2) which meshes with a smaller gear 220 that is loosely mounted on the short shaft 17 and compounded or integrally formed with a larger gear 221 also loosely mounted on said shaft. The gear 221 meshes with a gear 222 that is fixed on the feed roll shaft 215 and which through the described driving connections therewith with the cam shaft 20 drives the feed roller shaft 215, the feed rollers 213, 216 and the sheet conveying tapes 218.

The drop rollers 214 (Figs. 2, 4 and 5) are journaled on arms 223 fixed on a rock shaft 224 which extends transversely of the machine and is journaled in suitable bearings in side plates 225 projecting forwardly of the feeder and bolted or otherwise suitably secured to the front uprights 5 thereof. The rock shaft 224 has fixed thereon an arm 226 carrying a roller 227 which bears against a cam 228 secured to or formed integrally with the valve driving disc 150 that is secured to and rotated by the cam shaft 20. The rock shaft 224 also has fixed on one end thereof a second arm 229 with which is connected one extremity of a spring 230. The opposite extremity of the spring 230 is connected with adjusting devices 231 secured in any suitable manner on one of the side plates 225. It will thus appear that the rock shaft 224 is rocked in one direction by the spring 230 and in the opposite direction by the cam 228 and that this results in raising and lowering of the drop rollers 214, at predetermined intervals. Operation of the drop rollers is so timed that they are raised when the sheet forwarding devices 180 deliver a sheet on to the feed rollers 213, 216. After such delivery of the sheet and breaking of vacuum in the sheet forwarding devices 180, the drop rollers are lowered to engage the sheet and assist feeding of the same forwardly from the feeder by the feed rollers 213, 216 and the conveyor tapes 218. The front portions of tapes 218 pass around other rollers (not shown) and said tapes travel over a roller 232 that extends transversely of the feeder and is journaled in suitable bearings in the side plates 225. The tapes 218 also pass over tightening rollers 233 (Fig. 1) journaled on arms 234 which are fixed on a shaft 235 extending transversely of the feeder and secured against rotation on the side plates 225.

The feeder is provided with mechanism for lowering and raising the elevator so that a supply of sheets may be placed on said elevator and moved into proper position for feeding. This mechanism is also utilized to reload the feeder and, in accordance with the present invention, is preferably constructed and operated as follows. Fixed on the shaft 54 of the pump 55 at the end

thereof opposite that carrying the large sprocket 53 is a small sprocket 236 (Figs. 2, 4 and 5) around which passes a chain 237. This chain also passes around a sprocket 238 that is fixed on a short shaft 239 journaled in suitable bearings in one of the front uprights 5 and a bracket 240 bolted or otherwise suitably secured thereto.

This short shaft 239 has fixed thereon a sprocket 241 (Figs. 4 and 5) around which passes a chain 242 that also passes around a sprocket 243. The sprocket 243 and a part 244 of a clutch indicated broadly at 245 (Fig. 2) are secured to or formed integrally with each other and loosely mounted on the worm shaft 24. This clutch 245 is of well known construction needing no detailed description herein and includes another part 246 which is fixed on the worm shaft 24. The parts of the clutch 245 may be connected or disconnected by a device 247 loosely and slidably mounted on the worm shaft 24 and provided with a collar 248 in a groove of which extends an operating fork 249. This fork 249 is fixed on a shaft 250 extending transversely of the feeder and slidably mounted in suitable bearings in the brackets 25 that are secured to the front uprights 5. The slidable shaft 250 also has fixed thereon a fork 251 (Figs. 2 and 26) engaging in a groove of the pawl mask 97 that is slidably as well as rotatably mounted on the worm shaft 24. The shaft 250 is provided on one end thereof with spaced collars 252 having engaged therebetween the upper end of a lever 253 which is pivotally mounted in any suitable manner on one of the front uprights 5.

When it is desired to initially load the feeder the elevator may, for this purpose, be lowered to the proper position by moving the lever 253 to the left (Fig. 2) and starting the motor 49 so that the armature shaft 50 thereof rotates in the direction of the arrow D shown in Fig. 4 of the drawings. When the lever 253 is moved as aforesaid, the slidable shaft 250 is moved to the right (Fig. 2) and thereby moves the device 247 to the right and connects the two parts of the clutch 245. At the same time, the fork 251 and the pawl mask 97 (Figs. 2 and 26) are moved to the right so that a bevelled annular flange 254 on the mask will lift the pawl 26 out of engagement with the ratchet 28 if said pawl is not already disengaged therefrom. This pawl 26, as will be noted in Fig. 26 of the drawings, is provided with a slot 255 enabling the pawl to engage the ratchet when the mask is in its normal operating position and stopped by the means for this purpose hereinbefore described.

The pawl 26 having been disengaged from the ratchet and the parts of the clutch 245 having been connected, as described, the shaft 24 is rotated by the pump 55 counter clock-wise as viewed in Fig. 4; thereby rotating the described connections for said shaft with the elevator chains 33 so that the latter and the cross beams 34 and pile board 36 are lowered. As soon as these have reached the proper position for loading, the handle 253 is swung to the right (Fig. 2) thereby disconnecting the parts of the clutch 245, moving the pawl mask 97 back to its normal position, and stopping rotation of shaft 24 by the pump. The motor 49 is then stopped and the elevator is loaded with a supply or pile of sheets in the usual manner.

The elevator and said pile or supply are then raised to proper position for feeding of the sheets successively from the top of said pile or supply. This is accomplished by starting the motor 49 so that the armature shaft thereof rotates in the

direction of the arrow U shown in Fig. 4 of the drawings. The lever 253 is then swung to the left (Fig. 2) to connect the parts of the clutch 245 and shift the mask 97, as before described. The worm shaft 24 thus being connected with the pump shaft 54 and the latter now being driven in the same direction as the armature shaft 50, the elevator and the pile of sheets thereon are raised until the top of the pile reaches the proper level for feeding of the sheets one after another therefrom.

At this time the lever 253 is again swung to the right (Fig. 2) thus disconnecting the parts of the clutch 245 and moving the pawl mask 97 back again to its normal position. The motor 49 is then stopped and the worm shaft 24 now being disconnected from the pump shaft 54, feeding of the sheets from the top of the pile one after another may now be accomplished automatically as previously described or by hand, as desired. In either case, the motor 49 is now started so that the armature shaft 50 is rotated in the direction of the arrow D (Fig. 4). When the supply of sheets has been exhausted, the feeder may be reloaded by lowering and raising the elevator as described and through the medium of the mechanism for this purpose driven from the pump shaft 54.

The operation of the feeder will be clearly understood from the foregoing description thereof and may be briefly summarized as follows. The elevator having been loaded and the pile of sheets having been moved upwardly to proper position by the described means for this purpose, automatic feeding of the sheets one after another from the top of the pile may be accomplished by driving the jack shaft 13 and parts connected therewith and rotating the pump shaft 54 through operation of the armature shaft 50 of the motor 49 in the direction of the arrow D (Fig. 4). Air under pressure supplied from the pump 55 to the blow pipes 133 is delivered through the nozzles 132 against the rear upper corner portions of the pile of sheets 12 so that said portions are winded or partially separated. The sheet separators 102, through the described connections therefor with the pump 55 then act, as before described, to engage and lift the uppermost sheet at the rear thereof. Due to inclination of these sheet separating devices toward each other as described and illustrated, the rear corner portions of the sheet are bent inwardly toward each other as well as forwardly thus "peeling" the major portion of the top sheet from the one therebelow and insuring that the separators will not pick up more than one sheet at a time. This inward and forward bending of the rear corner portions of the sheet stiffens the sheet as before described so that when the sheet is winded by pipes 170 it will be completely lifted and its front edge will not buckle or sag. Also inclination of the sheet separating devices forwardly as described and illustrated causes them to exert a forward pushing action on the sheet thus insuring that the sheet will not be displaced rearwardly and mar or scratch the next sheet therebelow.

After the sheet has been engaged, lifted and stiffened, as described, it is winded by compressed air supplied by the described means for this purpose through the blow pipes 170 and delivered thereby between said sheet and the sheet therebelow. This completely lifts and separates the sheet from the one below and the separated, lifted and winded uppermost sheet is then engaged near

the front thereof by the sheet forwarding devices 180 that have been swung rearwardly by the described means for this purpose. These devices lift the sheet at the front thereof and swing forwardly, thus carrying the sheet between the driven feed rollers 213, 216, and the drop rollers 214 which at this time are raised. The sheet forwarding devices then release the sheet whereupon the drop rollers are lowered thereon and the feed rollers and the tapes 218 carry the separated and forwarded sheet on to the machine or instrumentality with which the feeder is associated. These operations are repeated in the order named, once during each cycle of operation of the feeder, so that the sheets are fed automatically in succession from the top of the pile to said machine or instrumentality.

When it is desired to feed the sheets one after another by hand from the top of the pile, instead of automatically therefrom as above described, the frame 39 and parts carried thereby are swung up to the inoperative positions thereof shown in Fig. 5 of the drawings and there locked by the pin 45. The sheet forwarding devices are also swung up to the inoperative positions thereof shown in Fig. 5 in which case the spring 188 is disconnected from the arm 185 and the set screw 186 is loosened to facilitate free rotation of the rock shaft 181 and movement of the sheet forwarding devices to said positions.

The sheets may then be fed by hand one after another between the feed and drop rollers, and to insure such feeding at the proper time front gages 256 (Fig. 2) located between the feed rollers 216 are employed to register or square up the hand fed sheets. These front gages are, in accordance with the present invention, operated by the drop rollers when sheets are being hand fed from the top of the pile 12. Accordingly, the front gages 256, which are provided on the lower ends thereof with rollers 257 bearing against the upper cross member 9, are preferably connected with and operated by the drop rollers as follows. Extending transversely of the feeder and journalled in suitable bearings on the upper cross member 9 is a rock shaft 258. This rock shaft has fixed thereon arms 259 (Figs. 2, 4 and 5) that are pivotally connected, as at 260 with the vertically movable front gages 256. The rock shaft 258 also has mounted thereon an arm 261 which, during automatic feeding of the sheets is disconnected from said shaft by loosening a screw 262 threaded on said arm for engagement with the shaft 258. When this screw 262 is loosened, as stated, no motion is imparted to the front gages 256 and they remain in downwardly inoperative positions so that automatic feeding of the sheets may proceed without interruption. When, however, the sheets are hand fed from the top of the pile 12, the screw 262 is tightened and engages the rock shaft 258 so that the arm 261 is fixed on said shaft. The arm 261 has pivotally connected therewith one end of a link 263 the opposite end of which is pivotally connected with the arm 229. It will be recalled that the arm 299 is rocked by the cam 228 and the spring 230, as previously described. Under these conditions and with the arm 261 fixed on the rock shaft 258 by the set screw 262, said shaft and the arms 259 will be rocked in one direction thus moving the gages 256 upwardly above the feed rollers 213, 216 and the tapes 218 when the drop rollers 214 are raised. At this time the operator hand feeds the sheet against said gages to register and square the sheet up, whereupon the drop rollers 214 and the

gages 256 are lowered by rocking of shaft 258 in the opposite direction and the sheet is fed forwardly by said rollers and the tapes 218. When the drop rollers are again raised, the gages 256 will also be raised so that the next sheet can be hand fed against the gages to register and square it up. The drop rollers and gages are again lowered and these operations are repeated so long as it is desired to hand feed sheets from the top of the pile.

While the sheets are being hand fed from the top of the pile 12 the elevator is raised automatically by the described means for this purpose in order to maintain the top of the pile at the required or predetermined level. It will be recalled that when hand feeding from the pile of sheets 12 the frame 39 and parts carried thereby are swung up to the positions thereof shown in Fig. 5 of the drawings. Under these conditions the operator may actuate the valve 82 by hand and thus control the operation of the pawl and ratchet mechanism 26, 28 so that the elevator will be operated to lift the pile and bring the top thereof to the proper or convenient position for hand feeding of the sheets off the top thereof.

The valve 82 and its housing 74 may, however, when hand feeding, be removed from the frame 39 and placed in the dotted line positions of said valve and housing shown in Fig. 5 of the drawings in which case the ball 84 will engage the top of the pile. As each sheet is hand fed and lifted forwardly between the feed and drop rollers, the valve 82 will be lifted and when the sheet has been fed off, the valve will lower by gravity. It will thus appear that raising and lowering of the valve in this manner will effect control of the pawl and ratchet mechanism 26, 28 (Fig. 26) as in the case of automatic feeding of the sheets from the top of the pile and that the elevator and the pile will be lifted automatically at intervals to maintain the top of the pile at the proper position for hand feeding of the sheets from the top thereof. In order to remove the valve 82 and its housing 74 from the frame 39, one of the clamps 77 is loosened by the screw 78 and operating handle 80 therefor (Fig. 28). Upon removal of the valve 82 and housing 74 the tenon 81 of the latter is fitted in a guide 26 (Fig. 5) that is bolted or otherwise suitably secured on the rear of the valve body 131. The tenon 81 is provided with an opening 265 (Fig. 26) and a machine screw 266 (Fig. 5) is placed in said opening and threaded into a corresponding opening in the guide 264. Upon tightening of the screw 266 the valve 82 and its housing 74 will be secured to the guide and held in position for proper operation by hand feeding of the sheets as before described.

When it is desired to feed the sheets automatically from the top of the pile, the valve 82 and its housing 74 are again secured on the frame 39. This frame and parts carried thereby including the sheet winding devices and the sheet separating devices are then swung down to the positions thereof shown in Fig. 1 of the drawings. The sheet forwarding devices are also swung down to their operative positions shown in Fig. 1. Thereupon, automatic feeding of the sheets from the top of the pile can be accomplished as before described.

During repeated cycles of operation of the feeder to automatically feed sheets from the top of the pile 12, or when hand feeding sheets from the top thereof, the pile is elevated step by step by the described means for this purpose, in order to keep the top of the pile at the described or re-

quired height. The control means for the pile elevating mechanism may include, as before described, the valve 82 (Fig. 26), the air operated plunger in housing 88, and the compressed air delivery connections for housings 88 with the valve housing 74 and between the latter and the pump 55.

Instead of employing a plunger such as mounted in the housing 88, a plunger 267 (Fig. 29) may be employed. This plunger 267 is mounted in a housing 268 secured to a bracket 269 mounted on and depending from the tubular shaft 66. The plunger 267 projects upwardly out of the housing 268 and is provided on the lower end with a reduced portion 270. This reduced portion 270 is provided on the bottom thereof with a lug 271 which, when the plunger 267 is in its lowermost inoperative position in the housing 268, engages the V-shaped interior bottom portion 272 of the housing and holds the plunger slightly thereabove to prevent it from becoming "air-bound". The flexible conduit 87 connected with the valve housing 74 is, in this case, connected with the plunger housing 268 at the bottom thereof and delivery of compressed air through the conduit 87 into the housing 268 and under the plunger 267 is controlled by the valve 82.

In the construction shown in Fig. 29 a pawl 273 is provided and this pawl is pivoted as at 274 on the bracket 269 above the plunger 267. When the top of the pile of sheets 12 is at the proper height, no compressed air will be delivered in the housing 268 and the pawl 273 will be held in the dotted line position thereof shown in Fig. 29 by a counterweight 275 that is secured in any suitable manner on said pawl. In this event, the nose 276 of pawl 273 will be held up above the path of travel of the shoulder 96 of mask 97 so that the latter and the carrier 23 for pawl 2 will oscillate idly as previously described. When the top of the pile 12 and valve 82 lower sufficiently so that said valve admits compressed air in the conduit 87 and the housing 268, said air will raise the plunger 267 and swing the pawl 273 to the full line position thereof shown in Fig. 29. The nose 276 of the pawl then engages the shoulder of mask 97 to stop rotation of the same and enable the ratchet or shaft 24 to be actuated, as previously described, to raise the elevator and the pile of sheets.

When the top of the pile has reached the proper height the valve 82 will cut off the supply of compressed air to conduit 87 and housing 268 whereupon the plunger 267 will drop by gravity in the housing and the pawl 273 will be swung to its dotted line inoperative position by the counterweight 275. The carrier 23, the pawl 26 thereon, and the mask 97 will then oscillate idly until it is again necessary to elevate the pile 12, whereupon the above described operation of the pawl and ratchet control means is repeated so that shaft 24 may be actuated to raise the elevator.

Instead of employing control means and pawl and ratchet mechanism such as shown in Fig. 29, control means and pawl and ratchet mechanism such as illustrated in Fig. 30 may be utilized. In this case, the flexible conduit 87 connected with the housing 74 for valve 82 is connected with a housing 277 at the bottom thereof. This housing 277 is provided with an extension 278 that is secured in any suitable manner on a shaft 279. The shaft 279 extends transversely of the feeder and is secured in any suitable manner to the frame thereof. Mounted in the housing 277 and projecting upwardly therethrough is a plunger

280 provided on the bottom thereof with a reduced portion 281 which normally engages the V-shaped bottom of the housing when no compressed air is being supplied therein through the conduit 87.

Extending over, and engaged with, the upper end of plunger 280 is a plate 282 provided with a pin 283 that is guided in a suitable opening in the top of the housing 277. Said plate 282 has connected therewith the upper end of a rod 283 the lower end of which is pivotally connected with a pawl 284 which is pivoted, as at 285, on a stationary part of the feeder. The nose of pawl 284 normally stands in line with a lug 286 formed on a pawl carrier 287 that is loosely mounted on the worm shaft 24 adjacent the ratchet 28 fixed thereon. The carrier 287 has mounted thereon a spring pressed pawl 288 for engaging the ratchet 28 and is pivotally connected with one end of a link 289 the opposite end of which is pivotally connected with an arm 290. This arm 290 is pivotally mounted on a stationary part of the feeder and provided with a roller 291 adapted to be engaged by a cam 292.

Cam 292 is fixed on a suitable driven shaft 293 of the feeder and the arm 290 has connected therewith a spring pressed rod 294 that normally tends to maintain roller 291 in engagement with said cam. When the top of the pile of sheets is at the proper height, however, and no compressed air is supplied in housing 277 through conduit 87, the nose of pawl 284 is disposed in line with lug 286 and prevents the spring pressed rod 294 from swinging arm 290 and carrier 287 a sufficient distance to enable the ratchet 28 and shaft 24 to be actuated by pawl 288.

As the sheets are fed off the top of the pile, and it becomes necessary to lift it, the valve 82 admits compressed air in conduit 87 and housing 277 thus raising plunger 280, plate 282, rod 283 and pawl 284. The cam 292 and the spring pressed rod 294 now actuate carrier 287 and pawl 288 so that ratchet 28 and shaft 24 are rotated and the elevator and pile of sheets thereon is raised. When the top of the pile is at the proper height valve 82 cuts off compressed air in conduit 87 and housing 277 whereupon the plunger 280, the plate 282, the rod 283, and the pawl 284 drop by gravity so that the nose of said pawl is again positioned in line with lug 286 and prevents spring pressed rod 294 from swinging carrier 287 a sufficient distance to enable pawl 288 to actuate ratchet 28 and rotate shaft 24. When the top of the pile again is below the predetermined height, the pawl and ratchet mechanism and control means therefor shown in Fig. 30 is again actuated, as described, to raise the pile. These operations are repeated from time to time as described, so that the top of the pile of sheets 12 is always maintained at proper height.

The method and mechanical embodiments of the present invention, while having great utility in the matter of separating and forwarding relatively heavy sheets such as metal, cardboard and the like from a pile or supply, are also adapted for the separation and forwarding of sheets of other materials. As respects mechanical aspects of the present invention, various novel mechanisms such as herein illustrated and described may be used singly, or in combination, as desired, for the feeding of sheets of all kinds of materials. It is therefore to be expressly understood that while the method and one mechanical embodiment of the present invention have been described and illustrated with more or less particu-

larity; said invention is not limited to such description or illustration or otherwise than by the terms of the appended claims.

What we claim is:

5 1. In a sheet feeder, vacuum sheet forwarders, a driven shaft, connections between the driven shaft and the forwarders for reciprocating the same, and rotary valve means mounted on and operated by said driven shaft for making and
10 breaking vacuum in said forwarders at predetermined intervals.

2. In a sheet feeder, vacuum sheet feeding means, a driven shaft, valve mechanism mounted on and operated by the driven shaft for making
15 and breaking vacuum in the sheet feeding means at predetermined intervals, feed rollers, and drop rollers cooperating with the feed rollers and operated by a driven part of said valve mechanism.

3. In a sheet feeder, vacuum sheet separators, pivotally mounted vacuum sheet forwarders, devices for winding upper rear corner portions of the pile and each sheet separated therefrom, a driven shaft and connections between the same and the pivoted forwarders for oscillating the
20 latter, and rotary valve means mounted on and driven by said shaft and controlling said separators and forwarders and said winding devices.

4. In a sheet feeder, sheet engaging means adjacent the front thereof, rear cylinders inclined upwardly and inwardly toward each other and toward said sheet engaging means, vacuum sheet
30 separators in said cylinders and likewise inclined, front cylinders, and vacuum sheet forwarders in said front cylinders.

5. In a sheet feeder, sheet engaging means adjacent the front thereof, rear cylinders inclined upwardly and inwardly toward each other and toward said sheet engaging means, vacuum sheet separators in said cylinders and likewise inclined,
40 pivoted front cylinders, vacuum sheet forwarders in the pivoted front cylinders, and means for oscillating said front cylinders and forwarders.

6. In a sheet feeder, stationary cylinders, vacuum sheet separators therein vacuum and spring reciprocated to engage and lift the sheets, pivoted
45 cylinders, vacuum sheet forwarders therein vacuum and spring reciprocated to also engage and lift said sheets, and means for oscillating said pivoted cylinders and forwarders to advance the lifted sheets.

7. In a sheet feeder, bell cranks arranged to swing transversely of the feeder and each having one arm inclined laterally with respect to the other arm, and vacuum sheet lifting devices
50 mounted for vertical adjustment on said inclined arms and adapted for angular adjustment relative to each other by swinging said bell cranks.

8. The method of separating and forwarding a metal, cardboard or similar stiff sheet, from a
60 pile or supply, which comprises engaging the sheet by suction and lifting the sheet at the rear corner portions thereof, stiffening the sheet from the rear forwardly by bending said rear corner portions of said sheet upwardly and inwardly toward each other at a predetermined angle while
65 the sheet is being lifted, and engaging the sheet adjacent the front thereof and forwarding the sheet from said pile or supply after said sheet has been lifted and stiffened as aforesaid.

9. The method of separating and forwarding a sheet from a pile or supply, which comprises temporarily holding the sheet on its front edge against forward movement, lifting the sheet at the rear thereof, stiffening the sheet from the
70 rear forwardly by bending or turning portions

thereof upwardly and inwardly toward each other and forwardly at a predetermined angle while the sheet is being lifted and temporarily held as aforesaid, and lifting the stiffened sheet at the front and forwarding it from said pile
5 or supply.

10. The method of separating and forwarding a sheet from a pile or supply, which comprises temporarily holding the sheet on its front edge against forward movement, lifting the sheet at the rear thereof, stiffening the sheet from the rear forwardly by bending or turning portions thereof upwardly and inwardly toward each other and forwardly at a predetermined angle while the sheet is being lifted and temporarily held as aforesaid, directing air under pressure between the lifted and stiffened sheet and the one below it, and lifting the stiffened and winded sheet at the front and forwarding it from said pile or supply.
20

11. In a sheet feeder, means for automatically elevating a pile of sheets when automatically or hand feeding them from the top of the pile, devices for automatically feeding the sheets from the top of the pile and movable to inoperative positions enabling the sheets to be hand fed therefrom, and means for automatically controlling the operation of said pile elevating means when automatically feeding the sheets from the pile or when hand feeding them therefrom.
25 30

12. In a sheet feeder, means for automatically elevating a pile of sheets when automatically or hand feeding them from the top of the pile, devices for automatically feeding the sheets from the top of the pile and movable to inoperative positions to enable the sheets to be hand fed therefrom, and means for automatically controlling the operation of said elevating means when automatically feeding the sheets from a pile and for manually controlling the operation of said elevating means when hand feeding the sheets from the pile.
35 40

13. In a sheet feeder, means for automatically elevating a pile of sheets when automatically or hand feeding them from the top of the pile, devices for automatically feeding the sheets from the top of the pile and movable to inoperative positions enabling the sheets to be hand fed therefrom, and shiftable sheet controlled means acting in one position to control the pile elevating means when automatically feeding sheets from the pile and acting in another position to automatically control said pile elevating means when hand feeding sheets from the top of the pile.
45 50

14. In a sheet feeder, means for automatically elevating a pile of sheets when automatically or hand feeding them from the top of the pile, devices for automatically separating and forwarding the sheets from the top of the pile and movable to inoperative position enabling the sheets to be hand fed therefrom, and means controlling the pile elevating means during operation of said devices and movable with the latter to their inoperative positions, said last named means when in its inoperative position with said devices being adapted for manual operation to automatically control the pile elevating means.
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15. In a sheet feeder for hand or automatic feeding, a driven feed roller, a drop roller, mechanism for operating the drop roller, stop means adjacent the feed roller, and means for connecting the stop means with the drop roller operating mechanism for actuation thereby when hand feeding and for disconnecting the stop means
70 75

from the said drop roller operating mechanism when automatically feeding.

16. In a sheet feeder, sheet winding devices, vacuum sheet feeding devices, a pump for supplying air to the winding devices and creating vacuum in the feeding devices; a stationary body provided in opposite sides thereof with spaced ports; conduits connecting certain of the ports with the pump and certain of the ports with said winding and feeding devices; a driven shaft extending loosely through the stationary body; and valves on opposite sides of said body connected with and rotated by said shaft and having ports periodically registering with said first named ports and connecting said conduits and said devices at intervals with said pump.

17. In a sheet feeder, sheet winding devices, vacuum sheet feeding devices, a pump for supplying air to the winding devices and creating vacuum in the feeding devices; a stationary body provided in opposite sides thereof with spaced ports; conduits connecting certain of the ports with the winding and feeding devices and certain of the ports with the pump; a driven shaft extending loosely through the stationary body; driving discs fixed on the shaft adjacent opposite sides of the stationary body; valves loosely mounted on the shaft between said sides of the body and the driven discs and provided with ports; and means connecting the valves with the driving discs so that said discs and said shaft rotate said valves and their ports to periodically register the latter with said first named ports and connect said conduits and devices at intervals with said pump.

18. In a sheet feeder, vacuum sheet lifting devices, a pump for creating vacuum therein; a stationary body provided with spaced ports opening outwardly through one side thereof and a third port open to atmosphere; conduits connecting the spaced ports with the lifting devices and pump respectively; a driven shaft extending loosely through the stationary body; and a valve on said side of the stationary body connected with and rotated by said shaft and having a port periodically registering with the spaced ports and connecting said conduits and devices at intervals with said pump, said valve port periodically registering with one of said spaced ports and said third port and connecting said devices at intervals with atmosphere.

19. In a sheet feeder, vacuum sheet lifting devices, a pump for creating vacuum therein; a stationary body provided with spaced ports opening outwardly through one side thereof; conduits connecting the spaced ports with the lifting devices and pump respectively; a driven shaft extending loosely through the stationary body; a driving disc fixed on the driven shaft adjacent said side of the stationary body; a valve loosely mounted on the driven shaft between the body and the driving disc and provided with a port; means connecting the valve and disc so that said disc and the shaft rotate the valve and its port to periodically register the latter with said first named ports and connect said conduits and devices at intervals with said pump; and ports in the stationary body, the valve, and the driving disc for periodically connecting said devices with atmosphere through one of said first named ports.

20. In a sheet feeder, sheet winding devices, vacuum sheet separating and forwarding devices, a pump for supplying air to the winding devices and creating vacuum in the separating and forwarding devices; a stationary body provided in

opposite sides thereof with pairs of ports arranged in spaced relation; conduits connecting certain of the ports with the sheet winding, separating and forwarding devices and certain of the ports with the pump; a driven shaft extending loosely through the stationary body; driving discs fixed on the shaft adjacent opposite sides of the stationary body; valves loosely mounted on the shaft between said sides of the body and the driving discs and provided with ports; means connecting the valves with the driving discs so that said discs and said shaft rotate the valves and their ports to periodically register the latter with the first named ports and connect said conduits and devices at intervals with the pump; means in the stationary body periodically registering with a valve port and one of the first named ports for opening the separating devices at intervals to atmosphere; and means in said body, one of the valves, and one of the driving discs for periodically opening said forwarding devices to atmosphere through one of said first named ports.

21. In a sheet feeder, means for separating and forwarding metal, cardboard or similar stiff sheets successively from a pile or supply thereof and comprising, normally stationary vacuum sheet separators located to operate on the rear of the pile or supply of sheets and reciprocated by vacuum to engage and lift the sheets, vacuum sheet forwarders adjacent the front of the feeder and reciprocated by vacuum to engage and lift the sheets and mechanically reciprocated to forward said sheets, and means supporting the vacuum sheet separators and providing for inclination of the same upwardly and inwardly toward each other and upwardly and forwardly toward the front of said feeder.

22. In a sheet feeder, means for separating and forwarding metal, cardboard or similar stiff sheets successively from a pile or supply thereof and comprising, normally stationary vacuum sheet separators located to operate on the rear of the pile or supply of sheets and reciprocated by vacuum to engage and lift the sheets, vacuum sheet forwarders adjacent the front of the feeder and reciprocated by vacuum to engage and lift the sheets, means for mechanically reciprocating the forwarders to forward the sheets, means supporting the vacuum sheet separators and providing for inclination of the same upwardly and inwardly toward each other and upwardly and forwardly toward the front of said feeder, and automatically operated means for making and breaking vacuum in said separators and forwarders at predetermined intervals.

23. In a sheet feeder, means for separating and forwarding metal, cardboard or similar stiff sheets successively from a pile or supply thereof and comprising, normally stationary vacuum sheet separators located to operate on the rear of the pile or supply of sheets and reciprocated by vacuum to engage and lift the sheets, pivotally mounted vacuum sheet forwarders adjacent the front of the feeder and reciprocated by vacuum to engage and lift the sheets, means for oscillating the forwarders to forward the sheets, means supporting the vacuum sheet separators and providing for inclination of the same upwardly and inwardly toward each other and upwardly and forwardly toward the front of said feeder, a pump connected with the separators and forwarders for creating vacuum therein, and automatically operated valve mechanism for connecting said pump with and disconnecting the same from said sep-

arators and forwarders at predetermined intervals.

24. In a sheet feeder, means for separating metal, cardboard or similar stiff sheets successively from a pile or supply thereof and comprising normally stationary pneumatic sheet separating means located to operate on the rear of the pile or supply of sheets and reciprocated pneumatically to engage and lift the sheets, means supporting the pneumatic sheet separating means and providing for inclination of the same upwardly and inwardly transversely of the feeder, and means adjacent the front of the feeder for forwarding the sheets successively relative to said pile or supply.

25. In a sheet feeder, means for separating metal, cardboard or similar stiff sheets successively from a pile or supply thereof and comprising normally stationary pneumatic sheet separating means located to operate on the rear of the pile or supply of sheets and reciprocated pneumatically to engage and lift the sheets, means supporting the pneumatic sheet separating means and providing for inclination of the same upwardly and inwardly transversely of the feeder and upwardly and forwardly toward the front thereof, and means adjacent the front of the feeder for forwarding the sheets successively relative to said pile or supply.

26. In a sheet feeder, means for separating metal, cardboard or similar stiff sheets successively from a pile or supply thereof and comprising normally stationary pneumatic sheet separating means located to operate on the rear of the pile or supply of sheets and reciprocated pneumatically to engage and lift the sheets, means supporting the pneumatic sheet separating means and providing for inclination of the same upwardly and inwardly transversely of the feeder, means providing for adjustment of said pneumatic sheet separating means transversely of the feeder and toward the front and rear thereof, and means adjacent the front of the feeder for forwarding the sheets successively relative to said pile or supply.

27. In a sheet feeder, means for separating metal, cardboard or similar stiff sheets successively from a pile or supply thereof and comprising normally stationary pneumatic sheet separators pneumatically reciprocated and disposed for operation on the sheets adjacent the top and rear of the pile or supply to engage and lift the sheets successively therefrom, means supporting the pneumatic sheet separators and providing for inclination of the same upwardly and inwardly toward each other, and means adjacent the front of the feeder for forwarding in succession relative to said pile or supply the sheets lifted successively therefrom by said pneumatic sheet separators.

28. In a sheet feeder, means for separating metal, cardboard or similar stiff sheets successively from a pile or supply thereof and comprising normally stationary pneumatic sheet separators pneumatically reciprocated and disposed for operation on the sheets adjacent the top and rear of the pile or supply to engage and lift the sheets successively therefrom, means supporting the pneumatic sheet separators and providing for inclination of the same upwardly and inwardly toward each other and upwardly and forwardly toward the front of said feeder, and means adjacent the front of the feeder for forwarding in succession relative to said pile or supply the sheets

lifted successively therefrom by said pneumatic sheet separators.

29. In a sheet feeder, means for separating metal, cardboard or similar stiff sheets successively from a pile or supply thereof and comprising normally stationary pneumatic sheet separators pneumatically reciprocated and disposed for operation on the sheets adjacent the top and rear of the pile or supply to engage and lift the sheets successively therefrom, means supporting the pneumatic sheet separators and providing for inclination of the same upwardly and inwardly toward each other and upwardly and forwardly toward the front of said feeder, means providing for adjustment of the pneumatic sheet separators to various positions transversely of the feeder and toward the front and rear thereof, and means adjacent the front of the feeder for forwarding in succession relative to said pile or supply the sheets lifted successively therefrom by said pneumatic sheet separators.

30. In a sheet feeder, stationary rear cylinders, vacuum sheet separating elements having piston stems extending in the stationary rear cylinders and provided therein with piston heads, means for reciprocating the vacuum sheet separating elements causing them to engage and lift the sheets successively at predetermined intervals, means supporting the stationary rear cylinders and providing for inclination of said cylinders upwardly and inwardly toward each other with corresponding inclination of the vacuum sheet separating elements, and means adjacent the front of the feeder for forwarding in succession the sheets lifted successively by said vacuum sheet separating elements.

31. In a sheet feeder, stationary rear cylinders, vacuum sheet separating elements having piston stems extending in the stationary rear cylinders and provided therein with piston heads, means for reciprocating the vacuum sheet separating elements causing them to engage and lift the sheets successively at predetermined intervals, means supporting the stationary rear cylinders and providing for inclination of said cylinders upwardly and inwardly toward each other and upwardly and forwardly toward the front of said feeder with corresponding inclinations of the vacuum sheet separating elements, and means adjacent the front of the feeder for forwarding in succession the sheets lifted successively by said vacuum sheet separating elements.

32. In a sheet feeder, stationary rear cylinders, vacuum sheet separating elements having piston stems extending in the stationary rear cylinders and provided therein with piston heads, means for reciprocating the vacuum sheet separating elements causing them to engage and lift the sheets successively at predetermined intervals, means supporting the stationary rear cylinders and providing for inclination of said cylinders upwardly and inwardly toward each other with corresponding inclination of the vacuum sheet separating elements, movable front cylinders, vacuum sheet forwarding elements having piston stems extending in the movable front cylinders and provided therein with piston heads, and means for reciprocating the vacuum sheet forwarding elements relative to the movable front cylinders and for reciprocating each movable front cylinder and its vacuum sheet forwarding element as a unit to engage and forward in succession the sheets lifted successively by said vacuum sheet separating elements.

33. In a sheet feeder, stationary rear cylinders, vacuum sheet separating elements having piston stems extending in the stationary rear cylinders and provided therein with piston heads, means for reciprocating the vacuum sheet separating elements causing them to engage, and lift the sheets successively at predetermined intervals, means supporting the stationary rear cylinders and providing for inclination of said cylinders upwardly and inwardly toward each other and upwardly and forwardly toward the front of the feeder with corresponding inclinations of the vacuum sheet separating elements, movable front cylinders, vacuum sheet forwarding elements having piston stems extending in the movable front cylinders and provided therein with piston heads, and means for reciprocating the vacuum sheet forwarding elements relative to the movable front cylinders and for reciprocating each movable front cylinder and its vacuum sheet forwarding element as a unit to engage and forward in succession the sheets lifted successively by said vacuum sheet separating elements.

34. The method of separating and forwarding a metal, cardboard or similar stiff sheet from a pile or supply thereof which comprises, engaging the sheet by suction and lifting the sheet by the rear corner portions at a predetermined angle, stiffening the sheet from the rear forwardly by bending portions of said sheet upwardly and inwardly toward each other, and engaging the sheet adjacent the front thereof and forwarding the sheet relative to said pile or supply when said sheet has been lifted and stiffened as aforesaid.

35. The method of separating and forwarding a metal, cardboard or similar stiff sheet from a pile or supply thereof which comprises, engaging the sheet by suction and lifting the sheet by the rear corner portions at a predetermined angle, stiffening the sheet from the rear forwardly by bending portions of said sheet upwardly and inwardly toward each other, winding the lifted and stiffened sheet by directing air under pressure between said sheet and the top of the pile or supply, and engaging the sheet adjacent the front thereof and forwarding the sheet relative to said pile or supply when said sheet has been lifted, stiffened and winded as aforesaid.

36. The method of separating and forwarding a metal, cardboard or similar stiff sheet from a pile or supply thereof which comprises, winding the pile or supply near the top and at the rear thereof by directing air under pressure against the same, engaging the sheet by suction and lifting the sheet by the rear corner portions at a

predetermined angle, stiffening the sheet from the rear forwardly by bending portions of said sheet upwardly and inwardly toward each other, winding the lifted and stiffened sheet by directing air under pressure between said sheet and the top of the pile or supply, and engaging the sheet adjacent the front thereof and forwarding the sheet relative to the pile or supply when said pile or supply has been winded and the sheet has been lifted, stiffened and winded as aforesaid.

37. In a sheet feeder, a device for delivering air under pressure for action thereof on the sheets, a pump for supplying air under pressure through the device, a stationary valve body provided in one side thereof with spaced ports, conduits connecting the spaced ports with the pump and the device respectively, a valve at said side of the valve body and having a port, a shaft with which the valve is connected for operation thereby, and means for operating said shaft and the valve to periodically register the port of said valve with said first named ports and periodically connect said device with said pump through said conduits.

38. In a sheet feeder, a device for acting on the sheets by vacuum, a pump for creating vacuum in the device, a stationary valve body provided in one side thereof with spaced ports, conduits connecting the spaced ports with the pump and the device respectively, a valve at said side of the valve body and having a port, a shaft with which the valve is connected for operation thereby, and means for operating said shaft and the valve to periodically register the port of said valve with said first named ports and periodically connect said device with said pump through said conduits.

39. In a sheet feeder, a device for delivering air under pressure for action thereof on the sheets, a device for acting on said sheets by vacuum, pump means for supplying air under pressure through said first named device and for creating vacuum in the second named device, a stationary valve body provided in opposite sides thereof with spaced ports, conduits connecting said spaced ports with the pump means and said devices respectively, valves at said opposite sides of the valve body and having ports, and means with which said valves are connected for operating them to periodically register their ports with said first named ports and periodically connect said devices with said pump means through said conduits.

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